Ecology and Landscape Management Plan

July 2018

Mt Messenger Alliance

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NZ TRANSPORT AGENCY WAKA KOTAHI

Mt Messenger Bypass

New Zealand Government

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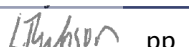
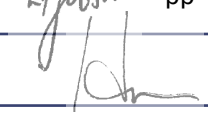
Reviewed by:	 pp	Dr Brett Ogilvie	Mt Messenger Alliance
Approved for release:		Hugh Milliken	Mt Messenger Alliance

Revision schedule		
Rev. Number	**Date**	**Description**
A	March 2018	Draft for discussion
B	10 May 2018	Draft for discussion
C	25 May 2018	Updated for Council
D	17 July 2018	Updated for Council Hearing

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Contents

Glossary

Acronym / Term	Definition
AEE	Assessment of Environmental Effects
CEMP	Construction Environmental Management Plan
ELMP	Ecology and Landscape Management Plan
LEDF	Landscape and Environmental Design Framework
MfE	Ministry for the Environment
NPDC	New Plymouth District Council
TRC	Taranaki Regional Council
DOC	Department of Conservation
MRMP	Myrtle Rust Management Plan
PPMP	Pest Plant Management Plan
PAMP	Pest Animal Management Plan
SH3	State Highway 3
The Project	The Mt Messenger bypass Project
Designation	The Parameters of the land parcel affected by the Project
Transport Agency/NZTA	NZ Transport Agency
RMA	Resource Management Act 1991
BBOP	Business and Biodiversity Offsets Programme
PMA	Pest Management Area
AWA	Additional Works Area
MPI	Ministry for Primary Industries
SEV	Stream Ecological Valuation
BMP	Bat Management Plan
Wildlife Act	Wildlife Act 1953
VRP	Vegetation Removal Protocols

Acronym / Term	Definition
ABM	Acoustic Bat Monitor
LED	Light Emitting Diode
AMP	Avifauna Management Plan
LMP	Lizard Management Plan
CCFC	Closed Cell Foam Cover
SVL	Snout to Vent Length
CWMP	Construction Water Management Plan
FRRP	Fish Recovery and Rescue Protocols
E & SC	Erosion and Sediment Control
SCWMPs	Specific Construction Water Management Plans
SRP	Stream Restoration Plan
SQP - E	Suitably Qualified Practitioner in Freshwater Ecology
RTC	Residual Trap Catch Index
RTI	Rat Tracking Tunnel Index
PAPP	Para-aminopropriophenone
CCI	Possum chew card activity/Chew Card Index
NPCA	National Pest Control Agencies
HSNOA	Hazardous Substances and New Organisms Act 1996
VTA	Vertebrate Toxic Agent
IUCN	International Union for Conservation of Nature
PTP	Peripatus Translocation Plan
AMRMC	Alliance Myrtle Rust Management Coordinator
MRNMP	Myrtle Rust Nursery Management Protocol
ABC	Alliance Biosecurity Coordinator
TRoNT	Te Runanga o Ngāti Tama

1 Introduction

This Ecology and Landscape Management Plan (ELMP) has been prepared for the NZ Transport Agency's Mt Messenger bypass Project (the Project).

1.1 Purpose and objectives of the ELMP

The ELMP has been prepared to identify how the Project will avoid, remedy, mitigate and offset potential adverse effects on the ecological, landscape and biodiversity values of the land within the Project area and its surrounds.

Specifically, the Plan outlines how the Project will avoid, remedy, mitigate, and offset effects on ecological and landscape values, including:

- Vegetation and habitat (including wetlands);
- Herpetofauna (lizards);
- Bats;
- Avifauna;
- Invertebrates (including peripatus species);
- Fish, kōura and kākahi;
- Streams; and
- Rehabilitation and restoration planting.

The ELMP also provides detail on the following ecological and landscape mitigation and offset measures to be implemented as part of the mitigation, biodiversity offset and compensation package for the Project (the Restoration Package), which is focused on achieving a net gain in biodiversity in the medium term following the completion of construction and includes:

- Management measures and protocols to avoid, remedy or mitigate the impact of construction on flora and fauna within the Project area (such as vegetation clearance protocols, lizard salvage and relocation protocols, bat roost surveys, kiwi fencing) as outlined in the respective management plan chapters of this ELMP;
- Pest management measures, particularly the control of rats, possums, stoats, ferrets, cats, goats and pigs and livestock;
- Restoration planting (including swamp forest planting), and replacement planting for significant tree species removed;
- Riparian planting and exclusion of livestock from existing streams;
- Relocation or cultivation of threatened plants found within the Project Area;
- Provision of fish passage;
- The physical mechanisms (e.g. fences) to protect the restoration and riparian planting from clearance and / or livestock on an ongoing basis;
- Landscaping design and treatments (landform and planting), including rehabilitation of all areas used for temporary work and construction yards; and

- The staging of planting and landscape treatments for the Project

The Plan also outlines monitoring to be undertaken both pre and post construction with the individual monitoring requirements described in the individual chapters of this ELMP.

The ELMP is an appendix to the Construction Environmental Management Plan (CEMP) for the Project. The construction methodology for the Project is detailed in the CEMP; and the Assessment of Effects on the Environment (AEE) or the Project.

1.2 Status of the ELMP

This ELMP has been prepared following discussions with Te Runanga o Ngāti Tama (Ngāti Tama) and the Department of Conservation (DOC) and ecologists from Wildlands Consultants Limited (as advisors to the Councils) in relation to managing the adverse ecological effects of the Project.

The ELMP will be reviewed and updated over the course of the Project in accordance with the designation and resource consent conditions, to reflect changes associated with construction techniques, communication, mitigation or the natural environments. Amendments to the ELMP may be made subject to the requirements set out in the designation and resource consent conditions, and in accordance with the review process set out in Section 13 of this ELMP.

1.3 ELMP Structure

The ELMP provides an overview of the ecological and landscape values within the Project area, along with the general approach to manage the ecological and landscape effects resulting from construction of the Project. This is followed by a series of discipline specific management plan chapters that outline in detail the measures to be implemented during the works to avoid, remedy, mitigate, offset or compensate ecological and landscape effects. The specific management plan chapters have been prepared by the Project ecology and landscape specialists who authored the AEE Ecological Technical Reports, which have informed this Plan (refer to Section 1.4).

The ELMP is set out as follows:

- Section 1 – Introduction (this section);
- Section 2 – Ecological values and effects summary;
- Section 3 – Ecological mitigation strategy and framework;
- Section 4 – Landscape and Vegetation Management Plan;
- Section 5 – Bat Management Plan;
- Section 6 – Avifauna Management Plan;
- Section 7 – Herpetofauna Management Plan;
- Section 8 – Freshwater Management Plan;
- Section 9 – Pest Management Plan;
- Section 10 – Peripatus Management Plan;

- Section 11 – Biosecurity Management Plan (addressing the management of Myrtle Rust, plant pests and animals (excluding those to be managed in the Pest Management Area));
- Section 12 – Roles and responsibilities and training requirements; and
- Section 13 – ELMP review process.

1.4 Associated documents

1.4.1 Technical reports

As outlined above, this ELMP has been informed by the assessment of ecological and landscape effects and management measures outlined in the relevant technical and supplementary reports supporting the AEE for the Project including

- Assessment of Ecological Effects – Vegetation (Technical Report 7a);
- Assessment of Ecological Effects – Freshwater Ecology (Technical Report 7b);
- Assessment of Ecological Effects – Invertebrates (Technical Report 7c);
- Assessment of Ecological Effects – Herpetofauna (7d);
- Assessment of Ecological Effects – Avifauna (7e);
- Assessment of Ecological Effects – Bats (7f);
- Assessment of Ecological Effects – Marine Ecology (Technical Report 7g);
- Assessment of Ecological Effects – Ecological Mitigation and Offset (7h);
- Landscape, Natural Character and Visual Assessment (Technical Report 8a); and
- Landscape and Environment Design Framework (LEDF) (Technical Report 8b), which sets out the landscape and environmental design elements for the Project. The purpose of the LEDF is to guide the detailed design and construction method development so that the Project's temporary and permanent works are integrated into the surrounding landscape and topography; having regard to the local landscape character and context.
- Ecology Supplementary Report – Vegetation;
- Ecology Supplementary Report – Freshwater Ecology;
- Ecology Supplementary Report – Terrestrial Invertebrates;
- Ecology Supplementary Report – Herpetofauna;
- Ecology Supplementary Report – Avifauna;
- Ecology Supplementary Report – Bats; and
- Ecology Supplementary Report – Ecological Mitigation and Offset.

1.4.2 Management plans

Implementation of this ELMP and the management of ecological and landscape effects has a number of linkages to other management plans prepared for the Project, including:

- **The Construction Environmental Management Plan (CEMP)**, which provides the overarching framework for managing adverse effects during construction of the Project. The CEMP outlines:
    - the Project construction methodology, including key works that may adversely affect ecological and landscape values;
    - the environmental and cultural management framework for the Project;
    - roles and responsibilities and training requirements (including Project induction and environmental awareness training);
    - emergency and incident response protocols; and
    - monitoring, reporting and review requirements.
- **The Construction Water Management Plan (CWMP)**, which sets out the overall approach to erosion and sediment control site management during construction of the Project, so that discharges of sediment from the site are minimised to the greatest extent possible. The Plan also addresses the management of other contaminants, such as concrete and fuel use which may also directly or indirectly discharge into receiving environments from construction works.
- **Specific Construction Water Management Plans (SCWMPs)**, erosion and sediment control plans prepared for specific work areas or activities within the site. The SCWMPs take into account environmental and ecological values and risks to determine the most effective and appropriate form of erosion and sediment control practices to manage construction water on a location and/or activity basis. The plans also outline detailed design information, specific erosion and sediment control measures and the staging and sequencing of works relevant to the specific location / activity.
- **The Construction Dust Management Plan**, which outlines the measures to be implemented during construction to avoid, remedy or mitigate the adverse effects of dust and odour from the construction works, including on ecological receptors.

1.5 Gaining kaitiaki inputs to ELMP implementation

Ngāti Tama are the iwi and exercise mana whenua for the land affected by the Project.

The Project traverses land returned to Ngāti Tama through the Treaty of Waitangi Settlement process. The Transport Agency has consulted, and worked collaboratively, with Ngāti Tama through the process of developing the Project.

Ongoing engagement with Ngāti Tama will occur as the Project progresses to enable Ngāti Tama to provide their kaitiaki inputs into the design, construction and operational phases of the Project. A process for gaining kaitiaki inputs is being developed with Ngāti Tama. The process will likely involve:

- A specific forum being established for Ngāti Tama and the Transport Agency (through the Mt Messenger Alliance) to work collaborative on kaitiaki matters (the 'Kaitiaki Forum Group').
- Kaitiaki matters being developed and progressed through the Kaitiaki Forum Group by way of a sequential process to a conclusion, generally involving:

- Identifying the kaitiaki matter.
- Determining the work required to develop the matter and the parties that need to be involved to progress the work.
- Completing the required work.
- Reviewing the outcomes / output and determining if additional work is required to progress the outcome / output.
- Completing more work if needed.
- Implementing the final outcome / output.

