Warkworth to Wellsford

Assessment of Effects on the Environment

March 2020

Warkworth to Wellsford Project

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Glossary of Abbreviations

The table below sets out the technical abbreviations

Abbreviation/acronym	Term
AAAQTs	Auckland Ambient Air Quality Targets
AADT	Average Annual Daily Traffic
ADP	Accidental discovery protocol
AEE	Assessment of Effects on the Environment
AEP	Annual Exceedance Probability
ANZECC/ARMCANZ	Australia and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand
ARI	Average Return Interval
ART	Auckland Regional Transport
ARLTP	Auckland Regional Land Transport Plan 2015-2025
AS/NZS 1158:2005	Standards New Zealand and Standards Australia, 2005
ASCV	Area of Significant Conservation Value
ASD	Approach Site Distance
ATP	Audio Tactile Profile (rumble strip)
AUP(OP)	Auckland Unitary Plan (Operative in Part)
BMM	Building modification mitigation
BPO	Best Practicable Option
BNZ/GLEAMS	Basin New Zealand and Groundwater Loading Effects of Agricultural Management Systems
CAQMP	Construction Air Quality Management Plan
CAS	Crash Analysis System
CEMP	Construction Environmental Management Plan
CESCP/s	Construction Erosion and Sediment Control Plan/s
CHI	Cultural Heritage Inventory
CLM	Contaminant Load Model
CLMP	Contaminated Land Management Plan
CLoS	Customer Levels of Service
CMA	Coastal Marine Area
CNVMP	Construction Noise and Vibration Management Plan
CoPTTM	Code of Practice for Temporary Traffic Management
Council	Auckland Council
CTMP	Construction Traffic Management Plan
CTP	Chemical Treatment Management Plan
CVA	Cultural Values Assessment

Abbreviation/acronym	Term
dB	Decibel
CWD	Clean Water Diversions
dB	Decibel
DBC	Detailed Business Case
DEB	Decanting Earth Bund
DOC	Department of Conservation
DSI	Detailed Site Investigation
DWD	Dirty Water Diversions
ECR	Environmental Compensation Ratio
EIANZ	Environment Institute of Australia and New Zealand
EM	Ecological Mitigation Series
EMMP	Ecological and Mitigation Management Plan
EPT	Ephemeroptera, Plecoptera and Trichoptera
ES	Ecological Sites
ESC	Erosion and Sediment Control
ESR	Environmental and Social responsibility
ESCP	Erosion and Sediment Control Plan
FFR	Freshwater Fisheries Regulations 1983
FIDOL	Frequency, Intensity, Duration, Offensiveness and Location factors
GD01	Stormwater Management Devices in the Auckland Region – Guideline Document 2017/001
GD05	Auckland Council Guidance for Erosion and Sediment Control
GDP	Gross Domestic Profit
GIS	Geographical Information System
GPS 2009	Government Policy Statement on Land Transport Funding 2009/2010 – 2018/19
GPS 2018	Government Policy Statement on Land Transport 2018/19–2027/28
ha	Hectares
HAIL	Hazardous Activities and Industries List
HAMP	Heritage and Archaeological Management Plan
HCV	Heavy Commercial Vehicles
HGMPA	Hauraki Gulf Marine Park Act 2000
HNZPT	Heritage New Zealand Pouhere Taonga
HNZPTA	Heritage New Zealand Pouhere Taonga Act 2014
HPMV	High Productivity Motor Vehicle
HSR	Highly Sensitive Receiver, as defined in the Transport Agency Guide to assessing air quality impacts from state highway projects (2015)

Abbreviation/acronym	Term
IAIA	International Association for Impact Assessment
IKHMG	Integrated Kaipara harbour Management Group
IMF	Integrated Management Framework
KDBP	Kauri Dieback Biosecurity Plan
KHIPA	Kaipara Harbour Integrated Strategic Plan of Action 2011
km	Kilometres
km2	Square kilometres
km/h	Kilometres per hour
kV	Kilovolt
LCA	Landscape character areas
LG(AC)A	The Local Government (Auckland Council) Act 2009
LINZ	Land Information New Zealand
LOS	Level of service
LTMA	Land Transport Management Act 2003
L/s	Litres per second
m	Metres
m2	Square metres
m3	Cubic metres
mgbl	Metres below ground level
MCA	Multi Criteria Analysis
MCI	Macroinvertebrate Community Index
MfE	Ministry for the Environment
MfE Dust Guide	Ministry for the Environment Good Practice Guide for Assessing and Managing Dust 2016
MSE	Mechanically Stabilised Earth
NAL	North Auckland Line
NEAP	Tai Tokerau Northland Economic Action Plan 2016
NES	National Environmental Standard
NESAQ	Resource Management (National Environmental Standard for Air Quality) Regulations 2004
NESETA	Resource Management (National Environmental Standard for Electricity Transmission Activities) Regulations 2009
NESSHDW	National Environmental Standards for Sources of Human Drinking Water 2007
NESPF	Resource Management (National Environmental Standard for Plantation Forestry) Regulations 2018

Abbreviation/acronym	Term
NES Soil	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
NFDS	National Freight Demands Study
NIWA	National Institute of Water and Atmoshperic Research
NLTP	National Land Transport Programme
NoR	Notice of Requirement
NO_2	Nitrogen dioxide
NPS	National Policy Statement
NPSET	National Policy Statement on Electricity Transmission 2008
NPSFM	National Policy Statement for Freshwater Management 2014
NPSUDC	National Policy Statement on Urban Development Capacity 2016
NRLTP	Northland Regional Land Transport Plan 2015-2021
NSMA	Natural Stream Management Area
NZAA	New Zealand Archaeological Association
NZCPS	New Zealand Coastal Policy Statement 2010
NZDWS 2008	New Zealand Drinking Water Standard
NZTS	New Zealand Transport Strategy
NZS 6803	New Zealand Standard NZS 6803:1999 “Acoustics – Construction Noise”
NZS 6806	New Zealand Standard NZS 6806:2010 “Acoustics – Road traffic noise – New and altered roads”
OGPA	Open Graded Porous Asphalt
ONC	Outstanding Natural Character
ONF	Outstanding Natural Feature
ONL	Outstanding Natural Landscape
ONRC	One Network Road Classification system
P-W	Ara Tūhono Pūhoi to Wellsford project
P2Wk	Pūhoi to Warkworth project
PBC	Programme Business Case
PPFs	Protected Premises and Facilities
PPP	Public Private Partnership
ppv	Peak Particle Velocity
PSI	Preliminary Site Investigation
PWA	Public Works Act 1981
RCA	Road Controlling Authority
REC	River Environment Classification

Abbreviation/acronym	Term
RFHA	River Flood Hazard Assessment
RLTS	Regional Land Transport Strategy 2010
RMA	Resource Management Act 1991
RMF	Rayonier Matariki Forests
RoNS	Roads of National Significance
RPS	Regional Policy Statement
RSA	Road Safety Audit
SAP	Site Access Points
SAR	Scheme Assessment Report
SEA	Significant Ecological Area
SEA-M1	Significant Ecological Area – Marine 1
SEA-M2	Significant Ecological Area – Marine 2
SEV	Stream Ecological Valuation
SH(x)	State highway (number)
SIA	Social Impact Assessment
SIDRA	Signalised and un-signalised Intersection Design and Research Aid
SOI 2017	Statement of Intent 2017-2021
SRA	Safe Road Alliance
SRP	Sediment Retention Pond
SSF	Super silt fences
SSTMP	Site Specific Traffic Management Plans
TPH	Total petroleum hydrocarbons
TP90	Auckland Regional Council Technical Publication No. 90
Transport Agency	NZ Transport Agency
TSS	Total Suspended Solids
TTM	Temporary Traffic Management
ULDF	Urban and Landscape Design Framework
ULDMPs	Urban and Landscape Design Management Plans
vpd	Vehicles Per Day
vph	Vehicles Per Hour
WWII	World War Two
2D	Two dimensional

Glossary of Defined Terms

The table below sets out the defined terms (and some acronyms above apply)

Term	Definition
Ambient air	The air outside that reflects the cumulative effect of all activities both human induced and natural. It does not refer to indoor air, air in the workplace, or to contaminated air as it is discharged from a source.
Ambient noise/vibration	The total noise or vibration existing at a specified point and time associated with a given environment, excluding the sound or vibration requiring control. It is a composite of all noise or vibration sources, near and far.
Amenity values	Defined in section 2(1) of the RMA as "those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes."
Annual exceedance probability	Defined in section J1 of the AUP(OP), as "the probability of exceeding a given threshold within a period of one year. It can be applied to any type of risk".
Archaeological site	Defined in section 6 of the Heritage New Zealand Pouhere Taonga Act 2014 as "Means, subject to section 42(3), (a) any place in New Zealand, including any building or structure (or part of a building or structure), that (i) was associated with human activity that occurred before 1900 or is the site of the wreck of any vessel where the wreck occurred before 1900; and (ii) provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand; and (b) includes a site for which a declaration is made under section 43(1)."
Average annual daily traffic	The equivalent to the total volume of traffic passing a roadside observation point over the period of a calendar year, divided by the number of days in that year for which traffic volumes were recorded. Measured in vehicles per day.
Average Recurrence Interval	The average time period between rainfall or flow events that exceed a given magnitude.
Best practicable option	Defined in section 2(1) of the RMA, as "in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to – (a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and (b) the financial implications, and the effects on the environment, of that option when compared with other options; and (c) the current state of technical knowledge and the likelihood that the option can be successfully applied."
Construction works	Activities undertaken to construct the Project.

Term	Definition
Contaminant	Defined in section 2(1) of the RMA, as "any substance (including gases, odorous compounds, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat – (a) when discharged into water, changes or is likely to change the physical, chemical, or biological condition of water; or (b) when discharged onto or into land or into air, changes or is likely to change the physical, chemical or biological condition of the land or air onto or into which it is discharged."
Contaminated land	Defined in section 2(1) of the RMA, as "land that has a hazardous substance in or on it that – (a) has significant adverse effects on the environment; or (b) is reasonably likely to have significant adverse effects on the environment."
Damming	Defined in section J1 of the AUP(OP), as "the activity of impounding surface water (and any substances dissolved in, suspended in or otherwise combined with the water) with any structure. This excludes water held in tanks, rain gardens, culverts and culvert headwalls and reclamation or drainage which results in the creation of dry land".
dB $L_{Aeq(24h)}$	Sound pressure level average, A-weighted, sound pressure level over the measurement period of 24 hours.
Designation	Defined in section 166 of the RMA, as "a provision made in a district plan to give effect to a requirement made by a requiring authority under section 168 or section 168A or clause 4 of Schedule 1 of the RMA."
Proposed designation boundary	The boundary of the land to which the notice of requirement applies.
Discharge	Defined in section 2(1) of the RMA, as including emitting, depositing, and allowing to escape.
Diversion of stormwater	Defined in section J1 of the AUP(OP), as "altering the natural course of stormwater flow, primarily through recontouring land or the establishment of impervious surfaces and associated drainage."
Earthworks	Defined in section J1 of the AUP(OP), as "disturbance of soil, earth or substrate land surfaces. Includes: blading, boring (greater than 250mm diameter); contouring; cutting; drilling (greater than 250mm diameter); excavation; filling; ripping; moving; placing; removing; replacing; trenching; and thrusting (greater than 250mm diameter). Excludes: ancillary forest earthworks; and ancillary farming earthworks."
Ephemeral stream	Defined in section J1 of the AUP(OP), as "stream reaches with a bed above the water table at all times, with water only flowing during and shortly after rain events. This category is defined as those stream reaches that do not meet the definition of permanent river or stream or intermittent stream".
Erosion control	Methods to prevent or minimise the erosion of soil, in order to minimise the adverse effects that land disturbing activities may have on a receiving environment.
Fish passage	The movement of fish between the sea and any river, including up-stream or downstream in that river.

Term	Definition
Flocculation	The process whereby fine particles suspended in the water column clump together and settle. In some instances, this can occur naturally, such as when fresh clay-laden flows mix with saline water, as occurs in estuaries. Flocculation can be used to promote rapid settling in sediment retention ponds by the addition of flocculating chemicals (flocculants).
Fuels and gas pipelines	Refining NZ and First Gas fuels and gas pipelines.
Groundwater	Natural water contained within soil and rock formations below the surface of the ground.
Heavy vehicle	A motor vehicle having a gross laden weight exceeding 3500 kg.
Historic heritage site	A site that is not identified as an archaeological site, but which has heritage significance.
Hui	Meeting or workshop with Mana Whenua.
Indicative Alignment	An indicative road design alignment assessed by the technical experts that may be refined on detailed design within the designation boundary. The Indicative Alignment is a preliminary alignment of a state highway that could be constructed within the proposed designation boundary. The Indicative Alignment has been prepared for assessment purposes, and to indicate what the final design of the Project may look like. The final alignment for the Project will be refined and confirmed at the detailed design stage.
Intermittent stream	Defined in section J1 the AUP(OP), as “stream reaches that cease to flow for periods of the year because the bed is periodically above the water table. This category is defined by those stream reaches that do not meet the definition of permanent river or stream and meet at least three of the following criteria: (a) it has natural pools; (b) it has a well-defined channel, such that the bed and banks can be distinguished; (c) it contains surface water more than 48 hours after a rain event which results in stream flow; (d) rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel; (e) organic debris resulting from flood can be seen on the floodplain; or (f) there is evidence of substrate sorting process, including scour and deposition.”
Kaitiakitanga	Guardianship.
$L_{Aeq\ (t)}$	The average, A-weighted, sound pressure level over the measurement period, t.
$L_{A90\ (t)}$	The A-weighted sound pressure level equalled or exceeded for 90% of the measurement period, t. This is commonly referred to as the background noise level.
L_{AFmax}	The maximum fast time weighted, A-frequency weighted sound pressure level which occurs during the measurement period.
Mainline carriageway	The mainline carriageway is the through-route portion of the Project, excluding the on and off ramps at interchanges, and works to local roads and the existing SH1.

Term	Definition
Mauri	The essential quality and vitality of a being or entity.
Network Utility Operator	As defined in section 166 of the RMA, "means a person who— (a) undertakes or proposes to undertake the distribution or transmission by pipeline of natural or manufactured gas, petroleum, biofuel, or geothermal energy; or (b) operates or proposes to operate a network for the purpose of— (i) telecommunication as defined in section 5 of the Telecommunications Act 2001; or (ii) radiocommunication as defined in section 2(1) of the Radiocommunications Act 1989; or (c) is an electricity operator or electricity distributor as defined in section 2 of the Electricity Act 1992 for the purpose of line function services as defined in that section; or (d) undertakes or proposes to undertake the distribution of water for supply (including irrigation); or (e) undertakes or proposes to undertake a drainage or sewerage system; or (f) constructs, operates, or proposes to construct or operate, a road or railway line; or (g) is an airport authority as defined by the Airport Authorities Act 1966 for the purposes of operating an airport as defined by that Act; or (h) is a provider of any approach control service within the meaning of the Civil Aviation Act 1990; or (i) undertakes or proposes to undertake a project or work prescribed as a network utility operation for the purposes of this definition by regulations made under this Act, — and the words network utility operation have a corresponding meaning."
Overland flow path	Defined in section J1 of the AUP(OP), as "a low point in terrain, excluding a permanent watercourse or intermittent river or stream, where surface runoff will flow, with an upstream contributing catchment exceeding 4,000 m2."
Permanent river or stream	Defined in section J1 of the AUP(OP), as "the continually flowing reaches of any river or stream."
Pier	Vertical support structure for a bridge.
PM10	Particulate matter with a diameter less than 10 micrometres.
PM2.5	Particulate matter with a diameter less than 2.5 micrometres.
Project	The Ara Tūhono Pūhoi to Wellsford project: Warkworth to Wellsford section.
Project area	The area within the proposed designation boundary, and immediate surrounds to the extent Project works extend beyond this boundary.
Project works	All proposed activities associated with the Project.
Sediment control	Defined in section J1 of the AUP(OP), as "measures to prevent or minimise the discharge of sediment that has been eroded."
Sediment yield	That sediment which leaves the sediment retention devices and enters the receiving environment.

Term	Definition
Stabilised area	An area inherently resistant to erosion such as rock, or rendered resistant by the application of aggregate, geotextile, vegetation or mulch. Where vegetation is to be used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once an 80% vegetation cover has been established.
State highway	Means a road, whether or not constructed or vested in the Crown, that is declared to be a State highway under section 11 of the National Roads Act 1953, section 60 of the Government Roading Powers Act 1989 (formerly known as the Transit New Zealand Act 1989), or under section 103 of the LTMA.
Taonga	A treasured/highly prized object or natural resource.
The Dome	The highest elevation within the Dome Forest Conservation Area.
The Application	Notice of Requirement and applications for resource consent

1. Introduction

1.1. Introduction to this Report

The NZ Transport Agency (Transport Agency) has lodged a Notice of Requirement (NoR) and applications for resource consent (collectively referred to as "the Application") for the Warkworth to Wellsford Project (the Project).

This Project is the second stage of the Ara Tūhono Pūhoi to Wellsford (P-W) project covering the State Highway 1 (SH1) corridor from the Northern Gateway Toll Road at the Johnstone's Hill tunnels, to Wellsford and Te Hana. The first stage, the Pūhoi to Warkworth project (P2Wk), was progressed as a separate project. It proceeded through scheme assessment, selection of a preferred alignment, and designation through a Board of Inquiry and is under construction. P2Wk provides a new and alternative alignment to the existing SH1 route between Pūhoi and SH1 just south of the Kaipara Flats Road intersection, which lies to the north of Warkworth.

This report has been prepared to support the Application for the Project, covering a new alignment for SH1 north from Wyllie Road, bypassing Wellsford and Te Hana, to tie in with a connection back to the existing SH1 north of Te Hana.

In summary, the primary reasons for the Project are to:

- Improve safety performance to reduce incidents on SH1;
- Improve route security and resilience of the state highway network north of Auckland;
- Reduce travel times and improve travel time reliability along the state highway network north of Auckland;
- Improve freight travel times, safety and reliability; and
- Improve the amenity of Wellsford and Te Hana through the removal of heavy truck movements through the townships.

1.2. The Requiring Authority/Applicant

The Transport Agency is a Crown entity established on 1 August 2008 under the Land Transport Management Act 2003 (LTMA). As a Crown entity it must give effect to government policy as directed by the Minister of Transport.

The Transport Agency's statutory objective, as set out in section 94 of the LTMA is:

> "*to undertake its functions in a way that contributes to an effective, efficient, and safe land transport system in the public interest*".

This objective also forms one of the Transport Agency's functions as defined in section 95(1)(a) of the LTMA.

The Transport Agency's other key function of relevance to the Project is:

> "*to manage the State highway system, including planning, funding, design, supervision, construction, and maintenance and operations, in accordance with this Act* [the LTMA] *and the Government Roading Powers Act 1989*" *(section 95(1)(c)).*

In meeting its objective and undertaking its functions the Transport Agency must adhere to, among others, the operating principles set out in section 96 of the LTMA. These operating principles include an obligation to exhibit a sense of social and environmental responsibility (section 96(1)(a)).

The Transport Agency's organisational direction is comprehensively set out in its Statement of Intent 2017–21 (SOI 2017). The SOI 2017 states that its direction will enable the Transport Agency to:

> *"...more effectively deliver on the transport sector goal for a transport system that maximises economic and social benefits for New Zealand and minimises harm"*.[1]

The SOI 2017 further states that the direction:

> "*…will also contribute to the government's wider priorities, providing modern infrastructure and services that support a more productive economy with more jobs, higher incomes and higher living standards.*"[2].

The Transport Agency is a network utility operator under the Resource Management Act 1991 (RMA) and is approved as a requiring authority under section 167 of that Act.[3] The Transport Agency's approval as a requiring authority includes:[4]

> *"the construction and operation (including the maintenance, improvement, enhancement, expansion, realignment and alteration) of any State highway or motorway pursuant to the Government Roading Powers Act".*

The Transport Agency, in its capacity as a requiring authority, is giving notice of a requirement for, and is also lodging resource consent applications for, the future construction, operation and maintenance of the Project.

1.3. The Warkworth to Wellsford Project

The Project involves the construction, operation and maintenance of a new four lane state highway, approximately 26 km in length. The Project commences at the interface with P2Wk near Wyllie Road and passes to the west of the existing SH1 alignment near The Dome, before crossing SH1 just south of the Hōteo River. North of the Hōteo River, the Project passes to the east of Wellsford and Te Hana, bypassing these centres. The Project ties into the existing SH1 to the north of Te Hana, near Maeneene Road.

[1] Statement of Intent 2017-21, Page 3.
[2] Statement of Intent 2017-21, Page 3.
[3] See Resource Management (Approval of Transit New Zealand Limited as Requiring Authority) Order 1992; Resource Management (Approval of Transit New Zealand as Requiring Authority) Notice 1994; and Resource Management (Approval of NZ Transport Agency as a Requiring Authority) Notice 2015.
[4] Resource Management (Approval of Transit New Zealand as Requiring Authority) Notice 1994.

The key components of the Project, based on the current Indicative Alignment, are shown on Figure 1-1 and summarised below (noting the Application seeks comprehensive approvals for all components of the Project):

a) A new four lane dual carriageway state highway, offline from the existing SH1, with the potential for slow vehicle lanes on the steeper grades.

b) Three interchanges as follows:

   i. Warkworth Interchange to tie-in with P2Wk and provide a connection to the northern outskirts of Warkworth.

   ii. Wellsford Interchange located at Wayby Valley Road to provide access to Wellsford and eastern communities including Tomarata and Mangawhai.

   iii. Te Hana Interchange located at Mangawhai Road to provide access to Te Hana, Wellsford and communities including Port Albert, Tomarata and Mangawhai.

c) Twin bore tunnels under Kraack Road, each serving one direction, that are approximately 850 metres long and approximately 160 metres below ground level at the deepest point.

d) A series of steep cut and fills through the forestry area to the west of the existing SH1 (west of The Dome) and other areas of cut and fill along the remainder of the Project.

e) A viaduct (or twin structures) approximately 485 metres long, to span over the existing SH1 and the Hōteo River.

f) A tie in to existing SH1 north of Maeneene Road, including a bridge over Maeneene Stream.

g) Changes to local roads:

   i. Maintaining local road connections through grade separation (where one road is over or under the other). The Indicative Alignment passes over Woodcocks Road, Wayby Valley Road, Whangaripo Valley Road, Mangawhai Road and Maeneene Road. The Indicative Alignment passes under Kaipara Flats Road, Rustybrook Road, Farmers Lime Road and Silver Hill Road.

   ii. Realignment of sections of Wyllie Road, Carran Road, Kaipara Flats Road, Phillips Road, Wayby Valley Road, Mangawhai Road, Vipond Road, Maeneene Road and Waimanu Road.

   iii. Closing sections of Phillips Road, Robertson Road, Vipond Road and unformed roads affected by the Project.

h) Associated works including bridges, culverts, stormwater management systems, soil disposal sites, signage, lighting at interchanges, landscaping, realignment of access points to local roads, and maintenance facilities.

i) Construction activities, including construction compounds, borrow sites, lay down areas and establishment of construction access and haul roads.

Further details of the Project are contained in *Section 4: Description of the Project* and *Section 5: Construction of the Project* of this Assessment of Effects on the Environment (AEE).

The Indicative Alignment is a preliminary alignment of a state highway that could be constructed within the proposed designation boundary. The Indicative Alignment has been prepared for assessment purposes, and to indicate what the final design of the Project may look like. The final alignment for the Project (including the design and location of associated works including bridges, culverts, stormwater management systems, soil disposal sites, signage, lighting at interchanges, landscaping, realignment of access points to local roads, and maintenance facilities), will be refined and confirmed at the detailed design stage.

The timing for construction of the Project is not certain. To enable an assessment of the potential effects of the Project on the environment, the assumed construction start date is 2030. However, the actual timing for construction could be sooner or later than this date.

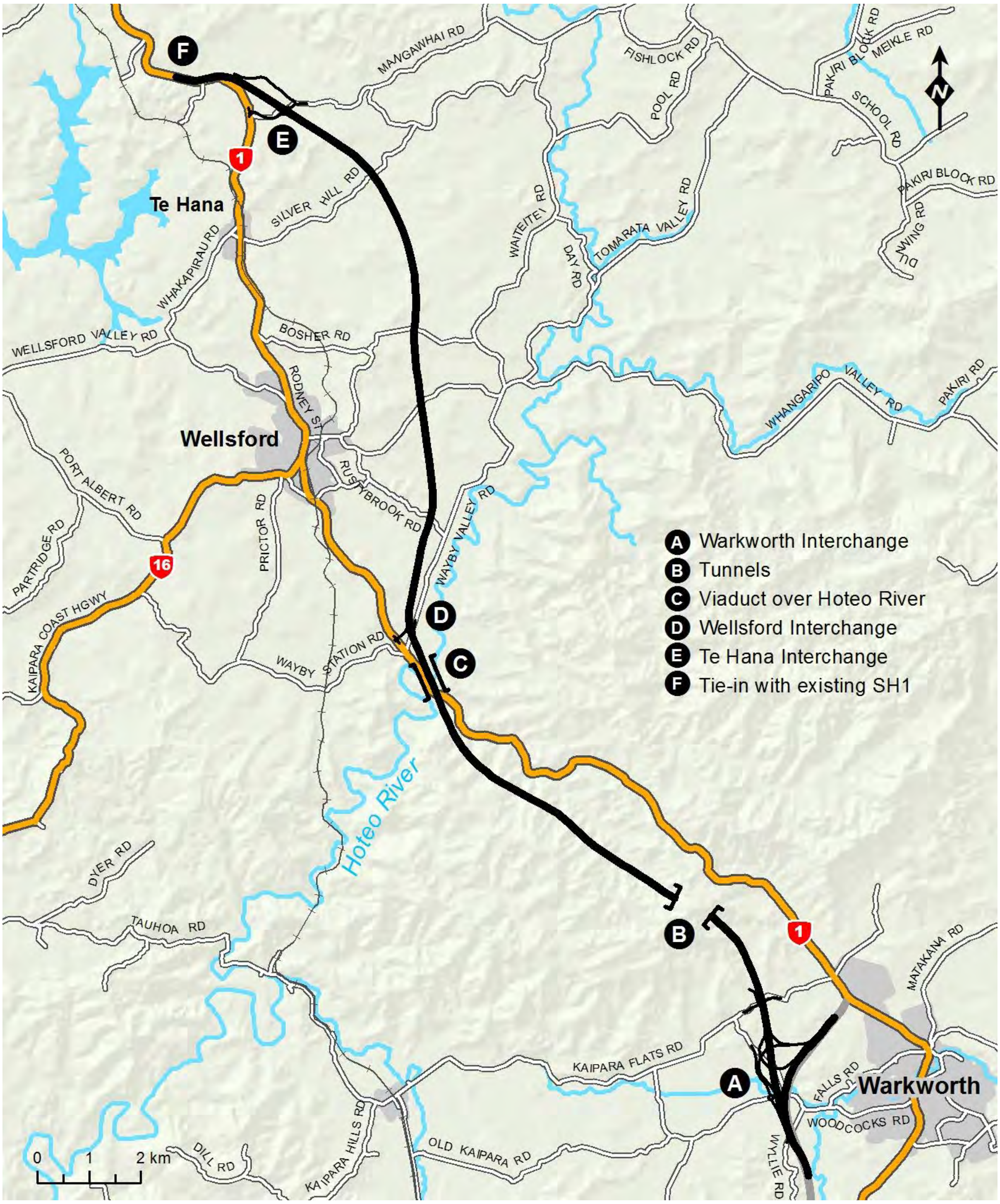

Figure 1-1: Key Project components

1.4. NoR to be confirmed and resource consents sought ("the Application")

To enable the construction, operation and maintenance of the Project, a new designation is proposed, and resource consents are sought.

1.4.1. NoR

The extent of the proposed designation is from Wyllie Road, north of Warkworth, bypassing Wellsford and Te Hana to tie in with a connection north of Te Hana. The proposed designation covers a total area of approximately 1,294 hectares (ha).

The extent of the proposed designation is sufficient to construct, operate, and maintain the Project, and includes land for access to construction sites, construction compounds, soil disposal, and mitigation of effects.

Once the Project is operational the Transport Agency will review the extent of the designation boundary and may remove any parts that are not required for the safe and efficient long-term operation, maintenance and improvements to the state highway. The Transport Agency will inform Auckland Council of its intention to remove parts of the designation (if required) following the process set out in section 182 of the RMA.

The proposed designation boundary is shown on the designation plans attached to the Notice of Requirement (NoR) and in the drawings in *Volume 3: Drawing Set*.

The Transport Agency will submit outline plans to Auckland Council under section 176A of the RMA or details required by designation conditions once the Project's detailed design has been progressed to an appropriate level of detail and prior to the commencement of the construction work. It is anticipated that some aspects of detailed design will be staged to accommodate an efficient construction programme.

1.4.2. Resource consents

Various resource consents are required for the construction, operation and maintenance of the Project as detailed in *Section 6: Statutory context* of this AEE. In summary, the following resource consents are required pursuant to the Auckland Unitary Plan (Operative in Part) (AUP(OP)):

- Land use consents in accordance with sections 9(2) and 13 of the RMA;
- Water permits in accordance with section 14 of the RMA; and
- Discharge permits in accordance with section 15 of the RMA.

1.4.3. Later approvals

The AEE is based on an Indicative Alignment and indicative construction methodology. Once a contractor is appointed and detailed design undertaken, additional approvals for the Project may be required and will be obtained prior to construction. These approvals may include:

- Resource consents determined relevant at the time of construction, such as consents for soil disturbance under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES Soil); forestry removal under the National Environmental Standard for Plantation Forestry (NESPF); water takes (e.g. for dust management); consents or consent

variations required to modify covenants relating to the removal of vegetation; and wastewater discharges from site office facilities;
- Archaeological Authority from Heritage New Zealand Pouhere Taonga (HNZPT) to modify and/or destroy or modify any known archaeological sites;
- Wildlife Act Authority to relocate any protected species prior to the commencement of construction; and
- Authority under the Freshwater Fisheries Regulations relating to fish passage.

1.5. Structure of the Application and supporting documents

This AEE and the associated technical reports, design drawings and supporting information, contains the information required by the RMA and the AUP(OP). The structure of the Application is set out in Table 1-1.

Table 1-1: Structure of the Application

Volume	Name	Contents
	Notice of Requirement	Form for Notice of Requirement (Form 18). Gazette notices. Designation plans showing the land to which the Notice of Requirement relates. Schedule of land directly affected by the Notice of Requirement. Proposed designation conditions.
	Resource Consent Application Forms	Forms for resource consents (Form 9). Schedule of land directly affected by the resource consents. Proposed resource consent conditions.
1	Assessment of Effects on the Environment	AEE (this report).
2	Supporting Technical and Assessment Reports	Technical reports assessing the effects of the construction and operation of the Project.
3	Drawing Set	Indicative design drawings for all aspects of the Project including the road alignment, structures, lighting and water systems. Drawings supporting the technical assessments, and the Urban and Landscape Design Framework (ULDF).

1.6. Structure of this AEE

In accordance with the requirements of the RMA (particularly Schedule 4), this AEE provides the following information and is structured as follows:

Table 1-2: Structure of this AEE

Section	Name	Contents
1	Introduction	An introduction to the Application, Applicant and Project, including summary of approvals required and structure of the AEE and Application.
2	Background and strategic context for the Project	Sets out the background and strategic context and need for the Project and the Project objectives.
3	Description of the existing environment	Description of the existing environment.
4	Description of the Project	Description of the Project.
5	Construction of the Project	An outline of an indicative method to construct the Project.
6	Statutory context	Identification of the legal framework that applies to the Application, and identification of the approvals required.
7	Consideration of alternatives	The methodology by which alternative sites, routes and methods of undertaking the work have been considered.
8	Consultation and engagement	An outline of engagement that has occurred during preparation of the Application, feedback received and responses to issues raised.
9	Assessment of effects on the environment	Outline of the methodology and assessment of the actual and potential effects on the environment, including consideration of measures proposed to avoid, remedy or mitigate effects.
10	Management of effects on the environment	Proposed measures to manage the identified effects, including a management plan framework.
11	Statutory assessment	An assessment of the Project against the matters set out in applicable provisions of the RMA. An assessment of the Project against the relevant provisions of relevant national, regional and local statutory and non-statutory documents.
12	Conclusion	Conclusion.

2. Background and strategic context for the Project

2.1. Overview

As the main inter-regional route connecting the Auckland and Northland regions, SH1 provides a vital lifeline connecting the Far North to Whangārei, Auckland and beyond. The Agency seeks to provide a safe, accessible, secure and efficient state highway network with environmental benefits to provide local, regional and national transport connections consistent with the outcomes sought in national, regional and local transport planning policy.

The Transport Agency has carried out a series of studies on the state highway network investigating the transport needs and opportunities for improving connections between the Auckland and Northland regions safety and reliably by road. These studies have considered the role of the state highway network in relation to the wider transport system between Auckland and Northland.

The Transport Agency's strategic studies and investigations of the state highway network have identified a number of key concerns in relation to the state highway network connecting Auckland and Northland, including:

- Safety of the network;
- Accessibility;
- Limited network resilience;
- The efficient movement of freight; and
- The capacity of the existing network to accommodate anticipated population growth.

The Project is supported by a range of broad strategic plans, which include projects and initiatives aimed at stimulating and transforming the Northland economy including the Tai Tokerau Growth Study[5] and Tai Tokerau Northland Economic Action Plan 2016 (NEAP). One of the key enablers identified in the NEAP for improving the economic performance of Northland is transport accessibility. Completion of the Project is seen as one of the key projects to address transport accessibility by Auckland Council, other government agencies and key stakeholders.

The Auckland Plan 2050 acknowledges the need to improve accessibility between Auckland and Whangārei and identifies the Project in the Strategic Road Network.

The Whangārei to Auckland – Connecting Northland Programme Business Case 2017[6] involved the development of options to best address the problems identified for the corridor and a suite of programmes to deliver the agreed outcomes sought by stakeholders. This project formed part of that suite of programmes.

More specifically, the problems on the existing SH1 Warkworth to Wellsford route identified in the Detailed Business Case for Ara Tūhono Pūhoi to Wellsford: Stage II Warkworth to Wellsford[7] are, in summary:

[5] Tai Tokerau Northland Growth Study Opportunities Report February 2015
[6] NZ Transport Agency, 2017a.
[7] NZ Transport Agency, 2019.

1. By national standards the corridor is substandard for a national strategic route, resulting in a higher number of crashes involving injury and death, flooding and slips; and
2. Poor resilience and costly journeys between Northland and key markets, which is constraining economic growth and investor confidence.

The above mentioned strategic investigations and assessments have formed the basis for the Project, which in turn assist the Transport Agency to meet its objectives under the LTMA. The outcomes of this Project, being a safer, more resilient route that provides improved accessibility to Northland (a key Regional Development area) are consistent with the Government Policy Statement on Land Transport 2018/19-2027/28 (GPS 2018). In delivering the Project in accordance with the Project objectives as outlined in the NoR, the agreed wider corridor objectives are expected to be delivered.

The Project objectives and outcomes are detailed in section 2.2 and section 2.5 of this AEE.

2.2. Project objectives

The Transport Agency's wider objectives for the Pūhoi to Wellsford project are:

- To enhance inter-regional and national economic growth and productivity;
- To improve movement of freight and people between Auckland and Northland;
- To improve the connectivity between the medium to long-term growth areas in the northern Rodney area (Warkworth and Wellsford); and
- To improve the reliability of the transport network through a more robust and safer route between Auckland and Northland.

To give effect to the above objectives, the Transport Agency's objectives for this Project (under RMA section 171(1)(c)) are to:

- Increase corridor access, improve route quality and safety, and improve freight movement between Warkworth and the Northland Region;
- Provide resilience in the wider State highway network;
- Improve travel time reliability between Warkworth, Wellsford and the Northland Region;
- Provide connections to and from Warkworth, Wellsford and Te Hana;
- Provide a connection at Warkworth that optimises the use of infrastructure from, and maintains the level of service provided by, the Pūhoi to Warkworth project; and
- Alleviate congestion at Wellsford by providing an alternative route for north – south through traffic.

2.3. Strategic context

The Project has been developed in accordance with key legislation and government transport policy that provides the Transport Agency with strategic direction and guidance. The key legislation and policies that have guided the development of the Project and the evaluation of the expected outcomes from it include:

- The Local Government (Auckland Council) Act 2009 (LG(AC)A), which has informed regional spatial planning (the Auckland Plan) which in turn provides input to a number of other implementation plans;
- The LTMA, which informs both the development of strategy (e.g. the Government Policy Statement on Land Transport and New Zealand Transport Strategy) as well as plans (e.g. the New Zealand and Regional Land Transport Plans and the Integrated Transport Plan); and
- The RMA, which is implemented through policy statements, national environmental standards (NES), and plans.

2.3.1. National context

The New Zealand Transport Strategy (NZTS) (Ministry of Transport, 2008) seeks to ensure that "people and freight in New Zealand have access to an affordable, integrated, safe, responsible and sustainable transport system." The Project will support the key objectives of the NZTS.

The Government released the National Land Transport Programme (NLTP) 2018-2021 in August 2018. The programme gave effect to GPS 2018, which recognised a transport system that prioritises safety and access followed by environmental benefits and value for money. GPS 2018 sets out the government's priorities for expenditure from the National Land Transport Fund over a ten-year period.

The key strategic priorities of the GPS 2018 are safety and access. In order to progress these outcomes, investments are also required to demonstrate benefits for the environment and offer value for money.

The Project responds to the direction set out in GPS 2018 for the following reasons:

- The design of the Project will meet high safety standards[8];
- The total number of crashes (including deaths and serious injuries) is predicted to reduce significantly;
- The Project will support safe cycling and walking by the provision of linkages where feasible as part of the Project scope (such as across interchanges, onto SH1 at the northern tie in, on local roads where the Project passes over on a bridge structure);
- The Project will support increased access for economic and social opportunities through improved access for freight and tourist movements between Auckland and Northland, improved access for residents of Wellsford and Te Hana who are currently subject to disruption due to congestion, and improved connectivity within Wellsford and Te Hana by removing significant levels of traffic off their main thoroughfares and allowing them to reconnect and improve the main streets of both centres;
- The Project provides resilience to the critical SH1 network, which is currently subject to delays and unreliable travel times due to road closures resulting from accidents, breakdowns and/or severe weather event related incidents, or due to congestion – especially during weekend and summer periods;

[8] As evidenced in the *Operational Transport Assessment* in Volume 2

- There will be improvements to the amenity of the townships of Wellsford and Te Hana with the removal of the heavy truck movements that currently influence walkability, noise and air quality within those town centres; and
- Once operational the Project will make a contribution to improvements in the environment, through treatment of road stormwater to leading to reduced contaminant loads for two river catchments, retiring of some land that contributes to the sediment load of the Kaipara Harbour, through landscaping and planting for mitigation and through design which will assist with more fuel efficient travel (through better gradients and less need to brake, accelerate and/or decelerate).

2.3.2. Regional context

The SH1 corridor is identified[9] as a National (High Volume) route between Pūhoi and Wellsford (the highest classification) and a National route from Wellsford to Whangārei, due to its role in providing access between Auckland and Whangārei (including Auckland International Airport and port facilities (Northport and Ports of Auckland)). It currently has a dual role providing for local as well as inter-regional traffic for light and heavy vehicles (freight) between major centres of population and economic activity. Currently, this corridor suffers significantly when there are unplanned incidents that affect its resilience and availability. These issues are discussed in section 2.4 below.

The overarching strategic approach adopted by the Transport Agency for Northland is 'Connecting Northland'; an integrated transport approach which recognises the importance of improving transport access. The Auckland to Whangārei Programme Business Case[10] (2017) responds to the vision of Connecting Northland with a number of major infrastructure schemes to deliver a safe corridor which provides reliable journey times to support the economic growth of the region and access to key markets. The current corridor strategy is a combination of significant capital investment targeted at the southern portion of the corridor through the P-W project, complemented by targeted investment to address localised safety and resilience issues along the corridor further north.

Northland's regional economy has been underperforming relative to other New Zealand regions[11]. Transport connections and resilience are critical for the Northland region given its geographical position and isolation from key markets. Efficient access to the markets and economic opportunities of metropolitan Auckland, and also connectivity to the Auckland airport and seaports at Northport, Auckland and Tauranga, are key to supporting future growth. One of the key enablers for improving the economic performance of Northland is transport accessibility. The Tai Tokerau Growth Study and all-of-government NEAP identify Connecting Northland, including the route protection and completion of the Ara Tūhono Pūhoi to Wellsford project as

[9] One Network Road Classification, NZ Transport Agency
[10] The Transport Agency, Whangārei to Auckland - Connecting Northland Programme Business Case, August 2017.
[11] Northland Economic Action Plan, 2016.

well as improvements between Wellsford and Whangārei, as enablers to support key economic growth opportunities.

The Project is identified in the Regional Land Transport Strategy 2010 (RLTS), developed by Auckland Transport. A key emphasis in the RLTS is reducing congestion for freight vehicles. The Project will improve journey times and journey time reliability for freight.

The Auckland Regional Land Transport Plan 2015-2025 (ARLTP) outlines how transport priorities will be delivered over a ten-year period and implements the NLTP. The ARLTP identifies the Project as a necessary improvement project with inter-regional significance.

2.3.3. Other strategic considerations

In 2006, the Transport Agency commissioned a strategic assessment of SH1 and SH16 between Auckland and Wellsford: the SH1/SH16 Auckland to Wellsford Strategic Study[12]. The purpose of the study was to identify the future function and form of SH1 and SH16. The recommended strategy, which emerged from a LTMA based evaluation framework, was retention of the functions defined in what was then the National State Highway Strategy, namely, retaining the national function on SH1, with SH16 fulfilling a regional function (refer Figure 2-1). The study concluded that the SH1 corridor was the preferred route for future development to meet the long-term inter-regional transport needs of Auckland and Northland.

[12] Sinclair Knight Merz, 2008.

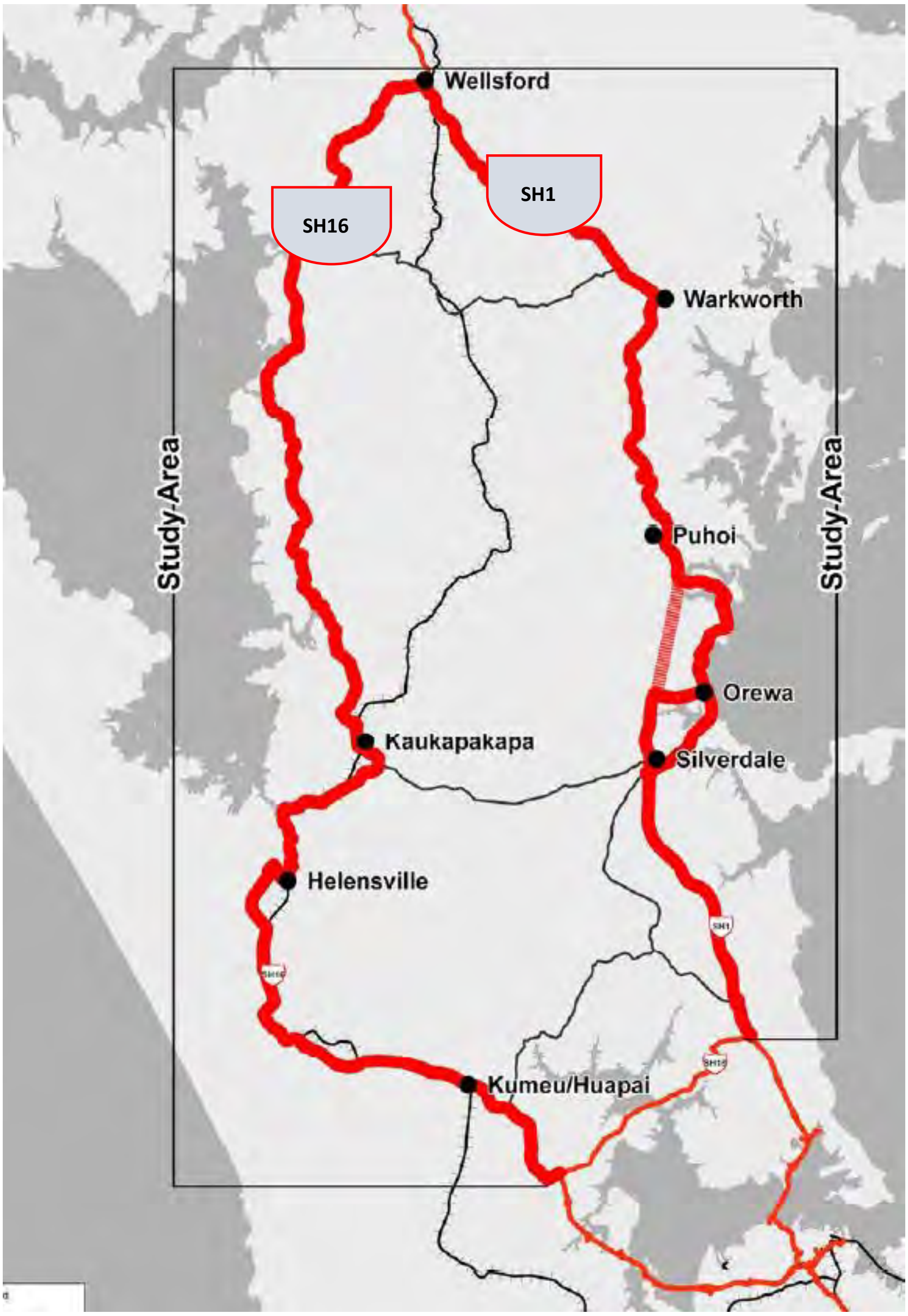

Figure 2-1: SH1/SH16 corridor

(Source: SH1/SH16 Auckland to Wellsford Strategic Study, 2008)

The Auckland to Whangārei Strategic Assessment: Strategic Context Report (2010)[13] concluded that by 2021, SH1 between Pūhoi and Wellsford would experience significant congestion during the peak traffic periods as a result of the current network capacity. The Strategic Context Report identified and confirmed the importance of the state highway network to the economic growth and sustainability of the Northland Region.

[13] Sinclair Knight Merz, 2010.

The key recommendation of the Strategic Context Report was that road-based transport was the only mode where a significant increase in capacity was possible to accommodate increased demand along the transport corridor between Auckland and Whangārei. In addition, the assessment provided clear guidance on the route configuration (a four-lane offline alignment being preferable to an online upgrade) that was most appropriate to meet the strategic objectives set down by the LTMA and the Government Policy Statement on Land Transport Funding 2009/2010 - 2018/19 (GPS 2009), and the objectives for Pūhoi to Wellsford adopted by the Transport Agency.

The Transport Agency developed a Network Plan for SH1 between Auckland and Whangārei[14] for the long-term future (2050) to consider the wider transport network implications of the Auckland to Whangārei Strategic Assessment (2010). The key purpose of the Network Plan is to support on-going integrated planning, optimisation of benefits and decision making for the local network and activities and infrastructure associated with the Pūhoi to Wellsford project, and wider Auckland and Northland Regional transport networks.

In 2010, the Transport Agency commenced a scheme assessment for the proposed state highway from Pūhoi to Wellsford. It was at this time that the Transport Agency determined that the Pūhoi to Wellsford project should be split in two discrete sections, given the scale of the works. The two sections were:

- Stage 1: Pūhoi to Warkworth, including a Warkworth bypass.
- Stage 2: Warkworth to Wellsford, including a Wellsford bypass.

The Pūhoi to Warkworth section was progressed as a separate project through scheme assessment, selection of a preferred alignment, and obtained resource consents and a designation through a Board of Inquiry. The P2Wk is currently under construction, and is being delivered as a Public Private Partnership (PPP).

The progression of the design, and the options considered for Stage 2: the Warkworth to Wellsford Project, are discussed in *Section 7: Consideration of Alternatives*.

2.4. The need for the Project

The Project has its genesis in the strategic planning documents referred to in section 2.3, above. In addition to these documents, the following more localised transport issues inform the need for the Project. These issues are documented in the Programme Business Case (PBC)[15] for the Auckland to Whangārei corridor and the Detailed Business Case (DBC)[16] for Warkworth to Wellsford and are summarised below.

2.4.1. Corridor resilience

SH1 between Auckland and Whangārei is of nationally strategic significance, as it is the primary inter-regional transport route between the Auckland and Northland regions. The section of SH1 from Warkworth to Te Hana is part of this main transport connection. This corridor suffers regularly from unplanned incidents (crashes,

[14] Auckland to Whangārei Strategic Assessment: Network Plan, Sinclair Knight Metz, July 2010.
[15] Whangārei to Auckland – Connecting Northland Programme Business Case, NZ Transport Agency, 2017.
[16] Detailed Business Case for Ara Tuhono – Puhoi to Wellsford: Stage II – Warkworth to Wellsford, NZ Transport Agency, 2019.

flooding or slips blocking the road), affecting its resilience and availability, and leading to increased travel times.

The DBC identifies:

> *"The existing section of SH1 between Warkworth and Te Hana traverses difficult terrain. The existing alignment is defined by a number of geometric constraints, resulting in areas of tight horizontal and steep vertical alignment.*
>
> *This situation is resulting in a disproportionately high number of deaths and serious injuries along the route. The route is also subject to resilience challenges, with over 30 hours delay from full closures on this section of SH1 (generally due to motor accidents and some environmental factors such as flooding and slips) over the period 2013-mid 2018. This is high compared to other High Volume Strategic National Routes"*[17].

The DBC reports that, in the 2013-2018 period, there were 9 full closures in this section of SH1, equivalent to full closure of the route every 7.3 months. A full closure is where SH1 is closed to both northbound and southbound traffic. There was a total of 29 hours of full closure during this period, giving an average delay of over 3 hours per closure. This data excludes partial closures, which would further compound resilience issues. Of these unplanned incidents, 89% resulted from crashes with the remainder a combination of other predominantly environmental factors (for example, flooding or slips). The location of these closures is shown in Figure 2-2, indicating that resilience challenges in the Dome Valley are a priority. Figure 2-2 shows a high number of incidents around the Wayby Valley Road intersection and the Hōteo River crossing.

The detour routes for many of these closures are challenging for users, as shown in Figure 2-2. The section between Warkworth and Wayby Valley Road is subject to a large detour with a significant travel time. Many of the detour routes are also not able to carry full High Productivity Motor Vehicles (HPMVs). SH16 provides the only available alternative route between Wellsford and Auckland in the event that SH1 through the Dome Valley is closed for these vehicles. The length of the detour routes and their inability to carry HPMVs significantly restrict the ability to divert freight traffic away from incidents.

[17] Ibid, 8.

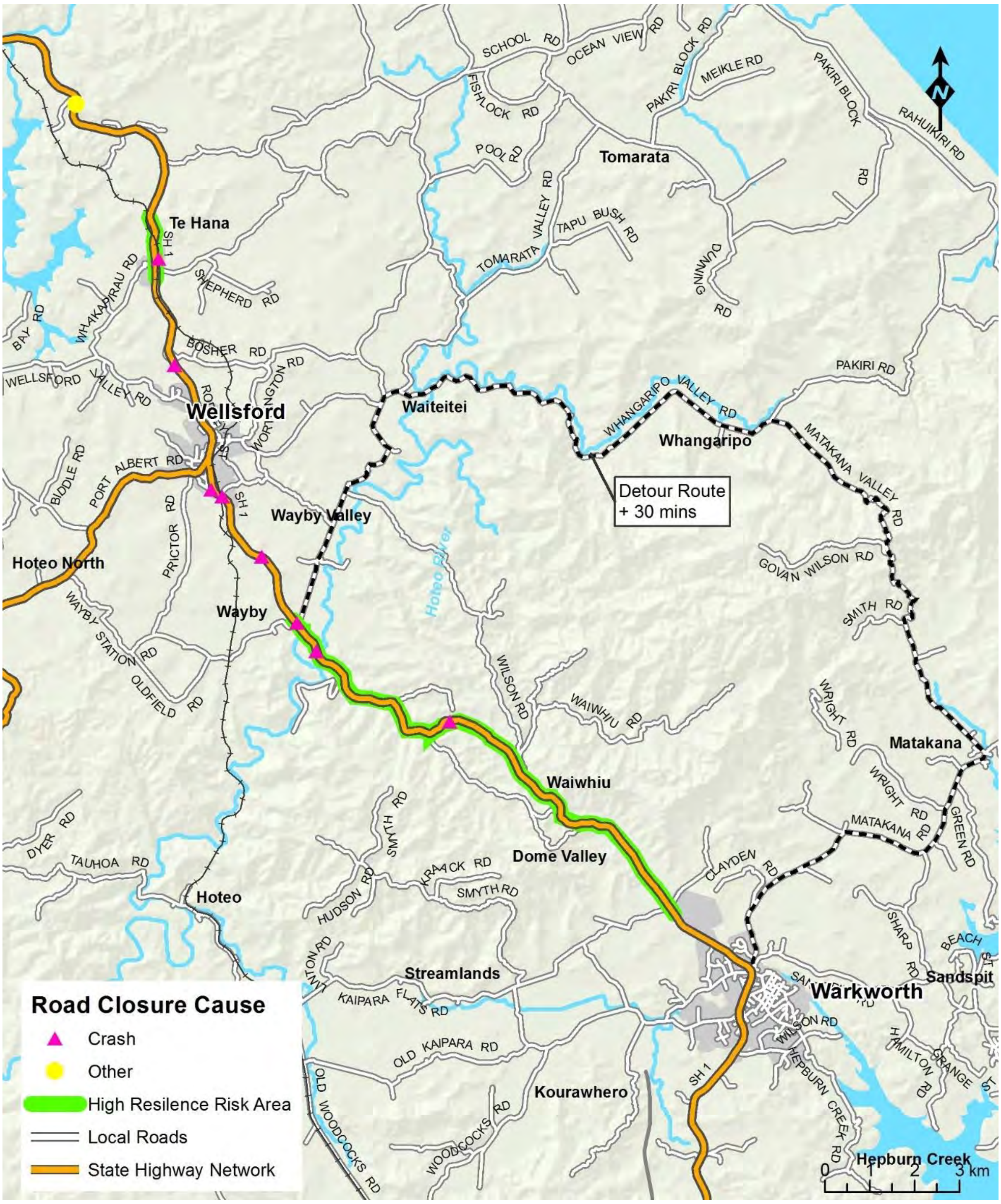

Figure 2-2: Warkworth to Te Hana unplanned incidents and detour restrictions (2013-2018)

(Source: Modified from the DBC)

2.4.2. Traffic volumes and travel time reliability

The Transport Agency's Traffic Management System (TMS) database records an Average Annual Daily Traffic (AADT) on SH1 of approximately 20,000 vehicles per day (vpd) through Warkworth, 12,000 vpd through the Dome Valley between Goatley Road and Wayby Valley Road, and 12,000 vpd between Wellsford and Te Hana. Traffic volumes vary throughout the year, with a noticeable decrease over the winter months.

Traffic volumes between Warkworth and Wellsford are the highest in December (13,000 vpd) and lowest in June (9,000 vpd)[18].

There are pronounced peaks in vehicle numbers coinciding with evening peaks, weekends and public holidays. This is particularly noted in summer, when the beaches and holiday areas east of Wellsford and further north draw people from Auckland. The typical holiday end[19] AADT on SH1 is on average 47% greater than the weekday AADT in the southbound direction (the direction in which most traffic is travelling at holiday end). AADT going both directions is 19% greater during the holiday end period than a typical midweek day[20].

The existing SH1 between Warkworth to Te Hana is currently subject to congestion[21]. The most regular congestion currently along SH1 occurs through Warkworth, at the southern end of the Project, and southbound queues extend back along SH1 towards Wellsford from Warkworth for several kilometres. This congestion results in increased travel times, not only through Warkworth but also through Wellsford and at various locations along the route, such as at the end of passing lanes. Congestion is quite pronounced at peak periods, such as weekends over the summer, and particularly around weekends which coincide with public holidays. Travel times for northbound traffic are significantly higher at the start of a holiday weekend, and for southbound traffic at the end of a holiday weekend. In addition, severe congestion can occur as a result of unexpected incidents (such as crashes, slips, etc.)

Analysis[22] shows southbound journeys from south of Te Hana to south of Wellsford have the most travel time variability in morning and evening peaks. In the morning peak 92% of these trips have a journey time between 2 and 5 minutes. During the holiday end period the same section, southbound through Wellsford, has the most variability with only 31% southbound trips achieving a journey time between 3 and 5 minutes. This analysis shows that travel time variability on SH1 between Warkworth and Te Hana is a significant issue during holidays, particularly through Wellsford, with typical journeys varying by up to 7 minutes in this section.

Daily traffic volumes on SH1 are predicted to grow at a rate of approximately 3.4% per annum between 2016 and 2046 between Warkworth and Te Hana, increasing by 71% between 2016 and 2036, without the Project in place. This growth rate means that daily traffic volumes on SH1 are expected to be in the order of 29,000 vpd in 2046 between Warkworth and Wellsford (with slightly lower traffic volume between Wellsford and Te Hana)[23], which would further reduce travel time reliability[24].

2.4.3. Safety of the network

A significant increase in traffic over the past few decades has highlighted the geometric issues associated with the current SH1 alignment, which has an unsatisfactory safety record.

[18] Based on average daily traffic volumes on SH1 between Warkworth and Wellsford for each month of 2016 (Traffic and Transportation Assessment, Jacobs, 2018).
[19] 10:00 am to 6:00 pm on a holiday end day.
[20] Operational Transport Assessment, Section 3.4.
[21] Operational Transport Assessment, Section 3.5
[22] Operational Transport Assessment, Section 3.6.
[23] Operational Transport Assessment, Section 4.2.
[24] Operational Transport Assessment, Section 4.4.

The section of SH1 from Warkworth to Wellsford is classified as a High Volume National route in the One Network Road Classification (ONRC) system. North of Wellsford to Whangārei it is classified as a National Route. From a safety perspective the High Volume National route requires the following standard (customer levels of service (CLoS)):

> ***High Volume National****: Mostly forgiving roads and roadsides, equivalent to KiwiRAP 4-Star standard. User hazards absent or mitigated, including head on risk. Active road users generally do not have access - if present, they are provided with separate space or are physically separated. The road form provides road user guidance.*

Currently, SH1 between Pūhoi and Whangārei is predominately a 2-Star standard as assessed by KiwiRAP[25], which falls short of the required 4-Star standard for a High Volume National route. The Dome Valley is noted as a particular blackspot for incidents.

The crash history reflects this lower standard road, with the Transport Agency's Crash Analysis System (CAS) database along SH1 between Warkworth and Te Hana identifying a total of 312 crashes between 2013 and 2018. Of these crashes, 46 involved minor injuries, 17 involved serious injuries, and 4 were fatal. The most common type of crash along this section of state highway is cornering crashes, with head on and rear end crashes being the second and third most common respectively. The majority of the fatal and serious injuries resulted from head on crashes, with cornering crashes resulting in the highest proportion of minor injury and non-injury crashes. The lack of a central median barrier on the route is considered to contribute to the high number of head-on crashes, many of which result in serious injuries or fatalities. Figure 2-3, below, shows the location of fatal and serious injury crashes on the corridor between 2013 and 2018. The collective risk rating is also shown through this corridor, which is measured in terms of the number of crashes per kilometre of state highway.

[25] KiwiRAP is the New Zealand Road Assessment Programme. It is part of the International Road Assessment Programme, otherwise known as iRAP (refer www.kiwirap.org.nz).

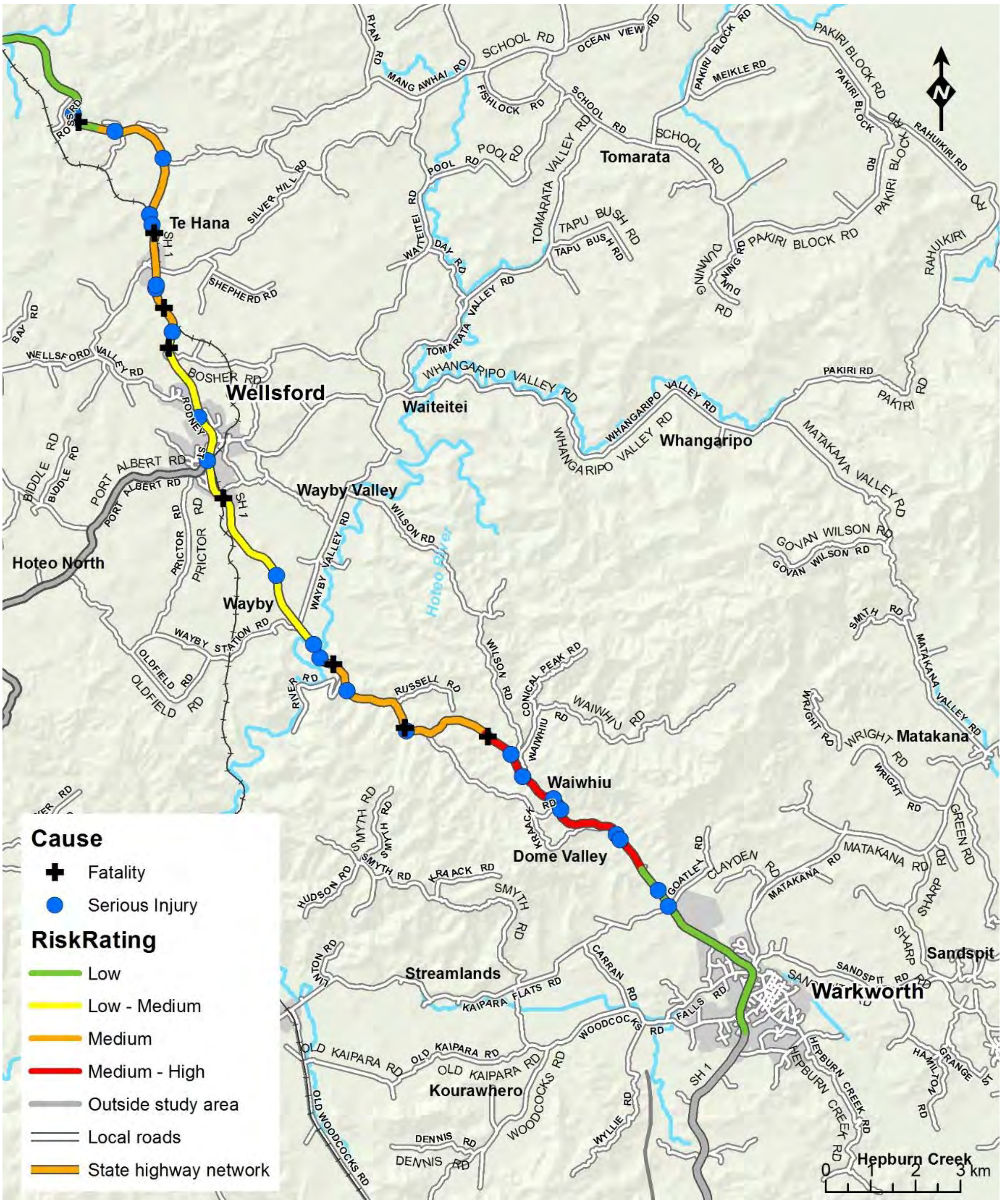

Figure 2-3: Fatal and serious crashes 2013-2018

(Source: Detailed Business Case, 2019)

SH1 intersects with local roads between Warkworth and Te Hana, and relatively few of these intersections include adequate acceleration and deceleration lanes on SH1. The lack of appropriate acceleration and deceleration lanes increases the potential for conflicts between state highway traffic and local traffic. This issue, coupled with the steep grades, tight corners and restricted sightlines along SH1, contributes to a number of crashes, particularly through the Dome Valley.

The speed limit along SH1 is generally 100 km/h, although this varies at some locations. In December 2007 the speed limit through the Dome Valley between Phillips Road and Wayby Valley Road was reduced to 80 km/h as an initiative by the Transport Agency to help address the poor safety record through this section. In 2012, further signage and minor safety improvements were carried out. As a result of the interventions, the road safety record over this corridor improved. However, three fatal crashes occurred in 2016-2017, two of which were as a result of head on crashes in the Dome Valley.

The government announced a Safe Network Programme in 2018 indicating the high priority of safety improvements. The Transport Agency, through the Safe Roads Alliance (SRA), is delivering safety improvements on SH1 from Warkworth to Wellsford, through the Dome Valley, as part of the governments Safe Network Programme launched in 2018. Construction commenced in early-2019 and includes widening the centre line and road side shoulders, installing flexible road safety barriers and installing right turn bays at key intersections. Northbound and southbound passing lanes will be replaced with widened shoulders to make the approach to the summit of the Dome safer.

These improvements will improve the safety of this corridor by reducing head-on and loss of control crashes. However, due to road geometry, the safety improvements will not achieve the KiwiRAP 4-Star standard sought for a High Volume National road. Nor will these works solve the issues identified above around route resilience or travel time reliability as no capacity enhancements are proposed.

2.4.4. Movement of freight

As the main inter-regional route between Northland and Auckland, SH1 has an important function in providing freight access between Auckland and Northland and carries a significant volume of freight traffic. An average of just under 10% of vehicles travelling on SH1 between Pūhoi and Whangārei are medium/heavy commercial vehicles, with the figure being higher, at 12%, between Warkworth and Te Hana.

The Northland region is a major producer of primary products, including milk and dairy products, meat, logs and timber products, aggregates and other building materials. In addition, a number of consumer goods and inputs to manufacturing in Northland and north Auckland are sourced from the Auckland region.

Northland-based industries are heavily reliant on a safe and efficient transport network to provide reliable access for people and freight to markets in the Auckland region, Auckland International Airport and beyond. As such, the provision of reliable freight links is an integral part of servicing the economies of the Northland and Auckland regions.

The 2014 National Freight Demands Study (NFDS) identified that freight tonnage by mode shares in 2012 between Auckland and Northland were: 76% by road, 3% by rail, and 21% by coastal shipping. The NFDS forecasts that by 2042, freight volumes between Northland and Auckland could increase by 68%, from 2.8 to 4.71 million tonnes. It also predicts that freight movements originating or terminating in Northland could increase by 38%, from 30.2 to 41.6 million tonnes.

The NFDS concludes that truck movements are likely to grow significantly in the future, particularly given the current (low) level of investment in non-road-based modes. Even if investment levels were to change, the study identified limited potential for a modal shift away from road-based freight. The NFDS does not forecast freight modal share by region, but its forecast for New Zealand overall remains stable at about 91% of freight tonnage moved by road in 2012 and is predicted to remain the same in 2042. The Government Policy Statement 2018 indicates the Government's commitment to investigate moving more freight by rail or coastal shipping. At 3%, the freight mode share of rail by volume is currently very low, so a doubling or trebling of the volumes of freight moved by rail would not have a significant effect on the overall traffic volumes, and therefore would not impact the need for improvements to SH1.

The Upper North Island Strategic Alliance (a group of industry, local authority and government organisations) undertook work in 2013 to support informed decision making on key land use, infrastructure and investment, to improve the economic performance of the Upper North Island and New Zealand. Their work, the Upper North Island Freight Story[26], sought to understand the supply and demand of industrial land, promote a strategic and integrated approach towards land use and transport planning and identify constraints on the Upper North Island's strategic rail and road networks. The problems identified for the SH1 corridor are consistent with a number of the critical freight issues that the Upper North Island Freight Story seeks to address.

2.4.5. Importance of the corridor to the Northland economy

Northland has approximately 175,000 residents spread across urban and rural areas.[27] It is connected to the rest of New Zealand through Auckland, and a key challenge of the road network in the Northland region is to provide a reliable, secure route to connect geographically, socially and economically disparate communities. Northland in the past has had an unemployment rate 3% above the national rate and nominal GDP per capita 32% below the national average.

The Northland Regional Land Transport Plan 2015-2021 (NRLTP) (Northland Regional Council, 2018) indicates the physical and socio-economic challenges that Northland has and one of its key outcomes is to ensure that the region is well-connected to Auckland and the rest of New Zealand[28]. One of the two key strategic road priorities identified in the NRLTP is the:

> *"Increase economic productivity and improve connectivity by progressively upgrading SH1 from Pūhoi to Whangārei."[29].*

SH1 plays a critical transport accessibility role, connecting Northland with New Zealand. The Auckland to Whangārei Programme Business Case[30] identifies that:

> *"Improving the northern state highway network will help Northland contribute to the so-called 'golden triangle' of Auckland, Hamilton and Tauranga. Together these three centres generate 36% of New Zealand's Gross Domestic Product (GDP) with a prediction for this to rise to 47% by 2026. Investment in transport between Auckland and Whangārei will contribute significantly to this".*

While rail and coastal shipping infrastructure connect the Auckland and Northland regions, SH1 to the north of Auckland remains the key transport link with Northland

[26] NZ Transport Agency, 2013
[27] Statistics New Zealand, Subnational population estimates: As at 30 June 2017 (provisional).
[28] NRLTP, 2018 (being the three year review version)
[29] NRLTP, 2015, page 6
[30] NZ Transport Agency, 2017a.

and the northern part of the Auckland region. It is therefore important that SH1 can accommodate the increasing demand for travel between these regions. As outlined above, at present the corridor between Auckland and Whangārei is often closed, its alignment is comparatively unsafe by national standards and the cost of travel and travel time reliability issues are an impediment to economic growth in Northland.

Providing for the reliable movement of goods and people to and from the North is important. Given the Northland economy's proximity to the country's largest and strongest performing centre – Auckland – there is real opportunity to improve the current issues in the Auckland and Whangārei corridor. The NEAP has identified that the lack of robust transport accessibility between Northland and the rest of the country is a contributing factor to the area's poor economic situation and has identified four 'game changers' to underpin business growth. One of these game changers is transport – promoting better connectivity with Auckland. Roading, in particular, is recognised in the NEAP as:

> *"critical for Northland to develop and affects virtually every part of the economy".*[31]

The Northland and north Auckland regions contain a large number of tourist destinations and the tourism industry is a major employer in both these regions. Providing reliable, uncongested routes for tourist travel to the region makes an important contribution towards increasing economic development.

2.4.6. Projected population and employment growth

The Auckland Plan 2050 sets the long-term strategic direction for Auckland over the next 30 years. The overarching objective of the Plan is to "create the world's most liveable city". Statistics New Zealand has projected the Auckland region will account for more than half New Zealand's population growth between 2013 and 2043, with an increase of 833,000 – from just under 1.5 million to over 2.3 million (using the medium projection figures).

Warkworth had a population of around 4,000 residents (at the time of the 2013 census) and around 2,300 jobs. As the largest settlement in rural north Auckland, it is a sub-regional centre servicing a wide rural catchment and many smaller towns and villages. The Auckland Plan identifies Warkworth as a Satellite Town with anticipated population growth of up to 20,000 over the next 30 years (refer Figure 2-4). The AUP(OP) has rezoned approximately 1,000 hectares in the north, west and south of the existing north Auckland urban area to allow for future urban development to meet the expected growth. The Warkworth Structure Plan enables 7,500 dwellings. To enable increased local employment opportunities to support this anticipated growth, new employment areas are identified, comprising land for new industry (e.g. warehousing, manufacturing, wholesalers, repair services) and land for small centres (e.g) convenicnce retail, local offices, restaurants/cafes).

Wellsford is identified in the Auckland Plan as a Rural and Coastal Town (refer Figure 2-4). While Rural and Coastal Towns are "less independent from the main metropolitan area[32]" than the Satellite Towns and will be less of a focus for developing substantial intensification or development, it is still anticipated to grow substantially in the future. Te Hana is identified as a Rural and Coastal Village (un-serviced). Un-

[31] Northland Economic Action Plan, page 7
[32] Auckland Council, Auckland Plan, page 235

serviced villages (particularly if small and more dispersed) are envisaged to have little or no growth. They are predicted to change and develop in ways that preserve their character, but are a lower priority for planning, services and infrastructure[33].

Rural and coastal towns like Wellsford are envisaged to grow to between 2,000 and 10,000 people and will become stronger and more attractive centres[34]. Wellsford is identified for future urban growth of approximately an additional 830 houses from 2023 – 2027[35] subject to confirmation around ground stability, a new water source and an upgrade to the wastewater treatment plant[36]. The AUP(OP) has rezoned around 1,000 hectares in the north, west and south of the existing Wellsford urban area to allow for future urban development to meet the expected growth.

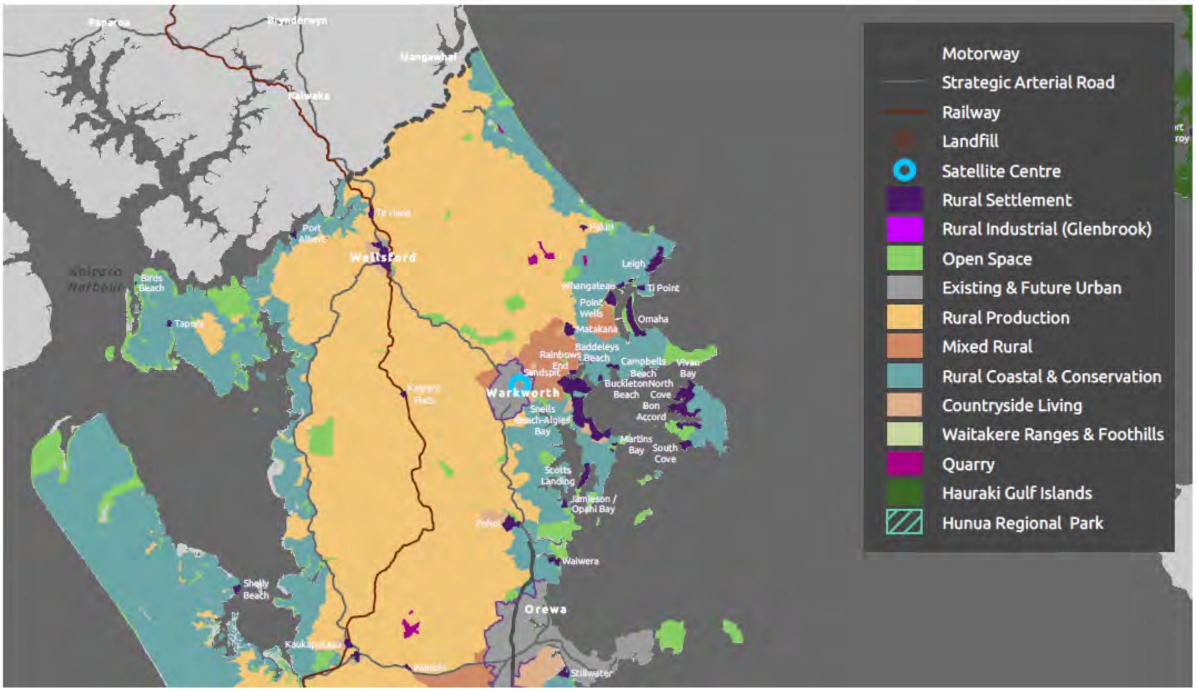

Figure 2-4: Auckland's Development Strategy: Rural

(Source: Auckland Plan, 2050)

To enable this growth in Warkworth and Wellsford, the Project is identified in the Auckland Plan as an enabling infrastructure project.

Future population growth will likely result in economic and social benefits at the local, regional and national levels. However, this level of predicted growth and additional demand needs to be appropriately managed and provided for to avoid significant adverse impacts on the safety and efficiency of the existing state highway network, which has limited capacity.

[33] Auckland Council, Auckland Plan, page 236.
[34] Auckland Council, Auckland Plan Table 9.1 Rural Settlements Classification, 2012.
[35] Auckland Council, Auckland Future Urban Land Supply Strategy, 2017.
[36] Auckland Council granted resource consent to Watercare on 27 November 2017 to expand the plant and discharge treated wastewater to a tributary of the Hōteo River.

2.5. The benefits to be delivered

In delivering the Project in accordance with the Project objectives outlined in section 2.2, the following benefits will be delivered:

- Improved safety performance compared to the existing SH1 with the Indicative Alignment designed to motorway standards and therefore, with the intended diversion of traffic to the new road, reduced incidents on the existing SH1;
- The Project will support safe cycling and walking by the provision of linkages where feasible as part of the Project scope (such as across interchanges, onto SH1 at the northern tie in, on local roads where the Project passes over on a bridge structure;
- Improved freight performance in terms of reduced travel times, improved route quality and safety, resilience and travel time reliability;
- Improved route security and resilience of the state highway network north of Auckland through reducing the reliance on one main route (the current SH1);
- Reduced travel times and improved travel time reliability along the state highway network north of Auckland increasing accessibility across many parts of the Regions' road network;
- Improvements to the amenity of Wellsford and Te Hana through the removal of heavy truck movements through the townships, including improved air quality and reduction in noise levels and improving walkability; and
- Treatment of stormwater, reduced contaminant loads for two river catchments, reduction of sediment load over time to the Kaipara Harbour, retiring of some land that contributes to the sediment load of the Kaipara Harbour, through landscaping and planting for mitigation and through design which will assist with more fuel efficient travel (through better gradients and less need to brake, accelerate and/or decelerate).

3. Description of the existing environment

3.1. Introduction

This section provides a description of the existing environment within which the Project will be constructed and operated. The wider Project area extends between Warkworth in the south, the wider Wellsford area, and the northern outskirts of Te Hana in the north. The specialist technical assessment reports in Volume 2 that accompany this AEE provide detailed descriptions of specific environmental features relevant to each discipline. The following section of this AEE is derived from these technical reports and provides a broad description of the Project area and surrounding environment, focussing on its historical and regional context, and the built and natural environment.

3.2. Historical context

The historical context for the Project area is described in detail in the *Historic Heritage Assessment* in Volume 2 of the AEE. Key aspects are summarised below.

3.2.1. Māori occupation

The area between Warkworth and Te Hana transects two significant areas of traditional Māori occupation: Mahurangi and Kaipara. A number of iwi and hapu groups are affiliated with the land within the Project area, dating from the arrival of the Mahuhu-ki-te-rangi waka between the Kaipara Harbour and the Hokianga.

Māori in the Mahurangi and Kaipara areas moved seasonally between villages, rather than occupying permanent settlement areas all year. The coastal boundaries to the east and west provided abundant marine resources, and the inland forest areas were utilised for hunting and gathering. The rivers present in the area supplied fresh water and coastal and alluvial soils were ideal for horticulture. Tracks and portage routes between the east (Mahurangi) and west (Kaipara) coast provided a good means of communication between the groups, most of which maintained close peaceful relationships.

3.2.2. European settlement

European missionaries and sawyers (timber millers) arrived in the Mahurangi and Kaipara areas around the early 1830s. With these arrivals came pressure on Ngāti Whatua to relinquish land for European settlement.

The Crown acquired its first large tract of land in the area on 13 April 1841. The Mahurangi Purchase, as it was known, included the Mahurangi and Omaha Block, approximately 100,000 acres stretching from Takapuna in the south to Te Arai Point in the north.

Prior to European settlement, the area was almost entirely covered with broadleaf and podocarp forest. Following European settlement, almost all the kauri and large areas of podocarp forest were felled for timber and to create pasture. Further clearing occurred in the pursuit of kauri gum.

3.2.3. Warkworth

A survey of the Mahurangi Harbour in 1840 revealed the area as an ideal site for the development of a town. Some European settlement had already commenced due to the attraction of the timber trade, and the deployment of camps of seamen cutting and dressing spars for the Royal Navy.

In 1853, one of the first licensees, John Anderson Brown purchased 153 acres of land between the Mahurangi River and the proposed Great North Road. He renamed the area Warkworth and began advertising quarter acre lots for sale in 1854. Settlement progressed slowly, with the Mahurangi Library and Post Office opening in 1859, and the first Mahurangi School established in 1863. The development of a flour mill and the manufacture of lime expanded the local industry. Lime production had begun in Warkworth as early as 1849, and eventually paved the way for the development of the Wilsons Cement Works in 1884.

During World War II, several United States military camps were established throughout the wider Warkworth area. These camps were set up to train forces for conflict, and to provide rest and relaxation for some of the troops fighting the war in the Pacific. The camps operated from October 1942 until mid-1944.

3.2.4. Wellsford

Wellsford was founded by non-conformist settlers known as the 'Albertlanders', who had arrived in New Zealand under a special settlement scheme. The first Albertland settlers arrived in September 1862. Wellsford was established in two stages: 'Old Wellsford' stretched between the mouth of the Whakapirau Stream and the eastern boundary of the Oruawharo Block. 'New Wellsford', further inland, was developed later after the sale of the Old Pakiri Block to the Crown in 1885.

Wellsford grew primarily as a timber town, and a timber mill was opened on the south bank of the Oruawharo River in 1864. Kauri gum was an important resource for early settlers in the local area, and temporary gumdiggers' camps spread across the district in the 1870s. Both industries had begun to decline by the turn of the 20th century, and farming became a primary source of income for settlers. The establishment of the Wayby Cooperative Dairy Company in 1902-1903 served the burgeoning dairy industry, and the establishment of the railway line into 'New Wellsford' in 1909 furthered the move inland away from the initial settlement areas, to the present day location of Wellsford.

3.3. Regional context

The population of the Rodney Local Board Area, which covers the northern most part of Auckland City and includes the Warkworth and Wellsford urban areas and their surrounding hinterland was approximately 54,882[37] in 2013.

Statistics New Zealand estimates total employment in the Rodney Local Board Area in February 2017 at 15,500, which represents 0.7% of the total persons employed in New Zealand. This figure compares with Rodney's 1.3% share of New Zealand's total population, highlighting that the area is currently more of a "dormitory suburb" for employment centres elsewhere within Auckland.

[37] 2013 Census

The Project area comprises predominantly rural, commercial plantation forestry (through the Dome Valley), and rural residential land uses. The main settlement areas in the vicinity of the Project are Warkworth, Wellsford and Te Hana. These areas are where the majority of local community facilities / amenities such as schools, shopping centres, churches and social services are located. This is described in further detail below.

3.3.1. Warkworth

Warkworth is the largest urban area in the vicinity of the Project. Warkworth's population in 2017 was approximately 4,760. Warkworth accounts for 2,750 jobs (17.7% of the Rodney Local Board Area's jobs). The most significant employment sectors in Warkworth are retail trade, manufacturing, education and training, healthcare and social assistance, construction and accommodation and food services.

Land in and around Warkworth is zoned for a variety of typical urban uses including residential, business, rural and open space. Large areas to the north-east, west, and south-west of the township are zoned Future Urban, which reflects the expectations and aspirations of significant growth in Warkworth. Auckland Council has prepared a Warkworth Structure Plan which will inform the future land use zones of the land currently zoned Future Urban. The Indicative Alignment, on the north west outskirts of Warkworth, passes through Mixed Rural and Rural Production zones.

The existing SH1 route passes through the town to the west of the commercial centre. Upon its opening (scheduled for 2021), the P2Wk will form part of the SH1 network. This motorway will bypass Warkworth to the west and join SH1 south of Kaipara Flats Road.

Some significant trip-generating activities include Mahurangi College, situated at the intersection of Woodcocks Road and SH1, and Warkworth Primary School on Hill Street. The Warkworth town centre provides a range of retail, commercial, healthcare, community, and other professional services, which, in combination, draw traffic from a wide catchment area.

A commercial centre (Kowhai Falls) is being developed off Woodcocks Road, to the west of the College and the existing industrial estate. This centre adopts a 'big box' retail warehouse format capable of drawing trade and traffic from a wider catchment area.

The spatial distribution of these activities, in combination with the road network pattern, leads to congestion and conflicts with SH1 at peak periods, such as the evening peaks, school closing times, weekends, and holidays.

3.3.2. Wellsford

Wellsford is the second largest urban area in the vicinity of the Project. It is the northern-most urban settlement in the Auckland region. Wellsford's population in 2017 was 2,030. Wellsford accounts for 970 jobs (6.2% of the Rodney Local Board Area's jobs). The most significant sectors are transport, postal and warehousing, education and training, healthcare and social assistance, retail trade and accommodation and food services.

The existing SH1 route passes through the commercial centre of the town, generally on a north-south alignment. SH16 connects with SH1 in the middle of the town. The North Auckland Line railway passes immediately east of the township with the railway station located to the east of the town, south of Matheson Road. The line is used for freight services with no commuter passenger service provided.

The development of Wellsford has been notably influenced by transport networks, in particular the junction of SH1 and SH16 and the North Auckland Line. As such, development of the town centre is, in general, constrained to a linear form. The North Auckland Line creates a physical barrier on the eastern edge of the town centre.

Given its strategic location, Wellsford has developed and functions as a district retail and highway service centre. A number of the commercial activities in the town centre are focussed on meeting the needs of regional through traffic, particularly travellers. Wellsford is the main service centre for the surrounding rural areas of northern Rodney and small coastal towns and settlements, including Matakana, Pakiri, Mangawhai and Te Arai to the east, and Port Albert, Wharehine, and Tapora to the west.

Land in and around Wellsford is zoned for a variety of typical urban uses including residential, open space, and rural. Several areas are zoned Future Urban, primarily to the south of the town (around the intersection of Centennial Park Road and SH1), and at the northern end of the settlement (south of Bosher Road).

Wellsford contains a number of service and wholesale trade and industrial activities, many of which are related to agriculture and manufacturing.

The town centre provides a range of retail, commercial, healthcare, community, and other professional services, which, in combination, draw traffic from a wide catchment area. Educational facilities in the town include Wellsford Primary School on School Road, Rodney College on Rodney Street, and Living Way Christian School on Station Road.

3.3.3. Te Hana

Te Hana is approximately 5 km north of Wellsford and services a population of approximately 200 people. The population is predicted to remain relatively constant in the future. Te Hana contains few services or shops. Businesses and industries include a plant nursery, orchard, house removal and relocation services, a café, and a service station. The Arts Factory is a workshop, studio and exhibition venue housing exhibitions from local and international artists.

In mid-2011, a replica 17th Century Māori village/cultural tourism centre was opened in Te Hana. Te Hana o Te Ao Marama is a community driven initiative that offers guided tours and cultural experiences, events, and noho (overnight stays). According to a case study undertaken as part of Auckland's Economic Development Strategy[38], Te Hana o Te Ao Marama draws in several thousand visitors monthly. Profits are reinvested into the community through the Te Hana Charitable Trust to support local economic development.

3.3.4. Smaller settlements

Several concentrations of smaller settlements are located in the vicinity of the Project, as follows:

- A rural-residential subdivision at Viv Davie-Martin Drive is present on the upper slopes in the vicinity of Falls Road to the west of Warkworth.

[38] Auckland Council, 2012.

- Small scale farming and rural residential blocks are located on Phillips Road and Kaipara Flats Road.
- Kaipara Flats is located approximately 12 km west of Warkworth. The township has a community hall, a sports club and a primary school with a roll of approximately 85.
- A scattering of rural dwellings accessed from Kraack Road.
- Rural residential properties located to the west and south-west of Wellsford, around Rustybrook Road, Whangaripo Valley Road, and Worthington Road, and also located further south-west around Wayby Valley Road.
- Twelve lots have been subdivided at Charis Lane, north of Te Hana, and are being developed as rural residential properties.

3.3.5. Other commercial activities

Businesses that operate outside the main settlement areas in the wider Project area include:

- Southern Paprika: 504 Woodcocks Road, Warkworth – a large scale horticultural producer and capsicum exporter. It operates 15 hectares (ha) of greenhouses to produce over 4000 tonnes of capsicums per year. Southern Paprika employs more than 100 staff.
- Sheep World: SH1, Warkworth – comprises a farm and nature park with sheep shearing and sheepdog shows, New Zealand's Sheep and Wool Centre, a shop selling natural NZ products, and a cafe.
- Top of the Dome café: Dome Lookout SH1, Warkworth – situated at the start of the Dome Forest walkway.
- A raw milk stall at a farm gate outside of Wellsford.

3.4. Transport environment

The transport network within the wider Project area is characterised by a range of existing infrastructure and facilities including state highways, local roads, freight rail lines, pedestrian paths, cycle ways and bus services.

3.4.1. State highways

State Highway 1

SH1 serves the dual purposes of providing the inter-regional transport function between the Auckland and Northland regions for the movement of people and goods, as well as providing access to local areas. As a consequence of this dual function, there is a mix of regional and local traffic on SH1. SH1 passes through Warkworth, Wellsford and Te Hana, although once construction of the P2Wk motorway is complete SH1 will bypass Warkworth to the west and join the existing SH1 north of Hudson Road.

The Warkworth to Te Hana section of SH1 has a single carriageway, with generally one lane each way. There are six passing or climbing lanes between Warkworth and Te Hana, with three northbound and three southbound. SH1 intersects with numerous local roads between Warkworth and Te Hana, which provide access to sparsely populated rural areas, settled rural communities and small towns. Other local roads provide connections or access to places of interest to tourists. The road follows the undulating landform, with restricted sightlines and steep grades in some locations, which present limited opportunities for overtaking safely, and inadequacies are identified with respect to length and spacing requirement of passing lanes and acceleration and deceleration lanes.

State Highway 16

SH16 runs from Ports of Auckland to Wellsford via West Auckland and the southern fringes of the Kaipara Harbour. In the Wellsford area SH16 predominantly serves as an access route for rural communities and development near the highway. It also acts as an alternative route to SH1 in the event of an incident on SH1, and for peak holiday periods. SH16 is part of the Twin Coast Discovery Highway tourist route, accessing Kumeu, Helensville, Parakai and Kaukapakapa, the West Auckland beaches, Woodhill Forest, and coastal areas on the southern side of the Kaipara Harbour. SH16 is generally a single carriageway (i.e. one lane in each direction) between the end of the North western Motorway at Brigham Creek Road and its terminus at Wellsford.

The Twin Coast Discovery Route is an 800 km circular tourist route of Northland, which includes SH1 and SH16 through Wellsford. The Twin Coast Discovery Route is extensively marketed by tour operators, rental car and campervan suppliers and accommodation providers.

Safe Network Programme

The Government is investing $1.3-1.5 billion over the next three years to prevent up to 160 deaths and serious injuries every year across New Zealand's highest risk state highways and local roads. The Safe Network Programme uses the Safe Systems approach, focusing on safe roads and roadsides, safe and appropriate speeds and safe level crossings (where relevant). Dome Valley, as part of the Auckland region, has been identified as a priority for the first phase of the three-year programme.

The SH1 Dome Valley Safety Improvements project, being delivered by the Safe Roads Alliance, aims to make this section of road more forgiving of human error, and reduce the risk of serious or fatal injuries when cars leave the road or cross the centreline. The project commenced construction in early-2019 and safety improvements include:

- New right turn bays at L Phillips Road/Sheepworld and, the Top of the Dome to make it safer for vehicles to turn;
- Side barriers to stop vehicles that have lost control from running off the road;
- Widened centreline areas and/or flexible median safety barriers in certain sections to keep vehicles apart and prevent head-on crashes; and
- The northbound and southbound Top of the Dome passing lanes will be replaced with a wide shoulder so slower vehicles will have room to pull over.

The Safe Roads Alliance is also reviewing the current speed limit along the following sections of Dome Valley:

- The 100km area from L Phillips Road (Sheepworld) to Kaipara Flats Road.
- The 70km area outside Wharehine Contractors and Castle Court motel.

3.4.2. Local road network

Between Warkworth and the northern outskirts of Te Hana, the existing SH1 intersects with a number of local roads providing access to small towns or settlements. These settlements include Pakiri and Mangawhai. Some of these local roads serve sparsely populated rural areas, whereas others serve more closely settled rural communities and settlements.

The Indicative Alignment intersects with Wyllie Road, Woodcocks Road, Carran Road, Phillips Road and Kaipara Flats Road in the vicinity of Warkworth. These are local roads serving rural residential properties.

Within the Dome Valley the Indicative Alignment crosses existing forestry access roads, some of which are unformed public roads and others are private roads used for forestry activities.

Wayby Valley Road and Wayby Station Road intersect with SH1 north of the Dome Valley. The Indicative Alignment will cross Wayby Valley, Rustybrook and Whangaripo Valley Roads, which are local roads serving rural properties and residences. Whangaripo Valley Road provides a link to Pakiri and Matakana.

Farmers Lime Road/Worthington Road is an unsealed local road servicing rural properties and residences. Silver Hill Road is an unsealed road providing a link between Te Hana and Waiteitei Road, and services the Silver Hill quarry. The Indicative Alignment crosses both of these local roads.

Mangawhai Road intersects with SH1 north of Te Hana. The Indicative Alignment will cross Mangawhai Road. It carries the Twin Coast Discovery Highway east to Mangawhai and beyond. It also serves communities at Te Arai and provides a link to Tomarata and Pakiri.

Vipond Road is a no exit road that intersects with SH1 north of Mangawhai Road. It is sealed for about 50 m and then changes to an unsealed road that provides access to farm and residential properties. Maeneene Road and Waimanu Road at the north end of the Indicative Alignment are also unsealed, no exit roads intersecting SH1 north of Te Hana. They provide access to private farms and residences.

3.4.3. Planned road network upgrades

There are a number of significant road upgrades either committed or planned that will or are likely to be in place prior to the Project being completed. The future transport network in Warkworth will be taken into account when the detailed design of this Project is undertaken at a later date. These upgrades will likely form part of the existing transport network at the time of construction of the Project and are summarised below and shown in Figure 3-1.

Pūhoi to Warkworth project (currently under construction)

The P2Wk will be a four lane motorway connecting SH1 north of the Johnstone's Hill tunnels with the existing SH1 north of Warkworth. At the southern end, south facing ramps are to be provided at Pūhoi Road. At the northern end, the motorway will connect into SH1 north of Warkworth at a roundabout. P2Wk is scheduled to be open to traffic in 2021.

Matakana link road (committed)

The Matakana link road project (Tūhonohono ki Tai) will provide a connection from the existing SH1 north of Hudson Road to Matakana Road in the area around Clayton Road. This project is scheduled to be open to coincide with opening of P2Wk in 2021.

Warkworth Western Link Road (previously known as the Western Collector) (Stage 1 open, remaining stages in planning)

The Warkworth Western Link road project is a three-stage plan to improve road connections to the west of the state highway developed to support the future urbanisation of the Warkworth area. The completed Stage 1 of the Western Link, connecting Mansel Drive to Falls Road, is the first of many transport infrastructure improvements planned for Warkworth over the next 30 years. The timing and exact route of the remaining two stages have yet to be determined but they will likely connect to SH1 in the vicinity of McKinney Road in the south and the new Matakana link road intersection which will be built in the north.

Supporting Growth (uncommitted)

The Supporting Growth Alliance (between Auckland Transport, Auckland Council and the Transport Agency) is a strategic transport planning programme set up to investigate and deliver the transport networks Auckland needs over the next 30 years to accommodate future urban growth. The Supporting Growth Alliance has identified a range of transport projects to support the anticipated growth of Warkworth over the next 20 years. These are:

- Future Matakana Road extension to Sandspit Road;
- Western Link road (previously known as Western Collector and referred to as the Western Collector on Figure 1-1);
- A new Eastern Connector route;
- Frequent bus services to Auckland, potential park and ride facilities and local services;
- Walking and cycling network; and
- Options for a new motorway interchange in the southern part of Warkworth.

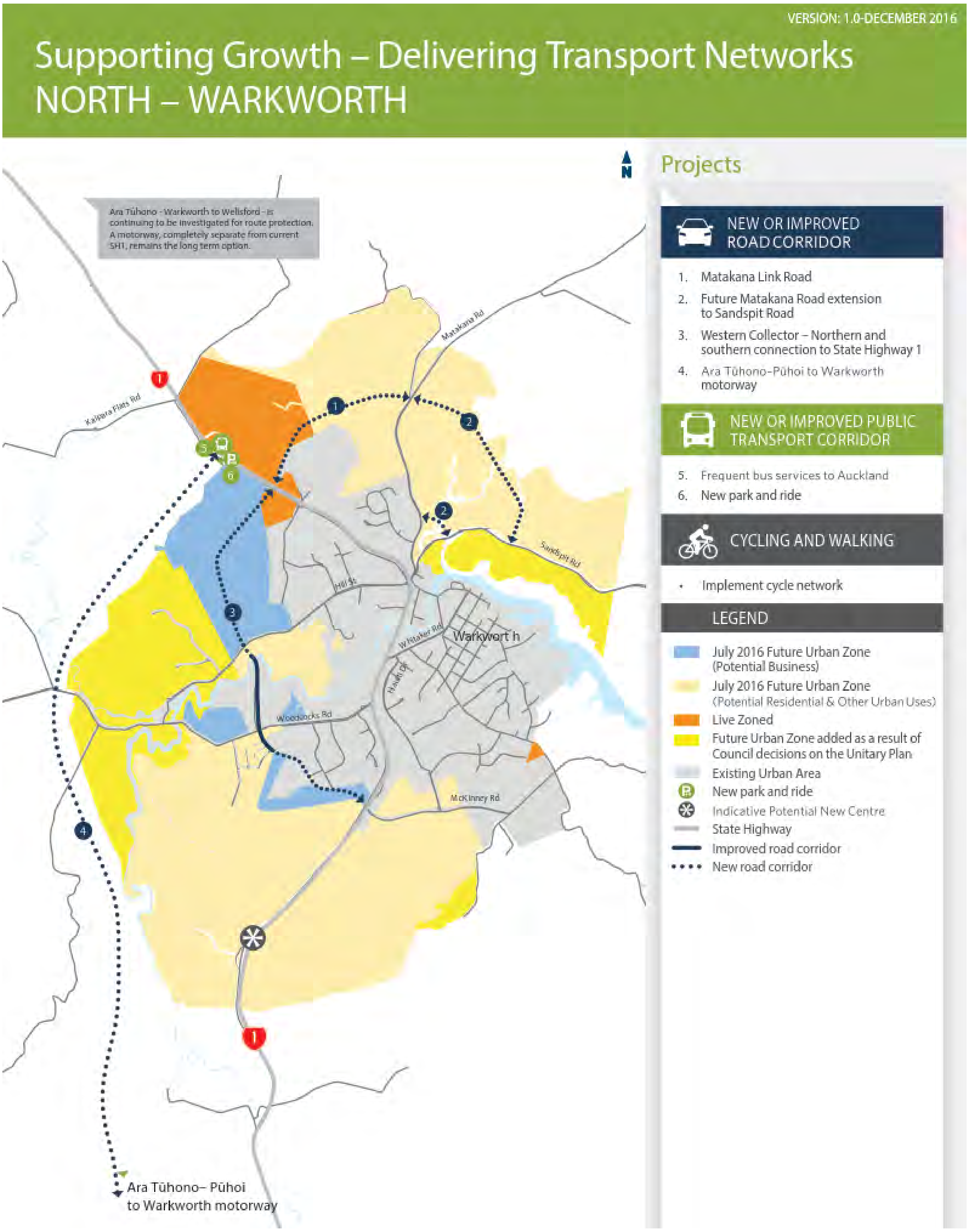

Figure 3-1: Planned network upgrades

(Source: Supporting Growth Programme)

3.4.4. Pedestrian and cycle networks

There are no pedestrian or cycle facilities along the majority of SH1 between Warkworth and Te Hana. There is a greater level of pedestrian activity within Wellsford, both along and across SH1. The section of SH1 through the Wellsford township generally has footpaths on both sides, but formal crossing opportunities are limited.

Te Araroa Trail is located within the Project area north of Warkworth within Matariki Forest above the proposed tunnels. Te Araroa Trail is a continuous 3,000 km walking track from Cape Reinga to Bluff. The Trail will not be affected by the Project.

3.4.5. Bus network

There are currently about eight regular buses that run along the SH1 corridor between Warkworth and Te Hana, daily, operated by various bus companies. In Wellsford, stops for these buses are located on SH1, on both sides of the road.

3.4.6. Rail network

The North Auckland Line (NAL) is located in the wider Project area to the west of the Indicative Alignment. The railway line provides freight services but no commercial passenger services.

3.5. Built environment

3.5.1. Land use

The Project area is located within a largely rural environment zoned Rural Production Zone for the most part, with some Mixed Zone Rural around the Warkworth Interchange and remaining zoned road reserve. The land use activities taking place within the Project area in this rural environment include pastoral farming and commercial plantation forestry activities. Rural residential properties are also scattered throughout the Project area, between the more concentrated areas of settlement at Warkworth, Wellsford and Te Hana.

Extensive tracts of pasture are present near Warkworth, largely used for mixed grazing, and to the north around Wellsford, which is predominately dairying / grazing land.

Commercial plantation forestry is a significant land use in the Project area. Matariki Forest is located between the proposed southern tunnel portals and the Hōteo River. Approximately 34% of the Project area (488 ha) is commercial plantation forestry. Through engagement with Rayonier Matariki Forests (RMF), based on the age of the trees, the forestry within the Project area is likely to reach maturity around the same time as the Project pre-construction phase and will be progressively harvested from around 2025-2027.

Resource consents to facilitate rural activities have been granted in the Project area. There are currently three water permits for properties located within the Project area, stretching between Warkworth and Te Hana. These water permits authorise:

- an off-stream dam used for stock watering[39],

[39] 50 Borrows Road

- the damming of the Maeneene Stream and Te Hana Creek to provide stock watering and dairy shed washing[40]; and
- the damming of an unnamed tributary of the Mahurangi River for “wildlife purposes”[41].

Within the wider Project area, where pastoral farming activities are dominant, water permits have been granted for stock watering and dairy shed washing. In addition, surface water and groundwater takes for reasonable domestic or stock watering purposes that are within permitted activity thresholds in the AUP(OP) do not require consent and are likely to occur throughout the Project area[42] and the surrounding rural environment.

Four discharge permits exist in the Project area to provide for the discharge of dairy wash water from dairying facilities[43].

A water permit for the extraction of groundwater is located near Te Hana for the take of up to 200 m^3 of water per day and up to 73,000 m^3 per year for community water supply and dairy farm use (North Albertland Community Water Supply Association).

Other consents granted in the wider Project area include water permits for horticultural activities (glasshouse crops and outdoor flower production).

Reserves of note located adjacent to the Project area include the Dome Forest Conservation Area and Sunnybrook Scenic Reserve (each zoned Open Space Conservation), both located within the Dome Valley on the eastern side of SH1. The project does not directly affect any reserves.

3.5.2. Infrastructure and network utilities

A number of regionally and/or nationally significant utilities are located within and surrounding the Project area, including transmission and distribution networks for gas, fuel, electricity, water supply, wastewater, telecommunications and rail.

These utilities include:

- The NZ Refining Company pipeline carrying fuels from the oil refinery at Marsden Point to the Wiri Oil Terminal in South Auckland, and the gas transmission pipeline owned and operated by First Gas. These pipelines are located within the same corridor. The Indicative Alignment crosses the gas and oil pipelines south of the Hōteo River bridge, Farmers Lime Road, and near Mangawhai Road at the location of the Te Hana Interchange.
- The Wellsford Delivery Point for natural gas distribution (and other associated infrastructure) owned by Vector in Farmers Lime Road (on land owned by First Gas).
- The Kraack Hill radio/telecommunications tower managed by Spark, under which the Indicative Alignment is proposed to pass in a tunnel.

[40] 18 Hindle Road
[41] 141 Kaipara Flats Road
[42] Land use consents to establish a groundwater bore for stock watering and domestic purposes was granted at 119 Carran Road and for domestic purposes at 17 Maeneene Road, domestic supply and stock watering at 351A Wayby Valley Road.
[43] 542 SH1 Topuni, 170 Whangaripo Valley Road, 18 Hindle Road, 263 Silver Hill Road

- The Wellsford water treatment plant operated by Watercare, is located at Wayby Valley Road. Wellsford's municipal water supply is sourced from the Hōteo River and is piped to the town reservoir (located near the intersection of Matheson Road and Worthington Road) via the water treatment plant.
- Wellsford's wastewater is piped from connected properties to Watercare's wastewater treatment plant, located on SH1 south east of the town. Wastewater is treated, and then discharged into a small, unnamed tributary of the Hōteo River.
- A 110 kV national grid electricity transmission line owned and operated by Transpower, crosses to the north of Wellsford passing east of Te Hana. The Indicative Alignment crosses this corridor (passing under the lines) near the location of the proposed Te Hana Interchange.

In addition to the above, there are numerous local service utilities such as telecommunications lines and power lines throughout the Project area.

Watercare's existing water abstraction and discharge consents in the surrounding environment are listed below:

- Two consented water takes for the municipal water supply at Warkworth. One of these takes is from the Mahurangi River at Warkworth and the other from a groundwater borehole to the west of Warkworth. It is noted that Watercare has transferred the potable water supply for Warkworth from surface water to groundwater abstraction.
- Four discharge consents to the Mahurangi River, including borehole and water treatment overflow discharges, and the discharge of treated wastewater from the Warkworth wastewater treatment plant.
- One consented water take from the Hōteo River to the west of Wellsford for the municipal water supply of Wellsford and Te Hana.
- Two discharge consents to the Hōteo River catchment. One is associated with the abstraction, while the other is the discharge consent for treated wastewater from the Wellsford and Te Hana wastewater treatment plant.

3.5.3. Built heritage and archaeology

Most of the Project area consists of sparsely populated rural land, which has little known history of concentrated settlement or human activity, other than the early settlements of Warkworth and Wellsford. As a result, relatively few historic buildings are present outside of these urban areas.

The *Historic Heritage Assessment* describes the recorded and unrecorded heritage and archaeological sites within the Project area. There are no sites listed on the Heritage New Zealand List/Rārangi Kōrero present within the Project area. Twelve archaeological sites are located within the Project area.

The archaeological and historic heritage sites are all located at the southern extent of the Project around Warkworth and relate to 19th century European settlement around Phillips and Carran Roads, and include one building (Woodthorpe House), with the possibility of archaeology where the buildings no longer exist on unsurveyed properties (the old Dome Valley school and school teacher's residence sites). Four US military camp sites related to World War II are also located within the Project area around Wyllie, Carran and Phillips roads. These World War II sites are of historic interest but are not recorded archaeological sites because of their post-1900 status. These sites are shown in section 9.8.

There is potential for unrecorded Māori sites within the Project area particularly at the Hōteo River and watercourses in the Te Hana area, which are reported in traditional histories.

There are three heritage sites located in the surrounding environment (although unaffected by the Project), which are detailed in the *Historic Heritage Assessment*.

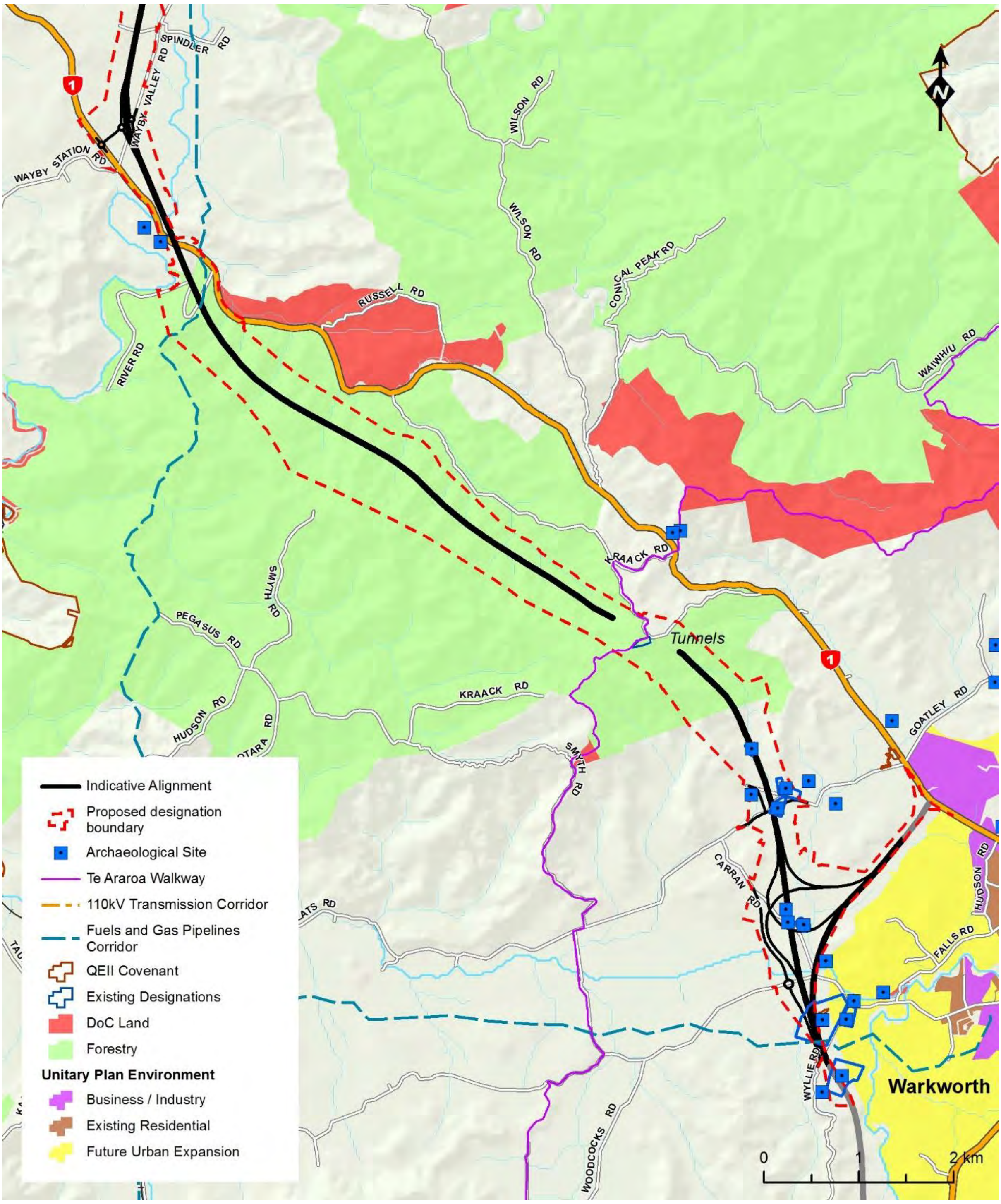

Figure 3-2: Built environment features south of the Hōteo River

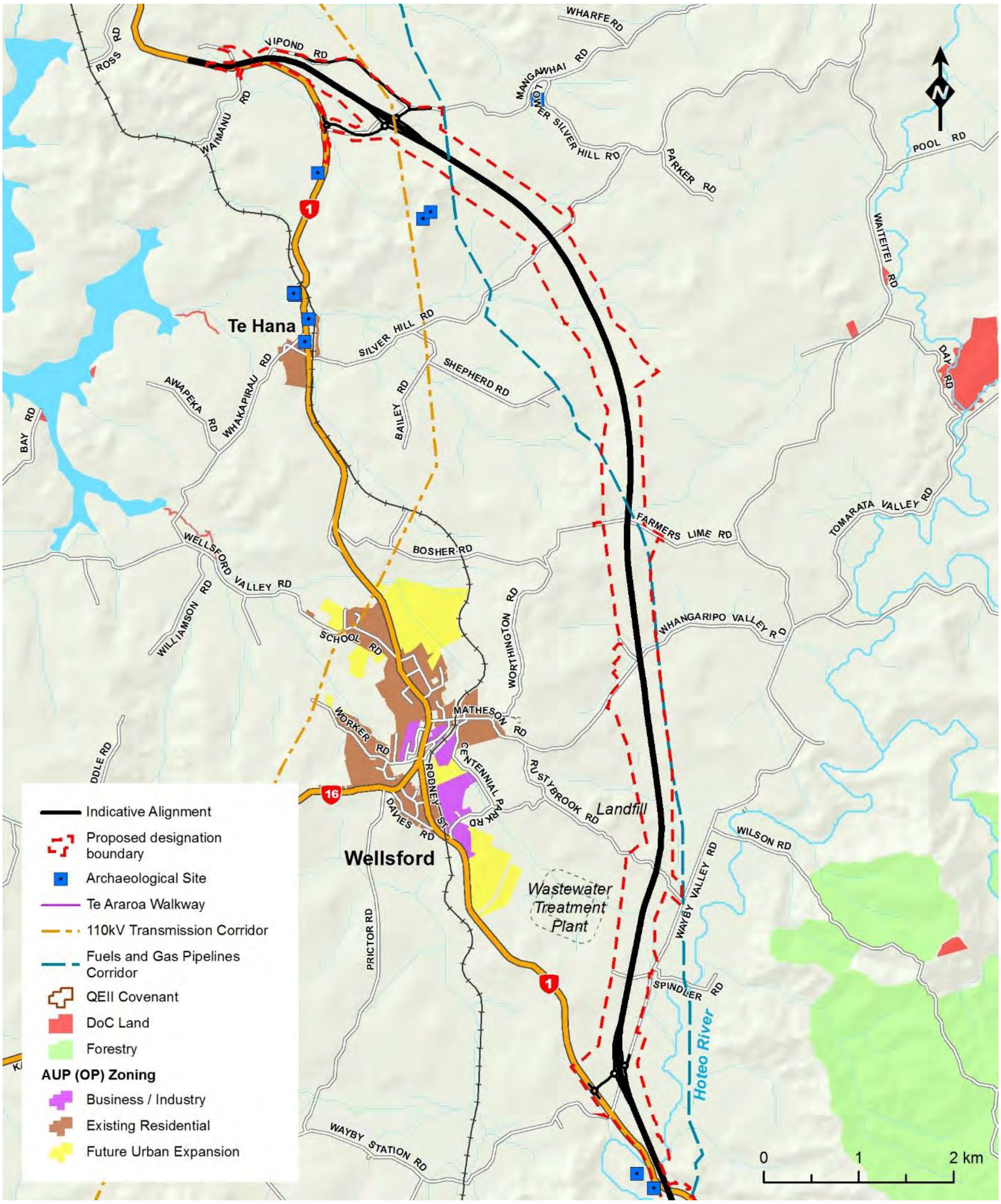

Figure 3.3: Built environment features north of the Hoteo River

3.6. Natural environment

3.6.1. Topography and landscape

The key landscape characteristics of the Project area are:

- A mixture of pastoral farming, native bush, and exotic forestry;

- Large land holdings; and
- Varied landforms.

The extensive network of rivers and streams throughout and surrounding the Project area reflects the relative complexity of the landform along much of the Indicative Alignment.

The topography of the area immediately surrounding the Project is shown in Figure 3-4 and can be broadly described as follows:

- Immediately to the west of Warkworth is generally flat with Warkworth situated on low hills and ridges and framed to the west by a low ridge and to the east by the Mahurangi River and Mahurangi Harbour.
- The topography north of Warkworth, particularly north of Kaipara Flats Road, rises steeply towards the prominent landform of The Dome (338 m elevation). The Dome Forest is located to the east of SH1, outside the Project area.
- The central and southern parts of the Project area comprise steeper rolling hill country with distinctive complex incised landforms of interconnected ridge and valley systems.
- The topography immediately south and east of Wellsford is characterised by rolling hills primarily in pasture, with gentle inclines along the current SH1 rising up to Wellsford. Similar topography continues northward to Te Hana.

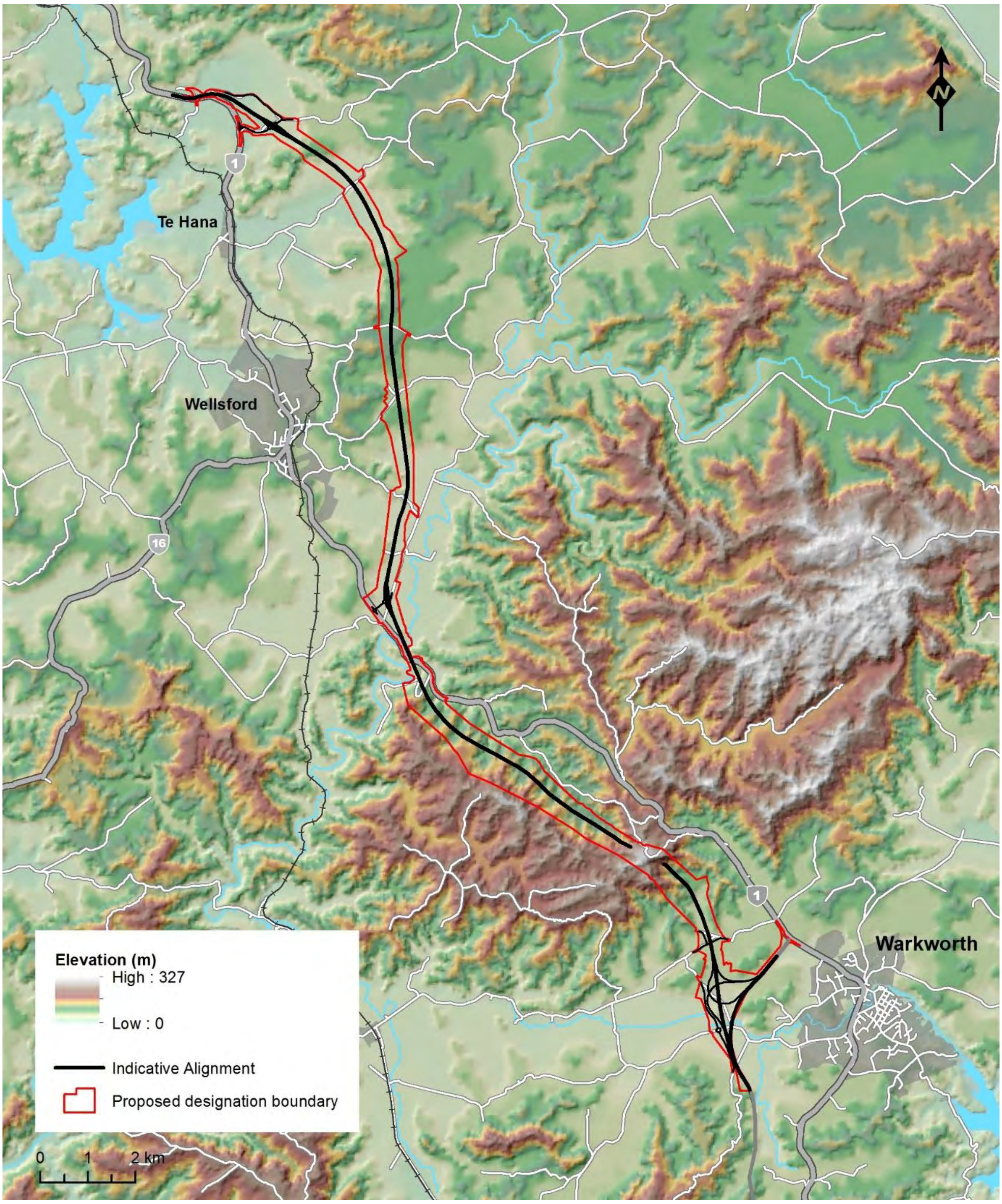

Figure 3-4: Topography of the Project area and surrounding environment

There are no Outstanding Natural Landscapes (ONL) scheduled in the AUP(OP) located within the Project area. The closest scheduled ONL is the Dome Forest (ID 32) which is immediately east of the Project. This ONL is shown in Figure 3-5 and Figure 3-6. There is one Outstanding Natural Feature (ONF) identified in the AUP(OP) (ID 49, Hōteo River incised meander) located within the Project area, located to the south of the existing SH1 bridge across the Hōteo River. This ONF is shown on Figure 3-6. There are no ONL, Significant Ecological Area (SEA) features within the proposed designation boundary north of Rustybrook Road as shown in Figure 3-7.

