# Warkworth to Wellsford

## Ecology Assessment

July 2019

# QUALITY ASSURANCE

## Prepared by

Jacobs GHD Joint Venture in association with Boffa Miskell Ltd. Prepared subject to the terms of the Professional Services Contract between the Client and Jacobs GHD Joint Venture for the Route Protection and Consenting of the Warkworth to Wellsford Project.

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# GLOSSARY OF ABBREVIATIONS

The table below sets out the technical abbreviations.

| Abbreviation | Term |
|---|---|
| 5MBC | Five-minute Bird Counts |
| ARD | Acoustic Recording Device |
| ARDS | Amphibian and Reptile Distribution Scheme |
| ARI | Average Return Interval |
| AUP(OP) | Auckland Unitary Plan – Operative in Part |
| DOC | Department of Conservation |
| ECR | Environmental Compensation Ratio |
| EPT | **E**phemeroptera (mayflies), **P**lecoptera (stoneflies) and **T**richoptera (caddisflies) |
| IBI | Index of Biotic Integrity |
| IUCN | International Union for the Conservation of Nature |
| LENZ | Land Environments of New Zealand |
| LVEA | Landscape and Visual Effects Assessment |
| MCI | Macroinvertebrate Community Index |
| MCI-sb | Macroinvertebrate Community Index for soft-bottom streams |
| NZFFD | New Zealand Freshwater Fish Database |
| OFLP | Overland flow path |
| PAH | Polycyclic aromatic hydrocarbons |
| PES | Priority Ecological Sites |
| REC | River Environment Classification |
| RMA | Resource Management Act 1991 |
| SE | Standard error |
| SEA | Significant Ecological Area |

| Abbreviation | Term |
|---|---|
| SEV | Stream Ecological Valuation |
| ULDF | Urban and Landscape Design Framework |

# GLOSSARY OF DEFINED TERMS

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

| Term | Meaning |
|---|---|
| Average Return Interval | The average time period between rainfall or flow events that exceed a given magnitude. |
| Benthic | Of, relating to, or occurring at the bottom of a body of water. |
| Canopy | Tallest layer of the forest. |
| Catchment | An area of land bounded by natural features such as hills or mountains from which surface water flows into streams, rivers and wetlands. |
| Construction Runoff | Any runoff, sediment laden or otherwise, that flows as a result of the construction related activities. Typically results from rain events. |
| Cryptic species | Species camouflaged and adapted for concealment in their habitat. |
| Construction works | Activities undertaken to construct the Project. |
| 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." |
| 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. |
| Edge effects | Changes in population or community structure that occurs at the boundary between two different habitats. |
| Fish IBI | The Fish Index of Biotic Integrity (IBI) is a measure of how intact the native fish community is within a stream reach or stream. |
| Fish passage | The movement of fish between the sea and any river, including up-stream or downstream in that river. |

| Term | Meaning |
|---|---|
| High-use Stream Management Area | An overlay in the AUP(OP). High-use Stream Management Areas identifies streams under pressure from demands to take water or use water. |
| Indicative Alignment | An indicative road design alignment assessed by the technical experts that may be refined on detailed design within the designation boundary.<br>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:<br>(a) it has natural pools;<br>(b) it has a well-defined channel, such that the bed and banks can be distinguished;<br>(c) it contains surface water more than 48 hours after a rain event which results in stream flow;<br>(d) rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel;<br>(e) organic debris resulting from flood can be seen on the floodplain; or<br>(f) there is evidence of substrate sorting process, including scour and deposition. |
| Macroinvertebrate | Macroinvertebrates are small organisms without backbones (e.g., insects, snails and worms) that are visible to the naked eye, of a size that will not pass through a 0.5 mm sieve. |
| Matariki Forest | The area of plantation forest owned and operated by Rayonier Matariki Forests in the Dome valley area. |
| Mitigation package | A collective term used in this report that includes all aspects of the EIANZ Mitigation Hierachy'. |

| Term | Meaning |
|---|---|
| Natural Stream Management Area | An overlay in the AUP(OP). Natural Stream Management Areas identifies river and stream reaches with high natural character and high ecological values. |
| 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 $m^2$. |
| Permanent river or stream | 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. |
| Priority Ecological Site | Locations of Moderate, High or Very High Ecological Value and/or locations recommended for ecological mitigation that are sensitive to the spatial (lateral or vertical) designed alignment within the proposed designation boundary. |
| Project | The Ara Tūhono Pūhoi to Wellsford Project: Warkworth to Wellsford section, which extends from Warkworth in the south, to the north of Te Hana. |
| Project area | The area within the proposed designation boundary, and immediate surrounds to the extent Project works extend beyond this boundary. |
| Proposed designation boundary | The boundary of the land to which the notice of requirement applies. |
| Rain shadow | An area that receives very little, or no, rain as it is in the shadow of a structure such as a bridge or viaduct. |
| Sediment control | Capturing sediment that has been eroded and entrained in overland flow before it enters the receiving environment. |
| Senescence | The growth phase in a plant or plant part (such as a leaf) from full maturity to death. |
| Significant Ecological Area (SEA) | Defined in section J1 of the AUP(OP), Areas of significant terrestrial indigenous vegetation or significant habitats of indigenous fauna located either on land or in freshwater environments. |

| Term | Meaning |
|---|---|
| Site | A habitat assemblage within the Project area identified and assessed by the Project team. |
| Stormwater | Water that flows from impervious areas and completed areas of the State Highway after the construction period. |
| Stream Ecological Valuation | A standardised stream ecological survey methodology. |
| Stream reach | A defined section a larger stream. |
| Taxon | Types / groups of animals (e.g. species). The plural is 'taxa'. |
| Terrigenous | Sediment derived from the erosion of rocks on land; that is, that are derived from terrestrial environments. |
| Terrestrial | Land-based. |
| Torpor | Decreased physiological activity in an animal, usually by a reduced body temperature and metabolic rate. |
| Treatment wetland | Vegetated stormwater treatment device designed to remove a range of contaminants, providing superior water quality treatment to wet ponds with increased filtering and biological treatment performance. |
| Treeland | Treeland is defined as vegetation in which the cover of trees in the canopy is 20–80 percent, with tree cover exceeding that of any other growth form, and in which the trees form a discontinuous upper canopy above either a lower canopy of predominantly non-woody vegetation or bare ground. |
| Tributaries | Small 'feeder' streams that drain into large streams and rivers. The catchments of these tributaries are known as sub-catchments. |
| True left or True Right | The true left and true right banks of a stream or watercourse refers the left or right side of the stream when looking downstream, i.e., looking to where the water is flowing to. |
| Turbidity | Turbidity is a measure of water clarity or murkiness of a waterbody. |
| Watercourse | A natural or artificial channel through which water flows. |

| Term | Meaning |
|---|---|
| Wetland | Defined in s2(1) of the RMA to include *"…permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions"*.<br><br>Treatment wetlands (defined above) are not included in the above definition as they are created for the purpose of water treatment, and therefore do not support a *"natural ecosystem."* |

# TABLE OF CONTENTS

# EXECUTIVE SUMMARY

The NZ Transport Agency (Transport Agency) is lodging a Notice of Requirement (NoR) and resource consent applications for the construction, operation and maintenance of an approximately 26 km section of state highway between Warkworth and north of Te Hana.

The purpose of this report is to identify the terrestrial and freshwater ecological values of the areas potentially affected by the Project, to assess the actual and potential effects of the Project on those values, and recommend appropriate mitigation to address identified adverse effects. A sensitivity analysis identifies the extent to which movement of the Indicative Alignment within the proposed designation boundary, and timing of construction, would alter the scale or severity of effects identified in our assessment.

For the purposes of the ecology assessment detailed in this report, the Project is divided into three sections:

- Warkworth North section - predominantly pasture on low-lying alluvial flats surrounding the Mahurangi River (Left Branch) and the Kourawhero Stream, interspersed with riparian podocarp, broadleaved forest remnants, alluvial kahikatea forest remnants, and regenerating scrub;
- Dome Valley Forest section - mostly plantation pine forest on elevated hill country, with narrow margins of indigenous riparian scrub around incised stream gullies; and
- Hōteo North section - gentle to rolling farmland interspersed with podocarp, broadleaved and kahikatea forest remnants, including kahikatea-dominated wetlands of high ecological value.

For the purposes of assessment, the construction of the Project is forecast to start in 2030. We have assessed ecology effects considering the current and expected future environment, using best practice guidelines. However, with a long lead-in time to construction, ecosystem values may change over time. As such, this assessment is focused on identifying key ecological features and habitats, while setting out recommendations for confirmation of features and habitats to inform appropriate action to be undertaken prior to, during and after construction.

The ecological assessment approach follows the Environmental Institute of Australia and New Zealand (EIANZ) guideline for Ecological Impact Assessment (EIANZ 2018), including assessment of ecological values and the magnitude and severity of ecological effects.

This report incorporates site data from earlier ecological assessments undertaken to inform the Ecological Assessment Report (Bioresearchers, 2010) used for obtaining consents for the Pūhoi to Warkworth section of the route, with additional fieldwork to address information gaps and confirm earlier findings or assumptions. When available, Kaitiaki from Hōkai Nuku attended site visits.

**Key terrestrial sites**

Within the Warkworth North section, the Indicative Alignment encroaches on a small kahikatea-pukatea swamp forest fragment and a raupo wetland, potentially compromising the viability of both features. Several areas of kanuka scrub and podocarp-broadleaved

forest of moderate value within this section would also be removed to construct the Indicative Alignment, amounting to an estimated loss of 6 ha in total.

Within the Dome Valley section, the proposed tunnels for the Project beneath Kraack Hill extend below a high-value forest remnant (DVF_T_Koura_02) thus avoiding any significant ecological effects on this feature. However, almost the whole of the proposed designation within this section intersects exotic pine forest, which has the potential for significant populations of long-tailed bats, Hochstetter's frogs, and kauri snails.

Within the Hōteo North section, the Indicative Alignment footprint impacts two high value stands of kahikatea-dominated swamp forest. Indicative works would result in clearance of 20 – 30% of each of these features which, along with associated indirect effects as a result of potential modifications to the water table, may compromise their long-term viability. Areas of flaxland and moderate value kauri-podocarp forest also occur within the proposed designation boundary.

**Fauna values**

We assessed the likelihood of fauna of interest occupying particular sites on the basis of site size and connectivity, previous land use, vegetation / habitat composition and structure, and availability of microhabitats. Specific fauna surveys were undertaken to confirm the presence of target species at representative sites where information reviews and habitat surveys identified the potential presence of a significant fauna population.

Lizard species potentially present within the proposed designation boundary are habitat generalists, and are commonly found on bush margins, in rough pasture areas and in refuge habitats that are less accessible to stock. Hence, lizards may be present throughout the proposed designation. Geckos are often found occupying early successional scrub habitats such as that present in our Warkworth North site labelled WN_T_Koura_02.

A single banded rail (At Risk – declining) was detected at Site WN_W_Koura_02, and Cooks petrel (classified as At Risk - Relict) were recorded over-flying Dome Valley Forest and parts of the Hōteo North section. All other birds detected were common and widespread native and introduced species.

A variety of significant indigenous fauna is present within plantation forest in the Dome Valley section, including Threatened and/or At Risk species (kauri snail, Hochstetter's frog and long-tailed bat).

Bats were detected at sites in the Dome Valley Forest section, and in the open valley system of the Kourawhero headwaters on the southern Forest margin. Previous surveys in the wider Rodney region have also recorded long-tailed bats, largely associated with sizeable tracts of native and exotic forest. Hōteo North and Warkworth North sections have poor landscape connectivity to any sizable tracts of large stature forest. Nevertheless, long-tailed bats are highly mobile and these areas contain shelterbelts and small forest remnants with cavity bearing trees that could be used by bats.

Hochstetter's frogs were previously recorded in watercourses within the Dome Valley Forest section (Bioresearches, 2011). The herpetofauna database administered by DOC also contains numerous Hochstetter's frog records from the adjacent Dome Forest Conservation Area (which is outside the proposed designation boundary). Records of Hochstetter's frogs

are almost exclusively associated with rocky waterfalls, enclaves and silt-free basal rock piles.

We observed live kauri snails in Matariki plantation forest, and numerous whole kauri snail shells and shell fragments were recorded in several locations throughout the forest. Heavy predation appears to be a factor in the detection rate, as almost all shells found showed some evidence of predation damage by pigs or rats, and/ or appeared to have been unearthed by pig rooting.

Bioresearches (2011) recorded numerous native snails of the species *Amborhytida dunniae* within the taraire forest comprising site HN_T_Hōteo _02, which the Indicative Alignment intersects at the Hōteo Viaduct.

**Freshwater values**

Freshwater sites within the proposed designation boundary and Indicative Alignment (i.e. those streams that would be culverted, bridged, or diverted in order to construct the Indicative Alignment) were identified for survey, along with representative aquatic habitats within each section of the proposed designation boundary. Stream ecological valuations (SEV) were undertaken using Auckland Council Stream Ecological Valuation (SEV) Assessment Methodology (Auckland Council 2011) at 14 sites. Surveyed watercourses were classified in accordance with AUP(OP) definitions.

Low value aquatic habitats are present in the Warkworth North and Hōteo North sections where many of the streams are located within grazed pasture. The Dome Valley Forest section currently has freshwater habitats of high ecological value, with high diversity of fish and macroinvertebrate species. These will be reduced following harvest.

The ecological effects of the Project (based on the Indicative Alignment and without mitigation) on freshwater values within the Warkworth North Section are moderate, owing to the potential effects on a high value wetland located within the upper Kourawhero Catchment. As the landuse within the Dome Valley Section is subject to the cyclical change, of forest harvest, the effects of the Project on the freshwater ecological values through the Dome Valley Section (and without mitigation) are low-moderate. Freshwater effects in the Hōteo North Section are low overall, as watercourses within the section are largely of low ecological value.

**Sensitivity of assessment to spatial and temporal changes**

Movement of the Indicative 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 in the upper Kourawhero Stream catchment in the Warkworth North section; and the Hōteo River floodplains area of the Hōteo North section. The pine plantation within the Dome Valley Forest section is currently mid-way through the production cycle, with harvest anticipated to occur prior to 2030. Harvesting is scheduled to be completed across the proposed designation prior to construction of the Project. We note that plantation forest harvesting is a permitted activity under the NES Plantation Forestry. However, harvesting within the forest will result in the loss of fauna habitat values, and potential impacts to streams that are likely to modify ecological values, and this is reflected in our overall assessment.

**Recommendations and conclusions**

As there is a current expectation that a period of approximately 10 years will pass prior to construction of the state highway, and therefore the final design may differ from the Indicative Alignment, we recommend that further baseline surveys of ecological values are undertaken closer to the time of construction. These will be conducted with the purpose of confirming the ecological values at that time, as well as being sufficiently detailed to better inform the quantum of mitigation required. Our more detailed recommendations address how that further survey work should take place and the process to quantify mitigation.

Recommendations for addressing adverse ecological effects include avoiding, as much as is practicable, movement of the Indicative Alignment in some areas to ensure effects on specific high value features are avoided or minimised. We have recommended the integration of the mitigation in specific areas to avoid a fragmentation of the mitigation effort. These areas for mitigation also generally align with the areas of highest sensitivity to the alignment of the final road. These locations are shown on the Ecological Mitigation and Priority Ecological Site maps included in the Project drawing set, Volume 3 of the AEE.

Our recommended strategy for managing and mitigating the impacts of the Project on the significant ecological values is founded on restoring the adaptive capacity of the environment by maintaining and enhancing biological diversity, and the diversity and connectivity of ecosystems at a landscape scale.

The Indicative Alignment will result in the loss of approximately 13 ha of native vegetation, out of a total of approximately 119 ha within the proposed designation boundary. Of this, approximately 1.5 ha of high to very high value indigenous wetland and kahikatea-dominated swamp forest is directly impacted through clearance, though the disturbance may result in substantive degradation to the remaining features. A further 8.9 ha compromises 'low-moderate' value vegetation, mostly kanuka forest and scrub and totara-dominated podocarp forest remnants.

In keeping with the mitigation principles (see section 5.1 for further detail) for the Project, mitigation for the loss of indigenous wetland and kahikatea-dominated swamp forest will be through the enhancement and reinstatement of lowland areas. Four areas have been identified as being appropriate for wetland enhancement and reinstatement:

- The Mahurangi River (Left Branch) floodplain;
- the upper Kourawhero Stream catchment;
- the Hōteo River floodplain at Wayby Valley Road; and
- Te Hana lowlands.

The areas have been chosen because each links to existing ecosystems and contributes to the aggregation of mitigation, prevention of fragmented mitigation and building resilience. Based on the Indicative Alignment, these areas amount to some 45 ha of mitigation planting. In addition, based on the Indicative Alignment, some 18 ha of planting is recommended for the improvement of linkages across the area where the Project will be built and to mitigate for increased edge effects resulting from the loss of vegetation features.

It is recommended that all mitigation areas outlined above are fenced, or stock excluded, are protected as appropriate, and subject to pest and weed management until they are well-established.

High fauna ecological values are mostly contained within the Dome Valley section, which contains populations of several threatened and at-risk species. Our recommended mitigation for the loss of habitat for these species will be through species-specific management, detailed in an overall Ecological Management and Mitigation Plan (EMMP), which will all include relocation as a component of management. As indicated above, the plantation forest is programmed to have been felled and harvested prior to the commencement of the Project. Nevertheless, we have recommended the retention of a parcel of land within the Dome Valley forest area within the proposed designation boundary as a preferred location for the purpose of providing a recipient area for salvaged organisms (especially lizards and land snails), and to act as a roost habitat and flyway for birds and bats across the designation (see EM plan series in the Volume 3 Drawing set of the AEE). We have identified this preferred location for this 'Fauna Habitat and Flyway Mitigation' area because it has the advantage of being (in part) above the proposed tunnel and thus not subject to bisection by the road, and contains an existing escarpment feature known to be a natural flyway. The area is also the location of a deep cut that means that the 'flyway' feature is at height above the road. Naturally occurring regrowth along with selective replanting within this location would provide the ecological benefits. However, should this location not be the available, an alternative location along the Hōteo can be identified, failing that other suitable areas will be determined by a suitably qualified person.

Some 27 km of length of intermittent and permanent streams will be directly affected by the Indicative Alignment within the proposed designation boundary. About 18 km of diversion channels are planned which will replace the stream losses, especially in lowland areas. Using standard stream ecological compensation ratios this amounts to some 71 km of additional stream riparian planting (allowing for planting the stream margins 20 m either side of watercourses selected for mitigation).

Matariki Forest will have been harvested prior to construction, hence there is an opportunity to restore riparian margins of the higher value streams in this section of the route.

A component of the stream loss in the Hōteo North section is from riverine wetlands. We have identified two areas for potential wetland enhancement: the upper Kourawhero Stream catchment, and the Hōteo River floodplain at Wayby Valley Road.

Mitigation and methods for implementation should be detailed in and guided by Ecological Management Plans that are informed by site specific pre-construction ecological surveys and assessment.

With the application of mitigation in line with the mitigation principles for the Project, the overall effects of the Project on terrestrial and freshwater ecology are acceptable.

We consider that the mitigation proposed is adequate to manage the adverse effects of the Project within the proposed designation boundary. However, we note that although our proposed mitigation package is contained within the proposed designation boundary, the ecological benefits extend beyond these boundaries and will lead to an overall enhancement of ecological outcomes.

# 1 INTRODUCTION

## 1.1 Overview of the Project

The NZ Transport Agency (Transport Agency) is lodging 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 report is part of a suite of technical assessments prepared to inform the Assessment of Effects on the Environment (AEE) and to support the Application. This assessment report addresses the actual and potential ecological effects arising from the Project. The assessment 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.

## 1.2 Project description

The Project involves the construction, operation and maintenance of a new four lane state highway. The route is approximately 26 km long. The Project commences at the interface with the Pūhoi to Warkworth project (P-Wk) near Woodcocks Road. It passes to the west of the existing State Highway 1 (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.

The key components of the Project, based on the Indicative Alignment, are as follows:

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

b) Three interchanges as follows:

   i. Warkworth Interchange, to tie-in with the Pūhoi to Warkworth section of SH1 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, which are approximately 850 metres long and approximately 180 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 within the Dome Valley 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 in the vicinity 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, signage, lighting at interchanges, landscaping, realignment of access points to local roads, and maintenance facilities.

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

For the purposes of the ecology assessment detailed in this report, the Project is divided into three sections (see Figure 1), as follows:

- Warkworth North;
- Dome Valley Forest; and
- Hōteo North.

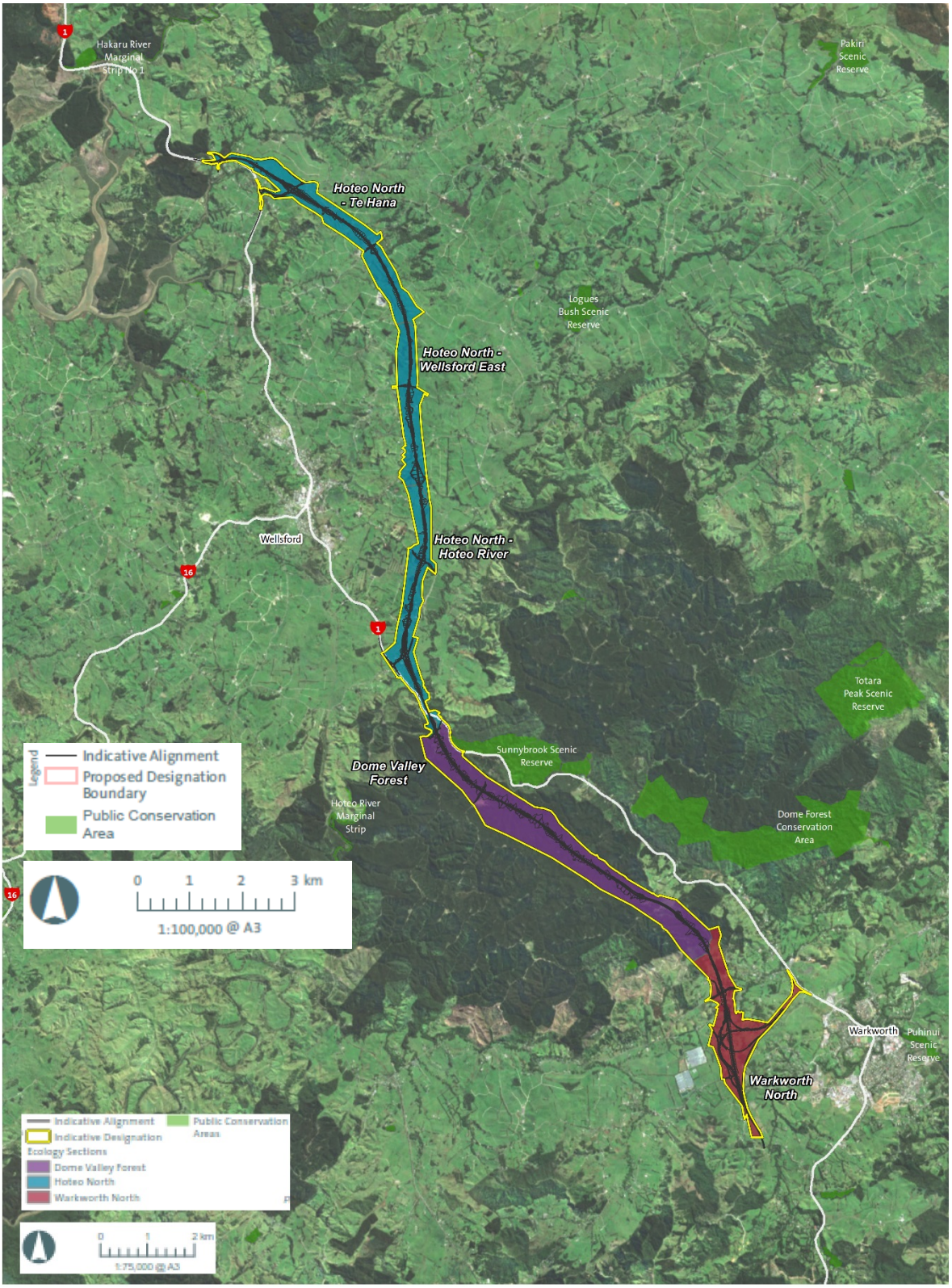


**Figure 1 - Project Area. Warkworth North Section – Red; Dome Valley Forest Section – Purple; Hōteo North Section – Blue.**

The Indicative Alignment shown on the Project drawings is a preliminary alignment for 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.