The Transport Agency will continue to work collaboratively with Ngāti Tama through the Kaitiaki Forum Group to ensure that Ngāti Tama's kaitiaki aspirations are provided for in Project outcomes. Examples of matters that may be progressed through the Kaitiaki Forum Group could include:

- The representation of cultural artwork in Project designs.
- Development and implementation of the pest management programme.
- The development and implementation of cultural indicators and cultural monitoring.
- Tikanga and cultural practice in relation to Project activities.

This kaitiaki process and associated recommendations, will as accepted by the Transport Agency be reflected in the implementation of this ELMP.

2 Ecological and landscape values and effects

2.1 Introduction

Ecological and landscape values and effects of the Project within and around the Project area are described in detail in the following AEE and supporting technical reports:

- Assessment of Ecological Effects – Vegetation (Technical Report 7a);
- Assessment of Ecological Effects – Freshwater Ecology (Technical Report 7b);
- Assessment of Ecological Effects – Invertebrates (Technical Report 7c);
- Assessment of Ecological Effects – Herpetofauna (Technical Report 7d);
- Assessment of Ecological Effects – Avifauna (Technical Report 7e);
- Assessment of Ecological Effects – Bats (Technical Report 7f);
- Assessment of Ecological Effects – Marine Ecology (Technical Report 7g);
- Assessment of Ecological Effects – Ecological Mitigation and Offset (7h);
- Landscape, natural character and visual assessment (Technical Report 8a);
- Landscape and Environment Design Framework (Technical Report 8b);
- Ecology Supplementary Report – Vegetation;
- Ecology Supplementary Report – Freshwater Ecology;
- Ecology Supplementary Report – Terrestrial Invertebrates;
- Ecology Supplementary Report – Herpetofauna;
- Ecology Supplementary Report – Avifauna;
- Ecology Supplementary Report – Bats; and
- Ecology Supplementary Report – Ecological Mitigation and Offset.

A summary overview of ecological and landscape values and effects is provided in this chapter. The locations of important ecological values and constraints within the Project footprint are shown on the Ecology Constraints Map provided in Appendix A.

The Project traverses an area forested with indigenous native vegetation, which is part of a wider vegetation sequence running from the coastal margins inland to the lowland mountains. It straddles an ecological boundary between two broad forest classes with podocarp, broadleaved forest largely in the Mimi catchment and the upper Mangapepeke Valley, and podocarp, broadleaved, beech forest within the lower Mangapepeke Catchment and northwards (Figure 2.1).

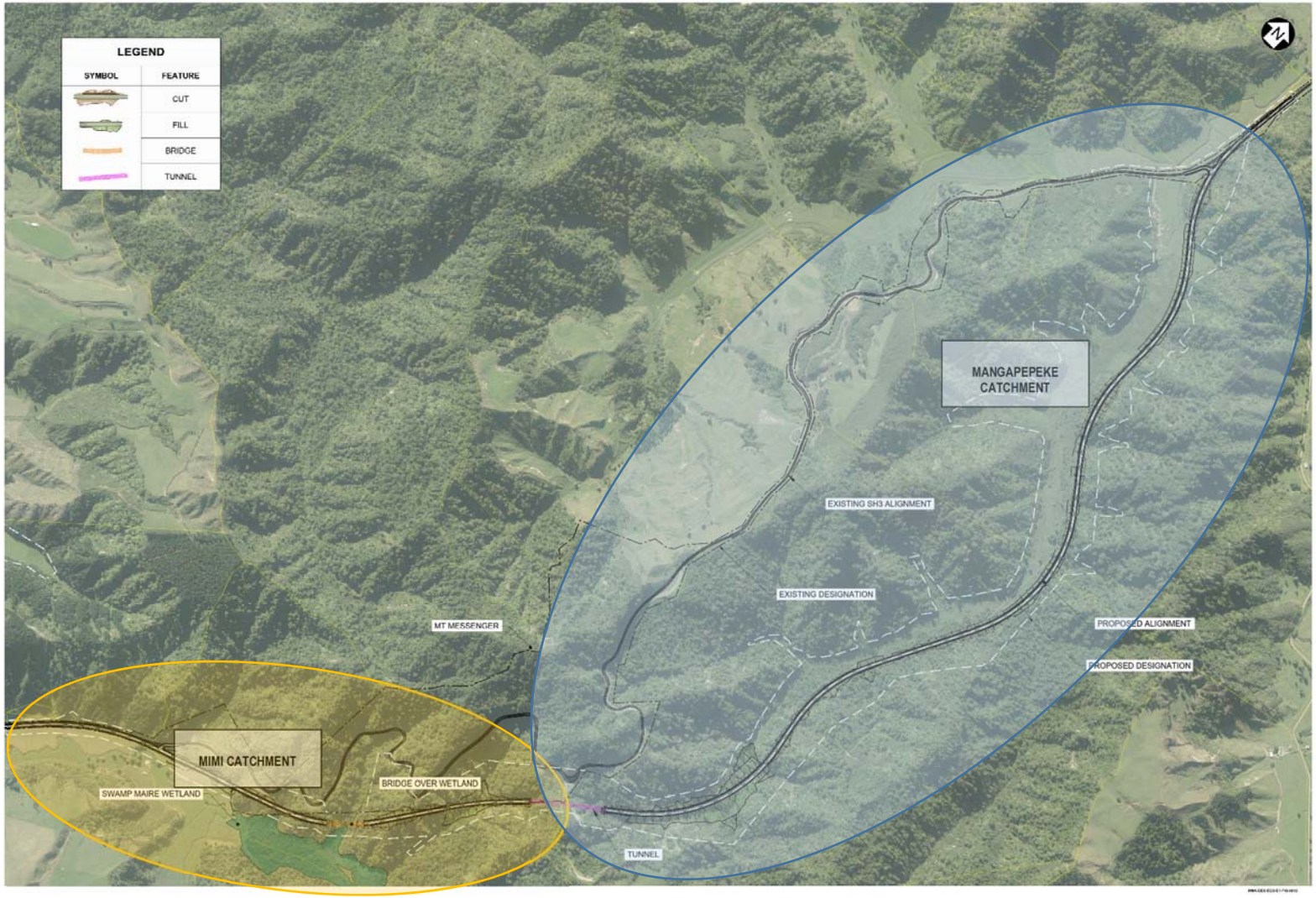

Figure 2.1 – Aerial plan of the wider Project area showing the main catchments and swamp forest

2.2 Summary of ecological values

The dominant forest on the Ngāti Tama block to the east of the existing State Highway 3 (SH3) corridor would have originally been very similar to the Parininihi land located to the west; however, it has not had consistent pest control (Figure 2.1). Consequently, the ecological condition of this area is poorer, with fewer palatable canopy trees remaining, such as thin-barked totara (*Podocarpus laetus*) and northern rata (*Metrosideros robusta*). Within the Mangapepeke Stream catchment, vegetation communities are more modified and have been affected by long-term stock grazing, fire and logging with the result being a transition to large open and grazed rushlands and poor quality pastureland further down the valley towards SH3. This valley bottom would once have been dense swamp forest.

Of greatest ecological significance in the wider Project area to the east of SH3 area is the hydrologically intact swamp forest and non-forest wetland areas in the valley floor of the northern Mimi Stream catchment (Figure 2.1). The valley floor sequence within the northern tributary of the Mimi Stream represents a full range of swamp forest, scrub and non-forest wetland communities that would once have been more common throughout this area.

Ecosystem and habitat types within the Project footprint are summarised in Table 2.1 and a summary of ecological values is provided in Table 2.2.

Table 2.1 - Ecosystem / habitat types within the Project footprint (ha) and ecological values

Potential Ecosystem Type	Vegetation community	Project footprint total	Ecological value*
WF8: Kahikatea pukatea forest	Kahikatea swamp maire forest	0.159	High
	Kahikatea forest	0.525	High
	Kahikatea treeland	0.641	Moderate
	Pukatea treefern treeland	0.722	Moderate
	Manuka scrub	0.582	Low
	Exotic rushland	5.826	Low (not significant)
WF13: Tawa kohekohe, rewarewa, hinau, podocarp forest	Tawa rewarewa kamahi forest	6.457	High
	Tawa nikau treefern forest	8.507	Moderate
	Miro rewarewa kamahi forest	0.536	High
	Pukatea nikau forest	1.347	High
	Secondary mixed broadleaved forest	2.231	Moderate
	Manuka treefern scrub	0.146	Low (not significant)

Potential Ecosystem Type	Vegetation community	Project footprint total	Ecological value*
	Manuka succession	0.514	Moderate
WF14: Kamahi, tawa, podocarp, hard beech forest	Hard beech forest	0.288	Moderate
	Tawa rewarewa kamahi forest	0.526	Moderate
	Manuka treefern rewarewa forest	3.291	Low-Moderate
	Manuka treefern scrub	3.164	Low
	Treefern scrub	0.080	Low
	Manuka scrub	1.560	Low
CL6: *Hebe*, whahariki flaxland/ rockland	Dry cliff	0.399	Moderate
Total ha		**31.277****	**High**

***** Refer to section 4.2 in Technical Report 7a – Vegetation (December 2017)

**Excludes exotic rushland

Table 2.2 – Summary of Ecological Values

Ecological aspect	Ecological values
Terrestrial vegetation	• The Mt Messenger – Parininihi area is characterised by mature podocarp broadleaved forest dominated by tawa, rewarewa and locally kamahi and pukatea, and occasional rimu, miro, northern rata and thin-barked totara. Areas of secondary scrub and forest also occur dominated by manuka, kanuka, tree ferns and small-sized canopy trees. Small areas of kahikatea (*Dacrycarpus dacrydioides*), pukatea (*Laurelia novae-zelandiae*) and swamp maire (*Syzygium maire*) forest and associated wetlands occur in valley floor areas (see Table 2.1 above for exact areas of each ecosystem type and ecological values). • 17 large, native trees that are required to be felled[1] for the Project are determined as being significant • The Project will result in the combined loss of 31.277ha of indigenous dominant forest and secondary scrub vegetation (Table 2.1) but excludes exotic rushland and dry cliff vegetation communities.
Freshwater	• The waterways in the wider Project area provide high quality habitat for freshwater fish and invertebrates. • Waterways draining north to the Mangapepeke Stream and headwater tributaries draining to the Mimi Stream on the south side of Mt Messenger all present high ecological values.

[1] Removal of one rimu may be able to be avoided through modifications in design and construction.