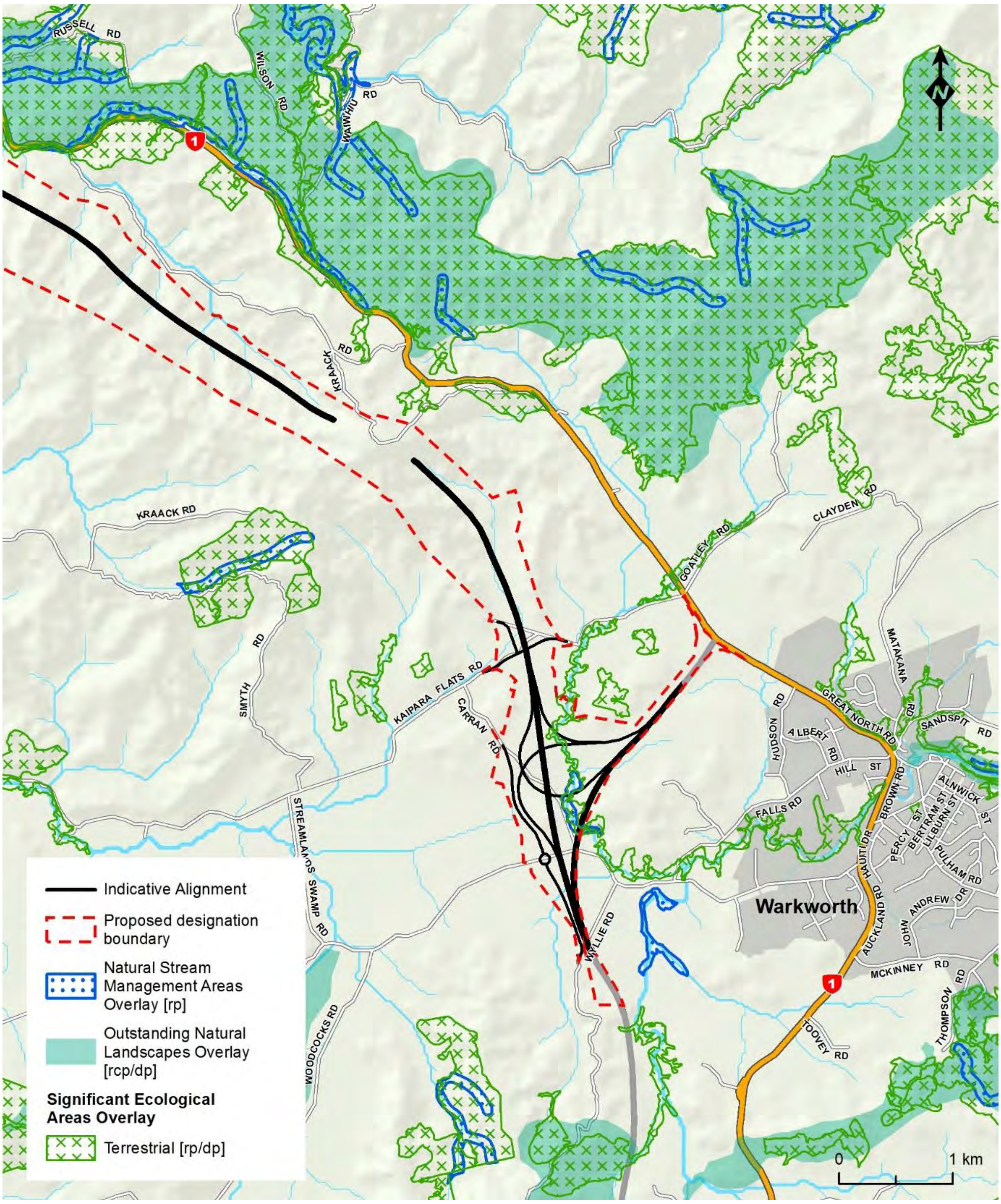

Figure 3-5: Location of ONL, ONF and SEA features in relation to the proposed designation boundary and Indicative Alignment near Warkworth

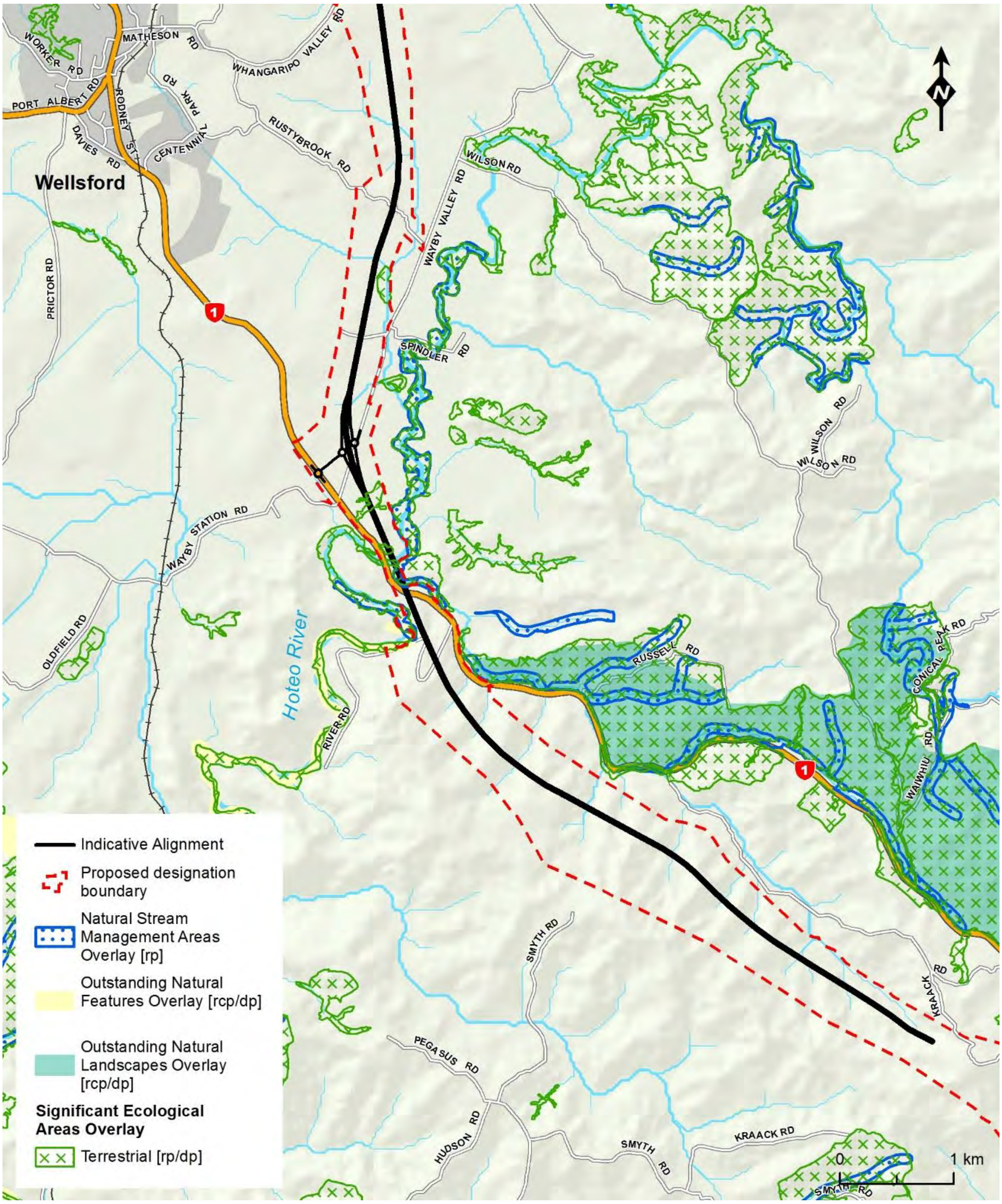

Figure 3-6: Location of ONL, ONF and SEA features in relation to the proposed designation boundary and Indicative Alignment around the Hōteo

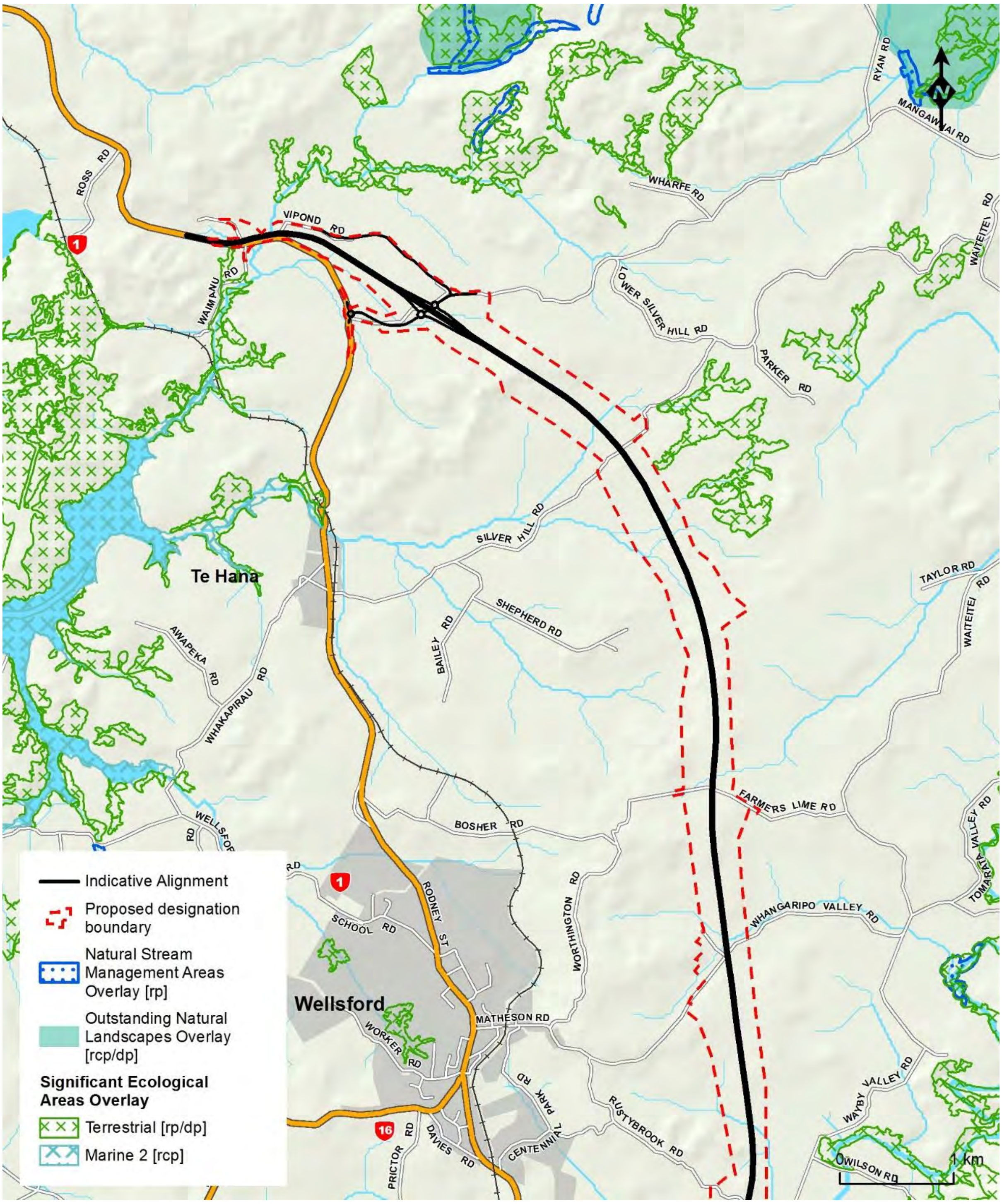

Figure 3-7: Location of ONL, ONF and SEA features in relation to the proposed designation boundary and Indicative Alignment around Te Hana.

3.6.2. Geology

The geology of the area surrounding the Project is shown in Figure 3.8. The Project is predominantly underlain by 'Northland Allochthon' rocks to the north of the Hōteo River and sedimentary rocks of the Waitemata Group south of the Hōteo River.

Over a few million years from about 25 million years ago, a tectonic plate collision process forced huge slabs of older sediment/rock formations (0.5-2 km thick and up to hundreds of square kilometres in area) to be uplifted and displaced onto large parts of Northland from the north east (Hayward, 2017) extending southwards as far as Silverdale, Auckland. These displaced rocks are geologically known as the 'Northland Allochthon'.

The Project spans the frontal (southern) edge of the continuous Northland Allochthon mass on land, just south of Wellsford (Hayward, 2017), and extends southwards across Waitemata Group rocks which were also deformed and disrupted by the Northland Allochthon emplacement at the time of their formation. Consequently, the southern end of the Project includes areas with an arrangement of faulted and folded Waitemata Group rocks with some smaller detached slices of significantly weaker and sheared Northland Allochthon rocks present around Warkworth.

The geology of the Project area typically comprises:

- Variable Northland Allochthon rocks of the Mangakahia Complex and the Motatau complex – composed of highly sheared siliceous and calcareous mudstones, siltstone, muddy limestone (Mahurangi Limestone) and a mixture of variable proportions of each. These rocks are typically encountered north of the Hōteo River.
- Areas where limestone outcrops along the Indicative Alignment have historically been quarried for small-scale and local commercial, roading or agricultural use.
- Sedimentary rocks of the Waitemata Group – in particular the Pakiri Formation – thick sandstones, gritstones and/or regular alternating layers of sandstone and siltstone. These are the predominant geological materials underlying the steep rugged topography of the Dome and hills surrounding Dome Valley, south of the Hōteo River.
- Relatively soft estuarine and alluvial soils (clays, silts and sands with some organic or peat layers) of the Tauranga Group are present in low lying regions and in-filled valley floors, including the Woodcocks Road, Carran Road, Kaipara Flats Road, Wayby Valley Road, Silver Hill Road and Vipond Road areas.

The main regional geological structures are inactive thrust faults (faults which do not have earthquakes) associated with emplacement of the Northland Allochthon. These faults define many of the sharp boundaries between the Pakiri Formation and Northland Allochthon thrust sheets. The layered Pakiri Formation rocks adjacent to these faults are often deformed with faults, tight folds, extensive jointing and sheared defects. Faults and folds formed during the deposition of the sedimentary layers have also added to the local deformation of the Pakiri Formation rocks in the area.

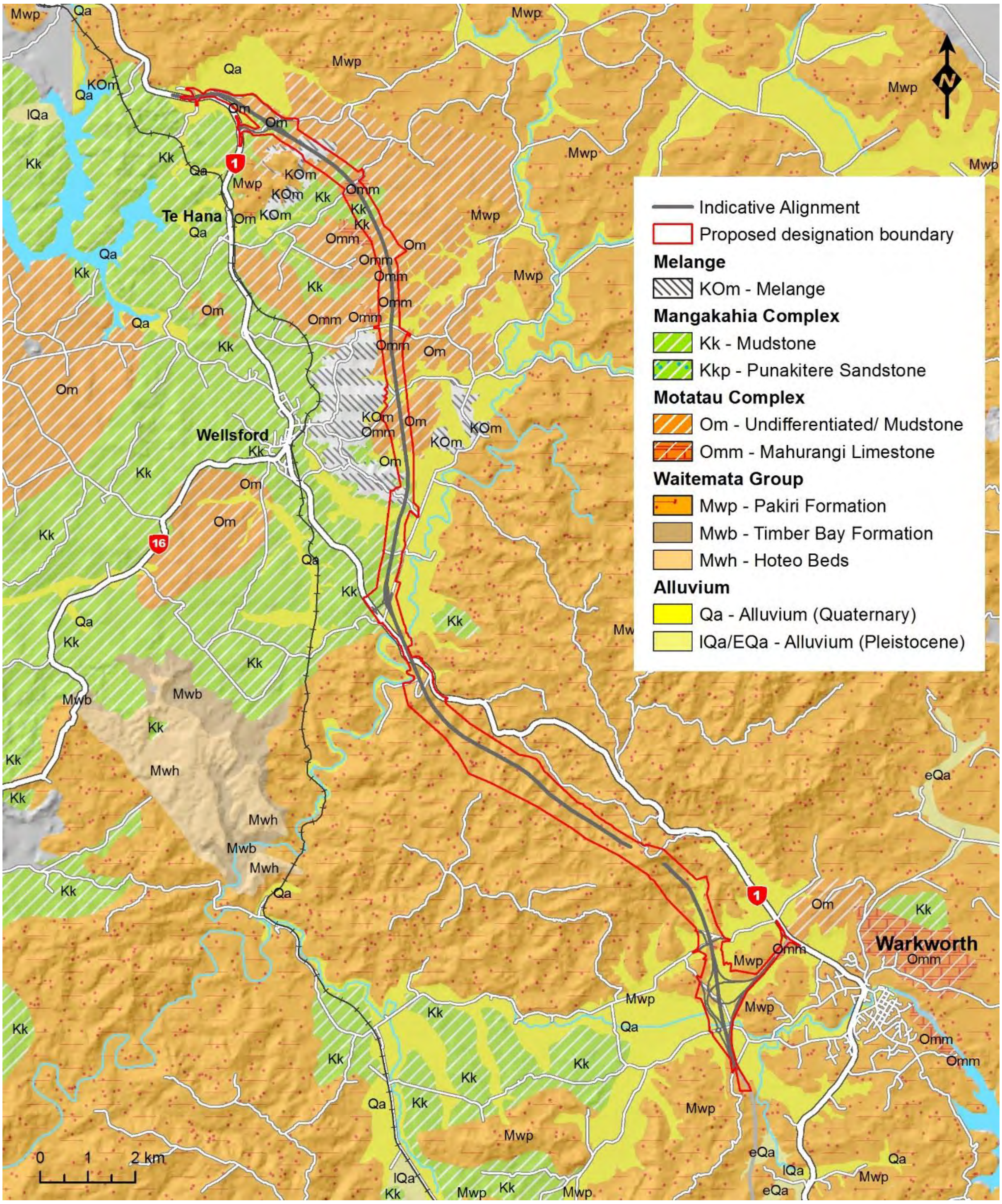

Figure 3.8: Geology within and surrounding the Project area

Landslide hazards exist throughout the region and are present within the Project area. Numerous examples of historical and current shallow slope failures (<5 m deep) exist along the present road network as a result of intense or prolonged rainfall events (e.g. SH1 through Dome Valley and local road cuts around Wellsford).

Larger landslides occur in both Pakiri Formation and Northland Allochthon Rocks and several very large features within the proposed designation are traversed by the Indicative Alignment. The landslides are predominantly considered dormant or inactive and are unlikely to be naturally re-activated unless subjected to significant earthquakes.

The Auckland and Northland regions are some of the least seismically active regions of New Zealand. The closest known active faults are the Wairoa North Fault located in the Hunua Ranges south-east of Auckland and the Kerepehi Fault within the Firth of Thames (Edbrooke, 2001). Another considered potentially active is the Drury Fault on the edge of the Hunua Ranges (Williams et al., 2006).

No major faults are identified on published geological maps in the vicinity of the Indicative Alignment (Edbrooke, 2001). However, fault shear zones have been intercepted in deep investigation boreholes in the Kraack Hill area and several main linear features have been recognised and may reflect weaker crushed or sheared rock marking significant, inactive fault zones associated with the Northland Allochthon.

3.6.3. Hydrogeology

The hydrogeological regimes found within the Project area are strongly influenced by the underlying geological units.

Permeability of the Northern Allochthon is typically very low, and groundwater is typically observed as a line of seepage or minor springs at geological boundaries between units within the formation.

Groundwater in the Pakiri Formation is strongly influenced by incised valleys, with groundwater typically being elevated along ridgelines and depressed along valley sides and floors. Perched and leaky water tables may be present at higher elevations than the local water table in discrete localities, reflecting the interbedded nature of the sandstone/siltstone formation and typically low permeability of the siltstones.

The Tauranga Group Alluvium within river valleys and estuarine embayments comprises shallow aquifers that have limited potential to supply good quality or high yields of groundwater.

3.6.4. Hydrology and drainage catchments

The Project traverses three major drainage catchments: the Mahurangi River catchment; the Hōteo River catchment; and the Oruawharo River catchment. The Project commences in the Mahurangi River catchment, which flows generally towards the south-east and discharges through the south-facing Mahurangi Harbour. North of the Mahurangi River catchment is the Hōteo River catchment (which includes the Kourawhero subcatchment). The northern extent crosses into two subcatchments of the Oruawharo River catchment (the Maeneene and Te Hana streams) at the northern extent of the Project. The Hōteo and Oruawharo Rivers both flow into the Kaipara Harbour.

There are numerous smaller streams and creeks in the wider Project area, some of which are steeply incised into the landscape.

The catchment and sub-catchment areas and divides are described in detail in the *Water Assessment Report* in Volume 2 and key aspects are summarised below. The catchments are shown on Figure 3-9.

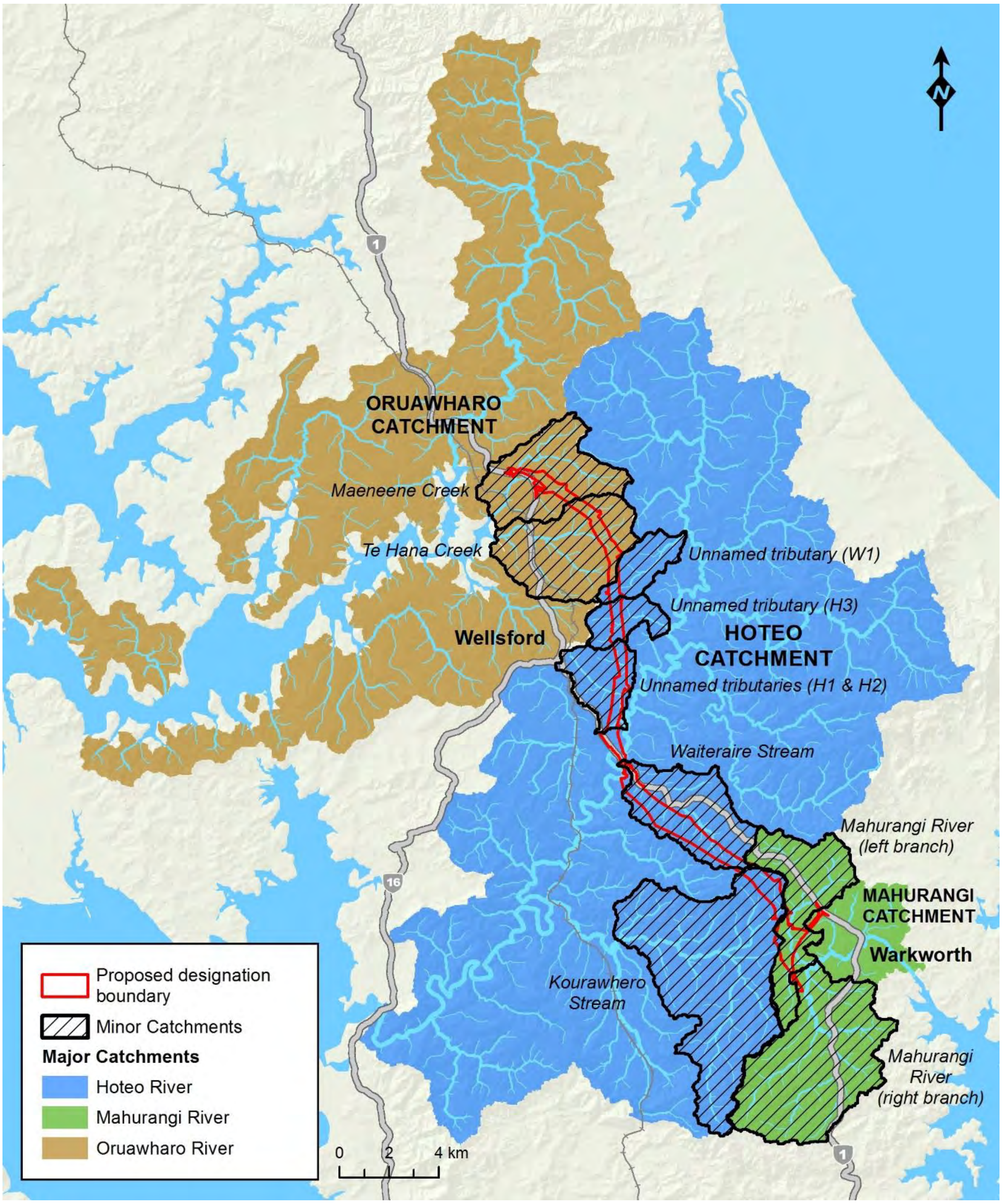

Figure 3-9: Catchment boundaries within the wider Project area

Mahurangi River catchment

The Mahurangi River catchment is approximately 11,700 ha in area. It has a wide catchment formed by its Right Branch flowing from the northern slopes of Moir Hill in the south, and the Left Branch flowing from the southern slopes of The Dome. The Left and Right branches of the Mahurangi River converge west of Warkworth, before flowing through the town into the estuary and then Mahurangi Harbour. Numerous freshwater streams discharge into the Mahurangi Harbour directly or via the Mahurangi River.

The Project area covers approximately 224 ha of the Mahurangi River catchment which is 1.9% of the total catchment area. The catchment divide between the Hōteo and Mahurangi catchments occurs near Carran Road and Kaipara Flats Road, approximately 8 km to the west of Warkworth.

The Mahurangi catchment has a rural character. The primary land use is rural production, particularly pastoral farming (64% of the catchment area), followed by native forest (20%) and production forestry (8%). Within the Project area the primary catchment land use is rural production and rural residential land uses.

The Mahurangi River is identified as a High Use Stream in the AUP(OP), and much of the catchment from the Dome Forest Conservation Area in the north to Moir Hill Road in the south is categorised as a High Use Stream Management Area. The catchment is under pressure from demands for water take and use by a number of users as set out in sections 3.5.1 and 3.5.2.

Some of the Mahurangi River is identified as a Natural Stream Management Area (NSMA) in the AUP(OP) (refer Figure 3-5). These are areas with high natural character and high ecological values. The NSMA and SEA areas identified in the AUP(OP) are shown in section 3.6.1.

Sediment accumulation within the Mahurangi Harbour has been linked to deforestation, development, and intensive land use[44]. This sedimentation has impacted on the quality of the river and harbour for navigation, recreation, commercial use (fishing and aquaculture) and as a habitat for fish and shellfish. Concerns regarding sedimentation pressures on the catchment have led to the adoption of the Mahurangi Action Plan[45] by Auckland Council in 2011 to address sediment inputs through land management techniques such as riparian planting and fencing, and education programmes.

Hōteo River catchment

The Hōteo River has the largest catchment in the Auckland Region, with an area of 40,502 ha. The Hōteo River drains into the Kaipara Harbour, where monitoring over the past 20 years shows continued pressure from contaminants, particularly sediment and phosphorus. Recent research has highlighted the importance of the Kaipara Harbour ecosystem, particularly the seagrass beds, which provide significant habitat for juvenile snapper. Extensive seagrass beds are located adjacent to the mouth of the Hōteo River.[46]

906 ha of the Project area sits within the Hōteo River catchment, which is 2.24% of the total catchment. North of Kaipara Flats Road, the Indicative Alignment passes through the Kourawhero Stream sub-catchment (a tributary of the Hōteo River). The Indicative Alignment runs along the southern valley of the Waiteraire Stream and crosses multiple tributaries in its sub-catchment. The Indicative Alignment crosses the Hōteo River immediately upstream of the existing SH1 road crossing and crosses multiple tributaries of the Hōteo River.

The main land uses in the Hōteo River catchment include pastoral farming (57%), commercial plantation forestry (23%), and indigenous forest (15%). Within the Project

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[44] Mahurangi Action Plan, A strategic plan for the catchment 2010-2030 (2011).

[45] ibid.

[46] Auckland Council – Technical Report 2014/201 - Hōteo River catchment: environment and socio-economic review – August 2014.

area the primary land use is commercial plantation forestry (Matariki Forest) and pastoral farming. The extent of the Matariki Forest is shown in Figure 3-10.

The existing land use (2017) for 35.2 km^2 of the Hōteo River catchment is exotic plantation forests. These forests are likely to reach maturity around the same time as the Project construction phase and are scheduled to be harvested prior to construction in 2025-2027. Harvesting within Matariki Forest within the Hōteo catchment is predicted to increase the sediment load within the Hōteo River by an average of between 3.2-7.5%.[47]

[47] Catchment Sediment Modelling technical report, section 5.

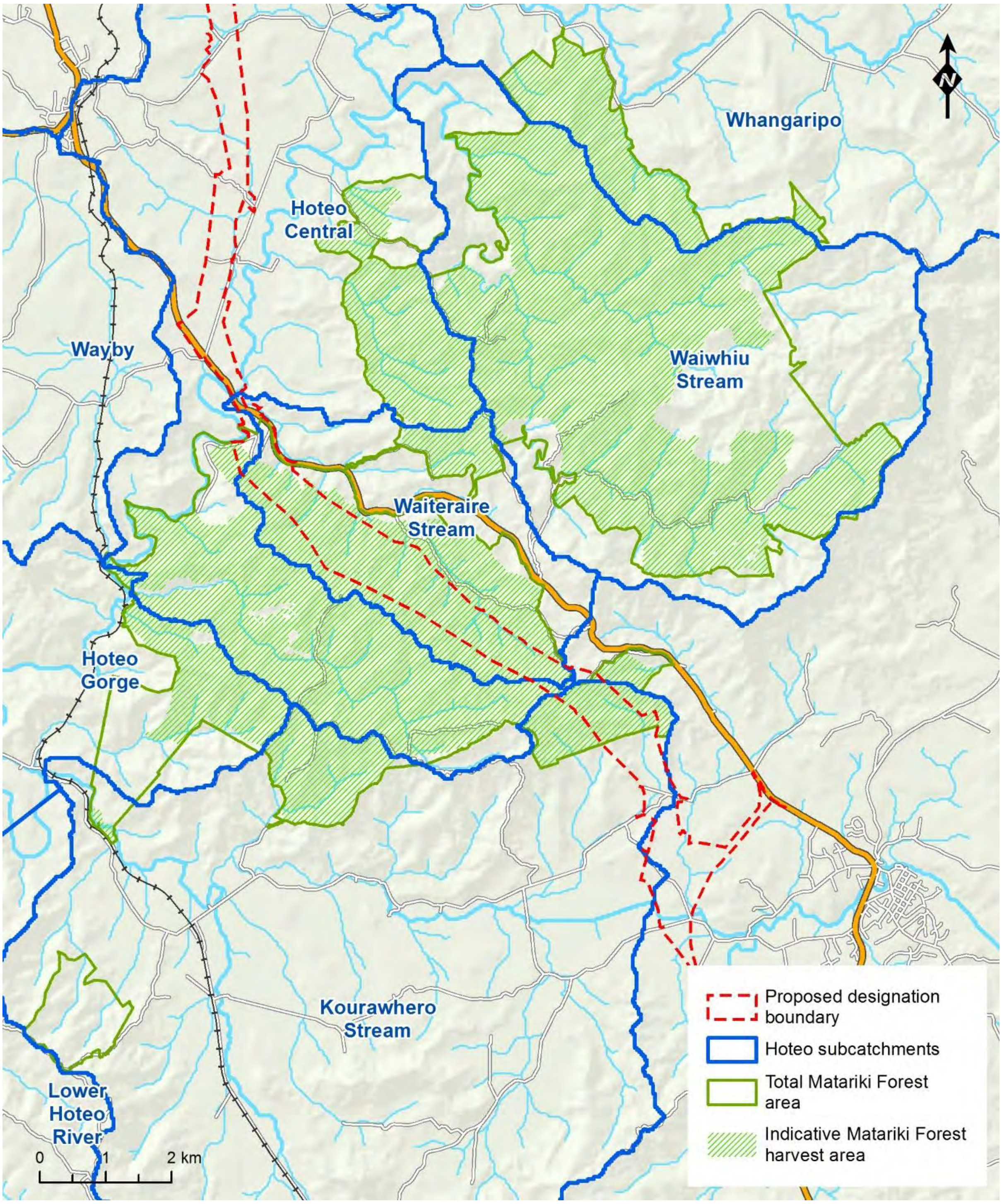


Figure 3-10: Extent of Matariki Forest

A number of the upper tributaries within the Hōteo River catchment, and parts of the Hōteo River mainstem, are identified as Natural Stream Management Areas (NSMAs) under the AUP(OP), and are shown in Figure 3-5, Figure 3-6 and Figure 3-7. Although identified on the AUP(OP) planning maps as a NSMA, the NSMA within the proposed designation west of the Indicative Alignment along the Hōteo River, does not meet the definition of a NSMA[48].

[48] Refer AUP(OP) Chapter J Definitions

Oruawharo River catchment

The catchment of the Oruawharo River is approximately 26,600 ha. The Indicative Alignment crosses two tributaries of the estuarine Oruawharo River; Te Hana Creek and Maeneene Creek. These tributaries collectively drain to the Oruawharo catchment, which ultimately drains to the Kaipara Harbour.

287 ha of the Project area sits within the Oruawharo River catchment, which is 1.07% of the total catchment area. Pastoral farming is the predominant land use in this catchment. Gradients in the catchment are moderate and soils are variable.

Te Hana Creek is a small creek with a total catchment of approximately 170 ha. The Indicative Alignment crosses multiple tributaries of Te Hana Creek. These tributaries are in the upper reaches within undulating pasture. Te Hana Creek becomes estuarine to the west of the existing SH1 and flows into Maeneene Creek, prior to discharging to the Oruawharo River, and ultimately the Kaipara Harbour.

Maeneene Creek has a total catchment of approximately 150 ha. Maeneene Creek becomes estuarine to the south of the existing SH1 and flows into Oruawharo River. The Indicative Alignment crosses multiple tributaries of the Maeneene Creek and crosses the main channel of the creek in an estuarine reach. The proposed Te Hana interchange at the northern end of the Project is located within this catchment.

3.6.5. Coastal marine areas

The coastal environment is described in detail in the *Marine Ecology Assessment* in Volume 2. The Project does not pass through any coastal marine areas (CMA). At its closest point the Project is located approximately 1 km upstream of the CMA at the northern tie-in with the existing SH1. The CMA in the surrounding area includes the Mahurangi Harbour and the coastal reaches of the inner Kaipara Harbour inlets at Te Hana Creek and Maeneene Stream. These harbours are the ultimate receiving environment for discharges from the Project and are shown Figure 3-9.

Mahurangi Harbour

The Mahurangi Harbour is part of the Hauraki Gulf. It is characterised by large areas of intertidal mud flats and sand flats inside the harbour, and a variety of more exposed shores (ranging from broad rock platforms to small sandy beaches) outside the mouth of the harbour. The harbour provides habitat for a varied range of animal and plant communities. Several established marine farms are located within the Mahurangi Harbour.

The AUP(OP) overlays classify a large area within the Mahurangi Harbour as Significant Ecological Area – Marine 2 (SEA-M2), and some smaller areas as Significant Ecological Area – Marine 1 (SEA-M1).

The western half of the Harbour and its surrounds are identified as an ONL (ID 43) under the AUP(OP), with several pockets of High Natural Character within and adjacent to the Harbour. The Mahurangi Harbour is also identified by the Department of Conservation (DOC) as an Area of Significant Conservation Value.

The Mahurangi Harbour has been identified as vulnerable to soil erosion and harbour infilling, primarily due to weather conditions that affect the area, the steep slopes present within parts of the catchment, and erosion-susceptibility of soils.[49] Sediment enters the Harbour from the Mahurangi River and sub-catchments along the Harbour. Most sediment originates from pasture and native forest areas between the Mahurangi River and the Harbour entrance[50].

Inner Kaipara estuarine areas

The Kaipara Harbour is the largest harbour in the Auckland Region, with a total area of 947 km^2. It contains a variety of high value species, habitats, and values. The AUP(OP) recognises a number of SEA-M1 and SEA -M2 areas within the harbour, including significant wading bird areas. In particular, the southern parts of the Kaipara Harbour contain much diversity of habitat, and are home to mangroves and salt marshes, seagrass beds, intertidal and subtidal habitat, deep channels, and rocky reefs.[51] The seagrass and horse mussel beds present in the harbour provide important nursery habitat for snapper[52].

The closest areas of CMA to the Project area include the intertidal area around Te Hana Creek, and Maeneene Stream. Te Hana Creek and Maeneene Stream are located to the immediate north-west of Te Hana.

There are pockets of High Natural Character (as identified in the AUP(OP)) within the Kaipara Harbour, on the northern side of the Te Hana Creek (AREA 7 - Browns Hill, high rating), between Maeneene Creek and the Topuni River (AREA 6 – Topuni River, high rating) and within the Hargreaves Basin in the Oruawharo River (AREA 5 – Hargreaves Basin, high rating). There are also areas of Outstanding Natural Landscape. These overlays are shown on Figure 3-7.

The Northland Regional Policy Statement identifies the Oruawharo River arm within the Kaipara Harbour as High Natural Character and there are two areas of Outstanding Natural Character also located in the Oruawharo River. The Kaipara District Plan identifies the interface between the Oruawharo River and land as an area of significance to Māori (SM03) which recognises the Statutory Acknowledgement of the Kaipara Harbour coastal area.

The Kaipara Harbour also has issues relating to the amount of sediment entering the marine environment. The environmental values of the Harbour have been and are continuing to degrade. The key threats to the Harbour include land use activities that generate sediment and other contaminants. The Hōteo River is found to be a key contributor of sediment to the southern Kaipara Harbour and river sedimentation poses a threat to the snapper breeding ground located near the Hōteo River mouth.[53]

3.6.6. Wetlands

The wetlands within the Project area are detailed in the *Ecology Assessment*, and a summary is presented here. Wetland habitats throughout the Project area vary in their ecological value; from low value to very high value. Low value wetland habitats occur

49 Carbines and Vaughan, 2013.
50 Ibid.
51 Ibid.
52 Ibid.
53 Warkworth to Wellsford Existing Water Quality Report, 2018.

throughout the Project area, where many of the wetland areas are degraded from stock access and modifications in the surrounding drainage systems.

The higher value wetland ecological values occur in the upper Kourawhero Stream valley northwest of Warkworth, which contains a high quality wetland mosaic with significant flora and fauna values and includes suitable habitat for birds and at least one regionally significant plant species (swamp maire). A wetland in the Kourawhero Stream headwaters is contiguous with a raupo reedland wetland downstream in the Phillips Road area.

Although many of the wetlands north of the Hōteo River are degraded due to stock access and modifications in the surrounding drainage systems there are also a number of high and very high value remnant wetland patches where stock have been excluded. These wetland sites are located on the alluvial terrace derived from the Hōteo River and likely formed part of an extensive kahikatea swampland prior to land conversion.

The AUP(OP) does not identify any Wetland Management Areas within the Project area.

3.6.7. Ecology

Vegetation and land cover

The majority of the land within the Project area is in productive land use, particularly for commercial plantation forestry and pastoral farming. Within the Project area there is approximately 848 ha of grass/pasture (59% of the total area), 488 ha of plantation forestry (34% of the total area), and 74 ha of native vegetation (5% of the total area).[54] The land cover of the Project area is represented in Figure 3-11.

Extensive tracts of pasture are present near Warkworth, largely used for mixed grazing, and to the north around Wellsford. The pasture near Wellsford is predominately dairying land. Matariki Forest is largely comprised of mixed aged stands of pine. Smaller areas of hardwoods, such as eucalyptus, are scattered along the corridor. While the commercial plantation forestry is currently vegetated, the nature of this environment is subject to a revolving cycle of change from a temporarily highly modified environment (during and immediately after harvesting) to a more natural environment while the replanted trees are growing. As discussed in section 3.5.1, these forests are likely to reach maturity around the same time as the Project pre-construction phase and progressively harvested from around 2025-2027.

The Mahurangi River (Left Branch) and the Kourawhero Stream are located within predominantly pastureland, interspersed with lowland kahikatea forest remnants and regenerating scrub. Riparian taraire forest and podocarp broadleaf forest border the Mahurangi River.

Plantation pine forest on steep, dissected hill country dominates the hills either side of the Dome Valley, interspersed with narrow riparian margins of native vegetation that line incised stream gullies. Also present are areas of mature Eucalyptus, small podocarp broadleaf forest remnants, and mixed native and exotic regenerating scrub along roadsides and in recently harvested sites.

[54] As adapted from Landcare Research's Land Cover Database - Plantation forestry definition

Forest and treeland clusters across north of the Hōteo River are largely surrounded by pasture and are currently in varying degrees of isolation and degradation due to the surrounding agricultural land use. The Hōteo River and its tributaries connect a number of remnant patches of lowland forest, including the totara-dominated forest lining the Hōteo River as well as patches of kahikatea swamp forest and taraire forest on areas of higher ground and escarpment near the river. The northern extent of the Project area towards Te Hana grades into rolling farmland interspersed with small patches of indigenous treeland, often associated with small tributaries.

Around Wellsford, the vegetation is characterised by areas of open pasture fragmented by some limited clusters of exotic and indigenous vegetation, including shelterbelt plantings.

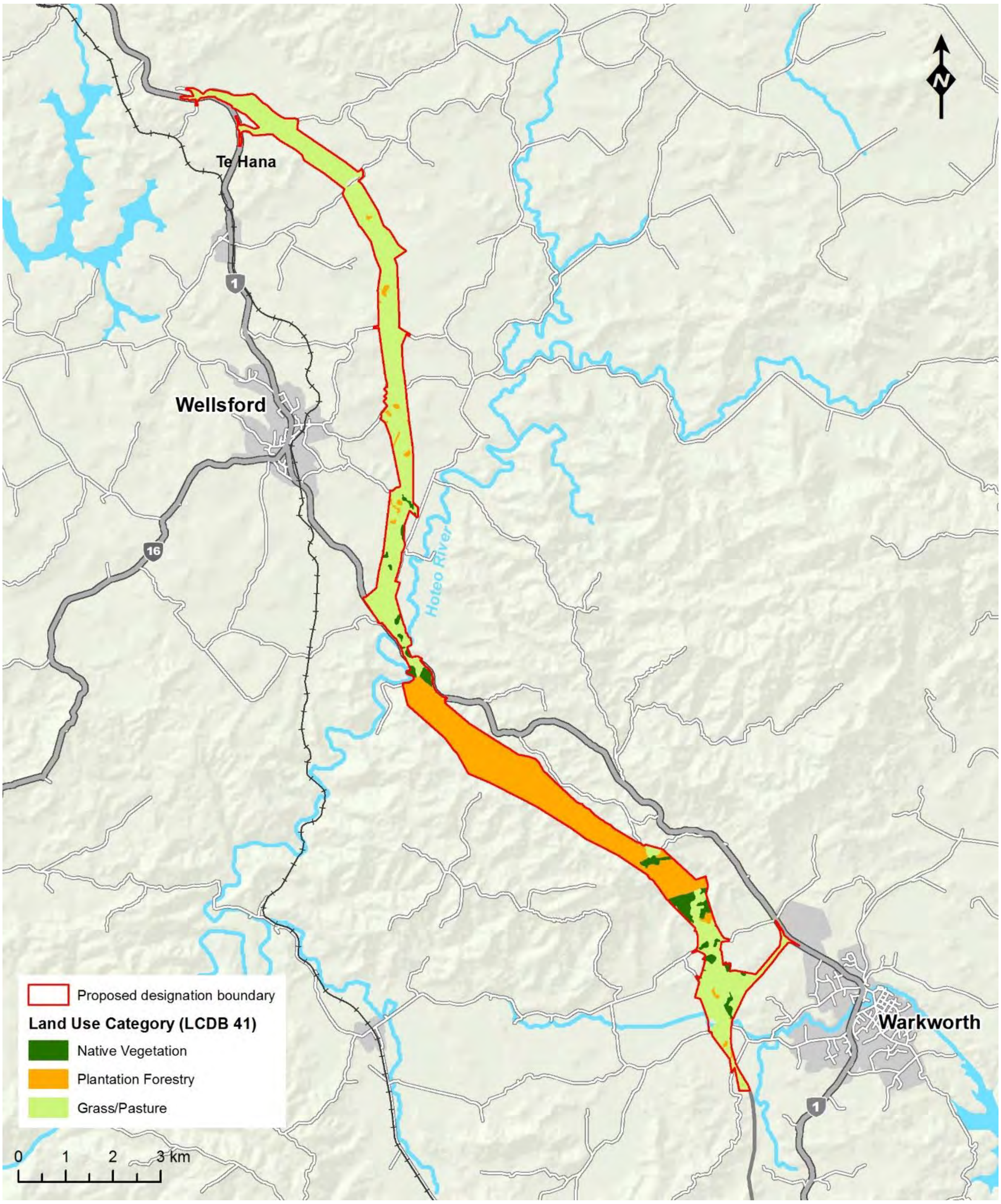


Figure 3-11: Vegetation and land cover within and surrounding the Project area

The AUP(OP) identifies several Significant Ecological Areas (SEA) in the Project area, including the riparian vegetation around the Mahurangi River and Hōteo River; some stands of indigenous vegetation around Wayby Valley Road and estuarine areas around Te Hana (refer Figure 3-5, Figure 3-6 and Figure 3-7).

Terrestrial fauna

The terrestrial fauna present in the Project area is detailed in the *Ecology Assessment* and consists of a combination of indigenous and exotic species, largely typical of the wider region. Several threatened species inhabit the Project area, including native land snails, native birds, native long-tailed bat and Hochstetter's frogs, details of which are summarised below. Introduced pest mammals including pigs, goats, possums, rabbits, hedgehogs and rats are also present in the Project area.

Native land snails

Two species of native land snails; the Kauri snail and the Rhytid snail, have been recorded in patches of native forest within the Project area and its surrounds. These species are classified as 'At Risk – Declining' in the New Zealand Threat Classification System. During the surveys undertaken as part of the *Ecology Assessment* live kauri snails were found in Matariki Forest.

Birds

A large proportion of the birds present in the Project area are native and introduced species common within the wider region and throughout New Zealand. Of the native species present within the wider Project area, five are classified as At Risk, namely: North Island kaka, New Zealand pipit, North Island fernbird, North Island robin and red-crowned parakeet. During the surveys as part of the *Ecology Assessment* a single banded rail was detected in the area north of Warkworth and Cooks petrel were recorded over-flying in the Dome Valley and north of the Hōteo. Kaka and red-crowned parakeet are likely to be intermittent visitors to both the plantation forest habitats and remnant native habitat in the wider area. These species are probably more frequent in the larger tracts of native forest vegetation nearby, such as the Dome Forest Conservation Area.

Kereru and other native forest birds likely use areas of remnant native vegetation present throughout the wider area. A number of wetland birds are known to exist in the wider area including marsh crake and spotless crake.

Bats

Native long-tailed bats have been detected using acoustic recorders as part of the *Ecology Assessment*, within Matariki Forest. Long-tailed bats are highly mobile. Shelterbelts and small forest remnants with cavity bearing trees that could be used by bats exist throughout the Project area. Long-tailed bats are classified as nationally vulnerable in the North Island and have a high risk of extinction in the wild.

Lizards

At least six species of native lizards are known to occur within the wider Rodney area, and potential habitat for these species may exist within the Project area. Areas of native forest, native riparian and wetland vegetation, and some pine forest areas present potential habitat for native lizards. In particular, areas north of Kaipara Flats Road through the western slopes of the Dome Valley, Matariki Forest and around the heavily vegetated hill area north-east of Te Hana, may provide habitat for lizards.

Native frogs

The Hochstetter's frog is a small endemic frog that occurs in small isolated populations throughout the northern half of the North Island and Great Barrier Island. No specific frog surveys have been undertaken for the *Ecology Assessment* however Hochstetter's frog surveys undertaken previously have identified the commercial plantation forest as the only part of the Project area with suitable habitat and where Hochstetter's frogs have been recorded previously. Frog habitat was assessed in the *Ecology Assessment* and suitable habitat was identified at several sites surveyed.

Aquatic fauna

There is great variation in the ecological value of freshwater habitats within the Project area, from low value to very high value. Low value aquatic habitats are present north of Warkworth up to the Dome Valley and north of the Hōteo River, where many of the streams are located within grazed pasture. These watercourses are often degraded with low aquatic faunal diversity, no riparian vegetation and extensive stock damage. However, in these pastoral areas the *Ecology Assessment* has identified that small pockets of existing riparian vegetation and areas with riparian fencing present were associated with an increase in aquatic habitat value.

The commercial plantation forest has freshwater habitats of high ecological value, with high diversity of fish and macroinvertebrate species.

Mahurangi and Kourawhero freshwater habitats

Two watercourses (Mahurangi River (Left Branch) and Kourawhero Stream) were assessed in the *Ecology Assessment* as having moderate to high freshwater values, with the surveys indicating excellent fish populations, good stream ecological valuation (SEV) scores and Macroinvertebrate Community Index (MCI) scores that were indicative of good water quality. Electric fishing carried out as part of the surveys has identified good diversity including short and long fin eel, banded kokopu and common bully. Koura (freshwater crayfish) was also identified at one site.

Matariki Forest freshwater habitats

Freshwater environments within Matariki Forest are characterised by steep hill country aquatic habitats located within plantation pine forest. The surrounding catchments are predominantly plantation pine, with the occasional forestry road. Riparian margins across the three sites surveyed for the *Ecology Assessment* were similar, with plantation pine canopy and a number of native species that had become established closer to the stream channel. Freshwater values identified in the *Ecology Assessment* were high across all sites surveyed, indicating very good fish populations, a high abundance of Ephemeroptera, Plecoptera and Trichoptera (EPT) species (mayflies, stoneflies and caddisflies), excellent SEV scores and MCI scores were indicative of excellent water quality. Fish surveys at three sites for the *Ecology Assessment* identified Longfin Eel, Banded Kokopu, Common Bully, Redfin Bully. Freshwater crayfish, koura, were also abundant across each of the sites.

Hōteo River and tributaries freshwater habitats

Freshwater environments north of the Hōteo River are characterised by degraded lowland aquatic habitats that are surrounded by grazed pasture. Watercourses are typically small to medium sized tributaries that are highly modified, with many historically channelised. Fine silts and sand dominant stream channels, with abundant bank erosion present and extensive damage by cattle at many sites. Riparian margins are rare with some pockets of existing native vegetation present, with overall shade and organic input to watercourses low.

Freshwater values north of the Hōteo River are generally low, with some discrete moderate value features including the Hōteo River and Waiteraire Stream. Surveys undertaken for the *Ecology Assessment* generally indicated poor fish populations, low abundance of EPT species, low SEV scores, and MCI scores indicative of poor water quality. Fish species were recorded at the ten sites surveyed by the Project ecologists; including shortfin and longfin eel, the whitebait species inanga and banded kokopu and redfin bully. Freshwater crayfish, koura was recorded at one of the sites surveyed by the Project ecologists.

Marine ecology

Mahurangi Harbour

The harbour contains areas classified as SEA M1 and M2 in the AUP(OP), in addition to the entire harbour being recognised as an ASCV by DOC. Dense mangrove stands fringe the tidal flats of the upper estuary and side embayments. Estuarine vegetation including seagrass meadows provides significant habitat for native fish, birds and invertebrates.

Benthic invertebrate community species diversity and richness is high in middle and lower reaches of the harbour. Benthic invertebrate diversity is low in the upper harbour (upstream of Hamiltons Landing). A large range of fish and birds use the harbour, including several Threatened or At Risk bird taxa.

Various embayments within the harbour have been modified through the establishment of intertidal oyster farms and terrigenous sediment input.

Kaipara Harbour

The Kaipara Harbour is identified as a SEA in the AUP(OP). The upper intertidal zone contains vegetation sequences consisting of mangrove forest and shrubland, various indigenous saltmarsh and exotic grassland and rushland species. Vast areas of shallow intertidal mud and sandflats exist, which, along with mangrove and saltmarsh, provide important habitat for a number of avifauna species. Some of these avifauna species are Threatened or At Risk.

Kaipara Harbour has vast seagrass meadows that support a wide variety of fish, invertebrates and birds. These meadows provide important ecosystem functions such as stabilising sediment, nutrient cycling, and primary productivity as well as habitat.

The Kaipara Harbour has significant channel environments with healthy shellfish communities, which provide significant nursery areas for range of fish species including snapper, rig, and Great White Shark (protected under the Wildlife Act and an International Union for the Conservation of Nature red listed species). The harbour is also recognised as an important area for the protected Maui Dolphin.

Benthic invertebrate community species diversity and richness is low in the middle and lower reaches of the harbour, and moderate in the upper harbour (Oruawharo River and Hōteo River), mainly due to the abundance of a number of mud tolerant species.

The harbour has been modified through the establishment of intertidal oyster farms, dredging, mangrove removal and the invasion of weed species within various embayments.

4. Project description

4.1. Introduction

The Project is for the design, construction, operation and maintenance of a new four-lane state highway, approximately 26 km in length. The Project will provide an alternative alignment to the existing SH1. The route heads north from the interface with P2Wk near Wyllie Road initially travelling to the west of the existing SH1 before crossing SH1 just south of the Hōteo River and then travelling to the east of Wellsford and Te Hana, bypassing these centres. The Project ties into the existing SH1 to the north of Te Hana, near Maeneene Road.

The design of the Project has been an iterative process, developed through collaborative design, input from environmental disciplines and considering feedback from stakeholders. This has enabled the large scale of the Project and the complex natural and moderate built environment values associated with the Project area to be addressed.

This section gives a description of the Project and should be read in conjunction with the *Volume 3: Drawing Set*. The Project description as set out in this section has informed the *Volume 2: Technical Assessment Reports*.

The information provided in this section and in the drawings describe the Indicative Alignment.

Any numbers, areas or dimensions outlined in this section are approximate and may change as a result of detailed design. The final alignment for the Project (including the design and location of ancillary components, such as stormwater treatment devices and soil disposal sites), will be refined and confirmed at the detailed design stage.

4.2. Indicative Alignment description by area

For description and assessment purposes, the Project has been divided into the following areas (as shown in Figure 4-1):

a) Hōteo South: From the southern extent of the Project at Warkworth to the Hōteo River.
b) Hōteo North: Hōteo River to the northern tie in with existing SH1 near Maeneene Road.

For construction purposes, the Hōteo South section is divided into two subsections being:

- South – from the southern tie in with P2Wk to the northern tunnel portals; and
- Central – from the northern tunnel portals to the Hōteo River.

The Indicative Alignment through these areas is shown on drawings R-100 to R-124 in *Volume 3: Drawing Set.*

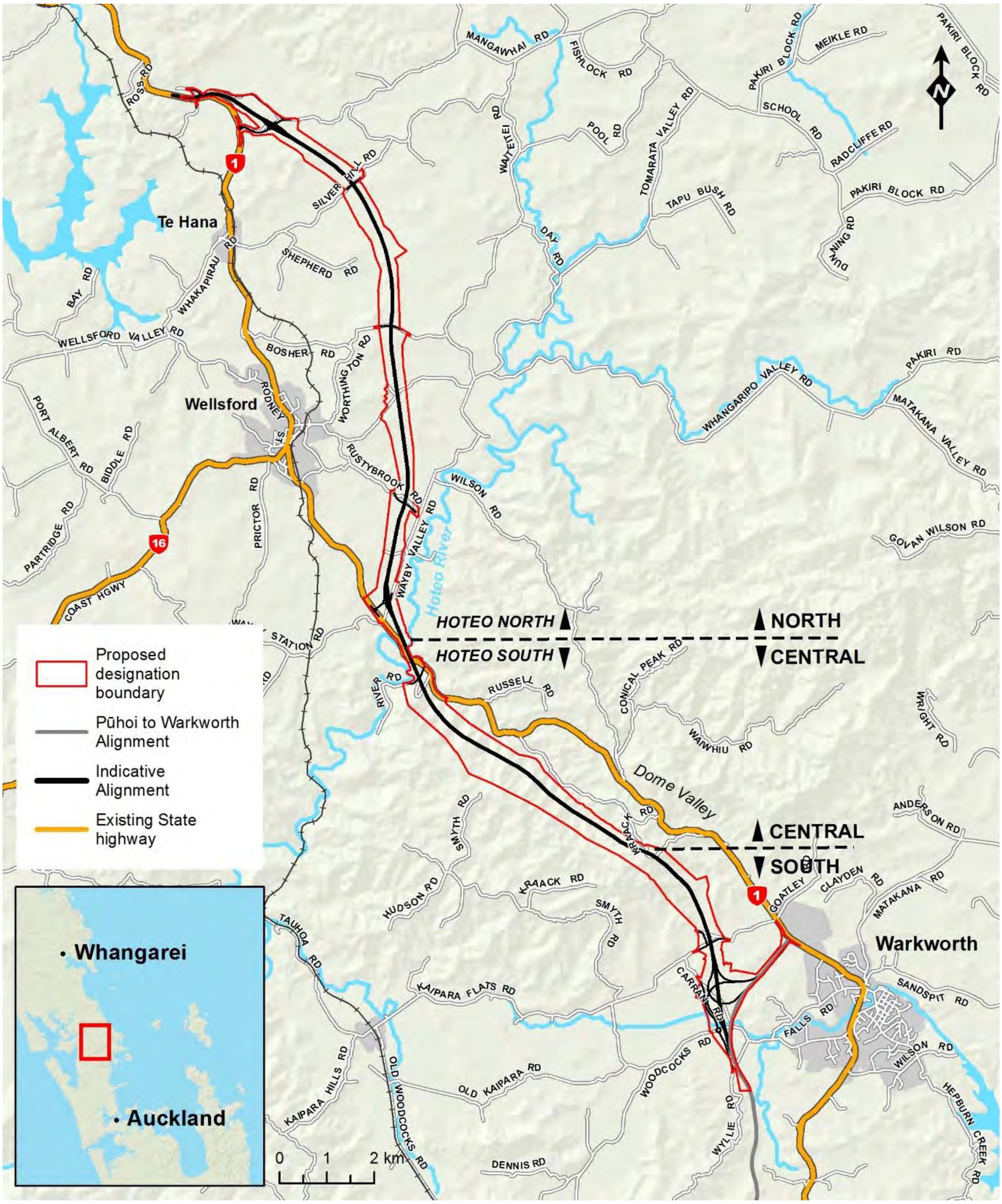


Figure 4-1: Indicative Alignment

4.2.1. Hōteo South

The Indicative Alignment connects to the alignment of P2Wk and continues in a northerly direction. The proposed Warkworth Interchange is located to the north of Wyllie Road. The Indicative Alignment passes over Woodcocks Road and requires a diversion of Carran Road to the west of the alignment at the proposed Warkworth Interchange.

Continuing north, the Indicative Alignment crosses the flat valley of the Mahurangi River and passes under Kaipara Flats Road near Phillips Road. Both Kaipara Flats Road and Phillips Road require realignment. Heading north, the Indicative Alignment begins to climb as it runs along a short valley towards the southern extent of the Matariki Forest, to the west of SH1. Due to the steepness of the terrain through this area, the Indicative Alignment will pass through 850 m long tunnels below Kraack Road. Two separate tunnels will carry north and south bound traffic.

The Indicative Alignment continues from the northern portals of the tunnels through the Matariki Forest plantation to the west of the existing SH1, running parallel to and below the main ridge and across a series of steep valleys as it passes through the Dome Valley. The Indicative Alignment in this location requires substantial cut slopes and fill embankments. The Indicative Alignment passes under and over private forestry roads to maintain forestry access.

The Indicative Alignment crosses the New Zealand Refining Company Ltd (Refining NZ) and First Gas pipelines (fuels and gas pipelines) just south of the Hōteo River, which will necessitate relocation works to these pipelines prior to construction of the Project in this location.

4.2.2. Hōteo North

At the north end of the Dome Valley the Indicative Alignment crosses SH1, the Hōteo River, and the Waiteraire Stream (which runs through the Dome Valley and discharges into the Hōteo River) on a viaduct. The proposed Wellsford Interchange is located north of Hōteo River, centred on Wayby Valley Road. The mainline carriageway spans over Wayby Valley Road, with Wayby Valley Road itself requiring a realignment to accommodate the interchange. The proposed interchange provides access to Wellsford and includes a new (roundabout) intersection with the existing SH1. The position of the interchange has been set to minimise intrusion into the floodplain of the Hōteo River.

The Indicative Alignment continues northward, parallel to Wayby Valley Road, crossing Robertson Road (which in that location would be closed by the Indicative Alignment), crossing beneath Rustybrook Road, before turning north and crossing over Whangaripo Valley Road (east of its intersection with Borrows Road). Continuing north, the Indicative Alignment passes beneath Farmers Lime Road, before crossing over the fuels and gas pipelines. The Indicative Alignment descends from Farmers Lime Road along the valley and crosses under Silver Hill Road at the site of a disused quarry. It then rises, turning northwest as it crosses the eastern extent of the ridgeline of the hills that extend westwards to Te Hana. The Indicative Alignment continues northwest and crosses over the fuels and gas pipelines again, and also a realigned Mangawhai Road with which the alignment connects at the proposed Te Hana Interchange. The Indicative Alignment passes under a Transpower high voltage electricity transmission line in the vicinity of this interchange and to the west of the existing Vipond Road reserve. The construction of an additional transmission line support structure is required to ensure the necessary vertical clearances are achieved between the carriageway and the lines. Vipond Road will be formed from Mangawhai Road, and its existing intersection with SH1 will be closed.

The Indicative Alignment continues northwest to bridge over the Maeneene Stream and a realigned Maeneene Road/Waimanu Road intersection before tying into the existing alignment of SH1 north of Waimanu Road.

4.3. Design principles and parameters applying to key Project components

4.3.1. Mainline carriageway characteristics

The mainline carriageway[55] of the Indicative Alignment has been designed in accordance with the following design parameters:

- Full length of the mainline carriageway designed to motorway standards with access to and from the state highway obtained via grade-separated interchanges;
- The design speed adopted for the mainline carriageway is 110 km/h;
- Two 3.5 m wide traffic lanes in each direction, including 3.0 m wide outside shoulders and edge barrier protection;
- Median divided carriageways incorporating a 6.0 m minimum median width, including 1.0 m wide shoulders and median barrier;
- Maximum uphill grade of 6% along the mainline carriageway; however, within the tunnel the maximum uphill grade is 5%;
- Minimum of 10.0 m wide x 6.0 m high clearance envelope for over dimension vehicles, including within the tunnel.

An approximately 2.7 km long slow vehicle lane is proposed in the northbound direction commencing on the approach to the southern tunnel portal, continuing through the northbound tunnel, before terminating approximately 600 m after the northern portal.

The Indicative Alignment northbound carriageway reduces from two lanes to one lane at the proposed Te Hana Interchange to enable a safe transition into the tie-in with the existing SH1. The southbound carriageway develops into two lanes approximately 1 km north of the proposed Te Hana interchange.

Cross sections representing these layouts are shown in Drawing R-181 of the Road Alignment (R-Series) in *Volume 3: Drawing Set*.

4.3.2. SH1, local and private access roads

The existing SH1 will be maintained for local access and will provide an alternate route once the Project is operational. It is anticipated that existing SH1 between SH16 and the Te Hana interchange will be re-named SH16, i.e. it will remain a state highway, this is yet to be confirmed. Connections to the existing SH1 are provided via all interchanges.

The Project requires works on a number of local roads along its length in order to maintain local access. With the exception of Robertson Road, all formed local roads that intersect with the Indicative Alignment are grade separated, enabling local connections, and therefore access to properties along these roads to be maintained.

[55] The mainline carriageway is the through-route portion of the Project, excluding the interchanges and local road connections.

The Indicative Alignment will result in the closure of eastern end of Robertson Road to its intersection with Wayby Valley Road.

The Indicative Alignment passes over the following existing roads:

- Woodcocks Road;
- Existing SH1 at Hōteo River;
- Wayby Valley Road;
- Whangaripo Valley Road;
- Mangawhai Road; and
- Maeneene Road.

The Indicative Alignment passes under Kaipara Flats Road, Rustybrook Road, Farmers Lime Road and Silver Hill Road.

Local road realignments to avoid intersecting with the Indicative Alignment are proposed to sections of Wyllie Road, Carran Road, Phillips Road, Vipond Road and Waimanu Road. Realignments are proposed to sections of Kaipara Flats Road, Wayby Valley Road, Rustybrook Road, Mangawhai Road and Maeneene Road to enable access around the Indicative Alignment.

Sections of Robertson Road, Vipond Road and paper roads within the Project area will be stopped. Where necessary, access to private properties will be maintained through road realignments.

The Indicative Alignment passes under and over forestry roads to provide for forestry access. Rationalisation of the forestry tracks may be undertaken, with further discussions to be held with the forestry owners/operators to confirm the final requirements. Consideration will be given to the provision of stock underpasses beneath the Indicative Alignment at appropriate locations where these are required to maintain viable farming operations. Access to private properties will be maintained through local roads where necessary. The design approach for private property access is as follows:

- Access is required from local roads to all properties; and
- Where access to existing dwellings or land use activities (e.g. operating farm) is severed and the activity remains viable within the residual land holding then new accesses will provide sufficient clearances for vehicles appropriate for the land use.

4.3.3. Interchanges and local road connections

The Project has been designed to provide connectivity to the local transport network along the Indicative Alignment. There are three state highway interchanges proposed – near Warkworth, Wellsford and Te Hana. Direct 'all direction' access to and from the main alignment will be provided at these interchanges.

Proposed Warkworth Interchange

The proposed Warkworth Interchange interfaces with P2Wk and provides a safe and efficient connection to the existing SH1 on the northern outskirts of Warkworth.

The proposed Warkworth Interchange in the Indicative Alignment includes free-flow ramps[56] connecting the Project with the existing SH1 at the northern terminus roundabout, north of Woodcocks Road, which will be built as part of P2Wk.

The Warkworth Interchange is shown in Figure 4-2 below.

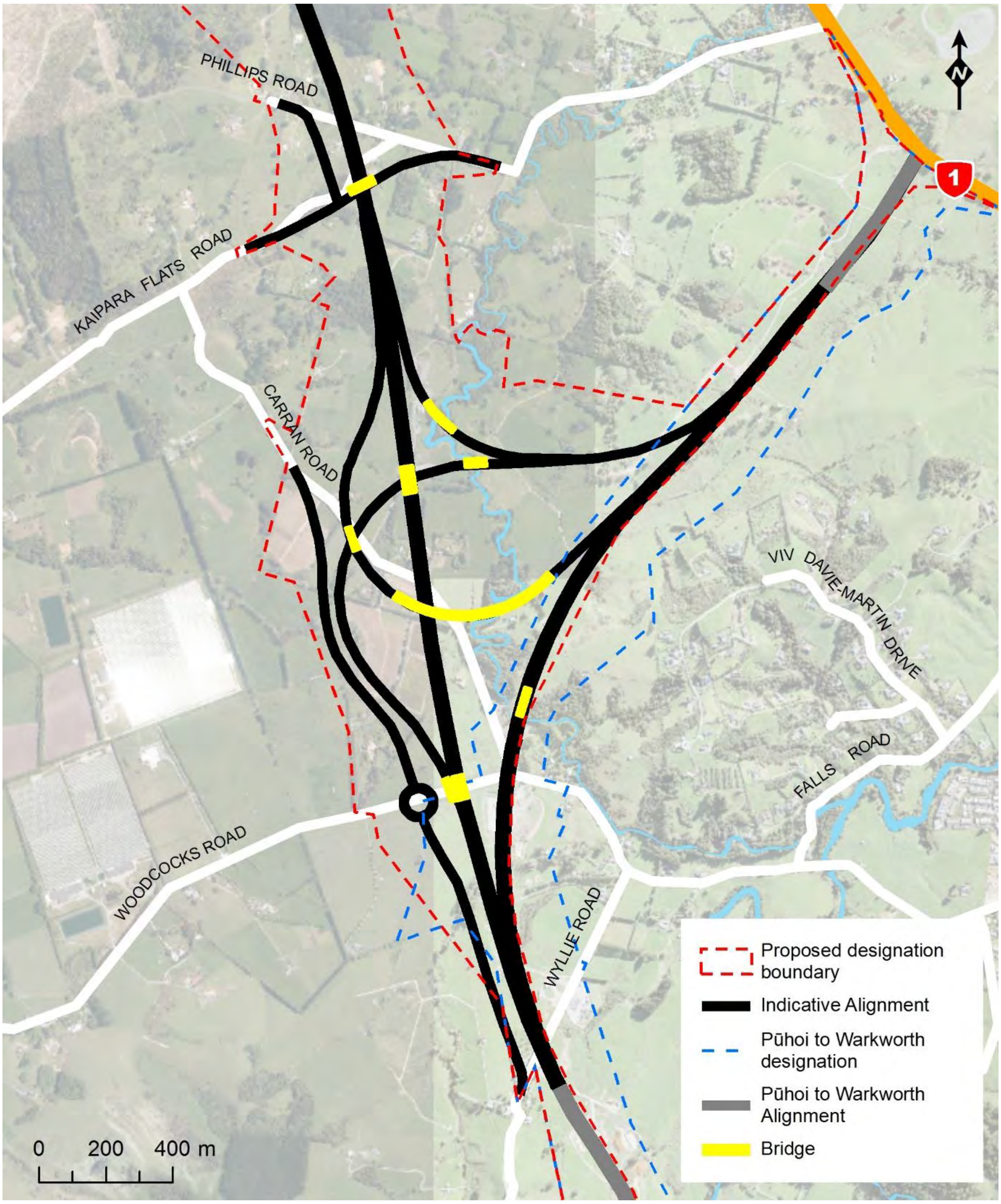


Figure 4-2: Proposed Warkworth Interchange

[56] Free flow ramps are motorway on and off ramps that allow unimpeded traffic movement on and off the highway, as distinct from intersections that are controlled by traffic lights or 'give-way' or 'stop' sign controls.

Proposed Wellsford Interchange

The proposed Wellsford Interchange in the Indicative Alignment is a diamond service interchange, where the on and off ramps diverge slightly from the mainline carriageway connecting to Wayby Valley Road. The on and off ramp connections to Wayby Valley Road are configured with a pair of roundabouts. The Indicative Alignment will necessitate the relocation of the existing intersection of Wayby Valley Road with SH1 for safety reasons. The Indicative Alignment includes a roundabout at the Wayby Valley/SH1 intersection.

The proposed Wellsford Interchange will provide the primary connection to Wellsford from the south and will provide access to and from SH1 and Wellsford, with approximately 12 km between adjacent interchanges i.e. the Wellsford and Te Hana interchange are 12km apart. The proposed Wellsford Interchange shown in Figure 4-3.

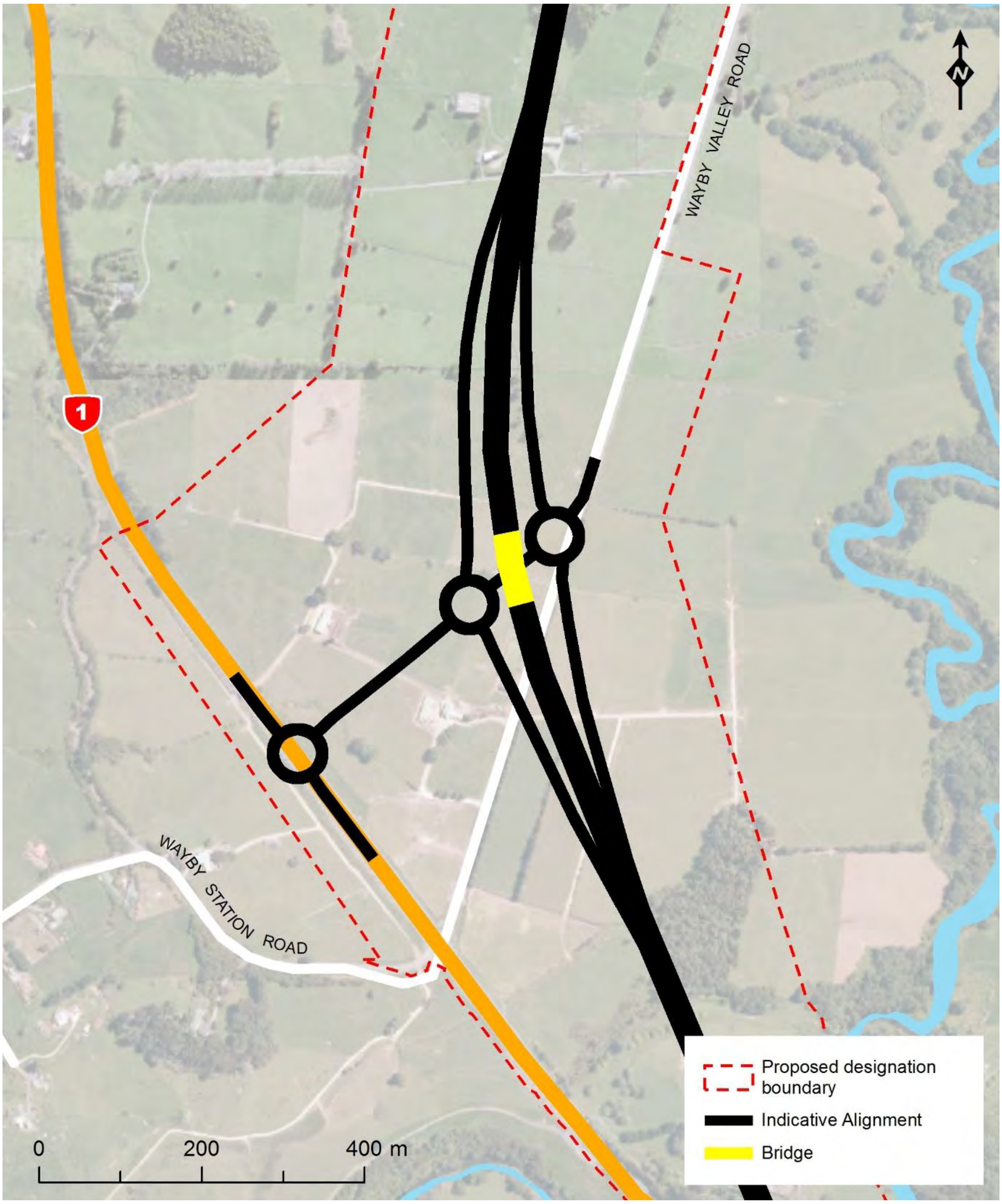


Figure 4-3: Indicative Wellsford Interchange

Proposed Te Hana Interchange

The proposed Te Hana Interchange in the Indicative Alignment is a diamond service interchange and the on and off ramp connections to Mangawhai Road are configured with a pair of roundabouts. Approximately 3 km of Mangawhai Road will be realigned and the existing intersection of Mangawhai Road with the existing SH1 replaced with a roundabout.

The proposed Te Hana Interchange will provide access to Mangawhai Road and the Twin Coast Discovery Highway. It will also provide access to Wellsford from the north and will service settlements such as Te Hana to the southwest and Mangawhai to the east and surrounding communities.

The proposed Te Hana Interchange is shown in Figure 4-4 below.

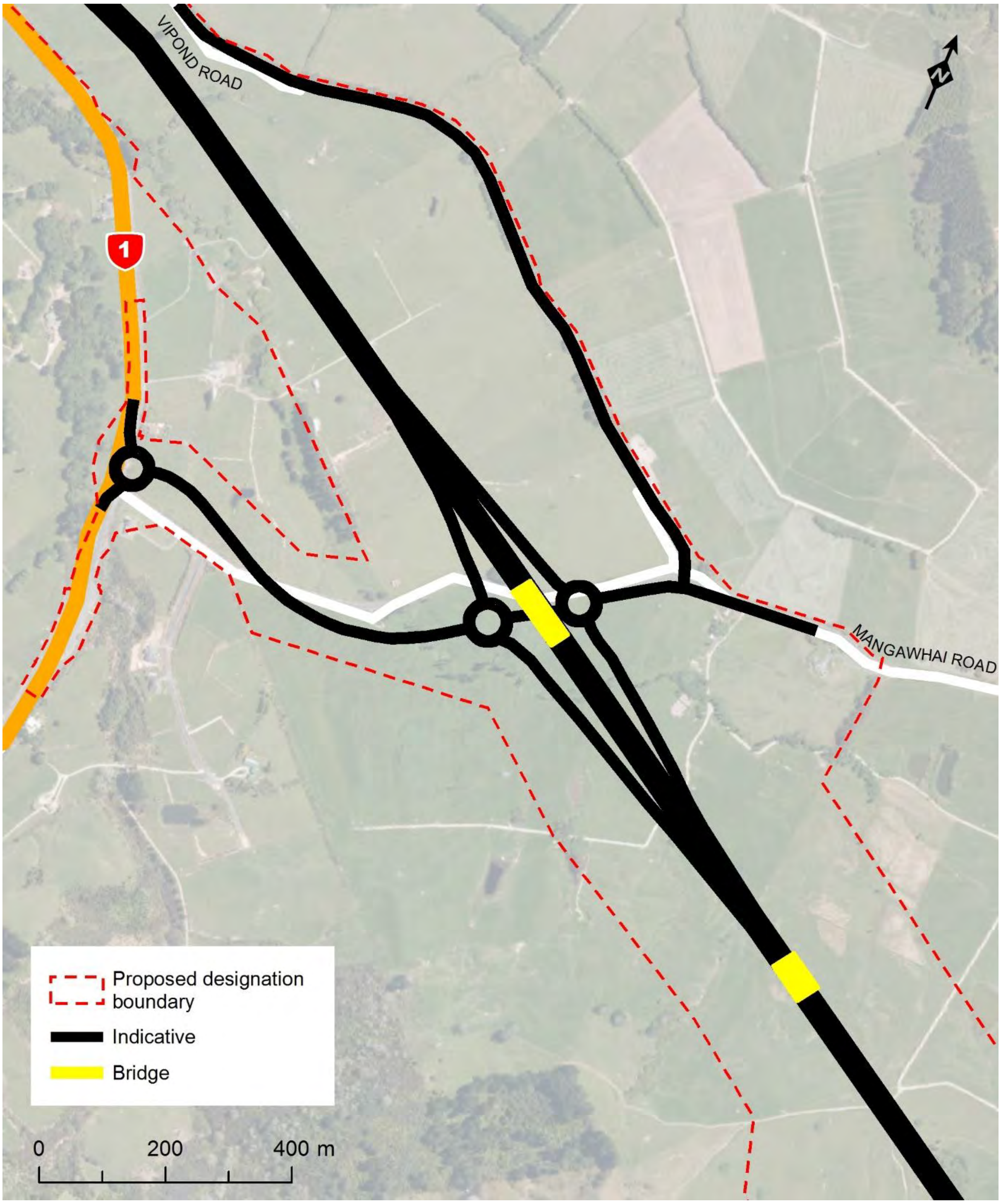


Figure 4-4: Indicative Te Hana Interchange

4.3.4. Structures

New structures proposed for the Indicative Alignment include bridges over the existing SH1, local roads, waterways and network utility assets; local road bridges over the mainline carriageway, and the tunnels. The location of these structures are shown in Figure 4-5 and Figure 4-6 and are described in further detail below.

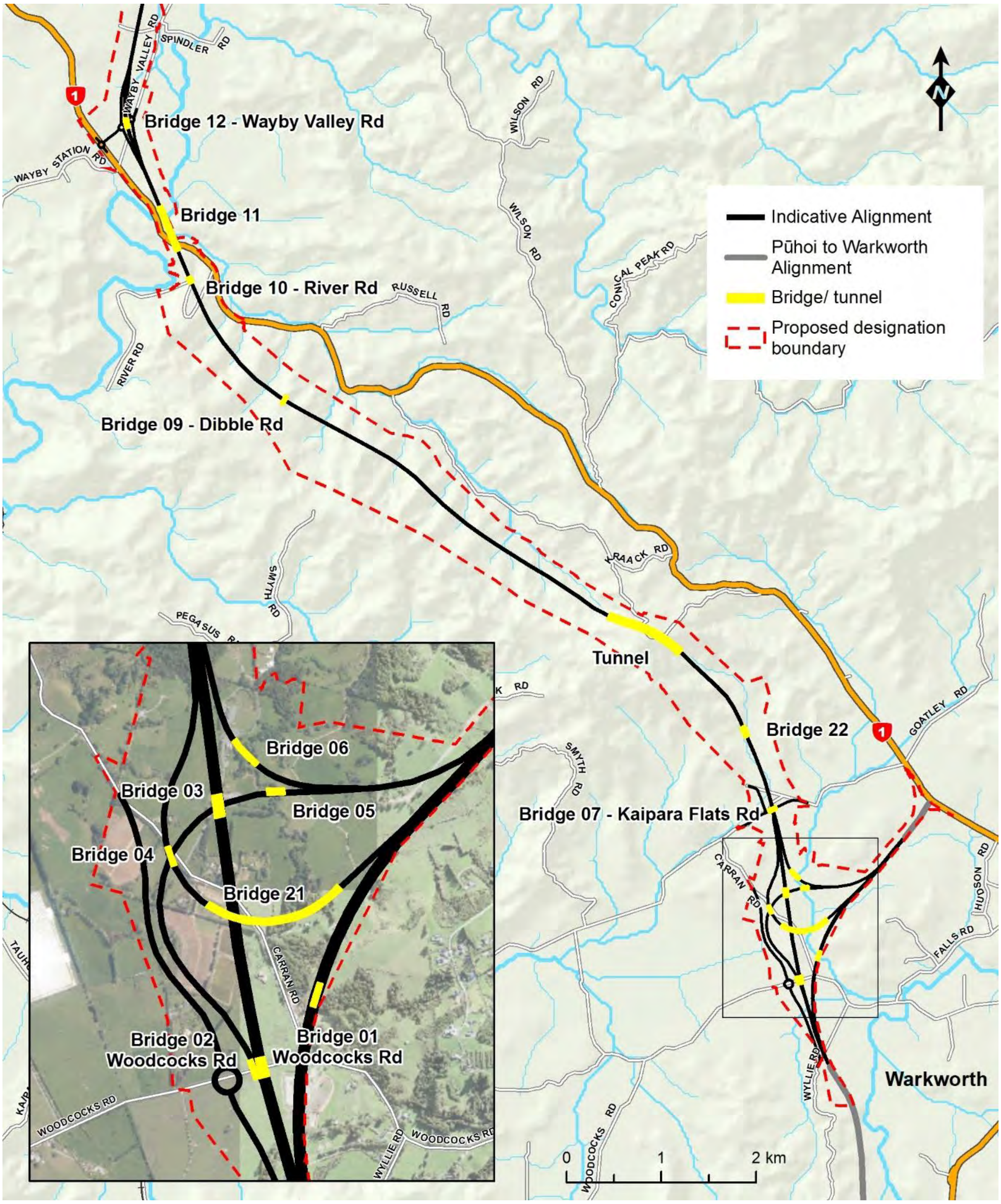


Figure 4-5: Indicative structures in Hōteo South

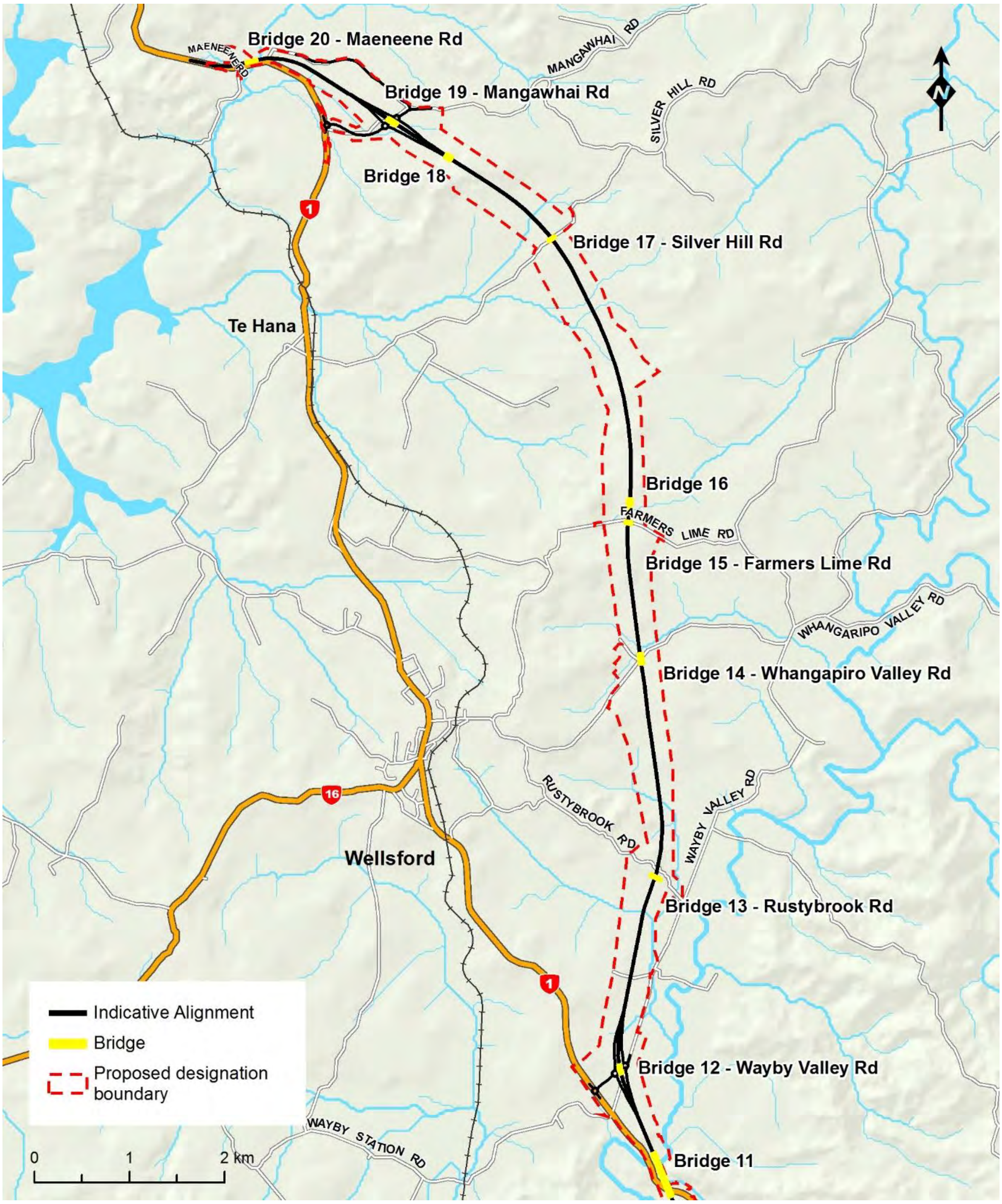


Figure 4-6: Indicative structures in Hōteo North

Bridges

The Indicative Alignment has 21 bridge structures. Three different bridge categories have been proposed for the bridges along the route. These are:

- Viaducts: Viaduct structures are proposed where the mainline carriageway crosses natural valley features at height or crosses waterways and floodplains. Carriageways on viaducts may be separate (i.e. separate structures for northbound and southbound lanes).

- Underpass: Bridges over the mainline carriageway. The majority of these bridges will carry local roads across the mainline carriageway, generally where it the mainline carriageway sits within a cut. Indicative bridge structures spanning over the mainline carriageway provide a vertical clearance of at least 6 m above the mainline carriageway surface and are generally less than 10 m in height.
- Overpass: Mainline carriageway bridges. These bridges are used to take the mainline carriageway (including on/off ramps) over localised features (e.g. local roads, pipelines or water courses) and are generally sitting on a fill embankment. The length of these bridge structures has been determined by the width of the local road. Bridge structures are generally less than 10 m in height.

A summary of the proposed bridge structures in the Indicative Alignment is included in Table 4-1.[57]

Table 4-1: Summary of indicative bridge structures

Bridge No.	Description	Approximate length (m)	Approximate spans (m)
1	Overpass – mainline carriageway over Woodcocks Road	70	1 x 30 2 x 20
2	Warkworth Interchange: Overpass – northbound off ramp over Woodcocks Road	70	1 x 30 2 x 20
3	Warkworth Interchange: Overpass – mainline carriageway over northbound off-ramp	70	1 x 30 2 x 20
4	Warkworth Interchange: northbound on-ramp over northbound off-ramp	70	1 x 30 2 x 20
5	Warkworth Interchange: northbound off-ramp over Mahurangi River	65	1 x 24 1 x 21 1 x 20
6	Warkworth Interchange: southbound off-ramp over Mahurangi River	120	5 x 24
7	Underpass – mainline carriageway under Kaipara Flats Road	72	1 x 32 2 x 20
8	Not allocated	–	–
9	Underpass – mainline carriageway under Dibble Road (forestry)	90	6 x 15
10	Overpass – mainline carriageway over River Road (forestry)	25	1 x 25
11	Hōteo viaduct – mainline carriageway over existing SH1, Hōteo River, and Waiteraire Stream	485	6 x 65 2 x 50
12	Wellsford Interchange: Overpass – mainline carriageway over Wayby Valley Road	70	1 x 30 2 x 20
13	Underpass – mainline carriageway under Rustybrook Road	74	1 x 32 2 x 21

[57] Bridge Number 8 was removed during design refinement prior to lodgement.

Bridge No.	Description	Approximate length (m)	Approximate spans (m)
14	Overpass – mainline carriageway over Whangaripo Valley Road	70	1 x 30 2 x 20
15	Underpass – mainline carriageway under Farmers Lime Road	64	1 x 32 2 x 16
16	Overpass – mainline carriageway over fuels and gas pipelines	105	3 x 35
17	Underpass – mainline carriageway under Silver Hill Road	72	1 x 32 2 x 20
18	Overpass – mainline carriageway over fuels and gas pipelines	25	1 x 25
19	Te Hana Interchange: Overpass – mainline carriageway over Mangawhai Road	70	1 x 30 2 x 20
20	Overpass – mainline carriageway over Maeneene Road	104	1 x 30 2 x 26 1 x 22
21	Warkworth Interchange: Underpass – mainline carriageway under northbound on-ramp	555	7 x 65 2 x 50
22	Overpass – mainline carriageway over wetland feature	96	3 x 32

Tunnels

Twin bore tunnels (each serving one direction) are proposed to enable the Project to pass beneath the ridgeline topped by Kraack Hill. A significant east-west ridge line to the north west of Warkworth is the key reason for the proposed tunnels, so that suitable gradients can be achieved (maximum grades of around 6% and 5% within the tunnel).

The indicative tunnels are approximately 850 m long and are approximately 160 m below existing ground surface at their deepest point. The design is similar to the existing Johnstone's Hill Tunnels (approximately 400m in length) located immediately south of Pūhoi.

The incline to the northbound tunnel will need a third lane northbound to safely accommodate slower vehicles.

The indicative tunnel design includes, but is not limited to, the following items:

- Tunnel drainage to cater for groundwater, wash-down and deluge systems, including capture and treatment;
- Lighting;
- Ventilation including requirements for emergency management;
- Provision for services (utilities);
- Emergency management systems (deluge and fire) including monitoring and incident management/response;
- Access requirements; and
- Power requirements.

The tunnels will be serviced by deluge tanks, a distribution point for power supply and other ancillary assets (E.g. power lines), that will sit within the proposed designation in proximity to the tunnel portals. The deluge tanks will sit on the hill above the tunnel.

Cross passageways will be included to provide access between each of the tunnels. These will allow access from one tunnel to another in the event of an incident in one tunnel requiring that tunnel be evacuated.

4.3.5. Traffic services

Traffic services along the Indicative Alignment will likely include (but are not limited to) ancillary features such as:

- Permanent road signs;
- Road lighting;
- Road markings;
- Roadside and median barriers;
- Ramp signalling;
- Gantries;
- Traffic count stations;
- Closed-circuit television;
- Speed enforcement;
- Emergency phones;
- Emergency laybys;
- Emergency vehicle access; and
- Maintenance access.

The traffic services in place when the Project opens to traffic will be finalised during the detailed design phase and will be designed in accordance with the relevant standards which apply at that time. Throughout the life of the Project, it is anticipated that traffic services will be renewed and upgraded as required, to ensure the continued safe and efficient operation of the state highway. Renewal and upgrade activities would be undertaken as part of the normal operation and maintenance of the road.

Interchanges will be lit in accordance with NZTA M30 and AS/NZS 1158:2005 (Standards New Zealand and Standards Australia, 2005), or the equivalent standard applicable at the time the Project is designed.

4.3.6. Walking and cycling facilities

Walking and cycling facilities are not included along the mainline carriageway, as the Indicative Alignment has been designed to motorway standards and specific aspects of the Project specifically preclude access (i.e. the tunnels and distance between local access connections). Pedestrians, cyclists and other road users will be able to use the existing SH1 and the local road network. Cycle paths are proposed where appropriate to provide cyclists with continuous and safe access to and across the Project and to the existing SH1.

Design of local road and interchange crossings will allow for pedestrians, cyclists and other road users within the width of the local road corridor across the Indicative

Alignment. The Project design will futureproof these structures for walking and cycling if such programmes are undertaken in the future and would integrate with potential cycle ways proposed by others (e.g. Auckland Council) to connect Wellsford with Pakiri (along Whangaripo Valley Road), and to connect Te Hana with Mangawhai along Mangawhai Road.

As with other aspects of the Indicative Alignment, walking and cycling facilities will be considered in detail at the later detailed design stage, taking into account the transport environment at that time.

Given the Indicative Alignment passes through tunnels below Kraack Road, the Te Araroa Trail will not be affected by the Project.

4.3.7. Geotechnical design considerations

The geotechnical design philosophy is based on identifying, avoiding where possible, or otherwise minimising key known geotechnical risks and environmental impacts to provide a safe, secure and constructible Indicative Alignment.

The proposed designation has been identified to, where practicable:

- Avoid or minimise exposure to major landslides and natural hazards;
- Avoid the need for large retaining walls and structures;
- Minimise earthworks and structures on steep or unstable slopes;
- Maintain flexibility and scope for future design innovations and improvements; and
- Use reinforced soil (mechanically stabilised earth (MSE) embankments) to steepen embankment slopes, where appropriate, for example to minimise further encroachment into SEAs.

Cut slopes

The Indicative Alignment will pass through steep terrain with numerous ridges and valleys. As such, the Indicative Alignment will include numerous cut slopes, ranging in height up to approximately 56 m. Cut slope gradients adopted in the Indicative Alignment vary depending on the geology and erosion characteristics. Detailed cut slope designs will be carried out during the detail design phase of the Project in accordance with standard geotechnical design guidelines and accepted New Zealand design criteria and standards.

A range of common stabilisation and construction management measures are available to manage potential slope instability (including rock fall hazards). Likely stabilisation measures include:

- Flattened cut batters and/or the rounding of the soil profile;
- Drainage, including horizontal bored drains, cut off drains and surface counterfort drains;
- Rock anchors or rock bolting;
- Undercutting to remove existing landslide masses and shear surfaces;
- Vegetation cover;
- Retaining structures, including anchored bored pile retaining walls;
- Scaling of the cut face to remove rocks;
- Compacted shear keys or buttress fill; and
- Rock fall barriers.

Figure 4-7: Indicative cut face batter (possible for cuts within the plantation forestry area)

Fill embankments

Given the terrain through which the Project passes, the Indicative Alignment in some locations will be located on engineered embankments up to approximately 40 m above existing ground level. Embankment design will respond to each geological formation that could reasonably be expected to be the material on which the embankment is founded (Pakiri Formation, Tauranga Group alluvium, and Northland Allochthon mudstones and limestone) to determine stable slope gradients and acceptable levels of settlement according to the general geotechnical conditions anticipated. Embankment construction will require the placement of large volumes of earthworks fill material and localised or site-specific ground treatment. Additional stabilisation measures may be incorporated during detailed design where appropriate to the circumstances.

MSE walls are proposed at some bridge abutments and approaches, and at certain other locations to prevent encroachment into or realignment of local streams located adjacent to the Indicative Alignment.

4.3.8. Network utilities

The Project will require the relocation of, and works in the vicinity of, several major utilities, including regionally and nationally significant infrastructure. Major infrastructure assets affected by the Project, and the proposed methods to address this, include:

- First Gas: in various locations, relocation of the gas transmission pipeline and/or bridging over it;
- Refining NZ: in various locations, relocation of the fuel pipeline and/or bridging over it;
- Vector: Wellsford Delivery Point; and

- Transpower: installation of an additional support structure along the existing transmission line alignment (110 kV line).

In addition, proposed stormwater discharge points are located upstream of Watercare's surface water supply take point for Warkworth. It is noted that Watercare has transferred from surface water to groundwater abstraction for Warkworth.

4.3.9. Operational drainage and stormwater management

The indicative stormwater design for the Project is outlined in the *Water Assessment Report* in Volume 2, and indicative elements of these systems are shown on the *Operational Water Series* drawings in *Volume 3: Drawing Set*.

The indicative stormwater design for the Project provides a best practicable option to safely convey and discharge stormwater runoff from the new road and to avoid, remedy or mitigate adverse environmental effects of the construction and operation of drainage and stormwater systems, determined through a robust evaluation of the Project against the Auckland Council and Transport Agency requirements relating to the design and construction of stormwater conveyance and treatment systems.

The indicative stormwater design integrates all aspects of the drainage and stormwater system, including the stormwater collection and conveyance network, treatment devices, culverts and watercourse diversions and has had due consideration of the floodplain.

The following design principles for the stormwater systems servicing the Indicative Alignment and altered local road corridors within the Project have been adopted:

- Water from outside the proposed designation is diverted around or through the Project, so that it does not mix with stormwater run-off from the new road.
- Cross drainage structures are designed to allow the continued flow of existing watercourses and overland flow paths with minimal effect on the surrounding environment.
- Overland flow paths are provided and maintained for flows in excess of the primary drainage network capacity, to allow for flows up to and including the 100 year average return interval (ARI) storm.
- Outfalls will incorporate erosion control measures that support fish passage.
- The design provides fish passage in culverts for all permanent streams with upstream habitats, and for intermittent streams where there is potential for fish habitat upstream.
- The mainline carriageway level will be set at a freeboard clearance above design flood levels (100 year ARI storm).
- Works will not significantly increase flood levels outside the designation.
- All stormwater runoff from the mainline carriageway and rock cuts will be captured and treated prior to discharge into the receiving environment.
- Stormwater discharges from the mainline carriageway and rock cuts will be directed to stormwater treatment devices, which will be designed to target the removal of suspended solids and contaminants of concern including zinc, copper and other persistent and bio-accumulative contaminants in accordance with Transport Agency and Auckland Council standards and guidelines.
- The design will include a range of water sensitive design solutions including treatment swales and treatment wetlands to deliver stormwater hydrology (flows and volumes) and stormwater quality (treatment) mitigation.

Overland flow paths and cross drainage

Overland flow paths will be designed to cater for a 100 year ARI event. Where no secondary flow route is available then the capacity of the primary system will be designed to cater for the 100 year ARI rainfall event.

Many small tributaries, some larger rivers, and overland flow paths are crossed by the Indicative Alignment. Cross drainage structures have been designed to allow the continued flow of existing watercourses and overland flow paths and will generally be in the form of viaducts or bridges or pipe or box culverts.

Viaducts and bridges will be designed to pass flow rates attributable to a 1 in 100 year ARI storm. These structures will have a freeboard of 600 mm in non-forested areas and a freeboard of 1200 mm in forested areas, where the risk of debris blockage is higher.

Culverts that cross the mainline carriageway will allow the passing of a 1 in 100 year ARI storm with a freeboard of 500 mm below the carriageway edge in accordance with the Transport Agency's Bridge Manual. All new culvert structures and pipe crossings under local roads will be designed in accordance with Auckland Council's Stormwater Code of Practice.

The Indicative Alignment requires 85 culverts – 69 are new and 16 are existing culverts beneath the existing SH1 and local roads which may require upgrading/extension due to construction of the Project. No culverts longer than 30 metres and will be located within SEAs.

Culverts will be designed to include consideration of debris management, fish passage, and erosion control and energy dissipation, as discussed below.

Culverts in forested catchments may include debris control structures such as a debris rack or screen.

Provision of fish passage in culverts placed within watercourses will be in accordance with Auckland Council's Technical Publication 131 and Transport Agency fish passage guidance. Fish passage will be provided at culverts for all permanent streams with upstream habitats and for all intermittent streams where there is potential for upstream fish habitat. Two methods of providing fish passage are proposed, being baffle type fish passage (refer to Figure 4-8) and natural bed type fish passage.

Figure 4-8: Baffle type fish passage installed at Waiwera

Erosion control measures are proposed upstream and downstream of culverts to provide for the on-going functioning and performance of culverts, by reducing the likelihood of erosion of the stream bed.

Energy dissipation structures will be required at all culvert outlets prior to discharge into the natural stream. Examples of energy dissipation structures typically used on similar roading projects and which could be used for this Project are included in the *Operational Water Design Report*.

Permanent stream diversions

Permanent stream diversions and flow channels are proposed where it is necessary to realign a natural stream channel for the Project, including around soil disposal site areas. The diversions will be designed to allow for the 1 in 100 year ARI storm event.

The design objective for stream diversions is to recreate streams and habitats to replicate as much as possible the natural state and habitats of the streams that existed prior to the Project.

A number of stream diversions are proposed within three stream typologies as follows:

- Stream Diversion Type 1: 'Lowland stream' that recreates habitats associated with a natural lowland stream. The total proposed stream diversion length is approximately 12,700m;

- Stream Diversion Type 2: 'Steep stream' that recreates habitats associated with a natural steep stream. The total proposed stream diversion length is approximately 5,560m; and
- Stream Diversion Type 3: 'Flow channel' for flow conveyance only. The total proposed stream diversion length is approximately 1,150m. These are either rock lined flow channels for high flow/steep gradients or grass lined flow channel for low flow or flat gradients.

The design of stream diversions will also meet the ecological objectives of the integrated mitigation approach outlined in section 10 of this AEE.

Stream Diversion Types 1 and 2 are shown in Figure 4-9 and Figure 4-10 below.

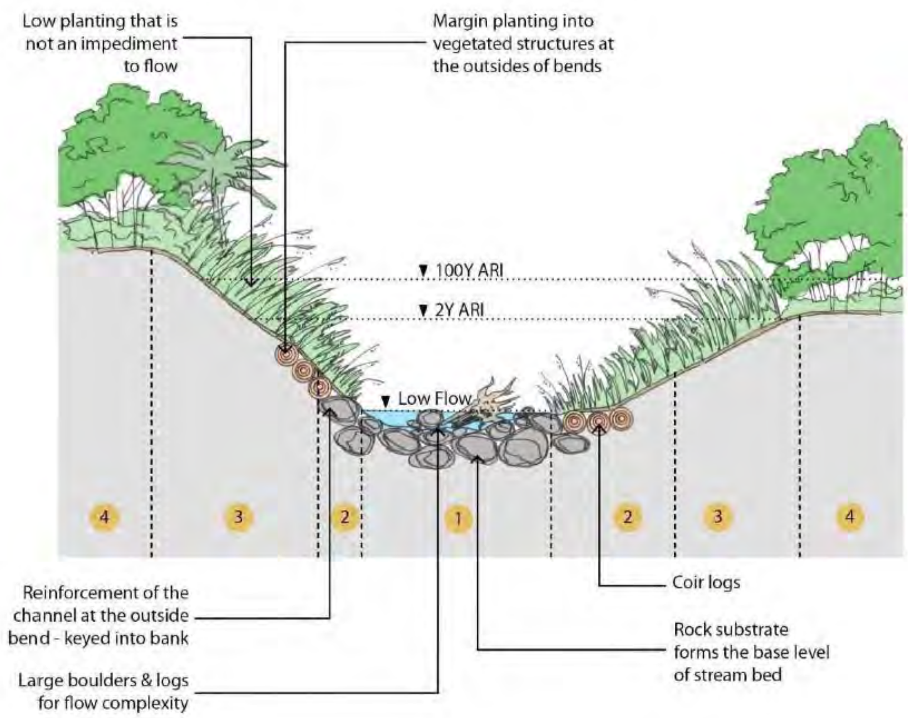


Figure 4-9: Indicative Stream Diversion Type 1 – Lowland stream cross section

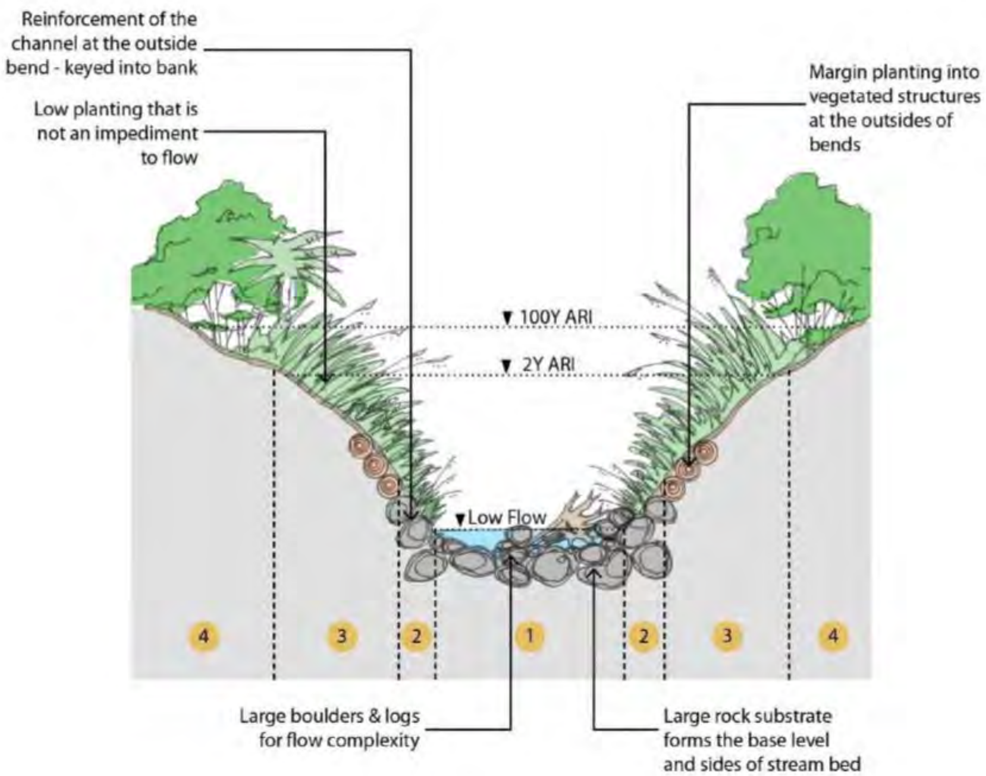


Figure 4-10: Indicative Stream Diversion Type 2 – Steep stream cross section

Stormwater collection and conveyance systems

Stormwater runoff collection systems for the Indicative Alignment will be designed as follows:

- Longitudinal drainage is designed to cater for the 1 in 10 year ARI event flow from all road pavements. Where no overland flow path is available to cater for the 1 in 100 year rainfall event the primary system will be designed to cater for the 1 in 100 year ARI event.
- Swales or open drains will be used adjacent to the road along the base of cut batters to convey flows in excess of the pavement collection system and will be designed to cater for the 1 in 100 year ARI event flow.
- Cut off drains are included at the top of all cut slopes and bottom of fill slopes to prevent stormwater flows from the natural catchment uphill of the mainline carriageway from flowing down the cut face or flowing along the toe of fill batters. These cut off drains will be sized as a minimum to convey the 1 in 100 year ARI storm event from the upstream catchment.
- Bridges and viaducts will be designed to ensure that stormwater runoff does not encroach onto a live traffic lane during a 1 in 10 year ARI event flow.

The stormwater conveyance system will convey stormwater from the carriageway and from the toe of cut (and fill) slopes to stormwater treatment devices. The stormwater conveyance system may include the following:

- Kerb and channel with catchpits to collect stormwater runoff for piping to stormwater treatment devices;
- Drainage channels including vegetated roadside drains/swales; and

- Inlet and outlet structures (i.e. inlets and outlets from wetlands, from carriageway and/or streams).

The road collection and conveyance systems will collect stormwater from new or modified impervious surfaces and rock cuts and will be designed to cater for a 1 in 10 year ARI rainfall event and will convey stormwater runoff to the stormwater treatment devices (wetlands and swales) located at appropriate locations along the Project.

Conveyance of water runoff from ancillary local roads will be via vegetated or rock lined swales that will discharge to existing streams.

Stormwater treatment and discharge

All stormwater runoff from the mainline carriageway and rock cuts will be conveyed to stormwater treatment devices and treated prior to discharge into the receiving environment.

The primary water quality objective of permanent stormwater treatment systems and devices is to remove suspended solids. Stormwater treatment systems and devices will be designed with a Best Practicable Option approach and in accordance with Auckland Councils *Stormwater Management Devices in the Auckland Region Guideline Document (GD01)* with an additional volume allowance made in each of the treatments systems for the hydrology mitigation and treatment requirements of the AUP(OP) in Chapter E10 (Stormwater Management Area – Flow 1 and Flow 2).

Stormwater runoff from the Project's impervious areas will be treated by stormwater treatment devices designed in accordance with GD01 and to meet the following criteria:

- Remove 75% total suspended solids (TSS) on a long-term annual average basis;
- Target the removal of contaminants such as copper, zinc, particulate nutrients, oil, grease and bacteria;
- Removal of litter and floatables including oil and volatile hydrocarbons;
- Where alternative or proprietary devices are proposed, the design will demonstrate how the device achieves an equivalent level of contaminant or sediment removal performance to that of GD01;
- Provide an emergency overflow or bypass system that will cater for the 1 in 100 year ARI event flow; and
- Where the discharge point is natural watercourse, erosion protection measures shall be provided at the outfall location.

The Indicative Design includes 34 stormwater treatment wetlands (refer Figure 4-11). The indicative locations and typical details of wetlands are indicated in the *Volume 3: Drawing Set*, *Operational Water Management Plan (SW-Series)*.

Figure 4-11: Indicative stormwater treatment wetland

4.3.10. Urban and Landscape Design

The planning version Urban and Landscape Design Framework (ULDF) provides a framework for the integration of the Project into the local context and sets out the urban and landscape design principles that will guide the design development of the Project such that it can be integrated into the landscape and minimise and mitigate adverse effects. The ULDF provides a consistency of urban and landscape approach for the whole Pūhoi to Wellsford project. The planning version of the ULDF for the Project is contained in *Volume 3: Drawing Set*.

The ULDF will be developed in further detail in accordance with the Transport Agency's guidance documents – "Bridging the Gap" and the "Landscape Guidelines", which require Transport Agency projects to be delivered utilising best practice to achieve positive urban design and landscape outcomes.

The overall purpose of the ULDF will be to:

- Demonstrate how the design of the Project supports the Transport Agency's strategic commitment to high quality urban design outcomes;
- Bring together the delivery of built and natural environment aspirations and outcomes; and
- Demonstrate alignment between the Transport Agency and other agencies in their planning, transport and urban design initiatives for the area.

5. Construction

5.1. Introduction

This section provides an outline of a possible construction methodology for the Project to inform the assessment of environmental effects in section 9 of this AEE. It provides a broad overview of an indicative construction methodology for the Project and gives further detail of the main construction elements that are likely to be undertaken. The approach outlined is based on the experience the Transport Agency has in developing and constructing road projects of a similar scale throughout New Zealand. An indicative construction programme for the Project is set out in section 5.3. Throughout this section there are cross-references to *Volume 3: Drawing Set* where further information describing construction of the Project is available.

The information provided in this section is indicative only and is intended to provide sufficient detail of the proposed construction activities to confirm the Project can be constructed, to enable an assessment of the potential construction related effects on the environment and to identify any necessary measures to avoid, remedy or mitigate those effects.

Construction of the Project will be influenced by a number of factors, including:

- The detailed design of the Project, which will occur at a future date once the designation has been confirmed and resource consents have been granted;
- The construction timing, staging, and duration;
- The procurement method adopted for construction of the Project; and
- Technological advances in construction techniques and methodologies.

The Transport Agency seeks flexibility in final design and construction methods to accommodate these factors, while ensuring that adverse effects on the environment are appropriately remedied or mitigated. Once the contract(s) for the Project have been awarded and a contractor (or contractors) are in place, the construction methodology will be further refined and developed. This refinement will be undertaken in compliance with conditions of the designation and resource consents which will be in place to manage the effects of the construction activities.

5.2. Development of construction methodology

The construction methodology and activities outlined in this section were developed through an iterative process that involved several rounds of multidisciplinary reviews and interaction with technical specialists. The intention was to consider the programme implications and potential adverse effects of various construction options to achieve a methodology that, as far as practicable, avoids, or otherwise minimises, potential adverse effects, while being operationally efficient. This included consideration of the following:

- The potential location and extent of construction compounds, bridge construction yards and construction haul and access roads. The intent is to minimise disturbance and vegetation clearance in sensitive environmental areas, and as far as practicable avoid locating temporary construction activities near sensitive land uses;

- Construction programme and timing of particular activities, to take advantage of seasonal weather conditions;
- Transport Agency construction guidelines and Auckland Council standards, relevant to the avoidance and minimisation of adverse effects on the environment;
- Practical implementation, access requirements, safety and cost considerations, and potential for staging;
- The use of well-established construction techniques while not precluding methods to maximise the opportunity for contractor innovations; and
- How open area limits will be set and managed through construction.

5.3. Indicative construction programme

It has been assumed that construction of the Project will start in 2030 and take 7 years to complete. Enabling works may be necessary and the construction programme anticipates this. Some relocation of utilities may be done in advance of the main construction period.

Construction of certain individual elements of the Project, such as the tunnels, the large viaduct crossing SH1 and the Hōteo River and some of the cut to fill operations, will require a construction duration of several years.

The indicative construction programme is based on the following typical sequence of works:

- Enabling works (forestry clearance if necessary, services relocation, site investigations);
- Early construction activities (site establishment, access and haul roads, trial embankments, environmental controls);
- Access to specific sites (culverting and access bridges);
- Ground improvements;
- Earthworks;
- Structures;
- Pavements and surfacing; and
- Completion works (traffic services, landscaping).

The specific staging and phasing of the work will be dependent on the method of procurement and contractor expertise, land acquisition, the availability of contractors and availability of other resources such as materials and construction equipment.

Many elements of the Project will be undertaken concurrently during the construction period. The total earthworks volume to be moved includes approximately 12.4 Million m^3 of cut and 9.6 Million m^3 of fill. Cut and fill bulk earthworks is the predominant activity during the construction programme. The programme has been based on 100 – 120 (average 110) days of bulk earthworks activity through the earthworks season of October to April.

The indicative construction programme adopts an open area limit of 75 ha within the Hōteo catchment. As set out in the Water and Marine Ecology assessments, the 75 ha open area limit is based primarily on modelling and expert assessment. This work confirms that the environmental risks associated with sediment discharges from up to 75 ha open area can be managed to an acceptable level through management controls and response mechanisms (addressed in section 10). The 75 ha maximum open area limit also enables efficient completion of the bulk earthworks for the

Project within an indicative 7 year construction programme. The modelling work is noted to be highly conservative and in practice, it is predicted that actual sediment yields will generally be lower than modelled.

No open area limit is assessed as being necessary in the Oruawharo or Mahurangi Catchments. As noted in the Water Assessment Report, the total area of earthworks for the Mahurangi catchment is materially less than the open area limits prescribed for P2Wk. The Marine Ecology assessment concludes that an open area upper limit is not necessary to manage effects in this catchment, recognising the other proposed controls to manage erosion and sediment generation. The area of earthworks within the Oruawharo catchment is similarly very small.

5.4. Construction sections

For the purposes of assessing the potential effects related to construction of the Project, the Project has been divided into three indicative construction sections based on delineation by major structures. These are set out in *Section 4* of the AEE.

5.4.1. South section

The South section extends from the Project tie in to P2Wk near Wyllie Road at Warkworth to the northern portal of the tunnel north west of Kraack Road. Key features of the Indicative Alignment in this section are:

- Approximately 5.5 km in length, passing west of Warkworth and west of the existing SH1;
- A southern tie-in to the Pūhoi to Warkworth motorway (which will become SH1);
- Warkworth Interchange consisting of free flow ramps as follows:
  - Northbound off-ramp to Warkworth passing under the mainline carriageway;
  - Northbound on-ramp to Whangārei passing over the mainline carriageway;
  - Southbound off-ramp to Warkworth connects into the P2Wk alignment west of the P2Wk termination roundabout;
  - Southbound on-ramp to Auckland utilises the southbound lanes of the P2Wk alignment.
- Mainline over Woodcocks Road (Bridge 01);
- Mainline under a realigned Kaipara Flats Road (Bridge 07);
- Realignments of Wyllie, Carran and Phillips Roads;
- A bridge over an ecologically sensitive wetland area north of Kaipara Flats Road (Bridge 22);
- Twin bore tunnels below Kraack Hill; and
- The southern tunnel portals.

5.4.2. Central section

The Central section extends from the northern tunnel portals to the northern abutment of the Hōteo Viaduct (Bridge 11). Key features of this section are:

- Approximately 6.6 km in length, passing to the west of the existing SH1 mostly through commercial plantation forestry and steep terrain;
- Northern tunnel portals;
- Mainline under Dibble Road (Bridge 09) and over River Road (Bridge 10);
- Crossing of the fuels and gas pipelines in the vicinity of the River Road bridge; and

- A viaduct structure over the existing SH1, the Hōteo River, Waiteraire Stream and native bush (Bridge 11).

5.4.3. North section

The North section extends from north of the Hōteo River to the tie-in with the existing SH1 north of Maeneene Road. Key features of this section are:

- Approximately 14.2 km in length passing through mainly farm land to the east of Wellsford and Te Hana;
- The Wellsford Interchange at Wayby Valley Road;
- Mainline under Rustybrook Road (Bridge 13), Farmers Lime Road (Bridge 15) and Silver Hill Road (Bridge 17);
- Mainline over Whangaripo Valley Road (Bridge 14);
- Two bridge crossings of the fuels and gas pipelines (Bridges 16 and 18);
- The Te Hana Interchange at Mangawhai Road;
- Bridge over the Maeneene Stream and realigned Maeneene and Waimanu Roads (Bridge 20); and
- Northern tie-in.

5.5. General construction aspects

5.5.1. Enabling and early works

Prior to the main phase of construction, there are a number of early activities that will be required along the alignment to facilitate construction. These will include activities such as:

- Further detailed site investigations (DSIs), including geotechnical, contaminated land and groundwater, and investigations to confirm the location of existing services;
- Baseline environmental investigations or surveys;
- Building and structure demolition and removal;
- Site establishment activities, including site access points, road sealing, access tracks, construction yards, temporary local road realignments and fencing;
- Establishing environmental mitigation measures (e.g. erosion and sediment controls); and
- Protecting and/or relocating of existing network utilities (as discussed in section 5.5.3).

5.5.2. Construction compounds

Indicative locations for construction compounds and bridge construction yards have been identified and are shown on Figure 5-2 to Figure 5-5 of this AEE. The proposed designation accommodates construction compounds and bridge construction yards. Final locations and areas required for the construction compounds and bridge construction yards will be confirmed at detailed design stage and once a contractor has been appointed.

Site office compounds

Each section will have a site office compound from which the individual section will be managed for the long-term duration of the Project. These compounds will include project offices, meeting rooms, ablution facilities, workshops for repairs and maintenance of plant and equipment, lay down and storage areas for materials delivery and parking.

At this stage, it is envisaged that site office compounds could be established in the following locations:

1. South section office compound close to Warkworth, for ease of access to both Warkworth and Auckland. It would be suitable to incorporate the main office for the entire Project at this location.
2. Central section office compound would likely be established in the existing forest clearing/logging skid site off Dibble Road.
3. North section office compound alongside the intersection of Wayby Valley Road and SH1 for easy access to the existing SH1.

Bridge construction yards

Smaller construction yards will be established at each bridge site to accommodate the bridges teams and materials, plant and equipment. The construction yards will be established as required for the construction of each bridge and will be decommissioned at the completion of the associated bridge. These construction yards are likely to consist of 2 to 4 containers within a fenced compound.

5.5.3. Protection and relocation of existing network utilities

As outlined in section 4.3.8 of this AEE, existing network utilities affected by the construction of the Project will need to be maintained, protected or relocated.

The Transport Agency has a number of existing memorandums of understanding with network utility providers for similar works throughout the country. Initial discussions have been undertaken with network utility operators regarding the management of their assets during construction. Network utilities will be protected or relocated to the relevant provider's standards. Protection or relocation of existing utilities will generally occur prior to or in conjunction with the main construction phase of the Project. The scope and timing of the necessary utility relocation and protection works will be developed and agreed between the Transport Agency and network utility operators to enable continued operation, to mitigate any safety hazards and provide cost efficiency for the required works.

During the subsequent design phases construction methodologies will be developed in consultation with each network utility operator to manage effects of construction on network utilities.

Fuels and gas pipelines

The construction of the Indicative Alignment requires the relocation and/or bridging of sections of the fuels and gas pipelines. The pipelines are designated in the AUP(OP). Approval is required pursuant to section 177(1)(a) of the RMA from First Gas and Refining NZ prior to any works occurring in their existing designations. The Transport Agency is continuing to work with First Gas and Refining NZ to obtain approvals regarding the project interface with their assets, and how to address these interfaces. Any additional consents which may be necessary to authorise the relocation of the fuels and gas pipelines (e.g. for any associated works outside of the designation) will be subject to a separate process, once the alignment is confirmed and the extent of any relocation of the fuels and gas pipelines is agreed.

High voltage transmission lines

A high voltage transmission line, forming part of Transpower's National Grid, crosses the Indicative Alignment in the vicinity of the Te Hana interchange. The New Zealand Code of Practice for Electrical Safe Distances (NZECP:34) specifies minimum approach distances to all overhead power lines which will apply to the design of the Indicative Alignment and to the construction activities. A new transmission line support structure will be required to maintain clearance height distances above the new state highway as recommended by Transpower during early engagement with them.

The Transport Agency will continue discussions with Transpower regarding the specific design, approvals and construction methodology for protection of transmission assets.

Telecommunication

There are telecommunication facilities in proximity to the Indicative Alignment, including Vodafone, Spark and Kordia owned assets. The Transport Agency will continue to liaise with telecommunication utilities providers regarding the management of their activities during construction.

Watermain

The Indicative Alignment crosses over Watercare's Wellsford watermain and the construction works will be undertaken upstream of the water take points for both Warkworth and Wellsford's reticulated water supply (noting Watercare has transferred from surface water to groundwater abstraction for Warkworth). In addition, the Project proposes to culvert part of a watercourse which the discharge from the Wellsford wastewater treatment plant enters. The Transport Agency will continue discussion with Watercare regarding the management of activities during construction.

Power distribution

Vector's Wellsford Delivery Point for gas distribution and infrastructure for electricity distribution falls within the proposed designation and in proximity to the Indicative Alignment. The Transport Agency will liaise with Vector regarding the management of their activities during construction.

5.5.4. Earthworks

Earthworks quantities and distribution

The Project will involve large volumes of earthworks over approximately 310 ha. The total volume of cut material is approximately 12.4M m^3 and the total volume of fill material is approximately 9.6M m^3. The indicative construction methodology has been based on a typical range of earthworks per annum per section of between 800,000 m^3 to 1,100,000 m^3. The contractor will undertake a more detailed analysis that will likely result in optimisation of earthworks quantities and potential for a reduction of the overall construction programme. A summary of the indicative cut/fill requirements is provided below.