A full description of the Project including its design, construction and operation is provided in Section 4: Description of the Project and Section 5: Construction and Operation of the AEE contained in Volume 1 and shown on the Drawings in Volume 3.

## 1.3 Project timeframe

Construction is anticipated to commence in approximately 2030. This lead-in time has implications due to potential changes to ecological values over time. As a result, our assessment methodology is focussed on identifying key ecological features and habitats, while setting out recommendations for confirmation of features and habitats to inform appropriate action, including mitigation, to be undertaken prior to construction.

## 1.4 Scope of this report

The assessment of terrestrial and freshwater ecological effects includes:

- An explanation of the methodology used in this assessment of ecological effects.
- A description of the key ecological character and ecological values of the Project area.
- An assessment of the significance of key ecological sites within the Project area and their importance in relation to the region.
- A description of the effects of the proposed Project on the significant ecological values of the Project area.
- An outline of recommended measures to avoid, remedy or mitigate adverse ecological effects.

This assessment is based on the Indicative Alignment, while a sensitivity analysis is also provided 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. We have also considered sensitivity to the timing of the Project, particularly as it relates to harvesting of the commercial pine plantation traversed by the Project, the Matariki Forest.

## 1.5 Report layout

This ecological assessment is structured as follows:

- **Section 2** - Methodology. Includes details of literature sources, field survey methods, and the effects assessment framework.

- **Section 3** - Terrestrial and wetland ecological values and effects: existing environment and assessment of effects on terrestrial vegetation and habitat.
- **Section 4** - Freshwater ecological values: existing environment and assessment of effects on freshwater ecological values.
- **Section 5** - Recommended mitigation. This chapter sets out recommended mitigation measures to address adverse effects of the Project.
- **Section 6** - Summary and conclusions.

Additional relevant data and information is provided in the Appendices.

# 2 METHODOLOGY

**Methodology summary**

Our scope of work provided for an assessment of the ecological values within the proposed designation boundary. This report relies on site data from earlier ecological assessments undertaken for the Ecological Assessment Report for the Ara Tūhono Project, Pūhoi to Warkworth Section (Bioresearchers, 2010). As such, the programme of field surveys primarily focused on addressing information gaps in previous work (where landowner permission was given to access private property), and confirming earlier findings or assumptions. Our report provides recommendations for confirmation of features and habitats to inform appropriate action to be undertaken immediately prior to construction.

The EIANZ (2018) methodology was also used to assess the magnitude and severity of ecological effects resulting from the Project. In addition, our evaluation also indicates the sensitivity of the impact assessment to movement of the Indicative Alignment and timing of construction. 'Ecological significance' criteria set out in the EIANZ Impact Assessment Guidelines (EIANZ 2018) have been used to assess ecological values of terrestrial and wetland sites. Factors considered (representativeness, rarity/distinctiveness, diversity and pattern, and ecological context) are widely accepted and commonly used across New Zealand to evaluate ecological significance in the context of the RMA.

## 2.1 Approach and conventions

### 2.1.1 Approach

Our assessment report follows the Environmental Institute of Australia and New Zealand (EIANZ) guideline for Ecological Impact Assessment (EIANZ 2018). Our approach to assessing the environmental effects of the Project on the terrestrial, wetland and freshwater ecological values falls into three main components:

- Existing ecological values and their significance;
- Impact of construction and operational Project activities on ecological values; and
- Recommendations to avoid, remedy or mitigate adverse effects on ecological values.

As outlined above, for ease of reference, the assessment of effects is separated into the three Project 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 addressed in the Marine Ecology and Coastal Avifauna Assessment.

## 2.2 Zone of influence

The EIANZ guidelines for ecological impact assessment refer to the 'zone of influence' and define this zone as 'the areas/resources that may be affected by the biophysical changes caused by the proposed Project and associated activities'.

The zone of influence considered for our assessment of ecological effects is primarily the impacts within the proposed designation boundary. However, we recognise that the influence of the Project on ecological values can extend beyond the proposed designation boundary in many cases (e.g., downstream effects in waterways, severance and fragmentation of vegetation), and we have addressed these matters as appropriate.

## 2.3 Survey site selection

Terrestrial and freshwater survey data compiled for the Warkworth to Wellsford Scheme Assessment Report (Bioresearches 2010; Jacobs 2016) was reviewed in the context of the proposed designation boundary and Indicative Alignment. Key ecological features and information gaps were identified, and representative sites were selected for further field survey with reference to:

- Topographic maps;
- Aerial imagery;
- AUP(OP) SEA overlay;
- Auckland Council online (GEOMAPS) data; and
- Other ecological records compiled for the Project area.

Sites likely to be directly impacted by the Indicative Alignment were prioritised for further survey.

In addition, for freshwater habitats, sites within the footprint of the Indicative Alignment (i.e. those streams that would be culverted, bridged, reclaimed or diverted) were identified for survey, along with representative aquatic habitats within each section of the proposed designation. Sites were identified primarily through a desktop review of Auckland Council Overland Flow Paths, relevant New Zealand Freshwater Fish Database (NZFFD) records, River Environment Classification (REC) stream orders, and catchment boundaries, along with reports and monitoring data from Auckland Council.

The following factors were used to ensure sample sites encompass the range of aquatic habitats across the Project area:

- river catchment (Mahurangi River; Hōteo River; Oruawhero River);
- catchment land use types within the proposed designation boundary (e.g., rural, lifestyle, forestry);
- the position of the stream in the catchment (stream order), and the nature of the water flow regime (whether the stream is ephemeral, intermittent or permanent);
- riparian vegetation; and
- stock access.

Some sites that were initially selected from the desktop review were deemed unsuitable to survey once visited in the field for the following reasons:

- not the predicted aquatic habitat type;
- inadequate water to undertake the SEV method (outlined below); and
- inaccessibility.

Where possible, suitable alternative sites were selected in order to ensure an appropriate sample of representative freshwater habitats was surveyed. Changes to the footprint of the Indicative Alignment over the course of the Project has resulted in some survey sites that would not be impacted by the Indicative Alignment. However, the information we collected is still informative and helped us to characterise other impacted aquatic habitats within the Indicative Alignment.

## 2.4 Site nomenclature

For ease of reference, a standardised four-part format has been used for site names in this report and shown on the Ecological Map Series, EV series included in Volume 3 Drawing set of the AEE. As an example, WN_F_Mahu_1 is as follows:

- WN is an abbreviation of the Indicative Alignment section (WN = Warkworth North, DV=Dome Valley, HN=Hōteo North).
- F represents the type of ecology (F = Freshwater, W=Wetlands, T=Terrestrial).
- Mahu is an abbreviation of the catchment (Mahu = Mahurangi, Koura=Kourawhero, Hot=Hōteo ).
- The numeral 1 is the number of the site, in ascending order from south to north.

## 2.5 Methodology to assess existing environment

### 2.5.1 Terrestrial and wetland ecology

A botanist and a fauna specialist conducted walkover surveys of each of the selected sites. Vegetation and habitat sites were recorded, along with observations of site condition. Ecosystems were classified as per the Singers et al. (2017) guidelines prepared for Auckland Council[1].

When available, Kaitiaki from Hō kai Nuku attended site visits. Hō kai Nuku is a collective formed in 2010 by mana whenua within the Project area, namely Ngā ti Manuhiri (Ngā ti Wai), Ngā ti Mauku/Ngā ti Kauwae (Te Uri o Hau), Ngā ti Rango (Ngā ti Whā tua o Kaipara) and Ngā ti Whā tua iwi.

Factors used to assess likelihood of occupancy for key fauna of interest included:

[1] Singers et al. 2017: This guide describes the 36 terrestrial and wetland ecosystems, and their regional variants, that have been identified by Auckland Council as occurring in the Auckland region. The work is based on the national ecosystem classification system developed by the Department of Conservation. The report lists the regional conservation status of all of the region's 36 terrestrial and wetland ecosystem types and their regional variants, using the IUCN Red List of Ecosystems criteria.

- size of site/ connectivity to other habitat sites;
- previous land use;
- structure and intactness of vegetation canopy tiers;
- depth of the leaf litter and humus layers; and
- provision of microhabitats for foraging, shelter and breeding.

Specific fauna surveys for snails, frogs, birds and bats were undertaken at representative sites, where information reviews and previous habitat surveys identified the potential presence of populations of protected or threatened fauna species. The purpose of fauna surveys was to confirm the presence of target species in key locations. Fauna surveys were carried out at sites not previously assessed, or which warranted further survey effort due to the scale or severity of potential effects from the Indicative Alignment. Estimates of population characteristics (density, abundance or occupancy) were beyond the scope of this assessment, as such detailed information would be of limited value given the long lead-in time for this Project.

We also note that detection rates for many species may not be a reliable indication of true occupancy or use of a particular habitat, especially with naturally cryptic taxa such as land snails or herpetofauna, and where populations are small and sparse. A variety of interrelated factors can influence detectability, including seasonality, environmental conditions, microhabitat variability, demographics and mobility of populations. As such, even intensive surveys undertaken within a single season will offer only a 'coarse-grained' characterisation of flora and fauna present, and may not detect all species.

Further details of methods utilised for terrestrial and wetland surveys are included in Appendix A.

### Land snails

Two species of native land snail, kauri snail (*Paryphanta busbyi*) and a Rhytid snail *Amborhytida dunniae*, are known to occur in the Project area, both of which are classified as At Risk – Declining (Mahlfeld et al., 2012). Warkworth (including Matariki Forest) is the southern distributional limit for *Paryphanta busbyi*. Both species are large, predatory land snails, found in leaf litter among ground cover plants and under logs, typically in kauri forest but they are also known to inhabit other forest types including pine plantation forests. They are normally active when the weather is cool and wet, remaining largely inactive in dry weather. Kauri snails are nocturnal and remain buried in the leaf litter throughout the day, coming out on warm, moist nights to feed and reproduce. They are prone to dehydration in dry conditions.

Opportunistic searches for land snails were undertaken by our team when areas of suitable habitat were encountered during the site walkovers.

### Hochstetter's frog

Hochstetter's frog (*Leiopelma hochstetteri*) is a semi-aquatic species which is generally confined to a narrow habitat zone alongside small forested streams. This habitat zone is normally found in upland streams located within densely forested catchments, usually containing small waterfalls, cascades and pools (Jewell, 2008). Large and swiftly flowing

waterways are generally unsuitable for Hochstetter's frogs, although sightings near such habitats have been reported (e.g., McLennan, 1985).

Hochstetter's frogs occur in isolated populations throughout the northern half of the North Island. There are four distinct genetic groups of Hochstetter's frogs in the Auckland Region (Great Barrier, Northland, Hunua and Waitakere Ranges). Hochstetter's frogs are classified as 'At Risk- Declining' species (Newman et al 2009), having a large population and a low to moderate ongoing or predicted decline. Hochstetter's frogs are known to be affected by Chytridiomycosis, a fungal disease linked to dramatic population declines and extinctions of amphibian species in New Zealand and globally (Bishop et al., 2009). This disease can be transported via soil particles and on equipment that has been in contact with infected material.

Stream habitats within the Warkworth North and Hōteo North sections of the proposed designation are mostly unsuitable for Hochstetter's frogs, being lowland in nature with soft-bottomed, silty substrates, high sediment loads and a lack of suitable habitat and crevices for Hochstetter's frogs. Bioresearches (2011) identified 12 streams within the Project area as potential Hochstetter's frog habitat, but their site investigations found that seven of these did not contain suitable habitat due to high silt content, muddy banks, felled pine trees within the stream, and a lack of adequate shelter structures.

Hochstetter's frog surveys undertaken by both Boffa Miskell (in 2012) and Bioresearches were confined to the Dome Valley Forest section as this is the only section of the Project area with potentially suitable habitat and where Hochstetter's frogs have been recorded previously (Herpetofauna database, accessed 2 June 2017). According to the Herpetofauna Database, Hochstetter's frogs have been recorded in the high upper reaches of the Kourawhero Stream within the Warkworth North section.

A tributary (DVF_F_Hōteo _2a) within the Dome Valley Forest section of the proposed designation was inspected and described, and suitable habitat (loose rocks and debris within the splash zone of the stream, and within fractures in the faces of waterfalls) were searched.

### Lizards

Lizard species that may occupy the Project area include copper skink (Not Threatened), elegant gecko (At Risk – Declining), forest gecko (At Risk – Declining) and Pacific gecko (At Risk – Relict). These species have 'generalist' habitat requirements, and may be present across the Project area where there is suitable long term habitat that provides food, refuge and protection from predators.

Specific lizard surveys were not carried out as part of this assessment because of seasonal constraints, and restricted access to some land parcels. Lizard habitat assessments were carried out during site walkovers and vegetation assessments. This assessment is based on a review of available literature and the results of the habitat assessments. These methods are further described in Appendix A.

### Avifauna

New Zealand Bird Atlas data from the Ornithological Society of New Zealand (OSNZ 2007, derived from surveys undertaken in 1999-2004) was reviewed for four 10 km x 10 km 'grid squares' that overlap with the proposed designation.

Avifauna surveys were undertaken to establish an index of bird species within the proposed designation boundary. Surveys included replicated five-minute bird counts (5MBCs, as per Dawson & Bull 1975) at 15 locations that involved a single 5MBC being carried out at each site on two separate days. Acoustic recording devices (ARDs, Version B.2) were deployed at nine locations and call-back surveys were undertaken at two wetland sites. The locations and species of all birds incidentally observed during site walkovers were also recorded.

In the Hōteo North section, ARDs were set up at four locations to record for 14 consecutive days (15 December to 29 December 2017). Replicated 5MBCs and incidental observations were made at six sites within the Hōteo North section (Ecological Survey (ES) Series Drawings)

In the Dome Valley section, replicated 5MBCs were undertaken at six locations within the Matariki Forest and ARDs were set up to record for 14 consecutive days (15 December to 29 December 2017; Map Series MS).

Within the Warkworth North section, replicated 5MBCs were undertaken at four locations and ARDs were set up at three locations (Ecological Survery (ES) Series Drawings) to record for 14 consecutive days (28 September to 12 October 2017). Three call back surveys were undertaken at two wetland sites (WN_W_Koura_02 and WN_W_Koura_05) to identify any cryptic marsh birds including banded rail, fernbird, Australasian bittern, marsh crake and spotless crake. Site locations are shown in Map Series MS.

A total of 812 hours of acoustic files was analysed using the software package RavenLite (Version 2.0) and the location and species of all detected bird species of note were recorded.

### Bats

Long-tailed bats are classified as Threatened – Nationally Critical (O'Donnell et al., 2018) and have been recorded in multiple locations across Rodney and the wider Auckland Region (Bioresearches, 2011, 2014, Boffa Miskell Ltd, 2015, 2017).

Bat surveys were undertaken using ARDs which passively record both long-tailed bat (40 kHz) and lesser short-tailed bat (28 kHz) echolocation calls, on two concurrently operating frequency channels. They operate remotely by recording and storing each echolocation call (bat pass), along with the date and time of occurrence. Two types of recorders were used: Acoustic Rec ARM v1.2 developed by the Department of Conservation and the Song Meter SMZC Bioacoustics Recorder developed by Wildlife Acoustics USA.

Acoustic recorders were deployed across the proposed designation (where access was permitted), targeting habitat sites preferred by bats, such as wetlands, tall stature native and exotic forest remnants, tall stature shelterbelts, river and stream margins, and forestry roads. Where the Indicative Alignment bisects linear habitat sites such as forestry roads and rivers, pairs of ABMs where deployed on either side to monitor if bats are using these features as fly-ways. A total of five pairs of ARs were deployed along potential fly-ways, four AR pairs along forestry roads in the Dome Valley Forest section and one pair along the Hōteo River. A further four ARs were deployed around non-linear features including wetlands and forest remnants (Ecological Survey (ES) Series Drawings).

Acoustic recorders were deployed for a minimum of 14 nights each during the period September 2017 to January 2018 (see Table 41, Appendix D for the deployment period at each survey location). Department of Conservation ARs were programmed to record from

one hour before sunset to one hour after sunrise each night. The Wildlife Acoustics ARs automatically begin recording at sunset and finish at sunrise. This is calculated based on the GPS location of each AR in combination with the time zone.

Long-tailed bat activity is influenced by overnight temperatures and rainfall (O'Donnell, 2000). Weather data from the survey period was analysed to ensure conditions were suitable for bats to be active and therefore detectable via acoustic recordings. Suitable conditions are henceforth referred to as 'fine weather nights', and are defined for the purpose of this report as nights where the minimum overnight temperature was above 5˚C and there was less than 5 mm of rainfall during the night. Weather data was taken from the "Warkworth Ews" located approximately 3.5 km from the southern boundary of the proposed designation (www.cliflo.niwa.nz).

Acoustic data from fine weather nights was analysed using BatSearch v3.12 (Department of Conservation) or Kaleidoscope 4.5.4 (Wildlife Acoustics Inc., 2017), depending on the type of recorder used. Both software types convert the bats' echolocation calls (passes) into spectrograms that are visually analysed. Each spectrogram was recorded with the date and time, which was then used to analyse the timing of activity across the site.

### Pest animals and pest weeds

The fragmentation of areas of continuous habitat often results in an increase in associated edge effects, and the creation of corridors that facilitate the dispersal of pest mammals and weeds. Pest animals and weeds may use the newly formed road corridor during and after construction, and once the road is completed traffic on the road can facilitate dispersal of weeds.

Monitoring of pest mammals was not undertaken during field surveys for native species, however, pest mammal field sign (e.g., vegetation damage, prints, scat, bark biting in the case of possums) and the occurrence of weed species was noted.

### Biosecurity

The introduction of exotic biota and diseases to New Zealand poses a real threat to our indigenous biodiversity. In recent times, there has been increased awareness of the threat from kauri dieback, myrtle rust and Chytridiomycosis (an infectious disease in amphibians).

Specific studies of the presence of these diseases were not undertaken during field surveys for the Project, although protocols for the prevention of the spread of these organisms were strictly adhered to.

## 2.5.2 Freshwater ecology

The basic methodologies employed to assess existing freshwater ecology values are outlined below, for further details see Appendix B.

Stream ecological valuations (SEV) were undertaken using Auckland Council Stream Ecological Valuation (SEV) Assessment Methodology (Auckland Council 2011) at 14 sites. This included the surveying of fish and macroinvertebrate communities, amongst other attributes.

Fish communities were surveyed through electric fishing, using a NIWA backpack mounted EFM300 electric fishing machine, and closely following standard protocols as outlined in the New Zealand Freshwater Fish Sampling Protocols (Joy et al., 2013). The length of stream fished in our surveys was chosen to match the length of the SEV survey reach.

At the two sites where a SEV was not undertaken (WN_F_Mahu_1 and HN_F_Hōteo _2), a standard stream habitat assessment was carried out (as per the protocol provided in Appendix C)

Macroinvertebrate samples were collected at all SEV sites (14), and processed in accordance with national standard protocols C2 and P3, as described in Stark et al. (2001). Data were analysed to obtain a Macroinvertebrate Community Index (MCI) score (a biotic index used as an indicator of stream water quality). Refer to Appendix B for SEV data.

## Stream classification

Surveyed watercourses were classified in accordance with AUP(OP) Updated 27 October 2017) definitions, as follows:

- **River or stream** - A continually or intermittently flowing body of fresh water, excluding ephemeral streams, and includes a stream or modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal except where it is a modified element of a natural drainage system).
- **Permanent stream** – The continually flowing reaches of any river or stream.
- **Intermittent stream** –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.

- **Ephemeral stream** – 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.
- **Overland flow path** – Low point in terrain, excluding a permanent watercourse or intermittent river or stream, where surface runoff will flow, with an upstream contributing catchment exceeding 4,000m².
- **Artificial watercourse** – Constructed watercourses that contain no natural portions from their confluence with a river or stream to their headwaters.

Includes:

- canals that supply water to electricity power generation plants;
- farm drainage canals;
- irrigation canals; and
- water supply races.

Excludes:

- naturally occurring watercourses.

Owing to the large scale of the Project, 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 (OLFP). The layer indicates the predicted extent and transition points of permanent, intermittent and ephemeral stream reaches (Auckland Council 2016). Predicted stream reaches are classified into three groups based upon contributing catchment area, as follows:

- Ephemeral - 2000 $m^2$ to 4000 $m^2$.
- Intermittent – 4000 $m^2$ to 30,000 $m^2$.
- Permanent – 30,000 $m^2$ and above.

While we understand that there are limitations with estimating both the length and permanence of watercourse from the overland flow path layer, it provides a good starting point. Prior to construction of the Project, all watercourses affected will need to be surveyed and classified.

We note that Auckland Council has an additional OLFP layer that predicts the transition between different stream classifications based on catchment size and underlying geology, based on the findings of Storey and Whadwa (2009). This OLFP layer is not available publicly and we were not able to gain access to this modified OLFP for our assessment; hence our reliance on the currently available OLFP. It is our understanding that use of the current OLFP may overestimate the length of intermittent stream as detailed in our assessment.

## 2.6 Evaluation methodology

### 2.6.1 EIANZ Guidelines

Our approach to assessing the existing ecological values and effects of the Project follows the EIANZ Ecological Impact Assessment Guidelines (EIANZ 2018). Tables of criteria and assessment matrices used are included below.

### 2.6.2 Terrestrial and wetland ecological values

'Ecological significance' criteria set out in the EIANZ Impact Assessment Guidelines (EIANZ 2018) have been used to assess ecological values of terrestrial and wetland sites. Factors considered (representativeness, rarity/distinctiveness, diversity and pattern, and ecological context) are widely accepted and commonly used across New Zealand to evaluate ecological

significance in the context of the RMA, though there is variation in how they are interpreted and applied.

Wetlands have been categorised as per the RMA definition, and the ecological value of wetlands has been assessed based on the aforementioned factors.