Ecological aspect	Ecological values
	• The lower section of the Mangapepeke Stream has an aquatic macroinvertebrate community that indicates good water quality and there is a good diversity of fish present including adult inanga (*Galaxias maculatus*), longfin eel (*Anguilla dieffenbachia*), koura/crayfish (*Paranephrops planifrons*) and redfin bully (*Gobiomorphus huttoni*) (all classified as At Risk – Declining), whilst common bully (*Gobiomorphus* cotidianus) and paratya shrimp (Not Threatened) are also present. • The main tributaries in the upper catchment are dominated by indigenous forest and macroinvertebrate communities that are indicative of excellent water quality/habitat. • 3.705km of stream loss will occur as a result of the project and a stream area of 3,376m^2 will be lost.
Bats	• The North Island long-tailed bat (*Chalinolobus tuberculatus*) is a Nationally Critical species and is present in the wider Project area. • Central lesser short-tailed bats (*Mystacina tuberculate rhyacobi*), listed as At Risk – Declining, may also be present in the wider Project area although they have not been detected in surveys. Lesser short-tailed bats are dependent on large tracts of old growth native forest and the wider Project area overlaps with the known national distribution of this sub-species.
Herpetofauna	• Herpetofauna records show that the goldstripe gecko (At Risk – Relict), striped skink (At Risk – Declining), copper skink (*Cyclodina aenea*) (Not Threatened), forest gecko (At Risk – Declining), Hochstetter's frog (*Leiopelma hochstetteri*) (At Risk – Declining) and Duvaucel's gecko (*Hoplodactylus duvaucelii*) (At Risk – Relict) have all been found within a 50km radius of the wider Project area. No herpetofauna species were found in artificial retreat surveys, although four copper skinks (*Oligosoma aeneum*) were found in visual encounter surveys near the existing SH3, although outside the Project footprint.
Avifauna	• A total of 36 diurnal and two nocturnal bird species were recorded during the first set of surveys in the wider Project Area, 23 of which are indigenous. • In total, eight 'At Risk' and 'Declining' species were recorded in these surveys or in subsequent field investigations in the Project footprint and proposed pest management area. These species include fernbird (*Bowdleria punctata*), North Island brown kiwi (*Apteryx mantelli)*, North Island robin (*Petroica longipes*), long-tailed cuckoo (*Eudynamys taitensis*), whitehead (*Mohoua albicilla*), pipit (*Anthus novaeseelandiae*), spotless crake (*Porzana tabuensis*) and black shag (*Phalacrocorax carbo*). • 10 potential kiwi pairs were detected within or in close proximity to the Project footprint during listening watches. It is anticipated that the road alignment is likely to encroach or bisect territories of between 10-15 pairs of kiwi. • North Island kōkako (*Callaeas wilsoni*; Threat Status: 'At Risk – Recovering') were released into the western part of the Parininihi area in winter 2017. The release site was approximately 4km to the west of Mt Messenger, and approximately 4.5km from the nearest parts of the Project footprint. Young kōkako typically do not disperse far from natal areas and the natural rate of spread of a populations from a source location is slow. This indicates that kōkako of Parininihi origin are unlikely to colonise the Project area for years, and possibly decades.
Invertebrates	• Invertebrate fauna that has been found in the area is 'typical' of communities inhabiting primary forests of the southern portion of the North Island. The forest habitat available to invertebrates is considered to be of high quality, with deep leaf litter layers, an abundance of dead wood and numerous potential plant hosts. • Two species of peripatus, *Peripatoides suteri* and *P. novaezealandiae* were found within the Project footprint. *P. suteri* is classified as 'Vulnerable' on the IUCN Red List of Threatened Species.

The ecological values present in the Project footprint and adjacent forested and wetland areas are high, although considerably diminished from their full potential because of the long term and largely unchecked impact of farm livestock and animal pests.

The Project will result in the combined loss of 31.277ha of indigenous dominant forest and secondary scrub vegetation, as well as the removal of up to 17 significant large trees, and 3.7km of freshwater habitat. This, combined with the diverse and high value nature of the ecology, means that the potential adverse ecological effects generated by the construction, operation and maintenance of the new road will also be high.

2.3 Summary of ecological effects

Potential adverse effects associated with the construction and operation of the Project will primarily occur through habitat loss associated with vegetation clearance, earthworks and stream culverting and diversions. The actual and potential adverse ecological effects associated with construction of the Project are described in detail in the AEE and supporting technical reports and summarised in Table 2.3 below.

Table 2.3 - Potential adverse ecological effects

Ecological aspect	Adverse construction effects
Terrestrial vegetation	• Loss of 31.277ha of indigenous dominant vegetation communities, including communities that are now rare, highly representative and of high ecological value. An additional 5.83ha of exotic rushland will also be lost. • Loss of up to 17 large significant trees, which provide significant habitat and resources for a range of other species. • Loss of plants classified as 'at risk – declining'. Potentially 25 individual plants of kohurangi (*Brachyglottis kirkii* var. *kirkii*), and small populations of two regionally distinctive species, swamp maire (*Syzygium maire*) and *Pittosporum kirkii*, will be lost. • Although unlikely, potential sedimentation may occur through the high value wetland and alluvial flood plain of the northern tributary of the Mimi Stream if control measures are overwhelmed during significant storm events.
Bats	• Loss of roosts and effects on roosting bats. • Loss of foraging habitat. • Habitat fragmentation, severance and isolation. • Impact of construction noise, vibration, light disturbance during night works, and operational lighting. • Mortality or injury on roads through vehicle strike.
Avifauna	• Direct removal or degradation of habitat used for nesting or foraging. • Direct mortality of nests and their contents. • Habitat fragmentation and isolation. • Construction noise disturbance. • Sediment runoff to wetlands and watercourses affecting the quality of wetland bird habitat.
Herpetofauna	• Habitat loss. • Habitat fragmentation.

Ecological aspect	Adverse construction effects
	• Vehicle strikes.
Freshwater	• 3.705km of stream length and 3,376m^2 of streambed area will be lost. • Sedimentation resulting from vegetation clearance and construction activity. • Direct removal of fish from streams. • Short-term loss of fish passage in some areas. • Short term loss of stream habitat where temporary culverts are used. • Contamination of water when in direct contact with wet concrete. • Water takes for the purpose of dust suppression.
Marine ecology	• The overall risk of potential adverse effects on marine ecological values arising from the release of sediment during construction ranges between low or no ecological effect depending on the habitat or species.
Terrestrial invertebrates	• Habitat loss and degradation. • Habitat fragmentation and isolation. • The creation of habitat edge effects. • Introduction of new exotic invertebrate taxa during construction. • Direct mortality of invertebrates (including peripatus) during vegetation clearance and earthworks.

2.4 Summary of landscape values

The landscape quality and capacity of the character sub-units directly impacted by the project to accommodate landscape change are summarised below (see Technical Report 8b Section 3.1.4).

Landscape **quality** was assessed taking into account the following matters:

- biophysical values such as the natural science values of landform, vegetation, waterways;
- perceptual values such as aesthetic quality, legibility (way-finding and orientation), distinctiveness and memorability;
- associative factors such as historical associations, recreational values, or values that tangata whenua and others might associate with a landscape.

The **highway absorption capability** is an appraisal of the likely degree of effects that would result from a highway of the type proposed taking into account such matters as:

- likely modification to natural landforms, waterways or vegetation;
- likely prominence, including density of dwellings, proximity to settlements, the ability to fit a road to the contours, potential screening by vegetation or topography; and
- likely extent of change to existing character – taking into account the landscape's complexity and existing degree of modification.

The Project is contained within Sub-Unit vii (the Mangapepeke Valley) in the north and crosses a small section of the wider Sub-unit ii – Upper Mimi Valley. The quality and

capacity of these units (as reported in the Multi-Criteria Analysis process) is described below.

Sub unit ii - Upper Mimi Bush Valley

- Very Steep Bush Hill country (includes DOC estate)
- Complex stream systems
- Sensitive Wetland / stream system (Mimi System and confluence)
- Includes existing SH3 corridor in the Northwest.
- Modified lowland valley
- SH3 roadway south of Mt Messenger
- High quality / Moderate to Low capacity for landscape change

Sub unit vii - Mangapepeke Bush Valley

- Well defined and visually contained bush valley
- Moderate ecological values
- Partially modified (grazed in the north) with an unmanaged 'scruffy' rural
- character partially in the valley floor
- Assumed cultural landscape values associated with land ownership
- Moderate quality / Moderate capacity to accommodate landscape change

In summary, the Project is predominantly within a contained valley system that has a moderate capacity to accommodate landscape change and crosses the north-western section of a higher quality landscape sub-unit (sub unit ii) in proximity to the existing SH3 corridor and the lesser quality lowland pastoral margins.

The landscape context of the wider Project area includes (see Technical Report 8b Section 3.1):

- the steep to very steep bush hill country from the coastal terraces south of the Tongaporutu River;
- south to the pastoral flats of the Mimi Valley;
- west to the coast and the Parininihi Cliffs; and
- east to the Mangaonga Road Corridor and the Mount Messenger Forest.

The wider Project area is set within an important cultural landscape. Ngāti Tama are acknowledged as mana whenua and the project traverses Ngāti Tama Treaty settlement lands which are located to the east and west of the existing SH3 alignment.

The combination of high ecological and cultural landscape values is reflected in the Regionally Significant Landscape notation of land to the west of Mount Messenger in the NPDP including notable features of the Parininihi Cliff and the Waipingao Catchment – home to the Parininihi Protection Project.

2.5 Summary of landscape effects

Potential adverse effects associated with the construction and operation of the Project will primarily occur through vegetation clearance, earthworks, stream culverting and diversions and the addition of structures into the landscape which have an impact on biophysical, perceptual and associative values. The actual and potential adverse landscape effects associated with construction of the Project are described in detail in the AEE and supporting technical reports and summarised in Table 2.4 below.

Table 2.4 – Potential adverse landscape effects

Landscape aspect	Adverse construction effects
Landscape and visual	• Introduction of a highway into two valleys that currently have a quiet, remote rural character – albeit exposed in places to the existing highway on the western flanking hills; • The introduction of additional built elements into the landscape including ancillary structures such as hydrant tanks and a tunnel control building; • Clearance of 31.277ha of indigenous vegetation and secondary scrub at the top of the valleys in particular; • Earthworks including batters cut into the side slopes of the valley in some cases up to approximately 60m; • Creation of permanent disposal areas; and • Crossing, filling and diversions of 3.7km of streams.

3 Ecological and landscape mitigation strategy and framework

This section summarises the general approach to the management of actual and potential ecological and landscape effects associated with the Project. The measures referred to in this section are set out in detail in the management plan chapters that follow.

3.1 General approach and guiding principles

The purpose of the Resource Management Act 1991 (RMA) is to promote the sustainable management of natural and physical resources, while avoiding, remedying, or mitigating adverse effects on the environment. International guidelines on the management of ecological effects, particularly those espoused by the Business and Biodiversity Offsets Programme (BBOP), promote a "mitigation hierarchy" or an "effects management hierarchy" that prioritises the sequence with which management of the effects should be approached:

AVOID ⇨ REMEDY ⇨ MITIGATE

The term *mitigate* in the RMA does not include "biodiversity offsetting" as the mitigation relates to the reduction of effects at or on the site where the effects were created. Instead offsetting provides new positive effects at another location (ideally close by). While recognising that the RMA is not a "no effects" statute, development of offsetting in the New Zealand context has led to an extended effects management hierarchy or order of priority:

AVOID ⇨ REMEDY ⇨ MITIGATE ⇨ OFFSET ⇨ COMPENSATE.

"Compensate" refers approaches such as cash payments towards achieving an environmental benefit, where mitigation and offsetting may not be possible.

This discussion is relevant to the management of ecological effects on the Project because, as is highlighted in sections below, it is not possible to avoid, remedy or fully mitigate the net residual ecological effects within the Project footprint. Significant ecological effects created by the construction and operation of the Project will need to be offset.

3.2 Avoidance and minimisation of effects

The nature and extent of potential effects of the Project on ecological and landscape values have been considerably reduced through the route selection and design refinement process.