Table 5-1: Indicative earthworks quantities (m^3) for each construction section

	Total cut	Total fill	Cut suitable for reuse as structural fill	Structural Cut to Fill Surplus	Excess soil for disposal
South section	1,610,000	1,961,000	962,000	-203,000	0
Central section	6,169,000	3,393,000	3,807,000	554,000	2,550,000
North section	4,571,000	4,259,000	2,413,000	-45,000	829,000
TOTAL	**12,350,000**	**9,613,000**	**7,182,000**	**306,000**	**3,379,000**

The earthworks can be summarised as follows:

- The South section has a 203,000 m^3 shortfall of structural fill depending on earthworks optimisation during detailed design.
- The Central section is self-contained and has a 554,000 m^3 excess of structural cut to fill, depending on earthworks optimisation during detailed design.
- The North section is largely self-contained with a minor shortfall of structural fill (45,000 m^3) but generally can be considered to provide all the required fills from the cuts within this section.

Any shortfall (in particular in the South section) can be addressed by numerous options, including design refinements to reduce fill requirements or increase cut volumes, importing excess structural fill from the Central section, importing material from borrow areas within the proposed designation or importing overburden from existing quarries or a combination of these options. For assessment purposes a combination of these options has been considered.

The Indicative Alignment will generate up to approximately 3.4M m^3 of surplus earthworks material. Surplus material will occur where the material cannot be reused as engineered fill due it to being over-wet or of poor quality and/or the quantity of suitable cut material exceeds that of the required fill volume. Potential locations for soil disposal are shown on Figure 5-2 to Figure 5-4 below.

The majority of the soil disposal areas identified are located close to the Indicative Alignment and involve extensions to the uphill sides of embankments, using some large gullies above the road. The final soil disposal site locations for surplus material and final volumes will be determined during the detailed design phase of the Project and once a contractor has been appointed and the construction methodology confirmed. Potential soil disposal sites are accommodated within the proposed designation boundary.

Figure 5-1: Bulk earthworks on Northern Gateway Toll Road, similar to proposed earthworks through the commercial plantation forestry

Haul routes and access routes

Earthworks operations can be contained within the proposed designation boundary, including internal hauling of material, disposal of excess soil and potential establishment of material borrow sites. Given the likely requirement for importation of structural fill to the South section (either from the Central section or quarries further afield) and pavement material across the site, there will be material movement on public roads outside the proposed designation boundary. The indicative construction access routes along the existing SH1 and the local road network and indicative internal haul routes (haul roads) within the proposed designation boundary for earthworks, plant and materials are shown in on Figure 5-2 to Figure 5-4 below and described within this section. Additional but shorter access tracks will be constructed from these internal haul roads to specific locations, such as bridge sites and sites for ground improvement works.

In the southern extent of the South section (i.e. between Kaipara Flats Road and Woodcocks Road), access to the earthworks footprint is expected to be from local roads (Woodcocks Road, Carran Road and Kaipara Flats Road) as well as alongside the P2Wk motorway alignment. It is currently envisaged that the shortfall of structural fill in the South section is hauled in on a combination of these roads. Should surplus structural material from the Central section be used to meet the shortfall in the South section, the preferred haul route would be through either one of the bored tunnels. Until the tunnel bore is complete, material would need to be hauled using the forestry roads and SH1.

In the northern extent of the South section (i.e. from Kaipara Flats Road to the southern tunnel portals), the haul road is likely to be aligned within the earthworks footprint, as the geology comprises of material suitable for haul roads. These haul routes will change in location and elevation as the earthworks progress but will remain within the proposed designation boundary.

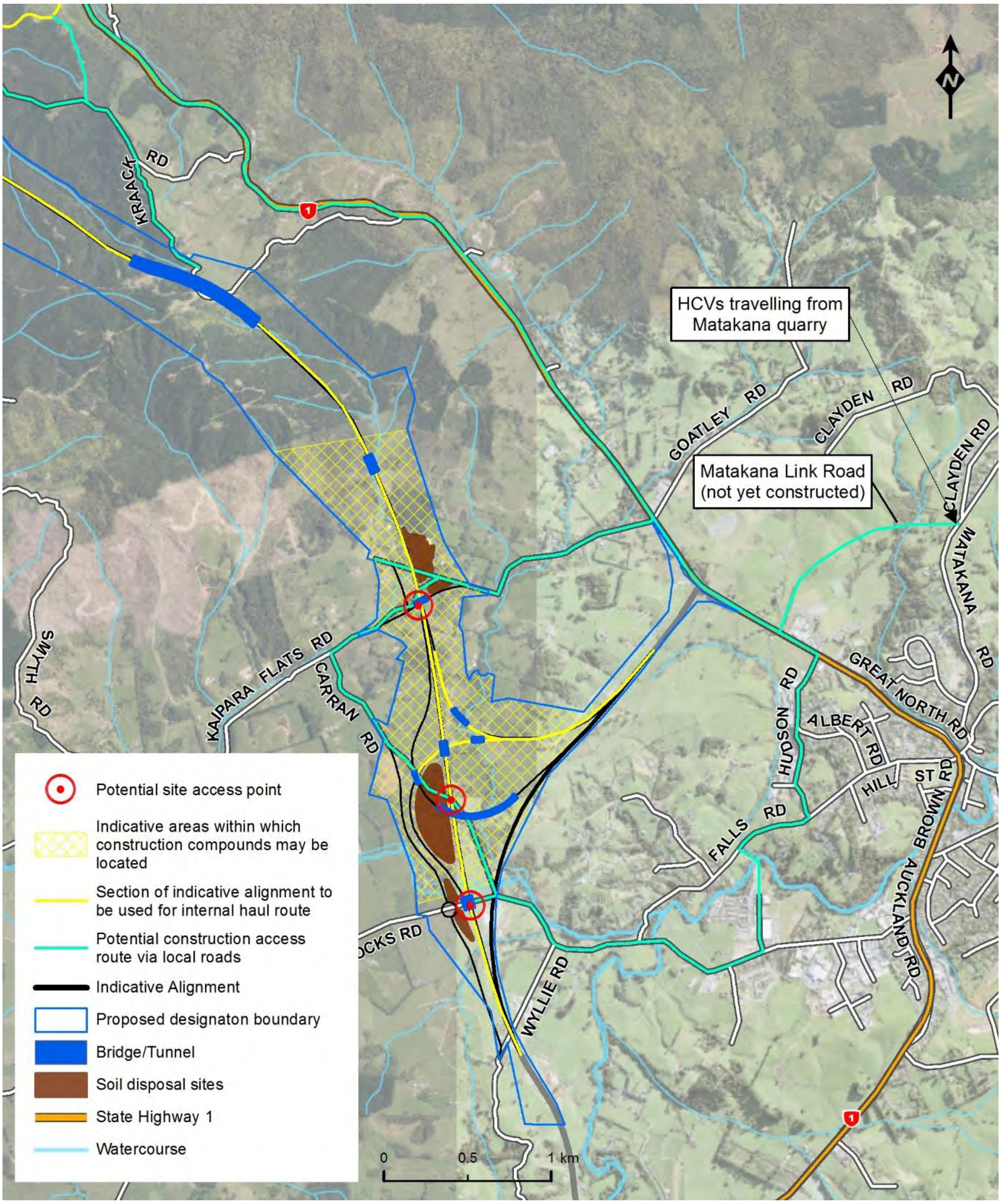


Figure 5-2 Construction: South section

The haul roads in the Central section are likely to be aligned generally within the earthworks footprint. Due to the steep topography, the primary haul road will follow the contours as much as possible to provide accessible gradients for earthworks plant. Access to the primary haul road would likely be provided from SH1 via the existing forestry roads. Some existing forestry access roads between the existing SH1 and the Indicative Alignment are incorporated within the proposed designation in this Central section to ensure access is available to the earthworks footprint from SH1.

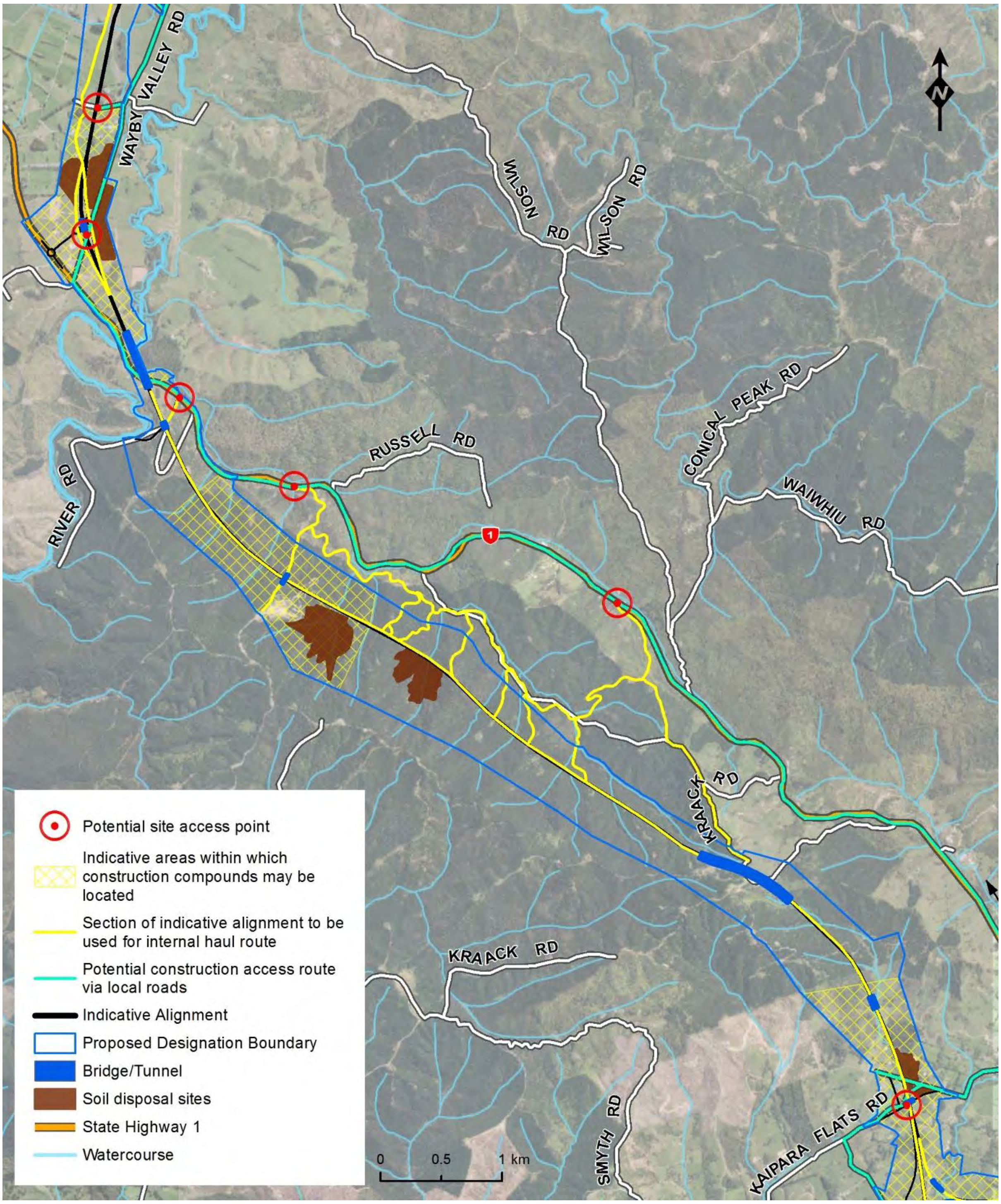


Figure 5-3: Construction: Central section

In the North section, there are areas of weaker materials (mudstone), and stronger materials (e.g. limestone). In areas of weaker materials, a haul route will be constructed outside the earthworks footprint, for construction purposes. In the stronger limestone material, the haul route will generally be constructed within the earthworks footprint and will change in location and elevation as the earthworks progresses.

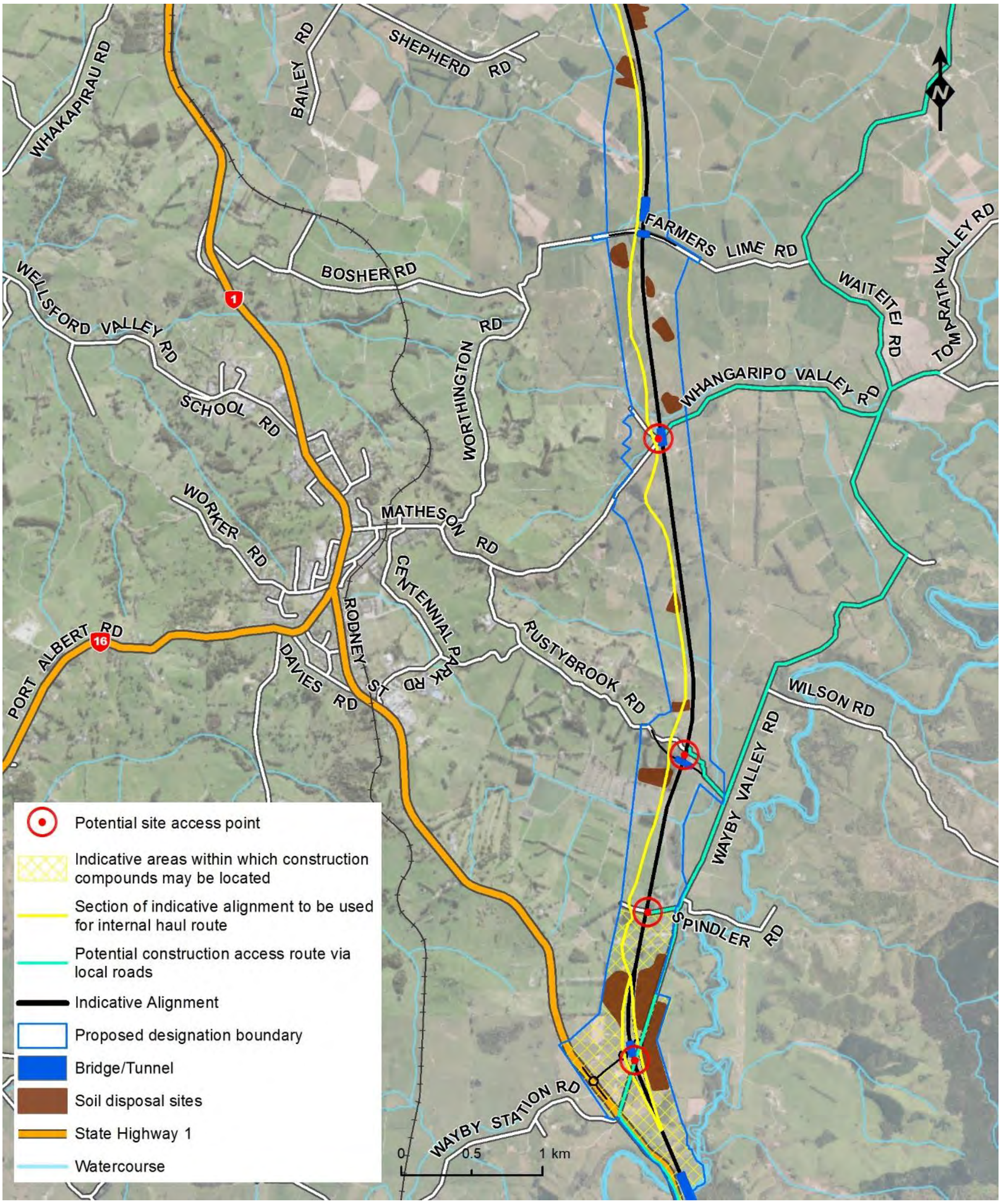


Figure 5-4: Construction southern extent of North section

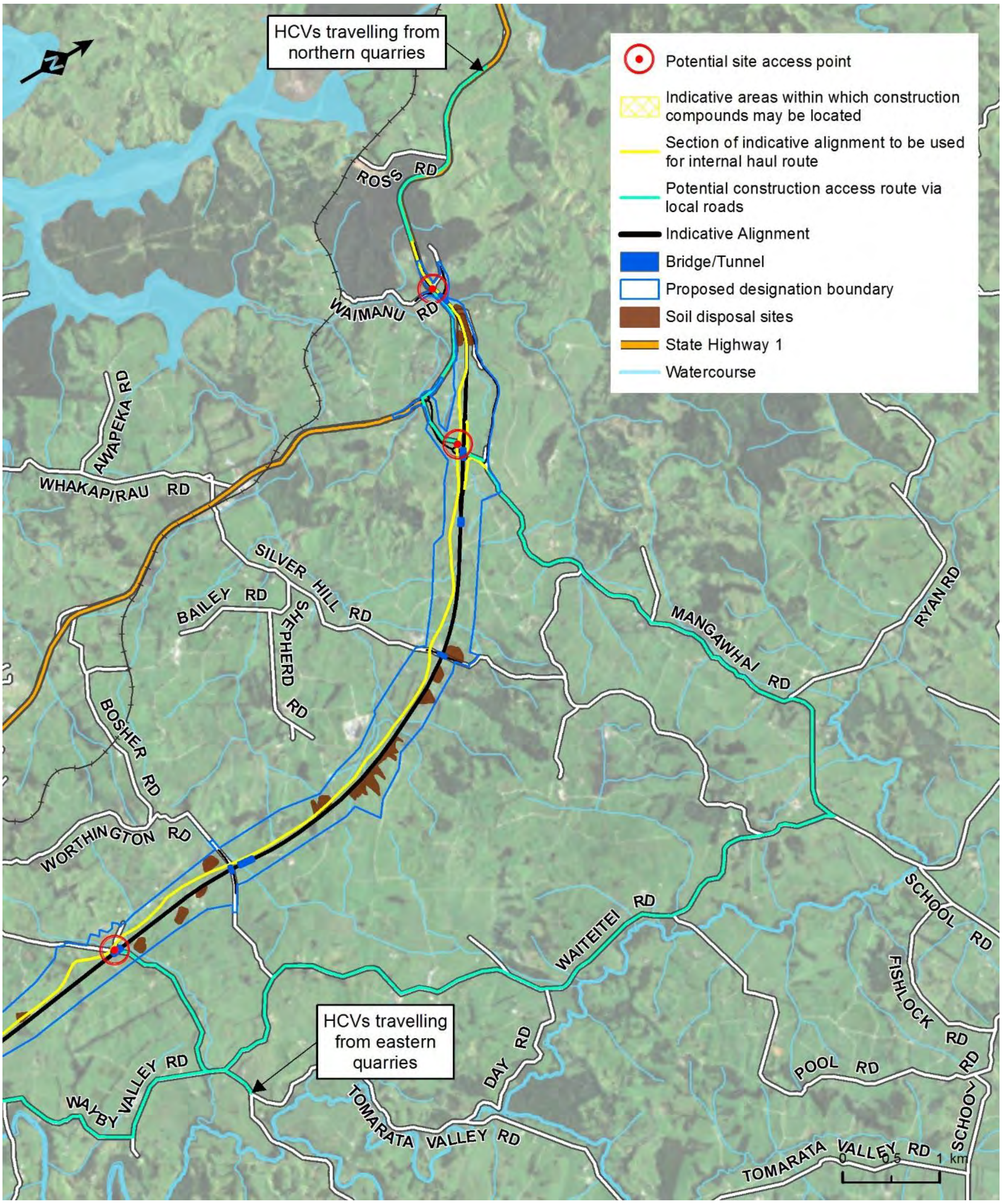


Figure 5-5: Construction northern extent of North section

To assist with the assessment of potential effects, the following four quarries in proximity to the Project have been used as the premise for the source of materials and resulting heavy traffic:

- Matakana Quarry: Approximately 20 km east of the South section;
- Rodney Aggregates Quarry: Approximately 16 km east of the North section;
- Atlas Quarry: Approximately 23 km north of the North section; and
- Millbrook Quarry: Approximately 35 km north of the North section.

The volume of construction aggregate procured from the individual quarries will be dependent on the available capacities and aggregate quality within these quarries or at other locations at the time of construction.

The overall volume of imported construction aggregates required for use on the Project is dependent on the availability of rock from within the site that may be suitable for crushing and reuse as construction aggregates. Areas with suitable underlying material within the proposed designation may be used as rock borrow sites to reduce the quantum of material required to be imported to the site.

Erosion and sediment control

The scale of the Project will require the disturbance of a large area of land within the proposed designation. An overriding principle for the Project has been to balance the land disturbance required against efficiencies in construction programme to minimise the amount of construction-related sediment from entering streams and watercourses and, in turn, the Mahurangi and Kaipara Harbours.

A key erosion and sediment control (ESC) principle will be to minimise the area and length of time that particular areas of ground are open through staging and sequencing of works and progressively stabilising open earthworks areas to reduce the potential for erosion to occur. This best practice approach will be used in conjunction with proven structural and non-structural control devices and methods. If monitoring confirms that the ESC devices are achieving higher standards of management than anticipated, it may be appropriate through conditions of consent to increase the proposed open area limit to reduce the construction programme.

Best practice erosion and sediment control measures will be implemented for the Project. The erosion and sediment control measures are discussed in further detail in section 9.2 and in summary will include:

- Working to industry best practice at the time of construction;
- Appropriate staging of the works, to appropriately limit the area of exposed earth open to the elements at any one point in time;
- Perimeter controls (predominantly earth bunds and drains) to divert clean water runoff away from the disturbed areas and divert sediment laden runoff to sediment retention devices;
- Progressive and rapid stabilisation of disturbed areas; and
- Sediment control devices, including sediment retention ponds (SRPs), decanting earth bunds (DEB) (where there is insufficient space to use ponds), sediment fences and silt socks.

The *Construction Water Management (ES-Series)* drawings contained in *Volume 3: Drawing Set* show how erosion and sediment control could be delivered for the Project.

Water use requirements for construction

Water will be required for construction activities; such as dust suppression. No resource consents for water takes are sought at this time. The contractor will be required to obtain sufficient water supply for construction of the Project. The potential source or sources are not yet known. If the contractor's chosen source requires resource consents, they will be required to obtain this from Auckland Council prior to the commencement of works.

Construction plant equipment

The typical earthmoving plant anticipated to be required for construction of the Project is identified in Table 5-2. This plant will be supported by an array of smaller plant for topsoil stripping, loading, drainage and structure construction purposes. The actual size, capacity and total plant numbers will be dependent on the required programme and number of work sites that could efficiently be operated in any section.

Table 5-2: Indicative earthmoving plant

Plant	Purpose	Conditions
Large off-road motorscrapers	Self-loading and carting	Soft soils in moderately sloping terrain
Large and medium sized excavators	Excavating	Soft and hard soils, including softer rock, in flat to steep terrain
Large bulldozers	Ripping and pushing	Soft and hard soils, including softer rock in flat to steep terrain
Large articulated dump trucks	Carting	Suitable for traversing moderately soft to hard material at moderately steep to flat grades
Large rigid-chassis dump trucks	Carting	Suitable for traversing firm material at moderate to flat grades
Medium-sized roller compactors	Compaction	Reasonably level surfaces

5.5.5. Construction traffic

Light vehicle movements

Light vehicle movements are associated with the workforce and expected visitors. For the purposes of the assessments, it is assumed that approximately 50% of the staff will be resident in Warkworth, Wellsford or the areas surrounding these centres. It is assumed that the remainder will travel mainly from Auckland, but also from as far afield as Whangārei. The indicative light vehicle movements are shown in the Table 5-3 below.

Table 5-3: Anticipated light vehicle movements per day (two way)

	Main Site Office	South section	Central section	North section	Visitors per day
Anticipated light vehicle movements to and from site	70-90	430-490	430-490	580-660	40-60

Heavy vehicle movements

Heavy vehicle movements on the road network will primarily be associated with the importation of fill to the South section (years 3, 4 and 5) and importation of pavement aggregates (years 6 and 7 for all construction sections). The highest traffic frequencies will occur on the roads directly between the quarries and the site and will reduce as the material is distributed via internal haul routes along the length of the site or if material is sourced within the Project area instead of external sources. For the larger bridges, concrete delivery truck volumes of 4 to 6 per hour may generally be expected, with occasional peaks of 6 to 9 per hour.

Table 5-4 and Table 5-5 show possible scenarios for heavy vehicle movements associated with importation of fill to the South section and importation of pavement aggregate to all construction sections. A range of heavy vehicle movements are outlined to compare the extent of traffic movements if this were to occur over a shorter or longer construction period (2 year or 3 year haul). Two material sources have been assessed for the importation of fill to the South section, as outlined in section 5.5.4 being either from Matakana Quarry or from the Central section. Note, no assumptions have been made around the source for the importation of pavement aggregate for each of the construction sections, however the table provides a worst case scenario of importation requirements and truck movements on the public road network.

Table 5-4: Indicative assumptions for importation of fill to South section

Importation of fill to South section	From southern quarry		From Central section*	
	2 year haul	3 year haul	2 year haul	3 year haul
Fill volume per day (m3)	800	530	750	500
Volume of truck (m3)	14	14	10	10
Hours per day	9.5	9.5	9.5	9.5
Truck loads per day	57	38	75	50
Loads per hour	6	4	8	5
Loads per hour (two way)	12	8	16	10
Truck movements per day (two way)	114	76	152	95

* If the aggregate is taken through the tunnel from the Central section (as outlined in section 5.5.4) this would significantly reduce truck movements on the public road network

Table 5-5: Indicative assumptions for importation of pavement aggregates for each construction section

Importation of pavement aggregate	South section		Central section		North section	
	2 year haul	3 year haul	2 year haul	3 year haul	2 year haul	3 year haul
Fill volume per day (m3)	878	585	878	585	2,050	1,365
Volume of truck (m3)	14	14	14	14	14	14
Hours per day	9.5	9.5	9.5	9.5	9.5	9.5
Truck loads per day	63	42	63	42	146	98
Loads per hour	7	4	7	4	15	10
Loads per hour (two way)	14	8	14	8	31	20
Truck movements per day (two way)	133	76	133	76	295	190

Site access points

It is anticipated that the contractor will seek access to site using most of the local and all or some of the forestry roads that connect from the existing state highway to the Project works site. Site access is also anticipated at the tie-ins with the state highway at either end of the Project, particularly during pavement construction.

Traffic management

Construction of the Project will require temporary traffic management (TTM) on both the existing state highway and local roads. This may include:

- Shoulder and lane closures;
- Temporary deviations;
- Road closures/detours;
- Site access arrangements including acceleration and deceleration lanes; and
- Temporary speed limits.

In many instances construction activities can be undertaken off line, with temporary traffic management only needed where construction of tie-ins is required under live traffic. Some road realignments or bridge works will require the construction of temporary diversions to maintain through traffic. Temporary traffic management controls will be implemented in accordance with the standards in the Code of Practice for Temporary Traffic Management (CoPTTM) to ensure that the TTM measures are put in place safely and that the impacts on traffic are minimised as much as practicable.

The proposed temporary traffic management measures are discussed and assessed in section 9.5 of this AEE and detailed in the *Construction Traffic Assessment* in *Volume 2: Technical Assessment Reports*.

5.5.6. Vegetation removal/ protection

For assessment purposes, it has been assumed that the area of commercial plantation forestry within the proposed designation boundary which is necessary for construction purposes will be cleared prior to construction commencement (refer Figure 3-5 and Figure 3-6). As outlined in section 3.5.1, the forest within the proposed designation is likely to reach maturity around the same time as the Project pre-construction phase and is programmed to be progressively harvested from around 2025 – 2027. Project construction commencement is indicatively 2030.

The methodology for construction of bridges across the Mahurangi River (Left Branch) will be developed so that temporary construction activities do not occur within the river bed and, to the extent practicable, its riparian margins (which are identified as a SEA).

There are other SEA sites located within the proposed designation which are proposed to be protected to the extent practicable during construction, through delineation and protection of these areas. These include:

- Removal of vegetation within the riparian margin of the Mahurangi River Left Branch except as necessary to construct on and off ramps for the Warkworth interchange; and
- Avoiding removal of the swamp maire north of Phillips Road.

The construction of Bridge 11 across the Hōteo River, Waiteraire Stream and SH1 will require two sets of piers and foundations to be located within a native forest area which is identified as a Significant Ecological Area (SEA). Temporary access will be required to construct the piers. The bridge design has positioned the piers to minimise the impacts of construction access and activities within the SEA, illustrated in Figure 5-6 below. The impact of the access to these locations may be further mitigated by means of temporary bridges across the Waiteraire Stream and native forest reinstatement.

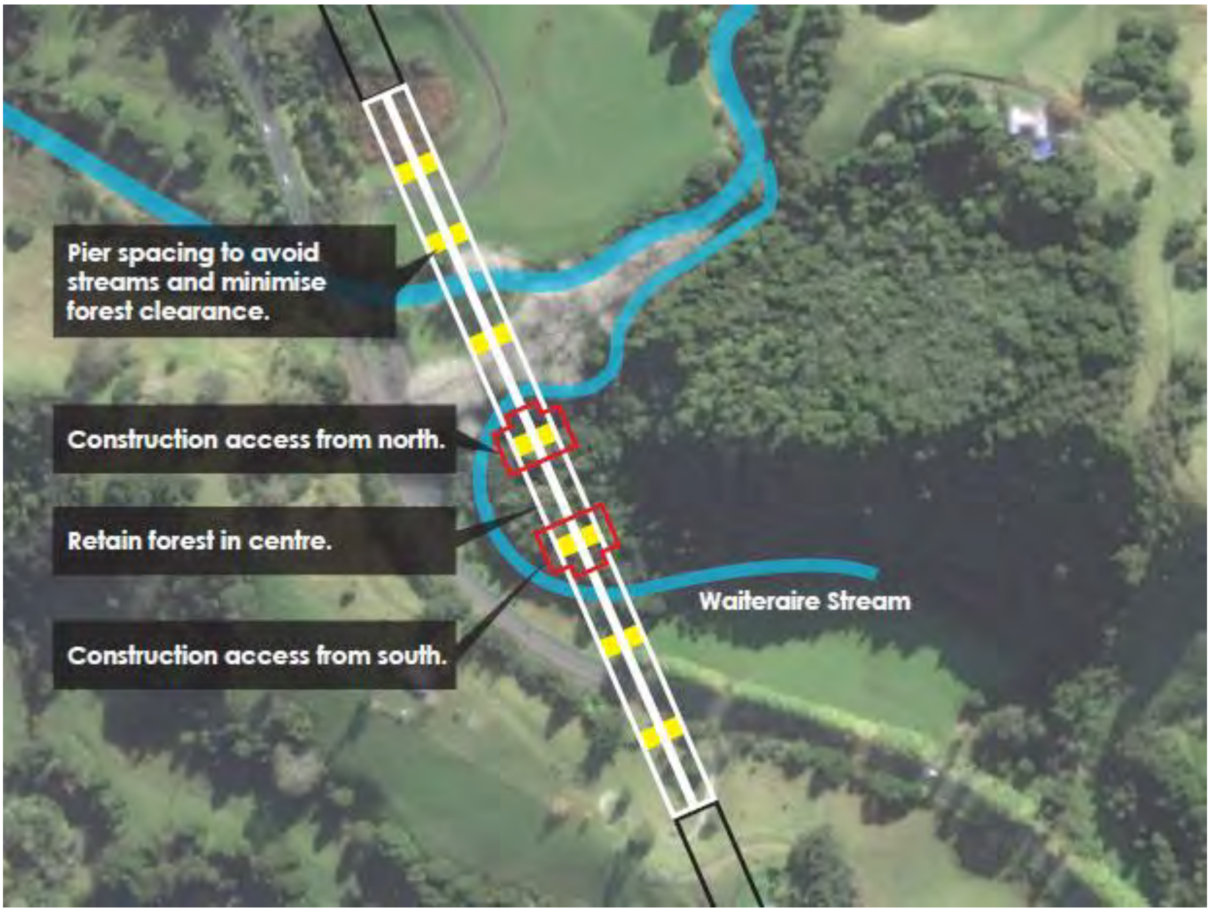


Figure 5-6: Proposed positioning of Bridge 11 piers within SEA

5.5.7. Works in watercourses

Stream realignment

Permanent stream diversions will be required to divert streams around or through permanent Project features, such as an embankment, bridge or culvert. Permanent stream diversions are discussed in section 4.3.9 of this AEE. Some temporary stream diversions will be required during the construction of the Project to allow construction works to progress, or to provide access to a construction area. In both cases, stream diversions will be necessary to establish an 'offline' environment to allow construction works to be completed outside of the active stream channel. This strategy will be based upon the temporary diversion of flows around the area of works or working immediately next to the stream.

Streams will be surveyed for the presence of fish species. If fish species are present, stream works will be programmed and undertaken, where practicable, so they do not occur during the fish spawning and migration periods (1 September to 30 November).

Culverts, erosion control and protection structures

Permanent culvert construction will be required in a number of locations throughout the Project. Temporary culverts are also likely to be required to allow construction vehicles to cross watercourses and overland flow paths during construction. All temporary culverts will be removed when no longer needed and the stream profile reinstated should any disturbance occur as a result of the temporary culvert.

Permanent culverts will be constructed in an off line environment, and thus isolated from the existing stream flows i.e. a temporary stream diversion will be required to divert flows prior to stream works commencing around the culvert construction site. Once completed, flows are then directed through the culvert.

Where culvert installation or an extension is required within a stream channel, the culvert works could be carried out either by bypassing the flows around the culvert footprint and establishing a stream diversion or by pumping the flows around the culvert works areas. Stream flows and fish passage requirements will determine which approach is used.

5.5.8. Hazardous substances and materials

As noted above, construction activities and site works will include a wide range of machinery and construction plant. The majority of this plant will be motorised and require a regular supply of fuels and oils. The machinery will require refuelling on-site, hence fuel, oils and other lubricants will be stored within the proposed designation.

The management of hazardous substances, including storage, handling, transport and disposal, will be subject to specific management practice and industry guidelines. This management will minimise potential effects on health and safety from exposure to hazardous substances and minimise potential for adverse effects on the environment.

5.5.9. Viaduct and bridges

The Project will require the construction of a number of bridges (21 bridges are shown on the Indicative Alignment).

Short span bridges, having spans of up to approximately 35 m in length, will most likely comprise of traditional precast beams. Precast beams may be lifted into place by either cranes or launching girders (used when access for lifting cranes is difficult, such as over wide waterways or where it is desirable to limit the construction footprint).

Long span bridges, having spans of more than 35 m in length, are likely to be constructed with structural steel beams or box girders.

Bridge 11 over the Hōteo River is approximately 490 m long, has spans of up to 65 m, and has a straight alignment. The viaduct is therefore well suited to span by span construction using an overhead gantry as used for the Waiwera Viaduct, shown in Figure 5-7. Piled foundations and columns will require access for a piling rig, cranes and other equipment required to construct the substructure (i.e. piers).

Alternative construction methods will be investigated further through detailed design and once a contractor is appointed. If concrete batching methods are proposed by the contractor instead of pre-cast, any consents required for establishing concrete batching plants will be sought by the contractor.

Figure 5-7: A launching gantry placing segmental box girder sections on the Waiwera Viaduct

Bridge 21 at the Warkworth interchange is approximately 555 m long and has spans of up to 65 m. Bridge 21 could be built using a similar construction methodology to that of Bridge 11.

5.5.10. Tunnels

Excavation of the twin tunnel bores would be undertaken most likely by using a track mounted roadheader and rock milling machinery, see Figure 5-8 below. The roadheader will excavate the upper section of the tunnel bore followed by the rock milling machinery to complete the lower section. The excavation will be temporarily supported whilst the permanent waterproof lining and support structure is completed.

The portals will follow the natural contours of the hill as much as practicable.

Groundwater inflow into the tunnels during excavation is expected to be limited to seepage from bedding planes and fault zones. Any inflow will be managed by temporary water management methods (bunds, table drains, pipes) and stored and treated within sediment devices prior to discharging as surface water.

Once operational, groundwater will be directed around the perimeter of the tunnel lining and collected in a piped system, to be collected, stored and treated by a treatment device prior to being discharged as surface water.

Figure 5-8: Excavation of lower bench by rock milling machine

5.5.11. Pavement construction

Pavement construction may be carried out in the last 12 months of each section of the Project following the completion of the bulk earthworks and the major structures, unless completed concurrently with the completion of earthworks activities.

It is anticipated that all pavement material will need to be imported. Aggregates required for pavement construction will be delivered to the site by truck and trailer. Material will generally be carted from the available quarries along local roads and the existing SH1.

5.5.12. Construction management plans

Construction of the Project will be managed through the development and implementation of a suite of management plans typical of large construction projects. The construction management plans form an integral part of how construction activities are managed to address the social, environmental and cultural effects identified in Section 9 of this AEE.

6. Statutory Context

6.1. Introduction

The purpose of this section is to set out the statutory framework against which the Project must be assessed. Relevant statutory matters are set out, including the relevant RMA planning documents as well as matters under other relevant legislation. It focuses particularly on those provisions of the RMA that are relevant to the application, including:

- Purpose and principles of the RMA (Part 2);
- Duties and restrictions (Part 3);
- NoRs for designations (Part 8); and
- Applications for resource consent (Part 6).

An assessment of the Project against the statutory framework is provided in Section 11 of this AEE.

In addition, this section identifies the statutory authorisations sought under the RMA for the Project. In summary, the Transport Agency is proposing a new designation for the construction, operation, and maintenance of a State highway.

The Transport Agency is seeking resource consents to authorise the following activities:

- Land disturbance activities including earthworks, roading, tracking, ground improvements, soil disposal, borrow sites and vegetation clearance under section 9(2) of the RMA;
- Activities in, on, under or over the bed of lakes, rivers and streams (including intermittent streams), including structures, stormwater outlets, erosion protection, restoration and enhancement under section 13 of the RMA;
- Diversion of water in rivers, streams and wetlands under section 14 of the RMA;
- New impervious surfaces for high use roads and diversion, and discharge of stormwater from new permanent impervious surfaces to land and water under sections 9(2), 14 and 15 of the RMA;
- Diversion of groundwater and associated dewatering caused by excavation and tunnelling under section 14 of the RMA;
- Discharges to air associated with mineral extraction activities and temporary crushing (rock borrow sites) under section 15 of the RMA.

6.2. Resource Management Act

6.2.1. Purpose and principles (Part 2)

Consideration of the NoR and of the applications for resource consent are subject to Part 2 of the RMA. Part 2 of the RMA is comprised of sections 5 to 8 and outlines the purpose and principles of the RMA.

Section 5 sets out the purpose of the RMA, being to promote the sustainable management of natural and physical resources, and states:

> *(2) In this Act, sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—*
>
> *(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
>
> *(b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
>
> *(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

Section 6 describes the matters of national importance that all persons exercising functions and powers under the RMA shall recognise and provide for. Matters (a), (b), (c), (d), (e), (f), (g) and (h) are of particular relevance to this Project. In summary, these matters relate to:

> *(a) … natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins…;*
>
> *(b) …outstanding natural features and landscapes …;*
>
> *(c) …significant indigenous vegetation and significant habitats of indigenous fauna;*
>
> *(d) …public access to and along … lakes, and rivers;*
>
> *(e) the relationship of Māori and their culture and traditions…;*
>
> *(f) …historic heritage…;*
>
> *(g) …protected customary rights; and*
>
> *(h) …significant risks from natural hazards.*

Section 7 sets out other matters to which particular regard shall be had. Of relevance to this Project are matters (a), (aa), (b), (ba), (c), (d), (f), (g) and (i). In summary matters relate to:

> *(a) kaitiakitanga;*
>
> *(aa) the ethic of stewardship;*
>
> *(b) the efficient use and development of natural and physical resources;*
>
> *(c) the maintenance and enhancement of amenity values;*
>
> *(d) intrinsic values of ecosystems;*
>
> *(f) maintenance and enhancement of the quality of the environment;*
>
> *(g) any finite characteristics of natural and physical resources; and*
>
> *(i) the effects of climate change.*

Section 8 requires all persons exercising functions and powers under the RMA to take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

6.2.2. Duties and restrictions (Part 3)

Part 3 of the RMA sets out a number of restrictions on the use of resources (including land and water), and on activities that impact on resources (such as the discharge of contaminants). Where relevant to this Project, these are summarised below:

Section 9 of the RMA imposes restrictions on the use of land. The Project will involve a number of land disturbance activities controlled under section 9(2) of the RMA. The proposed activities that would otherwise permitted or require consent under district rules (section 9(3) of the RMA) will be authorised by the proposed designation for the Project.

Section 13 of the RMA imposes restrictions on activities in, on, under and over the beds of lakes and rivers. There are streams in the Project area that will be affected by structures as part of the Project, through the installation of bridges and culverts.

Section 14 of the RMA relates to any take, use, damming or diversion of water. The Project will require temporary and permanent diversion of streams and diversion of water in wetlands, stormwater and groundwater diversion during construction and operation of the Project.

Section 15 of the RMA restricts discharges into or onto air, land or water. The Project will involve discharges to air, land and water during construction and operation.

The resource consents are set out in section 6.6 below.

6.2.3. Designations

As outlined in Section 1 of this AEE, the Transport Agency is a requiring authority and can give notice of its requirement to designate land for the state highway network in accordance with its statutory functions. The Transport Agency has given a notice of its requirement for a new designation in the AUP(OP) for the construction, operation, and maintenance of a state highway.

The process for considering a NoR for a designation is set out in Part 8 (sections 166 – 186) of the RMA. In accordance with section 168(2), where a matter is lodged with a territorial authority, a requiring authority may at any time give notice in the prescribed form to a territorial authority of its requirement for a designation for a project or work.

6.2.4. Resource consents

Territorial authorities must consider applications for resource consents under sections 104 to 112 and 138A of the RMA and may impose conditions under sections 108 and 108AA, if it chooses to grant consent.

6.2.5. Matters for consideration

As required by section 104, consent authorities considering applications for resource consent must, subject to Part 2, have regard to the following matters as assessed in this AEE:

RMA requirement	AEE reference
Actual and potential effects on the environment	Section 9: Assessment of effects on the environment and technical assessment reports contained in Volume 2
Measures proposed for the purpose of ensuring positive effects	Section 9: Assessment of effects on the environment Section 10: Management of effects on the environment
Relevant provisions of policy statements, environmental standards, plans and other regulations	Section 11: Statutory assessment
Other matters	Section 11: Statutory assessment

As required by section 171, consent authorities considering NoRs must, subject to Part 2, consider the effects on the environment having particular regard to the following matters as assessed in this AEE:

RMA requirement	AEE reference
Part 2 of the RMA	Section 11: Statutory assessment
Effects on the environment	Section 9: Assessment of effects on the environment and technical assessment reports contained in Volume 2
Relevant provisions of policy statements and plans	Section 11: Statutory assessment
Adequate consideration of alternatives	Section 7: Alternatives assessment
Necessity for achieving Requiring Authority objectives	Section 11: Statutory assessment
Other matters	Section 11: Statutory assessment

Section 105 of the RMA sets out further matters that must be considered in relation to the consents sought for the discharge of water and contaminants (stormwater and sediment) and dust from mineral extraction activities during construction of the Project and for the discharge of stormwater arising from the operation of the Project. The matters identified in section 105 of the RMA are assessed in section 9 and section 11 of this AEE demonstrates how the requirements of section 105 are met.

Relevant policy statements and plans are identified in section 6.2.7 below. An assessment against these provisions is provided in section 11 of this AEE.

In addition, there are a range of 'other matters' that must be considered, which can include matters outside the RMA, including non-statutory policy documents. A brief description of other matters relevant to the Project is outlined in section 6.3 to section 6.5 below. An assessment against other relevant matters is provided in section 11 of this AEE.

6.2.6. Restrictions on the power to grant consent

Section 107(1) of the RMA restricts the power to grant resource consent to discharge a contaminant or water where that discharge is likely, after reasonable mixing, to give rise to any of a number of specified types of adverse effects. This restriction is subject to the exceptions listed at section 107(2), including where there are exceptional circumstances, or where the discharge is of a temporary nature.

A detailed assessment against section 107(1) is contained in section 11 of this AEE.

6.2.7. Planning and Policy Documents

The national, regional and district planning and policy documents relevant to the Project (prepared in accordance with the RMA) are listed below.

National Policy Statements

New Zealand Coastal Policy Statement (NZCPS): The NZCPS came into effect on 3 December 2010 and contains objectives and policies relating to New Zealand's coastal environment. As the Project will potentially impact on the coastal environment through discharges, specifically in the vicinity of the northern tie in and Warkworth Interchange, the NZCPS must be considered.

There are seven overarching objectives of the NZCPS which set out the high level direction for managing the coastal environment, and 23 policies that follow this direction. The objectives of the NZCPS include to:

- Safeguard and preserve the natural character of the coastal environment including its function, resilience, and sustaining ecosystems for future generations;
- Preserve the natural character of the coastal environment and protect natural features and landscape values;
- Take into account the principles of the Treaty of Waitangi;
- Maintain public access and open space opportunities in the coastal environment;
- Ensure coastal hazard risks taking account of climate change are managed;
- Enable people and communities to provide for their social, economic and cultural wellbeing; and
- Ensure management of the coastal environment recognises and provides for New Zealand's international obligations.

National Policy Statement for Freshwater Management (NPSFM): The NPSFM came into effect on 1 August 2014, and a range of amendments came into effect on 7 September 2017. It contains nine groups of objectives and policies:

- Te Mana o Te Wai;
- Water quality;
- Water quantity;
- Integrated management;
- National objectives framework;
- Monitoring plans;
- Accounting for freshwater takes and contaminants;
- Tangata whenua roles and interests; and
- Progressive implementation programme.

The relevance of the NPSFM to the Project will be through consideration of consents required under the AUP(OP), which gives effect to the NPSFM. An assessment of the Project in relation to the NPSFM is provided in section 11 of this AEE.

National Policy Statement on Electricity Transmission (NPSET): The NPSET came into effect on 10 April 2008. The objective of the NPSET is:

> *"[t]o recognise the national significance of the electricity transmission network by facilitating the operation, maintenance and upgrade of the existing transmission network and the establishment of new transmission resources to meet the needs of present and future generations, while:*
>
> *· managing the adverse environmental effects of the network; and*
>
> *· managing the adverse effects of other activities on the network."*

As there is an electricity transmission line running through the Project area, the effects of the Project on the electricity transmission network need to be considered and managed. An assessment of the Project in relation to the NPSET is provided in section 11 of this AEE.

National Policy Statement on Urban Development Capacity (NPSUDC): The NPSUDC came into effect on 1 December 2016. The NPSUDC provides direction to decision-makers under the RMA to provide for sufficient development capacity for housing and businesses to enable urban areas to grow and change in response to the needs of communities. In the NPSUDC, development capacity is defined as:

> *"the capacity of land intended for urban development based on: the zoning, objectives, policies, rules and overlays that apply to the land; and the provision of adequate infrastructure to support the development of the land".*

The NPSUDC is relevant to the Project to the extent that it has a function of improving transport access to identified growth areas (i.e. Warkworth and Wellsford). An assessment of the Project in relation to the NPSUDC is provided in section 11 of this AEE.

Hauraki Gulf Marine Park Act 2000 (HGMPA): The HGMPA recognises the national significance of the Hauraki Gulf, including the interrelationship between the Hauraki Gulf, its islands and catchments, and the ability of that interrelationship to sustain the life-supporting capacity of the environment.

The HGMPA outlines broad policy matters, which recognise the features that contribute to the national significance of the Hauraki Gulf and appropriate objectives for the Gulf's management.

Section 7 of the HGMPA recognises the Hauraki Gulf as an area of national significance. Section 8 of the HGMPA provides further specific direction on resource management matters that contribute to the Hauraki Gulf's significance. Under section 9(5) of the HGMPA, sections 7 and 8 are deemed to be national policy statement under the RMA in respect of matters relating to the Gulf.

Part of the Project area is located in the Mahurangi catchment which is a catchment of the Hauraki Gulf. The potential effects of the Project on the Mahurangi catchment are outlined in section 9 and an assessment against the HGMPA is provided in section 11 of this AEE.

National Environmental Standards

National Environmental Standards for Air Quality (NESAQ): The NESAQ is intended to protect public health and the environment of New Zealand by, among other things, setting national environmental standards for ambient air quality. Different parts of the NESAQ came into effect between 2004 and 2006.

There are five ambient air quality standards relevant to the Project. Schedule 1 of the NESAQ sets out the ambient air quality concentration limits for the following:

- Carbon monoxide;
- Nitrogen dioxide;
- Ozone;
- Fine particular matter (PM10); and
- Sulphur dioxide.

The construction and operation of the Project will not trigger the requirement for resource consent under the NESAQ. The potential effects of the Project on air quality are addressed in sections 9 and 11 of this AEE.

National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES Soil): The NES Soil establishes a nationally consistent set of planning controls and soil contaminant values. The NES Soil contains a national set of soil contaminant standards for 12 priority contaminants, for five standard land use scenarios (rural residential, residential, high density residential, recreational and commercial/industrial).

Previous and existing land uses within the Project area have been identified as Hazardous Activities and Industries List (HAIL) activities. An assessment of the Project in relation to the NES Soil is provided in section 11 of this AEE. The potential effects of land contamination are addressed in sections 9 and 11 of this AEE. Given the site specific nature of potential contaminated sites identified and the indicative nature of the alignment, if consents are required under the NES Soil for land disturbances these will be obtained after detailed design, but prior to the commencement of any construction works for the Project which may disturb potentially contaminated soils.

National Environmental Standards for Electricity Transmission Activities (NESETA): This NES is applicable to the Project as works to protect an existing electricity transmission line will be required. Any work on the existing transmission lines will be undertaken in liaison with Transpower and subject to their agreement. Any approvals required in accordance with the provisions of the NESETA will be sought prior to the commencement of any construction works for the Project within the vicinity of the transmission lines. Approvals under the NESETA are not sought as part of this Application.

National Environmental Standards for Sources of Human Drinking Water 2007 (NESSHDW): This NES requires regional councils to ensure that effects on drinking water sources are considered in decisions on resource consents and regional plans. No consents relating to this standard are required. The potential effects of the Project on the quality of drinking water sources (including Watercare's surface water take from the Hōteo river and other potentially permitted water takes) are addressed in section 9 of this AEE.

National Environmental Standards for Plantation Forestry (NESPF): This NES came into effect on 1 May 2018. The NESPF objectives are to:

- maintain or improve the outcomes associated with plantation forestry activities; and
- increase the efficiency and certainty of managing plantation forestry activities.

The NESPF is relevant to the Project as part of the proposed designation is located within a plantation forestry area. Given this is a commercial plantation forest, consent (if required) is not being sought as part of this Application as the relevant areas may be cleared by the forestry operator prior to construction. If consent is required for forestry removal to facilitate construction of the Project, the Transport Agency will undertake the works in accordance with the NESPF provisions, including seeking any consent approvals prior to commencement of construction if necessary.

Auckland Unitary Plan

All provisions in the AUP(OP) relevant to the Project (regional plan and district plan) are operative, with the exception of some provisions within Chapter E15 – Vegetation Management and Biodiversity. The relevant objectives and policies are summarised below and discussed in greater detail in section 11 of this AEE.

AUP(OP): Regional Policy Statement

Relevant resource management issues addressed in the RPS section of the AUP(OP) are:

- Tāhuhu whakaruruhau ā-taone – Urban growth and form (Chapter B2);
- Ngā pūnaha hanganga, kawekawe me ngā pūngao – Infrastructure, transport and energy (Chapter B3);
- Te tiaki taonga tuku iho – Natural heritage (Chapter B4);
- Te tiaki taonga tuku iho – Built heritage and character (Chapter B5);
- Mana Whenua (Chapter B6);
- Toitū te whenua, toitū te taiao – Natural resources (Chapter B7);
- Toitū te taiwhenua – Coastal environment (B8);
- Toitū te tuawhenua – Rural environment (B9); and
- Ngā tūpono ki te taiao – Environmental risk (Chapter B10).

An assessment of the Project in relation to the RPS section of the AUP(OP) is provided in section 11 of this AEE.

AUP(OP): Regional Plan provisions

Activities covered by the Regional Plan section of the AUP(OP) which are relevant to the Project are:

- Earthworks (including on land slopes greater than 10 degrees, within the Sediment Control Protection Area and within SEAs);
- Vegetation alteration and removal (including within riparian margins, rural zones and SEAs);

- New structures within the beds of rivers, streams and wetlands and associated bed disturbance or depositing of any substance, reclamation, diversion of water and temporary damming of water;
- Diversion of rivers and streams;
- New impervious surfaces associated with high use roads;
- Diversion and discharge of stormwater from new impervious surfaces onto land or into water;
- Diversion, damming and discharge of treated sediment laden water associated with land disturbance activities;
- Groundwater diversion and dewatering associated with excavation and tunnelling;
- Drilling of bores;
- Groundwater takes;
- Discharges to air associated with road construction;
- Discharges to air from tunnels;
- Discharges to air from motor vehicles;
- Discharges to air from mineral extraction activities.

AUP(OP): District Plan provisions

Objectives and policies relating to the following activities covered by the District Plan section of the AUP(OP) are relevant to the Project:

- Infrastructure (new road) within the rural zone;
- Transport;
- Land disturbance;
- Vegetation alteration and removal;
- Heritage;
- Lighting;
- Signs;
- Noise and vibration;
- Mineral extraction from land;
- Flooding;
- Hazardous substances; and
- Activities in the rural zone.

AUP(OP) appeals

The policies of Chapter E15 Vegetation Management and Biodiversity (Regional Plan) of the AUP(OP) that are subject to appeal are not considered relevant to this Project as they relate to transferrable subdivision rights for vegetation projection:

AUP(OP) Plan Changes

Proposed Plan Change 4 (PC4) is an administrative Plan Change notified on 28 September 2017 that aims to correct technical errors and anomalies within a number of existing policies, rules, overlays and precincts and the GIS Viewer of the AUP(OP). PC4 does not seek to alter the outcomes of any of the objectives and policies of the AUP(OP). Neither does it introduce any new objectives, policies, rules, or zoning. Where relevant to the Project, this Plan Change has been considered.

Proposed Plan Changes 14, and 16 were notified on 29 November 2018 by Auckland Council and made operative on 17 January 2020. Plan Change 14 addresses the Auckland Wide and Overlay provisions and Plan Change 16 addresses the zone provisions. Plan Changes 15 and 17 were notified on 29 November 2018 by Auckland Council Plan. Change 15 addresses the coastal provisions and Plan Change 17 addresses provisions for the GIS Viewer. Both are subject to appeals. A number of changes within Plan Changes 15 and 17 have rules with immediate legal effect pursuant to rule 86B(3) of the RMA, amendments are also made to objectives, policies, rules and assessment criteria.

Private Plan Change 25: Warkworth North (PPC25) was notified 16 May 2019. Submissions for PPC25 close on 5 July 2019. The proposed private plan change is a request to rezone approximately 99 hectares of Future Urban zoned land to a mix of business and residential zones. The Private Plan Change went to a hearing in November 2019. There is no decision at the time of writing.

Plan Change 22: seeks additions to the following schedules:

- Schedule 12 sites and Places of Significance to Mana Whenua;
- Schedule 6 Outstanding Natural Features Overlay; and
- Schedule 14.1 Schedule of Historic Heritage.

Plan Change 22 (PC22) was notified by Auckland Council on 21 March 2019 with further submissions closing on 23 May 2019. A review of the additional sites sought by PC22 confirmed there are no sites located within the Project area and the Project does not traverse them.

As notified and at the time of writing, the plan changes identified and discussed above do not address matters germane to the Project or the suite of resource consents sought.

Northland Regional Policy Statement

The Northland Regional Policy Statement applies to the Project to the extent that sediment from stormwater discharges during construction may enter the marine receiving environment downstream. The Kaipara Harbour is located in part within the Northland Region jurisdiction. As such, the objectives and policies relating to water quality in the coastal environment have been considered as set out in section 11 of this AEE.

6.3. Other legislative matters

This section provides a brief introduction to the other legislation that will be relevant in the delivery of the Project. This section provides a context for other authorisations that may be necessary for the Project. Any authorisations required under other legislation are not applied for as part of the current application package and the requirement for additional authorisations is stated for completeness only. The additional authorisations will be applied for at the appropriate phase of the Project.

Other legislation that is relevant to the Project is outlined below.

6.3.1. Land Transport Management Act 2003

The LTMA provides the statutory framework for New Zealand's land transport system, including funding and managing land transport activities, and development. It is the statute under which the Transport Agency operates (in conjunction with the Government Roading Powers Act 1989).

Section 3 of the LTMA states its purpose to be to "*contribute to an effective, efficient, and safe land transport system in the public interest*". Consistent with that purpose, the Transport Agency's objective is to "*undertake its functions in a way that contributes to an effective, efficient and safe land transport system in the public interest*" (section 94 of LTMA). The Transport Agency's functions and principles under which the Transport Agency must operate are set out in section 1.2 of this AEE.

6.3.2. Public Works Act 1981

The Public Works Act 1981 (PWA) enables land to be acquired, either by agreement or by the compulsory processes set out in the PWA, for public works, including roads. It contains provisions for compensation for owners of land required for public works, and a process for the disposal of land no longer required for a public work.

A NoR for the designation of land (taking interim effect from the date the notice is given of the requirement for a designation) and a designation of land allows the owners of the land that is subject to the NoR or designation to apply to the Environment Court for an order obliging the requiring authority to acquire all or part of the land, in particular circumstances (section 185 of the RMA).

As of March 2020, the Crown has acquired approximately 16% of the land required for the Project (in addition to land already held by the Crown for the Project).

6.3.3. Heritage New Zealand Pouhere Taonga Act 2014

Under the Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA) no person may modify or destroy an archaeological site unless an authority is granted by Heritage New Zealand Pouhere Taonga whether or not the site is a recorded archaeological site.

The potential effects of the Project on archaeological/heritage sites are discussed in section 9 of this AEE. If required, an application will be made under the HNZPTA for an archaeological authority to cover construction works prior to commencement.

6.3.4. Wildlife Act 1953

The Wildlife Act 1953 addresses the protection and control of wild animals and birds, and the management of game. Permits are necessary under the Wildlife Act to deal with certain wildlife. The Wildlife Act also provides protection to some terrestrial invertebrates and marine species.

Part 1 of the Wildlife Act addresses the protection of wildlife. It provides varying levels of protection to different species. Most native birds, reptiles, bats and frogs are protected under the Wildlife Act. Some native and some introduced bird species have limited protection.

The potential effects of the Project on protected species are discussed in section 9 of this AEE. If required, an application will be made under the Wildlife Act for an authority to relocate any protected species prior to the commencement of construction of the Project.

6.3.5. Fisheries Act 1983

The Freshwater Fisheries Regulations 1983 (FFR) are regulations made under the Fisheries Act 1983. Part 6 of the FFR relates to fish passage and applies to "every dam or diversion structure in any natural river, stream, or water".

Under regulation 42(1):

> *"no person shall construct any culvert or ford in any natural river, stream, or water in such a way that the passage of fish would be impeded, without the written approval of the Director General incorporating such conditions as the Director-General thinks appropriate."*

These regulations require that the approval of the Director-General of Conservation be obtained for culverts where the passage of fish will be impeded. The Director-General can either:

- Issue a dispensation from the requirement to provide fish passage; or
- Specify that fish passage be provided and maintained.

The Indicative Alignment includes provision for all culverts required for the Project, to be designed to ensure adequate fish passage is provided where it is necessary.

Approval from the Director-General under the FFR is not expected to be required.

6.3.6. Marine and Coastal Area (Takutai Moana) Act 2011

The Marine and Coastal Area (Takutai Moana) Act 2011 acknowledges the importance of the marine and coastal area to all New Zealanders and provides for the recognition of the customary rights of iwi, hapū and whānau in the common marine and coastal area. Public access to the common marine and coastal area is guaranteed by the Act.

Numerous iwi groups have applied for recognition of customary interests under this Act, for the Mahurangi Harbour/Hauraki Gulf and the Kaipara Harbour. The Project does not seek any approvals for works or discharges within the common marine and coastal area.

6.4. Statutory acknowledgements

A statutory acknowledgement is a formal recognition by the Crown of a particular cultural, spiritual, historic and traditional association that an Iwi has with a specific area. The statutory acknowledgements provided under Treaty Settlement legislation for areas within Auckland are confirmed in the AUP(OP) at Appendix 21.

Statutory acknowledgements under the Ngati Manuhiri Claims Settlement Act 2012 relevant to the Project area include the Hōteo River statutory acknowledgement area. Statutory acknowledgements under the Te Uri o Hau Act Claims Settlement Act 2002 relevant to the Project area include the Kaipara Harbour Coastal Area (where discharges may potentially reach this harbour). No other statutory acknowledgements relate to the Project area.

6.5. Other relevant matters

For the resource consent applications, the consent authority must have regard to "any other matter the consent authority considers relevant and reasonably necessary to determine the application" (section 104(1)(c)). For the NoR, a consent authority must have particular regard to any other matter it considers reasonably necessary in order to make its decision (section 171(1)(d)).

The RMA does not define what matters are to be considered under these sections, however, it is accepted that these can include matters outside the RMA, including non-statutory processes. Case-by-case consideration of what other matters are relevant, is made by the consent authority considering resource consents and NoRs. As (generally) non-RMA planning documents, "other matters" have been selected as being particularly relevant for the Project for a range of reasons including:

- Having been through a public engagement process where feedback from the public has been sought;
- Prepared in accordance with other related legislation;
- Specifically mention the Warkworth to Wellsford project; or
- Are directly related to the objectives the Project is seeking to achieve (refer to Section 2 of this AEE).

6.6. Designations and resource consents

6.6.1. Notice of requirement

The Transport Agency has given a NoR for the designation of land required for the construction, operation and maintenance of a state highway.

Designation plans showing the land to which the NoR relates, and a schedule of land directly affected by the NoR. The drawings in *Volume 3: Drawing Set* also show the extent of the proposed designation.

In summary, the proposed designation directly affects the following types of landownership:

Table 6-1: Summary of land directly affected by the designation

Owner type	Area affected (ha) (Approximate)	No. of landowners
Private	1133	79
Crown	161	N/A
Road	50	N/A
Other (river bed)	2.38	N/A

Land subject to existing designations

Some of the land to be designated for the Project is already subject to existing designations held by the Transport Agency and other requiring authorities, as outlined in Table 6-2 below.

Table 6-2: Existing designations held by requiring authorities

Designation Reference	Requiring Authority	Purpose	Location
6769	NZ Transport Agency	The construction, operation and maintenance of a State highway (Ara Tūhono – Pūhoi to Wellsford Road of National Significance: Pūhoi to Warkworth Section)	From Johnston's Hill Tunnels to North of Warkworth
6763	NZ Transport Agency	State Highway 1	State Highway 1 from Titfords Bridge, Pūhoi to Ross Road (Kaipara District Council boundary), Topuni
6765	NZ Transport Agency	State Highway 1/Wayby Valley Road/Wayby Station Road intersection	State Highway 1 intersection with Wayby Station Road and Wayby Valley Road, Wellsford
2604	Chorus New Zealand Ltd	Kraack Hill Telecommunications Site – Telecommunication and radiocommunication and ancillary purposes	180 Kraack Road, Warkworth
751558	Spark NZ Trading Ltd	Kraack Hill Telecommunications Site – Telecommunication and radiocommunication and ancillary purposes	180 Kraack Road, Warkworth

[58] This is a secondary designation. Chorus New Zealand Ltd has the primary designation on the site pursuant to section 69XJ(3) of the Telecommunications Act 2001. See also: New Zealand Gazette No 180, 23 November 2011, pages 5223-5226.

Designation Reference	Requiring Authority	Purpose	Location
6500	New Zealand Refining Company Ltd (Refining NZ)	Petroleum pipeline: Rural Section – operation, maintenance and repair, upgrade and renewal of the existing petroleum transmission pipeline and ancillary facilities as required for the transportation of refined fuel products	102 Amreins Road, Taupaki to 109 Vipond Road, Topuni
9101	First Gas Ltd	Taupaki to Topuni Gas Pipeline – operation, maintenance and repair, upgrade and renewal of the existing gas transmission pipeline and ancillary facilities as required for the transportation of gas	102 Amreins Road, Taupaki to 109 Vipond Road, Topuni

In order to undertake work in accordance with a designation on land where there is an earlier designation in place, the written consent of the requiring authority for the earlier designation is required under section 177(1)(a). Prior to construction commencing on land subject to existing designations, approval under section 177(1)(a) will be required from:

- Chorus New Zealand Ltd;
- Spark NZ Trading Ltd;
- Refining NZ; and
- First Gas Ltd.

Designation lapse period

Section 184 of the RMA provides that a designation lapses, unless given effect to, on the expiry of five years after the date on which it is included in the district plan unless the designation specifies a different period.

Pursuant to section 184(1)(c), the Transport Agency proposes a lapse period of 15 years for the designation.

Land subject to existing resource consents

There are a number of parties that hold existing resource consents to establish and operate activities on sites either within the proposed designation boundary, or adjacent to the Project. Directly affected parties have all been contacted and an outline of these consents is provided in *Section 3: Existing environment*.

Project designation to be reviewed after construction

The proposed designation includes land required for both temporary and permanent works. Once construction is complete, the Transport Agency will review the designation area and may remove parts of the designation that are not required for the long term safe and efficient operation and maintenance of the state highway, using the process set out in section 182 of the RMA.

6.6.2. Outline Plan

Section 176A of the RMA requires that an outline plan must be submitted to a territorial authority before commencing construction of a project or work under a designation. The outline plan must detail the information required in accordance with section 176(3).

The Transport Agency intends to submit outline plan(s) for relevant aspects of the Project to Auckland Council prior to the commencement of works. Further discussion around what is proposed to be included within the outline plan is contained in Section 10 of this AEE.

6.6.3. Activities requiring resource consent

The activities which require resource consent under the AUP(OP) are set out below. No resource consents are required under the legacy district or regional plans.

All key resource consents for the Project are being sought as part of this Application. If, after detailed design is complete, further or different resource consents are required, these approvals will be sought at that time. As noted above, once the detailed design is confirmed, other site specific consents such as under the NES (Soil), water takes for construction, and wastewater discharge consents from site offices will be sought by the contractor.

Consents sought as part of this application

The consents sought for the construction, operation and maintenance of the Project are identified in Table 6-3.

Table 6-3: Types of consents sought

RMA consent sought	Activity/scope of application	AUP(OP) Chapter/Rule reference	Activity status
Land disturbance activities			
Land use (s.9(2)) – earthworks	Earthworks undertaken Project wide, including all construction yards, access and haul roads and tracks, soil disposal sites, rock borrow sites and cut and fill activities; which specifically involve the following extent of earthworks: greater than 50,000 m2 where land has a slope less than 10 degrees outside the Sediment Control Protection Area (SCPA); greater than 2,500 m2 where the land has a slope equal to or greater than 10 degrees; greater than 2,500 m2 within the SCPA; between 10 m2 to 2,500 m2 and between 5 m3 to 2,500 m3 within a SEA. In particular in the following location(s): SEA_T_2287, SEA_T_683, SEA_T_6854, SEA_T_5541, SEA_T_6851 and SEA_T_685.	Infrastructure (E26) Rule E26.5.3.2 (A103), Rule E26.5.3.2 (A106), Rule E26.5.3.2 (A107). Rule E26.6.3.1 (A117) (relating to SEAs) Includes earthworks which do not comply with Standards E26.5.5.1, E26.5.5.2, E26.6.5.1 & E26.6.5.2.	Restricted discretionary
Land use (s.9(2)) – earthworks	Earthworks as described above, which exceed 2,500 m2 or 2,500 m3 within a	Infrastructure (E26) Rule E26.6.3.1 (A118)	Discretionary

RMA consent sought	Activity/scope of application	AUP(OP) Chapter/Rule reference	Activity status
	SEA; in particular in the following location(s): South of Wellsford interchange (SEA_T_6851) North of Hōteo viaduct (SEA_T_6854)		
Land use (s.9(2)) – vegetation alteration and removal	Vegetation alteration or removal undertaken Project wide within rural zones, riparian margins and SEA's, including the following: trees over 6 m in height, or 600 mm in girth (unless otherwise permitted). removal of vegetation within a SEA (of an area more than 20 m2). In particular in the following location(s): SEA_T_2287, SEA_T_683, SEA_T_6854, SEA_T_5541, SEA_T_6851 and SEA_T_685. removal of more than 50 m2 of vegetation within a riparian margin not identified as a SEA. removal of more than 250 m2 of vegetation outside the legal road in a rural zone.	Infrastructure (E26) Rule E26.3.3.1 (A77) Includes vegetation alteration or removal which do not comply with Standards E26.3.5.1 to E26.3.5.4.	Restricted discretionary
Land use (s.9(2)) – stormwater detention/ retention ponds	Stormwater retention/ detention wetlands for the Project	Infrastructure (E26) Rule E26.2.3.1 (A55)	Controlled
Works in watercourses and wetlands			
Land use (s.13) – new structures in, on, under or over the bed of rivers, streams and wetlands Water permit (s.14) – diversion and temporary damming of water associated with new structures	The construction and ongoing use of new structures in, on, under or over the bed of lakes, rivers, streams (including intermittent streams) and wetlands throughout the Project area, including associated bed disturbance or depositing any substance, reclamation, diversion of water and incidental temporary damming of water, restoration and enhancement[59]. Including, but not limited to, the following: temporary structures associated with the construction of bridges across Mahurangi River and Hōteo viaduct; bridges over the Mahurangi River and Hōteo viaduct;	Lakes, rivers, streams and wetlands (E3) Rule E3.4.1 (A26) Rule E3.4.1 (A27) Rule E3.4.1 (A29) Rule E3.4.1 (A33) Rule E3.4.1 (A34) Rule E3.4.1 (A39) Rule E3.4.1 (A44) Includes activities not complying with the general permitted activity standards in E3.6.1.1 or the specific activity standards in	Discretionary

[59] Reclamation consents are not required when installing culverts, fords and erosion protection structures (AUP(OP)).

RMA consent sought	Activity/scope of application	AUP(OP) Chapter/Rule reference	Activity status
	culverts and culvert extensions exceeding 30 m in length (outside overlays); erosion protection structures less than 30 m in length within overlays; stormwater outfalls and erosion protection structures within overlays. No culverts exceeding 30 m in length are proposed within overlays. No culverts within soil disposal sites are proposed.	E3.6.1.10 to E3.6.1.12 and E3.6.1.14 to E3.6.1.23 outside overlays60 Does not include activities which do not comply with the general permitted activity standards in E3.6.1.1 or the specific activity standards in E3.6.1.10 to E3.6.1.12 and E3.6.1.14 to E3.6.1.23 within overlays	
Water permit (s.14) –Diversion of intermittent and permanent watercourses	Diversion of rivers and streams to a new course and associated disturbance and sediment discharge throughout the Project area during construction and operation, including diversions associated with soil disposal sites, fill embankments and cut slopes. No diversion of rivers and streams are proposed within overlays.	Lakes, rivers, streams and wetlands (E3) Rule E3.4.1 (A19)	Discretionary
Diversion of groundwater			
Water permit (s.14) – diversion of groundwater	Diversion of groundwater and dewatering associated with the tunnel through the Kraack Hill area and deep cut slopes during construction and operation.	Taking, using, damming and diversion of water and drilling (E7) Rule E7.4.1 (A28) Rule E7.4.1 (A20)	Restricted discretionary
Stormwater diversion and discharge			
Water permit (s.14) – diversion of stormwater Discharge permit (s.15) – discharge of stormwater runoff into or onto land or water	Diversion and discharge of stormwater runoff from all new impervious surfaces (greater than 5,000 m2 of road) and alterations to existing surfaces associated with the ongoing use of the highway and local roads within the Project area.	Stormwater discharge and diversion (E8) Rule E8.4.1 (A10) Includes discharges which do not comply with Standard E8.6.1 and Standard E8.6.4.1	Discretionary
Land use (s.9(2)) – development of impervious surfaces for high use roads	All new impervious surfaces for high use roads within the extent of Project works associated with the State highway.	Stormwater quality – High contaminant generating car parks and high use roads (E9) Rule E9.4.1 (A7)	Controlled

[60] Overlays include Significant Ecological Areas (SEA's) and Natural Stream Management Areas (NSMA's).

RMA consent sought	Activity/scope of application	AUP(OP) Chapter/Rule reference	Activity status
		The controlled activity standards under E9.6.2.2 will be complied with.	
Air discharges			
Discharge permit (s.15) – discharges to air associated with temporary crushing	Temporary crushing of aggregates greater than 60 tonnes per hour where the activity complies with permitted standards or up to 60 tonnes per hour but does not comply with the permitted activity standards in E14.6.1.13.	Air quality (E14) Rule E.14.4.1 (A94) The restricted discretionary activity standards under E14.6.3.4 will be met.	Restricted discretionary

Activities considered to be permitted

The permitted activities that are relevant to the Project are identified within Appendix A of this AEE. Appendix A identifies a number of typical permitted land use activities and discharges associated with construction and operation of the Project, these are summarised below. The scale and nature of the Project means that the majority of the major components require resource consent.

The following activities associated with the Project are permitted:

- Discharge of dust from construction of roads;
- Diversion, damming and discharge of treated sediment laden water and dewatering water during construction when seeking a consent for earthworks;
- Structures solely under the bed of a river;
- Drilling holes or bores for geotechnical investigations and contamination investigations (unless located within sensitive areas e.g. historic heritage or mana whenua site of significance); and
- Discharges to air from motor vehicles and tunnels.

Bundling of activities

Where there are a group of activities where the effects overlap or where the activities are intrinsically linked (such that one activity could not occur without the others), it is appropriate for them to be considered holistically as a single bundle according to the most stringent activity status. The AUP(OP) contains guidance that activities should be bundled if the effects overlap.

The resource consents for this Project are appropriately bundled together and are considered as a whole. The most restrictive activity status applies and therefore the Project is considered as a **discretionary** activity.

Resource consent lapse period

Section 125 of the RMA provides that a resource consent lapses, unless given effect to, five years after the date of commencement of the consent unless a date is specified in the consent. Pursuant to section 125(1), the Transport Agency proposes a lapse period of 15 years for each of the resource consents.

The reasons for seeking 15 year lapse periods include:

- The national significance of the Project, its broad geographic extent, and its complexity in terms of the range and scale of the works involved;
- The need to protect the alignment for this strategic transport project, so that there is certainty that it can be constructed and operated when it is required;
- The need for adequate time to undertake property acquisition negotiations and processes, including access negotiations;
- The need for adequate time to complete further site investigations and design (preliminary, detailed and construction) of all aspects of the Project;
- The need for adequate time to complete construction procurement and tendering processes; and
- The need to provide sufficient time to construct the Project, which it is estimated could take approximately 7 years.

Duration

The Transport Agency is seeking resource consents for the following durations:

- Unlimited duration in respect of the land use consents under section 9(2);
- 15 years from the date of commencement under sections (9)(2), (14) and (15) of the RMA, in respect of consents required specifically for construction activities; and
- 35 years from the date of commencement under the sections (9)(2), (13), (14), (15) of the RMA, in respect of all other consents required for the long term operation of the Project.

7. Consideration of Alternatives

7.1. Introduction

This section describes the process and summarises the consideration that has been given to alternative routes, sites and methods for undertaking the Project as required under section 171(1)(b) of the RMA.

The alternative routes, sites and methods that have been considered in respect of the applications for the discharge of contaminants are addressed in Section 11 of this AEE.

Identification of the preferred transport solution to connect Auckland and Northland has involved numerous studies since 2006. Alternative routes and methods were assessed at the early stages of Project development, commencing at a broad scale and then systematically narrowing the geographic area from potential corridors down to the Indicative Alignment.

Early strategic studies completed in 2008 confirmed SH1 (as opposed to the SH16 corridor) as the preferred corridor to accommodate the forecast increased demand on the Auckland to Whangārei corridor. In 2010, a long list of corridor options for the Puhoi to Wellsford corrdior was developed and subsequently assessed. From the long list assessment, a short list was identified.

In 2016, a number of refined short-list options were considered which provided for a tie-in north of Te Hana, and connections to Te Hana, Mangawhai and Wellsford. From these short-list options, an Indicative Route from Warkworth to north of Te Hana was identified. In 2017, the Indicative Route was refined based on environmental and other constraints as well as inputs from the community engagement on the Project undertaken in February 2017. An Indicative Alignment for the Project was confirmed by the Transport Agency in 2017.

The process to confirm the Project and to define a corridor, Indicative Alignment and proposed designation boundary has been highly iterative. It has involved on-going refinement on the basis of information progressively derived from desk top studies, field work and detailed environmental investigations, operational and cost considerations, and engagement with key stakeholders and the community.

The key steps involved in the assessment process are summarised as follows (and as illustrated in Figure 7-1 below):

- Assessment of corridor options;
- Assessment of alignment options (including interchange options and tunnel alignment); and
- Refinement of Indicative Route to achieve the Indicative Alignment.

This section covers the inputs provided by environmental specialists to refine the alignment and identify options that would avoid significant effects. It sets out the tool used to assess the options, being a multi criteria analysis (MCA) framework, and explains how the MCA was adapted to suit the evaluation at each phase.

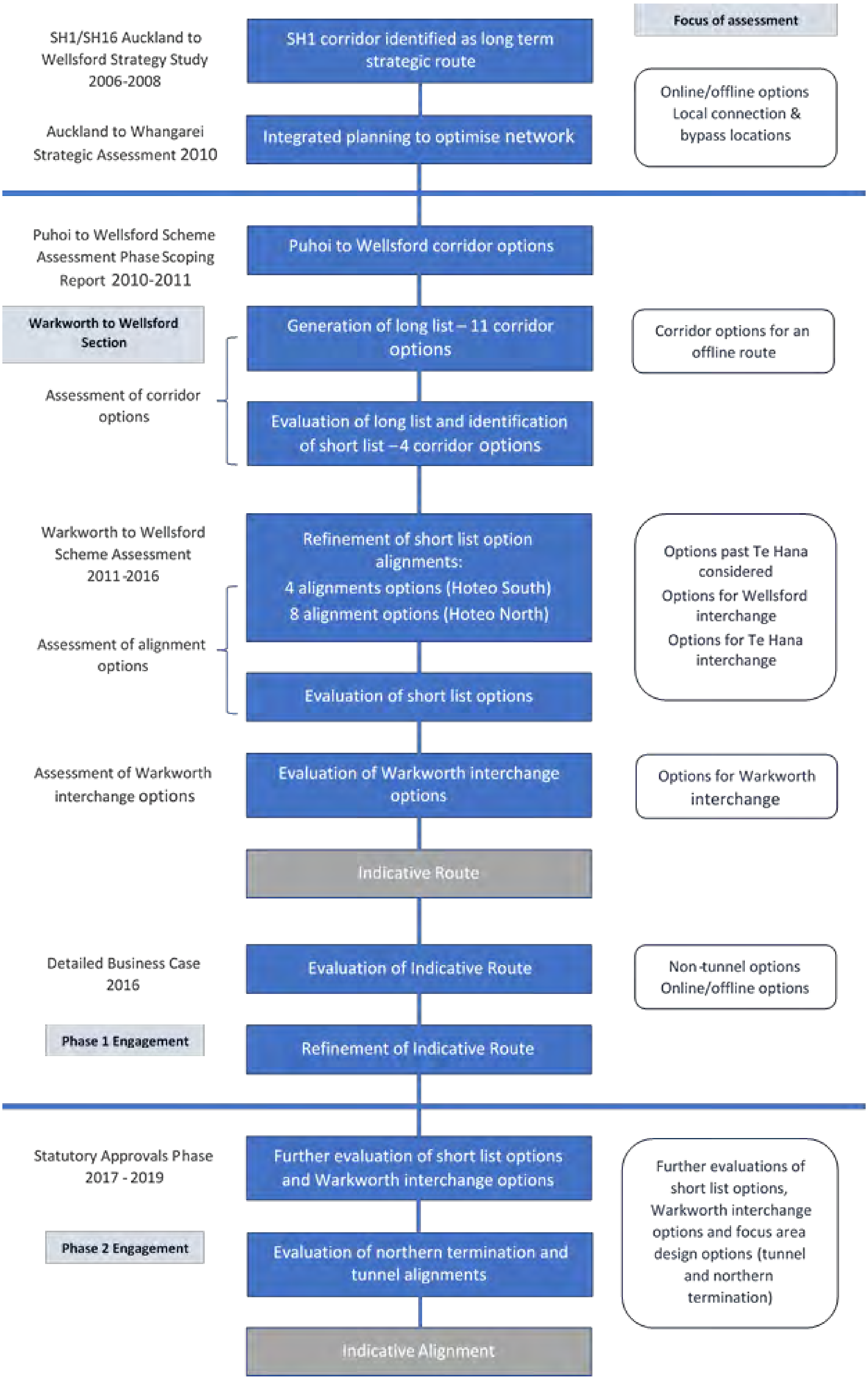


Figure 7-1: Options development process

7.2. Background and problem identification

The preliminary phases of the Pūhoi to Wellsford project development included strategic assessment work, a scoping phase and detailed scheme assessment. This work was undertaken over a considerable period from 2006 to 2016. During this period the Transport Agency introduced and adopted a "business case approach[61]" for transport planning and investment. The Pūhoi to Wellsford Project incorporates both a completed Scheme Assessment Report (SAR) and Detailed Business Case (DBC) to address the transition between the two processes.

As outlined in Section 2 of this AEE, the strategic investigations identified the problems with the existing transport network. These investigations examined both the inter-regional level (Northland to Auckland) and local issues and defined the project area as being from Warkworth to Wellsford (being part of the overall route from Pūhoi to Wellsford).

7.3. Evaluation framework and process

7.3.1. Introduction

Multi-criteria analysis (MCA) is a commonly used tool to guide the assessment of options for infrastructure. It is a useful tool to compare and assess alternative proposals or options where there are multiple considerations, and where there are a range of diverse effects which can range from beneficial to potentially adverse. The range of attributes that are relevant to a decision between options can be numerous and varied, and it is important to bring the information together in a consistent, reliable and credible way.

MCA was used to progress the scheme assessment and DBC phase works with criteria aligned with the LTMA. A more detailed environmental effects based MCA of the short list options was then undertaken in 2017 to more specifically address the tests in section 171(1)(b) of the RMA. This latter assessment was performed to ensure environmental effects and effects on private property have been appropriately considered across the short-listed options in the RMA context.

7.3.2. MCA assessment and evaluation methodology

The methodology for all MCA processes used across the key phases of the Project involved determining evaluation categories, confirming a rating system and then applying project specific evaluation criteria and rating each option. Criteria were refined as the Project developed through to a short-list level, to allow differentiation as the options became more specific. As the evaluation evolved from a framework that focused on the LTMA to a framework that focussed on the RMA, there were refinements to the evaluation criteria. However, the overall evaluation framework approach has remained consistent.

The MCA evaluation framework categories applied to the options consideration during the initial Project development phases (network planning, scoping, scheme

[61] https://treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/better-business-cases/guidance

assessment, and DBC process) followed six evaluation categories which are consistent with the themes of the purpose and operating principles (LTMA sections 95 and 96) for the Transport Agency under the LTMA. These categories are identified in Table 7-1.

Table 7-1: LTMA MCA evaluation framework and assessment criteria

Category	Assessment criteria
Assisting Economic Development	The extent to which the option will enhance inter regional and national economic growth and productivity.
	The extent to which the option will improve movement of freight and people between Auckland and Northland.
	The extent to which the option will improve connectivity between the medium to long term growth areas in the northern Rodney area (Orewa, Warkworth and Wellsford).
	The extent to which the option will support local economic development.
Safety and Personal Security	The extent to which the option is expected to improve road safety in the area and reduce all road crashes.
	The extent to which the option will improve the network operational performance of the State highway and connection to the local network.
Improving Access and Mobility	The extent to which the option achieves the strategic (through traffic) function of SH1 as a national significant route linking the Auckland to Northland regions.
	The extent to which the option provides a strategic alternative to address route security, resilience and flexibility.
	The extent to which the option provides a strategic alternative to address a point incident.
	Proximity of the option's interchange location to activity nodes.
	The extent to which the option will improve the reliability of the transport network through providing a more robust and safer route between Auckland and Northland.
	The extent to which the option maintains convenient local access and connectivity.
	Impacts on and realignment of SH1 during construction.
	Extent of disruption/impact on operations (live traffic) during construction.
Protecting and Promoting Public Health	The extent to which the option can provide for walking and cycling to contribute to positive health outcomes and provide more transport choices, both through and between towns.
Environmental Sustainability	The extent to which the option will minimise the physical extent and significance of the project.
	The extent to which the option will avoid potential environmental impacts on areas of high ecological value or high landscape value.
	The extent to which the option will impact on coastal areas or water courses.

Category	Assessment criteria
	The extent to which the option will impact on sensitive receptors with regards to air quality and noise during both construction and operation.
	The extent to which the option will reduce overall energy use and greenhouse gas emissions (NEECS).
	The extent to which the option will avoid impacts on places of archaeological or heritage significance (e.g. Protected Items – RDC).
	The extent to which the option will avoid impacts on places of cultural significance.
	The extent to which the option will impact on communities during both construction and operation.
	The extent to which the option will minimise social effects on community facilities (e.g. schools, hospitals, sports fields).
	The extent to which the option will minimise socio-economic effects including community attractions and businesses.
	The extent to which the option will support regional and local land use planning intentions.
Value for Money	The overall cost of the option.
	Geotechnical cost risk (construction and operation).
	Constructability cost risk.
	The ability of the option to be tolled.
	The ability of the option to be staged.
	The extent to which difficulties through the consenting process may delay the date for opening RoNS.
	The extent to which the difficulty of construction may need the construction period to be extended – delaying the date for opening RoNS.
	Ability for PPP to construct final solution as part of Pūhoi-Warkworth project.

In order to consider the relevant matters under section 171 of the RMA in the options evaluation process, the MCA was modified during the latter evaluation processes. The modification resulted in the "Environmental Sustainability" category being substituted for the following more RMA-specific specialist areas as set out below:

- Air quality;
- Landscape and visual effects;
- Freshwater ecology;
- Terrestrial ecology;
- Noise and vibration;
- Groundwater;
- Operational water quality (stormwater management);
- Construction water quality (erosion and sediment control);
- Flooding;
- Heritage and archaeology;

- Cultural heritage; and
- Land contamination.

The corridor and alignment options were assessed against each of the criteria listed Table 7-2 typically using the seven point rating scale shown in Table 7-2 below. The s 171 evaluation ranging from significant adverse effect and significant positive effect.

Table 7-2: Rating scale - RMA evaluation

Symbol	SAR evaluation	S171 evaluation
+ + +	very strong positive effects	significant positive effect
+ +	strong positive effects	moderate positive effect
+	small / moderate positive effects	minor positive effect
0	neutral with regard to the base option	neutral /benign effect
-	small / moderate negative effects	minor adverse effect
- -	strong negative effects	moderate adverse effect
- - -	very strong negative effects	significant adverse effect

7.4. Options assessed during Project development

7.4.1. Overview

Options assessment is, of necessity, an inherently iterative process and this Project has been investigated over a number of years and at different scales. The options assessment has progressed from the inter-regional (strategic) level through to corridor selection, then alignment selection and at a more granular level for certain aspects such as interchange and tie-in location and design layout. The options development process has been informed by the fact that this Project is the second stage of the Pūhoi to Wellsford project, with an offline alignment for the first stage (Pūhoi to Warkworth) having already progressed through to construction.

7.4.2. Early strategic assessment work

Early strategic assessment established the parameters for the Project, by confirming the general corridor, form and indicative route. The various studies that contributed to informing the Indicative Route are illustrated in Figure 7-2.

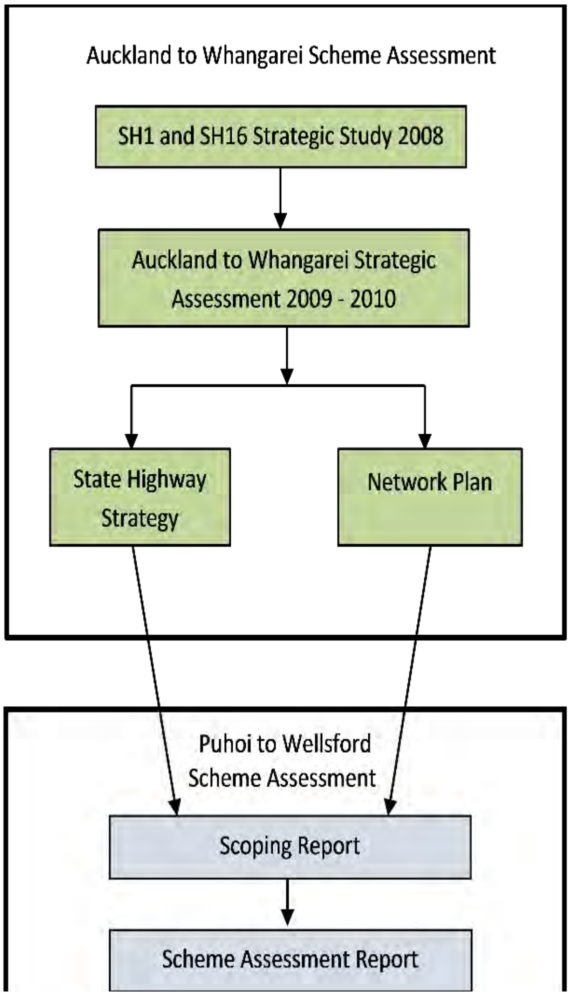


Figure 7-2: Early Strategic Assessment relationship

SH1 & SH16 Strategy Study

Between 2006-2008, the Transport Agency looked at the strategic transport needs between Auckland and Wellsford to determine the most appropriate corridor for development as the long-term roading investment focus for the region. As outlined in Section 2, this assessment considered the roles of the existing SH1 and SH16 corridors in providing strategic transport links to Wellsford and the north, together with potential new corridors. Options for the future functionality of SH1 and SH16 were assessed.

The conclusion of this assessment was that the SH1 corridor should provide the national/ inter-regional function and the regional function should be provided by the SH16 corridor. The assessment also recommended that SH1 from Pūhoi north to Wellsford be upgraded to a four lane dual carriageway.

Auckland to Whangārei Strategic Study and Network Plan

In 2009-2010 the Transport Agency undertook a strategic study of the transport requirements between Auckland and Whangārei. The assessment determined that:

- The state highway network is vital to the economic growth and sustainability of the Northland region;

- Travel demand arising from planned growth in the Auckland and Northland regions must be supported by an efficient, safe and economic highway system;
- An offline upgrade of SH1 between the northern termination of the existing tolled motorway (just south of Pūhoi) and Wellsford presented the most desirable response;
- Two broad corridors of interest were recommended to be investigated for this purpose, one being an inland corridor extending westward to meet and then follow the North Auckland Line railway to Wellsford, and the other extending more directly northwards to Warkworth and then on from there to Wellsford.

Following the strategic assessment work the Transport Agency developed a Network Plan that considered the wider transport network implications of the strategic assessment.

Online (widening of the existing SH1) and offline (independent of the SH1 but remaining within the wider SH1 'corridor') route options, bypass options of both Warkworth and Wellsford (to the east and west) and local connections to Warkworth and Wellsford were identified in the Network Plan. To determine a preferred network the Transport Agency and its advisors evaluated these options using the MCA evaluation tool in Table 7-1.

The options were assessed using a five point scoring system, options evaluated as having effects ranging from strongly positive to strongly negative.

Ten options were considered and following the MCA evaluation it was concluded that a new offline route in the broader SH1 corridor between Pūhoi and Wellsford was the option that best met the Transport Agency's objectives. The assessment provided clear guidance on the route configuration that was most appropriate to meet the strategic objectives set by the LTMA and GPS and objectives adopted for the Pūhoi to Wellsford project (four-lane offline alignment preferable to an online upgrade). This corridor was rated highest for improvements to strategic freight and tourism traffic, route security, resilience and road safety.

The Network Plan recommended the following alignments and connections relevant to the Project:

- A western bypass at Warkworth to facilitate access to proposed industrial and commercial development areas to the west of the town.
- A connection to SH1 at Warkworth. Northern, central and southern locations were considered and no clearly preferred location could be determined at the Network Plan level.
- An eastern bypass at Wellsford to facilitate access to proposed industrial/ commercial development to the south east of the town as well as the urban growth area proposed at Mangawhai.
- A connection to SH1 at Wellsford. A central location for this interchange was preferred at that time as it would provide direct access to Wellsford and improved access to Mangawhai. Southern, central and northern locations were assessed.

The Network Plan evaluation indicated that a bypass is preferred to address route security issues, with a bypass to the east providing greater benefit than a bypass to the west given the recommended location of the Pūhoi to Wellsford project alignment, to the east of Wellsford. An eastern bypass would also provide a better connection to Mangawhai than one to the west. The Network Plan also recommended as eastern bypass of Te Hana to be revisited when outcomes of a study between Kaipara and Rodney District Councils was known. It is unclear whether that study ever progressed.

7.4.3. Pūhoi to Wellsford Scheme Assessment: Scoping Report

Network Plan recommendations were used as a starting point for the Pūhoi to Wellsford Scheme Assessment in 2010. The Scoping Report developed corridors and investigated the planning, environmental, design and construction requirements for upgrading the SH1 to four lanes for the Pūhoi to Wellsford project.

In developing route options for the project, known physical constraints (such as topography, environmental features such as streams and culturally significant areas) were mapped in layers to enable evaluation of constraints across the entire study area. Using these data layers, the study area was analysed in terms of a wide range of physical environmental and social constraints. This analysis enabled the development of a long-list of route options that would avoid or minimise effects on major constraints. A Geographical Information System (GIS) was used to generate a line of 'best fit' for each constraint. The line of best fit was that which has the least cumulative impacts over its length, based on the constraints identified. The long list was developed in two stages, reflecting the two sectors of the project (being Pūhoi to Warkworth and Warkworth to Wellsford, with the Pūhoi to Warkworth section being completed first followed by Warkworth to Wellsford). Workshops were held to provide opportunity to input professional knowledge/ experience to ensure all views were represented.

The starting point of the Warkworth to Wellsford assessments was chosen as Perry Road. This point was chosen as it represented a common point on the options that were short-listed for the Pūhoi top Warkworth section.

Eleven alignment options were developed for the Warkworth to Wellsford section long list assessment, all of which terminated to the north of Wellsford but south of Te Hana. These options are listed below and shown in Figure 7-3.

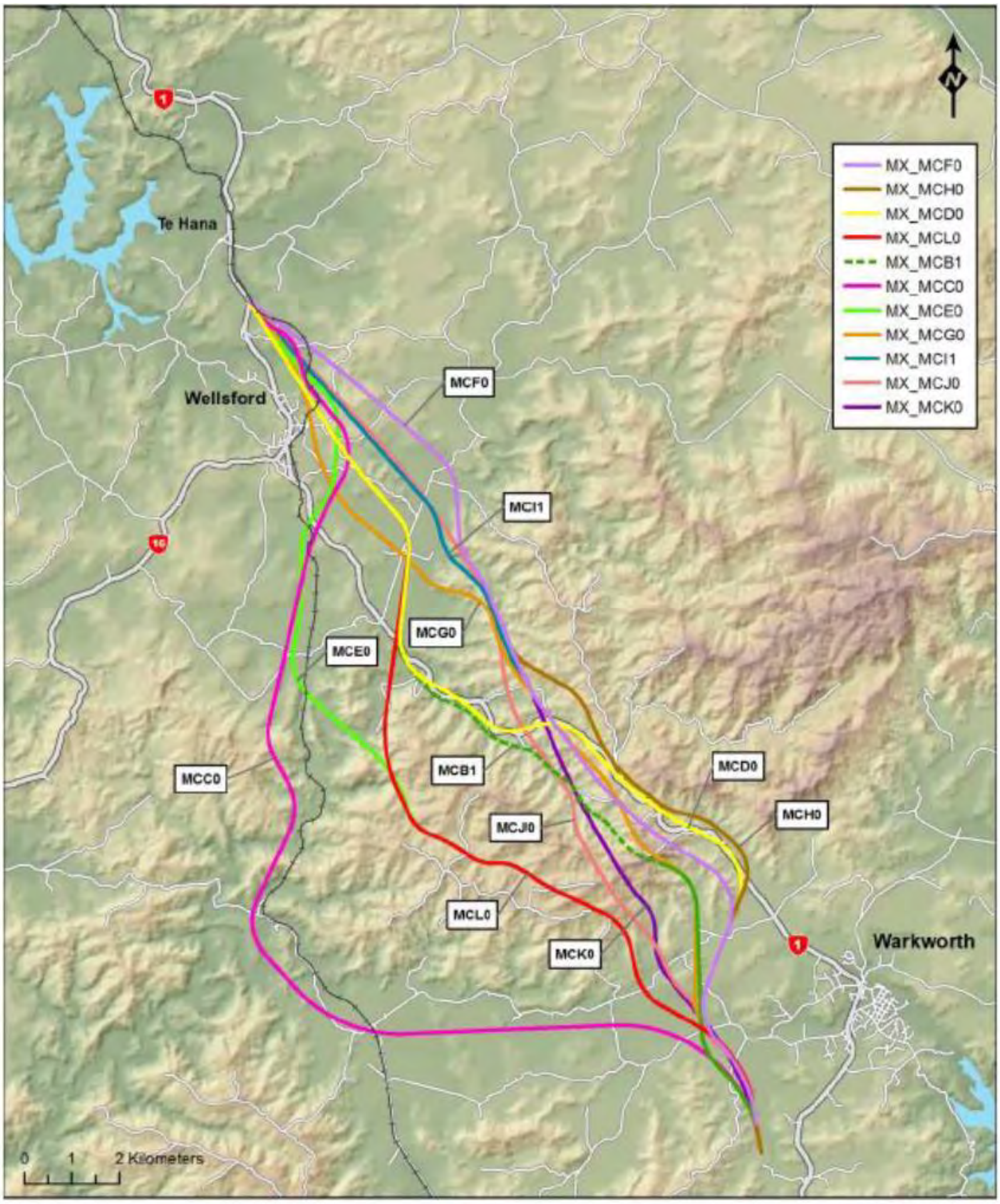


Figure 7-3: Long list of corridor options

- Western alignment (MCC0) – this alignment was approximately 28 km long. The alignment ran west across the Kaipara Flats and then generally northwards beside the railway corridor in order to avoid the difficult terrain around The Dome. The alignment crossed SH1 just south of Wellsford and continued around the eastern side of the town, crossing Worthington Road near its intersection with Matheson Road. This option was dependent on one specific corridor being selected for the Pūhoi to Warkworth Project.
- Mid-western alignments:

  - MCE0 – this alignment was approximately 24 km long. From the Kaipara Flats, the alignment headed north-west through a valley that is generally parallel to the existing state highway, east of Smyth Road. Once clear of The Dome, the alignment headed north to the railway corridor then crossed SH1 just south of Wellsford and continued around the eastern side of the town, crossing Worthington Road near its intersection with Matheson Road.
  - MCL0 – this alignment was approximately 23 km long. The alignment followed that of MCE0 through The Dome to the Hōteo River. From there it headed northeast across SH1 near Wayby Valley Road and continued around the eastern side of Wellsford, crossing Worthington Road near the intersection with Matheson Road.
- Eastern Alignments:
  - MCB1: this alignment was approximately 23 km long. The alignment intersected Kaipara Flats Road between Carran Road and Phillips Road and then ran along the eastern side of Saunders Road and SH1. The alignment crossed SH1 just south of Wayby Valley Road and continued around the eastern side of Wellsford, crossing Worthington Road near the intersection with Matheson Road.
  - MCJ0, MCK0, MCI1, MCG0 and MCF0: these alignments were all approximately 22 km long. They were similar in that they followed a broad strip crossing SH1 east of Saunders Road and continued around the eastern side of Wellsford. In the south, alignments MCJ0 and MCK0 were located on the western side of the strip whilst alignments MCI1, MCG0 and MCF0 were on the east. In the north, alignment MCG0 was located on the western side of the strip, closer to Wellsford, crossing Matheson Road near the intersection with Centennial Park Road. Alignments MCK0 and MCF0 were located on the eastern side of the strip, crossing Worthington Road near the intersection with Bosher Road. Alignments MCI1 and MCJ0 were located in the middle of the strip, crossing Worthington Road nearer to Matheson Road.
- Existing Highway (MCD0): this alignment was approximately 23 km long. The alignment broadly followed the SH1 corridor from north of Kaipara Flats Road to south of Wayby Valley Road. North of SH1, the alignment was the same as MCB1. This option was assessed as an offline, separate new road, albeit in the corridor of the existing SH1.
- East of Existing Highway (MCH0): this alignment was approximately 23 km long. It crossed SH1 just north of Kaipara Flats Road and continued along the eastern side of SH1. North of Russell Road, the alignment followed alignments MCK0 and MCF0.

The evaluation framework adopted for the assessment of the long-list options was developed from the MCA framework that was used in the Network Plan and refined to provide a more detailed quantitative and qualitative assessment of the options. It included functional/ engineering assessment, traffic assessment, environmental and social assessments and cost estimates.

The key findings on the eleven long list options were:

- All alignments were equal in assisting safety and personal security and protecting and promoting public health.
- The western alignment (MCC0) offered the lowest benefits in assisting economic development and improving access and mobility, as well as the highest negative effects in environmental sustainability, urban form, and value for money. Consequently, this alignment performed poorly overall.
- Alignment MCG0 offered comparatively low benefits in assisting economic development and improving access and mobility as well as higher negative effects in environmental sustainability and urban form. Consequently, this alignment performed poorly overall.
- Alignments MCE0, MCL0 and MCK0 provided average (mid-range) performance in most categories but offered the highest negative effect in value for money. Consequently, these alignments performed poorly overall.
- Whilst alignment MCH0 performed well in assisting economic development, it had comparatively high negative effects in environmental sustainability and urban form, as well as a comparatively high cost estimate.
- Alignments MCB1, MCJ0, MCI1 and MCF0 performed comparatively well in assisting economic development, improving access and mobility, and in environmental sustainability and urban form. Alignments MCJ0 and MCF0 had a neutral score in value for money, whilst options MCB1 and MCI1 had some benefits.
- Alignment MCD0 provided the highest benefit in value for money, however, this was balanced by higher negative effects in environmental sustainability and urban form than most other options.

In consideration of the overall performances of all alignments, MCB1, MCD0, MCF0 and MCI1 were, on balance, the best performing options. Consequently, these alignments were recommended for further consideration during the scheme assessment phase of the project.

The further consideration of options for the Pūhoi and Wellsford project was then split into two sections, Pūhoi to Warkworth and Warkworth to Wellsford for the subsequent work in the scheme assessment phase

7.4.4. Warkworth to Wellsford Online Options Assessment

A high level assessment of a range of online improvement options for the upgrade of SH1 between Warkworth and Wellsford was undertaken during the scheme assessment in 2010-2011. The online options developed were principally intended to consider a less costly option and focused on addressing safety issues through the Dome Valley and traffic issues in Wellsford as an interim measure. The online options were not able to address the Project objectives to the same extent as the offline options given the topographical and construction challenges.

Online options were considered in two separate sections; the Dome Valley and Wellsford sections as outlined below. These options are shown in Figure 7-4 below.

Warkworth to Hōteo River (Dome Valley)

The following options were developed and assessed as part of the online evaluation (including an off line option for comparison and options within and immediately adjacent to the existing SH1):

- Option 1: An offline route to the west of the existing SH1;
- Option 2: Online expressway – four lanes, 80 km/h expressway;
- Option 3: Significant upgrade of SH1 – upgrade to a 2+1 configuration (alternate direction passing lanes each approximately 1.5 km long provided through the length of the upgrade);
- Option 4: Moderate upgrade of SH1 – safety-focused upgrades based on the inclusion of a median barrier over the full length plus localised improvements, including some curve improvements and additional passing lanes;
- Option 5: Minor upgrade of SH1 – safety focused upgrade based on the inclusion of a median barrier over the full length.

Hōteo River to Wellsford (Wellsford Bypass)

The following options were developed and assessed as part of the SAR in 2010-2011:

- Option 1: An offline route to the east of SH1 and bypassing Wellsford;
- Option 2: Two lane Wellsford bypass – localised two lane bypass of Wellsford utilising the existing SH1 alignment north of Wayby Valley Road to a point just north of the Wellsford Golf Club and then through Wellsford to the east;
- Option 3: Four lanes through Wellsford – management of SH1 through Wellsford to provide four lanes with provision of an off-street parking facility in Wellsford and pedestrian signals or a pedestrian bridge on SH1.

Figure 7-4: Online options considered

During the early scheme assessment work in 2010-2011 the above options were reviewed in relation to specific RoNS criteria which applied at that time. The scheme assessment evaluation concluded that a full offline option (Option 1 in both the Warkworth to Hōteo River and the Hōteo River to Wellsford sections) delivered best on all criteria relative to the other options. The 80 km/h expressway (Option 2) in the Dome Valley area had a cost estimate that was comparable with Option 1 in this location, but performed less well against all other criteria, when compared with the offline option.

The other online options offered significant construction cost savings when compared to the offline option, but they delivered substantially less well on the project objectives. It was noted that the online options were predicted to improve crash risks in comparison to the current road alignment, especially through the Dome Valley, with different options achieving different levels of improvement.

Option 2, four-laning through Wellsford township, was assessed as being unlikely to be acceptable to the community and unlikely to obtain consent. This was due to social impacts (greater segregation of the town and two schools on/in close proximity to the route) and perceived economic impacts from loss of car parking through the main centre of Wellsford. All other online options were considered to have environmental and social effects that were expected to be able to be avoided, remedied or mitigated. The evaluation of the online options was undertaken as part of the DBC which is discussed in section 7.4.7 below.

7.4.5. Warkworth to Wellsford Scheme Assessment

Alignment options

During the two tranches of the scheme assessment work (2010/2011 and 2016), the four short-listed alignments from the 2010 scoping phase were refined, updated and then evaluated through MCA using the LTMA derived evaluation criteria, MCA and scoring system explained in section 7.3.2.

Refinements of the short-listed alignments arose from additional desk top assessments and limited site inspections across a range of specialist areas in 2010/11 and 2016. As part of the 2016 work additional options were identified that responded to recommendations of the Programme Business Case (PBC)[62] (including a tie-in point north of Te Hana, rather than the initial tie-in north of Wellsford). These options were derived in a manner consistent with the options development process.

The study area for the route was split into two sections for effective assessment and evaluation. This allowed the options to be 'mixed and matched' depending on the assessment outcomes and recommendations for each sector. This "mix and match" was able to be done as there was a single common crossing point in the vicinity of SH1 and the Hōteo River.

The refined short-list options are illustrated in Figure 7-5 below and included four options in Hōteo South and eight options in Hōteo North.

[62] https://treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/better-business-cases/guidance

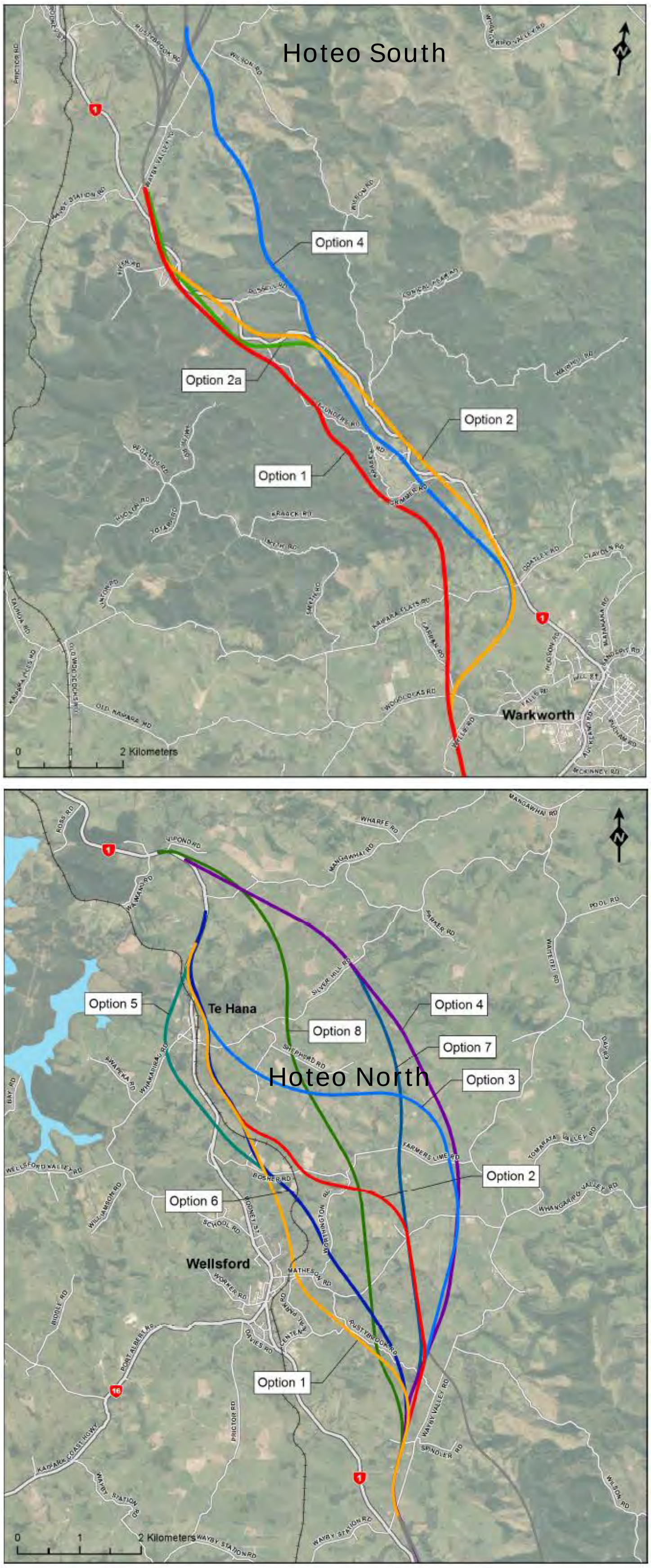


Figure 7-5: Short-list options

Option 1 was adopted as the selected option in Hōteo South. Option 1 was identified as having the following benefits compared to other short-list options:

- It was shorter than the other options which would result in improved movement of freight and people between Auckland and Northland.
- Its separation from SH1 provided greater route resilience than other options.
- It better avoids impact on areas of identified high ecological value and landscape value than other options.
- It was expected to have lower air and noise impacts on sensitive receivers due to its separation from the Dome Valley and associated sensitive receivers.
- It had lower geotechnical risks than the other options and lower constructability risks than most of the other options.

Option 7 was adopted as the selected option for Hōteo North. The selection of Option 7 provided the following benefits compared to other short-list options:

- It better avoided impact on identified areas of high ecological value or landscape value and on coastal areas and watercourses.
- It avoided areas of cultural significance.
- It avoided poor geological ground.
- It avoided community impacts.
- It avoided slip zones.
- It had a good cut-fill earthworks balance.
- It ran in proximity to an existing infrastructure corridor (fuels and gas pipelines and electricity transmission lines) which was seen to provide a logical barrier to development further east. The co-location of the road in proximity to the fuels and gas pipelines and electricity transmission lines, together with the presence of the adjacent ridgeline, make a natural and ensuring any future boundary to urban growth is not compromised.
- It provided better value for money.

The combined option 1 and option 7 formed the Indicative Route. The Indicative Route rated the best of all the options examined against the Project objectives for the following reasons:

- Its separation from SH1 provided greater route resilience than other options;
- It better avoided impact on areas of high ecological value, cultural value and landscape value than other options;
- It had lower geotechnical risks than the other options through The Dome and to the east of Wellsford;
- It provided for planned future growth around Warkworth and Wellsford in a complementary manner, whilst not compromising planned transport network upgrades or precluding further growth; and
- It represented an opportunity for Wellsford and Te Hana to develop and function better as community centres and tourist destinations.

7.4.6. Considerations of Interchange form and location

Warkworth Interchange

An analysis and assessment of interchange options at Warkworth was undertaken in November 2016.The general location of the Warkworth Interchange at a point north of Warkworth was informed by the Pūhoi to Warkworth scheme assessment process. The purpose of the Warkworth Interchange options assessment was to identify an interchange on the northern side of Warkworth and connection to the existing SH1, P2Wk and local road network.

Eight interchange designs were developed and assessed, including four service interchange options (simple interchanges that rely on roundabout / stop signs / traffic lights to control traffic exiting or entering the motorway), and four system interchange options (free flowing connections). The options considered are shown below (including Option I which is outlined in detail in section 7.5.3 below):

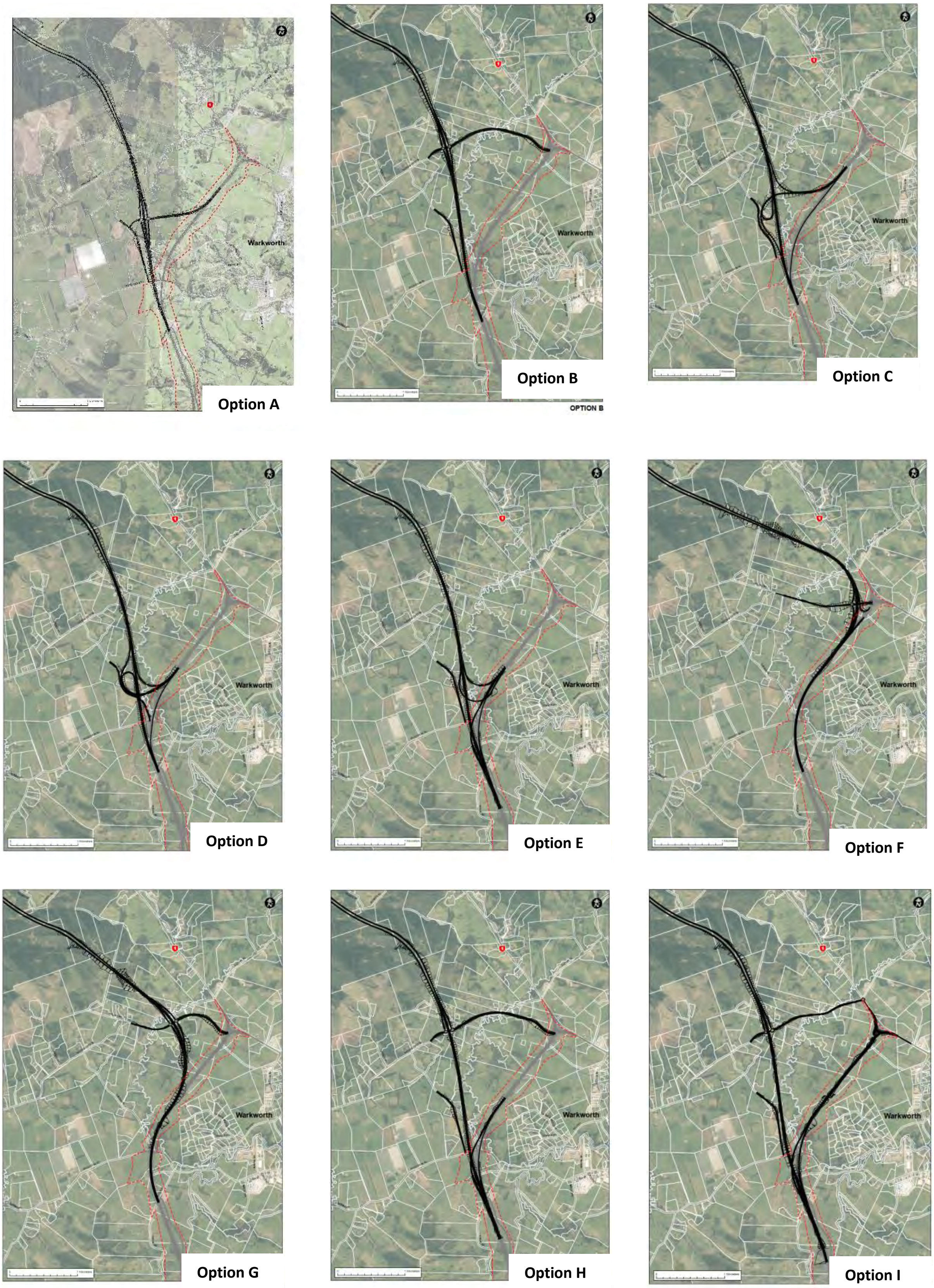


Figure 7-6: Warkworth Interchange options

The Warkworth Interchange options, as per the alignment options, were assessed using the evaluation criteria, MCA and scoring system explained in section 7.3.2 of this AEE.

Option H was the selected option after consideration of the outcomes of the MCA process, and was recommended as the preferred option subject to further refinement and public consultation. Option H was then further refined, prior to Phase 1 engagement in March 2017. "Option I" interchange, which was a modified version of Option H, formed part of the Phase 1 engagement. The key change was an additional roundabout connection and a reduced land take achieved through upgrading the eastern end of Kaipara Flats Road rather than constructing a new link road to serve traffic to and from the north.

Wellsford Interchange

A number of interchange options were considered at Wellsford during the scheme assessment. This included:

- Interchange form (layout);
- A single interchange at Whangaripo Valley Road;
- Split interchange south and north of Wellsford;
- Full interchanges south and north of Wellsford; and
- Different layout options for each of the above options.

Once the alignment far east of Wellsford was identified as the preferred option, the traffic analysis suggested that an interchange that far eastward would not attract sufficient vehicles, and most would choose to travel to Warkworth to join SH1. A southern interchange was identified as being necessary to avoid the dominant reliance on the SH1 through the Dome Valley. An assessment of these options concluded that two full interchanges, north and south of Wellsford, were preferred to a single interchange. This was due to:

- Making better use of existing infrastructure;
- A central Wellsford interchange would require extensive upgrades to Whangaripo Valley Road;
- Connectivity for the wider network (e.g. Twin Coast Discovery Highway);
- Difficulty in terrain, ground conditions and cost of a central interchange; and
- No transport advantage of a central interchange (travel times would not be improved vs two interchanges to the north and south)

The preferred Wellsford interchange (south) location was identified at Wayby Valley Road. This was due to:

- Urban design and landscape framework guidance;
- Extension of the Pūhoi to Wellsford project to the north of Te Hana, which connects to the Twin Coast Discovery Highway and SH16;
- Appropriate distance between the three proposed interchanges (Warkworth, Wellsford and Te Hana);
- Use of existing transport infrastructure;
- Potential connectivity to Mangawhai for resilience; and
- Operational flexibility with the proposed tunnels through the Dome Valley (by providing an interchange between Wellsford and the proposed tunnels).

Te Hana Interchange

In 2016, following recommendations from the PBC to address resilience and travel time issues through Te Hana, as well as ground conditions, topography and environmental and cultural considerations, options with a termination point extended to the north of Te Hana were considered. The extension to the northern terminus of the Project meant there was a need to consider the locations of interchanges at Wellsford and Te Hana.

The Te Hana Interchange location at Mangawhai Road was common for all of the alignment options in the scheme assessment which tied into SH1 south of Vipond Road (i.e. no other options were developed or considered for the general location of this interchange).

7.4.7. Detailed Business Case

This work, undertaken in 2017-2019, drew upon the earlier scheme assessment work (2010-2011) together with the more recent analysis (2016) to develop the detailed business case for this Project. This approach to analysis of the potential performance of a project against investment criteria is the Transport Agency's current practice for its projects and supersedes the previous Scheme Assessment approach which was current during the early work on the scheme as outlined above. The business case elements not covered by the scheme assessment work were addressed in the DBC. The DBC did not re-evaluate the offline alignment options considered in the scheme assessment work but included a further evaluation of online options using the same MCA criteria adopted for the shortlisted options assessment in order to test and confirm the initial outcomes on these options from the scheme assessment phase. Further consideration of the inclusion of a tunnel along the route was also addressed in the DBC.

Online vs offline

The MCA undertaken through the DBC phase confirmed that for both sections (Warkworth to Hōteo and Hōteo to Wellsford), in comparison with offline options, the online options performed worse than the "Do minimum" (with the Pūhoi to Warkworth section built) as a result of little benefit and increased adverse effects. In addition, all online options had considerable impacts during construction and did not fundamentally deliver against the objectives of the Project.

Alternatives to a tunnel

The DBC phase considered alternatives to the approximately 1 km long tunnel that was proposed as part of the Indicative Route. Alternative route alignments were considered in order to see if the tunnel could be avoided, given the costs of construction and operation and maintenance requirements associated with a tunnel.

A significant east-west ridge line to the north west of Warkworth is the key reason for the proposed tunnel, because suitable gradients for a high standard freight route need to be achieved (maximum grades of around 6%). The ridge feature is extensive and effectively runs from the existing SH1 westwards for several kilometres. Consequently, if the route were to be realigned in order to avoid the need for a tunnel, the route would have to be relocated significantly in order to avoid the east-west ridge topography resulting in significant additional lengths of carriageway and associated costs

Relocation of the alignment eastwards would put the alignment in, or very close to, the SH1 corridor where significant geological instability exists, with numerous existing landslides and steep side slopes. Further east of SH1 was considered to have sub-optimal outcomes in respect of environmental effects and land instability factors. Routes in these locations had been considered as part of the long list and short listing processes summarised in sections 7.4.3 and 7.4.5 of this report, and were found not to offer the best outcomes.