The AUP(OP) subcriteria used to identify Significant Ecological Areas (Schedule 3 AUP(OP)) have been used to interpret the broad significance criteria for the Project (Table 1). However, the AUP(OP) SEA classification is dichotomous, either classifying a site as significant or not significant. EIANZ guidelines assign an ecological value on a scale from 'low' to 'very high' significance (Table 2).

The EIANZ evaluation (2015) guidelines include criteria for assigning value to both species and habitats. The guidelines recognise that significant flora and fauna, including threatened, at risk or uncommon species and absolutely protected indigenous wildlife, may be found throughout the landscape, including in habitats of otherwise low ecological value (Table 3).

**Table 1 - Ecological significance criteria for evaluation of terrestrial and wetland sites, from EIANZ (2015) guidelines and Schedule 3 of the AUP(OP)**

| Criteria | Factors to consider | Detailed subcriteria derived from AUP(OP) |
|---|---|---|
| Representativeness | • Extent to which area is typical or characteristic size | • [2]Is a large, natural and intact example of an indigenous ecosystem (including both mature and successional stages) that occurs naturally in the Auckland Region as listed in Singers et al., 2017[3]. |
| Rarity/ distinctiveness | • Amount of habitat or vegetation remaining<br>• Supporting nationally or locally threatened, at risk or uncommon species<br>• Regional or national distribution limits<br>• Endemism<br>• Distinctive ecological features<br>• Natural rarity | • It is an indigenous habitat, community or ecosystem that occurs naturally in Auckland and has been assessed (using the IUCN threat classification system)[4]<br>• [5]It is a habitat that supports occurrences of flora or fauna that has been assessed by the Department of Conservation and determined to have a national conservation status of threatened or at risk; or<br>• (i) It is assessed as having a regional threatened conservation status including Regionally Critical, Endangered and Vulnerable and Serious and Gradual Decline.<br>• It is indigenous vegetation that occurs in Land Environments New Zealand (LENZ) Category IV where less than 20% remains. |

[2] This criterion has been modified from what appears in the AUP(OP) as the original criterion would require a largescale in-depth spatial study of ecosystems across the region which is beyond the scope of this Project.

[3] The original criterion in the AUP(OP) refers to Singer and Rogers (2014) to classify indigenous ecosystems. For the purpose of this Project we have updated this to Singers et al (2017) "Indigenous terrestrial and wetland ecosystems of Auckland". The latter was produced by Auckland Council and is Auckland-specific. It was not published at the time the AUP(OP) was developed.

[4] Singers et al (2017) (described in the footnote above) includes assessments of each indigenous ecosystem type using the IUCN criteria.

[5] This criterion has been modified from the AUP(OP) to exclude fungi, as no specific surveys for fungi were included in the ecological surveys for the Project.

| Criteria | Factors to consider | Detailed subcriteria derived from AUP(OP) |
|---|---|---|
| | | • It is any indigenous vegetation or habitat of indigenous fauna that occurs within an indigenous wetland or dune ecosystem.<br>• It is a habitat that supports an occurrence of a plant, animal or fungi that is locally rare; or<br>• (i) it has been assessed by the Department of Conservation and determined to have a national conservation status of Naturally Uncommon, Range Restricted or Relict. |
| Diversity and pattern | • Level of natural diversity<br>• Biodiversity reflecting underlying diversity | • It is any indigenous vegetation that extends across at least one environmental gradient resulting in a sequence that supports more than one indigenous habitat, community or ecosystem type e.g., an indigenous estuary to an indigenous freshwater wetland.<br>• It supports the expected indigenous ecosystem diversity for the habitat(s).<br>• It is an indigenous habitat type that supports a typical species richness or species assemblage for its type. |
| Ecological context | • Contribution to network, buffer, linkage, pathways<br>• Role in ecosystem functioning<br>• Important fauna habitat<br>• Contribution to ecosystem services | • It is an example of an indigenous ecosystem, or habitat of indigenous fauna that is used by any native species permanently or intermittently for an essential part of their life cycle (e.g. known to facilitate the movement of indigenous species across the landscape, haul-out site for marine mammals) and therefore makes an important contribution to the resilience and ecological integrity of surrounding areas.<br>• It is an example of an ecosystem, indigenous vegetation or habitat of indigenous fauna, that is immediately adjacent to, and provides protection for, indigenous biodiversity in an existing protected natural area (established for the purposes of biodiversity protection); or<br>• it is an area identified as significant under the 'threat status and rarity' or 'uniqueness' factor. This includes areas of vegetation (that may be native or exotic) that buffer a known significant site. It does not include buffers to the buffers.<br>• It is part of a network of sites that cumulatively provide important habitat for indigenous fauna or when aggregated make an important contribution to the provision of a particular ecosystem in the landscape.<br>• It is a site which makes an important contribution to the resilience and ecological integrity of surrounding areas. |

Table 2 - EIANZ ecological values assessment criteria for terrestrial and wetland habitats.

| Value | Description |
|---|---|
| Very High | • Rates High for all or most of the five criteria listed in Table 1. Likely to be nationally important and recognised as such. |
| High | • Rates High for at least one of the assessment criteria and moderate for the majority of the others. Likely to be regionally important and recognised as such. |
| Moderate | • Rates moderate for the majority of assessment criteria. Important at the level of the Ecological District. |
| Low | • Rates Low or Nil for all assessment criteria. Limited ecological value other than as local habitat for a tolerant native species. |

Table 3 - EIANZ criteria for assigning value to species.

| Value | Description |
|---|---|
| Very High | Species classified nationally as Threatened (Nationally Critical, Nationally Endangered, Nationally Vulnerable). |
| High | Species classified nationally as At Risk (Declining, Recovering, Relict, Naturally Uncommon). |
| Moderate | Species classified nationally as Not Threatened but are considered uncommon/rare locally. |
| Low | Native species classified as Not Threatened and Introduced species. |

### 2.6.3 Freshwater ecological values

The criteria we used to assign ecological value to freshwater ecosystems are modified from the EIANZ guidelines, to better include the array of attributes assessed for freshwaters in New Zealand. These modified EIANZ criteria have been applied to other similar roading projects (e.g., East West Corridor, Transmission Gully). The modified criteria are outlined in Table 4.

Table 4 – Criteria for classification of freshwater stream ecological values (based on EIANZ 2018).

| Value | Explanation | Characteristics |
|---|---|---|
| Very High | A reference quality watercourse in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants from human induced activities including agriculture. Negligible degradation | • Benthic invertebrate community typically has high diversity, species richness and abundance.<br>• Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments.<br>• Benthic community typically with no single dominant species or group of species.<br>• MCI scores typically 120 or greater.<br>• EPT richness and proportion of overall benthic invertebrate community typically high.<br>• SEV scores high, typically >0.8.<br>• Fish communities typically diverse and abundant. |

| Value | Explanation | Characteristics |
|---|---|---|
| | e.g., stream within a native forest catchment. | • Riparian vegetation typically with a well-established closed canopy.<br>• Stream channel and morphology natural.<br>• Stream banks natural typically with limited erosion.<br>• Habitat natural and unmodified. |
| High | A watercourse with high ecological or conservation value but which has been modified through loss of riparian vegetation, fish barriers, and stock access or similar, to the extent it is no longer reference quality. Slight to moderate degradation e.g., exotic forest or mixed forest/agriculture catchment. | • Benthic invertebrate community typically has high diversity, species richness and abundance.<br>• Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments.<br>• Benthic community typically with no single dominant species or group of species.<br>• MCI scores typically 80-100 or greater.<br>• EPT richness and proportion of overall benthic invertebrate community typically moderate to high.<br>• SEV scores moderate to high, typically 0.6-0.8.<br>• Fish communities typically diverse and abundant.<br>• Riparian vegetation typically with a well-established closed canopy.<br>• No pest or invasive fish (excluding trout and salmon) species present.<br>• Stream channel and morphology natural.<br>• Stream banks natural typically with limited erosion.<br>Habitat largely unmodified. |
| Medium | A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Moderate to high degradation e.g., high-intensity agriculture catchment. | • Benthic invertebrate community typically has low diversity, species richness and abundance.<br>• Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments.<br>• Benthic community typically with dominant species or group of species.<br>• MCI scores typically 40-80.<br>• EPT richness and proportion of overall benthic invertebrate community typically low.<br>• SEV scores moderate, typically 0.4-0.6.<br>• Fish communities typically moderate diversity of only 3-4 species.<br>• Pest or invasive fish species (excluding trout and salmon) may be present.<br>• Stream channel and morphology typically modified (e.g., channelised)<br>• Stream banks may be modified or managed and may be highly engineered and/or evidence of significant erosion.<br>• Riparian vegetation may have a well-established closed canopy.<br>Habitat modified. |
| Low | A highly modified watercourse with poor diversity and abundance of aquatic fauna and significant water quality issues. Very high degradation e.g., modified urban stream. | • Benthic invertebrate community typically has low diversity, species richness and abundance.<br>• Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments.<br>• Benthic community typically with dominant species or group of species.<br>• MCI scores typically 60 or lower.<br>• EPT richness and proportion of overall benthic invertebrate community typically low or zero. |

| Value | Explanation | Characteristics |
|---|---|---|
| | | • SEV scores moderate to high, typically less than 0.4.<br>• Fish communities typically low diversity of only 1-2 species.<br>• Pest or invasive fish (excluding trout and salmon) species present.<br>• Stream channel and morphology typically modified (e.g., channelised).<br>• Stream banks often highly modified or managed and maybe highly engineered and/or evidence of significant erosion.<br>• Riparian vegetation typically without a well-established closed canopy.<br>Habitat highly modified. |

### 2.6.4 Evaluating the level of effect

The ecological effects of the Project have primarily been assessed using the Indicative Alignment as a starting point. Under the EIANZ criteria we have used, the level, or severity, of adverse effects on an ecological site or process is determined by the magnitude of the effect, the nature of the effect, and the ecological value of the site or component (EIANZ 2018).

EIANZ (2018) uses matrices (Table 5 and Table 6) to provide a basis for clear and comparative assessments of the magnitude of effects and the associated impact on ecological values. These must be used in conjunction with a detailed explanation of how scores and evaluations have been derived. Assessment of the level of adverse effect excludes consideration of specific mitigation measures (i.e., it is a 'raw', unmitigated, assessment), but does consider whether the effect could be potentially mitigated or remedied.

'Effect magnitude' scores were derived for each of the ecological sites surveyed (or survey reach in the case of freshwater sites) based on the extent and duration of the proposed construction within the Indicative Alignment, and ongoing effects associated with its functioning. Level of effect was assessed for each ecological site and local fauna population using a matrix of 'effect magnitude' and 'ecological value' rankings. This matrix uses the ecological value assigned to each site in combination with the magnitude of the effect of Project activities on each site to determine the overall level (i.e., seriousness) of the effect.

Table 5 shows how the loss, change or deviation from the existing or baseline ecological quantity and quality conditions can be described in terms of the extent and duration of alteration to describe the magnitude of the effect. A scale of very high to negligible is suggested. 'Existing' and 'baseline' conditions may be the same; however, they may differ when the existing environment is expected to change before the activity causing an effect takes place.

We note that for the purposes of this assessment, we have assessed the impacts of the Project within the Dome Valley Section with full harvesting of the plantation forest having taken place and without. Thus both 'baseline' conditions are presented in this section of the route. We note that the pre-harvest scenario is considered worst-case.

**Table 5 - EIANZ criteria for describing magnitude[A] of effect (EIANZ 2018). NB. criteria exclude mitigation.**

| Magnitude | Description |
|---|---|
| Very high/severe | • Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will fundamentally change and may be lost from the site altogether; and/or<br>• Loss of a very high proportion of the known population or range of the element/feature |
| High | • Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; and/or<br>• Loss of a high proportion of the known population or range of the element/feature |
| Moderate/medium | • Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; and/or<br>• Loss of a moderate proportion of the known population or range of the element/feature |
| Low/minor | • Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; and/or<br>• Having a minor effect on the known population or range of the element/feature |
| Negligible | • Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; and/or<br>• Having negligible effect on the known population or range of the element/feature |
| **Notes:**<br>A - We note that where the level of effect is noted as moderate, high or very high, mitigation is usually required. Therefore, the effects would typically be considered significant under the RMA. | |

**Table 6 - EIANZ criteria for level of ecological effect (EIANZ 2018).**

| Magnitude | Ecological Value | | | |
|---|---|---|---|---|
| | **Very High** | **High** | **Moderate** | **Low** |
| **Very High** | Very High | Very High | High | Moderate |
| **High** | Very High | Very High | Moderate | Low |
| **Moderate** | Very High | High | Moderate | Very Low |
| **Low** | Moderate | Low | Low | Very Low |
| **Negligible** | Low | Very Low | Very Low | Very Low |

## 2.7 Sensitivity analysis

The Indicative Alignment has been used as a starting point for assessment purposes. However, 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 confirmed at the detailed design stage. The sensitivity of ecological effects to movement of the alignment and timing of construction is also a factor in our assessment, which considers both spatial sensitivity (movement of the alignment laterally or vertically within the proposed designation boundary), and potential timing of construction of the final alignment.

Spatial sensitivity factors include:

- extent and location of ecological values;
- the effects of the Indicative Alignment on these values;
- whether a lateral or vertical shift in the alignment would increase or reduce the potential impact on ecological values;
- whether the measures to avoid, remedy or mitigate the effect of a lateral or vertical shift in the alignment would be greater, the same or less than those recommended for the Indicative Alignment; and
- The potential for the ecological values and their significance within the proposed designation boundary to change over time, broadly considering a 15-year timeframe before the Project is expected to be implemented.

The temporal context is important especially for the Dome Valley Forest section where the proposed designation (and Indicative Alignment) passes through a production pine forest (Matariki Forest), as the harvest schedule for the forest is for harvesting to occur prior to Project construction.

# 3 TERRESTRIAL AND WETLAND ECOLOGICAL VALUES AND EFFECTS

## Terrestrial and wetland ecological values and effects summary

**Warkworth North section**

The low-lying alluvial Kaipara Flats landscape, formed by the Mahurangi River (Left Branch) and the Kourawhero Stream, characterises the Warkworth North section. The majority of the area is currently in pastureland, interspersed with lowland kahikatea forest remnants and regenerating scrub. Riparian taraire forest and podocarp, broadleaved forest borders the Mahurangi River. Small, low value wetland features are interspersed throughout the landscape, generally degraded due to stock access. However, a high quality wetland mosaic with significant flora and fauna values occurs in the upper Kourawhero stream valley near Phillips Road.

**Dome Valley Forest section**

Plantation pine (*Pinus radiata*) forest dominates the Dome Valley Forest section, which comprises elevated hill country. The proposed designation largely traverses the plantation forest at approximately mid-slope, such that native vegetation within the footprint of the Indicative Alignment is generally confined to the pine forest understorey. Nevertheless, a variety of native fauna has been found to be present or was previously reported to be 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. Construction within the proposed designation boundary has the potential to result in significant adverse effects on these fauna populations, although the extent and severity of Project-related effects depends upon when in the harvest cycle works are undertaken.

Harvesting of Matariki Forest within the proposed designation is scheduled to occur prior to Project construction. The current forest harvesting plan shows that this effectively results in the complete removal of tall stature pine within the proposed designation boundary prior to the scheduled commencement of the road construction in 2030. Forest harvesting is a permitted activity under the NES_PF. Large-scale modifications to available habitat for the aforementioned species of conservation interest prior to the road construction will lessen the impacts of the road as the ecological values within the harvested areas will be reduced. 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.

**Hōteo North section**

The broad, gently undulating Wayby Valley landscape alongside the Hōteo River defines the southern extent of Hōteo North section. The Hōteo River and its tributaries connect a number of remnant patches of lowland forest including the totara-dominated forest lining the Hōteo River, and patches of kahikatea swamp forest and taraire forest on higher ground. The northern extent of the section grades into rolling farmland interspersed with a few small, isolated patches of indigenous treeland, often associated

with small tributaries. Forest and treeland patches are mostly accessible to stock. Kahikatea-dominated wetlands of high ecological value are located within the Hōteo North section on the alluvial terrace derived from the Hōteo River.

**Impacts on forest and scrub patches**

The Indicative Alignment directly impacts a number of indigenous forest/scrub patches in the Warkworth North and Hōteo North sections. While the majority of these sites have been assessed as having Low – Moderate values we have assessed that there are three sites of High to Very High value impacted by the Indicative Alignment.

The Indicative Alignment also directly affects three of the five wetlands within the upper Kourawhero stream catchment in the Warkworth North section (although in most cases the relative proportion of the affected area is small). The Indicative Alignment affects two high value wetland features in the southern portion of Hōteo North (near Wayby Valley Road).

Our sensitivity analysis of the Indicative Alignment within the proposed designation boundary identifies that movement of the alignment within the proposed designation boundary has the potential to significantly increase impacts on ecological features, especially in the following locations:

- adjacent to the Mahurangi River (Left Branch);
- in the upper Kourawhero catchment in the Warkworth North section; and
- in the Hōteo River floodplains area of the Hōteo North section.

## 3.1 Warkworth North section

**Overview**

The Warkworth North section is located in the low lying landscape of the Kaipara Flats area. The proposed designation boundary traverses gentle topography and alluvial flats surrounding the Mahurangi River (Left Branch) and the Kourawhero Stream. The majority of the area is currently in pastureland.

A key landscape feature of the Warkworth North section is the large, open valley system comprised of a mosaic of habitats including raupo reedlands, kahikatea forest, regenerating kānuka scrub and mature pines suitable as communal roosts for long-tailed bats. A backdrop to this location is the escarpment (Site DVF_T_Koura_02).

There are several wetlands and the occasional kahikatea forest remnant throughout the section, reflecting the low-lying alluvial nature of the area. Podocarp, broadleaved forest surrounds the Mahurangi River. Kānuka scrub is also common where agricultural land has not been maintained.

Sites within the Indicative Alignment footprint identified as of High or Very High ecological value include WN_W_Koura_02, WN_T_Koura_01a and WN_W_Koura_05. Several of these high value 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.

The Indicative Alignment traverses the valley floor described above, directly impacting several of the wetlands and forest remnants surveyed. Direct impacts on High and Very High value wetland areas have been minimised through repositioning of the alignment and bridging, rather than culverting, the Upper Kourawhero Stream. However, much of the kahikatea-pukatea forest within WN_T_Koura_01 will still be removed and nearly 40% of WN_T_Mahu_02 will also be cleared.

Adjustments of the indicative road design to bridge the Upper Kourawhero Stream were made to maintain natural stream channel capacity and flooding pattern of the stream, thus also preserving existing hydrological conditions and connectivity for wetland sites: WN_W_Koura_02, WN_W_Koura_03, and WN_W_Koura_04. As concluded in the Water Assessment Report, the bridge in this location has avoided effects on the aforementioned wetlands, compared with if a culvert had been proposed in this location.

Our sensitivity analysis of the Indicative Alignment within the proposed designation boundary suggests three key areas where modifications to the alignment will present risks to ecological features. These occur in the upper Kourawhero catchment and in close proximity to the Mahurangi River (Left Branch) and Hōteo River crossing.

### 3.1.1 Terrestrial and wetland values

#### Fauna values

**Snails**

Land snails were not observed in vegetation accessed for survey in the Warkworth North section, and there are no records from previous ecological surveys of the area.

**Hochstetter's frogs**

The stream habitats within the Warkworth North section are generally alluvial with silty substrates, no stony crevices, and limited riparian cover, and as such are unsuitable for Hochstetter's frogs.

**Herpetofauna**

Herpetofauna database records include four records of native lizard species within 5 km of the Warkworth North/Dome Forest section boundary. These records include: copper skink (Not Threatened), elegant gecko (At Risk – Declining), forest gecko (At Risk – Declining) and Pacific gecko (At Risk – Relict). Bioresearches (2011) found a copper skink within WN_T_Mahu_04, a small native forest remnant, through deploying artificial refuges.

It should be noted that the most recent recordings of forest gecko and Pacific gecko were in 1994 and 1991 respectively, and that the database records provide an indication of what lizard species may be present rather than a definitive statement of presence or absence. Accordingly, we note that other species such as ornate skinks could be present, particularly in areas with thick ground-layer vegetation and dense, moist leaf litter.

The lizard species listed above are habitat generalists. While typically dwelling in forest and scrub habitats, they are occasionally found in exotic habitats including pine forest and pampas tussockland. Copper skink in particular are commonly found on bush margins, in rough pasture areas (such as along fence-lines), and in habitats that are less accessible to stock (e.g., under woody debris).

Lizards may be present in all of the terrestrial sites identified within the Warkworth North section. We note that copper skinks are less likely to occur in WN_T_Mahu_01 as they are ground dwelling, and stock access has resulted in a reduction in available habitat in that area. Geckos are often found occupying early successional scrub habitats (particularly mānuka and kānuka). Therefore, there is a higher likelihood of geckos occupying the regenerating kānuka scrub/forest (VS2) in Site WN_T_Koura_02, particularly where those areas have long standing vegetation or connectivity to patches of remnant vegetation.

**Avifauna**

ARD 09 deployed adjacent to WN_W_Koura_02 (Ecological Survey (ES) Series Drawings) detected a single banded rail (At Risk – declining). All other birds detected by ARDs, 5MBCs and incidental observations are common and widespread species, including a variety of native species (tui, swamp harrier, kingfisher, fantail, grey warbler, kereru, shining cuckoo, paradise shelduck and silvereye). A full list of bird species recorded is provided for ARDs 08 and 09 and 5MBCs (sites 12 to 15) (Appendix C). There were no responses to playback surveys for banded rail, fernbird, Australasian bittern, marsh crake and spotless crake at WN_W_Koura_02 or WN_W_Koura_05. No bird species of note were recorded during incidental observations.

**Bats**

Previous surveys undertaken between 2010 and 2016 in the wider Rodney area have recorded long-tailed bats, largely associated with sizeable tracts of native and exotic forest (Bioresearches, 2011, 2014; Boffa Miskell Ltd., 2016). The closest long-tailed bat records to the Warkworth North section are located within Matariki Forest immediately to the north, and Moir Hill, an area of plantation forest interspersed with native forest remnants approximately 3 km to the south of the southern extent of the proposed designation (Bioresearches, 2011; Boffa Miskell Ltd., 2016).

Surveys undertaken as part of the scoping of the proposed designation in 2010 – 2011 found low levels of bat activity, average of 0.8 passes per night at one of three acoustic recorders deployed across the Warkworth North section (Bioresearches, 2011).

A key landscape feature of the Warkworth North section is the large, open valley system comprised of a mosaic of habitats including raupo reedlands, kahikatea forest, regenerating kānuka scrub and mature pines suitable as communal roosts for long-tailed bats. A backdrop to this location is the escarpment (Site DVF_T_Koura_02).

A total of six bat passes were recorded using a single ARD deployed at WN_W_Koura_02 over 19 fine weather nights, averaging 0.3 bat passes per night. Bats were recorded on 32% of nights. These results confirm that bats occasionally move through the aforementioned valley but it does not appear to be a key habitat feature for the population. The relatively low level of bat activity is consistent with previous findings in the area, though potential roost trees have been identified through the valley and further survey effort will be required prior to commencement of works to mitigate for potential impacts of roost removal.