A large number of route options were considered before the Project route was selected. The assessment of effects of the various options played an important part in route selection. The options assessment process has meant routes affecting Parininihi have been avoided.

Before and after the selection of the preferred route, significant alterations to the road design have occurred to minimise the likely effects. These include:

- Inclusion of an approximately 240m long tunnel through the ridge dividing the Mangapepeke and Mimi catchments. The tunnel has greatly reduced the size of the cut and fill area that would otherwise have been required and has preserved the important

east – west connectivity of habitat (ridge to coast) and mobile animal movement (especially bats).

- Incorporation of an approximately 120m long bridge across a tributary valley of the Mimi Stream on the south side of the route. This bridge sits very close to the ecologically significant wetland area and has significantly reduced the effects that a cut and fill approach would have had on the wetland.
- Incorporation of an approximately 25m long bridge across a tributary valley of the Mangapepeke Stream on the north side of the route at CH2400.
- Introduction of construction techniques to reduce effects. For example, the larger bridge has been designed in a way that will allow it to be constructed from each side rather than from the valley bottom. This will reduce the amount of ground and vegetation disturbance compared to a more conventional approach of building the bridge from the valley bottom, and it will also reduce the risk of sediment erosion down into the wetland.
- The smaller bridge has been added to the Project as it will provide higher certainty of ensuring appropriate fish passage for a wider range of flows.
- Minor adjustments to the route to minimise the need to remove significant trees. The number of significant trees potentially needing to be removed has been reduced from 22 to 17 by this means.
- Realignment of the road corridor, including shifting part of the corridor further from the ecologically significant wetland area.
- Location of construction yards, laydown areas, construction access tracks and haul roads away from sensitive/significant areas to minimise the extent of disturbance and vegetation clearance.
- Use of retaining walls to avoid loss of significant trees where possible.
- Location of spoil fill areas in areas likely to cause the least ecological effect.
- Implementation of vegetation removal, construction and sediment management best practices to minimise effects on adjoining vegetation, habitat and fauna.
- Physical delineation (such as fencing or flagging tape) will be used to clearly mark the extent of vegetation clearance to be undertaken, along with vegetation to be protected.
- Installation of an effective waste management system to minimise the chances of attracting pest mammals.
- Having ecologists on site to advise the construction teams and recover important vegetation and animals, when vegetation is being cleared.
- Management of light spill associated with construction lighting through careful consideration of the layout and arrangement of temporary lighting (including shrouding and spectrum limits to minimise impacts on adjacent ecological habitats).

3.3 Project footprint rehabilitation and restoration

Only a small amount of ecological mitigation can occur within the physical Project footprint. This is because mature indigenous forest that is the habitat of many indigenous animal

species will be removed to construct the road and this cannot immediately be replaced. Most of the effort required to generate a "no net loss of biodiversity" outcome will need to occur as offset on adjacent land and stream margins where existing conditions are more suited to assisted ecological recovery.

However, it is the intention to work with the natural landscape and restore ecological processes to the extent possible along the new road margins. As stated in the 'Landscape and Environment Design Framework' (LEDF) the landscape design and rehabilitation objectives for the Project footprint are based around four overarching landscape design principles:

- "Keeping low in the landscape" – thereby minimising physical landscape effects;
- "Letting the landscape speak" – a clean uncluttered highway where the surrounding landscape provides the scenic amenity;
- Recognising culture – which means appropriately recognising human relationship to the land, including continuing the partnership with Ngāti Tama through the detail design process to express their mana whenua and kaitiakitanga; and
- Connecting 'Landscape' and 'Ecology' – responding to and reflecting natural elements, patterns and processes through design.

The ecological objective for the site rehabilitation work is to repair some ecosystem processes on altered landscapes, however the trajectory and endpoint may well be different from any previous state because of the works required to create the road.

Rehabilitation work is required to the altered and modified areas of the proposed alignment, such as fill and cut slopes, vegetated swales, stream diversions, temporary works areas and stockpile sites. Specific objectives that support the aim of 'rehabilitation' are:

- to support natural regeneration and succession to native shrubland and eventually forest, and
- to minimise medium-term maintenance.

The rehabilitation strategy (Chapter 4 of the ELMP) aims to work with the natural landscape, taking opportunities to harness and speed up natural processes, including the use of salvaged material including woody debris, organic matter and topsoil, to better the chance of successfully rehabilitating areas affected by the works.

3.4 Mitigation of effects

Mitigation of effects will occur within and along the margins of the Project footprint. This will occur through the application of a number of management approaches designed to reduce the severity of effects, reduce the likelihood of prolonged effects, and to neutralise effects by recreating replacement habitat as quickly as possible. Mitigation measures (detailed in later chapters in the ELMP) include:

- implementation of the modified bat vegetation removal protocol to minimise the likelihood of bats being harmed when trees are felled;

- the relocation of peripatus in their woody habitat (stumps and logs) from the footprint to the neighbouring forest which will be subject to ongoing pest management;
- search, capture and relocation of herpetofauna from the Project footprint;
- construction of the herpetofauna habitat/release site;
- construction of kiwi protection fencing at locations along the footprint margin to reduce the risk of kiwi mortality due to road kill); and
- replanting within the Project footprint, wherever soil conditions and hydrology remain essentially the same as prior to construction, with early successional plant species similar to or the same as those removed. It is expected that these areas of mitigation planting will resemble what is removed in a matter of a few years.

There will not be enough areas suitable for mitigation planting within the Project footprint to achieve no net loss of vegetation values, so additional mitigation planting areas will be established on land adjacent to the footprint that currently has a cover of pasture or low quality scrub. The aim with this will be to recreate areas of native vegetation that are of no less ecological or landscape value than the areas cleared, and in many cases, considerably better. Where planting conditions allow, mid and later successional native plant species will be mixed in with the early successional species. This will promote a more speedy transition to a forest state than would otherwise occur.

3.5 Offsetting of residual ecological effects

The objective of the ecological offsetting work is to restore a range of ecosystem processes (and therefore ecosystem function and landscape values) that have been degraded by human activity and the presence of animal pests and livestock by:

- intensive multi-species pest management in perpetuity (or until such time as pest management in the form we know of it today is no longer necessary to sustain the levels of biodiversity created);
- the re-establishment of swamp forest and wetland habitat to areas that were once swamp forest and wetland and which retain the environmental conditions suitable for re-establishment; and
- the restoration of stream habitat by pest and stock exclusion and riparian planting.

In summary, the proposed approach is to “kick start” natural processes in an environment that has enough of its original components to be restored to a state close to what it might have been previously. The stated target for the mitigation and offset package (and therefore the ecological restoration) is to achieve no net loss in biodiversity 10 years following the completion of road construction and a net gain from 15 years.

3.5.1 Pest management in perpetuity

The pest management proposed has a multispecies focus (rats, possums, mustelids, cats, goats and pigs) with the intention to hold all species to low densities in perpetuity sufficient to allow the permanent recovery of many indigenous plant and animal communities.

Based on evidence from other locations, particularly the adjacent Parininihi, the proposed pest management programme can be expected to generate biodiversity benefits for a wide range of plants and animal species. Plant biomass and diversity will increase as grazing and browsing pressure is reduced, the diversity and abundance of more palatable species will increase as seedling survival improves, and the health of old emergent forest giants especially rata and totara will improve as their foliage rebounds in the absence of possums in particular.

As forest and vegetation health improves in the low-pest environment, the carrying capacity within the Pest Management Area (PMA) for many indigenous animal species will increase substantially. This will result in spill over benefits for surrounding areas as juvenile birds and bats disperse. Because the pest management is proposed in perpetuity (or until such time as pest management in the form we know of it today is no longer necessary to sustain the levels of biodiversity created) the ecological and landscape benefits throughout the region should be permanent.

3.5.2 Swamp forest restoration planting

The intention of the restoration planting is to transform those grass-, rush- and sedge-dominated areas that are suitable for planting swamp forest into stands of kahikatea, pukatea and swamp maire, with small areas of rimu and matai where ground conditions are not as saturated.

While transition to a diverse mature swamp forest will take many decades, the ecological value will begin to improve immediately because of the removal of livestock and the management of pests. Ultimately the upper Mangapepeke valley will transform into a diverse, high value swamp/wetland ecosystem.

3.5.3 Riparian fencing and planting

Stream buffer plantings will consist of a mix of indigenous riparian margin sedges, shrubs and trees. The primary objective will be to provide shade and organic matter to the stream channel to improve the quality of habitat for native fish and invertebrates. A reduction of sediment and nutrient loads entering the streams, compared to the current situation, will also be achieved by fencing and planting, especially along the stream sections that pass unfenced through farmland.

Where the swamp forest restoration planting and stream restoration planting areas can coincide, the net ecological and landscape benefit will be substantial and considerably greater than if the swamp forest and riparian forest restoration plantings were undertaken in fragmented fashion. The result will be the conversion of these valleys back to fully-forested and connected swamp and riparian forest and the elimination of forest edge.

3.5.4 Effects not directly accounted for by the Biodiversity Offsets Accounting Model

The offsetting proposed to address the ecological effects has been developed using the Biodiversity Offsets Accounting Model. [2]

The Model requires certainty of data, to allow for net loss and then net gain to be calculated.

The achievement of no net loss and then net gain will be measureable for vegetation, stream habitat, and many bird species. However, research suggests that measurement of no net loss for long tailed bats, lizards, and invertebrates may not be possible (refer to the monitoring section in Chapter 9 of this ELMP). This is not necessarily because the proposed measures will not result in a beneficial effect, but because the monitoring methods available are not necessarily able to detect it.

Part of the reason for this is that, despite extensive monitoring effort, we have not been able to gain a definitive understanding of the nature and size of the populations of these animals, which have low levels of detectability (lizards), species complexity (invertebrates) or are highly mobile within large ranges (bats). With limited data to feed into the Biodiversity Offsets Accounting Model[3] the model cannot generate an appropriate offset for those animals. The offset derived from the application of the Model has not directly accounted for effects on these values.

The residual effects of this Project that have not been accounted for by the Biodiversity Offsets Accounting Model have been addressed by the provision of additional ecological restoration effort. The size and nature of the additional efforts has been based on the best available science and the professional opinions of fauna experts, and is considered to be more than sufficient to generate net biodiversity gain from 15 years following construction.

The additional ecological measures proposed include:

- Additional 3,420ha of pest management in perpetuity (over and above the 230ha required as calculated through the use of the Model, for a total of 3,650ha)
- The planting of 200 seedlings of the same species for every significant tree that will be removed within the Project footprint (3400 seedlings in total if 17 trees are removed)
- The construction of a predator-proof fence and pest eradication (including mice) of an area of known significance for herpetofauna (e.g., a known striped skink population) outside the Project footprint, which is to be used as a relocation / mitigation site.

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[2] Maseyk, F., Maron, M., Seaton, R. and Dutson, G. 2015. A biodiversity offsets accounting model for New Zealand. March 2015. The Catalyst Group 1-67.

[3] Maseyk, F., Maron, M., Seaton, R. and Dutson, G. 2015. A biodiversity offsets accounting model for New Zealand. March 2015. The Catalyst Group 1-67.