Moving the route westwards to avoid the ridge and eliminate the tunnel would likely require a shift of several kilometres, would still require significant earthworks, and result in a significantly longer route, offsetting the cost saving from the removal of the tunnel. A westward shift would be less attractive to traffic as compared to the SH1 route which is more direct and would also prevent the route from achieving the advantages offered by aligning it in the NW-SE valley which lies to the north of the east-west ridge line. An alignment to the west would offer sub-optimal outcomes in terms of cost and environmental outcomes and was discounted accordingly.

7.5. Alternatives considered during Indicative Route design refinement

7.5.1. Evaluation framework and process

Alternatives were considered in 2017 and 2018 during the refinement of the Indicative Route following feedback from Phase 1 engagement, outcomes of a Road Safety Audit and preliminary environmental and geotechnical investigation work. This work determined an Indicative Alignment.

The evaluation carried out in 2017 enabled a detailed consideration of the potential environmental effects of the Project by the specialists appointed to support the statutory approvals phase. The inputs into the MCA by environmental specialists were intended to ensure that the decision making process was integrated both with relevant engineering and LTMA criteria and the statutory requirements under the RMA.

The evaluation involved the environmental specialists assessing the effects of the options against their specific field of expertise. The specialists undertook a high-level preliminary assessment of options, to determine whether any moderate or significant adverse environmental effects were likely, given that s.171(1)(b) of the RMA addresses 'significant adverse effects' in testing the adequacy of consideration given to alternatives. Assessments were undertaken for the following subject matter areas:

- Air quality;
- Landscape and visual effects
- Freshwater ecology;
- Terrestrial ecology;
- Noise and vibration;
- Groundwater;
- Operational water quality (stormwater management);

- Construction water quality (erosion and sediment control);
- Flooding;
- Heritage and archaeology;
- Cultural heritage; and
- Land contamination.

In addition, the other MCA categories and criteria, as outlined in section 7.4.2, were considered in the evaluation where relevant.

The environmental specialists used the same seven-point rating scale that was used in the scheme assessment phase MCA evaluation, but adapted it to range from significant adverse effect to significant positive effect, as shown in Table 7-2 below.

Table 7-2: Rating scale – RMA evaluation

Symbol	Meaning
+ + +	Triple positive – significant positive effect
+ +	Double positive – moderate positive effect
+	Positive – minor positive effect
0	Zero – neutral /benign effect
–	Negative – minor adverse effect
– –	Double negative – moderate adverse effect
– – –	Triple negative – significant adverse effect

Workshops were held for the alignment and Warkworth Interchange evaluations. They were attended by project team representatives, environmental specialists, an iwi advisor, legal advisors and Transport Agency staff. A detailed description of the options was provided at the workshops, to ensure specialists had a clear understanding of the options so that they could validate their assessment. Scoring was reviewed and updated where necessary following these workshops.

7.5.2. Evaluation of short list options

The scores from the "Environmental Sustainability and Urban Form" category criteria in the MCA evaluation were refined to reflect categories that focused on the spectrum of social, environmental and cultural matters to be addressed in the statutory approvals phase.

Each short list option was evaluated on its individual merits, against a "Do Minimum" scenario. The "Do Minimum" scenario consisted of the P2Wk project connecting to the existing SH1 at a roundabout north of Warkworth on the existing SH1, and the route north from there being on the existing SH1 through the Dome Valley. The specialist assessments did not initially consider mitigation except, where that would be an inherent part of the project – such as erosion and sediment control, or concrete barriers on bridges, which achieve noise mitigation.

Following an environmental specialist workshop, updated cost and engineering information was obtained for inputting into the MCA evaluation process. The specialists' environmental scores were compared with the original MCA criteria ratings for the "Environmental Sustainability and Urban Form" category. This comparison revealed no substantive changes to the scoring and ranking of options across the environmental category and did not influence the ranking of the preferred options. As such, the original MCA scoring for that category did not change for evaluation purposes. The other criteria and categories were maintained as per the 2016 scheme assessment MCA, albeit with revised inputs where further information regarding costs and design amendments necessitated changes to the scoring or where criteria were deemed to be non-differentiators.

Sensitivity testing was undertaken to test whether there were any dominant criteria that were influencing the rankings.

The most favourable options identified by the revised MCA evaluation, and the subject matter area assessments undertaken in parallel, were Option 1 in the Hōteo South section and Options 4 and 7 in the Hōteo North section.

Whilst the overall scores for Options 4 and 7 in the Hōteo North section were the same in the subject matter area assessments, Option 7 did score slightly more favourably than Option 4 in relation to cultural heritage impacts (minor adverse for Option 7, moderate adverse for Option 4), while Option 4 scored slightly more favourably than Option 7 in relation to terrestrial ecology impacts (minor adverse for Option 4, moderate adverse for Option 7).

This analysis, including the sensitivity testing, confirmed the previously identified preference for the options that formed the preferred alignment for the Phase 1 engagement in early 2017 were appropriate. Notably, even when the environmental or engineering criteria were doubled, there was no notable difference in scoring or ranking of options.

7.5.3. Warkworth Interchange refinement

Following the Phase 1 engagement in March 2017, four further options (options 7-10) were developed for the Warkworth Interchange to take into account updated technical information and to address specific public consultation feedback.

The project team developed and progressed a refined MCA process to consider the resulting 13 interchange options. This refined process was established to:

i) test specific issues raised in public consultation feedback recorded in the Phase 1 engagement;

ii) fully evaluate Option I which had formed part of Phase 1 engagement, but was not assessed in detail prior to that; and

iii) enable more detailed consideration of the potential environmental effects of the project by the specialists appointed after the completion of the work to identify the Indicative Route, to support the statutory approvals phase.

The specialists evaluated and scored each of the interchange options, a workshop was held, and scores adjusted where appropriate. Following the environmental specialist workshop, more recent cost and engineering information was obtained for inputting into the MCA evaluation process.

The MCA criteria were updated, with the environmental and social criteria that were used in the scheme assessment MCA being replaced with the specific RMA environmental assessment criteria and the options scored (as identified in Table 7-2). Sensitivity testing was undertaken to identify whether there were any dominant criteria that were influencing the rankings. The ranking of options was tested under a series of scenarios that saw the weighting for each of the categories doubled in turn, to confirm the robustness of the outcomes of the evaluation.

Following initial evaluation results, the Transport Agency provided preliminary feedback that the evaluation should also provide for the updated traffic modelling[63] to identify whether the predicted growth in and around Warkworth would have any influence on the preferred interchange option. Additionally, the Transport Agency confirmed three specific interchange criteria as follows:

- maintaining the free flow level of service that the travelling public (including the Warkworth community) would be accustomed to from the new P2Wk infrastructure;
- optimising to the extent practicable use of the infrastructure built for the P2Wk project; and
- not relying on local road connections, given uncertainty at that time as to the future local road network. (New roads and improvements to several local road projects are planned, but the timeframe for their construction completion relative to that of the Project is uncertain).

Following all of the above processes and consideration of the additional specific interchange criteria, a recommendation was made to the Transport Agency to proceed with Option C as the preferred Warkworth Interchange option.

The Transport Agency decided to progress Option C for the purposes of seeking designation and consents for the project, as, on balance, it best met the Transport Agency's interchange specific outcomes as outlined above. Option C maintains the high level of service provided by the P2Wk project because it has free flowing ramps and does not require that traffic move through additional intersections (compared to a service interchange which would result in a lower level of service). Option C does not rely on local road connections to maintain that level of service; and it optimises the use of P2Wk infrastructure (as the P2Wk southbound alignment will form the key southbound on-ramp and most of the northbound carriageway is also utilised). Compared to other system interchanges considered, Option C is safer because the ramps that carry movements with higher traffic volumes have a higher radius and therefore less crashes are likely as compared to other options

The Project team noted that while Option C was not the highest-ranking option from an environmental effects perspective, the effects were such that they could be mitigated. The environmental specialists did not identify any effects that would preclude the selection of Option C as the preferred option.

As part of its incorporation into the wider scheme Indicative Alignment, Option C was subsequently assessed through a road safety audit (RSA). A consequence of RSA comments, was that the geometry of the Northbound on-ramp within the interchange

[63] Technical Note: Transport Assessment of Interchange Options, Ian Clark: Flow Transportation Specialists, 7 June 2017

was amended so that the connection provides improved safety characteristics. This interchange layout was termed “Option C No Loop”. All of the free-flow ramps connect with the P2Wk alignment to the south-west of the P2Wk northern terminus roundabout. Carran Road is diverted around the interchange to maintain local road connectivity but has no connection to the interchange.

7.5.4. Evaluation of northern termination

The Indicative Route as identified in the scheme assessment phase of the Project has the northern termination point located at the southern abutment of the existing Maeneene Stream bridge and approximately 170 m south of an existing staggered T-intersection of SH1 with Maeneene Road and Waimanu Road. An RSA report of the Indicative Route (the alignment that formed the basis of the Phase 1 engagement) was completed in July 2016. The audit identified safety concerns at the northern termination summarised as follows:

- Motorway terminating at a 7.0 m wide bridge;
- No provision for cyclists;
- Approach Sight Distance (ASD) from the left-hand curve to the bridge is short;
- No median protection through the bridge; and
- Poor sight distance to the intersection of Maeneene and Waimanu Roads with SH1.

Prior to resolving these safety issues, the Transport Agency undertook Phase 1 engagement on the Indicative Route in February 2017. Phase 1 engagement resulted in several individuals raising concerns over the safety aspects of the section of network around Maeneene Road, Waimanu Road and Vipond Road with the existing SH1.

A range of options to resolve these issues were identified. Two short-list options were progressed for evaluation (shown in Figure 7-7 and Figure 7-8) as follows:

- Option 1: New offline bridge and upgrade to at-grade intersection of Maeneene and Waimanu Roads with SH1 (JG01);
- Option 2: New offline bridge and grade separated intersection (JG02).

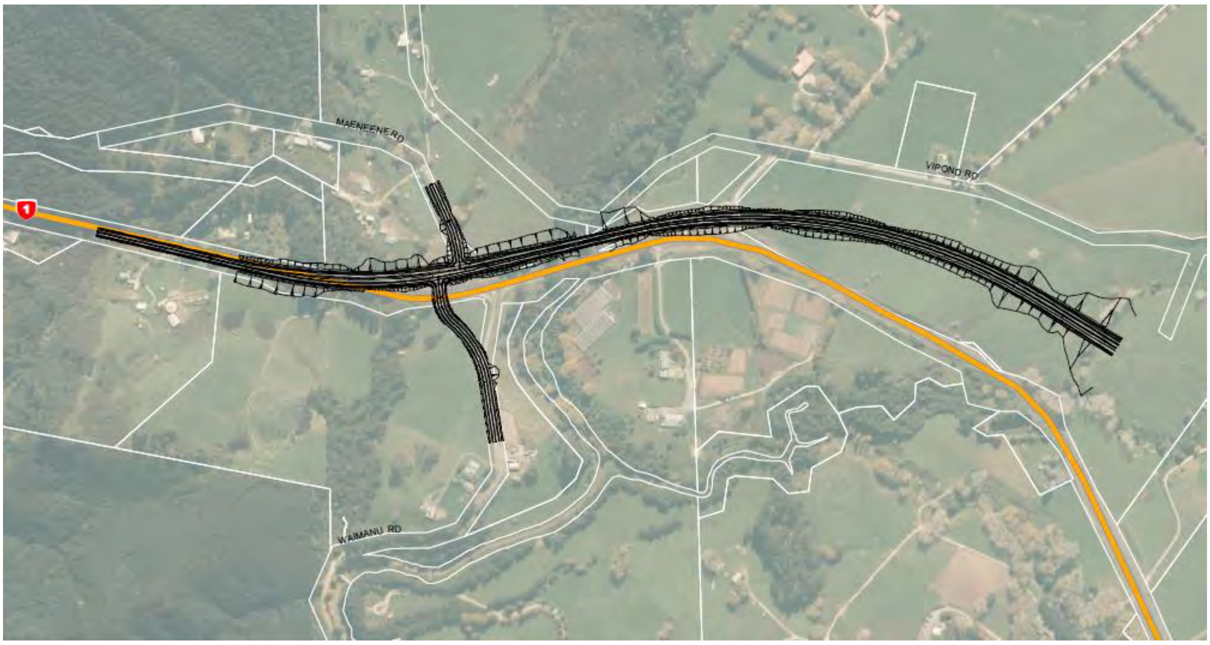


Figure 7-7: New offline bridge and upgrade to at-grade intersection (JG01)

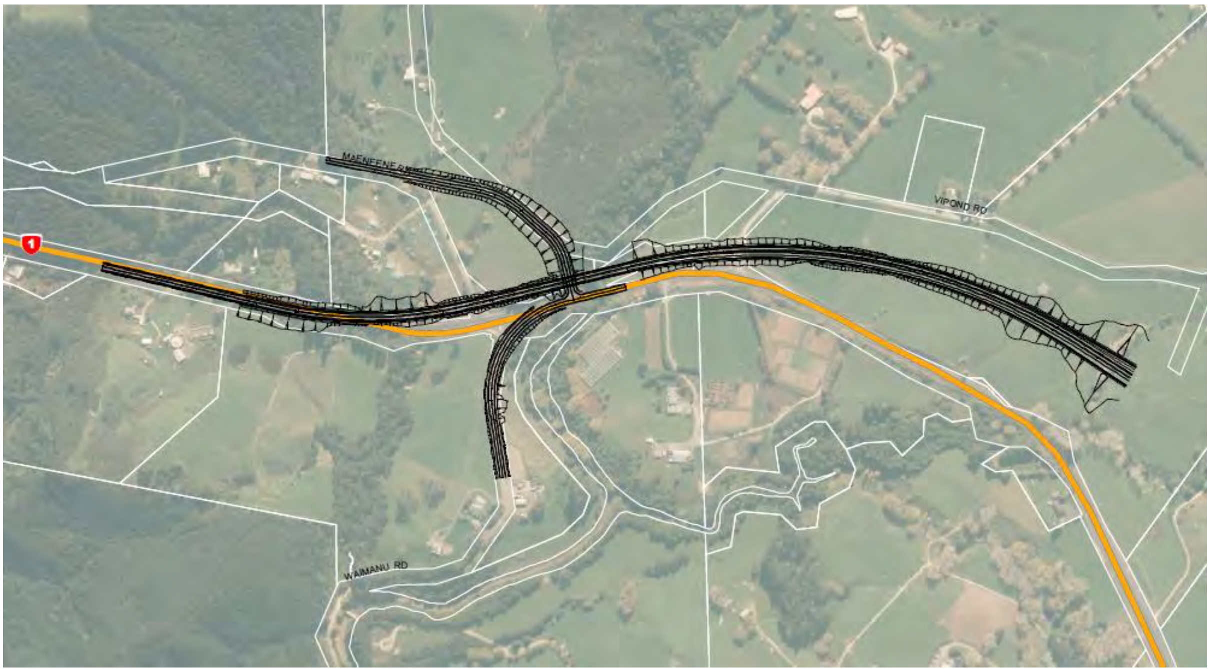


Figure 7-8: New offline bridge and grade separated intersection (JG02)

The MCA evaluation followed the process set out in 7.3 inlcuding the assessment of more RMA-specific specialist areas performed by environmental specialists to make sure that the relevant matters under section 171 of the RMA were considered in the options evaluation process.

Each option was considered against a baseline do-minimum option (Indicative Route option brought forward from the SAR phase) and all were assessed against the relevant LTMA and engineering and environmental criteria, and options rated and ranked in order based on their average score across these criteria. The options were rated, translated into quantitative scores, and ranked for each option across the criteria. This assessment allowed the Project team to make a recommendation to the Transport Agency as to the option to include as the northern termination for the Indicative Alignment.

The relevant LTMA and engineering criteria considered to differentiate the options ("Safety and Personal Security", "Improving Access and Mobility" and "Value for Money") were evaluated based on professional judgement and the experience of the assessors. The other criteria from the MCA framework were deemed to be non-differentiators, largely given the scale of this component of the Project being so discrete.

There were no significant differences in cost between the options (when considered in relation to the cost of the Project as a whole). With respect to safety, the grade-separated intersection removed the intersection conflict point (at grade SH1 with local roads) and therefore provided an optimal safety solution for this section of the route. The grade separated intersection also provided better local road connectivity. Therefore, the assessment recorded a preference for Option 2 (new offline bridge and grade separated intersection).

The environmental specialists assessed and scored the environmental effects of each option. Most environmental factors did not differentiate between the two options. Both options would result in adverse effects given the works required in the vicinity of the Maeneene and Waimanu Streams. Option 2 scored lower for freshwater ecology given the greater earthworks volumes predicted in proximity to Maeneene Stream. Option 1 scored lower for landscape and visual matters given the state highway restricts access between Maeneene and Waimanu Roads. Overall, the specialist assessments did not reveal any significant effects that could not be mitigated. The assessments recorded a slight preference for Option 2.

The new offline alignment with grade-separated intersection (Option 2) was therefore confirmed as the preferred option.

7.5.5. Evaluation of tunnel alignment

Geotechnical investigations undertaken in April 2017 identified a series of geological features in the tunnel area (beneath and west of Kraack Road) that might affect the design, construction, operation and cost of the tunnel, in particular the presence of a fracture zone and high artesian water pressure. Following the results of further geotechnical investigation work, alternative alignments for the route passing beneath Kraack Road were identified and assessed to determine the feasibility of a safer, more cost effective tunnel alignment.

In August 2017, alternative options for the alignment to pass through the Kraack Hill area were assessed. A key engineering outcome for assessing alternative alignments was to minimise the extent of tunnel interfacing with fracture zones associated with fault lines, as well as minimising interaction with areas of high artesian water pressure. This could be achieved by changing the alignment to cross the fault traces at right angles (perpendicular), or to avoid them altogether.

The location of the tunnel portals within the surrounding topography was a key factor in assessing the feasibility and alignment of the tunnels. In addition to the Indicative Route Alignment (JG15), two alternative options for the alignment in the Kraack Hill area were identified for assessment; one to the west of the existing alignment, and one to the east of the existing alignment as follows:

- Western Tunnel Alignment (JG16): This option realigned a section of the main alignment westwards into the adjacent valley south of the tunnel. The tunnel length is approximately 970 m. The length of the mainline realignment is approximately 7 km, extending from near Woodcocks Road to approximately 1.5 km north of the northern tunnel portal.
- Eastern Tunnel Alignment (JG18): This option realigned a section of the main alignment approximately 200 m eastwards adjacent to the tunnel (when compared to the refined Indicative Route). The tunnel length is approximately 850 m.

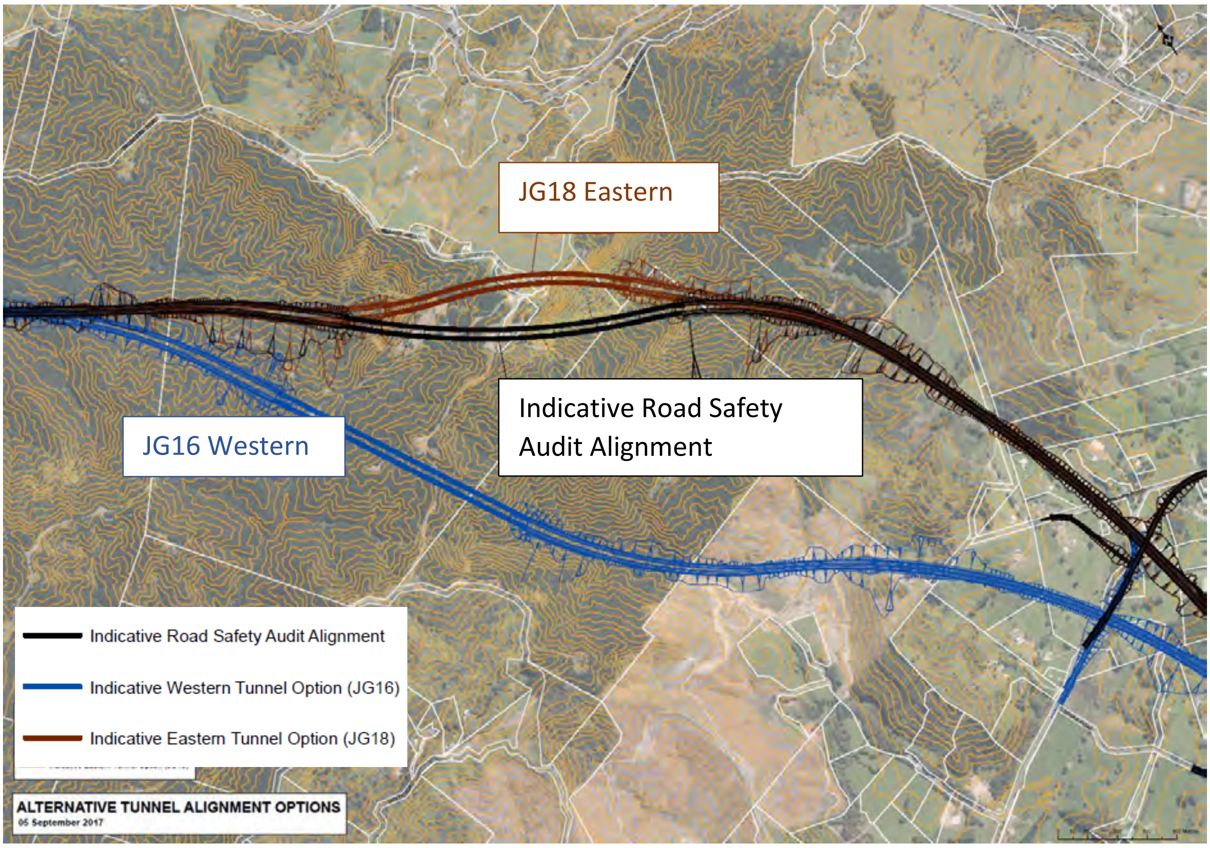


Figure 7-9: Alternative tunnel alignments

As for the northern termination alternatives assessment outlined above, the assessment of alternatives for the tunnel options used an MCA framework where the inputs into the MCA evaluation by environmental specialists were considered alongside LTMA and engineering criteria.

The majority of the LTMA and engineering criteria were deemed to be non-differentiators, as it was considered that all three alternative tunnel alignments had generally the same impacts. The exception to this was “Overall Cost of the Option”. The eastern alignment was assessed as the lowest cost option, the savings were considered to be significant when taking into consideration the outcomes from the additional geotechnical investigations and interpretation.

The environmental specialists assessed the Project's effects under section 171 of the RMA and scored the environmental effects of each option based on the subject matters listed above. For the majority of environmental criteria, the effects were deemed to be the same for each of the three tunnel alignment options. Only one criterion was considered to be a differentiator – water quality and flooding. For this criterion the effects of the JG15 and JG18 alignments were scored Moderate, and Minor for JG16. Overall, the environmental specialist assessments did not identify any significant effects that could not be mitigated.

Overall, given the significant cost savings offered by the eastern alignment option and that there were no significant environmental effects identified, the eastern alignment (JG18) was evaluated as the preferred tunnel option.

7.5.6. Design refinements

Refinements to the Indicative Route alignment were made in response to community inputs and in response to the outcomes of further, more targeted environmental investigations. The main design development changes included the following:

- **Wayby Valley Road Roundabout**: A new roundabout was developed at the intersection of the existing SH1 and Wayby Valley Road. The roundabout replaced a T-intersection that was proposed in the Indicative Route. The roundabout provides a safer and more efficient intersection.
- **Mangawhai Road**: Changes were made to address effects of the Indicative Route on twelve properties of Charis Lane. A new roundabout intersection at the existing SH1 and Mangawhai Road was developed. The Te Hana Interchange was shifted northwest approximately 110 m and the western termination point of Mangawhai Road was reduced, primarily to avoid crossing the fuels and gas pipelines.

7.6. Conclusion

Since the commencement of the Project, there have been a number of assessments to identify the preferred transport solution and progressively refine the Project alignment and hence the Project's land requirements and effects. This process has spanned a number of years and in that time the work undertaken has adapted to amendments to both the Transport Agency's processes, project objectives and in the context of evolving planning frameworks and planned growth. The assessments have been carried out by way of evaluation frameworks which have had regard to criteria derived from LTMA, the RMA and the Project's overarching objectives. This process has been thorough and robust in terms of the requirements of section 171(1) of the RMA. The Indicative Alignment will provide a large number of benefits and avoid major environmental, social and cultural constraints within the Project area and is considered the best overall outcome.

8. Engagement and consultation

8.1. Introduction

This section provides an overview of stakeholder, iwi and public engagement for the Project. It addresses the purpose of engagement and consultation, summarises feedback including the tools and techniques implemented, the parties engaged and the engagement outcomes. This section then goes on to outline the common issues and themes raised by stakeholders, iwi partners, communities of Warkworth, Wellsford and Te Hana and the wider public.

Engaging and building relationships with people who are interested in, or affected by, the project, is an important part of the Project.

There is a long history of engagement that has influenced development of the Project, commencing in 2010 with engagement on the P-W project. The P-W project was subsequently split into two separate projects - P2Wk, and Warkworth to Wellsford. Engagement for the Warkworth to Wellsford Project has been informed by, and built upon, the earlier engagement for the Ara Tūhono Pūhoi to Wellsford project, the Pūhoi to Warkworth project and the Whangārei to Auckland Programme Business Case (engagement undertaken in 2016).

Engagement for the Project has been guided by an Engagement Plan developed using the principles and core values of the International Association for Public Participation (IAP2) and the Transport Agency's own guidelines for best practice consultation under the RMA, the LTMA and HNZPTA.

Engagement with stakeholders, iwi, landowners and neighbours has been ongoing throughout Project development. Commencing in early 2017, an engagement programme was developed in accordance with the Engagement Plan and has been or is being delivered as follows:

- Indicative route -The Project was formally introduced to stakeholders, landowners and the public with the production and distribution of a project newsletter and a series of key stakeholder briefings, hui, property owner meetings and public information sessions in February 2017 to present and gain feedback on an Indicative Route. Noting, prior to this targeted engagement with key stakeholders had occurred;
- Pre-lodgement - Following further technical investigations and analysis, the Indicative Alignment was presented to stakeholders, landowners and the public for further feedback from November 2018 to March 2019;
- Post-lodgement engagement following lodgement of the Application. Communications and engagement will continue throughout the public notification and hearing process.

The Transport Agency will continue to engage with the community and neighbours prior to and throughout construction of the Project.

8.2. Engagement purpose and objectives

The purpose of the Indicative Route engagement was to inform, consult and obtain feedback on the Indicative Route. This process informed some of the refinements undertaken in development of the Indicative Alignment presented to iwi partners, key stakeholders, landowners and the public during the Indicative Alignment engagement.

Specific objectives were identified by the Transport Agency for consultation on the Indicative Route and pre-lodgement engagement.

Indicative Route

Specific objectives for the Indicative Route included:

- Inform stakeholders, affected parties and communities such that they achieve an understanding of the proposal and its effects;
- Gather knowledge and input from stakeholders, affected parties and communities to inform the Project design and understanding of potential effects to inform this AEE;
- Build awareness of the Application;
- Maximise positive and minimise negative submissions by supporting the public in understanding the Project and its benefits and incorporating feedback where practicable to address concerns;
- Support directly affected landowners and neighbours in understanding the process, navigating requirements and locating information available, and assisting to address site issues and concerns where possible.

Pre-lodgement Engagement

Specific objectives for the Pre-lodgement engagement included:

- Inform and educate stakeholders on the Indicative Alignment;
- Continue to reinforce the background to the Project and why it is required;
- Advise the potentially affected parties and communities of the potential extent of the Indicative Alignment as well as any potential effects;
- Ensure key target audiences and stakeholders have an accurate understanding how the Project fits into strategic regional development;
- Provide consistent information;
- Engage constructively with key stakeholders/target audiences;
- Minimise uncertainty and dispel misinformation; and
- Maintain and enhance existing relationships.

8.3. Iwi consultation

Since 2010, the Transport Agency has had an established relationship with iwi on the wider Pūhoi to Wellsford project. A partnership was formed in 2010 by Mana Whenua within the project area, namely Ngāti Manuhiri (Ngāti Wai), Ngāti Mauku/Ngāti Kauwae (Te Uri o Hau), Ngāti Rango (Ngāti Whātua o Kaipara) and Ngāti Whātua iwi. This collective is called Hōkai Nuku. Hōkai Nuku is mandated by their members to ensure that the enhancement of cultural footprint and values associated with collective mana whenua interests is an integral component of the Project.

Since early 2017, the Transport Agency has met regularly with Hōkai Nuku representatives to discuss the Project. The Transport Agency and Hōkai Nuku continue to work collaboratively on the Project.

In mid-2017 all iwi with potential interests in the Project area (based on Auckland Council's list at that time for the Rodney Local Board area) were invited to a hui to share information on the Project identify their interests and confirm whether they wished to be engaged. In addition to the four iwi and hapu represented by Hōkai Nuku, Ngāti Paoa, Ngāti Maru and Te Kawerau a Maki also expressed an interest in the Project area and surrounds and have been subsequently engaged with regarding the Project. This engagement has involved hui and exchange of information.

Draft cultural assessments were received from Hōkai Nuku, Ngāti Maru and Te Kawerau a Maki. The key concerns raised in these assessments related to the Project's impact on cultural values associated with waterways, indigenous vegetation and fauna and identified cultural heritage sites. Recommendations presented in the assessments are outlined in section 9.18. The Transport Agency will continue to liaise with Mana Whenua throughout design and construction of the Project.

8.4. Stakeholders

Several stakeholder groups were identified for targeted consultation grouped as follows: directly affected landowners and neighbours, Government agencies, statutory organisations and interest groups, utility providers, community groups, and local businesses.

Key stakeholder briefings were held in February 2017. The purpose of the briefings was to present the full extent of Indicative Route prior to its public release on 17 February 2017. Further pre-lodgement engagement on the Indicative Alignment took place from November 2018 to March 2019. Consultation and engagement has been undertaken with the following stakeholders:

- Affected landowners and immediate neighbours;
- Hōkai Nuku;
- Auckland Council;
- Auckland Transport;
- Department of Conservation;
- Heritage New Zealand;
- Other road project groups: Safe Roads Alliance and Supporting Growth Alliance;
- Forest and Bird;
- Healthy Waters;
- Auckland Chamber of Commerce;
- NZ Council for Infrastructure Development;
- Auckland Business Forum;
- Infrastructure NZ;
- One Warkworth Business Association;
- Waste Management NZ
- Interest groups (Walking Access NZ, NZ Walkways Commission, Bike Auckland, Integrated Kaipara Harbour Management Group, Mangawhai Residents and

Ratepayers, Tomarata Rural Women's Group, Warkworth Transport Forum, Vision Wellsford and Federated Farmers);
- Utility providers (Refining NZ, First Gas, Watercare Service Limited, Transpower, Vector Limited, Chorus, Spark, 2degrees Mobile Limited, and Vodafone); and
- Road user organisations (emergency services, freight and driver associations, National Road Carriers, Heavy Haulage Association, Automobile Association).
- Other local authorities and related entities (Kaipara DC, Whangarei DC, Northland RC, Far North DC, Northland Mayoral Forum; Northland Regional Transport Committee.

8.4.1. Directly affected landowners and neighbours

Indicative Route engagement

Directly affected landowners have been identified as those owners whose properties are fully or partly within the proposed designation. This also includes leasees and licensees of potentially directly affected properties. Project neighbours are those whose properties border the proposed designation or adjoin a directly affected property.

In January 2017, 87 potentially affected landowners and neighbours were sent letters, informing them of the Project and extending an invitation for affected landowners to meet with the Transport Agency. Property maps showing the Indicative Route in relation to individual property and the potential scale of property requirement (whether it is likely to be a partial or full land acquisition) were provided via email or presented at the individual meetings.

Indicative Alignment engagement

In November 2018, 171 affected landowners and neighbours of affected landowners were sent letters outlining the changes to the proposed route, now called the Indicative Alignment. The letters invited property owners to meet with representatives of the Transport Agency from 21 November 2018, prior to the Indicative Alignment being presented at public information days from 28 February 2019.

Communications with landowners and neighbours have been continuous throughout the Project development, including three letters and ongoing liaison to support advance acquisition and arrangement of site visits.

8.4.2. Local government and statutory agencies

Auckland Council (Project Development)

The Transport Agency has been in close liaison with Auckland Council staff on a regular basis throughout Project development to discuss the Indicative Route and Indicative Alignment, technical inputs and consenting matters, while providing regular Project updates for general information purposes. A primary focus of the meetings held with Council's compliance team (who are currently working on the compliance monitoring of the P2Wk project), was to seek feedback on how the designation and consent conditions were working during the construction phase and whether there were any lessons to learn for this Project.

Engagement with Auckland Council resulted in alterations and refinements being made to the design of the Project. The Warkworth Interchange was a particular concern for the Council as they identified the potential for land to become landlocked or ‘orphaned’ within the original Indicative Route design. The Indicative Alignment includes refinements in response to these concerns.

Auckland Council (Regulatory)

A number of meetings have been held with Council’s regulatory team, acknowledging the role they will have in the statutory process, and subsequent monitoring of conditions of the designation and resource consents for the Project, if approved.

Pre-lodgement discussions were undertaken with specialists within Auckland Council during the development of the Project. This has included specialists relating to ecology, stormwater, landscape and visual, heritage and archaeology. Meetings with these specialists included introductions of the Project, presentation of the Indicative Route and Indicative Alignment, and discussions regarding the assessment and effects of the Project relating to each specialist field. Potential designation and consent conditions were also discussed.

Local Boards

Joint meetings were held with the Rodney Local Board Infrastructure Committee and Auckland Council in May and August 2017. The issues raised related to the broader Auckland to Whangārei corridor and linkages with the “Heartland” cycling rides along the east coast. A written update on the Project was provided to the Rodney Local Board prior to lodgement.

Auckland Transport

Engagement with Auckland Transport on this Project has been ongoing, specifically in respect of the design standards of the Project and the integration of the Project with the local transport network (including road, pedestrian and cycleway elements). A key concern expressed during engagement with Auckland Transport has been how the Project will integrate with existing local roads and with planned upgrades to the local network. These discussions have influenced the refinements presented in the Indicative Alignment. Auckland Transport has been involved in the development of the draft conditions for the Project.

These aspects were discussed in regular meetings with Auckland Transport throughout the Project development. Ongoing meetings will continue as the Project develops.

Regular engagement occurred with the Safe Roads Alliance to discuss the Project interface. This included regular meetings, teaming up at respective project public engagement events, sharing information with shared landowners and coordination of external communications to support the Project. Site access points were considered collectively to ensure any safety implications were identified early.

Discussions were also held with the Supporting Growth Alliance regarding Project interfaces. Key aspects of discussion related to construction and approach to management, Auckland Council structure plan for Warkworth and the collaborative approach to traffic modelling.

Department of Conservation

The Project does not pass through land managed by DOC. Consultation with DOC has focused on the conservation values of sites within the Project area, the natural values of flora and fauna, management of erosion and sediment control, recreational access and opportunities and environmental effects and benefits. The main issue raised included early identification of relocation sites. Engagement with DOC around these key issues has influenced the mitigation proposed for the Project along with the proposed conditions. The Project does not encroach on Sunnybrook Reserve. DOC have been included in the development of the draft conditions. Ongoing engagement with DOC will continue as the Project progresses.

Heritage New Zealand

Heritage New Zealand has been engaged during development and assessment of the Project. During 2017 and in 2018, meetings were held to provide staff with an understanding of the Project's general alignment, identification of historic heritage features, and the potential effects of the Project on these features. Some of this engagement was carried out in conjunction with Auckland Council heritage experts. Engagement with Heritage New Zealand around these key areas of interest has influenced the mitigation proposed for the Project along with the proposed conditions. Ongoing engagement with Heritage New Zealand will continue, particularly regarding the later approvals required for the Project under the HNZPTA.

8.4.3. Utility providers

The Transport Agency has worked with utility providers with major infrastructure within the proposed designation. This engagement occurred during development of the alignment and design refinement to understand the location of existing services and to discuss any necessary relocations, proposed upgrades or new services required within the vicinity of the alignment. Engagement with utility providers included Refining NZ, First Gas, Watercare Services Limited (Watercare), Transpower, Vector Limited, Spark, 2degrees Mobile Limited, and Vodafone. Engagement with utility providers is ongoing.

Engagement with Refining NZ and First Gas has been undertaken to obtain information for the Project in relation to their fuels and gas pipelines that traverse through the Project area. Both network utility operators noted key matters to be addressed such as methods for crossings of the fuels and gas pipelines, security of ongoing operations, design of works around existing assets and potential settlement risks and maintenance access. The Indicative Alignment was refined where appropriate in response to these matters.

Watercare has been engaged with during the Project regarding design features and the interface between the Project and Watercare's water and wastewater assets. Watercare has a surface water take that has the potential to be impacted by Project related construction and operation discharges if works are not appropriately managed. The Project team has identified measures to manage impacts on Watercare, as discussed in section 9.2 and 9.12 of this AEE.

The Transport Agency has engaged with Transpower in relation to the potential impacts of the Project on the high voltage transmission lines which run across the

Project area in the vicinity of Mangawhai Road. Transpower advised that alterations will be required to their existing transmission line assets (an additional support structure, as described in section 4 of this AEE) to maintain clearance distances between the conductors and the mainline carriageway. Any resource consents required for the alterations of Transpower's transmission line assets will be sought prior to the works occurring.

8.4.4. Road user organisations

Road user organisations, including emergency services, freight associations and driver associations were consulted regarding the Project. This engagement sought to identify any areas of concern and solicit feedback on the alignment. Issues identified relate to lack of rest areas and stopping places for regional freight, particularly southbound. Generally, the feedback has been positive from these organisations due to the Project proposing to increase road safety.

8.4.5. Interest groups

Consultation was undertaken with organisations potentially interested in the Project, including Vision Wellsford, Forest and Bird, Walking Access, Bike Auckland, Fish and Game, and Federated Farmers.

Vision Wellsford support the Project, due to the business and growth opportunities as a result of the proximity to the road interchanges with Wellsford and the ability for travelling public to easily get on and off SH1. A key issue raised related to the Wellsford exit being curved to align better to the existing SH1 to create as a sense of arrival into Wellsford and prominent exit signage.

Consultation has also been undertaken with Waste Management NZ in relation to their future plan change and proposed resource consent applications to establish a new land fill. At the time of lodgement neither the plan change or resource consent applications had been notified.

8.5. Public engagement

8.5.1. Consultation on the Indicative Route

Public consultation commenced with information on the Transport Agency website which reflected the presentations at the information days including a map of the Indicative Route and supporting poster boards. The website also provided an animated fly through of the route along with five interview style videos covering specialist topics such as geology, design, planning and the environment.

Promotion of the public information days was made via digital advertising, printed brochures delivered to households via NZPost, website promotion, social media and newspaper (both digital and hardcopy) along with personalised landowner letters.

Five information days were held between 18-28 February 2017 in Warkworth, Wellsford and Te Hana. All five information days were well attended, attracting between 65 and 230 people.

8.5.2. Engagement on the Indicative Alignment and potential environmental effects

Public engagement for the Indicative Alignment commenced with updating of the Transport Agency website to present the refined Indicative Alignment. The website was updated with the information presented during the public information days and included an Indicative Alignment map and factsheet.

Promotion of the public information days was consistent with the approach taken during the consultation on the Indicative Route and included digital advertising, printed brochures, website promotion, social media, newspaper (both digital and hardcopy) along with the landowner letters.

Three information days were held between 28 February and 6 March 2019 in Warkworth, Wellsford and Te Hana. The Warkworth Hub office was also open for two half-day public drop in sessions on 28 February 2019 and 6 March 2019. As the Project is referenced within the Warkworth draft Structure Plan document, the project team representatives also attended Council's open days in Warkworth on 7 and 9 March 2019.

8.5.3. Feedback received from the Indicative Route and Indicative Alignment engagement

The targeted engagement with stakeholders, and the wider Indicative Route and Indicative Alignment engagement, generated a wide variety of feedback from stakeholders and the community. Several themes became evident during analysis of the feedback.

The primary themes identified in the feedback received during the Indicative Route and Indicative Alignment, were:

1. The feedback received generally presented universal support for the Project and its aims and objectives. Positive feedback was also received on the Transport Agency's objectives for the Project to improve safety, increase route resilience and travel time reliability.
2. Warkworth residents expressed the desire for a better solution for the Warkworth Interchange. The feedback stated that the Indicative Route design would have significant effects on properties and residents in the Kaipara Flat and Phillips Road area. A key concern was that so many properties were affected in these areas that the remaining residents would no longer function as a community.
3. Concern around the change to the nature of the Kaipara Flats Road area, including safety of the Kaipara Flats Road / SH1 intersection, noise, visual impact and potential effects on property value.
4. Flooding is an issue for residents around Kaipara Flats Road, and there was concern as to how the Project will adequately manage this and also avoid exacerbating and potentially improve the situation for local residents and private properties.
5. Support for a Warkworth southern interchange which is outside the scope of this Project.
6. The bypass of the Wellsford township was generally desired/accepted due to the current bottleneck and effects of trucks experienced in the town. However, there was some concern for businesses that serve passing trade, and a desire to ensure

the Wellsford town centre remains a stopping place for people travelling north and south.

7. Existing congestion through Wellsford, slow travel times due to growing traffic volumes and concern that with construction 10 years away from starting, the situation will continue to get worse with no plans for improvements.
8. A high number of truck movements including from quarries need to be considered in the design of intersections at the Wellsford and Te Hana interchanges – e.g slip lanes.
9. Mangawhai is growing exponentially, general feeling is traffic may still use Wayby Valley Road as Mangawhai Road is windy/unsafe. Complaints about drive speed and traffic volumes on Waiteitei Road heading to/from Mangawhai.
10. Flooding was a key concern for residents in the Wellsford interchange area around Wayby Valley Road – both flooding on the proposed highway and the potential to exacerbate existing flooding issues for farmers and increase water quality effects in the Hōteo River.
11. Design refinements were investigated around the Te Hana Interchange to reduce land impacts by making better use Mangawhai Road and on properties located on Charis Lane.
12. The location of the northern tie-in was of concern, particularly in relation to safety around Maeneene Bridge and the local roads which connect with the existing SH1. Generally, those commenting suggested that the route should tie-in further to the north between Ross Road and Kaiwaka.
13. There was a sense of pragmatism from some landowners, particularly in Wellsford and Te Hana, with them balancing their support for the Project's intent against the effect on their land, and what that means for them as individuals, families and communities.
14. Ensuring the Project is future proofed as tunnels can become restrictive if not wide enough/enough lanes.
15. Native vegetation is preferred over exotic pine forest.
16. Safety of current road through the Dome is a concern and a strong driver of community support for the Project.
17. Concern from Dome Valley residents about construction impacts (noise, vibration and construction traffic).
18. Vegetation pockets along the Project are valued by community. Anecdotally some have historical value. Impacts on these need to be considered and avoided where possible to maintain areas of environmental value.
19. Flora and fauna in and around streams and in pockets are highly valued in both the Warkworth and Wellsford areas.
20. Uncertainty regarding construction timeframes and the length of time 'in limbo' prior to active property purchase. Many landowners feel as though they are in a holding pattern with no certainty.
21. Impacts on farms, there is the feeling that the Project takes the "best land" on a number of larger farming blocks, leaving farmers with smaller/poorer lots to farm.
22. Severance of farms/farmlets making them unviable.
23. Most Te Hana residents that responded supported the extension of the northern tie-in on the Indicative Alignment as it alleviates some safety concerns raised in early consultation on the Indicative Route.

24. More general themes included:
    - Requests to minimise impacts on people, properties, farms and business as much as practicable through design and mitigation;
    - Views that the Project is necessary and should be constructed as soon as possible; and
    - Views that there is a desire for growth to continue in Northland, with an understanding that the Project will help facilitate this. There is a sense that this new section of state highway is just a small piece, and that further improvements should extend to at least Whangārei.

8.5.4. Post lodgement – Ongoing and future engagement

Ongoing communication and engagement with stakeholders and the community will be undertaken following lodgement of the Application. This will include ongoing discussions with key stakeholders, sharing Project information with interested parties, and providing updates via the Project website and local media.

A comprehensive communication plan will be developed and implemented prior to and for the duration of construction works.

8.6. Public communication channels

Communities interested in the Project are spread over a large area, reflecting the rural characteristics of the Project area, and the wide range of transport network customers. This distribution dictated the use of a variety of communication channels to ensure widespread dissemination of key messages and to ensure that opportunities to provide feedback on the Project were open to everyone.

Key channels of communication included information days, Project website, toll free telephone number, media, advertising, project website, videos, and printed and email newsletters.

8.6.1. Warkworth Hub

To complement the Public Information Days, the Warkworth Hub was established for the public to come in and view project information and to meet with the Transport Agency. This was specifically set up to facilitate face to face meetings with landowners and interested parties within the Project area, due to the Warkworth Hub being accessible for people affected by the Project.

8.7. Changes made as a result of engagement

All key themes identified in the feedback have been considered along with further technical information that has come to hand as the Project has progressed. Input received from the consultation process has informed the design and assessment process. For example, local knowledge has been valuable regarding flooding and ground conditions. The feedback has contributed to, but has not been solely responsible for, decisions regarding:

- Location and configuration of the indicative Warkworth Interchange;
- Variations to the alignment design around Charis Lane;
- Design of structures crossing over the fuels and gas pipelines;

- The proposed location of the designation boundary to manage practical matters, such as access and business management (eg stock movements) and
- The form of the northern tie in, in the vicinity of Maeneene Road and Waimanu Road.

9. Assessment of effects on the environment

9.1. Introduction and summary of effects on the environment

Overview

The assessment of effects on the environment for the Project has identified a wide range of actual and potential positive and adverse effects on the environment.

The significant positive effects of the Project relate to transport benefits, through improved safety, supporting safe cycling and walking, reduced journey times for general traffic and freight, increased capacity, improved route security by providing an alternative route resilient to incidents, improved travel time reliability, and improved accessibility. Through the transport benefits, there will be associated economic and environmental benefits, such as stormwater treatment leading to reduced contaminant loads for two river catchments, retiring of some land that contributes to the sediment load of the Kaipara Harbour, through landscaping and planting for mitigation and through design which will assist with more fuel efficient travel (through better gradients and less need to brake, accelerate and/or decelerate). As a result of moving a significant number of vehicles off the existing SH1 and on to the Project, there will be reduced noise and air emissions for existing receivers along SH1 including through Wellsford and Te Hana.

During construction there will be temporary adverse effects, including effects arising from construction water discharges, construction traffic, construction noise and vibration, and dust.

The Project will have some permanent adverse effects. Most notably these are associated with noise, stormwater discharges during operation, loss of streams and indigenous vegetation, and associated habitat for indigenous species; changes in hydrology and flooding, visual effects and loss of heritage values.

The indicative design for the Project has sought to avoid or mitigate adverse effects through the early identification of environmental constraints as part of the route selection process, design of Project elements and the proposed construction methodology. Potential adverse effects will be further avoided or mitigated through the implementation of designation and consent conditions requiring detailed design, construction and operation of the Project to achieve identified mitigation outcomes. Specific mitigation is proposed within sections 9.2 to 9.20 of this AEE. This mitigation will be implemented through the provisions of various management plans as set out in the proposed conditions.

9.1.1. Introduction

This section provides a summary of the actual and potential effects of the construction, operation and maintenance of the Project. The summary provides an overview of the effects associated with the Project and identifies whether they are positive or adverse and the scale at which they are likely to occur at (i.e. local, regional or national), and whether they are temporary or permanent.

Avoidance of adverse effects has been the first principle for the design of the Project. As noted in Section 7 of this AEE, identification of environmental constraints and features was undertaken at the early stages of Project development to inform consideration of corridor and alignment options. Where avoidance has not been possible, mitigation measures have been proposed and are reflected in proposed designation and consent conditions.

As informed by the proposed harvest programme supplied by Rayonier Matariki during pre-lodgement engagement, this assessment of effects and supporting technical reports has assumed that the Matariki Forest will be harvested prior to the construction of the Project (i.e post harvest). As such, the clear-felled forest land forms part of the environment against which this Project has been assessed. For clarity section 9 of this AEE has been written on that basis with the exception of three sections. Sections 9.2 *Construction Water*, 9.5 *Terrestrial and Freshwater Ecology* and section 9.12 *Operational Water* and the corresponding technical reports (Water Assessment Report and Terrestrial and Freshwater Ecology Report) have considered both scenarios (i.e pre and post harvest) as the pre harvest scenario represents the worst case in terms of effects in relation to the relative changes to ecological values and water quality. Harvesting of the Matariki Forest is currently a permitted activity under the NESPF and therefore can be lawfully undertaken.

As outlined in sections 1 and 4 of this AEE, the Indicative Alignment is a preliminary alignment of a state highway that can be constructed within the proposed designation boundary. The final alignment for the Project will be refined and confirmed at the detailed design stage, through the outline plan process under section 176A of the RMA, and in compliance with the designation and consent conditions. The final design of the Project may move anywhere within the proposed designation boundary, and design features may change. The assessment of effects on the environment for the Project has been sensitivity tested, where relevant, as follows:

- The actual and potential effects on the environment of the Indicative Alignment were assessed;
- Consideration was given as to how the assessment of effects might change if the alignment (and ancillary components such as soil disposal sites or stormwater treatment devices) were to move horizontally or vertically within the proposed designation boundary;
- Consideration was given as to how the assessment of effects might change with lower or higher traffic growth than expected;
- Consideration was given as to how the assessment of effects might change if the harvesting of Matariki Forest did not occur prior to Project construction (applies to Section 9.2, 9.5 and Section 9.12); and
- Mitigation was recommended that addressed the effects of the Project, even in the event that the alignment changed within the designation boundary.

9.1.2. Structure of the assessment

The following sub-sections in Section 9, identified in Table 9-1, describe the assessment undertaken for the key topic areas. A summary of the resulting assessment is provided in section 9.1.3.

Table 9-1: Effects on the environment assessment topics

AEE Section	Topic
9.2	Construction water
9.3	Groundwater/ Hydrology
9.4	Ground settlement
9.5	Terrestrial and freshwater ecology
9.6	Marine ecology and coastal avifauna
9.7	Construction traffic
9.8	Construction noise and vibration
9.9	Construction air quality
9.10	Heritage/ archaeology
9.11	Land contamination
9.12	Operational water
9.13	Landscape and visual
9.14	Operational transport
9.15	Operational noise
9.16	Operational air quality
9.17	Social impacts
9.18	Cultural values
9.19	Economic
9.20	Land use and property

9.1.3. Summary of effects on the environment

The actual and potential effects of the construction, operation and maintenance of the Project are summarised in Table 9-2. This table provides a summary of the positive and adverse actual and potential effects of the Project, and the level and duration of these effects. There are opportunities or measures that can be taken to minimise or mitigate the adverse effects identified, and the table demonstrates the scale of effect following implementation of mitigation recommendations. These mitigation measures are identified in the assessments in sub-sections 9.2 - 9.20, and are summarised in Section 10. An integrated mitigation approach has been developed as a core part of the Project with consideration of Mana Whenua, ecology, heritage, landscape and hydrology to achieve an integrated approach.

Table 9-2: Summary of effects on the environment following implementation of recommended mitigation measures

Actual or potential environmental effect	Positive effect	Adverse effect	Local, regional or national level effect	Duration of effect	Scale of effect with mitigation
Construction water					
Effects on hydrology and floodplains from construction activities within the floodplain and wider catchments		✓	Local	Short-term	Minor
Effects on drinking water quality at any abstraction point		✓	Local	Short-term	Negligible
Effects on health of people and communities interaction with fresh water or marine water		✓	Local	Short -term	Negligible
Groundwater/Hydrogeology					
Effects on streams, wetlands and existing consented groundwater users from drawdown of groundwater arising from deep excavations and tunnel construction		✓	Local	Short-term during construction Long-term during operation	Less than minor
Ground settlement					
Impacts on buildings/ structures/network utilities		✓	Local	Long and short-term	No more than minor
Terrestrial and freshwater ecology					
Integration of ecosystems providing greater ecological resilience	✓		Local, regional	Long-term	Positive
Improved adaptive capacity of ecosystems through pest and weed control	✓		Local, regional	Long-term	Positive
Improved North-South ecosystem connectivity, in particular between the Mahurangi River (Left Branch) and the upper Kourawhero Stream catchments	✓		Local, regional	Long-term	Positive

Actual or potential environmental effect	Positive effect	Adverse effect	Local, regional or national level effect	Duration of effect	Scale of effect with mitigation
Removal of indigenous vegetation and impacts on fauna (bats, snails, lizards, birds) from loss of habitat, construction activities and creation of edge effects		✓	Local, regional	Medium-term prior to establishment of habitat.	Minor
Loss of stream ecosystems through culverting/soil disposal, increased sedimentation and stormwater runoff during operation and associated impacts on freshwater ecology from loss of habitat and disruption to fish passage/spawning		✓	Local, regional	Long-term	Minor
Loss of wetland ecosystems through removal of vegetation and hydraulic changes and impacts on fauna resulting from loss of habitat		✓	Local, regional	Long-term	Minor
Marine ecology and coastal avifauna					
Increase in sediment runoff from open earthworks areas during large rainfall events discharging to the Mahurangi and Kaipara Harbours during construction of the Project		✓	Local	Short-term following storm events Long-term accumulation	Less than minor
Effects on ecology in the Mahurangi and Kaipara Harbours arising from stormwater runoff during operation		✓	Local	Long-term accumulation	Negligible
Effects on Avifauna		✓	Local	Short-term	Less than minor
Construction traffic					
Effects on the local transport network and SH1 arising from temporary construction traffic		✓	Local, regional	Short-term during construction	Minor
Effects arising from temporary traffic management (TTM) including travel time and safety		✓	Local, regional	Short-term during construction	No more than minor
Construction noise and vibration					

Actual or potential environmental effect	Positive effect	Adverse effect	Local, regional or national level effect	Duration of effect	Scale of effect with mitigation
Temporary increased noise levels in proximity to the Project resulting from construction activities		✓	Local	Short-term during construction	More than minor
Temporary increased vibration in proximity to the Project resulting from construction activities		✓	Local	Short-term during construction	Minor
Construction air quality					
Reduced air quality in proximity to the Project resulting from dust emissions arising from temporary construction activities (earthworks, topsoil removal and spread, cut and fill operations, vehicle movements, rock crushing)		✓	Local	Short-term during construction	Minor
Heritage/Archaeology					
Effects on known archaeological and historic heritage sites resulting from Project construction		✓	Local	Long-term	Minor
Effects on unidentified subsurface archaeological remains during earthworks		✓	Local	Long-term	Minor
Contaminated land					
Effects on human health and the environment during construction arising from disturbance of contaminated land		✓	Local	Short-term during construction	Minor
Operational water					
Reduced fresh and marine water quality as a result of stormwater discharges (contaminant and sediment) and erosion/ increased stream flows (sediment)		✓	Local, regional	Short-term arising from storm events throughout the long-term operation of the Project	Minor

Actual or potential environmental effect	Positive effect	Adverse effect	Local, regional or national level effect	Duration of effect	Scale of effect with mitigation
Effects on water users (Watercare surface water take at Wellsford) as a result of reduced water quality following spill events		✓	Local	Short-term following spill events throughout the long-term operation of the Project	Minor
Changes in hydrology and increased flood risk due to increased impervious areas and catchment area, stream diversions, and change in drainage patterns.		✓	Local, regional	Long-term	Minor overall Moderate with respect to natural wetlands
Landscape and visual					
Impacts on landscape character, visual effects, modification of rural character and amenity values resulting from alteration of landforms and vegetation cover through vegetation removal and earthworks activities and introduction in changes to the landscape through the built elements of the Project		✓	Local	Medium to long-term until establishment of screening vegetation	Less than minor
Impacts on Outstanding Natural Features arising from construction works using existing road which traverses through the Project area and may result in minimal vegetation loss		✓	Local	Long-term	Less than minor
Impacts on areas of High Natural Character in the coastal environment arising from sedimentation during construction		✓	Local	Short-term following storm events with potential long-term accumulation	Less than minor
Operational traffic					
Improved safety	✓		Regional	Long-term	Significant Positive
Improved access through reduced journey times for general traffic and freight	✓		Regional	Long-term	Significant Positive

Actual or potential environmental effect	Positive effect	Adverse effect	Local, regional or national level effect	Duration of effect	Scale of effect with mitigation
Improved resilience through travel time reliability	✓		Regional	Long-term	Significant Positive
Increased capacity within the SH1 corridor	✓		Regional	Long-term	Significant Positive
Improved route security by providing an alternative route resilient to incidents	✓		Regional	Long-term	Significant Positive
Operational noise					
Improved noise levels from the reduced traffic volumes in areas around the existing SH1, particularly through Wellsford and Te Hana townships	✓		Local	Long-term	Positive
Operational air quality					
Improved air quality at locations along the existing SH1, particularly through Wellsford where exposure to air contaminants will be reduced from the reduced traffic volumes	✓		Local	Long-term	Positive
Reduced air quality at locations where the new state highway is proposed within areas where existing air quality is to a high standard		✓	Local	Long-term	Less than minor
Social					
Improvement of social well-being for the wider community	✓		Local	Long-term	Positive
General disruption to local communities (residents, commercial business owners) as a result of construction activities, including diversions, change in access, and noise.		✓	Local	Short-term	Minor
Reduced amenity in areas around the new state highway		✓	Local	medium-term	Minor

Actual or potential environmental effect	Positive effect	Adverse effect	Local, regional or national level effect	Duration of effect	Scale of effect with mitigation
Anxiety and worry caused by uncertainty, navigating the RMA process, and loss of existing social and family networks.		✓	Local	Short-term	Moderate
Cultural values					
Effects on potential urupa, Pa settlements and other cultural heritage areas		✓	Local	Long-term	More than minor
Loss of wetlands affecting important mahinga kai sources, effects on wetland functions and fauna habitat		✓	Local	Long-term	More than minor
Adverse effects on the mauri of the Mahurangi River, Hōteo River and Maeneene Stream and associated impacts on ecosystems that sustain taonga species and therefore people		✓	Local	Long-term	More than minor
Loss of vegetation, impacting habitat for taonga species that are threatened (kauri snails, lizards and Hochstetter's frogs) and general impact on fauna behaviour, abundance and diversity within the Project area		✓	Local	Long-term	More than minor
Reduced public awareness of the Te Hana Te Ao Marama Cultural Centre as a result of reduced traffic flows potentially affecting visitor numbers to the Centre		✓	Local	Long-term	More than minor
Economic					
Improved accessibility between Auckland and Northland with associated economic benefits	✓		Regional	Long-term	Significant Positive
Increased economic activity in Auckland and Northland during construction	✓		Regional	Short-term	Significant Positive
Improved economic performance resulting from improvements in journey time, resilience and reliability	✓		Regional	Long-term	Significant Positive

Actual or potential environmental effect	Positive effect	Adverse effect	Local, regional or national level effect	Duration of effect	Scale of effect with mitigation
Land use and property					
Temporary occupation of property for construction purposes including construction site compounds		✓	Local	Short-term	Moderate
Changed access to some properties		✓	Local	Long-term	Moderate
Effects of severance and the remaining viability of commercial farmland and commercial plantation forestry		✓	Local	Long-term	Moderate

9.2. Construction water

Overview

Construction of the Project will involve land disturbing activities including earthworks, streamworks and vegetation removal. These activities, if not appropriately managed, have the potential to increase the risk of sediment-laden runoff being discharged to the receiving environment. The Mahurangi River, Hōteo River and Oruawharo River catchments are the receiving environments for the Project which drain into two coastal waterbodies; the Mahurangi Harbour and the Kaipara Harbour.

Erosion and sediment control measures will be designed and implemented to minimise the effects of sediment runoff reducing water quality on these receiving environments. These measures will be based on best practice erosion and sediment control in Auckland as set out in Auckland Council and Transport Agency guidelines. Preliminary Erosion and Sediment Control drawings have been prepared to demonstrate how erosion and sediment control could be delivered for the Project. These drawings are contained in the *Construction Water Management (ES-Series)* drawings in *Volume 3: Drawing Set*.

There is the potential that during construction the Project could result in changes to hydrology and flooding within receiving watercourses associated with:

- Temporary and permanent culverts and stream diversions;
- Increased flows and a reduction in baseflows due to ground compaction, reduction of forestry and grassland, and increased impervious areas;
- Increased hydrological connectivity through positive drainage resulting in increased peak flows;
- Construction within the floodplain.

With mitigation measures in place, effects associated with the construction of the Project on water quality, water users and hydrological impacts will be negligible to minor and temporary in nature.

9.2.1. Introduction

This section summarises the findings of the assessment of the actual and potential effects associated with water during the construction of the Project outlined in the *Water Assessment Report in Volume 2* of this Application. The *Water Assessment Report* is supported by a number of technical reports and in referencing the *Water Assessment Report* here, refer to the whole suite of reports, in particular those relating to construction water management[64]. Effects associated with water in relation to the operation of the Project (also outlined in the *Water Assessment Report*) are summarised in section 9.12 of this AEE.

The *Water Assessment Report* provides a detailed description of the existing hydrological regime in the Project area and provides an assessment of the environmental effects of construction-related water on the receiving environment

[64] Catchment Sediment Modelling technical report, Water Quality technical report, Construction Water Management Design Report.

including sediment yields that result from earthworks activity. The *Water Assessment Report* describes the methodology used to model sediment to predict sediment yields during the construction of the Project and identifies methods and practices that will be implemented to minimise associated environmental effects. The assessment has been undertaken based on the identification of construction-related water issues and principles, the development of methodologies for key construction activities, an assessment of environmental risks associated with sediment yield and assessment of effects of the eventual sediment loads in the receiving environment.

The potential effects on ecology and habitat resulting from effects of construction-related water in the receiving environment have been assessed in the *Ecology Assessment* and *Marine Ecology and Coastal Avifauna Assessment* in Volume 2 of this Application and are summarised in sections 9.5 and 9.6.

9.2.2. The receiving environment

The hydrology and drainage catchments within the Project area are discussed in section 3.3.4 (Hydrology and drainage catchments) of this AEE. Section 3 also provides an outline of the downstream receiving coastal environment. Key aspects of the existing environment as they relate to construction water management are outlined below.

Catchment characteristics

The Project passes through three catchments, the Mahurangi River, the Hōteo River and the estuarine Oruawharo River. These catchments drain into two coastal waterbodies. The Mahurangi River flows to the Mahurangi Harbour and out to the Hauraki Gulf, whereas the Hōteo and Oruawharo Rivers flow westward to the Kaipara Harbour.

The existing landform, rainfall, geology and land-uses within the Mahurangi, Hōteo and Oruawharo River catchments affect their existing water and sediment quality.

The steepness of these catchments along the Project area varies, with steep catchments in the hills to the east and west of the Dome Valley and lower gradient catchments associated with the Mahurangi River and Hōteo River floodplains.

The soil types influence the generation of sediment when exposed by earthworks. Fine textured sedimentary and alluvial soils predominate in the Project area. The fine (silt and clay) fractions of these soils are susceptible to erosion, particularly in steep terrain.

Pastoral farming and commercial plantation forestry are the main land uses throughout the Mahurangi River catchment and the Hōteo River catchment, while in the Oruawharo the main land use is pastoral farming. There are also areas of indigenous forest, towns and crops within the catchments.

The Mahurangi and Hōteo Rivers are known to experience flood events with high risk flood areas located within the Project area at Kaipara Flats Road and Wayby Valley Road.

Water quality

The AUP(OP) Regional Policy Statement identifies both the Kaipara Harbour and Mahurangi Harbour as degraded from a water quality perspective due to human activities. The *Existing Water Quality* technical report concludes that existing water quality data, and data collected for this Project, indicates that nutrients and *E. Coli* are elevated in various freshwater sites across both catchments. This data indicates that metals are generally below guideline values, however copper is elevated at some freshwater sites in both the Mahurangi and Kaipara catchments. Elevated sediment levels are an issue for both catchments, with elevated turbidity and suspended sediments in freshwater, and elevated sedimentation in the upper reaches of both harbours. The lower Mahurangi Harbour has excellent saline water quality and the Kaipara Harbour has fair water quality in the southern Harbour and good saline water quality at the entrance of the Kaipara Harbour.

Catchment values and uses

Within the catchments the rivers, streams and downstream estuarine environments provide a range of ecological, recreational and resource functions and are suitable for a range of uses. The catchments and coastal environment:

- support aquatic ecosystems;
- provide a food source (Mana Whenua food gathering traditions such as shellfish, fishing and white baiting);
- provide a drinking source for stock;
- provide a source of irrigation;
- provide a drinking source for residents of Wellsford; and
- support recreational uses including swimming, boating, fishing and bankside amenity.

9.2.3. Construction water assessment methodology

The potential changes to the receiving water environment during the construction of the Project relate to changes in water quality arising from the discharge of sediment from earthworks during rain and flood events, discharge of sediment from in-stream activities, and discharge of other contaminants (such as oils, fuels and cement) from general construction activities. Due to the nature of the Project, it is anticipated that sediment generation and yield due to earthworks operations is likely to be the main driver of changes to water quality during construction of the Project.

In addition, construction of the Project may result in changes to catchment hydrology and flooding.

Sediment modelling

Catchment sediment modelling has been carried out to predict sediment load during the construction of the Project, as compared to background sediment.

Two models were used (one for the Mahurangi Harbour and the other for the southern Kaipara Harbour) to predict the construction-phase sediment loads within the Mahurangi, Hōteo and Oruawharo river catchments, and subsequent sediment loads delivered to the coast.

The modelling has been undertaken based on scenarios both with and without erosion and sediment controls in place. These methodologies and practices are summarised in section 9.2.4 below.

For the Mahurangi Harbour sediment generation, predictions were derived based on the BNZ/GLEAMS model built for the P2Wk project. It assumed a maximum active area of 43.4 ha and predicted mean annual sediment loads, daily event loads and loads related to maximum active earthworks areas related to 2 year, 10 year and 50 year ARI storm events. Peak earthworks activity was assumed to occur in years 1-3 of construction.

A model was built specifically for the Hōteo and Oruawharo catchments using the eWater SOURCE software (Welsh et al. 2012) as the Project sediment modelling platform and with the addition of the Daily SedNet component to simulate sediment erosion.

Two different construction scenarios were modelled for the Hōteo and Oruawharo catchments:

- **The changing land-cover scenario** – this scenario modelled the changing land-cover across an approximate 7-year construction period including changes between summer (October –April) and winter earthworks' extents (May – September). The land-cover is based upon the construction phasing contained in the Construction Water Design technical report. It is based on a 6 year bulk earthworks period and provides for an active area in summer which equates to the full open extent programmed in any given year and a winter value that is 20% of the area of the preceding summer area. It also considered sediment generation during a 2 year, 10 year and 50 year ARI storm event. This scenario reported mean annual sediment loads and daily event loads for each construction year.
- **The maximum active area extent scenario** – this scenario is modelled as the maximum active area of earthworks across the entire construction footprint. This scenario has a fixed land-cover and corresponds to the years 1-2 construction extent for the Hōteo catchment of 75 ha, and a maximum extent for the Oruawharo catchment of 25 ha. This scenario modelled sediment generation during a 2 year, 10 year and 50 year ARI storm event and assumed that these would occur during peak earthworks activity. This scenario reported storm event related sediment loads for each peak active area.

These construction sediment models include the use of erosion and sediment controls (ESC) based on an indicative ESC design for the Project. In summary, the modelling incorporates a number of activities that have the potential to generate sediment including:

- Earthworks, including bulk earthworks, tracking and trenching where rainfall encounters exposed earth;
- Works in and around streams and wetlands (e.g. culverts, retaining walls, piles and bridges) that disturb and entrain sediment; and
- Soil disposal.

Project area by catchment

The construction of the Project is estimated to require approximately 310 ha of earthworks. Table 9-3 of the AEE provides an outline of the extent of the Project within each of the catchments. These comparisons illustrate that the Project area within each catchment is a relatively small percentage of the catchment area. The magnitude of the potential effects of the Project is therefore limited by this consideration.

Table 9-3: Areas (approximate) affected by the Project within affected catchments

Catchment and sub-catchments	Total catchment area (ha)	Proposed designation footprint		Indicative Alignment impervious footprint[1]		Indicative earthworks footprint[2]	
		Area (ha)	%	Area (ha)	%	Area (ha)	%
Mahurangi River catchment	5,670	225	25%	25	<1%	43.3	<1%
Mahurangi (right branch)	2,880	20	<1%	0.5	<1%	1.3	<1%
Mahurangi (left branch)	1,445	175	12%	20	1%	41	3%
Hōteo River catchment	39,815	905	2%	150	<1%	203	<1%
Kourawhero Stream	4,010	160	4%	20	<1%	23.7	<1%
Waiteraire Stream	1,415	395	28%	60	4 %	88.2	6%
Unnamed tributaries (H1 & H2)	735	150	20%	30	4%	91.5	5%
Unnamed tributary (H3)	455	75	16%	15	4%		
Unnamed tributary (W1)	500	40	8%	5	1%		
Oruawharo River	26,660	285	1%	45	<1%	63	<1%
Te Hana Creek	1,740	175	10%	20	1%	33	2%
Maeneene Creek	1,510	110	7%	25	2%	30	2%

1 – Indicative Alignment impervious footprint from Indicative Alignment (includes the road, interchanges, side roads and cut faces)

2 – Indicative earthworks footprint derived from conceptual areas of cut, fill and soil disposal sites to construct the Indicative Alignment.

9.2.4. Construction water management

The *Water Assessment Report* is based on the construction methodology developed for the Project (refer to section 5 of this AEE). This construction methodology indicates that construction activities will be carried out in stages and works within those stages will be sequenced to manage erosion and sedimentation.

The specific cut and fill locations and associated catchment boundaries, and soil disposal site locations will be finalised at detailed design.

Project approach to the management of construction water

Best practice ESC measures will be implemented during the construction phase of the Project to manage the sediment yield from the Project and avoid or mitigate effects on the freshwater and coastal receiving environments. All construction-related sediment runoff discharges are to a freshwater system after treatment.

The ESC for the Project will be designed and implemented with a hierarchy and priority order designed to minimise the extent of soil erosion and capture and retain, to the fullest practical extent, any resultant sediment yield generated from the upstream construction zone as follows:

- **Prevention:** Excluding clean water runoff from entering the active work areas, therefore preventing clean water runoff from combining with excavated spoil and/or construction material and will require the use of clean water diversion channels and/or bunds to divert runoff from the upstream side of the work area. This also includes avoidance of areas not necessary to earthworks and progressive stabilisation.
- **Capture:** Any sediment laden runoff generated within the working area will be captured using dirty water diversion channels and/or bunds on the downstream side of the construction site which will direct sediment-laden runoff from the site to an appropriate sediment control device. Sediment capture will be implemented through one or more sediment control measures.
- **Minimisation:** Minimising the length of time and the extent of the area of exposed/disturbed soil to reduce the potential for erosion generation. Timely stabilisation of exposed areas and the construction of impermeable areas will also reduce the potential for erosion to occur.
- **Staging and sequencing of Works:** Construction activity will be carried out in stages and works within those stages will be sequenced to manage erosion and sedimentation. Working areas will be progressively stabilised as the works progress.

Preliminary erosion and sediment control drawings have been developed to demonstrate the ability to install appropriate ESC devices for the Project. These drawings are contained in the *Construction Water Management* (*ES-Series)* drawings within the Drawing Set in *Volume 3*.

The key elements of construction related environmental risk for this Project are related primarily to works within, adjacent to, or connected to, freshwater and coastal environments and areas of steeper contour. High erosion risk areas include:

- Works within a sediment control protection area[65]; and
- Works in areas exceeding a slope of 10 degrees.

Potential effects of discharges from earthworks in these higher risk erosion areas will be managed through the implementation of appropriate ESC measures over and above those typically implemented. This may include the implementation of limits on the extents of open areas of earthworks, providing super silt fences down slope of sediment retention devices to provide a last line of defence, regular and

[65] Defined in the AUP(OP) as:
- 100m either side of a foredune or 100m landward of the coastal marine area (whatever is the more landward of mean high water springs); or
- 50m landward of the edge of a watercourse, or wetland of 1,000m² or more.

progressive stabilisation, increased frequency of inspection and maintenance of ESC measures and increased levels of monitoring.

A continuous improvement monitoring programme (explained in section 5.4 of the *Water Assessment Report*) will be implemented to provide both qualitative and quantitative monitoring outcomes to help inform the extent of construction activity on site and to influence and reduce the direct effect of construction works on the sediment yield into the receiving environment.

Non-sediment contaminants (i.e. cement, flocculants, fuel, oil) may directly or indirectly discharge into the receiving environment from site activities. Management of these non-sediment contaminants will be subject to specific best management practice and industry guidelines.

ESC principles

The key principles that have been applied to the Project relating to erosion and sediment control are set out in Table 9-4 below.

Table 9-4: Key ESC principles

Approach / Principle	Criteria
Erosion and Sediment Control Plan (ESCP)	The ESCP is the overarching erosion and sediment control plan that outlines and confirms the overall approach to construction water management. The ESCP includes the following elements: • ESCP design • Education and training of all site staff; • Implementation of a continuous improvement monitoring programme, which will form part of an overall Construction Environmental Management Plan (CEMP); • Process for the development of CESCPs; • Quality Assurance / Management System; • Proactive and reactive ESC maintenance Based on the indicative construction methodology and sequencing, and more detailed on site assessment of key activities (including looking at specific higher risk locations such as the Hōteo River bridge works), the methodologies identified and documented can be effectively implemented.
Construction Stage Erosion and Sediment Control Plans (CESCPs)	CESCPs are detailed erosion and sediment control plans which will be submitted to Council for certification for specific work areas and/or activities within the site. CESCPs will provide the detailed design, specific ESC measure location, staging and sequencing of works for that location and will be developed prior to works commencing in these locations. The CESCPs will determine specific measures to be employed and will also consider any alternatives that exist. The CESCPs will determine the most effective and appropriate form of construction water management devices and management practices required to manage discharges during the construction period in response to the environmental values for that location. As part of the Project implementation, the CESCPs will follow the principles and approach outlined within the *Water Assessment* and will also confirm specific design details.

Approach / Principle	Criteria
	The implementation of site specific CESCPs will further allow for innovation, flexibility and practicality of approach to construction related water management. They will enable the construction team to have ongoing input into the ESC measures and practices prior to and during construction. This CESCP process allows the construction water management measures utilised within the Project to continually adapt to changing construction, environmental and climatic conditions. CESCPs will include: • Contour information; • ESC measures for the works being undertaken within a particular construction area; • Chemical treatment design and details; • Catchment boundaries; • Location of the work; • Details of construction methods; • Design criteria, typical and site specific details of ESC measures including ensuring that all sediment retention ponds and decanting earth bunds have full access track provisions for maintenance at all times; • Identification of risk and sensitive area locations and the details of management (including contingency measures) around these aspects; • Details of open areas that exist for the project at the time of the CESCP and a programme for managing ongoing non-stabilised areas; • The identification of staff and resources who will manage and maintain ESCs; • The identification of staff who will monitor compliance with conditions; • Details of specific resources and responsibilities for managing environmental issues on site to ensure that any resultant conditions of consent are complied with; • Methods and procedures for decommissioning measures; and • Design details for managing the treatment, disposal and/or discharge of contaminants (e.g concrete wash water). In addition, each CESCP must clearly illustrate on a plan the specific location and boundaries of the CESCP (in the context of the wider Project) and what activities are addressed within them.
Construction staging and sequencing	Staging and sequencing are both important non-structural measures and will be implemented as necessary to achieve the progressive stabilisation on an ongoing basis. Detail of the staging and sequencing of works will be detailed within the CESCPs. The staging may include reduced area of working in winter. For the assessment it has been assumed in the winter the active area will be 20% of the area at the peak of the previous summer season, which reflects the wet nature of the period and the inability to achieve any necessary earthwork compaction standards. The 20% is assessed as a percentage of area that may be able to be successfully earthworked with progressive stabilisation in place. Dependent upon the ability to successfully implement earthwork activities over this winter period this 20% may well increase based on monitoring outcomes from the continuous improvement monitoring programme.
Device location and discharges	All ESC devices should be located outside the 20 year ARI flood level unless no other viable alternative exists. All construction related runoff discharges are either to a land environment or direct to freshwater systems with particular emphasis on avoidance of the

Approach / Principle	Criteria
	sensitive locations identified where practicable. Discharges to land are considered to be beneficial in that a land-based buffer zone will provide a 'polishing' effect of the discharged runoff. Where discharges are direct to freshwater systems, to minimise erosion of the stream bank and bed at that point, the outlet will be protected with geotextile and riprap material in the immediate vicinity of the outlet.
Non-Structural Measures	These elements include: • Proactive monitoring and reporting programme (as per Section 9 the *Water Assessment Report*); • Risk identification and management; • Progressive stabilisation as works progress; • Open area limit within the Hōteo catchment of 75 ha; • Staging and sequencing of specific work/activity programmes; and • Weather response.
Progressive stabilisation for erosion and dust management purposes	Progressive and rapid stabilisation of disturbed areas utilising top soil (where necessary) and seed, mulch and geotextiles will be ongoing throughout the Project. Stabilisation will be undertaken with three key purposes: • To achieve an effective erosion and sediment control programme inclusive of progressive stabilisation; • To reduce the exposed earthwork areas within higher risk locations to assist with a reduction in sediment generation; and • In response to the continuous improvement monitoring programme to address any potential effects or undesirable monitoring trends.
Streamworks	Works within or adjacent to freshwater streams are generally considered higher risk than other earthwork activities due to the close vicinity of the sensitive receiving environment and the associated increased potential for sediment yield. Within the Project, streamworks will be undertaken in a manner that recognises and responds to this risk. Where practical, streamwork activities and any associated works within these environments will be undertaken in an offline dry environment. This strategy will be based upon the temporary diversion of flows around the area of works or working immediately next to the stream with no formal stream diversion required. All streamworks will also be undertaken with consideration of fish spawning and migration periods.

ESC design criteria

Both Auckland Council and the Transport Agency have published guidelines and standards relating to the design, construction and management of ESC measures for land disturbing activities, which are applicable to the Project as identified below:

- Auckland Regional Council Technical Publication No. 90 – Erosion & Sediment control Guidelines for Land Disturbing Activities in the Auckland Region (TP90).
- Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region; June 2016; Guideline Document 2016/005 (GD05); Auckland Council.

- Erosion and Sediment Control Guidelines for State Highway Infrastructure; September 2014 (Transport Agency ESC Guidelines).
- Forestry Operations in the Auckland Region a Guideline for Erosion and Sediment Control; September 2007; Technical Publication 223 (TP223); Auckland Regional Council.

Construction water management for this Project will be implemented in accordance with all of these guidelines which provide information on the appropriate use, design and construction of ESC practices for the Auckland region. Where the guideline documents present a range of design criteria, the more onerous design criteria that are most protective of the environment for the design of the ESC measures have been adopted. Table 9-5 below summarises the key ESC design criteria that have been developed for the Project.

Table 9-5: Summary of key ESC design criteria

Device/methodology	Criteria
Erosion control measures	
Clean Water Diversions (CWD)	Clean water diversion channels and bunds will be designed to cater for the 1% annual exceedance probability (AEP) rainfall event.
Contour drains	Contour drains will be designed and implemented in accordance with GD05.
Dirty Water Diversions (DWD)	Dirty water runoff diversion channels will be sized to cater for the 1% AEP rainfall events. Sediment sumps with a minimum volume of 2 m^3 to be installed in all DWDs at a maximum distance of 50m between sumps.
Pipe drop structures/flumes	Flumes will be used to safely transfer runoff from the top of batters to the bottom of the batter slopes.
Rock check dams	Rock check dams will be designed and implemented in accordance with TP90.
Stabilised entrance ways	Stabilised entrance ways will be established at all entry and exit points of the site.
Sediment control measures	
Container impoundment systems	Container Impoundment Systems will be implemented as per Drawing ES-076. They will be based on a 3% volume criterion applied in relationship to catchment size and as such will apply to smaller catchment areas than DEBs and SRPs. Their primary purpose is for the initial earthworks in steep or constrained or constricted working areas prior to the formation of a SRP or DEB structures.
Decanting earth bunds (DEBs) and decant systems	All DEBs established will be based on a volume of 3% of the contributing catchment area and sized accordingly, subject to a to a maximum DEB catchment area of 3,000m^2 unless varied within the CESCPs. All DEBs will be fitted with floating decants. Decants will have a manual control mechanism (to prevent) outflow from the DEB during pumping activities to these structures.

Device/methodology	Criteria
Flocculation	Flocculation will be applied to SRPs and DEBs based on an approved Chemical Treatment Management Plan (CTP). Flocculation will be applied to DEBs with a catchment area above 500m^2, and all SRPs. For all contributing catchments over 2ha in area, two flocculation sheds will be installed per device for the purpose of increasing the volume of flocculant available and also for reducing the risk of failure if one of the flocculation systems fails or has reduced performance. Manual batch dosing will be applied as required. Flocculant socks will be utilised as alternative and/or additional measures as required.
Sediment retention ponds (SRPs)	All SRPs will be implemented based a 3% volume criterion applied in relationship to catchment size (i.e. 300 m^3 SRP volume per 10,000 m^2 of contributing catchment). All SRPs will be subject to a maximum catchment area of 50,000 m^2 unless varied within the CESCPs Baffles, decant pulleys and reverse slopes will be installed in all SRPs.
Super silt fences and silt fences (SSF)	All super silt fences and silt fences will be based upon the design criteria within TP90. SSF fabric will be installed with at least 200mm of fabric upslope at the base of the trench. In areas where sediment control devices are within 50 m of a watercourse, SSF will be utilised as a last line of defence such that if a failure of the primary control measure eventuates then the last line of defence will capture and treat such a discharge.

Construction activity management

The overall approach to ESC for the Project includes a number of construction activity specific ESC methodologies which have been developed to identify the ESC and pollution control measures and practices required to manage construction-related stormwater runoff. These methodologies are summarised in section 5.3 of the *Construction Water Design Technical Report* and will be further developed and detailed within the CESCPs to be produced prior to construction works commencing.

The activity-specific methodologies relate to the following construction activities:

- Stockpile establishment and management;
- Soil disposal site establishment and management;
- Temporary or permanent stream diversions;
- Culvert construction;
- Bridges;
- Concrete work;
- Pumping from excavations and shear keys;
- Chemical treatment of SRPs and DEBs (flocculation);
- Riprap placement;
- Stormwater wetland establishment;
- Access track and haul road establishment;
- Construction compounds and staging areas;

- Overall earthworks;
- Works within the flood plain; and
- Tunnel establishment.

9.2.5. Assessment of effects associated with water during construction

Effects on water quality

Conspicuous oil or grease films, scums or foams, or floatable or suspended materials

Oil and grease may be released in very small amounts due to accidental spills. Any conspicuous oil and grease films that develop would be temporary. The release of small quantities of floatable materials (in particular litter) may occur during construction and therefore will be temporary. These risks can be managed through construction management planning. With good management in place, and identified and confirmed within the CEMP and CESCPs, the effects on water quality are considered to be minor.

The receiving environment is not likely to develop nuisance films and scums as a result of construction water discharges.

Colour and clarity

The predicted increase in sediment yield during rain events is likely to result in a change in water colour and clarity of receiving waterways. Existing data and water quality sampling undertaken for the Project indicate that clarity is currently low in the Mahurangi River, the Hōteo River and its tributaries, Maeneene and Te Hana Creek. The sediment yield from the construction areas will consist of fine clays and silts. Conspicuous changes in colour and clarity in the rivers will be temporary and are expected to occur during and after storm events.

The catchment sediment model found that generally changes to sedimentation are more acute within smaller tributaries and smaller in the Mahurangi, Hōteo and Oruawharo Rivers. The largest predicted changes to sediment load were observed in the Waiteraire Stream, the Kourawhero Stream headwaters and the unnamed tributaries of the Hōteo River. The *Water Assessment Report* outlines an increase greater than 25% in TSS as a threshold for an unacceptable change in clarity in the Mahurangi Estuary and Kaipara Harbour.

In all events, the post-treatment increases in TSS concentrations are assessed to be less than the 25% threshold in the Mahurangi Estuary and Kaipara Harbour. In terms of an increase in sediment concentrations there is some relationship that can be established with the sediment loads as modelled. Effectively an increase in sediment loads will typically also result in an increase in sediment concentrations. On this basis the largest percentage increase in sediment loads is within the Kourawhero, Waiteraire and Tributary H2, and particularly for a 50 year ARI rain event. The specific nature of this sediment concentration is however not established. But based on previous water quality sampling results sediment concentrations of up to 2000 g/m^3 can occur at some periods during heavy rain events. Importantly, based on experience from other earthwork projects the sediment concentrations typically increases with flow rates and they often are for short periods of time and very quickly decrease back to lower levels. This can occur within less than 24 hours of the rain event.

Overall, it is considered the effects on colour and clarity will be minor due to their localised extent and temporary duration.

Odour

Algal blooms and eutrophic conditions can cause objectionable odours. The predicted increases in particular nutrients are not expected to cause the conditions that would result in noticeable a change in odour in the streams or marine environment. It is considered the effects on odour will be negligible.

Summary

Overall, the effects on water quality will be minor and the effects will be temporary and can be mitigated.

Effects on water users

Drinking water

Watercare currently takes raw water for Wellsford's potable water supply from a surface water take from the Hōteo River upstream of Wilson Road. The raw water taken from the Hōteo River is treated to meet drinking water standards.

The Project construction at times is expected to increase the level of sediment within the Hōteo River, which can impact on the treatment of raw water. An increase in sediment will result in increased turbidity which has aesthetic effects. The *Water Assessment Report* predicts an increase in sediment load of less than 1% (mean annual sediment load increase) at both the Watercare water abstraction sites on the Hōteo River and Mahurangi River, noting that Watercare has recently switched to a groundwater take for Warkworth's water supply. Watercare still holds a consent for surface water abstraction to maintain flexibility. The turbidity of surface water within the Hōteo River at the water take abstraction sites regularly exceed the New Zealand Drinking Water Standard (NZDWS 2008) values, but the water is treated by Watercare to meet the relevant NZDWS values (less than 2.5 Nephelometric Turbidity Units).

There may be instances where the TSSs in the Hōteo River could potentially impact on the treatment plant operations. However, the assessment indicates that construction water discharges from the Project would have only a small influence on whether increases in suspended sediment might occur. The background sediment load would be the main driver for determining when the raw water quality is approaching the limits of the plant's treatment capabilities.

The release of sediment will also result in the release of particulate nitrogen. Nitrate and Nitrite are nutrient compounds with human health significance. The increase in nutrients as a consequence of increased sediment during the construction period is not expected to alter the quality of the source compared to NZ drinking water standard (NZDWS 2008) values for nitrite and nitrate, neither of which are elevated at the source in the monitoring data.

There is the potential for an accidental spill of contaminants to enter the Hōteo River during construction. If an accidental spill occurred, it is likely that a large proportion of contaminants would be intercepted by the sediment retention devices, but some residual contaminants could be discharged into these rivers.

In the context of the construction water management techniques to be utilised within the Project; including, the open area limit, the continuous monitoring programme and the innovative practices proposed e.g sediment sumps in all diversion channels and rainfall activated flocculation devices, the effects of the Project on surface water drinking sources in the Hōteo River will be minor. The assessment recommends that Watercare be informed if a spill occurs or in the event of a larger rainfall event where large sediment loads are discharged from the site in the Hōteo catchment, so Watercare is able to determine what action, if any, is required.

Recreation

The existing water quality of river sites monitored in the *Water Assessment Report* exceed visual clarity indicators for swimming, meaning water quality is good for swimming.

The Mahurangi Estuary, Kaipara Harbour and Oruawharo River are popular for secondary contact (boating), and for swimming in some locations. The mid to upper parts of the Mahurangi Estuary have poor clarity, generally less than 1.6 m and do not meet the Australia and New Zealand Environment Conservation Council (ANZECC) contact recreation water quality guidelines for clarity. The clarity of the lower Mahurangi Estuary is good and meets standards for contact recreation, with clarity generally greater than 1.6 m. The suspended sediment concentration at the Kaipara Harbour mouth is below guideline values indicating that the elevated sediments from the Hōteo and Oruawharo River mouths settle out prior to reaching the Kaipara Harbour.

The increases in sediment load arising from the Project may result in changes in clarity that are noticeable, but it is not predicted that temporary changes in clarity will alter the suitability of the freshwater or marine receiving environments for contact recreation.

Overall, it is considered that the change in water quality associated with the construction runoff will have a negligible impact on the health of people and communities having contact with fresh water and/or marine water.

Other users

The predicted increase in sediment and sediment bound nutrients is expected to have a negligible effect on the drinking water quality for stock.

Apart from the Watercare surface water abstraction on the Hōteo River, there are no consented surface water abstractions on watercourses within the Mahurangi, Hōteo or Oruawharo catchments that are affected by the Project.

There may be an effect on permitted abstractions, if they are located close to discharge points assuming there is no filtration of the water take. However, the effect will be temporary, with TSS concentrations expected to return to background levels relatively quickly following rain events. The potential effect on existing and foreseeable water users is likely to be minor with potential moderate effects depending on the proximity of users to the Project discharges, and it is recommended that effects on existing users, if they are impacted by construction sediment are managed (for example providing or replacing filters).

Effects on hydrology and flooding

There is the potential that construction works could result in changes to hydrology within receiving watercourses, including changes to catchment runoff, changes to catchment boundaries, changes to stream flow, and changes to stream channel and stream bed morphology.

Temporary and permanent culverts and stream diversions may result in increased flows within some streams and decreased flows within others. This is assessed in detail in the operational water assessment (section 9.12). The effects are likely to be similar during construction with relatively large changes for flows experienced in small tributaries and negligible changes within major streams. All temporary and permanent culverts and diversions will be designed to accommodate the 1 in 20-year rain fall event, and therefore there will be no change in flooding for events up to this size.

There is less than a 30% chance of an event larger than the 1 in 20-year flood occurring across the 7-year construction period. In the event of a larger flood occurring, there might be some localised flooding associated with culverts and stream diversions. No changes to flooding depth, extent or hazard are anticipated outside of the proposed designation boundary, as diversions will be designed in accordance with GD05. As such the effect is assessed to be negligible.

Increased flows and a reduction in baseflows may result due to ground compaction, reduction of forestry and grassland and increased impervious areas. In addition, peak flows could also increase due to increased hydrological connectivity through positive drainage. These effects will be reduced through the implementation of the SRPs and DEBs which will provide some retention of flood water, although the primary function is a reduction in suspended sediment. Any residual changes to hydrology are unlikely to be large, given that the Project will only account for a small percentage of the total stream and river catchments in the area. In addition, any changes would be short term and occur prior to the installation of the permanent drainage.

There is the potential for construction within the floodplain to result in changes to flooding outside of the proposed designation boundary, however these would be equal to or less than the changes associated with the operational phase and these effects are addressed in section 9.12.

9.2.6. Measures to avoid, remedy or mitigate actual or potential adverse effects

The *Water Assessment Report* outlines recommendations to avoid, remedy and mitigate effects during construction of the Project, which are discussed below. The ESC approach and key devices and methodologies and design criteria are outlined in Table 9-4 and Table 9-5. In addition to those measures already identified, notice will be given to Watercare in the event of a sediment spill above the Watercare water take for Wellsford's reticulated supply. Warkworth's water supply is currently abstracted from groundwater.

Continuous improvement monitoring programme

A continuous improvement monitoring programme will be implemented which will allow for ongoing water quality and ecological assessment of the construction programme. The continuous improvement monitoring programme will:

- Provide information for making effective decisions on necessary continuous improvement of erosion and sediment control measures (both structural and non-structural);
- Assist in understanding the outcome of on-site decisions to water quality and stream ecology, and support any determination of potential ecological effects from sediment discharged by the Project earthworks; and
- Quantify potential sediment discharges from the Project and enable appropriate site management responses and mitigation to be identified to reflect sediment yields.

The continuous improvement monitoring programme will include the following key components:

- Receiving environment visual assessments;
- Weather forecasting;
- On site monitoring of devices;
- Flocculation monitoring; and
- Quantitative water quality and flow monitoring.

The results of the monitoring programme will be used to identify where improvement to site devices is needed and identify future risks based on pre-determined trigger levels. The improvement monitoring programme will also inform the overall effectiveness of the conditions and may be used as the prompt to review conditions in a positive light as appropriate, either at the initiative of Auckland Council or the Transport Agency.

Flooding

The potential of flood risk during construction has been considered. In the first instance, works within floodplain areas have been avoided where possible. Where works are required within floodplain areas, in particular those associated with culvert placement, the risk profile is increased, and works methodologies will be adapted for these areas. Construction works within overland flow paths will be avoided where practicable to ensure the function of the overland flow path is retained. Particular methods will be adopted to ensure that works are undertaken during predicted fine weather windows and that stabilised flow paths are available if weather conditions deteriorate.

Streamworks

Where works are required to streams, prior to any streamworks commencing on the site, development of a final methodology for the streamworks (through a CESCP) will occur. Particular emphasis will be placed on timing, staging and sequencing of streamworks, to outline how effects on streams will be managed.

9.2.7. Conclusion

Construction activities, if not appropriately managed, have the potential to increase the risk of sediment-laden runoff and other contaminants being discharged to the receiving environment.

The *Water Assessment Report* has assessed the effects associated with construction and made the following recommendations:

- All works to achieveidentified construction water management objectives;
- ESC devices to be designed on a best practice approach and include details from GD05, TP90 and Transport Agency ESC Guidelines. In addition, some specific design criteria have been identified that will be adopted;
- Preparation of CEMP, ESCP, CTP and CESCPs for all land disturbance activities is required;
- A 14 day stabilisation requirement will apply on all open areas for earthworks;
- An open area earthworks limit of 75ha for Hōteo catchment with the ability to adapt as necessary and dependent upon monitoring outcomes;
- Specific consideration within the CSCPs of ESC methodologies for identified high risk locations;
- Specific consideration of methodologies for stream works activities through a CESCP;
- Incident notification (including in relation to incidents upstream of Watercare's Wellsford water take);
- Within the CEMP ongoing training to ensure environmental awareness is in place; and
- Implementation of a continuous improvement monitoring programme.

It is considered that if the measures outlined above are implemented, sediment yields resulting from the earthworks and construction activities can be managed, resulting in the works having negligible to minor adverse effects.

9.3. Groundwater/ Hydrogeology

Overview

Effects on the groundwater regime can arise from deep excavations and tunnel construction below the groundwater table and can impact groundwater levels, surface water resources and groundwater quality and quantity.

Drawdown from the proposed tunnels is confined to a narrow 500 m corridor parallel to the tunnels, with the majority of drawdown occurring within 250 m. This constrained drawdown in the vicinity of the tunnels is typical of construction dewatering effects within low permeability materials and there will be negligible impacts on existing groundwater users and groundwater dependent ecosystems outside of this drawdown area. Nine bores are located within the proposed designation boundary. None of these are located within the calculated drawdown areas.

Drawdown from the proposed cuts is confined to a narrow 230 m corridor parallel to the Indicative Alignment. However, groundwater drawdown of any significance (i.e. 5 m or greater) is constrained to the immediate vicinity of the cut along the Indicative Alignment. The relatively small lateral extent of drawdown arising from the indicative cuts is typical of construction dewatering effects within low permeability materials, with negligible impacts on existing groundwater users and groundwater dependent ecosystems expected outside of this area.

There is only one bore located within the calculated drawdown profile of the proposed cuts and this is located directly underneath the Indicative Alignment in an area of fill which will mean the bore will no longer be able to be utilised.

No effects have been identified on stream baseflow as a result of the cuts as no streams were identified in the vicinity of the drawdown profiles of the proposed cuts. However, if the alignment changes through detailed design and cuts extend to below the groundwater table and are located within 200 m of a stream, the change in baseflow should be modelled to determine any change to effects as assessed. Groundwater baseflow reduction in gullies within the calculated drawdown profile for the tunnels is likely to be small and unlikely to be detectable over and above the influence of surface water (stormwater) runoff.

No potential changes in groundwater level or flow which may affect surface water features such as streams/rivers, springs/seeps, ponds, wetlands, and drains have been identified.

Overall, the Project is expected to have less than minor effects arising from groundwater changes associated with the Project, including reduction in baseflows for watercourses fed by groundwater.

9.3.1. Introduction

This section summarises the findings of the assessment of the actual and potential effects of the Project on groundwater levels and flow outlined in the *Hydrogeology Assessment* contained in *Volume 2* of this Application.

The *Hydrogeology Assessment* provides a detailed description of the existing groundwater environment in the Project area, the methodology used to model and determine groundwater impacts and an assessment of the potential effects of the construction and operation of the Project on the existing groundwater regime.

9.3.2. Existing groundwater environment and assessment methodology

The influence of the underlying geological units on hydrogeological regimes found within the Project area are discussed in section 3.3.3 (Hydrogeology) of this AEE.

Aquifer recharge

The hydrogeological regime of the Project area comprises very low permeability rocks with no appreciable aquifers within the depth range of the Project excavations.

Two dimensional (2D) groundwater modelling and analytical assessment was undertaken to assess potential groundwater impacts anticipated to result from cuts/excavations along the Indicative Alignment and the proposed tunnels. Aquifer recharge, which is the flow or infiltration of water into the saturated zone of the subsurface profile, was calculated for the 2D groundwater and the deep groundwater recharge rate for hard rock in the area was assessed as 50 mm/year, or approximately 3.3% of annual rainfall.

Existing groundwater boreholes, use and abstraction

Regional borehole database records from Auckland Council showed a total of 119 boreholes drilled within 2 km of the centreline of the Indicative Alignment. Most of these 119 bores have been drilled in the vicinity of Warkworth. This area has been identified as the Mahurangi Waitemata High-Use Aquifer Management Area within the AUP(OP).

Groundwater levels

An understanding of groundwater levels, including depth to groundwater, seasonal fluctuations and vertical groundwater gradients is important to inform the assessment of effects on groundwater from the Project. Information relating to groundwater levels was obtained from various sources, including the Auckland Council database, previous investigations in the region of the Indicative Alignment and site specific information collected as part of the Project investigations.

Piezometer installation enabled groundwater level recording and monitoring. Multiple groundwater level measurements collected over time are important to provide an understanding of groundwater level recovery following drilling. Hydraulic testing was also undertaken in some boreholes to estimate aquifer hydraulic conductivity (the ability of an aquifer to transmit water). Twenty-two piezometers were installed during the site-specific investigation for this the Project and recorded the depth to groundwater within each formation as follows:

- Alluvium: between 0.05 and 0.5 metres below ground level (mbgl);
- Pakiri formation: between 1.6 and 125.9 mbgl; and
- Northland Allochthon: between -0.1 and 17.8 mbgl.

Although limited depth to groundwater information was obtained across the Project area, meaning a piezometric surface could not be generated, the *Hydrogeology*

Assessment has assumed that given the similar geological units and topography of the Indicative Alignment to P2Wk, the groundwater flow directions will broadly be consistent with those identified in the P2Wk Hydrogeological Assessment, as follows:

- Groundwater flow will follow surface drainage pathways and will change direction as the topographical control changes; and
- Groundwater levels will generally follow the topography.

9.3.3. Assessment of hydrogeology effects

The impact of the Project on groundwater will largely arise from deep excavations and tunnel construction below the groundwater table, which can impact on the natural groundwater regime in the following ways:

- Drawdown: groundwater drawdown reducing existing groundwater levels;
- Surface water resources: reduction in groundwater levels that may affect stream baseflow regimes, and alter present inflows and outflows from springs, streams, rivers, ponds and wetlands; and
- Groundwater quantity: reduction in groundwater quantity (yield) for existing abstraction bores through the alteration of groundwater flow patterns.

Potential groundwater drawdown

Drawdown is the reduction in groundwater level resulting from any form of development or activity, for example, pumping from a borehole or drainage through an excavation. The magnitude and maximum extent of drawdown are important considerations as these define the potential severity and zone of impact from the activity.

Groundwater drawdown during construction has been calculated for the proposed tunnel section of the Indicative Alignment and is relatively localised to the area surrounding the tunnels, with estimated drawdown of 0.5 m approximately 500 m from the alignment of the tunnels. Groundwater drawdown of any significance (assessed as being 5 m or greater) is constrained to within 250 m of the tunnel.

This constrained drawdown in the vicinity of the tunnels is typical of construction dewatering effects within low permeability materials. This would also apply if the alignment of the proposed tunnels changes within the designation boundary, as the geology is consistent with that used in the modelling.

A review of the major cuts (cuts in excess of 20 m height in Pakiri Formation and in excess of 10 m height in Northland Allochthon) along the Indicative Alignment was undertaken to determine which cuts were required to be assessed for potential groundwater drawdown. Of the 21 major cuts along the Indicative Alignment seven were assessed and the effects were determined to be very localised to the areas of the cuts. The maximum extent of drawdown is confined to a narrow 230 m corridor parallel to the Indicative Alignment. However, groundwater drawdown of any significance (i.e. 5 m or greater) is constrained to the immediate vicinity of the cut along the Indicative Alignment.

The relatively small lateral extent of drawdown arising from the indicative cuts is typical of construction dewatering effects within low permeability materials. This would also apply if the proposed cuts move within the proposed designation boundary, as all of the geology in this area is consistent with that used in the modelling.

The effects associated with groundwater drawdown on existing groundwater users and stream baseflow are outlined below. Groundwater drawdown also has the potential to induce ground settlement in soft compressible sediments, such as alluvium and highly weathered rock or clay. The potential for settlement as a result of the groundwater drawdown is discussed in section 9.4.

Potential impact on neighbouring groundwater users

The 119 boreholes located within the 2 km radius of the Indicative Alignment were reviewed to determine if the modelled groundwater drawdown profile would impact any user of a registered groundwater abstraction. Most bores in the area are greater than 150 m in depth and provide only very small yields (< 1 L/s).

There are no bores located within the proposed designation within the calculated drawdown profiles for either the indicative cuts or tunnels, meaning there will be negligible impacts on existing groundwater users. One bore will be physically removed to allow for construction of the Project.

Potential stream baseflow reduction

The reduction in groundwater contributions to local streams (i.e. stream baseflow reduction) as a result of the Project was assessed and a review undertaken of potential streams within the calculated drawdown profiles for both the indicative tunnels and cuts.

No specific streams have been identified within the vicinity of the drawdown profiles of the cuts, so no effects were identified on stream baseflow as a result of the excavations for the Indicative Alignment. The level of effect on a stream baseflow is dependent on the depth and extent of the excavation, distance to a stream and the characteristics of the stream. If through detailed design, changes to the alignment are undertaken and require excavation that extends below the groundwater table and are located within 200 m of a stream, the change in stream baseflow should be modelled to determine potential effects.

Several gullies which enable surface water flow are located within the calculated drawdown profile for the tunnels, and although not specifically identified as streams, an assessment of potential effects on one of these gullies located within 200 m of the indicative tunnel alignment was undertaken. The assessment concluded that if baseflow reduction does occur within this gully, it is likely to be small (0.15 L/s maximum) and more likely to be a wet area (i.e. wet season groundwater seeps) rather than a permanent stream. It is expected that this level of reduction is unlikely to be detectable over and above the influence of surface water (stormwater) runoff.

Overall, the potential reduction in baseflow as a result of the Project, from a flow volume perspective, will be less than minor.

Groundwater and surface water interaction

Localised interaction between groundwater and surface water has been identified, as potential changes in groundwater level or flow may affect surface water features such as streams/rivers, springs/seeps, ponds, wetlands, and drains.

In areas underlain by the Pakiri Formation and the Northern Allochthon, where the topography is moderately steep to steep and with deeply incised valleys, flow rates are very low, and groundwater typically emerges at the base of slopes in the form of seeps, and along geological boundaries (sometimes partway up slopes) in the form of springs.

Some of these springs and seeps feed small streams, while in areas where alluvium has infilled the valleys, groundwater is responsible for the baseflow in the larger streams and rivers. Wetlands 17A – 24 (at 89D Phillips Road), as identified in the *Ecology Assessment Report* are predominately surface water fed by the numerous streams flowing off the slopes to the north. However, many of these streams will be fed from springs/seeps high up in the catchment which will not be affected by the impacts of the Project on groundwater.

9.3.4. Measures to avoid, remedy or mitigate actual or potential adverse effects

The *Hydrogeology Assessment* has not identified any mitigation or monitoring as being necessary for groundwater impacts from the Project. If detailed design of the Project requires an excavation that extends below the groundwater table and the excavation is within 200 m of a stream, the change in stream baseflow should be modelled and the design should be adjusted if necessary with advice from a suitably qualified ecologist.

9.3.5. Conclusion

The most significant hydrogeological potential impact from drawdown of groundwater associated with the Project is the reduction in stream baseflows and resulting flows to wetland areas. Overall and based on the low permeability of rocks and corresponding low groundwater flow rates throughout the Project area, impacts on these watercourses will be less than minor.

If the alignment changes through detailed design and cuts are required which extend to below the groundwater table and which are located within 200 m of a stream, the change in stream baseflow should be modelled to establish effects. It is considered appropriate to include a condition requiring this work to be undertaken should this scenario eventuate.

No impacts are anticipated resulting from the drawdown of groundwater on existing groundwater users, due to the limited extent of the drawdown. Furthermore, given the low permeability of rock and corresponding flow rates, and the proposed surface water collection and treatment system which will discharge collected groundwater back into natural water courses, operational effects are considered to be less than minor.

Based on the findings of the *Hydrogeology Assessment*, effects from the construction and operation of the Project on groundwater drawdown and associated effects on stream baseflow and groundwater users will be less than minor.

9.4. Ground settlement

Overview

Construction of the Project requires cutting and filling of ground surfaces at a number of locations along the Indicative Alignment and in some cases associated groundwater drawdown. The areas surrounding these locations can experience ground settlement due to the mechanical settlement of ground from the movement of retaining walls, the consolidation of the ground due to lowering of the groundwater and consolidation of the ground due to the construction of fills. This can result in total settlement and differential settlement which can affect buildings and structures, network utilities and transport infrastructure.

Ground settlement effects will be mitigated through the design of the Project e.g. specific geotechnical measures or by appropriate measures, such that effects on infrastructure and assets within the proposed designation boundary will be manageable in relation to relevant engineering criteria and no more than minor. No ground settlement effects are anticipated beyond the proposed designation boundary.

9.4.1. Introduction

This section presents the findings of investigations undertaken to determine the actual and potential effects of ground settlement arising from the Project.

9.4.2. Existing environment

Geology

The geology of the Project area is outlined in section 3 of this AEE. The features of particular relevance to the assessment of ground settlement effects are set out below.

In the Project area, the Indicative Alignment is underlain predominantly by sedimentary rocks of the Waitemata Group (Pakiri Formation) south of the Hōteo River and typically Northland Allochthon rocks to the north of the Hōteo River. Relatively soft estuarine and alluvial soils are present in low lying regions and in-filled valley floors in the Woodcocks Road, Carran Road, Kaipara Flats Road, Wayby Valley Road, Silver Hill Road and Vipond Road areas.

Buildings, assets and transport infrastructure

The majority of the buildings within the Project area can be characterised as dwellings or rural farm buildings. These are sparsely distributed throughout the Project area. They are also interspersed through the rural environment outside the proposed designation boundary.

The Project area includes network utilities; including the major, significant network utilities described in section 3 and specifically below:

- The fuels and gas pipelines which are located within the same trench. The Indicative Alignment crosses the fuels and gas pipelines in the vicinity of the Hōteo River bridge, Farmers Lime Road, and near Mangawhai Road at the location of the proposed Te Hana Interchange. The fuels and gas pipelines also traverse alongside the proposed designation boundary for much of the alignment in the Hōteo North area.

- A 110 kV national grid electricity transmission line owned and operated by Transpower crosses to the north of Wellsford passing east of Te Hana. The Indicative Alignment crosses this corridor at the location of the proposed Te Hana Interchange. Two existing transmission towers are located within the proposed designation north of Mangawhai Road.

Transport infrastructure within the Project area is described in section 3 and includes numerous local roads providing access to small towns or settlements including Pakiri and Mangawhai.

9.4.3. Assessment methodology

Anticipated settlement arising from embankment construction has been qualitatively assessed for the Project based on known ground conditions and the type of construction work proposed and proximity to existing infrastructure and assets.

The effects of settlement arising from predicted groundwater drawdown were initially assessed in locations of known infrastructure and assets. Areas without any existing infrastructure were not assessed. Locations with groundwater drawdown further than 1.0 m from existing infrastructure were also eliminated. The *Hydrogeology Assessment Report* presents the predicted groundwater drawdown based on the depth of cutting excavation and existing ground water levels. Dwellings and other buildings located within the proposed designation boundary were excluded from the assessment as they will be unoccupied or demolished as part of the Project.

Ground surface settlement using one dimensional compression theory was considered to determine anticipated effects on infrastructure and assets.

9.4.4. Assessment of ground settlement effects

Settlement may occur within the Project construction footprint generally over the construction period but in some areas, settlement may continue into the operational phase.

Effects on infrastructure structures or utilities within the proposed designation boundary as a result of ground settlement associated with the Project are anticipated to be minimal for the following reasons:

- Settlement of embankments founded on Pakiri Formation and Northland Allochthon mudstones and limestone is unlikely to be significant as the foundation materials are stiff and relatively incompressible.
- Where embankments are founded in areas with shallow deposits of soft ground or alluvium it would be normal practice to remove the compressible materials and largely eliminate the settlement risk.
- Where alluvium is thicker and/or more extensive and it cannot be removed, the construction of an embankment will result in settlement. Immediate settlements are expected to take place during or immediately after construction of the embankment, but completion of settlement is expected to take several months or years.

- Many of the cuts are predicted to be formed above the groundwater level and thus will have no discernible impact on the groundwater table.
- Due to the relatively low permeability of the Pakiri Formation and Northland Allochthon rocks, groundwater drawdown is very localised to the areas of cuts along the Indicative Alignment.
- In many situations, the predicted drawdown is within the expected range of natural groundwater fluctuation.
- Groundwater drawdown where it extends to any structures is, for the most part, predicted to be limited to groundwater levels within the relatively strong rock formations that have very low compressibility. In the case where groundwater drawdown may occur in soil layers in the vicinity of any structures, it is predicted to result in only minor settlement of the surficial soils and be within acceptable tolerance levels.
- While groundwater will seep into a tunnel during and after construction, groundwater drawdown effects that would cause settlement of the ground above and around the tunnel are not expected.

No effects of ground settlement on buildings and infrastructure outside the proposed designation boundary are anticipated, and with appropriate mitigation in place as summarised below, no effects are anticipated on infrastructure immediately adjacent to the proposed works and within the designation boundary.

A house located at 161 Kraack Road is within the designation. The tunnels will pass beneath this house. However, tunnels will be at a depth of approximately 160 metres and within rock, and settlement is not considered to be likely.

9.4.5. Measures to avoid, remedy or mitigate adverse effects

To mitigate the risk of settlement to infrastructure and utilities located within or immediately adjacent to the proposed designation, there are a range of solutions that can be applied through geotechnical design to control these to acceptable settlement criteria. Design of these measures depends upon the site specific geotechnical properties, the expected settlement magnitude and the horizontal and vertical extent of the potentially compressible layers.

There will be close liaison with utility operators throughout the design and construction phase of the Project. Existing transmission towers within the proposed designation in the vicinity of Vipond Road will be monitored and protected if required.

9.4.6. Conclusion

The fuels and gas pipelines and the transmission towers are particularly sensitive to changes in grade due to ground settlement. Effects arising from ground settlement on these and other assets located within the proposed designation boundary can be mitigated through design. Consultation with utility operators will continue during the detail design and construction of the Project to confirm the need for any specific protection or monitoring of assets during construction. If required, this could include pre-construction surveys and ongoing monitoring during construction to allow appropriate remedial actions to be taken. Collaboration with network utility operators and confirmation of specific protection or monitoring of assets will be an essential part of the design and pre-construction phases. With mitigation measures in place the potential effects on Project infrastructure and assets arising from ground settlement will be manageable in relation to engineering criteria and no more than minor.

9.5. Terrestrial and freshwater ecology

Overview

Construction of the Project will involve, among other things, earthworks resulting in clearance of vegetation and discharge of sediment laden water into streams, stream works, diversion of waterways and the construction of culverts, bridges and viaducts over watercourses. These activities have the potential to result in a loss of indigenous vegetation, degradation and loss of terrestrial habitat for snails, lizards, frogs, bats, and birds; degradation and loss of freshwater habitat and changes to fish passage.

The operational phase of the Project may result in permanent disturbance to fauna from light and noise from vehicles and the mainline carriageway will provide a physical barrier to less mobile fauna (i.e. lizards).

Priority ecological sites have been identified where site-specific attention is required. These sites will be avoided as much as practicable. These areas include: Mahurangi River (Left Branch) and associated riparian margins (SEA), wetlands within the upper Kourawhero Stream catchment, and wetlands within the Hōteo River floodplain.

There are stands of high value indigenous vegetation located within the Project area north of Warkworth and in the Hōteo North area. There are areas of high quality wetlands with significant terrestrial values located in the upper Kourawhero stream valley near Phillips Road and in the Hōteo floodplain near Wayby Valley Road. These terrestrial and wetland ecological values will be impacted by the Project.

A variety of native fauna is present within Matariki Forest, including several species such as long-tailed bats, Hochstetter's frogs and kauri snail that are of conservation interest due to their threat status. There are also lizards and geckos present throughout the Project area.

Freshwater habitat across the Indicative Alignment has great variation in its ecological value; from low value degraded pastoral streams to very high value streams within Matariki Forest.

The pine plantation is currently mid-way through the production cycle, and harvesting is currently planned to precede construction of the Project. Harvesting activity will itself impact on the current terrestrial fauna and freshwater ecological values identified.

Recommended mitigation measures for addressing adverse terrestrial and freshwater ecological effects include:

- confirming the outcomes of baseline surveys of ecological values prior to construction;
- survey and classification of watercourses affected by the Project prior to construction;
- as far as practicable, protecting specific high value features in the event the alignment moves within the proposed designation boundary;
- integration of the mitigation (terrestrial and wetland planting, and stream riparian planting) by focusing revegetation, fauna habitat enhancement and stream restoration within a few priority areas that contain existing high value features.

The purpose of this aggregated approach is to link to existing ecosystems, prevent fragmented mitigation and build resilience;
- retaining cross-project ecological corridors for bats and birds;
- protocols for capture and relocation of fauna that reflect seasonal constraints;
- relocation of species to protected and appropriate habitat;
- pest and weed control at mitigation and fauna relocation sites; and
- design requirements for fish passage.

When implemented, the recommended ecological mitigation will lead to a cohesive and enduring outcome for ecological diversity, function and connectivity in the region.

With the recommended mitigation in place, the overall effects of the project on terrestrial and freshwater ecological values is considered to be minor.

Positive ecological effects are anticipated for the Project which include increased ecological resilience and adaptive capacity and enhanced ecosystem connectivity. The scale of these positive effects is considered to be minor.

9.5.1. Introduction

This section summarises the assessment of the actual and potential effects on terrestrial, wetland and freshwater ecological values arising from impacts of construction and operation of the Project as outlined in the *Ecology Assessment Report* in *Volume 2* of this Application.

The *Ecology Assessment Report* identifies the existing ecological values and significance of terrestrial and freshwater areas within the proposed designation (and outside the proposed designation where relevant), assesses the actual and potential effects on those values arising from the construction and operation of the Project and identifies measures to avoid, remedy or mitigate the potential effects on ecological values.

For the purpose of the ecological assessment, the Project is divided into three sections (Warkworth North, Dome Valley Forest and Hōteo North).

The assessment of effects on the marine environments to the east (Mahurangi Harbour) and west (Kaipara Harbour) are included in section 9.6.

9.5.2. Assessment methodology

The focus of the methodology was on the identification and assessment of existing ecological values of sites and effects of the Project in accordance with the EIANZ Ecological Impact Assessment Guidelines (EIANZ, 2018).

The criteria for 'Ecological significance', as set out in the EIANZ Impact Assessment Criteria Guidelines (EIANZ 2018), were used to assess ecological values of terrestrial and wetland sites. Factors considered include representativeness, rarity/distinctiveness, diversity and pattern, and ecological context.

The assessment of potential freshwater ecological effects was informed by the predicted sediment loads from the Project and water quality assessments detailed in the *Water Assessment Report.*

The criteria used to assign ecological value to freshwater ecosystems were modified from the EIANZ guidelines, to better include the array of attributes assessed for freshwater environments in New Zealand. These modified EIANZ criteria have been applied to other similar roading projects.

The level, or severity, of adverse effects resulting from the Project on the ecological sites or process was determined by the magnitude of the effect, the nature of the effect, and the ecological value of the site, in accordance with EIANZ 2018. Based on the EIANZ 2018 where if a moderate level of effect occurs, typically, this would require mitigation. Terrestrial and wetland ecological values were assessed as follows:

- Desktop data review to determine the selection of terrestrial survey sites.
- Site walkovers, the ecological features selected as a result of the above desktop review were then visited by a botanist and a fauna specialist, and at times, kaitiaki from Hōkai Nuku.
- Specific fauna surveys for snails, frogs, birds and bat were undertaken at representative sites.
- Pest mammal field signs (vegetation damage, prints, scat, bark biting) and the occurrence of weed species was noted.

Freshwater ecological values were assessed as follows:

- Stream ecological valuations (SEV) were undertaken using the Auckland Council SEV Assessment Methodology at 14 sites and included surveying fish and macroinvertebrate community samples.
- At sites where a SEV was not undertaken a standard stream habitat assessment was carried out.
- Stream classification assessment was based on the definitions within the AUP(OP) being; river or stream, permanent stream, intermittent stream, ephemeral stream, overland flow path and artificial watercourse.

Due to the large size of the Project area it was not possible to visit all watercourses within the proposed designation boundary. Where site visits were not undertaken, the permanence of the stream was estimated from the Auckland Council Overland Flow Path Layer within Geomaps.

The *Ecology Assessment Report* is based on the Indicative Alignment; however, a sensitivity analysis was performed to give guidance on the extent to which potential changes to the alignment (and design and location of ancillary components) within the proposed designation boundary would alter the scale or severity of effects. The *Ecology Assessment* also considered sensitivity to the timing of the Project, particularly as it relates to harvesting of the Matariki Forest; the plantation pine forest traversed by the Project. Matariki's current harvest plans indicate that harvesting will occur prior to project commencement. The assessment considered both the pre and post harvest scenarios for the Matariki Forest.

For assessment purposes the Project area has been divided into three discrete sections along the course of the Indicative Alignment (south to north) and covering the land within the Project area as follows:

a) Warkworth North
b) Dome Valley Forest

c) Hōteo North

These sections are mapped on Figure 9-1 of this AEE.

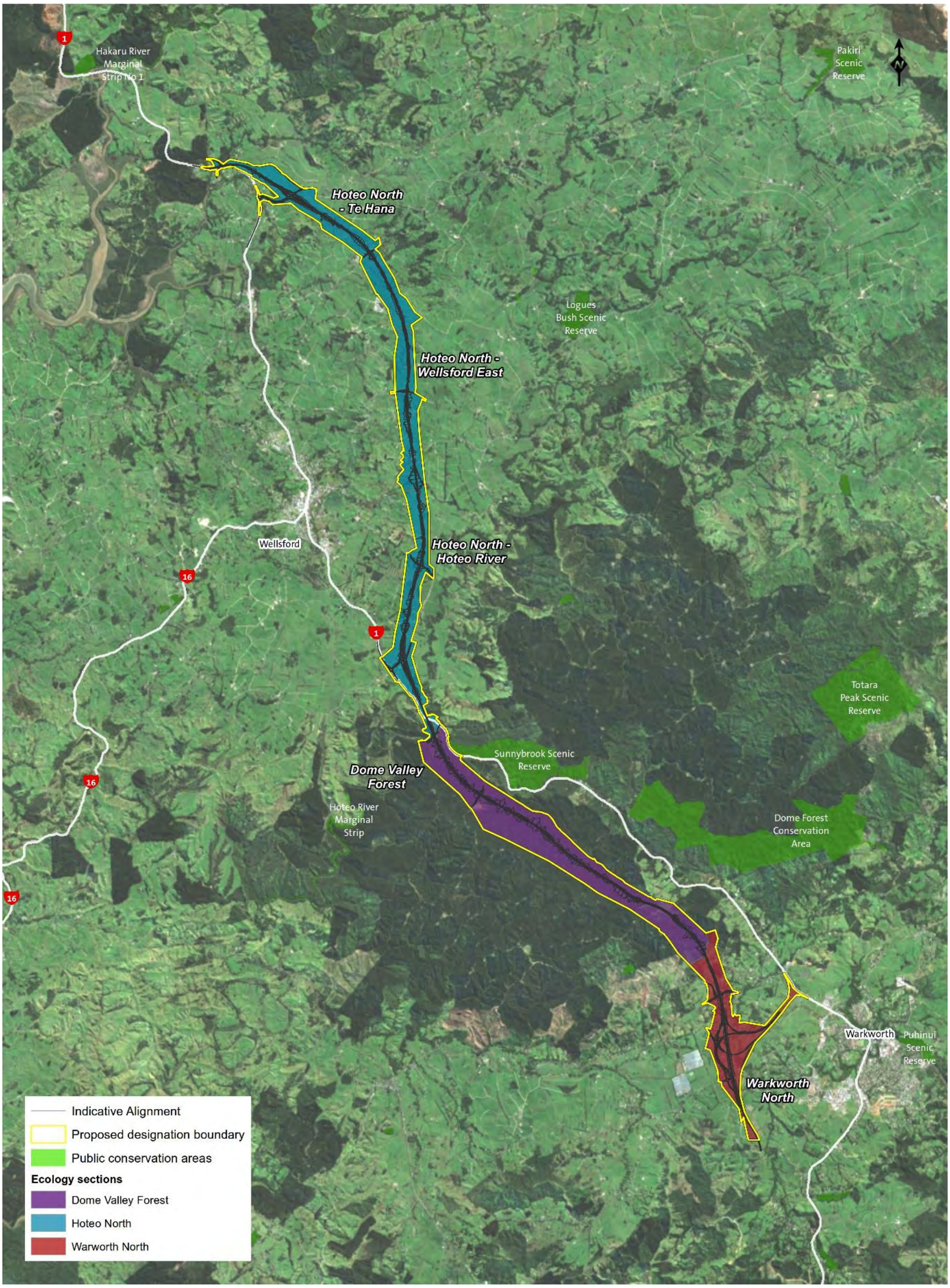


Figure 9-1: Ecology assessment sections

9.5.3. Assessment of terrestrial and wetland ecological values and effects

The effects of the Project on the terrestrial ecological values of the three sections vary and the summary below discusses each of these.

