NZ TRANSPORT AGENCY
WAKA KOTAHI

highways and network operations

Business Case for Implementation

Detailed Business Case to proceed from Initiation to Implementation

SH1 Waitarere Beach Road Curves

March 2015

Approval

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0	23 July 2014	Section A for NZTA submission
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0.5	1 November 2012	Incorporating learnings from PPP DBC

Contents

Glossary of Terms

Abbreviation	Term
AEE	Assessment of Environmental Effects
AO	Approved Organisation
BCR	Benefit-Cost Ratio
CAPEX	Capital Expenditure
CBD	Central Business District
CEMP	Construction Environmental Management Plan
CVIU	Commercial Vehicles Investigation Unit
D&C	Design and Construct
DBC	Detailed Business Case
DE	Design Estimate
DSi	Death & Serious Injury
EEM	Economic Evaluation Manual
EIR	Environmental Impact Report
EOI	Expression of Interest
FYRR	First Year Rate of Return
GPS	Government Policy Statement
HCV	Heavy Commercial Vehicle
HDC	Horowhenua District Council
HNO	Highways and Network Operations
HPT	Historical Places Trust
IAP2	International Association for Public Participation
ILM	Investment Logic Map
IRS	Investment and Revenue Strategy
ITS	Intelligent Transport Systems
KPI	Key Performance Indicator
LILO	Left In, Left Out
LLR	Lessons Learnt Review
LTMA	Land Transport Management Act
MOU	Memorandum of Understanding
MVKT	Million Vehicle Kilometres Travelled
NES	National Environmental Standards
NLTF	National Land Transport Fund
NLTP	National Land Transport Programme
NPC	Net Present Cost
NZCID	New Zealand Council for Infrastructure Development

Abbreviation	Term
NZTA (or the Agency)	The New Zealand Transport Agency
NZTS	New Zealand Transport Strategy
OPEX	Operating Expenditure
P&I	Planning and Investment
PFR	Project Feasibility Report
PI	Performance Indicator
PMS	Project Management Services
PoPS	Portfolio Procurement Strategy
PPFM	Planning Programming and Funding Manual
PPM	Principal Project Manager
PT	Public Transport
PWA	Public Works Act
RAMM	Road Assessment and Maintenance Management
RLT	Regional Land Transport
RLTS	Regional Land Transport Strategy
RMA	Resource Management Act
RoNS	Road of National Significance
SAR	Scheme Assessment Report
SE	Scheme Estimate
SH(#)	State Highway (number)
SOI	Statement of Intent
TA	Territorial Authority
TDM	Traffic Demand Management
TOC	Total Outturn Cost
VAC	Value Assurance Committee (formerly SSRC)
VMS	Variable Messages Sign
WEBs	Wider Economic Benefits

Executive Summary

The curves in the vicinity of Waitarere Beach Road have been a safety concern for some time. Realignments and improvements have been made at this site a number of times over the last 100 years or more, but fatal and serious crashes have continued to occur.

In 2010, this stretch of highway was included in the North of Otaki to North of Levin section of the Wellington Northern Corridor Road of National Significance. The objectives of the Otaki to Levin section are to improve the levels of service for journey time and safety and to improve the connection to the economic hub of Wellington City.

The strategy for the section of SH1 north of Levin is to upgrade the two lane existing highway to improve safety, roadsides and passing opportunities. The Waitarere Beach Road Curves project will address the worst performing part of this section north of Levin.

Eight deaths and serious injuries have occurred within the project extents in the previous five year period. Key safety and geometric deficiencies exist for the Waitarere Beach Road curves section of SH1, with the current road environment considerably below the standard required to achieve Safe System principles. The main safety and geometric issues being; out of context horizontal curves, no barrier protection, narrow sealed shoulders, local intersections (including one with high traffic volumes) and significant side friction.

Other key constraints include the cultural significance of many locations within or adjacent to the project area, that has seen extensive historic occupation. Therefore, numerous culturally significant sites are either directly on or in close proximity to the proposed alignment, with particular importance to Maori whakapapa and turangawaewae for this area.

Three main improvement options have been considered throughout the project development lifecycle. This began with the bypassed expressway early in the investigation, to a lower standard curve easing solution, and a full curve realignment option. The option selected (curve realignment to meet RoNS guidelines) is considered the optimum solution which closely meets the desired project objectives. The recommended project option will provide high standard geometry and a significantly improved road cross section and barrier protection. This option meets RoNS guidelines and Safe System principles. A summary of the recommended project economic assessment is provided below:

Option Description	Expected Costs	Benefits	Benefit Cost Ratio
Curve Realignment to meet RoNS Guidelines	$14.4M[1]	$15.0M	**1.4**

Consultation has been undertaken on the recommended option. There is general support from stakeholders and affected parties. However, given the presence of the median barrier and associated effect on local access, combined with the land acquisition required, further negotiation with some parties is required. The next phase of the project will require ongoing consultation, consenting and detailed design to take place, prior to implementation (in 2019).

The key risks remaining on the project relate to the presence of culturally significant sites (and associated archaeological discovery), property acquisition and unknown ground conditions.

Overall, the project is considered to support the Wellington Northern Corridor RoNS programme objectives and is consistent with the Programme Business Case that has been developed for the North of Levin. It will deliver on the desired outcomes of reducing fatal and serious injury crashes. It is recommended that the project should therefore be progressed to the consenting phase of the Project's development. It is recommended that consenting investigations are undertaken by the same team that undertook the DBC phase of work. Consents should seek to retain design and construction flexibility.

[1] The expected cost of the Project has increased from the previously reported $9.6m because of the introduction of a wire rope median and edge barriers. The predominant fatal crashes that have occurred have all involved vehicles crossing the centre line and so a median barrier will largely eliminate this risk. The treatments bring the design of the Project into alignment with the Safe Systems Approach.

PART A – THE CASE FOR THE PROJECT

1 Background

The Waitarere Beach Road Curves Realignment is a sub-project of the Otaki to Levin section of the Wellington Northern Corridor RoNS project. The purpose of the realignment is to reduce instances of fatal and serious crashes, as well as contributing to the broader RoNS objectives of improving access to Wellington and its amenities, promoting economic growth and productivity, and improving journey time reliability to Wellington.

This is the third investigative stage for this project, after an initial expressway corridor Scoping Report between Otaki to north of Levin, and a site specific Project Feasibility Report.

The NZ Transport Agency (NZTA) Board has overall responsibility for NZTA projects and reports directly to the Minister of Transport. NZTA is also the project sponsor.

The Wellington Northern Corridor is one of seven state highway Roads of National Significance (RoNS) projects the New Zealand Government has nominated as essential to increasing New Zealand's prosperity. The Transport Agency is tasked with substantially completing these state highway projects within a ten year period. The Wellington Northern Corridor is shown in Figure 1-1 below, with the north of Otaki to the north of Levin segment coloured purple at the northern extent of the corridor.

Figure 1-1: Wellington Northern Corridor Road of National Significance

The segments of the RoNS corridor located immediately to the south (known as Peka Peka to Otaki) is due to commence construction in 2016/17. Further to the south Mackays to Peka Peka and Transmission Gully are already under construction and are due for completion in 2016 and 2020 respectively. To the north, Whirokino Trestle and Manawatu Bridges are currently being investigated and on current programme will be replaced in 2016/17.

The Waitarere Beach Road Curves improvement project (the project) is part of the Otaki to North of Levin section of the Wellington Northern Corridor RoNS. The project is part of the north of Otaki to the north of Levin project and seeks to improve the safety and efficiency of a substandard length of SH1, located to the north of Levin.

In mid-2012 the Otaki to North of Levin Scoping Report[2] presented options for expressway alignments between north of Otaki to north of Levin. Based on the outcomes of this report, the NZ Transport Agency (the Agency) decided that the most appropriate strategy between north of Otaki and north of Levin was to upgrade the existing highway as the first stage of a long term strategy to meet the RoNS objectives.

From late 2012, twelve Project Feasibility Reports (PFR) were completed for a number of locations along the existing corridor, as well as assessing the overall route consistency. These identified a package of improvements that could be implemented in the short to medium term to improve the safety and efficiency of the existing state highway.

In December 2012 the PFR for Waitarere Beach Road Curves[3] was completed. This consisted of two options; a curve easing option and a curve realignment option. The proposed option recommended by the report was the curve realignment option, which replaced the existing three low radii curves[4] with two 800m radii curves and a 110 km/h design speed. The PFR did not investigate central and edge wire rope barriers (a recent initiative by the Agency for improvement projects), passing lanes or altering the form of control at the Waitarere Beach intersection, instead focusing on the specific geometric options for the realignment because this is the fundamental difference between alternatives.

1.1 Point of Entry

Since the investigations for the north of Otaki to north Levin RoNS (O2L) commenced the Transport Agency has introduced the Business Case Approach for project development. Whilst it was not strictly necessary it was decided to transition the investigations into the Business Case Approach, it was adopted given the overall duration of ongoing investigations associated with the staged approach to the Project, where latter stages of investigation might only be completed in 2016/17. Adopting the Business Case Approach means that decisions made on the Project are consistent with current practice.

As indicated above, O2L forms part of the WNC RoNS. The business case report for the WNC RoNS was completed in 2009 and then updated in 2013 and provides the strategic case for O2L Project.

As indicated above, the O2L project is being implemented in a staged approach. The staged approach proposed can be described, as follows (and as shown in Figure 1-2 below):

SHORT TERM

- Safety improvements at priority locations: Ohau and Manakau (construction underway).

MEDIUM TERM

- South of Levin: improvements to the connection between SH1 and SH57 (which also delivers the southern section of bypass of Levin) as well as safety improvements from

[2] MWH, July 2012

[3] Report No. 8: Waitarere Beach Road Curves (Final), February 2013

[4] The existing three horizontal curves are 300m, 360m and 340m radii respectively, from north to south.

Taylors Road through to Manakau (Forest Lakes plus potential additional enhancements between Forest Lakes and Manakau)

- Levin: accommodate growth and traffic on SH1 and SH57 [these investigations are now being undertaken with Horowhenua District Council].
- North of Levin: targeted safety improvement at Waitarere Beach Road Curves. Complimentary safety improvements and passing opportunities.

LONG TERM

- 4 lane expressway
- Northern bypass of Levin

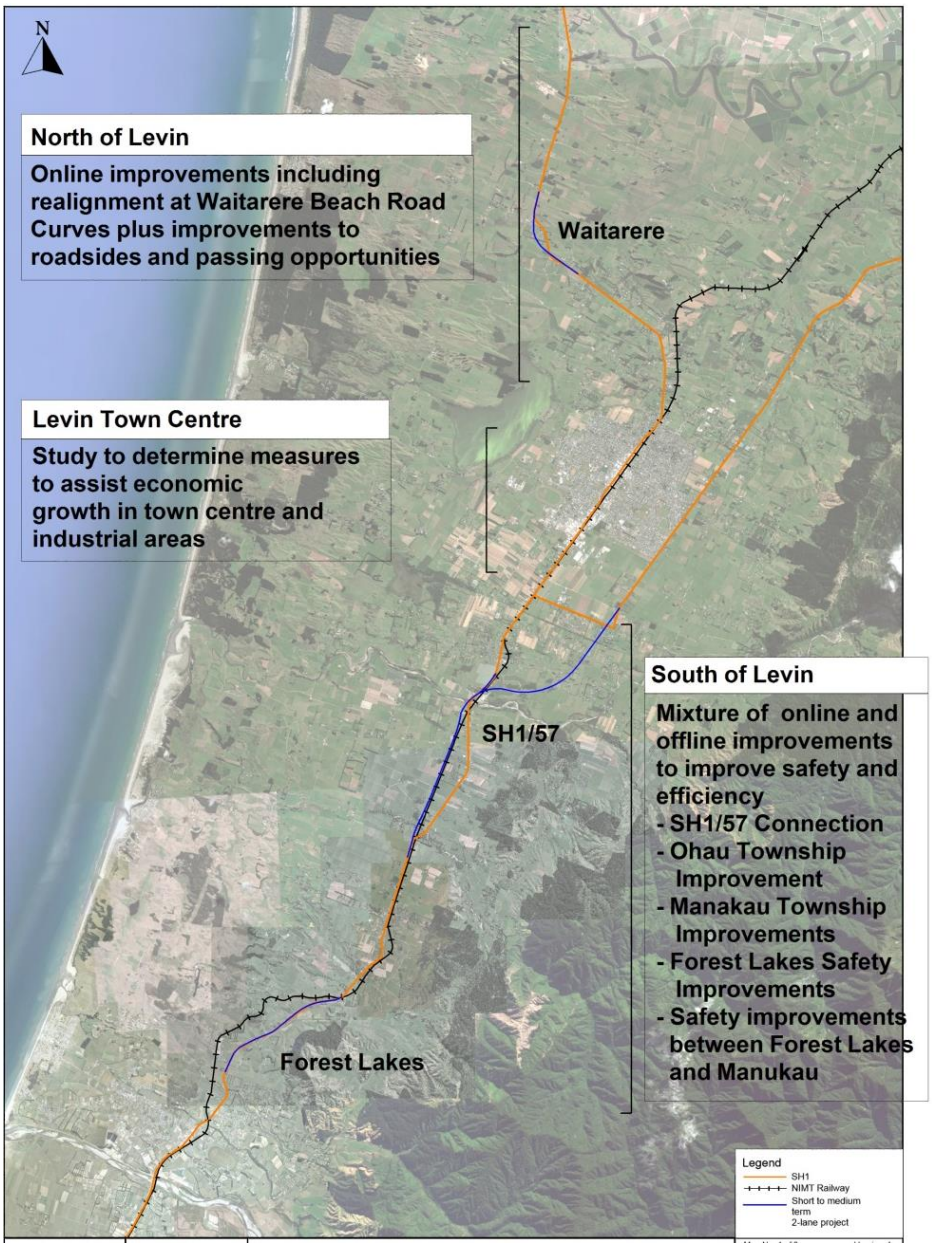

Figure 1-2: North of Otaki to north of Levin - Short and medium term improvements

A Project Feasibility Report, which investigated route improvements to the corridor, was completed in February 2013 wide. This work is being developed into a programme business case (draft issued in March 2015) and will inform the timing of implementation of the improvements at Waitarere Beach Road Curves relative to other improvements wanted on the corridor.

The Project Feasibility Report for Waitarere Beach Road Curves was also completed in February 2013 and this included an assessment of route and design options. The conclusions from this work have been developed into this Detailed Business Case report, and have been complimented by additional investigations including with stakeholders and landowners.

Accordingly the point of entry into the Business Case Approach for this project is the Detailed Business Case approach with other investigations providing information relevant to the preceding stages in the Business Case Approach process.

1.2 Project Governance

In addition to the NZTA organisational structure below, the project team is guided by the project Steering Group. This comprises:

- Brendan Duffy, Mayor, Horowhenua District Council
- David Clapperton, CEO, Horowhenua District Council
- Gallo Saidy, Group Manager, Community Assets, Horowhenua District Council
- Selwyn Blackmore, Wellington Transport Planning Manager, NZTA
- David McGonigal, Palmerston North State Highway Manager, NZTA
- Greg Lee/ Josephine Draper, NZTA

Other attendees at the meeting can include NZTA and HDC officers and the MWH project team leader.

1.2.1 Organisation structure

The following diagram represents the decision-making process structure within NZTA with regards to this project.

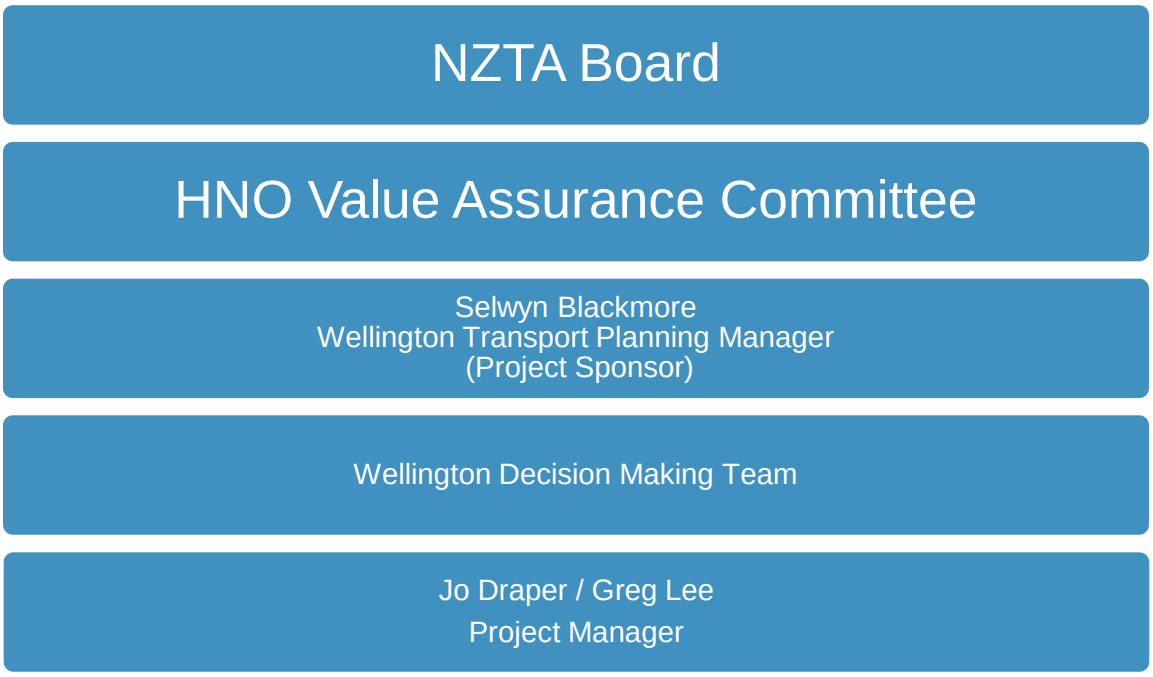

Figure 1-1: NZTA Organisation Structure

1.2.2 NZTA Board

The NZTA Board has overall responsibility for NZTA projects. The Board reports directly to the Minister of Transport and is responsible for:

- land transport planning
- managing the state highway network
- regulating access to, and participation in, the land transport network
- promotion of land transport safety and sustainability.

1.2.3 Highways and Network Operations Group Value Assurance Committee

The HNO Group Value Assurance Committee (VAC) is the most senior project decision making team within the HNO group, which comprises the National Manager Professional Services and various other senior managers and technical specialists.

1.2.4 Project Sponsor

The Project Sponsor is Selwyn Blackmore, Wellington Transport Planning Manager. The Project Sponsor is responsible for:

- Ultimate authority and responsibility for the project
- Endorsing changes to scope, schedule, budget and quality
- Endorsing escalation and championing recommendations to the Highways VAC
- Providing policy guidance to the Project Manager
- Endorsing the Project Management Plan to confirm that project scope and deliverables are correct
- Reviewing progress and providing advice on resolution of issues
- Supporting the Project Manager
- Resolving issues beyond the Project Managers authority.

1.2.5 Wellington Decision Making Team

The Wellington Regional Management Team comprises senior decision makers within HNO and P&I in the Central region. It includes representation from the Wellington Region State Highway Manager and his direct reports.

2 Problems, Opportunities and Constraints

The Waitarere Beach Road Curves form a short section of the overall Wellington Northern Corridor RoNS improvements. The primary issue at this location is the occurrence of fatal and serious crashes, which is nearly double the national average for a state highway of similar cross sectional standard. By altering the project to meet the RoNS guidance, the severity and propensity of crashes can be greatly reduced.

The main constraint to the project is the historical importance of the area to the local Maori community. There are a number of known and suspected culturally sensitive sites that the realignment would pass through or encroach upon. This includes possible burial sites located east of the current Waitarere Beach Road intersection.

With regard to other constraints, it is not expected there will be any major concerns with obtaining RMA approvals for the project. Any service relocation would be confined to telecom fibre cables, power lines and highway lighting.

Initial geotechnical investigations have identified the presence of loess soils in the northern part of the project, which are known as collapsible soils. Upon wetting, the cohesion of the soil is lost and large settlement can occur, which would create a significant problem for the alignment post construction.

2.1 Problems and Opportunities

2.1.1 Wellington Northern Corridor RoNS

The Wellington Northern Corridor, stretching from Wellington Airport to north of Levin, is one of the seven roads of national significance. The corridor has eight distinct project sections. These are:

- Airport to Mt Victoria Tunnel (including tunnel duplication);
- Transport improvements around the Basin Reserve;
- Terrace Tunnel duplication;
- Ngauranga to Aotea Quay;
- Linden to MacKays (Transmission Gully);
- MacKays to Peka Peka;
- Peka Peka to Otaki; and
- Otaki to north of Levin.

The investigation and statutory approval processes for the Otaki to North of Levin section are undertaken within a series of objectives for the RoNS Wellington Northern Corridor objectives. These are as follows:

- to enhance inter regional and national economic growth and productivity;
- to improve access to Wellington's CBD, key industrial and employment centres, port, airport and hospital;
- to provide relief from severe congestion on the state highway and local road networks;
- to improve the journey time reliability of travel on the section of SH1 between Levin and the Wellington Airport; and
- to improve the safety of travel on state highways.

The following specific project objectives apply to the Otaki to North of Levin project:

- In relation to the state highways between north of Otaki and north of Levin to:

- enhance inter-regional and national economic growth and productivity;
- improve journey times on the state highway network;
- enhance safety of travel on the state highway network.

- **To** achieve the above objectives through a staged approach that realises the longer term transport needs in a cost effective manner.
-

2.1.2 Otaki to North of Levin

State Highway 1 and State Highway 57 through the study area have a number of deficiencies, resulting in a poor crash history and a number of locations where the free flow of vehicles is restricted by the tight physical characteristics of the highway.

State Highway 1 currently follows the historic route established in the late 19th and early 20th centuries. As a consequence it is constrained by a now substandard alignment, straddling towns and villages, narrow curved bridges and significant side friction caused by local roads, commercial frontages and property accesses for the entire stretch.

2.1.3 Waitarere Beach Road Curves

The section of SH1 in the vicinity of Waitarere Beach Road had curve easing prior to the mid-1970s; however this section has witnessed a high number of on-going fatal and serious crashes in recent years. Of particular concern are the run-off-road and cross-centreline crashes, due to the severe nature of such crashes.

Key safety and geometric deficiencies for the Waitarere Beach Road Curves, determined through site inspections and previous reports, are numerous. These are considered to have contributed to the significant number of high severity injury crashes on this section of highway. Furthermore, the existing road environment is considerably below the standard required to meet Safe System principles. The project extent between RP 967/5.1 to RP 967/7.69 is shown in Figure 2-1.

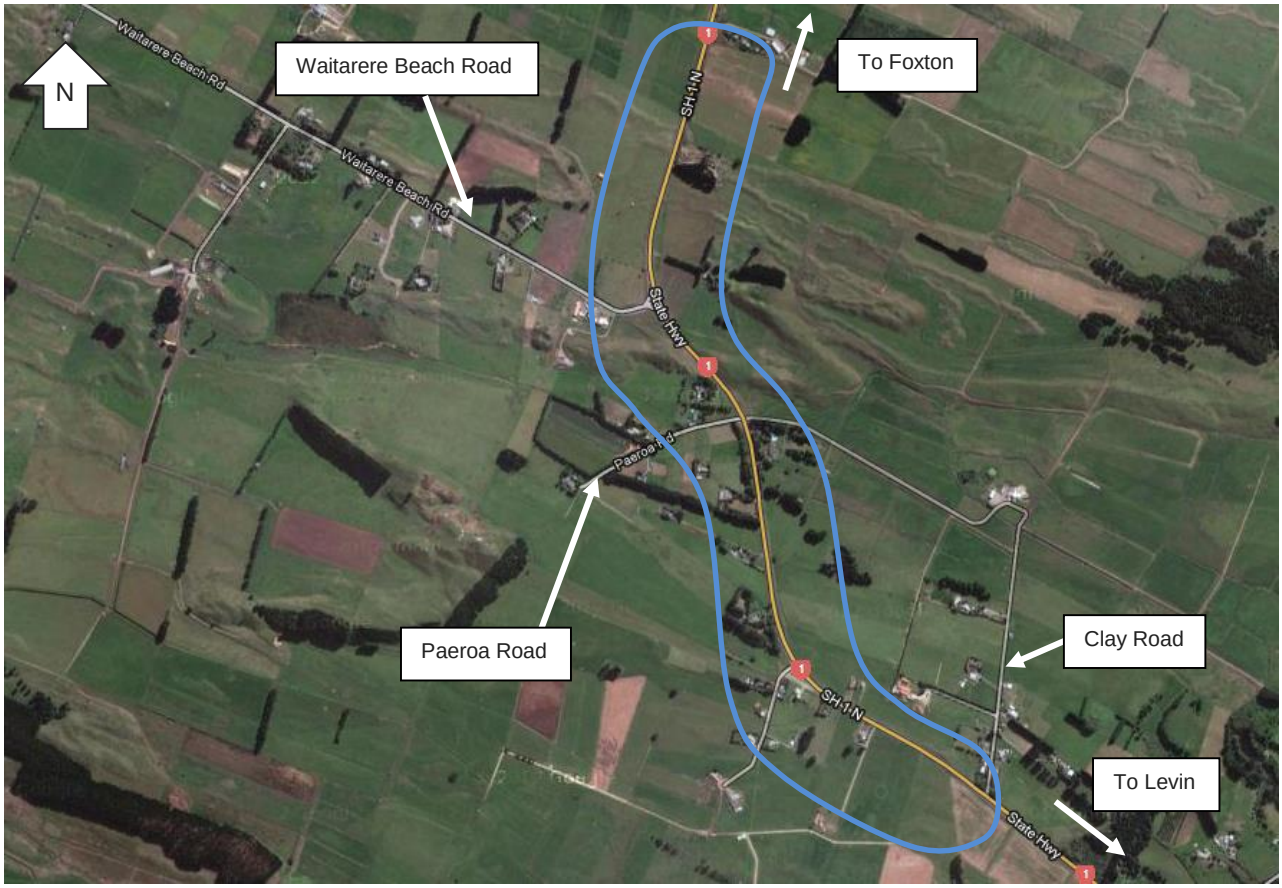

Figure 2-1: Study Area Location Map

2.2 Issues and Constraints

2.2.1 Economic Issues and Constraints

The section of State Highway 1 which runs through the study area is part of the Wellington Northern Corridor RoNS. Justification of the Wellington Northern Corridor RoNS is contained within the Wellington RoNS Business Case (NZTA, November 2009). This document outlines how the programme of projects contributes to economic growth and productivity in the region and nationally.

SH1 north of Levin is an important economic life line for the North Island, forming the main link between Levin and regions to the north, including Wanganui and Palmerston North.

The particular area around Waitarere Beach Road is mostly farm land with dairy farming the predominant land use. Waitarere Beach Road also provides access to multiple farms and also a number of rural commercial businesses as well as some residential property. All of these properties and land uses access the highway either directly or indirectly.

2.2.2 Social Issues and Constraints

This area has seen extensive historic occupation; therefore there are numerous culturally significant sites either directly on or in close proximity to the proposed alignment. Culturally significant sites are shown in Figure 2-2 and described further in Table 2-1. There are also parcels of land identified which, while not "Maori land" in terms of Te Ture Whenua Maori Act 1993, are Maori owned, and are of importance to Maori whakapapa and turangawaewae for this area.

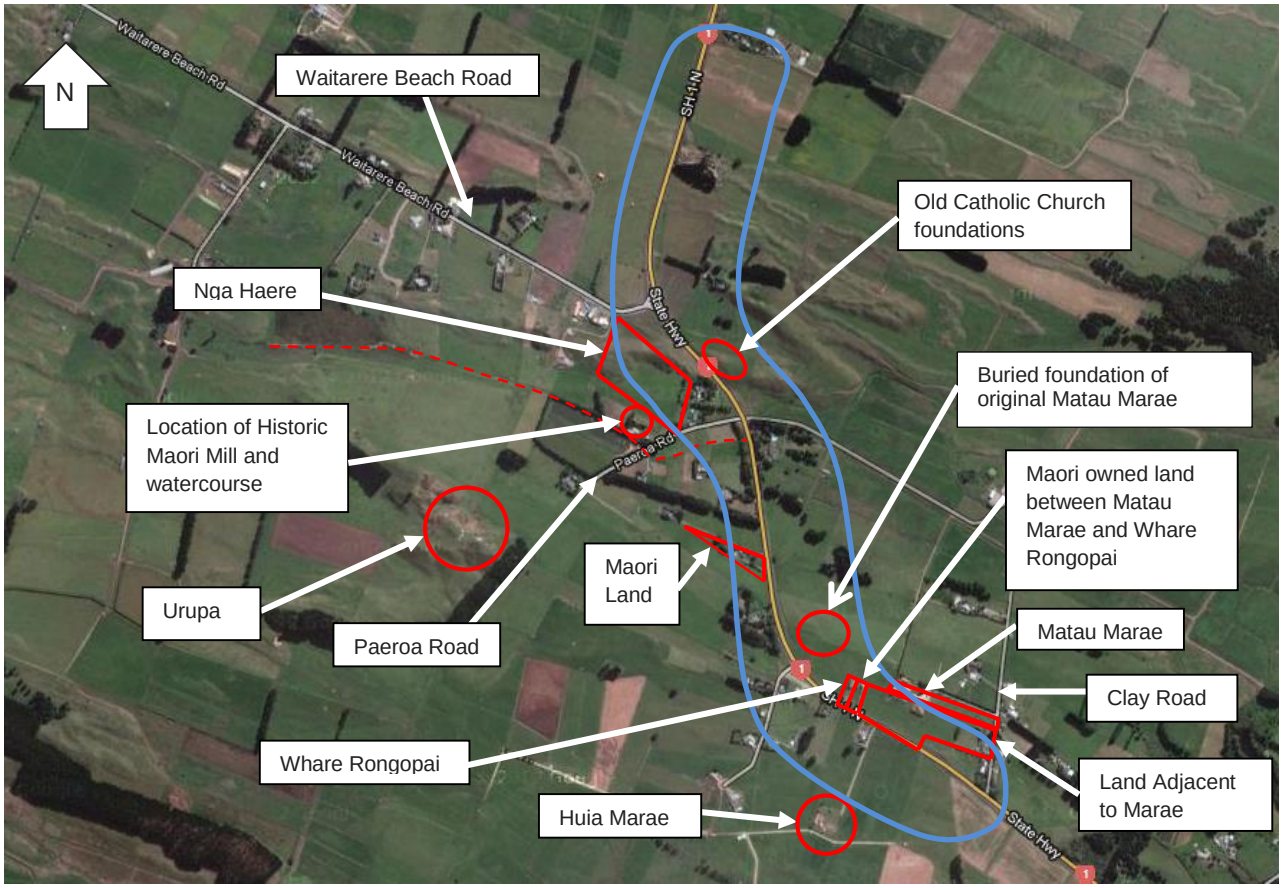

Figure 2-2: Study Area Cultural Constraint Map

The information in Table 2-1 has been compiled from consultation with local people and other available sources.

Table 2-1: Significant cultural sites

Site	Comment on significance
Potential burial sites	The project area may include the graves of the victims of the battles in this area. It is understood that the deceased may have been buried where they fell in unmarked graves. The sites will need to be investigated further and authorities under the Heritage New Zealand Act will be required if the land is to be disturbed.
Nga Haere Pa	This is Maori land. It is the site of a 'gunfighter pa', constructed in 1872 to guard against sallies from Te Kepa Rangihiwinui's Pipiriki Pa (S25/51) near Lake Horowhenua. The pa site is understood to be near the north western boundary of the land parcel, and the balance of the land could contain unmarked burial sites. Maori Land Court records refer to burials in the area defined as the pa (Manawatu-Kukutauaki 7D Section 2D No. 16 Blk).[5]
Urupa	Maori burial ground.
Site of an old mill	This is a site of an old Maori mill, though only the diverted watercourse remains.
Maori land	Maori land as defined under the Te Ture Whenua Act 1993, no further detail is known regarding significance.
Whare Rongopai	Distinctive church constructed in 1950. It is in deteriorating condition and seldom used, but very important to the local community.
Land adjacent to Marae (Lot 6 DP 61399)	This is general land in Maori ownership. While not 'Maori land' (defined by Maori Land Court) is considered to be part of the Marae and contains some of the ancillary buildings. It is in general title and was purchased to allow for future development of the Marae.
Matau Marae	This is Maori land but has one owner. This is unusual given it contains a Marae. Shifted to its current site some years ago. Its former site is the adjoining land to the west. The remains of the building were buried on its site.
Foundations of original Matau Marae	The foundations of the Marae were buried in this field. The site will need to be investigated further and authorities under the Heritage New Zealand Act will be required if the land is to be disturbed.
Land between Matau Marae and Whare Rongopai	This is general land in Maori ownership but not defined as 'Maori land'. Based on information from consultation to date it is likely to have greater significance than 'general land' in terms of turangawaewae because it is considered to be an important connection to the local area.

[5] Consultation with iwi identified another land block, referred to as section 15, may also contain burials. However, it appears from Maori Land Court records that section 15 was never legally defined and was eventually incorporated into Manawatu-Kukutauaki 7D Section 2D No. 16 Blk.

A number of roads in the locality were referred to as designated Maori road lines and were not public roads.

When a Tangi occurs at the Matau Marae, many vehicles cross SH1 travelling northwards towards the Urupa and traffic management is often arranged with the Police. Both Marae use the Urupa and during a Tangi, there is a concentrated cross highway demand for accessing/exiting the Urupa on Paeroa Road.

The monument on the ridgeline on the northern side of SH1 is the "Jim Stewart monument", a family site. To date no information or records have been found that indicate that the monument is significant. The ridgeline in the locality also contains the former site of a catholic church. It is believed that the foundations were buried near SH1 in the vicinity of the realignment of Waitarere Beach Road Intersection.

Given that any construction may involve earthworks in an area with a long history of occupation and of high tangata whenua values, it is envisaged that there is the potential to disturb archaeological sites[6]. Current information identifies several sites and an archaeological authority will be required from Heritage NZ. The historic Maori flour mill site located on Paeroa Road is identified in the NZ Archaeological Association's database and other sites are highly likely to be identified during any land disturbance. Any physical work that may potentially damage an archaeological site will require an archaeological authority.

2.2.3 Resource Management Issues and Constraints

The project must meet all resource management statutory requirements. There are a number of documents (both statutory and non-statutory) that must be considered when planning for state highway improvements. In particular, the following will be assessed to ensure that the proposed project meets the plan provisions and follows the statutory process:

- Resource Management Act
- Operative and Proposed Horowhenua District Plans (HDP)
- Horizons Regional Plan (proposed One Plan – including the regional policy statement)

SH1 is designated under the operative Horowhenua District Plan (HDP) for "state highway purposes" (D2) (Map 4). The existing designation will need to be altered to accommodate any realignment or widening of SH1. T

There is a small modified watercourse and small pockets of vegetation within the project area. It is expected that the vegetation will be removed but it is not currently proposed to undertake any work in the stream. It is noted that there are no ecologically significant sites identified in the HDP or regional plans for this locality. The locality is not identified as an outstanding natural landscape.

The locality is a rural area on the outskirts of Levin and there is currently no planned urban growth for this locality under the Operative or Proposed HDP. The issues of concern in the operative and proposed HDC for this area in relation to this project are securing a safe and efficient road network, matters of important to tangata whenua, protecting valued heritage features, protecting rural and landscape character and amenity values and maintaining biodiversity.

The proposed project designs and construction plans will be required to confirm the regional consents that may be required. Dependent upon the form, detail and nature of the proposed option, it is expected that resource consents for earthworks and discharges to water may be required under the proposed One Plan administered by the Horizons Regional Council. The general environmental issues of concern in the regional plan for this area in relation to this project are the recognition of the benefits of road networks (the standard and capacity of SH1 and improvements to road safety)[7] , tangata whenua values, land erosion (dune country) and

[6] Definition of "archaeological site" from HNZ Act 2014

[7] As defined in the Regional Land Transport Strategy. Noting the Waitarere Section is not specifically identified in this strategy as a key initiative.

sedimentation of waterbodies, protecting indigenous biodiversity, and flood control (drainage).

It is also expected that the scale of this work would not require the NoR to be notified. However, the consent applications should need to be notified unless they were undertaken on private property or involve a culturally or significant site.

2.2.4 Transport Issues and Constraints

In addition to the overall issues presented in Section 2.1.3 above, the following issues have also been identified.

All Poroutawhao school (immediately north of the project area) pupils generally get to school either by bus or private car. At present there is a stakeholder concern about safety at the right turn for buses from Waitarere Beach Road to SH1 for travel to Levin schools.

There are currently no dedicated pedestrian or cycle facilities along this section of SH1. Pupils do not walk to school due to safety concerns, nor is this encouraged by the school (pupils are not allowed to cross SH1).

The right-turn movement into and from Clay Road is a safety concern, especially when a Tangi occurs at Matau Marae. This is due to a lack of dedicated turning facilities and limited visibility.

The current road width is of concern with agricultural machinery using the shoulders of SH1 in this area as land is used primarily for farming.

2.2.5 Stakeholder Issues and Constraints

The major issue for all stakeholders are the out of context curves resulting in high severity crashes. This is further discussed in Appendix E – Crash History Information. The district and regional councils expressed concern regarding the out of context curves as safety is compromised for motorists.

Local landowners and residents concerns related of the proposed project include an increase in noise levels, increased travel times and convenience due to potential wire rope barrier introduction, not addressing the passing opportunities and concerns over private land acquisition. This is further discussed in Section 6.3.1 and 6.4.

The NZ Heavy Haulage Association expressed concerns should a median barrier be introduced, as this would conflict with over-dimension loads. This is further discussed in Section 6.3.4.

The NZ Automobile Association recommended a redesign of the Waitarere Beach Road intersection due to its poor crash history. This is discussed in more detail in Section 6.3.5 and Appendix E – Crash History Information.

Poroutawhao School is a community hub and the school representatives expressed concerns over restricted access due to a wire rope median barrier. The school indicated that a turning circle adjacent to the northbound lane would be needed to improve safety for pupil drop-off. This is further discussed in Section 6.3.7.

Tangata whenua were supportive of the project addressing the safety problems. However, they expressed concerns in relation to the potential impact on culturally important sites, access to the local marae and urupa, and land acquisition of Maori owned land.

Most stakeholders are generally supportive of the project, as it addresses the safety concerns they hold with the out of context curves and Waitarere Beach Road / SH1 intersection. However, there are concerns that the Project will cause some localised travel time delays, some inconvenience existing or accessing their properties, Maori cultural impacts and property acquisition (dependent upon the final form of the proposed upgrade).

2.2.6 Maintenance Issues and Constraints

The existing maintenance regime includes typical road routine maintenance. Since the 1996/1997 financial year, $87,055 has been spent on routine maintenance including; shoulder maintenance, minor levelling, emergency work, in-situ stabilisation, surfacing defects

repair, stormwater structure maintenance, digouts, edge marker post maintenance, environmental clean-up and surface water channel maintenance.

The current alignment has no formalised stormwater system resulting in higher maintenance costs after storm events. There are numerous large trees or hedges that require routine trimming to maintain adequate sight lines. Sight rails are located at Waitarere Beach Road / SH 1 intersection and require routine painting to maintain level of service. Lighting is present at Waitarere Beach Road / SH 1 intersection requiring routine maintenance.

The forward works programme shows a section of SH1 is programmed for maintenance reseal in 2016-2017, with a further section resealed in 2018-2019. The local roads and SH1 are currently maintained by the Horowhenua District Council and NZTA respectively.

2.2.7 Crashes Issues and Constraints

A full review of the crash history for this 2.5 km section of SH1 (RP 967/5.1 to RP 967/7.69) is analysed in Appendix E – Crash History Information, including crash classification and a crash map. For the five-year period from January 2009 to December 2013 a total of 16 crashes occurred (four high severity crashes resulting in eight DSi). The predominant fatal crashes that have occurred here have all involved vehicles crossing the centreline.

Undivided state highways with over 6,000 vpd generally have higher numbers of deaths and serious injuries as a result of head-on and run-off road crashes. This site is not an exception with five fatalities and one serious injury from head-on crashes, and one serious injury from run-off road crashes in the five year period[8].

There has been an average of more than one death or serious injury per injury crash. The DSi per high severity crashes for head-on is 3.0 which is well above the national average of 1.6. Run-off road, intersection and other high severity crashes are all below the national average based on the High-Risk Rural Roads Guide.

Based on the published 2012 KiwiRAP risk map, this section of SH1 has a medium personal risk and a high collective risk. Therefore this section of SH1 is classified as a high risk rural road signifying a 'Safe Systems Transformation Works' treatment strategy[9]. Further analysis details can be found in Appendix E – Crash History Information.

Figure 2-3 displays the existing Road Protection Score (RPS), which is calculated in 100m sections. The green line is the average RPS and the red line displays the equivalent 5km Star rating. These scores relate only to this specific section of SH 1 as bounded by the Route Position (RP) values. The larger spikes in RPS score for Paeroa Road is due to low sight distance and no left or right turning provision. Clay Road is reported as adequate sight distance and no left or right turning provision.

[8] The eighth DSi is from a vehicle crossing movement at the Waitarere Beach Road intersection.

[9] As defined within the NZ Transport Agency High-Risk Rural Roads Guide (2011)

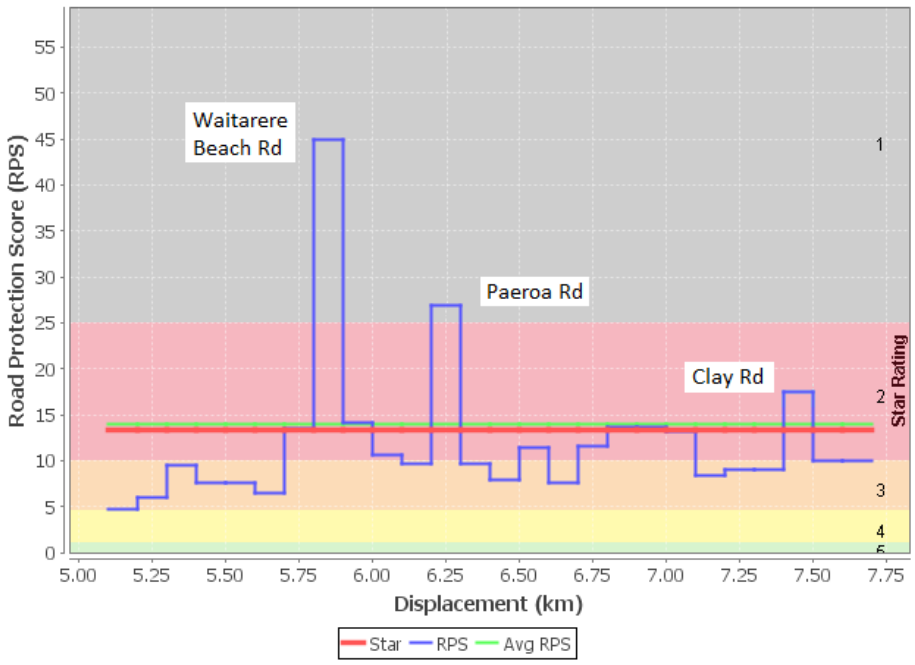

Figure 2-3: KiwiRAP Risk Worm for Waitarere Beach Road Curves Section (Location Coordinates: 01N-0967/05.10 to 01N-0967/07.70)

The data from which this table is produced has been edited to better match the actual road hierarchy. Currently KiwiRAP data has Waitarere Beach Road incorrectly defined as a local road, while Paeroa and Clay Roads are incorrectly defined as minor roads. Actual traffic data means Waitarere Beach Road should be classified as a minor road and the other two roads should be classified as unsealed roads, as they have an AADT below the necessary 260 vehicles per day to be classed as local roads.

2.2.8 Safety and Geometric Issues and Constraints

There are numerous safety and geometric issues:

- Out of context curves – the curves between Clay Road and Waitarere Beach Road are below the standard required for a 100 km/h highway;
- No median barrier – Austroads and NZTA guidance indicates that a median barrier should be provided when there is a high percentage, or high average daily number of heavy vehicles, or severe consequences for vehicles crossing the centreline.
- Inconsistent clear zone and a large number of accesses with resultant side friction concerns.
- Highly trafficked Waitarere Beach Road intersection is within the back to back deficient curve section.
- Substandard combinations of vertical and horizontal curves.
- Narrow sealed shoulder.
- Lack of passing opportunities to the north and south.
- Safety concerns at the intersections of Paeroa Road and Clay Road.

The above deficiencies are considered to have contributed to the significant number of high severity injury crashes within the project.

The existing curves within the project extents are defined as follows;

- Curve at Waitarere Beach Road - 300m radius, 6% superelevation, 440m length.
- Curve at Paeroa Road – 360m radius, 6% superelevation, 290m length.

- Curve between Paeroa Road and Clay Road – 340m radius, 7% superelevation, 390m length.
- Large curve north of Clay Road – 1000m radius, 3% superelevation, 210m length.

The rolling terrain will require vertical re-profiling for any realignment. However, the known (and potential) sites of cultural and historical significance are likely to result in some challenges to achieve a high standard geometric alignment. Anecdotally it is understood that the existing horizontal alignment was developed in its current form as a result of the desire to avoid culturally sensitive locations – this would seem reasonable given how the current road alignment curves through the various significant sites shown in Figure 2-2.

2.2.9 Stormwater

The existing management of stormwater from road runoff appears to be informal with no specific stormwater management features evident. The existing road appears simply crowned in the centre with runoff shedding to the road shoulder / berm (or private paddock) for infiltration to ground or outfalling to a local watercourse. Such a method of stormwater management is not best practice when upgrading a road and therefore more formalised stormwater management and treatment will be required as part of the upgrade works. Provision of stormwater swales on either side of the upgraded highway is likely to result in a significantly wider road corridor.

2.2.10 Geotechnical Issues and Constraints

A preliminary geotechnical assessment report was prepared by MWH in March 2014[10]. This report outlined that the majority of the stretch of the highway is underlined by beach deposits (Otaki Sandstone). To investigate the subsurface conditions along the alignment which includes the Waitarere Beach Road Curves study area, MWH completed field investigations consisting of hand-auger bores and Scala penetrometer tests.

Published geological mapping of the Waitarere Beach Road Curves project area indicates the northern portion to comprise aeolian (wind-blown) sand deposits; the central section to comprise alluvium and the southern section to comprise raised beach deposits. The longitudinal shaped undulating topography of the project area, particularly evident in the northern section in aerial photography, suggests the presence of sand dunes.

The five hand auger tests confirmed the presence of aeolian deposits and alluvium although the spatial distribution of these units varies from that of the published maps. The northern and central sections of the project area contains silty sand and sandy silt which becomes medium dense at between 0.3m-0.7m. The southern section of the project area contains what are possibly alluvial deposits of silt with some gravel and trace sand which becomes dense at 0.7m.

California Bearing Ratio (CBR) values were obtained from correlations with Scala penetrometer tests at 0.3m and 0.7m depth conducted along Waitarere Beach Road Curves. The sandy silt and silty sand have a CBR of between 1 and 12 at 0.3m depth and increases to between 7 and 31 at 0.7m depth.

It is possible that the silt component encountered in the hand auger tests in the central and northern parts of the project area may be loess material.

Collapsible soils, such as loess, usually have relatively low values of dry unit weight and moisture content. At these conditions, the materials are moderately strong and exhibit a slight but characteristic apparent cohesion. In their dry state, such soils can support moderate loads and undergo relatively small settlements. Upon wetting, however, the cohesion in the soil is lost and large settlements can occur even if the loading remains constant.

The shear strength of loess is greatly affected by the degree of saturation of the soil. Therefore, where loess soils exist, it will be necessary to develop an accurate estimate of the position of the depth to groundwater and to assess whether the degree of saturation for the deposit will likely change during the design life (i.e., whether there will be a change in the position of the groundwater table).

[10] North of Otaki to North of Levin (SH1): Preliminary Geotechnical Assessment Report, March 2014

The slope stability at the Waitarere Beach Road Curves project area has a gentle southward facing gradient. Cut and fill requirements of the preliminary route options for the project area has not been assessed prior to these investigations.

As noted above in Section 2.2.2 any proposed earthworks are likely to require an archaeological authority.

Detailed geotechnical investigations were not undertaken at this stage because it is envisaged that these can come later into the project development lifecycle, with this approach thereby avoiding considerable expenditure during concept design (noting that limited, but sufficient information has been collected to adequately inform the concept design). The geotechnical obstacles described above are common for all project options, not for any particular option. This means that a more expensive construction method (i.e. considerable undercut, additional pavement depth, conservative CBR) must be assumed and detailed investigations to take place during detailed design.

2.2.11 Service Utilities Issues and Constraints

Service utility providers have not been contacted about protection or relocation of any utility assets during the construction phase of the project. However, service information has been sought from providers via their online asset registers. Direct contact with providers should be made following selection of a preferred option, as prior to that is considered too early to be meaningful. This is discussed further in Section 5.1.6. The following services have been identified through the project extents;

- Chorus telecom cable
- Electra buried 1500kV power cables
- LINZ Benchmarks

Horowhenua District Council has indicated there are no water or wastewater services within the project extents.

Stakeholders in the area will need to be notified of disruptions during any utility service relocation works.

3 Outcomes

The Strategic Outcomes for the project are determined for the RoNS Wellington Northern Corridor, relating to economic growth, access, congestion relief and safety.

The Programme Objectives for the Otaki to North of Levin route are to provide the best value solutions for the corridor, by improving the levels of service for both safety and journey time.