## Vegetation and habitat ecological values

### Surveyed sites

Walkover surveys were undertaken at nine sites in the Warkworth North section:

- **WN_T_Mahu_01 (SEA_T_2287)** - kauri, podocarp, broadleaved forest (WF11);
- **WN_T_Mahu_02** - kauri, podocarp, broadleaved forest (WF11);
- **WN_W_Koura_01** – exotic wetland (EW), covenanted but currently dominated by exotic flora;
- **WN_T_Koura_01**- a mixed kahikatea, pukatea forest (WF8) and exotic forest (EF.1) remnant immediately upstream of WN_W_Koura_01;
- **WN_T_Koura_02** - regenerating kānuka scrub/forest (VS2);
- **WN_W_Koura_02** - raupō reedland (WL19) with a copse of regionally threatened swamp maire on its margin;
- **WN_W_Koura_03** – a degraded example of a raupō reedland (WL19)**;**
- **WN_W_Koura_04** – exotic wetland (EW); and
- **WN_W_Koura_05** – raupō reedland (WL19).

These sites are mapped in the Ecological Values (EV) Series Drawings in Volume 3 of the AEE, and the existing terrestrial ecology values of each site are described in Table 7 below. Wetland sites that were identified but not surveyed are all located in pastureland and are degraded by stock access and damage. All wetland sites identified met the RMA definition of wetland.

## Site Value Tables

### Table 7 - Assessment of values of terrestrial sites in the Warkworth North section

| Site ID | WN_T_Mahu_01[A] (SEA_T_2287) |
|---|---|
| **Size (ha)** | 16.5 |
| **Ecosystem type and vegetation description** | **Kauri, podocarp, broadleaved forest (WF11)**<br>Riparian forest ranging between 30 – 150 m wide along the margins of the Mahurangi River. Totara is the dominant canopy species along with occasional English oak. Sparse understorey of *Coprosma* shrubs, exotic weeds (mainly Chinese privet), and the occasional juvenile māhoe. Ground cover largely comprises the exotic weed *Tradescantia fluminensis* along with ground ferns on the river margin. |
| **Habitat quality** | Poor. Degraded by stock damage. The narrow shape of the remnant will contribute to increased edge effects. |
| **Ecological value** | Moderate |
| **Rationale** | • Listed as SEA **_T_2287** (Chapter L, Schedule 3, AUP(OP)) on the basis of 'Representativeness' and 'Threat Status and Rarity' criteria.<br>• Meets 'Ecological context' criterion as the site traverses a large portion of the landscape, and potentially facilitates wide-ranging movement of indigenous species.<br>• Good canopy coverage, but limited diversity and lower vegetation tiers degraded.<br>• Poorly buffered, lacks forest interior microclimate. |
| **Site photos** |   |

| Site ID | WN_T_Mahu_02 |
|---|---|
| **Size (ha)** | 4.5 |
| **Ecosystem type and vegetation description** | **Kauri, podocarp, broadleaved forest (WF11)**<br>Totara canopy interspersed with kahikatea and rimu. Canopy height is approximately 15 m and the DBH of the canopy trees ranges between approximately 40 – 60 cm. While kauri is noted as a component of ecosystem type WF11 (Singers et al., 2017), no kauri was observed during the site walkover.<br>Subcanopy vegetation comprises māhoe, pūriri, ponga and kānuka. There is a dense, even-aged understorey of thin-leaved *Coprosma*, twiggy *Coprosma*, hangehange, red mapou, karamu and lancewood, with some tree privet and Chinese privet around the margin. Ground cover comprises a dense layer of various moss species as well as ferns, grasses and sedges. The ground cover species include leather-leaf fern, thread fern, basket grass, hook sedge and forest sedge. There is abundant growth of the epiphytic white rata. |
| **Habitat quality** | Good. The remnant appears to have been recently fenced (within the last 10 years) and is recovering well from stock damage. Consequently, there is a very dense, even-aged, understorey comprising of broadleaved trees and shrubs, which likely persisted in the seedbank while the understorey was browsed. |
| **Ecological Value** | Moderate |
| **Rationale** | • The site rates as moderate for 'diversity and pattern' and 'ecological context'.<br>• Diverse vegetation assemblage but impacts of previous grazing evident.<br>• Comparable size to nearby SEA sites. |

| | | |
|---|---|---|
| **Site photos** |  |  |
| **Site ID** | **WN_T_Koura_01[B]** | |
| **Size (ha)** | 5.5 | |
| **Ecosystem type and vegetation description** | **WN_T_Koura_01a - Kahikatea, pukatea forest (WF8)**<br>**WN_T_Koura_01b - Exotic forest (EF.1)**<br>**WN_T_Koura_01c - Kā nuka scrub/forest (VS2)**<br>This site forms the headwaters of WN_W_Koura_01. Approximately 0.6 ha of the site is kahikatea-pukatea forest, surrounded by a mosaic of forest types including plantation pine, exotic forest of wilding conifers and acacia trees, and regenerating kā nuka forest interspersed with totara and kahikatea (part of which is covenanted). | |
| **Habitat quality** | Good<br>Although parts of the site are dominated by exotic species, the remnant kahikatea-pukatea forest patch appears intact and there is no evidence of degradation by stock.<br>The mosaic of forest types provides a diversity of habitats and the large exotic species potentially provide cavities for native fauna.<br>A key part of this site's value and function is its connectivity to other wetland remnants across the valley floor. | |
| **Ecological value** | **Kahikatea, pukatea forest (WF8)** - High<br>**Kā nuka scrub/forest (VS2)**- Moderate<br>**Exotic forest (EF.1)** – Low | |

| | |
|---|---|
| **Rationale** | • The kahikatea, pukatea forest meets the rarity/distinctiveness criterion, as this forest type is a LENZ IV category with less than 20% indigenous cover remaining (refer to Section 2.6 and Appendix A). The surrounding vegetation rates moderate for ecological context as it buffers the kahikatea, pukatea forest and the covenanted wetland (WN_W_Koura_01) downstream.<br>• The small size of the kahikatea, pukatea forest remnant (0.6 ha) means it does not rate highly for other significance criteria such as representativeness and diversity and pattern. However, the forest remnant has good connectivity to a variety of indigenous ecosystem types that sit within the same valley. |
| **Site photos** |   |
| **Site ID** | **WN_T_Koura_02** |
| **Size (ha)** | 28.3 |
| **Ecosystem type and vegetation description** | **Kā nuka scrub/forest (VS2)**<br>**Broadleaved species scrub/forest (VS5)**<br>Regenerating kā nuka forest grading into young treefern-dominated scrub on the upper slopes. Totara is a frequent canopy component, interspersed with young kahikatea, mā nuka, mamaku, ponga, and mature remnant pine trees. The site borders two wetland complexes, which include raupō reedland and kahikatea, pukatea forest. |
| **Habitat quality** | Good. A relatively large, intact example of a regenerating forest complex with community sequence from wetland through fernland on upper slopes. Some stock access evident around margins.<br>Gorse dominant along old farm tracks, but has been recently controlled. |

| | |
|---|---|
| **Ecological value** | Moderate |
| **Rationale** | The site rates as moderate for diversity and pattern and high for ecological context:<br>• The site is part of an ecosystem sequence from raupo reedland through kahikatea-pukatea forest to the regenerating forest on the upper slopes.<br>• As part of this complex, the forest provides a buffer the wetland (WN_W_Koura_02) which has been assessed as having Very High ecological value.<br>• Notwithstanding this, regenerating kā nuka forest is one of the few indigenous ecosystem types in Auckland that has been classified as Least Concern based on IUCN criteria (Singers et al., 2017). |
| **Site photos** |   |
| **Site ID** | **WN_W_Koura_01** |
| **Size (ha)** | 1.1 |
| **Ecosystem type and vegetation description** | **Exotic wetland (EW)**<br>**Machaerina sedgeland (WL11)**<br>A covenanted wetland largely vegetated in exotic pasture grasses, buttercup, Mercer grass and exotic water pepper. Native wetland species (*Machaerina teretifolia,* sharp spike sedge, Edgar's rush, leafless rush, harakeke, swamp sedge and giant umbrella sedge) are locally abundant towards the centre of the wetland. Occasional mā nuka and juvenile kahikatea are present on the wetland margin. |

| | |
|---|---|
| **Habitat quality** | Moderate. The wetland is largely exotic. However, the assemblage of naturally occurring native wetland species indicates suitable wetland hydrological conditions. Stock are excluded. |
| **Ecological value** | Moderate |
| **Rationale** | • The site rates as moderate for rarity/distinctiveness, as the feature includes a component of naturally occurring native vegetation and indigenous wetlands are a LENZ IV "threatened environment" category where less than 20% indigenous vegetation remains.<br>• However, the majority of the site is dominated by exotic vegetation.<br>• The intact wetland hydrology and remnant indigenous wetland vegetation community indicates good restoration potential, and restoration is likely because this is a requirement of the regulatory incentive provisions under which the site was covenanted. |
| **Site photos** |   |
| **Site ID** | **WN_W_Koura_02** |
| **Size (ha)** | 0.8 |
| **Ecosystem type and vegetation description** | **Raupo reedland (WL19)**<br>Raupo wetland and regenerating kahikatea forest with regenerating forest and scrub surrounding upper reaches. A stand (23 stems, 8.2 cm – 40.8 cm diameter) of regionally uncommon swamp maire is present on the wetland margin. |
| **Habitat quality** | Good. Remnant wetland with intact regeneration sequence occurring in the headwaters. Stock access evident and weeds present on the margin. Lower reaches of the wetland truncated by a deep drainage ditch. |

| | |
|---|---|
| **Ecological value** | Very High |
| **Rationale** | • Rates high for rarity/distinctiveness as the site supports regionally uncommon swamp maire and banded rail (At Risk – Declining, recorded October 2017).<br>• Meets diversity and pattern criterion due to connectivity over multiple environmental gradients from freshwater wetland to regenerating forest in the upper slopes.<br>• The site comprises raupo reedland and kahikatea, pukatea forest, which are identified as Endangered and Critically Endangered respectively in Singers et al (2017).<br>• Indigenous wetlands comprise a LENZ IV "threatened environment" category where less than 20% indigenous vegetation remains. |
| **Site photos** |   |
| **Site ID** | **WN_W_Koura_03** |
| **Size (ha)** | 1.1 |
| **Ecosystem type and vegetation description** | **Raupo reedland (degraded example) (WL19)**<br>Wetland dominated almost entirely by *Isolepis prolifera*, a native species tolerant of grazing and disturbance, and common in nutrient rich wetlands. Mānuka, mamaku, cabbage tree, Edgar's rush, and raupō are also sparsely present. The wetland is truncated and culverted by farm track. |
| **Habitat quality** | Poor. Full stock access, hydrological modification and limited species diversity. |

| | |
|---|---|
| **Ecological value** | Moderate |
| **Rationale** | • Meets rarity/distinctiveness criterion as indigenous wetlands are a LENZ IV "threatened environment" category where less than 20% indigenous vegetation remains.<br>• Nevertheless, this feature is a degraded example of a raupo reedland ecosystem that is degraded by stock access (the feature is unfenced) and modified drainage. |
| **Site photos** |   |
| **Site ID** | **WN_W_Koura_04** |
| **Size (ha)** | 0.8 |
| **Ecosystem type and vegetation description** | **Exotic wetland (EW)**<br>Sits within the same valley system as wetlands WN_W_Koura_02 and WN_W_Koura_03. Like WN_W_Koura_03, it is modified by livestock grazing. Vegetation comprises marsh clubrush, swamp millet, giant rush and abundant exotic soft rush. Sparse patches of regenerating secondary scrub (māʻnuka, juvenile totara and kahikatea) are present around the wetland margin, interspersed with gorse that has recently been sprayed and scrubbed. Upstream the wetland grades into a 1 ha patch of "kauri, podocarp, broadleaved forest" (WF11) dominated by kahikatea and totara, with pūriri, taraire and pukatea. This remnant is outside of the proposed designation boundary. |
| **Habitat quality** | Poor. Full stock access, hydrological modification and limited species diversity. With the exception of stock-related pugging, minimal hydrological modification. |

| | |
|---|---|
| **Ecological value** | Moderate |
| **Rationale** | • The wetland meets rarity/distinctiveness criterion as indigenous wetlands are a LENZ IV "threatened environment" category where less than 20% indigenous vegetation remains. However, the feature is a mosaic of patches dominated by both exotic and indigenous wetland species.<br>• Both the plant community assemblage and the hydrological functionality of the wetland are degraded by stock. |
| **Site photos** |   |
| **Site ID** | **WN_W_Koura_05** |
| **Size (ha)** | 0.6 |
| **Ecosystem type and vegetation description** | **Raupo reedland (WL19)**<br><br>Sits within the same valley system as wetlands WN_W_Koura_02, WN_W_Koura_03 and WN_W_Koura_04. The feature comprises a branched raupō wetland surrounded by pines within the southern boundary of the Matariki Forest. The wetland is truncated by a drain at the southern boundary of the forest, beyond which it becomes grazed pastureland. Part of the smaller western branch of the wetland grades into WN_T_Koura_02. The remainder of the wetland remnant is surrounded by a thin strip of native riparian scrub (māhoe, pate, mamaku, red mapou and cabbage trees, interspersed with juvenile totara and kahikatea) surrounded by plantation pines. |
| **Habitat quality** | Good. Stock excluded. The upstream reach of the larger eastern branch has been modified (bisected by a forestry road and a mountain bike track). |
| **Ecological value** | High |

| | |
|---|---|
| **Rationale** | • Meets rarity/distinctiveness criterion as indigenous wetlands are a LENZ IV "threatened environment" category where less than 20% indigenous vegetation remains.<br>• Stock have been excluded from the wetland remnant.<br>• Drains a sub catchment afforested in plantation pines. |
| **Site photos** |   |

**Notes:**
A - Viewed from roadside and/or adjacent property due to access restrictions.
B - Viewed from roadside and/or adjacent property due to access restrictions.

### 3.1.2 Magnitude and level of effects

The magnitude and level of effects of the Project in the Warkworth North section, without mitigation, is based on the Indicative Alignment and is described in Table 8. Criteria for describing the magnitude of effect are adapted from the EIANZ guidelines for ecological impact assessment in New Zealand (EIANZ, 2015). We note that where the level of effect is noted as moderate, high or very high, mitigation is usually required.

Table 8 - Assessment of effects of the Indicative Alignment on ecological sites in the Warkworth North section.

| Site ID | WN_T_Mahu_02 |
|---|---|
| **Extent of impact** | 1.7 ha of 4.5 ha (38%) |
| **Project activities** | Bulk earthworks |
| **Ecological value** | High |
| **Magnitude of effect (without mitigation) and reasons** | High<br>• 38% of site would be directly lost.<br>• The Indicative Alignment bisects the site. Impacts include loss of habitat, fragmentation and an increase in the extent of edge environment, with associated changes in microclimate variables (Davies-colley, Payne, & Elswijk, 2000; Denyer, Burns, & Ogden, 2006; Didham & Ewers, 2014; Norton, 2002; Young & Mitchell, 1994) and weed incursions.<br>• The operational phase of the State Highway may result in permanent, low level disturbance to sensitive native fauna (if present) from vehicle lights and noise.<br>• The State Highway will provide a physical barrier to less mobile fauna (e.g., lizards) between the two resulting forest fragments, therefore further reducing the amount of available habitat within the site. |
| **Level of effect (without mitigation)** | Very High |
| **Site ID** | **WN_T_Mahu_01 (SEA_T_2287)** |
| **Extent of impact** | 0.2 ha of 16.5 ha (2%) |
| **Project activities** | Bridge (Bridges 5, 6 and 21) |
| **Ecological value** | Moderate |
| **Magnitude of effect and reasons** | Low<br>• Approximately 2% of the feature would be removed or materially altered (due to shading and rain shadow effects) as a result of bridge installation.<br>• The feature is a narrow (~ 31 m wide), therefore no significant additional edge effects are anticipated.<br>• The bridge structures will not create a barrier to less mobile fauna. |

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| | • The chosen option of bridging the site rather than culverting it will minimise both aquatic and terrestrial impacts on the site through the retention of stream habitat and limiting vegetation removal. |
| **Level of effect** | Low |
| **Site ID** | **WN_T_Koura_02** |
| **Extent of impact** | 3.0 ha of 28.3 ha (11%) |
| **Project activities** | Bulk earthworks, Operational disturbance |
| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | Moderate<br>• 11% of site would be directly lost, all regenerating kā nuka scrub/forest.<br>• Indicative Alignment encroaches on the eastern margin of the site, resulting in vegetation loss but no significant further fragmentation.<br>• The operational phase of the State Highway may result in permanent, low level, disturbance to sensitive native fauna (if present) from vehicle lights and noise. |
| **Level of effect (without mitigation)** | Moderate |
| **Site ID** | **WN_T_Koura_01** |
| **Extent of impact** | 0.7 ha of 5.5 ha total (13%)<br>0.3 ha of kahikatea, pukatea forest (WF8) impacted (46% of kahikatea, pukatea forest) |
| **Project activities** | Bulk earthworks, Operational disturbance |
| **Ecological value** | **Kahikatea, pukatea forest (WF8)** - High<br>**Kā nuka scrub/forest (VS2)**- Moderate<br>**Exotic forest (EF.1)** – Low |
| **Magnitude of effect (without mitigation) and reasons** | **Kahikatea, pukatea forest (WF8)** - Moderate<br>**Kā nuka scrub/forest (VS2**) - Low<br>**Exotic forest (EF.1)** - Low |

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| | • 13% of site directly lost, but 50% of Critically Endangered kahikatea, pukatea forest would be removed to construct the Indicative Alignment.<br>• The Indicative Alignment encroaches on the forest margin in the southwest corner of the site, but limits further fragmentation. Notwithstanding this, a small (0.1 ha) patch of the kahikatea, pukatea forest will be fragmented and it is likely that the entire fragment will be subject to adverse impacts of edge effects, potentially compromising the viability of the remaining stand.<br>• The operational phase of the State Highway may result in permanent, low level disturbance to sensitive native fauna, e.g. long-tailed bats if present, from road and vehicle lights and noise. |
| **Level of effect (without mitigation)** | **Kahikatea, pukatea forest (WF8)** - High<br>**Kā nuka scrub/forest (VS2**) - Low<br>**Exotic forest (EF.1)** – Very Low |
| **Site ID** | **WN_W_Koura_01** |
| **Extent of impact** | 0.2 ha of 1.1 ha (18%) |
| **Project activities** | Bulk earthworks |
| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | Moderate<br>• 18% of site would be directly lost to construct the Indicative Alignment.<br>• The Indicative Alignment traverses the wetland margin in the south west corner of the site, which limits further fragmentation.<br>• The authors of the Water Assessment Report conclude that the construction and operation of diversion channels mean that the hydrology of the wetland WN-W-Koura-01, WN-T-Koura-01 is likely to be significantly changed.<br>• Given the narrow, linear shape of the existing site and its degraded condition due to heavy grazing along the western margin, the edge effects arising from the road construction are unlikely to be a large shift from baseline conditions. |
| **Level of effect (without mitigation)** | High |
| **Site ID** | **WN_W_Koura_02** |
| **Extent of impact** | 0 ha of 0.8 ha (0%) |

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| **Project activities** | Bridge 22<br>Operational disturbance |
| **Ecological value** | Very High |
| **Magnitude of effect (without mitigation) and reasons** | Low<br>• None of the site would be directly lost to construct the Indicative Alignment.<br>• A 96 m bridge, Bridge 22, will span the Upper Kourawhero Stream thus maintaining the natural stream channel capacity and flooding pattern of the area. Consequently, the authors of the Water Assessment Report have not predicted significant hydrological changes to the wetlands with hydrological connectivity to Upper Kourawhero Stream, including WN_W_Koura_02 (refer to Map Series EV).<br>• The operational phase of the State Highway may result in permanent, low level, disturbance to sensitive native fauna e.g. long-tailed bats from road and vehicle lights and noise.<br>• Long-tailed bats have been confirmed to move through the Kourawhero Valley system on occasion. Operational disturbance could deter bats from traversing the road, resulting in fragmentation of the wider valley for bats.<br>• Long-tailed bats could also suffer direct mortality due to vehicle collisions. However, the likelihood of this impact is low given the low bat activity levels and the operational disturbance potentially deterring bats from moving close to the road corridor. |
| **Level of effect (without mitigation)** | Moderate |
| **Site ID** | **WN_W_Koura_03** |
| **Extent of impact** | 0.04 ha of 1.1 ha total (3%) |
| **Project activities** | Bridge 22<br>Operational disturbance |
| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | Low<br>• Based on the Indicative Alignment, a very small area (approximately 50 $m^2$) will be permanently lost and a totally of approximately 3% of site will be impacted by rain shadow and shading effects of the proposed bridge.<br>• Bridge 22 traverses the western margin of the site, likely resulting in a small amount of habitat loss and alteration but avoiding habitat fragmentation. |

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| | • Bridge 22 will span the site as well as the Upper Kourawhero Stream thus maintaining the natural stream channel capacity and flooding pattern of the area. Consequently, the authors of the Water Assessment Report have not predicted significant hydrological changes to the wetlands with hydrological connectivity to Upper Kourawhero Stream, including WN_W_Koura_03 (refer to Map Series ES and EV). The authors of the Water Assessment Report conclude that the construction of Bridge 22 is important in maintaining the existing hydrological conditions and connectivity for wetland WN-W-Koura-03.<br>• The operational phase of the State Highway may result in permanent, low level, disturbance to sensitive native fauna e.g. long-tailed bats from road and vehicle lights and noise.<br>• Long-tailed bats have been confirmed to move through the Kourawhero Valley system on occasion. Operational disturbance could deter bats from traversing road resulting in fragmentation of the wider valley for bats.<br>• Long-tailed bats could also suffer direct mortality due to vehicle collisions. However, the likelihood of this impact is low given the low bat activity levels and the operational disturbance potentially deterring bats from moving close to the road corridor. |
| **Level of effect (without mitigation)** | Low |
| **Site ID** | **WN_W_Koura_04** |
| **Extent of impact** | 0 ha of 0.8 ha (0%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | Negligible<br>• None of the site would be directly lost to construct the Indicative Alignment.<br>• The Indicative Alignment traverses the slope on the downstream side of wetland. This placement relative to the site and the surrounding topography indicates that the construction will not influence the hydrology of the wetland relative to baseline conditions.<br>• Bridge 22 will span the Upper Kourawhero Stream thus maintaining the natural stream channel capacity and flooding pattern of the area. Consequently, the authors of the Water Assessment Report have not predicted significant hydrological changes to the wetlands with hydrological connectivity to Upper Kourawhero Stream, including WN_W_Koura_04 (refer to Map Series ES and EV). The authors of the Water Assessment Report conclude that the construction of Bridge 22 is important in maintaining the existing hydrological conditions and connectivity for wetland WN-W-Koura-04.<br>• The operational phase of the State Highway may result in permanent, low level, disturbance to sensitive native fauna e.g. long-tailed bats from road and vehicle lights and noise. |

| | |
|---|---|
| | • Long-tailed bats have been confirmed to move through the Kourawhero Valley system on occasion. Operational disturbance could deter bats from traversing road resulting in fragmentation of the wider valley for bats.<br>• Long-tailed bats could also suffer direct mortality due to vehicle collisions. However, the likelihood of this impact is low given the low bat activity levels and the operational disturbance potentially deterring bats from moving close to the road corridor. |
| **Level of effect (without mitigation)** | Very Low |
| **Site ID** | **WN_W_Koura_05** |
| **Extent of impact** | 0.1 ha of 0.6 ha (21%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | Moderate<br>• 21% of site would be permanently lost based on the Indicative Alignment.<br>• The Indicative Alignment encroaches on the western edge of the smaller western arm of the reedland, resulting in habitat loss but limiting further habitat fragmentation.<br>• The authors of the Water Assessment Report conclude that construction of the culvert and diversion channel in this location are likely to impact on the wetland in this location. In the operation phase, the diversion channel is likely to have increased flow conveyance capacity compared with the existing swamp wetland in this location, and this improved conveyance may result in a small increase in the drainage and a subsequent reduction in water level in the wetland area.<br>• The operational phase of the State Highway may result in permanent, low level, disturbance to sensitive native fauna e.g. long-tailed bats from road and vehicle lights and noise. The eastern arm of this site will likely be, at least partially, buffered from this disturbance by the small, forested ridge between the road corridor and the eastern arm of the wetland.<br>• Long-tailed bats have been confirmed to move through the Kourawhero Valley system on occasion. Operational disturbance could deter bats from traversing road resulting in fragmentation of the wider valley for bats.<br>• Long-tailed bats could also suffer direct mortality due to vehicle collisions. However, the likelihood of this impact is low given the low bat activity levels and the operational disturbance potentially deterring bats from moving close to the road corridor. |
| **Level of effect (without mitigation)** | High |

## 3.2 Dome Valley Forest section

**Dome Valley Forest terrestrial ecological values summary**

Dome Valley Forest section is dominated by plantation pine forest on steep, dissected hill country. The pine forest is interspersed with narrow riparian margins of native vegetation, which line incised stream gullies. Also present are areas of mature *Eucalyptus,* small podocarp broadleaved forest remnants, and mixed native and exotic regenerating scrub along roadsides and in recently harvested sites. Currently, a single Very High value site (DVF_T_Koura_02: podocarp, broadleaved forest) was identified. The proposed tunnels beneath Kraack Hill pass underneath the DVF_T_Koura_02 thus avoiding Project impacts on this ecological site. All other terrestrial sites are of Moderate or lesser ecological value. However, a variety of significant indigenous fauna is present within plantation forest in the Dome Valley Forest section, including Threatened and/or At Risk species (kauri snail, Hochstetter's frog and long-tailed bat).