Warkworth North

Ecological values

The key attributes of the terrestrial and wetland ecological values of the Warkworth North section are:

- The majority of the section is currently in pastureland interspersed with lowland riparian forest, native forest remnants and several wetlands.
- Lowland riparian forest (podocarp-broadleaf forest) surrounds the Mahurangi River ranging between 30-150 m in width. This forest is identified as a SEA in the AUP(OP) and has been degraded due to stock access.
- Kānuka scrub is also common where agricultural land this has not been maintained and has a high likelihood of being occupied by geckos.
- Small wetland features (including exotic and raupo reedland) are interspersed throughout the landscape, which are generally degraded due to stock access.
- The large, open valley system in this area which is comprised of a mosaic of habitats including raupo reedlands, kahikatea forest, regenerating kānuka scrub and mature pines are suitable as communal roosts for long-tailed bats and the surveys undertaken confirmed that bats use this habitat.
- Three sites within the Indicative Alignment footprint in this section were identified as having 'High' or 'Very High' ecological value. These sites occur in the wide valley floor of the upper Kourawhero Stream that extends north into the Matariki Forest and south into the large floodplain of the Kaipara Flats between the Mahurangi River (Left Branch). This area would have formed a single large wetland ecosystem prior to agricultural development.

A summary of the ecological values of the sites surveyed is outlined in Table 9-6 and the sites are mapped in the Ecological Sites (ES) series drawings in *Volume 3, PES map series*.

Assessment of ecological effects

The potential adverse effects on terrestrial and wetland ecology in the Warkworth North area will include direct and indirect loss of vegetation, ecosystems and habitat and impacts on fauna. The magnitude and level of effects in the context of the EIANZ assessment criteria are outlined in Table 9-6. It is noted that a moderate level of effect using EIANZ would typically require mitigation and would therefore be considered significant in an RMA context.

Through design, direct impacts on High and Very High value wetland areas have been avoided as far as practicable through repositioning of the Indicative Alignment, design of embankments to minimise encroachment into wetland area and bridging (bridge 22), rather than culverting, the Upper Kourawhero Stream to maintain natural stream channel capacity and flooding pattern of the stream, also maintaining, as far as practicable, the existing hydrological conditions and connectivity for wetland sites.

The sensitivity analysis of the Indicative Alignment within the proposed designation boundary suggests that there is significant risk of further impacts on wetlands in the upper Kourawhero catchment and in close proximity to the Mahurangi River (Left Branch) and the upper Kourawhero catchment (priority ecological sites) if the Indicative Alignment moves.

Table 9-6: Ecological values and potential adverse effects on ecological sites in Warkworth North arising from the Project, Ecological Sites (ES) series drawings in Volume 3, PES map series.

Site	Potential effect of Indicative Alignment (approximate)	Ecological value	Magnitude of effect	Level of effect (without mitigation)
WN_T_Mahu_01 (SEA_T_2287)	Loss of riparian vegetation associated with bridge installation.	Moderate	Low	Low
WN_T_Mahu_02	38% of the site would be directly lost as a result of bulk earthworks. Loss of habitat, fragmentation and an increase in the extent of habitat edge. Physical barrier to less mobile fauna (e.g. lizards) between the two resulting forest fragments.	Moderate	High	Very high
WN_T_Koura_01	13% of site directly lost, but 50% of Critically Endangered kahikatea, pukatea forest would be removed. Loss of habitat, fragmentation and an increase in the extent of habitat edge, potentially compromising the viability of the remaining stand. Permanent, low level disturbance to sensitive native fauna, e.g. long-tailed bats (if present), from road and vehicle lights and noise.	01a – High 01b – Low 01c – Moderate	01a – Moderate 01b – Low 01c – Low	01a – High 01b – Very Low 01c – Low
WN_T_Koura_02	11% of site would be directly lost. Loss of vegetation but no significant further fragmentation. Permanent, low level, disturbance to sensitive native fauna (if present) from vehicle lights and noise.	Moderate	Moderate	Moderate
WN_W_Koura_01	18% of site would be directly lost as a result of bulk earthworks. Hydrology of the wetland is likely to be significantly changed as a result of diversion channels created.	Moderate	Moderate	Moderate

Site	Potential effect of Indicative Alignment (approximate)	Ecological value	Magnitude of effect	Level of effect (without mitigation)
WN_W_Koura_02	None of the site would be directly lost. Change in hydrology resulting in shift in vegetation community and habitat quality. Regionally threatened swamp maire is particularly vulnerable to reduction in water levels. Permanent, low level, disturbance to sensitive native fauna e.g. long-tailed bats (if present) from road and vehicle lights and noise, resulting in fragmentation of the wider valley for bats or suffer direct mortality due to vehicle collisions.	Very high	Low	Moderate
WN_W_Koura_03	3% of site would be directly lost as a result of bulk earthworks. Loss of habitat but limit further habitat fragmentation. Change to hydrology resulting in a shift in vegetation community and habitat quality. Permanent, low level, disturbance to sensitive native fauna e.g. long-tailed bats (if present) from road and vehicle lights and noise, resulting in fragmentation of the wider valley for bats or suffer direct mortality due to vehicle collisions.	Moderate	Low	Low
WN_W_Koura_04	None of the site would be directly lost. Permanent, low level, disturbance to sensitive native fauna e.g. long-tailed bats (if present) from road and vehicle lights and noise, resulting in fragmentation of the wider valley for bats or suffer direct mortality due to vehicle collisions.	Moderate	Negligible	Very low
WN_W_Koura_05	21% of site would be directly lost as a result of bulk earthworks. Loss of habitat but limiting further habitat fragmentation. Change in hydrology of the wetland through culverting which may increase conveyance of water through the wetland and a subsequent small reduction in water level. Permanent, low level, disturbance to sensitive native fauna e.g. long-tailed bats (if present) from road and vehicle lights and noise, resulting in fragmentation of the wider valley for bats or suffer direct mortality due to vehicle collisions.	Moderate	Moderate	High

Dome Valley Forest

Ecological values

The key attributes of the terrestrial and wetland ecological values of the Dome Valley Forest section are:

- Currently, plantation pine forest on steep, dissected hill country, interspersed with narrow riparian margins of native vegetation that line incised stream gullies.
- Areas of mature Eucalyptus, small podocarp broadleaf forest remnants, and mixed native and exotic regenerating scrub along roadsides and in recently harvested sites.
- A pair of live kauri snails (at the time of the site visit undertaken) and numerous whole kauri snail shells and shell fragments in several locations throughout Matariki Forest.
- 35 records from 2012 onwards, of Hochstetter's frogs within Matariki Forest and in the indigenous forest of the Dome Forest Conservation Area and surrounding environs.
- Bat surveys undertaken in the Dome Valley Forest area indicate Matariki Forest is an important landscape feature for the long-tailed bat population in the area.
- Contiguous habitat corridors along and across the Indicative Alignment (currently without forestry felled).

A summary of the ecological values of the sites surveyed is outlined in Table 9-7 and the sites are mapped in the Ecological Sites (ES) series in *Volume 3: Drawing Set*.

Assessment of ecological effects

The potential adverse effects on terrestrial and wetland ecology in the Dome Valley Forest area will include direct and indirect loss of vegetation, ecosystems and habitat and impacts on fauna.

The Project area largely traverses the plantation forest at approximately mid-slope, such that native vegetation within the Indicative Alignment is generally confined to the pine forest understorey and remnant areas of indigenous vegetation close by. Although Matariki Forest it is not indigenous forest, it is a large tract of maturing forest that provides habitat for a variety of native fauna (including several species that are of conservation interest due to their threat status) during their life cycle and facilitates the movement of indigenous species such as long-tailed bats and avifauna across the wider area.

The effects assessment on terrestrial, wetland ecology and At Risk fauna is cognisant of forestry operations and harvest cycles and acknowledges that the production forest is scheduled to be felled in any event.

Harvesting of Matariki Forest within the proposed designation is currently scheduled to occur prior to Project construction. The current forest harvesting plan shows that this results in the complete removal of tall stature pine within the proposed designation prior to the assumed commencement of the road construction in 2030. Large-scale modifications to available habitat for the fauna species of conservation interest within Matariki Forest will reduce baseline ecological values prior to the road construction and will therefore lessen the relative impacts of the Project on ecological values. However, it should be noted that the forestry harvesting is unlikely to completely remove these species from the area, and the Project will still impact their highly vulnerable populations through habitat loss and overall loss of connectivity along and across the Project alignment.

Given the above, the assessment was been carried out for both the pre and post harvest scenario because , if the harvesting did not occur as programmed the level of effects would be relative to the higher exsiting ecological values and therefore worst case. A summary of these effects is presented in Table 9-7.

Table 9-7: Ecological values and potential adverse effects on ecological sites in Dome Valley Forest (preforest harvest) arising from the Project, Ecological Sites (ES) series drawings in Volume 3.

Site	Potential effect of Indicative Alignment	Ecological value	Magnitude of effect	Level of effect (without mitigation)
DVF_T_Koura_01	Bulk earthworks, tunnel works, and operational disturbance has potential to reduce the availability of habitat for long-tailed bats by functionally severing the flight paths. Loss or modification to waterways impacting Hochstetter's frogs. Vegetation and habitat clearance impact on kauri snails.	High	High	Very High
DVF_T_Koura_02	9% of the site would be directly lost as a result Project works. Impacts on Hochstetter's frogs associated with hydrological changes and sediment deposition. Temporary disturbance of heavy machinery and vegetation removal associated with construction impacting long-tailed bats from light, noise, vibration and potentially dust.	Very High	High	Very High
DVF_T_Hōteo_02 (SEA_T_814)	No direct impacts on the site. Permanent, low level disturbance to sensitive native fauna, e.g. long-tailed bats (if present), from road and vehicle lights and noise will be negligible given separation distance to alignment.	Moderate	Negligible	Very Low
DVF_T_Hōteo_03	No direct impacts on the site. Temporary disturbance to fauna during construction. Restriction of bat and bird connectivity from this site across the expanse of pine forest.	Moderate	Moderate	Moderate
DVF_W_Koura_01	No direct impacts on the site. Temporary, low level impacts of increased dust and runoff entering the wetland comparative to baseline levels associated with existing forestry operations. Potential changes in hydrology could lead to a shift in the vegetation community and thus habitat quality.	Moderate	Low	Low

Hōteo North

Ecological values

The key attributes of the terrestrial and wetland ecological values of the Hōteo North section are:

- The Hōteo River and its tributaries connect a number of remnant patches of lowland forest including the totara-dominated forest lining the Hōteo River, as well as patches of kahikatea swamp forest on floodplains and taraire forest on higher ground.
- The northern portion of the section grades into rolling farmland interspersed with a few small patches of indigenous treeland, often associated with small tributaries.
- Forest and treeland patches across the Hōteo North section are largely surrounded by pastureland and the majority of the sites surveyed were isolated and degraded due to the surrounding agricultural land use.
- Many of the wetlands are degraded due to stock access and modifications in the surrounding drainage systems. However, there are also High and Very high-quality remnant wetland patches where stock have been excluded.
- No kauri snails have been observed and given the stream habitats and limited riparian cover in the Hōteo North section it is unlikely to be suitable for Hochstetter's frogs.
- No Threatened or At-Risk forest birds were detected during the surveys in this section.
- No bats were detected at the five survey sites in the summer of 2017/18.

A summary of the ecological values of the sites surveyed is outlined in Table 9-8 and the sites are mapped in the Ecological Sites (ES) series drawings in *Volume 3: Drawing Set*.

Assessment of ecological effects

The potential adverse effects on terrestrial and wetland ecology in the Hōteo North area will include direct and indirect loss of vegetation, ecosystems and habitat and impacts on fauna.

The Indicative Alignment and proposed designation directly impact a number of the aforementioned forest and wetland patches. The Indicative Alignment proposes a viaduct (Bridge 11) that crosses a site comprising mature and diverse taraire forest which has been assigned an ecological value of Very High. Bridge 11 will minimise impacts to this very high value site compared to other potential road design options.

Table 9-8: Ecological values and potential adverse effects on ecological sites in Hōteo North arising from the Project. (Locations shown on Ecological Sites (ES) series drawings in Volume 3)

Site	Potential effect of Indicative Alignment (approximate)	Ecological value	Magnitude of effect	Level of effect (without mitigation)
HN_T_Hōteo_01	34% of the site would be directly lost as a result Project works. Due to stock access, the site is unlikely to be inhabited by less mobile, ground dwelling, fauna. Mobile fauna such as forest long-tailed bats are likely to use the site occasionally at most.	Moderate	Low	Low
HN_T_Hōteo_02 (SEA_T_683)	4% of the site would be directly impacted by the construction of the bridge. Rain shadow and shading effects from bridge. Fragmentation of the western edge of the site will increase edge effects. Temporary disturbance of fauna associated with heavy machinery and vegetation removal. Permanent, low level disturbance to sensitive native fauna during operation as a result of vehicle lights and noise.	Very High	Moderate	Very High
HN_T_Hōteo_03 (SEA_T_6851)	27% of the site would be directly lost as a result of Project Works. Lowering of water level of the Machaerina sedgeland. Temporary disturbance of fauna associated with heavy machinery and vegetation removal. Permanent, low level disturbance to sensitive native fauna during operation as a result of vehicle lights and noise.	03a – High 03b – Moderate	03a – High 03b – High	03a – Very High 03b – High
HN_T_Hōteo_04	The whole site would be directly lost as a result of Project works. Potential loss of bat habitat.	Low	High	Low
HN_T_Hōteo_05	39% of the site would be directly lost as a result of Project Works. Potential loss of bat and bird habitat. Temporary disturbance of fauna associated with heavy machinery and vegetation removal.	Low	Moderate	Low

Site	Potential effect of Indicative Alignment (approximate)	Ecological value	Magnitude of effect	Level of effect (without mitigation)
HN_T_Hōteo_06	The whole site would be directly lost as a result of Project works. Loss of habitat for small remnant populations of both mobile and immobile native fauna, including threatened copper skink.	Moderate	High	Moderate
HN_T_Hōteo_07	47% of the site would be directly lost as a result of Project Works. Minimal increase in edge effects.	Low	Moderate	Very Low
HN_T_Hōteo_08	23% of the site would be directly lost as a result of Project Works. Potential loss of bat and bird habitat. Temporary disturbance of fauna associated with heavy machinery and vegetation removal. Permanent, low level disturbance to sensitive native fauna during operation as a result of vehicle lights and noise.	High	High	Very high
HN_T_TeHana_01	43% of the site would be directly lost as a result of Project Works. Impacts arising from edge effects. Potential loss of bat and bird habitat. Changes in hydrology affecting wetland function and resulting impact on wetland bird habitat.	Low	Low	Very Low
HN_W_Hōteo_01 (SEA_T_6854)	56% of the site would be directly lost as a result of Project Works. Fragmentation of site and increased edge effects. Loss of wetland habitat through infilling, resulting in changes to hydrology of remaining wetland potentially resulting in complete loss of functional wetland habitat. Rain shadowing and increased shading of remaining wetland as a result of the bridge. Loss of habitat for Threatened and/or At Risk wetland bird species.	High	Very High	Very High

Site	Potential effect of Indicative Alignment (approximate)	Ecological value	Magnitude of effect	Level of effect (without mitigation)
HN_W_Hōteo_02 (SEA_T_685)	No direct impacts on the site. Changes in hydrology through lowering of the water levels could lead to a shift in the vegetation community and habitat quality. Loss of and abandonment of habitat of Threatened and/or At Risk wetland birds resulting from construction/ operational disturbance and bird mortality.	High	Low	Moderate
HN_W_Hōteo_03	45% of the site would be directly lost as a result of Project Works. Negligible effects on loss of habitat of Threatened or At Risk wetland birds and construction and operational disturbance.	Low	Low	Very Low
HN_W_TeHana_01	23% of the site would be directly lost as a result of Project Works. Negligible effects on loss of habitat of Threatened or At Risk wetland birds and construction and operational disturbance.	Low	Low	Very Low
HN_W_TeHana_02	99% of the site would be directly lost as a result of Project Works. Negligible effects on loss of habitat of Threatened or At Risk wetland birds.	Low	Moderate	Very Low

Terrestrial and wetland ecological sensitivity analysis across all sections

Sensitivities of the effects on terrestrial and wetland ecology values (and the fauna that occupy these habitats) to modifications to the alignment (lateral or vertical re-alignment) occur within all sections of the proposed designation boundary.

The Warkworth North and Hōteo North sections contain heterogeneous habitat complexes. Therefore, these sections are more sensitive to lateral deviations of the Indicative Alignment at specific locations, compared to the Dome Valley Forest section (which is comprised almost entirely of commercial plantation forest and will be harvested prior to construction).

For example, within the Warkworth North section a movement of the alignment east or west in the upper Kourawhero Stream valley will result in the loss of part, or all, of specific high value sites, but may also then reduce or avoid the bisection of other features within the proposed designation to the south. Similarly, an increase in the vertical height of the Indicative Alignment in the Warkworth North section could result in wider batters that may also intrude into the Mahurangi River (Left Branch) or the high value wetlands of the upper Kourawhero Stream valley. Similar sensitivities apply to the southern area of the Hōteo North section where multiple Moderate to Very High value forest remnants and wetlands are located. Thus, sensitivities to spatial movement of the Indicative Alignment are moderate to high, particularly in the Warkworth North and Hōteo North sections.

Areas identified at most risk through the sensitivity analysis are also the areas that have been recommended as mitigation locations. The *Ecology Assessment Report* recommends avoidance, as far as practicable, of particular sites of Moderate to Very High ecological values, where practicable, and limitations on movement of the alignment into particular sites and on reductions in water table levels.

Although the majority of the habitat available in the Dome Valley Forest section does not have high botanical values, multiple Threatened and/or At Risk native animals (e.g., kauri snail, Hochstetter's frog and long-tailed bat) have been recorded within Matariki Forest. All of these species will be impacted when harvesting occurs. Consequently, if commercial harvesting of the forest is undertaken prior to the commencement of vegetation clearance necessary to facilitate the road construction, as is currently anticipated, this will significantly reduce the habitat value of the Dome Valley Forest section for the aforementioned fauna species and will reduce the relative level of effects resulting from the road construction and operation through the Dome Valley Forest section due to the change in baseline conditions.

9.5.4. Potential effects of road construction and operation on freshwater environments

The construction and operation of roads, particularly state highways, has a number of potential effects that are applicable to the whole Project, regardless of section. Such effects can be broken into construction and operational effects and are outlined below.

Construction effects

The major activities associated with the construction of the Project that may affect the freshwater habitats and their associated aquatic organisms are:

- Bulk earthworks and the associated discharge of construction water;
- Streamworks resulting in the loss of watercourses and habitat quality, including culverting;
- Diversion of existing waterways through newly created stream channels; and
- The construction of bridges and viaducts over watercourses;

These activities have the potential to result in:

- The discharge of sediment laden water into streams with the potential to increase the amount of suspended solids (TSS) and deposition on the streambed;
- Partial or total loss of freshwater habitats;
- Reduction in freshwater habitat quality;
- Changes to fish passage; and
- Loss of terrestrial habitat due to earthworks and subsequent construction activities.

Operational effects

The major activities associated with the operation of the Project that may affect the freshwater habitats and their associated aquatic organisms, if not appropriately managed, are:

- Contaminant run off;
- Stream and riparian zone shading from bridges and viaducts;
- Operation of culverts;
- Increased flood flows;
- Increased temperature of water flowing off impervious areas and stormwater ponds; and
- Increased streambank erosion.

These activities have the potential to result in:

- The discharge of sediment laden water into streams with the potential to increase the amount of suspended solids (TSS) and deposition on the streambed;
- Increased contaminant runoff;
- Changes to flow regimes;
- Partial or total loss of freshwater habitats; and
- Changes to fish passage.

9.5.5. Assessment of freshwater ecological values and effects

Warkworth North

Freshwater ecological values

Watercourses located along the Indicative Alignment within the Warkworth North section encompass those within both the Mahurangi River (Left Branch) catchment and the Hōteo River (Kourawhero Stream sub-catchment) catchment.

The key attributes of the freshwater ecosystem values of the Warkworth North section are:

- Freshwater environments are characterised by lowland aquatic habitats predominantly surrounded by grazed pasture.
- With the exception of the Mahurangi River (Left Branch), watercourses are typically small to medium sized tributaries that are highly modified. Many of these tributaries have historically been deepened and straightened to provide drainage to the surrounding low-lying areas.
- Freshwater ecological values of the two surveyed watercourses (Mahurangi River (Left Branch) and Kourawhero Stream) are moderate to high with surveys indicating excellent fish populations, good SEV scores and MCI scores that indicate good water quality. It is predicted that other watercourses within the Warkworth North section affected by the Indicative Alignment will have similar ecological values.
- An area of higher ecological value watercourses is present in the north of the section, on the upper Kourawhero Stream.
- The riparian margin associated with the Mahurangi River (Left Branch) is identified as an SEA (SEA_T_2287) in the AUP(OP) based upon 'Representativeness' and 'Status and Rarity'.

Two sites were surveyed, with an SEV survey at site WN_F_Koura_1, and a visual assessment at site WN_F_Mahu_1. The SEV score indicated a moderately healthy stream, within the typical range of scores seen for streams within rural catchments in Auckland.

The *Ecology Assessment Report* anticipated, through aerial photography and brief visual assessments, that the upper and lower reaches of the Mahurangi River (Left Branch) affected by the Indicative Alignment will have similar values to those observed at site WN_F_Mahu_1. The assessment also anticipated that the upper and lower reaches of the unnamed tributary upon which site WN_F_Koura_1 is located will have similar habitat values to that of site WN_F_Koura_1. The ecological values of the sites surveyed are outlined in detail in the *Ecology Assessment Report* and summarised in Table 9-9.

Assessment of freshwater ecological effects

The design of the Indicative Alignment has avoided impacts on the High value Mahurangi River (Left Branch) and the upper Kourawhero through the use of bridges and elevated on and off ramps, significantly reducing the impact on the River, nearby wetlands and reducing the loss of aquatic habitat. Some sections of the upper Kourawhero are to be diverted through new, ecologically functioning, channels either side of the Indicative Alignment. Watercourses that will be culverted are typically of low ecological value.

The addition of suspended sediment resulting from earthworks activities to freshwater environments poses a particular risk within the Upper Kourawhero Stream owing to the numerous natural wetlands within the system.

The magnitude and level of effects of the Project on freshwater ecological values in the Warkworth North section are outlined in Table 9-9.

Table 9-9: Ecological values and potential adverse effects on surveyed sites in Warkworth North arising from the Project, Ecological Sites (ES) series drawings in Volume 3, PES map series.

Site ID	Potential effect (approximate)	Ecological value	Magnitude of effect	Level of effect (without mitigation but with ESC in place)
WN_F_Mahu_1	**Construction** Reduction in water quality resulting from earthworks activities with a predicted average yearly increase of 12% within Mahurangi 'flats' River **Operation** Reduction in water quality resulting from stormwater runoff Degradation to habitat through shading from four bridges over the Mahurangi River, limiting the growth of aquatic plants and riparian vegetation within these shaded areas	High	Low	Low
WN_F_Koura_1	**Construction** Loss of habitat through altering catchments of upper tributaries by earthworks and through diversion of the Kourawhero Stream and tributaries. Reduction in water quality resulting from earthworks activities with a predicted average yearly increase of 17% within Kourawhero Stream. **Operation** Reduction in water quality resulting from stormwater runoff.	Moderate-High	Moderate	Moderate

Overall, the level of effects on freshwater ecological values within the Warkworth North section, prior to mitigation are Low to Moderate. The Mahurangi River (Left Branch) is crossed four times by the Indicative Alignment, with effects minimised through the use of elevated bridges. The northern end of the section contains a number of watercourses that are fed by streams and wetlands within the Matariki Forest that will require extensive culverting and stream diversion.

Dome Valley Forest

Freshwater ecological values

The key attributes of the freshwater ecosystem values of the Dome Valley Forest section are:

- Freshwater environments are characterised by steep hill streams located within plantation pine forest.
- Watercourses are typically small to medium sized tributaries draining steep hill country. Stream channels are a mix of silt/sand, gravels and cobbles with channels having high hydrological diversity. Watercourses higher in the headwaters tend to have 'harder' bottoms, and large cascade/pool sequences and waterfalls are common. The lower parts of watercourses typically have higher levels of silt/sand present. Riparian margins contain native regeneration and provide high shading and organic matter to the stream channel.
- Freshwater ecological values were High across all surveyed sites with surveys indicating very good fish populations, a high abundance of EPT species, excellent SEV scores and MCI scores that indicate excellent water quality. It is predicted that other watercourses within the section affected by the Indicative Alignment will have similar high ecological values.

Four freshwater sites were surveyed within the Dome Valley Forest section (DVF_F_Koura_1, DVF_F_Hōteo_1, DVF_F_Hōteo_2-1 and DVF_F_Hōteo_2-2), with full freshwater surveys undertaken at each of the sites. These sites were spread across the Matariki Forest block and are considered representative of the watercourses within this section.

The ecological values of the sites surveyed are outlined in detail in the *Ecology Assessment* and summarised in Table 9-10 below. It is expected that the majority of the Matariki Forest will be harvested prior to the construction of the Indicative Alignment. This is likely to reduce the ecological value of streams within plantation pine catchments within the Dome Valley Forest section prior to Project construction.

Assessment of freshwater ecological effects

The sediment models predict a moderately-low increase in average TSS loads at the test site within the Dome Valley Forest with an average annual increase in sediment loads of approximately 8.7% from existing levels. The addition of suspended sediment to freshwater environments poses a particular risk within the Waiteraire Stream due to the steep slopes and the large area of proposed earthworks within the catchment. This model does not account for any sediment coming from harvesting within Matariki Forest.

Effects of the Project on freshwater ecological values have been assessed based on existing ecological values, as well as anticipated future ecological values following forestry harvesting. The values of streams affected by the Project will need to be updated prior to construction to ensure the values present at the time are appropriately reflected in the overall mitigation necessary for the Project. The magnitude of effects on freshwater values within the Dome Valley Forest, based on existing ecological values, prior to mitigation, are high. The magnitude of effects based on the predicted ecological values following forestry harvesting, and prior to mitigation, are likely to be moderate (EIANZ, 2015) and require some form of mitigation to be applied.

Table 9-10: Ecological values and potential adverse effects on surveyed sites in Dome Valley Forest arising from the Project, Ecological Sites (ES) series drawings in Volume 3.

Site ID	Potential effect	Ecological value	Magnitude of effect	Level of effect (without mitigation)	Ecological value	Magnitude of effect	Level of effect (without mitigation)
		Existing ecological values			Predicted ecological values post harvesting		
DVF_F_Koura_1	**Construction** Loss of aquatic habitat through filling, cut off drains, stream diversions and stormwater wetlands. Reduction of water flowing to the site due to changes in hydrology.	High	High	Very High	Moderate	High	Moderate
DVF_F_Hōteo_1	**Construction** Loss of aquatic habitat through filling, cut off drains and culverting. Potential reduction of stream flow due to changes in hydrology.	High	High	Very High	Moderate	High	Moderate
DVF_F_Hōteo_2-1	**Construction** Loss of aquatic habitat through filling, stream diversions and culverting.	High	High	Very High	Moderate	High	Moderate
DVF_F_Hōteo_2-2	**No effects are anticipated**	High	Nil	Very Low	Moderate	Nil	Nil

Overall, the potential effects on existing freshwater ecological values within the Dome Valley Forest section are Very High prior to mitigation. The Indicative Alignment, including soil disposal sites, crosses a number of watercourses resulting in a high amount of stream loss through fill embankments, culvert installation, and stream diversions consequently leading to a loss of freshwater habitat. The potential effects on freshwater ecological values within the Dome Valley Forest section, based on predicted ecological values after harvesting, are Moderate.

Hōteo North

Freshwater ecological values

The Hōteo North section includes the lower reaches of the Waiteraire Stream, a number of unnamed tributaries of the Hōteo River, and the Te Hana and Maeneene catchments of the Oruawharo River.

The key attributes of the freshwater ecosystem values of the Hōteo North section are:

- Freshwater environments are characterised by highly degraded lowland aquatic habitats, with stock access and poor water quality that are surrounded by grazed pasture. Some reaches have intact riparian vegetation and/or fencing off from stock.
- Watercourses are typically small to medium sized tributaries that are highly modified, with many historically channelised. Fine silts and sand dominate stream channels, with abundant bank erosion present and extensive damage by cattle at many sites.
- Riparian margins are rare, with some pockets of existing native vegetation present, with overall shade and organic input to watercourses low.
- The Hōteo River (upstream of the viaduct proposed within the Indicative Alignment) and the adjacent tributary, Waiteraire Stream (on which site HN_F_Hōteo_1 is located), are defined as a Natural Stream Management Area within the AUP(OP).
- Downstream of site HN_F_Hōteo_2, the Hōteo River is classified as an Outstanding Natural Feature (ID49) for its incised meanders.
- Five fish species were recorded across the sites; shortfin and longfin eel, the whitebait species inanga and banded kokopu and redfin bully. Longfin eel, inanga and redfin bully are important species with a threat status of At Risk – declining.
- Freshwater ecological values are generally Low, with some discrete Moderate value sites including the Hōteo River and lower Waiteraire Stream. Surveys generally indicated poor fish populations, low abundance of EPT species, low SEV scores and MCI scores that were indicative of poor water quality.

A total of ten freshwater sites were assessed within the Hōteo North section, with full SEV surveys undertaken on nine streams: three within the Hōteo River catchment, three within the Te Hana Creek catchment, and three within the Maeneene Creek catchment.

Assessment of freshwater ecological effects

The sediment models predict a low increase in average TSS loads at the test sites within the Hōteo North section, with average sediment load increases of approximately 0.4%, 4.5% and 1.5% from existing conditions predicted at Hōteo River (downstream of the unnamed tributaries), a tributary of Te Hana Creek and the Maeneene Creek, respectively. However, increases in suspended solids pose a particular risk to the unnamed pasture tributaries to the north of the Hōteo River viaduct, owing to the risk of flooding.

The Indicative Alignment crosses a large number of watercourses resulting in a high amount of stream loss, stream diversion and culvert installations. This will change the aquatic habitat of streams. The use of bridges and/or viaducts over the watercourses in this section, including locating piers out of the streambed and immediate riparian zone will minimise effects on these waterways.

Table 9-11: Ecological values and potential adverse effects on surveyed sites in Hōteo North arising from the Project, Ecological Sites (ES) series drawings in Volume 3.

Site ID	Potential effect	Ecological value	Magnitude of effect	Level of effect (without mitigation)
HN_F_Hōteo_1	**Construction** Reduction in water quality resulting from earthworks activities with a predicted average yearly increase of 0.4% (approximate) within the Hōteo River. **Operation** Reduction in water quality resulting from stormwater runoff. Degradation to habitat through shading from viaduct over the Hōteo River and SEA, limiting the growth of aquatic plants and riparian vegetation within these shaded areas.	Moderate	Low	Low
HN_F_Hōteo_2	**Construction** Reduction in water quality resulting from earthworks activities with a predicted average yearly increase of 0.4% within the Hōteo River. **Operation** Reduction in water quality resulting from stormwater runoff. Minimal impacts on aquatic habitat resulting from shading from viaduct.	Moderate	Low	Low
HN_F_Hōteo_3	Loss of aquatic habitat through filling, stream diversions and culverting headwater reaches.	Low	Low	Very Low
HN_F_Hōteo_4	Loss of all aquatic habitat through cutting/ filling and installing clean	Low	High	Low

Site ID	Potential effect	Ecological value	Magnitude of effect	Level of effect (without mitigation)
	water cut off drains that do not provide functioning aquatic habitat.			
HN_F_TeHana_1	Loss of all aquatic habitat through culverting and temporary loss of habitat through stream diversions upstream and downstream.	Moderate	High	Moderate
HN_F_TeHana_2	Loss of aquatic habitat through filling and culverting upstream.	Low	Moderate	Very Low
HN_F_TeHana_3	Alignment crosses stream within the upper reaches of its catchment and leads to loss of a very small section of stream.	Low	Negligible	Very Low
HN_F_Mae_1	Loss of all aquatic habitat through filling.	Low	Low	Very Low
HN_F_Mae_2	Loss of all aquatic habitat through culverting, and loss of habitat upstream through stream diversions and culverts.	Low	High	Low
HN_F_Mae_3	No effects anticipated.	Moderate	Nil	Very Low

Overall, the level of effects on freshwater ecological values within the Hōteo North section are moderate, with some areas of high value features having a moderate ecological effect. The catchments within the section are predominantly used for agricultural stock grazing, with many watercourses accessible by stock. Watercourses are generally highly degraded with poor water quality, limited riparian vegetation and poor quality aquatic habitat available for fauna and flora.

Freshwater ecological sensitivity analysis across all sections

The *Ecology Assessment* has identified the spatial and temporal sensitivities in relation to freshwater ecological effects.

The greatest spatial sensitivities to lateral movement of the Indicative Alignment are within the Warkworth North section and particularly the headwaters of the Kourawhero Stream and associated high value wetlands.

The Dome Valley Forest section has less spatial sensitivity. Any lateral deviation from the Indicative Alignment will essentially take the route through very similar habitat, with the assessment of effects of the construction and operation also similar.

The Hōteo North has low spatial sensitives, owing to the highly modified nature of the catchment.

The largest temporal sensitivity of the Project lies around the harvesting of Matariki Forest due to the existing high ecological value of the freshwater habitats within this area.

The forest harvesting cycle presents a particular sensitivity to the analysis of effects. If harvesting of the forest has occurred as expected, then the relative effects of the Project, particularly within the Dome Valley Forest section, will be less. Field surveys will need to be undertaken prior to construction, in order to update ecological values, and adjust mitigation accordingly.

In addition, with construction of the Project not likely to commence until around 2030 then the activities of private landowners may improve ecological values (i.e. through fencing and or planting riparian vegetation) on their properties prior to the Project construction commencing. Should this occur, then the ecological values of these waterways will be greater than currently assessed.

9.5.6. Measures to avoid, remedy or mitigate actual or potential adverse effects

This section provides a summary of the recommendations for mitigation of adverse effects on the existing ecological values arising from the Project. A mitigation package has been developed that applies a mitigation hierarchy that seeks to avoid, remedy, and then mitigate effects on ecological values[66].

Mitigation required for each of the ecological disciplines discussed above is presented in this section of the AEE. The landscape and ecological elements of mitigation are particularly closely integrated, and the mitigation outcome is dramatically improved by considering them together.

Section 10 of this AEE sets out an integrated mitigation approach which considers ecology, landscape, stormwater, cultural and potential amenity matters which have been brought together to ensure holistic ecological and wider mitigation outcomes that maximise environmental benefits.

The recommended mitigation is based on the assessment of the effects of the Indicative Alignment within the proposed designation boundary. The final details of mitigation will be confirmed at the time of detailed design based on the ratios recommended in the *Ecology Assessment*.

Mitigation principles

The following set of principles were used to guide the integration of mitigation outcomes:

- Mitigation should ensure that ecosystems are resilient such that they build structure and function and enable or enhance their adaptive capacity for the future.
- Mitigation purpose and the outcomes sought should be clearly defined.
- Mitigation is to respond to adverse environmental effects that cannot be avoided or remedied. It is one tool that can be used. Offsetting and compensation can also be used where loss cannot be reasonably mitigated.
- Mitigation should be a cohesive and integrated package of activities and outcomes.

[66] We note that there is a specific terminology that makes up the EIANZ mitigation hierarchy, which reflects the avoidance, remediation and mitigation of effects, and the offset or compensation for significant residual effects. However, for the purposes of this report we have collectively referred to all of these terms under the umbrella term of a single 'mitigation.

- A mitigation package should avoid an outcome that results in multi-fragmented partitioning of the environment and instead seek to connect and link systems across the landscape.
- Mitigation should be considered in the wider environmental context i.e. Ki Uta Ki Tai (from mountain to sea).
- Mitigation should link with existing ecosystems to build resilience in existing restored and constructed environments as applicable.
- Mitigation should include opportunities to integrate with other programmes, where possible and appropriate.

Route selection and design

Avoidance of key ecological features and minimisation of effects has been achieved through careful route selection (for the Indicative Alignment and the proposed designation).

In some cases, trade-offs have been made between features. This was most notable for the Mahurangi River (Left Branch) and Hōteo River. In both cases the continuous intact stream riparian margins were retained, and impacts avoided, and the benefits of this margin to terrestrial and aquatic biodiversity and function, was valued above some of the fragmented patches of vegetation (e.g., HN_W_Hōteo_01, HN_T_Hōteo_03b)) which are impacted by the Indicative Alignment. The *Ecology Assessment* recommends that, as much as is practicable, these key ecological features should be retained in the detailed design and construction of the final alignment.

Viaducts or bridges have been recommended as a means of avoiding or minimising direct impacts on high value rivers. The short bridge over the upper Kourawhero Stream has the benefit of avoiding direct impacts on the stream, while minimising the use of stream diversions and thus reduces modifications to the surface water hydrology minimising effects on wetlands. Minimising the impact of the Indicative Alignment on the wetlands of the Kourawhero Stream is also achieved through the lowering of the alignment to reduce the batter requirements so they do not intrude into the wetland areas.

Integrated Mitigation Framework

In line with the Project mitigation principles, mitigation for the potential adverse effects of the Project has been recommended within the Ecology Assessment with a view to maximising integration of the terrestrial, wetland and freshwater environmental ecological outcomes, and linking with Mana Whenua aspirations. These outcomes are necessarily linked with other desirable outcomes such as those for landscape and visual outcomes, stormwater management, heritage, cultural, social and amenity preferences.

The strategy for managing and mitigating the impacts of the Project on ecological values is founded on maintaining or enhancing the adaptive capacity of the environment. Ecosystems with high adaptive capacity are better able to respond to impacts and change without significant changes in crucial functions or declines in ecosystem services. The strategy provides for mitigation to be aggregated in specific locations, rather than spread along the length of the proposed designation boundary, to prevent the fragmentation and maximise benefits of the mitigation effort.

The integrated environmental mitigation framework means that in most cases the ecological mitigation and the landscape mitigation planting take a similar form and is located in the same key locations. Ecology is integrated with landscape and the form of stormwater treatment wetlands to provide a more continuous corridor of vegetation which will increase biodiversity throughout the proposed designation.

The integrated mitigation framework proposes that mitigation does not necessarily require for like-for-like loss and replacement at individual impact locations. The reason for this is to maximise the overall ecological benefits of the Project, to weigh mitigation in favour of values that are held highly within the region but are difficult to restore or replace, and to link ecosystems together to achieve an overall stronger outcome and achieve a greater adaptive capacity within the environment.

Section 10 of the AEE provides an overview of the integrated mitigation framework that incorporates all mitigation outcomes.

Mitigation for effects on terrestrial and wetland ecological values

The focus for mitigation is to establish areas of revegetation that provide a strong natural environment framework and lead to habitat creation and enhancement in identified priority areas that contain existing high value features. The recommended areas are shown in Figure 9-2 and are set out in Table 9-12 below.

Maps of the areas of landscape and ecological mitigation are provided in Ecological Mitigation Series (EM) drawings in *Volume 3: Drawing Set*.

Table 9-12: Ecology Mitigation Areas

Area	Mitigation
Mahurangi River (Left Branch) floodplains (Area A, EM1 *Volume 3: Drawing Set*)	• Design to incorporate bridges to avoid intrusion into the river and existing riparian margins (SEA) and elevating on/off ramps to avoid loss of riparian margins. • Riparian floodplain planting and habitat creation alongside the river.
Upper Kourawhero Stream and wetlands (Area B, EM2 *Volume 3: Drawing Set*)	• Design to incorporate bridge across the main stem of the upper Kourawhero Stream. • Design embankments to minimise encroachment into wetland area. • Weed control. • Edge/buffer planting of appropriate native species and enhancement planting within the respective wetland types. • Protect and enhance wetland habitat in the floodplain of the upper Kourawhero Stream through planting to further enhance the ecological values and functions. • Enhance connectivity throughout the valley with planting linking the existing portal escarpment the upper wetland

Area	Mitigation
	valleys, wetlands and downstream floodplains. • Use of proposed stormwater treatment wetlands in this area to compliment natural wetlands and provide additional wetlands habitat for fauna.
Dome Valley Forest (EM2-EM3 *Volume 3: Drawing Set*)	• Provide locations that enable successful mitigation for the loss of habitat (and potential habitat) resulting from the Project. • Area (or areas) within the Indicative Alignment of the Dome Valley Forest Section to be identified as a preferred area to provide a habitat for translocating fauna. • Where possible, large trees on eastern and western margins of the alignment to be retained to provide east-west crossover links for birds and bats. • Manage regrowth and plant native vegetation to provide habitat for native fauna. • Retain existing vegetated riparian margins of the streams, plant riparian margins of streams within the proposed designation. • Provide improved and permanent protected habitat for Hochstetter's frogs.
Hōteo River floodplains (Area C, EM4 *Volume 3: Drawing Set*)	• Restoration planting of a kahikatea-dominated lowland wetland to rehabilitate the ecosystem. Note planting should be cognisant of existing flooding issues and should not increase associated adverse effects. • Specific restoration planting of the margins of a tributary of the Hōteo River (HN_F_Hōteo_3) in sympathy with the floodplain planting to enhance the longitudinal and lateral benefits.
Upper Te Hana Creek tributary (Area E, EM5 *Volume 3: Drawing Set*)	• Planting proposed to protect streams and improve water quality and link with the SEAs to the east and the Kaipara Harbour coastal area to the west.

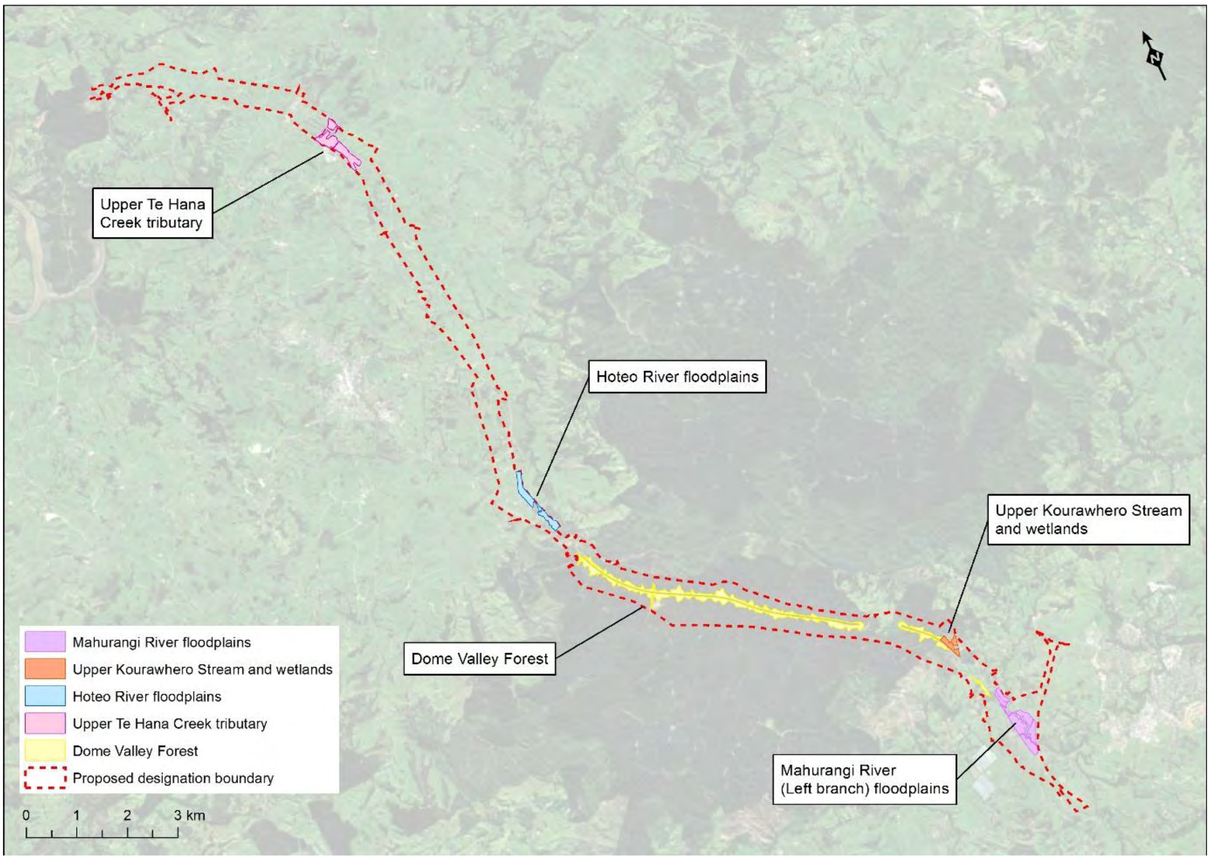


Figure 9-2: Map showing recommended mitigation areas

Mitigation measures are also proposed to address biosecurity risks as follows:

- Preparation of a Kauri Dieback Biosecurity Plan (KDBP) to avoid the spread of kauri dieback into uninfected areas; and
- All plants acquired for revegetation and landscaping should be appropriately sourced for the Ecological District and be purchased from nurseries that are free of myrtle rust and plague skink.

Mitigation for effects on fauna and avifauna ecological values

The Project may directly impact Hochstetter's frogs, native bats, kauri snails, lizards, and birds through loss of habitat. Recommended mitigation for the impact on these fauna species will include survey, salvage and relocation; species-specific management plans/protocols (where relevant); restrictions on timing of habitat clearance; pest animal and weed control and early mitigation where practical. In addition, wetland sites providing habitat to At Risk species are recommended to be avoided by the final alignment as far as practicable and maintenance of flyway connectivity and within the proposed designation is recommended through retaining existing vegetation or revegetation where this is not possible.

Recommended key components of fauna management are:

- Preparation and implmentation of an Ecological Management and Mitigation Plan (EMMP)
- Surveys prior to construction to establish presence of fauna and avifauna;

- Implementation of best practice fauna management protocols for translocation programmes (includingcapture, handling, retention and release, including timing);
- Managing vegetation clearance and earthworks in wetlands where avifauna is present to minimise effects, along with enhancement through pest animal and weed control and revegetation to buffer potential edge effects;
- Developing a construction programme that excludes vegetation clearance (excluding pasture) during forest and wetland bird breeding/nesting season (i.e. September to March inclusive);
- Surveys of potential bat roosting sites and protocol for vegetation removal including, where practicable, avoiding roost trees; and
- Pest animal and weed control at mitigation sites.

Mitigation for effects on freshwater ecological values

The loss of watercourses and ecological function under the Indicative Alignment and associated soil disposal sites through infilling of streams and culverting is unavoidable. As much as is practicable, it is recommended that the loss of streams, particularly those of higher ecological value, be minimised through detailed design of the final alignment i.e. at specific locations (Mahurangi River (Left Branch), Hōteo Viaduct and Upper Kourawhero) the use of stream crossings such as viaducts and bridges is recommended to prevent the loss of streams and their function. A number of these have been integrated into the current design and are key features in the Indicative Alignment.

Mitigation is required for the loss of habitat and ecological values for all permanent and intermittent streams under the AUP(OP). Not all watercourses potentially impacted along the Indicative Alignment were able to be surveyed during this early stage of the Project. These surveys will be completed prior to construction (as to stream permanence and ecological value), allowing the quantum of mitigation required to be confirmed. It is recommended that the Auckland Council SEV assessment is used to inform the ECR (Environmental Compensation Ratio) calculation (or similar best practice at the time), when calculating the specific quantum of mitigation that is required for the loss of stream habitat function.

In the interim, approximated stream lengths, as indicated by the overland flow path layer, and areas have been calculated to guide the mitigation package. This informed the estimations of the amount of potential mitigation required and whether the proposed designation boundary has the capacity to contain it all. These areas include the following across the Indicative Alignment:

- Approximately 27 km length of intermittent and permanent streams directly affected by the Indicative Alignment within the Project area (from approximately 150 km of stream length within the Project area).
- Approximately 18 km of new stream diversions are proposed as part of the Project These will be created in a manner that will provide at least equivalent ecological value to the stream length lost (See Appendix F of the *Ecological Assessment*).

Other recommendations relating to mitigating effects on freshwater ecology include:

- Sediment and erosion control should at the minimum comply with the guidance within Auckland Council TP90 and GD05, and Transport Agency ESC Guidelines (discussed in section 9.2 of this AEE).
- Streamworks should ideally be undertaken offline or should be isolated with water pumped around the area of works.
- Fish should be salvaged from all watercourses containing water at the time of streamworks.
- Peak fish migration occurs between September and February and streamworks should be avoided during this time if possible.
- Fish passage should be maintained through all temporary and permanent culverts with viable upstream habitat.
- Design of stream diversion channels to create a range of stable microhabitats for fish and invertebrates, including the creation of stable pool habitats and the inclusion of gravel and cobble habitat.
- Water quality treatment should follow the requirements of the AUP (OP) and guidelines in Auckland Council GD01 (discussed in section 9.12 of this AEE).
- Erosion control on stormwater outfalls to prevent scour of stream bed and banks in receiving watercourses. Water temperature is to be managed by ensuring that stormwater treatment wetlands are sufficiently shaded where practicable to ensure that any rise in water temperature is minimised.

Summary of positive ecological effects

The *Ecology Assessment* has identified a number of positive ecological effects following the implementation of management protocols and mitigation, including:

- Reduced contaminant loads to the Mahurangi River and the Hōteo River catchments as a result of capture and treatment of road stormwater runoff compared to the existing SH1.
- Aggregated mitigation providing integration of ecosystems to provide greater resilience.
- Pest and weed control at selected locations to improve the adaptive capacity of ecosystems.
- Improved N-S connectivity including between the Mahurangi River (Left Branch) and the upper Kourawhero Stream catchments.
- Increase in riparian planting for the protection and enhancement of water quality and aquatic habitat.
- Maintenance of flyway connectivity N-S and E-W within the proposed designation where suitable existing vegetation is retained and supported, if required, through revegetation following harvest of plantation forestry.
- Maintenance and enhancement of populations of land snails, lizards, Hochstetter's frogs, birds and bats in mitigation areas.
- Planting mitigation areas to achieve a positive increase in threatened indigenous ecosystems of the Auckland region.

9.5.7. Conclusion

The Project will result in the clearance of approximately 13 ha of native vegetation and wetland ecological features, approximately 1.5 ha of which has high/very high ecological value, resulting in a direct loss of biodiversity. There will also be indirect effects, for example, edge effects and changes to the water table, which may cause further degradation to remnants of partially cleared features. In addition, fauna will be impacted through loss of habitat (i.e. lizards, snails, Hochstetter's frogs, birds and bats). Adverse cultural effects also arise as a result of the works within these areas of high/very high ecological value.

Approximately 27 km of intermittent and permanent streams will be directly affected by the Indicative Alignment within the proposed designation boundary. Most of the affected watercourses are within Warkworth North and Hōteo North sections of the Project and are generally small, low-quality tributaries degraded by pastoral land use. Approximately 5 km of high-quality permanent and intermittent streams within the Matariki Forest will be impacted.

Movement of the alignment within the proposed designation boundary has the potential to significantly increase impacts on ecological features, especially adjacent to the Mahurangi River (Left Branch) and wetlands in the upper Kourawhero catchment in the Warkworth North section, and the Hōteo River floodplains area of the Hōteo North section. There is also some potential for the changes in alignment to have a beneficial effect on ecological features for example through reduced encroachment into areas of high value indigenous vegetation.

Ecological mitigation forms part of the broader integration mitigation package for the Project. The proposed ecological mitigation approach integrates terrestrial, wetland and freshwater environmental ecological outcomes by focusing revegetation, fauna habitat enhancement and stream restoration within a few focus areas that contain existing high value features. The purpose of this mitigation approach is to provide a cohesive, landscape-wide habitat framework to enhance biodiversity, provide ecological connections in a cohesive manner along and across the Project corridor. There are five key locations which have been identified in the Ecology Assessment as preferred areas for mitigating the impacts of the Project. These are mapped on the EM map series in *Volume 3* of the AEE and include:

- Mahurangi (left branch) – Stream management area and SEA;
- Upper Kourawhero stream and wetland complex;
- Dome Valley Forest – wetland, indigenous vegetation and preferred fauna habitat and flyway location;
- Hōteo River Flood Plains – includes 3 SEA locations; and
- Upper Te Hana Creek tributary.

The Ecology Assessment sets out other recommended mitigation for terrestrial and freshwater ecological effects. In summary, the recommended measures to avoid, remedy or mitigate effects on ecological values are:

- Where practicable and whilst considering design requirements, future alignment revisions enable specific high value features to be avoided as far as practicable;

- Identify priority mitigation locations based on existing ecological values and offer multiple and consolidated mitigation benefits to be achieved through an integrated approach;
- Maintain and provide connected habitat corridors to enable fauna movement and activity along and across the Project;
- Development and implementation protocols for managing relocation of fauna (snails, frogs, lizards); and
- Replace at least the equivalent ecological value of what was removed through terrestrial and stream riparian planting.

Not only does the proposed mitigation provide for the impacts of the project; over time it contributes to the return of some threatened significant ecosystems and habitats to the Auckland region. The integration and aggregation of mitigation in key priority areas provides greater resilience, diversity and connectivity within and between ecosystem types; as well as potentially across catchments.

Based on the findings of the *Ecology Assessment Report* and the recommended mitigation, effects from the construction and operation of the Project on terrestrial and wetland values is low and less than minor in an RMA context. Similarly, the effects on freshwater ecological values overall will also be low and less than minor. There will be ecological benefits arising from the Project.

9.6. Marine ecology and coastal avifauna

Overview

There are no works within the coastal marine area. However, sediment-laden runoff from open earthworks areas during rainfall events throughout Project construction and stormwater runoff from the road during operation of the Project will discharge to the Mahurangi and Kaipara Harbours. This discharge has the potential to adversely affect marine ecological values if not managed appropriately.

The marine ecological values within both the Mahurangi and Kaipara Harbours are moderate in the upper reaches where a high baseline load of sediment deposition currently occurs, and high in the middle and lower reaches.

Assessment of modelled acute rainfall events in conjunction with Project works indicated that a 30-year ARI event in the Mahurangi catchment and 10year ARI event in the Hōteo Inlet of the Kaipara catchment, if they occurred during earthworks, may result in Project-related sediment having significant adverse effects in the upper harbour benthic habitats, with potential flow on effects to coastal avifauna that forage on the benthic intertidal mudflats. If the cumulative amount of sediment released from the Project is above 5% of the baseline contribution, it is considered that there would be a significant adverse effect at these locations.

To minimise the potential for these effects occurring, best practice erosion and sediment control measures (as set out in Auckland Council and Transport Agency guidelines) will be designed and implemented to treat operational phase stormwater from the Project prior to discharge to aquatic environments and to minimise the effects of sediment runoff during construction.

Acknowledging that best practice erosion and sediment control will be in place and given that effects are directly related to the quantum of sediment released during storm events and the cumulative discharge exceeding 5% of the modelled baseline, mitigation responses have been developed. These responses are based on real-time monitoring of sediment discharge from erosion and sediment control devices and trigger levels based on sediment loads. Should these sediment triggers be reached, mitigation will be implemented as per the proposed conditions.

Whilst there is the potential for significant adverse effects to occur during acute events or as a result of the cumulative discharge, the Project related contribution to the long term sedimentation of the Mahurangi and Kaipara Harbours is assessed as very low. Mitigation is proposed in the event that sediment discharge exceeds 5% of the modelled baseline contribution or to mitigate for sediment discharge during acute rainfall events.

Overall, with mitigation provisions in place and benefits accruing within a generation (nominally 25 years), it is considered that adverse effects would be less than minor.

9.6.1. Introduction

This section summarises the findings of the assessment of the actual and potential effects of the Project on marine ecology values outlined in the *Marine Ecology and Coastal Avifauna Assessment* in *Volume 2* of this Application.

The *Marine Ecology and Coastal Avifauna Assessment* identifies the marine ecological values of the areas potentially affected by the Project, assesses the actual and potential effects of the Project on those values and identifies measures to avoid, remedy or mitigate the effects.

During construction of the Project, sediment-laden water will be treated and discharged, and during the operation of the Project treated stormwater runoff will be discharged. Discharges will be to streams and rivers that ultimately discharge to the Mahurangi Harbour and Kaipara Harbour.

The potential effects on the marine environment from construction are related to sediment discharged from the earthworks. The potential effects on the marine environment from operation are related to contaminants derived from the vehicles using the road and entering surface water via road runoff.

9.6.2. Existing environment and ecological values

This section outlines the existing environment and ecological values of the Mahurangi and Kaipara Harbours. Section 3.3.4 (Hydrology and drainage catchments) of this AEE identifies the harbours and contains a map of the catchment boundaries within the wider Project area (Figure 3-6).

Mahurangi Harbour

The Mahurangi Harbour is a drowned river valley, with vast intertidal flats and subtidal areas present in its middle to lower reaches. The harbour contains areas classified as SEA M1 and M2 in the AUP(OP), in addition to being recognised by DOC as an Area of Significant Conservation Value. Dense mangrove stands fringe the tidal flats of the upper estuary and side embayments. Seagrass patches have been noted in the middle to lower reaches. Estuarine vegetation that provide significant habitat for native fish, birds and invertebrates.

The water quality of the harbour has been ranked as excellent by Auckland Council. The concentration of common stormwater contaminants in surface sediment is typically below effects thresholds. The proportion of silt and clay within the harbour as a whole is rarely greater than 50% and surface sediment is oxygenated within the middle and lower reaches of the harbour.

Benthic invertebrate community species diversity and richness is high in middle and lower reaches of the harbour. However, benthic invertebrate diversity is low in the upper harbour (upstream of Hamilton's Landing). A large range of fish and birds use the harbour, including several Threatened or At Risk bird taxa.

Overall, the *Marine Ecology and Coastal Avifauna Assessment* has concluded that the marine ecological values of the Mahurangi Harbour are high in the middle to lower reaches, and moderate in the upper reaches.

Kaipara Harbour

Kaipara Harbour is the largest enclosed harbour/estuary in New Zealand. It is divided into three main peninsulas and has a total surface area of 947 km^2. The harbour is recognised as a SEA and the southern part of the harbour contains a number of SEA-M2 and SEA-M1 areas as classified in the AUP(OP).

The Indicative Alignment and associated earthworks span three catchments (Kourawhero, Hōteo and Oruawharo) that drain into the southern part of the Kaipara Harbour. The Kourawhero and Hōteo catchments drain into the Hōteo Inlet, whilst the Oruawharo and Maeneene subcatchments drain into the Oruawharo Inlet.

The upper intertidal zone contains vegetation sequences consisting of mangrove forest and shrubland, indigenous saltmarsh, exotic grassland and rushland species. Vast areas of shallow intertidal mud and sandflats exist, which, along with mangrove and saltmarsh, provide important habitat for a number of avifauna species. Some of these avifauna species are Threatened or At Risk. Kaipara Harbour has vast seagrass meadows that support a wide variety of fish, invertebrates and birds. The harbour also has significant channel environments with healthy shellfish communities.

The water quality of the harbour has been ranked as excellent by Auckland Council. The concentration of common stormwater contaminants in surface sediment is typically below effects thresholds. The proportion of silt and clay within the harbour as a whole, is rarely greater than 50% whereas surface sediment has a low oxygenation depth.

Benthic invertebrate community species diversity and richness is low in the middle and lower reaches of the harbour, and moderate in the upper harbour (Oruawharo River and Hōteo River), mainly due to the abundance of a number of mud tolerant species.

The harbour has been modified through the establishment of intertidal oyster farms, dredging, mangrove removal and the invasion of *Spartina anglica* within various embayments.

Overall, the *Marine Ecology and Coastal Avifauna Assessment* has concluded that the Kaipara Harbour has high marine ecological values in the middle to lower reaches, and moderate marine ecological values in the upper reaches. Coastal avifauna ecological values are assessed as very high due to the majority of species associated with the coastal environment having a threat status of Threatened or At Risk.

9.6.3. Assessment methodology

The *Marine Ecology and Coastal Avifauna Assessment* focused on those parts of the coastal marine area within the Mahurangi Harbour and Kaipara Harbour where there is the potential for adverse ecological effects due water discharges from the Project. The assessment considered the Indicative Alignment, but also considered potential changes to the alignment (and design and location of ancillary components) within the proposed designation. Information on the marine ecological values within the Mahurangi Harbour and Kaipara Harbour was collated from existing literature. Targeted field surveys were carried out in order to identify existing benthic ecological values and assess sensitivity of habitats and organisms to potential effects of the Project.

The investigation of marine ecological values in the Mahurangi Harbour and Kaipara Harbour included:

- a literature review of the existing marine ecological values;
- benthic invertebrate infaunal and epifaunal surveys;

- sediment grain size surveys and analysis; and
- analysis of common stormwater contaminants in sediment.

The assessment drew together the existing marine and coastal avifauna ecological values, the potential construction-related effects (including sediment discharge and habitat disturbance), the potential operational-phase effects (primarily the discharge of treated stormwater) and potential cumulative effects on the marine ecological values and the lifespan of the upper harbour areas.

The assessment of potential effects on the Mahurangi Harbour from construction sediment has relied on the marine ecology and coastal avifauna assessment undertaken for the P2Wk project[67].

The potential effects from construction sediment were assessed for the Kaipara Harbour using the output of the Kaipara Harbour Coastal Modelling and Effects Assessment[68] that estimated the concentration of suspended sediments and depth and extent of sediment deposition under a range of construction scenarios (short term and long term).

The assessment of operational phase stormwater discharges was informed by contaminant load modelling.

The level of the Project's potential adverse effects on marine and coastal avifauna ecological values was assessed using the EIANZ, 2015, assessment matrix that incorporated ecological values and effect magnitude to predict an overall level of effects without mitigation.

9.6.4. Assessment of marine ecology and coastal avifauna effects

Potential adverse effects on the marine environment are primarily indirect, arising from the discharge of treated water runoff during construction and operation. Discharge of sediment laden water and treated stormwater runoff to the Mahurangi Harbour (via the Mahurangi River) and the Kaipara Harbour (via the Hōteo River and Oruawharo River) may occur throughout the construction and operation phases.

Construction phase effects

It has been estimated that 310 ha of earthworks area will be required for the Project. Of this, 270 ha is proposed to occur in the Kaipara Harbour catchment, mostly within the Hōteo River catchment but some within the Oruawharo River catchment. The total amount of earthworks in the Mahurangi Harbour catchment is estimated at 43.3 ha.

Erosion and Sediment Controls (ESC) to manage the potential effects of these earthworks activities will be an inherent part of the construction methodology of this Project and best practice ESC will be implemented as outlined in section 9.2 of this AEE. However, sediment runoff from open earthworks areas during large rainfall events discharging to the Mahurangi and Kaipara Harbours during construction of the Project has the potential to adversely affect marine ecological values.

Sediment may be released to the receiving environment during large storm events and has the potential to result in acute adverse effects associated with those events

[67] Further North (2013) Puhoi to Warkworth Marine Ecology and Coastal Avifauna Assessment Report
[68] NIWA, 2018

or long-term contribution over the Project construction period i.e a cumulative effect. The assessment undertaken addresses both and considered suspended sediment and that deposited on the sea floor.

Suspended Sediment

The concentration of total suspended solids (TSS) and the area and depth of deposited sediment under a 10 year and 50 year rainfall events have been modelled and mapped for the *Marine Ecology and Coastal Avifauna Assessment* under a 5-year construction scenario in the Mahurangi Harbour catchment and a 7-year construction scenario in the Kaipara Harbour catchment.

The models predict a reduction in the suspended sediment concentration in marine receiving water (TSS) to concentrations significantly below effects thresholds within approximately three days in all scenarios within both the Mahurangi and Kaipara Harbours. An exception to this was observed in a small area on the Kakaraia Flats (within the Kaipara Harbour), where suspended sediment concentration was modelled to exceed 80 g/m^3 for more than 72 hours under a 50-year ARI event. Overall, the *Marine Ecology and Coastal Avifuana Assessment* concluded that the level of effect of suspended sediments from construction of the Project on benthic invertebrates and marine/estuarine habitat values is negligible.

Deposited Sediment

Modelling predicts that following the rainfall event, the deposition of sediment in both the Oruawharo Inlet (Kaipara Harbour) and Mahurangi Harbours in a 10-year average return interval (ARI) rainfall event will result in relatively small increases in sediment depth in the upper reaches of each harbour predicted to receive sediment. The 10 year ARI events are considered to have a less than minor level of effect.

In the Hōteo Inlet, however, modelling estimates increases above baseline during a 10 year ARI of up to a 14% (5.4 ha) in the area subject to sediment depths between 5 and 10mm and up to a 10% (2.3 ha) in the area exceeding 10 mm in depth. Deposition of sediment at 5-10mm depth is likely to cause mortality to sensitive benthic invertebrate species through smothering, which in turn affects the community composition. Effects on community composition are likely to be significant in the shorter term (3-5 years), with recolonisation potentially occurring naturally over time. Deposition of sediment at depths greater than 10mm is likely to cause mortality to most, if not all, benthic invertebrates present. In the Hōteo Inlet, if the modelled quantum of sediment is released from the Project in a 10 year ARI event there would be a significant adverse effect on benthic communities.

In the 50 year ARI rainfall event in Mahurangi Harbour and the Hōteo Inlet part of the Kaipara Harbour, significant adverse effects on marine ecological values are predicted if the sediment quantum results from the modelling work are realised. A predicted increase of 21 ha will exceed 10mm in depth as a result of sediment generation due to the Project construction. If the modelled quantum of sediment is released from the Project in a 50 year event this would result in a significant adverse effect on benthic communities.

The modelled long term cumulative sediment contribution over the Project seven year construction period was found to be less than 1% in comparison to the current baseline load generated in the wider contributing catchments. At this level of Project contribution, the effects on the long term lifespan of the Mahurangi and Kaipara Harbours is negligible.

Any potential adverse effects on avifauna during the construction phase of this Project will be indirect. During construction, there is the potential for adverse effects on marine water quality through increased suspended sediment. This can have potential impacts on the ability of visual foragers to locate prey items and can have flow-on effects to avifauna through reduced foraging resources due to deposition of Project related sediment.

Any potential effects on avifauna are dependent on potential effects on marine ecological values. Given the low to very low level of effect determined for the marine ecology and coastal avifauna assessment (during construction), the relatively low level of predicted additional deposition of Project related sediment and the short-term nature of the elevated TSS levels, the magnitude of effect on visual foragers to locate prey is assessed as negligible. The overall level of effect from both suspended sediment and the predicted additional deposition of Project related sediment is likely to have a negligible effect on migratory and resident wading, shorebird and marsh bird species in the upper, middle and lower Mahurangi Harbour and in the Kaipara Harbour.

Operational phase effects

During the operational phase of the Project, treated stormwater road runoff will be discharged to the Mahurangi Harbour via the Mahurangi River and the Kaipara Harbour via the Hōteo and Oruawharo Rivers. Stormwater treatment wetlands will primarily be used to treat operational phase stormwater from the Project prior to discharge to aquatic environments. Wetlands will be designed using best practice guidelines such as Auckland Council's GD 01. Devices designed with reference to such documents are expected to remove an average of 75% of suspended solids and associated contaminants from stormwater. Any residual sediment and associated contaminants discharged will largely be distributed within the upper estuary and upper harbour areas due to these areas being low energy depositional habitats.

The contaminant load model calculations indicate that there are no significant increases in stormwater contaminants within operational phase discharges to the Mahurangi and Kaipara Harbours, therefore the *Marine Ecology and Coastal Avifauna Assessment* concluded the potential adverse effects on marine ecological values are negligible.

Although operational phase stormwater discharges from the Project will contain low contaminant loads, there is the potential for these discharges to add to the long-term accumulation of common stormwater contaminants within marine sediments in both the Mahurangi and Kaipara Harbours. Stormwater contaminants are likely to have a very low to low level of effect on the value of the marine ecology within these receiving environments. Removing significant volumes of traffic from the existing state highway, where stormwater discharges are generally not treated, to the proposed state highway with treatment, will result in an overall reduction contaminant discharges and improvements to water quality.

The discharge of treated stormwater is likely to have a negligible effect on resident and migratory wading and cryptic marsh bird species in the Mahurangi and Kaipara Harbours.

The *Marine Ecology and Coastal Avifauna Assessment* concluded that the results of the assessment of construction and operational phases of the Project would not alter if the alignment were moved to a new position within the proposed designation.

9.6.5. Measures to avoid, remedy or mitigate actual or potential adverse effects

Mitigation principles have been developed for the Project and refer to taking an integrated approach, linking with Mana Whenua and other stakeholder's aspirations, and aggregating practical achievable mitigation into concentrated areas to achieve greater overall ecological outcomes. These mitigation principles are described earlier in section 9.5 of this AEE.

In order to manage potential adverse effects during construction, avoidance and mitigation measures include:

- Erosion and sediment control designed to regional best practice guidelines and standards.
- Staging of works and establishment of maximum open earthworks areas in the Hōteo catchment to reduce risk of sediment runoff.
- Storm event discharge monitoring and response.

Modelling of 10 and 50 year ARI rainfall events indicates that a 50-year event in both the Mahurangi and Kaipara Harbours (Hōteo catchment) and a 10-year event in the Hōteo catchment may result in a significant adverse effect on benthic invertebrate community composition and habitat quality that would require mitigation. Across the whole construction period, Project-related sediment discharges contribute to long-term sedimentation in both harbours and therefore contributes in a very small way to the cumulative effect of ecological decline.

For this Project, monitoring the depth and extent of Project related fine sediment, especially in the Kaipara Harbourarising from individual rainfall events is considered impractical because of the background characteristics of the environment and the inability to distinguish Project sediment from the background sediment given the quantum of the latter.

An alternative to visual and sample monitoring of sediment discharges in the harbours has been developed to mitigate the effects of sediment deposition. It is proposed that the actual sediment discharged from the Project during construction be monitored at representative erosion and sediment control devices to inform whether mitigation is required for larger acute rainfall events. These actual loads will be compared against catchment related mitigation triggers which if exceeded will require that a mitigation. Trigger levels have been proposed relating to the 10 year ARI event in the Hōteo Catchment and a 30[69] year ARI event in the Mahurangi catchment.

[69] The sediment load in a 30 year ARI event is proposed as the trigger level in the Mahurangi catchment, as we have modelled the 10 year ARI and 50 year ARI events, with significant adverse effects beginning to occur between these two events.

Likewise, with regards to cumulative sediment contribution, if large acute rainfall events occur during construction and if the total sediment contribution of the Project over the construction period exceeds 5% of the baseline, further measures to reduce sediment discharges to the harbours will be required to be developed and implemented. Mitigation measures that reduce the runoff of sediment from land to marine receiving environments that could be considered include additional planting of riparian margins (especially large streams) and retiring steep grazing or forestry land.

Mitigation, if required, should include additional planting of riparian margins (especially large streams) and retiring grazing or forestry land. The mitigation should be achieved within a generation (nominally 25 years). It is noted that the ecology and landscape planting proposed to mitigate adverse effects of the Project on terrestrial and freshwater ecology and landscape matters has multiple benefits, one of them being that it will, in the long term, result in reduced sediment runoff from those areas compared to the existing land use.

During the operational phase of the Project, the treatment of stormwater to remove 75% TSS and associated contaminants are likely to have a very low to low level of effect on the receiving environment.

9.6.6. Conclusion

Potential effects of the Project on marine ecological values may occur from the discharge of construction phase sediment and the discharge of operational phase stormwater. Recommended measures to minimise sediment runoff include erosion and sediment control designed to Auckland Council and Transport Agency guidelines and standards, staging of works and storm event monitoring.

Assessment of modelled rainfall events indicated that the 50-year event in the Mahurangi Harbour and 10- and 50-year events in the Hōteo Inlet of the Kaipara Harbour may result in Project-related sediment having significant adverse effects in the upper harbour benthic habitats, with potential flow on effects to coastal avifauna that forage on the benthic intertidal flats.

Project-related sediment discharges from erosion and sediment control devices should be monitored throughout the duration of the construction period and should the Project's contribution to cumulative sedimentation of the harbour be significantly greater than predicted (5% or more of the baseline), discharge of the same quantum of sediment should be reduced through mitigation measures within a 25-year period. In addition, it is recommended that sediment discharges during acute rainfall events that are greater than a 10-year event in the Hōteo catchment and greater than a 30-year event in the Mahurangi Harbour be mitigated in order to balance sediment discharged from those rainfall events also within a 25 year period. Options for reducing sediment discharges could include retiring steep farm or forestry land, additional riparian planting and stabilisation of stream banks. Such measures are proposed to be implemented after Project earthworks are complete.

The discharge of operational phase stormwater has been assessed as having a negligible level of adverse effects on marine ecological values.

With the recommendations above, it is considered that effects of the Project on marine ecological values overall can be appropriately managed and with appropriate mitigation applied, if required, can be considered to range from negligible to less than minor.

9.7. Construction traffic

Overview

The construction of the Project has the potential to impact the surrounding transport network. The mitigation proposed allows for an adaptive process that can be refined once the design has been progressed and construction methodology refined. The management of construction traffic effects will be through the preparation and implementation of the Construction Traffic Management Plan (CTMP). Temporary Traffic Management (TTM) will be in place in accordance with the Code of Practice for Temporary Traffic Management (CoPTTM). Localised construction traffic effects will be managed through the implementation of Site Specific Traffic Management Plans (SSTMPs).

The potential effects associated with construction traffic are assessed in the context of construction commencing in approximately 2030. It is intended that the preparation of the CTMP and SSTMPs will be undertaken by the contractor prior to construction works commencing. This approach allows for an adaptive method to effectively respond to further changes to the existing traffic environment and refinement of the Project.

With the proposed mitigation in place, adverse effects are considered to be no more than minor and minor.

9.7.1. Introduction

This section summarises the findings of the assessment of the actual and potential effects on the transport environment arising from construction traffic and temporary traffic management associated with the Project, as outlined in the *Construction Traffic Assessment* contained in *Volume 2* of this Application. The actual and potential effects on the transport environment arising from the operation of the Project are the subject of a separate report and are summarised in section 9.14 of this AEE.

The *Construction Traffic Assessment* addresses the actual and potential effects arising from traffic generated through the construction of the Project. The assessment also identifies the work that will be required on local roads located within the proposed designation to maintain local access.

9.7.2. Existing transport network

The existing transport network and environment is summarised in *Section 3* of this AEE.

9.7.3. Assessment methodology

The *Construction Traffic Assessment* assesses the potential impacts of construction traffic, based on the indicative construction methodology in *Section 5* of this AEE, on the transport network in two parts:

1. The effects of temporary traffic management measures and mitigation; and
2. The effects of construction traffic moving through the transport network.

The assessment of construction traffic effects has been divided into three sections as identified in *Section 5* of this AEE.

In accordance with best practice, the Project will be subject to a CTMP prepared in accordance with CoPTTM (including the local road supplement and Road Controlling Authority (RCA) specific procedures).

As part of its standard process for large projects, the Transport Agency develops CTMPs and SSTMPs (produced for specific activities or locations) in accordance with the CoPTTM. The purpose is to ensure that the construction traffic effects on the transport network will be

The *Construction Traffic Assessment* outlines recommendations which include appropriate management for an indicative construction methodology within the proposed designation boundary. Given the level of change that is anticipated in the Warkworth area prior to construction, it is considered appropriate that an update of the construction traffic assessment is undertaken closer to the time of construction to accurately consider the traffic environment of the day (including developments in passenger transport, walking and cycling).

The recommended mitigation approach (i.e preparation of management plans) will not require changing as that approach already requires consideration of the circumstances at the time of construction as does any authorisation from a road controlling authority under CoPTTM.

Temporary traffic management assessment

The methodology for assessing TTM effects is summarised as follows:

- Identification of the likely construction traffic resulting from construction activities and associated TTM requirements on the existing network;
- Qualitative assessments are required to determine the likely level of impact of the construction activities. This is based on experience and understanding of capacity reductions and delays caused by traffic management activities; and
- Assessment of potential routes to be used by construction vehicles.

Construction traffic assessment

Based on the indicative construction methodology the following was determined:

- Estimates of construction traffic for both type (e.g. light/heavy vehicles) and numbers travelling to and from each construction area of the Project; and
- Approximate number of staff likely to be required at each site and the volume of construction equipment and materials likely to be required to construct the Project.

Construction is assumed to commence around 2030. The transport modelling establishes the traffic environment predicted close to the time of construction. The year 2036 forecast model will most closely reflect traffic during the proposed construction programme. The modelling also took into account other committed nearby roading infrastructure projects including P2Wk, Western link road (partially complete) and the Matakana link road.

To assess the impact of construction traffic on the transport network, the following methodology was used:

- Based on the estimates of haulage requirements and potential routes, the construction traffic assessment identified the approximate number of additional vehicles estimated to travel on the existing road network during construction.
- The modelled traffic volumes for 2036 were compared to the capacities of the impacted road segments and turning movements, to assess whether there will be sufficient capacity to accommodate the expected heavy construction traffic.
- The intersections where there may not be sufficient capacity were identified, which were then modelled to estimate the impacts and inform the recommended mitigation.
- The South section, which includes Warkworth and would use SH1 as a haulage route, is the area where construction traffic is most likely to have adverse impacts on the network. For this section, SIDRA[70] intersection analysis was carried out to model the impacts of construction traffic at the intersections of SH1/Hudson Road and SH1/Matakana link road (future road intersection). These are the only intersections throughout the Project extent that are expected to be potentially negatively impacted by construction traffic.
- A sensitivity test was performed to assess whether the effects of construction traffic would remain the same if the transport network is further developed to include all of the road projects planned for Warkworth (these projects are described in detail in the *Operational Transport Assessment*).

The crash analysis carried out for the *Operational Transport Assessment* was examined to:

- Identify areas of safety concern along the indicative haul routes; and
- Include consideration of programmed safety improvements.

9.7.4. Assessment of construction traffic effects

Temporary Traffic Management

TTM is likely to be required at locations where construction activities will influence existing traffic. Existing traffic will be affected where there are interchanges and tie-ins, realignments, and locations where the Project will pass over or under existing roads. TTM measures would also be needed at site access points (SAPs). It is envisaged that SAP locations will be chosen so that they do not impede on the existing road.

The construction methodology is indicative, and the actual TTM used will be determined in SSTMPs closer to the time of construction. The final TTM plans will be developed as part of the CTMP process closer to the time of construction. SSTMPs will be prepared and submitted for approval to the RCA(s) before works begin. The key locations where TTM measures are likely to be required for the Project, and which have the potential to affect operating conditions on the existing road network, are shown in Figure 9-3 and Figure 9-4.

[70] SIDRA (Signalised and unsignalised Intersection Design and Research Aid) INTERSECTION is an advanced micro-analytical traffic evaluation tool that simulates traffic conditions at intersections.

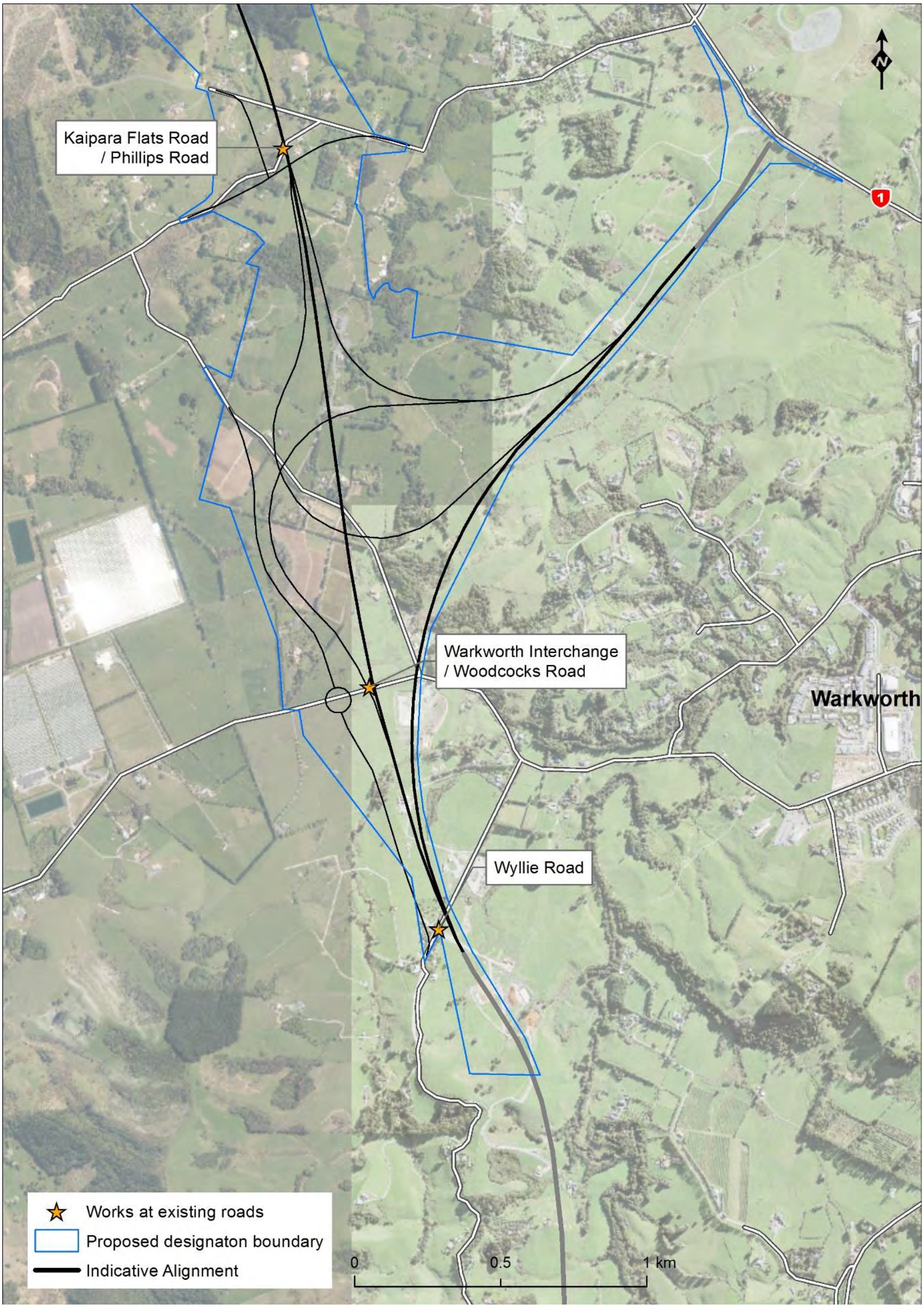

Kaipara Flats Road
/ Phillips Road
Warkworth Interchange
/ Woodcocks Road
Warkworth
Wyllie Road
1
N
Works at existing roads
Proposed designaton boundary
Indicative Alignment
0
0.5
1 km

Figure 9-3: Locations where TTM could impact traffic, Hōteo South

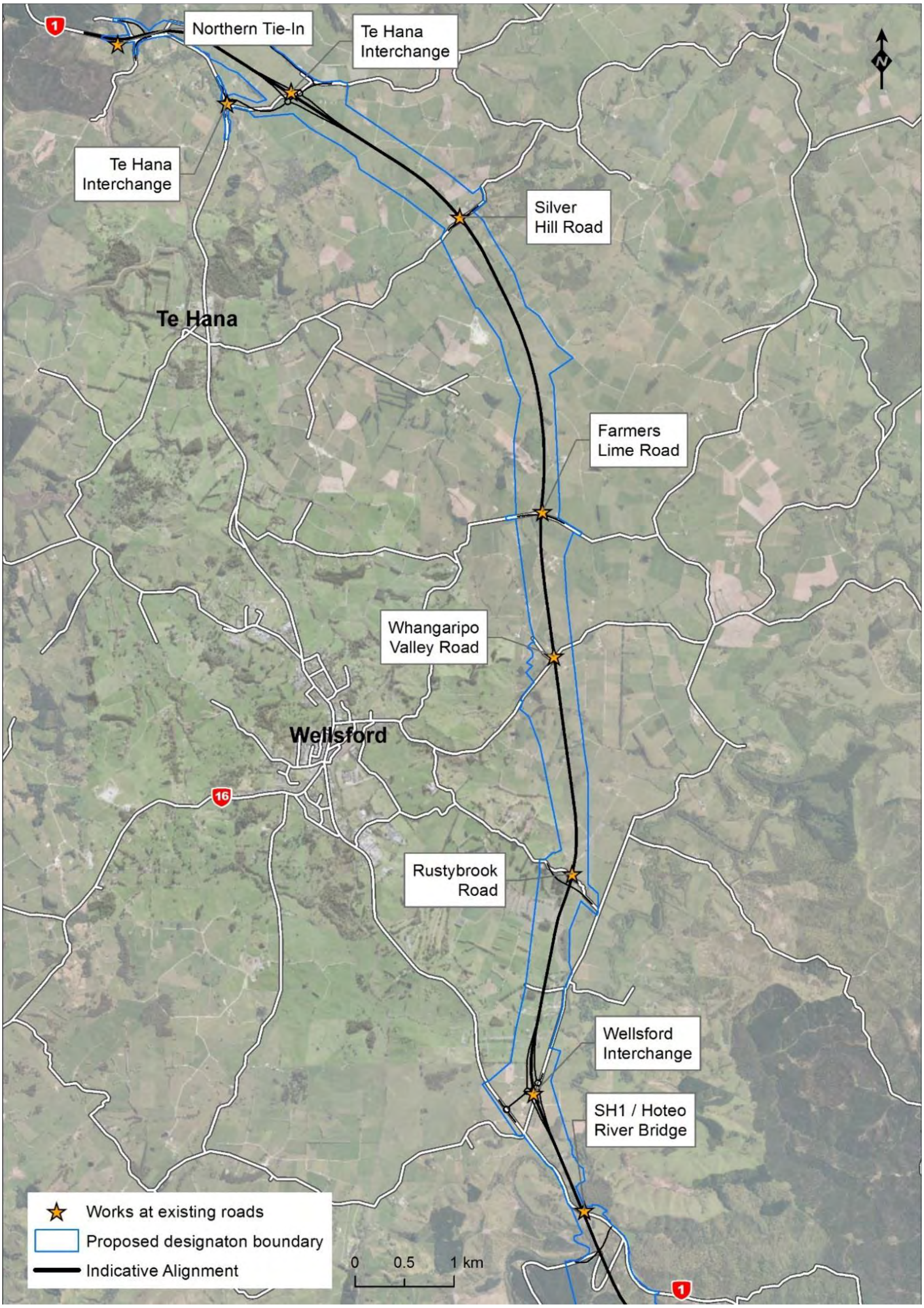


Figure 9-4: Locations where TTM could impact traffic, Hōteo North.

The types of potential mitigation measures that may be used to ensure that the effects of TTM on the transport network are minimised as far as practicable are summarised as follows:

Project connections

The construction of interchanges and tie-ins with the local road network will be undertaken through a range of measures such as lane closures, temporary diversions, and shoulder closures. In some instances, construction work such as that proposed for the Te Hana Interchange, the realignment of Wayby Valley Road or Carran Road can be undertaken off line with minimal conflict.

The southern tie-in with P2Wk will likely be undertaken via shoulder closure and effects will be managed through use of a SSTMP.

Local roads in the vicinity of interchanges, such as Wayby Valley Road, will be realigned first to maintain local access. Where possible these interchanges will be completed off line, and once built can then provide grade separation of local traffic and construction/haulage traffic. During the construction of interchanges SSTMPs will be in place which will outline the specific TTM type and timing to be in place, to ensure that traffic impacts are minimised as far as practicable.

Local roads

The construction of the Project will require modification of thirteen local roads and one crossing of SH1. Of the local roads that intersect with the Project, four are intended to be realigned to avoid crossing the alignment (Wyllie Road, Carran Road, Phillips Road, and Vipond Road). Nine roads (eight local roads and one existing SH1 crossing) will pass over or under the Project with some of these also requiring realignments of sections of the road.

Local road access will be maintained during construction, but where appropriate will be subject to TTM for safety reasons.

Indicative construction activities at the crossing of the existing SH1 relate to the construction of viaduct and embankments to enable the Project to cross over both SH1 and the Hōteo River. The *Construction Traffic Assessment* outlines that these works will not impede traffic on SH1, with the exception of brief closures of SH1 while the bridge structure is put in place. Such closures could be done at night, and, irrespective of the hour of the day or night, will be carried out in accordance with CoPTTM to ensure that they are carried out safely and with minimal impact on traffic.

The *Construction Traffic Assessment,* section 4.2 outlines in detail the potential effects associated with TTM in regard to specific local roads throughout the Project alignment. TTM will be required for safety reasons and to manage the effects of lane closures, temporary diversions and closure of shoulders.

Site Access Points (SAPs)

SAPs would be chosen in locations that allow for safe access without impeding on normal traffic flows. Any proposed SAP locations would require SSTMPs that consider the following:

- Available capacity;
- The need for temporary capacity to be added;
- The ease of adding and maintaining the access and any temporary infrastructure;
- Potential restrictions on construction vehicle turning movements (such as left in left out);
- Sight distance; and
- Proximity to quarries.

TTM has the potential for adverse effects on the surrounding traffic environment. Through the proposed measures as outlined in section 9.7.5, these effects will be appropriately managed so that effects are minor.

Construction traffic assessment

The *Construction Traffic Assessment* identifies the proposed construction access locations, haul routes and construction traffic volumes that would be likely to use these accesses and haul routes.

Effects of light vehicles

Light vehicles are assumed to travel to and from the office compounds in each location, with the main office likely incorporated into the South section due to proximity to Warkworth and Auckland. Movements will be concentrated at the beginning and end of the working day.

At this stage it is anticipated that majority of light vehicles will come from Auckland or Warkworth and would be in the counter-peak direction. However, the modelling undertaken shows the existing SH1 through Warkworth and south of Kaipara Flats Road will still be congested during peak hours so there is a potential for additional delays and queuing on the existing SH1 if light construction vehicles use this route. Any light vehicles accessing site compounds north of Warkworth are assessed as having negligible impacts on the transport network.

Staff travel plans are recommended to help reduce the effects of the light vehicles on the transport network.

Effects of heavy vehicles

At various stages of the Project heavy commercial vehicle (HCV) numbers will largely correspond to the volume of fill and pavement aggregate needed to be transported to each of the sections.

The South section will have a shortfall of fill, which will need to be imported from the Central section or from a quarry. The Central and North sections will be self-contained with sufficient structural cut to fulfil their needs. The Central section will have excess structural cut which could be hauled to the South section using forestry roads and SH1 until tunnel bores are complete, at which time the earthworks footprint can be used as the haul route.

In total, there are currently four quarries within proximity of the Project which have been identified as potential sources for fill and pavement material for the overall Project:

- Matakana Quarry (south part of the Project area);

- Rodney Aggregates Supplies (west of the North section);
- Atlas Quarry (north of the North section); and
- Milbrook Quarry (north of the North section).

There are two periods of time in which hauling is expected to occur:

- Year 3 – Year 5 of construction: Fill will be transported to the South section from the Central section and from Matakana Quarry or another quarry.
- Year 6 – Year 7 of construction: Pavement aggregate will be transported; to the South section from Matakana Quarry or another quarry, to the North section from one of the three northern quarries, and to the Central section from any of the four quarries.

The estimated number of heavy vehicles the proposed works will generate with aggregates from quarries in both the south and north is outlined in Table 9-13 below.

Table 9-13: Heavy Vehicle numbers and movements (one-way vehicles per hour)

Section	Year 3-5	Year 6-7 South	Year 6-7 North
South section			
From Matakana Quarry	6	13	26
From Central section	8	0	13
Central section			
From Matakana Quarry/South section	8	0	13
From Rodney Quarry/North section	0	13	0
North Section			
From Central Section	0	13	0
From Rodney Quarry	0	44	31

Due to the staging of proposed works there will be variation in the number of daily HCV movements to and from the site throughout the duration of construction.

South section

SH1 between Hudson Road and the P2Wk roundabout (under construction) is currently the most heavily congested area of the Project. It is the only area along the alignment that may be adversely impacted by construction traffic. The congestion is predicted to be worst (during a “normal” week) during the weekday evening peak. The 2036 model forecasts significant delays in the evening peak along this stretch of SH1, although it is noted that significant delay is also forecast without the Project. Construction traffic added to the network during peak hours will worsen the forecast congestion and these vehicles may have difficulty in making turns at priority intersections.

This section of SH1 would likely be part of the haulage route from south easterly directions (such as the Matakana Quarry). To reduce the impacts of haulage in this section, a specific haulage route is suggested as follows.

- Trucks hauling from south easterly locations to the southern section of the Project should turn right out of the future Matakana link road onto the existing SH1 at the SH1/Matakana link road intersection, where there will be traffic signals.
- The route should be a loop using left turns into Kaipara Flats Road.
- The return route would use Woodcocks Road, Mansel Road, Falls Road and Hudson Road, with a right turn back onto Matakana link road from the existing SH1 at the traffic signals. This route will avoid opposed right turns at priority intersections. It will also avoid Mahurangi College.

Signalised and unsignalised Intersection Design and Research Aid (SIDRA)(ie traffic modelling) analysis was undertaken for the two main intersections in the scenario of the above haulage route being implemented, these being the intersections with Hudson Road and Matakana link road. The SIDRA analysis used 2036 forecast flows.

The modelling indicates that the intersection of SH1 with Hudson Road will be operating close to capacity in the evening peak. However, the addition of approximately 26 construction vehicles per hour would only have a minimal impact on delays. Minimal delays were also predicted in a sensitivity test, which doubled the proposed number of HCVs going through the intersection.

The intersection of SH1 with Matakana link road is the main connection between Matakana Quarry and the South section construction sites. Typical HCVs through this intersection will be between 25 and 40 vehicles per hour (vph) but will largely depend on the aggregate source used for the Central section. During the morning peak and inter-peak periods, the intersection is predicted to be operating well within capacity and increases in delays of less than six seconds are predicted for all movements, even with the high end number of HCVs. Evening peaks will be adversely affected for certain movements because of the addition of construction HCVs.

The remainder of the roads in the South section are not forecast to have issues with congestion in 2036. The expected HCV volumes generated by the Project construction are predicted to be small in comparison to the remaining capacity of these roads.

<u>Central section</u>

The Central section passes through the Dome Valley. There are two places where traffic will be able to turn off SH1 onto the forestry roads and access the construction compound, being Dibble and Coach Roads (both are forestry roads). SH1 through this section of the Project area has few intersections and no forecast issues with congestion in 2036.

The Safe Roads Alliance plans to install (amongst other things) median barriers and wide centre line treatment along the full length of the 15.2km corridor along SH1 through the Dome Valley. These works are programmed to be completed by October 2021. The barrier and other works proposed will not impede access for construction vehicles as the proposed barrier design shows gaps in the barrier at the entrances to the proposed internal haul routes. The barrier and other works proposed will slow speeds and prevent other vehicles from overtaking HCVs. This will improve safety on SH1, but may adversely affect travel time, as cars will have to wait for passing lanes to overtake slow-moving HCVs. The largest volume of hauling to the Central section is expected to take place during the last two years of construction, when pavement aggregates are to be hauled. By that time, the Project alignment will likely be able to be used as a haul road. Therefore, the volume of construction HCVs travelling on SH1 through the Central section is likely to be low, and the impact of the slower speeds of these HCVs on other traffic is expected to be reduced.

The Central section is not expected to experience negative traffic impacts from construction traffic. There are areas of high crash risk along the proposed haul route in this section, though these risks will be mitigated by the planned safety improvements in the Dome Valley. It is important that a safety assessment be carried out in accordance with the CoPTTM as part of any SSTMPs prepared for this section. In addition, the locations of SAPs in this section will be carefully considered, as this section of road may present challenges for sight distance and space for temporary added capacity (such as turning lanes into the site) required to allow for easy site accessibility. If possible, SAP locations should minimise the amount of distance construction HCVs need to travel on the existing SH1, especially through the Dome Valley.

The Matariki Forest is planning to be harvested along SH1 through the Dome Valley prior to Project construction. As Project construction is assumed to begin in 2030, there is the potential for interaction between Project construction traffic and logging trucks from the forest harvest operation. The projected forest truck movements were assessed based on information provided by RMF. It is not expected that logging vehicles will cause capacity issues for Project construction traffic, provided that (as recommended) the Project does not haul during the evening peak through Warkworth, where logging trucks may contribute to congestion if they pass through at evening peak.

<u>North section</u>

Haulage routes in the North section will be along rural roads, mainly Wayby Valley Road, which will provide access to the intersection with SH1 and the Wellsford interchange. The section of SH1 between River Road and Wayby Valley Road, including the SH1/Wayby Valley Road intersection is identified as a location with high collective safety risk and it will be important for a CoPTTM safety assessment, including sight lines, to be carried out when the SSTMP is prepared for this location. The Project alignment may provide an alternate route when it is considered suitable for hauling.

The North section is not expected to experience negative traffic impacts from construction traffic. Assessments will need to be updated prior to the start of construction to reflect the traffic environment at that time.

Sensitivity testing

The final construction methodology will be determined by the contractor appointed to undertake the works. Whilst changes to the methodology can occur, the *Construction Traffic Assessment* is considered conservative for the following reasons:

- The volumes of light and heavy construction traffic were assumed as relatively high (a worst case scenario has been applied);

- 2036 traffic forecasts were used, although the construction is anticipated to start in 2030;
- Many light vehicle movements will be at the start and end of shifts (nominally 7am and 7pm) which will generally be outside of peak traffic volumes on the surrounding roads; and
- The development of a CTMP will enable more efficient implementation of traffic management activities to maximise efficiency of traffic flow and minimise disruption.

The *Construction Traffic Assessment* includes a sensitivity test which took into account all currently planned transport projects in Warkworth being constructed by the time the Project is constructed. This sensitivity test indicated the recommendations would still apply, in particular that hauling should cease on SH1 through Warkworth during the weekday and evening peak and holiday peaks. This is especially important for heavy vehicles hauling from Matakana Quarry (or any quarry in that area) using Matakana link road, to avoid causing adverse impacts on the Matakana link road/existing SH1 intersection.

Passenger transport effects

Only a small number of regular passenger transport services use the existing SH1. The regular passenger transport services (Intercity and Mana Bus services) allow pre-booked passengers to board and alight on SH1 at Warkworth, Wellsford and Te Hana. The InterCity bus stop in Warkworth is in central Warkworth, not on SH1. The stops in Wellsford and Te Hana are on SH1, but the construction operations will be well east of these locations and will have no impact.

There is a high number of school bus runs in the Project area due to its rural location and number of students living far from schools. The schools in Warkworth are well served by school buses using Woodcocks Road and Hill Street. Bus boarding and alighting takes place on Mahurangi College grounds and not on Woodcocks Road, so construction traffic is not likely to impact on this boarding/alighting. Provided that access for buses is maintained for these routes and suitable set-down areas are maintained, it is expected that the effects on passenger transport during construction will be minor.

Pedestrian and cycle effects

The numbers of pedestrians and cyclists within the area of the project are generally very low, with the exceptions being mainly within the townships of Wellsford and Warkworth.

There will be additional traffic on SH1 during construction which could increase the exposure of pedestrians and cyclists to potential conflicts.

The contractor, in developing the Project CTMP and SSTMPs, will need to give due consideration to the safe passage of pedestrians and cyclists through the areas controlled by TTM and routes used by construction traffic, particularly if haul routes are near school access routes. The effects of the construction activities on pedestrians and cyclists can be managed so that they are minor.

9.7.5. Measures to avoid, remedy or mitigate actual or potential adverse effects

As a result of the Project, the *Construction Traffic Assessment* has identified a number of potential impacts along SH1 and on the local road network. Construction traffic will require detailed mitigation strategies at the construction planning stage. The effects and mitigation strategies identified in this assessment can be used to inform the traffic management methodologies to facilitate the successful construction of the Project.

The following measures are recommended in order to mitigate construction traffic effects of the Project:

- A CTMP will be developed for the Project which will respond to traffic conditions at the time of construction, given the foreseeable change in the Warkworth area.
- A hauling operations plan and a staff travel plan will be developed for the Project.
- For any works that will impact traffic on existing roads, a SSTMP will be prepared that includes a plan for TTM in accordance with the standards in CoPTTM. This will ensure that the TTM measures are put in place safely and that the impacts on traffic are minimised as much as practicable.

The following measures will be taken into account in the development of the CTMP and SSTMPs:

- As part of developing the CTMP and associated SSTMPs for the Project, suitability of detour routes where short-term road closures are considered necessary to facilitate construction works will be addressed. Future assessment will take into account seasonal variations in traffic flows and conditions, and the construction of the Project will avoid exacerbating traffic issues during periods of increased traffic (such as holidays) when developing the overall schedule of works for the Project.
- Both Woodcocks Road and Carran Road will be signed as access routes to SH16 for use when SH1 is either closed or congested during holiday periods. These situations would be for a relatively short period of time. The SSTMP for this location will specifically include plans to accommodate these situations if closures of either of these roads is needed.
- Generally, any required road closures throughout the Project extent will be carried out at times of lowest traffic, and at night if possible.
- For roads requiring realignment, to ensure continued local access is maintained during the construction of the Project, the realignment of local roads will be undertaken prior to the severance of the original connections.
- Proposed SAP locations will require SSTMPs that consider available capacity for queuing vehicles, the need and ease of maintenance of adding temporary capacity, potential restrictions on vehicle turning movements, sight distance, proximity to quarries, and site-specific conditions.
- The section of SH1 through Warkworth and south of Kaipara Flats Road will be congested during peak hours. Construction traffic will avoid this part of SH1 as much as possible, and when it cannot be avoided, travel will be outside of peak hours. Light vehicles coming from Auckland will use P2Wk rather than SH1. Light vehicles from Warkworth will use local roads and avoid travelling through Warkworth during the evening peak (between 4 pm and 6 pm).

- If construction light vehicles are expected to use Woodcocks Road and Hill Street, appropriate treatments will need to be put in place during the morning and evening school peaks at Mahurangi College and Warkworth Primary School. The need for these treatments will be evaluated as part of the SSTMP prior to the work commencing.
- To reduce the impact on the road network of staff vehicles, a travel management plan will be included in the CTMP. For example, staff will be encouraged to carpool to sites, and a contractor could consider reducing traffic impacts by providing a bus or shuttle service from Auckland, Warkworth, or wherever the bulk of employees are located.
- Trucks hauling from south easterly locations (i.e. Matakana Quarry) to the South section are anticipated to turn right out of the future Matakana link road onto the existing SH1 at the SH1/Matakana link road intersection, where there will be traffic signals. The route will be a loop using left turns Kaipara Flats Road. The return will use Woodcocks Road, Mansell Road, Falls Road and Hudson Road, with a right turn back onto Matakana link road from the existing SH1 at the traffic signals. This route will avoid opposed right turns at priority intersections. It will also avoid Mahurangi College.
- Haulage trips from a south easterly location (such as Matakana Quarry) will not be made during the evening peak hours of 4 pm to 6 pm to avoid the most congested time for this section of SH1.
- SSTMPs must take into account passenger transport, pedestrian, and cyclist access as well as vehicle access.
- Site access points in Matariki Forest will require coordination with forest owners, as forest harvesting may also require use of those access points.
- Truck drivers must have appropriate training in sharing the road with vulnerable users.

With the above measures in place the *Construction Traffic Assessment* concludes that effects associated with construction traffic will be minor.

9.7.6. Conclusion

The construction traffic movements and TTM required to construct the Project have the potential to impact on the surrounding road network if not appropriately managed. The management of these effects requires detailed mitigation strategies at the construction planning stage.

The approach proposed will allow for flexibility that will respond to traffic volumes at the point of construction and for specific measures toward managing localised effects. This adaptive method will be achieved through the preparation of the CTMP. Specific localised effects will be managed through the preparation and implementation of SSTMPs. TTM will be undertaken in accordance with CoPTTM.

Based on the findings of the *Construction Traffic Assessment*, and with recommended mitigation including the preparation and implementation of a CTMP, and the CoPTTM requirements associated with SSTMPs and TTM, it is considered that the overall traffic effects from construction of the Project will be no more than minor.

9.8. Construction noise and vibration

Overview

Construction of the Project will result in temporary increases in noise and vibration levels. Potential noise and vibration effects from the construction of the Project have been assessed in accordance with the Transport Agency's *State highway construction and maintenance noise and vibration guide* (the Transport Agency Construction Noise and Vibration Guide), which in turn refers to relevant national and international standards. For construction noise the Transport Agency Construction Noise and Vibration Guide relies on *New Zealand Standard NZS 6803:1999 Acoustics – Construction Noise (NZS 6803)*, which is widely used throughout New Zealand and has been applied to all recent large scale roading construction projects in New Zealand.

The Project area is sparsely populated and being a predominantly rural area, the ambient noise levels in the Project area are often low. The noise and vibration levels associated with the construction of the Project, even if within applicable criteria, may be noticeably more apparent at nearby sensitive locations such as dwellings (referred to as Protected Premises and Facilities (PPFs)) than existing levels. A conservative approach has been taken when predicting construction noise and vibration levels. When taking into account mitigation proposed, daytime criteria are likely to be complied with in most cases, however, small exceedances are possible. A Construction Noise and Vibration Management Plan (CNVMP is recommended as the mechanism by which the primary methods to manage effects of construction noise and vibration are specified. Night time noise criteria will generally be exceeded if night time works are undertaken, these will be mitigated and managed through the implementation of a CNVMP and associated conditions.

There will be a degree of temporary disturbance and alteration to the amenity of the area. These effects should be to an acceptable degree for most people, who will be able to continue with normal activities albeit with some temporary disturbance.

It is envisaged that with a CNVMP process in place, construction related effects can be appropriately managed and are overall more than minor.

9.8.1. Introduction

This section summarises the findings of the assessment of the actual and potential noise and vibration effects arising from the construction of the Project, outlined in the *Construction Noise and Vibration Assessment* contained in *Volume 2* of this Application. Noise and vibration effects in relation to the operational phase of the Project are the subject of a separate report and are summarised in section 9.15 of this AEE.

The existing noise environment, identification of sensitive receivers, results of the assessment of construction noise and the associated potential effects are described in detail in the *Construction Noise and Vibration Assessment.* This section presents the findings of that assessment, namely the potential noise and vibration effects associated with the construction of the Project which has informed the proposed mitigation measures.

9.8.2. Existing noise environment

The ambient noise environment in the vicinity of the Project is relatively low due to the absence of major local roads and industry. The exceptions are the southern and northern tie-ins with P2Wk and the existing SH1, and where the Indicative Alignment crosses the existing SH1 in the vicinity of the Hōteo River, where traffic on SH1 affects ambient noise levels.

For consistency with the operation noise assessment for this Project the term PPFs has also been used to define locations for assessment of construction noise and vibration. For this Project PPFs are dwellings. Monitoring was undertaken at selected PPFs which are currently exposed to road traffic noise and also those that are not overly exposed to road traffic noise, providing a representative sample of the range in noise conditions. Noise monitoring was undertaken in accordance with New Zealand Standard *NZS 6806:2010 Acoustics - Road traffic noise - New and altered roads* (NZS 6806).

For those PPFs located in close proximity (<200 m) to SH1, road noise was noted as an audible noise source. Noise levels at PPFs located further away from SH1 were dominated by farm and other rural noises. For most of the Project the existing ambient noise levels near the proposed designation boundary are considered to be dominated by natural environmental sounds. Noise levels ranged from 24 dB $L_{Aeq(24h)}$ in rural areas to 54 dB $L_{Aeq(24h)}$ closer to SH1.

No existing vibration sources were identified either within the proposed designation boundary or surrounding the Project area which would immaterially influence the perception or other effects of potential construction vibration which typically occur a higher levels than typical ambient traffic vibration.

9.8.3. Construction noise and vibration assessment methodology

Overview

Construction activities are inherently noisy and can result in noise levels much higher than the existing ambient noise levels. This is particularly relevant in areas where there are low existing noise levels and construction activity would be the dominant noise source.

The assessment methodology for determining construction noise and vibration effects was undertaken via the following:

- Identification of PPFs located within 200 m of the proposed designation boundary;
- Determination of the appropriate construction noise and vibration criteria;
- Determination of the noise sources associated with construction activities, prediction of the noise and vibration levels from each construction activity and determination of the appropriate setback distances from the activity to achieve compliance with the appropriate criteria (without mitigation);
- Identification of PPFs at risk of exceeding the criteria for both noise and vibration, and recommendation of mitigation and management measures to address this risk.

The number of PPFs at risk of exceeding the noise criteria was assessed for noise and vibration in three scenarios:

1. Construction activities assumed to occur along the Indicative Alignment.
2. Construction activities occurring on a potential alignment located closer to the eastern side of the proposed designation boundary.
3. Construction activities occurring on a potential alignment located closer to the western side of the proposed designation boundary.

The predictions in scenarios (2) and (3) represent a hypothetical situation of the works being undertaken immediately adjacent to the proposed designation boundary, in reality the alignment would be at least slightly stepped in from the proposed designation boundary. These scenarios are therefore considered to be conservative. The *Construction Noise and Vibration Assessment* split the Project into three sections that align with the indicative construction methodology; South, Central and North.

Noise assessment criteria

NZS 6803 is the relevant standard for the assessment of construction noise in New Zealand and is considered to be the most appropriate standard on which to base an assessment of construction noise effects for this Project. The *Construction Noise and Vibration Assessment* also considered the AUP(OP) construction noise criteria, however, these AUP(OP) criteria are based on a 'typical' construction period. In many areas, the Project construction will be longer than 20 weeks, therefore the long-term duration criteria, as detailed in NZS 6803, are the appropriate criteria for assessment. Construction works in some areas, and in relation to individual PPFs may be less than 20 weeks in some instances. The long-term criteria are five decibels more stringent during daytime than the criteria for "typical duration" construction works (up to 20 weeks' duration).

NZS 6803 sets noise criteria which are to be met where practicable. Where full compliance with the criteria is not practicable, then measures should be employed to deal with potential exceedances. The construction noise criteria are generally higher than the criteria for operational noise because construction is a temporary activity with a finite duration.

For residential areas and rural dwellings, NZS 6803 allows higher noise criteria during daytime hours so that construction activity can take place (see Table 9-14). For Sundays and public holidays, lower noise criteria are set to provide respite from construction noise. Similarly, night-time criteria are low and only allow very quiet operations or operations remote from dwellings to be carried out to avoid sleep disturbance.

Table 9-14: Recommended upper limits for construction noise received in residential zones and dwellings in rural areas (Source: NZS 6803).

Time of Week	Time Period	Long Term Duration	
		$L_{Aeq(t)}$ dB	L_{AFmax} dB
Weekdays	0630-0730	55	75
	0730-1800	70	85
	1800-2000	65	80
	2000-0630	45	75
Saturdays	0730-1800	70	85
	1800-0730	45	75
Sundays and Public Holidays	0730-1800	55	85
	1800-0730	45	75

NZS 6803 does not anticipate that full compliance will necessarily be achieved at all times and at all receivers. It focuses on the implementation of the best practicable option (BPO) for construction noise management and mitigation, rather than requiring that the criteria be achieved.

Vibration criteria

The AUP(OP) and the Transport Agency Construction Noise and Vibration Guide have been considered in terms of construction vibration criteria. While both documents are based on the same fundamental standards, the criteria in the Transport Agency Construction Noise and Vibration Guide were taken forward as the primary basis for assessment of this Project as it has a more refined process accounting for substantial variabilities in vibration sensitivities. The construction vibration criteria provided in the Transport Agency Construction Noise and Vibration Guide are outlined in Table 9-15 below.

Table 9-15: Construction vibration criteria

Receiver	Location	Details	Category A mm/s PPV[71]	Category B mm/s PPV
Occupied PPFs	Inside the building	Night time 2000h to 0630h	0.3	1
	Free-field[72]	Daytime 0630h to 2000h	1	5
Other occupied buildings	Inside the building	Daytime 0630h to 2000h	2	5

[71] Peak particle velocity. This is the instantaneous maximum velocity reached by the vibrating surface as it oscillates about its normal position.

[72] Description of a location which is at least 3.5m from any significant sound reflecting surface other than the ground.

Receiver	Location	Details	Category A mm/s PPV[71]	Category B mm/s PPV
All other buildings	Building foundation	Vibration transient	5	BS 5228-2[73] –Table 4 of *Construction Noise and Vibration Assessment*
		Vibration continuous		BS 5228-2 - 50% of values in Table 4 of *Construction Noise and Vibration Assessment*)

In the first instance, construction vibration should be managed to comply with Category A as far as practicable, and then Category B as far as practicable. If levels exceed those of Category B, management of vibration effects may still be possible, but will require vibration monitoring of levels and effects.

Blasting noise and vibration criteria

There are no New Zealand standards specifically for blasting noise and vibration. Noise and vibration associated with blasting have been assessed against the criteria in the Transport Agency Construction Noise and Vibration Guide, as presented in Table 9-16.

Table 9-16: Blasting noise and vibration criteria

Receiver	Location	Details	Category A	Category B
Occupied PPFs	Inside the building	Blasting – vibration	5mm/s PPV	10 mm/s ppv
	Free-field	Blasting – air blast	120 dBL_{Zpeak}	–
All other buildings	Building foundation	Vibration transient	5mm/s PPV	BS 5228-2[74] – Table 4 of *Construction Noise and Vibration Assessment*
	Free-field	Blasting – air blast	–	133 dBL_{Zpeak}

Location of PPFs

For the purposes of the construction noise assessment, PPFs which fall within the Project area (apart from one noted below at 161 Kraack Road) have been excluded from the assessment as they will be unoccupied or demolished as part of the Project. All PPFs within 200 m of the proposed designation boundary were considered in the construction noise assessment. In addition, one residential property within the Project area was included in the assessment at 161 Kraack Road where the Indicative Alignment passes through tunnels below the property. As such the dwelling could

[73] British Standard BS5228-2:2009 Code of practice for noise and vibration on construction and open sites – Part 2 Vibration
[74] British Standard BS5228-2:2009 Code of practice for noise and vibration on construction and open sites – Part 2 Vibration

remain occupied as it is largely unaffected by construction of the Project. In total 60 PPFs were identified.

Construction noise effects are noted as potentially extending beyond 200 m of the proposed designation boundary. However, those PPFs located within 200 m of the proposed designation boundary are the most at risk of exceedances. Any measures and mitigation proposed to address exceedances at these PPFs would also manage effects in the wider area, including those PPFs located more than 200 m from the proposed designation boundary.

Noise level predictions

Noise level predictions have been undertaken based on the indicative construction methodology outlined in *Section 5* of the AEE. The final construction methodology will be determined by the contractor once appointed.

Noise level predictions generally consider:

- Source sound power levels of each item of equipment;
- Noise propagation characteristics over distance;
- Effects of ground and air absorption;
- Meteorological conditions; and
- Terrain (including shielding).

The noise level predictions undertaken for the assessment are considered conservative whereby weather conditions, shielding due to terrain (including buildings or hills/cutting) and absorption from the ground and air were not considered.

Vibration predictions

Vibration predictions need to take the following into consideration:

- Propagation through non-uniform ground types;
- Coupling between the vibration source and the ground; and
- Coupling between the ground and the vibration sensitive receiver.

Vibration calculations were based upon ground type. All construction activities occur within the Category III Soil Classification as defined in the Transport Agency Construction Noise and Vibration Guide: Hard soils (cannot dig with shovel, must use pick to break up); dense compacted sand, dry consolidated clay, consolidated glacial till and some exposed rock.

Blasting predictions

No predictions were undertaken for blasting as sufficient details are not available at this stage. The Construction Noise and Vibration Assessment has assumed that if blasting is required, the contractor will undertake initial trials (using smaller charge sizes) to determine the site specific blast response characteristics to define allowable blast sizes to maintain compliance with the criteria outlined earlier in this section.

9.8.4. Assessment of construction noise and vibration effects

Construction is inherently noisy and generally results in a large noise level increase above existing levels for a defined period. The increase is particularly apparent in low noise environments where construction noise is introduced.

Ambient noise levels within and in proximity to the Project area are generally low due to the surrounding primarily rural nature. Therefore, even when achieving compliance with the criteria of NZS 6803 there will be a significant increase in overall noise level during the construction phase.

The assessment within this section considers the effects of an Indicative Alignment and other potential effects that could occur if that alignment shifts within the proposed designation boundary when the design is finalised in the future.

Construction noise predictions

Construction equipment will be working in clusters along the Indicative Alignment, and would undertake the following general activities:

- Bulk earthworks;
- Earthworks fills, soil disposal areas and compaction;
- Rock breaking;
- Drilling (for blasting if required);
- Piling for bridges;
- Construction of bridge/viaduct structures;
- Pavement construction;
- Staging areas;
- Mineral extraction; and
- Rock crushing.

A list of likely equipment required for the above activities was completed based on similar roading projects throughout New Zealand. The ‘time weighted activity sound power levels and compliance distances’ were determined from the estimated equipment used for undertaking the above activities and the estimated time periods each of the equipment is used for. The distance the activity would need to be from the sensitive receiver to comply with the criteria (without mitigation) was calculated using the sound power level (see Table 9-17).

Table 9-17: Time weighted activity sound power levels and compliance distances

Activity (all equipment)	Time Weighted Activity Sound Power Levels dB L_{AW}	Distance beyond which compliance is achieved without additional mitigation (m)		
		Monday to Saturday 0730h to 1800h	Weekdays 1800 to 2000 hours	Sundays and Public Holidays 0730h to 1800h Limit 45 dB L_{Aeq}
		Limit 70 dB L_{Aeq}	Limit 65 dB L_{Aeq}	
Large bulk cuts	117	84	150	1497
Small bulk cuts	118	98	175	1748
Earthworks fills, spoil areas/ compaction	114	64	114	1142
Rock breaking	108	31	55	548
Drill rigs for blasting	116	80	142	1416
Bridges – piling	100	12	22	218
Bridges – super structure	107	30	53	526
Bridges – viaduct	107	30	53	526
Pavement construction	111	44	78	776
Staging area	109	34	60	603
Mineral extraction	108	31	55	548
Rock crushing	120	123	218	2181

The number of PPFs within 200m of the proposed designation boundary are set out in Table 9 of the *Construction Noise and Vibration Assessment*. The mitigation approach proposed to be adopted for construction of the Project will include techniques such as site hoardings/temporary noise walls, communication with PPFs and wider community, avoidance of working in close proximity to PPFs where practicable and using stock piling for screening. At times during the construction of the Project, construction activities will occur in close proximity to PPFs and in some instances there is the potential for noise and/or vibration levels to temporarily exceed the criteria, after best practicable option for mitigation has been implemented. For large scale projects such as this, minor temporary exceedances of the noise and vibration criteria are common, and practices are in place to address adverse effects of those exceedances. 16 PPFs were located within 50m of the proposed designation boundary and therefore required specific attention with respect to mitigation. These are located as follows:

Table 9-18: PPFs within 50 metres of proposed designation

Location	Number of PPFs affected
Southern section	
74 Wylie Road	1
Kaipara Flats Road	4
Central Secton	
Kraack Road	2
Northern Section	
Rustybrook Road	1
SH1	2
129/139 Vipond Road	2
Northern tie -in	4
Total	**16**

While there will be adverse construction noise effects, the *Construction Noise and Vibration Assessment* concludes it is practicable for noise levels to be controlled to comply with appropriate NZS 6803 criteria most of the time. On this basis people should be able to continue their normal activities with temporary alterations to their amenity. This temporary disturbance is considered acceptable and minor.