The specific Project Outcome is to eliminate the occurrence of road related fatal and serious crashes at the SH 1 Waitarere Beach Road Curves.

3.1 Strategic Outcomes

The strategic objectives for the RoNS Wellington Northern Corridor are;

- To enhance inter regional and national economic growth and productivity;
- To improve access to Wellington's CBD, key industrial and employment centres, port, airport and hospital;
- To provide relief from severe congestion on the state highway and local road networks;
- To improve the journey time reliability of travel on the section of SH1 between Levin and the Wellington Airport; and
- To improve the safety of travel on state highways.

3.2 Project Objectives

There are additional specific objectives for the Otaki to north of Levin section. These are;

- **In** relation to the state highways between north of Otaki and north of Levin to:
    - enhance inter-regional and national economic growth and productivity;
    - improve journey times on the state highway network;
    - enhance safety of travel on the state highway network.
- **To** achieve the above objectives through a staged approach that realises the longer term transport needs in a cost effective manner

3.3 Project Outcomes

The main project outcome is to have highway section free of fatal and serious injury crashes. Despite there only being two fatal crashes during the previous ten year period of 2004 to 2013, both of these crashes were multiple fatality crashes with a total of five people killed and one person seriously injured (six DSi). Therefore when crashes occur in this section of state highway, the severity is historically very high.

The majority of crashes, and all but one high severity crash, are related to the deficient horizontal curves. The project improvements will need to specifically address "head-on", "loss of control" and "overtaking" crashes by eliminating these crash types (or reducing their respective severity). This will leave human error and intersection type crashes, both of which can be mitigated by the Safe System Philosophy (for example by including edge and median safety barrier and upgraded intersections).

4 Options Assessment

Option development began with the four lane expressway corridor scoping stage in 2012, which concluded that a staged approach to enhancing SH1 from north of Otaki to north of Levin was preferable. The Otaki to Levin investigations then commenced as a number of specific sub-project investigations. For Waitarere Beach Road Curves, a long list of options was considered and from this subsequently two of the improvement options were analysed at the PFR stage, with the realignment Option 8-3 preferred. This option reduced the three existing curves down to two 800m radii curves, and proposed a higher standard road cross section.

Option 8-3 was carried forward into this DBC and has been enhanced by a number of additions. The installation of barrier protection provides safer roads and roadsides as per the Safer Journeys 2020 road safety strategy. The cross section now includes a 4.0m wide median with the median barrier centrally located. Each of the intersections will receive minor upgrades and a 'P' turn facility is provided at the southern extent of the project.

The proposed option aims to create a section of SH 1 that very significantly reduces fatal and serious injury crashes.

A scoping report that investigated the feasibility of a four lane expressway from north of Otaki to north of Levin was undertaken and completed in 2012. This determined that a full expressway was not an economically viable solution and accordingly the Transport Agency decided to adopt a staged approach to enhancing State Highway 1. A summary of the scoping report is contained within Appendix J – Scoping Report Summary.

This chapter is organised to show the order of follow on investigations and the decision making process:

- Long List of Options
- PFR Options Analysed
- Recommended Package of Alternatives
- Preferred Option Development

The level of investigation detail increased as the project was developed and hence the level of design information improves throughout this chapter.

The full description and latest information about the preferred option is presented in Chapters 5 and 7.

4.1 Long List of Options (and Alternatives)

During the initial expressway investigations significant constraints were identified in the vicinity of the Waitarere Beach Road Curves which limited the viable alternative options for the Waitarere Curve realignment[11]. A number of options were initially considered, but ultimately discarded. A brief description is provided below, with an indication of the extent of adverse effects compared with the options preferred for further analysis. The figure below provides an indicative illustration of the early stage options that were considered and assessed.

[11] Refer Otaki to North of Levin Expressway Scoping Report, MWH, July 2012

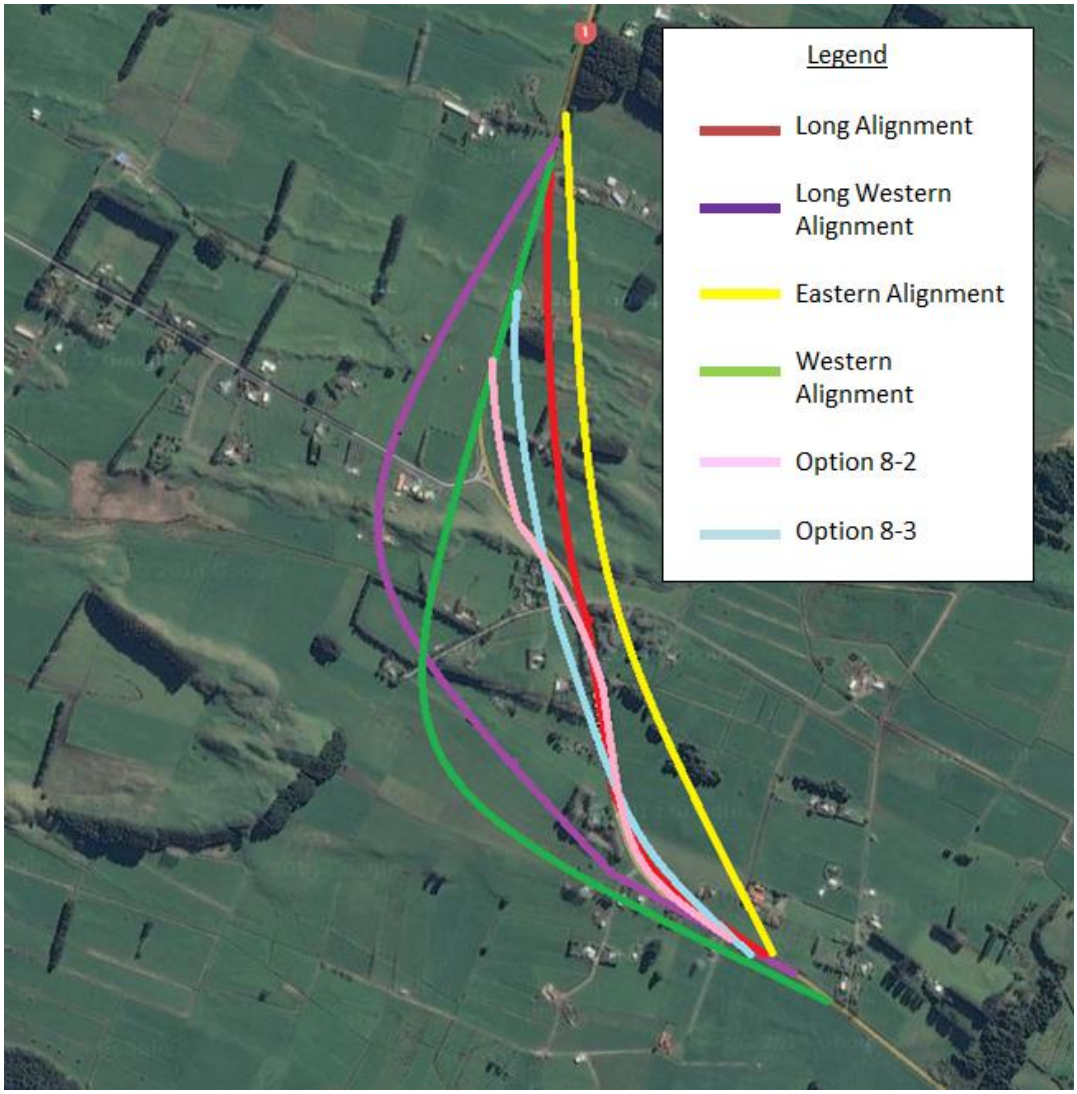

Figure 4-1: High Level Options Aerial

The options were assessed and checked by the project team including:

- Phil Peet
- Jamie Povall
- Marten Oppenhuis
- Sylvia Allan
- Morrie Love

The Transport Agency Team, including Jo Draper and Susan Rawles was consulted on the results of the assessment undertaken.

A rating score is applied to each effect listed in the below tables, which compares the discarded option generally against the other options. The rating system uses five scores; -2, -1, 0, +1 & +2, with -2 rating very poor and +2 very positive. The same effects have been assessed for each discarded option.

The effects considered are:

- Land Severance (i.e. – the extent to which existing land parcels would disrupted, particularly when the realignment results in land from the parcel remaining on both sides of the new road)
- Earthworks quantities
- Effects on known archaeological/cultural values
- Project length (this would affect cost and also travel time)
- Effect on dwellings (i.e. – how many dwellings would need to be removed, and how extensive would the effects be on the remaining dwellings through, e.g., additional noise exposure)
- Road connections (would there be sufficient connectivity within the network and would all land parcels have legal connection to a road?)

These factors were considered as the fundamental factors for the options to be considered against; with these components considered to be valued most by the local community and road users.

All options are considered to offer substantial safety and geometric benefits (given this is the fundamental project objective) and so these are considered a given across all options.

Western Alignment Option

A western alignment was considered to move the road away from the majority of the dwellings that front the highway through this section. The option involved extending the straight from Clay Road further west before making the right hand bend and joining back to the existing SH1 just north of Waitarere Beach Road.

Negative Effects	Rating
• Land severance (sterilisation); this option severs seventeen land parcels; the option is particularly adverse for some properties where it splits existing farms and would be likely to create difficulties with farming operations.	-2
• Effects on known archaeological/cultural values; this option traverses close to Nga Haere Pa and the historic mill with significant potential to disturb them.	-1
• Project length; the approximate 2668m length in comparison to the existing 2400m length would result in travel time and vehicle operating cost disbenefits.	-2
• Potential direct effects on dwellings; whilst this option is further away from most dwellings, it does have direct effects on two dwellings. Noise and visual effects could be expected for six other properties.	-1
Neutral Effects	**Rating**
• Road connections; this option still provides all necessary connections.	0
• Earthwork quantities; not assessed in detail, but no issues envisaged.	0
Beneficial Effects	**Rating**
• No specific beneficial effects.	0

Table 4-1: Western Alignment Effects

This option was discounted primarily due to the land ownership arrangements with multiple parties and the close proximity to the Urupa between Waitarere Beach Road and Paeroa Road.

Eastern Alignment Option

An eastern alignment was considered as it would provide the shortest route through the project extent, thereby providing the best outcome in terms of travel time efficiency. This option involved deviating right from the highway to the north of Clay Road, traversing through the sand hills and connecting back to SH1 approximately 900m north of Waitarere Beach Road.

Negative Effects	Rating
• Land severance (sterilisation); this option severs eleven land parcels. Most of these land parcels are large in size and would become oddly-shaped, potentially creating difficulties for farming operations; this option also has a serious effect on farming operations for Lot 4 DP 61399. In addition, the old Matau Marae is located on this land parcel and this option potentially affects the site.	-1
• Earthwork quantities; as this option traverses through hilly terrain, the earthworks are likely to be greater.	-2
• Effects on known archaeological/cultural values; this option has major impacts on the Matau Marae and its surrounds. It will run very close to the marae and sever the land between the marae and the highway. Potential fatal flaw.	-2
• Potential direct effects on dwellings; overall this option moves the highway away from dwellings but will have noise and visual effects on three properties	-1
• Road Connections; potentially effects the connection through to Waitarere Beach Road because of topography (10m difference in elevation).	-1
Beneficial Effects	**Rating**
• Project length; the approximate 2230 m length is shorter than the other options.	+1

Table 4-2: Eastern Alignment Effects

This option was considered to lie too close to the Matau Marae, the old Matau Marae site and the Whare Rongopai so was not considered further due to the cultural significance of these sites and the surrounding area.

Long Alignment

This option improved the southern curve north of Clay Road then continued straight ahead, bypassing the curves at Paeroa Road and Waitarere Beach Road to connect back into the highway approximately 800m north of Waitarere Beach Road.

Negative Effects	Rating
• Land severance (sterilisation); this option severs 14 land parcels and would potentially affect farming operations though not as severely as the Eastern Alignment.	-1
• Effects on known archaeological/cultural values; crosses more of the land (mainly sand dunes) likely to have burials. Also close to the Whare Rongopai.	-1
• Potential direct effects on dwellings; directly affects three dwellings with one dwelling likely to be removed.	-1
Neutral Effects	**Rating**
• Road connections; a new connection to Waitarere Beach Road is needed, and the topography should allow this.	0

• Earthwork quantities; not assessed in detail, but no issues envisaged.	0
Beneficial Effects	**Rating**
• Project length of approximately 2,315 m is similar to three of the options.	+1

Table 4-3: Long Alignment Effects

This option was rejected as it would require extensive earthworks and may cross unidentified Maori archaeological sites. The purchase of several dwellings would be necessary, due to the alignment bisecting at least one house and some small land parcels. It would also cost significantly more than the proposed option with very few additional benefits.

Long Western Alignment

A longer western alignment was also considered, similar to the western alignment, but even further west. This option was developed in an attempt to avoid adverse effects close to the new state highway, but the adverse effects generated at a greater distance away from the state highway are likely to be similar on closer examination. Also the greater distance increases risk/safety effect potential.

Negative Effects	**Rating**
• Land severance (sterilisation); this option severs eighteen land parcels, the greatest number land parcels of all the options.	-2
• Earthwork quantities; increased due to the extra length.	-1
• Effects on known archaeological/cultural values; potentially a very large effect due to the closer proximity to the Urupa and associated noise and visual effects.	-2
• Project length; the length of approximately 2670 m which is the longest of all the options.	-2
• Potential direct effects on dwellings; directly affects six dwellings. An additional two dwellings are considerably affected by this option through noise and visual effects.	-2
Neutral Effects	**Rating**
• Road connections; this option provides all necessary connections.	0
Beneficial Effects	**Rating**
• No specific beneficial effects	0

Table 4-4: Long Western Alignment Effects

This option was rejected for a number of reasons, including unacceptable bisecting of property, unnecessary complications with local road intersections, and increased journey length.

Option 8-2

A lower impact, shorter alignment option was considered, which closely tracked the existing highway, but provided some geometric improvement to the curve radii, as well as improved consistency through the curves. Impact on land would be reduced due to using a considerable length of the existing highway instead of greenfield construction.

Negative Effects	**Rating**
• No specific negative effects	0
Neutral Effects	**Rating**

• Road connections; this option still provides all necessary connections.	0
• Earthwork quantities; not assessed in detail, but no issues envisaged.	0
Beneficial Effects	**Rating**
• Land severance (sterilisation); this option would not sever any properties but would affect six land parcels.	+2
• Project length of approximately 2,377m; is slightly shorter than the existing	+1
• Effects on known archaeological/cultural values; limited due to closely following the existing highway.	+1
• Potential direct effects on dwellings; none expected.	+2

Table 4-5: Option 8-2 Alignment Effects

This option was selected given the positive impacts on land severance, archaeological/cultural values and no anticipated impact on dwellings.

Option 8-3

A new alignment in close proximity to the existing highway was considered, which resulted in two larger radii curves and a long section of straight. This option provides a balance between a full realignment without deviating too far from the existing highway. This option also offers the potential for reduced project length.

Negative Effects	**Rating**
• Effects on known archaeological/cultural values; potentially due to the location near known significant sites	-1
• Potential direct effects on four dwellings	-1
Neutral Effects	**Rating**
• Road connections; this option still provides all necessary connections.	0
• Earthwork quantities; not assessed in detail, but no issues envisaged.	0
Beneficial Effects	**Rating**
• Land severance (sterilisation); this option should not result in severance of land parcels but the deviation from the existing highway will require land from 14 land parcels.	+1
• Project length of approximately 2,325m which is shorter than three of the other options.	+1

Table 4-6: Option 8-3 Alignment Effects

This option was selected given the positive impacts on land severance and journey length.

Do-Minimum Option

The Do Minimum has been assumed to be the continued maintenance and operation of the existing highway, as per the EEM. The Do Minimum alignment is not satisfactory, failing to meet the Project Outcomes listed in Section 3, hence leading to this project investigation.

There is no significant scheduled maintenance work within the near future and this option represents the minimum level of service to maintain the current level of service, i.e. standard maintenance and operational improvements. Expenditure for this option preserves the minimal level of service.

The Do-Minimum consists of the following geometry:

I. For the state highway, two two-lane rural road models with lane widths of 3.6 m and shoulder widths of 1.2 m, for north and south of Waitarere Beach Road.

II. For Waitarere Beach Road, a two-lane rural road model with lane widths of 3.25 m and shoulder widths of 0.25 m.

III. Three isolated rural curves, with design speed equal to negotiation, and with approach speeds determined from the Curve Context table in the RAMM data base.

The Do Minimum option has a 5 year severe crash prediction rate of 2.22, based on KiwiRAP star rating from Appendix E – Crash History Information.[12]

Other Design Considerations

Median and edge treatments

The predominant fatal crashes that have occurred here have all involved vehicles crossing the centreline. This combined with the KiwiRAP star rating, the volumes of traffic on local roads and the Transport Agency's safe systems approach to design means that edge treatments and a central median barrier need to be carefully considered, particularly where options are advanced that don't provide these additional facilities.

Passing Lanes and opportunities

The northbound and southbound departure from the Waitarere Beach Road intersection are (potentially) good passing lane locations as this is approximately 5 km from other proposed and existing retained passing lanes on this section of highway north of Levin. These were discussed in the Otaki to Levin Route Improvements Report (Report No. 11). Subsequently, passing lanes have been further considered in the context of the corridor from Levin to the Manaawatu River and the preferred location for northbound passing lanes would be north of the Koputaroa Road (south) intersection north of Levin, and north of Mitchpine north of Waitarere.

In terms of southbound passing opportunities, there is currently a passing lane south of the Manawatu River. Investigations show that no other formal passing lanes can be safety provided on the approach into Levin.

The northbound passing lanes will continue to be investigated further in tandem with finalisation of implementation of any proposed improvements at Waitarere Beach Road curves.

Intersection Form

Roundabouts have fewer conflict points than T-junction intersections. However, roundabouts induce significant delays to through traffic. Waitarere Beach Road intersection does not have a severe crash history with only one injury crash at this intersection in the last five years, so a roundabout would result in unjustifiable travel time and vehicle operating cost disbenefits to SH 1 traffic. As indicated in Section 5, the existing priority controlled layout, which would be retained (but upgraded) with the two options (investigated during the PFR), will provide a high level of service within the analysis period.

4.2 PFR Options Analysed

An assessment of two options selected from the long list of options was subsequently undertaken during the PFR[3] stage. The following tables summarise the assessment of both of the two options, Option 8-2 and Option 8-3,that was undertaken in the PFR.

As all prior analysis has been undertaken before the transition into the Transport Agency's Business Case approach (see section 1.1), some items in the tables below had not been previously assessed / determined.

[12] HRRRG Appendix C Using Personal reported vs predictive risk correlation charts

The information in the tables below also reflects the information that was available at the time that the PFR analysis was undertaken. As the project has progressed, further investigations have increased the level of knowledge of the project team and this is presented in subsequent sections.

PFR – ASSESSMENT OF OPTIONS – SUMMARY TABLE Option 8-2

Proposal Details			
Activity Name:	Waitarere Beach Road Curves	Name of Project Manager & Region:	Jo Draper, Wellington
Activity Description:	Investigate and develop preferred option for addressing the fatal and serious crashes for the section of SH1 from north of Clay Road to north of Waitarere Beach Road as part of the wider Otaki to north of Levin RoNS project.		
Background Information			
Geographic Context:	State Highway 1 through the Waitarere Beach Road Curves, north of Levin. The geographical extent of this project is from Clay Road (967/7.47) in the south to north of Waitarere Beach Road (RP967/5.00) in the north, a length of approximately 2.5 km. The surrounding land use primarily consists of farm land and several rural residential properties.		
Social Context:	The community in this area has historically been centred around Matau Marae and Huia Marae. The alignment is confined by culturally significant features including two Marae, Urupa, the Whare Rongopai, and rural residential dwellings.		
Economic Context:	The surrounding land use primarily consists of farm land and several rural residential properties. There are a number of dairy farms in the area and Waitarere Beach Road provides access to a number of rural commercial businesses.		
OPTION 8-2 – Curve Easing			
Option Description:	Slight easing of all three curves on the existing alignment to a minimum 550 m radius with a design speed of 100 km/h. Improved cross section with wider sealed shoulders and edge barrier, together with intersection upgrades.		

Estimated Total Public Sector Funding Requirement:		Lower	Upper
	Capital Cost ($m):	5.62M (expected)	7.25M (95th percentile)
	Net Property Cost ($m):	0.17M	
	Opex ($m/30yr):	-	
	Maintenance ($m/30yr):	Not Assessed	
	Present Value of Cost to Govt.($m):	5.32M	
Estimated BCR Range:		1.6[13]	

Timing of need:	*Optimal Programme:*	Not assessed	*Likely:*	
IRS Profile:[14]	*Strategic Fit:*	H	*Effectiveness:*	H	*Efficiency:*	L
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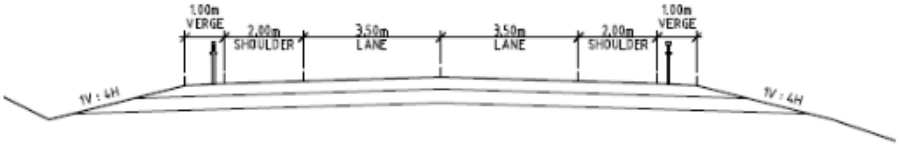
[13] The BCR calculated in the original PFR for Option 8-2 was determined to be 2.1. However, it has since been revealed that the original BCR contained an error in the reduced route length as a result of the curve easing. These figures were calculated with the 30 year EEM assessment and are therefore expected to be higher when using the 40 year assessment period.

[14] The IRS profile shown relates to this option and is used to help differentiate options. This IRS does not replace the profile that applies to the WNC RoNS.

Planning Objectives	
Objective:	Performance against planning objective:
Provide best value solutions which will progressively meet the long term RoNS goals for this corridor	The installation of edge barrier protection provides safer roads and roadsides as per the Safer Journeys road safety strategy. The design just reaches the minimum RoNS guidelines for horizontal geometry, with curve radii of 550m.
Provide better Levels of Service, for journey time and safety.	As there is only 45m difference in distance when compared to the existing route, there are negligible journey time benefits to be gained. Safety is improved by the addition of edge barriers; however the fatal crashes that have occurred here have all involved vehicles crossing the centreline. Therefore a safety risk remains without the introduction of a median barrier. The 550m radii curves would support an increase in safe operating speed due to the improved geometry and much more uniform average speeds.
Remove or improve at-grade intersections.	The local road intersections would each receive minor upgrades, but their location would not deviate from the existing alignment, so the ability to improve safety is limited. Waitarere Beach Road would move eastwards from its current location, but still intersect with SH 1 on a curve (albeit with improved sight distance).
Rationale for Selection or Rejection of Option:	The key risk with this option is that NZTA may require further realignment improvements at some stage in the future if the upgrade fails to satisfactorily address the crash performance. The lower standard of upgrade is unlikely to result in the desired level of safety performance. Whilst crash costs will be reduced, an underlying road related safety risk remains. Therefore this option is not selected for consideration at Detailed Business Case.
Implementability Appraisal of Option 8-2	
Technical:	This option uses reduced design standards for the cross section and horizontal curve geometry. As a result the overall capital cost (and land requirement) is less than for a higher standard option. The reduction in standards does not realise all the potential safety and travel time benefits that a higher standard upgrade would achieve.



TYPICAL SECTION - STATE HIGHWAY 1

The option consisted of:

- Two 3.5 m sealed lanes;
- Two 2.0 m sealed shoulders;
- Two 1.0m unsealed shoulders behind the edge barrier;
- Easing each of the curves to 550 m radius (100 km/h design speed);
- Shifting the Waitarere Beach Road intersection to meet the new alignment.

Option 8-2 would upgrade the existing two lane undivided carriageway with 3.5 m lanes, 2.0 m shoulders (with edge protection) and ease all three curves to 550 m radius. The option would result in a small reduction in length of the existing highway alignment.

The proposed geometric alignment and upgraded cross section does not

	meet RoNS requirements.
Consentability	The following resource consents would likely have been required under the proposed One Plan administered by the Horizons Regional Council: • Land use consents for the placement/extension of structures in a water course; • Temporary diversions of water during culvert works; • Bore permit for geotechnical investigation; • Stormwater discharges from bulk earthworks; • Soil and vegetation disturbance; • Discharges of contaminants to land; and • Discharge of contaminants to air from road construction. No analysis was undertaken as to whether obtaining these would be problematic. Archaeological authorities from Heritage NZ will be needed.
Operational/ Maintenance:	Option 8-2 decreased the length of carriageway by 45m. The increased carriageway width means that there is only a marginal increase in carriageway area. The installation of the roadside edge barrier would also require additional maintenance due to vehicle strikes. Waitarere Beach Road, a local road, would have marginally increased in length by approximately 40 m, which will result in increased maintenance costs for Horowhenua District Council.
Financial:	Option 8-2 has lower capital costs, however it also delivers less benefits than a higher standard alignment could provide. It also does not provide a robust solution to the current deficient alignment and would require further improvement work in future.
Public/ Stakeholders:	Consultation has been carried out under the scoping phase of the Otaki to North of Levin RoNS and on-going consultation would continue with stakeholders throughout the planning and design process. The area is identified as being of cultural importance to the iwi of Rangitane o te Whanganui a Tara, Ngati Raukawa ki te Tonga and Ngati Toa Rangitira. No specific consultation was carried out with stakeholders in relation to Option 8-2.
Multi-Criteria Assessment of Option 8-2	
Criterion	**Supporting Information**
No MCA was undertaken for this option during the PFR stage, however supporting commentary for each criterion is provided below	
Safety:	It is clear from the crash analysis that the majority of crashes which result in high severity resulted from drivers having difficulty with the out of context curves. Therefore by addressing these curves it is reasonable to assess that the crash risk is substantially reduced (and road related crashes reduced accordingly, noting that risk does still remain).
Economy:	This option was initially assessed as providing a reduction in journey time by providing a higher standard more direct alignment than the existing situation. The net effect would be a reduction in overall journey length, with increased traffic speeds. As this option did not include median wire rope barrier, existing access arrangements are generally unchanged for local roads or private accessways. Crash cost savings provide a significant economic return. The option also

	delivers vehicle operating cost and carbon dioxide savings. Since the PFR was undertaken, it has become apparent that the route length reduction in the PFR was incorrect. The correct route length reduction is in fact only 45m for Option 8-2 which substantially reduces the travel time benefits previously presented.
Integration:	Does not offer any opportunities for improving integration.
Social:	This option has a negligible effect on accessibility, given the proposal results in only a minor realignment of the existing highway. Improves accessibility as safer to come off and get onto SH1. Due to the limited nature of the upgrade, this option would have limited (or no) effect on the important local sites, such as Matau Marae.
Bio-Physical:	Not assessed as part of the PFR.
Human Health:	Not assessed as part of the PFR.
Cultural:	The Waitarere Beach Road Curves project extents do include a number of known or possible culturally significant sites (described in greater detail in Section 2.2.2). As this option includes only a minor realignment, the potential impact on culturally significant sites is therefore less compared to more substantial realignment options (Option 8-3). No detailed assessment of the Option 8-2 impact on cultural sites was undertaken as part of the previous PFR.
Property:	Land requirement has been included in the concept development and cost estimation and uses the following preliminary findings: • Option 8-2 requires 25,400 m2 of land. The land calculations are based on that required for the construction of the road using aerial plan areas. There would also be a quantity of surplus land as a result of the curve easing. No assessment of this was undertaken during the PFR stage. Option 8-2 requires land from six land parcels, comprising of three farms, two rural residential, and the Whare Rongopai.

PFR – ASSESSMENT OF OPTIONS – SUMMARY TABLE Option 8-3

OPTION 8-3 – Curve Realignment							
Option Description:	Realignment of the highway on approximately the current alignment to have two 800 m radius curves with a design speed of 110 km/h. Improved cross section with wider sealed shoulders and edge barrier, together with intersection upgrades.						
Estimated Total Public Sector Funding Requirement:			Lower		Upper		
	Capital Cost ($m):		9.69M (expected)		12.56M (95th percentile)		
	Net Property Cost ($m):		0.36M				
	Opex ($m/30yr):		-				
	Maintenance ($m/30yr):		-				
	Present Value of Cost to Govt.($m):		9.16M				
Estimated BCR Range:			1.8[15]				
Timing of need:	*Optimal Programme:*	Not Assessed	*Likely:*				
IRS Profile:[16]	*Strategic Fit:*	H	*Effectiveness:*	H	*Efficiency:*	L	

Planning Objectives	
Objective:	Performance against planning objective:
Provide best value solutions which will progressively meet the long term RoNS goals for this corridor	The installation of edge barrier protection provides safer roads and roadsides as per the Safer Journeys road safety strategy. The design meets the desired RoNS guidelines for horizontal geometry, with curve radii of 800m.
Provide better Levels of Service, for journey time and safety.	There are minor journey time benefits generated with the approximately 80m reduction in road length. Safety is improved by the addition of edge barriers, however, the fatal crashes that have occurred here have all involved vehicles crossing the centreline. Therefore some safety risk remains without the introduction of a median barrier.
Remove or improve at-grade intersections.	The local road intersections would each receive minor upgrades, with sight distance improving at most of the intersections due to the straightening nature of the alignment. Waitarere Beach Road would move eastwards from its current location and intersect with SH 1 on a straight length of highway. This is a major improvement for sight distance at this intersection.

[15] The BCR calculated in the original PFR for Option 8-3 was determined to be 2.5. However, it has since been revealed that the original BCR contained an error in the reduced route length as a result of the realignment. These figures were calculated with the 30 year EEM assessment and are therefore expected to be higher when using the 40 year assessment period.

[16] The IRS profile shown relates to this option and is used to help differentiate options. This IRS does not replace the profile that applies to the WNC RoNS.

Rationale for Selection or Rejection of Option:	Option 8-3 realigns the existing highway and will achieve travel time, vehicle operating cost and crash saving benefits, particularly addressing loss of control crashes. It will extend from RP967/7.28 to RP 967/5.0. This Option was selected ahead of Option 8-2 because it delivers a much better final solution, with higher standard geometry and road cross section. The higher standard upgrade will result in higher crash savings and is therefore considered to more accurately address the project outcomes. In addition, the improvements investigated in Option 8-2 are likely to require further upgrade works at some point in future and therefore are not considered to offer good value for money expenditure. The increased BCR calculated for Option 8-3 also suggests a better solution than Option 8-2.
Implementability Appraisal of Option 8-3	
Technical:	This option realigns the highway through the Waitarere Beach Road Curves, altering the double-S bend to two curves in the same direction separated by a straight section of highway. Waitarere Beach Road intersects at the northern end of this straight. (A typical project cross section of the 13 m highway is shown in the description of Option 8-2 above). The option consists of: • Two 3.5 m sealed lanes; • Two 2.0 m sealed shoulders; • Two 1.0m unsealed shoulders behind the edge barrier; • Realignment with two curves at approximately the Whare Rongopai curve and Waitarere Beach Road curve with 800 m radius (110 km/h design speed); • A relocated intersection on the realigned section of highway for Waitarere Beach Road. Option 8-3 will realign the existing highway and was assessed as achieving travel time, vehicle operating cost and crash saving benefits, particularly addressing head on and loss of control crashes.

Consentability	The following resource consents would likely be required under the proposed One Plan administered by the Horizons Regional Council: • Land use consents for the placement/extension of structures in a water course; • Temporary diversions of water during culvert works; • Bore permit for geotechnical investigation; • Stormwater discharges from bulk earthworks; • Soil and vegetation disturbance; • Discharges of contaminants to land; and • Discharge of contaminants to air from road construction. No analysis was undertaken as to whether obtaining these would be problematic. Archaeological authorities from Heritage NZ will be needed.
Operational/ Maintenance:	Option 8-3 decreases the length of carriageway, but the increased carriageway width means that there is a significant increase in carriageway area. The installation of edge barrier would also require additional maintenance due to vehicle strikes. Waitarere Beach Road, a local road, would marginally increase in length by approximately 30 to 70 m, which will result in increased maintenance costs for Horowhenua District Council.
Financial:	Option 8-3 has the higher BCR of the two PFR options and therefore purely in economic terms is favoured. It is also incrementally favoured with an incremental BCR of 2.3. Option 8-3 has higher costs (than Option 8-2), with some uncertainty around sensitive land requirements affecting rural dwellings and culturally significant buildings.
Public/ Stakeholders:	Consultation has been carried out under the scoping phase of the Otaki to North of Levin RoNS and on-going consultation will continue with stakeholders throughout the planning and design process. The area is identified as being of cultural importance to the iwi of Rangitane o te Whanganui a Tara, Ngati Raukawa ki te Tonga and Ngati Toa Rangitira. No specific consultation was carried out with stakeholders in relation to Option 8-3.
Multi-Criteria Assessment of Option 8-3	
Criterion	**Supporting Information**
No MCA was undertaken for this option during the PFR stage, however supporting commentary for each criterion is provided below.	
Safety:	It is clear from the crash analysis that the majority of crashes which result in high severity resulted from drivers having difficulty with the out of context curves. Therefore by addressing these curves it is reasonable to assess that the crash risk will be substantially reduced. Option 8-3, due to the higher standard proposed, would provide a safer solution than Option 8-2. A better standard alignment will reduce the likelihood of run-off road and cross centreline crashes. Therefore Option 8-3 more adequately meets the project objectives.
Economy:	This option was originally assessed as providing considerable travel time cost savings. This would be achieved through a reduction in journey time by providing a higher standard, more direct alignment than the existing situation. The net effect would be a reduction in overall journey length, with increased traffic speeds (due to the higher

	geometric standard of the horizontal curves). However, the journey length reduction calculated during the PFR stage has since been found to contain an error and results in a journey length reduction of 89m (rather than the reduction of 330m previously presented). The result of this change to the journey length significantly reduces the travel time benefits expected (and therefore the reported BCR). As this option did not include median wire rope barrier, existing access arrangements are generally unchanged for local roads or private accessways. The recalculated BCR for this option is higher than Option 8-2, as a result of the reduction in the route length and associated travel time cost savings.
Integration:	No opportunities exist for improved integration within the project scope.
Social:	This option has only a minor effect on accessibility despite the realignment of the existing highway. However, the investigation identified the potential for other improvements such as wire rope median barrier. The provision of such a barrier would affect local access given the right turn into or out of local accessways and local roads would be affected (dependent upon the placement of the barrier and any breaks for turning).
Bio-Physical:	Not assessed as part of the PFR.
Human Health:	Not assessed as part of the PFR.
Cultural:	The Waitarere Beach Road Curves project extents do include a number of known or possible culturally significant sites (described in greater detail in Section 2.2.2). As this option includes only minor realignment, the potential impact on culturally significant sites is therefore lessened when compared to more substantial realignment. Given Option 8-3 deviates from the existing alignment far more significantly than Option 8-2, the potential for impacts on sites of cultural significance is greater. However, the proposed alignment selected in Option 8-3 has been chosen in order to avoid, as far as practicable, known cultural sites. Further assessment will be required during the next, more detailed, phase of investigation (i.e. Detailed Business Case), refer to Section 4.4 for this further analysis.
Property:	Land requirement was considered in the concept development and cost estimation and uses the following assumptions: • Option 8-3 requires 66,500 m2 of land. The land calculations are based on that required for the construction of the road using aerial plan areas. Option 8-3 requires land from 14 land parcels, comprising of three farms, seven rural residential, three “lifestyle” properties, and land from the Whare Rongopai. The land required for Option 8-3 would be significantly greater than Option 8-2 due to the long lengths of greenfield construction required for the high standard alignment. This results in greater land cost and possible community dissatisfaction from those landowners where land is necessary.

4.3 Recommended Package of Alternatives

The assessments undertaken and summarised in the tables above (Section 4.2), identify Option 8-3 as the preferred option (this is a summary of the investigations undertaken and reported in the PFR). The basis for selection of the preferred option is the better safety outcomes expected due to the higher standard geometry, together with the higher BCR calculated, which is a function of the considerable travel time cost savings (through a reduction in journey time by providing a higher standard, more direct alignment) and increased traffic speeds (due to the higher geometric standard of the horizontal curves).

The PFR also recommends that the following package of measures to be taken through to the Detailed Business Case assessment of the preferred option:

4.3.1 Alignment

The realignment of the multiple horizontal curves is an essential component of the improvements. An improved geometric standard is key to reducing crashes, specifically fatal and serious injury crashes. Option 8-3 was selected as it provides a better solution with higher radius curves and also involves two, rather than three curves. The improved geometry is consistent with the RoNS guidance on geometric design.

Intersection upgrades will also be introduced (with intersections being of higher standards in more identifiable locations away from deficient curves).

4.3.2 Cross Section

An improved cross section with consistent lane widths, consistent (and wider) sealed shoulders and a median will also result in a significantly enhanced safer road environment, delivering improved safety performance.

4.3.3 Safety Barrier

Undivided state highways with over 6,000 vpd generally have higher numbers of deaths and serious injuries as a result of head-on crashes rather than run-off road crashes. There have been five fatalities and one serious injury related to head on crashes on this relatively short section of highway in the five year crash history. The occurrence of fatal and serious crashes is nearly double the national average for a state highway of similar cross sectional standard.

A median barrier would protect against head-on, run-off road to the right and other cross centreline crashes. A median barrier with appropriate turn around facilities at either end could be considered as part of a larger treatment extending as far north as Koputaroa Road and as far south as Kawiu Road with a gap for Waitarere Beach Road only. This would restrict Paeroa Road, Clay Road and all accesses to left in left out (LILO) arrangement.

The decision to include a median barrier was introduced post PFR stage. These components were added to the preferred option because the predominant fatal crashes involving vehicles crossing the centreline. Further an edge barrier, in combination with the median barrier, would further enhance the roadside protection and prevention of run-off road crashes which can be serious or fatal in nature. Therefore, median and edge barriers would be highly beneficial in supporting a safe system approach (in combination with improved geometry and cross section) by protecting vehicles that have lost control from crossing the centreline or running off road. This approach is consistent with the RoNS guidelines.

Local residents and stakeholder attitudes to the barrier are discussed in Section 6.

4.3.4 Preferred Option Specification and Summary of Safety Benefits

The preferred option consists of the following geometric elements:

I. Realignment of three adjoining 300 to 340mR rural curves to become two same direction left hand 800mR (southbound) curves, separated by a straight and a 2000mR left hand curve at the southern end.

II. Vertical re-profiling given the new horizontal alignment is through rolling terrain.

III. The existing state highway seal is widened to 17m in order to accommodate the following:

- 4.0m median with wire rope barrier
- 3.5m traffic lanes (one each direction)
- 3.0m sealed shoulders
- 0.5m unsealed shoulder
- Swale drainage

IV. Wire rope barrier in median and also side protection throughout (broken only for the Waitarere Beach Road intersection).

V. Waitarere Beach Road allows all movements (RI / RO) and also has a slip lane off SH1 to allow the N back to S turnaround.

VI. Paeroa Road becomes LI/LO.

VII. An access intersection is created at RP967/6.82 and RP967/6.2 combining a number of accessways into a single more significant access.

VIII. A new SH 'P' turn facility is provided around RP967/7.13 for the South to North turnaround.

IX. The intersection with Clay Road will allow all movements as per the current arrangement however it will be improved (RTB, sight line improvements etc.)

The recommended option is predicted to reduce the 5 year severe crash rate to 0.47 (a reduction of 79%), based on road safety treatment measures[17].

The severe crash prediction rate reduction will improve the published KiwiRAP star rating from its current rating of 2 to 4. This achieves Transport Agency's national strategic aim "to achieve a mostly 3 to 4 star KiwiRAP safety risk rating".

These 5 year severe injury crash predictions can be found in Appendix C – Economic Worksheets.

[17] HRRRG Appendix D Countermeasures – infrastructure measures

4.4 Preferred Option Development

The table below outlines the development of the preferred option for the Project. The preferred option for implementation is directly derived from Option 8-3 investigated during the PFR phase but with a number of key alterations which are detailed in the table below. The alterations occurred in response to further detailed assessments and design work (geotechnical, stormwater, cultural, environmental screening, utilities, and planning assessment) and in consultation with land owners and local iwi. A safety audit has also been undertaken.

Proposal Details			
Activity Name:	Waitarere Beach Road Curves	Name of Project Manager & Region:	Jo Draper, Wellington Region
Activity Description:	Investigate and develop the Detailed Business Case for the Waitarere Beach Road Curves improvements, to address the fatal and serious crashes for this section of SH 1.		
Background Information			
Geographic Context:	State Highway 1 through the Waitarere Beach Road Curves, north of Levin. The geographical extent of this project begins north of Waitarere Beach Road (RP967/5.10) and finishes south of Clay Road (967/7.69), a length of approximately 2.5 km. The surrounding land use primarily consists of farm land and several rural residential properties.		
Social Context:	The community in this area has historically been centred around Matau Marae and Huia Marae. It is also the primary access for Waitarere Beach. The alignment is confined by culturally significant features including the two Marae, Urupa, a Whare Rongopai, and rural residential dwellings.		
Economic Context:	The surrounding land use primarily consists of farm land and several rural residential properties. There are a number of dairy farms in the area and Waitarere Beach Road provides access to a number of rural commercial businesses and beach community.		
DBC OPTION – RoNS Standard Realignment (Opt 8-3)			
Option Description:	The RoNS Standard Realignment option provides a significantly improved road corridor by improving the geometric alignment and also road cross section throughout the project extents. It also provides intersection improvements throughout the project. Safety barrier is provided throughout in both the central median and roadside edge. The highway is realigned by two left hand 800m radii curves with a design speed of 110 km/h. As a result of the two significant horizontal curve realignments, the resulting straight between the two new curves is almost entirely greenfield construction. This Option was the only option supported from the previous stage and taken through to DBC assessment.		
Estimated Total Public Sector Funding Requirement:		Lower	Upper
	Capital Cost ($m):	14.2M	18.1M
	Net Property Cost ($m):	1.9M	2.2M
	Opex ($m/40yr):	-	
	Maintenance ($m/40yr):	3.3M	-
	Present Value of Cost to	11.1M	13.9M

	Govt.($m):					
Timing of need:	*Optimal Programme:*			*Likely:*		
IRS Profile:[18]	*Strategic Fit:*	H	*Effectiveness:*	H	*Efficiency:*	L

Planning Objectives	
Objective:	Performance against planning objective:
Provide best value solutions which will progressively meet the long term RoNS goals for this corridor	The installation of edge and median barrier protection provides safer roads and roadsides as per the Safer Journeys road safety strategy. The design achieves the minimum desired RoNS standard for horizontal geometry, with curve radii of 800m. The cross section includes a 4.0m wide median (with central barrier in the middle) and a 3.0m sealed shoulder to the edge barrier. Outside of the edge barrier is a further 1.0m sealed shoulder. Each of the intersecting local roads will receive minor upgrades and a 'P' turn facility is provided at the southern extent of the project.
Provide better Levels of Service, for journey time and safety.	There are minor journey time benefits generated with the approximately 80m reduction in road length. Safety is improved by the addition of edge and median barriers. The predominant fatal crashes that have occurred here have all involved vehicles crossing the centreline, therefore, the addition of the median barrier will eliminate this crash risk.
Remove or improve at-grade intersections.	The minor local roads would each receive minor upgrades, with sight distance improving at most of the intersections due to the straightening nature of the alignment. Waitarere Beach Road would move eastwards from its current location and intersects with SH 1 on a straight length of highway. This is a major improvement for sight distance at this intersection. The right turn bay and priority control intersection continue as the form of control.
Rationale for Selection or Rejection of Option:	The proposed works will provide a high standard long term solution that meets the RoNS design guidance. The higher standard alignment will provide a much improved geometric alignment, which will result in a much safer road environment with fewer propensities for high severity crashes. The improved cross section will also provide greater resilience for the highway – for example should a larger vehicle breakdown, the wider cross section will ensure traffic can still pass. The proposed improvement forms part of the staged approach to delivery of the O2L WNC RoNS. This section of SH1 is outside of possible future (4 lane) expressway extents as this would likely terminate at the SH1/57 intersection south of Levin.
Implementability Appraisal of Option: RoNS Standard Realignment (Opt 8-3)	
Technical:	The option is relatively straight forward in terms of overall complexity. The option provides an improved alignment and cross section for this section of SH 1. The proposed alignment runs close to the existing SH1 alignment but will result in new road construction for the majority of the project extent to achieve a high standard geometrically. As little of the existing SH1 can be used, land acquisition will be needed to

[18] The IRS profile shown relates to this option and is used to help differentiate options. This IRS does not replace the profile that applies to the WNC RoNS.

	allow the realignment to be constructed outside of the existing highway corridor. Whilst the general alignment for the Detailed Business Case has been fixed using Option 8-3 from the Indicative stage, two sub-options were investigated to ensure the best overall alignment is provided. The variations are described briefly below, including the identification of the preferred option; • **Paeroa Road Variation**: This variation would have resulted in the Option 8-3 alignment being shifted further east and closer to the existing SH1. This would have introduced a very large radius horizontal curve instead of the straight section south of Waitarere Beach Road. This was considered in order to try and minimise the amount of land acquisition around the existing SH1/Paeroa Road intersection where there was the potential for the option to impact where a culturally significant Pa site could potentially exist. Following the investigation by an archaeologist, it was confirmed that the Pa does not exist at this location and therefore this alternative has been rejected (given it is unnecessary). • **Whare Rongopai Variation**: This variation is still considered as a viable alternative to the proposed option. The vast majority of the main option is retained, the only difference being the alignment of the southern 800m radius horizontal curve. In the Whare Rongopai variant, the curve is shifted further west than currently proposed. The effect of this would be to reduce the overall impact on the culturally significant Whare Rongopai property and an adjacent residential property. However, the impact would be greater onto the other side of the existing SH1, where the road alignment would become much closer to a dwelling (property number 511), and could ultimately result in full acquisition of this property. From a geometric design perspective there is little difference between the two options, however the option that pushes the road closer to Whare Rongopai is marginally preferred because it provides a very slight reduction in route length and preferred geometry. This is therefore the preferred option at this stage of assessment, recognising further assessment and consultation is required prior to, or during, detailed design. The RoNS Standard realignment has been developed and expanded beyond the PFR Option 8-3, to better determine the costs, benefits, and impacts and to ensure it was the best possible solution. Further technical detail is provided in Section 5, with the design elements described in Section 5 of this report.
Consentability	Consenting requirements and a consenting strategy is discussed in section 7.2.3 of this report. It is anticipated that a Notice of Requirement (NoR) would be publicly notified. The project is generally straightforward but there are cultural and local land owner concerns that need consideration. These aspects will need to be addressed with mitigation measures prior to lodging the NoR. It is expected that an authorisation from Heritage NZ will be required given the existence of known heritage sites in the area (Pa), the land settlement history and the potential for archaeological material to be disturbed. Regional resource consents will also be required and can be applied for either at the same time as the filing of the Notice of Requirement or separately.
Operational / Maintenance:	The proposed works will result in a change to the highway asset and therefore a corresponding change to the ongoing maintenance and operation of this section of SH1. Overall, the length of SH1 will be reduced by approximately 80m as a result of the realignment. This is a positive from a maintenance perspective.

	However, as a result of the significantly wider road cross section (as described in Section 5.1.1) the effect would be a significant increase in sealed area over the length of the realignment, as follows: • Current Seal Area: 24,400m2 • Proposed Seal Area: 42,800m2 • Net increase: 18,400m2 The increase in seal area will result in additional maintenance costs for the seal and underlying pavement structure. The additional seal area is a result of providing a 4.0m median and 3.0m sealed shoulders. In addition to the seal area, the proposed upgrade will also introduce further assets that require ongoing maintenance and management. Significant lengths of new TL4 wire rope barrier will be introduced across the project length with new median and edge wire rope barrier installed throughout the entire project (but with the necessary break for intersections and access). Despite the above, the additional maintenance cost is closely offset by a new asset with the overall change in Net Present Value being small.
Financial:	It is proposed to fund the option from the National Land Transport Fund. As it is part of the wider Otaki to Levin RoNS project, construction funding is currently earmarked for 2019. Options to fund earlier construction will also be explored. Increased maintenance costs will be able to be managed through the Network Outcome Contract for Manawatu. There would be no operation costs.
Public / Stakeholders:	The various option iterations have been made public through individual and group landowner meetings. While there is general support for the new alignment, some landowners are concerned about access to their property. Refer to stakeholder feedback in Section 6.

4.4.1 Preferred Option Assessment

As there is only one option assessed for the Detailed Business Case, no multi-criteria analysis has been undertaken for option comparison. However the proposed alignment has been assessed against a range of social and environmental criteria.