We note that this area is programmed for harvesting prior to Project commencement which will reduce exsiting terrestrial values. One wetland (DVF_W_Koura_01) was identified within the Dome Valley Forest section, in the Kourawhero Stream headwaters and contiguous with WN_W_Koura_05 in the Warkworth North section. As a result of focussed design in this area, the Indicative Alignment does not directly impact DVF_W_Koura_01. However, a realignment of the Indicative Alignment within the proposed designation boundary has the potential to cause direct effects and loss of a portion, or all, of this site.

### 3.2.1 Terrestrial and wetland values

#### Fauna values

**Land snails**

Patches of pine forest adjacent to tracks and streams were opportunistically searched for kauri snails in the course of other fieldwork. Numerous whole kauri snail shells and shell fragments were recorded in several locations throughout the planted pine forest stands throughout the Matariki Forest. A pair of live kauri snails were observed within the plantation pine forest. A study of kauri snail shell decay (Beauchamp, 2011) found that complete shell breakdown occurs within moist leaf litter in less than 3.5 years, indicating that the entire snail shells observed are likely to be less than 2-3 years old. No *Amborhytida dunniae* were recorded in this section.

It may be that kauri snails have been able to survive between plantation forestry rotations by remaining deeply buried in litter and woody debris, particularly in less disturbed areas around riparian margins. The rapid regeneration of the surrounding pine forest after planting may facilitate the expansion of their population. Heavy predation appears to be a factor in the detection rate, as almost all the shells we found showed some evidence of predation damage by pigs or rats, and/ or appeared to have been unearthed by pig rooting.

### Hochstetter's frogs

The habitat values of the Dome Valley Forest section for Hochstetter's frogs are moderate to high. There are many records (35 records from 2012 onwards) of Hochstetter's frogs within the Matariki Forest, and on the other side of the existing SH1 in the indigenous forest of the Dome Forest Conservation Area (refer Ecological Survey (ES) and Ecological Values (EV) Series Drawings in Volume 3) and surrounding environs. Where frogs have been located in pine plantation forests, the habitat in these areas is almost exclusively associated with rocky waterfalls, enclaves and silt-free basal rock piles (Boffa Miskell Ltd, 1997; Douglas, 1999).

All of the stream channels we inspected had large amounts of fine silt and abundant debris jams (logs/twigs/leaf matter) along the survey reach. Erosion was evident at all three survey sites, with recent bank slumping evident along stream banks. The habitat values of the plantation forest streams are detailed in Section 4.

Hochstetter's frogs were detected in the high upper reaches of the Kourawhero Stream below the Grimmer Road escarpment, in close proximity to the proposed tunnels under Kraack Hill (Bioresearches 2013).

Matariki Forest has set aside a small area (1.5 ha) of remnant pines as a frog reserve that is protected from harvesting (DVF_T_Hōteo _01). It is our understanding that the area is not protected by covenant and does not have legal status as a reserve. The area was not surveyed during the investigations for this report but frogs have been recorded here previously (Bioresearches, 2011) and further surveys are recommended prior to construction. Approximately half of this site sits within the earthworks footprint of the Indicative Alignment.

### Lizards

Vegetation and habitats within the Dome Valley Forest section are dominated by pine forest, with small areas of native vegetation (e.g., Site DVF_T_Koura_02, which is comprised of remnant podocarp, broadleaved forest). Lizards are known to occupy pine forest areas although anecdotal evidence suggests this is generally a low density. Within a predominatly agricultural landscape production forest may provide long term undisturbed habitat. A range of lizard species (including elegant gecko, forest gecko, Pacific gecko and ornate skink) may also occupy the native forest present in the Dome Valley Forest section.

### Avifauna

No Threatened or At Risk forest birds were detected in the Dome Valley Forest section. Cooks Petrel (classified as At Risk - Relict) were heard calling on ARD05 whilst flying over the site in the hour after sunset. Cooks Petrel are very unlikely to be using habitat within the proposed designation boundary, but are known to traverse the Auckland Isthmus on spring and summers evenings returning from feeding grounds in the Tasman Sea to roosting sites on Little Barrier and Great Barrier Islands (Rayner et al., 2008). All other birds detected by ARDs, 5MBCs and incidental observations by the Project team are common and widespread, including a variety of native species including fantail, grey warbler, kereru, tui, shining cuckoo, swamp harrier, kingfisher and silvereye. A full list of bird species recorded is provided for ARDs (sites 05 to 07) and 5MBCs (Sites 06 to 11) (Ecological Survey (ES) Series Drawings). No Threatened or At Risk bird species were recorded during incidental observations.

**Bats**

Bioresearches (2011) detected long-tailed bats in three of five locations surveyed across the Dome Valley Forest section. All locations surveyed by Bioresearches concentrated on habitat features e.g., edges and roads within the maturing pine stands. Other records show long-tailed bats have also been recorded in the indigenous forest of the Dome Valley Conservation Area and surrounds (to the east of the Indicative Alignment, on the opposite side of the existing State Highway 1). The number of bats passes recorded during the Bioresearches survey ranged between 0.9 to 2.4 passes per night, this is low comparative to other nearby plantation forest habitat (Moir Hill – Boffa Miskell unpublished data, 2015). Notwithstanding the low activity levels, bats were present across the full geographic range of the Dome Valley Forest section from south to north.

We deployed a further eight ARs across the Dome Valley Forest section on 15 December 2017 for 27 nights. During this period the average minimum overnight temperature was 14.6°C (± 0.45 SE) and there was more than 5 mm of rain on two nights. These eight ARs were deployed in four pairs along forestry roads that would be bisected by the Indicative Alignment (refer Ecological Survey (ES) Series Drawings).

One AR did not record any data due to an equipment malfunction. Of the seven working ARs, six recorded bats. The levels of activity were generally similar to that recorded by Bioresearches in 2010 except for the pair D1 and D2 which were deployed close to the southern boundary of the plantation forest (Table 41, Appendix D). Acoustic recorders D1 and D2 recorded the highest activity levels with an average of 5.1 and 8.9 passes per night and recorded bats on 83% and 88% of fine weather nights respectively (Table 41, Appendix D). With the exception the AR pair with a malfunctioning unit, bats were recorded at both units within each pairing, indicating bats are moving along forestry roads. This finding is consistent with other long-tailed bat studies in plantation forestry (Boffa Miskell Ltd., 2016; Borkin & Parsons, 2009).

Results from the AR pairs deployed along the Matariki forestry roads as part of this assessment indicate that bats are commuting and foraging along these corridors. Based on this observation and previous work conducted by Bioresearches in 2010 which confirmed the presence of bats, it is evident that this area of forest habitat currently supports bat activity. This finding is consistent with other long-tailed bat studies in plantation forestry (Boffa Miskell Ltd., 2016; Borkin & Parsons, 2009).

**Surveyed sites**

Walkover surveys were undertaken at three sites in the Dome Valley Forest section:

- **DVF_T_Koura_02** - kauri, podocarp, broadleaved forest (WF11[6]) and Broadleaved species scrub/forest (VS5) complex;
- **DVF_T_Hōteo_02 (SEA_T_814)** - broadleaved species scrub/forest (VS5);
- **DVF_T_Hōteo_03** - Exotic forest (EF.2); and
- **DVF_W_Koura_01** - Exotic wetland (EW) which forms the upstream reach of WN_W_Koura_05.

[6] Ecosystem classifications follow Singers et al., (2017)

These sites are mapped in the Ecological Values (EV) Series Drawings in Volume 3, and the existing terrestrial ecology values of each site are described in the Table 9 below. All wetland sites identified met the RMA definition of wetland.

## Site Value Tables

### Table 9 - Assessment of values of terrestrial and wetland sites in the Dome Valley Forest section.

| Site ID | DVF_T_Koura_01 - assessed on current ecological values |
|---|---|
| **Size (ha)** | 460 ha (within the proposed designation boundary), out of a total contiguous area of 3560 ha |
| **Ecosystem type and vegetation description** | **Exotic Forest**<br>Plantation forest primarily comprised of mid-cycle *Pinus radiata* trees interspersed with small areas of native scrub along the riparian margins of the tributaries dissecting the site. Stands of other exotic trees are also present including Eucalyptus species and Tasmanian blackwood. |
| **Habitat quality** | Moderate - Low botanical value but provides habitat for a variety of Threatened and At Risk native fauna. |
| **Ecological value** | High |
| **Rationale** | • The site rates high for 'rarity/distinctiveness' as Threatened and At Risk fauna are associated with the remnant including:<br>o Long-tailed bat (Threatened – Nationally Critical);<br>o Kauri snail (At Risk – Declining), incidentally observed during site walkovers in 2017; and<br>o Hochstetter's frog (At Risk – Declining), recorded November 2010 by Bioresearches Group Ltd. in multiple tributaries within the site.<br>• The site rates high for 'ecological context'. Although it is not indigenous forest, it is a large tract of forest that used by native species during their life cycle and likely facilitates the movement of indigenous species such as long-tailed bats across the wider landscape. |
| **Site photos** |   |

| Site ID | DVF_T_Koura_02 |
|---|---|
| **Size (ha)** | 8.1 |
| **Ecosystem type and vegetation description** | **Kauri, podocarp, broadleaved forest (WF11)**<br>**Broadleaved species scrub/forest (VS5)**<br>Native forest covering a steep slope. Podocarps present on ridgetop with rewarewa and mamaku dominating the lower slopes. Kawaka (At Risk) also observed. |
| **Habitat quality** | Excellent. Mature forest with high species diversity, an intact understorey and few weeds.<br>Previous surveys identified kauri snail in DVF_T_Koura_02, a native podocarp broadleaved forest remnant within the Matariki Forest (Bioresearches, 2011). |
| **Ecological value** | Very High |
| **Rationale** | • The site rates high for 'rarity/distinctiveness' as Threatened and At Risk flora and fauna are associated with the remnant including:<br>o Kawaka (At Risk - Naturally Uncommon);<br>o Long-tailed bat (Threatened – Nationally Vulnerable, recorded October/November 2010 by Bioresearches Group Ltd.)<br>o Hochstetter's frog (At Risk – Declining, recorded November 2010 by Bioresearches Group Ltd.) in the stream below the escarpment.<br>The site also rates high for 'diversity and pattern' and 'ecological context' as the remnant contains a high level indigenous diversity across all structural tiers and provides important fauna habitat and ecosystem services by buffering the stream below. |
| **Site photos** |   |

| Site ID | DVF_T_Hōteo _02 (SEA_T_814) |
|---|---|
| Size (ha) | 10.4 |
| Ecosystem type and vegetation description | **Broadleaved species scrub/forest (VS5)**<br>Common broadleaved species including kā nuka, pate and mahoe. |
| Habitat quality | Moderate. Early stage of regeneration, weeds prevalent along margins including pampus, Himalayan honeysuckle and gorse. |
| Ecological value | Moderate |
| Rationale | • Listed as SEA_**T_814** (Chapter L, Schedule 3, AUP(OP)) on the basis of connectivity (stepping-stones, migration pathways and buffers).<br>• Although listed as significant in the AUP(OP) it does not rate highly under any ecological significance criteria as it is a small area comprising common early successional species and is impacted by weeds. One of the few ecosystem types in Auckland classified as Least Concern based on IUCN criteria (Singers et al., 2017).<br>• Part of the site located within a LENZ IV category where less than 20% indigenous vegetation remains. |
| Site photos |   |
| **Site ID** | **DVF_T_Hōteo _03** |
| Size (ha) | 4.5 |

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|---|---|
| **Ecosystem type and vegetation description** | **Exotic forest (EF.1)**<br>Tall (20+ m) canopy of *Eucalyptus* with a regenerating native understorey including māhoe, pate, karamu and mamaku. |
| **Habitat quality** | Good. Although the canopy is exotic there is dense understorey regeneration and mature *Eucalyptus* is a preferred exotic roost tree for long-tailed bats in modified landscapes. |
| **Ecological value** | Moderate. |
| **Rationale** | • Rates low on all ecological significance criteria due to its small size, exotic canopy, and native subcanopy and understory of common, early successional species.<br>• However, the emergent *Eucalyptus* trees could provide roosting habitat for Threatened long-tailed bats. |
| **Site photos** |   |
| **Site ID** | **DVF_W_Koura_01** |
| **Size (ha)** | 0.8 |
| **Ecosystem type and vegetation description** | **Exotic wetland (EW)**<br>This wetland occurs upstream of WN_W_Koura_05 described in Table 7. The two sites are contiguous but the hydrology of DVF_W_Koura_01 appears to have been modified by the construction of a forestry road through its upper reaches. Consequently, the assemblage of DVF_W_Koura_01 now differs from the raupo reedland (WN_W_Koura_05) occurring further downstream. Therefore, we have described these as separate sites. SIte DVF_W_Koura_01 is surrounded by mature plantation pine, while downstream it is dominated by mercer grass and swamp millet before it grades into the raupō of WN_W_Koura_05. Upstream is transitioning into terrestrial riparian |

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| | vegetation. Pampas is prevalent along with raupo, kiokio and wheki-ponga close to the stream channel, and common riparian shrubs around the margin. |
| **Habitat quality** | Moderate. Hydrological changes and weed species have altered the wetland community, but presence of wheki-ponga indicates remnant wetland vegetation with high restoration potential. |
| **Ecological value** | Moderate |
| **Rationale** | • Rates Low for 'rarity/distinctiveness' as the site contains some indigenous vegetation but is primarily dominated by exotic species.<br>• Small parts of the wetland meet the rarity/distinctiveness criterion as the site sits within a LENZ IV category where less than 20% indigenous vegetation remains. Rates low or nil on all other significance criteria.<br>• The open valley landform with surrounded mature plantation pine indicates that that the wetland could be a preferred foraging habitat for Threatened long-tailed bats. |
| **Site photos** |   |

### 3.2.2 Magnitude and level of effects

The magnitude and level of effects of the Project in the Dome Valley Forest section, without mitigation, is based on the Indicative Alignment and is described in Table 10. Criteria for describing the magnitude of effect are adapted from the EIANZ guidelines for ecological impact assessment in New Zealand (EIANZ, 2015). Note that for the Plantation Forest site we have assessed the impacts based on current values (mature pine forest) and post-harvest of the plantation forest. We emphasise that the current harvesting plan means that at the scheduled time of the proposed road construction, the forest will have been harvested (although this scenario is not guaranteed). Assessment against current values provides the highest degree of change in ecological values and is therefore considered worst case.

Table 10 - Assessment of effects on terrestrial and wetland sites in the Dome Valley Forest section

| Site ID | DVF_T_Koura_01 assessed on current ecological values |
|---|---|
| **Extent of Impact** | 87.5 ha of 3560 ha (2%) |
| **Project activities** | Bulk earthworks<br>Tunnel works<br>Operational disturbance |
| **Ecological value** | High |
| **Magnitude of effect (without mitigation) and reasons** | High<br>• Multiple forestry roads are bisected by the Indicative Alignment which could functionally sever these fly-ways for long-tailed bats and consequently reduce the availability of habitat disproportionality to the amount of habitat physically removed to create the road. If the State Highway does not functionally sever these fly-ways and bats do attempt to cross the operational State Highway, this could result in vehicle collisions and increased mortality.<br>• The plantation pine within the Indicative Alignment is currently too young to provide roosting habitat, particularly communal roosts. However, this will need to be reconfirmed closer to the time of construction. Furthermore, there are some areas of native forest, remnant pines and mature Eucalyptus stands within the wider road footprint that have a higher likelihood of providing roosting habitat. If these trees do contain bat roosts, felling them could result in mortality of bats if the roosts are occupied at the time of felling. The removal of maternity roosts could reduce the reproductive success of the bat population, resulting in population-level impacts.<br>• As the proposed designation crosses a number of waterways through the Dome Valley Forest section, with a loss or modification to some a large portion of these waterways, the potential direct impacts causing injury or mortality to Hochstetter's frogs is very high. Potential indirect impacts include disturbance, noise and vibration, and the potential spread of Chytridiomycosis, and the potential effects of these is also very high on Hochstetter's frog populations.<br>• Noise and vibration, created by works activities near streams, are likely to be short-term stressors, and therefore the effects are considered minor. However, large vibrations could cause movement of unstable rock shelters or increase siltation in streams reduce habitat suitability. As small crevices are important habitats for frogs, infilling from dust and silt particles will also result in loss of habitat and potential food sources.<br>• The construction of the Project within the Dome Valley Forest section has the potential to affect the population of kauri snails. Direct adverse effects are likely from vegetation and habitat clearance which would result in significant injury or mortality to land snails, as well as a reduction in the availability of habitat and resources (i.e. food and shelter). Indirect effects include the additional removal of vegetated debris and burying shelter structures (e.g., leaf litter, logs and nikau palm fronds) under soil. These indirect effects are |

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| | also likely to cause injury and mortality to resident snail communities, and result in a loss of habitat. Kauri snails are limited in their ability to disperse and move rapidly away from disturbed areas. |
| **Level of effect (without mitigation)** | Very High |
| **Site ID** | **DVF_T_Koura_01 assessed following harvest of plantation forest** |
| **Extent of Impact** | 87.5 ha of 3560 ha (2%) |
| **Project activities** | Bulk earthworks<br>Tunnel works<br>Operational disturbance |
| **Ecological value** | Low-moderate |
| **Magnitude of effect (without mitigation) and reasons** | Low-moderate<br>• Harvesting would substantially reduce the habitat for ground-dwelling fauna (e,g, land snails), and the proposed designation boundary would have a low impact on the remaining habitat and populations of land-based fauna.<br>• Harvesting would remove the existing fly-ways for long-tailed bats and remove the potential for roosting and maternity habitat, and the Project would have a minimal impact on the remaining habitat and populations of long-tailed bats.<br>• As the proposed designation boundary crosses a number of waterways through the Dome Valley Forest section, with a loss or modification to some a large portion of these waterways, the potential direct impacts causing injury or mortality to Hochstetter's frogs is very high. Potential indirect impacts include disturbance, noise and vibration, and the potential spread of Chytridiomycosis, and the potential effects of these is also very high on Hochstetter's frog populations.<br>• Noise and vibration, created by works activities near streams, are likely to be short-term stressors, and therefore the effects are considered minor. However, large vibrations could cause movement of unstable rock shelters or increase siltation in streams reduce habitat suitability. As small crevices are important habitats for frogs, infilling from dust and silt particles will also result in loss of habitat and potential food sources. |
| **Level of effect (without mitigation)** | Moderate |

| Site ID | DVF_T_Koura_02 |
|---|---|
| **Extent of Impact**[7] | 0.7 ha of 8.1 ha (9%) |
| **Project activities** | Bulk earthworks<br>Tunnel works<br>Operational disturbance |
| **Ecological value** | Very High |
| **Magnitude of effect (without mitigation) and reasons** | High<br>• 9% of the Site would be directly lost to construct the Indicative Alignment.<br>• Interruption of groundwater as a result of the tunnel could lead to hydrological changes in the Site's, substrate and consequently a shift in vegetation community and habitat quality.<br>• The At Risk Hochstetter's frog occur in the stream within this Site. Hydrological changes and sediment deposition potentially associated with tunnel construction could negatively impact frogs inhabiting the site as they avoid high levels of silt (Easton et al., 2016).<br>• Based on the Air Quality Assessment Report (refer Volume 2), the localised concentrations of dust and vehicle emissions at the tunnel portals are not anticipated to exceed ambient air quality guidelines for ecosystem effects, hence effects of air discharges on ecological features are likely to be minor.<br>• Long-tailed bats have been recorded in the vicinity of this Site. Disturbance from heavy machinery and vegetation removal associated with construction of the road could result in disturbance to bats from light, noise, vibration and potentially dust. As this site is being tunnelled, this disturbance will be temporary and will not be an effect during the operational phase of the State Highway. |
| **Level of effect (without mitigation)** | Very High |
| **Site ID** | **DVF_T_Hōteo_02 (SEA_T_814)** |
| **Extent of Impact** | 0 ha of 10.4 ha (0%) |
| **Project activities** | Bulk earthworks |
| **Ecological value** | Moderate |

[7] This does not include the area of the tunnel in the Indicative Alignment.