4 Landscape and Vegetation Management Plan

4.1 Introduction

This chapter outlines the management processes required to avoid, remedy, mitigate and offset adverse effects on vegetation, habitat and landscape values as a result of the Project, including:

- avoiding adverse effects on flora, associated species and habitat on the margins of the project footprint;
- habitat restoration;
- like for like mitigation;
- ecological offsetting to address residual habitat loss; and
- rehabilitation planting and plant establishment to address landscape and visual effects; provide amenity and screening and as part of measures proposed to control stormwater; and to provide for cultural expression and recognition, in conjunction with Ngāti Tama.

It also includes information about the use of materials for cultural purposes such as harvesting timber, and forest resources for restoration and site rehabilitation purposes.

4.2 Baseline vegetation ecology survey results

All information pertaining to vegetation, biodiversity offsetting and mitigation in the Project footprint is included in the following reports:

- Technical Report 7a – Vegetation (December 2017)
- Ecology Supplementary Report – Vegetation (February 2018)
- Technical Report 7h – Mitigation and Offset (December 2017) and Appendix A – Biodiversity Offset Calculations (December 2017)
- Ecology Supplementary Report – Mitigation and Offset (February 2018) and Appendix A Ecology Supplementary Report – Biodiversity Offset Calculations (February 2018)

Technical Reports 7a – Vegetation and 7h – Mitigation and Offset were finalised in December 2017 for lodgement as part of the AEE and include information regarding field surveys undertaken from January to August 2017. Additional field work was subsequently undertaken to address knowledge gaps, specifically within private land in the Mangapepeke Valley. The results are described in the Ecology Supplementary Report – Vegetation and Ecology Supplementary Report – Mitigation and Offset.

Vegetation loss has been assessed at 31.277ha of indigenous dominant forest and secondary scrub vegetation loss. This area includes the permanent road corridor, the additional works area (AWA) and an additional 5m buffer to account for edge effects. The additional works area includes a 5 – 20m margin either side of the road footprint and all

access roads and other temporary work areas associated with construction. Where habitat of high ecological value adjoins the road footprint, the margin of vegetation clearance is 5m, while 20m has been allowed in areas of lower ecological value. The additional loss of 5m for edge effects has been included to account for loss or modification during and following completion of the project. It is likely that overall vegetation loss at the completion of the project will be less than estimated.

4.3 Landscape and Environmental Design Framework

The Landscape and Environmental Design Framework (December 2017) (LEDF) sets out the landscape and environmental design elements for the Project. The approvals version of the LEDF was lodged with the resource consent application in December 2017 (Technical Report 8b) but the LEDF is intended as a 'living' document. The LEDF will inform the development of detailed design and construction methods so that the Project's temporary and permanent works are integrated into the surrounding landscape and topography, having regard to the local landscape character and context. The design of the LEDF has included input from the project ecologist integrating ecological design and restoration elements.

4.4 Measures during construction to avoid and minimise adverse effects on vegetation and the habitat of associate species

A range of measures will be undertaken to avoid and minimise adverse effects on vegetation and habitat of associate species. These include:

- Specifically avoiding damage to adjoining vegetation in high value vegetation areas;
- Removal and relocation of forest resources; and
- Mulching and storage of wood and soil material.

4.4.1 High value vegetation areas

High value vegetation areas adjoining the Project footprint were identified during the design process. In these areas the margin of vegetation clearance within the Additional Works Area (AWA) is typically 5m wide. These areas are shown in Figures 4.1 & 4.2 and in the Ecology Constraints Map (Appendix A to the ELMP). In these areas, the edge of both the road footprint and the AWA will be physically delineated prior to vegetation removal. Within the AWA, vegetation clearance will be minimised to ensure a vegetation buffer remains as large as practicable and clearance does not trespass into high value ecological areas.

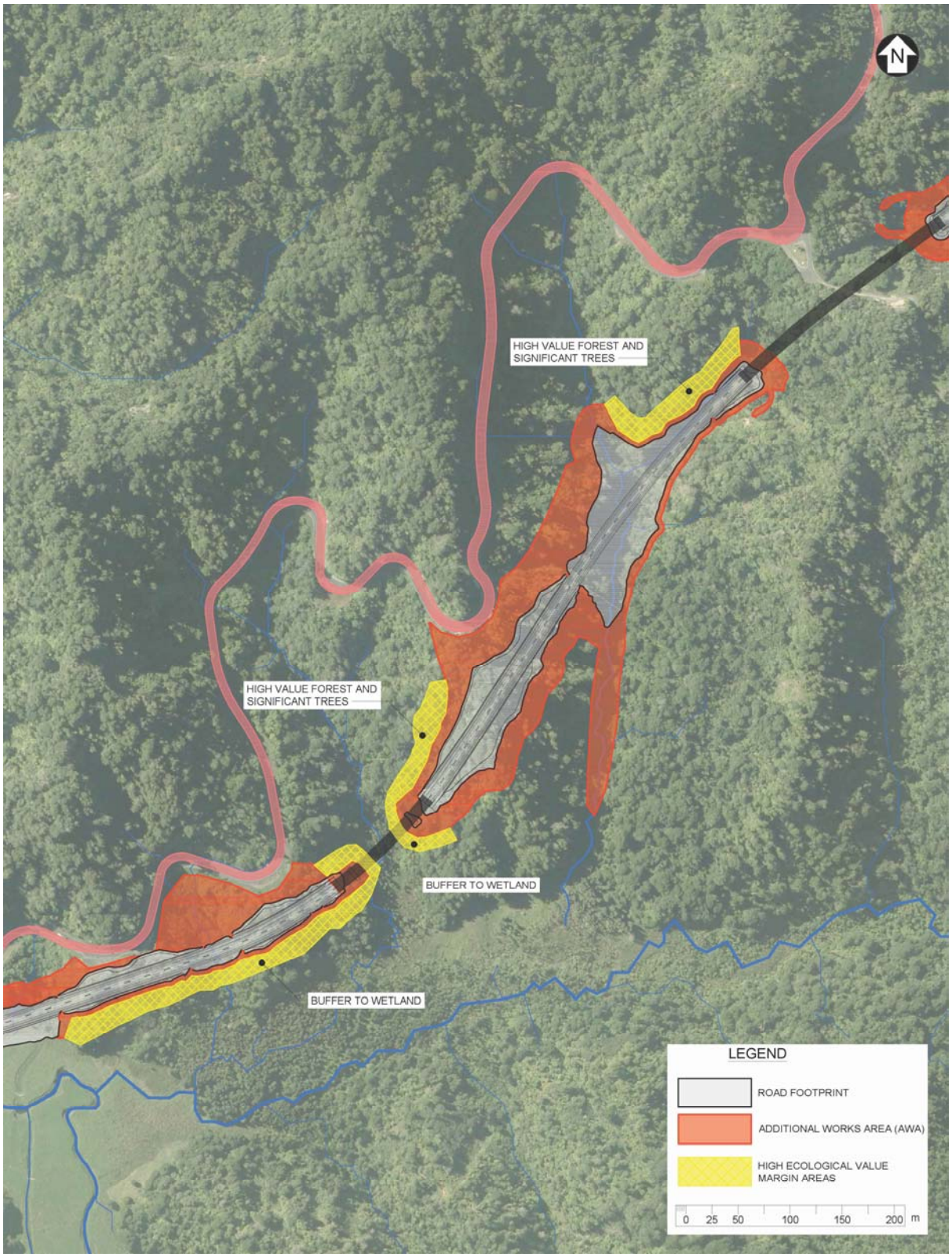

Figure 4.1 - Margin areas of high ecological value in the Mimi Catchment

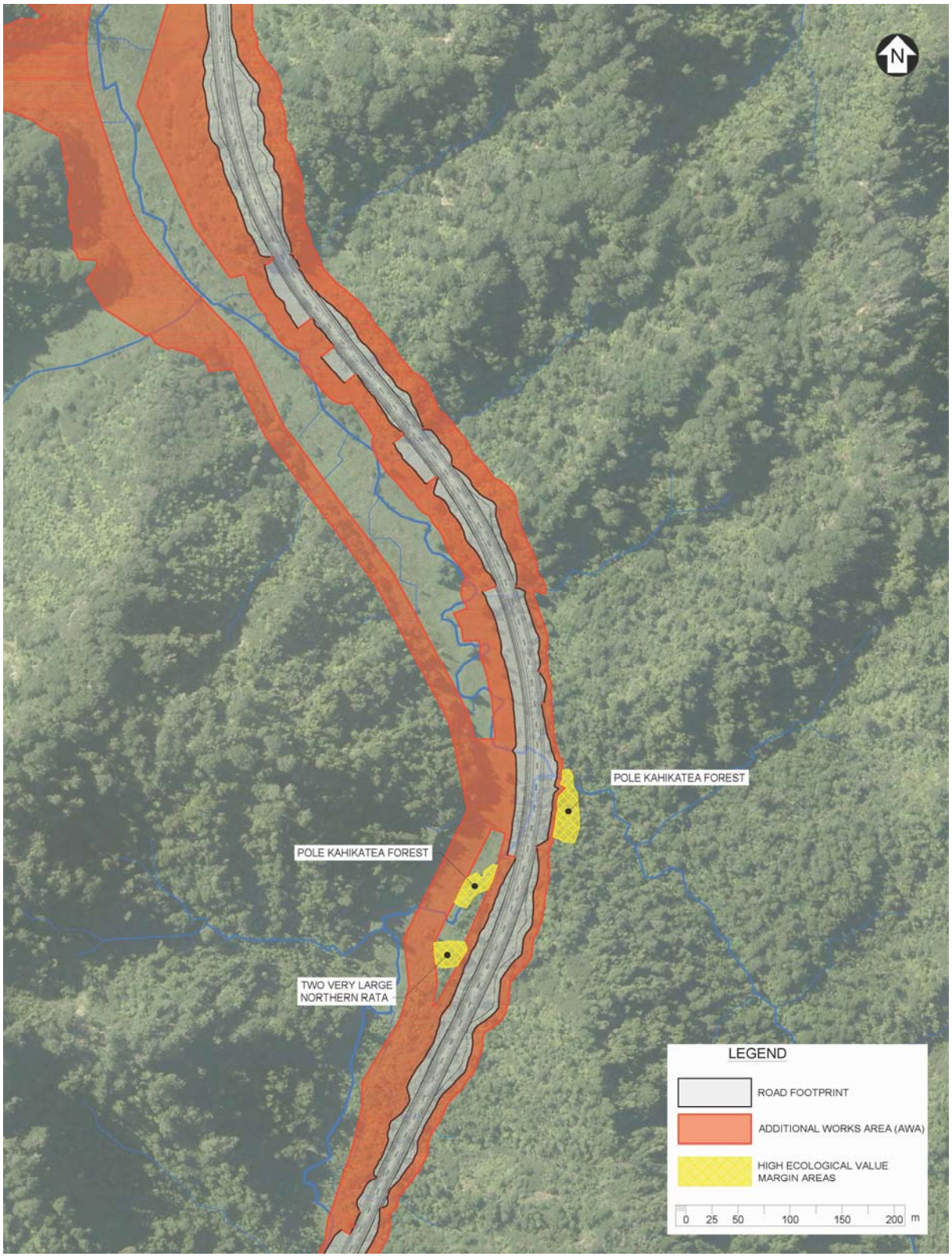

Figure 4.2 – Margin areas of high ecological value in the Mangapepeke Catchment

4.4.2 Further design improvements avoiding the loss of high value vegetation

There is also intent to further reduce impacts on vegetation identified in the supplementary ecology report – vegetation which was produced after the lodging the consent drawings. Vegetation identified to avoid includes; two small areas of kahikatea on private land of approximately 0.2ha in the lower Mangapepeke Valley (Figures 4.3), and one very tall rimu tree (NZTM: E1738504; N5693361) south of the tunnel in the Mimi Catchment. These may require site specific assessment, surveying and may require bespoke design methods, such as a gabion basket to locate fill away from the large rimu's roots.