Assessment of Option: Full RoNS Standard Realignment (Opt 8-3)	
Criterion	**Supporting Information**
Safety:	There is a significant issue with the existing horizontal alignment through the project length. The curvature of the alignment has resulted in numerous crashes including those of high severity. The crash information is provided in detail in Appendix E – Crash History Information. It is clear from this crash analysis that the majority of crashes of high severity resulted from drivers having difficulty with the out of context curves. Therefore by addressing these curves by easing the radii and segregating the opposing traffic streams, the crash risk will be substantially reduced. This RoNS Standard Realignment Option will result in a far higher standard of geometric alignment. The existing curves on the current SH 1 alignment at this location are all small radii and deficient. These curves are difficult for drivers to judge and can result in loss of control crashes. The removal of these curves and replacement with two much larger length and

	800 m radii curves results in a much improved geometric standard, with the longer sweeping curves much easier for drivers to perceive and negotiate smoothly at a consistent travel speed. The design speed for the improvements is 110km/h. In addition to the improved alignment, additional safety gains are secured through a greatly improved road cross section and barrier provision. The Safe System approach recognises the need to create safer roads and roadsides, which the provision of improved cross section, geometry and safety barrier provision all contribute towards achieving this goal. The provision of substantial wire rope barrier will result in incremental safety gains because the barrier will reduce the propensity or completely prevent run-off road and cross centreline crashes which are two of the most serious forms of crash types. The median wire rope barrier will also prevent right turns into and out of private accessways and intersections. The benefit of this is to remove conflicting movements particularly given right turning crashes have a high likelihood of being severe, especially in high speed environments such as this. Obviously, with movements restricted to left in / left out only, there is a consequential requirement to provide some form of turnaround facility at (or in close proximity) to either end of the project extents. Therefore turning facilities are proposed at either end of the project where it is considered right turning is safer using appropriately designed and located facilities (rather than uncontrolled turning at all accessways and intersections). Additionally, the proposed road cross section of wider median (4.0m) and wider shoulders (3.0m) will further enhance the safety improvements. The median and wider shoulders (of constant width) will provide additional road space for driver evasive action or vehicle recovery should it be required.
Economy:	The detailed economic analysis is provided in Section 0 of this report. The main benefit of this option is the crash cost savings which are significant, due to the improved geometry, cross section and barrier provision. This option was also assessed as providing a degree of travel time cost savings (not the project's main objective). This is achieved by providing a more direct alignment and thereby reducing the journey length by 89m. As this option includes median wire rope barrier, existing access arrangements are substantially changed for private accessways along the project length (to left in and left out only). In addition, the median barrier is proposed to continue through the Paeroa Road intersection, resulting in only left in / left out movements being possible. This results in a disbenefit for access to properties along the route, together with access for Paeroa Road, where vehicles (no longer able to turn right) will be forced to travel additional distance to the turnaround facility. Whilst local trips may be slightly longer they will be much safer and the retained intersections should be more efficient.
Integration:	The project supports road safety targets of a reduction in death and serious injury crashes. The proposed wider shoulders will provide a safer and more desirable area for cyclists to use. A bus service operates collecting passengers on SH1 close to the Waitarere Beach Road intersection to go to and from Palmerston North. It is not uncommon for numerous cars to be parked just off Waitarere Beach Road in close proximity to SH1. Therefore, there is a significant opportunity benefit to provide a more formal facility for both parking and passenger collection that would not require bus passengers to cross SH1 at any point. Passenger collection for the bus is discussed further in Section 5.1.7.
Social:	The main positive social impact generated by this proposed design, is the reduction of fatal and serious injury crashes. This benefit is predominantly recognised for the wider society, however local residents benefit by not attending serious crash scenes as a first responder. Witnessing such traumatic events can take a strong emotional

	toll on those persons unqualified, or not trained to experience such events. The provision of a median barrier would affect local access given the right turn into or out of local accessways and local roads would be affected (dependent upon the placement of the barrier and any breaks for turning). Whilst residents have expressed support for the project (being familiar with the safety deficiencies of the road), concerns have also been expressed in relation to the median barrier and the inconvenience it would create in terms of additional journey detour lengths. Turnarounds have been designed on the basis of safety but also with cognisance of reasonable detour distances for local residents. The turnarounds ensure the total detour length for any property is no greater than 2.4km. There are three properties that must travel over 2.0km in order to complete a right turn in movement using the turnarounds. Please refer to Appendix C – Economic Worksheets for a full list of detour lengths. Some residents will have to travel what they may consider being unreasonable distances on a daily basis and may therefore deem the access and turnaround proposals unacceptable. However, a major benefit for the local community will be the reduction in the number of crashes that eventuate in this area (which provides some compromise between benefits and disbenefits for the local community). With this option, the acquisition of some privately owned land is required. It may be necessary to for dwellings to be acquired as part of the process to allow for the new road corridor. Other potential social impacts identified are; • Highway traffic noise (highway closer to homes and the Whare Rongopai). • Some potential disruption to farming activities as the proposed rope barrier will reduce accessibility as well as a loss of productive land. • Cultural and heritage impacts through archaeological disturbance and requiring of Maori land. Overall the project will have considerable social benefits, as this stretch of the SH will have significantly enhanced safety performance, for strategic journeys as well as for the local community. There will however be some minor disbenefits as some land owners will have slightly longer journeys.
Bio-Physical:	The expected environmental effects are as follows: • Some minor loss of vegetation adjoining the highway. The habitat is not high quality and the vegetation is very common. • A highly conservative stormwater design has been undertaken as part of this DBC. It includes new swales running the full length either side of the project. • There are four detention ponds located at low points along the eastern side of the project. These can attenuate a 100 year, one hour storm event. Pond sizes could be reduced if more knowledge is gathered about the soakage rate of the soils. • Existing stormwater culverts will need to be protected, capped or extended during the construction works, depending on their location with respect to the proposed alignment • There is a potential for temporary reduction in water quality during construction. Earthworks and sediment control yet to be defined. Mitigation will need to be developed to address the above.
Human Health:	The improvement in road safety (and decreased risk of fatal or serious injury) is a key human health benefit of the proposals. The option will have a neutral contribution to reducing emissions of CO2, other pollutants and air quality. The proposed improvement will bring the road closer to some residential properties but further away from others. Therefore, there is potential for increased noise effects that will require assessment and potentially mitigation.

	In terms of the distributional impacts, there is potential for individual winners and losers (land owners) from the final alignment through property impacts, median barrier changing access arrangements and travel and safety improvements.
Cultural:	The DBC proposal has considered the potential cultural impact of the proposed road realignment, given the known and potential sites of archaeological and cultural value. The cultural constraints are described in Section 2.2.2. In order to ensure that the known cultural constraints have been identified and considered in sufficient detail, a number of meetings have also been held with local land owners and Iwi representatives to discuss the proposals prior to the final proposed alignment being selected. Local iwi have indicated broad support for safety outcomes that will be delivered by the proposed improvements and note that localised effects on iwi (and notably on overall iwi land holdings) will need to be appropriate mitigated and or resolved.
Property:	A preliminary indicative land requirement has been prepared to ascertain the probable scale of impact on property and for cost estimation. Overall it is estimated the option will require approximately 10 ha of private land. The calculation includes land required for the construction of the road and stormwater detention ponds and some of this land may be able to be returned following that process. There will be a quantity of surplus land as a result of the curve easing i.e. existing parts of state highway land that will not be required and can be sold or exchanged following construction of the project. No assessment of this was undertaken during the DBC stage. The preferred option requires land from 30 land parcels, including; nineteen farms, three “lifestyle” properties, seven rural residential, and the Whare Rongopai land parcel (but does not require the removal of the building). The land required for DBC proposal is significantly greater than previous options (8-2 and 8-3) due to the long lengths of greenfield construction and increased carriageway width required for the higher standard alignment. This results in greater land cost and is likely to cause dissatisfaction from affected landowners.

5 Recommended Project Option

The recommended project option is based upon PFR Option 8-3: Curve Realignment, but with significantly enhanced design standards. The recommended option will provide both a geometric alignment and road cross section that fully meets the RoNS design guidance framework. The proposed works fits in with the programme of safety improvements planned for the state highway corridor north of Levin and fits with the long term strategy of delivering a bypass of Levin.

The recommended option provides two 800m radii curves in place of the existing three substandard curves and provides a significantly improved road cross section with 3.5m traffic lanes, a wide central median and wide sealed shoulders. Median and roadside edge barrier are provided throughout the project length and deliver significantly improved safety outcomes for this section of the state highway.

Of the three local road intersections within the project length, Waitarere Beach Road and Clay Road will remain open for all movements whereas Paeroa Road will be reduced down to left in/ left out movements only. Clay Road and Waitarere Beach Road will also be upgraded.

A new stormwater system will also be provided so as to treat runoff from the road in accordance with current NZTA guidelines. At present, the system is conservatively designed, based on the limited information available. Consequently, the stormwater system requires a considerable amount of land acquisition for stormwater management – however this will be refined and the land affected to accommodate these facilities may reduce as more information becomes available.

5.1 Scope

The north of Otaki to north of Levin Project is to be delivered in a staged manner with the first stages of the programme focussing on localised safety improvements. PFRs[19] undertaken in February 2013 by the project team identified that safety improvements are required at the curves at Waitarere Beach Road, as well as passing lanes, passing opportunities and edge treatments to the north and south of this location.

A separate investigation (Programme Business Case) of the preferred programming of the delivery of these improvements is being completed in parallel with this DBC. It is noted that the most significant component of the improvements programme is the proposed works at Waitarere Beach Road. Accordingly, it is important that the form of those works is understood.

The recommended project option for Waitarere Beach Road Curves is the RoNS Standard Curve realignment based on Option 8-3 of the previous PFR stage. This option has been developed further for the Detail Business Case and the details of the recommended project option are described below.

5.1.1 Geometry and Cross Section

Refer to the drawings provided in Appendix I – Project Drawings.

An improved cross section is proposed for the full length of the project (excluding the tapers back to the existing alignment at the north and south extents). The improved cross section is a safer design to that previously proposed during earlier PFR investigations, as a result of further discussions with NZTA and their desire to provide the full RoNS and Safe System standards, as opposed to an interim lower standard solution.

The preferred cross section includes a single 3.5m wide traffic lane in each direction, 3.0m sealed shoulders, 1.0m unsealed shoulders and a 4.0m median. Full barrier protection is

[19] Project Feasibility Report: Route Improvements Report (February 2013) (http://www.nzta.govt.nz/projects/otaki-to-north-of-levin/docs/pfr-11-route-improvements.pdf)

Project Feasibility Report: Waitarere Beach Road Curves (February 2013)

(http://www.nzta.govt.nz/projects/otaki-to-north-of-levin/docs/pfr-08-waitarere-curves.pdf)

provided, including wire rope barrier in the central median and edge protection wire rope barrier (on the edge of the 3.0m sealed shoulder) along the full length of the realignment (except across accessways). The preferred cross section and barrier provision are the minimum requirements necessary to meet the RoNS design guidelines.

The preferred option realigns the section of SH1, removing the back to back out of context curves. The realignment results in two proposed 800m left hand radii curves separated by a new straight section of highway. There is also a 2000m radius horizontal curve at the southern end of the project near Clay Road.

The alignment has been selected on the basis of providing a high standard geometric solution within the context of known cultural constraints together with limiting the number of parcels and quantities of private land required as much as practicable. All alignment options are likely to affect cultural sites, the proposed option attempts to minimise the impact on known cultural sites as far as practicable. Refer to Section 2.2.2 on possible cultural constraints that have been identified. There is likely to be an impact on Whare Rongopai in terms of land acquisition, but should avoid the physical structure of the church building. Some Maori land is also affected, however the extents of Maori land acquisition has been minimised (but recognising some acquisition is inevitable with the high standard realignment).

At the southern extent of the project, two alternatives were considered for the location of the horizontal curve (north of Clay Road). The two alternatives had different implications for property owners in this vicinity and therefore will be subject to further landowner negotiations and investigation prior to confirmation of the preferred location of this curve. The first southern curve option proposes a longer length circular curve which results in a greater property impact on the southern side of the existing SH1. The second option had a slightly shorter curve length which therefore impacted more significantly on the property north of the existing SH1 (in particular Whare Rongopai and the land between this and Matau Marae). The alternative alignment at this location is included as an indicative sketch option within the drawing package in Appendix I – Project Drawings). The preferred design option is the curve which runs closer to the north (near Whare Rongopai / Matau Marae).

Cyclists are provided for by way of the wide 3.0m sealed shoulders. No other specific measures for cyclists are proposed, as it is not considered necessary.

5.1.2 Intersections

There are three local road intersections within the project extents:

- **Waitarere Beach Road:** This is the main intersection (on the west side) within the project extents, carrying the largest volume of traffic of the intersecting roads to SH 1 (approximately 3,000 vpd). The intersection provides the only access to the Waitarere Beach community which includes residential properties as well as commercial and leisure facilities. This intersection will continue to operate as a priority T intersection where all movements are permitted as per the existing situation.

  The preferred option provides a high standard left turn slip lane for northbound traffic turning into Waitarere Beach Road. This facility will also be utilised by local residents who live on both sides of the proposed alignment, either by western residents who wish to head south to Levin or for eastern residents to access their properties when coming from the south. The slip lane forms a priority controlled T-junction with Waitarere Beach Road. From here, road users turn right and then exit south via the Waitarere Beach Road / SH 1 intersection, utilising the break in the wire rope barrier.

  The sight distance to the south and north is much improved when exiting Waitarere Beach Road, due to the straightened realignment of SH 1. It has also reduced the high super elevation which exiting right turning vehicles had to cross when heading southbound.

  Closure of right turn movements and provision of a mid-block ('P-turn') facility was not considered further north of Waitarere Beach Road; this is because this intersection already exhibits a good crash history (and is being improved). Waitarere Beach Road is used by around 3,000 vpd which would all be required to undertake left in / left out movements and use 'P' turn facilities to the north and south. This is not considered necessary.

- **Clay Road:** This intersection serves a small number of properties (on the east side) and Matau Marae. It currently operates as priority T intersection with all movements permitted and will remain so under the preferred option. However, the intersection will be improved, with a slight extension of Clay Road to connect into the realigned SH 1. This allows the intersection limit line to be pushed further south which removes the visibility issues at the current location in the cutting, whilst also providing a slightly improved approach angle. The intersection is further improved with the provision of a right turn bay on SH 1 and wider sealed shoulders for SH 1 left turn in traffic.
- **Paeroa Road:** The intersection (limit line) of Paeroa Road will be moved approximately 40m west of the current location as a result of the SH 1 realignment. This means Paeroa Road now intersects with a straight section of SH 1, so the sight distance will now be considerably improved. The intersection will remain a priority controlled T intersection.

  However, it is not proposed to break the wire rope barrier at this intersection and therefore the intersection will ultimately operate as left in / left out movements only. The basis of closing this intersection to right turn traffic is, as follows:

  - Proximity to the proposed left turn slip to Waitarere Beach Road (for local road access u-turning) with only 40m separation. A break in the barrier here permitting right turns into, and out of, Paeroa Road would introduce unnecessary conflict.
  - Longer lengths of continuous barrier provide more effective protection, with a break already proposed at Waitarere Beach Road in close proximity. A break at this location could also encourage north to south U-turn movements without adequate facilities to accommodate leading to unsafe driving behaviours.
  - Low traffic demand on Paeroa Road (estimated in 2012 at 70 vehicles per day, two-way movements).
  - Acceptable turning facilities proposed to the north (Waitarere Beach Road) and south ('P' turn facility), with acceptable detour lengths.

  The proposed changes to this intersection will make this a safer facility for road users.

  An alternative arrangement however is also being considered for development in the Preliminary Design Phase. This would result in the current intersection of Paeroa Road being closed at the intersection with SH1. Access would be provided by a newly created link, running between Waitarere Beach Road and Paeroa Road. This is positive (for safety and efficiency) as it completely removes an additional local road intersection with SH1. The proximity of Waitarere Beach Road left turn slip lane and Paeroa Road would also be undesirable, and potentially create safety issues if Paeroa Road was not closed at SH1. Further, it concentrates traffic movements onto the SH1 / Waitarere Beach Road intersection, which will be of a high standard.

  This alternative is currently being discussed with iwi representatives to determine its likely effect.
- **'P' Turn Facility:** Whilst not strictly an intersection, this has been provided toward the southern extent of the project 260m north of Clay Road. This facility is proposed to allow southbound vehicles to safely perform a U-turn movement and turn back north. This facility is necessary due to the median wire rope barrier preventing right turns along the project length. The vertical profile of the road has been designed to ensure appropriate Safe Stopping Distance throughout, and this is not different to the limit line for the right turn movement into the 'P' turn facility.

5.1.3 Access

Access is a key consideration for the project. Whilst the benefits of a median wire rope barrier are clearly known and accepted, for the barrier to be effective, it must be provided in continuous lengths to prevent cross centreline crashes.

Therefore, the inclusion of a median wire rope barrier affects access along the corridor, except for where the wire rope is interrupted, such as at key intersections or turnaround facilities.

The provision of a wire rope median barrier is a vital requirement according to RoNS guidelines and Safe System projects to ensure maximum safety benefits result. However, in

order to maximise the safety benefits whilst providing a reasonable level of access, careful consideration of suitable breaks in the barrier have been assessed.

Turning facilities have been proposed at Waitarere Beach Road, which will remain open for all movements, and by way of a mid-block 'P' turn type facility north of Clay Road. Between these two points the wire rope median barrier will be continuous.

Access for all properties along the length of the route will therefore be reduced to left in / left out only, with no right turns possible either into or out of accessways. Between the proposed 'P' turn facility and Clay Road, no wire rope barrier is proposed. This is not considered necessary on the straight section of highway (and regardless would result in an unacceptably short length of barrier).

The effect of the wire rope and detour length has been assessed for every property along the corridor as shown in Appendix C – Economic Worksheets.

Individual property accessways have not been fully designed for this DBC as this is unnecessary detail not required for this level of investigation.

A key aspect of this DBC and associated consultation has been to establish where median barrier should be located. Given median wire rope barrier is a project minimum requirement, the starting point has been the intention to include median wire rope barrier throughout, limiting all local roads and accessways (within the project extents) to left in / left out movements only. Breaks in the barrier have then been determined based on safety, suitability and then convenience (i.e. in terms of acceptable detour lengths).

The proposed breaks within the median barrier have been considered at length to ensure they are the most appropriate on balance, but recognising that a level of inconvenience (and therefore resistance) is inevitable. Nevertheless, further consideration of breaks in the barrier or alternative turning facilities is not considered necessary or appropriate.

In addition, the consultation that has been undertaken with the local community has been based on the barrier breaks and turning facilities presented within this DBC and reassessment would result in community uncertainty.

5.1.4 Stormwater

A concept design for stormwater management has been undertaken for the preferred option in accordance with Transport Agency's 'Stormwater Treatment Standard for State Highway Infrastructure' (May 2010) design guidelines. The details are provided below. It is important to recognise that the design is conservative. It is highly likely that when further information becomes available, then the stormwater design refinement process will likely reduce the size of any stormwater detention ponds, and could in fact negate the need for ponds in certain locations.

Swales

Swales are proposed to run along the entire length of both sides of the road alignment and will provide both conveyance and treatment. The proposed swale sizing is outlined below;

- Top Width: 3.5m
- Bottom Width: 0.5m
- Depth: 0.5m
- Side slopes: 3H:1V

Ponds

In addition to the swales, dry ponds are desirable for stormwater attenuation. Four ponds are proposed and these in combination are designed to attenuate the 100 year post development, one hour storm. These are situated at (or near to) the low points. The dimensions for each pond are detailed in Table 5-1.

Table 5-1: Proposed pond dimensions

Pond	Bottom	Top	Length	Depth	Side Slope	Attenuation

Number	Width	Width				Volume (m^3)
1	21m	25m	100m	0.5m	1 in 4	1150
2	4m	20m	45m	2.0m	1 in 4	1080
3	10m	30m	50m	2.5m	1 in 4	2500
4	9m	25m	30m	2.0m	1 in 4	1020

The proposed location of the ponds is detailed in Table 5-2, together with conservative estimates of land that will need to be acquired. If the ponds are ultimately required, a level of flexibility exists as to the specific locations and pond layout.

Table 5-2: Pond locations through the alignment

Pond Number	Station From	Station To	Side of the Road	Land Area Required (m^2)	Land Area Required to be Acquired (m^2)
1	5210	5240	Eastern	2,700	3,000
2	6140	6180	Eastern	1,000	0
3	6380	6440	Eastern	1,800	1,000
4	7570	7610	Eastern	1,000	1,000
Total				6,500	5,000

Infiltration via soakage was considered as part of this project as a method to reduce the discharge from the treatment swales and to reduce the size of the dry ponds. However, due to the lack of soakage rate information, the high ground water table and limited number of ground water bores undertaken at this stage of the project it has not been integrated into the design.

It is possible that with more groundwater and soakage information, pond sizes may be able to be reduced or potentially removed from the design. This would reduce the impact on neighbouring properties, especially where the need for storage has been highlighted on these properties as part of this concept stormwater design. The stormwater DBC design therefore is considered to be highly conservative. When further information is known the expectation is that some or all of the ponds can be removed, or at least reduced in size. It may also be possible to reconfigure and utilise additional surplus land from the existing state highway corridor that is no longer required for the realigned highway.

Existing stormwater culverts will need to be protected, capped or extended during the construction works. However, this will depend on stormwater asset proximity to proposed designation.

5.1.5 Signage and Road Markings

The drawings provided have included indicative road markings. These will need to be fully considered at detailed design stage. Nevertheless the drawings provide a reasonable level of detail to demonstrate how the road markings could be used within the proposed layout.

Signage has not been included at this stage of the investigation. Signage plays an important safety role in providing driver information and will be an important aspect of detailed design, particularly given the changed road layouts and turning restrictions (though at DBC stage signage design is not considered necessary). An indicative value has however been included in the cost estimate.

5.1.6 Services

Investigation of utility services through the proposed designation was undertaken using the "BeforeUdig" website. The following services were identified;

- There is an existing telecom fibre cable to be relocated during construction. There are also numerous obsolete and live copper cables in the area;
- Electra power has numerous local mains overhead power lines passing through the proposed designation; and,
- Street lighting at Waitarere Beach Road / SH1 intersection will need to be relocated or replaced.

No water and wastewater utilities are present within the project extents;

The telecom fibre is located through the existing road designation and will need to be relocated into the proposed designation. Existing telecom pedestals will need to be relocated to align with new access locations for properties. This work will need to be undertaken to ensure limited disruptions during the construction works.

Electra Power has overhead utilities that run across the proposed designation at approximately RP967/5.9. The overhead power lines also run alongside the eastern side of the current road designation from RP967/6.2 to extent of works at RP967/7.69. There are numerous overhead lines providing power to local residents. Paeroa Road has an existing overhead power line that will cross the proposed designation and may need to be underground as part of works.

The existing street lighting at Waitarere Beach Road / SH1 intersection shall be relocated to the new intersection layout. A lighting design needs to be carried out at detailed design stage to ensure lighting standards are met.

There is also at least one well and one septic tank on private property that will need to be relocated. Further discussions with landowners are needed to confirm if any further facilities exist.

The utilities affected by the realignment have been identified and an expected rough order costing for relocating or protection include within the scheme estimate. Detailed discussions with utility service providers will be required at the detailed design stage. Preliminary discussions have identified that no significant issues are anticipated with regards accommodating and reconnecting local property supply/ connections. It is recommended that a wider utility meeting is undertaken for the entire Otaki to North of Levin corridor at an appropriate time.

5.1.7 Bus Provision

From the investigations undertaken, there is an existing bus service that runs along SH 1 through the project area and stops at Waitarere Beach Road morning and evening. This bus service and the associated drop off and pick up often result in numerous cars being parked on Waitarere Beach Road in close proximity to the intersection with SH1, as shown in Figure 5-1.

Figure 5-1: Car parking at Waitarere Beach Road / SH1

Discussions with the bus operator, Horizons Regional Council, have revealed that this stop forms part of a daily bus service running return from Levin to Palmerston North. The bus arrives to the intersection around 7:00 am heading north, and returns (travelling south back to

Levin) at around 6:05pm. It is understood that up to 12 people may board and exit the bus at this location.

Whilst this is not actually an official bus stop, it has been confirmed that the car parking around the intersection is related to a bus which stops to pick up and drop off passengers on SH 1 in close proximity to Waitarere Beach Road.

The current situation, whilst it has not been witnessed, is expected to result in pedestrian movements across SH1 (primarily in the evening when the bus is travelling south). This is highly undesirable.

A number of treatments outlined in Table 5-3 have been considered to provide a suitable facility for the bus, which provides a safe and convenient solution for the bus operator and passengers and does not impact the overall state highway operation.

Table 5-3: Assessment of Bus Stop Options

Bus Stop Treatment	Positives	Negatives	Option Viability
Bus bays directly on SH1 north and south bound, SH 1 widened to provide for bays	• No detour for the bus (resulting in no operational delay and therefore likely to be supported)	• Unacceptable from a pedestrian safety perspective and all other users • Shoulders insufficient width for bus to stop with waiting pedestrians or for cyclist to pass bus	Option discarded
Bus turnaround within Waitarere Beach Road	• Provides a single facility for buses • Could use area of the existing / redundant seal (for parking, bus turnaround) • Avoids pedestrians crossing SH1 • Avoids pedestrians crossing Waitarere Beach Road	• Double right turn (from SH1 and then into bus / parking facility) is not desirable (potential for nose to tail collisions) • Requires bus to turn right out of Waitarere Beach Road • Visibility to west will need to be protected	Option discarded
Bus bay located on left turn slip lane and formalised parking	• Provides a single facility for buses • Southbound buses would be required to use P turn to enter facility. Will require the bus company to officially agree to the travel plan in the interests of safety. • Parking becomes formalised • Avoids pedestrians crossing SH 1	• Pedestrians forced to cross Waitarere Beach Road (to use car parking area) • Requires bus to turn right out of Waitarere Beach Road	Option unlikely
Split facility (northbound use slip lane bay) and southbound use car parking location	• Could use area of the existing / redundant seal (for parking, bus turnaround) • Avoids pedestrians crossing SH1 • Only limited detour for	• Split facility may be ambiguous • On northbound journey, pedestrians still forced to cross Waitarere Beach Road • Requires bus to turn right	Favoured option

Bus Stop Treatment	Positives	Negatives	Option Viability
	buses	out of Waitarere Beach Road • Added cost	

On the balance of the information presented in Table 5-3, the split facility is considered to be most appropriate. However, it is recognised that further assessment will need to be undertaken, for example to understand whether any of the existing seal (which becomes redundant) can be utilised for vehicle parking and bus turnaround due to the existing superelevation. Any decision will need to be based on cost, convenience and safety. A conceptual layout for this option is shown below in red.

If this facility is wanted by Horizons or by the national bus service supplier (for example the naked bus or InterCity buses) then there is opportunity to deliver it as part of the Project. However, these discussions have not been advanced at this stage and can be considered during the pre-implementation phases once all mitigations for the Project have been considered and assessed.

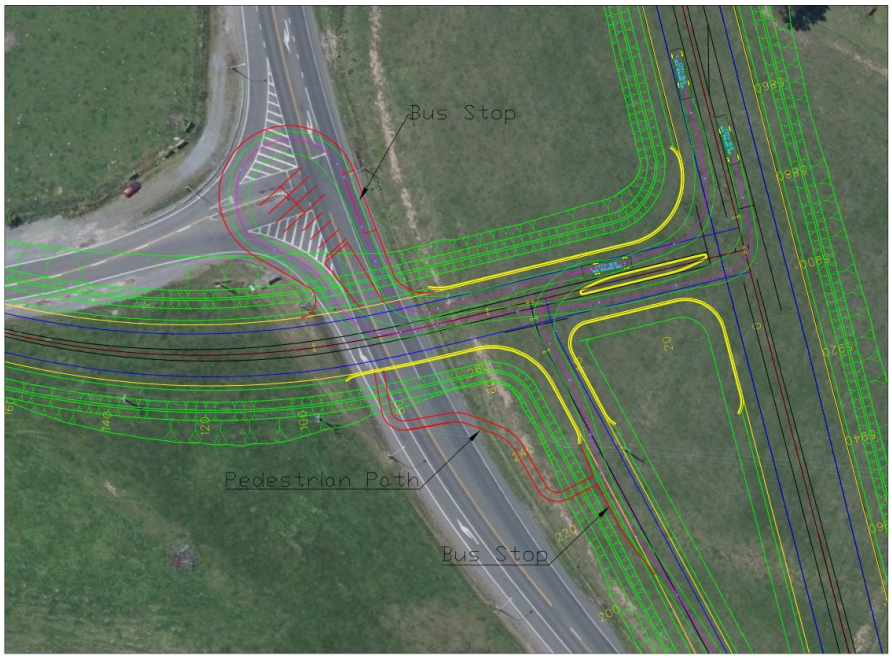


Figure 5-2: Potential Bus Stop Layout at Waitarere Beach Road

5.1.8 Property

The proposed project design will provide for a safer geometric alignment that is predominantly greenfield construction. However this will have a negative impact on local residents as it entails private property purchase and use. Further information can be found in Section 7.2.3. Table 5-4 indicates the various areas of land requirement for property owners and any particular commentary based on the current design and assuming that no additional land is required beyond the current design limits for maintenance and any associated access.

Table 5-4: Indicative Land Requirement Areas

Address	Land Title	Indicative Area (m^2)	Comments
717 SH1	41B/687	754	
709 SH1	41B/688	559	

Address	Land Title	Indicative Area (m²)	Comments
703 SH1*	41B/690	1329	
18 Waitarere Beach Road	38A/845	1193	
5 Waitarere Beach Road*	38A/846	-	
9 Waitarere Beach Road*	56B/959	942	
607 SH1	56B/959	2992	Large trees to be removed
12 Paeroa Road	12A/1024	946	Large trees to be removed
9 Paeroa Road	30B/22	8487	
577 SH1	46C/120	3799	
563 SH1	522202	1598	Well and septic tank present
559 SH1	25B/703	452	Maori land
553 SH1*	281943	-	
551 SH1*	5C/606	-	
549 SH1	778/55	-	
545 SH1*	22C/297	-	
541 SH1*	22C/296	-	
533 SH1	742/88	-	
527 SH1	56B/877	-	
519 SH1	6C/735	-	
511 SH1	301/263	511	
507 SH1	261/150	8057	
463 SH1	262/228	5261	
728 SH1*	509490	340	
708 SH1	509491	5916	
682 SH1	17796	1045	
670 SH1	17795	2006	Forestry plantation
648 SH1	55D/172	29323	Possible burial ground
648 SH1*	55D/171	248	Possible burial ground
610 SH1*	33A/206	341	
606 SH1*	40B/914	-	
598, 594. 576 SH1	33A/203	74	
550 SH1*	40B/915	2279	
530 SH1*	33A/205	16253	
516 SH1	56A/296	710	Whare Rongopai
514 SH1	760/66	657	Land adjacent to Marae
13 Clay Road*	33A/207	2562	Land adjacent to Marae
7 Clay Road	900/31	1135	
6 Clay Road	769/92	230	
8 Clay Road*	9C/1154	2890	

*No Terraview address therefore approximated by property access location.

The table does not take into consideration land disposal likely to be required in relation to the parts of the existing state highway and Waitarere Beach Road that will no longer be required. Also the land requirement indicated includes land required for the proposed stormwater detention ponds where that land might be able to continue to be used by private landowners albeit on the proviso that the detention facility is retained.

At this stage, there has been no input from property consultants. Refer to Part B – Property Strategy.

5.2 Excluded from Scope

The following is excluded from the scope of the project:

5.2.1 Grade Separation of Intersections

Grade separation has not been considered for any of the intersections within this DBC. This is because existing traffic volumes (and projected future traffic increases on SH1) north of Levin, are not sufficient to warrant the introduction of grade separated interchanges. Furthermore,

such treatments would be out of context given the number of remaining at-grade intersections and private accessways immediately north and south of the Waitarere Beach Road Curves project extents. Also it has not been considered because four laning is not currently required.

5.2.2 Four-laning & Passing Lane Provision

Four laning of this section of SH1 has not been considered for this location due to the low traffic volumes. Any four-laning of SH 1 would end further south, with the northern extent expected to be the intersection of SH1/57.

Passing lanes in either or both directions were considered on this section, however, they have been rejected as the realigned and upgraded section is too short in length between the horizontal curves (and intersections / turning facilities) for them to be safely provided.

Instead passing lanes and opportunities along with edge treatments are being investigated concurrently. The current PFR level investigation proposes improvements to the north and south of the Waitarere Beach Road Curve improvements. A programme business case for these improvements is currently being completed and will advise on programming for the implementation of these improvements (see section 5.1). .

5.2.3 Pedestrian Facilities

Pedestrian facilities have not been investigated or proposed as part of this DBC. This is due to the rural nature of the route and there being very limited or no demand for pedestrian provision. Furthermore, providing pedestrian facilities in this location is not considered viable given it could in fact induce pedestrian demand (including state highway crossing movements) which would be highly undesirable.

It is noted that Poroutawhao School does not permit pupils to walk to school under any circumstances due to safety concerns.

5.2.4 Lighting

No lighting improvements have been specifically designed as part of this DBC. However, it is recognised that lighting currently exists around the Waitarere Beach Road intersection and this would be replaced (at the relocated intersection) in accordance with Transport Agency design standards for lit rural intersections. Lighting has been allowed for in the cost estimate.

At this stage of investigation only lighting around the Waitarere Beach Road intersection is proposed, to replicate the level of lighting currently provided. No further lighting is considered necessary – however this can be further assessed at detailed design stage. The visual and light spill effects will be considered in future phases although given that the intention is to provide like for like no material adverse effects are anticipated.

6 Stakeholders

Consultation has been ongoing since 2011, since then there have been four key stages held, ranging from the wider public and key stakeholder engagement on the Otaki to Levin route, through to direct consultation with the adjacent landowners specifically for the Waitarere Beach Road Curves project. The consultation process has been adopted and adhered to, as defined in the Otaki to Levin Consultation Report (August 2013) and Supplementary Consultation Report (April 2014).

There is Local Government, non-government organisation and general public support to improve the safety of the road section, as it is a known crash spot. However those stakeholders directly affected by the proposed realignment are concerned about the central median barrier which precludes their ability to turn right out of their private accessways. The land requirement for the new alignment is also a concern.

6.1 Consultation and Communication Approach

The consultation process is described in the Otaki to Levin Consultation Report (August 2013) and Supplementary Consultation Report (April 2014).

The consultation process was initiated in May 2011 with input sought from key stakeholders. The general public was introduced to the study. A series of follow up meetings, letters and newsletters were sent to residents and landowners affected by the road corridor, as well as local government and non-government organisations. Proposals were also advertised in local print media for the general public. A summary of the staged approach to the consultation is outlined in 6.1.2 below.

The Waitarere Beach Road Curves project team have held three rounds of meetings with the local residents and communities directly impacted by the alignment alterations proposed at the Waitarere Beach Road intersection and its surrounds.

6.1.1 Communication Objectives

Communication is an essential element of consultation. NZTA advised of the following communication objectives:

- To raise stakeholder awareness and understanding of the project.
- To understand stakeholder concerns so these can be passed on to the project team.
- To engage early and effectively with all stakeholders on relevant matters that may require stakeholder input.
- To ensure stakeholders are advised on new developments, key milestones and planned activities on the project.
- To work with potentially affected property owners in a fair manner at all times.
- To work with business owners in a helpful and fair manner at all times.
- To maintain contact with stakeholders so as to keep on top of any potential issues.

6.1.2 Stages and Content of Consultation

The process of identifying the details of an appropriate “work”, or works, for which consents will be sought must meet the requirements of the RMA and can be a lengthy and systematic one. The key elements of the processes involve a range of legal and “best practice” methods of identifying a preferred route option and refinement of the route, as well as NZTA processes, consultation stages and reporting.

Consultation Stage 1 (Area/Corridor Stages)

This stage of consultation focused on information collection for the project. Active input was sought from key stakeholders, such as local authorities, iwi and infrastructure providers in mid-2011. The general public was informed of the study via newsletters and a public display at the Council offices, and told of their role later in the project. If the public wanted to offer

information at this stage, they were welcome to, but it was not actively sought. Some organisations were specifically contacted for information/input.

Consultation Stage 2 (Improvement Options)

This stage involved the release of information about the modified approach to the project, and the specific areas and issues that were identified for further investigation. It was initiated by press releases and announcements of the intention to have future detailed consultation about options relating to the areas and the issues that were to be the focus of further investigations. In the interim, comment was sought as to whether the right issues and locations have been identified, and whether the community have any further suggestions. The purpose of this stage of consultation was to elicit information held by people, and community input to the options to assist with later decision-making.

Consultation Stage 3 (Preferred Package)

This stage involved the release of the preferred package of targeted projects. A staged approach was taken and eight sub-projects were identified. These projects included:

- Forest Lakes
- Manakau
- Manakau to Ohau
- Ohau Township
- SH1/SH57 Connection
- Levin By Pass
- Waitarere Curves
- Whirokino Trestle

Stage 3 defined those who were most likely to be affected by the preferred corridor/route (and those on other options considered will be out of contention). This resulted in significant positive feedback and general support for a staged approach to safety improvements between Otaki and north of Levin. There was however, also a high level of anxiety from many potentially affected landowners given that individual properties that were likely to be required to facilitate the sub-projects identified during this stage.

One-on-one meetings were held with landowners who were directly affected by the routes and a series of Open Days were also held for the wider public

Consultation Stage 4 (Refinement of Specific Options)

This stage involved reporting back on the feedback received from the earlier consultation during Stage 3. It also included on-going liaison with the affected parties, discussions relating to specific access and property agreements, and exploration of possible mitigation measures. Following confirmation of the project details during the Stage 3 consultation processes, the bulk of the work undertaken in this stage was via NZTA's property consultants.

6.2 Professional Engagement Process

As the Consultant, MWH has worked very closely with NZTA on all projects which form a part of the Otaki to north of Levin corridor upgrade. NZTA are the funder, operator and planners for this corridor project.

Discussions have been held with NZTA's national office on the overall scope and standards for the Otaki to Levin corridor, including this project. NZTA's National Design Engineer was also part of the Road Safety Audit team for this project.

The National Office Environmental Team have provided input and guidance in respect of the environmental screen which has in turn helped develop and refine understanding of project design risks and the next, subsequent, consenting phase. The legal team (comprising NZTA staff and Buddle Findlay) have also provided strategic advice on the consenting strategy. P&I

also have a planning representative on the Otaki to Levin project team, therefore the consenting strategies and being developed with input from across the Agency.

The Journey Manager at Palmerston North has reviewed a draft of this document and is satisfied with the proposed design and approach taken so far. There has been no specific discussion with the maintenance contractor, although MWH have been the Network Manager's for this stretch of highway for a number of years and our knowledge of this road has therefore been used in the development of the project.

6.3 Stakeholder Views

The following provides an outline and summary of the comments and concerns raised during the consultation process with the stakeholders. Stakeholder feedback was explicitly used to inform the Clay Road intersection design, to understand and cater for resident concerns with this intersection and how it is utilised by the locals when a Tangi occurs. The Tangi finishes with a funeral procession taking the short drive up to the local Urupa.

The following list details the stakeholders engaged;

- Local landowners;
- Local community;
- Horowhenua District Council;
- Horizons Regional Council;
- NZ Heavy Haulage Association;
- NZ Automobile Association;
- Otaki Road Safety Group;
- Poroutawhao School;
- NZ Police;
- Bus service provider (Horizons Regional Council); and,
- Public submitters.

6.3.1 Local Landowners – Stage 3 and Stage 4 Consultation

- Generally supportive of the project and that improvements are required to the current arrangement;
- Concerns with the alignment affecting their individual properties and increased noise levels, vibration and pollution;
- Concerns with the inability to turn right and drive to Levin because of the median barrier.
- Concerns by Iwi of encroachment into Maori land;
- Clay Road and Paeroa Road intersections need upgrading;
- Concerns with Whare Rongopai land acquisition and the impact to the church and its use; and,
- Some landowners are not supportive of land acquisition and are concerned about the negative impacts on families and farmers.

In order to achieve the safety improvements that the local landowners and residents are supportive of, land acquisition is necessary for the new alignment. As in most scenarios similar to this, people would like the road to be improved, but for it to not adversely affect them and their property. While some landowners and residents are affected more than others, there are others who are likely to benefit from the alignment moving further away from their home and boundary.

One of the major changes to local residents' traffic journeys is the severance of right turn movements when exiting their driveways onto SH 1. Most residents will have to drive to

Waitarere Beach Road, or the 'P-turn' area and use turning facilities provided before continuing their journey.

Letters outlining the proposals in further detail were sent to the affected landowners to inform them of the proposals and to invite comments. Meetings with landowners are currently occurring. See also Section 6.4.

6.3.2 Horowhenua District Council

- Supports the realignment of the curves.

6.3.3 Horizons Regional Council

- Supportive of proposals to realign this section to improve safety.

6.3.4 NZ Heavy Haulage Association

- Supportive of proposal to realign curves as the existing alignment is problematic for over dimension loads due to the reduced visibility the curves produce; and,
- Concerns with proposed median barrier as this could affect over-dimension loads.

In order to address these concerns the distance between the edge barrier and the median barrier is proposed to be 8.5 metres. This distance exceeds the 7.5m minimum clearance the NZ Heavy Haulage desires. . They also want the barriers to not be higher than 1.0 metre, which is, in principle, achievable. However, this is a matter of detailed design and will need to be considered against the safety performance wanted, where higher barriers reduce possibility of vehicles overtopping the barrier.

6.3.5 NZ Automobile Association

- Supports the realignment with median barriers installed; and,
- Supports redesign of Waitarere Beach Road intersection due to its poor crash history.

6.3.6 Otaki Road Safety Group

- Supports any improvements carried out on this highly dangerous corner.

6.3.7 Poroutawhao School

- Supports the realignment;
- Does not support median barriers for fear it will restrict access to the school, which is also a community hub;
- Suggests speed restriction periods around school day start and end; and,
- A proper turning circle adjacent to northbound lane, rather than current pull off to side of the road.

The project does not extend as far north as Poroutawhao School. Therefore concerns about a median barrier cutting off northbound turning access into the school are allayed for now (noting that the outcome of ongoing investigations on passing lanes will influence driving behaviour in the vicinity of the school). Currently there are no proposed changes to the road corridor in the immediate vicinity of the school.

6.3.8 Public Submitters

- Generally supportive of the project;
- Suggestion to ease curve on Waitarere Beach Road 80m west of the SH1 intersection;
- Suggestion to install a median barrier through section;
- Identified the main problem as the Waitarere Beach Road Intersection; and,
- Suggest that the Clay Road intersection needs upgrading.

The following aspects have been incorporated into the design, to alleviate some of the concerns raised by public submitters. The curve approximately 80 metres west of SH1 on Waitarere Beach Road has been eased. Median and edge barriers are installed to prevent vehicles leaving their lane, crossing the centreline or edge line and being involved in a fatal or

serious crash. Waitarere Beach Road and Clay Road intersections are both being upgraded to tie in with the new SH1 alignment.

6.4 Specific Landowner Consultation

In late June and early July 2014 further direct landowner consultation was undertaken and this is ongoing. This utilised the up to date alignment design. Some of the feedback is outlined below:

6.4.1 Positive Feedback

- Recognition that the wire rope barrier will increase travel distance and time but noted the overall benefits to the community and the safety provided by the barrier. There was concern about people speeding and overtaking without the wire rope in place.
- Another landowner thinks the concept looks all right, although the wire barriers will not stop 'run-off road' crashes and believes these are the predominant type of crash in the area.
- Comfortable with the land take given certain conditions

6.4.2 Neutral Feedback

- Raised the possibility of using red/orange plastic markers rather than a wire rope? Noted these are currently in place south of the Peka Peka turn off.
- Commented on agricultural activity on the road and these vehicles go slowly. There are no passing lanes between Levin and Foxton North – requested consideration of new passing lanes
- Does the conflict of the intersections erode the usefulness of the barrier?
- Some unwillingness to sell property, acknowledgement they may have to for wider benefits.
- Lowering the speed limit to 80km/h and erecting 'accident zone' signs would help to resolve the problem. Noted there used to be an accident sign but it had been removed.
- Would need to seek noise mitigation to shelter property from the road noise.
- Access to the Huia Marae will need to be worked through with the committee.
- Questioned whether the turnaround was necessary for the milk tankers.
- Concerns with drainage provisions and how road run off will affect some properties.
- Questioned how an upgrade around Clay Road would work in practice.

6.4.3 Negative Feedback

- Numerous land requirement issues, each specific to the affected landowner.
- Objection to the wire rope barrier as it restricts the ability to turn into and out of access.
- Consider that the proposed solution is not necessary as the problem is driver frustration at not being able to pass on state highway heading north from Levin until this point on the highway. Therefore the correct solution would be to provide passing opportunities on SH between Levin and this location so that frustrated drivers no longer (need to) attempt to overtake on this section of the state highway.
- Consider that the proposed solution will exacerbate safety on this section of SH1 as there is inadequate space for farm vehicles to pull over so as to allow normal traffic to overtake.
- A concern that people would use the end of the barrier at Waitarere Beach Road to do U-turns on SH 1 rather than using the left slip lane.
- Landowner noted concerns for with Fonterra. They think Fonterra would have a problem with the wire rope barrier due to additional turning movements and inconvenience, especially if this is to become standard practice all over the country. They do not want

the wire rope barrier and will fight to get it removed from the proposal. They also noted forming a community group with neighbours to advocate for its removal.

- The wire rope barrier will severely disrupt the heavy vehicles that access a farm; milk tankers, feed delivery and harvesting contractors, etc. At times, it can be very busy with truck movements.
- The realignment makes the barrier unnecessary. Lower impact solutions should be considered such as safe-hit posts or centrally located double yellow line markings.
- Some of the property boundaries on plans they were shown during the consultation meeting appeared incorrect.
- Suggestion that an 80km/h zone would solve the problem, rather than a realignment.
- With the road closer, would want to relocate elsewhere.
- Increased noise for those whom the road moves closer towards.
- Concerns with property resale with a busier road and closer to houses.

6.4.4 Consenting phase consultation with land owners

Fundamental objections to the proposed improvement have been carefully considered and assessed. Significantly, the comments that the proposed median barrier improvement will not address the key safety concern on this part of the state highway cannot be true. The key safety issue on this section of the state highway is head on collisions, which are highly dangerous and almost always results in fatalities. This risk will be entirely eliminated by proposed median barrier.

It is noted that the lack of passing lanes on the state highway to the south of this location may well increase driver frustration which then can lead to some motorists attempting an entirely unsafe manoeuvre of overtaking at the curves. However, equally it does not follow that provision of passing lanes anywhere will eliminate the desire to undertake passing on the curves. It also follows that any further straightening of the curves would only increase the desire to undertake passing at this location and thus the insertion of wire rope median barrier becomes increasingly relevant and necessary. Finally it is noted that passing opportunities are being investigated to the north and south of the Waitarere Beach Road Curves project area, as described in section 5.1.

Part B of this report summarises the approach to be undertaken to resolve outstanding land owner concerns with regards the project.

7 Recommended Option – Assessment

The project outcomes are met by reducing the occurrence of fatal and serious accidents through a design that meets RoNS guidelines.

Implementing the project is not expected to be overly problematic, although if archaeological sites are encountered, accidental discovery protocols would need to be employed and archaeological investigations could result in some construction delays. The constructability of the project is fairly straight forward, as a large portion of the works would be greenfield construction. Tie-ins with the existing state highway must be carefully managed, as will maintaining access during construction.

There are significant property requirement impacts for the adjoining landowners, who will also suffer increased journey times when the median barrier restricts turning movements out of access points. Particular access requirements and environmental mitigations (notably noise barriers, landscape treatments including ecological planting) needs to be designed as part of the following RMA consenting phase in discussions with land owners and affected parties. Mitigation for the loss of maori land to allow for the Project will also need to be carefully considered.

There is significant crash history during the period 2009 to 2013 within the project extents. The existing section of SH 1 equates to a KiwiRAP 2-star rating. The crash risk is classified as a high-risk rural road that requires a 'Safe Systems Transformation Works' treatment strategy. Based on the proposed realignment, the section would increase to a KiwiRAP 4-star rating.

7.1 Outcomes

The project outcome is defined in Section 3.3, which explains the outcome is to reduce the occurrence of fatal and serious crashes whilst retaining levels of service and improving journey times consistent with the Wellington Northern Corridor RoNS objectives (see section 2.1.1). This project improves the safety of the site in a number of ways.

The realignment removes the existing series of deficient double S curves. These are replaced with two 800m radii curves with a 110 km/h design speed and higher design standard. Secondly a large portion of the realignment is enveloped by roadside edge and median wire rope barriers. This will help to further reduce the likelihood of the fatal or serious crashes where vehicles have strayed outside of their lane either into oncoming traffic or running off the road. The cross section is more forgiving than the existing arrangement, with a 2.0m wide median either side of the central barrier (4.0m total median width) and a 3.0m sealed shoulder to the edge barrier (a further 1.0m sealed beyond the barrier). Therefore, there is an increased area for drivers to recover their vehicle if they were to lose control momentarily.

There is no recorded crash problem at the Waitarere Beach Road intersection, but after the realignment takes place, it remains the most likely location where a severe crash could occur within the section. Allowing full intersection movements results in numerous conflict points, hence the continued risk (particularly given the high volumes of traffic using the intersection). So while there is confidence in that fatal and serious crashes will reduce in number, there is still a possibility that they might occur at this intersection due to the traffic conflicts. That said, the intersection operates safely now, with a good crash history. Given it is being improved (geometrically – resulting in a higher standard intersection layout and improved visibility) as part of the upgrade works, then the risk of crashes will be reduced.

Ultimately a successful outcome will be measured by the crash history record after the proposed alignment has been opened. A successful project would involve no fatal or serious injury crashes occurring within the project length, over the following ten year period. However, by providing a break in the central wire rope barrier to facilitate the priority controlled Waitarere Beach Road intersection, it means that the possibility remains for a fatal or serious injury crash to occur in the future. This risk can only be eliminated through construction of a grade separated intersection.

Recently the ten year crash history for the Centennial Highway[20] was publicly reported on[21]. This article stated that since the central median was installed, the incidence of fatal and serious injury crashes has dramatically reduced. During the ten years post installation, there was only one serious crash and no fatalities. This is despite over 100 vehicle strikes to the 3.5km central wire rope median barrier. The ten year period prior to the wire rope barrier installation had 15 fatal and serious injury crashes, including a total of 16 fatalities and 14 serious injuries.