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| **Magnitude of effect (without mitigation) and reasons** | Negligible<br>• There are no direct impacts on the site from construction of the Indicative Alignment.<br>• The Indicative Alignment is located approximately 150 m upslope of the site at its closest point. Consequently, disturbance (noise and light) to fauna inhabiting the site during both the construction and operational phase of the Project is likely to be negligible (Berthinussen & Altringham, 2012). |
| **Level of effect (without mitigation)** | Very Low |
| **Site ID** | **DVF_T_Hōteo_03** |
| **Extent of Impact** | 0 ha of 0.8 ha (0%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | Moderate<br>• There are no direct impacts on the site from construction of the Indicative Alignment.<br>• The Indicative Alignment is approximately 250 m upslope of the site at its closest point. However, the forestry road, Dibble Road, bisects the site and it is likely that this road will be used as a haul road during construction. Consequently, there will likely be temporary disturbance (above background levels associated with forestry operations) to any fauna inhabiting the site during the construction phase, but this will cease once the State Highway is operational.<br>• This site has been identified as potential bat habitat, the construction of the State Highway restricts connectivity from this site across the expanse of plantation forest to the southwest. Based on international research on the impacts of roads on bats, particularly in relation to roads becoming barriers to movement (Berthinussen & Altringham, 2012), habitat connectivity to the Dome Forest Conservation Area and the Sunnybrook Scenic Reserve has likely already been impacted by the existing SH1. Consequently, unless habitat connectivity is maintained for bats, this Indicative Alignment could render the site functionally unsuitable for bats. We note that this effect would only be realised if the site is in fact used by long-tailed bats for roosting. |
| **Level of effect (without mitigation)** | Moderate |
| **Site ID** | **DVF_W_Koura_01** |
| **Extent of Impact** | 0 ha of 0.8 ha (0%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |

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| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | Low<br>• There are no direct impacts on the site.<br>• The Indicative Alignment traverses approximately 100 m to the west of the site. If the large-stature pines between the Indicative Alignment and the wetland remain, there will be minimal operational disturbance. However, the existing forestry road, Grimmer Road, bisects the wetland and this may become a haul road during construction. In this case there could be temporary, low level impacts of increased dust and runoff entering the wetland comparative to baseline levels associated with existing forestry operations.<br>• Upstream the Indicative Alignment traverses both branches of the watercourse that drain into this wetland site. Consequently, potential changes in hydrology could lead to a shift in the vegetation community and thus habitat quality. |
| **Level of effect (without mitigation)** | Low |

## 3.3 Hōteo North section

**Hōteo North terrestrial ecological values and effects summary**

The broad, gently undulating Wayby Valley landscape alongside the Hōteo River defines the southern extent of Hōteo North section. 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 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. Such modifications include understory damage from stock and hydrological changes due to alterations in drainage.

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, examples include HN_W_Hōteo _01 (SEA_T_6854) and HN_W_Hōteo _02 (SEA_T_685). 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 Indicative Alignment and works within the proposed designation boundary directly impact a number of the aforementioned forest and wetland patches. The majority of these sites have been assessed as having Low – Moderate values. However, five sites (HN_T_Hōteo _02 (SEA_T_683), HN_T_Hōteo _03 (SEA_T_6851) and HN_T_Ho.teo_08 and HN_W_Hōteo _01 (SEA_T_6854) have been assessed as having High or Very High value. HN_W_Hōteo _01 (SEA_T_6854) and HN_T_Hōteo _03 (SEA_T_6851) are located within the Indicative Alignment footprint and would have large (69% and 27% respectively) proportions of their current extent permanently removed. The Indicative Alignment is also near the western margin of HN_W_Hōt eo_02 (SEA_T_685) which has Very High ecological values. In this area the Indicative Alignment avoids direct impacts but may cause low level indirect effects such as modifications to the water table. The Indicative Alignment proposes a viaduct (Bridge 11) that crosses site HN_T_Hōteo _02 (SEA_T_683). This site comprises 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 designs.

The sensitivity analysis suggests that, in some parts of the Hōteo North section, movement of the Indicative Alignment within the proposed designation boundary may directly or indirectly impact upon sites of Very High to High ecological values.

### 3.3.1 Terrestrial and wetland values

#### Fauna values

**Snails**

Bioresearches (2011) recorded numerous *Amborhytida dunniae* within the taraire forest comprising site HN_T_Hōteo _02, which the Indicative Alignment intersects at the Hōteo Viaduct. No Kauri snails have been observed to date in the Hōteo North section.

**Hochstetter's frogs**

The stream habitats within the Hōteo North section are generally alluvial with silty substrates and no stony crevices, and limited riparian cover. As such, these stream habitats are likely to be unsuitable for Hochstetter's frogs.

**Lizards**

The majority of the Hōteo North section comprises farmland with isolated indigenous treeland. Potential lizard habitats within the Hōteo North section include remnant patches of lowland forest (e.g., totara-dominated forest and taraire forest). These areas may not be large enough to support a viable lizard population, with the exception of copper skinks that are better adapted to farmland and occupying edge habitats provided there are available refuge habitats.

Bioresearches (2011) recorded two copper skinks within two separate areas of native remnant forest (SEA_T_683: HN_T_Hōteo _02) through deploying artificial refuges.

**Avifauna**

No Threatened or At Risk forest birds were detected during surveys in the Hōteo North section. Cooks Petrel (classified as At Risk - Relict) were heard calling on ARDs 01, 03 and 04 (Figure A.5) whilst flying over the site in the hour after sunset. Cooks Petrel are very unlikely to be using habitat within the proposed designation boundary, but are known to traverse the Auckland Isthmus on spring and summers evenings returning from feeding grounds in the Tasman Sea to roosting sites on Little Barrier and Great Barrier Islands (Rayner et al., 2008). All other birds detected by ARDs, 5MBCs and incidental observations by the Project Team are common and widespread, including a variety of native species including: morepork, tomtit, fantail, silvereye, tui, kereru, swamp harrier, shining cuckoo, pukeko, grey warbler, paradise shelduck and kingfisher. A full list of bird species recorded is provided for ARDs (sites 08 and 09) and 5MBCs (sites 01 to 05) (refer to Appendix D). No bird species of note were recorded during incidental observations.

**Bats**

Bioresearches (2011) recorded a single long-tailed bat pass across 10 survey locations (69 useable survey nights) in the Hōteo North section. This single pass was recorded in the northern extent of the Section close to Te Hana township.

Follow-up acoustic bat surveys were undertaken in summer 2017/18. Five ARs were deployed in the Hōteo North section on 20 December 2017 for 22 nights, during this period the average minimum overnight temperature was 14.8˚C (± 0.53 SE) and there was more than 5 mm of rain on two nights. No bats were recorded. However, due to access restrictions, the full extent of the Hōteo North section was not surveyed. All ARs deployed

in the Hōteo North section were in the southern extent of the section to the south of Wellsford (Ecological Survey (ES) Series Drawings).

The lack of landscape connectivity to any sizable tracts of large stature forest is the likely reason for the paucity of bats across this section. Notwithstanding the above, long-tailed bats are highly mobile and there are multiple small forest remnants that contain cavity bearing trees throughout the landscape, particularly around the Hōteo River which could be used by bats a foraging and commuting corridor. The agricultural landscape that characterises this section also contains many shelterbelts of tall stature exotic trees as well individual trees. These potential long-tailed bat roost features have not been surveyed but it is recommended that further roost surveys are undertaken closer to the time of construction in areas where bat activity is recorded.

It should also be noted that due to limitation to access private properties, the northern extent of the Hōteo North section has not been surveyed since 2010 /11. Consequently, a current assessment of the habitat value of the northern extent of the proposed designation for bats has not been undertaken. Our recommendation is that pre-construction surveys be undertaken to confirm ecological values and any necessary mitigation.

**Surveyed sites**

Walkover surveys were undertaken at ten sites in the Hōteo North section:

- **HN_T_Hōteo_01** - anthropogenic[8] totara forest (AVS1);
- **HN_T_Hōteo_02 (SEA_T_683)** - taraire forest (WF8);
- **HN_T_Hōteo_03 (SEA_T_6851)** - Kahikatea, pukatea forest (WF8) and Machaerina sedgeland (WL11) complex;
- **HN_T_Hōteo_04** - kahikatea treeland (TL.1);
- **HN_T_Hōteo_05** - kahikatea treeland (TL.1);
- **HN_T_Hōteo_06** - kauri, podocarp, broadleaved forest (WF11);
- **HN_W_Hōteo_02 (SEA_T_685)** - Kahikatea forest (MF4) fringed by dense swathe of flax;
- **HN_T_Hōteo_07** - Kauri, podocarp, broadleaved forest (WF11) and Anthropogenic totara forest (AVS1) complex;
- **HN_T_Hōteo_08** - Kahikatea forest (MF4); and
- **HN_T_TeHana_01** - Anthropogenic totara forest (AVS1) and Exotic wetland (EW) complex
- **HN_W_Hōteo_01** – Flaxland (WL18);
- **HN_W_Hōteo_03** – Exotic wetland (EW);
- **HN_W_TeHana_01** – Exotic wetland (EW); and
- **HN_W_TeHana_02** – Exotic wetland (EW).

[8] Ecosystem classifications follow Singers et al., (2017). Note that anthropogenic totara forest is induced by human disturbance associated with pastoral landscapes. See Singers et al., (2017) for detailed description.

These sites are mapped in the Ecological Values (EV) Series Drawings in Volume 3, and the existing terrestrial ecology values of each site are described in the Table 11 below. Wetland sites that were identified but not surveyed are all located in pastureland and are degraded by stock access and damage. Due to land access restrictions, several sites identified in the preliminary investigations that could not be assessed. Notwithstanding this, the Project team were able to survey (some were viewed from the roadside) all sites assessed as potentially high value, while a representative range of moderate and low value sites was also assessed. Hence, we consider the assessments below provide a good description of the existing wetland characteristics across the Hōteo North section. We note that some sites were a mosaic of ecosystem types. Where this has occurred we have labelled the site with the most dominant of the ecosysytem types present. All wetland sites identified met the RMA definition of wetland.

## Site Value Tables

### Table 11 - Assessment of values of terrestrial and wetland sites in the Hōteo North section.

| Site ID | HN_T_Hōteo_01 |
|---|---|
| **Size (ha)** | 1.1 |
| **Habitat type (bold) and dominant species** | **Anthropogenic tōtara forest (AVS1)**<br>Tōtara canopy with scattered kānuka and gorse and a rank grass groundcover.<br>Present under a stand of pine trees close by (partially under the Indicative Alignment) were scattered juvenile kaikōmako (*Pennantia corymbosa*) shrubs. This species is considered naturally uncommon in the Auckland region. |
| **Habitat quality** | Low<br>Tōtara canopy intact but understorey is sparse with little diversity due to grazing. High connectivity to the Hōteo River and SEA_T_5541. |
| **Ecological value** | Low |
| **Rationale** | • The site rates moderate for 'rarity/distinctiveness' as it is in close vicinity to the Hōteo River where Threatened long-tailed bats have been previously recorded (November 2010 by Bioresearches Group Ltd.).<br>• The site rates low or nil for all other significance criteria as although the site has an indigenous totara canopy, it is small (1.1 ha), has a low level of natural diversity, and the vegetation community is driven by anthropogenic land use. |

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| **Site photos** |   |
| **Site ID** | **HN_T_Hōteo_02 (SEA_T_683)** |
| **Size (ha)** | 11.0 |
| **Habitat type (bold) and dominant species** | **Taraire forest**<br>Old growth taraire dominates the canopy along with pū riri, tī toki and pukatea. Scattered emergent trees include tō tara kahikatea and rewarewa. The regionally rare shrub kaikō mako was also recorded here.<br>Riparian margin comprised largely of kā nuka, mā hoe, totara, crack willow, ribbonwood and nī kau. *Tradescantia* and rank grass dominates the groundcover along the stream margin in places where the canopy is sparse.<br>The At Risk – Naturally Uncommon fern mokimoki was noted during the 2010 botanical assessments undertaken in 2011 (Bioresearches 2011).<br>DOC plant records show that the At Risk – Naturally Uncommon orchid *Danhatchia australis*, which is commonly associated with taraire forest, has been identified in close proximity to the site on multiple occasions. |
| **Habitat quality** | Good<br>Comparatively large patch of mature forest with high species diversity. The understory is largely intact although weeds are invading the margins. The stream banks are heavily scoured and lack stabilising vegetation.<br>Bioresearches (2011) identified multiple *Amborhytida dunniae* within the taraire forest comprising site HN_T_Hōteo _02. This is the location of the proposed Hōteo Viaduct (Bridge number 11). |

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|---|---|
| **Ecological value** | Very High |
| **Rationale** | • The site is listed as SEA_**T_683** in the AUP(OP) on the basis of Threat Status and Rarity' and 'Diversity' criteria.<br>• The site rates highly for all ecological significance criteria (except 'representativeness') due to its age, natural diversity and connectivity to other important ecological sites such as the Hōteo River and Sunnybrook Scenic Reserve to the south. |
| **Site photos** |   |
| **Site ID** | **HN_T_Hōteo_03 (SEA_T_6851)** |
| **Size (ha)** | 3.0 |
| **Habitat type (bold) and dominant species** | **HN_T_Hōteo_03a - Kahikatea, pukatea forest (WF8)**<br>**HN_T_Hōteo_03b - Machaerina sedgeland (WL11, degraded example)**<br>The majority (2.3 ha) of the site is kahikatea forest. The canopy is comprised of kahikatea interspersed with matai. The subcanopy/ understorey is characterised by abundant kiekie as well as cabbage trees, māhoe, and kaikomako. Tradescantia forms an almost continuous groundcover and Chinese privet dominate the margins. A group of at least 20 *Doodia squarrosa* ferns was noted during the botanical surveys undertaken to inform the SAR (Bioresearches, 2011). *D. squarrosa* is classified as At Risk – Naturally Uncommon. The sedgeland is largely dominated by exotic *Juncus* species with localised patches of flaxland with emergent cabbage trees, mānuka and the occasional kahikatea. There are also dense patches of sharp spike sedge. |
| **Habitat quality** | Moderate |

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| | The kahikatea forest has been highly modified by deep drainage ditches and stock access. The downstream wetland also has stock access and consequently is largely dominated by exotic species that are tolerant of disturbance. The habitat condition has been assigned moderate instead of poor, due to the mature and intact kahikatea canopy and the persistence of some species diversity. |
| **Ecological value** | **Kahikatea, pukatea forest (WF8)** - High<br>**Machaerina sedgeland (WL11)** - Moderate |
| **Rationale** | • The site is listed as **SEA_T_6851** in the AUP(OP) on the basis of Representativeness', 'Threat Status and Rarity' and 'Diversity' criteria.<br>• The Kahikatea, pukatea forest rates highly for Rarity/distinctiveness' as it supports At Risk flora and is located within a LENZ IV category where less than 20% of indigenous cover remains.<br>• The Kahikatea, pukatea forest also rates moderately for 'Ecological context' as it provides stepping stone connectivity to other wetland and swamp forest remnants in wider landscape.<br>• The Kahikatea, pukatea forest does not rate highly for other significance criteria as the surrounding land use has degraded the remnant and it does not reflect the biodiversity expected of this ecosystem type. The Machaerina sedgeland is also included in SEA_T_6851 but does not rate highly for any significance criteria due to the high level of degradation by stock. |
| **Site photos** |   |
| **Site ID** | **HN_T_Hōteo_04** |
| **Size (ha)** | 0.1 |

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| **Habitat type (bold) and dominant species** | **Kahikatea treeland**<br>Kahikatea stand lacking understorey vegetation, with the exception of the occasional cabbage tree and the weed Chinese privet. The groundcover is grazed pasture grass. |
| **Habitat quality** | Poor<br>Three very small and heavily modified stands of kahikatea trees with full stock access. Given the small total size of the stands, the benefit of restoring these stands would be limited in comparison to other modified habitats in the area. |
| **Ecological value** | Low |
| **Rationale** | • Rates low on all ecological significance criteria due to the site's small size and lack of diversity across all structural tiers. It should be noted that the site is located within a LENZ IV category where less than 20% of indigenous cover remains thus satisfying a single criterion of 'Rarity/distinctiveness'.<br>• It should also be noted that the site could provide roosting habitat for Threatened long-tailed bats but the minimal habitat extent indicates that this is unlikely. |
| **Site photos** |   |
| **Site ID** | **HN_T_Hōteo_05**[9] |
| **Size (ha)** | 0.1 |

[9] Viewed from roadside and/or adjacent property due to access restrictions.

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| **Habitat type (bold) and dominant species** | **Kahikatea treeland**<br>Three small, heavily grazed kahikatea stands. Understorey absent, and the groundcover is grazed pasture. |
| **Habitat quality** | Poor<br>Three very small and heavily modified stands of kahikatea trees with full stock access. The small total size of the stands suggests the benefit of restoring these stands would be limited in comparison to other modified habitats in the area. |
| **Ecological value** | Low |
| **Rationale** | • Rates low on all ecological significance criteria due to the site's small size and lack of diversity across all structural tiers. It should be noted that the site is located within a LENZ IV category where less than 20% of indigenous cover remains thus satisfying a single subcriterion of 'Rarity/distinctiveness'.<br>• It should also be noted that the site could provide roosting habitat for Threatened long-tailed bats but the minimal habitat extent indicates that this is unlikely. |
| **Site photos** |  |
| **Site ID** | **HN_T_Hōteo_06**[10] |
| **Size (ha)** | 0.5 |

[10] Viewed from roadside and/or adjacent property due to access restrictions.

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| **Habitat type (bold) and dominant species** | **Kauri, podocarp, broadleaved forest (WF11)**<br>Previous surveys (Bioresearches 2011) noted maturing totara dominates the remnant, interspersed with kauri, rimu and kahikatea. Towards the margin the podocarp canopy is replaced with mature kā nuka. The understorey is modified and dominated by Chinese privet, but with a number of white maire and tī toki seedlings establishing. The structure of the remnant indicates it had been grazed until recently before the site visit in 2010. |
| **Habitat quality** | Moderate<br>The remnant appears to be fenced with a dense understory. However, due to access restrictions it is unknown how much of this understory comprises native species. The site has been assessed as of 'moderate' quality due to its small size. |
| **Ecological value** | Moderate |
| **Rationale** | • The site rates moderately for 'diversity and pattern' and 'ecological context' due to the diverse canopy tier, provision of stepping stone habitat from the Hōteo River and the presence of native copper skink (Not Threatened; recorded by Bioresearches 2010). |
| **Site photos** |  |
| **Site ID** | **HN_W_Hōteo _02 (SEA_T_685)** |
| **Size (ha)** | 2.9 |
| **Habitat type (bold) and dominant species** | **Kahikatea forest (MF4)** |

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| | Canopy of semi-mature kahikatea and tree privet interspersed with occasional rimu and a sparse subcanopy of Chinese privet and flax with kowhai, cabbage tree and manuka on forest margins. Tradescantia dominates the groundcover. A dense swathe of flax surrounds the margin of the stand, however the absence of seedling recruitment in the ground layer and subcanopy indicate that the remnant is impacted by stock and modifications to drainage. |
| **Habitat quality** | Moderate<br>The native species present in the stand are indicative of a once high quality kahikatea swamp forest remnant. However, the remnant is degraded to the extent that weed species are abundant to dominant across all structural tiers. Sources of disturbance like.ly include livestock trampling and hydrological changes resulting from the surrounding agricultural land use. |
| **Ecological value** | High |
| **Rationale** | • The site is listed as SEA_**T_685** in the AUP(OP) on the basis of 'Representativeness' and 'Threat Status and Rarity' criteria.<br>• The site rates highly for 'Rarity/distinctiveness' as kahikatea forest has been classed as critically endangered in the Auckland Region (Singers et al., 2017) and this remnant represents a relatively large and intact example of this ecosystem type. The site also rates highly for 'diversity and pattern' and 'ecological context' due to the intact vegetation assemblage and its provision of ecosystem services (as an intact wetland remnant) and linkage habitat to other kahikatea forest remnants to the west of the Hōteo River. |
| **Site photos** |   |
| **Site ID** | **HN_T_Hōteo_07** |

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|---|---|
| **Size (ha)** | 1.5 |
| **Habitat type (bold) and dominant species** | **HN_T_Hōteo_07a - Kauri, podocarp, broadleaved forest (WF11)**<br>**HN_T_Hōteo_07b - Anthropogenic totara forest (AVS1)**<br>Mixed kahikatea, rimu, totara, kauri treeland over grazed pasture grasses with Juncus tussocks in wetter areas. Little understorey vegetation due to grazing.<br>Dense totara hedging on roadside with mixed broadleaved and exotic shrubs in the understorey. |
| **Habitat quality** | Poor<br>Heavily grazed with no native understorey. The kauri trees appear unhealthy, this may be caused by roost disturbance, wet feet, kauri dieback disease, or a combination of these factors. |
| **Ecological value** | Low |
| **Rationale** | • Degraded understory and unhealthy canopy condition.<br>• It should be noted that part of the kauri, podocarp, broadleaved forest (WF11) is located within a LENZ IV category where less than 20% of indigenous cover remains. |
| **Site photos** |   |
| **Site ID** | **HN_T_Hōteo_08** |
| **Size (ha)** | 1.2 |

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| **Habitat type (bold) and dominant species** | **Kahikatea forest (MF4)**<br>Canopy of abundant kahikatea and totara with a sparse subcanopy of mā hoe, tī toki, red mapou, cabbage tree, mamangi, kaikomako (regionally rare) and occasional Chinese privet and black maire along the margin. Groundcover comprises closely cropped native grass and a sparse assemblage of native and exotic herbs.<br>A sparse rushland has also developed in the wetter pasture areas surrounding the kahikatea stand. |
| **Habitat quality** | Moderate<br>Tall stature podocarps that could provide roosting/nesting and foraging habitat for mobile native fauna. However full stock access has resulted in a sparse and degraded understorey. Stock were present in the remnant at the time of survey. |
| **Ecological value** | High |
| **Rationale** | • The site rates moderate for 'rarity/distinctiveness' as kahikatea forest has been classed as critically endangered in the Auckland Region (Singers et al., 2017) and the site supports the regionally uncommon plant species kaikō mako.<br>• The site rates moderately for 'ecological context' as the remnant provides stepping stone habitat for mobile species across the pastoral landscape.<br>• The site is a mature forest remnant with some diversity in the canopy and subcanopy tiers. However, stock access has resulted in a degraded understory and the ground cover layer is almost completely absent. |
| **Site photos** |   |
| **Site ID** | **HN_T_TeHana_01a** |

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|---|---|
| **Size (ha)** | 0.7 |
| **Habitat type (bold) and dominant species** | **HN_T_TeHana_01a - Anthropogenic totara forest (AVS1)**<br>A small (0.7 ha) forest patch on the western slope of a small stream gully. The canopy is dominated by totara and interspersed with kānuka. Understorey flora is largely absent with the exception of occasional exotic hawthorn shrubs.<br>A stream runs along the eastern margin of the remnant and forms a wetland in flatter areas along the gully gradient. In shaded areas along the stream bank a small fernland has developed comprising common species including gully fern, Deparia, rough tree fern and rasp fern. |
| **Habitat quality** | Poor<br>Tall stature totara and mature kānuka could provide some roosting/ nesting and foraging habitat for mobile native fauna. However full stock access has resulted in a highly degraded understorey to the point where large areas of ground are completely bare. The wetland area is similarly degraded.<br>We observed a cat in the remnant during the survey. |
| **Ecological value** | **Anthropogenic totara forest (AVS1**) - Low |
| **Rationale** | • The site rates low for all ecological significance criteria due to its small size (0.7 ha), lack of diversity and high degradation of understory and ground layer resulting from stock impacts. |
| **Site photos** |   |

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| **Site ID** | **HN_T_TeHana_01b - Exotic wetland (EW)** |
| **Size (ha)** | 0.6 ha |
| **Habitat type (bold) and dominant species** | This wetland extends downslope of the remnant into open pastureland. The wetland covers approximately 0.6 ha. It is pugged by stock and dominated by exotic water pepper and soft rush. |
| **Habitat quality** | Poor<br>Wetland is defraded. |
| **Ecological value** | **Exotic wetland (EW)** - Low |
| **Rationale** | |
| **Site ID** | **HN_W_Hōteo_01 (SEA_T_6854)** |
| **Size (ha)** | 0.7 |
| **Habitat type (bold) and dominant species** | **Flaxland (WL18)**<br>Wetland comprised of a mosaic of microhabitats each often dominated by a single species. These species include mānuka, harakeke, raupō and *Carex* species. The southern margin is fringed by exotic water pepper. |
| **Habitat quality** | Good<br>A small but high quality wetland with a species composition that is rare in the Auckland Region. |
| **Ecological value** | High |
| **Rationale** | • The site is listed as SEA_**T_6854** in the AUP(OP) on the basis of 'Threat Status and Rarity'.<br>• Rates highly for 'rarity/distinctiveness' as:<br>  • Flaxland (WL18) ecosystems have been classified as Critically Endangered in the Auckland region using the IUCN classification system (Singers et al., 2017);<br>  • The site is located within a LENZ IV category where less than 20% indigenous vegetation remains; and<br>  • The site comprises indigenous vegetation that occurs within an indigenous wetland ecosystem.<br>• The site rates moderately for 'diversity and pattern' as although the remnant is small (0.7 ha) it contains a variety of microhabitats with a species richness typical of Flaxland ecosystems. |

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| | • The site rates moderately for 'ecological context' as it forms part of a network of other high-quality wetland habitats in close vicinity to the Hōteo River. |
| **Site photos** |   |
| **Site ID** | **HN_W_Hōteo_03** [11] |
| **Size (ha)** | 0.4 |
| **Habitat type (bold) and dominant species** | **Exotic wetland (EW)**<br>The wetland has complete stock access and is consequently highly degraded. The vegetation assemblage is dominated by exotic species including soft rush, pasture grasses, buttercup water pepper and starwort. |
| **Habitat quality** | Poor<br>Highly degraded wetland, dominated by exotic species and closely cropped pasture grasses. |
| **Ecological value** | Low |
| **Rationale** | • The site rates low for all ecological significance criteria due to its small size (0.4 ha), lack of indigenous vegetation, and high level of functional degradation resulting from stock access. |

[11] This wetland site was not visited by the terrestrial ecology team, instead it was assessed from site photos provided by the freshwater team who undertook an SEV here (see Chapter 3).