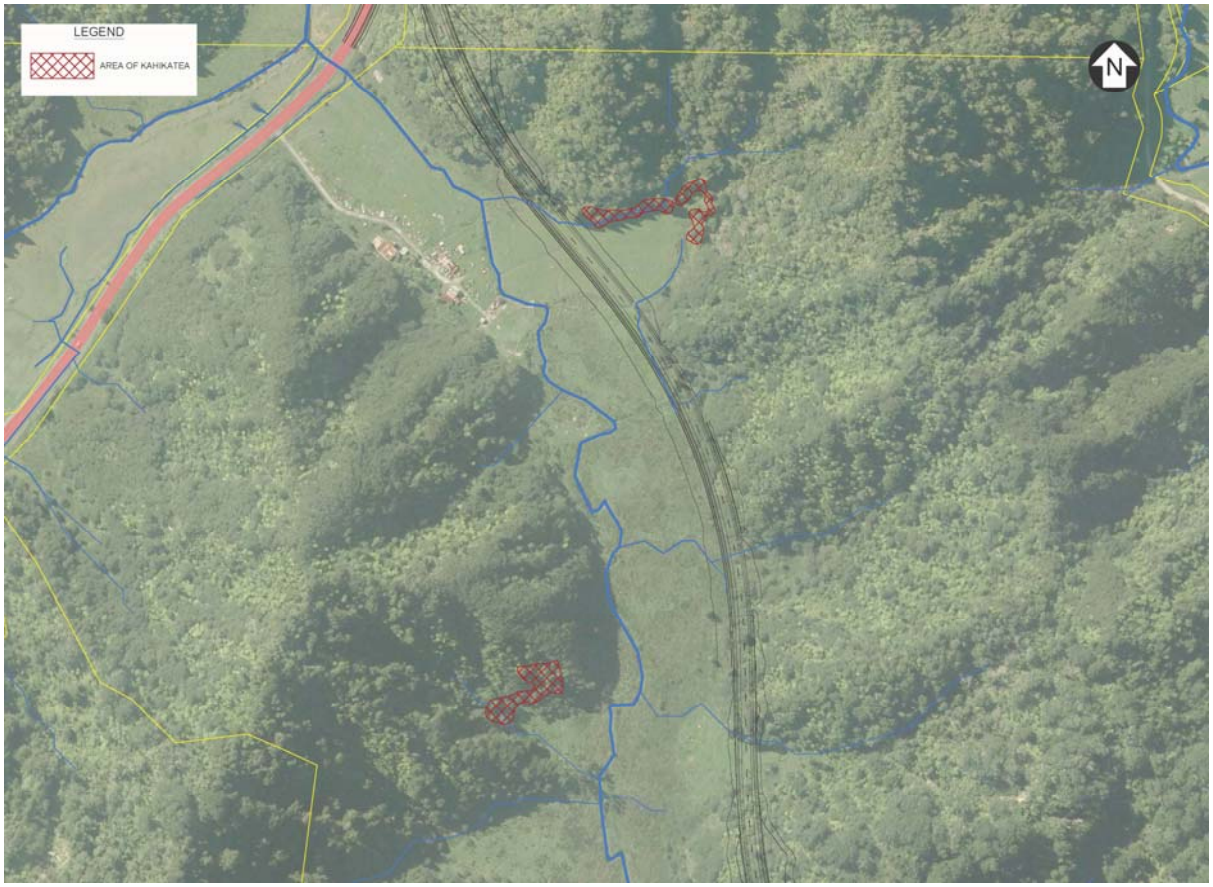

Figure 4.3 Areas of kahikatea in the lower Mangapepeke Valley

4.4.3 Removal and relocation of forest resources and threatened, regionally distinctive plants and hosts of other threatened species

Fallen trees are ecologically important to forest regeneration processes and as habitat for a wide range of species. Fallen wood provides habitat for decomposers including invertebrates, fungi and bacteria and sites for plant regeneration. Of significance is the presence of the velvet worm (*Peripatoides suteri*) a species regarded as "Vulnerable" on the IUCN Red List of Threatened Species. Fallen trees also provide habitat for lizards and kiwi regularly nest beneath them. They are also very important as habitat for plant regeneration, including regeneration of kamahi which is locally an important canopy dominant.

For these reasons it is desirable to leave large fallen logs and as much cut vegetation as possible within the works area until it can be relocated to suitable sites outside of the Project footprint where avoidance of vegetation damage is possible. As construction will take place over several years, regeneration will likely have naturally initiated in these locations during this time.

For practical reasons, however, most vegetation will need to be mulched and removed and used either for sediment/ erosion control during construction or used along with site-won topsoil for site rehabilitation and ecological restoration purposes. Some whole vegetation, such as tree ferns, will also be used for sediment control as required. Procedures to avoid impacts to lizards, birds, bats and fish during the vegetation clearance process are included in Chapters 5, 6, 7 and 8, such as removal or fish and lizards before vegetation clearance.

Where suitable sites exist, large fallen and decaying logs and a proportion of cleared vegetation will be left in-situ adjoining the road footprint. Suitable sites occupying approximately >0.6ha occur within and adjoining the AWA in the Mangapepeke Valley, down slope of the road footprint. Elsewhere suitable smaller sites include open clearings dominated by pasture and rushland, canopy gaps within forest areas and beneath tall forest where sparse understory vegetation exists. Within the works area, suitable areas for placement of vegetation will be physically delineated prior to vegetation clearance occurring.

Vegetation left in-situ should be placed into small and compact windrows within defined areas. Windrows should not be placed in locations where material could move and enter the Mangapepeke Stream or within any of the smaller streams. In forest areas smaller volumes of material can be placed with minimal damage to existing sub-canopy and ground cover vegetation. Larger logs (of greater than 50cm diameter or more than 5m long) will likely need to be cut into manageable sections.

Priority plant material for leaving in-situ includes:

- Large (>50cm diameter) fallen (rotting) logs — these are habitat for invertebrates such as the threatened velvet worm (*Peripatoides suteri*) and lizards;
- The heads of large trees (>50cm diameter) typically covered in epiphytes — these tree heads will be habitat for invertebrates and potentially lizards; and
- Large tree trunks (>50cm diameter), especially any which are partially rotten and contain cavities. These should be cut up into manageable portions (3-5m sections).

It is expected that where vegetation is left in-situ rapid natural regeneration will occur. If required planting of suitable species will also occur within gaps and on margins to hasten regeneration.

The Project footprint contains a small number of the *At Risk* plant kohurangi (*Brachyglottis kirkii* var.*kirkii*) and two regional distinctive plants, *Pittosporum cornifolium* and swamp maire (*Syzygium maire*). Both kohurangi and *P. cornifolium* are small epiphytic shrubs that grow in the tops of large trees such as rimu and matai, and are known to occur on at least three significant trees in the Mangapepeke Valley.

Cultivation of these two epiphytic shrub species will be attempted by collecting cuttings, seed or potentially whole plants (if practicable) from fallen host trees. Cultivation methods

for these species, in order to reintroduce them back into suitable habitat, are relatively new and therefore success has not been measured. For these reasons a small number (up to 30 for each species) will be trialled on dead ponga which will likely be introduced to a suitable location within restoration areas. Kohurangi also grows on fallen logs, stumps and cliff edges in herbivore free habitat and all of these locations will be considered for relocation. Swamp maire will be propagated from local sources and planted especially within valley floor swamp forest sites.

Gahnia (*Gahnia pauciflora and G. setifolia*) is ideally suited to dry and exposed sites such as the top of cuttings. Plants known or found within the Project footprint will be harvested, cultivated and returned to suitable restoration sites. Harvesting *Gahnia* and threatened plants known or found within the Project footprint will be a responsibility of the onsite ecologist.

4.4.4 Setting aside wood for stream restoration

Large wood is an important component of natural stream channels, providing habitat and food for insects, koura, fish and birds. In low gradient streams with fine sediment substrate, large wood is an important stable microhabitat. Large wood is usually defined as >100mm diameter and >1m long, however larger pieces with more complexity provide for better stability and habitat.

During the process of vegetation removal some large wood will be stockpiled for use in stream restoration including: root wads and hole tree tops and cover a range of sizes in diameter classes of 150-300mm, 300-600mm and >600mm. Some lengths should be long, i.e. about 6m. The number of logs required in each size class shall be finalised as part of the detailed design. It will allow for 1 to 5 pieces of wood per 20m of stream length as described in the Stream Ecological Design Principles (chapter 7 of the LDEF).

The harvest of wood for in stream work should focus on denser woods such as tawa, maire, hinau, and kamahi. Additionally, large manuka and kanuka will be harvested to secure wood to stream beds (sized about 100-200mm diameter, and >1.2m long).

4.4.5 Mulching and storage of wood and soil

Vegetation which is not left in-situ will be mulched on-site using a mulching head on a large excavator. This process will result in mulch being distributed across the Project Area. With the forest duff and top soil layers this will all be harvested together and stored in windrows for site rehabilitation and selected ecological restoration use, such as replacement mitigation areas. Larger trees not able to be mulched on-site will be felled and removed, with some being used for stream habitat restoration or sediment and erosion control purposes.

Mulching trees can potentially result in mulch entering small streams, causing smothering of stream habitat, and deoxygenation as green leaf and woody material decomposers. This ultimately could cause stream invertebrates and fish life to die downstream. To avoid this occurring, mulching needs to be undertaken in a manner that prevents mulch entering small streams. Where practicable, this will involve manually chipping in to the back of a truck,

removing any vegetation that falls within 10–20m of a stream and mulching this at a suitable location. See Ecology Constraints Map (Appendix A to the ELMP).

Mulched wood and soil will be removed from the Project footprint and placed into stockpiles. In this process the focus should only be on removing the A (organic) and B (organic stained subsoil) soil horizons. Care will be needed to minimise the incorporation of subsoil and parent material (papa mudstone) layers when this process is undertaken.

Invasive weeds are likely to grow on soil stock piles, especially species which are currently known from the Project footprint such as African clubmoss, tradescantia, wild ginger and gorse. Wind dispersed species such as pampas grass will also likely rapidly colonise. As the intention is to utilise soil stock within rehabilitation sites and selected ecological restoration areas, weed surveillance and control will occur at six-monthly intervals in spring and autumn. Any weeds found will immediately be controlled to zero-density using appropriate methods.

4.5 Cultural use of significant trees

The Project Area will likely result in the loss of up to 17 significant trees, including 11 rimu, two totara, and one tree each of hinau, matai, miro and pukatea. Ngāti Tama has expressed a desire to use some of the best timber for cultural use. Of these trees the matai and at least two rimu have heart rot and would be unsuitable for milling. Other rimu trees may also be similarly affected with heart rot given their large size.