Therefore it is realistic to assume that the sections of the proposed Waitarere Beach Curves alignment, complete with central and edge wire rope barrier segregation, can achieve zero fatal and serious injury crashes during the ten year period post construction. However, it must be noted that there is more roadside friction within the Waitarere Beach Road project than experienced along Centennial Highway barrier length. Also the speed limit will be 20 km/h higher (80 km/h compared to 100 km/h) at Waitarere Beach Curves.

7.2 Implementability

There are likely to be a number of consents required to construct the realignment. The cultural constraints and sensitive archaeology sites within the vicinity will require careful construction processes and the need for a clear archaeological authorities and accidental discovery protocol. The physical construction of the project does not require any large structures other than a large culvert installation across SH 1, therefore it is not envisaged to be complex in terms of constructability.

The general public and stakeholder feedback has been generally supportive for the realignment of the curves. The local population see the curves as hazardous and some adjacent landowners commented they were sick of the number of times they have needed to repair fences damaged by errant vehicles. Local Government, the AA and NZ Haulage Association are supportive of improving the deficient curves. A possible obstacle to implementability will be managing and mitigating iwi and landowner concerns, a process currently taking place.

The roading improvements are to be staged to keep traffic moving efficiently during the construction period. Staging will include careful consideration of tying in between existing and greenfield construction, and maintaining local access. It is important the general public is notified prior to any construction works.

7.2.1 Constructability

The new alignment is predominantly a greenfield construction with a tie-in with the existing state highway at each end. The new alignment crosses the existing state highway corridor on three occasions, therefore temporary traffic management of the SH 1 traffic during construction of these crossover sections will need careful management and consideration.

The Preliminary Geotechnical Assessment Report (PGAR) has identified the possible existence of collapsible loess soils at the Waitarere Beach Road Curves. An assessment of where loess soils exist, an accurate estimate of the groundwater depth is required and whether the degree of saturation of the soil is likely to change during the design life.

The vicinity of the existing road and new alignment cuts through a significant area of historical Maori settlement, which necessitates consideration of the potential for archaeological discovery. The area is still an area of Maori settlement, with Marae, the Whare Rongopai and Urupa nearby. Therefore all greenfield construction must be undertaken with utmost consideration and the high possibility of uncovering archaeological material and Maori artefacts. While the new alignment has attempted to avoid most of the suspected locations of historic Maori activity, there may be unknown sites that are disrupted. This introduces the risk of accidental discovery, and potentially, depending upon the significance of the findings, major delays and redesign of the project during the construction phase. This can be mitigated by comprehensive consultation and specialist input (i.e. of an archaeologist).

[20] Located south of Paekakariki, within the Wellington Northern Corridor RoNS project length

[21] Fairfax “Down to the wire, barrier saves lives”, published 4 November 2014 at www.suff.co.nz

7.2.2 Operability

No change in operation will be needed once the project is constructed, however increased maintenance will result. The two main causations are the much increased sealed surface area and the central and edge barriers which do not exist currently. There will be increased Opex cost due to on-going repair of the wire rope barriers when they are impacted by errant vehicles and the periodic resealing of the road surface.

The recommended option has higher Opex implication than the original PFR Option 8-3 as it now includes the median wire rope barriers and a wider pavement area. However to counter these increased costs the alignment has improved safety and meets RoNS design guidelines (where barrier strikes should be reduced due to the higher standard geometry and cross section). In addition, this will be a new asset, which will generally require less maintenance, especially during the first 20-30 years of asset operation.

7.2.3 Statutory Requirements and Consenting Strategy Overview

This project will require a Notice of Requirement, regional resource consent applications and applications for Heritage New Zealand Authorisations (discussed in more detail below).

It is expected that the consenting process will be through HDC, Manawatu Wanganui Regional Council (Horizons) and Heritage New Zealand. While the Waitarere section is part of the North of Otaki to North of Levin section of the Wellington Northern Corridor Road of National Significance, it is not of a national scale of significance and, therefore, would not require submission to the Environmental Protection Authority.

A social and environmental screen has been completed and is attached in Appendix K – Social & Environmental Screen.

Designation Alteration

The entire length of State Highway 1 within the Horowhenua District is currently designated for State Highway purposes (reference D2) in both the operative District Plan 1999 and the proposed District Plan 2013. There are no designation conditions. The designated purpose in the proposed District Plan includes the "*maintenance, operation and use of, and improvement of a State Highway*".

The proposed realignment will extend beyond the boundary of the existing designation. Accordingly, an alteration to a designation will be required under s181 of the Resource Management Act 1991 (RMA). The current presumption is that the alteration would be subject to public notification and would be lodged with HDC.

Resource Consents

The realignment will require earthworks (cut and fill) through sand dunes and former swampland (historically drained and converted to pastoral farming). The realigned sections of highway are likely to cross watercourses (such as a stream, wetland/swamp or drain) that may require diversion or the installation of culverts.

The current drainage patterns may also be altered by stormwater management through attenuation ponds and swales. The local drainage pattern has been modified over time and discussions will be required with Horizons to confirm the requirements that apply.

Resource consents are expected to be required from Horizons for:

- **Earthworks and vegetation removal**. The work would require consent as a Discretionary Activity. This is due to works being undertaken on land with an existing slope greater than 20 degrees and close to a watercourse and where the runoff result in the watercourse breaching water clarity guidelines.

- **Discharges of stormwater to land and/or to water.** The work would require consent as a Restricted Discretionary Activity. However, this could be either a Discretionary or Non-Complying Activity depending on the interpretation of contaminants and whether or not they are considered persistent or harmful.

The regional consents are likely to be non-notified.

Heritage New Zealand Authorisations

There are several significant sites through the project area which the Project seeks to avoid. However, there is a high risk that the identified sites are larger than expected and/or that there are other unidentified sites or koiwi. Therefore, Heritage New Zealand authorisations are required to modify and destroy the whole or part of archaeological sites that are discovered whilst undertaking the physical works in the locality.

It is noted that an authority would also be required to undertake any geotechnical investigations involving test pits. Should a geotechnical investigations be undertaken in advance then the results from those works would usefully inform the application for a general authority pertaining to the whole project area.

Consultation

The consultation to date has followed the consultation strategy outlined in Section 6 of this report. The consultation undertaken with landowners and stakeholders has influenced the design to date. Maori are being consulted with hui held at the two Marae located close to SH 1.

Further consultation will be required prior lodging the NoR to alter the designation and apply for the required resource consent applications. This consultation would be inform the stakeholders of the final form of the project and to provide an opportunity for final stakeholder feedback.

The **key issues or effects** that have been identified from the consultation and will need to be addressed are:

- Archaeological, heritage and cultural effects;
- Social and economic activity due to the land acquisition and the rope median barrier;
- Noise effects due to the proximity of some houses to the highway;
- Erosion and sediment control from earthworks in sand dune landscapes; and
- Potential ecological/water quality from discharges and watercourse realignment.

A Cultural Impact Assessment is currently being prepared in order to support the RMA and Archaeological Authority applications. .

Programming consenting activity

As outlined above, the proposed works need to be authorised as follows:

- Alteration to designation (Resource Management Act)
- Resource consents from the regional council (Resource Management Act)
- Archaeological authorities required (Heritage New Zealand Pouhere Taonga Act)

There are likely to be efficiencies in considering the regional consent and designation matters as a single package. Notably, in order to determine the extent of the notice of requirement it wll be necessary to determine the stormwater treatment and management needed. Further in order to assess construction and operational effects it will be necessary to determine extent of cut and fill and a broad (indicative) construction methodology. Landscape design should be developed with the ecologists cognisant of the stormwater design so that any required mitigations serve multiple purposes efficiently and effectively. Therefore, an integrated design approach is likely to create project design efficiencies and help reduce land take.

It is also noted that whilst the regional resource consenting matters are relatively low risk that obtaining these consents at the same time as the Notice of Requirement will facilitate subsequent rapid implementation. The level of additional investigation to secure the relevant regional consents is likely to be low and will increase certainty as to the overall level of project effects.

The current programme allows for a 15 month process from the preparation of the applications and Assessment of Effects on the Environment in February 2015 to end of appeal period in April 2016. The lodging the applications would be around July 2015 and a final decision by NZTA in December 2015. There is some contingency allowed for in this programme.

Avoid, remedy and mitigate

An environmental screening exercise has been undertaken. That screen helps to identify key environmental issues and the level of risk associated with each. Based on the outcome of that exercise, particular consideration has been given to assessing cultural and archaeological effects of the project. Discussions with local iwi have enabled the design team to conclude that ongoing discussions and assessment could lead to some minor modifications to the alignment of the proposed improvements but that these are minor in the context of the whole project.

The following stages of work (leading to the lodgement of RMA applications) will include a process of refining the design of the proposal to seek to first avoid then remedy and then mitigate effects. It is anticipated that the key areas for this process will centre around:

- **Cultural/heritage/archaeological.** It is likely that there will be residual effects on the cultural heritage and archaeology that will be unable to be avoided or remedied. The mitigation is expected to be centred on the cultural aspects. It will be developed following the completion of the cultural impact assessment. This could take the form of land swap, access formation and site memorial.

- **Noise.** It is likely that most noise effects will be able to be avoided through careful design, including landscaping and edge treatments. Any residual effects are likely to be able mitigated through noise attenuation such as close-boarded wooden fences and/ or double glazing (last resort).

- **Landscaping.** The design of the project is expected to involve landscaping to replicate or replace vegetation that has been removed and/or return of cut or fill embankments to the natural dune vegetation as early as possible.

It is anticipated that the NZTA Revocation Policy will not need to be implemented for this project there is unlikely to be any part of the redundant state Highway that would revert to local public road.

The final form of mitigation has not yet been defined but it is considered that the mitigations are likely to be related to landscaping and property on the whole. The SE has accordingly allowed sums for landscaping ($512,000 + contingency of $76,000) and property costs ($1.8m). Additional sums are allocated for environmental compliance ($80,000), preliminary and general ($1m plus $153,000 contingency) and extraordinary costs ($100,000) to help accommodate 'mitigation' costs risks.

As discussed in the preceding section, the proposed strategy is to seek to design mitigation to serve multiple purposes so as to maximise efficiency of resource utilisation.

Risks and potential appeals

At this stage the key consenting risks for this project are considered to be:

- Opposition to the barrier from a landowner. There is a high risk they will appeal and challenge the project strongly without an agreed solution to access SH1, risking delays to implementation and further high severity crashes. There is also a secondary risk of negative feedback and the perception that the community feedback is being disregarded.

- Maori land acquisition. Maori have voiced their concern about no more land being acquired. On the basis of the current design land would be required around both Marae.

- Loss of primary production land. The landowner affected may appeal and challenge the project strongly without an agreed solution to the land loss. This has the risk of delaying the project with the attendant risk of further high severity crashes

The potential risk mitigation is:

- Continue the dialogue with the landowners to find access solutions and land replacement options.

- Continue the dialogue with the Maori landowners to find solutions to the land loss.

The aim of this risk mitigation is to find solutions before lodging the NoR and resource consent applications.

7.2.4 Property Impacts

In order to reduce the number of existing curves from three to two and increase the radius of these two new curves, the new alignment is predominantly a greenfield construction. The recommended alignment has an impact on local residents via both land requirement and the restriction of turning movements due to the median barrier. See Table 5-4 for land requirement impact on local residents. A total of 102,890m^2 of land is to be purchased for required designation, however the existing highway will become surplus to requirements and should have a value which offsets some property costs. Turning movement restrictions resulting in time delays for property owners are summarised in Appendix C – Economic Worksheets.

Whare Rongopai would require a new access which could be located from the rear of the site. During consultation the possibility of relocating the Whare Rongopai was discussed, but there was a desire to keep it in place and there is a risk that the building could not be relocated without significant damage. The new alignment passes through areas of cultural significance including potential burial sites, possible Pa/Marae, Maori land, Whare Rongopai and land adjacent to the two Marae. Another impact would be the removal of large trees, which in one instance includes a section of forestry plantation.

Those residents most adversely affected by the restricted turning movements, are the two private residences north of the Waitarere Beach Road intersection. The median barrier will extend past the current location of their accessways, effectively cutting off their direct access when travelling northbound and turning right. The residents must now drive north into the space beyond the extent of the barriers, pull over safely to the left side of the road (where widened shoulder is also proposed) and undertake a U-turn to head south and finally turn left into their properties.

All residents in the project length will no longer have the ability to turn right onto SH 1 when exiting their driveway. Those wishing to turn right towards Levin will have to use the new Waitarere Beach Road intersection slip lane to turn safely, while those wishing to turn right towards Foxton must drive south to the new right turn bay and 'P-turn' facility constructed at the southern extent of the barriers. This arrangement may frustrate local residents, but if the central median barrier was not installed the maximum safety benefits would be not be achieved.

7.2.5 Asset Management

The main implication for future highway maintenance is the additional amount of pavement surface area, despite the reduction in length of the state highway. The sealed cross section width is generally 17.0 m wide and wider still at locations of right turn bays and left turn slip lanes. Future resealing of the road will be at a much greater cost than the present 11.0 m wide nominal lane width. Full road rehabilitations will also cost significantly more due to the

The installation of median and edge wire rope barriers will require repairs and replacements of damaged sections of barrier throughout the life of the road, as vehicles unintentionally leave their lane and strike a barrier.

The calculated undiscounted 40 year maintenance cost is $3.3M for the preferred option, and $1.3M for the Do-min. A more appropriate consideration is the discounted maintenance costs to Present Value:

- Do-min:
  - Annual Maintenance: $0.0M
  - Periodic Maintenance: $0.4M
- Option:
  - Annual Maintenance: $0.4M
  - Periodic Maintenance: $0.4M

The discounted periodic maintenance costs for both are very similar due to the timing of the large cost maintenance items (i.e. pavement rehabilitation) being much later for the Option than the Do-min (given this would be a newly constructed facility). However, the annual maintenance for the Option is greater than the Do-min on the basis of there being median and edge barrier to maintain following barrier strikes, which would not occur in the Do-min (given no barrier exists). Additionally, the greater area of pavement for the Option also incurs increased annual maintenance costs.

Horowhenua District Council will also incur minor increased costs with the extended lengths of local roads, in order to intersect with the new SH 1 alignment. The construction or upgrade of a section of the old state highway into a new service lane for the cluster of residents on the outside of the southern 800m curve will also be proposed access the Local Council might adopt and maintain, unless it has RoNS status.

The upgraded section of SH 1 at the Waitarere Beach Curves will require a much higher intensity of maintenance when compared to neighbouring existing sections of SH 1. This is due to the enlarged sealed surface width to maintain, along with the wire rope barriers.

7.3 Wider Project Impacts

7.3.1 Environmental Impact

An environmental screen has been completed for the project (attached as Appendix K), which identifies largely localised effects, which are discussed in the preceding section. Aside from these, and using a strategic lens, there are no known major environmental impacts with this project as most are cultural and detailed in Section 7.3.2. The main impact is the construction on greenfield landscape and the removal of the disused sections of the old SH 1 alignment and restoration back into pastured land.

The predominant major drainage feature will be the construction of formed swales the full length of the project. Where previously watershed from the road surface just soaked into the verge, it will now track into swales and then appropriately dissipate the runoff via soakpits.

The recommended alignment includes a large portion of greenfield construction. It would also require the loss of some vegetation as well.

7.3.2 Social Impact

The recommended alignment has a significant social impact on the local residents. However when considering the social impact to the general public over the past decade, due to the fatal and serious injuries in this section, it can be debated that a balance can coexist with the need to protect cultural heritage and residential convenience. Therefore the micro level social impact is large for the “few”, but the overall scale of social impact to the “many” is minor. This is where the balance between adversely affecting local residents meets the ‘greater good’.

The area has been identified as being of cultural importance to the iwi of Rangitane o te Whanganui a Tara, Ngati Raukawa ki te Tonga and Ngati Toa Rangitira. A number of culturally significant sites are outlined in Section 2.2 and have been taken into consideration when proposing the new alignment.

Beginning at the northern extent of the project, the realignment will bisect the gap between two potential burial sites east of the Waitarere Beach Road intersection. As the locations of the sites are only suspected, no assurances are given that the alignment construction will avoid either of the sites. Equally there is no assurance that the site exist for certain.

The historic Maori flour mill site along Paeroa Road will be avoided by the realignment, however, there is potentially a Pa or Marae located at the intersection of Paeroa Road and SH 1, which the alignment will travel right through the middle of. For both this site and the potential burial sites, full cultural consideration and co-operation for the repatriation of items found under accidental discovery protocol will be undertaken.

7.3.3 Joint Working

With the extension of Waitarere Beach Road and a new access road for some of the affected property owners, there is the ability to co-ordinate with the Horowhenua District Council (the road controlling authority), as they would likely adopt these new short sections into their road network (though the service road could also remain in private ownership). .

It has not been discussed at this stage whether there are efficiencies or value for money to be gained with other stakeholders or approved organisations. There is the possibility of undergrounding electrical or telecom services, this would need to be addressed during the detailed design stage.

7.3.4 KiwiRAP Assessment

Within the specific project length the existing KiwiRAP star rating is 2.60, therefore classing it as a 2-Star road and the average Road Protection Score (RPS) is 13.97. Both of these results are depicted on the existing KiwiRAP Risk Worm profile in Figure 7-1.

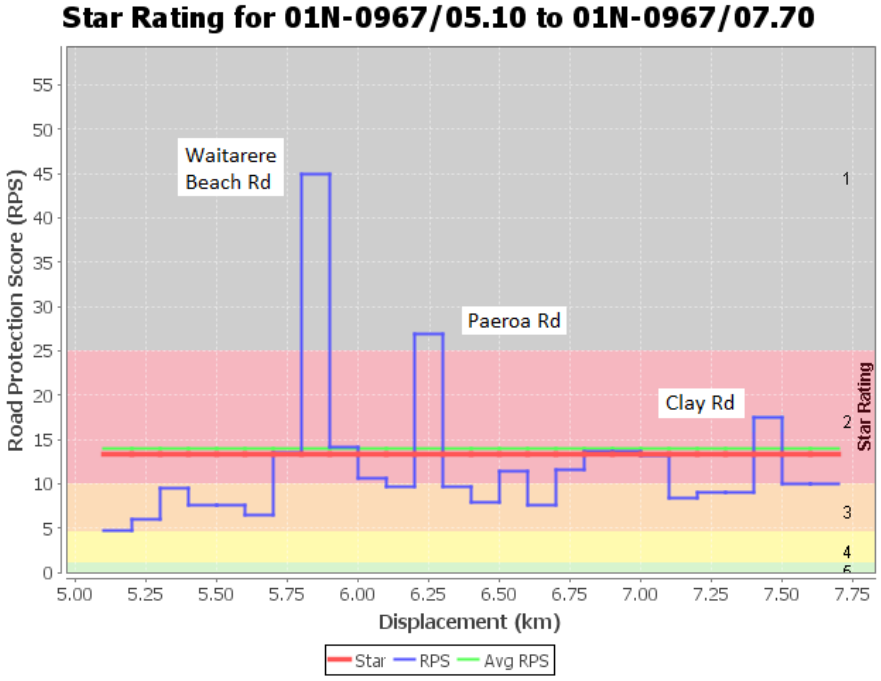


Figure 7-1: Existing KiwiRAP Risk Worm Profile

Figure 7-1 identifies the three intersections as the most hazardous locations along the project length. Paeroa Road is rated worse than Clay Road due to its poorer sight distance lengths and being located on the inside of one of the Waitarere SH1 bends. Waitarere Beach Road has a high RPS score due to the higher numbers of vehicles using the road compared to the other two roads. Paeroa Road and Clay Road have very low traffic volumes, enough to be classed equivalent to unsealed roads under the KiwiRAP rating assessment.

Assessment	Existing	Proposed
Star Rating Length	2.60	4.25
Average RPS	13.97	3.52
Average Head-on RPS	12.58	2.61
Average Run-off road RPS	8.72	1.19
Average Intersection RPS	0.22	0.18

Table 7-1: KiwiRAP Existing and Proposed Ratings

Table 7-1 outlines how much improvement the proposed design would make to this existing section of SH 1, classing it as a 4 Star rated road. All RPS categories have a reduction in their value, in most instances this is a substantial improvement on the existing situation.

The same KiwiRAP Risk Worm profile was updated to reflect the proposed design, graphically showing the improvements gained in Figure 7-2. The light blue line represents the proposed RPS for the project, which shows a marked improvement to Paeroa Road intersection in particular. The Waitarere Beach Road intersection retains a high RPS score of 34 because the intersection remains priority controlled. The reduction in RPS is due the improved alignment and sight distance visibility.

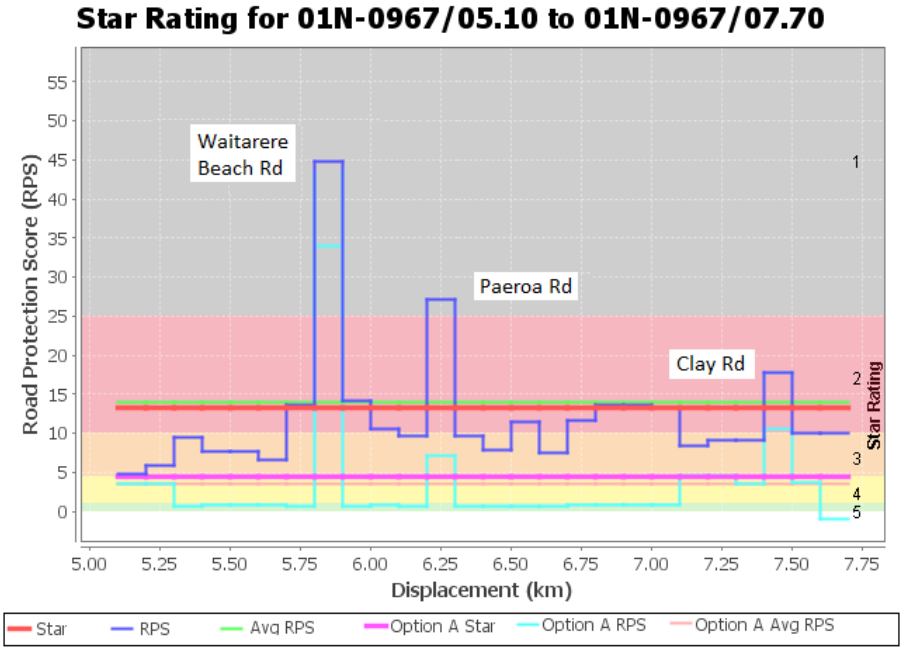


Figure 7-2: Proposed KiwiRAP Risk Worm Profile

The introduction of wire rope median and side barriers has reduced the RPS for the majority of the project to a score of just above zero.

8 Recommended Option - Economic Analysis

The Project forms part of the Wellington Northern Corridor RoNS Project which has a BCR of 1.6 (not allowing for wider economic impacts) and has an assessment profile of HHL; high strategic fit, high effectiveness and low economic efficiency.

In order to test how the proposed work contributes towards the overall project, the BCR of the project has also been calculated as if it were a standalone project. In this way, the preferred option of carriageway widening, safety barriers and curve realignment was evaluated against the Do Minimum of continued maintenance in accordance with the Economic Evaluation Manual (EEM, July 2013). The benefit cost ratio was evaluated as 1.4 for the preferred project option with a first year rate of return (FYRR) of 13%. Further sensitivity analysis undertaken calculates the BCR to range from 1.1 to 3.2. The BCR was most sensitive to increases in construction cost and the effect of a further fatal or serious head-on crash.

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8.1 Economic Summary of Recommended Project Option

The Project forms part of the Wellington Northern Corridor RoNS Project which has a programme BCR of 1.6 (not allowing for wider economic impacts) and has an assessment profile of HHL; high strategic fit, high effectiveness and low economic efficiency. If wider economic impacts are included then the programme BCR is 1.8 (excluding the benefits of Petone to Grenada project).

In order to test how the proposed work contributes towards the overall project, the BCR of the project has also been calculated as if it were a standalone project. An economic evaluation has been carried out in accordance with modified full procedures of the Economic Evaluation Manual (EEM, July 2013). The recommended option was analysed against the Do minimum option. The recommended option and the Do Minimum option are outlined in outlined in Section 5 and Section 4.1 respectively.

The outputs of the economic evaluation are summarised in Figure 8-1, with key assumptions and inputs outlined in the following sections.

The worksheets used for the economic evaluation are included in Appendix C – Economic Worksheets.

Table 8-1: Economic Summary Table

Timing				
Earliest Implementation Start Date			October 2019	
Expected Duration of Implementation			18 months	
Analysis Period and Discount Rate			40 years and 6%	
Economic Efficiency				
Time Zero			1 July 2014	
Base date for Costs and Benefits			1 July 2013	
Present Value of Total Project Cost of Do Minimum			$0.4m	
Present Value net Total Project Cost of Recommended Option			$10.7m	
Present Value net Benefit of Recommended Option (exc. WEBs)			$15.0m	
Present Value net Benefit of WEBs of Recommended Option			$0m	
BCR (exc. WEBs)			1.4	
BCR (inc. WEBs)			Not calculated	
First Year Rate of Return (FYRR)			13%	
P50 Costs				
	Do Min	**Recommended Option**	**Present Value**	
			Do Min	**Recommended Option**
Design	$0m	$0.9m	$0m	$0.6m
Statutory Applications	$0m	$0m	$0m	$0m
Property	$0m	$1.9m	$0m	$1.4m
Construction/Implementation	$0m	$11.6m	$0m	$8.3m
External Impact Mitigation	$0m	$0m	$0m	$0m
Other Capital (e.g. insurances)	$0m	$0m	$0m	$0m
Capital Risk Management	$0m	$0m	$0m	$0m
TOTAL IMPLEMENTATION COST	**$0m**	**$14.4m**[22]	**$0m**	**$10.3m**
Maintenance	$0.1m	$1.2m	$0.0m	$0.4m
Renewal (Periodic Maintenance)	$1.2m	$2.1m	$0.4m	$0.4m
Operating	$0m	$0m	$0m	$0m
Other Ongoing Costs (e.g. Toll Collection)	$0m	$0m	$0m	$0m
Post Project Evaluation	$0m	$0m	$0m	$0m
ONGOING COST	**$1.3m**	**$3.3m**	**$0.4m**	**$0.8m**
Project Contingency	Included in above figures.			
TOTAL P50 PROJECT COSTS	**$1.3m**	**$17.7m**	**$0.4m**	**$11.1m**
BENEFITS				
			Present Value	
			Do Min	**Recommended Option**
Travel Time Costs			$56.1m	$50.6m
Vehicle Operating Costs			$62.8m	$64.5m
Accident Costs			$20.7m	$9.3m
Vehicle emissions Costs			$2.5m	$2.6m
Driver frustration Costs			$0m	$0m
Walking & Cycling Costs			$0m	$0m
Travel Behaviour Costs			$0m	$0m
PV total net costs			$142.1m	$127.0m
Option NPV benefits				**$15.0m**

[22] This is the Expected Project Cost (Scheme Estimate) – see Appendix D.

8.2 Traffic Data

8.2.1 Traffic Volumes

The latest traffic count data for SH1 and the intersecting local roads, sourced from the NZTA's Traffic Monitoring System (TMS) and RAMM/CAS data, in the vicinity of the Waitarere Curves is outlined in Table 8-2 below.

Table 8-2: Summary of Traffic Volumes

Traffic Volumes				
Description	**Location**	**AADT**	**% Heavies**	**Count Type**
SH1 Whirokino (ID:01N00964) North of Waitarere Beach Road	RP 967/9.79 (SH1 North)	7,300 (2013)	13%	Non-continuous
SH1 North of Levin (ID:01N00979) South of Waitarere Beach Road	RP 967/11.66 (SH1 South)	9,350 (2013)	11%	Non-continuous
SH1 Waitarere Beach Road Curves Length weighted AADT	RP 967/5.10-7.69	8,720 (2013)[23]	-	-
SH1 Ohau (ID:01N00988 - Telemetry Site 56)	RP 985/3.48	14,600 (2013)	10%	Continuous
Waitarere Beach Road	RP 967/5.90	2,400 vpd	-	Non-continuous
Paeroa Road	RP 967/6.27	70 vpd	-	Non-continuous
Clay Road	RP 967/7.48	unknown[24]	-	-

The length weighted SH1 AADT between the Whirokino and North of Levin count sites for the project length was calculated as 8,720 vpd.

The Otaki to north of Levin SATURN base network model outputs[25] shows that link and intersection Level of Service (LoS) for 2011 and 2041 for the intersection of SH1 and Waitarere Beach Road are expected to be A/B. The model does not include intersection nodes for Paeroa Road. Therefore long term, the level of service for Waitarere Beach Road intersection suggests that a proposed layout similar to that which currently exists will deliver the required performance.

From the traffic turning counts carried out in May 2011, 37% of the total surveyed traffic (morning, inter-peak and afternoon peak) turned left from SH1 (Travelling north from Levin) into Waitarere Beach Road and 38% of traffic turned right out of Waitarere Beach Road to SH1 (Travelling south to Levin). The remaining movements, right turns in to Waitarere Beach Road and left turns out of Waitarere Beach Road both accounted for 12% of the total surveyed movements.

8.2.2 Traffic Growth

The historic 10 year growth rate was -0.5% and the historic 20 year growth rate was recorded at 1% for the closest telemetry site, located at Ohau, south of Levin. The nearest non-continuous count site to Waitarere Beach Road is located approximately 6 km to the south (North Levin – Kawiu Rd); historic growth shows similar trends to Ohau with -1.4% growth in the last 10 years and 0.3% growth in the last 20 years, as shown in Figure 8-1 below.

[23] The SATURN length weighted average between the links north and south of Waitarere Beach Road was calculated as 8,640 vpd. The modelling link outputs between SH1 Waitarere Beach Rd and Koputaroa Rd North (Northern link) showed volumes of 7,850 vpd (adjusted to 2013), with the southern link between SH1 Waitarere Beach Rd and Kawiu Road showing volumes of 8,990 vpd (adjusted to 2013).

[24] There was no traffic data available for Clay Road based on HDC records/RAMM; however, it is estimated that the ADT would be similar or slightly more than Paeroa Road. In addition to a number of residential dwellings, Clay Road also has a Marae, refer Section 2.2.2 for further details.

[25] See Otaki to north of Levin Scoping Report

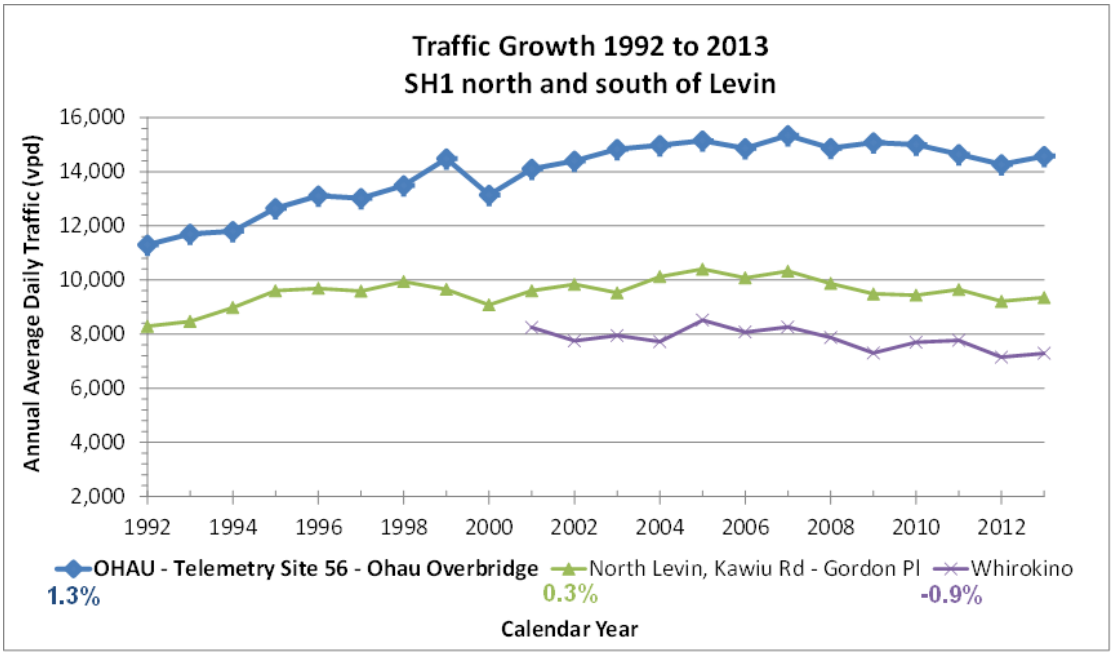


Figure 8-1: Traffic Growth 1992 to 2013

The Wellington Northern Corridor RoNS is expected to result in increased development in this part of the region. Accordingly, a slightly higher growth rate has been adopted than would otherwise have been the case based on historic data.

The Otaki to Levin SATURN base traffic model shows growth rates of 0.5% to 0.6% for the SH1 links in the vicinity of Waitarere Beach Road, this has been adopted as the base case by using the model outputs in the economics.

A growth rate of 1% was adopted as the high growth scenario due to the long term 40 year horizon and the effect of the Wellington Northern Corridor RoNS projects. Due to uncertainty in growth rate, a sensitivity test was also conducted at 0% growth.

In relation to other projects in the Otaki to Levin programme of work, the work at Waitarere Beach Road curves will not be directly affected by the programme to the south (i.e. the 1/57 connection or any future Levin bypass) as the tie-in to the existing state highway with these projects would be south of Waitarere Beach Road.

It is noted that the NZTA is investigating traffic growth rate trends on state highways within NZ, with the results expected soon. The investigation was initiated in response to traffic increases detected in the last year or two, linked to economic recovery, and hence this could see traffic growth predictions change.

Refer Appendix C – Economic Worksheets for further traffic and modelling information.

8.2.3 Travel Speed

Travel speed data has been collected and validated using the following three sources:

- Car following travel time surveys[26] undertaken in July 2014 along the project extent.
- Design speed estimates for the existing situation based on RAMM High Speed Data and Out of Context Curve tables.
- Design speed estimates for the existing situation using geometric model data.

[26] These surveys involved following another vehicle, at approximately the same speed, along the project extent and recording the travel time and distance travelled. This was repeated five times in each direction.

The results of the passenger car following survey are shown in Figure 8-2 below. The average southbound and northbound travel speeds were recorded as 87.1 km/h and 86.4 km/h respectively, with a combined average speed of 86.8 km/h.

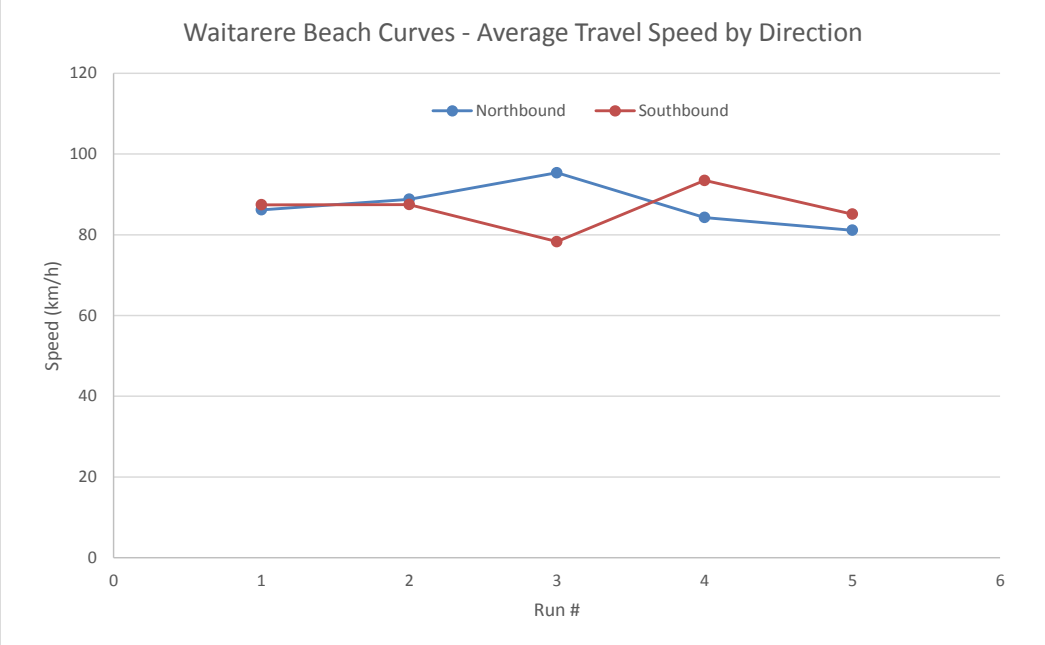


Figure 8-2: SH1 Waitarere Curves Travel Time

The car following survey average speed estimate was validated based on dividing the project length into curves and straight sections, with curve design speeds assigned based on both the geometric model and RAMM out of context curve inputs. The existing curve design speeds ranged from 81 km/h (300 m radius curve at Waitarere Beach Road) to 100 km/h (large radius curve north of Clay Road). It was assumed that the short straight sections between curves had a theoretical speed of 105 km/h. A length weighted average design speed was calculated for both the geometric and RAMM curve speeds, this was then factored by the EEM 'design speed to mean speed factor' of 0.885.

The geometric model and RAMM based existing length weighted mean speed was estimated at 86.1 km/h and 86.7 km/h respectively, showing close correlation with the car-following survey estimate of 86.8 km/h. The RoNS design allows for 110 km/h radii curves, therefore the mean speed through the project length is expected to increase towards 100km/h.

Refer to Appendix C – Economic Worksheets for further survey and validation information.

8.3 Crash Benefits

For the purposes of crash analysis, the study length was divided into the following sections:

- **Waitarere Beach Road intersection**: crashes within a 50m radius of the Waitarere Beach Road and SH1 intersection.
- **Midblock crashes**: The crashes occurring along the project length, excluding crashes within 50m of the Waitarere Beach Road intersection. Crash modelling was not undertaken for the Paeroa Road/SH1 intersection and Clay Road/SH1 intersection due to a combination of very low side road volumes and no intersection related crash movements within 50m of either intersection.

Waitarere Beach Road Intersection

In the five year period from 2009-2013 there were four reported crashes within 50m of the intersection, including one serious crossing turning crash and three non-injury crashes.

Method C (weighted accident procedure) was adopted for the Do Minimum as there has only been one injury crash in the latest five year period, which is insufficient for Method A (accident by accident analysis). The injury crash rate for the intersection was determined using the EEM 'General high speed cross and T intersections >=80km/h' crash model with the output from the model weighted based on the single injury crash that has occurred in the last five year period. Injury crash costs for both the Do Minimum and option were determined from EEM Table A6.22 for a priority T intersection, adjusted for the Do Minimum and option mean speed[27].

Method B (accident rate analysis) was adopted for the option due to fundamental change as a result of the completely new intersection being provided, with significant alignment/ sight distance improvements compared to the existing intersection. The injury crash rate for the intersection was determined using the EEM 'General high speed cross and T intersections >=80km/h' crash prediction model. A crash reduction factor for intersection sight distance improvements of 30%[28] was applied to the model.

Midblock

In the five year period from 2009-2013 there were 11 reported crashes along the project midblock extent (RP 967/5.10 to RP 967/7.69), excluding crashes within 50m of the Waitarere Beach Road intersection. The midblock section included two fatal crashes, one serious crash, two minor injury crashes and six non-injury crashes.

As there has been greater than one high severity crash per km, Method A (accident by accident) analysis was adopted for the Do Minimum. The analysis considered the movement type of each crash separately with costs determined from EEM Table A6.21, adjusted for the Do Minimum mean speed of 87km/h.

Method B, accident rate analysis, was adopted for the option due to fundamental change as a result of the highway realignment, wider 17m carriageway and central median and edge safety barrier provision. The injury crash rate for the midblock section was determined using the EEM 'Rural two-lane roads >=80km/h' exposure crash model. Crash reductions factors for guardrail provision of 25%[29] and wire rope median barrier provision of 30%[30] were applied to the model, as both these treatments are not included in the typical two-lane rural road model. Injury crash costs for the option were determined from EEM Table A6.22 for midblock crashes for a 100km/h near rural speed limit area.

Crash Migration

A potential effect of undertaking a significant highway realignment, can be crash migration from the project site to nearby site(s). However, as the project extent has long straights of greater than 2 km in either direction of the improvement works, crash migration is considered to be unlikely.

It is also noted that the Otaki to North of Levin RoNS (of which Waitarere Beach Road curve improvements is a part) also includes overall route improvements comprising; consistent seal width, vertical profile improvements and additional passing lanes. These route improvements are considered to further reduce the risk of crash migration.

8.4 Travel Time and Vehicle Operating Costs

For the purposes of Travel Time Cost (TTC) and Vehicle Operating Cost (VOC) analysis, the study length was divided into the following sections:

[27] The Do-Minimum average speed of 87km/h was based on car-following surveys and an option mean speed of 100km/h was adopted.

[28] NZTA, High Risk Intersection Guide July 2013, Intersection Improvements – Sight distance improvements, IS3, pg. 111.

[29] NZTA, EEM (July 2013), Crash Model #11 Rural two lane road >=80km/h, Effects of crash barriers, pg. 5-309.

[30] NZTA, High Risk Rural Roads Guide, Appendix D, Table D1 - Median Barriers, pg. 92.

- **Highway realignment**: The SH1 realignment results in a reduction in route length of 80m, reducing both travel time and vehicle operating costs. In addition, the realignment increases the mean speed by providing a significantly improved highway alignment replacing the existing out of context curves with large 800m and 2000m radii curves. The highway realignment was split into three sections; SH1 north and south of the Waitarere Beach Road (due to changes in traffic volume) and the midblock section of Waitarere Beach Road (due to an increase in length of 90m and improved horizontal alignment as a result of the proposed option).

- **Wire Rope Median Barrier effects**: Travel time and vehicle operating dis-benefits relating to the wire rope median barrier have been assessed based on the additional delays introduced from turning restrictions (Paeroa Road/SH1 intersection LILO, direct accesses LILO).

- **Waitarere Beach Road Intersection**: Since the proposed intersection layout is the identical to the existing layout apart from the addition of a left turn slip lane, it was considered that the travel time and vehicle operating costs associated with the intersection operation would be minimal and therefore no modelling was undertaken. In addition, as the left turn slip for northbound would reduce delays marginally for SH1 northbound traffic, this assumption is considered conservative.

Highway Realignment

As outlined above, the SH1 highway realignment to remove the out of context curves will result in a shortened route (80 m) at a higher design speed. This will provide travel time benefits for vehicles travelling on SH1.

The highway realignment also has a significant impact on vehicle operating costs (VOC) and CO_2 emissions. The reduction in route length of the option results in VOC savings, however the increase in travel speed results in an increase in VOC. For this project, the VOC benefits from the route shortening and a more uniform operating speed are outweighed by the increase in travel speed, resulting in negative VOC benefits.

The following assumptions were made in the calculation of VOC and travel time costs/benefits:

- As outlined in Section 8.2.3, the Do-Minimum mean speed through the project length is assessed as 87 km/h, based on car following speed surveys and validated with RAMM high speed data/out of context curve speed data and geometric design model outputs. The mean speed for the Waitarere Beach Road section was estimated at 70 km/h.

- The SH1 proposed option mean speed has been estimated as 100km/h with the option speed for Waitarere Beach Road increasing to 80km/h due to the improved alignment.

- Traffic volumes for the sections of highway north (7,890 vpd) and south (9,030 vpd) of Waitarere Beach Road intersection were based on SATURN modelling outputs factored to 2014 time zero. Traffic volumes for Waitarere Beach Road (2,400 vpd) were based on RAMM/RCA records (Retrieved using CAS).

- As outlined in Section 8.2.2, traffic growth of 0.5% was adopted as the Wellington Northern Corridor RoNS is expected to result in increased development in this part of the region. Waitarere Beach Road growth was estimated at 0% based on modelling outputs.

- Travel time costs were calculated using a rural strategic standard vehicle composition profile as per Table A4.3 in the EEM, noting that the percentage of HCVs was close to the rural strategic value of 12% at both of the nearby traffic count sites. Travel time costs for Waitarere Beach Road section were based on the rural other composition values.

- Base VOC costs were interpolated from EEM Table A5.9 and A5.10 based on the Do Minimum and option estimated/surveyed speeds (outlined above) and a gradient of approximately 2-3% for each of the three realignment sections.

- Analysis of RAMM/high speed data showed that the existing roughness was low (NAASRA <60) and that there are no VOC benefits to be obtained from improving roughness as part of the option.

- Carbon dioxide savings have been assessed as 4% of the vehicle operating cost saving, in accordance with the guidance in EEM.

Wire Rope Median Barrier effects

As outlined in Appendix E – Crash History Information, the provision of central median wire rope barrier has implications for movements at intersections and property accessways.

An assessment was carried out to determine both the additional distance travelled and additional travel time incurred from the restriction of right turning movements. The key assumptions of the assessment included:

- Side road AADTs were extracted from CAS/RAMM databases with values estimated where no records were available.

- An assumed 50% of traffic will be affected, i.e. 50% of traffic will be undertaking right in or right out movements.

- Existing side road right in or right out turning delays will be equivalent to the introduced right in/right out delays at the nearest intersection. This is based on the fact that traffic volumes along SH1 are relatively consistent, resulting in similar side road gap acceptance. Left turn delays were assumed to be negligible.

- Where right turn in/out movement is restricted, distances were measured to the nearest intersection/ turnaround facility. The turnaround facilities provided as part of the proposed option are Waitarere Beach Road intersection in the north (where the median wire rope barrier is broken to allow all movements) and the P turn facility to the south, where a right turn bay and P turn facility are provided at the termination of the median wire rope barrier. Where appropriate, additional manoeuvring time was added to account for u-turning movements.

- A 10.4 vpd trip generation rate for a dwelling was adopted in accordance with Appendix 5B of the NZTA Planning and Policy Manual.

There are two intersections that will be affected by the median wire rope barrier; Paeroa Road and a combined access road intersection that will both be restricted to LILO. In addition to the two intersections, approximately 10 dwellings which currently have direct access to SH1 will be affected (restricted to LILO) by the provision of a wire rope median barrier along the project length.

The analysis revealed that there will be approximately $16,000 of travel time dis-benefits per annum, $21,000 of vehicle operating cost dis-benefits per annum and $1,000 of CO2 dis-benefits per annum associated with the turning restrictions at intersections and property accesses. Carbon dioxide savings have been assessed as 4% of the vehicle operating cost saving, in accordance with the guidance in EEM.

Refer Appendix C – Economic Worksheets for further details on the wire rope barrier disbenefits.

8.5 Maintenance Costs

The Do-minimum future maintenance costs were based on the future works programme, noting that there is no significant pavement rehabilitation works planned along the project extent in the near future.

The recommended option will result in an increase in maintenance cost due to the following:

- Significant increase in carriageway width from approximately 24,000m^2 to 43,000m^2, which increases the cost of both annual maintenance and renewals.
- Maintenance costs attributed to both the side protection (3.1 km total) and median (1.7 km) wire rope barrier were included. These costs were factored based on the actual RAMM maintenance costs for a similar state highway site (SH58 RP 0/1.4-2.3). Refer Appendix C – Economic Worksheets for further details.

8.6 Wider Economics Benefits

This project is part of the Otaki to Levin RoNS which in turn is part of the Wellington Northern Corridor RoNS. It is noted that analysis of wider economic benefits was assessed as part of the economic evaluation of the entire Wellington Northern Corridor.

8.7 Comparison with Earlier Stages

The outputs of the current economic evaluation were compared to the early Project Feasibility Stage (2012) and the results are outlined in Table 8-3 below along with discussion on key differences.

Table 8-3: Economic History Summary Table

Timing		
	Previous Estimate	**Current Estimate**
Earliest Implementation Start Date	July 2013	October 2019
Expected Duration of Implementation	6 months	18 months

Economic Efficiency			
	Previous Estimate[31]	**Previous Estimate Updated**[32]	**Current Estimate**
Base date for Costs and Benefits	1 July 2012	1 July 2013	
Expected Project Cost (SE)	$9.7m	$9.7m	$14.4m
Total Ongoing maintenance and renewal Costs	$0m	$0m	$3.3m
Expected Cost plus Ongoing maintenance and renewal Costs	$9.7m	$9.7m	$17.5m

Economic Efficiency			
	Previous Estimate	**Previous Estimate Updated**	**Current Estimate**
Present Value of Costs of Do Minimum	$0m		$0.4m
Present Value net Cost of Recommended Option	$9.2m		$10.7m
Present Value net Benefit of Recommended Option (Exc. WEBS)	$16.9m		$15.0m
Present Value net Benefit of WEBS of Recommended Option	$16.9m		$15.0m
BCR (Exc. WEBS)	1.8		1.4
BCR (Inc. WEBS)	1.8		1.4

[31] Note the PFR BCR was updated to reflect the correct route shortening; refer Section 4.1 for further details. The updated values are presented in this section.

[32] Note the EEM 2013 update factor for construction and maintenance costs for 2012 is 1.00. I.e. there is no update required to bring 2012 costs to 2013 costs.