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| | • It should be noted that part of the site is located within a LENZ IV category where less than 20% of indigenous cover remains, thus satisfying the 'Rarity/distinctiveness' criterion. |
| **Site photos** |   |
| **Site ID** | **HN_W_TeHana_01** [12] |
| **Size (ha)** | 2.1 |
| **Habitat type (bold) and dominant species** | **Exotic wetland (EW)**<br>This site is relatively large (2.1 ha) comparative to other wetlands in this LCA, which are all located within an agricultural land use area. Notwithstanding its size, the wetland has complete stock access and is consequently highly degraded. The vegetation assemblage is dominated by exotic species including soft rush, pasture grasses and buttercup. There are also scattered stands of totara across the upper reaches. |
| **Habitat quality** | Poor<br>Highly degraded wetland, dominated by exotic species and closely cropped pasture grasses. |
| **Ecological value** | Low |
| **Rationale** | • The site rates low for all ecological significance criteria due to its lack of indigenous vegetation, and high level of functional degradation resulting from stock access. |

[12] This wetland site was not visited by the terrestrial ecology team, instead it was assessed from site photos provided by the freshwater team who undertook an SEV nearby.

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| | • It should be noted that part of the site is located within a LENZ IV category where less than 20% of indigenous cover remains, thus satisfying 'Rarity/distinctiveness'.<br>• It should however be noted that the comparatively large size (2.1 ha) of this wetland suggests a high restoration potential comparative to other wetlands in the area with similar values. |
| **Site photos** |   |
| **Site ID** | **HN_W_TeHana_02** |
| **Size (ha)** | 0.6 |
| **Habitat type (bold) and dominant species** | **Exotic wetland (EW)**<br>Rushland with full stock access. The site is heavily pugged and contains a closely cropped flora assemblage comprising of soft rush, buttercup, Yorkshire fog, pasture grass, and patches of sphagnum moss. Water pepper was also abundant in the wetter areas. The margin of the lower reaches was lined with mature poplars (necklace and Lombardy), crack willow and the occasional juvenile kānuka. |
| **Habitat quality** | Poor<br>Conversion to pasture and stock access has changed the hydrology and species assemblage of this wetland. Consequently, it is now dominated by exotic species and there is limited habitat for native wetland fauna. |
| **Ecological value** | Low |

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| **Rationale** | • The site rates low for all ecological significance criteria due to its lack of indigenous vegetation, and high level of functional degradation resulting from stock access.<br>• Located within a LENZ IV category where more than 20% of indigenous cover remains.<br>• The structure and quality of the wetland vegetation indicates that the site would be unlikely to be occupied by Threatened or At Risk marsh birds.<br>• The poplars and willows on the margin of the lower reach have the capacity to provide roosting habitat for Threatened long-tailed bats. However, the lack of connectivity to large forested areas indicate that occupation by bats is unlikely. |
| **Site photos** |   |

### 3.3.2 Magnitude and level of effects

The magnitude and level effect of the Project in the Hōteo North section, without mitigation, is based on the Indicative Alignment and is described in Table 12. Criteria for describing the magnitude of effect are adapted from the EIANZ guidelines for ecological impact assessment in New Zealand (EIANZ, 2015).

Table 12 - Assessment of effects on terrestrial and wetland sites in the Hōteo North section.

| Site ID | HN_T_Hōteo_01 |
|---|---|
| **Extent of impact** | 0.4 ha of 1.1 ha (34%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | Low<br>• 34% of site would be permanently lost to construct the Indicative Alignment.<br>• Small, degraded stand of trees that is already impacted by edge effects.<br>• The Indicative Alignment traverses the eastern margin of the site and therefore maintains connectivity to SEA_T_5541 and the Hōteo River that are adjacent to the west.<br>• 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. |
| **Level of effect (without mitigation)** | Low |
| **Site ID** | **HN_T_Hōteo_02 (SEA_T_683)** |
| **Extent of impact** | 0.4 ha of 11 ha (4%) |
| **Project activities** | Bulk earthworks<br>Viaduct works<br>Operational disturbance |
| **Ecological value** | Very High |
| **Magnitude of effect (without mitigation) and reasons** | Moderate<br>• 4% of site is located directly under the Hōteo Viaduct footprint of the Indicative Alignment, some of this vegetation would be directly impacted i.e., trimmed or removed for piers. The remainder of the vegetation under the viaduct footprint would be subject to rain shadow and shading effects.<br>• The placement of the viaduct, based on the Indicative Alignment, would fragment the western edge of the site, subjecting it to increased edge effects; this fragment measures a further 0.6 ha. |

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| | • Apart from the 0.4 ha fragment described above, the Indicative Alignment closely follows the existing SH1 at the point of the crossing. Consequently, the western edge of the site is already subject to edge effects from the existing SH1. Therefore, the effects of further fragmentation will be reduced in comparison to the more intact habitat in the interior of the site.<br>• The site is likely to provide habitat for Threatened and/or At Risk fauna, at least intermittently. Consequently, along with the temporary disturbance of heavy machinery and vegetation removal associated with construction of the road, the operational phase of the State Highway will result in disturbance to native fauna from vehicle lights and noise. |
| **Level of effect (without mitigation)** | Very High |
| **Site ID** | **HN_T_Hōteo_03 (SEA_T_6851)** |
| **Extent of impact** | Total impact on 0.9 ha of 3.2 ha total (27%)<br>0.6 ha of 2.4 ha of kahikatea pukatea forest (WF8) impacted (24%)<br>0.3 ha of 0.8 ha of Machaerina sedgeland (WL11) impacted (34%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Kahikatea, pukatea forest (WF8) - High<br>Machaerina sedgeland (WL11) - Moderate |
| **Magnitude of effect (without mitigation) and reasons** | High<br>• 27% of the site is permanently lost based on the Indicative Alignment.<br>• The Indicative Alignment traverses the western margin of the kahikatea, pukatea forest remnant and therefore limits the fragmentation and creation of edge effects on the forested part of the site. The authors of the Water Assessment Report have assigned a high likelihood that the proposed road design will result in a lowering of the water level of the Machaerina sedgeland.<br>• Although both the ecosystem types in this site are degraded by current land use, the kahikatea, pukatea forest remnant contains cavity-bearing trees that could provide habitat for mobile fauna such as long-tailed bats and forest birds. An acoustic bat monitor was deployed at this site but no bats were recorded.<br>• If native fauna continues to occupy the remainder of the site post-construction, along with the temporary disturbance of heavy machinery and vegetation removal associated with construction of the road, the operational phase of the State Highway will result in disturbance to native fauna from vehicle lights and noise.<br>• As the Indicative Alignment traverses the western margin of the site, the remaining part of the site will maintain its high connectivity to the Hōteo River which could be a commuting corridor for long-tailed bats. |

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| **Level of effect (without mitigation)** | **Kahikatea, pukatea forest (WF8)** - Very High<br>**Machaerina sedgeland (WL11)** - High |
| **Site ID** | **HN_T_Hōteo_04** |
| **Extent of impact** | 0.1 ha of 0.1 ha (100%) |
| **Project activities** | Bulk earthworks |
| **Ecological value** | Low |
| **Magnitude of effect (without mitigation) and reasons** | High<br>• The entirety of this site would be permanently lost to construct the Indicative Alignment.<br>• Given the small size (0.1 ha) and the very high level of degradation of this stand of kahikatea the potential loss of fauna habitats is likely to be negligible. Notwithstanding this, the trees have cavities that could be used by cavity roosting/nesting mobile fauna such as long-tailed bats and some forest birds. However, the lack of long-tailed bat records in the area indicate that this is unlikely. |
| **Level of effect (without mitigation)** | Low |
| **Site ID** | **HN_T_Hōteo_05** |
| **Extent of impact** | 0.05 ha of 0.12 ha (39%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Low |
| **Magnitude of effect (without mitigation) and reasons** | Moderate<br>• 39% of the site would be permanently lost based on the Indicative Alignment.<br>• This site is comprised of three distinct stands of kahikatea trees. Consequently, the removal of one of these stands will not contribute to increased edge effects for the remaining stands.<br>• Given the small size (0.1 ha) and the very high level of degradation of this stand of kahikatea the potential loss of fauna habitats is likely to be negligible. Notwithstanding this, mobile fauna such as long-tailed bats and forest birds may use the tree cavities for roosting and nesting. However, the lack of long-tailed bat records in the area indicate that this is unlikely. |

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| | • The Indicative Alignment is immediately adjacent to the remaining two stands of trees. Consequently, if mobile faunas do inhabit these trees, they will be impacted by both construction and operational phase disturbance. |
| **Level of effect (without mitigation)** | Low |
| **Site ID** | **HN_T_Hōteo _06** |
| **Extent of impact** | 0.5 ha of 0.5 (100%) |
| **Project activities** | Bulk earthworks |
| **Ecological value** | Moderate |
| **Magnitude of effect (without mitigation) and reasons** | High<br>• The entirety of this site would be permanently lost based on the Indicative Alignment.<br>• This site appears to have been fenced for at least seven years (based on Bioresearches observations in 2010) and our more recent observations from the road indicate that the understory is regenerating well. The structural integrity across forest tiers indicates the site could provide habitat for small remnant populations of both mobile and immobile native fauna. Note threatened copper skink for example were confirmed in the site by Bioresearches in 2010.<br>• As the site was assessed from the roadside, it is unknown if its removal could impact rare or threatened plants |
| **Level of effect (without mitigation)** | Moderate |
| **Site ID** | **HN_W_Hōteo _02 (SEA_T_685)** |
| **Extent of impact** | 0 ha of 2.9 ha (0%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | High |
| **Magnitude of effect (without mitigation) and reasons** | Low<br>• This site would not be directly impacted based on the Indicative Alignment. |

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| | • The Indicative Alignment traverses the channelised stream that drains into this wetland site and includes a diversion of this channel. Consequently, the authors of the Water Assessment Report state the road construction will likely result in a lowering of the water level at this site. Such changes in hydrology could lead to a shift in the vegetation community and thus habitat quality.<br>• The high value of the vegetation community indicates that there is a likelihood that Threatened and/or At Risk wetland birds could occur within the wetland at least intermittently. The Indicative Alignment runs immediately adjacent to the western margin of the site. As wetland birds are limited to specific habitats that are severely depleted on a national scale, if construction and/or operational disturbance result in birds abandoning the wetland, their available habitat has been reduced. The severity of this impact is higher comparative to more generalist bird species. Furthermore, abandonment during the breeding season could lead to the mortality of eggs and chicks. |
| **Level of effect (without mitigation)** | Moderate |
| **Site ID** | **HN_T_Hōteo_07** |
| **Extent of impact** | Total impact on 0.7 ha of 1.5 ha (47%)<br>0.1 ha of 0.8 ha of kauri, podocarp, broadleaved forest (WF11) impacted (14%)<br>0.6 ha of 0.7 ha of anthropogenic totara forest (AVS1) impacted (83%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Low |
| **Magnitude of effect (without mitigation) and reasons** | Moderate<br>• 47% of this site would be directly removed to construct the Indicative Alignment.<br>• Given the high level of degradation of this site, the potential loss of fauna habitats is likely to be negligible.<br>• The site is linear in shape and is already impacted by edge effects (e.g., weed incursion, trees in poor health likely due to exposed conditions). Consequently, the increased extent of edge habitat is unlikely to have a notable impact on the remaining vegetation. |
| **Level of effect (without mitigation)** | Very Low |

| Site ID | HN_T_Hōteo_08 |
|---|---|
| **Extent of impact** | 0.3 ha of 1.2 ha (23%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | High |
| **Magnitude of effect (without mitigation) and reasons** | High<br>• 23% of this site would be permanently removed based on the Indicative Alignment.<br>• The Indicative Alignment traverses the western corner of the site therefore minimising the increase in edge effects.<br>• Given the high level of degradation of the understory and ground layer of this kahikatea remnant, the potential loss of fauna habitats is likely to be low. Notwithstanding this, mobile fauna such as long-tailed bats and forest birds may use available tree cavities for roosting and nesting.<br>• If mobile faunas are using this site and continue to occupy the site post-construction, they will also be indirectly impacted by construction and operational phase disturbance such as increased noise and light. |
| **Level of effect (without mitigation)** | Very High |
| **Site ID** | **HN_T_TeHana_01** |
| **Extent of impact** | Total impact on 0.6 ha of 1.3 ha (43%)<br>0.5 ha of 0.7 ha of anthropogenic totara forest (AVS1) impacted (67%)<br>0.1 ha of 0.6 ha exotic wetland (EW) impacted (17%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | **Anthropogenic totara forest (AVS1)** - Low<br>**Exotic wetland (EW)** - Low |

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| **Magnitude of effect (without mitigation) and reasons** | Low<br>• 43% of the site would be permanently removed, the anthropogenic totara forest will be primarily removed, based on the Indicative Alignment.<br>• The Indicative Alignment would bisect the totara stand through the middle, separating the remainder of the stand into two very small remnants that will be highly impacted by edge effects.<br>• Notwithstanding the above, the current totara stand is approximately 40 m in width and therefore will already be largely exposed to edge conditions.<br>• Given the small size and very high level of degradation of the understory and ground layer of this totara stand, the potential loss of fauna habitats is likely to be low. There are a small number of mature, cavity-bearing kā nuka trees that could be used by mobile fauna such as long-tailed bats and forest birds for roosting and nesting. However, there are larger, more suitable sites within the wider landscape.<br>• The Indicative Alignment will result in the infilling or culverting of approximately 140 m of exotic wetland running alongside the totara stand. This will likely affect the hydrology of the remainder of the wetland downstream.<br>• However, the wetland is already highly modified by stock degradation and retiring the area from grazing could have positive effects on the wetland function.<br>• The low ecological value of this wetland indicates that there will be negligible impacts on native wetland bird habitat resulting from the loss of this wetland. |
| **Level of effect (without mitigation)** | Very Low |
| **Site ID** | **HN_W_Hōteo_01 (SEA_T_6854)** |
| **Extent of impact** | 0.4 ha of 0.7 ha (56%) |
| **Project activities** | Bulk earthworks<br>Viaduct construction |
| **Ecological value** | High |
| **Magnitude of effect (without mitigation) and reasons** | Very high<br>• 56% of site would be permanently lost based on the Indicative Alignment.<br>• The Indicative Alignment bisects the middle of the site, which would result in a high level fragmentation and therefore increased edge effects. |

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| | • Notwithstanding the above, based on the Indicative Alignment, part of the wetland will be bridged which will reduce the fragmentation to some extent.<br>• The northern portion of the wetland will be infilled, this will directly remove a large proportion of the site and also likely significantly change the water levels of the remainder of the wetland (see the Water Assessment Report). These changes could result in complete loss of functional wetland habitat.<br>• The viaduct will also result in a rain shadow and increased shading of the remaining wetland. Wetland plants are adapted to high light environments and the presence of the viaduct will likely shift the vegetation community to more shade tolerant species.<br>• Although this site is small, it has a high ecological value and is in close proximity to other high quality wetland sites. Consequently, the removal of part of this site could result in the removal of Threatened and/or At Risk wetland bird habitat. |
| **Level of effect (without mitigation)** | Very High |
| **Site ID** | **HN_W_Hōteo _03** |
| **Extent of impact** | 0.2 ha of 0.4 ha (45%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Low |
| **Magnitude of effect (without mitigation) and reasons** | Low<br>• 45% of the wetland would be permanently lost based on the Indicative Alignment.<br>• The existing wetland is already small and degraded by stock access. Consequently, the remaining extent of the site is unlikely to undergo a notable shift from baseline conditions.<br>• Due to the existing level of degradation the site is unlikely to provide habitat for Threatened or At Risk wetland birds and therefore habitat loss and construction and operational disturbance have not been deemed to have a notable impact. |
| **Level of effect (without mitigation)** | Very Low |

| Site ID | HN_W_TeHana_01a and b |
|---|---|
| **Extent of impact** | 0.5 ha of 2.2 ha (23%) |
| **Project activities** | Bulk earthworks<br>Operational disturbance |
| **Ecological value** | Low |
| **Magnitude of effect (without mitigation) and reasons** | Low<br>• 23% of the wetland would be permanently lost based on the Indicative Alignment.<br>• The existing wetland is already small and degraded by stock access. Consequently, the remaining extent of the site is unlikely to undergo a notable shift from baseline conditions.<br>• Due to the existing level of degradation the site is unlikely to provide habitat for Threatened or At Risk wetland birds and therefore habitat loss and construction and operational disturbance have not been deemed to have a notable impact.<br>• This site is notably larger comparative to the other pastoral wetland sites assessed. The larger size increases the potential benefits of restoring the wetland. The infilling of part of this site will fragment the habitat and likely alter the downstream hydrology, resulting in a reduction in its restoration potential. |
| **Level of effect (without mitigation)** | Very Low |
| **Site ID** | **HN_W_TeHana_02** |
| **Extent of impact** | 0.62 ha of 0.62 ha (99%) |
| **Project activities** | Bulk earthworks |
| **Ecological value** | Low |
| **Magnitude of effect (without mitigation) and reasons** | Moderate<br>• 99% of the wetland would be permanently removed based on the Indicative Alignment.<br>• The wetland is small and highly degraded and is unlikely to provide habitat for Threatened or At Risk wetland birds. Therefore, habitat loss has not been deemed to have a notable impact. |
| **Level of effect (without mitigation)** | Very Low |

## 3.4 Sensitivity analysis

### 3.4.1 Spatial sensitivity

Sensitivities of our assessment of effects on terrestrial and wetland ecology values (and the fauna that occupy these habitats) to modifications (lateral or vertical re-alignment) to the Indicative Alignment occur within all sections of the proposed designation.

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 plantation pine forest).

For example, a movement of the Indicative Alignment east or westwards in the upper Kourawhero Stream valley in the Warkworth North section 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 boundary 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.

The Prority Ecological Sites are listed in Table 13, along with the recommended response to the sensitivity to the alignment. These sites are also shown in the PES Map Series in Volume 3, Drawing set of the AEE.

It will also become evident that the Prority Ecological Sites at most risk in our sensitivity analysis also coincide with our recommended mitigation locations; most notably the areas where we recommend an aggregation of mitigation effort (see Chapter 5). Site-specific consideration of the specific features listed in Table 13 have a higher imperative when the proposed mitigation is also considered.

For example, we draw particular attention to the upper Kourawhero Stream catchment area. Several priority ecological sites occur within this area, and this area is also a recommended mitigation area (see Chapter 5). The features in this area create more severe constraints on the final alignment design than elsewhere within the proposed designation boundary. We have mapped these features together in the PES map series (PES02).

Table 13 - Priority ecological sites: terrestrial and wetland features for site-specific consideration. All Priority Ecological Sites are sites of Moderate, High or Very High Ecological Value and/or a recommended location for ecological mitigation.

| Feature (area) | Sensitivity | Action | Map series reference |
|---|---|---|---|
| **Warkworth North Section** | | | |
| WN_T_Mahu_01 (SEA_T_2287) (16.5 ha) | SEA. Stream Management Area. Kauri, podocarp, broadleaved forest (WF11). Moderate ecological value. | Minimise vegetation removal to the extent practicable and to that necessary for the operational project footprint. | EV-001 |
| WN_W_Koura_01 | Machaerina sedgeland (WL11) Moderate ecological value. | Avoid, as much as practicable, eastward adjustment to alignment, and modifications to water table. | EV-005 |
| WN_W_Koura_02 (0.8 ha) | Raupo reedland (WL19). Very high ecological value | Avoid, as much as practicable, eastward adjustment to alignment, and modifications to water table. | EV-010 |
| WN_W_Koura_03 (1.1 ha) | Raupo reedland (WL19) Moderate ecological value. | Avoid, as much as practicable, eastward adjustment to alignment, and modifications to water table. | EV-011 |
| WN_W_Koura_04 (0.8 ha) | Exotic wetland (EW). Moderate ecological value. Recommemded mitigation area. | Avoid, as much as practicable, eastward adjustment to alignment, and modifications to water table. | EV-012 |
| WN_W_Koura_05 (0.6 ha) | Raupo reedland (WL19). High ecological values. Recommended mitigation area. | Avoid, as much as practicable, eastward adjustment to alignment, and modifications to water table. | EV-013 |
| WN_T_Koura_01a | Kahikatea, pukatea forest (WF8). High ecological value | Avoid, as much as practicable, westward adjustment to alignment | EV-006 |
| WN_T_Koura_02 | Kānuka scrub/forest (VS2) plus Broadleaved species scrub/forest (VS5). Moderate ecological value. | Avoid, as much as practicable, eastward adjustment to alignment | EV-009 |
| WN_T_Mahu_02 | Kauri, podocarp, broadleaved forest (WF11). Moderate ecological value. | Avoid, as much as practicable, westward adjustment to alignment | EV-002 |
| **Dome Valley Forest Section** | | | |
| DVF_W_Koura_01 (0.8 ha) | Exotic wetland (EW). Moderate ecological value. Recommended mitigation area. | Avoid, as much as practicable, eastward adjustment to alignment, and modifications to water table. | EV-015 |

| Feature (area) | Sensitivity | Action | Map series reference |
|---|---|---|---|
| DVF_T_Koura_02 (8.1 ha) | Kauri, podocarp, broadleaved forest (WF11) and Broadleaved species scrub/forest (VS5). Very high ecological value. | Road tunnel underneath this feature. Avoid, as much as practicable, adjustments to alignment that result in intrusion into this feature. | EV-016 |
| **Hōteo North Section** | | | |
| HN_W_Hōteo _01 (SEA_T_6854) | Flaxland (WL18). High ecological value. | Avoid, as much as practicable, any further encroachment south into remaining wetland area. | EV-023 |
| HN_W_Hōteo _02 (SEA_T_685) (2.9 ha) | Kahikatea forest (MF4). High ecological value. | Avoid, as much as practicable, eastward adjustment to alignment. | EV-029 |
| HN_T_Hōteo _02 (SEA_T_683) | SEA. Taraire forest. Very high ecological value. | Avoid, as much as practicable, eastward adjustment to alignment. | EV-022 |

### 3.4.2 Temporal sensitivity

Plantation pine forest is the main terrestrial habitat type in the Dome Valley Forest section. At the time of survey, the pine plantation was in the earlier-mid stages of the production cycle. However, as the pine plantations mature, the harvesting of the pine will begin to occur, all felling within the proposed designation boundary has been indicated to occur prior to 2030.