9.8.5. Measures to avoid, remedy or mitigate actual or potential adverse effects

Construction activities throughout the extent of the proposed designation will occur in the vicinity of some PPFs. As outlined above, there is potential for specific construction related activity to temporarily exceed applicable construction noise and vibration criteria at PPFs located within 200 m of the proposed designation boundary, and more specifically identified for 16 PPFs located within 50 m of the proposed designation boundary.

The proposed mitigation measures applied on Transport Agency projects are well established processes and are currently being implemented on the current P2Wk construction. Although exceedances at times during construction for large scale infrastructure projects are expected, measures can be implemented to manage or mitigate noise generation as far as practicable. The BPO will be applied to the management and mitigation of construction noise and vibration. The contractor will need to develop the BPO for the mitigating of noise and vibration generating construction activities. The mitigation measures detailed below are considered to be the baseline mitigation for most circumstances.

Recommendations to mitigate effects are as follows:

- Construction should be undertaken in accordance with a CNVMP which provides a framework to manage and mitigate noise and vibration effects.
- Long term construction staging areas should be separated from PPFs as much as practicable and should not be located in the vicinity of occupied PPFs on Kaipara Flats Road
- Kraack Road should not be used as a haulage route.

The potential risk of exceedances of the recommended criteria can be managed and mitigated through a CNVMP which will be prepared by the contractor prior to construction when details of the design, construction method and programme are finalised. The CNVMP will provide overall direction for management and mitigation of potential impacts during construction for both on-site and off-site measures and will outline a process for development of activity specific or area specific schedules to the CNVMP where exceedances of the criteria are likely. The CNVMP will be prepared in accordance with NZS 6803 and the Transport Agency Construction Noise and Vibration Guide.

The CNVMP will set out measures to manage construction noise and vibration effects. These will include general noise management and mitigation measures to be adopted throughout construction, such as considerate operating procedures on and off-site and appropriate communication with affected residents. Examples of on-site measures include training of personnel, maintenance of equipment, noise barriers and enclosures and considerate behaviour and use of equipment. Examples of off-site measures include public liaison and communication, temporary barriers, and noise level monitoring. Temporary relocation should also be offered where all other practicable mitigation measures have been implemented. In addition, targeted management approaches such as individual engagement with residents should be undertaken for ‘at risk’ receivers.

9.8.6. Conclusion

The Project will introduce construction related noise and vibration generating activities to an area with a generally low ambient noise environment. Therefore, even noise increases within the applicable standards may be noticeable at nearby PPFs when compared to the existing situation.

The assessment has determined that daytime compliance with applicable noise and vibration criteria is likely in most cases, but there could be localised exceedances at specific PPFs and in conjunction with specific construction activities.

Measures to manage noise and vibration effects during construction are recommended through the preparation of a CNVMP. The development and implementation of a CNVMP should be able to mitigate significant adverse effects of construction noise and vibration with the BPO followed in terms of mitigation. Even if compliance cannot be achieved, the CNVMP will provide methods to minimise the overall effect of the exceedances to the noise and vibration criteria.

Additional measures have been recommended for PPFs located on Kaipara Flats Road and Kraack Road.

Based on the findings of the *Construction Noise and Vibration Assessment*, and with adherence to relevant construction noise and vibration criteria (where practicable) and the implementation of the CNVMP, it is considered that noise effects from construction of the Project will be more than minor and vibration effects from construction of the Project will be minor.

9.9. Construction air quality

Overview

The construction phase of the Project has the potential to generate dust, particularly from earthworks, topsoil removal and spread, cut and fill operations, vehicle movements on unsealed roads, rock crushing and other activities in road construction such as trackout (the transport of dust and dirt on the road network where it may be deposited and re-suspended by vehicles).

There are some specific receivers in the vicinity of the Project with higher sensitivity to air quality effects from construction dust. The locations at risk to air quality effects include highly sensitive receivers (HSRs), such as dwellings, within 200 m of the proposed designation boundary, and within close proximity to both sealed and unsealed access roads which extend outside of the proposed designation boundary. The HSRs which are most at risk to air quality effects are located:

- downwind of and within 50 m of the proposed designation boundary;
- within 100 m of any proposed mobile rock crushing machine;
- within 50 m of sealed access roads, up to 500 m from the proposed designation boundary where trackout is proposed; and
- within 100 m of all unsealed access roads and local roads.

Dust generation can be reduced by implementing mitigation measures. For example, construction roads can be well metalled and regularly watered during dry periods and excavated surfaces can be watered and stabilised immediately after works. Several access roads are recommended to be sealed, should these be utilised for construction access. Suitable separation distances for the rock crushing plant operation from HSRs can be implemented.

It is recommended that a Construction Air Quality Management Plan (CAQMP) be developed and implemented to manage effects of dust from construction of the Project. The CAQMP will outline a range of general mitigation measures, and procedures for implementing site dust controls.

Through the implementation of the CAQMP, dust effects during construction are considered to be manageable and minor.

9.9.1. Introduction

This section summarises the findings of the assessment of the actual and potential effects on air quality arising from construction of the Project outlined in the *Air Quality Assessment*, contained in *Volume 2* of this Application. Air quality effects in relation to the operational phase of the Project are also the subject of that assessment report and are summarised in section 9.16 of this AEE.

The existing air quality environment, identification of highly sensitive receivers (HSRs) in proximity to the Project area, and potential construction air quality effects at specific locations are described in detail in the *Air Quality Assessment*. Whilst undertaking this assessment, reference has been made to the Ministry for the Environment *Good Practice Guide for Assessing and Managing Dust 2016* (MfE Dust Guide) and the *Transport Agency Assessment Guide to assessing air quality impacts* *from State highway projects (2015)* (Transport Agency Air Quality Assessment Guide). Based on the guidance, the *Air Quality Assessment* outlines the potential air quality effects arising from the construction of the Project. This section of the AEE presents the findings of that assessment, namely the potential effects on air quality associated with the construction of the Project.

9.9.2. Existing air quality environment

Background ambient air contaminant concentrations for the Project area are low given the rural nature of the area.

The Project area environment is characterised by:

- Hilly terrain requiring a series of cuts and fills for road construction;
- Prevailing winds from the west to south-west sector, with winds above 5 m/s likely around 30% of the time; and strong winds are predominant from that direction; and
- Strong winds over 10 m/s which are likely to be infrequent at around 2.5% of the time.

9.9.3. Construction air quality assessment methodology

Overview

Construction dust effects were assessed by considering the separation distance of the construction areas and potential access roads to HSRs, and the nature and extent of the construction activities. Potential air quality effects from construction access roads were assessed by evaluating trackout dust from construction areas and dust suspension from unsealed roads.

Highly sensitive receivers (HSRs)

The Transport Agency Air Quality Assessment Guide defines a HSR as a location where people or surroundings may be particularly sensitive to the effects of air pollution. For the Project, HSRs identified are dwellings.

Proximity of HSRs to the Project is a determining factor when assessing construction dust effects. HSRs for the assessment of construction air quality effects were identified based on the following criteria:

- HSRs located 200 m from the proposed designation boundary;
- HSRs within 50 m of sealed access roads, up to 500 m from the proposed designation boundary; or
- HSRs within 100 m of unsealed local roads used for access outside of the proposed designation boundary.

One HSR is located within the proposed designation boundary (located above the proposed tunnels). It is assumed that this HSR can remain occupied during the construction of the Project. All other HSRs located within the Project area were considered to be unoccupied at the time of construction, and therefore were excluded from the assessment. Table 9-19 outlines the number and proximity of HSRs to the proposed designation boundary and Indicative Alignment for the South, Central and North sections of the Project.

Table 9-19: HSRs near the Indicative Alignment proposed designation boundary

Section	Number of HSRs within 200 m of proposed designation boundary	Approx. distance of nearest HSR to proposed designation boundary (m)	Distance of nearest HSR (outside of the proposed designation boundary) to Indicative Alignment road edge (m)
South	20	5	40
Central	2	1	112
North	41	8	11
Total	63[75]		

The transport of dust and dirt from the Project construction activities on the public road network, where it may be deposited and re-suspended by vehicles using the network, is referred to as trackout. Construction dust originating from trackout is relevant for HSRs located within 50 m of sealed roads, up to 500 m from the proposed designation boundary[76]. Dust from unsealed roads are relevant for HSRs located within 100 m of the entire length of unsealed road. The specific roads and number of HSRs potentially impacted by dust from trackout and vehicle movements along sealed and unsealed roads are summarised in Table 9-20. There are seven HSRs within 50 m of the sections of sealed access roads with potential to have elevated dust from construction trackout, with the nearest HSR being 20 m from SH1, North of Maeneene Road. There are two HSRs within 100m of unsealed roads being used for construction site access, with the nearest being 42 m at Silver Hill Road.

Table 9-20: HSRs with potential for dust effects from access roads

Construction dust trackout from sealed access roads, up to 500 m from proposed designation boundary edge			
Road	**Section**	**Number of HSRs within 50 m**	**Distance of nearest HSR to access road (m)**
Kaipara Flats Road - Carran Road to SH1	South	2	37
Carran Road	South	0	200+
Woodcocks Road	South	1	45
SH1, south of Hōteo Bridge, to Warkworth	Central/South	1	30
SH1, north of Maeneene Road	North	2	20
Mangawhai Road	North	1	50

[75] This excludes the one HSR located within the proposed designation boundary also assessed.
[76] *Institute of Air Quality Management Guidance on the assessment of dust from demolition and construction (2014)*

Whangaripo Valley Road	North	0	98
Wayby Valley Road	North	0	200+
Dust from unsealed access roads			
Road	**Section**	**Number of HSRs within 100 m**	**Distance of nearest HSR to access road (m)**
Lower Silver Hill Road	North	0	–
Silver Hill Road	North	2	42
Farmers Lime Road	North	0	–

In summary, the following have been identified as being potentially affected by dust associated with the Project:

- 64 residential properties within 200 m of the proposed designation boundary. This is made up of:
  - 63 residential properties within 200 m of the proposed designation boundary, and
  - one residential property within the proposed designation boundary.
- An additional nine residential properties outside of the proposed designation boundary. This is made up of:
  - seven residential properties within 50 m of sealed access roads up to 500 m from the proposed designation boundary (for construction dust trackout assessment purposes); and
  - two residential properties within 100 m of unsealed access roads.

Assessment methodology

Dust is the primary contaminant of concern for the construction phase of the Project. The assessment of construction effects on air quality was based on a qualitative assessment and "Frequency, Intensity, Duration, Offensiveness and Location" (FIDOL) factors, see Table 9-21.

Table 9-21: Description of FIDOL Factors

Frequency	How often an individual is exposed to the dust
Intensity	The concentration of the dust
Duration	The length of exposure
Offensiveness/character	The type of dust
Location	The type of land use and nature of human activities in the vicinity of the dust source

For construction dust, the relevant assessment criterion in line with the MfE Dust Guide 2016 and Standard E14.6.1.1 of the AUP(OP) aims for no adverse effects on health or dust nuisance predicted beyond the site boundary i.e. no noxious, dangerous, offensive or objectionable dust or odour from dust deposition. Construction dust effects are influenced by the location and separation distance between the construction activities and HSRs around the Project, and the nature and extent of the construction activities.

Sensitivity assessment

The assessment considered the location of construction activities within the proposed designation boundary, allowing for the possibility of the alignment being constructed anywhere within the proposed designation boundary. However, it is noted that it is unlikely construction works will occur immediately adjacent to the proposed designation boundary for the entire length of the Project and therefore the approach adopted is conservative.

9.9.4. Assessment of construction air quality effects

The potential effects of dust from construction are dependent on multiple variables including wind direction and strength, rainfall, the distance from the earthworks activity to potentially affected properties, the size and scale of earthworks and other activities, the number of vehicle movements and the nature of the surface material, including moisture content.

The construction phase of the Project has the potential to generate dust, particularly from earthworks, topsoil removal and spread, cut and fill operations and other activities in road construction such as blasting, rock crushing and trackout to access roads (construction traffic on sealed and unsealed roads) from construction areas. These activities have been assumed to be able to be located anywhere within the proposed designation boundary with the exception of the mobile crushing plant which has been assessed based on where the activity will be reasonably expected to be located (see below).

Dust will be generated as a result of vehicle movements and wind on exposed or unsealed surfaces. The cut volumes for the Project have been estimated at approximately 1.9 million m^3 in the South section, 6 million m^3 in the Central section, and 4.5 million m^3 in the North section. Haulage by heavy vehicles will largely be determined by cut/fill balances. Current estimates show a shortfall of fill in the South section, an excess of material in the Central section and a cut/fill balance in the North section. Therefore, construction dust may be generated through vehicle movements, transporting of material between the Central and South sections, and from nearby quarry sources along roads and through the importing of other materials such as those required for pavements. The construction routes are described in more detail in section 9.7 in this AEE.

Other discharges to air include emissions from vehicle and equipment exhausts. However, these were not specifically assessed as the associated effects are considered to be less than those for vehicle travel from the operational phase of the Project.

The primary potential construction air quality effects resulting from the Project are considered to be health effects from exposure to inhalable particular matter, and dust nuisance. The Project area is located in a rural location, and therefore dwellings are assumed to rely on roof water collection for their water supply. Dust deposition on roofs of dwellings has the potential to cause increased suspended solids in the water supply, although it is noted that this is more of an aesthetic issue than a health concern.

Rock crushing activities have the potential for adverse dust effects, however, this is largely dependent on the moisture content of the materials being crushed and the amount of fine particulate matter present. The mobile crushing plant could be operated at locations where excavated materials require crushing in order to be used as fill. Consequently, areas of the Project where the mobile crushing plant could be located have been identified as:

- South section: anywhere in cut areas between the southern portal of the tunnel and Bridge 22 as Pakiri Formation rock will be encountered in these cuts.
- Central section: anywhere in cut areas as Pakiri Formation rock will be encountered in all cuts.
- North section: anywhere in cut areas as several cuts are in limestone and other cuts may have bands of stronger mudstone.

Effects on HSRs

All HSRs are susceptible to dust effects from construction. However, those located more than 50 m from construction areas are less likely to be impacted by dust deposition given the likely mitigation measures in place following industry good practice. Properties located more than 200 m from the proposed designation boundary will likely experience less than minor impacts, even without mitigation measures for dust management in place.

The effects from construction dust will be greatest immediately downwind of earthwork activities or exposed surfaces, when conditions are dry and there are strong winds. In the South section there are four properties located within 50 m of the proposed designation boundary. The HSRs identified as being nearby (i.e. within 50 m) and downwind of potential dust producing activities are residential properties 74 Wyllie Road, 130, 131 and 211 Kaipara Flats Road.

In the Central section there is one residential property located within 20 m of the proposed designation boundary. This residence is located at 145 Kraack Road and is relatively far from the likely location of the majority of dust producing construction activities within the proposed designation boundary. Dust effects to this property will have a no more than minor effect.

In the North section there are ten residential properties located within 50 m of potential dust producing activities, with six of these being closer than 20 m. Of these properties, 177 Rustybrook Road, 47 Borrows Road, 35 Vipond Road, 704 SH-1, Wellsford, 542 SH-1, Topuni, 490 SH-1, Wellsford, 139 Vipond Road, 129 Vipond Road, 17 Maeneene Road and 33 Maeneene Road are identified as being both within 50 m and located downwind of the prevailing wind in-line with potential dust producing activities.

There is potential dust from trackout activities and for construction traffic on unsealed access roads to adversely affect specific dwellings and as such mitigation is recommended.

The HSRs within 200 m of potential rock borrow and mobile rock crushing operations are as follows:

- South section: there are eleven HSRs within 200 m and one HSR within 50 m of the proposed cut/fill areas where a mobile rock crusher has potential to be used.
- Central section: there are no HSRs within 200 m of the proposed cut/fill areas where a mobile rock crusher has potential to be used.
- North section: there are 25 HSRs within 200 m and three HSRs within 50 m and two HSRs within 20m of the proposed cut/fill areas where a mobile rock crusher has potential to be used.

There is potential that these properties will be impacted by construction dust associated with potential mobile rock crushing operations. However, these potential impacts can be effectively managed through the implementation of mitigation measures and through following good industry practice as outlined in section 9.9.5 below.

Based on the potential number of HSRs that may be affected by construction dust, the effects of construction on air quality is assessed as being potentially significant and mitigation is recommended.

Effects on electricity transmission lines

There is one existing transmission line located within the Project area which is a 110 kV Line owned and operated by Transpower. The Indicative Alignment is proposed to cross beneath this transmission line in the vicinity of the Te Hana interchange. Construction dust has the potential to cause a line to flashover/fault from dust deposition if dust mitigation measures are inadequate. 'Flashover' is the term used to describe a momentary, but major electric arc; a flashover or contact with the electricity transmission lines, may result in an outage of electricity supply to communities, people and industry[77]. Effects on transmission lines will be managed through the implementation of dust mitigation measures and through consultation with Transpower as outlined below.

9.9.5. Measures to avoid, remedy or mitigate actual or potential adverse effects

It is recommended that a comprehensive Construction Air Quality Management Plan (CAQMP) be developed for the Project once the construction activities and associated areas are at the detailed design stage. The full list of likely mitigation measures is outlined in the *Air Quality Assessment*, and includes measures such as:

- Sealing of access roads near HSRs (where dwellings are located closer than 50 m);
- Maintenance of construction areas, haul roads and site accesses with an appropriate base material;
- Watering/dampening and covering as necessary for truck loads, haul roads, stockpiles or other exposed surfaces;
- Limiting of vehicle speeds;

[77] Ministry for the Environment (2010) *National Policy Statement of Electricity Transmission: further guidance on risks of development near high-voltage transmission lines* publication. Relevant text *The Problems with Development near High-voltage Transmission Lines* available at: http://www.mfe.govt.nz/publications/rma/national-policy-statement-electricity-transmission-further-guidance-risks

- Staging of earthworks as much as practicable to limit the exposed surface area at any one time;
- Limiting earthworks activities in close proximity to HSRs during windy conditions;
- Installation of wind fencing where appropriate; and
- Revegetating of exposed surfaces where practicable.

In addition to the management and mitigation of construction dust effects, the CAQMP will identify procedures for implementing site dust controls, including identifying responsibilities for monitoring, as follows:

- What has to be done and why;
- Who has to do it and/or see that it is done;
- How it will be done;
- The desired outcomes;
- How these outcomes will be monitored; and
- Procedures for acting on any issues identified.

In the event of an exceptional weather event where the controls fail, additional mitigation of adverse effects from dust deposition onto neighbouring properties should include consideration of the need for external house cleaning services and supply of drinking water for residences in the event that drinking water supplies are affected.

Specific mitigation measures are proposed to be adopted to minimise dust in areas where HSRs are located within 50 m and downwind of earthworks activities. The measures to be implemented will be adaptively managed in response to the level and cause of effect and taken from the full list in section 6.1.1 of the *Air Quality Assessment.* Properties requiring this adaptive and specific mitigation are:

- 74 Wyllie Road;
- 211 Kaipara Flats Road;
- 177 Rustybrook Road;
- 47 Borrows Road;
- 490 and 704 SH-1, Wellsford;
- 542 SH-1, Topuni;
- 17 and 33 Maeneene Road;
- 130 and 131 Kaipara Flats Road;
- 127, 145 and 161 Kraack Road; and
- 35, 129 and 139 Vipond Road.

Sealing of some extents of Silver Hill Road and Lower Silver Hill Road is recommended if these roads are confirmed to be used for the construction phase access road network within proximity to PPFs. Provision of vehicle wheel wash facilities for construction vehicles accessing the site off sealed roads should be provided (when departing the construction area), particularly when construction traffic is using:

- Woodcocks Road;
- Kaipara Flats Road;
- SH1, south of Hōteo Bridge;
- Mangawhai Road; and

- SH1, north of Maeneene Road.

Systems for dust suppression will need to be incorporated into the design and management of the crushing plant. These systems could include enclosure of dust sources and extraction to control equipment or water suppression. The *Air Quality Assessment* also recommends a minimum 100 m separation distance from HSRs for rock crushing machines.

Monitoring will be undertaken to ensure dust is kept to an acceptable level and that mitigation measures are having the required effect. Three methods are recommended for dust monitoring during the construction phase:

- Visual inspection and record keeping on a daily basis;
- Weather observations; and
- Dust complaint investigation and reporting.

The above recommended mitigation measures are considered to be sufficient to manage the effects on HSRs and the transmission line. However, if additional measures are necessary, these will be developed and implemented in consultation with the residential occupants and Transpower.

Good practice measures for dust control via a CAQMP will be sufficient to avoid significant adverse effects for the majority of the time and the majority of the route. There are, however, many variables, in particular wind direction and strength, sunshine or rainfall, and the management methods that may be applied. In the unlikely event that significant adverse effects occur, the recommended additional measures are considered sufficient to remedy these.

9.9.6. Conclusion

Construction activities will generate dust which has the potential to impact HSRs in close proximity to the construction areas and access roads. Specific activities such as mobile rock crushing operations also have potential to generate high dust levels. To manage construction dust effects, a suite of control measures, monitoring and mitigation controls are recommended to be put in place and implemented throughout construction of the Project.

A CAQMP will outline the requirements for minimising potential for adverse effects associated with dust generation from construction activities. For mobile rock crushing plant, good industry practice for dust control should be applied and in addition a separation distance of a minimum of 100 m from HSRs is recommended. The CAQMP will be developed prior to the commencement of construction and earthwork activities.

Overall, it is considered the recommendations outlined in the *Air Quality Assessment* are industry good practice, and the assessment has concluded that with these mitigation measures in place significant adverse effects on air quality arising from construction of the Project will be avoided. The recommendations include the preparation of a CAQMP including sufficient setback distances for rock crushing operations. It is considered that air quality effects from construction of the Project with the recommended mitigation in place, will be minor.

9.10. Heritage / archaeology

Overview

The Project is located in an area associated with both Māori and early European settlement. Māori history in the area was largely one of transient settlement, with pathways and tracks recorded in traditional histories and other notable events, particularly in the Hōteo River and Te Hana areas. In the Hōteo South area within the Project area, the archaeological and historic heritage sites relate to 19th century European settlement around Phillips and Carran Roads and include four US Military camp sites related to World War II. In the Hōteo North area, no archaeological and historic heritage sites have been identified within the proposed designation, however there is potential for unrecorded Māori sites to be found in this area. There is one site within the Project area which is identified on the AUP(OP) Historic Heritage Overlay and Schedule of Historic Heritage. However, it is outside the proposed designation boundary and will not be affected.

The Indicative Alignment has avoided some known archaeological and historic heritage sites. The Project where possible by early identification of historic heritage values through the design and alternatives assessment stages of the Project and avoidance of the main towns and centres, which have a higher number of sites of heritage significance.

There are nine known archaeological and built heritage sites located within the proposed designation and seven sites will be affected by the Indicative Alignment with two being destroyed, and five being modified or partially modified. These sites have low to moderate significance as they are either demolished, are only subsurface remains or are in a dilapidated state. Two other sites may also be directly affected by the Project should the Indicative Alignment or the design and location of ancillary components be altered. There is also potential for unrecorded archaeological sites to be affected in the Warkworth, Hōteo River and Te Hana areas.

The historic heritage significance of the identified archaeological sites has been evaluated, and none of the affected or potentially affected sites within the Project area are of more than moderate historic heritage significance. Work will be carried out in accordance with an Archaeological Authority and a range of measures have been recommended to mitigate the adverse effects of the Project on historic heritage values, including a Heritage and Archaeological Management Plan (HAMP) to ensure that archaeological issues are managed appropriately to be minor.

9.10.1. Introduction

This section outlines the actual and potential effects associated with the construction and operation of the Project on archaeology and built heritage. It identifies archaeological and historic heritage sites in the vicinity of the Project area and identifies potential effects from a historic heritage perspective.

The *Historic Heritage Assessment* in *Volume 2* of this Application identifies archaeological and built heritage sites within 200 m of the proposed designation boundary, identifies any areas of archaeological sensitivity where unrecorded archaeological sites are likely to be located, describes the archaeological and historic heritage sites with the potential to be affected by the Project and assesses the potential effects of the Project on historic heritage.

This section does not provide an assessment of potential effects on Māori cultural values. That assessment is contained in Section 9.18 this AEE.

9.10.2. Existing historic heritage and archaeological environment

The assessments undertaken in the preparation of the *Historic Heritage Assessment* involved background research, field surveys and mapping the locations of identified archaeological and historic heritage sites.

The research approach focused on the wider area surrounding the Project (including 200 m beyond the proposed designation boundary), rather than just within the Project area, in accordance with standard heritage assessment procedure. This assessment of effects section only discusses the archaeological and historic heritage sites within the Project area.

The research involved a review of archaeological and heritage databases including New Zealand Archaeological Association (NZAA) site record file (ArchSite), the Heritage New Zealand Pouhere Taonga (HNZPT) New Zealand Heritage List/Rārangi Kōrero archaeological reports, Land Information New Zealand (LINZ) plans, the Auckland Council's Cultural Heritage Inventory (CHI) database and the AUP(OP) Historic Heritage Overlay and Schedule of Historic Heritage, and other relevant plans, and historical research using general and archival sources.

Following the background research, a series of field surveys were undertaken to examine sections of the Project area considered to have archaeological potential based on the known distribution of archaeological and historic heritage sites and topographic analysis, and to visit recorded archaeological and historic heritage sites. This field survey included examining the ground surface for evidence of former occupation (in the form of middens, depressions, terracing or other unusual formations within the landscape, or indications of 19th century or early 20th century European settlement or other remains). This examination included an inspection of exposed and disturbed soils, where encountered, for evidence of earlier modification and to gain an understanding of the local stratigraphy.

Subsurface probing and test pitting with a spade at points across the Project area was undertaken as part of the *Historic Heritage Assessment* to determine archaeological potential. New or updated site record forms relevant to the Project were prepared and filed in the New Zealand Archaeological Association (NZAA) database.

Twelve known archaeological and/or historic heritage sites have been identified within the Project area, nine of these are located within the proposed designation[78], and seven of these are crossed by the Indicative Alignment (refer Table 9-22 below). These sites are all within the Hōteo South area and relate to 19th century European settlement around Phillips and Carran Roads and four 20th century United States military camp sites related to World War II.

[78] NB Whitson's house and stockyard are two sites on the same archaeological reference as shown in Figure 9-5

The nine sites within the proposed designation are listed in Table 9-22, whilst Figure 9-5 and Figure 9-6 show sites within the proposed designation and within proximity to it.

In the Hōteo North area there are no archaeological or historic heritage sites within the Project area. However, given the watercourses in the Te Hana area provide a direct link to the Kaipara Harbour, there is potential for unrecorded Māori sites to be found in this area, where the proposed designation crosses the hills to the east of Te Hana and at Maeneene Road where the land surrounding the stream holds potential for sites.

Table 9-22: List of recorded archaeological and historic heritage sites within the proposed designation

CHI No.	NZAA No.	Site type	Site Name	Category	Condition	Significance	Intercepts Indicative Alignment?
16996	N/A	US Military Camp	Dome Camp M6	Historic Structure	Demolished but subsurface remains	Low/Moderate	Yes
17005	N/A	US Military Camp	Carran Road Camp H2	Historic Structure	Demolished but subsurface remains	Low/Moderate	Yes
17006	N/A	US Military Camp	Wyllies Road Camp E	Historic Structure	Demolished but subsurface remains and impacted by P2Wk	Low/Moderate	Yes
17007	N/A	US Military Camp	Wyllies Road Camp F and G	Historic Structure	Demolished but subsurface remains and impacted by P2Wk	Low/Moderate	Yes
N/A	R09/2064	Historic Building	Woodthorpe	Historic Structure/ Archaeological Site	Extant poor condition	Moderate	Yes
N/A	R09/2224	Site of Building and structure	Whitson's House and Stockyard	Archaeological Site	Demolished. Potential for archaeological remains	Low/Moderate	Yes
N/A	R09/2226	Site of Building	Dome Valley Teacher's Residence	Archaeological Site	Unknown. Potential for archaeological remains	Moderate	Yes
N/A	R09/2225	Site of Building	Dome Valley School	Archaeological Site	Structure removed and built over. Potential for archaeological remains	Moderate	No
19027	R09/2063	Historic Building	Site of Phillips Cottage	Archaeological Site	Extant good condition	Low/Moderate	No

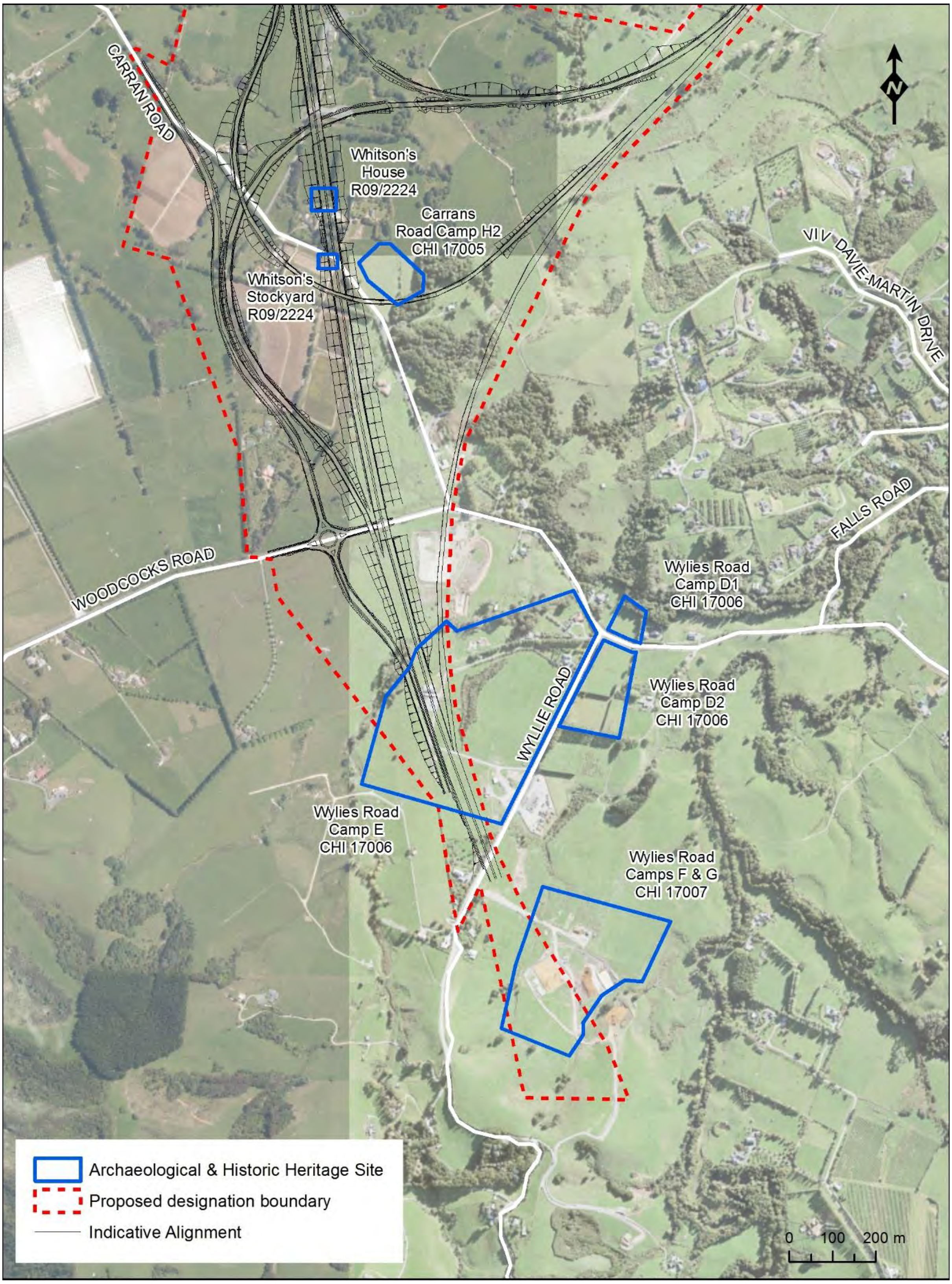


Figure 9-5: Location of archaeological and historic heritage sites within the Project area at Carran, Woodcocks and Wyllie Roads

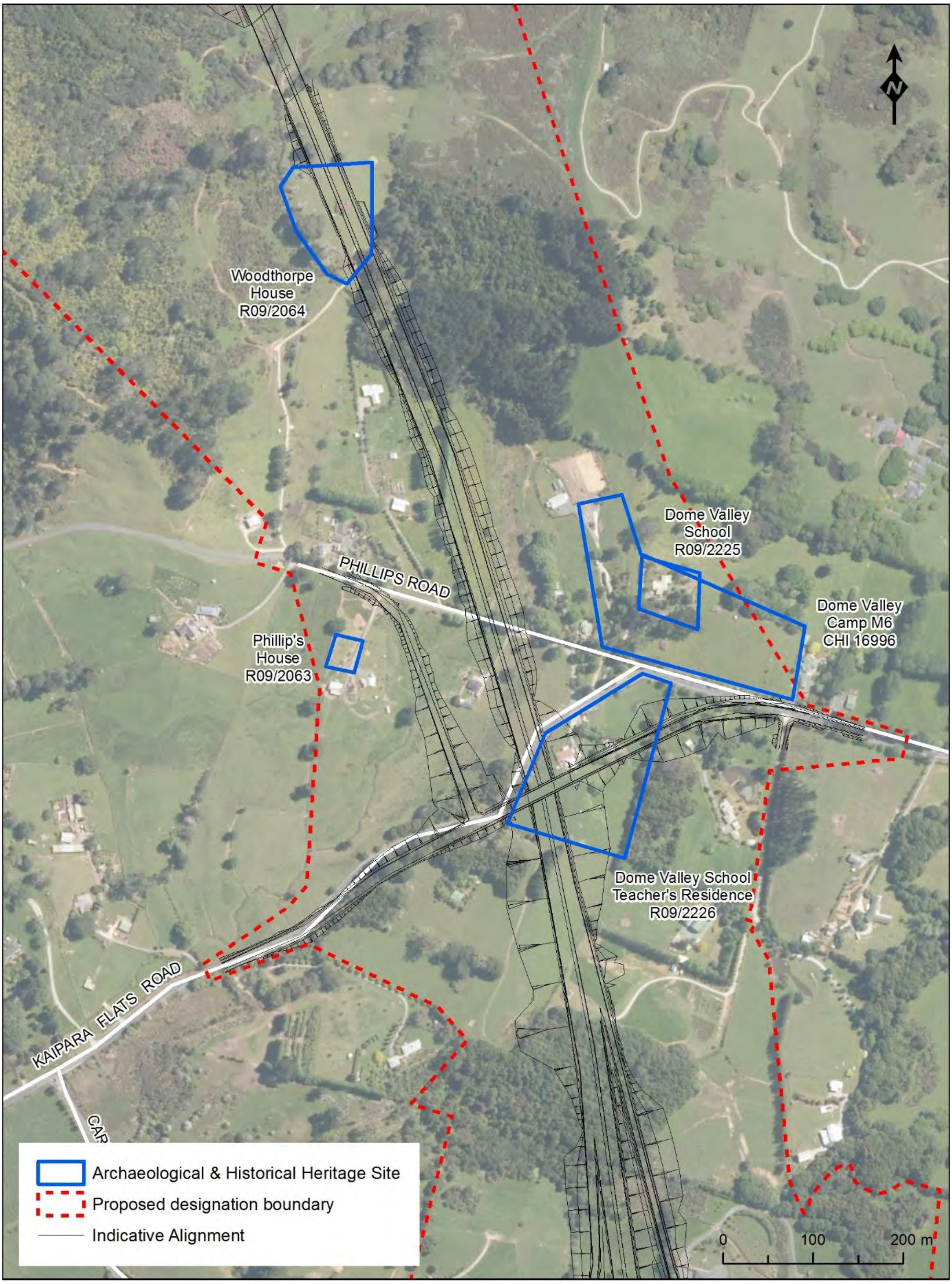


Figure 9-6: Location of archaeological and historic heritage sites within the Project area at Phillips Road

9.10.3. Assessment of effects on archaeological sites and built heritage

Heritage significance

There is one site located within the Project area which is identified in the AUP(OP) Historic Heritage Overlay and Schedule of Historic Heritage within the Project area. However, it is outside of the proposed designation and will not be affected. The evaluation of the historic heritage significance of the identified archaeological sites located within the Project area has been undertaken with reference to the AUP(OP) criteria. The evaluation did not identify any sites of high significance within the Project area.

Woodthorpe House (R09/2064) has moderate significance, but the building is in a poor state of repair, and beyond the scope of restoration/conservation works.

The Dome Valley School site R09/2225 and the Dome Valley School Teacher's residence site R09/2226 have moderate significance but at this time cannot be accessed to confirm their significance.

Whitson's House and Stockyards (R09/2224) has low/moderate significance.

The site of Phillips Cottage (R09/2063; CHI 19027) had low/moderate significance, but the house was relocated in 2011 so no longer has any significance. The site still retains low/moderate significance.

The military camps in the Hōteo South area are of some historical significance but have low physical heritage value. They are part of a wider group of military encampments in the Warkworth area, but with few visible remains they have no significant heritage landscape value. The two Wyllie Road camps are affected by construction works for P2Wk.

Heritage and archaeological effects

Potential adverse effects on known archaeological and historic heritage sites will be confined to the Hōteo South area, where all nine of the historic heritage and archaeological sites recorded in the proposed designation boundary are located. The Indicative Alignment will directly adversely affect seven of the nine heritage sites and may affect the remaining two sites should the Indicative Alignment or the design and location of ancillary components be altered. The sites will be affected as follows:

- R09/2064 Woodthorpe House: the house and surrounds will be destroyed.
- R09/2224 Whitson's House and Stockyards: any surviving subsurface remains will be destroyed.
- R09/2226 Dome Valley Teacher's Residence: any above ground structural remains and subsurface remains will be destroyed where they are under the Indicative Alignment or potentially modified where they are outside the Indicative Alignment.
- Dome Valley Military Camp M6, CHI16996: will be partially modified due to most of the site being within the Project area and a small area in the south east being adjacent to the Indicative Alignment relating to the Phillips Road re-alignment.
- Carran Road Military Camp H2, CHI 17005: will be partially modified due to parts of the site being within and adjoining the Indicative Alignment.
- Wyllie Road Camp E, CHI 17006: will be partially modified where the site is under the Indicative Alignment (already affected by P2Wk construction works).

- Wyllie Rd Camp F and G, CHI 17007: will be partially modified where the site is under the Indicative Alignment (already affected by P2Wk construction works).

The two sites that may be affected by the Project should the Indicative Alignment or the design and location of ancillary components be altered are:

- R09/2225 Dome Valley School: possible adverse effects on any buildings/structural remains, through a change in use of the structures (as a result of potential relocation).
- R09/2063 Site of Phillip's House – possible adverse effects through change in land use (currently a paddock on a residential lifestyle block, noting this could change as a result of the Project to a yard, parking area or other uses).

There is potential for unrecorded sites to be affected in the Warkworth, Hōteo River and Te Hana areas and for effects on unidentified subsurface archaeological remains exposed during construction.

Potential effects on unrecorded archaeological sites

In any area where archaeological sites have been recorded in the general vicinity it is possible that unrecorded subsurface remains may be exposed during earthworks. If not managed appropriately, earthworks can destroy such sites without investigation and recording taking place.

The *Historic Heritage Assessment* has concluded that there is little potential for unrecorded archaeological remains over most of the central part of the Project area (through the Dome Valley). The key areas with historic heritage potential are the Warkworth area up to the pine plantations north of Phillips Road, the Hōteo River area, the hill range to the east of Te Hana, and the Maeneene Road area.

9.10.4. Measures to avoid, remedy or mitigate actual or potential adverse effects

The *Historic Heritage Assessment* proposes various measures to manage and mitigate the actual or potential effects of the Project on archaeological and other historic heritage values and concluded that effects on recorded and unrecorded archaeological sites should be mitigated by detailed investigation and recording to recover information that will contribute to knowledge of the history of the Project area.

Where historic heritage or archaeological sites cannot be avoided by the Project, the appropriate for of mitigation is minimising adverse effects on heritage and archaeological sites. Where practicable, archaeological investigation and recording of any affected pre-1900 heritage and archaeological sites and post-1900 heritage sites within the designation should be undertaken in order to obtain information which will contribute to our knowledge of the history and archaeology of the area. Modification of pre-1900 archaeological sites and any investigations will require an Archaeological Authority under the HNZPTA.

The Project has the potential to affect unidentified subsurface archaeological remains during earthworks. All earthworks or other activities involving soil disturbance in the general vicinity of recorded archaeological sites, United States military camps, the surrounds of heritage buildings and in the identified areas of archaeological potential should be monitored by an archaeologist to establish whether subsurface archaeological remains are present and to record any remains.

An Accidental Discovery Protocol (ADP) consistent with The Transport Agency Minimum Standard P45 – Accidental Archaeological Discovery Specification or subsequent version will be prepared in consultation with mana whenua for any accidental archaeological discoveries which occur during Project works and modified as necessary to reflect the site specific Project detail.

A HAMP will be prepared by a Suitably Qualified Person (e.g. an archaeologist) in consultation with HNZPT and Council. The purpose of the HAMP will be to manage and mitigate potential adverse effects on heritage and archaeological sites. The HAMP will identify:

- Known historic heritage and archaeological sites within the proposed designation boundary;
- The pre-1900 archaeological sites which will be covered by an Archaeological Authority under the HNZPTA;
- Roles, responsibilities and contact details of Project personnel, Mana Whenua representatives, and relevant agencies involved with heritage and archaeological matters including surveys, monitoring of construction works and monitoring of conditions;
- Specific areas to be investigated, monitored and recorded to the extent these areas will be affected by Project works; and provide the proposed methodology for assessment, monitoring and documentation, including, but not limited to the following areas:
  i. Recorded archaeological sites;
  ii. Identified areas of archaeological potential in Warkworth, Hōteo and Te Hana, including Maeneene Stream; and
  iii. WWII US military camps.
- Methods for protecting or minimising adverse effects on heritage and archaeological sites within the designation during Project works where practicable (for example the fencing off of heritage and archaeological sites to protect them from damage during construction);
- Training requirements for contractors and subcontractors on heritage and archaeological sites within the designation, legal requirements relating to accidental discoveries, and ADP's. The training should be undertaken under the guidance of a Suitably Qualified Person and Mana Whenua representatives, and should include a pre-construction briefing to contractors; and
- For heritage buildings to be demolished or relocated, a methodology for investigating and recording heritage buildings, their condition, measures to mitigate any adverse effects and timeframe for implementing the preferred methodology, in accordance with HNZPT Guideline *AGS 1A: Investigation and Recording of Buildings and Standing Structures dated 4 July 2014* (or any subsequent revision).

9.10.5. Conclusion

There are twelve known archaeological and historic heritage sites within the Project area. Nine of those are located within the proposed designation, and of those, seven are within the Indicative Alignment. Two further sites in the Hōteo South Sector may be affected by the Project should the Indicative Alignment or the design and location of ancillary components be altered. There is also potential for unrecorded archaeological sites to be located in the Warkworth, Hōteo River and Te Hana areas.

None of the affected or potentially affected sites within the Project area have a high historic heritage significance. A range of measures to mitigate the adverse effects of the Project on historic heritage values, including a HAMP to ensure that archaeological issues are managed appropriately during the construction phase are recommended to be adopted.

The mitigation measures recommended above are considered appropriate, and as concluded in the *Historic Heritage Assessment*, it is considered that the adverse effects of the Project on archaeological and historic heritage values will be minor in view of the limited number of heritage sites affected, and the low to moderate heritage significance of the affected sites. While there is potential for new sites to be uncovered during construction, it is considered that the effects on potential sites can be managed with adoption of the recommended mitigation measures, and within the provisions of the HNZPTA.

9.11. Land contamination

Overview

There are a number of properties within and surrounding the Project area that are, have previously been or may have been subject to land uses listed on the Ministry for the Environment's (MfE) Hazardous Activities and Industries List (HAIL).

The actual and potential adverse environmental effects posed by soil contamination relate to the level of contamination present and the construction activities proposed which result in land disturbance of contaminated sites. An interim Preliminary Site Investigation (PSI) has been undertaken which identifies existing areas of known and potentially contaminated land within the Project area and outlines the typical contaminants likely to be present.

Additional contamination investigations prior to any soil disturbance are recommended to determine the actual levels of contamination within the Project area. On completion of that more comprehensive investigation and when the detailed design is known, appropriate consents will be sought if necessary.

Overall, based on a preliminary PSI, the effects related to contaminated land are able to be managed and are assessed as minor. This will be confirmed prior to construction.

9.11.1. Introduction

This section provides a preliminary assessment of the actual and potential effects arising from disturbance of contaminated land associated with the construction and maintenance of the Project.This section is based on the findings of an interim PSI and Land Contamination Assessment given access to properties was limited.

This section identifies existing areas of known and potentially contaminated land within the Project area and outlines the typical contaminants likely to be present informing a qualitative risk assessment of effects of contamination.

Given that the assessment is based on an Indicative Alignment, and detailed design is yet to be undertaken, works on or in proximity to potentially contaminated sites will be identified, assessed and managed through updating the interim PSI to reflect the final alignment and include the results of future site walkover inspections, information obtained from landowners and geotechnical investigations. The Transport Agency will apply for any consent under the NES Soil and AUP(OP) if required prior to construction commencing. No consents relating to contaminated land disturbance or discharges are sought as part of this Application.

9.11.2. Existing areas of known and potentially contaminated land

To identify known and potentially contaminated sites, an interim PSI was conducted within the Project area in accordance with the Ministry for the Environment's "Contaminated Land Management Guidelines No.1, Reporting on Contaminated Sites in NZ (Revised 2011)" and the NES Soil.

The Project is located in a predominantly pastoral farming and forestry environment. These two land uses have been present for the past 50 plus years based on a review of historical aerial photographs.

The HAIL is produced by MfE and is a compilation of activities and industries that have the potential to cause land contamination resulting from hazardous substance use, storage or disposal. Land used for pasture and forestry is not identified on the HAIL and, therefore, no widespread areas of contaminated land are anticipated. However, there is the potential for discrete HAIL sites in rural and forestry land. Examples of discrete rural HAIL sites include sheep dips, farm dumps and small timber treatment sites. The interim PSI concludes that it is unlikely that discrete HAIL sites are present on every rural property or within every forestry block.

Known and potentially contaminated sites were identified using a combination of the following:

a) A review of historical aerial photographs into land uses or activities that had the potential to cause ground contamination within or adjacent to the proposed designation; and

b) A search of the Council Contaminated Sites Register/information held on file.

A PSI typically includes a site walk-over inspection to assess if a HAIL activity occurs or has occurred at a property. However, access was not available to all of the privately wned land. Therefore, site walk-over inspections were not undertaken.

For the purposes of ranking the risk profile of the potentially contaminated sites identified through the PSI process, a qualitative risk assessment process was adopted, which assesses probability and consequence of contaminants being present. In accordance with the NES Soil the interim PSI utilised the “more likely than not” test which helps inform whether the activity is more likely than not to have occurred. This test identifies sites with greater than 50% chance of soil contamination being present. The qualitative risk assessment classifies sites into three relative levels of risk: low, moderate and high.

48 properties within the Project area have had or currently have actual or potential HAIL activities on them. Of these properties, 37 are categorised as having a low risk of ground contamination and 11 properties as having a moderate risk. There are no properties with a high risk of ground contamination. The low risk ranked properties are those with typically agricultural activities which may have led to relatively low levels of contamination of the land. Table 9-23 identifies the 11 potentially contaminated pieces of land within the Project area with a moderate risk ranking from the interim PSI.

Table 9-23: Potentially contaminated properties identified as having a moderate risk ranking

Address	Comments
156 Kaipara Flats Road	Farm dumps containing “old treated timber posts”.
173 Carran Road	Vehicle workshop (Gary Barber Auto Services), hydrocarbon and chemical storage likely
1207 SH1 Wayby Valley	Stock yards or possible timber storage and outbuildings
199 Rustybrook Road	Commercial (2008 -2010) car dump site Outbuildings predate 1953
200 Rustybrook Road	Scrap metal (2008-2010) Outbuildings predate 1953
37 Borrows Road	Quarrying activities and outbuildings Wintering barn discharge Dairy washwater discharge
50 Farmers Lime Road	Cluster of outbuildings, ground disturbance
200 m north of Worthington Road and Farmers Lime Road	Pump station for First Gas Ltd, formerly Vector Gas Anticipate fuel tanks present on site
18 Hindle Road (various properties)	Stock yards in corner of Farmers Lime Road and Worthington Road. Outbuildings, quarry Dairy discharge
Hindle Road (approx. 500 m North of Farmers Lime Road)	Commercial shed
200 Mangawhai Road	Outbuildings, quarry

9.11.3. Assessment of effects from contaminated land disturbance

The disturbance of and discharges from contaminated land can impact:

- Human health, including site workers and/or the public from the discharge of contaminants (as a matter covered by the NES Soil); and
- The environment from the disturbance of contaminants and associated discharge of contaminants to air, land and water (surface and groundwater).

The potential contaminants of concern that may be associated with the moderate risk ranked properties are:

a) Arsenic, lead, copper, mercury – associated with wood treatment, bulk storage of treated timber, scrap yards and motor vehicle workshops;

b) Organochlorine and organophosphate pesticides – associated with wood treatment, bulk storage of treated timber;

c) Herbicides, fungicides- associated with wood treatment, bulk storage of treated timber;

d) Carbamates, and synthetic pyrethroids – associated with sheep dips or spray race operations;

e) Asbestos – associated with buildings constructed pre 1990’s; and

f) Hydrocarbons – associated with wood treatment, bulk storage of treated timber, fuel storage, scrap yards and motor vehicle workshops.

Effects on human health

The potential effects posed by soil contamination as a result of historic activities relate to the level of residual contamination present and the construction activities proposed which result in land disturbance of the sites identified as having the potential to be contaminated.

Given the construction works will be over approximately 7 years the potential exposure duration for the Project is likely to be a few weeks at most. The actual risk to construction workers is therefore likely to be minimal. Worker exposure to contaminated soils would only occur at the sites where contaminated soils occur. The opportunity for residents to be exposed to soil contamination during construction is very limited. Therefore, the risk to human health is considered to be minimal.

Effects on the environment

The risk of actual or potential contaminated land to the environment will be minor for the following reasons:

a) The potential contaminants of concern are generally not very mobile within the soil environment as metals tend to bind to the mineral/clay fraction of the soil and pesticides will tend to bind to the organic fraction of the soil;

b) A portion of these contaminants will not be bioavailable (available for organism uptake);

c) The potential for groundwater contamination is low as there are no high risk sites, and the medium risk sites are not located near known groundwater abstraction bores and existing and potentially future groundwater takes are from deep bores, with limited yield for shallow abstraction;

d) If future DSIs encounter elevated levels of contaminants, these will be managed through the contaminated land consenting process, including through using a Contamination Land Management Plan (CLMP); and

e) Unforeseen ground contamination that may be discovered during future Project earthworks will be appropriately and safely managed using a CLMP.

9.11.4. Conclusion

An interim PSI has identified 48 properties within the Project area that are, have previously been or may have been subject to land uses listed on the HAIL and are subject to the requirements of the NES Soil. The majority of the properties in the Project area are likely to have a low risk of contamination. There are 11 sites within the Project area which are classified as having a moderate risk of contamination. The interim PSI will be updated once the Transport Agency takes ownership of the properties within the proposed designation and the detailed design is completed. Any consents required under the AUP(OP) and/or NES Soil will be submitted prior to construction commencing. Overall, the effects are assessed as likely to be minor, but this will be confirmed prior to construction.

9.12. Operational water assessment

Overview

The design of the Project's operational drainage and stormwater management systems will be in accordance with best practice guidelines.

The Project has the potential for the following effects:

- Reduction in water quality arising from stormwater discharges generated from the mainline alignment and local roads (contaminants and sediment) and spill events;
- Impacts on Watercare's surface water take as a result of reduced water quality in the event of a spill;
- Loss of baseflow, increased stream flow, and channel erosion in streams and impacts on water levels in wetlands arising from changes in hydrology (increased impervious areas and catchment area, and change in drainage patterns); and
- Increased flood risk, reduced flood conveyance and reduced flood storage through changes in flood volume and pathways.

The following approaches for operational water management are proposed to mitigate the potential effects of the Project:

<u>Water quality</u>

- Stormwater quality treatment is proposed for the mainline carriageway surface and rock cuts.
- Stormwater treatment design will be based on GD01 and includes the removal of 75% Total Suspended Solids (TSS) on a long-term average basis, which includes the removal of contaminants associated with sediment such as particulate trace metals, particulate nutrients, oil, grease and bacteria; and;
- Removal of gross litter and floatables such as oil and volatile hydrocarbons by stormwater treatment devices.

<u>Water quantity</u>

- Stormwater collection and conveyance systems to provide a safe road and collect stormwater for treatment;
- Provision of stream diversions either around the Project or through the Project via culverts;
- Provide for the hydrology mitigation requirements of the AUP(OP) by providing detention and controlled release over a 24-hour period for the rainfall generated by the 95 percentile rainfall event on the Project's impervious surfaces.

The proposed stormwater treatment will be effective in reducing contaminant and sediment discharges, with predicted increases in contaminants associated with the Project not expected to result in freshwater quality exceeding guideline values.

The hydrology mitigation requirements and design of the stream diversions, culverts and bridges will mitigate the impacts of the Project on stream and wetland hydrology and flooding.

Overall, the effects associated with operational water management, with mitigation to be incorporated into design of the Project as proposed, are considered to be minor with a moderate level of effects on the hydrology of natural wetlands. The ecological effect of these changes are addressed in the *Ecology Assessment.*

9.12.1. Introduction

This section summarises the findings of the assessment of the actual and potential effects associated with water during the operation of the Project outlined in the *Water Assessment* in Volume 2 of this Application. Water effects in relation to the construction of the Project (also outlined in the *Water Assessment*) are summarised in section 9.2 of this AEE. The *Water Assessment* is supported by a number of technical reports and in referencing the *Water Assessment* here, it is inferred to be the whole suite of reports, and specifically those relating to operational water management[79].

The *Water Assessment* provides an assessment of the environmental effects arising from water during the operation of the Project, including effects of stormwater derived from the Project on the receiving environment as well as the impacts of the Project on the existing hydrological environment.

The *Water Assessment* describes the Project's operational water systems, including the stormwater management devices and modifications to streams and floodplains necessary for the operation of the Project. The approach to operational water management has been to minimise effects by designing mitigation measures into the Project based on a BPO approach. The extent of the mitigation measures discussed in the *Water Assessment Report* is based on consideration of the sensitivity of the receiving environment.

9.12.2. Existing hydrological environment

Catchment description and values

The Project traverses the Mahurangi, Hōteo and Oruawharo river catchments, draining into two coastal waterbodies (Mahurangi Estuary and Kaipara Harbour) as described in section 3 and summarised in section 9.2.

Water quality

Water quality within the Project catchments is discussed in section 9.2. In summary, the water quality in the Mahurangi River and Oruawharo River is generally assessed as good, while the Hōteo is fair to good. All catchments have slightly elevated suspended solid levels, turbidity and phosphorus. Metals are low within all three catchments. During rainfall events, water quality within these environmentsdeclines.

Flooding

Flooding is an issue in the lower Mahurangi catchment. The Council River Flood Hazard Assessment (RFHA) 100 year ARI event floodplain extends into some areas of Warkworth, across farmland and inundates a number of local roads, including Kaipara Flats Road, Carran Road, Woodcocks Road and Goatley Road.

Flooding is also known to be an issue in the Hōteo River catchment. The Council RFHA shows that there is an extensive floodplain to the east of Wellsford, north of the existing SH1, which extends across Wayby Valley Road, farmland and properties within Wayby Valley. Downstream of the Project area the Hōteo River floodplain is generally confined within the river valley, however extends across Hōteo. The

[79] Water Quality technical report, Motorway Runoff technical report, Hydraulic Modelling technical report, Hydrological Assessment technical report and Operational Water Design Report.

Kourawhero Stream floodplain is also extensive and runs along Kaipara Flats Road and impacts on properties including at Streamlands and Kaipara Flats.

Within the Oruawharo catchment, the Council RFHA floodplain is generally confined to the stream valleys in the vicinity of the Project area. For Te Hana Creek the flooding is generally confined to the river channels, however farmland and some properties are located within the RFHA floodplain. Maeneene Creek has an extensive floodplain upstream of the Project area across farmland.

Existing flooding within the Project is shown in Figure 9-7, with high risk flood areas identified as follows:

1. Crossings of Mahurangi River and its tributaries;
2. Crossings of Kourawhero Stream tributary of the Hōteo to the south of the proposed tunnel;
3. Inundation of areas along Wayby Valley Road due to flood water from the Hōteo River.

The figure below shows flooding already occurs at many different locations along the Project area.

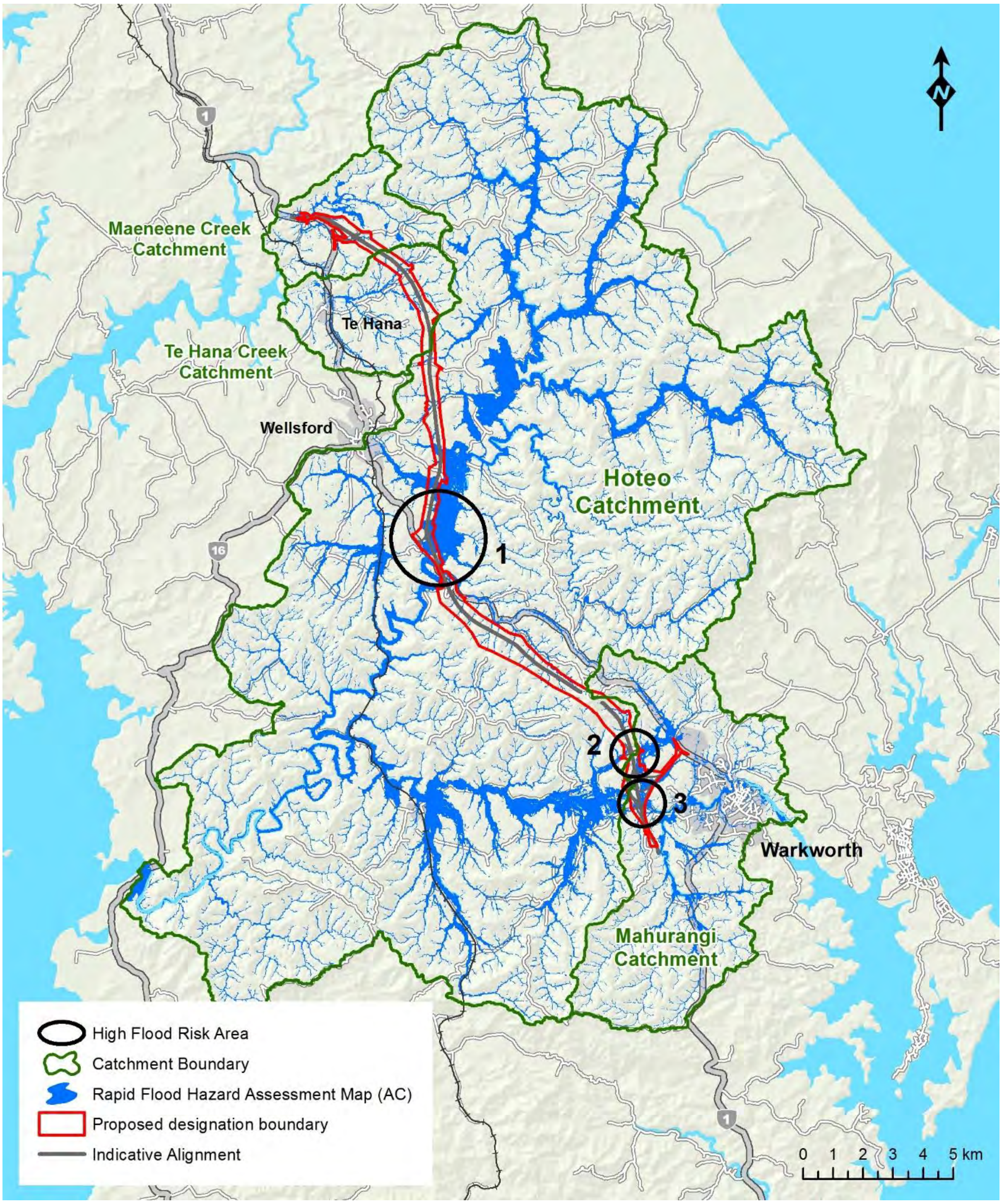


Figure 9-7: 100 year ARI event floodplain extent for the Mahurangi, Hōteo and Oruawharo catchments

Existing consents

The existing consents held for water takes and discharges from and to the Mahurangi and Hōteo Rivers are outlined in section 3.

9.12.3. Operational water assessment methodology

The potential changes to the water environment due to the operation of the Project relate to:

- water quality: these effects include changes to water quality arising from the discharge of stormwater and associated contaminants from the mainline carriageway and effects on stream and marine environmental and potential human impacts;
- hydrology: these effects include changes to stream flow, and changes to stream channel and stream bed morphology; and
- flooding: these effects include changes to flood risk arising from changes to impermeable area, flood conveyance systems (bridges/culverts/stream diversions) and construction activities, permanent works (e.g. embankments) and mitigation planting in floodplains.

Operational water systems

Rainfall onto rock cuts and the mainline carriageway will be collected and conveyed via stormwater treatment devices prior to discharge to streams, which then drain to the estuary and harbours. Rainfall onto local roads will be managed in rock and grass lined swales. Rainfall adjacent areas will be diverted away from cuts and the road carriageways. Rivers and streams, and overland flow paths that intersect the Project alignment will be conveyed via a culvert or crossed by a bridge/viaduct or stream diversions. In some circumstances, the Project fills and soil disposal areas or other elements of the Project will occupy existing floodplains.

A summary of the operational drainage and stormwater management devices proposed for the Project is outlined in section 4 of this AEE.

Methodology to identify changes to water quality

The operational phase of the Project has the potential to result in changes to water quality, these changes may be associated with:

- discharge of contaminants, such as heavy metals, fuels and oils that are generated from vehicles, from the road carriageway;
- discharge of sediment from eroded cut faces along the road carriageway; and
- discharge of gross pollutants (litter) from the road corridor.

Two models were used to assess water quality in the receiving environment during the operational phase, accounting for changes due to the road carriageway runoff, which modelled contaminant loads and contaminant concentrations associated with the Project.

The Contaminant Load Model (CLM) estimates contaminant loads to predict the relative change in contaminant loads on a catchment scale. This information is useful to understand any potential effects on the marine receiving environments.

The CLM model enables the water quality in the existing environment to be compared to water quality guideline values, and for the predicted change in the water quality to also be assessed against those guideline values.

The second model (contaminant concentration method) provides site specific estimates of the predicted change in contaminant concentrations in freshwater due to Project runoff. The model uses 2017 monitoring data for surface water and the average (median) motorway runoff water quality data from existing New Zealand motorways applied on a weighted catchment basis to estimate contaminant concentrations in receiving environments. The water quality in the existing environment is compared to water quality guideline values, and the predicted change in the water quality is also assessed against those guideline values.

Methodology to identify changes in hydrology

The Project has the potential to cause changes to catchment runoff and changes to catchments boundaries that may result in changes to stream flow, and changes to stream channel and stream bed morphology. These changes may arise from the Project due to:

- alteration of catchment areas as a result of the introduction of the road with high and low points, road embankments, culverts, stream diversions and cut-off drains;
- alteration of flow pathways and altered runoff regime (drainage features, impermeable area and slope change); and
- changes to stream channel and stream bed morphology due to stream diversions, culverts, bridges and other instream structures.

A hydrology analysis was applied to assess the following changes in catchment characteristics:

- changes in catchment area; and
- changes in impervious cover.

Catchment area influences runoff flows because it defines the maximum flow and volume of runoff that drains to a specific point. Impervious cover influences runoff flow, because increases in imperviousness increase the amount of runoff, correspondingly reducing the amount of rainfall that is infiltrated into the ground and potentially baseflow into streams.

The existing sub-catchments were defined using the River Environment Classification (REC) GIS layer. The operational drainage and stormwater management design was analysed to determine where proposed alterations to flow pathways and runoff regime would result in changes to catchment areas at the downstream limit of the affected REC sub-catchments.

Methodology to identify changes to flooding

The Project may result in changes to flood risk in the rivers/streams upstream and downstream of the Project. These changes may occur due to:

- alteration of flow pathways due to culverts and stream diversions;
- change in flows and flood depths due to culverts and bridges;
- changes in flood depths or extent due to planting in the flood plain and
- change in flows and flood depths due to embankments located in the floodplain.

Three hydraulic models were developed for three areas of the Project that were identified in the *Water Assessment Report* as having a high flood risk. These areas are identified in Figure 9-7 of this AEE and summarised below:

- Mahurangi River in the vicinity of Kaipara Flats and Carran Road;
- Kourawhero Stream (a tributary of the Hōteo River to the south of the proposed tunnel); and
- Hōteo River along Wayby Valley Road.

All three models were run with the 2, 10, 20 and 100 Year ARI floods, including an allowance for climate change, to 2130. Each model was run for the 'without Project' scenario and 'with Project' scenario. A comparison was made between the scenarios to understand the effects of the Project on flooding.

Methodology assessment criteria

The assessment of effects arising from water during operation has been based on the requirements of the RMA, AUP(OP), relevant Auckland Council guidelines and Transport Agency policy, standards and guidelines.

9.12.4. Project approach to the management of operational water

The Project design will integrate the stormwater system collection and conveyance network, treatment systems, culverts and stream diversions and consideration of the floodplain, and will include full consideration of the implications of stormwater management through the design life of the asset. The design will include a range of water sensitive design solutions including stormwater treatment wetlands and swales to deliver stormwater quality (treatment) and stormwater hydrology (flows) mitigation.

A summary of the specific design criteria for stormwater components is outlined in section 4 of this AEE.

The following stormwater management measures are included as the BPO and are designed to release water slowly into streams to maintain baseflow and to minimise stream bank erosion resulting from change in peak-flow:

- Diversion of clean runoff to prevent it flowing down cuts or mixing with runoff from the road;
- Stormwater treatment wetlands, which were selected as the preferred treatment for the main alignment carriageway through the BPO assessment, these will include the AUP(OP) hydrological mitigation requirements;
- Vegetated or rock lined road side drains are preferred on ancillary/local roads;
- Sediment traps are proposed along the base of rock cuts;
- Erosion protection at outfalls.

In terms of flood management, the Project comprises an integrated design of road, bridge/culverts, stream diversions and stormwater management elements.

9.12.5. Assessment of effects arising from water during operation

The effects of the Project resulting from management of water during operation has been assessed based on a design that incorporates the BPO measures identified above to avoid, remedy and mitigate effects. Criteria from the AUP(OP) have been relied on to assess potential effects.

Effects on water quality of receiving environments

The existing water quality at all the freshwater sites is considered to be good in relation to metals, with dissolved concentrations all below the default trigger values, with the exception of copper at the Mahurangi river mouth.

The assessment predicts small increases in concentrations at all sites for "2046 traffic with Project, with treatment" compared to existing. This is a conservative assessment as the modelling methodology does not account for the expected transfer of traffic from the existing SH1 (no formal stormwater treatment) and on to the Project (with improved stormwater treatment).

The largest proportional increases of contaminant concentrations arising from the Project occur in the catchments where the road footprint makes up a larger proportion of the overall catchment. It is noted that prior to this Project being constructed the Safe Roads Alliance will have implemented plans for safety upgrades to the existing SH1 which will include some treatment of stormwater, arising from 25,500m^2 of additional highway pavement. Stormwater treatment for the additional impervious areas is proposed as part of those proposed safety improvement works. This assessment is conservative, as it does not account for the reduction of traffic on the existing SH1 (with limited stormwater treatment) by its transfer to the Project (with full stormwater treatment).

The predicted increase in metal contaminant concentrations associated with the Project is not expected to result in the freshwater quality exceeding the Australia and New Zealand Environment Conservation Council (ANZECC/ARMCANZ) (2000) guideline trigger values for 95% level of species protection in freshwaters, provided stormwater runoff is treated to the standard assumed in the assessment. The exception is copper at the Mahurangi River mouth, which already exceeds the guideline value and will increase to a small extent. There will be no change in total petroleum hydrocarbons (TPH) concentrations as a result of the Project.

The decrease in contaminant loads predicted by the modelling at the mouths of the Hōteo and Mahurangi Rivers and at Te Hana Estuary downstream of the confluence of Te Hana Creek and Maeneene Creek when considered in conjunction with the existing sediment quality within the Mahurangi and Kaipara Harbours suggest an expected negligible change in the long term estuarine sediment quality as a result of the Project with treatment accounted for.

With the proposed design criteria and a suitable maintenance regime, the Water Assessment has assessed the contaminant effects on freshwater quality to be minor or negligible and on the long term marine sediment in the sensitive receiving environments of the harbours, and a negligible or slight minor contaminant effect on freshwater and estuarine water quality. With the proposed design criteria and a suitable maintenance regime, the effect of the stormwater treatment wetlands, permanent diversions and changes in hydrology, on the development of excessive growths of aquatic plants (algal blooms) in receiving freshwater is considered to be minor.

With respect to the recreational use, overall the predicted change in bacteria associated with the Project is assessed as having negligible effect on contact recreation. Similarly, the predicted change in metals associated with the Project is assessed as having negligible effect on contact recreation.

The effects of the state highway operation on the drinking water supply is considered to be negligible. It is recommended that Watercare is informed if an event resulting in a pollution spill occurs (such as a collision involving a truck), so that Watercare is able to determine what action, if any, is required. With conditions to alert Watercare about spills, the effect on drinking water is considered to be minor.

Hydrological effects

The impervious land cover introduced by the new road surfaces of the Project prevents natural infiltration of rainfall into the ground surface. This has two potential hydrological outcomes, a loss of baseflow and an increase in storm flow in streams. This can result in changes in stream health related in dry weather to less water and in wet weather to erosion of the stream that modifies habitats and increases suspended sediment.

The catchments that the road passes through are predominately rural with very low levels of imperviousness. The cumulative effects of the increased imperviousness of the road on stream flows is likely to be negligible (at the catchment scale) to minor (at the local sub-catchment scale), given that for the majority of catchment the impervious road will occupy less than 5% of the catchment, and hydrological mitigation is provided in the stormwater treatment wetlands. The hydrological mitigation involves the detention (temporary storage) of the difference between the existing and operational phase stormwater runoff, and slow release of this water over 24 hours. This will reduce peak flows in the receiving watercourses. Hydrological mitigation by retention (infiltration to ground) is not provided for in the design, due to assumed geotechnical constraints (poor infiltration rates) and because of the challenging operating environment (high sediment loads and safety issues with maintenance).

Changes in catchment area once the Project is constructed and operational compared with the existing environment, arise from the proposed stream diversions and changes in flow paths due to the road catchments draining to adjacent catchments. These changes in drainage patterns can impact on stream flows, stream erosion, and natural wetlands.

The stormwater design has avoided most changes in flows by locating culvert crossings to maintain the existing natural drainage patterns of the contributing catchment where possible. This means that there are a limited number of stream diversions. Where they do occur, the stream diversions are located within first order catchments (headwaters with small upstream catchments). The stormwater design has also avoided effects of stormwater routing by directing flow to the proposed stormwater treatment wetlands, generally located in the same sub-catchment as where the stormwater originated. However, increased localised changes in stream flows will occur where flow is routed from one sub-catchment to another, but effects are likely to be localised and similar to those assessed.

The *Water Assessment* assesses the effect of changes in flows related to the diversion of stormwater as minor because for most freshwater catchments the changes in stream flow are less than 10% at the REC catchment scale. There a limited number of catchments with increases larger than 10%, however these are localised and generally affect streams with catchments of less than 1 km^2. As such the change to the flow within streams and rivers due to diversions is small.

Tributary streams where there is an increase in flow may have an increased risk of erosion. This risk can be mitigated by providing stream diversion designs which account for the Project hydrology and provide erosion protection as necessary. In addition, all stormwater outfalls are proposed to incorporate energy dissipation and/or erosion protection measures that will minimise bed scour and bank erosion.

All stream diversions will be stabilised and designed to allow for the 1 in 100-year ARI event.

A number of the wetlands located within the Project area will be impacted by the road embankment and or stream diversions and culverts, likely resulting in loss of wetland area, lowering of water levels in some locations and/or times within the natural wetlands, and increases in water levels in some locations and/or times due to loss of storage and changes in flood patterns. Changes to wetland hydrology, without mitigation, are expected to result in a significant level of effect for a number of wetlands.

Within the Kourawhero Stream catchment there are a number of wetlands that are hydrologically connected to surface water and are located within the floodplain. Adverse effects on the hydrology of the wetlands in this location will be avoided by the bridging of the Kourawhero Stream, which provides for maintenance of the hydrologic connection between the wetland areas east and west of the Indicative Alignment. If a culvert instead of a bridge was proposed in this location, more changes would be expected in the hydrological condition of the wetlands.

The level of ecological effect of these hydrological changes on the aquatic habitats within the natural wetlands is contained in the *Ecology Assessment*.

The Project will minimise and mitigate changes in hydrology and stream erosion as far as practicable. However, post construction monitoring and remediation for erosion prone streams is recommended.

The effects of the imperviousness of the road surface on infiltration and stream baseflows are likely to be negligible to minor, given that for the majority of catchment the impervious road will occupy less than 5% of the catchment. However, in very small subcatchments this proportional increase in impervious area is larger but the level of effect is not considered to be significant.

While the effect of hydrological changes to wetlands is assessed in section 9.5 of this AEE, detailed design can further minimise changes to hydrology to maintain the wetlands to as neutral a state as is practicable this is expected be able to reduce adverse effects to a no more than minor level.

Flooding effects

Changes in flood patterns will occur as result of the Project due to impact on flood storage and conveyance as follows:

- Alteration of flow pathways due to culverts and stream diversions;
- Change in flows and flood depths due to culverts and bridges;
- Change in flood depth due to planting in flood plains; and
- Change in flows and flood depths due to embankments located in the floodplain.

The stormwater design does not provide for flood attenuation as this has not been necessary to mitigate effects.

Culverts and bridges have been designed such that the assessment illustrates that headwater extents are located within the floodplain of the streams and minimal headwater is predicted to extend beyond the proposed designation. The bridges located within floodplains have minimal impact on upstream flood levels. The culverts and bridges have been designed to maintain existing overland flow paths in most cases. In some locations, stream diversions have been recommended that will alter overland flow paths, in these instances' diversions have been designed to convey the 100 year ARI climate change event.

Complete avoidance of floodplains has not been possible, and parts of the Indicative Alignment are located within the floodplains of the Mahurangi River, the Kourawhero stream and the Hōteo River. Where possible fill areas and stormwater treatment devices have been located out of the 100 year ARI floodplain, however there are locations where these features occupy parts of floodplains especially as the Hōteo River has an extensive floodplain that must be crossed by the Project.

The assessment shows changes to flood levels due to the Indicative Alignment. Most of the increases in flood levels and extents are located within the proposed designation and will not affect properties upstream or downstream of the designation.

In terms of the increases in depth outside of the designation:

- Effects are generally less than 150mm in increase, with one exception where the increase (600mm) is very localised and immediately adjacent to the proposed designation boundary on pasture.
- Effects are generally restricted to land which is already subject to flooding and the current land use is pasture.
- For all local roads, increases in flood levels are localised and do not result in significant changes in the peak flood level or flood durations along the road.
- There is no predicted increase in flood depth or hazard to dwellings or other structures outside of the proposed designation.

Effects on water users

The predicted small increases in sediment, metals, TPH, bacteria and algae are expected to have a very minor effect on the quality of the surface water and are not expected to affect the ability of the treated water to meet NZ drinking water standard values (NZDWS 2008).

There is the potential for an accidental spill of contaminants entering the Mahurangi and Hōteo Rivers, for example due to an accident. If an accidental spill occurs during the operational phase, it is likely that a large proportion of contaminants would be intercepted by the stormwater treatment wetlands, but some residual contaminants may be discharged to the Mahurangi and Hōteo Rivers. The operational water assessment outlines that the effects of the Project on surface water drinking sources in the Mahurangi and Hōteo Rivers will be potentially moderate in the event that a large spill was to occur.

The predicted change in metals, clarity, bacteria and algal growth associated with the Project is assessed as having negligible effects on contact recreation and stock drinking water. Outside a reasonable mixing zone, effects are considered minor on existing water users with permitted water takes.

9.12.6. Measures to avoid, remedy or mitigate actual or potential adverse effects

The Project design includes mitigation measures within the proposed operational water systems. These measures are incorporated into the Project to mitigate any potential adverse environmental effects associated with stormwater management and stream works. The *Water Assessment* details these BPO mitigation measures for avoiding, remedying or mitigating effects. The design of the BPO has focused on managing the water quality and hydrological effects of the operational stormwater discharges. Mitigation measures are also included for key areas of risk. The summary of design mitigation for the Project is outlined below:

Stormwater discharges

- Water quality treatment for the mainline carriageway and rock cuts will be designed to follow GD01 guidelines, recognising that a design to this standard will remove the majority of suspended sediment and vehicle/road derived contaminants;
- Stormwater wetlands with forebays and submerged or baffled low flows outlets so that floatables and litter will be trapped in the wetland;
- Stormwater wetlands discharging to stream environments will achieve the hydrology mitigation requirements specified in the AUP(OP) by providing detention and controlled release over a 24-hour period for the rainfall generated by the 95 percentile rainfall event on the Project's impervious surfaces;
- Stormwater wetlands will have dense, healthy planting in emergent, littoral and riparian zones and vegetation to provide shading;
- Sediment traps or alternative mitigation for sediment eroded off rock cuts;
- Vegetated and rock lined roadside drains for water quality treatment forlocal roads;
- Energy dissipation and erosion protection for stormwater outfalls to minimise bed scour and bank erosion at the point of discharge or downstream;
- Stormwater outfalls design to assess various rainfall and tailwater levels to ensure the critical storm is considered.

Stream diversions

- Stream diversions designed to convey the 100 year ARI rainfall event, with consideration given to the risks of blockage;
- Stream diversions designed to maintain hydrological connectivity with wetlands where hydrological connectivity currently exists;
- Riparian planting of all new diversions and existing watercourses where flow regime is altered by the Project;
- Stream diversions to provide channel stability, in-stream habitat and riparian planting;
- Stream diversions designed in accordance with their type (lowland stream, steep stream, or flow channel).

Works in the beds of streams and wetlands

- Culverts and bridges designed to convey the 100 year ARI rainfall event, with consideration given to the risks of blockage;

- Fish passage in culverts to be provided for all permanent streams and in all instances where there are fish present or there is the potential for fish habitat upstream in intermittent streams;
- Energy dissipation and erosion protection for culverts to minimise bed scour and bank erosion at the point of discharge or downstream;
- Monitoring (and remediation if necessary) over a limited post-construction period for erosion prone streams;
- Provide for a bridge to maintain the hydrological connectivity between the wetlands on the east and west side of the final design alignment in the Kourawhero floodplain;
- Avoid locating stormwater treatment wetlands within natural wetlands that are otherwise avoided by the road embankment.

Flooding

- TP108 hydrology methodology is used for the sizing of culverts;
- Bridge manual hydrological methods are used for hydrological assessment of bridge performance;
- Calibrated hydraulic models are used for assessing flood effects on the Hōteo and Mahurangi floodplains.

In addition to specific design features, the following recommendations are also proposed to mitigate effects:

- Operation and maintenance plans to ensure the ongoing performance of stormwater treatment devices including sediment traps and wetlands;
- Notification to inform Watercare if a spill occurs on the mainline alignment within the Hōteo catchment (upstream of Wilson Road in Wellsford), so that Watercare can take measures to protect their surface water take.

9.12.7. Conclusion

Stormwater runoff from new impermeable surfaces associated with the Project will be treated before discharge to remove the majority of contaminants. The stormwater treatment design of the mainline carriageway and rock cuts will achieve GD01 standards. Increased sediment will be managed through sediment traps. Retention of stormwater flows and erosion control will also be provided. As a result, it is considered that the effects on water quality will be minor.

The effects on water quality at Watercare's water abstraction point in the Hōteo River will be moderate in the event of an accidental spill. As noted earlier, it is recommended that Watercare is notified of any spill event.

Changes in hydrology as a result of the Project will affect stream flows, channel erosion and hydraulic connectivity within streams and wetlands. With the proposed BPO to be achieved through design to mitigate these effects (through hydrological mitigation, design of stream diversions, scour protection and providing a bridge at the Kourawhero wetland), it is considered that the effects associated with the changes in hydrology will be minor.

The Project will be designed to convey flood events. The residual effects of the road embankment and cross drainage on flood levels, are increases in flood depth and extent within the proposed designation. In one location outside of the proposed designation some pasture land is also predicted to experience increased flood levels.

With implementation of the recommended operational water management design elements the effects of the Projects operational water systems are considered to be minor with a moderate level of hydrological effect on a number of natural wetlands.

9.13. Landscape and visual

Overview

The actual and potential landscape and visual amenity effects arising from the Project have been assessed in the *Landscape and Visual Assessment*. The assessment has considered the effects of the Indicative Alignment and the potential effects that could occur if that alignment shifts within the proposed designation boundary when the design is finalised in the future.

The Project has the potential to result in landscape and visual effects including effects on wetlands, rivers and their margins; identified sites of outstanding natural features and significant ecological areas; visual amenity and the quality of the environment, during construction and upon completion of the Project.

Landscape mitigation has been developed with ecology, heritage, Mana Whenua and hydrology factors in mind in order to achieve an integrated approach and to maximise the landscape and ecological outcomes.

A Planning Version ULDF has been developed which identifies landscape and urban design objectives, principles and opportunities for the Project.

Overall, consideration of the landscape context of the Project area and the assessment of the potential landscape and visual effects has identified that the effects can be minimised through design development guided by the ULDF, and the proposed integrated mitigation approach. With mitigation in place the landscape and visual effects of the Project will be less than minor.

9.13.1. Introduction

This section summarises the findings of the assessment of the actual and potential landscape and visual amenity effects of the Indicative Alignment of the Project as well as the effects that could occur if that alignment shifts within the designation boundary, as identified in the *Landscape and Visual Assessment* in Volume 2 of this Application.

The *Landscape and Visual Assessment* provides a description of the landscape character and the context of the Project area and considers the character and quality of the existing environment and landscape and amenity values. It includes an assessment of effects of the Project on the landscape and considers the effects on the visual amenity of potential viewing audiences. The assessment outlines recommended measures to avoid, remedy or mitigate adverse landscape and visual effects.

9.13.2. Existing environment

The existing landscape environment is outlined at a broad level in section 3 of this AEE. Section 9.13.4 provides greater detail of the character and values associated with the landscape through which the Project is located.

9.13.3. Assessment methodology

The methodology used for the identification of landscape values and assessment of the significance and the framework for assessing the magnitude and level of effects on landscape and visual amenity effects included; reviewing relevant literature, site visits, identifying landscape units (broad types of landscapes found in various places across the Project area) and identifying landscape character areas (LCA's) for description and assessment purposes (discrete areas along the Project area).

Analysis was undertaken to identify the likely extent of visibility of the Project utilising a Zone of Theoretical Visibility (ZTV) analysis and panoramas from 22 public viewpoints. The assessment was not able to access private land and therefore private view points have not been assessed. Visual simulations of the Indicative Alignment from selected viewpoints have been used to inform the assessment of landscape and visual effects. The simulations are included in the *Volume 3: Drawing Set* as the *LS-Series*.
The assessment considered:

a) **landscape effects**; which considers the effects of change and development on landscape as a resource which includes the physical elements and features that make up the landscape such as vegetation, watercourses and landform and the overall character of the landscape, including the physical, sensory and associative aspects; and

b) **visual effects**; which relates to the effects of change and development on the views available to people and the visual amenity that people experience as a result of those views. It considers the visual effects arising from changes to public views and changes to private views.

The assessment used a seven-point scale of ratings (from 'very low' to 'very high') to describe the significance of the landscape and visual effects resulting from the Project. The assessment has also considered the nature of effects; which may be positive (beneficial), neutral (benign), or negative (adverse) in the context within which they occur.

For description and assessment purposes the Project area was divided into five discrete landscape character areas (LCAs) along the Indicative Alignment (south to north) and covering the land within the Project area. The five LCAs (refer Figure 9-8 below) are:

a) Warkworth North;

b) Dome Valley;

c) Upper Hōteo River Valley;

d) Wellsford East; and

e) Te Hana North.

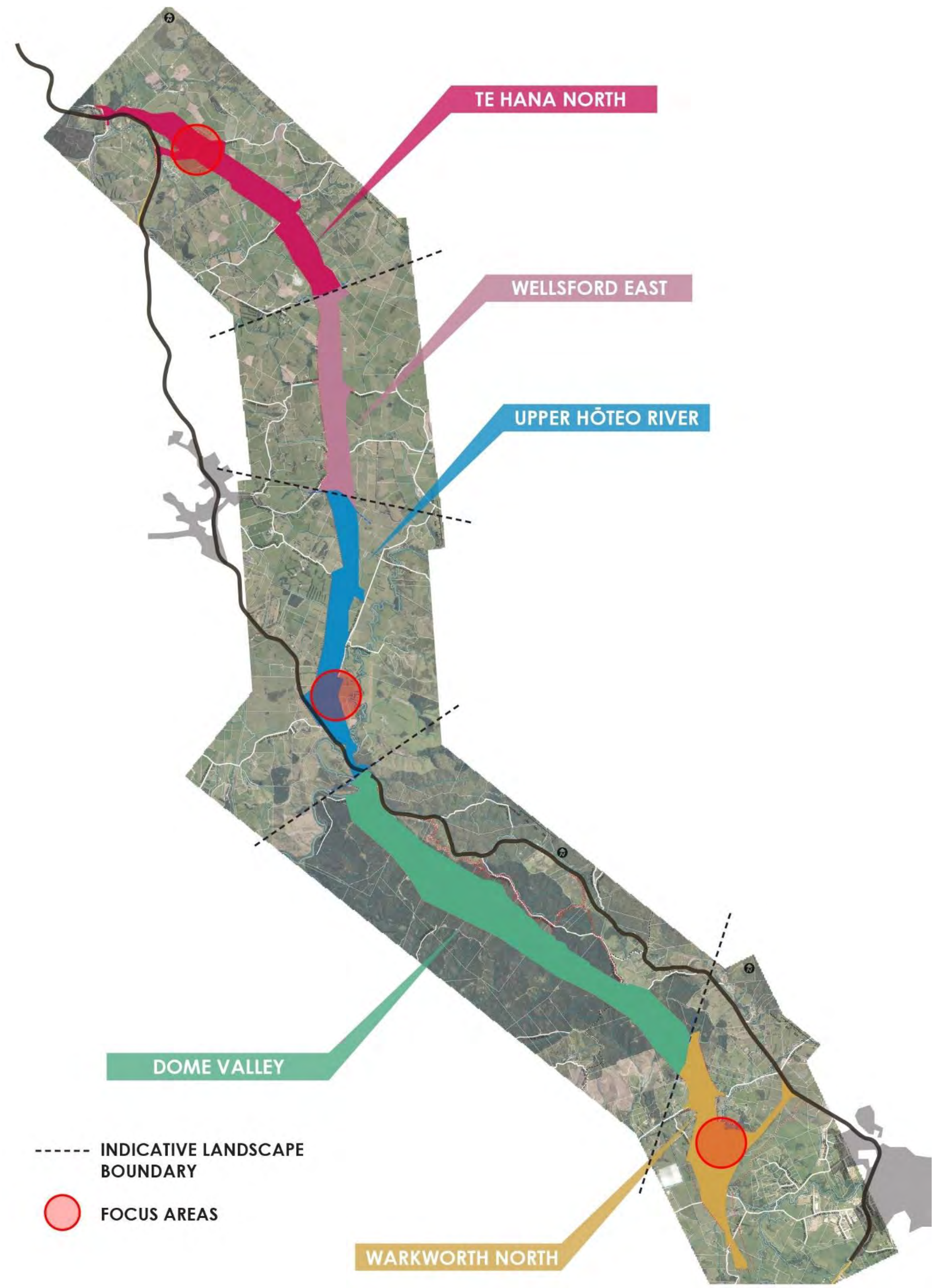


Figure 9-8: Location of each of the five Landscape Character Areas

Following consideration of the Project elements and the impact on landscape character, visual catchment and landscape values for the five LCAs, key areas (worst case scenarios from publicly accessible locations based on the Indicative Alignment) were identified where adverse visual effects would be experienced. Visual simulations for these areas were prepared and show a panorama of the existing view, the proposed view with the state highway at completion and the proposed view with mitigation native planting after 10 years (refer LV 35–LV 39 located in *Landscape and Visual Assessment* Appendix 1: Landscape Figures).

9.13.4. The Urban Landscape Development Framework

The *Landscape and Visual Assessment* is supported by a Planning Version ULDF in *Volume 3: Drawing Set*

The principles of the ULDF are:

- Clean uncluttered highway;
- Stitched together landscape;
- Human landmarks; and
- Celebrate cultural and natural features along the Corridor.

The ULDF provides guidance for the detailed design with respect to:

- Connectivity;
- Wayfinding and highway stopping places;
- Integration of landscape and ecology;
- Place making on the corridor and in relation to urban environments; and
- Integration of Mana Whenua values.

There are project specific mitigation principles and opportunities identified in relation to the bridge and viaduct structures, interchanges, tunnels and associated infrastructure, walking and cycling, retaining walls and earthworks and landscape mitigation.

9.13.5. Landscape and visual effects assessment

The potential landscape and visual effects of the Project are:

- Effects on the natural character of wetlands and rivers and their margins;
- Effects on outstanding natural features and landscapes;
- Effects on visual amenity values;
- Effects on the quality of the environment; and
- Landscape effects during construction.

Warkworth North landscape character area

Figure 9-9: Kaipara Flats Road near Phillips Road, within the Warkworth North character area (showing areas of lower valley pasture, enclosed to the north by the rising land associated with the Dome Valley).

Landscape character and values

The key attributes of the Warkworth North LCA are:

- The landscape is characterised by flat valley land, small rural properties and a predominance of agricultural land uses. These land uses include dry stock grazing (primarily sheep), horticulture, orchards and glasshouses.
- The Mahurangi River and its mature remnant riparian vegetation is a key landscape feature.
- The highest landscape values are attributed to the vegetated stream courses, and particularly those parts of the Mahurangi River (left branch) which features indigenous vegetation cover and are identified within a SEA overlay in the AUP(OP).

Assessment of landscape effects

The main landscape sensitivity for this LCA is associated with the Warkworth Interchange which involves the construction of embankments, several bridges up to 21m above ground level, including three bridges over the Mahurangi River, and the realignment of Carran Road.

The Project will impact several of the key characteristics of this project area with the main effects on the physical landscape during construction resulting from the removal of indigenous vegetation, including within an SEA, in addition to earthworks for the mainline and structures and presence of construction equipment. The Project will change the character of this area to a transport infrastructure dominated landscape, particularly around Woodcocks Road and west along Kaipara Flats Road.

The wider landscape character has a reduced susceptibility to the proposed changes due to the presence of existing infrastructure including large scale developments (e.g. glasshouses along Woodcocks Road) and the P2Wk which is currently under construction. Moreover, the south eastern slopes of the valley including Viv Davie-Martin Drive are zoned Future Urban, which generally indicates that sensitivity to these areas to urbanisation is of a reduced level (compared to the rest of the character area which is zoned rural production).

Assessment of visual effects

The most sensitive areas in terms of visual effects within the Warkworth North LCA are Viv Davie-Martin Drive and Woodcocks Road, the Warkworth Interchange and Kaipara Flats Road which results from these areas including residential properties and therefore, more sensitive receivers than any other character area.

Views of the Indicative Alignment from properties off Kaipara Flats Road will be screened (where possible) by retaining existing shelter belts within the designation and by revegetating a wide strip of land on the eastern side of the Indicative Alignment to buffer the Kaipara Flats Road rural residential area to the east.

Mitigation

The proposed mitigation of the Warkworth Interchange involves extensive native planting between the ramps to visually absorb the various lanes, fill embankments and structures, particularly when viewed from elevated properties off Viv Davie-Martin Drive. Shelter belt type screen planting will screen views of the interchange from properties off Wyllie Road, Woodcocks Road and Carran Road. A shelter belt is proposed on the western side of the Indicative Alignment, by Phillips Road, to screen views from properties to the west off Kaipara Flats Road.

There is an opportunity to retain the existing indigenous riparian vegetation along the Mahurangi River (left branch) except where limited clearance is needed to construct bridges over the river. This along with planting residual land within the interchange will create a distinctive landscape feature that integrates all the lanes and bridge structures of the interchange. Planting at the interchange will connect the Mahurangi River (left branch) with remnants of indigenous vegetation up to Kaipara Flats Road which will filter views of the alignment from the more sensitive residential viewing areas around Warkworth, as well as presenting an opportunity to create a vegetated corridor between the upper Kourawhero Stream and Mahurangi River that links remnant patches of indigenous forest within the two catchments. This will create a buffer between the Indicative Alignment and the Kaipara Flats Road rural residential area as well as assisting to mitigate the change in character to the area reducing the scale and effects of the interchange infrastructure.

Summary of landscape and visual effects in the Warkworth North landscape character area

The *Landscape and Visual Assessment* concludes that landscape effects generated by the Project will have Moderate-High adverse physical landscape effects and High landscape character effects on the Warkworth North LCA. These effects can however be reduced to Low if the mitigation shown on the Landscape and Visual Mitigation plans is implemented. Visual effects are assessed as being low.

Dome Valley character area

Figure 9-10: River Road, within the character area (overlooking the Hōteo River corridor which is enclosed by plantation forestry and smaller pockets of indigenous vegetation around the Hōteo River margins).

Landscape character and values

The key attributes of the Dome Valley character area are:

- The landscape is characterised by elevated hill country and forms a backdrop to views from the northern parts of Warkworth.
- Includes notable peaks such as The Dome (at 336 m above mean sea level), to the east of the character area, and Kraack Hill (at 310 m above mean sea level).
- Vegetation cover, particularly to the west, is almost entirely comprised of exotic plantation forestry.
- Areas of indigenous vegetation are found along the north eastern side of the existing SH1 corridor within an ONL (ID 32, Dome Forest) to the east of the character area, several SEAs and two DOC reserves, all of which are outside of the proposed designation boundary.
- The wider Project area contains a number of public walking trails including the Te Araroa national walkway. The trail crosses the character area on the northern side of the Kraack Hill ridge, where the Project is in a tunnel.

Assessment of landscape effects

The main landscape sensitivity for this LCA is associated with a series of steep cuts before passing through the tunnel beneath Kraack Hill and Kraack Road. These works would likely require the filling of gullies, which include streams/overland flows that flow into the Waiteraire Stream which flows to the Hōteo River. Effects on the physical landscape will result from a wide bench cutting across a series of ridges and valleys.

The cut and fill works would require substantial clearance of pine plantation across much of the character area, however it is assumed that this forestry is harvested prior to construction of the Project. The project area avoids areas of indigenous vegetation on the northern side of SH1 (i.e. around Sunnybrook Reserve) and around the Kraack Hill summit. Apart from the impact on streams, the filling of gullies and clearance of any forestry in this character area will have a low landscape effect. In addition, mitigation will help to blend cut and fill batters with adjacent landform and integrate the state highway into the wider landscape. The Te Araroa national walkway is identified as a valuable landscape feature within this character area. The Indicative Alignment at this location is in the tunnel and completely avoids the walkway. In terms of effects on the wider landscape character, the key characteristic of value within this character area is the high coverage of forest vegetation. However, by nature the character of the area is dynamic and subject to change and this commercial forest is expected to have been harvested prior to construction of the project. Noting the anticipated harvesting of the forest along with the existing SH1, logging activities and forestry roads, the Project is not incompatible with the landscape character of the Dome Valley.

Assessment of visual effects

This section of the Indicative Alignment passes through the steeply undulating Dome Valley. The Indicative Alignment is proposed to be largely located below the existing grade (i.e. within areas of cut). Due to the limited occurrence of roads or dwellings through this location, this character area has the lowest number of potential viewers, of any character area along the alignment.

Mitigation

To mitigate effects of the twin bore tunnels, consideration will be given to the associated infrastructure (e.g. portals and deluge storage tanks) to ensure that the infrastructure is integrated with the landscape. Whist this detail will be finalised at the detailed design stage of the Project, integration techniques could include sloped portal structures and revegetation works. In addition, as recommended in the *Landscape and Visual Assessment*, tunnel infrastructure will be recessive in design including being located so that they are not visible from the Te Araroa Trail.

To mitigate general effects in this character area:

- The final contour on completion of earthworks will visually and physically transition into the natural landform;
- Cut and fill batters and soil disposal sites will be designed to include slope gradients that can sustain vegetation;
- Some area of exposed rock from cutting/blasting will likely be retained as a feature; and
- Extensive revegetation will be undertaken to integrate infrastructure and soil disposal sites with the adjoining landforms and provide screening.

Summary of landscape and visual effects in the Dome Valley landscape character area

The *Landscape and Visual Assessment* concludes that for the Dome Valley LCA the landscape effects generated by the Project will have Moderate-High physical landscape effects and Moderate landscape character effects which can reduce to Moderate-Low with mitigation. Visual effects are assessed as being low.

Upper Hōteo River landscape character area

Figure 9-11: Wayby Valley Road, within the character area (showing the flat pastoral landscape, and Wayby Valley Road along the valley floor).

Landscape character and values

The key attributes of the Upper Hōteo River LCA are:

- The landscape is characterised by a gently undulating valley landscape featuring the Hōteo River, Auckland's longest river and several of its key tributaries. Some parts of the river and its tributaries feature connected swathes (and pockets) of indigenous vegetation (some of which are recognised in the AUP(OP) as SEAs for their ecological value).
- Land uses in this area are largely pastoral (grazing).
- Infrastructural activities are featured within the character area, including the existing SH1, and in the surrounding environment (i.e. the Springhill Aerodrome and the North Auckland Rail Line).
- The values of the landscape within and surrounding this character area are of moderate/regional importance, primarily as a result of the Hōteo River.
- The Hōteo River contributes (both directly and indirectly) the highest values to the landscape, particularly those parts of the river that feature indigenous vegetation cover and are identified in the AUP(OP) as ONF and SEA overlays.
- The Hōteo River also has significant cultural value to Mana Whenua.

Assessment of landscape effects

The main landscape sensitivity for this LCA is associated with the Hōteo River which is a highly valuable landscape feature and recognised in the AUP(OP) as an ONF. The Project includes the construction of the Wellsford Interchange (likely to be formed on fill embankments) in this LCA, which will include a series of cut and fills through ridges and across valleys to the north.

Areas of riparian indigenous vegetation and the existing tributaries to the Hōteo River are also of value, particularly those which are identified as SEAs. While the Indicative Alignment avoids the SEAs immediately alongside the river, it will intersect with two tributaries and one SEA area and will result in some indigenous vegetation removal, impacting the wider natural values of the Hōteo River.

The Indicative Alignment passes over the Hōteo River via a proposed viaduct. The viaduct is proposed to ensure that there will be no direct impact upon the riverbed or its banks, but the supporting structures are likely to impact an area of native vegetation cover (SEA_T_683) to the south of the river's southern banks. The proposed designation has been narrowed down substantially at this point to minimise impacts on the SEA and avoid, to the greatest extent practicable, the Hōteo River ONF (ID 48). The indicative design of this area considered several bridge layouts with pier spacings from 35 m centres to 80 m. After careful evaluation, an (approximately) 65 m span was incorporated within the Indicative Alignment as this enabled all piers to be located outside of watercourses and minimises vegetation clearance for construction purposes. The design for the northern bridge abutment retains most of the wetland SEA_T_6854 and with piers located on the northern and southern edge of SEA_T_ 683, enabling the centre of the vegetation to be retained.

Assessment of visual effects

The most sensitive areas in terms of visual effects within the Upper Hōteo River LCA are views of the Indicative Alignment from properties off Wayby Station Road, views of the Hōteo River viaduct, the Wellsford Interchange and from elevated properties in Rustybrook Road.

Views of the Hōteo River viaduct should be partially screened by retaining the existing Poplar shelter belt inside the designation near SH1 and through the design and construction methodology for the viaduct in line with the principles outlined in the ULDF. The visual effects following mitigation will be Low.

Views of the Wellsford Interchange will be screened by retaining existing shelter belts inside the proposed designation beside Wayby Valley Road and planting a shelter belt on the western sloping fill batter of the interchange. The visual effects will be Moderate-Low/Moderate-High following mitigation.

Views of the Project from elevated properties off Rustybrook Road, Whangaripo Valley Road and from Wayby Valley Road will be screened, where necessary by planting shelter belts on any eastern and western fill batter slopes of the final design.

Mitigation

Measures are proposed to mitigate the effects of the Project on the landscape qualities of the upper Hōteo River LCA as follows:

(a) The final design of the Wellsford Interchange should serve as a gateway feature along the Project and provide a feature that connects to Wellsford and the surrounding landscape setting. Native planting and design work at the interchange will promote a sense of place that reflects the destination presented e.g. by using culturally and locally important plant species.

(b) The support structures (piers), abutments and embankments of the Hōteo viaduct will be carefully placed to minimise their physical impact where possible on SEAs. Refer to Section 4.1 Viaducts and Bridge design principles of the Planning Version ULDF.

(c) The design of the Hōteo Viaduct, the hardscape material (e.g. rock rip rap), inspection and maintenance areas/access, and any railings or barriers will be considered holistically as part of the overall urban and landscape design treatment for the corridor and not as an isolated area, as outlined in the design principles of the Planning Version ULDF.

(d) Revegetation and mitigation planting will be undertaken as early as possible to gain maximum benefit. These works should also be reflective of the surrounding landscape character and pasture may be most appropriate in this character area.

(e) Plant the riparian margins of streams in the pastural landscape north of the Hōteo River to help stitch together and enhance the legibility of the landscape.

The *Landscape and Visual Assessment* concludes that the Upper Hōteo River LCA will experience Moderate-High physical landscape effects and High landscape character effects which can be reduced to Moderate or even Moderate-Low depending on the extent of mitigation. The visual effects will be Moderate-Low following mitigation.

Wellsford East landscape character area

Figure 9-12: Whangaripo Valley Road, within the character area (showing areas of undulating and lower valley pasture).

Landscape character and values

The key attributes of the Wellsford East character area are:

- The landscape is characterised by sparsely populated undulating to rolling farmland typified by a sequence of low ridges, which rise and form part of a more elevated ridge to the west of the character area (around Worthington Road).
- The Worthington Road ridge provides a physical separation between the character area and the Wellsford settlement.
- Ridgelines enclose a network of stream courses, which feed into three main catchments, including those of the Hōteo River and Te Hana Creek.
- Land use is predominantly open pastoral, with limited vegetation cover which is typically pockets of exotic vegetation.
- The values of the landscape within and surrounding this character area are primarily recognised and appreciated at a local level. The local population are likely to value the open, undeveloped agricultural character of the landscape in this character area, particularly for the sense of rural tranquillity.

Assessment of landscape effects

The main landscape sensitivity for this LCA is associated with the introduction of substantial infrastructure in a rural landscape and extensive earthworks forming a series of cuts and fills through ridges and across valleys with an elevated bridge proposed across Whangaripo Valley Road.

The impact of the Project upon the landform will be very high due to the physical extent of the earthworks. Minimal vegetation clearance will be required due to the lack of existing trees within the footprint of the Indicative Alignment in the Wellsford East LCA.

The Worthington Road ridge and the rolling topography will contain the Project within the more immediate landscape ensuring the Project does not impact upon the character or amenity of Wellsford and/or its rural interface. However, the Project will have a significant impact upon the character surrounding Burrows Road, Whangaripo Valley Road and Farmers Lime Road due to the introduction of a new bridge and embankments that will change the character of these rural areas currently characterised by open pasture, shelter belts and agricultural (farming) land use with interspersed residential dwellings.

Assessment of visual effects

The most sensitive areas in terms of visual effects within the Wellsford East LCA are the views from Whangaripo Valley Road looking west and Borrows Road looking south-east. At this location the Indicative Alignment passes through sparsely populated open farmland so has a limited visual catchment in relation to any known public or private viewing audiences. The Hōteo Viaduct and Wellsford Interchange will be visible from properties off Wayby Station Road with the Indicative Alignment also visible from elevated properties off Rustybrook Road.

Mitigation

Measures are proposed to mitigate the effects of the Project on the landscape qualities of the Wellsford East LCA as follows:

(a) Earthworks will be designed and graded out to integrate with the surrounding landscape. This approach will be particularly important for the fill embankments proposed around the Borrows Road area.

(b) Small woodlots and tree belts are common in the wider landscape around Borrows Lane/Whangaripo Valley Road. Similar planting will be used/replicated around the Borrows Road bridge area to soften and visually anchor the proposed bridge and the tall engineered fill embankments.

(c) Appropriate surface treatment of cut slopes will be undertaken, including grassing, revegetation or leaving an exposed rock face. Rock cuttings can provide features within the local landscape, and reflect the local character of the area, in particular the distinctive limestone geology of the area.

(d) The bridge form and design will be considered as part of the overall urban and landscape design for the corridor as outlined in the Planning Version ULDF.

(e) Worked areas, and embankments (outside of the Borrows Road area) will be returned to pasture, to blend with the character of the surrounding open pasture land.

(f) Plant the riparian margins of streams that flow through the proposed designation within the Wellsford East LCA.

Summary of landscape and visual effects in the Wellsford East landscape character area

The *Landscape and Visual Assessment* concludes that the Wellsford East LCA will experience Moderate physical landscape effects and Moderate-High landscape character effects which can reduce to Moderate-Low physical landscape effects and Moderate character effects with mitigation.

Te Hana North landscape character area

Figure 9-13: Lower Silver Hill Road looking from the east (showing areas of undulating pasture and former quarry workings).

Landscape character and values

The key attributes of the Te Hana character area are:

- The landscape is characterised by sparsely populated undulating to rolling farmland typified by a sequence of low ridges, which form part of a more elevated ridge/land to the east of Te Hana.
- The land use is predominantly open pastoral, with limited vegetation cover apart from pockets of indigenous vegetation found around the tributaries and main channel of the Maeneene Stream.
- The values of the landscape within and surrounding this character area are primarily recognised and appreciated at a local level. The local population are likely to value the open, undeveloped agricultural character of the landscape in this character area, particularly for the sense of rural tranquillity that is evident in the wider landscape to the east of Te Hana settlement.

Assessment of landscape effects

The main landscape sensitivity for this LCA is the extensive earthworks forming a series of cuts and fills through ridges and across valleys, a large fill to form the Te Hana Interchange over Mangawhai Road and the landform and land cover modification which will result in a change to the rural character.

The Project passes over several stream/tributaries feeding into the Te Hana Creek catchment and wetlands. The associated earthworks will require the removal of the existing, largely exotic vegetation and indigenous wetland vegetation. Steep cuts through pasture are required to construct this part of the Project impacting the typical rolling contour and occasional boundary vegetation that contribute to the scenic value of the wider landscape. The Indicative Alignment intersects with a prominent ridgeline north of Silver Hill Road, at which point the road is on embankments. These embankments gradually increase in height/scale towards the Te Hana Interchange where the embankments then reduce in scale and continue through relatively flat open fields to the proposed bridge over Maeneene River.

The susceptibility of the wider landscape to effects from the Project is limited due to the enclosing and screening effect of intervening landforms as well as the overall sense of scale.

The impact of the Project will be realised in the smaller pockets of residential development e.g. around Silver Hill Road where the extent of the engineered slopes and the bridge will be most noticeable.

At the northernmost limits of the Project area, the Indicative Alignment will result in a considerable change to the character of the valley to the east of SH1 where a roundabout will be constructed on the existing SH1 and a full north/south interchange straddling Mangawhai Road. This proposed interchange will alter the landform, use and appearance of the ridge slopes surrounding the lower parts of Mangawhai Road, and will impact upon the landscape character of nearby areas, including the subdivision at Charis Lane, and the rural residential areas around Vipond, Maeneene and Waimanu Roads. The Project will change the character of the valley introducing a large engineered structure, I.e. an elevated road with ramps and lighting. However, the character within this area is already influenced by the existing SH1 road, a local subdivision and local roads; so those areas have a relatively low sensitivity to change.

There is opportunity to integrate place making features into the interchanges to assist with this connectivity.

Assessment of visual effects

The most sensitive areas in terms of visual effects within the Te Hana LCA are considered to be from Mangawhai Road looking south-east, Vipond Road looking south and from Charis Lane looking north-east. The Indicative Alignment intersects with Silver Hill Road, the latter which crosses over the mainline carriageway via a bridge and will be visible along nearby parts of Silver Hill Road and a number of nearby private properties. The Te Hana Interchange and the associated roading realignments/connections will be visible across parts of Mangawhai Road, Vipond Road and SH1.

Mitigation

Measures are proposed to mitigate the effects of the Project on the landscape qualities of the Te Hana East LCA as follows:

(a) Earthworks will be designed and graded out to integrate with the surrounding landscape. This approach will be particularly important in relation to the tall fill embankments proposed around Silver Hill Road.

(b) The Silver Hill Road bridge design will be considered as part of the overall corridor approach to bridge architecture and structures, so that it is part of the corridor wide family of structures as outlined in the ULDF.

(c) For the areas of cut proposed, opportunities for rock cuttings will be explored with the aim of providing features within the local landscape, reflecting its local character (e.g. by exposing the underlying limestone).

(d) The Te Hana Interchange will be the northern gateway to Wellsford as well as connecting visitors to the Te Hana Te Ao Marama Cultural Centre and Te Hana. The landscape treatment of the Te Hana Interchange and the Wellsford Interchange to the south will be similar (creating a family of interchanges) to reinforce the connections into and out of Wellsford. Similar native planting will be replicated around the Te Hana Interchange to visually screen local views towards the interchange and the tall engineered fill embankments.

(e) Plant the riparian margins of streams in native species that flow through the proposed designation in the Te Hana East LCA.

(f) Construction compounds will be located a minimum of 200 m from residential properties where practicable and will be screened with grassed mounding and or fast growing shelter belt trees.

Summary of landscape and visual effects in the Te Hana landscape character area

The Landscape and Visual Assessment concludes that the Te Hana North LCA will experience Moderate-High physical landscape effects and High landscape character effects which can reduce to Moderate with mitigation. The visual effects will be Moderate following mitigation

Natural character effects

The Project area crosses a number of watercourses including the Mahurangi and Hōteo Rivers, Kourawhero and Maeneene Streams, and the Te Hana Creek, which feed into the Mahurangi and Kaipara Harbours. Sections of the Kaipara and Mahurangi Harbours are identified as High Natural Character areas in the AUP(OP) and an area in the lower reaches of the Mahurangi Harbour is identified as an Outstanding Natural Character (ONC) area and therefore potential impacts on natural character have been considered. Based on the findings of the *Marine Ecology and Coastal Avifauna Assessment*, and the *Assessment of Coastal Sediment*, it is considered that the potential effects on natural character of the coastal environment would be low, including cumulatively.

Lighting

The only lighting currently anticipated along the Project alignment will be at the interchanges and the tunnel (including the portals) with the remainder of the Indicative Alignment being unlit to preserve rural amenity. The effect of lighting in the interchange areas will add to the urban presence of the interchange infrastructure. Lighting at the interchanges and in the tunnels is required for safety reasons. The lighting will be designed to achieve the lighting category (medium brightness) identified in the AUP(OP) for the Rural Production Zone and the requirements of "AS/NZS 1158:2005: Lighting for roads and public spaces". The lighting design will control the intensity, location and direction of artificial lighting to avoid significant glare and light spill onto adjacent sites, maintain safety for road users and minimise the loss of night sky viewing. Mitigation planting (shelterbelts and woodlots) is proposed in some areas to screen views of the road and interchange lighting.

Potential landscape effects if the alignment shifts within the designation boundary

The assessment undertaken and outlined in detail in the *Landscape and Visual Assessment* is based on the Indicative Alignment. Consideration was also given to the potential landscape and visual effects should the alignment shift within the proposed designation boundary during future design development phases. Particularly sensitive areas identified are:

- The Mahurangi River and its associated riparian vegetation;
- Remnant patches of indigenous vegetation south and north of Kaipara Flats Road;
- Upper reaches of the Kourawhero Stream;

- The Hōteo River and adjoining indigenous forest identified as SEA_T_ 683; and
- A high value wetland SEA_T_6854 and a remnant of indigenous floodplain forest SEA_T_6851 north of the Hōteo River.

The *Landscape and Visual Assessment* identified that the final design has potential to increase the level of landscape effects in two parts of the Warkworth North LCA:

- the Mahurangi River (left branch) running parallel with the Indicative Alignment;
- the wetlands at the headwaters of the Kourawhero Stream.

Provided the current level of impact on these two areas is maintained or reduced, by the following, the *Landscape and Visual Assessment* concludes that future changes to the alignment can be accommodated without an increase in effects on these areas:

- Bridges crossing the Mahurangi River should be perpendicular to the river to minimise the impact on riparian vegetation. The number of bridges associated with the Warkworth Interchange over the river will be restricted to a maximum of three;
- Loss of vegetation from remnant patches of forest will be no greater in area to that shown on the Indicative Alignment;
- The bridge over the upper Kourawhero Stream will be retained in any further designs;
- The designation is very narrow at the Hōteo River crossing so will avoid any change to the impact on the river and SEA_T_ 683;
- The Hōteo River viaduct northern bridge abutment is located on the northern edge of wetland SEA_T_6854. Future designs will not increase the area (i.e. m^2) of the physical works which impact on the wetland area within the Indicative Alignment;
- Future designs will not encroach further into SEA_T_685.

Potential changes to the Indicative Alignment within the designation boundary should have similar effects to the Indicative Alignment on the assumption that the final design gives effect to the mitigation principles and guidelines recommended in the ULDF. The proposed integrated mitigation approach is discussed in detail in section 10.3 of this AEE.

9.13.6. Overall assessment of landscape and visual effects

A project of this nature and scale will inevitably have landscape and visual effects. However, the Project has been through a detailed route selection process involving the assessment of alignment options and environmental effects to avoid significant adverse effects where possible. This process resulted in the avoidance of all scheduled landscape features and minimal impact on a scheduled outstanding natural feature (Hōteo River).

Effects on landscape character and features

The Project will alter the composition of the landform and vegetation cover within the Project area and will introduce changes to the various landscape character areas along the route. The significance of the landscape effects resulting from those changes will range from moderate adverse to high adverse effects during and immediately following the construction works. However, many of these effects can be mitigated to between low adverse to moderate adverse effects through the design development phase being guided by the design principles outlined in the ULDF and over time with the establishment of the proposed revegetation.The Project will alter existing landscape elements and features within the Project area which will have an effect on the Project area's character, and the wider character outside of the Project area in places. The significance of the landscape effects resulting from those changes will range from moderate adverse to moderate-high adverse effects during and immediately following the construction works. However, many of those effects can be remedied or mitigated to between moderate-low adverse to moderate-high adverse effects.

There is potential for the Project to create positive beneficial effects as a result of landscape ecological mitigation. The proposed mitigation will strengthen existing vegetation frameworks and improve the management of riparian margins in certain locations resulting in positive landscape and ecological effects.

Protected natural landscapes

The Project does not encroach on and therefore does not result in adverse effects on the values of the any scheduled Outstanding Natural Landscapes. The potential effects on the ONF (Hōteo River) that overlaps and adjoins the proposed designation boundary have been minimised to the greatest extent possible with the Indicative Alignment having been designed to ensure that construction works do not encroach on the ONF itself. River Road currently runs through the ONF in this area and the proposed upgrades to this local road as part of this project will not affect the values of the scheduled landform.

Visual effects

The potential effects of the Project on public viewing areas will range from very high to very low adverse effects during and immediately following the construction works and it is considered that many of those effects can be remedied or mitigated over time generally to be moderate-low with the establishment of the proposed mitigation and screen planting.

Post construction, the residual and enduring effects of the Project will be the modification of the rural character and amenity values. Well-considered specific mitigation will assist considerably in ameliorating such effects.

Further design and development

The use of the ULDF as a guiding document to ensure the final design avoids or minimises adverse landscape and urban design effects is a proven mechanism for minimising adverse effects. The development of this document during the detailed design process will ensure that the potential adverse effects are appropriately considered and managed. In addition, the *Landscape and Visual Assessment* identifies areas particularly sensitive to the Project and makes specific recommendations to manage effects in these areas. These are listed in section 9.13.7.

9.13.7. Measures to avoid, remedy or mitigate actual or potential adverse effects

A Planning Version ULDF has been developed which identifies landscape and urban design objectives, principles and opportunities for the Project (see volume 3 drawing set of the AEE). Cultural values have been one of the key drivers in its development. The ULDF will be developed to inform the detailed design and the construction and implementation phases, and sector specific Urban Design and Landscape Management Plans will also be prepared.

The recommended measures to mitigate potential adverse landscape and visual effects of the Project include:

- Implementation of the *Landscape Mitigation Plans, LM* – Series in Volume 3 of the AEE which depicts locations for planting specifically to address landscape and visual effects;
- Design of structures and highway features as guided by the principles of the Planning Version ULDF and subsequent versions;
- Structures in the Dome Valley area should be recessive in design and not be visible form the Te Araroa Trail;
- The Warkworth Interchange and Te Hana Interchange should serve as a “gateway features”;
- Earthworks design and implementation to visually and physically integrate highway batter slopes with adjacent landform and land cover;
- Cut to fill batters and soil disposal sites to include slope gradients that can sustain vegetation;
- Construction mitigation that includes maximising the retention of existing vegetation and locating construction yards to minimise visual effects;
- Planting and revegetation that includes extensive planting at key locations to maximise the opportunity to provide high value and resilient landscape and ecological outcomes;
- Visual screening by planting shelter belts and hedge rows with fast growing species that are common in the area;
- Riparian planting of streams in the pastural landscape north of the Hōteo River;
- Locating construction compounds that are within 200 m of a residential properties so that they are screened from view. This may include visual screening.

9.13.8. Conclusion

Landscape considerations have been an integral component of the design of this Project to date including the process of assessing the alignment options (MCA process) and determining the Indicative Alignment. This has enabled the most significant landscapes and features to be avoided or the effects minimised and landscape and visual considerations to be integrated with other aspects of the Project. The adverse landscape and visual effects of the Project are summarised in Table 9-24 of this AEE.

Landscape mitigation has been considered together with ecological mitigation, hydrology, stormwater treatment and cultural values in order to provide a more effective and resilient environmental outcome overall. The focus for mitigation is to establish large areas of revegetation that provide a strong landscape framework and habitat creation around a few key areas that contain existing high value features.

Overall, consideration of the landscape context of the Project area and the assessment of the potential landscape and visual effects has identified that the effects can be minimised through design development guided by the ULDF, and the recommended mitigation planting. The residual and enduring effects are summarised in Table 9-24 below.

Table 9-24: Summary of adverse landscape and visual effects

LCA	Landscape - character				Landscape - Values				Visual	
	Effect rating									
	Construction	Completion	Once mitigation established	RMA scale of effect	Construction	Completion	Establishment of mitigation	RMA scale of effect	Establishment of mitigation	RMA scale of effect
Warkworth North	Moderate-High	Moderate	Low	Less than Minor	High	Moderate-High	Low	Less than Minor	Low	Less than Minor
Dome Valley	Moderate-High	Moderate	Moderate-Low	Minor	Moderate	Moderate	Moderate-Low	Minor	Moderate - Low	Less than Minor
Hōteo River	Moderate-High	Moderate	Moderate to Moderate-Low	More than Minor	High	Moderate-High	Moderate	More than Minor	Moderate	Less than Minor
Wellsford East	Moderate	Moderate-Low	Moderate-Low	Minor	Moderate-High	Moderate-High	Moderate	More than Minor	Moderate	Less than Minor
Te Hana North	Moderate-High	Moderate-High	Moderate	More than Minor	High	High	Moderate	More than Minor	Moderate	Less than Minor

9.14. Operational Traffic

Overview

The identified problems on the existing SH1 Warkworth to Wellsford route are, in summary:

1. The corridor is substandard for a national strategic route, resulting in a higher number of crashes involving injury and death; and
2. Poor resilience and costly journeys between Northland and Auckland, which is constraining economic growth and investor confidence.

The Project will deliver significant positive transportation and traffic effects (i.e. benefits). The Project will improve road safety, improve resilience and accessibility, reduce journey times, and improve consistency of journey times for general traffic and freight. It will improve route security by providing an alternative route to the current SH1 built to higher standards, which will be safer and more resilient to incidents.

9.14.1. Introduction

This section summarises the findings of the assessment of the actual and potential effects on the transport environment arising from the operation of the Project outlined in the *Operational Transport Assessment* contained in Volume 2 of this Application. Traffic effects in relation to the construction phase of the Project are the subject of a separate report and are summarised in section 9.7 of this AEE.

The *Operational Transport Assessment* establishes a baseline transport environment which was developed by considering the existing transport environment and how the performance of the transport network might change over time, informed by traffic modelling.