The key differences which relate to the approximately 20% decrease in the BCR of this sub project (which is only a small part of the Wellington Northern Corridor RoNS), includes:

- **Construction/Implementation start:** The assumed implementation start date is now 2019, compared to 2013 in the previous stage. This reflects the RoNS programme.
- **Construction timeframe and Total Implementation Cost:** The expected duration has tripled in comparison to the earlier phase and the total implementation cost increased by approximately 50%. This is due to greater detail into the investigation and higher standard design features, as well as the addition of central and edge wire rope barrier, a much larger carriageway cross-section (in accordance with recent NZTA requirements) and ancillary works when compared to the previous stage.
- **Reduction in PV net benefits:** The 11% reduction in PV benefits can be attributed to the following:
    - A reduction in the route shortening in the previous stage for the proposed option. This has had an impact on the travel time and vehicle operating cost savings.
    - The existing average travel time was estimated based on RAMM data in the previous stage, whereas surveys were conducted to obtain a sample of actual average travel speeds as part of the current stage.

8.8 Sensitivity Analysis

The BCR for the Wellington Northern Corridor RoNS is 1.6 or 1.8 if including Wider Economic Impacts. The following section provides a sensitivity assessment of the Waitarere Beach Road Curves sub project to help inform understanding of the contribution it can make to the overall Wellington RoNS programme.

8.8.1 Cost/Benefit Variability

A number of sensitivity tests were undertaken to provide a likely BCR range, the results of the analysis are summarised in Table 8-4 below.

Refer Appendix C – Economic Worksheets for full sensitivity analysis of the recommended option, showing both the BCR and first rate of return (FYRR) for each sensitivity test.

Table 8-4: Sensitivity Analysis

Sensitivity Testing								
Variable	**Base Case**		**Lower Bound**			**Upper Bound**		
	Value	**Note**	**Value**	**Note**	**BCR**	**Value**	**Note**	**BCR**
Cost Variability								
Construction / Implementation	$14.4m	Expected Estimate	$18.4	95th %tile Estimate	1.1	$12.0m	Base Estimate	1.6
Benefit Variability								
Existing Average Speed	87 km/h	Surveyed	90 km/h	High estimate	1.3	80 km/h	Low estimate	1.6
Crash Benefits: Additional Fatal	$11.4m	09-13 crash history				$30.1m	Add. Head-on Fatal	3.2
Crash Benefits: Additional Serious	$11.4m	09-13 crash history				$15.8m	Add. Head-on Serious	1.8
Crash Benefits: Wire Rope Median Barrier	$11.4m	included	$11.0m	excluded	1.4			
Vehicle Emissions Reductions	CO_2 emissions included in VOC savings							

Sensitivity Testing								
Variable	Base Case		Lower Bound			Upper Bound		
	Value	Note	Value	Note	BCR	Value	Note	BCR
Traffic Growth	0.5%	Model	0%	10yr growth	1.2	1%	long term est.	1.6

The results of the sensitivity testing show the BCR ranges from 1.1, when using the 95th percentile cost estimate, to 3.2 when including the effect of an additional fatal head-on crash.

The first year rate of return (FYRR) did not significantly alter from the base of 13%, with the exception of testing the effect of additional high severity crashes occurring in the future (17% FYRR with an additional serious head-on crash to 31% FYRR with an additional fatal head-on crash).

8.8.2 Discount Rate/Evaluation Period Sensitivity

As part of the full procedures of the EEM 2013, projects with a significant amount of benefits occurring in the future are required to undertake discount rate sensitivity testing.

Sensitivity testing was conducted at a discount rate of 4% (higher realisation of future long term benefits/costs) and 8% resulting in BCR of 1.8 and 1.1 respectively.

Further sensitivity testing was undertaken into the effect of the construction start timing on the BCR. The construction timing affects the impact the existing situation (Do-Minimum) will have on the economics, with delaying construction increasing the impact of the Do-Minimum. Delaying construction start to 2021 reduced the BCR slightly, while bringing construction forward to 2016 increased the BCR slightly, however in both cases the BCR remained at 1.4.

8.9 Assessment Profile

Please refer to the Assessment Profile of the Wellington Northern Corridor RoNS. This is available at http://www.nzta.govt.nz/projects/wellington-northern-corridor/publications.html.

9 Financial Case

This section includes a summary of the financial impacts and effects of the proposed project. This includes an expected construction cost estimate of $11.6M, and expected project estimate of $14.4m. Additional maintenance costs resulting from the project are also described.

Funding options and potential revenues are also considered.

9.1 Project Delivery Costs

Project delivery costs at this Detailed Business Case stage are based on analysis undertaken to date and certain assumptions, as follows:

- Construction to commence October 2019 with duration of 18 months.
- Property purchase areas based on aerial photos and without input of a specialist property consultant (expected estimate $1.88M, 95th percentile estimate $2.19M)
- Design and project documentation costs including consultancy fees and NZTA-managed costs (expected estimate $0.70M, 95th percentile estimate $0.85M)
- Construction costs (expected estimate $11.6M, 95th percentile estimate $15.0M)
- Expected project estimate $14.4M
- Statutory application costs (expected estimate $287k, 95th percentile estimate $350k)
- Funding risk cost assessed and analysed ($3.9M)

The DBC project proposal cost estimation is found in Appendix D – Capital Cost Estimates .

9.2 Ongoing Maintenance and Operations Costs

The proposed works will result in a change to the highway asset and therefore a corresponding change to the ongoing maintenance and operation of this section of SH1.

Overall, the length of SH1 will be reduced by approximately 80m as a result of the realignment. This is a positive from a maintenance perspective. However, as a result of the significantly improved road cross section (as described in Section 5.1.1) the effect would be a significant increase in sealed area over the length of the realignment, as follows:

Current Seal Area: 24,400m2

Proposed Seal Area: 42,800m2

Net increase: 18,400m2

The increase in seal area will result in additional maintenance costs for the seal and underlying pavement structure. The additional seal area is a result of providing a 4.0m median and 3.0m sealed shoulders. The annual increase in maintenance costs for the additional pavement is considered to be $2,300 per annum. For periodic maintenance, the additional cost of a reseal is estimated as $105,000. For a full rehabilitation, the estimated additional cost is $578,000.

In addition to the seal area, the proposed upgrade will also introduce further assets that require ongoing maintenance and management.

Significant lengths of new TL4 wire rope barrier will be introduced across the project length with new median and edge wire rope barrier installed throughout the entire project (but with the necessary break for intersections and access). Provision of barrier will result in increased barrier maintenance due to vehicle strikes – an estimated number of strikes have been included in the economic evaluation. The cost of the guardrail (edge and median) hits has been estimated as $26,000 per annum.

Despite the above, the additional maintenance cost is closely offset by a new asset with the overall change in Net Present Value being small.

9.3 Project Revenues

There are no third party contributions or revenue gathering prospects for this project.

9.4 Funding Options

The project will be funded from the National Land Transport fund under the State highway activity class.

9.5 Financial Risk

Project funding is understood to be entirely Government share, therefore no funding risk is associated with the project. However a change in national Government at future general elections could mean budgets are altered for roading projects.

PART B – READINESS AND ASSURANCE

10 Commercial Analysis

Construction funding for the Project is to be sourced from the Wellington Northern Corridor RoNS Programme. The Project is currently identified in the Programme for a construction start in 2019 (and the overall Programme has an investment profile of HHL giving it priority 3 ranking for funding in the National Land Transport Programme's 2012 – 2015 and 2015 – 2018.

As the Project's commercial viability is established via the Wellington Northern Corridor Road of National Significance Programme, and the Project itself is still four years away from a construction start, Section 10 focuses predominately on the Project's next key step: RMA Consenting Phase.

Based on the Project's current programme, it is recommended that a notice of requirement and resource consents (that is, the RMA applications) be sought in advance of the design phase or a final procurement decision on design/construction for the following reasons:

- To secure route security (via a designation). This will provide long term certainty for the Transport Agency and the property owners regarding the location of the improvements. This is particularly beneficial if the construction start date is moved forward or backwards;
- The process for securing the designation will require further design to complete the necessary environmental effects assessments. This design will be sufficient to enable the key resource consents to be secured at the same; and,
- To help manage property risks associated with Maori land, which are now, as a consequence of the recent 'Grace decision' more significant. The RMA process allows discussions and agreements in principle to be developed with Maori land owners as part of CIA and effects consideration process, mindful of overall land take issues.

With regard to the first bullet point there is a possibility that the Project could be brought forward to NLTP 2015 to 18 if a decision is made to include the Project as part of NZ Safety Improvements Alliance. If this decision is eventually made, the design and construction procurement process would need to be completed for the Project. Accordingly, the benefit of having the RMA applications in place first is that it would enable the Transport Agency to provide a well defined scope of the works for such an Alliance to advance. This approach would in any event provide clearer direction for the Transport Agency's Principal Advisor if the RMA approvals weren't in place. It is noted that a similar procurement delivery model has been adopted for the Peka Peka to Otaki section of the Wellington Northern Corridor Road of National Significance

If the Project is to be delivered as currently programmed, and given its expected cost and that it is not a complex project, the design and construction phase is likely to be via a traditional delivery model. In summary, this would entail the following:

- Procurement of a Specimen Design Contract and a Transport Agency Principal Advisor Contract; and,
- Procurement of a Detailed Design and Construction Contract.

The RMA consenting phase will be undertaken on a basis of providing constructability and design flexibility for the ensuing Design Phase (see also the following Management Case). To this end, the RMA consenting phase will inevitably lead to some minor adjustments to the proposed design and will necessitate the development of mitigation agreements (in principle) with affected land owners and iwi. Accordingly, the Central Region Property Team (Project Management Services) as well relevant 'Journey Managers' and P&I advisors will be involved in discussions and decision making. This process will develop broad based relationships with stakeholders and project understanding so as to provide better business continuity for subsequent the pre-implementation and construction phases.

The existing Investigation and Reporting Project Team (MWH) is well placed to deliver RMA Consenting Phase. It is not desirable to change the consultancy team at this stage in the

process as this will create business continuity issues and introduce risk to stakeholder and land owner relationships and to programme.

Therefore, the preferred procurement method for resourcing the RMA Consenting Phase is to continue use the existing Professional Service Provider (MWH) as it represents the least consenting risk approach and most time and resource efficient method.

10.1 Introduction

The Waitarere Beach Road Curves project is a part of the north of Otaki to north of Levin segment of the Wellington Northern Corridor Road of National Significance.

Construction funding for the Project is to be sourced from the Wellington Northern Corridor RoNS Programme. The Project is currently identified in the Programme for a construction start in 2019 (and the overall Programme has an investment profile of HHL giving it priority 3 ranking for funding in the National Land Transport Programme's 2012 – 2015 and 2015 – 2018.

As the Project's commercial viability is established via the Wellington Northern Corridor Road of National Significance Programme, and the Project itself is still four years away from a construction start, this section focuses predominately on the Project's next key step: RMA Consenting Phase.

The contract let for the investigation of the Otaki to Levin segment of the RoNS extends to lodgement of RMA applications and includes provision for the successful consultancy team to then provide services and resources for the follow on phases up to grant of consent. This is consistent with the overall approach on RoNS projects where the intent is to make the Project construction ready.

This section of the report considers how the proposed project is advanced from the current stage through to its construction and then operation. This section of the report then focuses on RMA consenting phases on the premise that these should be obtained now as it is desirable to provide certainty for the consequent design and construction phases. The strategy for obtaining RMA consents (and related archaeological authorisations) is formed mindful of the procurement options that are likely to be available during the design and construct phases and also mindful of the possibility that construction ahead of the current programmed start date of 2019 is a possibility. In this latter scenario, it will be advantageous to have relevant consents secured so that risks (and thus costs) are minimised during the design and construction phases. Accordingly an important factor in the consenting phase is maintaining sufficient levels of design and construction flexibility so as to not unduly constrain subsequent procurement decisions. Equally, risk to consenting outcomes also need to be managed appropriately.

10.2 Output Based Specification

The current RoNS programme is for construction of the Project to commence in 2019 as part of the overall north of Otaki to north of Levin segment. At this stage decisions have not been made as to how construction within this segment of the Wellington Northern Corridor RoNS is to be programmed, although it is likely that construction of the various improvements investigated and proposed for this segment of the RoNS will be undertaken progressively.

The proposed improvements at Waitarere Beach Road Curves are discrete and can be constructed as a standalone project. Accordingly, there is a possibility that it will be delivered first, and given its relatively small scale, it may be brought forward in the programme. There is also a possibility that this project might be included in the package of safety projects along the SH1 corridor to the north of Levin or across the country. Delivery could also be via use of the NZ Safety Improvements Alliance, which could also mean that the improvements will be delivered earlier than the current RoNS programme.

A procurement strategy has not been prepared at this stage, but, due to the small scale of the project, the low complexity and the high capacity in the market place to undertake construction a traditional procurement method is likely to be suitable. A traditional

procurement approach is not complex and so can be undertaken quickly thereby providing programme flexibility as to when the Project is constructed. A traditional procurement method will also provide price tension during both the design and construction phases.

A key hurdle to early delivery of the Project is property. The proposed works will require acquisition of relatively significant amounts of Maori owned land which given the recent Grace decision, can cause increased project uncertainty. It is desirable to remove (or at least significantly reduce) this risk prior to commencing with the detailed design stage of projects. The Resource Management Act consenting process provides a good basis for addressing these issues as it provides a basis for negotiating the principles of land acquisition in parallel with developing the design (to 20-30%).

As indicated above, there is a possibility that the project will be brought forward earlier and accordingly, in order to provide the flexibility for this to occur, it is proposed that RMA consents are obtained now. This approach will provide route security as well as removing or significantly reducing property risks so as to allow the project to proceed swiftly if wanted.

Should the RMA applications be opposed then consenting could elongate by a year. It is further noted that looking at property issues in parallel with the RMA process means that opposition to the Project can be reduced and can help ensuing property acquisition phases. Given the amount of Te Ture Whenua Maori land that is traversed by the Project this step could be important to allowing an earlier construction start, or even to meet the currently programmed start of 2019/2020/

Therefore, proceeding with the RMA consenting phase now will provide desirable design certainty thereby enabling property purchase issues to be resolved in a timely manner. Nevertheless, it is important that RMA consents are structured so as to provide design flexibility and hence promote innovation during the design and construction phases.

Resource consenting specification

The critical success factor for RMA consenting is delivering route security, which is achieved by means of a designation. A designation is enduring albeit they this form of consent will normally need to be exercised in a specified period, normally 5 years but can be longer say up to 20 -25 years.

Resource consents from the regional council (for earthworks, work in streams, discharges of water to ground etc.,) have been assessed in this instance as being minor and, therefore, low risk. The investigations undertaken to secure a designation is likely to represent a significant proportion of the work needed to support regional consenting processes. It is possible to obtain consents on an 'envelope of effects' basis that does not unduly rely on a particular design type but instead is based on an activity type and establishes an allowed scale of effect by activity.

Accordingly, the approach is to seek to obtain regional consents in parallel with the process for obtaining a designation. However, this is not vital for route security purposes, and as these consents are considered to be low risk, this aspect can be kept under review mindful of the critical success factor of securing a designation and the efficiencies of securing resource consents in tandem with the designation.

A detailed specification of the RMA applications is provided in the consenting strategy section of this report. The deliverables for the following RMA phase of work are, likely to be as follows:

1. Regional Resource Consents (RMA) applications and then all tasks leading up to attendance at hearings.

2. Preparation and filing of a Notice of Requirement with Horowhenua District Council to construct, maintain and operate a state highway. This is likely to be an alteration to the existing designation.

3. The above applications will be supported by:

    a. Drawings that will include preliminary roading and storm water design, indicative landscape design and a land requirement plans.

b. Technical assessments covering noise, air quality, landscape, ecology, archaeology, heritage, social and cultural issues.

4. Approvals required under the Heritage New Zealand Pouhere Taonga Act 2014 (if needed and useful);

In addition, to support this phase of work the Project's stakeholder engagement strategy/plan for the consenting phase will need to be updated. This will provide the basis for a coordinating ongoing consultation and communications with affected landowners and stakeholders. The consultation phase will be developed in tandem with the Property Team, so as to enable effective integration of property issues with the RMA consenting phase. This is discussed in more detail below.

At this stage there is some flexibility in the precise specification of work to be undertaken. This is desirable as it better enables management of known and potential consenting risks, such as effects on landowners.

10.3 Implementation Strategy

This section focuses on the overall strategy and approach to managing the RMA consenting phase. The following factors are key relevant considerations which shape and inform any proposed strategy:

- **Strategic context:** The application documentation will outline how the project forms part of the overall RoNS programme. Further investigations are currently underway to assist to make decisions on the preferred sequence and programming of improvements to the Otaki to Levin section of the RoNS. The output from these ongoing investigations will become available within the next few months and will be cognisant of other proposed improvements at Whirokino Trestle (and Manawatu Bridge) as well as planned / emerging urban design projects within Levin Town Centre.

  The outputs from this work are not expected to alter the proposed timing of the implementation of the Waitarere Beach Road Curves project. However, the outputs could indicate that the benefits of the Project are likely to be enhanced by further improvements to SH1 north of Levin comprising passing lanes and edge treatments.

- **Tangata Whenua:** Local iwi have identified a number of issues and risks that need to be managed during the following phases. These residual issues / effects are considered to be minor in nature and are unlikely to materially affect the proposed design of the Project. Some iwi land issues remain and will need to be carefully considered as part of the assessment of effects phase. Issues that require consideration include storm water and land drainage and effects on Marae access, as well as alignment of actual titles with road networks.

- **Local access and effects:** Some residual land access issues and amenity effects need to be considered as part of the assessment of environmental effects assessment phase. These residual issues / effects are considered to be minor in nature and are unlikely to materially affect the proposed design of the Project.

- **Property:** Table 5-4 above (section 5) provides indicative detail of the private land that is likely to be required for the Project.

  It is estimated that 30 private properties are affected by the proposed Project. In most instances (all bar 4) the land required by the Project represents a small proportion of the lot affected. Of the other 4 lots, the land required represents roughly half of the lot and brings proposed road infrastructure closer to existing buildings (3 of which are in residential use and 1 is the Whare Rongapai). Six properties are known to have potential iwi interest. The amount of land required by size varies, as follows:

Amount of land required (estimated)	Number of properties
Less than 1,000 sqm	13
Between 1,000 sqm and 3,000 sqm	10
Between 1,000 sqm and 1 ha	5
Greater than 1ha	2
TOTAL	**30**

Land owners in their discussions with the Project team have focussed on environmental noise effects and land access issues. Some local iwi land owners have requested that the Project be amended so as to reduce or avoid potential land take requirements. The Project team has made some changes to the design to manage issues identified. It is considered appropriate that remaining known issues are managed and considered as part of the Assessment of Environmental Effects assessment phase of the project, so that 'in the round' decisions can be made.

A record of agreement and any residual (and un-agreed) issues with affected parties shall be kept (normally in the form of correspondence that identifies agreed mitigation). The objective of discussions will be to secure affected party approval forms, which can be provided in support of RMA applications. It may be necessary and expedient to enter into land purchase agreements with selected land owners during the consenting phase.

Implementation Strategy

The ensuing RMA phase of work will focus on (i) refining the design to avoid effects; and, (ii) developing appropriate mitigation measures and methods, in order to manage remaining environmental effects notably on land owners and iwi. Front loading the process with an overall assessment of environmental effects provides a consenting risk based approach to finalisation of the design and of mitigation. This approach helps provide a robust basis for agreeing and developing land owner agreements.

A property strategy is being developed to assist with this process. The strategy will aim to reduce/ remove property risks during the consenting phase by securing high level / in principle agreements with property owners and by critically bearing in mind the needs Maori land. There may be opportunities to offset loss of Te Ture Whenua Maori land with replacement land of relative equivalent value in proximity. Accordingly, this will be a key factor in the property strategy.

It is likely that the Project will be consented as an alteration to the existing designation and via application to the Horowhenua District Council. Accordingly, it will be helpful if affected party approvals are obtained. Thus, the next phase of work, leading up to lodgement of RMA applications is proposed to be staged, as follows:

1. Undertake assessment of environmental effects of proposed design (following confirmation of this report);
2. Identify mitigation, including modifications to design, to appropriately manage identified effects (mitigation workshop);
3. Consult on proposed mitigation and design with land owners and stakeholders (including local iwi);
4. Assess risks associated with any unmitigated effects;
5. Confirm / finalise the project design;
6. Finalise assessment of effects;
7. Finalise land requirement plans;
8. Review property strategy (developing land purchase / entry agreement as necessary); and,

9. Finalise RMA lodgement documentation in consultation with relevant authorities.

The proposed approach enables whole of project mitigation discussions to occur, which enables development of complimentary and efficient mitigation methods to be adopted. Equally, this allows design and construction flexibility issues to be considered. Thus, transparent communications across the Project team will be maintained when making decisions about design and mitigation through (i) bi-weekly project team meetings (existing); and (ii) involvement of the technical assessment of effects team in the risk register up-date process. The risk register will focus on managing both consenting and construction risks (see also following section below).

In parallel with the process of obtaining RMA consents it will be necessary to monitor design and construction options, mindful of available options to bring forward proposed construction, including a potential national safety project alliance model. Once a designation has been then the procurement strategy should be able to be finalised.

10.4 Risk Allocation and Transfer

The current design of the Project has not had the benefit of detailed geotechnical investigations and additional investigations will be undertaken during the consenting phase. The risk of underestimating the physical costs of the project is managed by assuming poor soil conditions and hence by making appropriate construction methodology allowances. However, the lack of information also means that stormwater design is conservative resulting in an increased land take assumptions. It is likely that the land ultimately needed for stormwater treatment will reduce and accordingly land acquisition costs are likely to reduce.

The key risk types that will feature in the ensuing RMA phases are:

- **Effects** type risks where effects either lead to significant design change or cause significant cost escalation (by introducing or increasing the scope of mitigation);
- **Property and Cultural effects** type issues which cause either design change or cost escalation (by introducing or increasing the scope of mitigation);
- **Programme elongation** caused by for example, extended negotiations / discussions with affected parties and stakeholders, staff resourcing; or hearings and appeal processes;
- **Project misunderstood**, leading to local opposition. This for example could be caused by lack of understanding of the relationship of the Project to other aspects of the Otaki to Levin section of the Wellington RoNS and/ or other Projects, or by lack of understanding of the problem being solved.

These risks are being managed, as follows:

Risk	Management approach	Lead organisation	Change from current process?
Environment effects	Good discussions with stakeholders and ongoing liaison with local authorities that ensure that effects are identified and understood, including in terms of relevance. Undertake robust assessments so that effects and consenting risk are well understood and resilient to change during the hearings/ consenting phases.	MWH	Yes: Adapt current approach so that discussions focus on RMA consenting based on developing an overall understanding of effects and consenting risk
Property and Cultural effects	Develop mitigation package with local iwi and land owners so as to manage potential for change at any RMA hearing and to allow subsequent	NZ Transport Agency	Yes: adapt current practice so that discussions reach agreements, based on understanding of overall

	design and construction phases to commence.		consenting risk and on subsequent construction phase.
Programme elongation	Careful programme management combined with managed discussions with stakeholders.	MWH	No change to current practice.
Project misunderstood	Maintain good and regular public communications	NZ Transport Agency	No change to current practice.
Property costs escalate during process of negotiation	Develop a property strategy and involve property experts in discussions with land owners. Consider project design refinement in context of land effects, including land likely to come available.[33]	NZ Transport Agency	Yes: coordinate property and design discussions.
Project cost escalate in order to mitigate project effects	Hold a mitigation workshop to provide a balanced approach to development of mitigation solutions. Convene a value engineering workshop to determine where design refinement is possible, mindful of consenting risks.	NZ Transport Agency	Yes: undertake value engineering in context of consenting risk.

In parallel with RMA consenting process it may be necessary to develop property agreements with land owners. It may also be necessary to develop a programme of land acquisition mindful of Maori Land Court process. This aspect of the Project will need careful review.

10.5 Contract Management

Consultancy services – expert witnesses and design services

The current let contract is for consultancy services up until lodgement of RMA applications with the consenting authority(s). However, the contract and tender documents were let on the basis of investigation of a single project (from north of Otaki to north of Levin) and following initial investigations it was decided to undertake improvements to this segment of the RoNS in a staged approach with the first stage being a series of localised safety improvements.

The current investigation team fully understand the project design and context, and have well developed relationships with affected stakeholders and landowners that will be helpful to the delivery of the next phase of work. Therefore, in order to manage consenting risks it is proposed that the same expert team is preferred to refine the Project design through the AEE process (see iterative process described in section 10.3), to prepare supporting assessment documentation and to advise as needed during the post RMA lodgement phases (hearings).

Accordingly, resourcing for the following stages of investigation will be negotiated with the current consultant team to prepare RMA documentation and to further develop the Project design (to the required RMA level). In order to ensure value for money a parallel estimate has been prepared, to be used to guide negotiations. The parallel estimate is based on the Agency's recent experience of RMA consenting, including the resources needed to consent the Whirokino Trestle replacement.

It is noted that a new consultancy team is highly likely to be less efficient as the new team will need to spend time understanding the existing project and its design, and to develop relationships with affected land owners and stakeholders. This will result in cost increases and also affect the RMA consenting programme.

[33] Note that land take for stormwater treatment is likely to reduce, and this in combination with land that is currently state highway becoming available once the Project is completed means that there is a medium to good chance that overall land take costs will not increase significantly.

It is likely that there will be a public hearing and that this phase will require appearances by some or all experts. At this stage, it is difficult to predict precisely how much support will be needed by each expert during the hearings phase. Thus, it is proposed that a budget is established now based on an estimated level of support by each expert, and then refreshed once the applications are lodged. The budget is then used on a time-writing basis, with use of resource being authorised by the NZTA Project Manager in advance.

Legal and property advice

The legal team are providing strategic legal advice in respect of the Project. This role is expected to continue with specific points of input predicted, as follows:

- Legal team – advise on the scope of consents needed and the technical material needed to support those applications;
- Property team advising generally on property negotiations with land owners;
- Legal team - review application documentation; and,
- Legal team – assist with hearings as needed.

10.6 Programme

The table below provides an estimated programme for the consenting, design and construction phases. The programme is an estimate and there is opportunity to bring forward aspects and if needed, for example the property acquisition stage could commence sooner, this year if needed once RMA a Notice of Requirement is lodged, as a number of willing sellers have already been identified.

Task / Time (milestone indicated)	2015									2016													2017													2018											
	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December
Prepare RMA applications	■	■	■	■																																									
Confirm / finalise the project design (allowing for VE)		■																																										
Property Strategy	■																																											
Lodge RMA Applications				■																																								
Public notification (estimated)					■																																							
Hearing (estimated)							■																																					
RMA Decision (estimated)									■																																			
Procurement strategy							■	■	■	■																																		
Property acquisition													■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									
Procure and undertake specimen design														■	■	■	■	■	■																										
Detailed design																								■	■	■	■	■	■	■	■	■	■	■	■										
Construction commences																																							■	■	■						

The time estimates for public, notification, hearing and decision is estimated and is controlled by the local planning authority.

11 Management Case

11.1 Project Roles

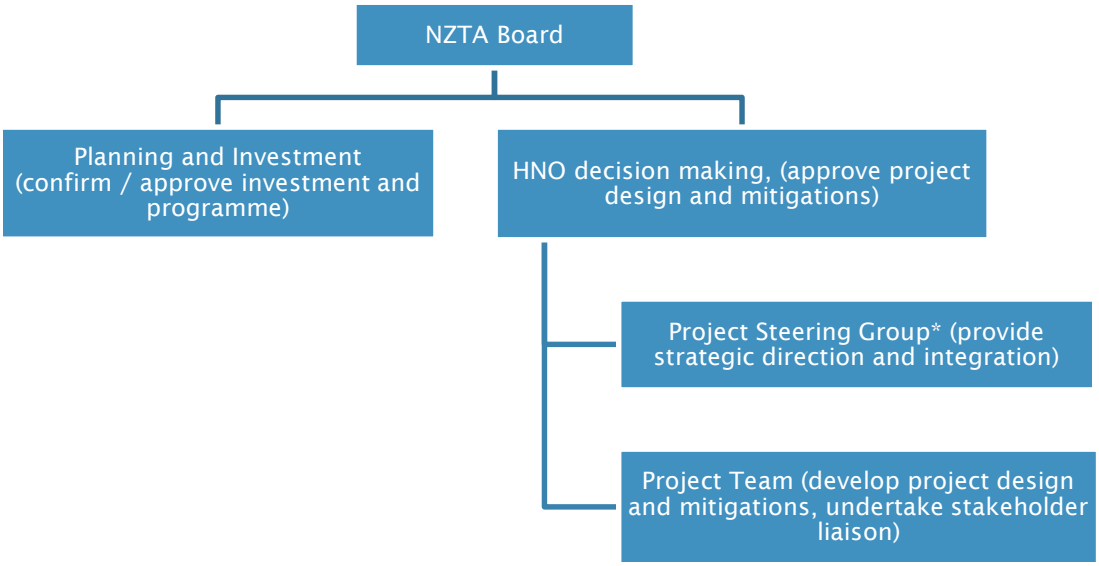
The Project Team will comprise of:

ROLE	NAME
Project Sponsor (HNO)	David McGonigal and Selwyn Blackmore
Investor Client (P&I)	Peter Hookham
Project Manager	Greg Lee
Senior Supplier	MWH
Team leader	Phil Peet
Lead Planning Advisor	Sylvia Allan, Allan Planning and Research
Lead legal advisor	Paul Beverley, Buddle Finlay

11.2 Governance Structure

The current governance structure for the project development is proposed to be retained for the RMA consenting phase. This will provide continuity with other parts of the Otaki to Levin segment of the Wellington Northern Corridor RoNS. This structure can be modified to fit following implementation construction phases.

The figure below provides the relationship between the different elements that forms the Governance Structure.



* The project Steering Group comprises senior staff from HDC and from the NZTA, and is attended by the Project Manager. The Project Steering Group provides strategic direction for

the Otaki to Levin segment of the Wellington Northern Corridor RoNS and allows whole of network and land use planning issues to be integrated into the investigations (see section 1.1 of this Report).

11.3 Assurance & Acceptance

To date, the Project has been the subject of normal review processes have been undertaken, including internal and external roading, environmental reviews and safety audits.

The Project design will be subject to the normal project review processes with no specific unusual engineering or operational considerations prevailing. With regards to post consenting decision making, formal construction funding acceptance (sign-off) will require NZTA Board approval, where all standard HNO and P&I value gate processes would apply. This process will occur after consenting.

The project is being delivered as part of the Wellington Northern Corridor RoNS Project and so care is needed to ensure that the Project's role in the broader programme is understood and recognised.

A key aspect of the project is iwi land ownership and interests, which are likely to require particular relationships to be established in the consenting and then construction stages. This element of the Project is potentially complex and accordingly discussions about how this aspect is handled will involve working closely with the Agency's legal, property and Maori advisors.

The table below lists the particular detailed review processes anticipated to be needed in the period up until lodgement of the RMA consents.

Item	Component and description
Project design	Safety audit process with National and Regional Office. Review by Regional Performance Manager Review by Horowhenua District Council as local transport authority in respect of the local road connections.
Project economics (if material design change occurs)	External peer review of project economics Planning and Investment
RMA documentation	National Office Environmental Team to review technical reports and advise on relevant policy standards Legal review (including by National Office Legal Team) Planning and Investment review Project Management Service Team review of any proposed conditions to ensure that constructability not compromised and to retain flexibility for ensuing phases.
Transport modelling	Peer review of model and interpretation of outputs

The post RMA consenting implementation process (specimen and detailed, and construction) has not been determined. It is anticipated that these ensuing phases will be subject to normal quality assurance processes. In order to manage retention of suitable levels of flexibility for these phases (post consenting), it is proposed that the Project Management Services team have a review role of the Project, focussing on the scope of proposed resource consents (including designations) and any proposed consequent designation and consent conditions.

11.4 Change Control

It is anticipated that the senior decision making will be required for this Project at the following stages:

STAGE	WHO	DESCRIPTION
RMA consent documentation	RMT	Approval to lodge final design, and

including final designs	BUDMT	proposed conditions of consent including the mitigation package.
Property Strategy (in parallel with approval of RMA consent documentation)	RMT BUDMT	Approval of proposed approach to handling property acquisition and approach to managing s.185 RMA risks
Designation Decision	RMT BUDMT	Approval of designation decision including conditions

It is likely that it will be necessary to offer changes to proposed resource consent conditions during the RMA hearings phase and if these are significant then they will be discussed with members of the BUDMT via email correspondence. Should other matters arise, for example to do with property and or cultural matters, then these matters can be discusses as necessary during the RMT and BUDMT.

11.5 Cost Management

The project design includes mitigation and design risk factors that are allowed for in the project cost. The environment effects assessment together with discussions with property owners and Horowhenua District Council (as transport authority) will help provide certainty around the scope of mitigation needed and the agreed project design. These will be costed and checked against the cost estimate. The risk register will be maintained and, if required, the cost estimate revised.

At this stage the cost estimate allows for adequate levels of mitigation and so an update is unlikely to be needed. Nevertheless, should the above process result in a significant variation (of 10%) from the cost estimate then this will be discussed with P&I, taking into account project risks and economics. The outcome of these discussions will be reported to RMT and BUDMT seeking decisions as necessary.

11.6 Issues Management

Issues are proposed to be managed through the risk register process, with the top risks reported to BUDMT monthly.

The project team meets bi-weekly allowing detailed project issues to be discussed and actioned.

Issues that have potential strategic implications or may create precedents will be escalated to the relevant part of the NZTA business, as per normal process.

12 Lessons Learned and Post Implementation Monitoring

12.1 Lessons Learned

The RoNS budget includes an allocation for a lessons learnt review process, normally after the RMA consenting process. The scope of the review required to be undertaken will be tailored to suit the complexity of the Project. Feedback from the process will be reported to RMT and BUDMT.

The Project forms part of the Otaki to Levin segment of the Wellington Northern Corridor RoNS. The same team is intended to be used to deliver the following projects within the segment. Thus, project specific lessons learnt will be transferred to and used in subsequent project development.

Management structures for the project are common to delivery of the other parts of the Wellington Northern Corridor RoNS. These two factors allow cross fertilisation of ideas and lessons learnt across the Central Region business. Should BUDMT consider that there are particularly interesting and valuable lessons learnt on the Project then these can be reported to VAC to allow cross fertilisation across the Agency.

12.2 Post Implementation Monitoring - Approach and Schedule

Once the Wellington Northern Corridor RoNS is (substantially) complete then it is expected that post implementation monitoring assessment will be undertaken. This assessment will measure how well the Project overall has delivered on its objectives, which relate to safety, journey time reliability and savings, network resilience and economic stimulus/ growth.

The Waitarere Beach Road Curves Project is geared towards improving journey times, resilience and improving the safety performance of this part of the network. Mindful of anticipated monitoring assessment process for the overall RoNS, existing CAS, AADT and RAMM data collection is proposed to be used to measure the general performance of the Project. The data shall be collected and reported on at the end of the first and second year of operation.

In addition it is proposed that affected land owners will be consulted with (via letter survey) six months and then one year after implementation. This process will be used to measure performance of the construction team and to ensure that any detailed construction issues have been resolved. No budget is allocated for this task, but it is anticipated that it can be accommodated either in the construction budget (as part of the 2 years defects and liability monitoring process) or be undertaken by internal NZTA staff.

Appendix A – Investment Logic Map

No Logic Map exists, as there was no Strategic Assessment undertaken for this particular Detailed Business Case.

Appendix B – Alternatives Assessment Summary

The prior Project Feasibility Report was one of a number of reports undertaken to determine a package of improvements that should be implemented in the short to medium term to improve the safety and efficiency of the highway between Otaki and north of Levin as part of the Wellington Northern Corridor RoNS.

The main purpose of that report was to determine the feasibility of options for improving State Highway 1 through the Waitarere Beach Road Curves, north of Levin. The current alignment contains three out-of-context curves with operating speeds between 80 km/h and 90 km/h with narrower than desired sealed shoulder widths. The alignment is confined by culturally significant features including two Marae, Urupa, Whare Rongopai, and rural residential dwellings.

Two options were considered; a cost estimate was undertaken for each of these options together with an economic assessment to obtain a Benefit-Cost Ratio.

The two options considered improving the three existing curves (300 – 340m radius) , firstly with a 550 m radius curve easing for a 100 km/h design speed, or replacing the three curves with a short realignment with only two 800 m radius curves and a 110 km/h design speed.

A summary of the options is shown below.

Table B-1: Option Summary

Option Description	Expected Costs	NPV Benefits	Benefit Cost Ratio
Option 8-2 Curve Easing	$5.62M	$8.4M	**1.6**
Option 8-3 Curve Realignment	$9.69M	$16.9M	**1.8**

Option 8-3 had the greater BCR and therefore in economic terms was the preferred option. Option 8-3 also had higher costs, with some uncertainty around sensitive land requirements affecting rural dwellings and culturally significant buildings. While Option 8-2 had lower capital costs, it also had lower benefits and did not provide a robust solution to the current deficient alignment.

Other potential features of this project such as a wire rope median barrier, northbound and southbound passing lanes, and altering the form of the Waitarere Beach Road intersection with State Highway 1 to a roundabout (penalises the state highway TT and VOC, to achieve small safety gains) were not assessed at PFR stage. However all three were advised for further consideration during the DBC for the benefits or disbenefits they individually provide.

Appendix C – Economic Worksheets

As there is only one option for this Detailed Business Case, additional summary tables have not been generated. Please refer to Section 5 for the recommended option assessment.

SH1 Waitarere Beach Road Curves
Crash Reduction Summary

	DSI per F&S crash (weighted)	1.27	Included	% Reduction (All Crashes all injury)	% Reduction (Crashes by severity)			
Treatment	**Reference**	**Comment**		**/ Adopted % reduction**	**Fatal**	**Serious**	**Minor**	**Non injury**
Section								
Midblock/Curves - Guardrailing	EEM 2013, Crash Model #11 Rural two lane road >=80km/h, Effects of crash barriers, pg 5-309. • Crash Reduction factor = 25% in mountainous and **rolling** terrain where barriers are installed	**25%** adopted due to the rolling terrain, with gradients of 1% to -3%+	**1**	25%	**25%**	**25%**	**25%**	**0%**
Midblock/Curves - Median Barrier	HRRRG Appendix D Table D1 -Median Barriers 30% reduction in injury crashes if installing central WRB. 51% decrease in mid block injury crashes and 63% decrease in fatal and serious injury crashes as a result of installation of a 2+1 wire rope barrier median. 100% reduction in fatal and serious crashes following installation of a 1+1 wire rope median barrier. 40-60% reduction in head-on and run-off road crashes	Adopted 30% reduction in injury crashes if installing median WRB.	**1**	30%	**30%**	**30%**	**30%**	**0%**
Midblock/Curves: Combined BASE *Applied to Method B midblock option crash rate*	Side protection guardrail throughout (25%) + Wire rope median barrier & wide median (30%)			48%	48%	48%	48%	0%
Midblock/Curves: Combined - Low Sensitivity *Applied to Method B midblock option crash rate*	As per Base, **excluding wire rope median barrier**			25%	25%	25%	25%	0%
Waitarere Beach Road Intersection Improvements - Improved Sight Distance resulting from new alignment	NZTA High Risk Intersection Guide July 2013 (HRIG) Intersection Improvements - **Sight distance improvements** - Ref HRIG, IS3, pg 111. • Crash Reduction factor = **30%** reduction in crashes where sight distance is improved.	Due to the significant re-alignment of the Waitarere Beach Road Intersection a reduction of **30%** was adopted.	**2**	30%	**30%**	**30%**	**30%**	**0%**
Waitarere Beach Road Intersection Improvements - Left turn slip	**HRIG, Intersection improvements - Turning bays** • Crash Reduction factor = 33-35% reduction in injury crashes. HRIG does not specify a reduction for left turn bays and right turn bays. **Austroads Road Safety Engineering Toolkit** http://www.engtoolkit.com.au/default.asp?p=treatment&i=69 Treatment type: Turn lanes • Crash Reduction factor 20% for installing left turn lane (all environments) Note the EEM 2013, table A6.18(e) contains a reduction for the installation of a right turn bay and seal widening but doesn't include a	Based on the literature available a crash reduction factor due to the upgrade from the existing high angle left turn bay to the proposed left turn low angle slip was not found.	**2**	0%	0%	0%	0%	0%
Waitarere Beach Road Intersection Improvements Combined *Applied to Method B option intersection crash rate*	Sight distance improvements (30%)		2	30%	30%	30%	30%	30%

Annual Average Daily Traffic (vpd)	TRAFFIC GROWTH 1992-2013 As published 2013 1N/988	1N/984	1N/979	1N/964
Calendar Year	**OHAU - Telemetry Site 56 - Ohau Overbridge**	Levin, South of Town	North Levin, Kawiu Rd - Gordon Pl	Whirokino
1992	**11300**	10570	8290	
1993	**11700**	10850	8470	
1994	**11800**	11230	8980	
1995	**12650**	11930	9600	
1996	**13110**	12300	9690	
1997	**13020**	12160	9590	
1998	**13490**	12600	9940	
1999	**14480**	12960	9650	
2000	**13140**	12250	9080	
2001	**14104**	12143	9600	8245
2002	**14399**	12157	9837	7748
2003	**14831**	11662	9524	7947
2004	**14977**	12467	10124	7721
2005	**15145**	12343	10401	8514
2006	**14860**	12085	10079	8072
2007	**15347**	12341	10323	8262
2008	**14872**	12098	9871	7872
2009	**15080**	11737	9486	7299
2010	**15004**	11458	9439	7697
2011	**14643**	11484	9647	7767
2012	**14269**	11647	9211	7149
2013	14571	11756	9349	7289
Lin Reg start yr	**1992**	**1992**	**1992**	**2001**
end yr	**2013**	**2013**	**2013**	**2013**
Continuous data				
std err slope	23.2	19.3	16.4	24.1
slope	157.9	12.3	33.9	-66.8
R square	0.699	0.020	0.176	0.411
beg yr est	12287.5	11790.4	9198.0	8214.6
end yr est	15602.6	12048.5	9909.4	7413.4
% wrt end yr	1.0%	0.1%	0.3%	-0.9%
% wrt end yr+1	**1.0%**	**0.1%**	**0.3%**	**-0.9%**
Missing data				
beg yr est	12287.5	11790.4	9198.0	8214.6
end yr est	15602.6	12048.5	9909.4	7413.4
slope	157.9	12.3	33.9	-66.8
% wrt end yr	1.0%	0.1%	0.3%	-0.9%
% wrt end yr+1	**1.0%**	**0.1%**	**0.3%**	**-0.9%**

Annual Average Daily Traffic (vpd)	TRAFFIC GROWTH 2004-2013 As published 2013 1N/988	1N/984	1N/979	57/02
Calendar Year	**OHAU - Telemetry Site 56 - Ohau Overbridge**	Levin, South of Town	North Levin, Kawiu Rd - Gordon Pl	Whirokino
1992	**11300**	10570	8290	
1993	**11700**	10850	8470	
1994	**11800**	11230	8980	
1995	**12650**	11930	9600	
1996	**13110**	12300	9690	
1997	**13020**	12160	9590	
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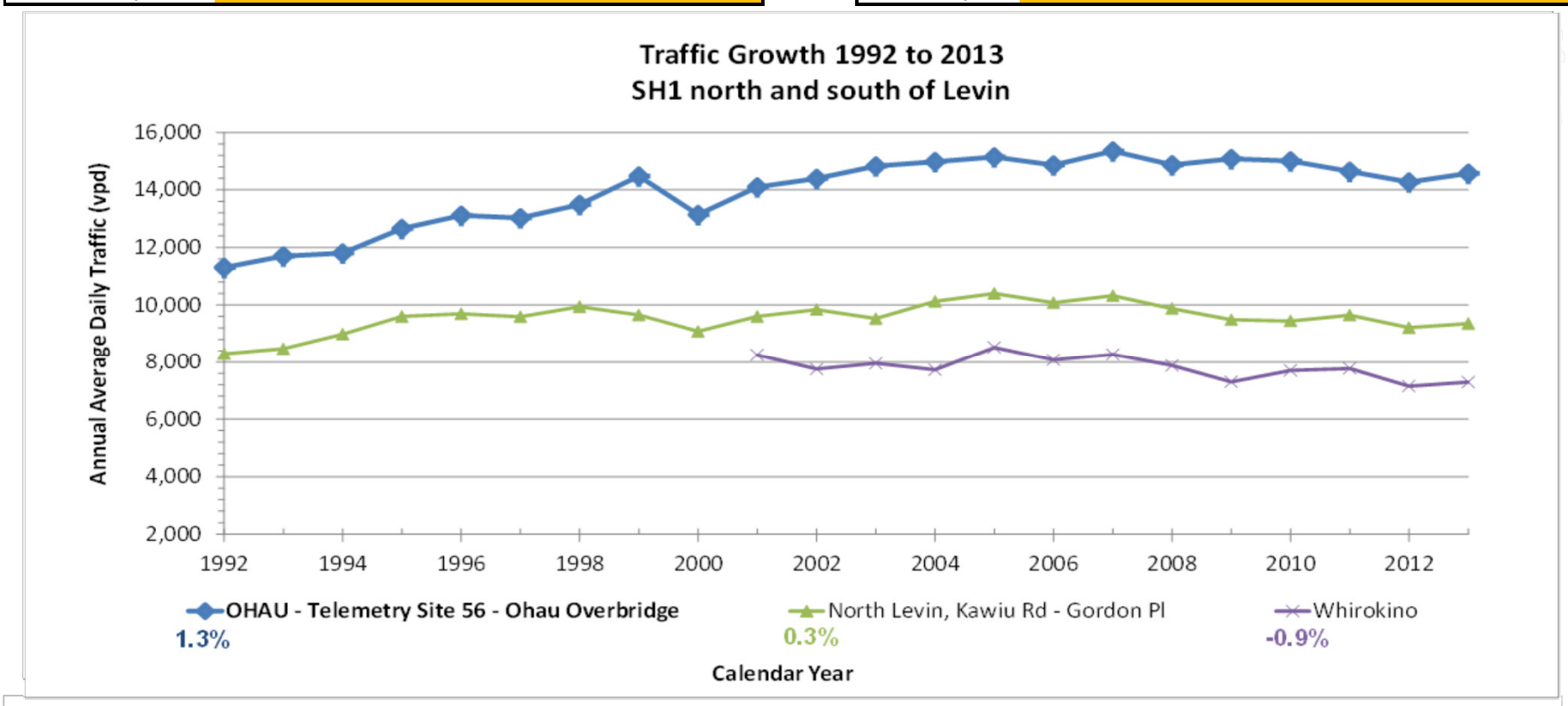
2011	**14643**	11484	9647	7767
2012	**14269**	11647	9211	7149
2013	14571	11756	9349	7289
Lin Reg start yr	**2004**	**2004**	**2004**	**2004**
end yr	**2013**	**2013**	**2013**	**2013**
Continuous data				
std err slope	26.5	22.8	23.1	35.7
slope	-70.9	-104.8	-124.3	-104.5
R square	0.472	0.725	0.784	0.516
beg yr est	15195.7	12413.0	10352.1	8234.3
end yr est	14557.9	11470.2	9233.9	7294.1
% wrt end yr	-0.5%	-0.9%	-1.3%	-1.4%
% wrt end yr+1	**-0.5%**	**-0.9%**	**-1.4%**	**-1.5%**
Missing data				
beg yr est	15195.7	12413.0	10352.1	8234.3
end yr est	14557.9	11470.2	9233.9	7294.1
slope	-70.9	-104.8	-124.3	-104.5
% wrt end yr	-0.5%	-0.9%	-1.3%	-1.4%
% wrt end yr+1	**-0.5%**	**-0.9%**	**-1.4%**	**-1.5%**



Traffic Growth Discussion

The historic 10 year growth was -0.5% and the historic 20 year growth was recorded at 1% for the closest telemetry site, located at Ohau, south of Levin. The nearest non-continuous count site to Waitarere Beach Road is located approximately 6 km to the south (North Levin – Kawiu Rd); historic growth shows similar trends to Ohau with -1.4% growth in the last 10 years and 0.3% growth in the last 20 years.

The Wellington Northern Corridor RoNS is expected to result in increased development in this part of the region. Accordingly, a slightly higher growth rate has been adopted than would otherwise have been the case based on historic data.

The Otaki to Levin SATURN base traffic model shows growth rates of 0.5% to 0.6% for the SH1 links in the vicinity of Waitarere Beach Road, this has been adopted as the base case by using the model outputs in the economics.

A growth rate of 1% was adopted as the high growth scenario due to the long term 40 year horizon and the effect of the Wellington Northern Corridor RoNS projects.

Due to uncertainty in growth rate a sensitivity test was conducted at 0% growth.