The forest harvesting cycle presents a particular challenge to our analysis of effects. The current forest harvesting plan shows that effectively the complete removal of tall stature pine within the proposed designation boundary will occur prior to the indicative commencement of the road construction in 2030. We have noted above that forest harvesting is a permitted activity under the NES_PF.

Although the majority of the habitat available in the Dome Valley Forest section does not have high botanical values, we note that multiple Threatened and/or At Risk native animals (e.g., kauri snail, Hochstetter's frog and long-tailed bat) have been recorded within the plantation forest that comprises this section. All of these species will be impacted as harvesting occurs in the forest, which is expected to occur prior to the construction of the Project. This change in land cover will significantly reduce the suitable habitat available in the Dome Valley Forest section for the aforementioned fauna species. Thus, the effects of the road construction and operation through the Dome Valley Forest section will be low-moderate, because the harvested baseline condition will have less ecological value than currently exists.

## 3.5 Biosecurity

The following biosecurity risks are relevant to the Project, and we make comment on how these vectors are spread.

Kauri dieback is a disease caused by a microscopic pathogen, called Phytophthora agathidicida. There is currently no cure for Kauri dieback and it is easily spread through the

movement of soil on footwear, animals, equipment and vehicles. Preventative measures are essential to ensuring infected soil is not moved into or within the site.

Myrtle rust is a fungal disease that severely attacks plants in the myrtle family including pōhutukawa, ramarama, mānuka and rātā. Pohutukawa and ramarama are particularly vulnerable whereas kanuka and Manuka have had few records of infection. Myrtle rust has already been recorded in the Auckland region, however, efforts should be made to limit its spread through known infection routes including infected nursery plant stock.

Chytridiomycosis is an infectious disease in amphibians caused by the chytrid *Batrachochytrium dendrobatidis*, a fungus. Chytrid fungus mostly affects amphibian species associated with permanent water, such as streams. Chytrid fungus typically live in soil and water and have spores that can move through the water. Chytridiomycosis has not been detected in Hochstetter's frogs (Bishop et al. 2013), however, hygiene and handling protocols for Hochstetter's frogs are required to ensure the health of native frogs.

Plague skinks were declared an unwanted organism in 2010 and although they may already be present within the site, efforts should be made to avoid transporting them to mitigation areas where they may impact native lizards.

# 4 FRESHWATER ECOLOGICAL VALUES AND EFFECTS

**Freshwater ecological values summary**

Freshwater habitats across the Indicative Alignment have great variation in their ecological value; from low value degraded pastoral streams to very high value streams within the Dome Valley Forest section.

Low value aquatic habitats are present in the Warkworth North and Hōteo North sections, 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. Small pockets of existing riparian vegetation and/or fencing are present within these pastoral areas and were associated with an increase in aquatic habitat value. In comparison, the Dome Valley Forest section has freshwater habitats of high ecological value, with high diversity of fish and macroinvertebrate species.

The overall level of ecological effects on freshwater habitats across the Project are moderate prior to mitigation.

Freshwater ecological effects within the Warkworth North section are moderate owing to the potential effects on the high value wetland located within the upper Kourawhero Catchment, while effects (based on the Indicative Alignment) on the Mahurangi River (Left Branch) have been minimised through design. Existing freshwater ecological effects on the Dome Valley section are very high, with the freshwater habitats being of high ecological value, and the construction of the Indicative Alignment requiring a large amount of fill through gullies. The Hōteo North section has an overall low level of effect on freshwater ecology; many watercourses within the section are of low ecological value and highly disturbed, while effects to the lower Waiteraire Stream and Hōteo River are minimised through construction of a viaduct.

The harvesting of Matariki Forest will occur prior to the construction of the Project. Although a permitted activity, this harvesting is likely to have a considerable impact on the ecological values of watercourses within the Dome Valley Forest section, and will change the ecological values of the receiving environment.

Sensitivity analysis of the Indicative Alignment within the proposed designation boundary indicates that there is high sensitivity in some areas. Lateral and vertical modifications to the Indicative Alignment around Mahurangi River (Left Branch) and the upper Kourawhero wetland are highly sensitive.

## 4.1 Ecological value of freshwater ecosystems

The ecological values of watercourses potentially affected by the Project, and more specifically the Indicative Alignment footprint and associated cut and fill, are discussed in the following chapters. As for our assessment of effects on terrestrial and wetland ecology, the ecological values and potential effects are discussed in relation to three sections: Warkworth North, Dome Valley Forest and Hōteo North.

Field surveys of freshwater environments were undertaken at representative sites across all three sections. The number of surveys able to be undertaken was comparatively low relative to the area of potentially affected habitat. Therefore, generalisations have been inferred from survey data and desktop research.

### 4.1.1 Warkworth North section

**Warkworth North freshwater ecological values and effects summary**

Freshwater environments within the Warkworth North section 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 values of the two surveyed watercourses in this section (the 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 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 design of the Indicative Alignment has been modified to avoid and minimise the effects on these watercourses.

Ecological effects of the Project in this section are considered to be moderate, with higher effects within the upper Kourawhero area resulting from the extensive stream diversions. Effects have been minimised where possible through the design of the Indicative Alignment, including the complete avoidance of loss to the Mahurangi River (Left Branch) and its vegetated riparian margin, avoidance of parts of the upper Kourawhero Stream (to also minimise changes to the water table in this area), and the utilisation of elevated on and off ramps over the Mahurangi River (Left Branch).

#### Characteristics of freshwater ecosystems of Warkworth North section

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. Sections of the Mahurangi River (Left Branch) run both alongside and directly under the Indicative Alignment, whilst a number of tributaries of the Kourawhero Stream are located under the Indicative Alignment. There is a small section of the Indicative Alignment that crosses a single tributary of the Mahurangi River (Right Branch) at the southern end of the proposed designation, south of Wyllie Road. This tributary has not been surveyed as part of this assessment. However, it appears (from satellite imagery) to be a degraded stream located within a paddock.

Freshwater survey sites were selected based on the criteria outlined in Chapter 2, with two sites being surveyed (refer Ecological Survey (ES) Series Drawings). We carried out an SEV survey at site WN_F_Koura_1, and a visual assessment at site Mahu_1. Site WN_F_Koura_1 was deemed typical of surrounding streams under the Indicative Alignment. Sites along

the Mahurangi River (including Site WN_F_Mahu_1) were not suitable for SEV surveys as the river was too deep to undertake SEV measurements. A summary of the key ecological attributes of each surveyed watercourse is summarised in Table 14 and shown on the Ecological Survey (ES) Series Drawings.

With the exception of the Mahurangi River (Left Branch), watercourses within the Warkworth North section, are typically highly modified first and second order streams. Many of the watercourses run through grazed pasture, with stock access, or lifestyle blocks. There are a small number of small farm ponds and dams located on first order streams.

**Table 14 - Key freshwater attributes from Site WN_F_Koura_1 and WN_F_Mahu_1 within the Warkworth North section.**

| Stream | WN_F_Koura_1 | WN_F_Mahu_1 |
|---|---|---|
| Sample Date | 15 May 17 | 7 June 17 |
| Surrounding Land Use | Pasture | Pasture |
| **Characteristics** | | |
| REC Order | 2 | 3 |
| Permanence | Permanent | Permanent |
| **Habitat** | | |
| Wetted Width (m) | 0.53–1.47 | > 2 |
| Depth (m) | 0.02–0.43 | - |
| Substrate Type | Silt/Sand | - |
| Stock Access | No* | No |
| Predominant Shade | <10% | - |
| Macrophytes (vegetation) | Water pepper, watercress | - |
| **Macroinvertebrates** | | |
| No. Taxa | 22 | *Not Sampled* |
| EPT Taxa | 6 | |
| Dominant Taxa | Oligochaeta (worm) | |
| MCI-sb Value | 103.5 – Indicative of good water quality | |
| **Fish Species** | | |
| Taxa Observed | Shortfin Eel; Longfin Eel; Banded Kokopu; Common Bully; Koura | *Not Sampled* |
| Fish IBI | 54 - Excellent | |
| **SEV** | | |
| Score | 0.489 | - |
| **EIANZ criteria** | | |
| Value | **Moderate - High** | **High** |
| Reasons for our assessment | • Pathway for migratory species<br>• At Risk – Declining fish species<br>• Benthic community dominated by pollution tolerant species<br>• MCI-sb score indicates possible mild pollution | • Permanent 3rd order watercourse<br>• Riparian Margin AUP(OP) Significant Ecological Area (SEA_T_2287)<br>• Key migratory pathway for freshwater fish |

| Stream | WN_F_Koura_1 | WN_F_Mahu_1 |
|---|---|---|
| | • EPT richness and proportion of community moderately-low<br>• SEV score Moderate<br>• Fish diversity moderate<br>• IBI score Excellent<br>• Stream channel incised and riparian vegetation limited to sparse exotic weed species | • NZFFD search indicates presence of four At Risk – Declining fish/invertebrate species.<br>• Established riparian margin<br>• Stream channel unmodified but areas of active erosion on stream banks |
| * Note – Stream not fenced but stream highly incised so that stock could not get to stream bed. | | |

| Site WN_F_Koura_1 | |
|---|---|
| a) Stream channel | b) Koura and common bully |
|  |  |
| **Site WN_F_Mahu_1** | |
| a) Stream channel | d) Stream channel |
|  |  |

Figure 2 – Photo of survey sites within the Warkworth North Section.

## Freshwater ecological value classification

We classified the current ecological value of each site using the EIANZ criteria outlined in Chapter 2. We consider that:

- Site WN_F_Mahu_1 is of High ecological value, and

- Site WN_F_Koura_1 of Moderate-High ecological value.

The reasons for our assessment are outlined in Table 7. As a full survey (i.e., no SEV) was not carried out at Site WN_F_Mahu_1, our assessment and classification of the Site relies upon a visual survey and desktop information.

### Summary of freshwater values

Overall, the freshwater habitats assessed within the Warkworth North section have Moderate-High ecological values. We anticipate, through examination of aerial photography and brief visual assessments, 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 those surveyed. Similarly, we anticipate the upper and lower reaches of the Mahurangi River (Left Branch) affected by the Indicative Alignment to have similar values to those observed at site WN_F_Mahu_1.

Other watercourses in the Warkworth North section, within the Hōteo Catchment and within pastoral land use are likely to have similar, if not somewhat lower, ecological value to that seen at site WN_F_Koura_1. Many other watercourses in this section located under the Indicative Alignment have been straightened and deepened to drain land, and have stock access. These factors are likely to result in extensive stream degradation, and a lower ecological value.

## 4.1.2 Dome Valley Forest section

**Dome Valley Forest freshwater ecological values and effects summary**

Freshwater environments within the Dome Valley section 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. Channels have 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 contained native regeneration and provided high shading and organic matter to the stream channel.

Freshwater values were high across all sites in the Dome Valley section, with surveys indicating very good fish populations, a high abundance of EPT species, excellent SEV scores, and MCI scores that indicate excellent water quality. We expect that other watercourses within the Dome Valley section, with similar habitats, will have similar high ecological values. Effects of the Project based on the existing values would be high.

The pine trees within Matariki Forest will be harvested prior to the construction of the Project. This harvesting is expected to reduce the ecological value of the watercourses within the proposed designation boundary and will likely lead to lower freshwater ecological values.

We consider that the effects of the Project on freshwater habitat values within the Dome Valley Forest section will be moderate, owing to the expected low-moderate ecological value of watercourses within the section post harvest, and the amount of stream loss and culverting required by the Indicative Alignment.

## Characteristics of freshwater ecosystems of Dome Valley Forest section

The Dome Valley Forest section of the proposed designation crosses through the Matariki Forest. This area is very steep, with the proposed designation crossing the steep foothills of the forest before it enters a tunnel that passes under Kraack Road and Grimmer Road. The proposed designation crosses a number of larger first and second order watercourses, the majority of which intersect somewhat perpendicularly with the Indicative Alignment. These watercourses drain into the Hōteo River, either through the Kourawhero Stream or the Waiteraire Stream and its tributaries. Many of these streams are fed by groundwater.

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 plantation pine of the Matariki Forest block and considered representative of the watercourses within this section. A summary of the key ecological attributes of each surveyed watercourse is summarised in Table 15, Table 16 and Figure 3 below.

Watercourses within the Dome Valley Forest section are almost entirely located within plantation forestry. They are typically of high ecological value with extensive riparian margins and diverse fish and macroinvertebrate populations.

**Table 15 - Key freshwater attributes from survey Site DVF_F_Koura_1, DVF_F_Hōteo_1, and DVF_F_Hōteo_2-1 within the Dome Valley Forest section.**

| Stream | DVF_F_Koura_1 | DVF_F_Hōteo _1 | DVF_F_Hōteo _2-1 |
|---|---|---|---|
| Sample Date | 19 May 17 | 19 May 17 | 18 May 17 |
| Surrounding Land Use | Forestry | Forestry | Forestry |
| **Characteristics** | | | |
| REC Order | 1 | 1 | 1 |
| Permanence | Permanent | Permanent | Permanent |
| **Habitat** | | | |
| Wetted Width (m) | 0.67-2.43 | 0.84-2.21 | 1.56-2.44 |
| Depth (m) | 0.0-0.43 | 0.0-0.45 | 0.0-0.31 |
| Substrate Type | Silt/sand/ cobble/gravel | Silt/sand/cobble/gravel | Silt/sand/cobble/gravel |
| Stock Access | No | No | No |
| Predominant Shade | 51-70% | 31-50% | 31-50% |
| Macrophytes (vegetation) | None | None | None |
| **Macroinvertebrates** | | | |
| No. Taxa | 22 | 19 | 20 |
| EPT Taxa | 7 | 8 | 9 |
| Dominant Taxa | *Zephlebia* (mayfly) | *Zephlebia* (mayfly) | *Deleatidium* (mayfly) |
| MCI-sb Value | 132.1 | 130.8 | 120.1 |
| **Fish Species** | | | |
| Taxa Observed | Longfin Eel; Banded Kokopu; | Longfin Eel; Banded Kokopu; Common Bully; Redfin Bully; | Longfin Eel; Unidentified Eel; Banded Kokopu; Common Bully; |

| Stream | DVF_F_Koura_1 | DVF_F_Hōteo _1 | DVF_F_Hōteo _2-1 |
|---|---|---|---|
| Fish IBI | 48 - Very Good | 56 - Excellent | 44 - Very Good |
| **SEV** | | | |
| Score | 0.761 | 0.820 | 0.790 |
| **EIANZ criteria** | | | |
| Value | **High** | **High** | **High** |
| Reasons for our assessment | • At Risk – Declining fish species.<br>• Invertebrate community dominated by pollution sensitive taxa<br>• MCI-sb score High<br>• Abundant EPT taxa<br>• SEV score High<br>• fish diversity Moderate<br>• Complex riparian margin of plantation pine and native vegetation | • At Risk – Declining fish species<br>• Invertebrate community dominated by pollution sensitive taxa<br>• MCI-sb score High<br>• Abundant EPT taxa<br>• SEV score Very high indicative<br>• fish diversity Good<br>• Complex riparian margin of plantation pine and native vegetation | • At Risk – Declining fish species<br>• Invertebrate community dominated by pollution sensitive taxa<br>• MCI-sb score High<br>• Abundant of EPT taxa<br>• SEV score High<br>• fish diversity Moderate<br>• Complex riparian margin of plantation pine and native vegetation |

**Table 16 - Key freshwater attributes from Site DVF_F_Hōteo_2-2 within the Dome Valley Forest section.**

| Stream | DVF_F_Hōteo _2-2 |
|---|---|
| Sample Date | 19 December 17 |
| Surrounding Land Use | Plantation Pine Forest |
| **Stream Characteristics** | |
| REC Order | 1 |
| Permanence | Permanent |
| **Habitat** | |
| Wetted Width (m) | 0.26-1.21 |
| Depth (m) | 0.001-0.13 |
| Substrate Type | Silt/Sand and bedrock |
| Stock Access | No |
| Predominant Shade | 51 – 70% |
| Macrophytes | None |
| **Macroinvertebrates** | |
| No. Taxa | 29 |
| EPT Taxa | 9 |
| Dominant Taxa | *Deleatidium* (mayfly) |
| MCI Value | 115 – Indicative of good water quality |
| **Fish Species** | |

| Stream | DVF_F_Hōteo _2-2 |
|---|---|
| Taxa Observed | Shortfin Eel; Longfin Eel; Banded Kokopu; Redfin Bully; Koura |
| Fish IBI | 38 - Good |
| **SEV** | |
| Score | 0.783 |
| **EIANZ criteria** | |
| Value | **High** |
| Reasons for our assessment | • Habitat for two At risk – declining fish species<br>• Benthic community dominated by high value species<br>• Good MCI-sb score<br>• High proportion of EPT taxa<br>• High SEV score<br>• Moderate diversity of fish species given natural physical barriers<br>• Good Fish IBI score<br>• Stream channel with abundant bryophytes and regenerating native vegetation |

| Site DVF_F_Koura_1 | Site DVF_F_Koura_1 |
|---|---|
| a) stream channel | b) stream channel |
|  |  |
| **Site DVF_F_Hōteo _1** | **Site DVF_F_Hōteo _1** |
| c) stream channel | d) banded kokopu |
|  |  |
| **Site DVF_F_Hōteo _2-1** | **Site DVF_F_Hōteo _2-1** |
| e) stream channel | f) stream channel |
|  |  |

Figure 3 – Photos of survey sites within the Dome Valley Forest Section.

### Freshwater ecological value classification

We classified the current ecological value of each site using the EIANZ criteria outlined in Chapter 2.6.3. As outlined in Table 15, we consider that:

- Site DVF_F_Koura_1 is of high ecological value;
- Site DVF_F_Hōteo _1 is of high ecological value; and
- Site DVF_F_Hōteo _2-1 is of high ecological value.
- Site DVF_F_Hōteo _2-2 is of high ecological value.

We consider that the majority other watercourses within the proposed designation boundary within the Dome Valley Forest Section are also of high current ecological value owing to their similar habitat values.

### Summary of freshwater values

Overall, the freshwater habitats assessed within the Dome Valley Forest section currently have high ecological values, with some values seen resembling those seen in watercourses within mature pristine native forests. It is expected that other watercourses within the plantation pine will have the same ecological values as those surveyed.

The Matariki Forest will be harvested prior to the construction of the Project. This will reduce the ecological value of streams within plantation pine catchments within the Dome Valley Forest section.

## 4.1.3 Hōteo North section

**Hōteo North freshwater ecological values and effects summary**

Freshwater environments within the Hōteo North section 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 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.

Freshwater 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.

Ecological effects of the Project within the section are considered to be low overall. While the ecological value of watercourses across the section is predominantly low, the magnitude of effects on some watercourses is high with high levels of stream loss and culverting across the section.

## Characteristics of Freshwater Ecosystems of the Hōteo North section

The proposed designation within the Hōteo North section crosses watercourses within the Hōteo River and Ourawhero River Catchments, including the sub-catchments of the Te Hana Creek and Maeneene Creek. The proposed designation crosses the Hōteo River, and a number of smaller permanent, intermittent and ephemeral watercourses.

A total of 10 freshwater sites were assessed within the Hōteo North section, with full SEV surveys undertaken on nine streams: three each within the Hōteo River Catchment, Te Hana Creek catchment, and the Maeneene Creek catchments. Full SEV assessments were not undertaken at site HN_F_Hōteo _2 as it was not wadeable. Refer to Table 17 to Table 20, and Figure 4 and Figure 5 below for key ecological attributes of each surveyed watercourse. The tables are ordered from south to north.

Site HN_F_TeHana_3 is not affected by the Indicative Alignment, but is within the proposed designation boundary and provides an indication of ecological value for similar habitats affected within the Section. Accordingly, the survey results are still presented below.

Site HN_F_Mae_3 is not within the proposed designation boundary as this watercourse has been avoided. However, the results of the survey and SEV are still presented as they provide insight as to the ecological value of similar streams within the section and stream values that can be achieved through restoration.

Watercourses within the Hōteo North section are predominantly highly modified first and second order streams (Table 17 to Table 20).

**Table 17 - Key freshwater attributes from survey sites HN_F_Hōteo_1, HN_F_Hōteo_2 and HN_F_Hōteo_3 within the Hōteo North section.**

| Stream | HN_F_Hōteo _1 | HN_F_Hōteo _2 | HN_F_Hōteo _3 |
|---|---|---|---|
| Sample Date | 9 May 17 | 9 May 17 | 9 May 17 |
| Surrounding Land Use | Bush (SEA) & Pasture | Pasture | Pasture |
| **Stream Characteristics** | | | |
| REC Order | 3 | 5 | 2 |
| Permanence | Permanent | Permanent | Permanent |
| **Habitat** | | | |
| Width (m) | 2.26–4.0 | - | 0.9–2.16 |
| Depth (m) | 0.1–0.74 | - | 0.04–0.44 |
| Substrate Type | Sand/silt | - | Silt/Sand |
| Stock Access | No | Yes | Yes |
| Predominant Shade | 11–30% | <10% | <10% |
| Macrophytes (vegetation) | Water pepper | - | *Egeria densa* |
| **Macroinvertebrates** | | | |
| No. Taxa | 19 | *Not Sampled* | 12 |
| EPT Taxa | 3 | | 0* |
| Dominant Taxa | Potamopyrgus (snail) | | Oligochaeta (worm) |