This section presents the findings of the assessment of the actual and potential effects of the operation of the Project on the road network and road users, including safety, route quality, resilience and travel time reliability, and predicted changes in travel times.

9.14.2. Existing transport and traffic environment

The description of the existing transport and traffic environment is included in section 3 of this AEE.

In summary:

- SH1 serves the dual purposes of providing the inter-regional transport function between the Auckland and Northland regions for the movement of people and goods, as well as providing access to local areas. As a consequence of this dual function, there is a mix of regional and local traffic on SH1.
- The Warkworth to Te Hana section of SH1 has a single carriageway, with generally one lane each way. The road follows the undulating landform, with restricted sightlines and steep grades in some locations, which present safety, resilience and capacity issues.

The specific objectives for the Project are directly relevant to the problems experienced on the existing corridor. The objectives are identified in section 2.2 of this AEE and the key issues are summarised below.

Safety

The geometric issues associated with the current SH1 alignment has an unsatisfactory safety record. The geometric issues contribute to a number of crashes, particularly through the Dome Valley.

The following sections of the route have a high crash rating (from south to north) as shown in Figure 9-14:

- Between Kraack Road and L Philips Road;
- Near Saunders Road;
- Between Wayby Valley Road and River Road;
- At the Wayby Valley intersection;
- Between School Road and Port Albert Road; and
- Between Mangawhai Road and Whakapirau Road

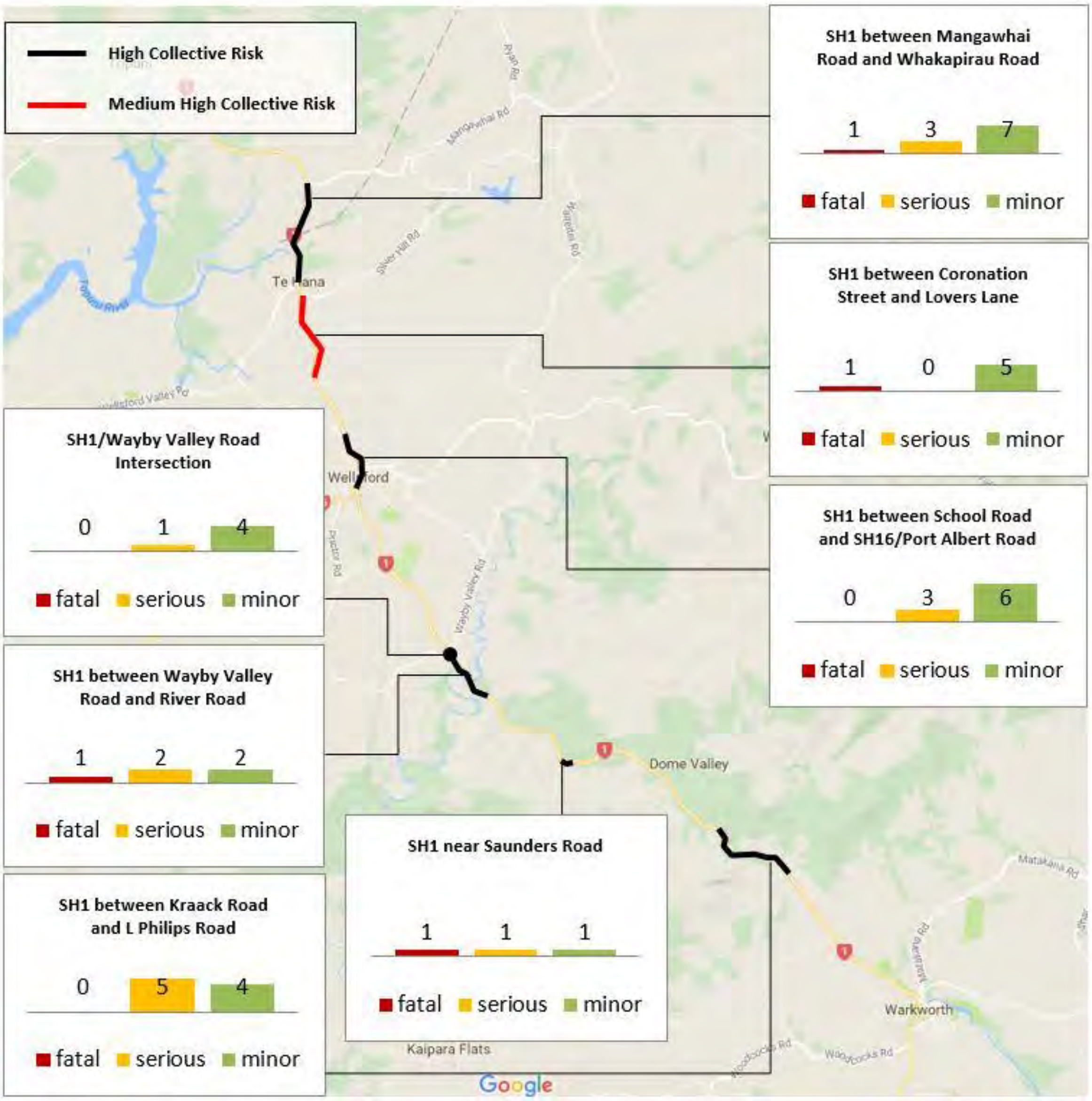


Figure 9-14: Sections of SH1 with a High or Medium High Crash Risk Ranking (2006-2011)

The Dome Valley safety improvements project will improve safety along SH1 through providing improved and widened shoulders and shoulder barriers, providing wider centre medians or median safety barriers, and improvements to the passing lanes[80].

Travel times

The existing Warkworth to Te Hana section of SH1 is currently subject to congestion. The most regular congestion currently occurs through Warkworth, at the southern end of the Project, and southbound queues extend back several kilometres. This congestion results in increased travel times, not only through Warkworth but also through Wellsford and at various locations along the route, such as at the end of passing lanes. Congestion is known to be extensive at peak periods, such as at weekends over the summer, and particularly around weekends which coincide with public holidays. Travel times for northbound traffic are significantly higher at the start of a holiday weekend, and for southbound traffic at the end of a holiday weekend. In addition, severe congestion can occur as a result of unexpected incidents (such as crashes, slips, etc.).

Travel time reliability

Congestion not only results in increased travel times but also increased variability of travel times and reduced reliability. The southbound trip through Wellsford has the most variability in the morning, evening and holiday end peaks. In the morning weekday peak 92% of trips have a journey time between 2 and 5 minutes. However, only about 31% of southbound trips have a journey time between 3 and 5 minutes during the holiday end period. Travel time variability is mainly an issue during holidays, particularly through Wellsford.

Increased variability makes journey planning difficult for individuals and businesses such as freight operators and others who rely on the transport system for the movement of goods and services.

Route resilience

The SH1 corridor between Auckland and Whangārei is of nationally strategic significance as it provides the primary strategic inter-regional transport route between the Auckland and Northland regions. However, the Warkworth to Te Hana section of the existing SH1 route is closed on average five times per year for an average of three hours as a result of events such as crashes, flooding or slips blocking the road. The detour routes for many of these closures are challenging.

Road freight performance

The SH1 corridor has an important freight function, providing freight access between Auckland and Whangārei.

The geometry of the Warkworth to Te Hana section of SH1 presents difficulties for heavy vehicles, particularly through the Dome Valley where SH1 is a single carriageway with tight horizontal curves and steep grades in some locations, both of which force heavy vehicles to lose speed. HCVs were involved in approximately 12% of all injury crashes and 20% of fatal and serious injury crashes on SH1 between

80 This project will lead to safety improvements along the corridor, but will have minimal effects in terms of the traffic capacity along the route.

Warkworth and Wellsford. In addition, the lack of resilience affects HCVs as many of the detour routes are not able to carry HCVs.

Public transport, pedestrian and cycle network performance

There are currently limited public transport services in the Project area and no pedestrian or cycle facilities along the majority of SH1 between Warkworth and Te Hana, with the exception of Wellsford town centre. Accordingly, the levels of pedestrians and cyclists travelling along or across the route are very low. There is a greater level of pedestrian activity within Wellsford, both along and across SH1. The section of SH1 through the Wellsford township generally has footpaths on both sides, and only one pedestrian crossing within the town centre.

9.14.3. Transport assessment methodology

The assessment of the operational transport effects of the Project has been undertaken by forecasting the performance of the transport network for a "Future Reference Case Scenario" which assumed that the Project was not constructed. The forecast performance of the transport network in the future for a "Project Scenario" was then determined, which assumed that the Project was constructed. A comparison of the performance of the transport network in the two scenarios was undertaken to assess the potential positive and adverse transportation and traffic effects of the Project.

Transport model

The assessment of operational transport effects is based on the outputs of traffic modelling. A SATURN traffic model was developed for the road network from Pūhoi to Te Hana, including the townships of Warkworth and Wellsford. The regional transport demands for the model were sourced from the Auckland Regional Transport (ART) model.

The assessment of transport effects has been undertaken using the forecast years of 2036 and 2046, as the construction of the Project is assumed to be complete and operational by 2036. The traffic model has a base year of 2016. Irrespective of the operational date of the Project the overall outcomes of the traffic assessment are valid.

Definition of scenarios

Future Reference Case Scenario

The Future Reference Case Scenario allows the future transport network performance to be assessed in the absence of the Project. It represents the future transport environment baseline and was forecast for the years 2036 and 2046.

Land use forecasts for the Future Reference Case Scenario were developed from the following sources:

- Auckland Regional Transport (ART) model with I11.4 land use assumptions[81]
- Auckland Transport forecast growth for Warkworth and Wellsford
- Kaipara District Council forecast growth for Mangawhai.

[81] This reflects Auckland Council/ Auckland Transport growth expectations (updated September 2017) and was sourced from the Auckland Forecasting Centre.

The Future Reference Case Scenario assumes a number of changes and improvements relating to the future transport network which are anticipated to take place over time. These transport network changes include the P2Wk section, and new roading around the Warkworth township. These changes and improvements are identified in section 2.5 of the *Operational Transport Assessment*.

Project Scenario

The Project Scenario has the same network, land use and demand assumptions as the Future Reference Case Scenario, but it also includes the Project.

Sensitivity testing

There is a level of uncertainty around the accuracy of future traffic forecasts. Therefore, a series of sensitivity tests were carried out to consider:

- The inclusion of only committed transport projects;
- A lower increase in the rate of growth (slower growth), and
- Increased traffic growth based on a higher number of trips in the local network.

9.14.4. Assessment of operational transport effects

The Project has been developed to address the issues identified with the existing transport environment, i.e. the predicted scenario in the future if the Project is not constructed. Accordingly, as would be expected, there will be significant positive operational transport effects as a result of the Project. In addition, the transport environment that exists at the time of detailed design will be assessed and reflected in the detailed design.

Safety

In the future, if the Project is not constructed, traffic volumes on SH1 between Warkworth and Wellsford are predicted to increase from approximately 14,000 vpd to approximately 29,000 vpd in 2046. The increases in travel times predicted indicate that more congestion and queuing is expected in future. This congestion and queuing is predicted to increase the rate of rear-end crashes and may also increase the number of head-on crashes due to increases in two-way traffic demands. These increased demands will reduce the margin for error (i.e. it will increase the possibility of there being an oncoming vehicle if a vehicle accidentally crosses the centre line) and it will reduce the possibility of safe overtaking manoeuvres.

It is expected however, that the slower travel speeds along the route may reduce the severity of crashes during busy time periods. In addition, improvements are being implemented by the Safe Roads Alliance to the existing SH1 through the Dome Valley.

While volumes in the corridor will increase over time, if the Project is constructed a large proportion of trips between Warkworth and Wellsford will travel along the Project route. The Project route can be expected to have a significantly improved safety performance compared to the existing SH1, as it will be designed to the highway standards which apply at the time of detailed design. As a result, the Project will deliver a range of safety improvements (dual lane carriageway, median, side barriers, removal of local road intersections, and accesses etc.).

The Project is predicted to result in a significant reduction in crashes along the existing SH1, primarily due to the reductions in traffic volumes. The net effect of the

Project is expected to be a reduction in annual injury crashes from 19 crashes to 17 crashes (a 10% reduction), along the existing SH1 and the Project route (i.e. combined), relative to the 2036 Future Reference Case Scenario, in which the Project is not constructed. This 10% reduction significantly underplays the expected effects of the Project, which is expected to lead to a change in the level of injury incurred, namely a significant reduction in serious or fatal crashes in the Project area. The Project may change the severity of crashes occurring on the existing SH1 as the predicted lower volumes may result in higher speeds (due to the reduction in congestion along the route) and therefore a higher proportion of high severity crashes. However, as the vast majority of vehicles are predicted to divert off the existing SH1 and on to the new, safer route, the total number of crashes involving deaths and serious injuries is predicted to reduce significantly. The Project will also provide a safer walking and cycling environment within Wellsford and Te Hana with the shift of vehicles to the new road.

Public transport, pedestrian and cycle networks

In the future if the Project is not constructed, increased traffic on SH1 will cause longer travel times and decreased travel time reliability for the existing bus services between Auckland and Whangārei. These effects will be particularly pronounced during holiday periods, when bus services are likely to be more heavily utilised and traffic flows on SH1 are highest. The increase in traffic will also increase the difficulty for pedestrians of crossing SH1.

With the Project, the performance improvements forecast below for general traffic will be experienced by the regional bus services that run between Auckland and Whangārei, in terms of shorter travel times and increased travel time reliability. The significant reduction in traffic on the existing SH1 will make it easier and safer for pedestrians in Wellsford to cross SH1. The reduction in traffic could also facilitate the addition of more convenient crossings in Wellsford in the future.

Higher levels of traffic along the existing SH1 in the Future Reference Case Scenario could present an increased risk of conflict for recreational cyclists in the Project area, and for pedestrians and cyclists within Wellsford. The lower volumes of traffic along the existing SH1 route between Warkworth and Te Hana with the Project will improve safety and amenity for pedestrians and cyclists using that route. In addition, the Project will significantly reduce traffic flows within Wellsford and Te Hana, which will improve safety and amenity for pedestrians and cyclists within those townships.

Pedestrians and cyclists will be prohibited from using the new state highway through this section. Provisions have been made for pedestrians and cyclists on local roads affected by the Project in the indicative design. These provisions support the potential development of further future walking and cycling infrastructure in the area.

Traffic volumes

Modelling of the Future Reference Case Scenario (that is without the Project) indicates that traffic volumes on the existing SH1 are predicted to grow at a rate of approximately 3.4% per annum between 2016 and 2046 between Warkworth and Wellsford, increasing by 71% between 2016 and 2036, without the Project in place. This growth rate means that daily traffic volumes on SH1 are expected to be in the order of 29,000 vpd in 2046. This forecast growth rate is consistent with the 3.7% per annum growth rate observed over the last five years at this section of SH1. The evening peak flows are the highest, and there is more traffic in the inter peak than in the morning peak. This pattern is consistent in all three model years, becoming more pronounced as overall volumes increase.

With the Project Scenario, traffic volumes on the existing SH1 are forecast to significantly reduce by 86% to 4,000 vpd in 2046 (refer Figure 9-15). These reduced traffic volumes on SH1, with the shift of the majority of traffic to a four lane dual carriageway, will provide faster and more reliable travel times for vehicles. Traffic volumes on the Project (between Warkworth and Wellsford) are expected to be 24,600 vpd in 2046.

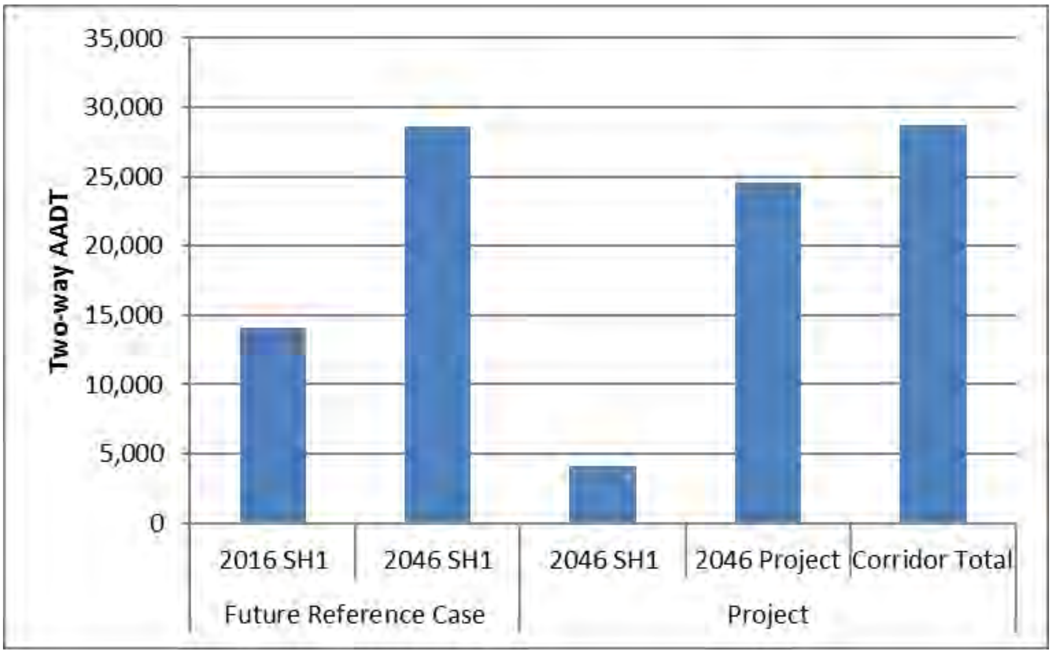


Figure 9-15: Traffic volumes between Warkworth and Wellsford in the Future Reference Case (without Project) and with Project scenarios

Travel times

In the Future Reference Case Scenario, the travel times along SH1 between Warkworth and Wellsford on a normal weekday are not expected to increase significantly between 2016 and 2046 (refer Table 9-25). This is because the improvements proposed to the road network considered in the Future Reference Case Scenario (such as P2Wk project, which will allow traffic to bypass Warkworth centre, or the Sandspit Link which will allow traffic from the eastern beaches to bypass the Hill Street intersection) can be expected to significantly relieve the queues that currently extend north from Warkworth at peak times. With the increase in traffic volumes on SH1, travel time reliability is likely to decrease on the Warkworth to Te Hana section of SH1 in the Future Reference Case Scenario. In summary, the traffic demand will be balanced by provision of new infrastructure, so travel times will not significantly increase, yet there will be more traffic on the road and the network will be closer to capacity overall, resulting in less travel time reliability.

Table 9-25: Travel times on SH1 between Warkworth and Wellsford (minutes)

	Period	2016	2036	2046	Change 2016 to 2046	
					Absolute (minutes)	%
Northbound						
Warkworth to Wellsford	Morning	17	18	18	2	10%
	Inter peak	17	18	19	2	12%
	Evening	18	19	21	3	16%
Southbound						
Wellsford to Warkworth	Morning	18	18	19	1	8%
	Inter peak	17	19	20	2	13%
	Evening	19	19	21	2	10%

The Project's new four lane dual carriageway will reduce travel times and allow journeys to be planned with a greater level of certainty. The modelling results indicate a decrease in travel times for travellers on both the existing SH1 and the Project.

For through traffic (from Pūhoi to Te Hana), travel times on the Project are predicted to be consistent in both directions and all time periods, indicating that it is predicted to operate with free-flow conditions. Travel times via the existing SH1 are predicted to reduce between 6% and 24%, depending on period and direction. Travel times via the Project are predicted to reduce between 36% and 48% (refer Figure 9-16).

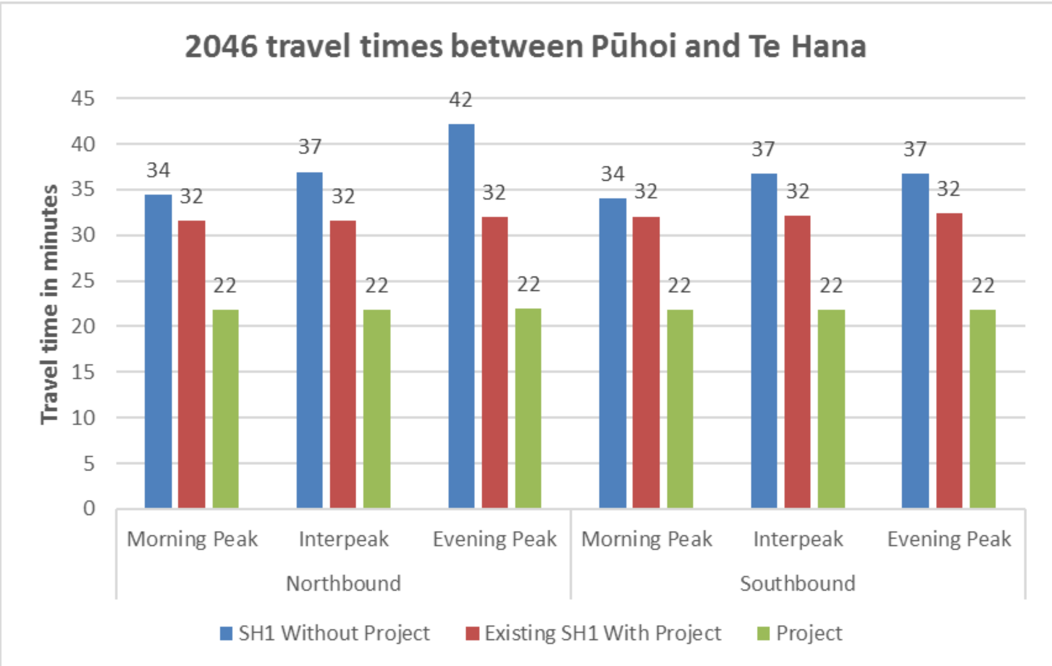


Figure 9-16: Travel times between Pūhoi and Te Hana (through traffic)

For local traffic, the Project is predicted to have the lowest travel times overall, even though it will have a longer distance than the existing SH1 route. Travel times via the Project (when compared to the existing SH1 route) are predicted to reduce between 9% and 19% (refer Figure 9-17). Travel times on the Project are predicted to be consistent in both directions and all time periods, indicating that it will be operating with free-flow conditions. Travel times via the existing SH1 are also predicted to reduce between 6% and 16%, depending on time period travelled and direction.

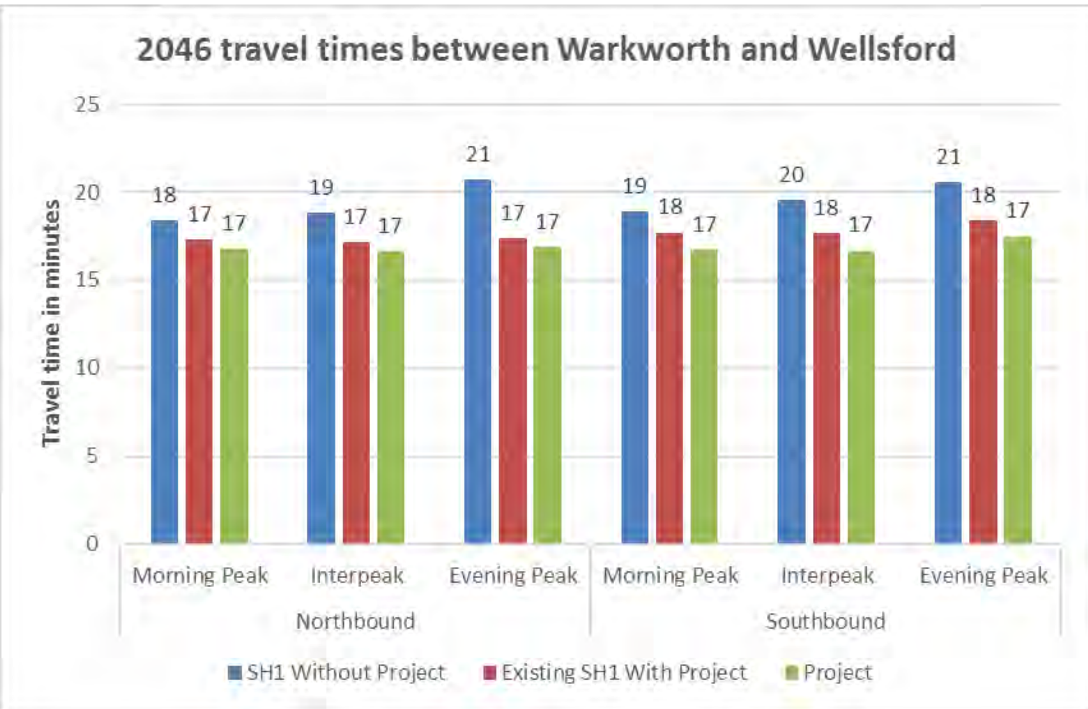


Figure 9-17: Travel times between Warkworth and Wellsford (local traffic)

The proposed interchanges are predicted to operate within their capacity, at level of service[82] B or higher in 2046, with average delays of less than 20 seconds.

Travel time reliability

With the increased traffic volumes on SH1 travel time reliability is likely to decrease on the Warkworth to Te Hana section of SH1 in the Future Reference Case Scenario. In congested conditions, small disturbances in flow are more likely to result in delays and queuing.

Travel time reliability is expected to improve in the future with the Project, given the capacity along the corridor will increase significantly as a result of the Project. Trips to and from locations to the north of Wellsford will be faster along the Project route, while the reduction in traffic along the existing SH1 route will also reduce travel times for vehicles that remain on the existing SH1. With two traffic lanes in each direction along the Project route, plus crawler lanes, more opportunities for passing will be provided than on the existing SH1. Reduced traffic volumes on the existing SH1 corridor will allow light vehicles to be less constrained by slow moving HCVs. A shift of HCVs onto the Project route will provide greater travel time consistency for HCVs due to the improved road geometry along this route.

Although not directly forecast by the models, travel time reliability generally decreases as traffic levels approach capacity. Therefore, the significant increase in

[82] Level of service (LOS) is a qualitative measure used to relate the quality of traffic service

capacity provided by the Project is expected to significantly improve travel time reliability.

This improvement in travel time reliability will be a significant benefit of the Project, enabling individuals and businesses to plan their travel with a much greater degree of certainty and providing for a much more robust network that will be able to cater for some disruption without significant increases in travel time.

Route resilience

The introduction of a high quality, alternative route to the existing SH1 route between Warkworth and Te Hana will reduce the effects of incidents (crashes and natural events such as slips and flooding) on travel between Warkworth and Te Hana – which in turn will mean improved resilience for those travelling between Northland and Auckland. The Project will improve route resilience in the following ways:

- Having two routes will provide a measure of redundancy and a greater level of security and availability of travel routes between Auckland and Northland.
- The Project route will have four traffic lanes. This design will allow the route to be opened sooner following a crash than is currently possible on the existing SH1, which is primarily a single carriageway.
- The number of crashes both on the existing SH1 and in the Project corridor overall is forecast to reduce, which will consequently reduce the number of times the route is closed.
- Improved resilience through the reduction of natural hazards i.e. slips and increased choice for route diversion.

As a result of these factors, the resilience of the wider state highway network will be improved as a result of the Project.

Road freight performance

With the Project in place, the volume of HCVs along the existing SH1 is expected to reduce by 80% as they will be attracted to the Project route, given road freight performance will be improved in the following ways:

- The Project will be designed to the highway standards which apply at the time of detailed design, with grades and alignment favourable to HCVs. The Project will therefore improve travel times and vehicle operating costs for HCVs and increase travel time reliability for HCVs.
- Improved travel times for freight will improve opportunities for trade by effectively bringing freight destinations closer together.
- HCVs will be able to bypass the Dome Valley, which currently presents geometric challenges and safety risks for heavy vehicles.
- The Project route will have four lanes, which will improve safety and travel times by eliminating the need for passing lanes and risky overtaking manoeuvres.
- Travel times and travel time reliability for HCVs will improve in the same way as described for general traffic.
- Safety for HCVs will also improve as described for general traffic.

Overall, the project is expected to have a positive impact on the performance and safety of freight.

Increased efficiency and economic benefits

It is expected nearly all of the traffic using the new road will have an origin or destination within the Auckland and Northland regions. As a result there will be benefits for businesses and residents in these areas from improved connectivity and efficiency in travel time.

For businesses, savings in vehicle operating, travel time and accident costs and improvements in travel time reliability and route resilience will result in increased productivity and improvements in business competitiveness. For residents, the traffic-related benefits of the Project will produce cost savings, improve personal safety and enable greater reliability in travel time.

Offline effects

Traffic volumes are predicted to grow on most parts of the wider transport network in the Future Reference Case Scenario, with a few exceptions (Mangawhai Road and Whangaripo Valley Road).

With the Project in place, traffic volumes are predicted to reduce on most parts of the existing wider transport network. One key exception is Mangawhai Road, which is the location of the Te Hana Interchange. However, most of the additional traffic will be between the existing SH1 and the interchange only. Traffic on Mangawhai Road to the east of the interchange is only predicted to increase by about 100 vpd on top of the existing and is unlikely to result in any significant adverse effects.

The models also indicate very minor increases in traffic on Whangaripo Valley Road and the Kaipara Coast Highway (SH16) (due to decreased traffic on SH1 making it easier to turn right into SH16), but these are very small changes of fewer than 100 vpd and are therefore unlikely to result in any significant adverse effects.

Sensitivity testing

Exclusion of planned but uncommitted projects

When all proposed projects are excluded from the Future Reference Case Scenario and Project Scenario models, there is a significant change in traffic volumes south of Woodcocks Road in Warkworth, but only a slight change in traffic at locations north of the Dome Valley. This is expected given the additional proposed projects are located in Warkworth and would have little impact on SH1 further north. It was assessed that whether or not these projects are constructed will have a minimal impact, if any, on the benefits of the Project.

Slower growth

If growth is slower than predicted (i.e. a lower rate of growth), the benefits of the Project will be reduced. Because travel times are faster in the Future Reference Case Scenario with slower growth (due to lower traffic volumes), the travel time savings resulting from the Project will be less, both for those using the Project and those remaining on SH1. There will also be fewer people gaining the benefits of the Project.

Higher traffic growth

If the future distribution of trips to/from Warkworth differs from the base assumption as a result of future land use changes, there could be an increase in traffic flow in and around Warkworth. Through traffic using P2Wk to bypass Warkworth and continuing onto the Project would not be impacted by the higher volumes as both the Project and P2Wk will have sufficient capacity. However, local traffic travelling between Warkworth and Wellsford using the Project would experience longer travel times (based on a high growth scenario and higher traffic demand assumptions) resulting from additional traffic within Warkworth on the existing SH1 and the local roads.

9.14.5. Measures to avoid, remedy or mitigate actual or potential adverse effects

The assessment has identified benefits for transport within the corridor. As such, the *Operational Transport Assessment* does not consider any mitigation or monitoring is necessary for the Project.

9.14.6. Conclusion

The Project will provide a new four-lane state highway route between Warkworth and north of Te Hana. The *Operational Transport Assessment* has predicted that the Project will significantly increase the safety and capacity of the corridor as the majority of vehicles travelling between Warkworth and Te Hana are forecast to transfer from the existing SH1 to the Project route.

The *Operational Transport Assessment* has predicted the following transport benefits of the Project:

- Improvements in safety as the Project will be designed to high design standards, improving crash performance when compared with the existing SH1. In addition, the reduced traffic volume on SH1 will reduce crashes on that road.
- Significant reductions in the effects of incidents on travel between Warkworth and Wellsford (due to crashes and natural events such as slips and flooding). The Project will also provide redundancy because it will provide an alternative route to the existing SH1, improving the resilience of the state highway network.
- All of the benefits detailed above for general traffic will be experienced by HCVs and buses (if running along the Project alignment). Freight vehicles in particular will receive travel time reduction benefits because of the higher speed horizontal curves and reduced grades along the Project route.
- Improvements in travel time reliability enabling individuals and businesses to plan their travel with a much greater degree of certainty and providing a much more robust network that will be able to cater for some disruption without significant increases in travel time.
- Reductions in congestion through Wellsford and reductions in the effects of planned events (such as road maintenance) and unplanned incidents (such as crashes and slips), through increasing corridor capacity between Warkworth and the Northland Region.

The sensitivity tests carried out show that the benefits of the Project increase relative to the amount of traffic growth that occurs in the Project area, with higher growth resulting in more travel time savings.

Therefore, the Project is predicted to offer significant transport benefits of significantly improved safety, improved route quality including for access to and within the local road network, resilience and travel time consistency, reduced travel times, meeting the Transport Agency's objectives for the Project.

9.15. Operational noise

Overview

Potential noise from operation of the Project has been assessed against New Zealand Standard NZS 6806:2010 *Acoustics - Road traffic noise - New and altered roads* (NZS 6806). An assessment of noise effects through determination of noise level changes at individual properties was also undertaken. NZS 6806 requires identification of sensitive receivers (such as dwellings and schools) within 200 m of the road edge and establishes noise criteria categories for new and altered roads based on a Best Practicable Option (BPO) approach. For this Project, given the alignment may shift, all PPFs within 200 m of the proposed designation boundary were considered.

The sensitive receivers for the Project are located alongside the existing SH1 and in the vicinity of the Indicative Alignment. Locations beside the existing SH1 have elevated noise levels, while in areas away from SH1 the noise levels are low.

Once constructed, the Project will result in an overall reduction in noise levels currently experienced by sensitive receivers adjacent to the existing SH1 as a result of a reduction in traffic. An increase in noise levels is predicted for residents within proximity of the Project. The proposed mitigation (based on a BPO approach) involves the use of low noise road surfacing along 15 kilometres of the Project in the Hōteo North section and 800 metres north of Kaipara Flats Road. In addition, building improvements have been recommended for 3 dwellings to achieve reasonable noise level. Sensitivity testing was performed to assess effects should the main alignment be moved within the proposed designation. Recommendations are proposed to mitigate effects on PPFs that could be closer to noise sources than the Indicative Alignment, which enables specific noise categories to be achieved.

It is considered that with the proposed mitigation in place the road traffic noise associated with the operation of the Project will be reasonable and comply there will be a significant change to the acoustic amenity in some areas. Amenity effects are addressed in conjunction with social effects in section 9.17.

No notable vibration impacts are expected from the operation of the Project.

9.15.1. Introduction

This section summarises the findings of the assessment of the actual and potential noise and vibration effects arising from the operation of the Project outlined in the *Operational Noise and Vibration Assessment*, contained in Volume 2 of this Application. Noise and vibration effects in relation to the construction phase of the Project are the subject of a separate report and are summarised in section 9.7 of this AEE.

The existing noise environment, identification of sensitive receivers, results of noise modelling and potential noise effects at specific locations are described in detail in the *Operational Noise and Vibration Assessment*. This section presents the findings of that assessment, namely the potential effects generated by road traffic noise from the new state highway.

The *Operational Noise and Vibration Assessment* confirms that vibration impacts are not expected as a result of vehicles using the new state highway and therefore this has not been subject to further commentary here.

9.15.2. Existing noise environment

The existing noise environment for the Project is characterised by a number of different land uses and is predominantly rural in character. As a result, the current noise environment within, and in the wider proximity of, the Project area is relatively quiet. Ambient noise monitoring was undertaken at eight locations and presents baseline noise environment information. Noise monitoring locations were selected based on their proximity to either the Project's Indicative Alignment or the existing SH1. Three of the eight monitoring locations are in the vicinity of the existing SH1 while the other locations are in the vicinity of the Indicative Alignment.

The main noise source is the existing SH1. In the vicinity of SH1 noise levels are elevated generally above 34 $dB_{LAeq(24h)}$ and up to 54 $dB_{LAeq(24h)}$, while in areas away from SH1 in more rural environments, noise levels were as low as 24 $dB_{LAeq(24h)}$. Local roads may contribute to the overall existing noise environment; however, they have relatively low traffic volumes.

9.15.3. Operational noise assessment methodology

Overview

The Transport Agency's *Guide to assessing road-traffic noise using NZS 6806 for state highway asset improvement projects* outlines that NZS 6806 is the most current, and appropriate document with which to assess road traffic noise in New Zealand. Road traffic noise is covered by NZ6806. Complinance with that Standard is a permitted activity under Noise and Vibration Rule E25.6.33 of the AUP (OP). This Standard is based on the BPO approach and aligns with the duty to avoid unreasonable noise under section 16 of the RMA. NZS 6806 establishes noise criteria categories which are not based on existing ambient noise levels, and noise levels are dependent on forecast traffic volumes. Conformance with NZS 6806 will generally achieve reasonable noise levels for affected sensitive receivers in the vicinity of the Project.

For the purposes of assessing noise from roads, NZS 6806 focuses on identifying and managing effects on PPFs. PPFs are defined as buildings used for residential activities such as dwellings, hotels and motels in residential areas, marae, overnight medical care, boarding houses, elderly homes, educational facilities, and playgrounds within 20 m of buildings used for teaching purposes. Commercial and business uses are not considered to be PPFs as they are not considered to be noise sensitive and are therefore excluded from the assessment. NZS 6806 applies to PPFs in rural areas that are located within 200 m from the edge of the closest traffic lane for the new or altered road.

Following identification of PPFs, the potential effects of the Project on these PPFs are assessed in accordance with NZS 6806 based on modelled predicted noise levels for these PPFs from the Project and consideration of methods to mitigate actual and potential adverse effects.

There are two elements to the operational noise assessment which are discussed below:

1. Assessment of compliance with NZS 6806 following the BPO process; and
2. Assessment of noise effects through determination of noise level changes at individual properties.

NZS 6806 assessment

NZS 6806 has been used to assess the actual and potential noise effects from the operation of the Project based on computer noise modelling. This modelling enabled many factors affecting the propagation of road traffic noise (such as terrain elevation, ground conditions, road parameters and barriers/bunding) to be taken into consideration in the prediction of road traffic noise. The model outputs are specific noise levels at individual receivers and noise contours over a larger area. The individual receiver noise levels were used to assess compliance with NZS 6806 and to determine the noise level change at each PPF assessed. The noise level contours provide a wider picture of the road noise effects of the Project. The contours were used to visually represent the extent of road traffic noise in the wider area.

The assessment of operational noise effects involved identifying the PPFs within 200 m of the road edge of the Indicative Alignment. Houses which are within the proposed designation boundary or owned by the Transport Agency were excluded from the assessment. To sensitivity test the operational noise assessment, additional dwellings outside the 200 m alignment assessment area were also included given the alignment for the Project has not been finalised, resulting in all PPFs within 200 m of the proposed designation boundary being assessed. In total, there are 77 PPFs that were assessed for the Project. 42 of those PPFs were assessed for the "New Road" as they were within 200 m of the proposed designation boundary. The remaining 35 PPFs were assessed as "Altered Road" as they are within 200 metres of the existing SH1. Existing road traffic noise levels were predicted for all of these PPFs through noise modelling.

The design year requires the design of a Project to be based on a future year, making an allowance for changes in traffic volumes over that time. NZS 6806 requires a design year between 10 and 20 years after the opening of the Project to the public. The year 2046 has been chosen as the design year. It was noted in the *Operational Noise Assessment* that based on the road opening to the public in 2037, although the design year is one year earlier than the range required by NZS 6806 the traffic volumes should not change markedly. The design year has been used to assess the difference between the "Do-nothing" scenario where the Project is not implemented, and the "Project with mitigation" scenario.

NZS 6806 does not set rigid noise limits but gives categories (A, B and C) of noise criteria as set out in Table 9-26.

Table 9-26: NZS 6806:2010 noise criteria categories

Category	Road Type	
	Altered Roads dB$L_{Aeq(24h)}$	New Roads dB$L_{Aeq(24h)}$
A Primary external noise criterion	64	57
B Secondary external noise criterion	67	64
C Internal noise criterion Note 1	40	40

Note 1:
This criterion is triggered if habitable rooms would receive internal noise levels greater than 45 dB LAeq(24h) despite mitigation such as bunds, barriers and road surface materials being used.

The "New Road" criteria were applied to all PPFs along the Indicative Alignment, except for PPFs where the Project is within the area of influence of the existing SH1 (and other existing local roads). The "Altered Road" criterion was applied to these areas. Sensitive receivers outside the area of influence of the Project alongside the existing SH1 were not assessed in accordance with NZS 6806, with the exception of noise modelling to understand the change in noise levels on these receivers.

NZS 6806 requires the following operational scenarios to be assessed and compared:

- **The existing noise environment**: for altered roads this consists of the current road layout and traffic volume, and for new roads this consists of the current ambient noise level;
- **Do-nothing scenario**: consists of the existing SH1 at the design year (2046), with increased traffic volume. This scenario (and the following two scenarios) includes P2Wk;
- **Do-minimum scenario**: consists of the Project Indicative Alignment at the design year (2046), but without any specific noise mitigation; and
- **Project with mitigation**: consists of the Project Indicative Alignment at the design year (2046) and includes BPO mitigation that is designed specifically to reduce noise levels.

NZS 6806 adopts the BPO methodology for noise mitigation. The BPO requires a noticeable noise level reduction to be achieved by any structural mitigation. The mitigation option chosen as the selected option may not provide the greatest noise level reduction, but is considered optimal and practicable on balance, when evaluated against all relevant criteria.

Under NZS 6806, structural noise mitigation options (e.g. road surface material, bunds and barriers) are assessed, and if practicable, the noise levels within Category A achieved. If this is not practicable then structural mitigation should be assessed to achieve Category B noise levels. However, if it is still not practicable to comply with Categories A or B then building modification mitigation (BMM) may be implemented to ensure the internal criterion of Category C is achieved. The upper category (Category C) provides a backstop against adverse health effects, such as sleep disturbance, by providing for noise level reduction for the indoor environment through improving glazing and/or providing mechanical ventilation if the external noise would not be sufficiently reduced using the BPO. The preference is for structural mitigation rather than BMM in order to protect the widest possible area rather than rooms in specific PPFs only.

The *Operational Noise and Vibration Assessment* considered possible alignment adjustment within the proposed designation boundary as a sensitivity test for the noise effects assessed.

Subjective perception of noise change

An assessment of noise effects through determination of noise level changes has also been undertaken. In addition to modelling the noise level change, this involved the interpretation of the general subjective responses of people to predict the effect of noise level changes along the Project between the "Do-nothing" scenario and the "Project with mitigation" scenario. While people can react differently to noise level changes, the *Operational Noise and Vibration Assessment* outlines that research typically shows a general correlation between noise level changes and subjective responses as shown in Table 9-27 based on information documented in Architectural Acoustics[83]. While the complex subjective responses to changes cannot be accurately represented by single numbers, the table provides an initial indication of possible effects.

Table 9-27: Subjective response to change in noise levels

Change in noise level		Subjective response
Reduction	>10 dB	Major reduction
	10 dB	About half as loud
	7 to 9	Significant reduction in noise level
	4 to 6 dB	Noticeable reduction in noise level
	3 dB	Just perceptible reduction in noise level
	≤2 dB	Negligible
Increase	≤2 dB	Negligible
	3 dB	Just perceptible increase in noise level
	4 to 6 dB	Noticeable increase in noise level
	7 to 9	Significant increase in noise level
	10 dB	About twice as loud.
	>10 dB	Major increase

9.15.4. Assessment of operational noise effects

In order to assess the noise effects on PPFs in the vicinity of the Project, the noise levels for the Project and existing SH1 together in the design year (2046) were predicted.

The "Do-nothing" scenario (where the Project is not built) showed that noise levels would increase up to 11 dB. Increases of 4 dB are generally expected along the existing SH1.

The introduction of the Project will result in a noise level increase along its length, as expected when a new road is introduced into an area that does not currently contain a road, or local roads do not have large traffic volumes. Conversely, there will be an improvement in noise levels for PPFs in close proximity to the existing SH1. Noise levels reduce or remain similar to existing noise levels due to the reduction in traffic volumes given the shift of traffic to the Project corridor.

The "Do-minimum" scenario (where the Project[84] is built with no noise mitigation) predicted noise levels would increase by up to 26 dB. The areas with dwellings most affected by the Project include Maeneene Road, Kaipara Flats Road, Wayby Valley Road, Whangaripo Valley Road, Silver Hill Road, Mangawhai Road and Vipond Road (the impacts on these areas are assessed in detail below). Most PPFs exposed to road traffic noise from existing SH1 in the "Do-nothing" scenario would benefit from

[83] M David Egan, Architectural Acoustics, J Ross Publishing 2007, page 21

[84] Designed for a chip seal road surface for the Hōteo North section of the alignment, stone mastic asphalt (SMA) for 400 m either side of the tunnel portals and the tunnel itself and open graded porous asphalt (OGPA) for the Hōteo South section of the alignment south of Kaipara Flats Road.

the Project due to the reduction in traffic flow along SH1. Improvements up to -6dB for these PPFs in the do-minimum scenario represents a positive effect of the Project. In the “Do-minimum” scenario, up to 17 PPFs fell into Categories B and C which is typical of new state highway projects.

Noise effects from the Project with the recommended mitigation, (the Project with mitigation scenario), generally comply with Category A. Whilst the PPFs are predicted to have increases greater than 10 dB, at most PPFs the predicted noise level complies with Category A noise for a ‘new’ road of 57 dB $L_{Aeq(24h)}$.

The potential noise level changes should the alignment be moved within the proposed designation boundary during detailed design has been considered. Around Wayby Valley Road, Mangwhai Road and Maeneene Road areas shifting the alignment will not affect the category or selected mitigation. In other locations, a shift of the alignment closer to the proposed designation boundary (and PPFs) may result in a change from the modelled and predicted noise categories (i.e. Vipond Road, Whangaripo Valley Road/Silver Hill Road/Kaipara Flats Road areas).

Should an alignment shift within the designation in these locations the realignment should be tested to confirm that the noise category limits can still be met and if not mitigation solutions will need to be developed and/or the design will need to respond accordingly.

Kaipara Flats Road

In the Kaipara Flats Road area eight PPFs were assessed with noise levels that are dictated by traffic flow along Kaipara Flats Road. These PPFs are identified in Table 9-28 below.

The addition of the Project in the do-minimum scenario (i.e. the Project with no mitigation) will significantly change the noise levels at two of the eight PPFs, with noise level increases in excess of 10 dB. Furthermore, in the do-minimum scenario three PPFs would change from Category A to Category B when compared to the do-nothing scenario (see Table 9-28).

With the selected mitigation, the overall noise levels will improve at 39 Philips Road. While the noise levels at 131 Kaipara Flats Road will increase, this residence will remain within the Category A which is an acceptable outcome. Other PPFs would experience either a perceptible increase in noise level or a significant increase in noise level, with two PPFs remaining in Category B (215 Kaipara Flats Road and 130 Kaipara Flats Road) and all others in Category A. Overall the Project will significantly increase noise levels in this area and within Category A and B levels.

Table 9-28: PPFs in the Kaipara Flats Road assessment area

PPF address	Existing dB $L_{Aeq(24h)}$	Do nothing (2046) dB $L_{Aeq(24h)}$	Do minimum (2046) dB $L_{Aeq(24h)}$	Project with mitigation (2046) dB $L_{Aeq(24h)}$
131 Kaipara Flats Rd	36	45	57	56
211 Kaipara Flats Rd	41	47	57	55
215 Kaipara Flats Rd	50	56	59	58
214 Kaipara Flats Rd	44	49	45	42
155 Kaipara Flats Rd	38	45	53	53
115 Kaipara Flats Road	46	51	54	54
39 Phillips Road	42	47	58	53
130 Kaipara Flats Rd	50	55	58	58

Wayby Valley Road

The noise levels in the area of the Wellsford Interchange are affected by the existing SH1. The Project shifts the majority of the traffic away from existing SH1. However, with the Project the PPFs in this area would remain exposed to noise from existing SH1, the Project or a combination of both road corridors.

Compared to the do-nothing scenario, the noise levels at three PPFs in this area are predicted to increase up to 7 dB in the do-minimum scenario. The selected mitigation has reduced the change in noise level to an overall reduction for two PPFs and a negligible increase at one PPF, when compared to the do-nothing scenario. All PPFs fall within Category A (refer Table 9-29). Overall, the Project has a minor positive change in noise levels in this area.

Table 9-29: PPFs in the Wayby Valley Road assessment area

PPF address	Existing dB $L_{Aeq(24h)}$	Do nothing (2046) dB $L_{Aeq(24h)}$	Do minimum (2046) dB $L_{Aeq(24h)}$	Project with mitigation (2046) dB $L_{Aeq(24h)}$
1232A SH-1, Wayby Valley (ground floor)	50	53	59	55
1232A SH-1, Wayby Valley (first floor)	51	53	60	55
4 Wayby Station Rd, Wellsford	57	60	60	57
44 Wayby Station Road	57	60	50	57

Whangaripo Valley Road

Whangaripo Valley Road has relatively low existing noise levels as it does not have considerable traffic flow and the area is more than 2 km away from the existing SH1.

Under the do-minimum scenario, the noise level increase for all PPFs would be significant (seven PPFs would experience increases of more than 10 dB), and four of the eight PPFs would change from Category A (in the do-nothing scenario) to Category B.

The selected mitigation achieves Category A for all eight PPFs. Nevertheless, the increase in noise level for six of the eight PPFs remains in excess of 10 dB which is a significant change. These include 263 Worthington Road, 177 Rustybrook Road, 351 Wayby Valley Road, 64 Whangaripo Valley Road; 40 and 47 Borrows Road. Overall, there will be a significant increase in noise level in this area and within the Category A and B noise range.

Table 9-30: PPFs in the Whangaripo Valley Road assessment area

PPF address	Existing dB $L_{Aeq(24h)}$	Do nothing (2046) dB $L_{Aeq(24h)}$	Do minimum (2046) dB $L_{Aeq(24h)}$	Project with mitigation (2046) dB $L_{Aeq(24h)}$
177 Rustybrook Road	36	38	58	53
351 Wayby Valley Road	39	40	60	54
64 Whangaripo Valley Road	35	37	58	53
96 Whangaripo Valley Road	48	46	56	52
40 Borrows Road	47	45	62	57
47 Borrows Road	33	34	57	52
213 Whangaripo Valley Road	51	49	56	53
263 Worthington Road	35	37	56	51

Silver Hill Road

The Silver Hill Road area has low existing noise levels due to the low levels of traffic along Silver Hill Road.

Under the do-minimum scenario the noise levels for PPFs located on Silver Hill Road would increase by more than 25 dB compared to the do-nothing scenario, with four of the five PPFs falling in Category B for a new road.

The selected mitigation achieves Category A for all five of the PPFs located within the area (refer Table 9-31). Nevertheless, the increase in noise level for all of the PPFs still remains in excess of 10 dB which is a significant change. These PPFs include 250, 263, 273, 332 and 344 Silver Hill Road. There will be a significant increase in noise level in this area and within the Category A and B noise range.

Table 9-31: PPFs in the Silver Hill Road assessment area

PPF address	Existing dB $L_{Aeq(24h)}$	Do nothing (2046) dB $L_{Aeq(24h)}$	Do minimum (2046) dB $L_{Aeq(24h)}$	Project with mitigation (2046) dB $L_{Aeq(24h)}$
250 Silver Hill Rd, Wellsford	30	32	58	53
263 Silver Hill Rd, Wellsford	29	32	58	52
273 Silver Hill Rd, Wellsford	29	31	57	52
332 Silver Hill Rd	35	37	61	56
344 Silver Hill Rd, Wellsford	34	36	59	54

Mangawhai Road

The 13 PPFs within proximity of the Te Hana Interchange are already exposed to road traffic noise occurring on SH1 for the existing and do-nothing scenarios.

Eight of the 13 PPFs show an improved overall noise level in the Project with the mitigation scenario, as traffic is moved away from existing SH1 onto the Project alignment, including significant reductions of greater than 10 dB at PPFs along SH1 (542 SH1 and 575 SH1). The scale of effects varies in this area from a significant positive effect to a moderate adverse effect.

Table 9-32: PPFs in the Mangawhai Road assessment area

PPF address	Existing dB $L_{Aeq(24h)}$	Do nothing (2046) dB $L_{Aeq(24h)}$	Do minimum (2046) dB $L_{Aeq(24h)}$	Project with mitigation (2046) dB $L_{Aeq(24h)}$
469 SH-1, Te Hana	58	61	55	53
490 SH-1, Wellsford	63	66	62	61
10 Charis Lane	55	58	55	52
13 Charis Lane	49	52	59	55
8 Charis Lane	54	57	57	54
7 Charis Lane	52	54	59	55
9 Charis Lane	52	54	60	56
6 Charis Lane	56	59	58	55
542 SH-1, Topuni	68	72	60	59
557 SH1, Wellsford	58	62	59	55
139 Vipond Road	54	54	61	57
129 Vipond Road	45	47	59	54
575 SH-1, Topuni	66	70	64	59

Vipond Road

The do-minimum scenario for the Project results in 35 Vipond Road and 17 Vipond Road being within Categories C and B respectively. With the inclusion of the selected mitigation these are moved to Category B and Category A respectively.

The overall change in noise levels for 35 Vipond Road due to the selected mitigation is 4 dB compared to the do-nothing scenario. This represents a noticeable increase in noise level. The overall change in noise level for 17 Vipond Road with the selected mitigation is 1 dB compared to the do-nothing scenario. This represents a negligible increase in noise level and minor adverse noise effect.

Maeneene Road

The eight PPFs within the vicinity of Maeneene Road are already exposed to road traffic noise from the existing SH1. PPFs towards the south benefit from the Project under the do-minimum scenario because the Project takes some traffic away from the existing SH1. Towards the north this benefit is not apparent because the Project ties in with existing SH1.

For the do-minimum scenario, three PPFs would fall within Category C. This noise exposure also occurs in the do-nothing scenario. Therefore, it is not an impact arising from the Project. One PPF falls within Category B.

With the inclusion of the selected mitigation ((Open Graded Porous Asphalt (OGPA) road surface)), the overall change in noise level is an improvement on the do-minimum and do-nothing scenarios, moving one PPF Category C to Category B and one Category B PPF to Category A There will be a negligible reduction in noise levels for eight PPFs, with two PPFs (705 and 704 SH1) receiving significant reductions due to the BMM required on those Category C PPFs. This represents a minor positive effect in this area.

Table 9-33: PPFs in the Maeneene Road assessment area

PPF address	Existing dB $L_{Aeq(24h)}$	Do nothing dB $L_{Aeq(24h)}$	Do minimum dB $L_{Aeq(24h)}$	Project with mitigation dB $L_{Aeq(24h)}$
705 SH-1, Wellsford (ground floor)	66	70	70	68
705 SH-1, Wellsford (first floor)	67	71	71	70
704 SH-1, Wellsford	67	71	70	69
17 Maeneene Road	60	64	66	62
45 Maeneene Road	57	61	61	59
33 Maeneene Road	57	61	63	59
18 Maeneene Road	55	59	61	57

9.15.5. Measures to avoid, remedy or mitigate actual or potential adverse effects

The most effective noise reduction option is through appropriate alignment selection at the outset of a Project's planning e.g. selecting an alignment which largely avoids populated areas.

The selected mitigation measures considered and then applied in the assessment are set out below. Having selected an alignment which largely avoids populated areas, a BPO approach was then adopted in accordance with NZS 6806, to identify options for noise mitigation where adverse effects were assessed to be at a level that mitigation was required.

The general measures that can be used to control traffic noise are:

- Selecting noise reducing road surface material;
- Installing noise barriers (or bunds);
- Combination of noise reducing road surface material and noise barriers (or bunds);

- Upgrading building envelopes, e.g. upgrading glazing, insulation or seals around doors and windows, and installing alternative ventilation options so that windows can remain closed.

Mitigation of traffic noise is most effective at source. Therefore, choosing low noise road surface material is the preferred mitigation method as it protects the widest possible area. Following this preferred mitigation, barriers can be used to break acoustic line-of-sight from the noise source (the road) to the PPFs. Barriers should be as close as possible to the road or the PPF. Only if these measures are not sufficient to achieve suitable noise levels at the PPFs, should BMM be considered.

The proposed selected mitigation for the Project is the combination of:

- OGPA on the mainline carriageway in the Hōteo South area for 800 m north of Kaipara Flats Road;
- OGPA on the mainline carriageway in the Hōteo North area for 15 km;
- BMM for two PPFs which fall into Category C, at 704 and 705 SH1. While these two PPFs could have slightly greater noise exposure without the Project (do-nothing), NZS 6806 and Transport Agency guidance requires such legacy problems to be addressed as part of the Project.
- BMM for one PPF (35 Vipond Road) that has an increase of more than 3 dB due to the Project and is in Category B even with OGPA.

OGPA (or other asphaltic surface with low noise generating characteristics) has been recommended based on consideration of wider amenity effects, in addition to the direct benefits modelled at the nearest PPFs.

Noise barriers such as walls and bunds were considered in the process of determining the selected mitigation. Mitigation scenarios for different noise walls and bunds were modelled and inputs from specialists were considered and discussed by the project team. In consideration of the inputs from other specialists (road design, landscape and visual and planning) and due to the relatively limited acoustic efficiency of noise walls and bunds in this Project context, they were not chosen as part of the selected noise mitigation. The limited efficiency of noise barriers, which on this Project would not meet the NZS 6806 requirement of achieving more than 5 dB reduction, is partly due to the topography but mainly due to the sparse nature of the PPFs. The barriers would need to be a considerable height and length.

Consideration was given to improvements, such as extended concrete safety barriers or noise walls, and whether these should be part of the selected mitigation in addition to OGPA. However, as for noise barriers alone, when in combination with OGPA the noise barriers still have limited acoustic benefit. Furthermore, due to the desired urban design and landscape outcome of retaining the current rural landscape, noise barriers and acoustic bunds were deemed undesirable. On balance given their adverse effects from a landscape and visual perspective and the limited effectiveness, noise barriers were not considered appropriate for this Project.

Noise Mitigation Plan

In addition to noise effects related to the level of noise, subjective responses can depend on the character of noise. In most respects the Project should result in noise characteristics that are not unduly disturbing as traffic on the new road will be free flowing, with smooth and gradual changes in horizontal and vertical alignment.

Despite the positive attributes of a new road in terms of noise characteristics there are a number of potential issues that are recommended to be addressed in the detailed design and construction. Under the Transport Agency specification for noise mitigation (NZTA P40:2014) a Noise Mitigation Plan is required. It is recommended that the Noise Mitigation Plan for the Project should explicitly address the following matters to minimise adverse noise characteristics:

- Bridge joints within 200 metres of houses should be selected to reduce noise and should be installed to minimise discontinuities between the road surface, and mechanical joints.
- Audio Tactile Profile (ATP) (rumble strip) and raised lane markers should not be located near houses unless necessary for safety reasons. Any rumble strip should be offset outside lane markings.
- The road environment should encourage gradual deceleration on approach to roundabouts and other intersections through lighting, landscaping, signage and road markings. In particular, treatment is needed for the proposed roundabout at the existing SH1 and Mangawhai Road, which is likely to introduce significant braking and acceleration sounds. Likewise, the eastern roundabout of the new Te Hana Interchange has a relatively steep downhill approach from the east that is likely to exacerbate braking sounds, and therefore requires mitigation through the design of the road environment.

Alignment changes

Based on the *Operational Noise Assessment*, in some cases it might not be practicable to provide adequate mitigation as a result of a change in the position of the alignment within the proposed designation boundary in which case changes to the alignment may in practice be constrained. It is recommended that noise effects as a result of a change in alignment are predicted and mitigation reconsidered such that the noise levels at PPFs achieve the noise categories outlined in the *Operational Noise Assessment*.

9.15.6. Conclusion

The operational noise effects of the Project have been assessed by comparing predicted future "Do-nothing" scenario noise levels with the predicted noise levels of the "Project with mitigation" scenario. This comparison showed that an increase in noise levels is predicted for residents within proximity of the Project. In addition, with the Project in operation there is a decrease in noise level from traffic reduction on the existing SH1.

A BPO approach was adopted to identify options for noise mitigation where adverse effects were assessed to be at a level that mitigation was required to be assessed under NZS 6806. The selected mitigation recommended for the Project is the use of asphaltic surface with low noise generating characteristics i.e. OGPA. BMM is proposed for two PPFs to address high exposure that exists regardless of the Project (and is in fact marginally reduced by the Project). BMM is also proposed at one PPF that has an increase of more than 3 dB due to the Project and is in Category B even with proposed mitigation. With mitigation in place the *Operational Noise and Vibration Assessment* concludes that the Project can be operated to achieve reasonable noise levels at affected dwellings accepting there will be a significant change in acoustic amenity in some areas.

The following recommendations have been made in the *Operational Noise and Vibration Assessment* to ensure that appropriate traffic noise outcomes are achieved:

- Confirmation of predicted sound levels for the construction design and re-assessment of the selected mitigation so that noise exposure categories of PPFs do not increase i.e. preparation of a Noise Mitigation Plan; and
- A requirement to install, where appropriate, noise mitigation measures prior to opening of the Project to the public.

It is considered that with the proposed mitigation in place the noise associated with the operation of the Project will be reasonable and comply with the appropriate Standard. Amenity effects are addressed in conjunction with social effects in section 9.17.

No notable vibration impacts are expected from the operation of the Project.

9.16. Operational air quality

Overview

The operational air quality impacts of the Project on the nearest highly sensitive receivers (HSRs) have been evaluated and the assessment demonstrates that the Project will maintain air quality at acceptable levels. Compliance with relevant air quality guidelines and standards, in particular the Auckland Ambient Air Quality Targets (AAAQTs) and the National Environmental Standards for Air Quality (NESAQ) will be achieved with the Project operation. The proposed Project tunnels have been assessed as a low risk for effects on air quality. Accordingly, the tunnel discharges are not expected to impact on the local air quality and will meet AUP(OP) permitted activity standards.

If the Indicative Alignment were to shift within the proposed designation boundary, or if traffic flow increases by as much as 100%, the air quality guidelines and standards would still be achieved for the Project.

The Project will improve air quality at locations along the existing SH1, particularly at Wellsford and Te Hana, where exposure to air contaminants will be reduced due to the movement of traffic flow and consequently, operational air quality emissions, onto the new road.

9.16.1. Introduction

This section summarises the findings of the assessment of the actual and potential effects on air quality arising from the operation of the Project outlined in the *Air Quality Assessment*, contained in Volume 2 of this Application. Air quality effects in relation to the construction phase of the Project are also the subject of that assessment report and are summarised in section 9.8 of this AEE.

The existing air quality environment, identification of HSRs, results of an air quality screening model and assessment of the potential air quality effects at specific locations are described in detail in the *Air Quality Assessment*. Whilst undertaking this assessment, reference has been made to the Transport Agency *Draft Guide to Assessing Air Quality Impacts from State Highway Projects 2015* (Transport Agency Air Quality Assessment Guide) and the *MfE Good Practice Guide on Assessing Air Discharges to Air from Land Transport 2008* (MfE Guide). Based on the guidance, the *Air Quality Assessment* assesses the potential air quality effects arising from the operation of the Project. This section presents the findings of that assessment, namely the potential effects on air quality generated by vehicle emissions associated with this Project.

9.16.2. Existing air quality environment

Background ambient air contaminant concentrations for the Project area are low, which is typical of rural areas. The Project area is located outside the nearest airshed set to manage air quality under the NESAQ, which is around the urban area of Warkworth, therefore air quality in the Project area is considered to be generally good.

An analysis of existing air quality data in proximity to the Project area indicates that the Warkworth airshed, and by implication the Project area, complies with the relevant ambient air quality standards under the NESAQ. Based on available data, the following background concentrations of air contaminants have been used in the assessment and are considered representative of air quality in the Project area.

Table 9-34: Background contaminant concentrations

Contaminant	Averaging period	Concentration µg/m^3
Particulate matter smaller than ten microns (PM_{10})	24 hour average	28.3
Particulate matter smaller than 2.5 microns ($PM_{2.5}$)	24 hour average	14.2
Nitrogen dioxide (NO_2)	Annual average	4

There are no air discharge permits within 500 m of the proposed designation boundary.

9.16.3. Air quality assessment methodology

Methodology

The Transport Agency Air Quality Assessment Guide promotes the Transport Agency's recommended approach to assess air quality effects resulting from state highway projects. The assessment approach for this Project is consistent with this guide, which outlines a three tiered approach as follows:

- Environmental and social responsibility (ESR) screen (Tier 1) – a high level assessment to identify any potential effects and risks;
- Preliminary technical assessment (Tier 2) – an assessment based on simplified techniques and on an air quality screening model; and
- Technical assessment (Tier 3) – a detailed level of assessment of effects, based on the level of potential effect identified at Tier 2. Tier 3 includes atmospheric dispersion modelling of predicted operational emissions.

For this Project, the preliminary screening assessment work identified that there was no need for a Tier 3 air quality assessment (refer section 5.2.4 of the *Air Quality Assessment*).

The key purpose of the preliminary air quality technical assessment (Tier 2) is to establish whether the predicted Project (relative air quality impact) or cumulative air quality impact (from the Project when combined with background air quality) is likely to result in relevant air quality criteria being exceeded. The two key transport-related air pollutants assessed are particulate matter (as PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2).

As with other technical assessments the model provides an assessment of potential air quality impacts for the 'With Project' and 'Without Project' scenarios for opening and design years (2036 and 2046 respectively). The screening model automatically outputs the project contribution and the cumulative impact is calculated. The project contribution is that from the Project under assessment only. The cumulative contribution is that from the Project added to the assessed background.

The Transport Agency Air Quality Assessment Guide recommends a set of human health based air quality criteria to help assess whether the predicted increased concentrations of road traffic contaminants from the Project are 'significant'. If the road contribution is below 10% of the ambient guideline value, and the road contribution plus background value is below 90% of the ambient air guideline value, then the risk is considered low. For low risk projects further air quality assessment work, such as full air dispersion modelling is not required. The criteria used to evaluate operational phase effects relevant to a Tier 2 screening level assessment are provided in the table below (all criteria are from the Transport Agency Air Quality Assessment Guide).

Table 9-35: Transport Agency air quality significance criteria (Transport Agency Air Quality Assessment Guide)

Contaminant	Standard/ Guideline µg/m³	Averaging time	Criteria for project road contribution* µg/m³	Criteria for cumulative contribution µg/m³
NO_2	40	Annual	4	36
PM_{10}	50	24 hour	5	45
$PM_{2.5}$	25	24 hour	2.5	22.5

* Note: The project road contribution is the contaminant concentration predicted for the project road under consideration

The Transport Agency Air Quality Assessment Guide presents a risk assessment method for road tunnels to determine an air quality risk rating and the level of technical assessment necessary to determine tunnel air quality effects. This assessment method is similar to the process outlined in the AUP(OP) to assess whether a proposed tunnel requires consent[85]. The potential operational air quality risk from the proposed tunnel portals has been characterised and no further assessment has been undertaken as a result of this risk assessment process. This consideration is explained in section 9.16.4 below.

Traffic modelling and vehicle emission estimation

The air quality screening model is used to calculate contaminant concentrations for specified distances from the road based on the traffic flow in Annual Average Daily Traffic (AADT), fleet composition and average speed for opening and design years. Section 2 of the *Operational Transport Assessment* summarises the traffic modelling undertaken for the Project, the outputs of which were interpolated for providing the data used for the air quality assessment.

The air quality screening predicts the road contribution concentration of PM_{10} and NO_2. To allow particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$) to be included in the assessment, all PM_{10} road contribution, including exhaust emissions and tyre and brake wear, has been assumed to be $PM_{2.5}$. Not all of the non-exhaust PM_{10} is actually $PM_{2.5}$, therefore, this approach will produce conservative $PM_{2.5}$ road emission concentrations.

Highly sensitive receivers

The Transport Agency Air Quality Assessment Guide defines a HSR as “a location where people or surroundings may be particularly sensitive to the effects of air pollution”. Examples include residential housing, hospitals, schools, early childhood

[85] Permitted activity standard E14.6.1.18.

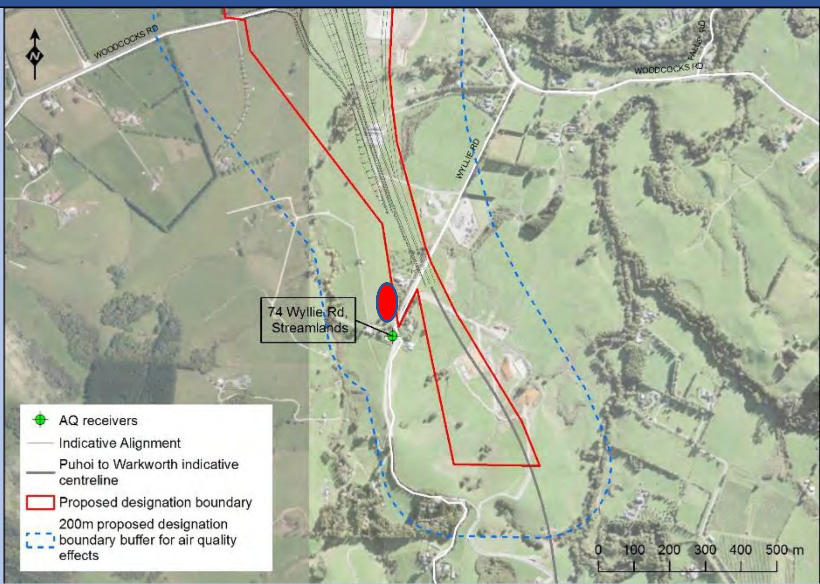
education centres, childcare facilities, rest homes, marae, other cultural facilities, and sensitive ecosystems.

For the purposes of the air quality assessment, all except one HSRs which fall within the proposed designation have been excluded from the list of HSRs potentially impacted by operational air quality emissions from the Project[86] as they will be unoccupied or demolished as part of the Project. These HSRs are identified in Appendix A of the *Air Quality Assessment*.

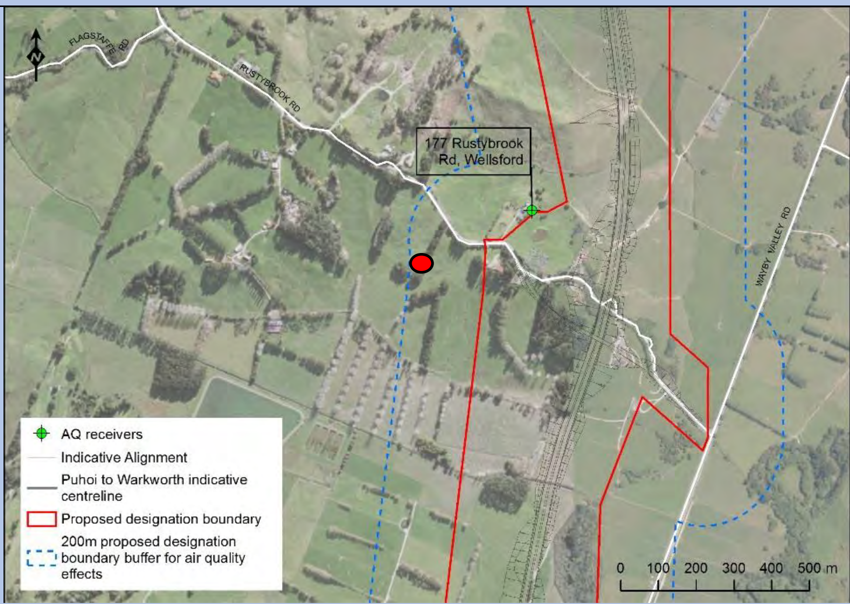
All HSRs within 200 m of the proposed designation boundary were considered in the operational air quality effects assessment, which included 66 residences. In addition, one residential property within the proposed designation is also relevant where the Indicative Alignment passes through tunnels below the property. The 67 HSRs are shown on the drawings in Appendix D of the *Air Quality Assessment*.

The air quality screening model was applied to predict contaminant concentrations at the nearest HSRs to the road edge at three worst-case locations which have the most potential to be adversely affected by the Project. The nearest HSRs assessed were 74 Wyllie Road, 211 Kaipara Flats Road and 177 Rustybrook Road. The distance of these HSRs from the Indicative Alignment and proposed designation boundary is outlined in Table 9-36.

Table 9-36: Location of HSRs relative to Indicative Alignment and proposed designation boundary

HSR Address	Distance	Location
74 Wyllie Road	165 m to Indicative Alignment 30 m to proposed designation boundary	

86 161 Kraack Road is the only residential property within the proposed designation boundary which will be occupied during the operational phase of the Project as it is located above the tunnels.

HSR Address	Distance	Location
211 Kaipara Flats Road	106 m to Indicative Alignment 34 m to proposed designation boundary	
177 Rustybrook Road	124 m to Indicative Alignment 9 m to proposed designation boundary	

Sensitivity analysis

A sensitivity analysis to assess the impact of changes to the Indicative Alignment within the proposed designation was undertaken, identifying the worst-case HSR's and their potential air quality impact from the Project based on the methodology outlined above. For the sensitivity analysis, the worst case HSRs included 130 Kaipara Flats Road (potential to be impacted by a movement of the Indicative Alignment and subject to higher traffic flows and therefore total air quality emissions) and 177 Rustybrook Road (the closest HSR to the proposed designation boundary with potential to be impacted by a movement of the Indicative Alignment). Sensitivity analysis testing was also undertaken to assess the potential effects if traffic flows are higher than predicted.

9.16.4. Assessment of operational air quality effects

Air quality effects from operation of the Project

The air quality screening model was used to assess the effects of the Project on the nearest HSRs to the road edge at three worst-case locations. The HSR location where the highest increase between the 'Without Project' and 'With Project' scenarios is predicted is at 211 Kaipara Flats Road. At this location the screening model effectively predicts no increase for 24 hour average PM_{10} and $PM_{2.5}$, and a 0.8 μg/m^3 increase for annual mean NO_2, which is 2% of the relevant air quality guideline of 40 μg/m^3. The cumulative effect on air quality is predicted to be 4.8 μg/m^3 as an annual average or 12% of the annual average air quality guideline.

In the "With Project" scenario there are no predicted contaminant concentration increases by more than 10% of the respective air quality criteria at all HSRs most likely to be affected as a result of the Project operation. Cumulative (Project plus background) concentrations of contaminants are predicted to be well below air quality standards and guidelines at all HSRs. The air quality risk is rated low and therefore a more detailed technical assessment (beyond that undertaken) is not required for the Project.

The Indicative Alignment may be moved within the proposed designation. Such a movement has the potential to result in HSRs being closer to the Project roads than assessed above. Air quality effects have been considered for those HSRs that could potentially fall within 5 m of the Indicative Alignment (as a worst case scenario). The assessment predicted that air quality guidelines and standards will still be met when considered cumulatively with the background air quality.

Should traffic flow increase by as much as 100% (i.e. from approximately 35,000 AADT to 70,000 AADT), the significance criteria will be met, and cumulative air quality concentrations would be predicted to be well below air quality standards and guidelines.

The background air quality within the Project tunnel vicinity is good and there are no HSR's within 200 m of the Indicative Alignment tunnel portals. The closest HSR is at 127 Kraack Road; 275 m from the northern tunnel portals. For these two parameters the risk from the tunnel discharge to air quality is rated as low. The predicted AADT is in the medium range, therefore, the overall air quality risk rating for the proposed Project tunnels is low, and a detailed assessment of the effects on air quality from tunnel portal discharges is not required. The tunnel portals could be situated at any location within the proposed designation at final design stage. The air quality risk from the tunnel discharges will remain low given the background air quality and low number of HSRs (less than ten) located within 200 m of any possible point of discharge.

Air quality effects resulting from changes to the transportation network

The main operational effect of the Project on the transportation network will be the movement of traffic from SH1 to the Indicative Alignment. In the 'Without Project' scenario, all traffic would continue to travel on SH1, leading to increased traffic and congestion along that route, which includes the townships of Wellsford and Te Hana. Consequently, in the 'Without Project' scenario in these areas, there would be increased air quality emissions and therefore a potential for increased exposure to air contaminants in Wellsford and Te Hana townships and at other HSRs along existing

SH1, especially with projected growth in traffic over time. Emissions will be decreased in these townships in the "With Project" scenario.

9.16.5. Measures to avoid, remedy or mitigate actual or potential adverse effects

Specific mitigation measures for the operational air quality effects of the Project are not needed because effects on human health will be less than minor with the Project operation achieving compliance with relevant air quality guidelines and standards.

9.16.6. Conclusion

The operational air quality effects of the Project were assessed by comparing predicted future 'Without Project' scenario contaminant emission levels with the predicted contaminant emission levels of the 'With Project' scenario.

The assessment demonstrates that the Project will maintain air quality at acceptable levels throughout the largely rural environment of the Project area. Predicted concentrations are below the Transport Agency criteria for Project contribution, and well below the relevant air quality guidelines and standards when considered cumulatively with the background air quality. Therefore, the air quality risk from the operation of the Project is deemed to be low for the Indicative Alignment and the Tier 2 approach undertaken for this assessment is appropriate for the Project.

The operation of the Project will result in increased concentrations of contaminants in air along the Indicative Alignment, but this level of increase will have less than minor effects on human health and the environment due to:

- the low predicted concentrations of contaminants from traffic as compared to the relevant air quality guidelines and standards. In particular compliance with the Auckland Ambient Air Quality Targets and NESAQ;
- the low background concentrations of contaminants in the area; and
- the generally rural nature of the surrounding environment with good separation distances to HSRs.

The operational air quality risk remains low and compliant with relevant air quality guidelines and standards for human health in the event that the Indicative Alignment (including location of the tunnel portals) is shifted within the proposed designation boundary and if traffic flow increases by as much as 100%.

The Project also has a positive effect on air quality taking into account the effects on the wider road network. While this effect has not been quantified, there will be a reduction in exposure to vehicle emissions at HSRs due to network effects. This reduction will be due to the movement of traffic flow and consequently, operational air quality emissions, from areas along SH1 such as the townships of Wellsford and Te Hana onto the Indicative Alignment. Additionally, traffic movement on the new road will be free flowing compared to often congested traffic on existing SH1 through Wellsford, therefore resulting in less emissions.

Based on the findings of the *Air Quality Assessment* it is considered that the air quality effects from the operation of the Project will be less than minor.

9.17. Social impacts

Overview

The Project has the potential to generate both positive and adverse social effects.

The key positive regional and local community effects are the result of improved transport safety, reduced congestion, improved journey time reliability as well as economic benefits for Northland and north Rodney. Significantly, the Project avoids community infrastructure such as schools, community facilities such as libraries, parks and reserves, hospitals or medical facilities, emergency services facilities or large residential areas.

Potential adverse effects include stress and anxiety for those directly affected (related to the uncertainty of the Project timelines); how land can be managed in the intervening period until construction starts; disruption and a reduction in amenity during construction and the loss of residential/rural residential dwellings within small coherent social enclaves. There are a number of recommendations proposed to avoid, remedy and mitigate potential adverse effects that are set out in other sections. The Transport Agency will continue to communicate with directly affected landowners and early acquisition is possible for those meeting criteria within the Transport Agency's Advance Purchase Policy. Additionally, there is mitigation proposed to maintain open lines of communication and provide stakeholder liaison up to and during construction.

Adverse effects arising from disruption to local communities (residents, commercial business owners) from construction activites, including diversions, change in access and noise are minor. Social adverse effects, such as anxiety and worry caused by uncertaintity, navigating the RMA process and loss of existing social and family neworks are moderate. The social effects will have an overall moderate adverse effectbut at a wider local and regional level the effects are assessed as significant positive overall.

9.17.1. Introduction

This section outlines the social effects assessment in relation to the Project. These effects focus on the experiences (actual or anticipated, direct or indirect) of individuals, households or communities in response to changes resulting from the Project.

9.17.2. Social effects assessment framework and methodology

This section has been guided by the Transport Agency's Social Impact Guide (September 2016) and the International Association for Impact Assessment (IAIA) recognised best practice framework for social impact assessment.

In its Social Impact Guide, the Transport Agency adopts the position that social impact assessment is a process that project teams should follow to:

(a) Identify and assess/rate social impacts of a proposed state highway project from the perspective of those potentially affected either positively or negatively by it; and

(b) Develop strategies to mitigate and monitor those impacts that occur because of the project.

9.17.3. Existing social environment

Community Area: Warkworth

Warkworth is predominantly urban, surrounded by rural lifestyle blocks. Warkworth is home to around 4760 people and has experienced strong growth in the past 10 years. The Auckland Plan and AUP(OP) have both identified Warkworth as a key future growth area.

Warkworth is a typical, well serviced urban centre. While not an exclusive list, the following illustrates the breadth of services available: there are two schools including Mahurangi College and Warkworth Primary School; there are multiple childcare centres, supermarkets, churches, retail stores, petrol stations, cafes, restaurants, banks and medical services; there is a recently refurbished town hall, post office, library, police station, fire station, ambulance services, Work and Income and an RSA; there are also a number of sports and recreation clubs/facilities for rugby, football, bowls and scouts.

Community Area: Wellsford

Wellsford is a rural town centre. It is home to around 2,030 people. Neither the Auckland Plan or AUP(OP) have identified Wellsford as a growth area, although there is some land zoned for future urban development. There has been some subdivision and new residential development in the past 4 to 5 years.

Wellsford provides goods and services for the rural community that surrounds it. Again, while not an exclusive list, the following services are available in Wellsford: there are two schools including Wellsford School and Rodney College; there are childcare centres, churches, convenience stores, retail, cafes, restaurants and banks; there is a medical centre, post office, library, convention centre, police station, fire station, ambulance, citizens advice bureau and an RSA; there are also a number of sports facilities available providing for golf, rugby, netball, equestrian, archery and squash.

Community Area: Te Hana

Te Hana is a small rural town, home to around 200 people. Te Hana has (amongst other things) a community hall, a local recreation reserve (field and playground) and a petrol station. In addition, Te Hana Nurseries is a wholesale and retail supplier of plants, located off SH1. Te Hana Te Ao Marama is a key tourist destination, offering Māori cultural experiences for visitors. Te Ao Marama is credited as having enabled “the previously deprived community of Te Hana [to] rebuild and reinvent itself”[87].

Other surrounding areas

The land to the east of Warkworth, stretching out towards the eastern coastline, is predominantly rural. Matakana is a popular township and has experienced strong population growth in the past 10 years. Matakana is known for its farmers’ market, cinemas, cafes, restaurants and boutique food-places. The reasonably close

[87] www.tehana.co.nz

proximity to Auckland (about one hour's drive), make Matakana a popular destination for visitors.

The eastern beaches (coastal settlements to the east of Warkworth) are predominantly residential areas and many dwellings are used as baches and holiday homes (indicated by a high percentage of usually unoccupied dwellings).

Mangawhai and Mangawhai Heads, located to the north of the Project, are similar – there are a lot of holiday homes which causes the population to 'spike' during peak holiday periods.

Port Albert and Tapora are small rural communities located to the west of Te Hana and Wellsford. Tapora in particular is an agricultural growth area.

9.17.4. Assessment of regional and local social effects

The key regional and local social effects and social consequence related to the Project are outlined in Table 9-37 below.

Table 9-37: Key regional and local social effects

Actual or potential effect	Social effect	Effect rating	Potential Mitigation
New/alternative route between Warkworth and Te Hana resulting in safe and more reliable travel (less congestion, travel time savings).	Improved access and connectivity to work places, schools, recreational facilities and other activities.	Regional – positive – from road opening	
New/alternative route north of Warkworth and towards Northland.	Improved economic welfare or economic well-being of people in Northland and Rodney.	Regional – positive – from road opening	
New/alternative route between Warkworth and Te Hana, and further north towards Northland.	Improved social well-being for the wider community as individuals' perceptions of their life situation is improved through: satisfaction that "something is being done", perception or experience of improved quality of the environment in which they live due to improved infrastructure provision.	Regional – positive – from road opening	
New/alternative mode choice.	Improved connectivity for cross route cycling, at interchanges and northern tie in	Local – positive – from road opening	
Uncertainty about the timing of the Project and its final form – i.e. extent of property impacts, what it will look and feel like for	Concern, stress, depression, anxiety and worry, affecting people's ability to plan for their future, their ability to make decisions about	Local – negative – preconstruction	Advance Purchase Policy for landowners who meet the criteria. Provide for certaintity on future

Actual or potential effect	Social effect	Effect rating	Potential Mitigation
neighbours 'left behind'.	property ownership and whether or not they stay or leave. Some people are feeling a loss of emotional attachment to land and places, and/or are worried about their ability to find a like-for-like replacement residence (as a result of property purchase, land take, and/or displacement). Some people (both directly affected and neighbours) are concerned they will not be able to sell property between now and when construction starts, now that people will know the road is planned for construction at a future date. Whether a perceived or actual issue, this matter is causing stress. In many cases people feel like they are 'stuck', 'trapped', or their life is 'on hold'.		land acquisition timeframe and process. Negotiation of fair compensation in accordance with the Public Works Act (PWA) and NZTA's land purchase and compensation policy On-going and regular communications to provide (where able) certainty about timing for project works, use and management of land until required for the Project, acquisition (if required) and the relocation of any businesses. Identify activities that landowners can undertake without recourse to s176 i.e activities that the landowner can undertake as of right without requiring the prior written consent of the Transport Agency.
Loss of social coherence though some landowners in an area relocating out of designation (e.g. Phillips Road/Kaipara Flats Road)	Isolation, loss of community (social and family networks)	Local - negative - construction	Advance Purchase Policy for landowners who meet the criteria. Negotiation of fair compensation in accordance with the Public Works Act (PWA) and NZTA's land purchase and compensation policy.
Changes to rural amenity of area due to the construction activities.	As expressed through consultation, the community places a high degree of importance on maintaining the existing rural and rural lifestyle amenity. This existing amenity will change with the construction activity associated with the	Local - negative - construction, with adverse amenity effects decreasing over time through adjustment (e.g. getting used to hearing and/or seeing the construction activity	Maintaining communication throughout construction.

Actual or potential effect	Social effect	Effect rating	Potential Mitigation
	Project introducing a level of activity not previously experienced in what are currently quite isolated areas – notably north of Wellsford interchange.	as part of the environment) and with mitigation implemented.	
Changes to rural amenity of area due to operational activities.	Potential adverse impacts on wellbeing and quality of life such as annoyance, disturbance, general nuisance with the potential to affect how people enjoy their home life. The significant change in noise levels, while meeting appropriate noise standards as discussed in Section 9.15, is a significant change given the current noise environment.	Local – negative – from road opening, adverse amenity effect decreasing over time through adjustment (eg, getting used to hearing a road as part of the environment).	As above, and ensuring design meets requirements of NZS 6806 (operation road noise).
Loss of land (used for farming, businesses and/or residential), affecting future aspirations of land owners (partial land acquisition).	Reduction in usability and enjoyment of property, frustration at loss of part of property.	Local – negative – construction and from road opening.	Communication around timeframes and PWA process, engagement with affected landowners on ULDF. Identify post designation operational requirements for farms so they can continue to operate between designation and construction phases.

9.17.5. Conclusion

Once operational the Project will offer significant benefit to the local community and wider Auckland and Northland by (amongst other things) improving safety for road users, reducing congestion, improving travel time reliability, as well as economic benefits for Northland and North Rodney. This responds well to some of the concerns raised by the communities.

During the Project's anticipated seven year construction period there will be increased economic activity for Auckland and Northland. This is a result of the additional expenditure, employment and incomes directly generated by the Project's construction. Indirect economic benefits will arise through expenditure, employment, and incomes generated via the suppliers of goods and services to the Project and those employed on it.

However, the impact is disproportionately experienced by those that are directly affected by the Project i.e. owners of properties that are physically crossed by the Project, and those that will become immediate neighbours to the Project.

It is important to acknowledge that this Project does not directly affect any community facilities/amenities or social infrastructure. The Project does however affect 75 private land owners/families.

The most significant adverse social impacts are those that are happening now i.e. during the planning (pre-construction) phase, and these impacts will continue until properties are purchased and more certainty is provided about construction timing.

The Transport Agency has engaged with landowners and neighbours to the Project. However, it is recognised that it is not possible to entirely relieve the concern, stress, anxiety and worry that is currently being felt amongst some of those that are directly affected. While funding for early property purchase is constrained, the Transport Agency's Advance Purchase Policy may enable vulnerable landowners to negotiate early and move on with their lives. On-going communication with directly affected people and businesses will also be helpful in enabling them to plan well-ahead for relocation. It is somewhat of an 'advantage' that there is a long (~10 year) lead time before construction starts, meaning people do have time to plan for change. On-going communication with the 'new neighbours' would contribute towards appeasing their concerns about residential amenity impacts and construction timing.

Once people gain certainty, whether this be through property purchase or through the confirmation of a date for construction, it is anticpated they will have less concern, stress, anxiety and worry. For some people this would would start to dissolve some of the negativity.

During construction there will be temporary effects that will inevitably have social consequences e.g. disturbance from construction noise. These temporary effects will be appropriately addressed through the mitigation measures recommended by specialists e.g. implementation of a construction noise and vibration management plan. The proposed mitigation is considered adequate to address the social consequences of the temporary construction effects.

In summary, the majority of adverse effects on the social environment are those experienced during the planning (pre-construction) phase. A range of mitigation measures have been proposed which if implemented will go some way towards addressing these effects (as set out in the table above). The Transport Agency will continue to keep landowners and neighbours to the Project informed of Project timing and any Project information, recognising that it is not possible to avoid the planning (pre-construction) phase social impacts. Once operational, it is considered that the Project will have a positive impact on the local and wider communities.

9.18. Cultural values

Overview

The Project is recognised both as having potential adverse impacts on values important to Mana Whenua, and equally providing opportunities to reflect cultural values in the Project through design and mitigation. The key opportunity is through the application of a design approach which reflects the principles of partnership through Te Tiriti o Waitangi by taking a holistic approach to the urban and landscape design and ecological mitigation.

The Project has the potential to affect cultural heritage and Mana Whenua values as follows:

- The Project traverses' areas historically occupied by Mana Whenua;
- The waterbodies within the Project area are important taonga which have mana, and the mauri of these waterbodies is also significant.
- Native vegetation and fauna are important taonga and have mauri.

There is potential for the cultural heritage and Mana Whenua values to be impacted during construction and operation of the Project.

In response to ongoing engagement with Mana Whenua the following Project design features and proposed measures to manage the effects of construction and operation works on cultural heritage and Mana Whenua values have been identified:

- Ongoing engagement with Mana Whenua;
- Design to avoid cultural heritage sites and areas of cultural significance, where practicable;
- Holistic approach to mitigation design;
- Preparation of Cultural Indicators Framework;
- Preparation and implementation of a Cultural Monitoring Plan;
- Preparation and implementation of an Accidental Discovery Protocol.

9.18.1. Introduction

This section identifies the potential effects of the Project on cultural values. It has been informed by engagement with Mana Whenua (as outlined earlier, in Section 8.3 of this AEE) and consideration of cultural values assessments (CVA) provided to the Transport Agency. Hōkai Nuku has provided cultural input and advice during site investigations and preparation of various supporting technical assessments.

In developing the Project, recognition has been given to both the relationship of Mana Whenua to their lands, culture and traditions in this area and the commitment to partnership between Mana Whenua and the Transport Agency (as representative of the Crown) founded through Te Tiriti o Waitangi.

9.18.2. Mana Whenua

During engagement with Mana Whenua, histories and stories were shared, identifying connections to significant places within the Project area and broader region. The whole area is recognised as a cultural landscape, by the long history of occupation, settlement, trade and activity in the area. Within this landscape, specific sites and significant features are identified. These are discussed briefly below.

9.18.3. Assessment of effects on cultural values and sites

Cultural concerns have centred on maintaining or enhancing environmental values. These largely relate to the protection of waterways and native vegetation and fauna and the effects of the Project on them. Effects on cultural values have been assessed below based on the engagement undertaken and findings of the cultural advice provided by Mana Whenua to the Transport Agency.

Effects on waterways

Mahurangi River and Hōteo River are identified as highly valued taonga within the Project area. These were once important portage and access routes inland from the harbour. However, over time land use practices have caused degradation to the mauri of the waterways. Riparian margins are recognised as providing important ecological benefits for stream and river health. The Project has the potential to modify these rivers and affect their cultural value.

"Ki Uta, Ki Tai" or "from the mountain to the sea" is a Matauranga Māori approach identified during engagement with Mana Whenua. It has been adopted as one of the principles for integrated management and mitigation for the Project.

The loss of wetland areas affects the plant communities, important wetland functions and the habitat they provide for fauna. Construction will have a negative impact on and permanent loss of wetlands; changes to topography and flow paths as a result of cut and fill activities and stream diversions may alter the hydrological regime of wetlands and may result in changes to the size, species composition or permanence of wetlands. This will affect the mauri of the river catchment.

Adverse impacts to the mauri of the river catchments will affect the catchment's ability to sustain the conditions which support taonga species within it, and this will in turn affect the people.

Effects on native flora and fauna and their ecosystems

Vegetation clearance and plant species loss (permanent, direct), and alteration to fauna behaviour (breeding, feeding, nesting, recruitment), abundance and diversity will result from construction and operation of the Project. Native flora and fauna are taonga to Mana Whenua.

Kauri are important taonga to mana whenua. Several kauri stands have been identified within the Project area, some may require removal. It is unknown as to whether these suffer from Kauri Dieback disease. Mana Whenua are concerned for the protection and survival of kauri species. There is a risk that Kauri Dieback may be introduced or spread during Project construction works if not appropriately managed.

Effects on natural landform

There will be effects on the natural landform through earthworks, landscaping, and new infrastructure associated with the Project. Other possible impacts are associated with removal of excavated soils to an area outside of the rohe of Mana Whenua and infilling of gullies and streams.

People

Healthy indigenous ecosystems sustain indigenous biodiversity and therefore sustain the people. As noted above, the Project will impact the mauri of the river catchments and the function of ecosystems, as well as impact the abundance and diversity of taonga species within them and the wider Project area, which will affect the people.

The purpose of this Project is to provide a safe route with improved access between two regions. Mana Whenua have identified that the ability to travel on safe routes is of high importance and reduces risks to travelling public including their kaumatua and mokopuna.

9.18.4. Measures to avoid, remedy or mitigate actual or potential adverse effects

The Transport Agency will continue to engage with Mana Whenua during the design and construction of the Project. In addition, there will be opportunities for Mana Whenua to be actively involved in the Project through a variety of mechanisms from cultural ceremonies to advising on cultural values and cultural guidance on design matters.

Based on the engagement with Mana Whenua to date, and recommendations made through cultural advice, the following measures are proposed to avoid, remedy or mitigate effects on cultural heritage and cultural values:

- Ongoing engagement with Mana Whenua during detailed design, prior to and during construction to enable on-going cultural input from Mana Whenua with an interest in the Project;
- Preparation of a Cultural Indicators Framework to inform the protection and management of taonga during construction works;
- Engagement with Mana Whenua during the preparation of management plans, including Stakeholder and Communication, ULDF, Heritage and Archaeological, ADP and the Ecological Management and Mitigation Plan/s;
- Preparation of a Cultural Monitoring Plan which sets out the recommended cultural monitoring requirements during enabling works or construction activities, including karakia at commencement of works and cultural inductions for construction staff;
- Development of an ADP in consultation with Mana Whenua. Project works which impact on known or potential archaeological sites will be undertaken in accordance with any required Archaeological Authority granted by HNZPT.

9.18.5. Conclusion

Overall, it is assessed that the Project adequately responds to the matters raised by Mana Whenua. Based on the proposed mitigation measures, in particular ongoing involvement of Mana Whenua in the design and construction phases, it is considered that effects on cultural heritage and cultural values will be more than minor.

9.19. Economic

Overview

The Project will deliver significant benefits to the local north Auckland area and the Auckland and Northland region's economies. During construction, these will include employment opportunities for local contractors and the supply of construction materials. Once the Project is completed, it will enable efficient and more reliable travel times and reduced congestion, resulting in economic efficiencies that support businesses for growth and less congestion for motorists. Some individual businesses located along the existing SH1 alignment may lose some passing trade from through traffic. Reduced accidents will also reduce government costs for public health and personal costs for victims and their support networks. Overall economic effects are assessed as being significant positive.

9.19.1. Introduction

This section summarises the actual and potential economic effects arising from the construction and operation of the Project.

Effects on properties directly affected by the land requirements of the Project are assessed in section 9.20 of this AEE.

9.19.2. Existing economic environment

The existing economic environment for the Project is discussed in sections 2 and 3 of this AEE. The Northland region and Rodney Local Board area's existing economic environment is summarised below:

- The resident population in the Northland region, Warkworth and Wellsford areas are increasing;
- Employment in the Northland region is driven through agriculture, forestry, manufacturing especially the processing of agricultural and forestry products) and tourism which accounts for some but not all of the jobs created in the retail trade and accommodation and food services sectors.
- Employment in other sectors within the Northland region is driven by the demand for goods and services by these industries and their employees and their families.
- The three biggest contributors to the Northland region's GDP in 2017 were manufacturing (16.9%), agriculture, forestry and fishing (11.6%) and tourism (8.9%). These sectors are heavily dependent upon road transport links between Northland and Auckland, and to a lesser extent further south to the Waikato and Bay of Plenty regions.

9.19.3. Assessment of economic effects

Overall, the Project will provide positive economic benefits as the population of Northland region and north Rodney area increase. Improvements to the route provide greater trip reliability.

During the Project's anticipated seven year construction period there will be increased economic activity for Auckland and Northland. This is a result of the additional expenditure, employment and incomes directly generated by the Project's construction. Indirect economic benefits will arise through expenditure, employment, and incomes generated via the suppliers of goods and services to the Project and those employed on it.

Over the anticipated seven year construction period for the Project, it is estimated that there will be around 530-650 additional jobs[88], $42-$52 million in additional wages and salaries per annum, and upwards of $250 million per annum in additional expenditure with local businesses for the supply of goods and services to the Project.

The Project is likely to result in increased population growth within Northland and the local Rodney area. Improved net income and profits are associated with increased levels of economic activity.

Greater route resilience and trip time reliability in particular will improve the competitiveness of the Northland region and Rodney local area-based businesses and the attractiveness of these areas to locate new businesses or expand existing businesses.

The Project may have an adverse effect on net income or profits of some local businesses dependent to some degree on the passing motorised trade along the existing SH1 alignment.

The businesses that are dependent to varying degrees on the passing motorised trade and therefore may be affected by reduced traffic volumes on the existing SH1 include destination tourist and recreational activities, specialist food providers, accommodation providers and nurseries.

The extent of loss of trade for any individual businesses will be limited by:

- The businesses only in part being dependent upon the passing motorised trade;
- The extent to which the existing SH1 route is promoted as a "tourist" route;
- Amenity value improvements on the existing SH1 associated with reductions in traffic flows;
- Signage at the proposed interchanges providing advertising to the individual businesses;
- Population and business growth over time before, during and after the Project; and
- The Twin Coast Discovery Touring Route, providing an alternative circular route from Auckland to and around Northland linking tourist destinations on both the west and east coasts, will continue to pass through Wellsford and Te Hana via SH16 to the south, the existing SH1 alignment and SH15 to the north.

9.19.4. Conclusion

The Project will promote the Rodney local area and Northland region's residents and businesses viability.

The Project will have some trade re-distribution effects for those businesses on the existing SH1 alignment at Wellsford and Te Hana which are currently dependent to some degree on the passing motorised trade

Overall the economic effects of the Project are positive and significantly positive at a regional and local level.

[88] Based on an average salary rate of around $75,000 per annum.

9.20. Land use, property and network utilities

The Project traverses land uses primarily for forestry and/or farming with an area of lifestyle blocks north west of Warkworth. There is a significant block of commercial plantation forestry south of the Hōteo River. The Project passes through farmland in the Wellsford and Te Hana areas.

Construction effects have the potential to disrupt farming operations. Given the indicative harvest programme provided by Rayonier Matariki, the commercial plantation forestry within the designation is likely to be felled prior to construction. The effects of the Project on the commercial plantation forestry relate to land acquisition and a designation being located on their land.

Acquisition of land will be undertaken by the Crown through the Public Works Act (PWA) process. The PWAestablishes the acquisition and compensation processes for land to be acquired land and as such, this matter is not considered further in this AEE.

The Project impacts 79 private landowners. Approximately 49 dwellings are identified as being located within the proposed designation boundary. All assessments have been undertaken on the assumption that dwellings within the designation will be vacant at the time of construction.

Land uses and activities within and adjoining the Project area include:

-Residential dwellings;

- Farms;

-Commercial plantation forestry;

-Businesses (predominantly small and medium sized enterprises);

-Network utilities and infrastructure; and

-Quarries.

Construction activities will require the establishment of construction yards, haul routes, temporary road works and traffic management. The key disruption effects arise from temporary restrictions to property access and daily operation on sites. These will be managed through addressing site specific issues at the time of construction, through the implementation of a Stakeholder Engagement and Communications Plan.

Permanent effects of the Project include loss of farm infrastructure and potentially severing primary production lots such as farms. These effects will be mitigated through identifying means to maintain access across the Project including installation of stock underpasses, and reinstatement of farm infrastructure such as fencing, races and yards.

Network utilities will be avoided, relocated and/or bridged to avoid permanent adverse effects on their functionality.

Overall, the potential adverse effects on land use and property are moderate.

9.20.1. Introduction

The existing environment is described in section 3 of this AEE. The land use surrounding the Project area is largely rural and zoned Rural Production Zone. Settlements within the Project area include Warkworth, Wellsford and Te Hana. Warkworth is identified as a high growth area and a Warkworth Structure Plan has been prepared by Auckland Council. Other land uses within the area include commercial plantation forest located in Dome Valley (Matariki Forest) and commercial farming land, primarily in the Hōteo North area.

This section provides an assessment of the effects of the Project on land use, property and network utilities. Potential effects relate to:

- Temporary and permanent restrictions and changes to property access during construction;
- Configuration for the movement of stock and farm buildings during construction;
- Impacts on the ongoing operation of sites post construction, particularly in regard to commercial farms and forestry; and
- Impacts on the operation and maintenance of network utilities and infrastructure, including on-going access.

For those properties where land is required either permanently or for construction, the acquisition or lease of land will be undertaken by the Crown through the Public Works Act process. The Public Works Act establishes acquisition and compensation processes for this required land and as such, this specific matter is not considered further in this AEE.

Visual and amenity effects are discussed in sections 9.13, 9.15 and 9.16 of this AEE and construction effects are discussed in section 9.7 and 9.8 of this AEE and are not repeated here.

9.20.2. Assessment of effects on land use, property and network utilities

Land acquisition

79 private landowners are affected by the proposed designation. Three of these have the proposed tunnel beneath them.

Commercial plantation forestry

Approximately 34% of the Project area (488 ha) is commercial plantation forestry. The commercial plantation forestry is likely to reach maturity around the same time as the Project pre-construction phase and will be progressively harvested from around 2025-2027. It is assumed that all areas of commercial plantation forestry within the proposed designation boundary (Matariki Forest) will be harvested prior to construction as part of the harvesting programme. Approximately 468.46 ha of the Matariki Forest is located within the proposed designation boundary. The proposed designation boundary will be located on Rayonier Matariki owned land which will impact their ongoing operations. Discussions with Rayonier Matariki are ongoing.

Horticultural and agricultural land uses

Agricultural activities such as grazing and dairy dominate land uses north of the Hōteo River and are directly affected by the proposed designation. Preliminary engagement with some of the operators of these activities indicate that their operations would require reorganisation, such as access to fields, how grazing rotation is carried out and farming units reconfigured. Forethought and planning for such land uses could generally continue. Temporary and permanent adverse effects relate to stock and vehicle access restrictions both during construction and operation. Some farms will have fields and farm races severed from milking sheds and stock yards. New access in the form of underpasses may be required to some farms. Discussions with landowners are ongoing. The reinstatement of infrastructure including fencing, farm races and infrastructure such as water supply systems, sheds and stock yards will mitigate the effects of the Project on horticultural and agricultural land uses.

Network utilities and infrastructure

The following network utilities and infrastructure are located within or near the proposed designation:

- Watercare's Wellsford watermain and their water abstraction point;
- Refining NZ and First Gas fuel and gas pipelines and associated infrastructure;
- National Power Grid;
- Telecommunication assets (Vodafone, Spark, Chorus and Kordia);
- Vector's power and gas distribution network; and
- Local roads.

Protection and relocation of infrastructure and network utilities is discussed in section 5.5.3 of this AEE.

Discussions are ongoing with network utility providers. Those ongoing discussions will ensure that works undertaken in close proximity to network utilities and assets will align with the infrastructure providers requirements. An additional Transpower intermediary transmission pole will be required to provide the necessary clearance over the alignment. This will be confirmed at detailed design, the appropriate approvals sought from Transpower.

General construction activities

Measures will need to be implemented during construction to mitigate or minimise potential effects on property owners and the operation of their land use activities. Mitigation identified in other sections, such as construction traffic management plans, noise and vibration management plans and the stakeholder communication plan will assist to manage effects on land use activities. Additionally, at detailed design a variety of works will be identified and confirmed with landowners for implementation prior to construction works commencing. These works will provide for continuity of activities to the extent practicable. For example, reconfiguration of water supply networks for grazing or horticultural activities, cattle underpasses and/or redevelopment of farm races may form part of the accommodation works for the project.

Relocation of telecommunication or local electricity supplies may be undertaken as enabling works to avoid conflict with Project construction works.

9.20.3. Conclusion

Overall, majority of the potential adverse effects on land use, property and network utilities can be appropriately managed through construction management plans and ongoing discussions with landowners to identify appropriate works to provide for continuity of activities. The plantation forestry (Matariki Forest) is anticpated to be harvested prior to construction. Temporary and permanent adverse effects relate to stock and vehicle access restrictions both during construction and operation. With appropriate engagement process through detailed design and construction it is considered that the effects on land uses, network utilities and property are moderate.

10. Management of effects on the environment

10.1. Introduction

This section outlines the environmental management measures proposed to be implemented before, during and after construction, to mitigate the actual or potential effects on the environment from the Project as identified in section 9.

As discussed previously, the Project to date has sought to avoid adverse effects through the route selection process, Project design and the indicative construction methodology. Where it has not been practicable to avoid adverse effects measures are proposed to appropriately manage, remedy or mitigate adverse effects.

Where adverse effects have not been avoided, an integrated approach to mitigation has been adopted. At a high level this approach is informed by the philosophy of Ki Uta Ki Tai (from mountain to sea) and seeks to connect the upper catchments within the Project area to the receiving environments of the Mahurangi and Kaipara Harbours. The concept seeks to holistically maintain healthy ecosystems, which in turn sustains indigenous biodiversity, and therefore people, cultural practices and connections within the Project area and beyond which aligns with mana whenua values.

In part, this integrated approach has been developed to reflect lessons learnt from previous projects, particularly those from Puhoi to Warkworth (P2Wk) Project. The final designation and resource consent conditions and the final mitigation approach for P2Wk have been a strong driver for seeking to achieve a holistic environmental outcome for this Project. In terms of the delivery phase, the Project has adopted a more typical process to ensure adverse effects resulting from projects such as this are managed. The detailed design will be developed to outcomes sought by the proposed designation and resource consent conditions. In addition, the conditions require best practice construction methods and the preparation and implementation of environmental management plans as well as monitoring of construction activities and longer-term management and maintenance requirements.

The Project delivery phase is supported by conditions seeking to combine and integrate the mitigation of permanent effects that cannot be avoided based on the philosophy and concept referred to above.

All the proposed Project mitigation, where practicable, will be delivered in an integrated manner including effects relating to ecology, heritage, social, landscape, visual and cultural value as well as those effects associated with the additional impervious surface and stormwater runoff. This integrated approach to mitigation is explained in Section 10.3.

10.2. Project Delivery

10.2.1. Proposed conditions

Based on the recommended mitigation and monitoring measures summarised in section 9, proposed designation conditions and resource consent conditions have been developed to ensure that potential adverse effects that might arise from the final design and construction/operation of the Project will be adequately avoided, remedied or mitigated. The conditions have also been developed to seek to achieve integrated mitigation where practicable.

Specific conditions are proposed to ensure that the final design avoids impacts in specific areas and conditions associated with the pre-construction, construction and operational phases of the Project are proposed to minimise effects during Project works. The scope of those conditions is summarised below.

Proposed design related conditions include:

- Preparation of the Urban and Landscape Development Framework
- Bridge/viaduct structures designed over, with no piers in the bed of the following watercourses:
    - Hōteo River
    - Waitaraire Stream
    - Mahurangi River (Left Branch)
    - Maeneene Stream
    - Unnamed tributary of the Kourawhero Stream north of Kaipara Flats Road
    - Upper Kourawhero Stream
    - Mahurangi River (left branch)
- Pre-construction water table levels of the wetland complex associated with the Kourawhero Stream will be maintained.
- Bridge structure/viaduct crossing the Hōteo River and SH1 will be designed to minimise the impacts on the adjacent SEA.
- Operational stormwater management design to meet GD01 standards.
- Permanent project works in watercourses, including culverts, designed to provide for the 100-year ARI storm event and incorporate fish passage.
- Retention of existing shelterbelts and establishing replacement planting to assist in screening permanent project works from residential properties.
- Managing the potential effects of flooding.
- Designing tunnel portals so that they integrate with the surrounding landform and ensuring that tunnel ancillary structures are recessive in form and colour.
- Permanent urban design and landscape planning that incorporates mitigation responding to effects on:
    - Cultural values;
    - Heritage and archaeology;
    - Fresh water and terrestrial ecology;
    - Stormwater management; and
    - Sediment deposition (if required).

Proposed pre-construction conditions require:

- The undertaking of additional baseline environmental surveys and monitoring;
- Preparation and implementation of a Stakeholder Engagement and Communications Plan to set out proposed engagement and ongoing communication with stakeholders throughout Project works;
- Identification and fencing/demarcating of areas (where no construction works will take place); and

- Preparation and implementation of the construction and environmental management plans;

Proposed construction conditions require:

- Implementation of specific restrictions to manage construction related effects; including limits on the extents of open areas of earthworks in the Hōteo catchment, an exclusion for winter works, and re-stabilisation;
- Incident management procedures.

Proposed conditions relating to operation require:

- Post construction monitoring of erosion prone streams;
- Ongoing management of planting, weeds and pests;
- Ongoing operation and maintenance of stormwater treatment devices including wetlands and sediment traps

10.2.2. Detailed design and outline plan process

Detailed design of the Project will be undertaken, following confirmation of the designation and grant of the resource consents, and a decision being made to proceed to construction. At this time the outline plan(s) will be prepared in accordance with section 176A(3) of the RMA and will incorporate detail of the proposed work, including how the Project will meet the relevant conditions of the designation. The outline plan(s) may be staged to reflect the Project phases or construction sequencing.

The outline plan(s) may be staged to reflect the Project phases or construction sequencing.

10.2.3. Permanent design certification

Aspects of the design will require certification from Auckland Council, including the following temporary and permanent elements of the Project:

- Permanent structures in watercourses i.e. bridges, viaducts and culverts;
- Operational stormwater management devices including stormwater treatment wetlands.

The outline plan, and certification process, will confirm that the final design is in accordance with the designation and resource consent conditions.

10.2.4. Urban and landscape design

The Planning Version ULDF contained in *Volume 3: Drawing Set* describes and illustrates the urban and landscape principles and concepts that will assist in integrating the Project into the surrounding environment.

A final ULDF will be prepared in the detailed design phase, to confirm the framework for the Project as a whole. Prior to construction, more detailed Urban and Landscape Design Management Plans (ULDMPs) will be prepared for specific design sectors within the Project area, setting out further detail on how the principles of the ULDF will be implemented. Both the ULDF and ULDMPs will be developed in consultation with Auckland Council, Mana Whenua, directly affected landowners and other key stakeholders.

The ULDMPs will contain detailed design drawings and information that:

- Demonstrates how the ULDF's key design principles and sector outcomes in the ULDF are reflected in the design concepts;
- Describes and illustrates the overall landscape and urban design concept and explains the integration of cultural narratives and rationale for the landscape and urban design proposals;
- Includes developed design detail for the landscape and urban design features; and
- Identifies planting and vegetation management details.

10.2.5. Ecological Management Plan

An Ecological Management Plan (EMP) will be prepared at the detailed design phase. The EMP will be developed in consultation with Mana Whenua, DoC and Auckland Council.

The EMP will address the following matters:

- Best practice survey methods and monitoring programmes to identify Fauna, Avifauna and Native Fish and related habitat affected by the Project and report the results.
- Best practice measures to be implemented to minimise potential adverse effects of construction on Flora, Fauna, Avifauna and Native Fish.
- Best practice procedures, methods and practices for:
    - Salvage and relocation including how relocation will be timed, planned and undertaken;
    - Seasonal limitations/restrictions of Project Works reflecting best practice; and
    - Reflecting the overall integrated approach to mitigation.
- Identify relocation site/s including best practice site preparation.
- Identifying the preferred area/s for mitigation relating to planting, restoration and ecological enhancement.
- Identify Ecological Sites within the designation that are affected by Project Works.
- Best practice biosecurity protocols and procedures to prevent the introduction and/or spread of kauri dieback disease and any other applicable identified biosecurity risk as defined by the appropriate Government Agency (e.g. Myrtle Rust).
- Best Practice pest animal and plant management of mitigation areas and relocation sites.

10.2.6. Ecological Mitigation Map Series

The EM series of drawings contained in Volume 3 of the AEE set out an integrated mitigation approach which considers mitigation for landscape, visual, ecological, hydrological and stormwater treatment. It highlights priority areas for mitigation and draws together proposed landscape and ecological mitigation planting, stormwater treatment wetland locations, preferred locations for fauna management and denotes existing areas of indigenous vegetation and recorded SEA locations. This holistic approach aligns with the identified cultural values.

10.2.7. Management plans

Many of the potential effects identified in section 9 of this AEE can be managed through the preparation and implementation of management plans. All management plans will be prepared and provided to Council either as part of the outline plan process, for certification under the resource consent conditions, or for information, prior to construction commencing. The proposed management plans include:

- Construction and Environmental Management Plan including for enabling works
- Heritage and Archaeological Management Plan
- Construction Air Quality Management Plan
- Construction Traffic Management Plan including site specific management plans
- Ecological Management Plan
- A Project Erosion and Sediment Control Plan supported by:
    - Enabling Works Erosion and Sediment Control Plans
    - Construction Erosion and Sediment Control Plans
    - Chemical Treatment Plan
    - Adaptive Monitoring Plan

10.2.8. Ongoing operation and maintenance

- On completion of the Project Works, the Transport Agency's ongoing operational maintenance regime will include: Retention of a mitigation site within the designation;
- Ongoing management and maintenance of stormwater management devices including wetlands and silt traps;
- Weed and pest control at mitigation sites for 5 years from completion of the Project;
- Ongoing management and maintenance of mitigation planting for 5 years from completion of the Project.

10.3. Integrated Mitigation Framework

10.3.1. Integrated mitigation approach

An integrated approach to mitigation has been embedded throughout the Project. As discussed in section 7, the route selection process sought to avoid adverse effects. Once the Indicative Route was identified, the design was developed with the aim of minimising effects on the environment. This process identified opportunities to mitigate adverse effects through the implementation of specific design features how these could be defined at this stage to mitigate specific adverse effects. These matters are outlined in section 9 of this AEE.

To ensure integration is achieved, the proposed conditions require mitigation to contribute to achieving the following Integrated Mitigation Principles and for demonstration of how and where the integration of mitigation has been achieved:

- Mitigation that forms cohesive and integrated ecological restoration.
- Creation and enhancement of resilient ecosystems.
- Mitigation that connects and links ecosystems across the landscape.
- Mitigation that contributes to Mana Whenua aspirations for cultural and environmental restoration.
- Mitigation that considers the concept of Ki Uta Ki Tai (from mountain to sea).
- Mitigation that is practical to implement and maintain in order to support a successful long-term outcome.

Much of the mitigation outlined in the AEE and proposed in the conditions has been designed to achieve greater holistic contribution to the natural environment. This will result in an environmental outcome that will, in the longer-term, provide an overall greater benefit to the environment, whilst adequately mitigating the adverse effects of the Project.

An example of where the project will achieve integrated mitigation includes planting to mitigate for ecological effects that reconnects an area of bush located to the east of the Mahurangi River with proposed visual mitigation planting at the Warkworth Interchange. The combining of these two sources of mitigation will enhance the ecological value and amenity in this area and reconnect the ecosystems of the upper Mahurangi with the upper Kourawhero catchments. A more traditional approach to mitigation is likely to have resulted in the opportunity to enhance the overall ecological value being overlooked due to these two mitigation types being considered in isolation and a more fragmented approach being undertaken.

10.3.2. Mitigation focus areas

Five focus areas have been identified (refer drawings EM1-6 and PES 1-14 in *Volume 3: Drawing Set*) as being locations within the designation that are suitable for integrated mitigation to be delivered and where it will enhance existing high value areas/features. These areas/features can be enhanced through improving ecological linkages, providing buffer planting and supplementing the values to further reinforce their value. The focus areas are as follows:

- Warkworth interchange
- Kourawhero
- Tunnels location
- Hōteo River/Wellsford Interchange
- Alignment from Hōteo to Maeneene

The integrated outcomes that are sought to be achieved through the conditions are summarised as follows:

Warkworth Interchange

- Landscape planting to achieve screening from houses.
- Planting for visual mitigation of the interchange from surrounding view points in a manner that complements ecological mitigation.
- Protection of and enhancement of ecological linkages with existing SEAs along the Mahurangi River through linking riparian planting with landscape and ecological planting.
- Provision of ecological connections with existing covenanted bush to create ecological corridors.
- Integration of stormwater treatment wetlands into the overall Project design and mitigation/landscape planting to provide landscape character and biodiversity benefits.

Kourawhero

- Minimise effects on ecologically sensitive wetlands through the provision of a bridge (Bridge 22) to cross the Kourawhero Stream.
- Enhancing ecological linkages between wetlands through appropriate mitigation planting.
- Maintenance of hydraulic connectivity of waterbodies through placement and lowering of alignment height to minimise encroachment of embankments and stormwater wetland design and location.
- Restoration planting including regeneration of pre-development functions of wetlands
- Establishing ecological corridor linkages between the Mahurangi and Kourawhero catchments through landscape and ecological mitigation planting.
- Maintaining existing habitat over the top of tunnels as corridor for fauna including birds and bats.

Tunnels location

- Establish corridor to maintain an east-west connection enabling fauna and avifauna to traverse the Project.
- Provide for a potential fauna relocation area.
- Enhancement planting to connect this area to the existing remnant indigenous vegetation located south of the tunnel, which provides an ecological corridor and landscape connection along the Indicative Alignment.

The Hōteo River/Wellsford Interchange

- Linkage of landscape and ecological mitigation planting to the riparian margins of the Hōteo River and existing indigenous vegetation to reduce edge effects and connect and consolidate benefits.
- Planting in the Hōteo flood plain to reduce habitat fragmentation whilst not increasing the risk of adverse effects due to flooding.
- Minimise effects on ecologically sensitive areas, including existing SEA and high-value waterways (Hōteo River and Waiteraire Stream) through the provision of a viaduct structure (Bridge 11) crossing both the Hōteo River and Waiteraire Stream.
- Landscape planting providing visual mitigation for the interchange from surrounding viewing locations and to provide a broader amenity value.
- Integration of stormwater treatment wetlands into the overall Project design and mitigation/landscape planting to provide landscape character and biodiversity benefits.
- Introduction of a “gateway” to Wellsford which will be developed with the consideration of Mana Whenua values and the local community.

Alignment from Hōteo to Maeneene

- Riparian planting to reflect landscape character and improve ecological value along streams providing for Mana Whenua values.
- Inclusion of grass batter slopes and landscape planting that is consistent with the overall rural character along this section of the Indicative Alignment.
- Ecological planting to incorporate remnant native vegetation along Silver Hill Road.
- Minimise effects to Maeneene Stream through the provision of a bridge (Bridge 20).
- Complementary design and planting of stormwater treatment wetlands to be sympathetic to the rural landscape, provide visual amenity for road users/wider community and to provide ecological function.

10.3.3. Mitigation of effects from sediment within the marine environment

As discussed in section 9.2, there is the potential for sediment to be discharged into the Kaipara Inlet, the Ourawhero Inlet and the Mahurangi Harbour. To minimise the potential effects of this, the construction methodology will incorporate effective management and control of the earthwork activity through the implementation of best practice erosion and sediment control measures to minimise sediment release.

To measure any effects that may occur, the proposed conditions require the monitoring of sediment released at a representative number of devices specifically located to measure into these three locations.

As discussed in section 9.6, mitigation is required to respond to sediment discharge over 5% of the modelled baseline and to effects that are likely to occur during acute storm events (i.e. >10-year ARI in the Hōteo catchment and >10-year ARI in the Mahurangi catchment) should they occur during the construction period. The total quantum will be calculated after Project earthworks are complete to ensure that the mitigation response is directly attributable to the effects of the sediment in the marine environment and is a method that is both measurable and unambiguous.

The mitigation effort in response to any effects in the marine environment will include planting to support natural revegetation and stabilisation of stream banks to reduce erosion or retiring forestry that has not been clear felled. The location of any additional planting/land retirement will be considered in the context of 'integrated mitigation' to ensure that it will contribute to the integrated landscape, ecological, cultural and wider community benefits of the Project.

11. Statutory assessment

11.1. Introduction

This section sets out the assessment of the Project against the statutory requirements of sections 171, 104, 105 & 107 and Part 2, being sections 5 to 8 of the RMA.