SH1 Waitarere Beach Road Curves

Traffic Growth/Modelling

	Model Outputs - Base case						
	Source	2014	2024	2034	2044	Growth	Model Growth
Waitarere Road to SH1 Intersection	RAMM	2393	2393	2393	2393	0%	0.0
SH1 Waitarere Beach Rd to Koputoroa Rd North	Saturn model	7890	8351	8811	9271	0.6%	0.6%
SH1 Waitarere Beach Rd to Kawiu Road	Saturn model	9031	9491	9952	10412	0.5%	0.5%

		1% Growth - high sensitivity test						
	1% SH Growth	Source	2014	2024	2034	2044	Growth	Comments
Waitarere Road to SH1 Intersection	0	RAMM	2393	2393	2393	2393	1.0%	CAS flows (RAMM) t
SH1 Waitarere Beach Rd to Koputoroa Rd North (1%)	0	Saturn model	7823	8621	9419	10218	1.0%	0
SH1 Waitarere Beach Rd to Kawiu Road (1%)	0	Saturn model	8940	9853	10765	11677	1.0%	0

		0% Growth - low sensitivity test						
	0% SH Growth	Source	2014	2024	2034	2044	Growth	
Waitarere Road to SH1 Intersection	0	RAMM	2393	2393	2393	2393	0.0%	
SH1 Waitarere Beach Rd to Koputoroa Rd North	0	Saturn model	7982	7982	7982	7982	0.0%	
SH1 Waitarere Beach Rd to Kawiu Road	0	Saturn model	9123	9123	9123	9123	0.0%	

Difference between 2013 TMS and Modelling link flows				
2013 - Note time zero is 2014. For comparison purposes only.				
	Source			
	Modelling	NZTA TMS	Length	Difference
Waitarere Beach Rd to Koputoroa Rd N	7845	7289	0.79	93%
SH1 Waitarere Beach Rd to Kawiu Roac	8985	9349	1.81	104%
Length weighted average	**8637**	**8720**		**101%**

4/7/2014 – Time trials, Waitarere Curves

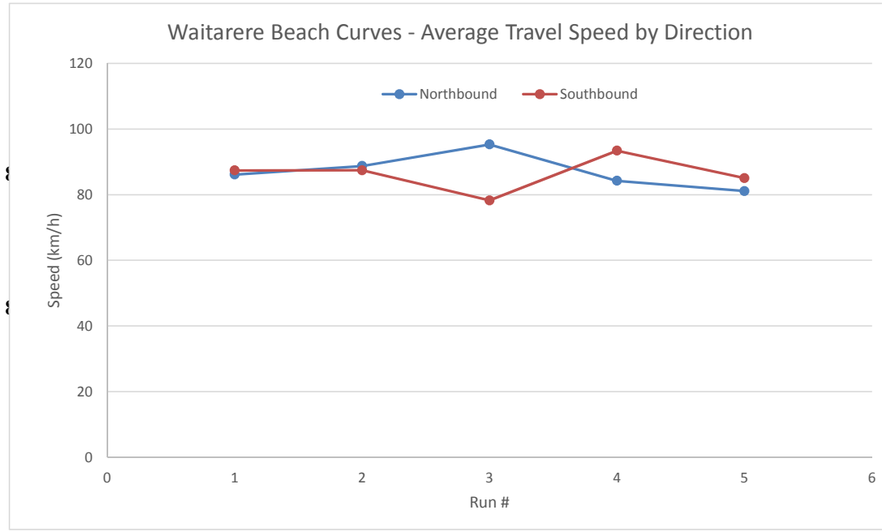
RP- 967/5.112 – 967/7.602

2.49 km

Trial	Direction	Time	Comment	seconds	Time (min)	Time (hr)		Average Speed
2	Northbound	1.44.03		104.03	1.734	0.029		86.2
4	North	1.40.96		100.96	1.683	0.028		88.8
6	North	1.34.00		94	1.567	0.026		95.4
8	North	1.46.37	Car travelling behind a truck	106.37	1.773	0.030		84.3
10	North	1.50.48		110.48	1.841	0.031		81.1
1	Southbound	1.42.53		102.53	1.709	0.028		87.4
3	South	1.42.46		102.46	1.708	0.028		87.5
5	South	1.54.47	Truck	114.47	1.908	0.032		78.3
7	South	1.35.92		95.92	1.599	0.027		93.5
9	South	1.45.32		105.32	1.755	0.029		85.1
						Southbound average speed (km/h)		87.1
						Norhtbound average speed (km/h)		86.4
						Overall Average Speed (km/h)		**86.8**

80

90



Estimated Existing Design Speed and Mean Speed

Section	Description	Geometric Model					RAMM HSD Analysis				RAMM Out of Context Curve Table						
		Radius	Start	End	Curve/ Section Length	Estimated Curve Design Speed/ Theoretical speed	Minimum Curve Radius	Start	End	Curve/ Section Length	Radius	Start	End	Curve/ Section Length	Approach Speed Increasing Dire	Approach Speed Decreasing	RAMM Curve Speed/ Theoretical speed
Mid 0			**5100**	**5660**	560	***105***		**5100**	**5650**	550		**5100**	**5680**	580			***105***
Curve 1	Curve at WB Rd	**300**	5660	6100	440	85	**294**	5650	6060	410	239	5680	6040	360	110	105	81
Mid 1								6060	6120	60		6040	6120	80			105
Curve 2	Curve at Paeroa Rd	360	6100	6390	290	90	293	6120	6380	260	289	6120	6360	240	99	107	89
Mid 2			6390	6700	310	105		6380	6730	350		**6360**	**6740**	380			105
Curve 3	Curve between Paeroa and Clay Rd	340	6700	7090	390	90	**314**	6730	7070	340	**314**	6740	7060	320	107	110	90
Mid 3			7090	7240	150	105		7070	7280	210		**7060**	**7240**	180			105
Curve 4	Large curve just north of clay	1000	7240	7450	210	100	746	7280	7430	150	Not OCCC	7240	7450	210			100
Mid 4			7450	7700	250	105		7430	7700	270		**7450**	**7700**	250			105
	Total				2600	97.3				**2600**				**2600**			**98.0**
				Geometric Model Length Weighted Average Design Speed		**97.3**								RAMM OCCC Length Weighted Average Design Speed			**98.0**
				EEM Design speed to mean speed factor		**0.885**	as per EEM A6.8 pg 5-320							EEM Design speed to mean speed factor			**0.885**
				Geometric Model Length Weighted Average Mean Speed		**86.1**								**RAMM OCCC Length Weighted Average Mean Speed**			**86.7**
				Correlation to floating car survey		99%	Therefore both models are a close fit to the survey results							Correlation to floating car survey			100%

MWH.

SH1 Waitarere Beach Road Curves

EVALUATION SUMMARY — WORKSHEET 1

1 Evaluator(s) Dhimantha Ranatunga
Reviewer(s) Prasad Tala

2 Project / Package Details

Approved Organisation Name	NZTA
Project / Package Name	SH1 Waitarere Beach Road Curves
Your Reference	80500902\\cc0862
Project Description	Safety Improvements
Describe the problem to be addressed	Reduce the number and severity of crashes through the Waitarere Beach Curves

3 Location

Brief description of location: State Highway 1, between south of Clay Road (967/7.69) and north of Waitarere Beach Road (967/5.10)

4 Alternatives and Options

Describe the Do Minimum: Retain existing with scheduled maintenance

Summarise the options assessed:
- Realignment of the existing out of context curves to become two same direction 800mR (southbound) left hand curves resulting in approx 80m route shortening.
- Widening of highway (3m shoulder, 3.5m lanes, 4m median)
- Vertical re profiling given the new horizontal alignment is through rolling terrain
- Proposed wire rope barrier in median and also guard rail side protection throughout (broken for side roads and access).
- Re-access (and effect of WRB): Waitarere Beach Road allows all movements (RI / RO) and also has a slip off SH1. Paeroa Rd LILO. proposed access combining multiple accessways. P turn facility. Improvements to Clay Road int (RTB, sight distance)

5 Timing

Time Zero	1 July 2014
Expected duration of construction (years)	1.50
End construction	31 March 2021

6 Economic Efficiency

Analysis Period and Discount Rate	40 years, 6%
Date economic evaluation completed (mm/yyyy)	May-14
Base date for costs	1 July 2014
AADT at Time Zero (vpd)	SH1 Waitarere Beach Rd North - 7890 SH1 Waitarere Beach Rd South - 9031 SH1 Length Weighted Average - 8683 Waitarere Beach Road - 2393
Adopted Traffic Growth Rate at Time Zero (%)	0.50%

Existing Roughness (weighted)	52	NAASRA	Existing Traffic Speed	87	km/hr	(surv)
Predicted Roughness	52	NAASRA	Predicted Traffic Speed	100	km/hr	
Length Before Improvements	2.59	km	Ex.Posted Speed Limit	100	km/hr	
Length After Improvements	2.51	km	Opt Posted Speed Limit	100	km/hr	
			Road Type	Rural Strategic		
			Gradient Before Improvements			
			Gradient After Improvements			

7 PV Cost of Do Minimum — **Cost $** $419,263 — **A**

8 PV Cost of the Option — **Cost $** $11,097,796 — **B**

9 Benefit values from Worksheet 4, 5 or 6

PV Travel Time savings	$	$3,880,313	C	x Update Factor^{TTC}	1.40	= $	$5,432,438	W
PV VOC & CO2 savings:	$	-$1,744,591	D	x Update Factor^{VOC}	1.06	= $	-$1,849,266	X
PV Accident Cost savings:	$	$9,374,824	E	x Update Factor^{AC}	1.22	= $	$11,437,285	Y

10 B/C Ratio = $\frac{W + X + Y + Z}{B - A}$ = $\frac{\text{BENEFITS}}{\text{COSTS}}$ = $\frac{5,432,438 + -1,849,266 + 11,437,285}{11,097,796 - 419,263}$ = **1.4**

11 FYRR = $\frac{1^{st}\text{ Year BENEFITS}}{\text{COSTS}}$ = $\frac{\$1,419,473}{\$10,678,533}$ = **13%**

SH1 Waitarere Beach Road Curves
Capital Costs (undiscounted)

		Option 1
Component	*Comment*	Curve Realignment, Highway Widening, Wire Rope Median Barrier, Guardrail Side Protection
A	*Project Property Costs*	*$1,877,300*
B	*Investigation and Reporting (sunk cost)*	*$0*
C	*Design and Project Documentation*	*$698,920*
D	*Construction & MSQA*	*$11,582,568*
Total Expected Estimate		*14,158,788*

SH1 Waitarere Beach Road Curves
Maintenance Cost

Option	Year	Unit Rate	Quantity Reseal (m2) /ATP (km)	Cost	Subtotal
Do Minimum: Continued Maintenance					
Annual Maintenance					**$ 2,830.0**
Asphalt		$ 0.55	0	$ -	
Chipseal		$ 0.12	23,583	$ 2,830	*From RAMM data*
Operational				$ -	
Periodic Maintenance					**$ 1,161,395**
Reseal (Chipseal)	1	$5.50	6,966	$ 38,313	*Based on FWP*
Reseal (Chipseal)	3	$5.50	4,674	$ 25,707	*Based on FWP*
Rehab	8	$30.00	1,080	$ 32,400	*Based on FWP*
Reseal (Chipseal)	11	$5.50	3,150	$ 17,325	*Based on FWP*
Reseal (Chipseal)	13	$5.50	7,713	$ 42,423	*Based on FWP*
Reseal (Chipseal)	14	$5.50	6,966	$ 38,313	*Based on FWP*
Rehab	21	$30.00	23,583	$ 707,498	*Estimate*
Reseal (Chipseal)	29	$5.50	23,583	$ 129,708	*Estimate*
Reseal (Chipseal)	37	$5.50	23,583	$ 129,708	*Estimate*
Option 1: Curve Realignment, Highway Widening, Wire Rope Median Barrier, Guardrail Side Protection					
Annual Maintenance					**$ 5,140.8**
Asphalt		$ 0.55	0	$ -	*from cost estimate*
Chipseal		$ 0.12	42,840	$ 5,141	*Estimate*
Operational				$ -	
Periodic Maintenance					**$ 2,067,539**
Reseal (Chipseal) - Do-Min	1	$5.50	6,966	$ 38,313	*Based on FWP*
Reseal (Chipseal) - Do-Min	3	$5.50	4,674	$ 25,707	*Based on FWP*
Reseal (Chipseal) - Option	15	$5.50	42,840	$ 235,620	*Estimate*
Reseal (Chipseal) - Option	23	$5.50	42,840	$ 235,620	*Estimate*
Reseal (Chipseal) - Option	31	$5.50	42,840	$ 235,620	*Estimate*
Rehab	39	$30.00	42,840	$ 1,285,200	*Estimate*

Wire Rope Barrier Maintenance - Median WRB costs

Based on the maintenance costs for the existing SH58 Wire Rope Median Barrier (800 m)

Cost to Repair and Replace Barrier After Vehicle Impact (RAMM maintenance costs -refer WS2c_WRB mtce)

Financial Year	Total Cost	Number of hits	
2010/2011	$ 3,120	7	
2011/2012	$ 15,574	9	
2012/2013	$ 14,440	7	
Average Annual Number of Hits		8	
Average Cost of Repair per hit		$1,441	
Length of SH58 Wire Rope Median Barrier (km)		0.8	
Approximate Annual Number of Hits per 1km		9.58	
Maintenance Costs for Option			
Length of new wire rope barrier (km)		1.660	Exl. Existing WRB
Reduction factor		50%	Basis is the existing SH58 WRB is on a high risk section (P/L, OOCCs etc). Proposed option alignment for Waitarere is vastly improved.
Expected Number of Hits per Year		8	
Expected Cost of Repair per Year		$ 11,459	

Wire Rope Barrier Maintenance - Guardrail/Side protection WRB costs

Based on the maintenance costs for the existing guardrail either side of the SH58 Wire Rope Median Barrier (800 m)

Cost to Repair and Replace Barrier After Vehicle Impact (RAMM maintenance costs -refer WS2c_WRB mtce)

Financial Year	Total Cost	Number of hits	
2009/2010	$ 1,931	**3**	
2010/2011	$ -	0	
2011/2012	$ 16,870	3	
2012/2013	$ 750	3	
Average Annual Number of Hits		2.25	
Average Cost of Repair per hit		$2,172	
Length of SH58 guardrail (median WRB) (km)		0.80	
Approximate Annual Number of Hits per 1km		2.8	
Maintenance Costs for Option			
Length of new wire rope barrier side protection (km)		3.170	(combined left and right)
Reduction factor		25%	Improved alignment over existing SH58 roadside protection
Expected Number of Hits per Year		6.7	
Expected Cost of Repair per Year		$ 14,525	

SH1 Waitarere Beach Road Curves

Benefit Cost Analysis of the Option

				Curve Realignment, Highway Widening, Wire Rope Median Barrier, Guardrail Side Protection
Project Options	***Do Min***	***Option 1***		***Option 1***
PV Costs				***NPV Costs***
Capital Costs	0	10,334,639		10,334,639
Maintenance Costs	419,263	763,157		343,894
Total Costs	419,263	11,097,796		**10,678,533**
PV Benefits				***NPV Benefits***
Travel Time Costs	56,055,427	50,622,989		$5,432,438
Vehicle Operating Costs	62,752,517	64,530,658		-$1,778,141
Carbon Dioxide Costs	2,510,101	2,581,226		-$71,126
Crash Costs	20,746,116	9,308,831		$11,437,285
Tangible Benefits	142,064,160	127,043,703		**$15,020,457**
B/C Ratio				**1.4**
First Year Rate of Return (FYRR)				**13%**

SH1 Waitarere Beach Road Curves
First Year Rate of Return

Option:	***Option 1***
Present Value of Net Costs:	10,678,533
Mid Point of First Year of Benefits (Relative to Time Zero):	7.25
SPPWF for First Year of Benefits (Table A1.2):	0.6554

Benefit	***Annual Do Min***	***Annual Option 1***	***Annual Net Benefit (Option 1)***	***PV of Benefits*** ***Option 1***
Travel Time Costs	2,241,956	1,926,508	315,448	415,375
Vehicle Operating Costs	3,313,993	3,455,069	(141,076)	(140,652)
Carbon Dioxide Costs	132,560	138,203	(5,643)	(5,626)
Crash Costs	1,145,198	142,673	1,002,525	1,150,375
Present Value of Benefits in First Year				1,419,473
First Year Rate of Return				**13%**

Indicative minimum FYRR (BCR/15.4) *15.40* *9%*

Therefore, it may be beneficial to fund the project earlier as the FYRR >minimum FYRR

SH1 Waitarere Beach Road Curves

Sensitivity Analysis **Worksheet 6**

Option 1												
Variable	**Base Case**				**Lower Bound**				**Upper Bound**			
	Value	**Assumptions**	**BCR**	**FYRR**	**Value**	**Assumptions**	**BCR**	**FYRR**	**Value**	**Assumptions**	**BCR**	**FYRR**
Construction Costs	$14,158,788	Scheme Expected Estimate	**1.4**	**13%**	$18,068,978	95th percentile estimate	**1.1**	**11%**	$12,018,588	Base Estimate	**1.6**	**16%**
Discount Rate	6%	EEM 2013 Default	**1.4**	**13%**	8%	Higher discount rate, lower realisation of long term benefits/costs.	**1.1**	**14%**	4%	Lower discount rate, higher realisation of long term benefits/costs.	**1.8**	**12%**
Existing Average Speed (TTC)	$5,432,438	86.8 km/h existing average speed based on car following surveys and validated by high speed data/geometric model.	**1.4**	**13%**	$4,075,767	Higher existing speed of 90 km/h	**1.3**	**13%**	$8,604,526	Lower existing speed of 80 km/h.	**1.6**	**15%**
Existing Average Speed (VOC)	-$1,778,141				-$1,203,604				-$2,880,422			
Crash Benefits: Effect of additional high severity crashes	$11,437,285	2009-2013 High severity crash history: 2 fatal crashes and 2 serious crashes	**1.4**	**13%**					$30,133,086	One additional fatal head-on crashes.*	**3.2**	**31%**
									$20,182,254	Two additional serious head-on crashes.	**2.2**	**22%**
									$15,809,769	One additional serious head-on crash	**1.8**	**17%**
Crash benefits: Wire Rope Median Barrier Provision	$11,437,285	Wire rope median barrier included (includes WRB costs, crash benefits, travel time and VOC disbenefits)	**1.4**	**13%**	$10,998,663	Wire rope median barrier excluded (excludes WRB costs, crash benefits and removes travel time and VOC disbenefits)	**1.4**	**13%**				
Safety Only BCR	-	Include all benefits/disbenefits	**1.4**	**13%**	-	Ignore TTC, VOC and consider safety benefits only.	**1.0**	**10%**				
Traffic Growth	0.5%	Medium to Long term growth assumption based on long term historic growth trends and future growth due to the construction of the Wellington Northern Corridor.	**1.4**	**13%**	0%	Stagnant growth scenario based on the last 10 year period.	**1.2**	**13%**	1%	Long term (40y) high growth rate assumption based on long term historic growth trends and future growth due to the construction of the Wellington Northern Corridor.	**1.6**	**14%**
Construction start timeframe	2019	Assumed start of construction October 2019.	**1.4**	**13%**	2021	Assumed start of construction October 2021.	**1.4**	**14%**	2016	Assumed early start of construction October 2016.	**1.4**	**12%**

*note: large ~3x increase due to the fatal/serious ratio which, if there are greater than three fatals, changes from the default movement split (33% for head-ons) to the actual proportion (100% in this case as there are already 2 Head-on fatal

Wire Rope Barrier Time Delay Effects

Side Road / Address	Land Title+	Delay	Movements Affected	Right Turn Out	Right Turn In	Total Delays (s)
				Extra midblock distance/veh (m)	Extra midblock distance/veh (m)	
717 SH1	41B/687	no delay	None	-	-	-
709 SH1	41B/688	no delay	None	-	-	-
703 SH1*	41B/690	left in left out	no right in or right out	100	1100	83.7
18 Waitarere Beach Road	38A/845	no delay	None	-	-	-
18 Waitarere Beach Road	38A/845	no delay	None	-	-	-
Waitarere Beach Road	-	no delay	None	-	-	-
5 Waitarere Beach Road*	38A/846	no delay	None	-	-	-
9 Waitarere Beach Road*	56B/959	left in left out	no right in or right out	2200	300	137.4
607 SH1	56B/959	left in left out	no right in or right out	1900	600	137.4
12 Paeroa Road	12A/1024	left in left out	no right in or right out	1900	600	137.4
Paeroa Road	-	left in left out	no right in or right out	1900	600	137.4
9 Paeroa Road	30B/22	left in left out	no right in or right out	1900	600	137.4
577 SH1	46C/120	left in left out	no right in or right out	1500	1000	137.4
563 SH1	522202	left in left out	no right in or right out	1140	1360	137.4
559 SH1	25B/703	left in left out	no right in or right out	1100	1400	137.4
553 SH1*	281943	left in left out	no right in or right out	940	1560	137.4
551 SH1*	5C/606	left in left out	no right in or right out	860	1640	137.4
549	778/55	left in left out	no right in or right out	780	1720	137.4
545 SH1*	22C/297	left in left out	no right in or right out	700	1800	137.4
541 SH1*	22C/296	left in left out	no right in or right out	620	1880	137.4
533 SH1	742/88	left in left out	no right in or right out	620	1880	137.4
527 SH1	56B/877	left in left out	no right in or right out	620	1880	137.4
519 SH1	6C/735	left in left out	no right in or right out	620	1880	137.4
511 SH1	301/263	left in left out	no right in or right out	140	2360	137.4

Side Road / Address	Land Title[+]	Delay	Movements Affected	Right Turn Out Extra midblock distance/veh (m)	Right Turn In Extra midblock distance/veh (m)	Total Delays (s)
507 SH1	261/150	no delay	None	-	-	-
463 SH1	262/228	no delay	None	-	-	-
728 SH1*	509490	no delay	None	-	-	-
708 SH1	509491	no delay	None	-	-	-
682 SH1	17796	left in left out	no right in or right out	900	200	79.5
670 SH1	17795	left in left out	no right in or right out	680	420	79.5
648 SH1	55D/172	left in left out	no right in or right out	200	900	79.5
648 SH1*	55D/171	no delay	None	-	-	-
610 SH1*	33A/206	left in left out	no right in or right out	1000	500	96.1
606 SH1*	40B/914	left in left out	no right in or right out	1900	600	137.4
598, 594, 576 SH1	33A/203	left in left out	no right in or right out	1700	800	137.4
550 SH1*	40B/915	left in left out	no right in or right out	1300	1200	137.4
530 SH1*	33A/205	left in left out	no right in or right out	700	1800	137.4
516 SH1	56A/296	left in left out	no right in or right out	380	2120	137.4
514 SH1	760/66	left in left out	no right in or right out	300	2200	137.4
13 Clay Road*	33A/207	no delay	None	-	-	-
7 Clay Road	900/31	no delay	None	-	-	-
Clay Road	-	no delay	None	-	-	-
6 Clay Road	769/92	no delay	None	-	-	-
8 Clay Road*	9C/1154	no delay	None	-	-	-

*No Terraview property address available therefore approximated by access location.

[+]Some of the land titles have one owner

Date: 11/07/2014
Prepared By: Martin Hoffmann
Job Number: 80500902_0851

Waitarere Curves Crash Prediction

Do-Minimum Option 5 year severe crash prediction, 2015 - 2020

Using KiwiRAP star ratings and personal crash risk:

AADT (vpd)	=	8062
Star Rating	=	2.9
Length of section (km)	=	2.52

Using figure C-2 (HRRRG Appendix C) esimate the equivalent personal crash rate:

Injury crashes per 100 million vehicle kilomenters travelled (vkt)	=	20.0

Estimate the equavalent high-severity crash rates (30% of injury crashes):

Severe injury crashes per 100 million vkt	=	6

Use Figure 4-2 from the HRRRG to determine the personal risk band:

Personal Risk Bank	=	Medium

Using previous analysis we estimate the crash density:

Severe injury crashes per km per year = $\frac{\text{Injury crash rate x AADT x 365(days of the year)}}{10^8}$

= 0.59

Convert to severe crash density (30% of injury crashes):

Severe injury crashes per km per year	=	0.18

Estimate crashes on section:

Injury crashes per year	=	Injury crashes per km per year x length(km)
	=	1.48
Injury crashes in next 5 years	=	7.42
Severe crashes per year	=	Severe Injury crashes per km per year x length(km)
	=	0.44
Severe injury crashes in next 5 years	=	2.22

Note: Lower than 3 severe crashes in 5 years required to be classed as a high risk rural road

Recommended Treatment Option, 2015 - 2020:

Treatment Summary Table:

Identified Treatment Options from HRRRG	Reference in HRRRG	Benefits/Crash Reduction	Severe Crash Reduction (%)	Comments
Realignment (800mR curves)	HRRRG Appendix D Table E5.2 and Figure A6.2 EEM volume1	4 crashes/100 million vehicles		
Widen shoulders (3m)	HRRRG Appendix D Table E3.3	35% reduction of casualty crashes for widening sealed shoulder to greater than 1.2m 14% reduction in injury crashes	14%	14% reduction in injury crashes
Roadside Barriers	HRRRG Appendix D Table D3	45% reduction in run-off road injury crashes 40% reduction in total crashes	40%	40% reduction in total crashes
Median Barriers	HRRRG Appendix D Table D1	30% reduction in injury crashes if installing WRB. 51% decrease in mid block injury crashes and 63% decrease in fatal and serious injury crashes as a result of installation of a 2+1 wire rope barrier median. 100% reduction in fatal and serious crashes following installation of a 1+1 wire rope median barrier. 40-60% reduction in head-on and run-off road crashes	60%	60% reduction in injury crashes if installing WRB.
		Total Severe crash reduction	79%	

Post treatment (KiwiRAP star back calculation):

Reduce severe and injury crashes in next 5 years (83%)

Injury crashes in next 5 years	=	Injury crashes in next 5 years x Crash Reduction(%)
	=	1.56
Injury crashes per year	=	0.31

Injury crashes per km per year = $\frac{\text{Injury crashes per year}}{\text{Length (km)}}$

= 0.12

Estimate the equivalent personal crash rate:

Injury crashes per 100 million vkt = $\frac{\text{injury crashes per km per year X } 10^8}{\text{AADT x 365 (days of the year)}}$

= 4.2

Severe injury crashes in next 5 years	=	Injury crashes in next 5 years x Crash Reduction(%)
	=	0.47
Severe injury crashes per year	=	0.09

Severe injury crashes per km per year = Injury crashes per year

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$$= \frac{}{\text{Length (km)}}$$

= 0.04

Estimate the equivalent personal crash rate:

Severe injury crashes per 100 million vkt

$$= \frac{\text{injury crashes per km per year X } 10^8}{\text{AADT x 365 (days of the year)}}$$

= 1.26

Using figure C-2 (HRRRG Appendix C) estimate the KiwiRAP star ratings:

KiwiRAP star rating = 5

Use Figure 4-2 from the HRRRG to determine the personal risk band:

Personal Risk Bank = Low

Appendix D – Capital Cost Estimates

Project estimate

Form C

Project name: Waitarere Beach Road Curve Improvements DBC

SE

Scheme estimate

Item	Description	Base estimate	Contingency	Funding risk
A	**Nett project property cost**	**1,255,000**	**622,300**	**313,800**
	Investigation and reporting:			
	- consultancy fees	Nil	Nil	Nil
	- the NZTA-managed costs	Nil	Nil	Nil
B	**Total investigation and reporting**	**Nil**	**Nil**	**Nil**
	Design and project documentation:			
	- consultancy fees	576,760	86,510	144,200
	- the NZTA-managed costs	31,000	4,650	7,800
C	**Total design and project documentation**	**607,760**	**91,160**	**152,000**
	Construction			
	MSQA			
	- consultancy fees	541,246	81,190	135,300
	- the NZTA-managed costs	25,000	3,750	6,300
	- consent monitoring fees	10,000	1,500	2,500
	Sub-total base MSQA	**576,246**	**86,440**	**144,100**
	Physical works			
1	Environmental compliance	80,000	12,000	20,000
2	Earthworks	3,220,835	483,100	1,127,300
3	Ground improvements	0	0	0
4	Drainage	544,490	0	544,490
5	Pavement and surfacing	2,907,257	436,100	726,800
6	Bridges	0	0	0
7	Retaining walls	0	0	0
8	Traffic services	551,250	82,700	137,800
9	Service relocations	393,750	59,100	98,400
10	Landscaping	512,000	76,800	128,000
11	Traffic management and temporary works	250,000	37,500	62,500
12	Preliminary and general	1,020,000	153,000	255,000
13	Extraordinary construction costs	100,000	0	200,000
	Sub-total base physical works	**9,579,582**	**1,340,300**	**3,300,290**
D	**Total construction**	**10,155,828**	**1,426,740**	**3,444,390**
E	**Project base estimate** (A+C+D)	**12,018,588**		
F	**Contingency** (Assessed/Analysed) (A+C+D)		**2,140,200**	
G	**Project expected estimate** (E+F)		**14,158,788**	
	Project property cost expected estimate		1,877,300	
	Investigation and reporting expected estimate		**Nil**	
	Design and project documentation expected estimate		698,920	
	Construction expected estimate		11,582,568	
H	**Funding risk** (Assessed/Analysed) (A+C+D)			**3,910,190**
I	**95th percentile Project Estimate** (G+H)			**18,068,978**
	Project property cost 95th percentile estimate			2,191,100
	Investigation and reporting 95th percentile estimate			**Nil**
	Design and project documentation 95th percentile estimate			850,920
	Construction 95th percentile estimate			15,026,958

Date of e	**23-Jul-14**	**Cost index (Qtr/Year)**	
Estimate	**MH**	**Signed**	
Estimate	**GC**	**Signed**	
Estimate external peer review by		**Signed**	
Estimate accepted by the NZTA		**Signed**	

Note: (1) These estimates are exclusive of escalation and GST.
(2) Investigation and reporting project phase estimates are set to nil as these are now sunk costs.

Appendix E – Crash History Information

1.1 Crash History

1.1.1 Crash Data

A review of the NZTA's CAS database over the five-year period from January 2009 to December 2013 revealed a total of 16 crashes (four high severity crashes resulting in eight DSi) which occurred on SH1 along the approximately 2.5 km project length[1] (RP 967/5.1 to RP 967/7.69). An additional two non-injury crashes have occurred in 2014 to date.

The following tables provide a summary of the CAS output data for the study area.

Additional outputs from the CAS database are found in this Appendix.

Table 1-1: Annual Distribution of Crashes

Year	Fatal	Serious	Minor	Non-Injury	Total	DSi*
2009	2	1	1	2	**6**	**7**
2010	-	-	1	2	**3**	-
2011	-	-	-	2	**2**	-
2012	-	1	-	1	**2**	**1**
2013	-	-	-	3	**3**	-
Total	**2**	**2**	**2**	**10**	**16**	**8**
2014	-	-	-	2	2	-

* Death and serious injury casualties

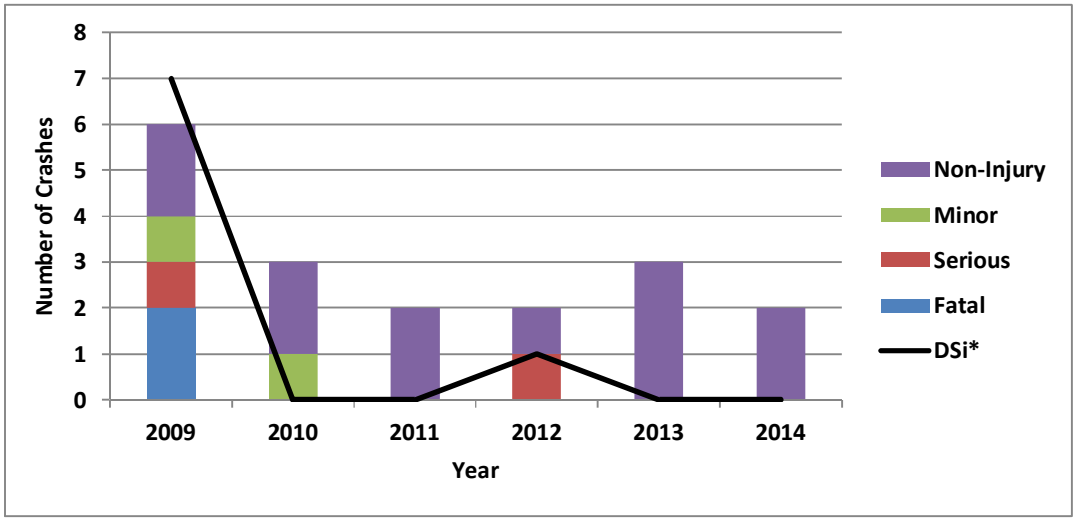


Figure 1-1: SH1 / Waitarere Beach Road Crash History 2009-2014

[1] This includes crashes on Waitarere Beach Road within a 50 m radius of the intersection with SH1.

Table1-2: CAS Crash Type

Crash Type	Number of Reported Crashes	Injury Crashes	DSi	Percentage of Reported Crashes
Overtaking	-	-	-	-
Straight Lost Control / head on	3	2	3	**19%**
Bend Lost Control / Head on	8	3	4	**50%**
Rear End / Obstruction	3	-	-	**19%**
Crossing / Turning	2	1	1	**13%**
Pedestrian Crashes	-	-	-	-
Miscellaneous Crashes	-	-	-	-
Total	**16**	**6**	**8**	**100%**

Table 1-3: Environmental Factors

	Wet/ Icy	Dry		Night	Day		Weekend (Fri 6:00PM to Monday 5:59AM)	Weekday
Count	3	13		10	6		5	11
%	19%	81%		63%	38%		31%	69%

Table1-2 shows 50% of the reported crashes from lost control on a bend/ head on crash types resulted in deaths or serious injury.

There were three (19%) crashes occurring when the road surface was wet resulting in one serious, one minor, and one non-injury crash. Sixteen (81%) crashes occurred when the road surface was dry resulting in two fatal, one serious, one minor, and nine non-injury crashes. According to HRRG appendix B table of regional percentage of high severity crashes states for the South-west north Island climate zone a 28% of all severe crashes occur in the wet. The crash analysis data shows one (25%) of high severe crashes occurring in the wet which is similar the expected 28%. For crashes occurring in the next for the dark it shows 36% of high severity crashes occurring in this climatic zone. Our crash analysis shows two (50%) high severity crashes occurring in the dark which is above the expected 36%.

Table 1-4: Hit Object Crashes

Object Hit*	Number of Reported Crashes	% of Reported Crashes	Number of Reported High Severity Crashes	% High Severity	Number of Reported Injury Crash	% Injury
Bridge or Approach	-	-	-	-	-	-
Cliff/Bank	-	-	-	-	-	-
Ditch	1	6%	1	13%	-	-
Fence	6	33%	2	25%	1	20%
Overbank / Cliff	-	-	-	-	-	-
Utility post/pole	4	22%	2	25%	1	20%
Tree	3	17%	3	38%	3	60%
Guard / guide rail & median barrier	-	-	-	-	-	-
Water/River	-	-	-	-	-	-
All other objects	4	22%	-	-	-	-
Total	**18**	**100%**	**8**	**6%**	**5**	**100%**

*Note: Some crashes could have involved more than one object hit; 67% of the total number of injury crashes involved one or more objects hit (50% of the total number of injury crashes involved multiple hit objects).

Table 1-5: HRRRG Crash Type

Crash Type	Number of Reported Crashes	DSi	% of Reported Crashes	% of Reported High Severity Crashes	% of High Severity Crashes (National)
Run-off Road	8	1	50%	25%	21%
Head On	3	6	19%	50%	54%
Intersection Crashes	2	1	12%	25%	13%
Other	3	-	19%	-	12%
Total	**16**	**8**	**100%**	**100%**	**100%**

Table 1-6: Crash Causation Factors of Reported Injury Crashes

Causation	Number of Reported Crash Causation Factors	Number of Reported Injury Crash Causation Factors	Number of Reported High Severity Crash Causation Factors
Alcohol	3	2	1
Too fast	2	-	-
Failed Give Way/Stop	2	1	1
Failed keep left	2	1	1
Overtaking	-	-	-
Incorrect lane/position	-	-	-
Poor handling	5	3	2
Poor observation	3	1	1
Poor judgement	2	1	1
Fatigue	3	2	1
Disabled/old/ill	-	-	-
Vehicle factors	2	1	-
Road factors	2	1	1
Weather	1	1	1
Enter/exit land use	-	-	-
Cyclist factors	-	-	-
Pedestrian factors	-	-	-
Other	5	2	2

1.1.2 Crash Summary

Of the crashes occurring on this 2.5 km section of SH1 (from 2009 to 2013):

- Two were fatal, two were serious, two were minor and 10 were non-injury.
- There has been on average of more than one death or serious injury per injury crash. The DSi per high severity crashes for head-on is 3.0 which is above the national average of 1.6. Run-off road, Intersection and other high severity crashes are all below the national average based on the HRRRG
- Eight (50%) involved run-off road movements resulting in one serious (one DSi), and two minor injury crashes.
- Three (19%) were head on resulting in two fatal crashes (six DSi). One of the fatal crashes had causes of; alcohol, returning to seal from unsealed shoulder, and attention diverted. The second fatal was caused by fatigue and swinging wide.
- Two (13%) were intersection related, resulting in one serious (one DSi), and one non-injury crash. Both of these crashes occurred at the intersection of Waitarere Beach Road and SH1.
- Three (19%) crashes had a movement code classed as 'Other' (defined in the HRRRG as crashes which were not run-off road, head on or intersection related), these included three hit-object non-injury crashes.
- The percentage of wet high severity crashes is similar to the network average of approximately 28%.
- The percentage of dark high severity crashes (50%) is much higher than the network average of approximately 36%.
- Ten (63%) crashes involved vehicles crossing the centreline from either; losing control, head on, or hitting an object (Note: this excludes crossing/turning movements at intersections). This included seven of the eight deaths and serious injuries and one minor injury crash. Two of these crashes occurred on Waitarere Beach Road close to the SH1 intersection.

- Four crashes occurred on Waitarere Beach Road or turning movements from Waitarere Beach Road including one serious injury crash (1 DSi).
- Twelve crashes involved objects being struck; the most common objects struck included fences, poles or trees, which were hit in seven separate crashes.
- Two crashes involved 'road factors' with both occurring due to obstructions; one due to a power pole across road and another due to flood waters.

1.1.3 Crash Risk

The project area has been assessed using both the High Risk Rural Roads Guide[2] (HRRRG) and the draft High Risk Intersections Guide[3] (HRIG). Refer To this Appendix for crash risk calculations.

Based on published 2012 KiwiRAP risk map, SH1 along the approximately 2.5 km project length (RP 967/5.1 to RP 967/7.69) has a medium-high personal risk (annual average fatal and serious injury crashes per 100 million vehicle km) and a high collective risk (annual average fatal and serious injury crashes per km). As a result, this section of SH1 is classified as a high-risk rural road.

The calculated star rating for this section of SH1 is 2.87, resulting in a published KiwiRAP star rating of 2-star. This is below the NZTA's national strategic aim "to achieve a mostly 3 to 4 star KiwiRAP safety risk rating".

The crash risk for the project length is as follows:

- High collective risk (0.29 high severity crashes per km per year)
- Medium High personal risk (9.71 high severity crashes per 100 million veh-km)

Therefore this section is classified as a high-risk rural road with predominately a 'Safe Systems Transformation Works' treatment strategy.

Three intersections were analysed according to the HRIG even though there were less than the three serious or fatal crashes in five years required for a high risk intersection, refer section 1.1.4 and 1.1.5 below for further detail.

1.1.4 Crash Risk: SH1/Waitarere Beach Road Intersection

In terms of collective crash risk for the T intersection of SH1/Waitarere Beach Road intersection, there are two methods of calculation:

- Reported F&S Crashes: Over the five year assessment period: there has been one high severity crash reported within 50 m of the intersection (one DSi).
- Estimated DSi equivalent: The second method involves using DSi equivalents estimated from all injury crashes. This method takes into account the crash movement type, intersection form and control, and collision speed on crash severity outcomes. The estimated collective crash risk is calculated at 0.37 DSi equivalents for a 5-year period. This is presented in the table below:

[2] High Risk Rural Roads Guide (HRRRG), NZTA, September 2011

[3] High Risk Intersection Guide (HRIG), NZTA, July 2013

Table 1-7: Estimation of Collective Risk Using DSi equivalents SH1/Waitarere Beach Road Intersection

Crash Type	Number of Reported Injury Crashes	Adjusted F&S crashes / All injury crashes[4]	Estimated Number of F&S Injury Crashes
Crossing turning (J Type)	1	0.37	0.37
Total	**1**	-	**0.37**

Therefore, according to the HRIG[5], this intersection is considered 'Low medium' risk when quantifying collective risk.

When considering personal risk; a calculation is performed which considers the major and minor road traffic volumes to determine the product of flow to standardise the number of potential conflicts that could occur at an intersection. The SH1 / Waitarere Beach Road intersection is calculated as having a personal risk value of 20. According to HRIG[6], this results in a 'Medium high' personal risk level.

The Level of Safety Service (LoSS)[7] for this intersection has been assessed as Category I[8] and demonstrates an observed injury crash rate that is lower (better) than expected of 30% of similar intersections.

Therefore although this intersection has not resulted in high-risk classification (based on collective and personal risk), the HRIG recommended safety improvement strategy is 'Safety Management'.

1.1.5 Crash Risk: SH1/Paeroa Road Intersection and SH1/Clay Road

There were no reported crashes for the T intersection of SH1 and Clay Road within a 50m radius therefore no reporting was undertaken.

In terms of collective crash risk for the T intersection of SH1 and Paeroa Road, there are two methods of calculation:

For Collective Crash Risk:

- Reported F&S Crashes: Over the 5 year assessment period, there have been two F&S crashes.
- Estimated DSi equivalent: The estimated collective crash risk is calculated at 0.95 DSi equivalents for a 5 year period. This is presented is the table below:

[4] HRIG, Table 8.10

[5] HRIG, Table 4-1

[6] HRIG, Table 4-2

[7] Level of Safety Service, as defined by HRIG, is a method of categorising the safety performance of an intersection compared to other intersections of that type.

[8] LoSS categories range from I (one) to V (five) where intersections classified as LoSS I have a safety performance that is better than other intersections of that type, in the same speed environment and with similar traffic flows. For intersections of Category V, the converse is true. Category V have LoSS values greater than 3.

Table 1-8: Estimation of Collective Risk Using DSi equivalents SH1 and Paeroa Road Intersection

Crash Type	Number of Reported Injury Crashes	Adjusted F&S crashes / All injury crashes	Estimated Number of F&S Injury Crashes
Head-on (B Type)	1	0.61	0.61
Cornering (D Type)	1	0.34	0.34
Total	**2**		**0.95**

Therefore, according to the HRIG, and using the DSi equivalent method the intersection is 'Medium' risk when quantifying collective risk.

The SH1 and Paeroa Road intersection is calculated as having a personal risk value of 157, according to HRIG, this results in a 'High' personal risk level.

The Level of Safety Service (LoSS) for this intersection has been assessed as category III and demonstrates an observed injury crash rate that is lower (better) than expected of 70% of similar intersections, and higher (worse) than 50%.

This intersection has been classified as having a medium collective risk and a high personal risk. As there have been fewer than four injury crashes and less than three high severity crashes in the five year period this intersection cannot be classified as high risk.

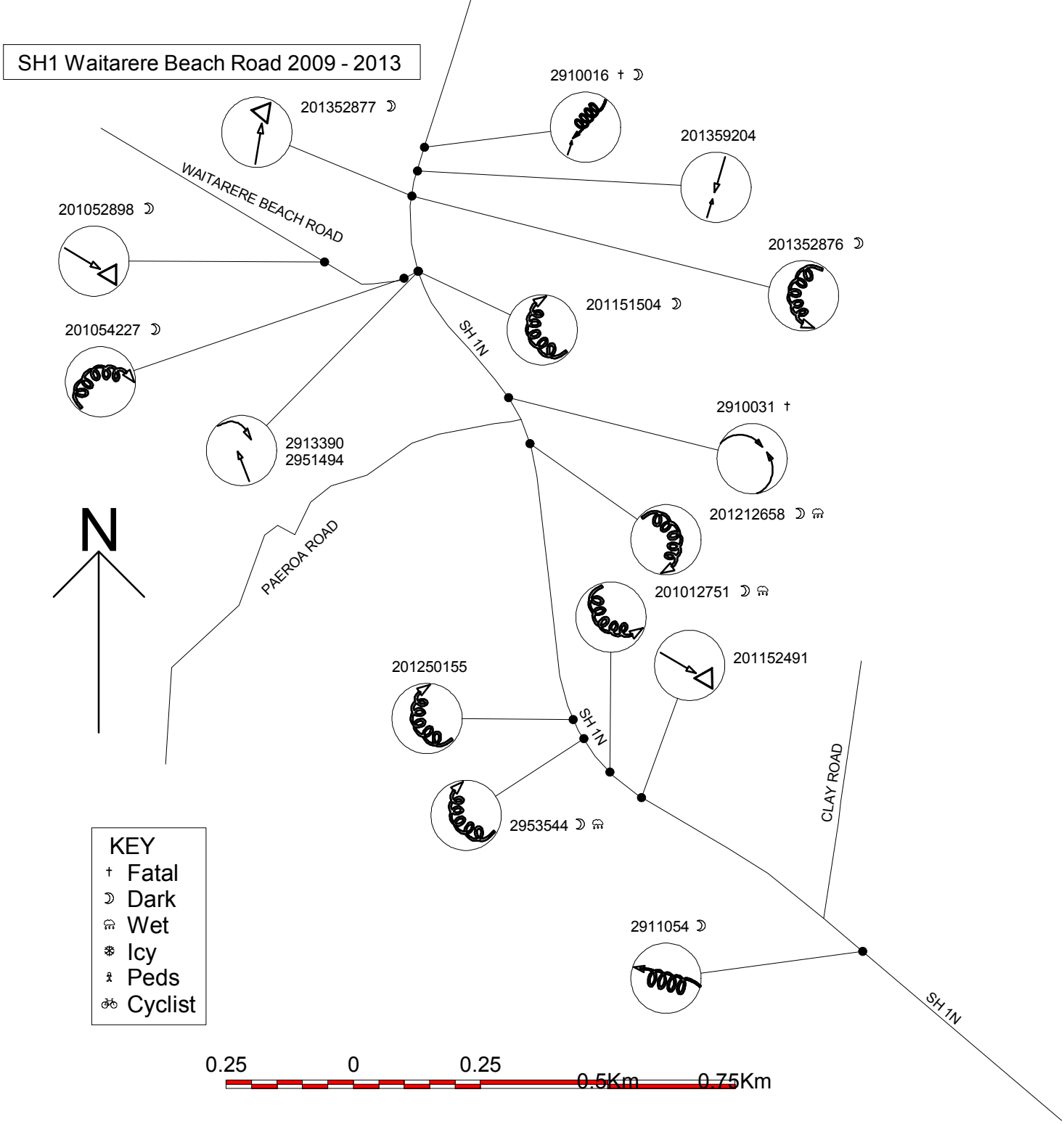
The crashes that have occurred within a 50m radius of the intersection have not been related to traffic movements in and out of the intersection. The two crashes were caused by turning to miss flood waters, and fatigue and swinging wide. Therefore this is not a high-risk intersection based on the type of crashes within a 50m radius of the intersection.

1.1.6 Crash Risk Summary

Undivided state highways with over 6,000 vpd generally have higher numbers of deaths and serious injuries as a result of head-on crashes, rather than run-off road crashes. This site is not an exception with six death and serious injuries from head-on crashes, and one from run-off road crashes in the five year period from 2009 to 2013.

It is clear from the crash analysis that the majority of crashes which result in high severity resulted from drivers having difficulty with the out of context curves. Therefore by addressing these curves it is reasonable to assess that the crash risk will be substantially reduced.

The crash data, including a collision diagram found in this Appendix.