Harvesting and milling of native timber is administered by the Ministry of Primary Industries (MPI). As vegetation removal is for public works and will be undertaken by consent, the appropriate process to utilise any timber is to obtain a milling statement under the Forests Act 1949. The application for a milling statement is fairly straight forward and requires information about landownership, tree species, location, volume, proof of entitlement and preferably photos of each tree.

Application for a milling statement should occur once resource consent has been granted and prior to vegetation removal. All trees suitable for cultural use will be visited and assessed for heart rot, volume and permanently marked for this purpose — providing the basis of the milling statement. Additional milling statements may be applied for additional millable trees, if identified during vegetation clearance.

Any tree chosen for cultural use will need to be felled in such a way as to minimise damage to vegetation margins, the tree itself and also to enable extraction. Trees felled for timber will also need to be transported promptly to a suitable approved mill, to avoid sap stain rot developing and the timber becoming spoiled.

4.6 Proposed measures to offset and mitigate residual adverse effects on vegetation and the habitat of associate species

A range of measures will be undertaken to mitigate and offset the residual adverse effects on vegetation and the habitat of associate species. These include:

- Offset restoration of 6ha of kahikatea dominant forest (referred to as kahikatea/swamp forest restoration and Type 4 in the LEDF)
- Offset riparian planting of a length of 8.455km of stream habitat (which equates to approx. 16.91ha of terrestrial riparian margin)
- "Replacement mitigation planting" mitigation planting of 9ha (referred to as Type 3 in the LEDF)
- Establishment of an integrated Pest Management Area (PMA) over 3,650ha of native forest.
- Planting of 3400 seedlings as replacement plants for the (up to) 17 significant trees that will be felled (see section 4.5 above)

Additionally, rehabilitation of site works will occur on modified landscapes (12.9ha) resulting in a total area of planting associated with all aspects of the Project of approximately 44ha.

All rehabilitation and restoration areas used will require the Transport Agency to acquire the necessary rights to implement the rehabilitation and restoration programme. Details about the management of all of these, excluding the pest management, can be found in sections below. The establishment and management of a PMA is addressed specifically in chapter 9.

4.6.1 Propagation material

All native plants produced for rehabilitation and mitigation and offset planting (ecological restoration) must be grown from propagation material sourced from naturally occurring plants in the North Taranaki Ecological District. This is to ensure that propagation material used for rehabilitation and restorative planting and plant establishment is genetically suitable for the local environment.

Where possible, plants should be grown from seed. For those species that are not easily propagated from seed, production of plants from cuttings or wildlings (naturally occurring seedlings) is acceptable where the wildings will otherwise be destroyed as the road is built. For site rehabilitation, and particularly where there are steep slopes and planting is not practicable, other measures will be used to encourage plant establishment, through assisted and natural regeneration.

4.6.2 Kahikatea dominant swamp forest restoration

Technical Report 7a – Vegetation (December 2017) states that 2.63ha of valley floor vegetation communities will be lost, of which 1.325ha is dominated by kahikatea. Intensive, multi-species pest management will offset the loss of associate species within much of these communities; however, this method is regarded as being insufficient to offset for the loss of kahikatea trees.

6ha of valley floor kahikatea forest restoration planting is proposed to fully offset the loss of the kahikatea component affected by the Project. Increasing the area of this forest type by planting, when supported by pest management in perpetuity, will improve the likelihood of swamp forest species and kahikatea forest expanding naturally back into suitable habitat in the wider Project area.

4.6.2.1 Potential kahikatea / swamp forest restoration planting locations

There are several suitable potential sites for the establishment of new kahikatea and swamp forest. Since most of the potential sites are also preferred locations for stream and riparian restoration, the areas given below, as available for kahikatea / swamp forest restoration, are after deduction of the area required for stream restoration.

1. Mangapepeke Valley

The Mangapepeke Valley is considered to be the best location for kahikatea / swamp forest restoration because the kahikatea and swamp forest plantings can be linked to the riparian margin plantings to create a fully reforested valley, generating a substantial additional net biodiversity benefit. It is also the area closest to the vegetation removed by the Project so delivers on the best practice principle of proximity.

The required 6ha of area suitable for kahikatea / swamp forest restoration exists along the Mangapepeke Stream valley within Ngāti Tama land and the Pascoe property (determined by ground survey in December 2017; Figures 4.4 and 4.5).

The Mangapepeke Valley is a mosaic of:

- Small permanently water logged areas which are not suitable for kahikatea or swamp forest tree planting. These areas will be planted with native sedges and rushes that are tolerant of being planted into permanently water logged or water covered soils.
- Intermittently wet areas which are ideal for kahikatea / swamp forest tree and wetland shrub planting.
- Imperfectly drained areas, which may be periodically flooded and are ideally suitable for planting with wetland margin species including kahikatea. The most suitable of these areas will be used to make up the full 6ha valley floor / swamp forest restoration planting requirements; the rest will be planted as part of the 8.38ha of replacement mitigation planting.

Areas that remain permanently saturated are not suitable for the establishment of swamp forest because nursery-raised seedlings of most swamp and wetland species are not tolerant of being planted in open water. Only some wetland sedge, rush and reed species will survive open water planting.

Upper Mimi Valley

There are additional areas adjacent to the Project Footprint that are suitable for kahikatea / swamp forest restoration planting if all or some of the Mangapepeke Valley is not available (property negotiations are yet to be concluded).

Adjoining kahikatea forest in the proposed offset site in the Mimi Stream, 2.3ha of land suitable for kahikatea / swamp forest restoration exists within Mt Messenger Conservation Area (outside the designation; Figure 4.6). As this area adjoins existing kahikatea forest area immediately upstream, it would expand the extent of this remnant and be colonised by associate species, some not found in the Mangapepeke Valley.

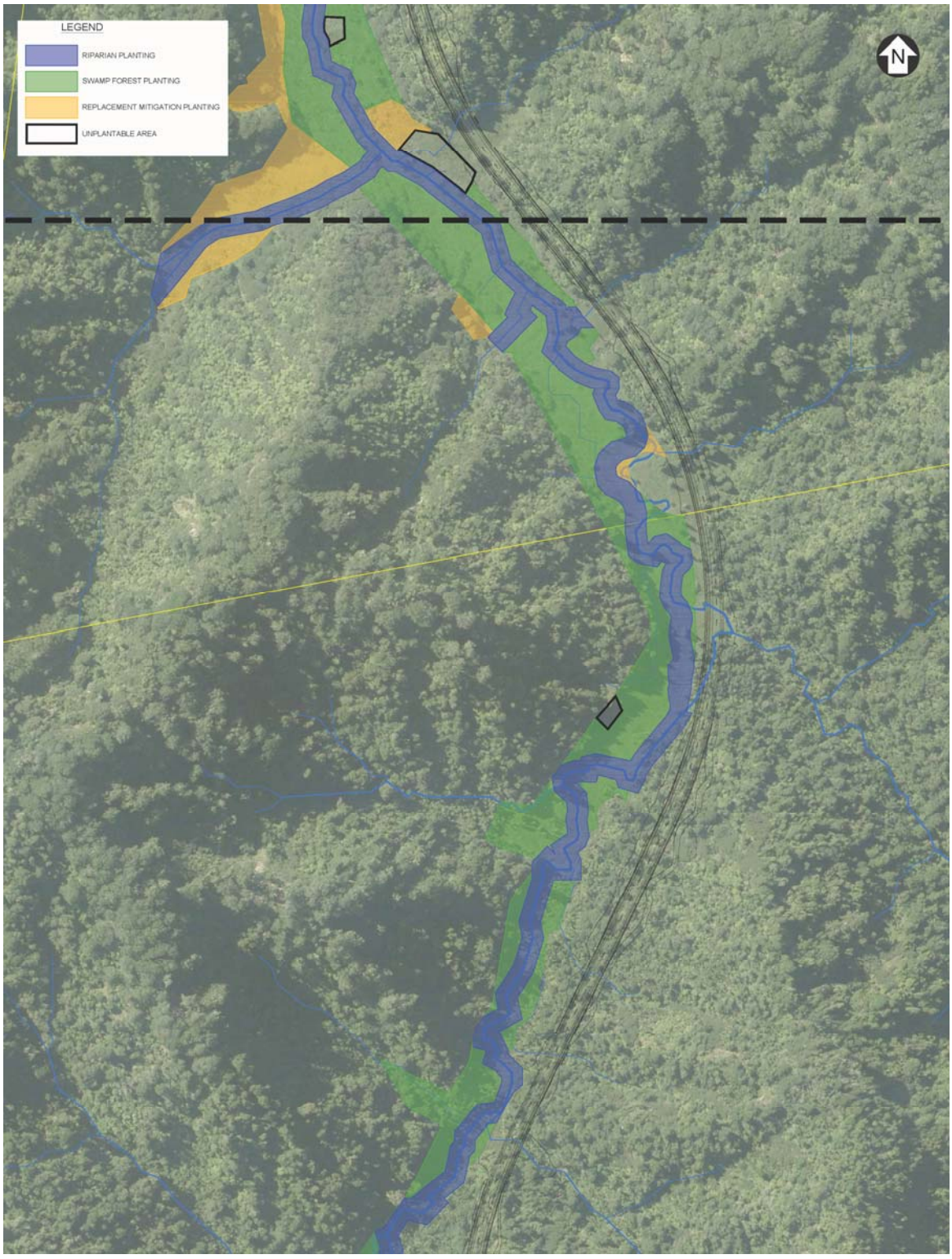

Figure 4.4 – Upper section of the eastern branch of the Mangapepeke Stream showing areas suitable for kahikatea / swamp forest or wetland planting (green colour), or mitigation replacement planting (beige). Sections of the stream and its tributaries that are suitable for riparian restoration are marked in blue. Black encircled areas are permanently water covered and are unplantable. Figures 4.4 and 4.5 join at the black dotted line.