11.2. Assessment of relevant provisions of planning documents

There are a number of provisions relevant to the Project and these are assessed below. The following sections provide an assessment of the Project against the relevant provisions of the following planning documents:

- New Zealand Coastal Policy Statement
- Hauraki Gulf Marine Park Act
- National Policy Statement for Freshwater Management
- National Policy Statement on Electricity Transmission
- National Policy Statement on Urban Development Capacity
- Auckland Unitary Plan – Regional Policy Statement
- Auckland Unitary Plan – Regional and Coastal Plan and Regional and District provisions

The assessment has been structured as follows:

- Infrastructure and transport
- Natural heritage
  - outstanding natural features
- Natural resources
  - water quality and quantity;
  - lakes, rivers, streams and wetlands;
  - land disturbance;
  - air quality; and
  - indigenous biodiversity
- Mana Whenua
- Built environment
  - heritage; and
  - noise and vibration
- Environmental risk
  - contaminated land;
  - hazardous substances;
  - natural hazards; and
  - flooding
- Rural environment
- Coastal environment
- Urban growth and form

11.2.1. Infrastructure and transport

Infrastructure

National Policy Statement (NPS) relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
NPSET Objective Policy 10	*RPS B3.2 – Infrastructure, transport and energy - Infrastructure* RPS B3.2.1 Objectives (1), (2), (3), (4), (5), (6), (7), (8) RPS B3.2.2 Policies (1), (2), (3), (6), (7), (8), (9) *AUP E26 - Infrastructure* AUP E26.2.1 Objectives (1), (2), (3), (4), (5), (7), (9) AUP E26.2.2 Policies (1), (2), (4), (5), (6) *AUP D26 – Infrastructure – National Grid Corridor Overlay* AUP D26.2 Objective (1) AUP D26.3 Policy (1)	The RPS and AUP(OP) recognise the importance of resilient, efficient and effective infrastructure (Objective B3.2.1(1)) in realising Auckland's full economic potential, including recognition of the functional and operational needs of infrastructure, integrating the provision of infrastructure with urban growth, while providing for the wellbeing of communities and protecting the quality of the natural environment. The development and upgrading of infrastructure is enabled through Policy B3.2.2(1). The objectives and policies anticipate development, operation, use and maintenance of infrastructure and acknowledge both the benefits infrastructure can have, as well as a range of adverse effects that can be created and that these are to be avoided, remedied or mitigated. Avoiding constraints on the operation of infrastructure arising from reverse sensitivity effects is recognised as essential. The Project is significant infrastructure that will provide essential services for the functioning of communities, businesses and industries within and beyond Auckland and Northland. One of the key benefits of the Project will be contributing to the economic growth of Auckland and Northland. Policy B3.2.2(6) seeks to enable the development, operation, maintenance and upgrading of infrastructure, including in areas with natural and physical resources that are scheduled in the Plan in relation to natural heritage, natural resources, coastal environment, historic heritage and special character; while ensuring adverse effects on the values of such areas are avoided where practicable or otherwise remedied or mitigated. The Project has largely avoided passing through identified overlay areas. Where the Project does pass through these areas, there are measures proposed that will appropriately mitigate adverse effects. These measures are outlined in section 10 above and the proposed conditions of designation and resource consent. The measures include recording heritage sites prior to construction, implementing best practise erosion and sediment control measures, treating road run off prior to discharging to the natural environment, and aggregated landscape, cultural, ecological and stormwater mitigation delivered through an integrated mitigation framework. The policies promote the safe and efficient operation of infrastructure. The Project interfaces with existing infrastructure, including land designated to protect that infrastructure. The co-location of

National Policy Statement (NPS) relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		infrastructure is encouraged through Policy B3.2.2(7). The Transport Agency is working with network utility operators to ensure protection of existing infrastructure and where required will develop solutions for any potential adverse effects on other network utilities to be agreed with those network utility operators. Conditions are proposed in response to this. As outlined under "Transport" below, the Project will deliver significant transport benefits. The Project incorporates a wide range of mitigation for the potential adverse effects on people and communities. The Project passes through the National Grid Corridor Overlay. Following the direction of the NPSET, the RPS and AUP(OP) seek that the national significance of the National Grid is recognised and provided for and adverse effects from development in proximity to the National Grid are managed. The Project has sought to minimise the impact on transmission assets, and the Indicative Alignment requires the installation of an additional transmission line support structure in order to comply with the clearance requirements in NZECP34:2001. Having particular regard to the NPSET, the Transport Agency and Transpower have been working together to identify a solution for the impact of the Project on the transmission network which appropriately manages adverse effects and maintains security of supply. The details of this will be developed further in consultation with Transpower. Ongoing access to transmission lines and support structures for maintenance and upgrading will not be compromised by the Project. In addition, effects on transmission lines from dust emissions during construction and ground settlement have been assessed as minor and will be appropriately managed in consultation with Transpower. The Project is consistent with the objectives and policies in the NPSET, RPS and AUP(OP) in relation to infrastructure as set out above.

Transport

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*RPS B3.3 – Infrastructure, transport and energy - Transport* RPS B3.3.1 Objective (1) RPS B3.3.2 Policies (1), (2), (3), (4), (7) *AUP E26 - Infrastructure* AUP E26.2.1 Objectives (1), (2), (3), (4), (5), (6), (7), (9) AUP E26.2.2 Policies (14), (15) *AUP E27 - Transport* AUP E27.2.1 Objectives (1), (2)	The RPS and AUP(OP) seek an effective, efficient and safe transport network that supports the movement of people, goods and services, integrates with and supports a quality compact urban form, enables growth, facilitates transport choices while avoiding, remedying or mitigating adverse effects on the quality of the environment and amenity values and the health and safety of people and communities (Objective B3.3.1(1)). The Project is an integral component of the state highway network that promotes the safe and efficient movement of people, goods and services throughout the Region. The Project has been designed, located and managed to integrate with adjacent land uses and support future growth areas. It avoids outstanding natural areas and will minimise impacts on significant ecological areas and heritage sites. The Project will deliver significant transport benefits. It will: • Increase corridor access, improve route quality and safety, and improve freight movement between Warkworth and the Northland Region; • Provide resilience in the wider State highway network; • Improve travel time reliability between Warkworth, Wellsford and the Northland Region; • Provide connections to and from Warkworth, Wellsford and Te Hana; • Provide a connection at Warkworth that optimises the use of infrastructure from, and maintains the level of service provided by, the Pūhoi to Warkworth project; and • Alleviate congestion at Wellsford by providing an alternative route for north – south through traffic. The operation of the Project has been designed to comply with the relevant criteria of NZS 6806 and air quality standards. Effects arising from the predicted increase in noise levels will be mitigated to an appropriate level by using the BPO approach as detailed in section **Error! Reference source not found.** of this AEE. The emissions arising from the Project will not exceed the relevant air quality guidelines and standards. The policies seek to ensure roads are designed, located and constructed to provide for all users and transport modes while avoiding, remedying or mitigating effects on the amenity values of adjoining properties. Whilst noting that adverse construction effects are part of infrastructure construction, the policies seek to avoid, remedy or mitigate adverse construction effects including effects of vibration, noise and dust. Construction noise, vibration and dust effects

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		assessment is detailed in sections 9.8 and 9.9 of this AEE. Mitigation of adverse effects associated with the construction of the Project is proposed through the implementation of best practice approaches such as construction management plans and will be achieved through implementation of proposed designation and resource consent conditions. The construction of the Project has the potential to impact on the surrounding transport network and will be mitigated and managed as far as practicable though the implementation of a CTMP and SSTMPs. The Project is consistent with the objectives and policies of the RPS and AUP(OP) in relation to transport and transport infrastructure as set out above.

11.2.2. Natural resources

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
NPSFM Objectives A1, A2, A3, A4 C1, C2 D1	*RPS B7 - Toitū te whenua, toitū te taiao – Natural resources* *RPS B7.3 – Freshwater systems* RPS B7.3.1 Objectives (1), (2), (3) RPS B7.3.2 Policies (1), (4), (5), (6) *RPS B7.4 - Coastal water, freshwater and geothermal water* RPS B7.4.1 Objectives (2), (4), (5), (6) RPS B.7.4.2 Policies (1), (2), (3), (4), (5), (6), (7), (8), (9)	**RPS** The objectives of the RPS, supported by the objectives of the AUP(OP), seek to enhance degraded freshwater systems (through progressive improvement over time) (B7.3.2(1) & B7.4.1(2)) and maintain the quality of freshwater where it is excellent or good (B7.4.1(2)), including through progressive reduction of existing adverse effects. RPS Policy B7.3.2(1) (supported by B7.3.2(3) and B7.4.2(1)) seeks to achieve these outcomes through integrated management of use and development of freshwater systems by the following: • Controlling the use of land and discharges to minimise the adverse effects of runoff on freshwater systems and progressively reduce existing adverse effects where those systems are degraded, and • Avoiding development where it will significantly increase adverse effects on freshwater systems, unless these adverse effects can be adequately mitigated. The intent of this policy is met, as the Project has been designed such that the adverse effects of stormwater discharges on freshwater are minimised through treatment methods (elaborated below). It is considered that existing adverse effects will be reduced through removing traffic from the existing SH1 which provides limited treatment, as well as mitigation planting for the Project. It is noted that the upgrades to SH1 undertaken by the SRA will include additional stormwater treatment. This will include a reduction in contaminants entering the receiving

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	AUP(OP) E1 – Natural resources – Water quality AUP E1.2 Objectives (1), (2) AUP E1.3 Policies (1), (2), (4), (5), (8), (10), (11), (12), (13), (14), (26) *AUP(OP) D3 – Natural resources – High-use Stream Management Area Overlay* AUP D3.2 Objective (1) AUP D3.3 Policy (3) *AUP(OP) D4 – Natural Resources – Natural Stream Management Area Overlay* AUP D4.2 Objective (1) AUP D4.3 Policy (2)	environment, however this treatment will still be limited and the progressive reduction in traffic from the existing SH1 will result in further positive effects. Objective B7.3.2(3) and B7.4.1(5) seek to avoid, remedy or mitigate the adverse effects of changes in land use on freshwater, including through managing effects on rivers, streams and wetlands (assessed under "Lakes, rivers, streams and wetlands"); managing discharges of contaminants to water to avoid (where practicable) or minimise significant bacterial contamination, adverse effects on water quality, adverse effects on Mana Whenua values and adverse effects on the water quality of catchments that provide water for domestic supply; and minimising generation and discharges of contaminants from stormwater and adopting the best practicable option for every stormwater diversion and discharge. The *Water Assessment Report* and ecology assessment reports have provided an assessment of the effects of the Project on water quality during construction and operation. Based on the conclusions of these assessments and consideration of the relevant objectives and policies relating to water quality (B7.4.1 and B7.4.2), it is considered that adverse effects on water quality, mana whenua values and domestic supply water takes will be minimised through implementation of the following: • Best practice standards appropriate to the nature and scale of the disturbance activity and sensitivity of the receiving environment will be utilised to minimise the effects of discharges of sediment during construction. • The best practicable option of utilising stormwater treatment wetlands (based on GD01) has been adopted to reduce contaminant load in stormwater discharges. The predicted increase in contaminant levels associated with the Project is not expected to result in the freshwater quality exceeding the guideline trigger values for 95% level of species protection in freshwaters, provided stormwater runoff is treated to the standard assumed in the assessment. The Project provides for the management of gross stormwater pollutants, such as litter. • Providing for detention and controlled release on site (explained in further detail under "Water quantity" statutory assessment) to minimise flood risks. • Watercare has a water take downstream of proposed discharge point on the Hōteo River for the Wellsford water supply. Any effects on the health of people and communities resulting from the discharges have been assessed as no more than minor, and a proposed condition requires notification to Watercare in the event of a spill event.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		No significant adverse effects on the life supporting capacity of freshwater, including any ecosystems, have been identified. Objective B7.4.1(6) of the RPS seeks to recognise and provide for Mana Whenua values associated with freshwater, including their traditional and cultural uses and values. The Project seeks to address Mana Whenua values through engagement and incorporating mitigation to address and reinforce Mana Whenua values. The Project has adopted the Ki Uta Ki Tai concept to inform the mitigation framework, which will assist to re-establish key landscape and ecological linkages that contribute to restore the “mountain to the sea” relationship. **AUP(OP)** Objective E1.2(2) of the AUP seeks to maintain or progressively improve the mauri of freshwater over time to enable traditional and cultural use of the resource by Mana Whenua. Adverse effects on Mana Whenua values associated with freshwater are discussed below under the “Mana whenua” statutory assessment. The Project is located within a High-use Stream Management Area (Mahurangi River) and is located upstream of the Whangaripo Stream High-use Stream Management Area. With regards to water quantity, the policies (especially D3.3.2) seek to safeguard the life-supporting capacity and amenity values of the streams and avoid as far as practicable and otherwise remedy or mitigate adverse effects on other uses of the stream and, in particular, avoid reducing the stream’s assimilative capacity as far as practicable from proposals to discharge contaminants into high-use streams. The Project will not alter the flow regime of the stream systems to any noticeable extent. Two localised sections of the Project are located within Natural Stream Management Area (NSMA) Overlays. These areas are near the Warkworth Interchange (with two ramps crossing a NSMA along the Mahurangi River, and in the vicinity of the Hōteo River crossing. At the Hōteo River there is a NSMA both east and west of the Indicative Alignment. The NSMA to the west will be avoided through design and appropriate conditions of designation. In addition, the project includes bridges over the Mahurangi (left branch) River, avoiding works within the beds of streams/rivers in the NSMA. The NSMA that is shown on the Hōteo River within the proposed designation has been assessed as not meeting the criteria to qualify as an NSMA under the AUP (OP).

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		The AUP(OP) objectives and policies relating to water quality in these areas seek to protect these areas and allow contaminant discharges only where they are of a scale and type that protects the in-stream values of these rivers and streams. The measures outlined above will minimise effects of contaminant discharges on water quality in the NSMAs which have been assessed to be within the tolerances of the receiving environment. The quality of water in the coastal environment is assessed under "Coastal environment". In summary, the Project will utilise best practice techniques to manage sediment which is predicted to result in a minor to negligible change in marine sediment quality in the estuarine receiving environments, when considered in conjunction with the existing sediment quality within the Kaipara and Mahurangi Harbours. With the measures discussed above in place adverse effects from discharges of sediment and contaminants on freshwater quality will be minimised such that effects on freshwater and associated ecosystems are no more than minor. The Project is consistent with this policy framework. **NPSFM** The NPSFM seeks to safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems and the health of people and communities through management of the use and development of land and discharges of contaminants. The overall quality of freshwater is to be maintained or improved while protecting significant values. The policies set directions to regional councils to achieve the objectives of the NPSFM. Policy A4 sets out the matters the consent authority must have regard to when considering consent applications. Based on the conclusions of the *Water Assessment* and as outlined in section 9.5 above, in responding to these matters, the values of the freshwater bodies are appropriately maintained, and through proposed mitigation enhanced, and effects associated with stormwater discharges to the receiving environment during construction and operation are minor on the life-supporting capacity of freshwater, including ecosystems, and on the health of people and communities as affected by their contact with fresh water.

Water quantity - Freshwater

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
NPSFM B. Water Quantity Objectives (B1), (B4) & (B5)[89]	*RPS B7 Toitū te whenua, toitū te taiao – Natural resources* *B7.4 Coastal Water, freshwater and geothermal water* RPS B7.4.1 Objectives (1) & (5) RPS B7.4.2 Policies (7) & (11) *AUP(OP) D1 High-use Aquifer Management Areas Overlay* AUP(OP) D1.2. Objective (1) AUP(OP) D1.3 Policy (1) *AUP(OP) E2 Water Quantity, allocation and Use* AUP(OP) E2.2. Objectives (1), (2), (4) and (5) AUP(OP) E2.3 Policies (6), (7), (8), (13), (14), (17), (22) and (23)	The RPS and AUP(OP) freshwater water objectives and policies seek to manage water availability and maintain base flows for surface streams in High-use Aquifer Management Areas and manage development to facilitate the drainage function of freshwater systems while retaining the natural, recreational and amenity values of the system. The AUP(OP) water quality, allocation and use objectives and policies seek to ensure that the diversion of surface and groundwater avoids significant adverse effects and manages the effects on lakes, rivers, streams, springs, wetlands and aquifers. The policies also require consideration of mitigation options, the NPSFM, the consent duration and comprehensive review of consents, existing lawfully established water takes and flood hazard and stability risks and, in the allocation, diversion and use of water resources acknowledges Mana Whenua values. The effects of the Project on consented and domestic water takes within the Mahurangi Waitematā High-use Aquifer Management Area have been assessed. As there are no substantial cuts proposed in this area there will be no effect on existing groundwater users from the proposed construction and operation of the Project. Drawdown from the proposed cuts and tunnel is confined to a narrow corridor parallel to the Indicative Alignment and is typical of construction dewatering effects within low permeability materials. There will be negligible impact on either existing groundwater users or groundwater dependent ecosystems outside of this area. The Project does not “use” water, but does divert watercourses, with potential effects on downstream freshwater systems. The effects on surface water and groundwater from diversions are minimal and localised with any groundwater diversions being contained within the Project’s surface water drainage system and subsequently discharged to downstream surface water bodies. The effects on wetlands within the Project area and maintaining their connectivity and functionality within the wider groundwater, surface water and ecological context has been assessed in the *Hydrogeology Assessment* and the *Ecology Assessment Report*. The Project has been designed to minimise changes in hydrology and avoid effects, however it will result in small localised increases in imperviousness, changes in catchment area and surface flows due to diversions and changes in flow routes. The stormwater design has avoided most changes in

[89] Note, no permits to take water are being sought as part of the Project. Therefore, Policy B7 is not applicable to this assessment.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	AUP(OP) E7 Taking, damming and diversion of water and drilling AUP E7.2. Objectives (1), (2), (4) and (5) AUP E7.3 Policies (6), (7), (8), (13), (14), (22) and (23)	flows by locating culvert crossings to maintain the existing drainage patterns where possible and limiting the number of stream diversions. Where stream diversions are proposed, these will be appropriately designed as described in section 5 of this AEE. The NPSFM provides "a National Objectives Framework to assist regional councils and communities to more consistently and transparently plan for freshwater objectives"[90]. The NPSFM directs regional councils, in consultation with their communities, to set objectives for the state of fresh water bodies in their regions and to set limits on resource use to meet these objectives, which include objectives and policies relating to water quantity. The *Hydrogeology Assessment* technical report has assessed the existing values and effects on surface water and groundwater of the Project. That assessment did not identify any significant effects on water quantity, including potential effects on bores in the vicinity of the proposed designation. The *Ecology Assessment* did not identify any effects on indigenous species or ecosystems that could not be adequately mitigated. The Project will be consistent with the water quantity objectives and policies of the NPSFM, RPS and AUP (OP).

Lakes, rivers, streams and wetlands

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	RPS B7 - Toitū te whenua, toitū te taiao – Natural resources *RPS B7.3 – Natural resources – Freshwater systems* RPS B7.3.1 Objective (2) RPS B7.3.2 Policies (4), (5), (6)	Objective B7.3.2(2) of the RPS seeks to minimise the loss of freshwater systems. This is to be achieved through Policy B7.3.2(4) which requires the avoidance of the permanent loss and significant modification or diversion of rivers, streams and wetlands, unless <u>all</u> of the following apply: • it is necessary to provide for infrastructure, • no practicable alternative exists, • mitigation measures are implemented to address the adverse effects arising from the loss in freshwater system functions and values, and

[90] National Policy Statement for Freshwater Management 2014 (updated 2017) preamble pg 4

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	AUP E1 – Natural resources – Water quality AUP E1.2 Objectives (1), (2) AUP E1.3 Policies (2), (8), and (10) *AUP E3 – Natural resources – Lakes, rivers, streams and wetlands* AUP E3.2 Objectives (1), (2), (3), (4), (5) AUP E3.3 Policies (1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (15) *AUP D3 – Natural resources – High-use Stream Management Area Overlay* AUP D3.2 Objective (1) AUP D3.3 Policies (1), (2), (3) *AUP D4 – Natural Resources – Natural Stream Management Area Overlay*	• where adverse effects cannot be adequately mitigated environmental benefits are provided. Notably policy B7.3.2(4) seeks to avoid the permanent loss and significant modification or diversions of rivers, streams and wetlands unless four criteria are met. Taking the four criteria into account, the Project has had regard to the need to avoid permanent loss and significant modification. Overall the Project is consistent with the policy as follows: • The Project is necessary to provide for infrastructure (B6.3.2(4)(a)(iv)), as evidenced by the description of the environment in section 2.4 of this AEE and the consideration of alternatives in section 7 of this AEE; • As is often the case with linear infrastructure, particularly over a 26 kilometre stretch of highway, it would be extremely difficult to avoid all rivers, streams and/or wetlands. Additionally, no practicable alternative road alignment exists that could achieve avoidance of rivers, streams and wetlands (B6.3.2(4)(b)); • The mitigation measures proposed will mitigate for the loss of freshwater systems, and notably seek to enhance the overall mitigation through consolidating locations and establishing longer term ecological benefits (B6.3.2(4)(c)); and • The adverse effects can be adequately mitigated (B6.3.2(4)(d)). Based on the relevant technical assessments and the analysis above, the Project is consistent with policy B7.3.2(4). Policy B7.3.2(5) of the RPS seeks to manage discharges and activities in the beds of rivers, streams and wetlands to protect identified Natural Stream Management Areas (NSMAs) and to maintain or where appropriate enhance areas of significant indigenous biodiversity. This is supported by Policy E3.3(1) of the AUP(OP) which requires the avoidance of significant adverse effects and where practicable, to remedy or mitigate adverse effects on NSMAs and SEAs. There are no Wetland Management Areas within the proposed designation. Through a comprehensive corridor and route selection process as outlined in section 7 of this AEE these overlay areas were avoided where practicable. It would be extremely difficult for such a significant linear project to avoid all NSMA and SEA areas. The design has sought to avoid directly affecting these areas, however where it was not practicable (due to space and operational constraints), significant adverse effects have been avoided. Bridge structures have been designed over these overlay areas and riparian vegetation loss has been minimised where practicable and no structures will be located within the bed of a river (piers/culverts) within these overlays. There will be some temporary adverse effects on these overlay areas during construction, however

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	AUP D4.2 Objective (1) AUP D4.3 Policies (1), (2), (3), (4), (5)	construction methodologies and areas will as far as practicable be avoided minimising these effects, along with mitigation planting. The effects and the mitigation proposed for them are consistent with this policy. Policy E3.3(5) of the AUP seeks to avoid significant adverse effects, and avoid, remedy or mitigate other adverse effects of activities in, on, under or over the beds of rivers, streams or wetlands on the mauri of freshwater and mana whenua values. The AUP(OP) provides guidance in areas outside SEA and NSMA overlays and culturally sensitive areas and notes that adverse effects should be avoided where practicable or otherwise mitigated and where appropriate rivers, streams and wetlands should be enhanced. No significant adverse effects are identified associated with activities in the beds of rivers, streams and wetlands. Erosion and modification of the beds and banks will be minimised through erosion control (for example through installing energy dissipation at culvert and stormwater outfalls), structures within the beds of streams have been limited to those that have a functional need or operational requirement. No significant residual adverse effects have been identified. The Project does not require reclamation of stream beds beyond that for the road alignment. The Project maintains stream flow through culverts and stream diversions. Whilst avoided as far as practicable, the Project will have adverse effects on wetland remnants of high value that will have portions of their current extent permanently removed. The wetlands within the Kourawhero stream catchment will be impacted by the road embankment and by stream diversions. Significant effects on wetlands in this area have been avoided by proposing a bridge crossing the Kourawhero, which is reflected in the proposed conditions, to ensure maintenance of the hydrologic connection. In addition, the Project will include the enhancement and reinstatement of lowland wetland which will further mitigate effects to wetlands. The Project also includes stormwater treatment wetlands which, through considered placement, will assist in maintaining the hydrologic function of the existing wetlands. In addition, the incorporation of ecological and biodiversity function into the design of stormwater treatment wetlands will provide wetland habitat and associated ecological benefits. The Project meets the requirements of Objective E3.2(5) and Policy E3.3(7) of the AUP(OP), seeking to minimise effects of activities, in, on under or over the bed as structures and stream diversions will meet all of the following: • No piers will be located in the bed of a river; • Structures will be designed to be the minimum size necessary for their purpose,

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		• Structures will be designed to avoid creating or increasing a hazard • The proposed stream structures are associated with infrastructure; • Structures avoid significant adverse effects and avoid, remedy or mitigate other adverse effects on mana whenua values. With respect to the soil disposal sites, these are an integral part of any large roading project, and it is not practicable to dispose of large quantities of soil outside the proposed designation. The adverse effects of the soil disposal sites have been assessed and the effects can be adequately mitigated. The soil disposal sites are not located within the bed of a stream and no consents are sought that would enable the placement of soil not required for the Project within the beds of permanent or intermittent watercourses. The proposal to divert watercourses and to recreate the stream bed provides an opportunity to create habitat that in the longer term will provide some ecosystem value, where this would otherwise be lost beneath the soil disposal site. The intent of Policy E3.3(15) of the AUP(OP), which seeks to protect riparian margins, will be met for the Project. While some areas of existing riparian vegetation will be removed as part of the construction of the Project, as discussed in Section 9 and 10 of this AEE, proposed conditions of consent and designation require extensive ecological planting, including along riparian edges to mitigate for this loss to safeguard habitats for fish, plant and other aquatic species, aesthetic and landscape values, contribute to biodiversity, resilience and integrity of ecosystems. The Natural Steam Management Area (NSMA) applies to a small stretch of Mahurangi River (within the proposed designation under the proposed Warkworth Interchange), and parts of the Hōteo River (downstream of the proposed designation). The Project meets the policy requirements of D4.3, in relation to NSMAs, by protecting the instream values and riparian margins as follows: • Stormwater contaminant discharges are of a scale and type that will still protect the in-stream values of the Mahurangi and Hōteo Rivers, • Fish passage between the CMA and upstream extent will be maintained, • Structures within NSMAs will be avoided that would disturb, damage, remove or replace the natural bed and course and associated riparian vegetation. Bridge structures across the Mahurangi and Hōteo Rivers will be designed to exclude structures within the bed avoiding disturbance and damage or removing or replacement of the natural bed or course. This is supported by proposed conditions of the designation and the resource consent. With respect to the NSMA, the Project would not have an effect significant enough to result in the NSMA no longer meeting the required definition in the AUP(OP). The policy framework (D4.3(5)) specifically anticipates and addresses instances where the development of infrastructure is

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		appropriate in these areas where there is a functional or operational need and there is no practicable alternative. Area sensitive overlays identified in the AUP(OP) were avoided to the extent practicable when defining the extent of the designation and assessing alternative options. The proposed mitigation framework is set out in section 10 of this AEE. The Project is located within a High-Use Stream Management Area (HUSMA) overlay. No water takes are proposed from streams within the Mahurangi catchment. Discharges into high use streams are assessed under sections 9.12 and 9.2 which concludes that while stormwater discharges to the Mahurangi River are not avoided, mitigation measures proposed during construction and operation will minimise effects of contaminant discharges on water quality in the HUSMAs which have been assessed as minor. As discussed in detail under section 9.18 Cultural Values, adverse effects on cultural heritage will be managed through initiatives and conditions that respond to Mana Whenua values, including involvement in the development of the ULDF and other management plans, and the identification of cultural indicators for referencing through the Project development. The proposed mitigation and delivery framework is set out in Section 10 and includes proposed conditions requiring compliance with accidental discovery protocols, design requirements and the mitigation proposed. The NPS FM has an objective (B4) to "protect significant values of wetlands and of outstanding freshwater bodies". This objective is in relation to water quantity and is discussed above. The Project is consistent with the objectives and policies of the RPS and AUP(OP) relating to lakes, rivers, streams and wetlands.

Land disturbance

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*RPS B7 - Toitū te whenua, toitū te taiao – Natural resources* *RPS B7.4 – Coastal water, freshwater and geothermal water*	Policy B7.4.2(8) of the RPS seeks to minimise the loss of sediment from subdivision, use and development, and manage the discharge of sediment into freshwater and coastal water by requiring land disturbing activities to use industry best practice and standards appropriate to the nature and scale of the land disturbing activity and the sensitivity of the receiving environment. The Project approach to the management of sediment during construction has been to minimise sediment generation from earthworks activities through implementing ESC measures in accordance with Transport Agency guidelines, TP 90 and GD05 which are industry best practice.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	RPS B7.4.2 Policy (8) *AUP E11 – Land disturbance (regional)* AUP E11.2. Objectives (1) & (2) AUP E11.3 Policies (1), (2), (3), (4), (5), (6), (7) *AUP E12 – Land disturbance (district)* AUP E12.2 Objective (1) AUP E12.3 Policies (1), (2), (3), (4), (5), (6)	The objectives of the AUP(OP) seek to ensure land disturbance is undertaken in a manner that protects the safety of people and avoids, remedies and mitigates adverse effects on the environment. In particular, through minimising sediment generation from land disturbance. To achieve these objectives, policies E11.3(1) and E12.3(1) require land disturbance within scheduled natural and physical resources to be avoided, where practicable, or otherwise mitigated. The alternatives assessment process as set out in section 7 of this AEE identifies the steps taken to avoid, where practicable, areas of natural and physical resources scheduled in the AUP(OP). Within the proposed designation, where land disturbance cannot be practicably avoided in NSMA and SEAs, this policy is addressed through identification of careful management of those parts of the Project that operationally must encroach on the NSMA and SEAs throughout the corridor, and through measures proposed to mitigate effects of land disturbance on these sites by Project design (i.e. bridge instead of culvert) and implementation of erosion and sediment controls. Land disturbance during construction will result in the discharge of sediment laden water to surface waterbodies and coastal waterbodies. Policy E11.3(7) requires that land disturbance that will likely result in the discharge of sediment laden water to a surface water body or to coastal water to demonstrate that sediment discharge has been minimised to the extent practicable, having regard to the quality of the environment with significant adverse effects to be avoided, and other effects avoided, remedied or mitigated in areas of relevance to Mana Whenua, where there is collection of fish or shellfish or a downstream receiving environment sensitive to sediment accumulation. With the adoption of best practice erosion and sediment control and other mitigation measures in place, the *Water Assessment Report* considers effects associated with construction and operation water will be minor on these receiving environments. The *Marine Ecology and Coastal Avifauna Assessment* has concluded that the effect of sediment deposition on marine ecological values and avifauna from the 10 year or larger ARI event in the Hōteo Inlet and 30 year or larger ARI event in the Mahurangi upper harbour will result in effects that range from very low to moderate[91] which is assessed as significant. Cumulative effects on the Mahurangi and Kaipara Harbours are assessed as being negligible on marine ecological values and relatively insignificant on the lifespan of the harbours themselves. The Project will adopt best practice erosion and sediment control measures including progressive stabilisation, and the circumstances that would give rise to a significant effect on marine ecological values require storm events to occur without warning or peremptory measures being taken, the risk

[91] Based on EIANZ criteria, Table 16 Marine Ecology and Coastal Avifauna Assessment

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		of a significant effect has a very low probability. The Project is not incongruent to the policy direction. Sensitive receiving surface waterbodies and coastal waterbodies have been identified within the AEE and where practicable, adverse effects will be avoided as far as practicable through the implementation of best practice ESC measures including the avoidance of discharges to freshwater systems (where practicable). In addition, the project includes the bridging of approximately eight bridges/viaducts over watercourses, avoiding works within sensitive watercourses. Additional ESC measures include discharging sediment downstream from ecological features, including wetlands, progressive stabilisation, refining the construction sequencing and programme to minimise risk and the potential winter close-down in areas of high risk. Adverse effects within areas identified as sensitive because of their ecological values (terrestrial, freshwater and coastal) must be avoided as far as practicable. The Project responds to this policy as the *Marine Ecology and Coastal Avifauna Report* and the *Catchment Sediment Modelling Technical Report* confirmed that while sediment will potentially reach the middle and lower reaches of the Mahurangi (downstream of Hamilton's Landing) and Kaipara Harbour (downstream of Port Albert within the Oruawharo River and downstream of the mouth of the Hōteo River) which have been identified as sensitive to sediment deposition, the effect on the areas of deposition will be less than minor overall. Land disturbance will be managed to retain soil and sediment on the land by implementing best practicable options for sediment and erosion control that are appropriate to the nature and scale of the activity; manage the amount of open area disturbed; avoid, remedy or mitigate effects on accidentally discovered artefacts or ko iwi; and maintain the cultural and spiritual values of mana whenua. Section 10 outlines the mechanisms proposed to manage effects of sediment generation such as open area limits, stabilisation requirements and limited works during winter. Protocols will be in place during construction to manage accidental discovery of ko iwi, archaeology and artefacts of Māori origin. The assessment of cultural effects (section **Error! Reference source not found.** of t his AEE) concludes in relation to cultural and spiritual values effects can be adequately mitigated through aligning with "Ki Uta Ki Tai", ongoing engagement and participation in aspects of the Project relating to exercise of kaitiaki and cultural values. The AUP(OP) enables land disturbance necessary for a range of activities undertaken to provide for people and communities' social, economic and cultural well-being and their health and safety. The Project will provide for people and communities social, economic and cultural well-being.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		All earthworks activities will be designed and undertaken in a manner that ensures the stability and safety of surrounding land, buildings and structures, in particular existing network utility assets. The project has been evaluated against the objectives and policies of the RPS and AUP(OP) and is consistent with these provisions as demonstrated above.

Air Quality

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*RPS B7 Toitū te whenua, toitū te taiao – Natural resources* *RPS B7.5 - Air* RPS B7.5.1 Objectives (1), (2) & (3) RPS B7.5.2 Policy (1) *AUP E14 – Natural resources – Air quality* AUP E14.2. Objectives (1), (2), (3) & (4) AUP E14.3 Policies (1), (2), (3), (6), (8), (9)	The RPS and AUP(OP) seek to manage discharge of contaminants to air to maintain air quality at appropriate levels, while enabling infrastructure by providing for reduced ambient air quality amenity in appropriate locations. The policy recognises that air quality in rural areas is generally reduced through emissions generated by dust, odour and rural production activities and seeks to provide for minor and localised elevation of dust where the air discharge is from the operation of infrastructure or rural industries. <u>Discharge of contaminants during construction</u> Policy 14.3 states that discharges of contaminants to air from industrial activities in rural zones are to be avoided, unless it relates to certain activities. The rock borrow activities (mineral extraction and rock crushing activities) are a rural industry activity and are provided for in Policy 14.3(3) as the quarried material is a natural resource from the site, will only be used for on-site purposes. Furthermore, the activity will be temporary for uses ancillary to the construction of the Project. Policy B7.5.2(1) seeks to enable the development of infrastructure whilst managing the discharge of contaminants to air. Effects arising from discharges associated with these activities will be managed through the CAQMP. Based on section 9.9 of this AEE and having regard to the relevant provisions as outlined above, it is considered that the dust emissions associated with construction of the Project will be appropriately managed, consistent with the relevant objectives and policies of the RPS and AUP(OP). <u>Discharge of contaminants during operation</u> Human health, property and the environment will be protected from significant adverse effects, as required by Objective E14.2(2), and as outlined in section 9.16 of this AEE, the Project will comply with relevant air quality guidelines and standards, in particular the Auckland Ambient Air Quality

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		Targets (AAAQTs) and the National Environmental Standards for Air Quality (NESAQ). HSRs potentially affected by the Project operation have negligible increases in 24-hour average PM_{10} and $PM_{2.5}$, and a small increase in annual mean NO_2 but these effects are considered to be less than minor. The tunnel discharges are not expected to impact on the local air quality. While air quality in rural areas is to be maintained at appropriate levels, the Project is facilitated by Objective 7.5.1(2) of the RPS which seeks to enable infrastructure by providing for reduced ambient air quality amenity in appropriate locations. The Project will improve air quality at locations along the existing SH1, particularly at Wellsford and Te Hana where exposure to air contaminants will be reduced compared to the 'without Project' scenario. The Project will be consistent with the air quality objectives and policies of the RPS and AUP(OP).

Indigenous biodiversity - terrestrial

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	RPS B7 Toitū te whenua, toitū te taiao – Natural resources *B7.2 - Indigenous biodiversity* RPS B7.2.1 Objectives (1) & (2) RPS B7.2.2 Policy (5) *AUP D9 Natural resources - Significant Ecological Areas Overlay* AUP D9.2 Objectives (1), (2) & (3)	The RPS indigenous biodiversity objectives seek the protection and enhancement of significant ecological areas and indigenous biodiversity. The relevant objectives and policies of the Regional Plan and in SEA Overlays seek the protection and enhancement of areas of significant biodiversity value, the recognition and provision for the relationship of Mana Whenua to indigenous vegetation and fauna, managing effects by avoiding in the first instance, remedying, mitigating, and potential offsetting, m whilst acknowledging the practicable need to locate infrastructure, and avoidance of adverse effects on SEAs in the coastal environment. Policies D9.3(1) (b) to (d) outline this hierarchy, and step through the options, finishing with the consideration of offsetting residual adverse effects where mitigation is not available. Based on the discussion in sections 9.5 and 10 of this AEE, the effects on SEAs will be adequately mitigated, and this policy is satisfied. Policy D9.3 (8) specifically seeks to manage the adverse effects from the use, maintenance, upgrade and development of infrastructure while recognising that it is not always practicable to locate and design infrastructure to avoid significant ecological areas.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	AUP D9.3 Policies (1)(b) to (d), and (8) *AUP E15 Natural resources - Vegetation management and biodiversity* AUP E15.2 Objectives (1) & (2) AUP E15.3 Policies (1) to (4) & (6) to (8) NOTE: Regional coastal plan [rcp] objectives and policies are not operative until the Minister of Conservation has formally approved the regional coastal plan part of the Auckland Unitary Plan. NOTE: Policy E15.3 (4) (a) is subject to appeal and is not operative, it relates to using transferable rural site subdivision to protect areas identified as SEA–Terrestrial and is therefore not relevant to this application.	The regional plan and district plan vegetation management and biodiversity objectives and policies seek the maintenance and enhancement of values and areas while providing for appropriate use and development, restoration and enhancement of degraded areas, protection of contiguous vegetation cover in sensitive environments, management of effects to avoid adverse effects on biodiversity values (as far as practicable), offsetting of significant effects, enabling vegetation management, and recognition that infrastructure cannot always avoid areas of indigenous biodiversity. There are also policies that seek to manage and control kauri dieback to maintain indigenous biodiversity. Policy E15.3 (7) specifically seeks to manage the adverse effects from the use, maintenance, upgrading and development of infrastructure while recognising that it is not always practicable to locate and design infrastructure to avoid areas with indigenous biodiversity values. Surveys were undertaken as part of the *Ecology Assessment* to determine the terrestrial, wetland, fauna and freshwater ecological values of the SEA's identified in the AUP(OP) and other representative areas of potential ecological significance. Effects have been minimised where practicable through the avoidance of sites of high to very high ecological value in identifying the proposed designation boundary and the careful placement of the Indicative Alignment in specific locations. Where ecological effects cannot be avoided the approach to minimising impacts has included the indicative design of the viaduct over the Hōteo River and bridges to protect significant ecological areas and watercourses of high ecological value and appropriate mitigation put in place for residual effects. Overall the effects on terrestrial, wetland, fauna and freshwater ecological values are avoided through limitations on shifting in the Indicative Alignment in particular locations or mitigated through the implementation of the mitigation strategy outlined in the *Ecology Assessment* and section 9 and 10 of this AEE. The strategy includes maintaining or enhancing the adaptive capacity of the environment. It ensures that the mitigation for adverse effects focuses on revegetating a few key large areas where ecological and landscape values exist. This approach will create resilient and ecologically valuable mitigation areas that will increase benefits over time. The approach will also maximise environmental outcomes and benefits for habitat, hydrology and aesthetics. Based on the recommendations of the *Ecology Assessment* and the integrated mitigation strategy outlined, adverse ecological effects of construction and operational Project activities including vegetation clearance, bulk earthworks and stream diversion on SEAs will be minimised though implementation of best practice techniques of sediment control during construction and stormwater treatment during operation. Mitigation for stream loss will include riparian wetland restoration and

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		enhancement. The impact on fauna will be managed through best practice salvage and relocation. Relocation will occur as close to the areas of habitat loss as possible, and within the revegetated and regrowth areas identified for the terrestrial ecological mitigation. Ecological management plans will be prepared to provide detail of revegetated and regrowth areas; riparian and wetland enhancement; fauna surveys, capture and relocation; timing/staging of vegetation clearance and habitat removal; biosecurity management (including pest and weed, kauri dieback and myrtle rust). With the mitigation as proposed in place the adverse effects from the Project will be minimised such that Project will be consistent with the relevant objectives and policies.

Indigenous biodiversity - Coastal

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
NZCPS Policy 11	*RPS B7 Toitū te whenua, toitū te taiao - Natural resources* *RPS B7.2 Natural resources - Indigenous biodiversity* RPS B7.2.1 Objectives (1) & (2) RPS B7.2.2 Policy (5) *RPS B8 Toitū te taiwhenua - Coastal environment* *RPS B8.5 Coastal Environment - Managing the*	The RPS indigenous biodiversity objectives seek the protection and enhancement of significant ecological areas and indigenous biodiversity and the policy seeks to avoid adverse effects on scheduled significant ecological areas, terrestrial and marine. This policy is given effect to in E15. Policy E15.3 moderates the absoluteness of the RPS policies, through E15.3.2 which seeks to "…avoid significant adverse effects on biodiversity values as far as practicable…". As noted in above, with the adoption of best practice erosion and sediment control measures coupled with appropriate mitigation in the event significant sediment is discharged to the receiving environment it is considered that the Project is not abhorrent to this policy. Consideration of the cumulative effects of use and development on the ecological and amenity values of the Hauraki Gulf and the identification and protection of areas or habitats significant to the ecological and biodiversity values of the Hauraki Gulf are requirements of the RPS Coastal Environment – Managing the Hauraki Gulf Policies B8.5.2 (3) & (9). The *Marine Ecology and Coastal Avifauna Assessment* has concluded that the effects of the discharges to the Mahurangi and Kaipara Harbours from the Project will not adversely affect the ecological and biodiversity values, significant habitats, life-supporting capacity of the environment or the marine ecosystems or result in adverse cumulative effects on the ecological or amenity values of the Hauraki Gulf, its islands and catchments values. The exception to this is in the event of a

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	Hauraki Gulf/ Te Moana Nui o Toi/Tīkapa Moana *RPS B8.5.1 Objectives (1)* *RPS B8.5.2 Policies (3) & (9)*	greater than 10 year ARI event in the Hōteo catchment and/or a 30 year ARI in the Mahurangi catchment. As noted above, the Project has adopted best practice erosion and sediment control measures, coupled with appropriate mitigation including measures to address any significant quantum of sediment lost during acute storm events. appropriate consideration has been given to mitigation including best practice erosion and sediment control measures staging of works and storm event monitoring and on that that basis the Project is not considered to be abhorrent to the objectives and policies in relation to indigenous marine biodiversity.

11.2.3. Outstanding Natural Features Overlay

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*AUP D10.1 – Outstanding Natural Features and Outstanding Natural Landscapes* AUP D10.2 Objective (1) & (2) AUP D10.2 Policies (1), (2), (3), (4) & (5)	The AUP(OP) outstanding natural landscape and outstanding natural features objectives and policies seek to protect these landscapes and features from inappropriate use and development and protect the physical and visual integrity of these landscapes and features. Policy D10.2(3)(b) seeks to ensure that the provision of infrastructure is consistent with the protection of the values of the outstanding natural feature and Policy D10.2(4)(j) seeks consideration of the functional or operational need of any proposed infrastructure to be located within the outstanding natural feature. The Project route selection process has avoided all scheduled ONLs identified in the AUP(OP). There is one ONF (ID 49, Hōteo River incised meanders) that overlaps a small length of the proposed designation boundary (near the point where the Hōteo River is crossed by the existing State Highway 1). The proposed designation boundary has been narrowed down substantially at this point as far as reasonably practicable to avoid to the greatest extent the Hōteo River ONF. The Indicative Alignment and related construction works occur on the existing road which is located within the ONF any encroachment will be minimal (if any). The Project will not compromise the physical or visual integrity of the Hōteo River incised meanders outstanding natural feature. The effect of the Project on those ONLs adjacent to the Project area have been assessed in the *Landscape and Visual Assessment* as having very low or benign impacts. While accepting that construction of the Project will have an adverse effect on the landscape, the overall effect will be acceptable. The Project will not have an adverse effect on the ONF and is consistent with the relevant objectives and policies of the AUP(OP) and RPS.

11.2.4. Mana Whenua

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
NZCPS Objective 3 NZCPS Policy 2 HGMPA sections 7 & 8 *NPS FM (AA) Te Mana o te Wai* Objective AA1 Policy AA1 *NPS FM (D) Tangata Whenua roles and interests* Objective D1 Policy D1	*RPS B6 Mana Whenua* *Recognition of Treaty of Waitangi/ Te Tiriti o Waitangi partnerships and participation* RPS B6.2.1 Objectives (1), (2), (3) RPS B6.2.2 Policies (1), (2) *Recognising Mana Whenua values* RPS B6.3.1 Objectives (1), (2) RPS B6.3.2 Policies (1), (2), (3), (4), (5), (6) *Protection of Mana Whenua cultural heritage* RPS B6.5.1 Objectives (1), (2), (3), (5) RPS B6.5.2 Policies (1), (6), (8), (9) *AUP(OP) D.9 Significant Ecological Areas* AUP D9.2 Objective (3) AUP D9.3 Policies (2), (3)	Objective 3 of the NZCPS requires the principles of the Treaty of Waitangi to be taken into account, and recognition of the role of tangata whenua as kaitiaki and provide for tangata whenua involvement in management of the coastal environment. This recognition has been achieved for this Project through the relationship of the Transport Agency with Mana Whenua, in recognition of Mana Whenua values associated with the environment of the Project. Mitigation is proposed to reduce effects of sediment discharge on the coastal environment through ESC measures, and monitoring. The Project has ensured, through the Transport Agency relationship with Mana Whenua and proposed mitigation, that it will facilitate the protection of the relationship of iwi with the historic, traditional, cultural and spiritual elements of the Hauraki Gulf. The *Marine Ecology and Coastal Avifauna Assessment* has concluded overall that the adverse effects with proposed mitigation associated with the sediment laden water on the ecological values or life supporting capacity of the environment of the Mahurangi Harbour and Hauraki Gulf are less than minor. The Project will not compromise the life supporting capacity of the Gulf, consistent with the HGMPA. Mana Whenua has been positively engaged with throughout the development of the Project to date, including the participation in the alternatives assessment, considering technical reports and the ULDF. Feedback and hui have enabled consideration and recognition of Te Mana o Te Wai, identification and incorporation of mana whenua values and expression of kaitiakitanga in accordance with the NPS FM. The RPS requires recognition of and provision for the principles of Te Tiriti o Waitangi, in particular through Mana Whenua participation in resource management processes. Recognition of Te Tiriti o Waitangi partnerships is inextricably embedded in the Project through the Transport Agency being an agent of the Crown, taking responsibility for that partnership commitment. The Project achieves these objectives through Mana Whenua having been involved from early concept design through to the development of the design for consenting, identification of opportunities for mitigation, and representation of cultural features in the landscape. This aligns closely with the RPS's long term view, which is also represented in the commitment to ongoing development of the Project post-consenting phase.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	AUP(OP) Outstanding Natural Features and Outstanding Natural Landscapes AUP D10.2 Objective (2) AUP D10.3 Policies (3), (4) *AUP(OP) E1 Water quality and integrated management* AUP E1.2 Objective (2) *AUP(OP) E.3 Lakes, rivers, streams and wetlands* AUP E3.3 Policies (5), (6), (7) *AUP(OP) E.11 Land disturbance (regional)* AUP E11.3 Policies (2), (3) & (7) *AUP(OP) E.12 Land disturbance (district)* AUP E12.3 Policies (2), (4)	Mana Whenua values are recognised and provided for in the sustainable management of natural and physical resources, waahi tapu and other taonga. The Project, through design, has generally sought to avoid known waahi tapu and other taonga, and where it has not been practicable to avoid effects on unknown resources, the development and implementation of an accidental discovery protocol (ADP) based in the Transport Agency's recently adopted P45 standard will mitigate adverse effects on them. The relationship of Mana Whenua and their customs and traditions with indigenous vegetation and fauna has been recognised and provided for. Adverse effects on indigenous biodiversity values in SEAs must be avoided, remedied or mitigated where there is a reduction in historical, cultural and spiritual association held by Mana Whenua. Indigenous biodiversity values in SEAs are to be enhanced through providing for the role of Mana Whenua as kaitiaki and for the practical exercise of kaitiakitanga in restoring and enhancing areas. The ancestral relationships of Mana Whenua with outstanding natural features are recognised and provided for. Project design including the viaduct over the Hōteo River has ensured protection of the physical and visual integrity of the ONF within the proposed designation boundary and avoided adverse effects on Mana Whenua values associated with the ONF. Objective E1.2(2) of the AUP seeks to maintain or progressively improve the mauri of freshwater over time to enable traditional and cultural use of this resource by Mana Whenua. Policy E3.3(5) of the AUP(OP) requires avoidance of significant adverse effects, and avoidance, remediation or mitigation of other adverse effects of activities in, on, under or over the beds of lakes, rivers, streams or wetlands on the mauri of the freshwater environment and Mana Whenua values in relation to the freshwater environment. Significant adverse effects will be mitigated through re-creation of stream typology, appropriate riparian restoration and through avoiding culverts in SEAs. The Project will not impact any scheduled cultural heritage sites. Other effects, including stream loss associated with culverting will be mitigated through planting and restoration of naturally occurring functions of ecological environments.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		The integrated mitigation framework aligns with the principle of Ki Uta Ki Tai which aligns with the Māori world view and is consistent with policy C1 (a) of the NPSFM. In determining plant selection for mitigation, Mana Whenua values will be incorporated. Should any kōiwi, archaeology and artefacts of Māori origin be identified or discovered the ADP will assist to mitigate effects, which will ensure Mana Whenua cultural heritage will be protected as far as possible. Land disturbance will be managed to maintain cultural and spiritual values of Mana Whenua in terms of land and water quality, preservation of waahi tapu and kaimoana gathering. As outlined above, impacts on Mana Whenua cultural heritage that are discovered during land disturbance will be managed through the implementation of the ADP. There may be a discharge of sediment laden water to surface water bodies, however the Project will adopt best practice as required by the policy direction. The amount of land disturbed at any one time will be managed which will also assist to maintain Mana Whenua values. The Project is consistent with the objectives and policies of the planning documents referred to above through recognising Treaty of Waitangi principles and participating with Mana Whenua throughout the development of the Project, identifying and recognising cultural values, and protection of cultural heritage.

11.2.5. Built environment

Heritage[92]

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*RPS B5 Ngā rawa hanganga tuku iho me te āhua – Built heritage and character* *B5.2 Historic Heritage* RPS B5.2.1 Objectives (1) & (2) RPS B5.2.2 Policy (1), (2) (6), (7) & (8) *AUP(OP) D17 Historic Heritage Overlay* AUP(OP) D17 Objectives (1) & (2)	The RPS historic heritage objectives relate to the identification and protection of significant historic heritage places from inappropriate subdivision, use and development. The RPS historic heritage policies seek that places with historic heritage values are identified and evaluated and that significant adverse effects on the primary features are avoided and where they cannot be avoided, they should be remedied or mitigated so that they no longer constitute a significant adverse effect. There are no sites within the proposed designation boundary that are identified as scheduled historic heritage sites in the AUP(OP). There are nine sites which are archaeological and/or have been assessed as having some historic heritage value within the proposed designation boundary and of those seven are crossed by the Indicative Alignment. There are two further sites that may be affected by the Project if the alignment moves within the proposed designation. There is also potential for unrecorded archaeological sites to be located in the Warkworth, Hōteo River and Te Hana areas. Where archaeological and historic heritage sites have been identified within the proposed designation boundary the heritage significance and effects have been assessed. In a large portion of the proposed designation boundary, construction will have no effects on any known archaeological and historic heritage sites and little potential for effects on unrecorded subsurface sites. While some sites with low to moderate historic heritage values will be adversely affected by the Project, the *Heritage Assessment* considers that the overall potential effects of the Project on historic heritage are acceptable and manageable through the proposed designation conditions and within the existing provisions of the HNZPTA. The RPS objectives and policies and AUP(OP) objectives have been achieved through: • the proposed designation avoiding all scheduled historic heritage features;

[92] Note: The AUP(OP) Historic Heritage Overlay (D17) objectives and policies are not included in this assessment as they all relate to activities on the scheduled building or extent of place and there are no AUP(OP) identified scheduled historic heritage building/site within the proposed designation boundary.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		• evaluation of other historic heritage features to ensure that none of the affected or potentially affected sites within the Project area are of more than moderate historic heritage significance; and • a range of measures to mitigate adverse effects including a Heritage and Archaeological Management Plan to ensure that archaeological issues are managed appropriately during the construction phase. Recommended conditions of designation include a Heritage and Archaeological Management Plan (HAMP), recording of the affected WWII United States Military Camps affected by the Project, specific areas to be monitored by an archaeologist and any remains investigated and recorded. Based on the assessment in section 10 of this AEE, the proposed mitigation measures will ensure that adverse heritage effects of the Project will be minor. There is a limited number of heritage sites affected. Those that are have low to moderate heritage significance, the effects on which are able to be mitigated. The potential for new sites to be uncovered during construction can be managed through the proposed mitigation, including using accidental discovery protocols and within the existing provisions of the HNZPTA.

Noise and vibration

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*AUP E25 – Built environment – Noise and vibration* AUP E25.2. Objective (4) AUP E25.3 Policy (10)	<u>Construction noise and vibration</u> The AUP(OP) seeks to avoid, remedy or mitigate adverse effects of noise and vibration from construction, maintenance and demolition activities while having regard to the sensitivity of the receiving environment, duration and hours of operation and the practicability of complying with permitted noise standards. The *Construction Noise and Vibration Assessment* outlines the likely construction noise and vibration effects of the Project. That report has assessed the potential effects of construction noise and vibration and concludes that daytime compliance with applicable noise and vibration criteria is likely, but there could be localised exceedances at specific PPFs and in conjunction with specific construction activities. In this regard, Objective E25.2.4 of the AUP(OP) recognises that construction activities may not be able to meet noise and vibration standards at all times. The AUP(OP) therefore anticipates exceedances, but requires control of duration, frequency and timing to manage adverse effects whilst having regard to the sensitivity of the environment, duration of exceedances and practicalities of compliance as stated in Policy E25.3(3). The construction period is longer than most construction projects, but the construction activity will be

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		periodic in most locations, rather than constant over the construction period. Measures will be implemented to mitigate potential noise and vibration effects arising from construction of the Project which will be detailed in a CNVMP. The CNVMP will provide overall direction for management and mitigation of noise and vibration effects, whilst detailing activity and area specific approaches where exceedances of criteria are likely. Construction of the Project, with the proposed mitigation measures, will be consistent with the noise and vibration objectives and policies of the AUP(OP).
N/A	*AUP E25 – Built environment – Noise and vibration* AUP E25.2. Objective (1) AUP E25.3 Policies (2), (3), (9)	<u>Operational noise and vibration</u> Objective E25.2.1 of the AUP(OP) seeks to protect people from unreasonable levels of noise and vibration, to be achieved through minimising noise and vibration at its source or on the site from which it is generated (where practicable) to mitigate adverse effects on adjacent sites. The AUP(OP) anticipates the working nature of the rural environment and resulting noise. Potential noise from operation of the Project has been assessed against NZS 6806 and on amenity. Once constructed, an increase in noise levels is predicted for residents near the Project. The operation of the Project will comply with the relevant criteria within NZS 6806. Effects arising from the predicted increase in noise levels will be mitigated to an appropriate level as detailed in the *Operational Noise Assessment* – minimising noise at source (where practicable) through the use of OGPA or other low noise generating pavement surfaces. Low noise surfaces will be implemented from where the Project connects with the P2Wk to the southern portal of the tunnels, and from Dibble Road (a forestry road) to the northern tie in with the existing SH1. The Project will result in an overall reduction in noise levels currently experienced by sensitive receivers adjacent to the existing SH1 as a result of a reduction in traffic along that route. The road traffic noise arising from the Project, with the proposed mitigation measures as summarised in section 9 and 10 of this AEE, will be consistent with the objectives and policies of the AUP(OP).

11.2.6. Environmental risk

Contaminated land

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*RPS B10 Ngā tūpono ki te taiao - Environmental risk* *B10.4 - Contaminated land* RPS B10.4.1 Objective (1) RPS B10.4.2 Policies (1), (2) & (3) *AUP(OP) E30 - Environmental risk – Contaminated land* AUP(OP) E30.2. Objective (1) AUP(OP) E30.3 Policy (2)	The RPS and AUP(OP) seek to protect human health and the quality of air, land and water resources by identification, management and remediation of land that is contaminated. Discharges from contaminated land into air, or into water or onto or into land should also be managed. An interim investigation has been undertaken to identify land that is or may be contaminated based on sites known to have supported contaminating land use activities in the past. There are 11 sites within and immediately surrounding the Project area which are classified as having a moderate risk of contamination. Contamination effects will be able to be appropriately managed through obtaining any required consents under the NES Soil/AUP(OP) prior to construction. The Project is therefore consistent with the objectives and policies of the RPS and AUP(OP).

Hazardous substances

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*RPS B10 – Ngā tūpono ki te taiao - Environmental risk* *RPS B10.3 Land – hazardous substances* RPS B10.3.1 Objectives (1) & (2)	The RPS and AUP(OP) seek to protect the environment from adverse effects associated with the storage, use, disposal and transport of hazardous substances, in particular Policy E31.3(1) seeks to achieve this through locating and managing hazardous activities to avoid or adequately mitigate adverse effects, including risk to people, property and the environment. The construction works will require the use of machinery on site and will involve the storage of diesel and other potentially hazardous substances, such as water treatment chemicals and heavy metals. The management of hazardous substances, including storage, handling, transport and disposal, will be subject to specific management practice and industry guidelines. These management practices will minimise potential

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	AUP E31 – Environmental risk – Hazardous substances AUP E31.2. Objective (1) AUP E31.3 Policy (1) & (2)	effects on health and safety from exposure to hazardous substances and reduce potential for adverse effects on the environment as sought by Policy E31.3(1). The Project is consistent with the objectives and policies of the RPS and AUP(OP).

Natural hazards and flooding

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*RPS B10 - Ngā tūpono ki te taiao - Environmental risk* *RPS B10.2 -Natural hazards and climate change* RPS B10.2.1 Objectives (2), (3), (4), (5), (6) RPS B10.2.2 Policies (3), (4), (5), (7), (8), (11), (12) *AUP E36 – Natural hazards and flooding* AUP E36.2 Objectives (1), (4), (5), (6) AUP E36.3 Policies (4), (18), (20), (21), (22), (24), (29), (30), (33), (35)	The RPS and AUP(OP) seek to ensure that new development (including infrastructure) is located and designed to manage the impacts from natural hazards that may be experienced over their lifetime. Objectives E36.2(1) and E36.2(4) require consideration of the effects of development from natural hazards, including avoiding significant adverse effects and if these cannot be avoided, mitigated to the extent practicable. The Project is located within areas of known flood risk. Predicted changes in climate, which can exacerbate flooding effects, have been taken into account in the flood modelling. Best available and up-to-date hazard information across a range of probabilities was used to assess the flooding risk associated with the Project. The Project, including its structures and earthworks activities, will be designed so as to minimise the flood risk and adverse effects to people and property by maintaining the function and capacity of overland flow paths and designing bridges and culverts to convey the 100 year ARI. While there will be flooding effects associated with the Project, the adverse effects overall will be minor. The Project will result in the increase of flood depths, duration and velocity. Generally, these changes are contained inside the proposed designation, In isolated locations modelled flooding extends beyond the boundary and onto areas of adjacent pasture, and this extent is very limited. There is no predicted increase in flood depth or hazard to dwellings or other structures outside of the proposed designation.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		These effects will be mitigated through Project design to provide for flood attenuation and limit the increase in flood levels. The location and scale of the Project has been managed so that the risks of flooding are not significantly increased (RPS Policy B10.2.2(7)), in particular when taking into consideration) Policy E36.3(35). That policy allows for the operation, maintenance, upgrading and construction of infrastructure in areas subject to natural hazards when infrastructure is functionally or operationally required to be located in hazard areas or it is not reasonably practicable that it be located elsewhere. The Project has gone through an alternatives assessment process and from a functional perspective the Indicative Alignment and the proposed designation is the most suitable location (Policy E36.3(18). Within the flood hazard areas, risks to people, property and the environment have been mitigated to the extent appropriate and practicable. With regard to land instability, geotechnical advice has been provided which considered the risk of land instability. The Project will be designed to manage risk of seismic activity, slope stability, rock fall and settlement in accordance with the Transport Agency's guidance. Through the alternatives assessment process, the alignment has avoided numerous large-scale and deep-seated landslides through the Dome Valley. The alignment was refined to avoid issues associated with fault zones at the tunnel southern portals. Where required, structural controls will be implemented through design to mitigate residual land instability risks. The Project is consistent with the objectives and policies of the RPS and AUP(OP) relating to natural hazards and flooding.

11.2.7. Rural environment

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
N/A	*RPS B9 Toitū te tuawhenua - Rural environment* *RPS B9.2 Rural Activities*	The RPS rural activities objectives and policies relate to activities that support rural communities, protection of rural areas from inappropriate development, and avoiding, remedying or mitigating adverse effects on rural character, amenity, landscape and biodiversity values.

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
	RPS B9.2.1 Objectives (1), (3) & (4) RPS B9.2.2 Policy (1) *AUP(OP) H19. – Rural zones* *AUP H19.2.1 – General rural zone* AUP H19.2.1 Objective (1) AUP H19.2.2 Policy (5) *AUP H19.2.3 – Rural character, amenity and biodiversity values* AUP H19.2.3 Objective (1) & (2) AUP H19.2.4 Policy (3) *AUP H19.3 – Rural production zone* AUP H19.3.2 Objective (2) *AUP H19.4 – Mixed rural zone* AUP H19.4.1 Objective (3)	The AUP(OP) general rural objectives and policies seek to enable a range of activities and services that support rural areas, with Policy H19.2.2(5)(d) acknowledging that in some circumstances the development of infrastructure may place constraints on productive land and other rural activities. Objective H19.2.3 (1) & (2) and Policy (3) relate to maintenance and enhancement of character, amenity values and biodiversity of rural areas and protection/enhancement of areas of significant indigenous biodiversity and SEAs. It is not uncommon to find four lane state highways through rural zoned land. As such the Project is not considered to be an inappropriate development in the context of B9.2.1(1). As a large roading infrastructure development, the Project will alter the composition of the landform and vegetation cover and will also alter existing landscape elements and features within the Project area. As noted above, the Project will seek to maintain rural amenity values through the mitigation proposed, including maintaining shelter belt type landscaping where appropriate, the use of low noise generating pavement surfaces, grassing any fill embankments to tie in with the rural character in the section north of the Hōteo River. While the productive capacity within the alignment footprint will be lost, the Project is considered to be an appropriate development and covers a relatively small footprint within a large rural area. The Project is consistent with the relevant objectives and policies of the Rural Zone.

11.2.8. Coastal environment

Water quality

NPS relevant provisions	Auckland and Northland RPS, ACRP, and AUP(OP), relevant provisions	Assessment
NZCPS Objectives (1), (3) NZCPS Policies (1), (2), (5), (11), (21), (22), (23) HGMPA sections 7 & 8	*RPS B7.4 Natural resources – Coastal water, freshwater and geothermal water* RPS B7.4.1 Objectives (2), (4), (5), (6) RPS B7.4.2 Policies (1), (5), (6), (7), (8), (9) *RPS B8.5 – Coastal environment - Managing the Hauraki Gulf/Te Moana Nui o Toi/Tikapa Moana* RPS B8.5.1 Objectives (1), (3) RPS B8.5.2 Policies (1), (2), (3), (4), (6), (11), (13) & (15) *Northland RPS* Objective 3.2 & 3.4 Policy 4.2.1	The NZCPS is relevant to the Project, to the extent that sediment discharged to freshwater streams during construction and contaminants during operation may reach the downstream receiving environments of the Mahurangi and Kaipara Harbours. The RPS coastal water objectives and policies seek to ensure that adverse effects from land use on the quality of coastal water quality are avoided, remedied or mitigated, minimising the discharge of sediment into coastal water, requiring land disturbing activities to use industry best practice and standards and manage stormwater to minimise the generation of contaminants. The downstream receiving environments of the Mahurangi and Kaipara Harbours are identified as Marine SEAs in the AUP(OP). During construction, the Project will utilise best practice techniques to manage sediment and erosion control. Marine sediment from the Project is predicted to result in less than minor adverse effects overall on the estuarine receiving environments of the Kaipara and Mahurangi Harbours except in the event of a >10 ARI year event in the Hōteo Inlet and a >30 year ARI event in the Mahurangi. The *Marine Ecology and Coastal Avifauna Assessment* did not raise issues with respect to water quality, but rather the effect on benthic ecology, which is discussed under Biodiversity and Coastal above. During operation all stormwater will be treated in stormwater wetlands prior to discharge to ensure that contaminants from the roading network entering the freshwater and downstream coastal environment are within acceptable limits. During the operational phase of the Project stormwater will be discharged to the Hōteo, Oruawharo and the Mahurangi Rivers. Constructed wetlands will be used to treat operational phase stormwater from the Project prior to discharge to aquatic environments. Wetlands will be designed to remove 75% of suspended solids and associated contaminants from stormwater. Any residual sediment and associated contaminants will largely be distributed within the upper estuary and upper harbour areas due to their low energy depositional characteristics.

NPS relevant provisions	Auckland and Northland RPS, ACRP, and AUP(OP), relevant provisions	Assessment
		The *Water Assessment Report* indicates that potential adverse effects relating to increases in stormwater contaminants within operational phase discharges to the Mahurangi and Kaipara Harbour are minor overall. The Northland RPS seeks to safeguard ecological integrity and improve the overall quality of Northland's coastal water with a focus on a range of matters including reducing sedimentation rates in the region's estuaries and harbours and protecting areas of significant habitats of indigenous fauna (Objective 3.2 & 3.4). As discussed above the *Marine Ecology and Coastal Avifauna Assessment* has assessed the effects of discharges into the Kaipara Harbour and concluded overall with mitigation the adverse effects on water quality and ecological integrity are less than minor. The Project is consistent with the objectives and policies of the NZCPS, HGMPA and RPSs.

Natural character

NPS relevant provisions	Auckland and Northland RPS relevant provisions	Assessment
NZCPS Objective (2), (3) NZCPS Policy 13(1)	*RPS B8 Toitū te taiwhenua - Coastal environment* *RPS B8.2 Coastal environment - Natural Character* RPS B8.2.1 Objectives (1) & (2) RPS B8.2.2 Policies (3) & (4) *Northland RPS* Objective 3.14 Policy 4.6.1	The NZCPS (Preservation of natural character) policy directs that areas with high and outstanding natural character value be identified, that the adverse effects of activities on the natural character of these areas be avoided and that in all other areas significant adverse effects of activities on natural character be avoided. In accordance with the NZCPS the AUP(OP) has identified areas of High Natural Character in the Kaipara and Mahurangi Harbours and an area of Outstanding Natural Character in the lower reaches of the Mahurangi Harbour. The RPS Coastal environment natural character objectives seek that use and development are managed to preserve the characteristics and qualities that contribute to the natural character of the coastal environment. The policies seek to preserve and protect areas of outstanding and high natural character from inappropriate use and development by avoiding adverse effects of activities on natural character in outstanding natural character areas, and avoiding significant adverse effects and avoiding, remedying or mitigating other adverse effects of activities on natural character in all other areas of the coastal environment.

NPS relevant provisions	Auckland and Northland RPS relevant provisions	Assessment
		Sections of the Kaipara and Mahurangi Harbours are identified as High Natural Character areas in the AUP(OP). An area in the lower reaches of the Mahurangi Harbour is identified as an Outstanding Natural Character area. The Northland RPS also identifies the Kaipara Harbour as an area of High Natural Character and seeks to protect the qualities and characteristics that make up the natural character of coastal environments from inappropriate use and development (Objective 3.14). The effects on natural character and marine ecology arising from discharges of contaminants, sediment and stormwater from the Project into the Kaipara and Mahurangi Harbours have been considered and as discussed above the potential adverse effects from sedimentation and stormwater discharges, which could compromise the Outstanding Natural Character and High Natural Character areas of the Mahurangi and Kaipara Harbours, are assessed overall as being less than minor with mitigation. The natural character will be preserved and protected.

Managing the Hauraki Gulf/Te Moana Nui o Toi/Tikapa Moana

National Policy Statement	Auckland RPS and AUP(OP) relevant provisions	Assessment
NZCPS Policy (5) HGMPA sections 7 & 8	*RPS B8 Toitū te taiwhenua - Coastal environment* *B8.5 – Coastal environment - Managing the Hauraki Gulf/Te Moana Nui o Toi/Tīkapa Moana* RPS B8.5.1 Objectives (1), (3) RPS B8.5.2 Policies (3), (4) and (5)	For the coastal environment of the Hauraki Gulf, sections 7 and 8 of the HGMPA must be treated as a NZCPS. The NZCPS seeks that effects on land and water in the coastal environment managed under other Acts (including the HGMPA) for conservation and protection purposes have regard to the purposes for which the land or waters are held or managed and avoid adverse effects that are significant or otherwise avoid, remedy or mitigate adverse effects of activities in relation to those purposes. The RPS Coastal environment – Managing the Hauraki Gulf/Te Moana Nui o Toi/Tīkapa Moana objectives seek that the management of the Hauraki Gulf gives effect to the HGMPA and that the use of the Hauraki Gulf's natural and physical resources does not result in further degradation of environmental quality or adversely affecting the life-supporting capacity of marine ecosystems. The RPS Coastal environment policies seek that applications be assessed in terms of the cumulative effects on the ecological and amenity values of the Hauraki Gulf, maintain and

National Policy Statement	Auckland RPS and AUP(OP) relevant provisions	Assessment
		enhance the values of the islands in the Hauraki Gulf and avoid compromising the natural character, landscape, conservation and biodiversity values. The Project has ensured that the relationship with mana whenua, cultural assessment and proposed mitigation will facilitate the protection of the relationship of iwi with the historic, cultural and spiritual elements of the Hauraki Gulf. The *Marine Ecology and Coastal Avifauna Assessment* has concluded that the effects of the discharges to the Mahurangi Harbour from the Project will not adversely affect the ecological values, life-supporting capacity of the environment or the marine ecosystems or result in adverse cumulative effects on the ecological or amenity values of the Hauraki Gulf, its islands and catchments values. The potential impacts on the High Natural Character and Outstanding Natural Character areas of the Mahurangi Harbour have been outlined above, and the Project will not result in further degradation of environmental quality or compromise the life supporting capacity or the natural character, landscape, conservation and biodiversity values of the Hauraki Gulf.

11.2.9. Urban growth and form

Urban Growth

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
NPSUDC Objectives (PA2), (PD2).	*RPS B2 Tāhuhu whakaruruhau ā-taone – Urban growth and form* *RPS B2.2 Urban growth and form* RPS B2.2.1 Objectives (1), (5) RPS B2.2.2 Policy (2)	The NPSUDC provides direction for planning for urban environments enabling growth and development in response to the changing needs of existing communities and future generations while also providing enough space for communities to live and work. Primarily, the NPSUDC relates to provision for housing and businesses. However, the NPSUDC also reiterates that development capacity must be supported by infrastructure, encouraging the integration of land use and infrastructure planning. The availability of development infrastructure and other infrastructure in the short, medium and long term can potentially be a constraint on development capacity, therefore provision of and forward planning for infrastructure can play an important role in supporting urban development and planning for future capacity. The RPS likewise seeks the integration of land use planning, infrastructure and development and enables the provision and use of infrastructure in a way that is efficient, effective and

NPS relevant provisions	Auckland RPS and AUP(OP) relevant provisions	Assessment
		timely pursuant to Policy B2.2.2(2). This integration is specifically outlined in relation to the development of land within the Rural Urban Boundary, towns, and rural and coastal towns and villages. The Project will support the development of the areas currently zoned Future Urban Zone under the AUP OP located around Warkworth and Wellsford. The Project is a significant key piece of infrastructure that will provide improved connections within the Auckland Region and north into centres located in Northland. The Project, through enhanced accessibility between centres, will support the development of the areas currently zoned Future Urban Zone under the AUP OP located around Warkworth and Wellsford. Both Warkworth and Wellsford have identified areas for future urban growth under the provisions of the AUP(OP). The provision of infrastructure and efficient use of existing and proposed infrastructure is identified as an aspect required for consideration by local authorities when determining the capacity for growth in both brownfield and greenfield locations. The Project is considered to appropriately respond to and support the growth aspirations of the AUP(OP) through improving connectivity between Warkworth and Wellsford, and will remove traffic from Wellsford main town centre, which currently acts as a divide. The Project is consistent with the urban growth objectives and policies of the NSPUDC and the RPS.

11.3. Other matters

Section 171(1)(d) requires decision makers to have regard to, and 104(1)(c) particular regard to, other matters directly relevant in consideration of the Project. These other matters are discussed below. As stated in section 6.5 of this AEE, case-by-case consideration of what other matters are relevant, is made by the consent authority considering the resource consent applications and NoR.

Table 11-1: Assessment of other matters

Matter	Discussion
Economic development policies	
Tai Tokerau Northland Economic Action Plan 2016	The NEAP identifies Connecting Northland including the route protection and completion of the P2Wk and this Project including improvements between Whangārei and Wellsford as enablers to support key economic growth opportunities.
Transport Planning	
Government Policy Statement on Land Transport 2018/19-2027/28 National Land Transport Programme 2018-2021	The four strategic priorities of the GPS 2018 are safety, access, environment and value for money. The NLTP, developed under the GPS 2018, focuses on "creating a safe, resilient, well-connected and multimodal transport system that enables new housing opportunities, liveable cities and sustainable economic development in regional New Zealand."[93] As discussed in section 2.3.1 of this AEE the Project aligns with both the GPS and NLTP. Notably the project will contribute to the safety and resilience of the southern part of the Auckland to Whangārei corridor.
Connecting Northland 2017, The Transport Agency	Connecting Northland is an integrated transport approach which recognises the importance of improving transport access within a multi-modal environment. The vision for the Auckland to Whangārei corridor is a safe corridor which provides reliable journey times to support the economic growth of the region and access to key markets. The Project is identified as one of four major infrastructure schemes to progress to construction in the next 30 years in Connecting Northland.
National Freight Demand Study 2014, Ministry of Transport	The NFDS forecasts that by 2042, freight volumes between Northland and Auckland could increase by 68% from 2.8 to 4.71 million tonnes. It also predicts that freight movements originating or terminating in Northland could increase by 38% from 30.2 to 41.6 million tonnes. The NFDS concludes that truck movements are likely to grow significantly in the future. The Project will improve road freight performance between the Auckland and Northland Regions.
Upper North Island Freight Strategy 2013, Upper North Island Strategic Alliance	More than fifty five percent of New Zealand's freight travels through the Northland, Auckland, Waikato and Bay of Plenty regions, and collectively these regions generate over fifty percent of New Zealand's gross domestic product. This is

[93] National Land Transport Plan 2018, page 7

Matter	Discussion
	predicted to increase in the future. The strategy promotes a strategic and integrated approach towards land use and transport planning and identifies constraints on the Upper North Island's strategic rail and road networks. The problems for the existing SH1 corridor are consistent with a number of the critical freight issues that the Upper North Island Freight Strategy seeks to address. The Project will improve road freight performance between the Auckland and Northland Regions.
Auckland Regional Land Transport Strategy 2010, Auckland Regional Council	A key emphasis in the ARLTS is reducing congestion for freight vehicles. The Project will improve journey times and journey time reliability for freight.
Auckland Regional Land Transport Plan 2018-2028, Auckland Transport, Auckland Council, The Transport Agency and KiwiRail	The ARLTP outlines how transport priorities will be delivered over a ten year period and implements the NLTP. The ARLTP identifies the Project as an improvement project with inter-regional significance.
Auckland Integrated Transport Programme 2013, Auckland Transport	The Auckland Integrated Transport Programme was created in response to the Auckland Plan and sets out the 30 year investment programme to meet the transport priorities that are contained within the Auckland Plan. The Project is identified as a transport project where investment is to be directed.
Iwi management plans	
Kawerau a Maki Trust Resource Management Statement 1994	This Statement outlines the concerns and goals the Kawerau a Maki Trust have with regard to the sustainable management of the taonga within the tribal area of Te Kawerau. The Statement sets out the objective and policies with respect to their responsibilities as Kaitiaki and matters of resource management significance. Consultation with Te Kawerau a Maki has not identified any specific sites. However, consideration has been given to the identification and recognition of mana whenua values, enabling the management of effects on cultural values associated with water, CMA, landscape and flora and fauna.
Interim Ngati Paoa Regional Policy Statement 2013	This Statement was developed for Auckland Council to take into account when preparing the AUP(OP). It identifies sites and areas of importance to Ngati Paoa, including within the Mahurangi catchment. There are no AUP(OP) scheduled sites or places of significance to Mana whenua within the Project area.
Ngati Paoa Resource Management Plan 1996	This Resource Management Plan focuses on the four most important resource management issues for Ngati Paoa. These are the issues of consultation, issues surrounding the recognition and protection of waahi tapu sites, the need for redress of breaches of the Treaty of Waitangi and the issue of economic development. Ngati Paoa has requested they be kept up-to-date throughout development of the Project and this will continue. There are no known waahi tapu sites located within the Project area.

Matter	Discussion
Environmental strategies	
Mahurangi Action Plan 2010	The Mahurangi Action Plan is an Auckland Council strategic plan for the Mahurangi Catchment (2010-2030). It has a vision of maintaining a healthy Mahurangi River and Harbour. The MAP identifies key values and issues including: • Sedimentation of the Harbour environment; • Maintaining a Commercial Asset; and • Natural Heritage, Biodiversity and Ecological Values. The plan contains objectives and priority actions for 2010-2016, as well as medium to long term actions that are relevant to the project timescale. The Project has been designed to be consistent with the objectives of the plan.
Kaipara Harbour Integrated Strategic Plan of Action 2011	This strategic plan for the Kaipara Harbour (2011-2021) was developed by the Integrated Kaipara Harbour Management Group (IKHMG). The plan is the first stage of managing Kaipara ecosystems, harbour and catchment in a way that will achieve integrated management, with the aim to achieving a healthy and productive Kaipara Harbour. The KHIPA identifies key issues within the harbour: • Declining native biodiversity; • Declining fish and shellfish stocks; and • Increased sedimentation and poor water quality. The KHIPA contains long-term objectives and goals. The Project has been designed to be consistent with the objectives of the plan.
The New Zealand Biodiversity Strategy 2000-2020	This Strategy establishes a strategic framework for action, to conserve and sustainably use and manage New Zealand's biodiversity. The main objectives are to promote community and individual action, protect Mana Whenua interests, halt the decline of New Zealand's indigenous species and maintain the genetic resources of introduced species which contribute to the wellbeing of New Zealanders. The Project responds to this strategic framework by recognising effects on indigenous biodiversity and mitigating for any loss.
Draft National Policy Statement for Freshwater Management	The draft National Policy Statement for Freshwater Management was published in Septemer 2019 and is proposed as a full replacement to the National Policy Statement for Freshwater Management 2014 (as amended 2017). The submission period for this closed on 31 October 2019 and the document is yet to be finalised. The purpose of document is to set out the objectives and policies that relation to freshwater management in New Zealand and to specify what local authorities, in their governance and management roles, must do to help achieve those objectives and policies. The document reflects the fundamental value of water and its importance. The Project has been developed to protect waterways and recognises the importance of prioritising the health and wellbeing of water. The Project is supported by a Water Quality Assessment Report which has

Matter	Discussion
	informed the design and development of proposed draft conditions.
Proposed National Policy Statement on Indigenous Biodiversity 2011	The proposed National Policy Statement on Indigenous Biodiversity was issued in 2011 for consultation, though has not been finalised. This NPS is relevant to the Project given its works impact on indigenous biological diversity (which includes naturally uncommon ecosystems, indigenous vegetation or habitats associated with wetlands). The Project generally affects only pockets of indigenous vegetation and habitats. These effects have been identified and assessed in the *Ecology Assessment*. The mitigation proposed in section 10 of this AEE is informed by the findings in that assessment and will ensure that the Project will maintain biodiversity through mitigation and management plans where there may be an adverse effect.
Auckland Indigenous Biodiversity Strategy 2012	The Auckland Indigenous Biodiversity Strategy seeks to protect, maintain and restore the indigenous biodiversity within Auckland. This involves conserving as many species as possible with particular attention being given to those species which are threatened, implementing iwi values, educating Auckland's communities and fostering guardianship and the collaboration of governmental organisations. Biodiversity has been a key consideration of the Project in particular with efforts to avoid, remedy or mitigate the potential adverse construction effects and to achieve post construction benefits.
Local Government Act policies	
Auckland Plan 2050 (June 2018)	The Auckland Plan 2050 sets the long-term strategic direction for Auckland over the next 30 years. The Plan identifies "the development of quality transport links within Warkworth, as well as between Warkworth, Northland and the rest of Auckland to be critical to supporting the town's future growth"[94]. The Project supports this aspiration.
Rodney Local Board Plan 2017	One of the outcomes of the Rodney Board Plan is to get around easily and safely. The Plan outlines that transport infrastructure needs to keep pace with the needs of the community. The Local Board seeks to advocate to the Transport Agency for higher prioritisation of Rodney transport projects, such as this one.
Transport Agency guidance	
Environmental Plan 2008	The Environmental Plan outlines the Transport Agency's intentions with respect to the contribution of state highways to the environment and social wellbeing of New Zealand. The LTMA, NZTS and RMA are the primary supporting legislative and policy context for the Plan.

[94] https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/auckland-plan/development-strategy/future-auckland/Pages/what-warkworth-look-like-future.aspx

Matter	Discussion
	The Plan guides the design, construction, operation and maintenance of the State highway network in relation to a range of potential environmental and social impacts in order to: • Protect and enhance the environment where appropriate; • Avoid adverse effects to the extent reasonable in the circumstances; • Use and manage resources efficiently; • Consider environmental issues early; • Contribute to sustainable outcomes by working with others; and • Continually improve environmental performance. The Project will meet the relevant objectives of the Transport Agency Environmental Plan, including those regarding noise emissions, air quality, stormwater discharges, sediment and erosion control, landscaping, heritage and biodiversity.
Other guidance	
NZ Urban Design Protocol 2005	The Transport Agency is a signatory to the NZ Urban Design protocol. The Urban Design Protocol identifies seven essential design qualities that together create quality urban design: • Context: seeing buildings, places and spaces as part of whole towns and cities • Character: reflecting and enhancing the distinctive character, heritage and identity of our urban environment • Choice: ensuring diversity and choice for people • Connections: enhancing how different networks link together for people • Creativity: encouraging innovative and imaginative solutions • Custodianship: ensuring design is environmentally sustainable, safe and healthy • Collaboration: communicating and sharing knowledge across sectors, professions and with communities. A Planning Version ULDF has been prepared for the Project which has had close regard to the above.

11.4. Additional statutory consideration relevant to Notice of Requirement

11.4.1. Adequate consideration of alternatives (s.171(1)(b))

Section 171(1)(b) of the RMA requires the consent authority to have particular regard to whether the requiring authority has given adequate consideration to alternative sites, routes and methods of undertaking the work where a requiring authority does not have an interest in the land sufficient for undertaking the work, or it is likely that work will have a significant adverse effect on the environment.

At the time of lodgement, the Transport Agency administers on behalf of the Crown a portion of the land required for the Project, however there are numerous properties which will be required for the Project which are not owned or leased by the Transport

Agency. As a result, the Transport Agency has given extensive consideration to alternative sites, routes and methods for undertaking the work.

The Transport Agency must assess alternatives and demonstrate that its investigation of alternatives has not been carried out in an arbitrary or cursory way. This does not mean that it is required to consider the full suite of alternatives available, or that it is obliged to select any particular option, including the one that scores the 'best' under any particular assessment system used. The process followed is set out in section 7 of this AEE.

The process of consideration of alternatives involved an extensive option evaluation process to arrive first at a preferred corridor and Indicative Route, and then an Indicative Alignment within the preferred corridor. The assessment process included consideration of meeting operational (transport) needs, technical and environmental constraints, and the social, cultural and economic environment in which the area is located. The process was robust, comprehensive and iterative. It involved assessment of options by relevant independent experts. The assessment of alternatives clearly meets the relevant statutory tests.

11.4.2. Reasonably necessary to achieve objectives (s.171(1)(c))

Section 171(1)(c) of the RMA provides that when considering a NoR the decision maker must have particular regard to – *whether the work and designation are reasonably necessary for achieving the objectives of the requiring authority for which the designation is sought*.

The Project objectives are set out in section 2.2 of this AEE.

The Project is reasonably necessary for achieving these objectives because it will:

- Improve safety performance compared to the existing SH1 with the Indicative Alignment designed to motorway standards and therefore, with the intended diversion of traffic to the new road, reduced incidents on the existing SH1;
- Support safe cycling and walking by the provision of linkages where feasible as part of the Project scope (such as across interchanges, onto SH1 at the northern tie in, on local roads where the Project passes over on a bridge structure;
- Improve freight performance in terms of reduced travel times, improved route quality and safety, resilience and travel time reliability;
- Improve route security and resilience of the state highway network north of Auckland through reducing the reliance on one main route (the current SH1);
- Reduce travel times and improved travel time reliability along the state highway network north of Auckland increasing accessibility across many parts of the Regions' road network;
- Improve the amenity of Wellsford and Te Hana through the removal of heavy truck movements through the townships, including improved air quality and reduction in noise levels and improving walkability; and
- Treat stormwater, reduce contaminant loads for two river catchments, reduce sediment load over time to the Kaipara Harbour, retire some land that contributes to the sediment load of the Kaipara Harbour, through landscaping and planting for mitigation and through design which will assist with more fuel efficient travel (through better gradients and less need to brake, accelerate and/or decelerate).

The designation is considered to be reasonably necessary as follows:

- It will enable the Transport Agency to achieve its objective under the LTMA;
- It is necessary for the Transport Agency to achieve the Project objectives;
- It will allow the Transport Agency and/or its authorised agents to undertake the works in accordance with the designation, notwithstanding anything contrary in the district plan components of the Auckland Unitary Plan: Operative in Part;
- It will allow the land required to be identified in the Auckland Unitary Plan: Operative in Part, giving a clear indication of the intended use of the land;
- The proposed construction date is a number of years away, and a designation of land is necessary to provide certainty for the Transport Agency and land owners;
- The designation is necessary to ensure that the Project can be constructed, operated and maintained with certainty and efficiently using a consistent suite of conditions;
- It will enable the Project to be undertaken in a comprehensive and integrated manner; and
- It will protect the proposed route from future development which may otherwise preclude the construction of the Project.

11.5. Section 105 assessment

Some of the resource consent applications are for discharge permits, involving discharges to air, and discharges of contaminants into water and onto land. Therefore, section 105 is relevant. Section 105 outlines additional matters that must be considered by consent authorities for discharge permits in addition to the matters in section 104(1).

11.5.1. Nature of the discharge and the sensitivity of the receiving environment

The nature of the proposed discharges and sensitivity of the receiving environment in relation to the discharges of stormwater during construction and operation have been outlined in sections 9.2, 9.5, 9.6 and 9.12 of this AEE.

The nature of the proposed discharges and sensitivity of the receiving environment in relation to the discharges to air during construction have been outlined in 9.9.

In summary, the nature of the discharges will be as follows:

- The Project involves significant earthworks, and during construction there will be associated discharges of treated sediment laden stormwater to water from earthworked areas. Once operational, stormwater from the new impervious road surfaces will be collected and conveyed to stormwater treatment wetlands prior to discharge into the receiving environment (Mahurangi, Hōteo and Oruawharo Rivers).
- The Project will involve discharges of dust during construction associated with earthworks activities.

The sensitivity of the receiving environments can be summarised as follows:

- The Mahurangi River is located within a High Use Stream Management Area, and a Natural Stream Management Area (as scheduled in the AUP(OP)). There is a water take for the Warkworth public supply located downstream of the Project (noting Watercare has transferred from surface water to groundwater abstraction for Warkworth). The water quality is assessed as good. The upper and lower reaches of the Mahurangi River (Left Branch) are likely to have high ecological value (as assessed in the *Ecology Assessment*).

- The Hōteo River is identified in part as a Natural Stream Management Area. There is a water take for the Wellsford public supply located downstream of the Project. The water quality is fair to good. The Kourawhero Stream tributary of the Hōteo River has moderate-high ecological value. The tributaries of the Hōteo within the plantation forest areas have high ecological values. The higher reaches of the Hōteo River and tributaries and the Oruawharo tributaries (Te Hana Creek and Maeneene Creek) have low ecological value. The water quality in the Oruawharo River is good.
- The Mahurangi Harbour and Kaipara Harbour have high marine ecological value in the middle and lower reaches and moderate marine ecological values in the upper reaches. SEAs are located within both harbours. Sedimentation is an existing issue within these harbours.
- Background ambient air contaminant concentrations for the Project area are low given the rural nature of the area and there is a low density of dwellings and other sensitive receivers.

11.5.2. Possible alternative methods of discharge and the applicant's reasons for the proposed choice

The Indicative Alignment and indicative construction methodologies developed to date have, as far as possible, avoided creating adverse effects on sensitive receiving environments.

In circumstances where this has not been achievable the BPO is to be employed to remedy or mitigate any actual and potential effects on these areas as no other feasible alternative method of discharge is available.

Discharges to water during construction

During construction of the Project, discharges will occur to the Mahurangi, Hōteo and Oruawharo receiving environments, and consequently the Mahurangi and Kaipara Harbours. This discharge will largely consist of sediment run off from earthworks and general construction activities.

These discharges are a necessary part of the construction process and cannot practicably discharge to an alternative receiving environment due to their geographic location. There are a range of methods for erosion and sediment control. It is critical that industry best practice methodology is used for the construction phase to minimise effects on people and the environment, particularly given works are required in natural stream management areas, and close to high value ecological areas.

Once a contractor is appointed, the contractor will confirm the proposed methodology for construction and will develop detailed procedures for management of construction related effects, including discharges to land and water to meet the conditions of resource consent.

Discharges to water during operation

The operation of the Project will generate a new discharge of contaminants from the road surface. These contaminants will be picked up in stormwater which will then be treated before discharge to the receiving environments of the surrounding river catchments.

The consideration of options and choice of treatment methods has involved many elements which has included:

- the efficacy of treatment and contaminant removal;
- erosion protection requirements at outfalls;
- water sensitive design solutions;
- retention and detention.

The AUP(OP) and Transport Agency guidance inform best practice measures for treatment of stormwater runoff from high use roads. The Project has been designed in accordance with these requirements.

Discharges to air

During construction of the Project, discharges of dust will take place as a result of earthworks activities. These discharges are a necessary part of the construction process and cannot practicably discharge to an alternative receiving environment due to their geographic location. There are a range of methods for dust control, and best practice will be used during the construction phase to minimise effects on people and the environment.

11.6. Section 107 assessment

The Project is to be considered under section 107 of the RMA. Section 107(1) sets out restrictions on granting discharge permits if, after reasonable mixing, the contaminant or water discharge is likely to give rise to certain effects (as listed in s.107(1)(c)–(g)).

The Project will meet the tests of section 107 allowing the grant of discharge permits for the following reasons:

- The potential for effects on receiving waters associated with odours, conspicuous oils, floatable or suspended solids are considered in sections 9.2, 9.5, 9.6 and 9.12 of this AEE, and are assessed as minor (s107(1)(c) and (e));
- The *Water Assessment* concludes there will be minor effects on the colour or visual clarity after reasonable mixing. During construction, the effects from stormwater discharges on colour and clarity are assessed as minor due to their localised extent and temporary duration, as they are limited to the construction period and during the earthworks season only, with the balance of the site being stabilised during the winter months. A maximum open area threshold of 75 ha has been proposed for the Hōteo catchment. Discharges of stormwater during operation, with the proposed stormwater management systems in place, are considered in the *Water Assessment* to have negligible effects on colour and clarity in the Mahurangi River, Hōteo River and marine receiving environments and where discharges are to smaller tributaries, the effects occur over localised

extent and are of temporary duration. After mixing these discharges are not considered conspicuous (s107(1)(d)).

- The *Water Assessment* concludes that fresh water will not be rendered unsuitable for consumption by farm animals (s107(1)(f)).
- The marine and freshwater ecology assessments conclude that there will be no significant adverse effects from the discharge of contaminants on aquatic life during construction and operation (s107(1)(g)).

11.7. Part 2 analysis

11.7.1. Section 5 – Purpose

SH1 is a regionally and nationally significant physical resource. The Project will provide a safer travel environment, better and more reliable travel times, and greater efficiency in movement of goods and services for people and communities. The Project will also enable Auckland, Warkworth, Wellsford and those communities further north to provide for their health, safety and wellbeing. Bypassing Wellsford and Te Hana will enable those communities to reconnect, with the significant reduction in through traffic that they currently experience. Interchanges will maintain connectivity to and from these towns to SH1.

The Project will (with mitigation) be undertaken in a manner that does not result in significant adverse effects on the natural or physical resources of the area. The management of effects during construction, as identified in sections 9 and 10, will ensure that there are no significant long-term effects on natural resources, that water quality is maintained, and that erosion and sediment runoff is managed to avoid exacerbating siltation of the Mahurangi and Kaipara Harbours and the contributing watercourses with the Project area. Overtime the Project will contribute to the improvement of water quality within the Project area through treatment of State highway stormwater, riparian planting and less active land use. Construction effects can be adequately mitigated through proposed conditions.

The Project includes a suite of measures appropriate to the scale and significance of the potential effects that may arise during the operation of the Project, to avoid, remedy or mitigate those adverse effects.

The Project will achieve the RMA's purpose of sustainable management of natural and physical resources.

11.7.2. Section 6 – Matters of national importance

The section 6 matters of national importance that must be recognised and provided for are addressed below:

(a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development

The potential downstream effects of sediment will not have any effect on the natural character of the coastal environment as detailed in section 9.13 of this AEE.

The Project and associated works in watercourses will be designed to be the appropriate size necessary for their purpose, minimise erosion and modification of the stream beds (for example through installing energy dissipation at culvert outfalls), maintaining existing base flow and flood flows, limit establishment of structures within the stream beds to those that have a functional need, and where practicable maintain existing riparian vegetation and areas of significant indigenous biodiversity. As a result, the natural character of rivers and streams will be maintained, diversions will replicate the natural character to the extent practicable as detailed in section 9.5, 9.6 and 9.13 of this AEE. Overall the Project responds to the natural character which has been recognised and provided for.

(b) The protection of outstanding natural features and landscapes from inappropriate subdivision, use and development

Through a thorough and robust alternatives assessment process, there are no outstanding natural landscapes (ONL) scheduled in the AUP(OP) within the proposed designation boundary.

There is an area of the proposed designation boundary that overlaps with the Hōteo River incised meanders which are identified in the AUP(OP) as an outstanding natural feature (ONF Feature Type A) and is recognised as follows:

> "*The Hōteo River is the longest in the Auckland Region. It flows in a deeply incised meandering gorge through broken hill country for some 30km and is one of the outstanding landforms in this part of the region.*"

The footprint of the Indicative Alignment does not encroach into the ONF. The extent of the designation in this location is to ensure access for construction vehicles is provided for along River Road (the private forestry road).

Given the works that may occur will be limited to construction traffic, it is considered that the Project will have no adverse effect on the ONF, and that it will be adequately protected as it is.

(c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna from inappropriate subdivision, use and development

Development of the Project has had regard to areas of significant indigenous vegetation and significant habitats of indigenous fauna. The alternatives assessment outlined in section 7 of this AEE noted the process used to identify and avoid many SEAs. Documented subsequent design changes were informed by assessments from ecologists to avoid impacts on most of the high and very high value terrestrial, wetland and freshwater ecological features and sites within the proposed designation boundary. High ecological value areas avoided include Mahurangi River (Left Branch) and associated riparian margins, SEA's, wetlands within the upper Kourawhero Stream catchment, and wetlands within the Hōteo River floodplain.

Given the linear nature and the design standards adopted for the Project it has not been possible to avoid all areas of significant ecological value. However, the adverse effects have been minimised through Project design including reduction of the proposed designation footprint in places, design of the Hōteo Viaduct and bridges over the Mahurangi River and north of Phillips Road on the Kourawhero River tributary, and footprint design to reduce fragmentation and edge effects. Mitigation will focus on key areas where the highest ecological values exist and include revegetation, fauna creation and potential movement corridors for bird species. Mitigation for the loss of wetlands will be enhancement and reinstating lowland wetland areas that link to existing ecosystems. This will protect and strengthen these areas, preventing further fragmentation and building ecological resilience.

Overall the significant indigenous vegetation and habitats have been adequately assessed, recognised and appropriately managed as identified in the *Ecological Assessment.* The avoidance of significant ecological areas, the minimisation of effects in areas that cannot be avoided, together with the extent of mitigation proposed will ensure that most significant indigenous vegetation and significant habitats of indigenous fauna are protected.

(d) The maintenance and enhancement of public access to and along the coastal marine area, lakes and rivers

The Project does not adversely impact on existing access to the margins of watercourses within the Project and will maintain and enhance access to or along the margins of the coastal marine area, lakes or rivers. The reduction of vehicle traffic on the existing SH1 may encourage public access to the Waiteraire Stream (in the Dome Valley) which will be a safer stopping point than currently exists.

(e) The relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga

The Project, through feedback from Mana Whenua, has identified and provided for the maintenance of the relationship of Māori with water, waahi tapu and other taonga. The proposed conditions of designation and resource consent provide for an ongoing commitment to maintaining that relationship.

(f) The protection of historic heritage from inappropriate subdivision, use and development

The route selection and design of the Project has had regard to the historic heritage within the Project area. As noted in section 9.10 of this AEE, there is limited historic heritage within the Project area, and that which exists is of only moderate value given its highly modified and/or degraded state. Work will be carried out in accordance with an Archaeological Authority and a range of measures are proposed to mitigate the adverse effects of the Project on historic heritage values, including a HAMP to ensure that archaeological issues are managed appropriately during the construction phase. Given the strategic significance of the Project and the limited sites of value of historic heritage within the proposed designation, it is considered that historic heritage has been adequately recognised and provided for.

11.7.3. Section 7 – Other matters

The following matters in section 7 of the RMA have been given particular regard:

- Kaitiakitanga and the ethic of stewardship (s.7(a) and 7(aa)) have been recognised and actively incorporated into the Project design and proposed mitigation including the preparation of particular management plans with Mana Whenua, and the development and implementation of a Cultural Monitoring Plan and Cultural Indicators Framework for construction.

- The efficient use and development of natural and physical resources, whereby the Project will provide improved safety for all users including walking and cycling through removal of heavy vehicles from current walking and cycling routes, improving accessibility and resilience, reducing congestion, improving travel time reliability and improving freight efficiency. The Project is considered to be an efficient use of natural and physical resources.
- The maintenance and enhancement of amenity values (s.7(c)) is recognised in this assessment of effects, and mitigation has been proposed to manage amenity issues. The Project's effects on amenity (especially relating to noise and air quality) during construction will be managed through implementation of construction management plans, adopting best practice techniques. During operation the ambient noise levels will be increased in areas in close proximity to the Project, however the design will be required to achieve compliance with NZS 6806, to provide a reasonable level of amenity for affected residents. Air quality during operation will comply with relevant air quality standards and guidelines. Mitigation proposed through the *Landscape and Visual Assessment* includes establishment of screening the Project from nearby residential properties.
- The intrinsic values of ecosystems (s.7(d)) and the maintenance and enhancement of the quality of the environment (s.7(f)) were at the forefront of the alternatives assessment process which sought to avoid effects on natural and built environments to the greatest extent possible. Where adverse effects could not be avoided, mitigation is proposed to ensure there are no significant residual effects on these values and qualities. The Project will be designed to minimise effects on wetlands and their supporting ecosystems through maintaining hydrological connections through measures such as incorporating a bridge across a tributary of the Kourawhero Stream. The Project will incorporate a range of measures that will enhance the physical environment especially through the integrated mitigation framework.
- The effects of climate change (s.7(i)) have been considered through the incorporation of predicted changes in climate in the stormwater design standards for the Project.

11.7.4. Section 8 – Treaty of Waitangi

The Transport Agency as a Crown agency recognises its role in taking into account the principles of the Treaty of Waitangi through its partnership with local iwi. Principles of the Treaty of Waitangi have been taken into account through engagement with the relevant iwi early in the development of the Project. In developing the Project, recognition has been given to both the relationship of Mana Whenua to their lands, culture and traditions in this area and the commitment to partnership between Mana Whenua and the Transport Agency (as representative of the Crown) founded through Te Tiriti o Waitangi. In particular, Hōkai Nuku has provided cultural input and advice during site investigations and preparation of various supporting technical assessments. This partnership and relationship will be maintained in the subsequent phases of the Project and is reflected in proposed designation and resource consent conditions.

12. Conclusion

The Transport Agency has lodged an Application for the Warkworth to Wellsford Project, the second stage of the Ara Tūhono Pūhoi to Wellsford project, to complete the new SH1 corridor from the Northern Gateway Toll Road at the Johnstone's Hill tunnels, to north of Te Hana.

The Project is described in section 4 of this AEE and involves a new off-line four-lane, dual carriageway highway commencing at the interface with P2Wk around Woodcocks Road and initially travelling to the west of the existing SH1 alignment before crossing it at the Hōteo River and bypassing Wellsford and Te Hana to the east. The Project ends to the north of Te Hana where a connection will be provided back onto the existing SH1 just north of a realigned Maeneene Road. Connections to the local road network will be provided through interchanges at Warkworth, Wellsford and Te Hana.

As the main inter-regional route connecting the Auckland and Northland regions, SH1 provides a vital lifeline connecting Auckland to Whangārei, and onto the Upper North Island. A safe, accessible, resilient, effective, and efficient state highway network is required to provide local, regional and national transport connections.

The Project will provide a new state highway route between Warkworth and Te Hana and is expected to provide significant safety and transport benefits. The Project will provide significant transport benefits of significantly improved safety, improved route quality including for access to and within the local road network including for cyclists, resilience and travel time consistency and reduced travel times.

Economic benefits include improved economic performance resulting from improvements in journey time, resilience and reliability and improved accessibility to support increased economic activity in Auckland and Northland. Reduced noise and air emissions will be experienced at existing receivers along SH1 as road traffic is predicted to move to the new alignment (and overall through better gradients and less need to brake, accelerate and/or decelerate).

The selection of the Indicative Alignment and proposed designation boundary has sought to avoid adverse effects as far as possible, however the Project will generate some adverse effects, particularly during the construction phase. Where the adverse effects cannot be avoided or remedied through design, mitigation has either been incorporated within the Indicative Alignment as described in section 4 of this AEE or is proposed and is reflected in the proposed designation and resource consent conditions.

Adverse effects include sediment runoff during construction, stormwater runoff and changes in hydrology during operation, impacts on terrestrial, freshwater and marine ecology, heritage, noise and visual effects associated with Project operation. The Project delivery framework incorporates the development and implementation of a suite of measures that cover detailed design, preparation of management plans and monitoring of construction activities. The delivery framework aims to achieve consistency with the Transport Agency's environmental objectives, manage areas of environmental sensitivity, recognise environmental risk issues, and identify the mechanisms to avoid, remedy or mitigate the actual and potential effects of the Project.

An integrated mitigation framework has been developed to address the effects of the Project and where mitigation will be enduring to provide long term benefits to the environment that align with the Ki Uta Ki Tai concept. There are significant opportunities to integrate the design response and mitigation requirements to achieve benefits across a range of environmental considerations and deliver an outcome to the wider environment that will make a longer term contribution to the natural environment, whilst adequately mitigating the adverse effects of the Project. Those effects that can be managed through an integrated mitigation framework relate primarily to the loss of freshwater and terrestrial values, impacts on mana whenua, changes to the landscape, heritage, stormwater and visual effects.

Taking into account the positive effects of the Project and the proposed measures to avoid, remedy and mitigate adverse effects, the Project is consistent with the purpose and principles of the RMA.

The purpose of the RMA with regards to the sustainable management of natural and physical resources will be achieved by confirming the proposed designation and granting the applications for resource consent for the Project.

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Appendix A: List of permitted activities

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
12.1. Land Use Activities – Earthworks				
Land use (s9(2))	Ancillary forestry earthworks	Table E11.4.1 (A12)	Construction and maintenance of infrastructure and facilities typically associated with forestry including tracks, roads and landings, and related erosion and sediment control measures, to facilitate construction of the Project.	The Standards under E11.6.4 need to be complied with.
Land use (s9(2))	Earthworks up to 10,000m² where land has a slope less than 10 degrees outside the Sediment Control Protection Area other than for maintenance, repair, renewal, minor infrastructure upgrading	Table E26.5.3.2 (A101)	Enabling works and discrete areas where specific localised works are required that include earthworks no greater than 10,000m² at one time including where progressive closure and stabilisation of works is undertaken to ensure that no 10,000m² is being earth worked at one time.	The standards under E26.5.5.2 need to be complied with.
Land use (s9(2))	Earthworks up to 2,500m² where the land has a slope equal to or greater than 10 degrees other than for maintenance, repair, renewal, minor infrastructure upgrading	Table E26.5.3.2 (A104)	Enabling works and discrete areas where specific localised works are required that include earthworks no greater than 10,000m² at one time including where progressive closure and stabilisation of works is undertaken to ensure that no 10,000m² is being earth worked at one time.	The standards under E26.5.5.2 need be complied with.
Land use (s9(2))	Earthworks up to 2,500m² within the Sediment Control Protection Area other than for maintenance, repair, renewal, minor infrastructure upgrading	Table E26.5.3.2 (A105)	Enabling works and discrete areas where specific localised works are required that include earthworks no greater than 10,000m² at one time including where progressive closure and stabilisation of works is undertaken to ensure that no 10,000m² is being earth worked at one time.	The standards under E26.5.5.2 need to be complied with.
12.2. Land use activities – Vegetation alteration/removal and planting				
Land use (s9(2))	Dead wood removal works in riparian margins and SEAs	Table E26.3.3.1 (A72)	Project-wide	No specific standards that must be complied with.

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Land use (s9(2))	Pest plant removal in riparian margins and SEAs	Table E26.3.3.1 (A74)	Project-wide	No specific standards that must be complied with.
Land use (s9(2))	Vegetation alteration or removal within riparian margins and SEAs	Table E26.3.3.1 (A76)	Vegetation alteration and removal for enabling works and in discrete areas where specific localised works are required.	The standards under E26.3.5.2 need to be met.
Land use (s9(2) and s9(3))	Dead wood removal	Table E15.4.1 (A2)	Project-wide	The Standards under E15.6.1 need to be complied with.
Land use (s9(2)	Forestry activities as existing at 30 September 2013	Table E15.4.1 (A5)	Removal of forestry trees through the Dome Valley Forest	There are no standards that must be complied with. .
Land use (s9(2) and s9(3))	Dead wood removal within SEA and ONF/ONC/HNC/ONL overlay areas	Table E15.4.2 (A32)	Project-wide	The Standards under E15.6.1 need to be complied with.
Land use (s9(2) and s9(3)))	Conservation planting	Table E15.4.1 (A7)	Project-wide	The Standards under E15.6.3 need to be complied with.
Land use (s9(2) and s9(3))	Conservation planting within SEA and ONF/ONC/HNC/ONL overlay areas	Table E15.4.2 (A37)	Project-wide	The Standards under E15.6.3 need to be complied with.

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Land use (s9(2) and s9(3))	Vegetation alteration or removal of any indigenous contiguous vegetation up to 25m² within ONF overlay	Table E15.4.2 (A25)	Project-wide	The Standards under E15.6.6 need to be complied with.
Land use (s9(2) and s9(3))	Vegetation alteration or removal of any indigenous contiguous vegetation up to 50m² within HNC/ONC/ONL overlay areas	Table E15.4.2 (A27)	Project-wide	The Standards under E15.6.6 need to be complied with.
Land use (s9(2) and s9(3))	Tree trimming	Table E15.4.2 (A42)	Project-wide	No specific standards that must be complied with.
12.3. Land use activities (earthworks and harvesting) under the Resource Management (National Environmental Standard for Plantation Forestry) Regulations 2017				
Land use (s9(1))	Earthworks associated with plantation forestry activities	Regulation 23 Regulation 24	Within the commercial plantation forest through the Dome Valley	The permitted activity conditions under Regulations 25 to 33 need to be complied with.
Land use (s9(1))	Harvesting associated with plantation forestry activities	Regulation 63	Within the commercial plantation forest through the Dome Valley	The permitted activity conditions under Regulations 64 to 69 need to be complied with.

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
12.4. Diversion, damming and discharge of treated sediment laden water				
Land use (s9(2))	The temporary diversion and damming of surface water and the discharge of treated sediment laden water from any land disturbance that complies with all relevant permitted activity standards	Table E11.4.2 (A13)	Project-wide during construction	The Standards under E11.6.1 and E11.6.2 need to be complied with.
Land use (s9(2))	The temporary diversion and damming of surface water and the discharge of treated sediment laden water from any land disturbance allowed by a land use consent in the above tables	Table E11.4.2 (A14)	Project-wide during construction	The Standards under E11.6.1 and E11.6.2 need to be complied with.
12.5. Works in watercourses				
Planting and the associated diversion of water				
Uses of beds of lakes or rivers (s13)	Conservation planting complying with the standards in E3.6.1.2	Table E3.4.1 (A2)	Project-wide	The Standards under 3.6.1.2 need to be complied with.
Activities involving depositing of any substance (other than that associated with a structure authorised by another rule…)				
Uses of beds of lakes or rivers (s13)	Depositing any substance for the purposes of providing fish passage for culverts lawfully existing on or before 30 September 2013 complying with the standards in E3.6.1.3	Table E3.4.1 (A8)	Project-wide	The Standards under 3.6.1.3 need to be complied with.
Activities involving disturbance and associated sediment discharge				

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Uses of beds of lakes or rivers (s13)	Channel clearance outside overlay areas less than 100m complying with the standards in E3.6.1.2	Table E3.4.1 (A10)	Project-wide	The Standards under 3.6.1.2 need to be complied with.
Uses of beds of lakes or rivers (s13)	Pest plant removal complying with the standards in E3.6.1.8	Table E3.4.1 (A14)	Project-wide	The Standards under 3.6.1.8 need to be complied with.
Structures in the bed of watercourse*				
Uses of beds of lakes or rivers (s13)	Temporary structures outside overlay areas complying with the standards in E3.6.1.15	Table E3.4.1 (A27)	Project-wide outside overlay areas	The Standards under E3.6.1.15 need to be complied with.
Uses of beds of lakes or rivers (s13)	Bridges or pipe bridges outside overlay areas complying with the standards in E3.6.1.16	Table E3.4.1 (A29)	Project-wide outside overlay areas	The Standards under 3.6.1.1 and E3.6.1.16 need to be complied with.
Uses of beds of lakes or rivers (s13)	Culverts or fords less than 30m in length when measured parallel to the direction of water flow outside overlay areas and complying with the standards in E3.6.1.18	Table E3.4.1 (A32)	Project-wide outside overlay areas	The Standards under 3.6.1.1 and E3.6.1.18 need to be complied with.
Uses of beds of lakes or rivers (s13)	Erosion control structure less than 30m in length when measured parallel to the direction of water flow outside overlay areas and complying with the standards in E3.6.1.14	Table E3.4.1 (A34)	Project-wide outside overlay areas	The Standards under 3.6.1.1 and E3.6.1.14 need to be complied with.

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Uses of beds of lakes or rivers (s13)	Stormwater or wastewater outfall outside overlay areas complying with the standards in E3.6.1.14	Table E3.4.1 (A39)	Project-wide outside overlay areas	The Standards under 3.6.1.1 and E3.6.1.14 need to be complied with.
Uses of beds of lakes or rivers (s13)	Structure solely under the bed including any associated drilling, tunnelling, thrusting or boring complying with the standards in E3.6.1.21	Table E3.4.1 (A40)	Project-wide	The Standards under 3.6.1.1, E3.6.1.14 and E3.6.1.21 need to be complied with.
Uses of beds of lakes or rivers (s13)	Surface water intake structure outside overlay areas	Table E3.4.1 (A41)	Project-wide outside overlay areas	The Standards under 3.6.1.1 will be complied with.
Uses of beds of lakes or rivers (s13)	Weirs, floodgates and flow monitoring devices complying with the standards in E3.6.1.23	Table E3.4.1 (A43)	Project-wide	The Standards under 3.6.1.1, E3.6.1.14 and E3.6.1.23 will be complied with.
Uses of beds of lakes or rivers (s13)	Any activity that is undertaken in, on, over or within the bed of an ephemeral river and streams complying with the standards E3.6.1.1	Table E3.4.1 (A53)	Ephemeral streams within the Project area	The Standards under E3.6.1.1 will be complied with.
* Reclamation consents are not required when installing culverts, fords and erosion protection structures.				

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
12.6. Stormwater discharge and diversion				
Discharge of contaminants (s15)	Diversion of stormwater runoff from lawfully established impervious areas directed into an authorised stormwater network or a combined sewer network that complies with Standard E8.6.2.1.	Table E8.4.1 (A1)	Existing impervious areas within the Project area	The Standards under E8.6.2.1 will be complied with.
Discharge of contaminants (s15)	Diversion and discharge of stormwater runoff from lawfully established impervious areas as of 30 September 2013 not directed to a stormwater network or a combined sewer network that complies with Standard E8.6.1 and Standard E8.6.2.2	Table E8.4.1 (A3)	Existing impervious areas within the Project area (existing roads).	The Standards under E8.6.1 and E8.6.2.2 will be complied with
Discharge of contaminants (s15)	Diversion and discharge of stormwater runoff from impervious areas up to 5,000m^2 of road (which include road ancillary areas that are part of a road, motorway or state highway operated by a road controlling authority) or rail corridor that complies with Standard E8.6.1 and Standard E8.6.2.3.	Table E8.4.1 (A4)	Areas of road less than 5,000m^2	The standards under E8.6.1 and E8.6.2.3 will be complied with
12.7. Take, use, damming and diversion of water				
Take and use of groundwater				

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Water use (s14)	Take and use of groundwater up to 5m³ /day when averaged over any consecutive 20-day period	Table E7.4.1 (A14)	Small volume take and use of groundwater during construction.	The take and use of groundwater will comply with the activity standards under E7.6.1.3.
Water use (s14)	Take and use of groundwater up to 20m³ /day, when averaged over any consecutive five-day period, and no more than 5000m³ /year	Table E7.4.1 (A15)	Small volume take and use of groundwater during construction.	The take and use of groundwater will comply with the activity standards under E7.6.1.4.
Water use (s14)	Pump testing a bore for seven days at an average rate of no more than 1000m³ /day	Table E7.4.1 (A16)	Project-wide Pumping tests required during construction	No standards.
Water use (s14)	Dewatering or groundwater level control associated with a groundwater diversion permitted under the Unitary Plan, outside Wetland Management Areas overlay	Table E7.4.1 (A17)	Project wide Dewatering or groundwater control from trenching and excavations undertaken	Dewater and groundwater level control will comply with the activity standards in E7.6.1.6.
Water use (s14)	Land drainage outside Wetland Management Areas overlay	Table E7.4.1 (A19)	Project-wide.	The standards under E7.6.1.9 will be complied with.
Diversion of groundwater				
Water use (s14)	Diversion of groundwater caused by any excavation (including trench) or tunnel outside Wetland Management Areas overlay	Table E7.4.1 (A27)	Enabling works, minor utility works and smaller-scale excavations, and installation of piles that comply with the standards.	The standards under E7.6.1.10 will be complied with.
Damming water				

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Water use (s14)	Temporary dams	Table E7.4.1 (A32)	Temporary dams required during construction.	The Standards under E8.7.6.1.11 and E7.6.1.14 will be complied with.
Drilling and use of holes and bores				
Water use (s14)	Holes for: • geotechnical investigation; • mineral exploration; • mineral extraction; • geological investigation; • contaminated site investigation; or • down-hole seismometers outside Wetland Management Areas overlay	Table E7.4.1 (A36)	Investigation and extraction drilling during enabling works and construction.	The Standards under E7.6.1.16 and E7.6.1.17 will be complied with.
Water use (s14)	Bores for groundwater level or quality monitoring outside Wetland Management Areas overlay	Table E7.4.1 (A38)	Monitoring bores prior to and during construction, and during operation.	The Standards under E7.6.1.16 and E7.6.1.18 will be complied with.
Water use (s14)	Restoration, alteration or replacement of lawfully established bores outside the Wetland Management Areas overlay	Table E7.4.1 (A39)	Project-wide Relocation/alteration/replacement of existing bores during construction	The Standards under E7.6.1.16 and E7.6.1.19 will be complied with.

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Water use (s14)	Decommissioning (abandonment) of holes or bores outside the Wetland Management Areas overlay	Table E7.4.1 (A40)	Project-wide Decommissioning of existing holes or bores during construction.	The Standards under E7.6.1.16 and E7.6.1.20 will be complied with.

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
12.8. Discharge of contaminants to land/ water associated with land use activities				
Discharge of contaminants (s15)	Discharge of water and/or contaminants (including washwater) onto or into land and/or into water from any of the following activities: (a) concrete/asphalt laying or reworking; (b) drilling (excluding bore development and testing); (d) washing vehicles, plant or machinery; (f) road construction activities; (g) construction, repair, maintenance, upgrade or removal of any component of the stormwater or wastewater network that does not border, span or otherwise extend over any water body; (h) construction, repair, maintenance, upgrade or removal of network utility infrastructure that does not border, span or otherwise extend over any water body; (j) dust suppression;	Table E4.4.1 (A1)	Project-wide Discharges during construction.	The Standards under E4.6.1 will be complied with.

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Discharge of contaminants (s15)	Discharge of water onto or into land and/or into water from any of the following: (a) testing or emptying of pipelines, tanks or bunds; (c) bore development, testing or purging (dewatering), except for contaminated groundwater; (d) temporary or permanent discharge of diverted uncontaminated groundwater;	Table E4.4.1 (A2)	Project-wide.	The Standards under E4.6.1 and E4.6.2.1 will be complied with.
Discharge of contaminants (s15)	Discharge onto or into land and/or water for the purpose of dewatering trenches or other excavations	Table E4.4.1 (A5)	Project-wide, discharge of dewatering from excavations during construction.	The Standards under E4.6.1 and E4.6.2.5 will be complied with.
12.9. Discharge of contaminants to air associated with land use activities				
Discharge of contaminants (s15)	Activities meeting permitted activity standards and not provided for by other rules	Table E14.4.1 (A1)	Project-wide, including discharges to air associated with earthworks and construction of public roads and demolition of buildings.	The Standards under E14.6.1.1 will be complied with
Discharge of contaminants (s15)	Cement storage, handling, redistribution, or packaging outside High air quality - dust and odour area	Table E14.4.1 (A77)	Project-wide where cement is stored or handled during construction	The Standards under E14.6.1.1 and E14.6.1.12 will be complied with

RMA Section	Activity	Rule	Geographic area	Permitted Activity Compliance
Discharge of contaminants (s15)	Temporary crushing of concrete, masonry products, minerals, ores and/or aggregates on a development site using a mobile crusher at a rate of up to 60 tonnes/hour	Table E14.4.1 (A92)	Project-wide in locations where temporary crushing of materials is required during construction	The Standards under E14.6.1.1 and E14.6.1.13 will be complied with
Discharge of contaminants (s15)	Discharges to air from motor vehicles (excluding tunnels)	Table E14.4.1 (A114)	Project-wide, from motor vehicles using the motorway during operation (excluding tunnels)	The Standards under E14.6.1.1 will be complied with.
Discharge of contaminants (s15)	Discharges to air from motor vehicle tunnels established from 30 September 2013 with a Low or Medium Risk Rating (as assessed under Table E14.6.1.18.1 and Table E14.6.1.18.2 in Standard E14.6.1.18)	Table E14.4.1 (A116)	Discharges to air from the tunnel portals during operation.	The overall risk rating is low as assessed under Table E14.6.1.18.1 and Table E14.6.1.18.2 in Standard E14.6.1.18.
12.10. Discharges arising from contaminated land disturbance				
Discharge of contaminants (s15)	Discharges from intrusive investigations (including sampling) involving chemical testing/monitoring	Table E30.4.1 (A1)	Project-wide Contaminated or potentially contaminated land subject to intrusive investigations	The Standards under E30.6.1.1 will be complied with
Discharge of contaminants (s15)	Discharges of contaminants into air, or into water, or onto or into land from disturbing soil on land containing elevated levels of contaminants	Table E30.4.1 (A2)	Project-wide Disturbance of contaminated or potentially contaminated land	The Standards under E30.6.1.2 will be complied with