SH1 Waitarere Beach Road 2009 - 2013
2910016 † ☽
201352877 ☽
201359204
WAITARERE BEACH ROAD
201052898 ☽
201352876 ☽
201151504 ☽
201054227 ☽
SH 1N
2910031 †
2913390
2951494
201212658 ☽ 🌧
N
PAEROA ROAD
201012751 ☽ 🌧
201152491
201250155
SH 1N
CLAY ROAD
2953544 ☽ 🌧
2911054 ☽
SH 1N
KEY
† Fatal
☽ Dark
🌧 Wet
❄ Icy
Peds
Cyclist
0.25 0 0.25 0.5Km 0.75Km

First Street	Distance	DIR	Second street or landmark	Crash Number	Date DD/MM/YYYY	Day DDD	Time HHMM	MVM DR VN 1 VVV 234	Factors and Roles A is for vehicle 1 B is for veh 2 etc	OBJECT	CURVE	WET	LIGHT	WEATHER	JUNCTION	CONTROL	MANOEUVRE	SPEED	Total Inj	FATAL	SERIOUS	MINOR	PEDAGE	CYCAGE	Map Coordinates
WAITARERE BEACH ROAD	30	W	SH 1N	201054227	30/08/2010	Mon	1800	DA CE1	103A 110A 431A	FP	M	D	TO	F		N	C	100							1791749 5506881
WAITARERE BEACH ROAD	200	W	SH 1N	201052898	03/07/2010	Sat	0540	EC 4E1	195A 912	W	M	D	DN	F		N	C	100							1791593 5506913
1N/967/5.644	250	N	WAITARERE BEACH ROAD	2910016	17/02/2009	Tue	2300	BE CS1T	103A 134A 350A	TT	R	D	DN	F		N	C	100	3						1791789 5507139
1N/967/5.695	200	N	WAITARERE BEACH ROAD	201359204	28/10/2013	Mon	1130	BA CS1C	682A	D	R	D	BF	F		N	C	100							1791775 5507092
1N/967/5.745	150	N	WAITARERE BEACH ROAD	201352877	07/08/2013	Wed	1800	EC CN1	341A 820	X	E	D	DO	F		N	L	100							1791764 5507043
1N/967/5.745	150	N	WAITARERE BEACH ROAD	201352876	07/08/2013	Wed	1800	DB CS1	121A 411A	FP	E	D	DO	F		N	L	100							1791764 5507043
1N/967/5.894	I		WAITARERE BEACH ROAD	2913390	26/10/2009	Mon	1508	JA VN1C	145A 302B 387B		E	D	B	F	T	G	C	100	1		3				1791777 5506895
1N/967/5.894	I		WAITARERE BEACH ROAD	2951494	07/02/2009	Sat	1120	JA CN1T	302B		R	D	B	F	T	G	C	100							1791777 5506895
1N/967/5.895	I		WAITARERE BEACH ROAD	201151504	30/03/2011	Wed	0330	DA TN1	131A 358A		E	D	DO	F	T	G	R	100							1791776 5506895
1N/967/6.201	50	N	PAEROA ROAD	2910031	25/03/2009	Wed	1123	BC CN1C	121A 410A 106B		E	D	B	F		N	C	100	2	1					1791954 5506647
1N/967/6.302	50	S	PAEROA ROAD	201212658	16/07/2012	Mon	0435	DA CS1	135A 823 901	FPT	M	W	DN	H		N	C	100		1	1				1791996 5506557
1N/967/6.852	600	S	PAEROA ROAD	201250155	13/01/2012	Fri	1622	DA CN1	131A 402A 407A	F	E	D	O	F		N	C	100							1792081 5506015
1N/967/6.894	1000	S	WAITARERE BEACH ROAD	2953544	29/04/2009	Wed	1935	DA 4N1	111A	F	M	W	DN	L		N	C	100							1792102 5505977
1N/967/6.979	510	N	CLAY ROAD	201012751	12/09/2010	Sun	0521	DB CS1	103A 131A 632A	FP	E	W	DN	L		N	C	100		1					1792153 5505912
1N/967/7.059	430	N	CLAY ROAD	201152491	26/06/2011	Sun	1534	EC CS1	911	W	E	D	O	F		N	C	100							1792215 5505862
1N/967/7.588	100	S	CLAY ROAD	2911054	22/01/2009	Thu	0400	CB CN1	410A	V	R	D	DO	F		N	C	100		1					1792649 5505560

First Street	Distance	D/I/R	Second street or landmark	Crash Number	Date DD/MM/YYYY	Day	Time HHMM	Description of Events	Crash Factors (ENV = Environmental factors)	Road	Natural Light	Weather	Junction	Cntrl	Tot Inj F A T	S E R	M I N	Map Coordinates Easting	Northing
WAITARERE BEACH ROAD	30W		SH 1N	201054227	30/08/2010	Mon	1800	CAR1 EBD on WAITARERE BEACH ROAD lost control turning right, CAR1 hit Fence, Post Or Pole on right hand bend	CAR1 alcohol test above limit or test refused, too fast for conditions, showing off racing	Dry	Twilight	Fine	Unknown	Nil				1791749	5506881
WAITARERE BEACH ROAD	200W		SH 1N	201052898	03/07/2010	Sat	0540	SUV1 EBD on WAITARERE BEACH ROAD hit obstruction, SUV1 hit Stray Animal	SUV1 suddenly swerved to avoid animal ENV: farm animal straying	Dry	Dark	Fine	Unknown	Nil				1791593	5506913
1N/967/5.644	250N		WAITARERE BEACH ROAD	2910016	17/02/2009	Tue	2300	CAR1 SBD on SH 1N lost control on straight and hit TRUCK2 head on, CAR1 hit Tree, TRUCK2 hit Tree	CAR1 alcohol test above limit or test refused, lost control while returning to seal from unsealed shoulder, attention diverted	Dry	Dark	Fine	Unknown	Nil	3			1791789	5507139
1N/967/5.695	200N		WAITARERE BEACH ROAD	201359204	28/10/2013	Mon	1130	CAR1 SBD on SH 1N hit CAR2 headon on straight, CAR2 hit Debris	CAR1 load not well secured or moved	Dry	Bright	Fine	Unknown	Nil				1791775	5507092
1N/967/5.745	150N		WAITARERE BEACH ROAD	201352877	07/08/2013	Wed	1800	CAR1 NBD on SH 1N hit obstruction, CAR1 hit Other	CAR1 obstruction on roadway ENV: obstructed	Dry	Dark	Fine	Unknown	Nil				1791764	5507043
1N/967/5.745	150N		WAITARERE BEACH ROAD	201352876	07/08/2013	Wed	1800	CAR1 SBD on SH 1N lost control turning left, CAR1 hit Fence, Post Or Pole	CAR1 swung wide on bend, fatigue due to long trip	Dry	Dark	Fine	Unknown	Nil				1791764	5507043
1N/967/5.894		I	WAITARERE BEACH ROAD	2913390	26/10/2009	Mon	1508	VAN1 NBD on SH 1N hit CAR2 turning right onto SH 1N from the left	VAN1 didn't signal in time incorrect signal CAR2 failed to give way at give way sign, misjudged intentions of another party	Dry	Bright	Fine	T Type Junction	Give Way Sign		1	3	1791777	5506895
1N/967/5.894		I	WAITARERE BEACH ROAD	2951494	07/02/2009	Sat	1120	CAR1 NBD on SH 1N hit TRUCK2 turning right onto SH 1N from the left	TRUCK2 failed to give way at give way sign	Dry	Bright	Fine	T Type Junction	Give Way Sign				1791777	5506895
1N/967/5.895		I	WAITARERE BEACH ROAD	201151504	30/03/2011	Wed	0330	TRUCK1 NBD on SH 1N lost control turning right on right hand bend	TRUCK1 lost control when turning, attention diverted by cigarette etc	Dry	Dark	Fine	T Type Junction	Give Way Sign				1791776	5506895
1N/967/6.201	50N		PAEROA ROAD	2910031	25/03/2009	Wed	1123	CAR1 NBD on SH 1N swinging wide hit CAR2 head on	CAR1 swung wide on bend, fatigue (drowsy, tired, fell asleep) CAR2 alcohol not suspected, tested and -ve (MoT use only)	Dry	Bright	Fine	Unknown	Nil	2	1		1791954	5506647
1N/967/6.302	50S		PAEROA ROAD	201212658	16/07/2012	Mon	0435	CAR1 SBD on SH 1N lost control turning right, CAR1 hit Fence, Post Or Pole, Tree on right hand bend	CAR1 lost control due to road conditions ENV: road obstructed (flood waters), heavy rain	Wet	Dark	Heavy Rain	Unknown	Nil		1	1	1791996	5506557
1N/967/6.852	600S		PAEROA ROAD	201250155	13/01/2012	Fri	1622	CAR1 NBD on SH 1N lost control turning right, CAR1 hit Fence on right hand bend	CAR1 lost control when turning, new driver showed inexperience, driver over-reacted	Dry	Overcast	Fine	Unknown	Nil				1792081	5506015
1N/967/6.894	1000S		WAITARERE BEACH ROAD	2953544	29/04/2009	Wed	1935	SUV1 NBD on SH 1N lost control turning right, SUV1 hit Fence on right hand bend	SUV1 too fast entering corner	Wet	Dark	Light Rain	Unknown	Nil				1792102	5505977
1N/967/6.979	510N		CLAY ROAD	201012751	12/09/2010	Sun	0521	CAR1 SBD on SH 1N lost control turning left, CAR1 hit Fence, Post Or Pole	CAR1 alcohol test above limit or test refused, lost control when turning, worn tread on tyre	Wet	Dark	Light Rain	Unknown	Nil			1	1792153	5505912
1N/967/7.059	430N		CLAY ROAD	201152491	26/06/2011	Sun	1534	CAR1 SBD on SH 1N hit obstruction, CAR1 hit Stray Animal	ENV: household pet rushed out or playing	Dry	Overcast	Fine	Unknown	Nil				1792215	5505862
1N/967/7.588	100S		CLAY ROAD	2911054	22/01/2009	Thu	0400	CAR1 NBD on SH 1N lost control; went off road to left, CAR1 hit Ditch	CAR1 fatigue (drowsy, tired, fell asleep)	Dry	Dark	Fine	Unknown	Nil			1	1792649	5505560

High Risk Intersection Guide				Rural T-Junction		Rural T-Junction	
Period 5 years				WAITARERE BEACH ROAD		PAEROA ROAD	
		Table A3-10		WAITARERE BEACH ROAD		<>M	
		Rural Priority T Junction		<>N	<>M	<>N	
	TYPE	Adjusted FS Rate		Injury	Estimated DSI eqv	Injury	Estimated DSI eqv
Overtaking/lane change	A		0.38	0	0	0	0
Head-on	B		0.61	0	0	1	0.61
Loss of control or off road (straight)	C		0.36	0	0	0	0
Cornering	D		0.34	0	0	1	0.34
Hit Object	E		0.33	0	0	0	0
Rear-end	F		0.1	0	0	0	0
Turning versus same direction	G		0.41	0	0	0	0
Crossing (no turning)	H		0.37	0	0	0	0
Crossing (turning)	J		0.37	1	0.37	0	0
Merging	K		0.32	0	0	0	0
Right turn against	L		0.4	0	0	0	0
Manoeuvring	M		0.3	0	0	0	0
Pedestrian crossing road	N		0.6	0	0	0	0
Pedestrian other	P		0.6	0	0	0	0
Misc	Q		0.5	0	0	0	0
Estimated FS Crashes/Collective Risk		Total		**1**	**0.37**	**2**	**0.95**
Actual FS Crashes					1		2
Collective Risk Band				5	**Low medium**	5	**Medium**
Qmajor 1 (Highest Main Road flow)				SH1 South of Waitarere	8122	SH1 South of Paeroa	9211
Qmajor 2 (Second Main Road flow)				SH1 North of Waitarere	7149	SH1 North of Paeroa	8122
Qminor 1 (Highest Side Road flow)				Waitatere Beach Road	2393	Paeroa Road	70
Qminor 2 (Second Side Road flow if appl.)							
Daily Product of Flow (PoF)					803		206
		Adjusted to 365 days * number of years			1,465,463		375353
EEM high speed priority T junction model							
Personal Risk Metric					20		157
Personal Risk Band					**Medium high**		**High**
Injury Crashes Per Year					0.2		0.40
Level of Safety Service (LoSS) Band		Refer HRIG LOSS Graphs			**I**		**III**
LoSS Safety Performance					The observed injury crash rate is lower (better) than that expected of 30% of similar intersections.		The observed injury crash rate is lower (better) than that expected of 70% of similar intersections, and higher (worse) than that of 50%.
High Risk Intersection?					**No, insufficient crashes**		**No, insufficient crashes**
Transformation Potential		Refer Section 6.6.2 Graphs			RBT ~0.3 DSI/5y, priority T 0.9 DSi/5y. Current T performing better than the 50th %tile.		RBT ~0.1 DSI/5y, priority T 0.3 DSi/5y. Current T performing better than the 50th %tile.

Appendix F – Implementation Funding Forecast

Forecast ($state year)	Financial Year Starting 1 July											
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Design	$m	$m	$0.7m	$m	$m	$m	$m	$m	$m	$m	$m	$m
Statutory Applications	$m	$0.3m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m
Property Purchase	$m	$m	$m	$0.8m	$1.0m	$m	$m	$m	$m	$m	$m	$m
Property Management	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m
Property Disposal	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m
Construction/Implementation	$m	$m	$m	$m	$m	$4.7m	$7.0m	$m	$m	$m	$m	$m
External Impact Mitigation	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m
Other Capital (e.g. insurances)	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m
Capital Risk Management	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m	$m
TOTAL IMPLEMENTATION COST	**$m**	**$0.3m**	**$0.7m**	**$0.8m**	**$1.0m**	**$4.7m**	**$7.0m**	**$m**	**$m**	**$m**	**$m**	**$m**

Appendix G – Project Risk Analysis

Risk Analysis Process

The Risk Analysis for the Waitarere Beach Curves project has evolved as the extent and content of the Otaki to Levin project investigation work has progressed.

An initial risk register was developed with the Otaki to North of Levin scoping phase in September 2011. It was an extensive register, developed from a number of sources including project team meetings and consultation. No quantitative analysis was completed on the risks at that time. The risk analysis was based on the NZTA Risk Management Process Manual (AC/Man1)

After the major Otaki to Levin project was broken in to a series of smaller, separated projects, an individual Project Feasibility Report was prepared for the Waitarere Beach Curves section. No individual Risk File was developed at that stage – the risk assessment being a series of bullet points based, to a large degree, on the broader risks identified as part of the overall project with a few project-specific issues identified.

A more detailed Risk File has been developed for the progression from PFR to Detail Business Case. The Risk File conforms to the qualitative level assessment using the Z/44 framework.

The Risk File has been developed from a series of project team meeting (not specifically risk workshops), using initial risk register, PFR and localised investigation and consultation feedback. Full, formal updates were programmed and executed in May 14, and at the completion of the DBC phase in July 14. The general format, composition and structure of the risk file were reviewed by the NZTA Risk Advisor for conformance with Z/44 intentions and formats in June 14.

No formal risk modelling has occurred at the DBC phase. A modelling level assessment has not been considered necessary at this stage of the project development, given the risks identified, and the general extent of the project.

Key Project Risks

The project risk file is included in this Appendix. The top five project risks, with HNO Risk Level of "High Threat" or "Extreme Threat" (risk score above 13) are identified as:

- Risk Rank 1: Archaeological Discovery During Construction: Untreated Risk = Extreme. Treated Risk = High. There is a risk of uncovering culturally historical and/or archaeological sites during construction. This area is known for its cultural heritage, but not all archaeological sites are known. Risk treatment is engagement with iwi and cultural representatives to identify as many sites as possible, but others are unknown. The consequence of discovery during construction is likely to be a halt to construction, while the sites are appropriately managed. There is a potentially high cost with this, so a risk sum of $200,000 has been included in the project cost schedule, as well as $100,000 in the base estimate.

- Risk Rank 2: Unexpected Ground Conditions: Untreated Risk = High. No treatment available. There is a risk that ground conditions requiring additional excavation or earthworks will be discovered during construction – conditions that weren't identified during geotechnical investigation. Given the extent of the project, local knowledge and the likelihood of such an event, it is considered that the cost effects of this risk will be covered by the normal tolerance on earthworks fees within the pricing schedules.

- Risk Rank 3: Discovery of and/or damage to Services and Utilities: Untreated Risk = High. No treatment available. While DBC and Pre-implementation survey and consultation will identify services and utilities, there may still be some underground elements that are discovered and possibly damaged during construction. No treatment is available. Construction schedule includes provision of $100,000 for utility risk response.

- Risk Rank 3=: Property Acquisition Difficulty: Untreated Risk = High. Treated Risk = Moderate. There is a risk that the property acquisition process may be delayed by difficult negotiation by property owners. Risk treatment is through a high level of engagement with property owners, already covered as part of the consultation process. Risk consequences may be delay acquisition rather than costs, but programme has sufficient float for acquisition delay to not impact on construction.

- Risk Rank 3=: Maori and Cultural Issues: Untreated Risk = High: Treated Risk = Moderate. With the rich cultural history of the area, the risk is that cultural issues may impact on alignment footprint, delay the acquisition process, or affect the Transport Agency's public profile. Treatment involves continued high levels of engagement with iwi and cultural representatives (for example – site walkover in October 14). Treatments costs included in DBC and Pre-implementation phase consultation costs. Construction programme has sufficient float to accommodate delay.

Risk Quantification

Only two of the five risks above have risk costing applied:

- Accidental Archaeological Discovery has a construction risk cost applied to the schedule of $200,000 (plus $100,000 in base estimate). It is intended to cover implementation of archaeological protocols, and recognise possible delays to completion (i.e. continuation of TTM for extended periods).

- Service discovery and its possible damage have a construction risk cost applied to the schedule of $100,000. While identification of services, and any consequent damage from unidentified services is the contractor's responsibility (and their insurance cover), the risk cost works toward any potential (variation) cost of service protection/relocation.

Risk Management Information

Project/M&O Contract Title	Otaki to Levin - Sect 8 Waiterere Beach Curves
Project/M&O Contract ID	464PN

NZTA Office:

NZTA Managing Office	Wellington

Key Personel:

	Name
NZTA Lead	Jo Draper

	Name	Organisation
Supplier Lead 1	Phil Peet	MWH
Supplier Lead 2	Jon England	MWH
Supplier RM Specialist	Michael McLellan	MWH

Capital Project/M&O Contract Risk Cost Data:

	Cost ($)
Total Project or M&O Contract Cost	$ 13,500,000
$% deemed to represent a 'Very High' exposure	10%

Risk Scoring:

Capital Project/M&O Contract Cost Banding

	Cost ($)		
Very High		>	$ 1,400,000
High	$ 140,001	to	$ 1,400,000
Medium	$ 14,001	to	$ 140,000
Low	$ 1,401	to	$ 14,000
Very Low		<	$ 1,401

Capital Project/M&O Renewals programme - Delivery Banding

	Duration (days)		
Very High		>	180
High	90	to	180
Medium	45	to	89
Low	25	to	44
Very Low		<	25

Ian Rich – HNO Risk Advisor (Tel: 04 894 6287)
Ian.Rich@nzta.govt.nz
October 2013

Risk Register

Project/Contract:	Otaki to Levin - Sect 8 Waiterere Beach Curves
Project/Contract ID:	464PN
NZTA Office:	Wellington
NZTA Lead:	Jo Draper

Document Date:	22 July 2014	
Supplier Lead 1:	Phil Peet	MWH
Supplier Lead 2:	Jon England	MWH
RM Specialist:	Michael McLellan	MWH

									Current Exposure				Residual (Target) Exposure			
									Semi-Quantitative			Treatment Strategy	Semi-Quantitative			
Rank	RID	Risk Title	Description/ Cause/ Consequence	Risk Owner	Risk Owning Org	Date Raised	Risk Status	Phase	Established Controls	Consq.	Prob	Risk Score	(refer to Actions Register for detail)	Consq.	Prob	Risk Score	Commentary & Closure Statement
1	OTLWB005	Discovery During Construction	Description: There is a threat that historical, archaeological and cultural items are discovered during construction. Cause: The cause of the threat is unknown artifacts or sites lie on the construciton alignment. Consequence: The consequence of the threat is: * delays while archaeologica protocols are followed; * costs of recovery, excavation, relocation or design change.	Jo Draper	NZTA	21/05/2014	Live - Treat	Implementation	Accidental Discovery Protocols	High	High	21	Efforts to reduce likelihood by consultation with iwi and site walkovers. Still need to recognise possible impact during construction phase.	High	Medium	19	Cost impact of accidental discovery estimated at $250k and inserted in project estimates.
2	OTLWB012	Ground Conditions	Description: There is a threat that the ground conditions may not be expected. Cause: The cause of the threat is that the project geotechnical information is incomplete Consequence: The consequence of the threat is: * delays and cost increases while treatments are found for unexpected conditions.	Phil Peet	MWH	21/05/2014	Live - Parked	Implementation	No established controls	High	Low	16	While DBC and Preimplementation will undertake geotechnical assessments as much as possible, unknown conditions may still be experienced during construction.	High	Low	16	Construction estimates, earthworks components will carry cost bounds that allow for this risk, as a matter of course.
3	OTLWB002	Services and Utilities	Description: There is a threat that services will be discovered during construction phase. Cause: The cause of the threat is either inaccurate services information gathered during earlier phases, or service locations generally not known. Consequence: The consequence of the threat is delay to construction, and additional costs while services are located and relocated or possible damage to the services	Jo Draper	NZTA	21/05/2014	Live - Parked	Implementation	No established controls	Medium	Medium	15	No Treatment strategy at this point in project.	Medium	Medium	15	Risk will require reassessment after DBC and pre-implementation and consideration of confidence in thoroughness of services located. Cost provision of $100k included in construction estimates for service relcoation or protection.
3	OTLWB008	Property Acquisition	Description: There is a threat that property acquisition will be difficult. Cause: The cause of the threat is landowner reluctance to willingly sell land required. Consequence: The consequence of the threat is delayed construction and higher acquisition process costs.	Jo Draper	NZTA	21/05/2014	Emerging	Property	Local Government Act processes	Medium	Medium	15	Initial treatments will be landowner consultation and engagement.	Medium	Low	11	
3	OTLWB003	Maori and Cultural Land	Description: There is a threat that Maori and cultural property issues will be significant influencers on this project. Cause: The cause of the threat is the recommended alignment and footprint lies over cultural or taonga property Consequence: The consequence of the threat is possibly: *delays and costs in extended or extensive consultation; *delays, costs and operational performance limits in moving road footprint to accommodate land; *poor image for NZTA in process or decisions made.	Phil Peet	MWH	21/05/2014	Live - Treat	Detailed Business Case	NZTA Stakeholder engagement process requirements	Medium	Medium	15	Meet and engage (collaborate) with iwi and Maori property interests to resolve an approach	Low	Low	6	Treatment has proven quite effective so far, with general knowledge of the project in the Maori domain, further engagement planned, and unlikely delays or issues later.
6	OTLWB010	Construction Effects	Description: There is a threat that the construction will cause vehicle delays. Cause: The cause of the threat is construction phased and undertaken in such a way that traffic is delayed. Consequence: The consequence of the threat is vehicle operating costs are increased, and drivers are unhappy with NZTA.	Phil Peet	NZTA	19/05/2014	Live - Parked	Implementation	Temporary Traffic Management Plans	Medium	Low	11	Scheme and detailed design to specifically consider constructability. Construction tender documents to include requirements for traffic flow	Medium	Low	11	Reassess after Pre-implementation
6	OTLWB006	Access and Serverance	Description: There is a threat that the median barrier creates significant local opposition. Cause: The cause of the threat is the median barrier will restrict turning movements into and out of properties. Consequence: The consequence of the threat is: *potential delays due to extended consultation period; *additional costs to mitigate turning restrictions	Phil Peet	MWH	21/05/2014	Live - Treat	Detailed Business Case	No established controls	Medium	Low	11	Maintain consultation that has already resulted in median breaks and turning opportunities.	Medium	Very Low	4	

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October 2013

Risk Register

										Current Exposure Semi-Quantitative			Treatment Strategy	Residual (Target) Exposure Semi-Quantitative			
6	OTLWB007	Access and Serverance	Description: There is a threat that the median barrier creates significant local opposition - generally from further afield than the OTLWB006 risk. Cause: The cause of the threat is that the median barrier may extend to cover the current side road accesses (2 roads) Consequence: The consequence of the threat is: *potential delays due to extended and more extensive consultation and engagement: *additional costs to mitigate side road turning restrictions.	Phil Peet	MWH	21/05/2014	Live - Treat	Detailed Business Case	No established controls	Medium	Low	11	Develop turning facilities within the turning area for side road vehicles only.	Medium	Very Low	4	
6	OTLWB011	Construction Effects	Description: There is a threat that construction will have adverse environmental effects. Cause: The cause of the threat is construction activities which generate noise, vibration, runnoff and air quality effects. Consequence: The consequence of the threat is potential breaches of consents leading to negative publicity, rectification costs and delays, and downstream damage.	Jo Draper	NZTA	21/05/2014	Live - Treat	Implementation	RMA processes and standard management plans typically required through the NZTA MS&QA phase.	Medium	Low	11	No treatment strategy at this point in project. Future treatments will include storwater, air quality and noise management plans.	Medium	Very Low	4	
	OTLWB001	Services and Utilities	Description: There is a threat that service relocation will add to the project costs. Cause: The cause of the threat is that service location is an unknown at the start of the DBC phase of the project. Consequence: The consequence of the threat is considerable cost addition when the extent of services is knowns	Phil Peet	MWH	21/05/2014	Impacted	Detailed Business Case	No established controls	High	Medium	19	Detail Business Case is required to identify services where possible.	High	Medium	19	Impacted risk - in that DBC identifed services and identified costs of protection/ relocation in overall construction estimates.
	OTLWB004	Project Cost	Description: There is a threat that the project feasibility estimate may be inaccurate. Cause: The cause of the threat is the level of assumptions made about utilities, services, passing opportunities, turnaround areas and road structure/seal/pavement types. Consequence: The consequence of the threat is the Detail Business Case identifies higher project costs (there is also a chance they may be lower, but going for the worst case scenario at this point).	Phil Peet	MWH	19/05/2014	Impacted	Detailed Business Case	No established controls	High	High	21	Cost estimation accuracy will improve with development of detail business case. No specific additional treatment	High	Medium	19	DBC has identified higher project costs.
	OTLWB009	Scope Change	Description: There is a threat that the preferred option is changed to the 2+1 configuration, or other scope change affecting footprint. Cause: The cause of the threat is a late change to highway performance requirements or preference of decision makers Consequence: The consequence of the threat is: *larger land footprint requiring alteration designation and acquisition processes; *revisions to scheme and design phase work with commensurate costs and delays; *higher construction costs	Phil Peet	NZTA	21/05/2014	Impacted	Detailed Business Case		High	Low	16	Review of option selection decision at each stage of project delivery beyond Indicative Business Case	Medium	Very Low	4	Scope has continued to develop through the DBC. Although construction costs generally higher than at IBC stage, scope issues have not impacted significantly. Some changes include turning facilities as solutions to other risks.
												0				0	
												0				0	
												0				0	
												0				0	
												0				0	

Ian Rich – HNO Risk Advisor (Tel: 04 894 6287)
Ian.Rich@nzta.govt.nz
October 2013

Action Register

Contract / Project:	Otaki to Levin - Sect 8 Waiterere Beach Curves	**NZTA Lead:**	Jo Draper	**Document Date:**	22 July 2014
Project/Contract ID:	464PN	**NZTA Office:**	Wellington		

Risk Rank	RID	Risk Title	Threat/Opp	Risk Owner	Action ID	Action Description	Status	Start Date	Completion Date	Treatment Cost ($)	Comment
1	OTLWB005	Discovery During Construction	Threat	Jo Draper	OTLWBA009	Costs associated with accidental discovery delays and archaeology costs included in construction estimates. However walkover and iwi liaison is intended to identify most likely sites for concern so remediation action can be taken before construction.	Live	21/07/2014	30/06/2020	250,000	Despite early mitigation, there are still likely to be costs associated with accidental discovery.
2	OTLWB012	Ground Conditions	Threat	Phil Peet	OTLWB008	Undertake normal geotechnical investigation practices during Pre-implementation work to lessen likelihood of encountering unexpected conditions	Live	21/05/2014	30/06/2020	Nil.	Nil additional cost as DBC and pre-implementation have geotechnical investigtation costs programmed, and construction costs include greater bound on earthworks risk.
3	OTLWB003	Maori and Cultural Land	Threat	Phil Peet	OTLWBA002	Full, open and tranparent engagement with iwi, with collaborative approach to issue resolution	Live	21/05/2014	31/12/2015	Nil.	Nil at this stage as costs are included in DBC and Pre-Implmentation consultation fees.
3	OTLWB008	Property Acquisition	Threat	Jo Draper	OTLWBA005	Consultation processes should start early when property requirements are known, and retain active engagement with the landowners	Proposed	1/08/2014	31/12/2015	Nil.	Treatment costs included as part of consultation process requirements.
3	OTLWB002	Services and Utilities	Threat	Jo Draper	OTLWBA010	No risk treatment per-se. Risk response cost included in project estimates.	Live	21/07/2014	30/06/2020	100,000	Cost response for service relocation or protection.
6	OTLWB010	Construction Effects	Threat	Phil Peet	OTLWBA007	Scheme assessment, and detailed design processes will specifically include considerations of constructability, with the aim of ensuring traffic lanes remain open for full operation	Live	21/05/2014	31/12/2014	Nil.	Treatment is included as part of investigation process.
6	OTLWB006	Access and Serverance	Threat	Phil Peet	OTLWBA003	Project design to include turning facilties to allow effectively unrestricted access to properties alongside the highway. Consultation to emphasise this and seek to reduce opposition if there is any. Project consultation should also emphasise the overall safety effects of this approach	Live	21/05/2014	31/12/2014	Nil.	At this stage, it is understood that the design will specifcally include turning bays, hence no additional treatment cost. Further consulation is also planned so additional treatment costs nil.
6	OTLWB007	Access and Serverance	Threat	Phil Peet	OTLWBA004	Project investigation to communicate specific turning facilities related to connecting side road traffic.	Live	21/05/2014	31/12/2014	Nil.	Treatment cost nil at this point, as preferred approach to OTLWB006should also address this; further action built into DBC work
	OTLWB001	Services and Utilities	Threat	Phil Peet	OTLWBA001	Service identification and cost estimation is required during DBC activities.	Live	21/05/2014	31/12/2014	Nil.	Expected part of DBC development.
	OTLWB009	Scope Change	Threat	Phil Peet	OTLWBA006	All phase reporting clearly identifies prefereed option with the associated risks and assumptions. Reporting should also indicate the costs and delay effects of scope change at that particular point, so that the decision to change, if it happens, is made as early as possible	Live	21/05/2014	31/12/2014	Nil.	Treatment aimed at either minimising the likelihood of a scope change, or ensuring the decision is made early enough to avoid higher downstream costs or delays.
		-	-	-							
		-	-	-							
		-	-	-							
		-	-	-							

Appendix H – Reviews and Audits

Peer Review

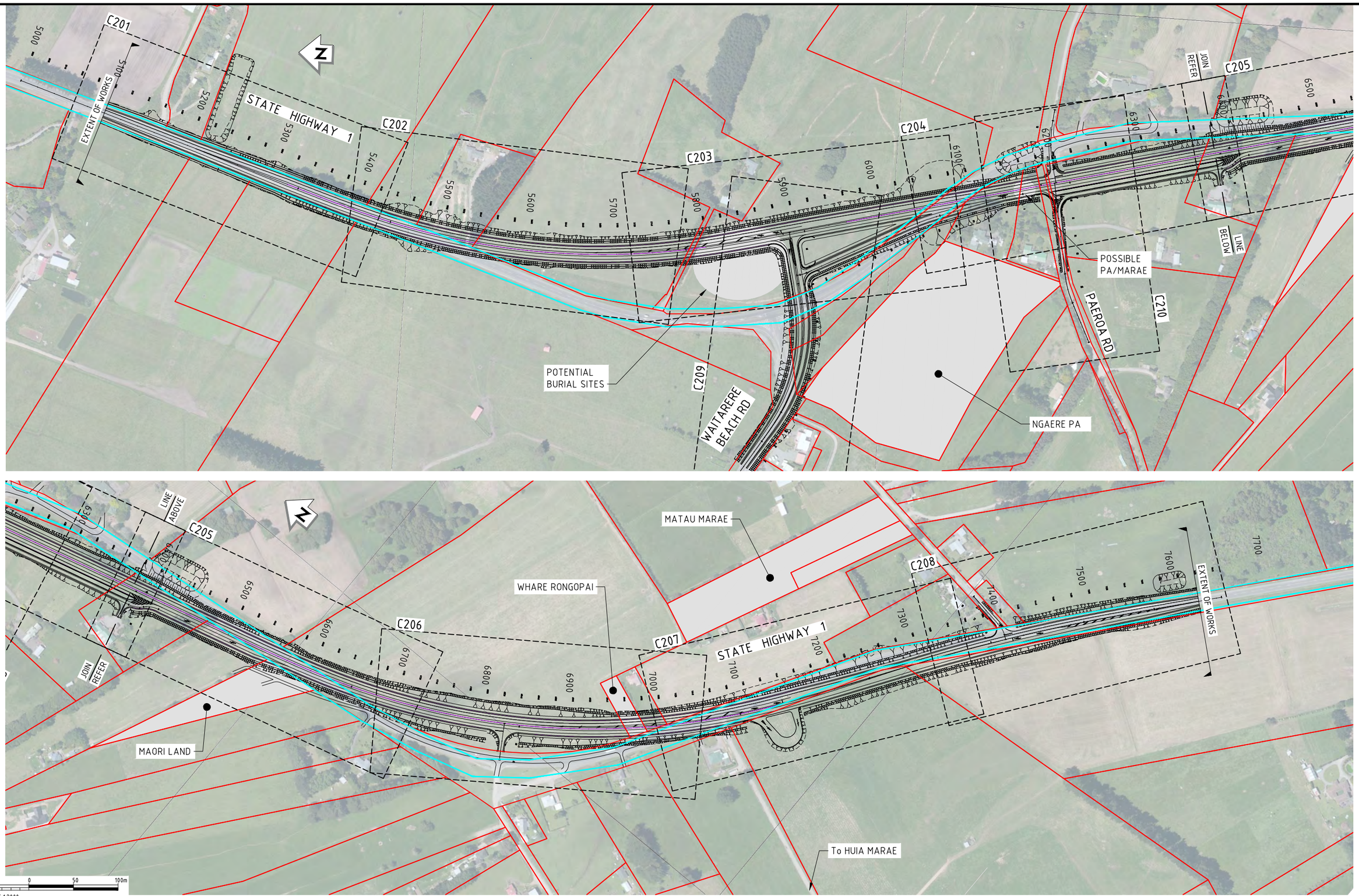
No economic peer review has been undertaken at this stage.

Safety Audits

A scheme stage road safety audit was completed in December 2014 *(SH1: Waitarere Beach Curves Realignment, Road Safety Audit of the Preliminary Design, December 2014, Ref: 14343, Traffic Planning Consultants).*

The key findings related to the form of the highway improvement, restricted visibility for right turners, signage for intersection arrangements and street lighting. These issues have been discussed with the auditors and the designers response, client decision and action taken is being finalised. It is expected that all issues raised in the audit can be adequately addressed.

Appendix I – Project Drawings



DO NOT SCALE – IF IN DOUBT, ASK

200 mm 150 100

ORIGINAL SIZE A1

NOT FOR CONSTRUCTION

REV	REVISIONS	DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW	PJC			09/14

SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW		
APPROVED	NOT APPROVED	
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 – OTAKI TO NORTH OF LEVIN
WAITARERE BEACH – RP 967/5.10 – RP 967/7.62

SHEET LAYOUT PLAN

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: 1 : 2000
Drawing No.: 80500902-04-0853-C004
Rev.: A

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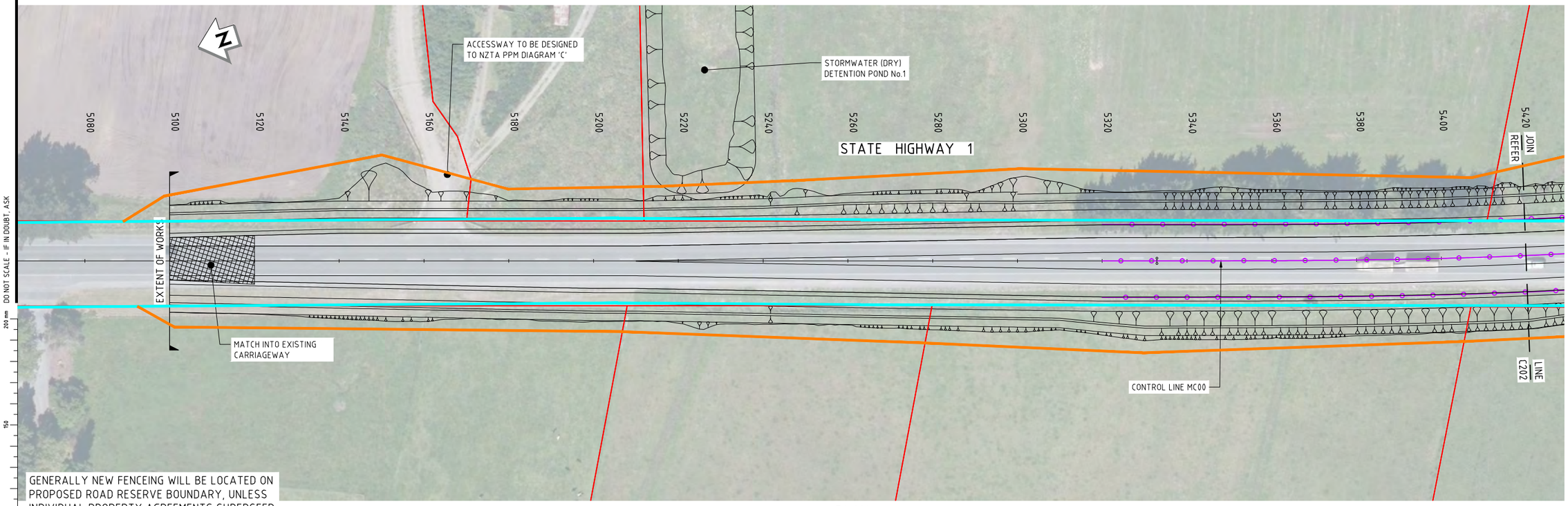

GENERALLY NEW FENCEING WILL BE LOCATED ON PROPOSED ROAD RESERVE BOUNDARY, UNLESS INDIVIDUAL PROPERTY AGREEMENTS SUPERSEED

PLAN

SCALE 1:500

VPI: NO. 3
STN: 5208.511
LVL: 23.158

DATUM R.L.=21.0																		
-CUT/+FILL DEPTH	0.034	-0.007	-0.057	-0.052	0.001	-0.004	-0.065	-0.034	-0.040	-0.068	-0.054	-0.005	0.087	0.146	0.137	0.112	0.098	
EXISTING LEVEL	23.808	23.729	23.671	23.578	23.453	23.402	23.426	23.377	23.381	23.425	23.443	23.442	23.401	23.391	23.451	23.525	23.589	
DESIGN LEVEL	23.842	23.722	23.615	23.525	23.453	23.399	23.362	23.343	23.341	23.356	23.389	23.437	23.487	23.537	23.587	23.637	23.687	
STATION (MC00)	5100.0	5120.0	5140.0	5160.0	5180.0	5200.0	5220.0	5240.0	5260.0	5280.0	5300.0	5320.0	5340.0	5360.0	5380.0	5400.0	5420.0	
VERTICAL GEOMETRY	K	K=228.722 L=202.021											P=0.250% L=227.131					
HORIZONTAL GEOMETRY	D=332.893												CL=110.000					
SUPERELEVATION LEFT	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.050	-3.959	
SUPERELEVATION RIGHT	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-2.404	-1.495	-0.586	0.323	1.232	2.141	3.050	3.959	

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

LONGITUDINAL SECTION

SCALES - H 1: 500
V 1: 100

NOT FOR CONSTRUCTION

REV	REVISIONS	DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW	PJC			09/14

SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW	NOT APPROVED	
APPROVED		
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 - OTAKI TO NORTH OF LEVIN
WAITARERE BEACH - RP 967/5.10 - RP 967/7.62

WORKING PLAN, MC00

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C201
Rev.: A

ORIGINAL SIZE A1

DO NOT SCALE - IF IN DOUBT, ASK

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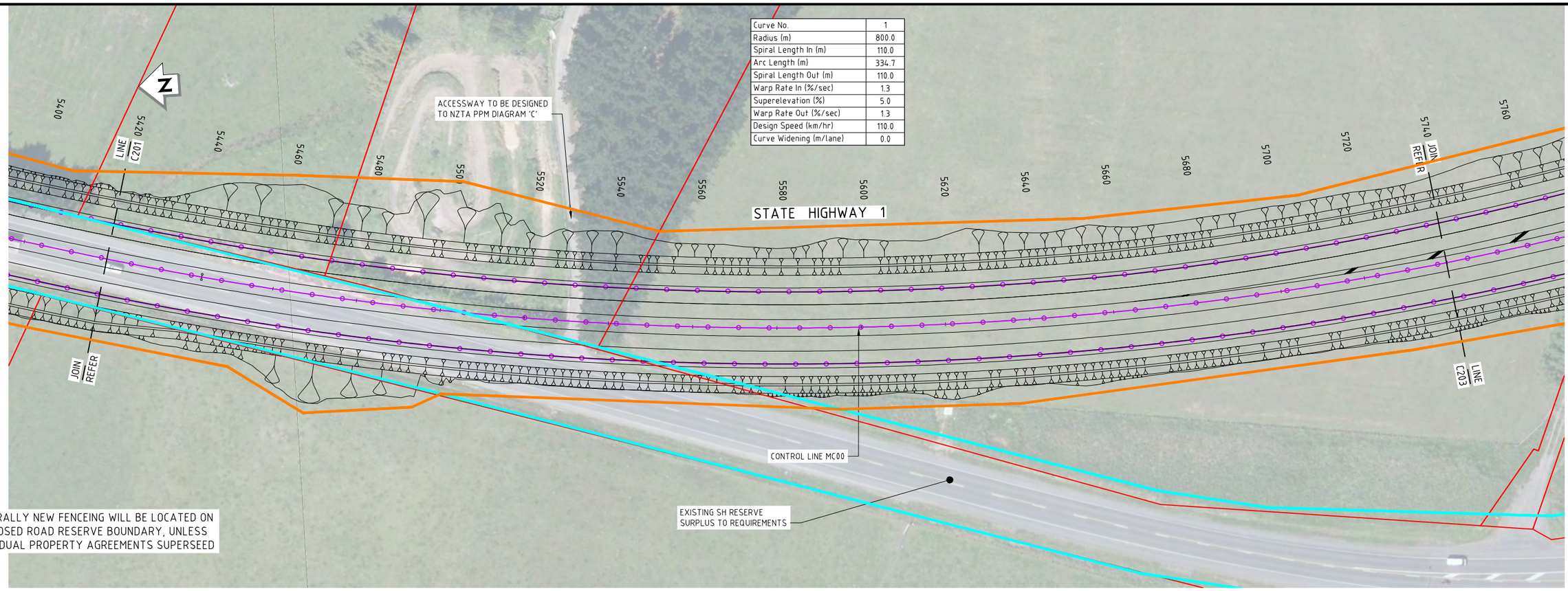
ORIGINAL SIZE A1

Curve No.	1
Radius (m)	800.0
Spiral Length In (m)	110.0
Arc Length (m)	334.7
Spiral Length Out (m)	110.0
Warp Rate In (%/sec)	1.3
Superelevation (%)	5.0
Warp Rate Out (%/sec)	1.3
Design Speed (km/hr)	110.0
Curve Widening (m/lane)	0.0



PLAN

SCALE 1 : 500

DATUM R.L.=20.0																		
-CUT/+FILL DEPTH	0.098	0.078	0.091	0.551	1.742	0.867	0.069	0.082	0.099	0.244	0.468	0.163	0.280	0.164	0.002	0.054	0.022	
EXISTING LEVEL	23.589	23.660	23.697	24.388	25.630	24.804	24.056	24.107	24.139	24.282	24.483	24.135	24.188	23.988	23.719	23.651	23.477	
DESIGN LEVEL	23.687	23.737	23.788	23.838	23.888	23.938	23.988	24.024	24.041	24.038	24.014	23.971	23.908	23.825	23.721	23.598	23.455	
STATION (MC00)	5420.0	5440.0	5460.0	5480.0	5500.0	5520.0	5540.0	5560.0	5580.0	5600.0	5620.0	5640.0	5660.0	5680.0	5700.0	5720.0	5740.0	
VERTICAL GEOMETRY	P=0.250% L=227.131						K=-200.000 L=455.074											
HORIZONTAL GEOMETRY	CL=110.000						R=-800.000 L=334.719											
SUPERELEVATION LEFT	-3.959	-4.868	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	
SUPERELEVATION RIGHT	3.959	4.868	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

LONGITUDINAL SECTION

SCALES – H 1 : 500
V 1 : 100

NOT FOR CONSTRUCTION

REV	REVISIONS	DRN	CHK	APP	DATE
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DESIGN REVIEW		
APPROVED	NOT APPROVED	
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MWH

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STATE HIGHWAY 1 – OTAKI TO NORTH OF LEVIN
WAITARERE BEACH – RP 967/5.10 – RP 967/7.62

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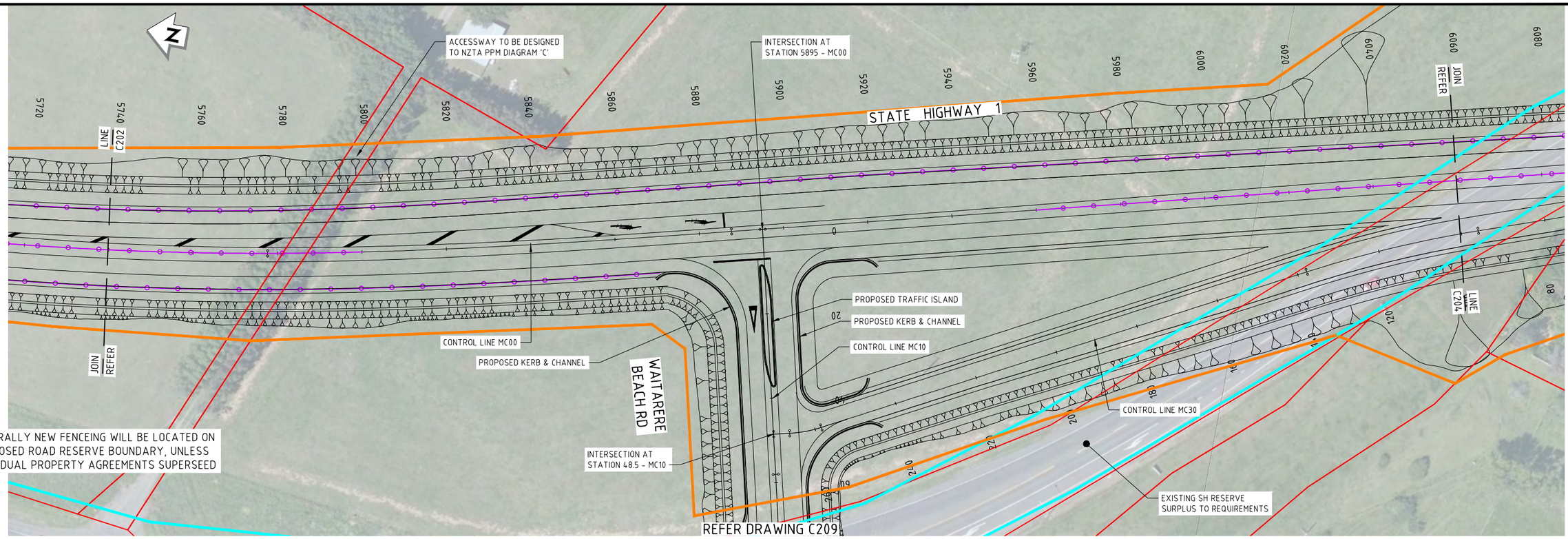
DO NOT SCALE – IF IN DOUBT, ASK

ORIGINAL SIZE A1



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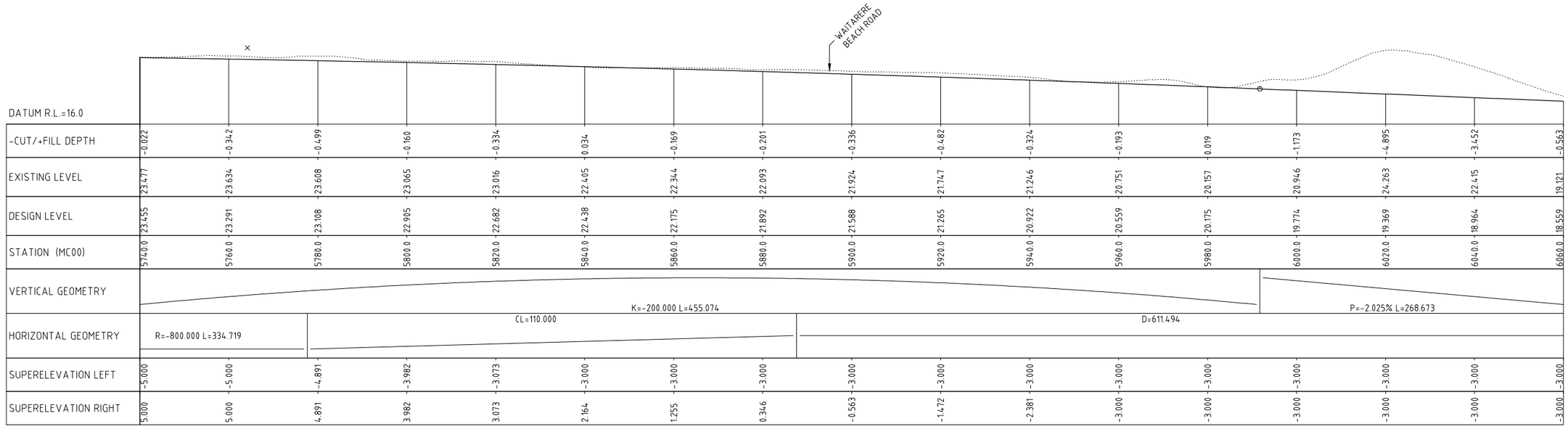
PLAN
SCALE 1 : 500



-CUT/+FILL DEPTH	-0.022	-0.342	-0.499	-0.160	-0.334	0.034	-0.169	-0.201	-0.336	-0.482	-0.324	-0.193	0.019	-1.173	-4.895	-3.452	-0.563								
EXISTING LEVEL	23.477	23.634	23.608	23.065	23.016	22.405	22.344	22.093	21.924	21.747	21.246	20.751	20.157	20.946	24.263	22.415	19.121								
DESIGN LEVEL	23.455	23.291	23.108	22.905	22.682	22.438	22.175	21.892	21.588	21.265	20.922	20.559	20.175	19.774	19.369	18.964	18.559								
STATION (MC00)	5740.0	5760.0	5780.0	5800.0	5820.0	5840.0	5860.0	5880.0	5900.0	5920.0	5940.0	5960.0	5980.0	6000.0	6020.0	6040.0	6060.0								
VERTICAL GEOMETRY	K=-200.000 L=455.074													P=-2.025% L=268.673											
HORIZONTAL GEOMETRY	R=-800.000 L=334.719		CL=110.000						D=611.494																
SUPERELEVATION LEFT	-5.000	-5.000	-4.891	-3.982	-3.073	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000								
SUPERELEVATION RIGHT	5.000	5.000	4.891	3.982	3.073	2.164	1.255	0.346	-0.563	-1.472	-2.381	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000								

LONGITUDINAL SECTION
SCALES – H 1 : 500
V 1 : 100

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

NOT FOR CONSTRUCTION

REV	REVISIONS	PJC	DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW					09/14

SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW	NOT APPROVED	
APPROVED		
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 – OTAKI TO NORTH OF LEVIN
WAITARERE BEACH – RP 967/5.10 – RP 967/7.62

WORKING PLAN, MC00

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C203
Rev.: A

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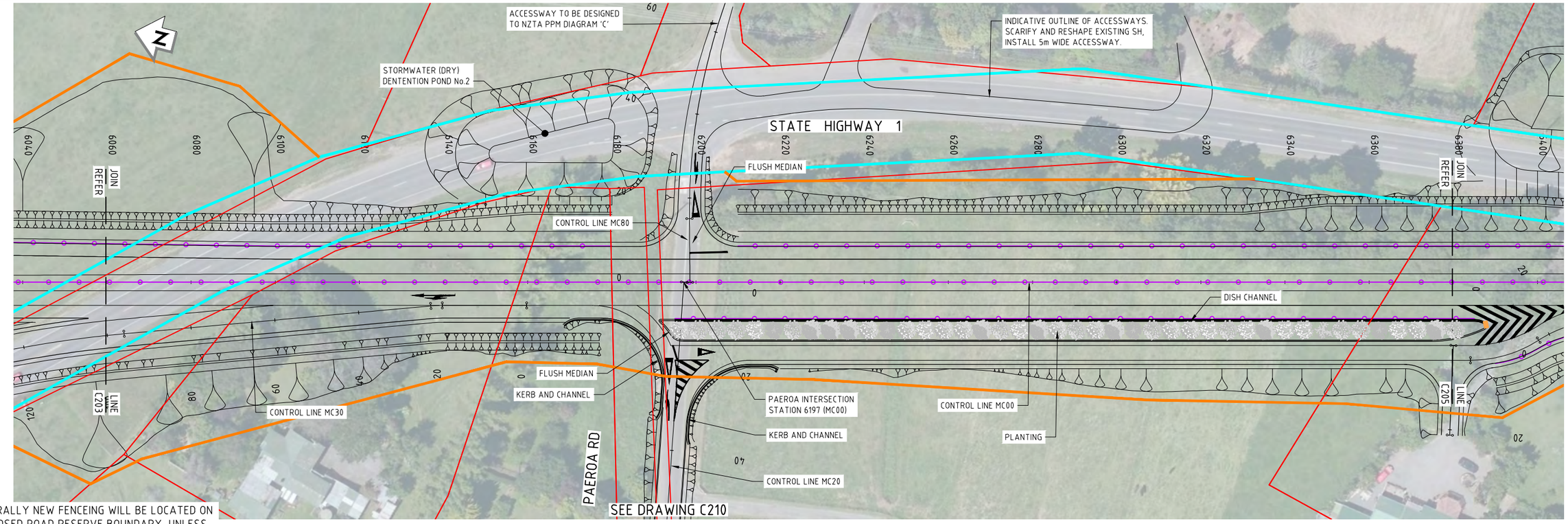

GENERALLY NEW FENCEING WILL BE LOCATED ON PROPOSED ROAD RESERVE BOUNDARY, UNLESS INDIVIDUAL PROPERTY AGREEMENTS SUPERSEED

PLAN
SCALE 1 : 500

-CUT/+FILL DEPTH	-0.563	-0.143	-0.479	0.635	1.121	2.100	0.622	-0.104	0.695	0.974	0.921	0.554	-0.598	-0.769	-0.128	1.382	1.602
EXISTING LEVEL	19.121	18.297	18.228	16.708	15.817	14.433	15.506	15.827	14.624	13.939	13.588	13.565	14.361	14.210	13.280	11.514	11.072
DESIGN LEVEL	18.559	18.154	17.749	17.344	16.939	16.534	16.129	15.724	15.319	14.914	14.509	14.119	13.764	13.441	13.152	12.897	12.674
STATION (MC00)	6060.0	6080.0	6100.0	6120.0	6140.0	6160.0	6180.0	6200.0	6220.0	6240.0	6260.0	6280.0	6300.0	6320.0	6340.0	6360.0	6380.0
HORIZONTAL GEOMETRY																	
SUPERELEVATION LEFT	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000
SUPERELEVATION RIGHT	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000

LONGITUDINAL SECTION
SCALES - H 1 : 500
V 1 : 100

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

NOT FOR CONSTRUCTION

REV	REVISIONS	DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW	PJC			09/14

SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW		
APPROVED	NOT APPROVED	
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 - OTAKI TO NORTH OF LEVIN
WAITARERE BEACH - RP 967/5.10 - RP 967/7.62

WORKING PLAN, MC00

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C204
Rev.: A

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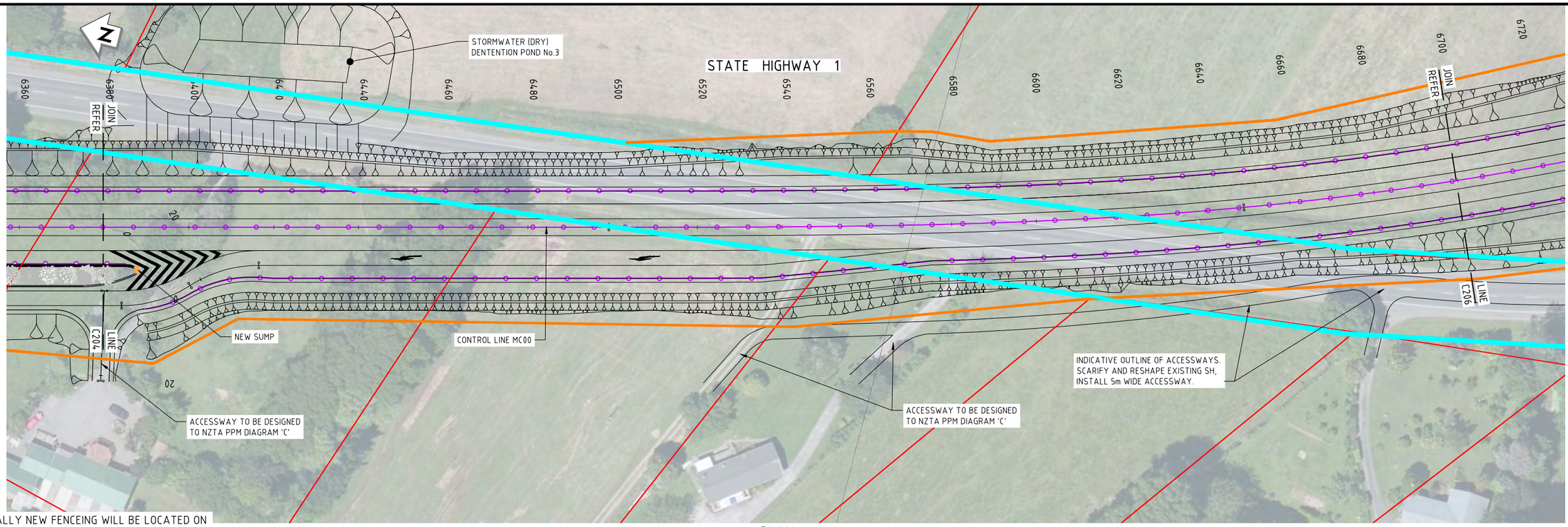
DO NOT SCALE - IF IN DOUBT, ASK
ORIGINAL SIZE A1

DO NOT SCALE – IF IN DOUBT, ASK

ORIGINAL SIZE A1



GENERALLY NEW FENCEING WILL BE LOCATED ON PROPOSED ROAD RESERVE BOUNDARY, UNLESS INDIVIDUAL PROPERTY AGREEMENTS SUPERSEED

PLAN
SCALE 1 : 500

VPI: NO. 5
STN: 6496.913
LVL: 9.711

DATUM R.L.=7.0																		
-CUT/+FILL DEPTH	1.602	1.100	0.820	1.057	0.830	1.140	1.060	0.595	-0.059	-0.322	-0.380	-0.321	-0.047	-0.471	-0.903	-0.499	1.181	
EXISTING LEVEL	11.072	11.386	11.509	11.150	11.289	10.923	10.981	11.456	12.155	12.495	12.664	12.749	12.654	12.346	12.158	12.840	12.469	
DESIGN LEVEL	12.674	12.485	12.330	12.207	12.118	12.063	12.040	12.051	12.096	12.173	12.284	12.429	12.606	12.817	13.062	13.339	13.650	
STATION (MC00)	6380.0	6400.0	6420.0	6440.0	6460.0	6480.0	6500.0	6520.0	6540.0	6560.0	6580.0	6600.0	6620.0	6640.0	6660.0	6680.0	6700.0	
VERTICAL GEOMETRY	K=120.000 L=473.029																	
HORIZONTAL GEOMETRY	D=611.494						CL=150.000								R=-800.000 L=441.822			
SUPERELEVATION LEFT	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.363	-4.030	-4.696	-5.000	-5.000	-5.000	
SUPERELEVATION RIGHT	-3.000	-3.000	-2.637	-1.970	-1.304	-0.637	0.030	0.696	1.363	2.030	2.696	3.363	4.030	4.696	5.000	5.000	5.000	

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

LONGITUDINAL SECTION
SCALES – H 1 : 500
V 1 : 100

NOT FOR CONSTRUCTION

REV	REVISIONS	PJC DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW				09/14

SURVEYED	LIDAR & Aerial Photos	04/14
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DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW	NOT APPROVED	
APPROVED		
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 – OTAKI TO NORTH OF LEVIN
WAITARERE BEACH – RP 967/5.10 – RP 967/7.62

WORKING PLAN, MC00

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C205
Rev.: A

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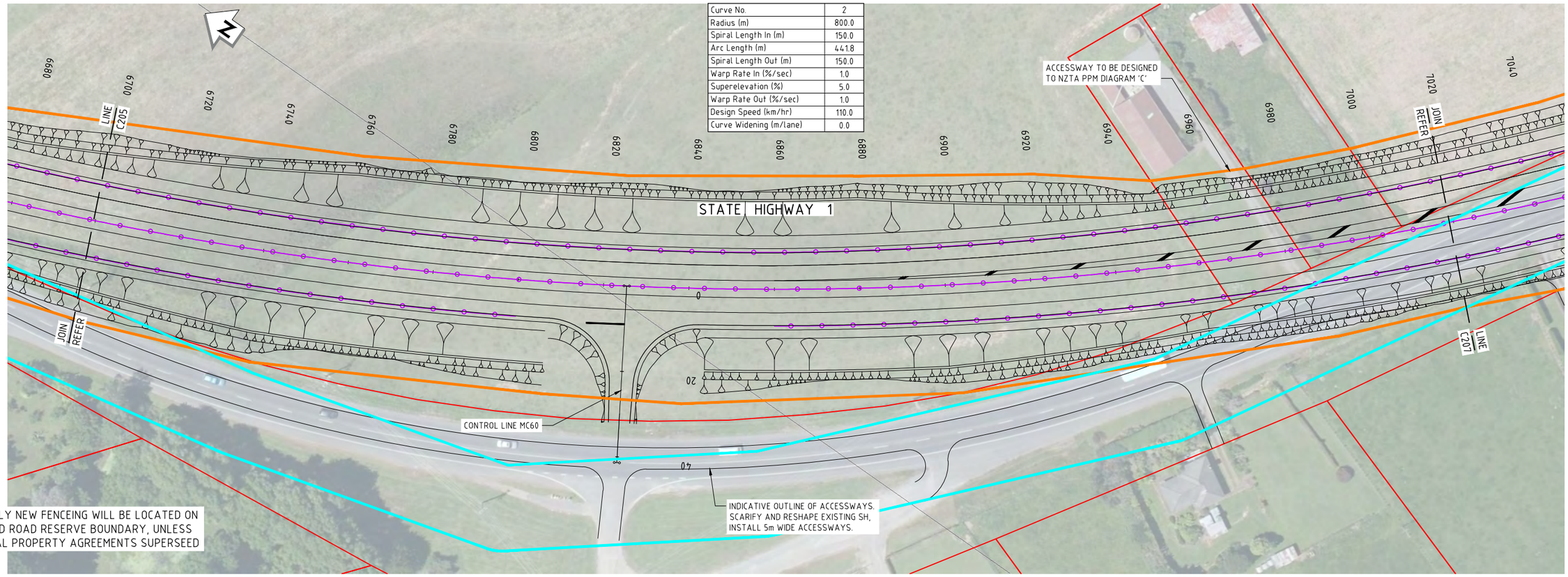
Curve No.	2
Radius (m)	800.0
Spiral Length In (m)	150.0
Arc Length (m)	441.8
Spiral Length Out (m)	150.0
Warp Rate In (%/sec)	1.0
Superelevation (%)	5.0
Warp Rate Out (%/sec)	1.0
Design Speed (km/hr)	110.0
Curve Widening (m/lane)	0.0



PLAN
SCALE 1 : 500

DATUM R.L.=9.0																		
-CUT/+FILL DEPTH	1.181	2.063	2.578	2.734	2.605	1.913	1.207	1.680	2.968	3.241	3.086	2.865	2.658	1.380	0.847	0.600	0.303	
EXISTING LEVEL	12.469	11.931	11.792	12.002	12.478	13.496	14.510	14.324	13.303	13.276	13.657	14.086	14.479	15.925	16.604	16.977	17.382	
DESIGN LEVEL	13.650	13.995	14.369	14.736	15.083	15.410	15.717	16.003	16.270	16.517	16.744	16.951	17.137	17.304	17.451	17.578	17.685	
STATION (MC00)	6700.0	6720.0	6740.0	6760.0	6780.0	6800.0	6820.0	6840.0	6860.0	6880.0	6900.0	6920.0	6940.0	6960.0	6980.0	7000.0	7020.0	
VERTICAL GEOMETRY	K=120.000 L=473.029									K=-200.000 L=801.515								
HORIZONTAL GEOMETRY	R=-800.000 L=441.822																	
SUPERELEVATION LEFT	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	
SUPERELEVATION RIGHT	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

LONGITUDINAL SECTION
SCALES - H 1 : 500
V 1 : 100

NOT FOR CONSTRUCTION

DO NOT SCALE – IF IN DOUBT, ASK

ORIGINAL SIZE A1

REV	REVISIONS	DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW	PJC			09/14

SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW	NOT APPROVED	
APPROVED		
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 - OTAKI TO NORTH OF LEVIN
WAITARERE BEACH - RP 967/5.10 - RP 967/7.62

WORKING PLAN, MC00

Status Stamp: **FOR REVIEW**
Date Stamp: **26.09.14**
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C206
Rev.: A

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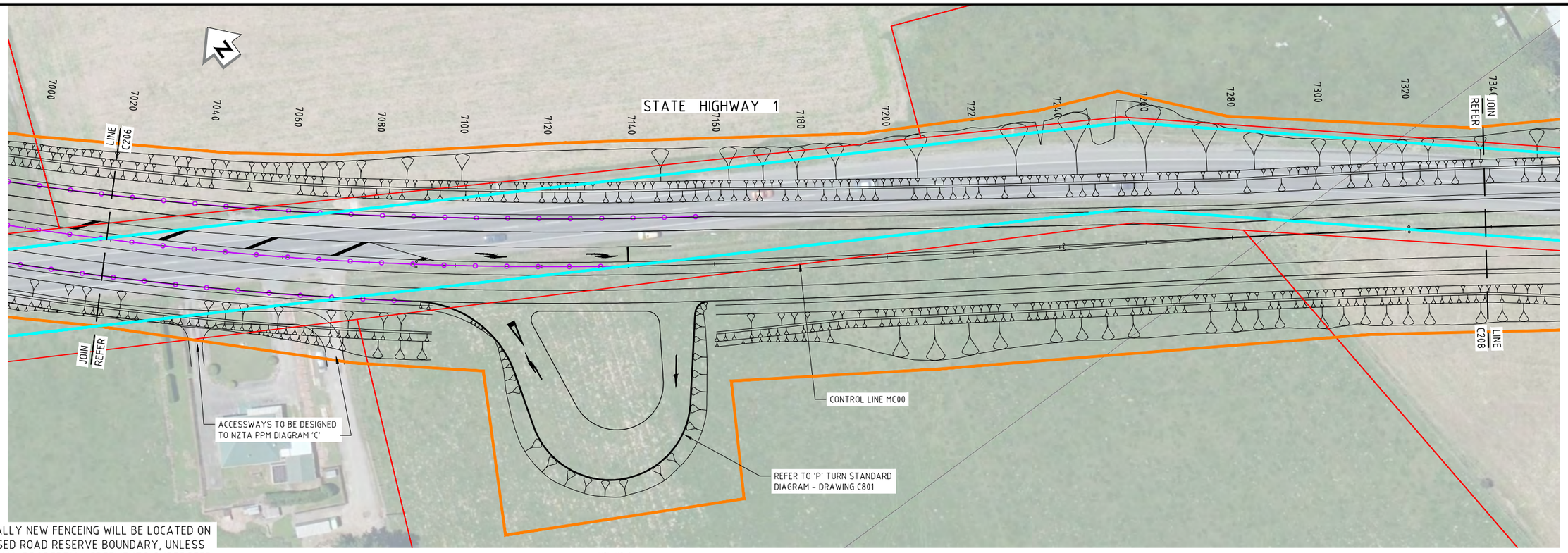
DO NOT SCALE – IF IN DOUBT, ASK

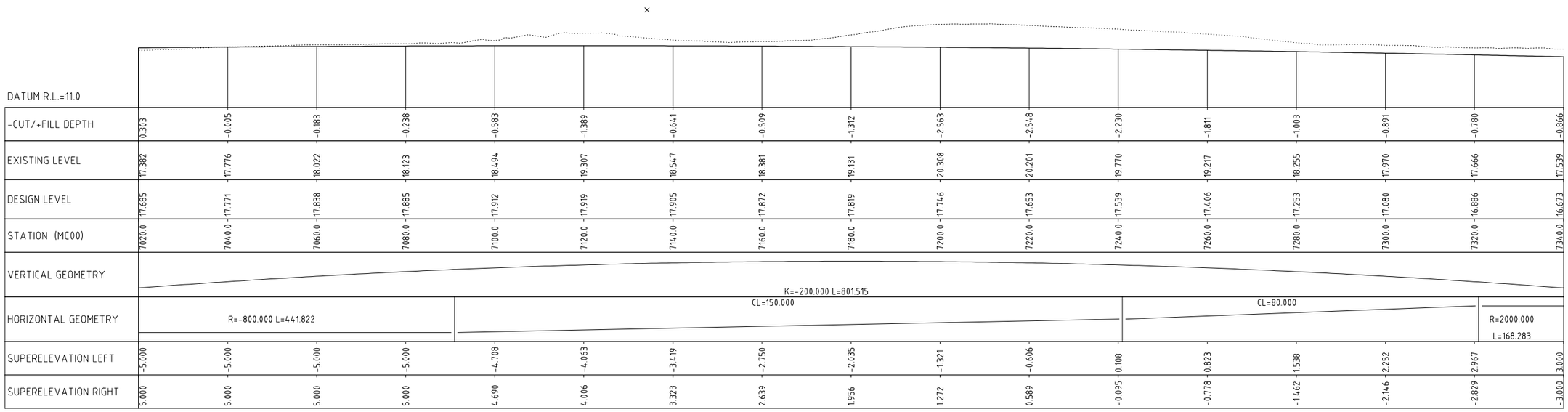
ORIGINAL SIZE A1



GENERALLY NEW FENCEING WILL BE LOCATED ON PROPOSED ROAD RESERVE BOUNDARY, UNLESS INDIVIDUAL PROPERTY AGREEMENTS SUPERSEED

VPI: NO. 6
STN: 7134.185
LVL: 21.926

PLAN
SCALE 1 : 500



LONGITUDINAL SECTION
SCALES – H 1 : 500
V 1 : 100

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

NOT FOR CONSTRUCTION

REV	REVISIONS	PJC DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW				09/14

SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW		
APPROVED	NOT APPROVED	
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 – OTAKI TO NORTH OF LEVIN
WAITARERE BEACH – RP 967/5.10 – RP 967/7.62

WORKING PLAN, MC00

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C207
Rev.: A

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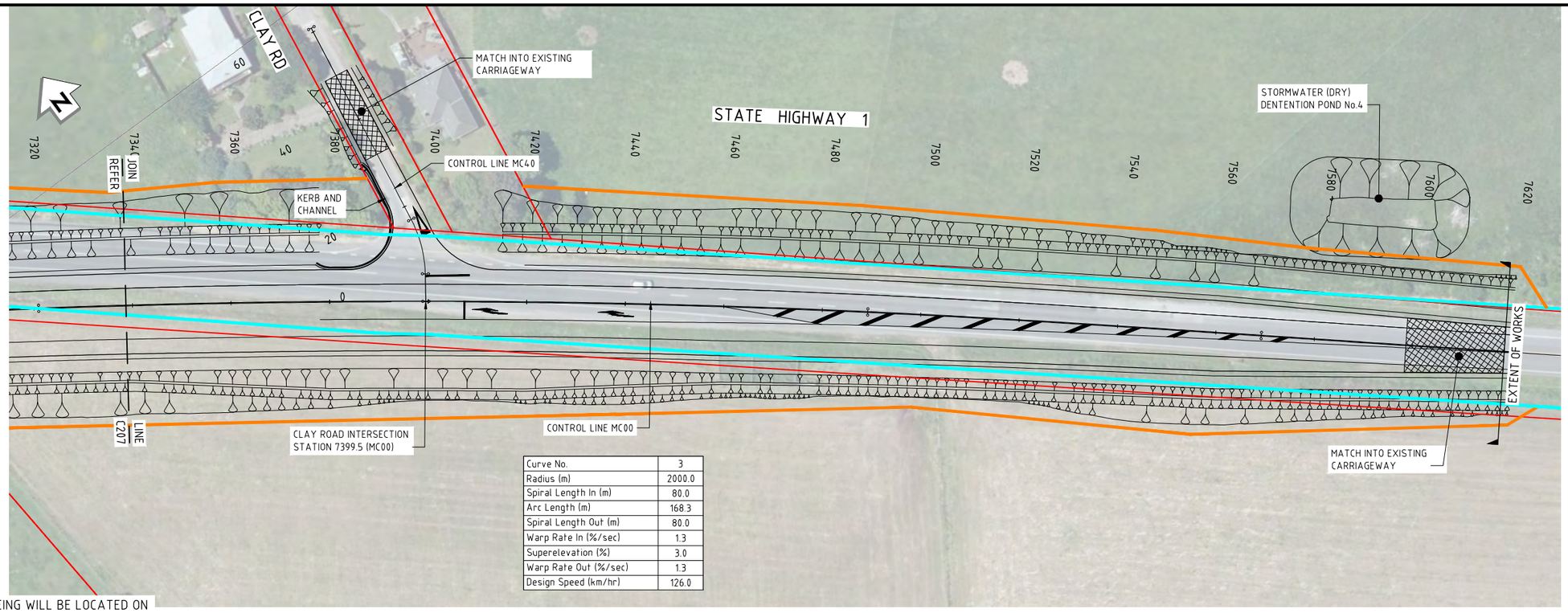
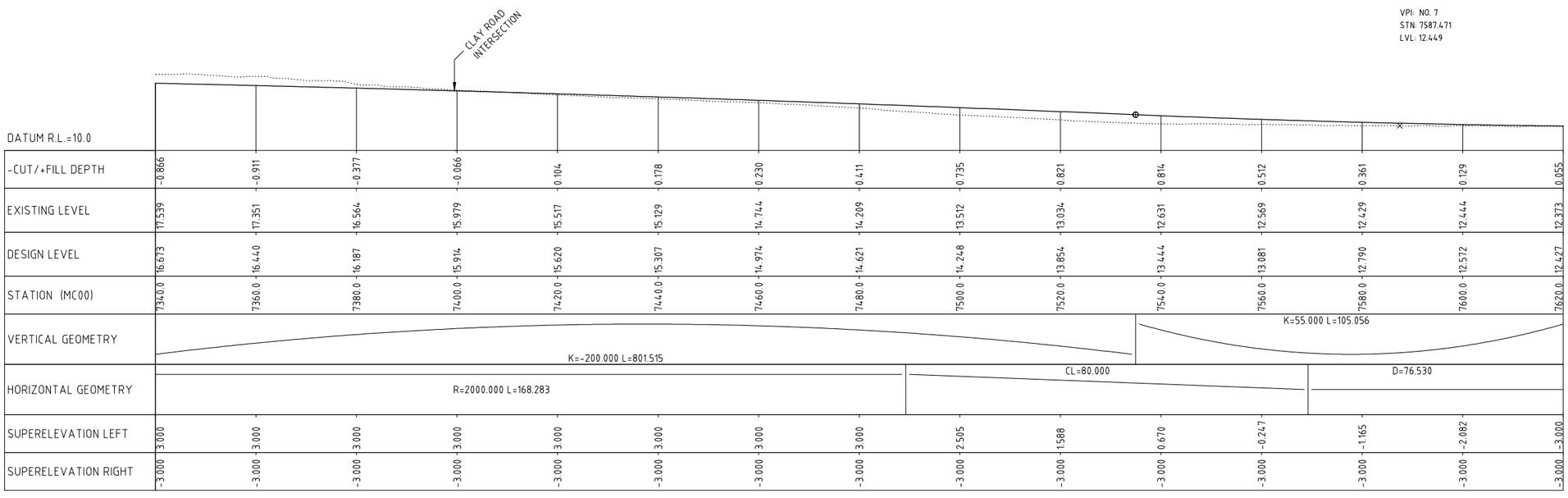


Curve No.	3
Radius (m)	2000.0
Spiral Length In (m)	80.0
Arc Length (m)	168.3
Spiral Length Out (m)	80.0
Warp Rate In (%/sec)	1.3
Superelevation (%)	3.0
Warp Rate Out (%/sec)	1.3
Design Speed (km/hr)	126.0

GENERALLY NEW FENCEING WILL BE LOCATED ON PROPOSED ROAD RESERVE BOUNDARY, UNLESS INDIVIDUAL PROPERTY AGREEMENTS SUPERSEED

PLAN
SCALE 1 : 500



LONGITUDINAL SECTION
SCALES - H 1 : 500
V 1 : 100

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

NOT FOR CONSTRUCTION

REV	REVISIONS	DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW	PJC			09/14

SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW	NOT APPROVED	
APPROVED		
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 - OTAKI TO NORTH OF LEVIN
WAITARERE BEACH - RP 967/5.10 - RP 967/7.62

WORKING PLAN, MC00

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C208
Rev.: A

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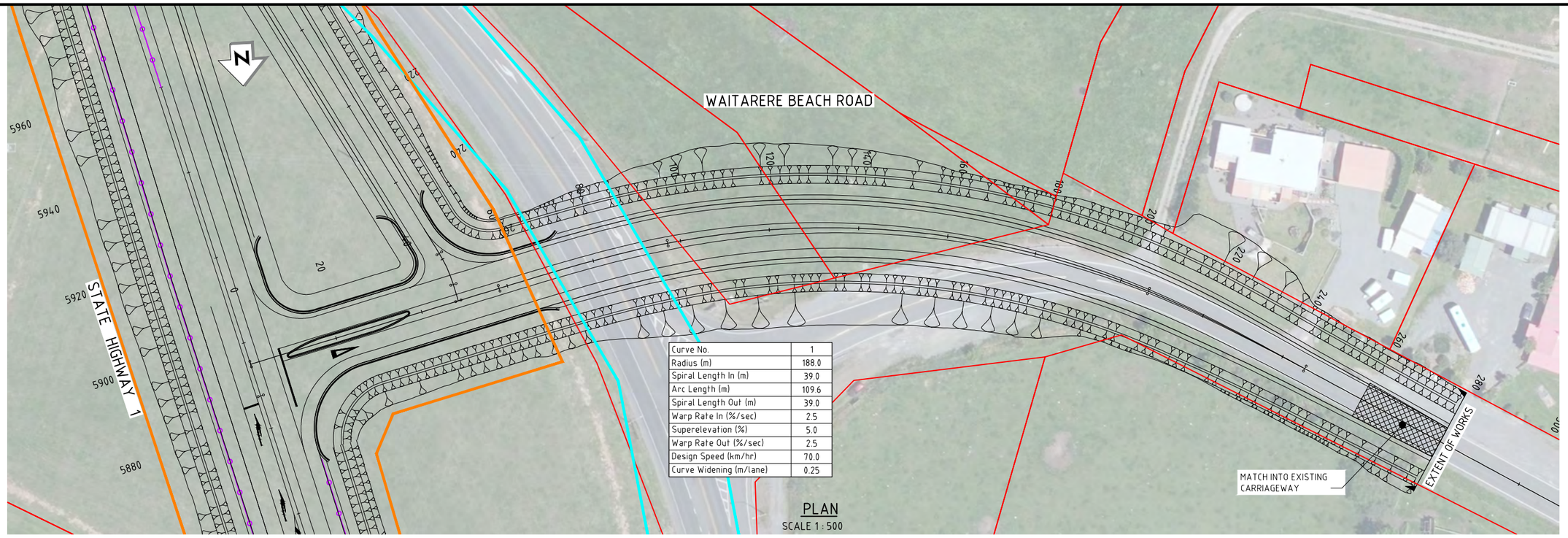
DO NOT SCALE - IF IN DOUBT, ASK
ORIGINAL SIZE A1



Curve No.	1
Radius (m)	188.0
Spiral Length In (m)	39.0
Arc Length (m)	109.6
Spiral Length Out (m)	39.0
Warp Rate In (%/sec)	2.5
Superelevation (%)	5.0
Warp Rate Out (%/sec)	2.5
Design Speed (km/hr)	70.0
Curve Widening (m/lane)	0.25

PLAN
SCALE 1 : 500

GENERALLY NEW FENCEING WILL BE LOCATED ON PROPOSED ROAD RESERVE BOUNDARY, UNLESS INDIVIDUAL PROPERTY AGREEMENTS SUPERSEED

VPI: NO. 1
STN: 0.000
LVL: 21.666

VPI: NO. 2
STN: 16.443
LVL: 21.616

VPI: NO. 3
STN: 134.328
LVL: 23.502

VPI: NO. 4
STN: 223.546
LVL: 23.132

DATUM R.L.=19.0															
-CUT/+FILL DEPTH	-0.340	-0.241	-0.120	-0.254	-0.338	-1.214	-1.222	-1.051	-1.147	-1.057	-0.443	-0.014	-0.005	-0.071	0.023
EXISTING LEVEL	22.006	21.917	21.872	22.059	22.968	24.109	24.317	24.280	24.441	24.352	23.674	23.213	23.229	23.260	23.416
DESIGN LEVEL	21.666	21.676	21.993	22.313	22.629	22.896	23.095	23.228	23.295	23.294	23.232	23.200	23.234	23.330	23.439
STATION (MC10)	0.0	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	280.0
VERTICAL GEOMETRY	P	K	P=1.600% L=51.730		K=-60.000 L=120.887						K=60.000 L=57.550			P=0.544%	L=85.114
HORIZONTAL GEOMETRY	D=58.059		CL=39.000		R=188.000 L=109.550						CL=39.000		D=91.826		

LONGITUDINAL SECTION
SCALES - H 1 : 500
V 1 : 100

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

NOT FOR CONSTRUCTION

REV	REVISIONS	DRN	CHK	APP	DATE
A	FOR CLIENT REVIEW	PJC			09/14

SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW	NOT APPROVED	
APPROVED		
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 - OTAKI TO NORTH OF LEVIN
WAITARERE BEACH - RP 967/5.10 - RP 967/7.62

WORKING PLAN, MC10
WAITARERE BEACH ROAD

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C209
Rev.: A

ORIGINAL SIZE A1

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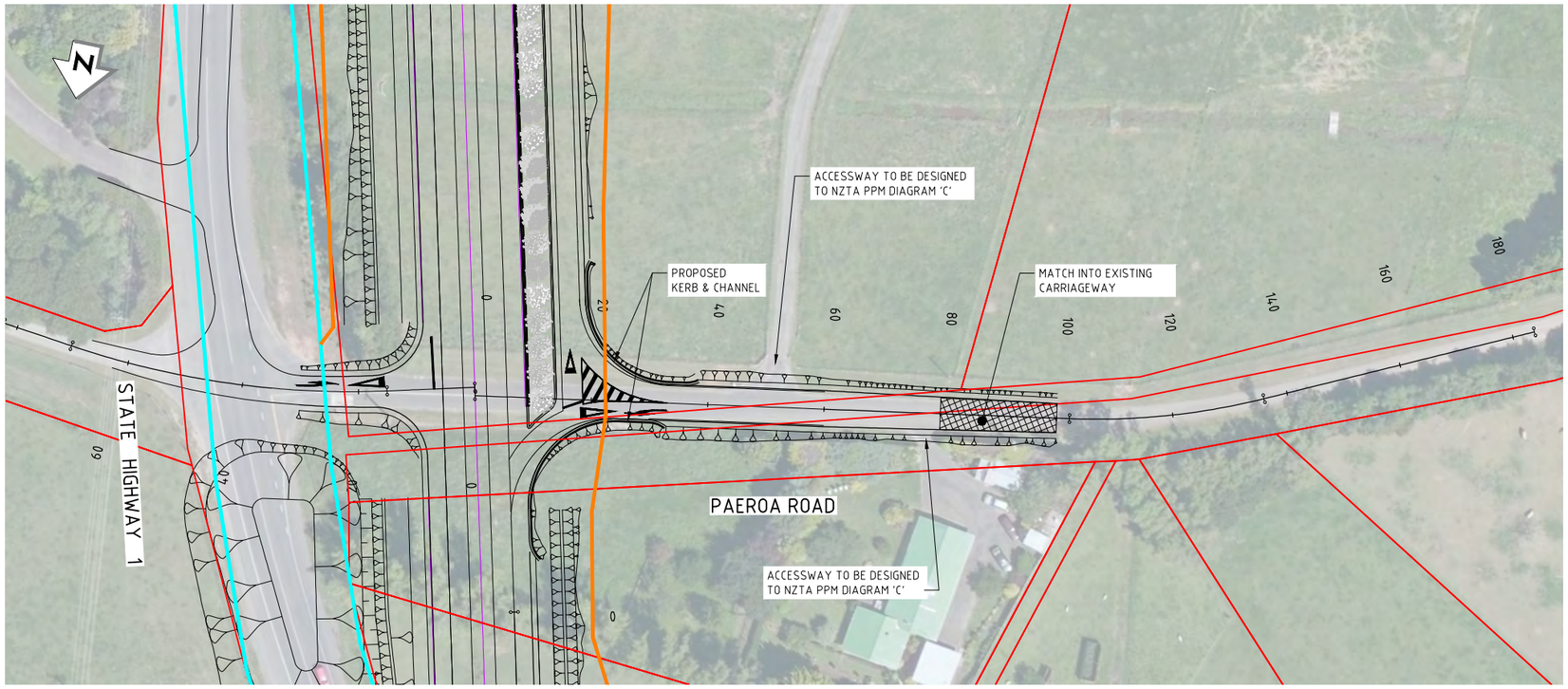


PLAN
SCALE 1 : 500

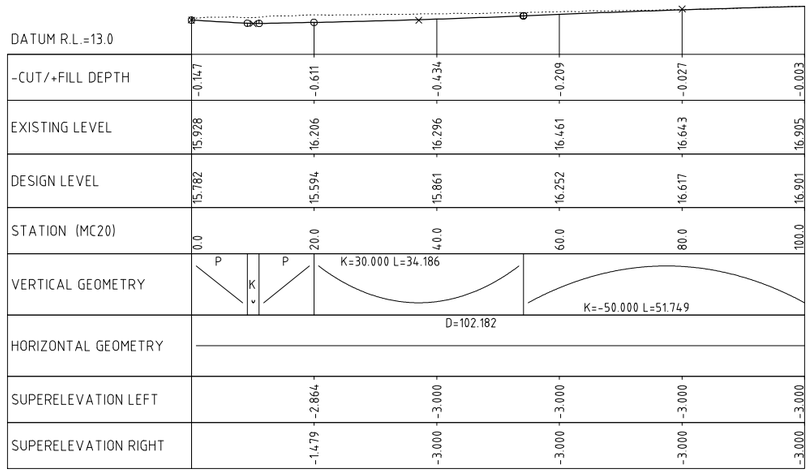
GENERALLY NEW FENCEING WILL BE LOCATED ON PROPOSED ROAD RESERVE BOUNDARY, UNLESS INDIVIDUAL PROPERTY AGREEMENTS SUPERSEED

VPI: NO. 1
STN: 0.000
LVL: 15.782

VPI: NO. 2
STN: 10.071
LVL: 15.495

VPI: NO. 3
STN: 37.062
LVL: 15.765

VPI: NO. 4
STN: 80.029
LVL: 16.684



DATUM R.L.=13.0						
-CUT/+FILL DEPTH	-0.147	-0.611	-0.434	-0.209	-0.027	-0.003
EXISTING LEVEL	15.928	16.206	16.296	16.461	16.643	16.905
DESIGN LEVEL	15.782	15.594	15.861	16.252	16.617	16.901
STATION (MC20)	0.0	20.0	40.0	60.0	80.0	100.0
VERTICAL GEOMETRY	P	K	P	K=30.000 L=34.186	K=-50.000 L=51.749	
HORIZONTAL GEOMETRY	D=102.182					
SUPERELEVATION LEFT		-2.864	-3.000	-3.000	-3.000	-3.000
SUPERELEVATION RIGHT		-1.479	-3.000	-3.000	-3.000	-3.000

LONGITUDINAL SECTION
SCALES - H 1 : 500
V 1 : 100

10 0 10 20m
SCALE 1:500

2 0 5m
SCALE 1:100

NOT FOR CONSTRUCTION

REV	REVISIONS	PJC DRN	CHK	APP	DATE
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SURVEYED	LIDAR & Aerial Photos	04/14
DESIGNED	Barbara Browne	06/14
DRAWN	Phillip Cook	06/14
CAD REVIEW		
DESIGN CHECK		
DESIGN REVIEW	NOT APPROVED	
APPROVED		
PROF REGISTRATION:		

MWH

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

STATE HIGHWAY 1 - OTAKI TO NORTH OF LEVIN
WAITARERE BEACH - RP 967/5.10 - RP 967/7.62

WORKING PLAN, MC20
PAEROA ROAD

Status Stamp: FOR REVIEW
Date Stamp: 26.09.14
Scales: AS SHOWN
Drawing No.: 80500902-04-0853-C210
Rev.: A

ORIGINAL SIZE A1

DO NOT SCALE - IF IN DOUBT, ASK

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Appendix J – Scoping Report Summary

SCOPING REPORT – ASSESSMENT OF OPTIONS – SUMMARY TABLE

Proposal Details							
Activity Name:	Waitarere Beach Road Curves Improvements			Name of Project Manager & Region:	Jo Draper, Wellington		
Activity Description:	A high level investigation and development of preferred corridor options for a four lane expressway north of Otaki. Completed July 2012.						
Background Information							
Geographic Context:	The expressway option was assessed for the section between north of Otaki and north of Levin. This would be a continuation of the development of an expressway that runs from Wellington Airport to north of Levin and would therefore bypass the Waitarere Beach Road Curves section of SH1. There were a number of expressway alignments investigated but all shortlisted options resulted in SH1 being located significantly away from the current Waitarere Beach Road Curves location.						
Social Context:	The expressway alignments had far reaching social impacts, particularly in the vicinities of the urban areas and villages. The main social impact in the Waitarere Beach Road Curves area was ease of access to the expressway.						
Economic Context:	The surrounding land use primarily consists of farm land and several rural residential properties. This section of the State Highway forms part of the economic lifeline of Horowhenua to the Greater Wellington region.						
OPTION – Otaki to north of Levin Expressway							
Option Description:	This option is an expressway as investigated in the Otaki to north of Levin scoping report which would run from Otaki to the Manawatu River.						
Estimated Total Public Sector Funding Requirement:			Lower		Upper		
	Capital Cost ($m):		$330M		$650M		
	Net Property Cost ($m):		$50M		$130M		
	Opex ($m/30yr):		n/a		n/a		
	Maintenance ($m/30yr):		n/a		n/a		
	Present Value of Cost to Govt.($m):		$200M		$450M		
Estimated BCR Range:			0.01		0.12		
Timing of need:	*Optimal Programme:*	n/a		*Likely:*	n/a		
IRS Profile:	*Strategic Fit:*	H	*Effectiveness:*	M	*Efficiency:*	L	
Planning Objectives							
Objective:	Performance against planning objective:						
N/A	This project was assessed against the Otaki to north of Levin objectives rather than the Waitarere Beach Road Curves objectives.						
Rationale for Selection or Rejection of Option:	Option rejected as building a new expressway away from the existing highway did not perform well against the project objectives of value for money or significant improvements in journey time. This was because the expressway options were longer than the existing route. Expressway options that provided a shorter route were rejected earlier in the option selection process as they had serious social, environmental and cultural						

	impacts. The expressway is only viable up to SH1/57 split, therefore the short / medium term solution throughout the SH1 / Waitarere Beach Road Curves project extent is also the longer term solution, and will remain two lanes only.

Appendix K – Social & Environmental Screen

ENVIRONMENTAL AND SOCIAL RESPONSIBILITY SCREEN JUNE 2014

The purpose of the screen is to identify opportunities, inform the risk management process and ensure the environmental and social matters of a highway project have been addressed. The questions below have been categorised into five areas for ease of reference, however a number of the questions relate to multiple categories. Refer to the Environmental and Social Responsibility Screen Explanation for further detail.

PROJECT: WNC RoNS Otaki to Levin: Waitarere Beach Road Curves Upgrade

OPTION: Preferred

DATE: 27 January 2015

NZ TRANSPORT AGENCY WAKA KOTAHI

CATEGORY OF EFFECT	QUESTION	INFORMATION SOURCE	ANSWER (CIRCLE)	RESPONSE/NOTE
SOCIAL	Where is the project located?	NZTA GIS, Stats NZ	Urban/Peri-urban	
			Rural	Small group of rural residential properties and dairy farms in the area.
	What is the construction timeframe?	Project Team	>18 months	
			<18 months	At this stage it is estimated that construction could take around 12 months.
	What are the designation requirements?	Resource Planner	Altered	The existing designation would need to be altered. There are no existing designation conditions.
			Existing	
	Does the option enhance cycling infrastructure and improve access for cyclists?	Project Team, Regional Land Transport Plan	Y	Improved cross section will provide more width on the shoulder
			N	
	Does the option affect community facilities i.e. libraries, open space etc?	District Plan	Y	Requires land from a small Māori church (Brethren)
			N	
NATURAL ENVIRONMENT	Are there any significant natural features/landscapes?	District and Regional Plan and Policy Statement	Y	
			N	The project area neither contains nor is situated within a significant natural feature or landscape.
	Will the project affect the coastal marine area, wetlands, lakes, rivers or their margins?	District and Regional Plan and Policy Statement	Y	A small existing realigned stream in the vicinity of Paeroa Road
			N	
	Will the project affect areas of significant native vegetation or significant habitats of native fauna?	District and Regional Plan and Policy Statement	Y	
			N	There is no significant areas of native vegetation within the proposed alignment and project area
	Are there any natural hazards e.g. fault lines, significant erosion, flooding etc?	District and Regional Plan and Policy Statement	Y	
			N	There is possibly minor surface flooding in the locality due to heavy rain.
	Is the project located on a scenic route?	Tourism NZ	Y	
			N	Is not identified by NZTA or Tourism NZ as scenic route.
	Will more than 0.5 hectares of vegetation be removed?	Project Team, NZTA GIS	Y	
			N	A small amount of woody vegetation (hedged, trees) will need to be removed. This is expected to be less than 0.5ha.
HUMAN HEALTH	What is the One Network Road classification?	State Highway, Asset Management Plan	National or Regional	State Highway 1 (Limited Access Road)
			Regional or Collector	
	Is the area of interest designated as a non-compliant airshed?	NZTA GIS, MfE Website	Y	
			N	The project area is not within an identified airshed
	Are there educational sites in the area of interest?	NZTA GIS, District Plan	Y	The closest educational facility is the Poroutawhao School (primary) some 1500-1800 m north of Waitarere Beach Road. Matau Marae has a kohanga reo facility which is within the project area.
			N	
	Are there medical sites in the area of interest?	NZTA GIS, District Plan	Y	
			N	No medical sites in project area.
	Are there HAIL (contaminated) sites within 200m of the area of interest?	Regional Council	Y	
			N	No identified HAIL sites in project area.
CULTURE AND HERITAGE	Are there listed heritage sites/areas within 200m of the area of interest?	NZTA GIS, Heritage New Zealand Register, NZ Archaeological Association, District Plan	Y	There is a listed archaeological feature within 200m – Ngaere Pa near Waitarere Beach Road. There are other non-protected or non-listed features such as an old flour mill site near Paeroa Road.

			N	
	Are there sites/areas of significance to Maori within 200m of the area of interest?	Iwi	Y	There are a number of sites of interest within 200m including 2 marae, Ngaere Pa, the old mill site, old marae sites, an urupa, and a church.
			N	
URBAN DESIGN	Does the option enhance pedestrian infrastructure and improve access for pedestrians?	Project Team, Regional Land Transport Plan	Y	
			N	There are no existing pedestrian facilities. The project is neutral on pedestrian facilities.
	Does the option enhance public transport infrastructure?	Project Team, Regional Land Transport Plan	Y	
			N	Bus stop facilities will be provided for within the proposed design on Waitarere Beach Road. The project is neutral to minor positive on public transport
	Does the option enhance the development potential of adjacent land where appropriate?	Project Team, Strategies & District Plan	Y	
			N	The project design provides some minor service roads that could facilitate further land development,.
	Does the option enhance community cohesion and accessibility including vehicular connectivity on the local road network?	Project Team, Strategies & District Plan	Y	
			N	There is likely to be some minor inconvenience for local traffic movements due to the proposed median barrier (required for improved safety).
	Does the option enhance the built environment, character and amenity?	Project Team	Y	
			N	The area is a rural area with a limited built environment adjacent to SH1. There is likely to be a minor negative effect on the built environment as an old Māori church will be affected and some houses will become closer to SH1.

SUMMARY	Analyse and summarise the Environmental and Social Responsibility Screen using the information from page 1 and discuss the risks and opportunities and any necessary actions to be taken to meet the NZTA Environmental and Social Requirements. Note – any significant risks should be recorded in the relevant risk register in accordance with Z/44.

Project Overview

The project involves realigning three curves on State Highway 1 from just north of Waitarere Beach Road to just south of Clay Road, modifications to intersections to local side roads and a wire rope median barrier. The realignment will in part fall outside the existing designation in the Horowhenua District Plan.

The realignment will require earthworks (cut and fill) through sand dunes and former swampland (historically drained and converted to pastoral farming). The realigned sections of highway are likely to affect a historically diverted watercourse (for an old flour mill, which is no longer in evidence) that may require diversion or the installation of culverts. The current drainage patterns may also be altered by stormwater management through attenuation ponds and swales. The local drainage pattern has been modified. It is noted that currently there are no culverts under State Highway 1 and new ones are not part of the proposed design.

The project area has a long history of occupation and conflict and contains several significant heritage sites such as urupa, an old Pa site and two Marae close to State Highway 1. It is noted that Ngati Huia and Ngati Matau (Raukawa) have manu whenua status, but it is possible that there may also be archaeological sites of importance to former occupiers, Muaupoko, in the locality. It is expected that Heritage New Zealand authorisations to modify archaeological sites would be required to undertake physical works in the locality.

The area is farmed with the local farmers using the highway to access land on either side of the highway. The need to maintain the current level of access to and across the highway has been clearly communicated by the farmers.

Consultation is being undertaken with landowners and stakeholders who have influenced the design to date. Maori are being consulted with hui held at the two marae that are close to State Highway 1. Further consultation will be required to address specific issues that have arisen during the consultation.

RMA resource consents from Horizons Regional Council and an alteration to the existing designation in the Horowhenua District Plan will be required. Additional project design is anticipated to be needed to support consents sought from Horizons.

Consents may be required for geotechnical bores or test pits. However, the geotechncial investigations programme is proposed to be undertaken once the substantive RMA consents for the proposed work have been obtained.

Key issues or effects

The key issues that are currently known and will need to be addressed are:

- Archaeological, heritage and cultural effects due to proximity to significant sites and the likelihood that Māori land would need to be purchased;
- Effects on social and economic activity due to the land acquisition and the wire rope median barrier; and
- Noise effects due to the proximity of some houses to the highway.

Risks

At this stage the key consenting risks for this project are considered to be:

- Opposition to the barrier by affected farmers and residents. An access solution needs to be found for both farms or they will oppose the project and may possibly appeal.
- Lack of clear project rationale, particularly around the median barrier and the issue of passing lanes (note that passing lanes are not included in the current project). This is due to opposition to the barrier and therefore potential challenges to the project rationale.
- Maori land acquisition. Maori have voiced their concern about no more land being acquired. On the basis of the current design land would be required in the vicinity of both Marae.
- Some loss of primary production land.

Possible Risk Mitigation Actions

At this stage the following actions may be required to reduce the risks:

- Refinement of the design to reduce the Māori and farm land requirement
- Examine solutions for farmer access across the highway
- Enunciation of clear project rationale, particularly around the median barrier and resolution of the issue of passing lanes
- Undertake assessment of environmental and cultural effects to identify mitigation options and endeavour obtain agreement on these with affected stakeholders

Completed by	Steven Kerr, Principal Planner, MWH, 27 January 2015.
Reviewed by NZTA Project Manager	Greg Lee, Principal Planner (Contractor), Wellington Transport Planning Team, 28 January 2015