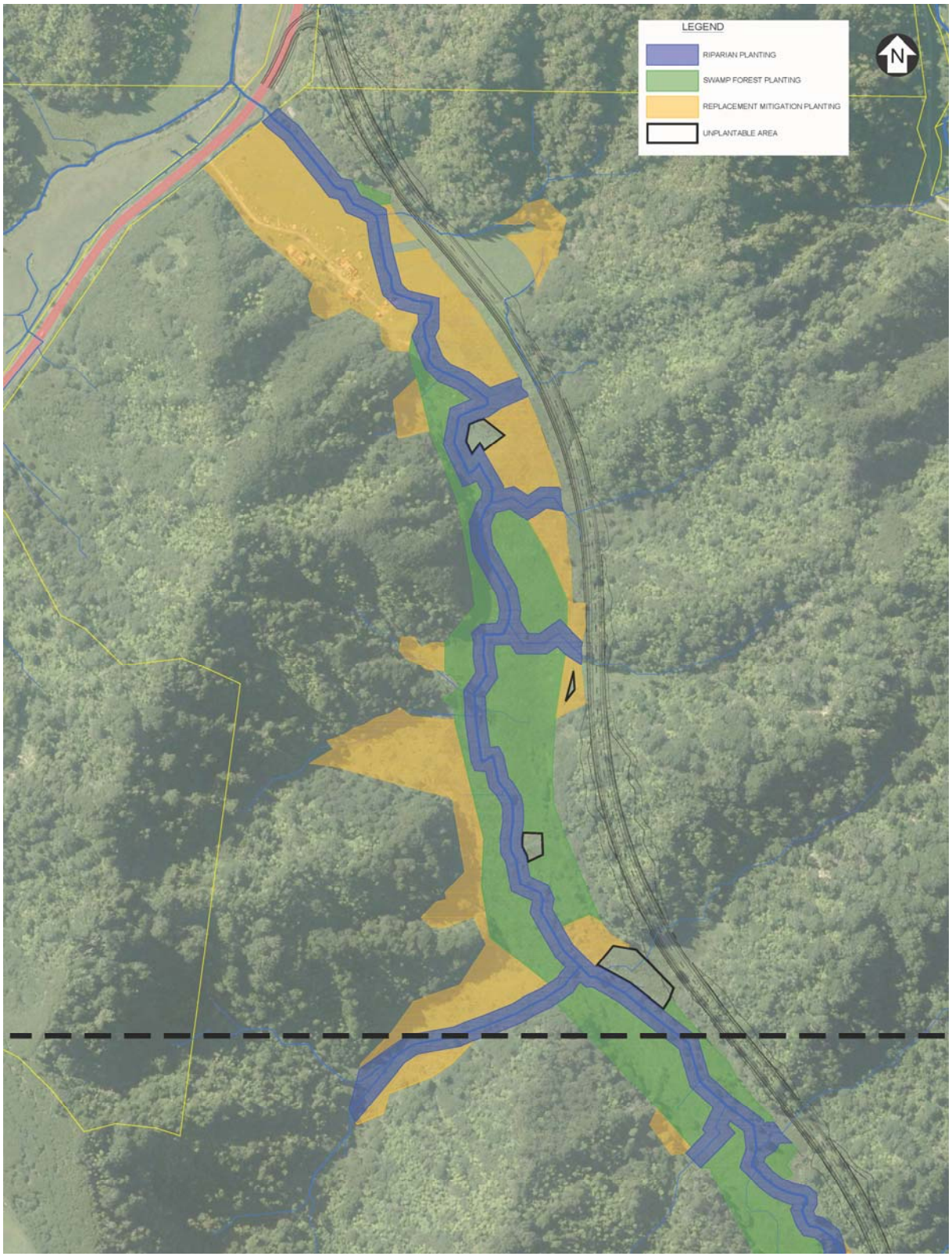

Figure 4.5 – Lower section of the eastern branch of the Mangapepeke Stream showing areas suitable for kahikatea / swamp forest or wetland planting (green colour), or mitigation replacement planting (beige). Sections of the stream and its tributaries that are suitable for riparian restoration are marked in blue. Black encircled areas are permanently water covered and are unplantable. Figures 4.4 and 4.5 join at the black dotted line.

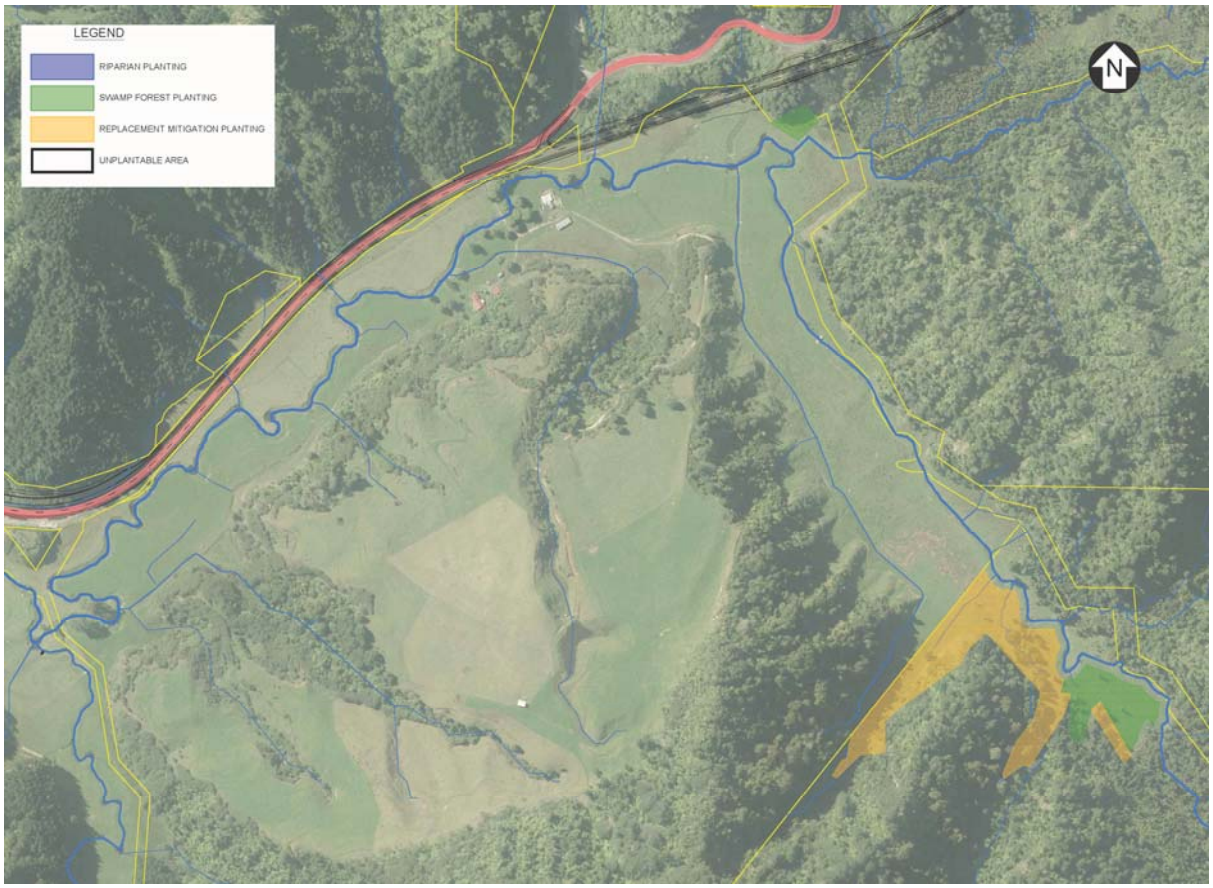

Figure 4.6 – Upper tributary and main branch of the Mimi Stream showing areas suitable for kahikatea / swamp forest or wetland planting (green colour), or mitigation replacement planting (beige). Sections of the stream and its tributaries that are suitable for riparian restoration are marked in blue. Black encircled areas are permanently water covered and are unplantable.

3. Other potential kahikatea / swamp forest planting sites

Other wet valley floor areas that would once have been swamp or kahikatea forest and are potentially suitable for kahikatea / swamp forest restoration exist in the surrounding landscape, on public conservation land and private property. While these areas are somewhat removed from the Project site and are less favoured than the Mangapepeke and upper Mimi valley sites, it is likely that 6ha of suitable planting sites could be found if required.

4.6.2.2 Nature of the kahikatea / swamp forest restoration and likely outcomes

The intention of the restoration planting will be to transform grass, rush and sedgeland dominated areas that are suitable for kahikatea, pukatea and swamp maire, with small areas of rimu and matai where ground conditions are not as saturated. Initial planting in the more exposed zones will need to consist of hardy, early successional species including manuka, hukihuki, ramarama, houhere, putaputaweta, kaikomako, wineberry, koromiko, karamu, toetoe and whaririki. Whaririki has specifically been chosen because this is growing on the

margin of the upper Mimi Stream and harakeke or swamp flax is absent. The tree species can be inter-planted once the initial shrub and small tree layer is established.

While transition to a diverse mature swamp forest will take many decades, the ecological value will begin to improve immediately because of the removal of livestock and the management of pests and weeds. Ultimately the valley will transform into a diverse, high value valley floor kahikatea, pukatea, swamp maire forest, with small areas of hukihuki/ carex sedge-shrublands in the small permanently saturated areas. The biodiversity offset targets for all valley floor planting are to obtain a near complete cover of indigenous species across the valley (including riparian areas) by year six (target 80% canopy cover) and to have kahikatea contribute 65% of the forest canopy by year 35.

4.6.2.3 Kahikatea / swamp forest plant and planting specifications

The design and management of the swamp forest restoration will need to be supervised by an appropriately qualified restoration ecologist or landscape architect who has an understanding of the ecological requirements of kahikatea and other species involved, including their tolerance of flooding, and a good knowledge of the environmental conditions prevalent in the Mt Messenger area. Details of the planting zones, the specific plant mixes for each zone, the planting prescription (including species-specific planting spacings), and pre- and post-planting maintenance treatment will be contained in the swamp forest design specifications. Conceptually, the objective of the planting will be to restore ecologically appropriate vegetation communities across the valley floor (Figure 4.7).

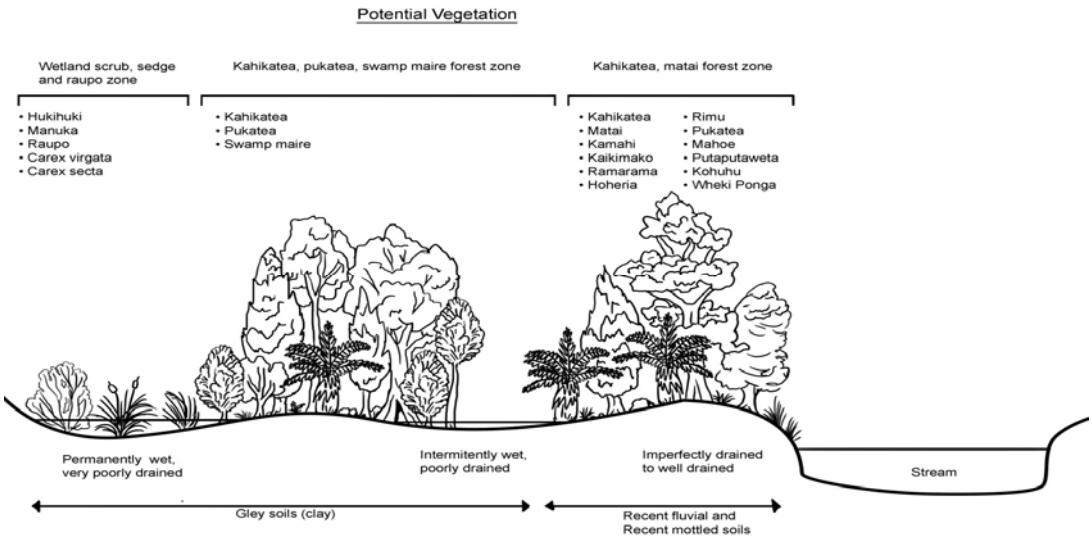

Figure 4.7 - Vegetation communities proposed to be restored (based on communities present in the north branch of the Mimi Stream)

The Mangapepeke and upper Mimi valleys are a mosaic of zones with different and variable soil moisture conditions. Growing conditions vary considerably over small distances and plant species selections will need to be altered accordingly to ensure plant tolerances are matched to site conditions to achieve high plant survival. Some initial small scale planting trials will be undertaken, especially in the wettest zones, to ensure the species selected are tolerant of the site conditions through 12 months of the year.

Planting zones will be physically marked out with stakes immediately prior to planting to delineate the highly variable nature of the valley floor areas where the swamp forest (and other plant communities) will be planted. This will be undertaken under instruction from the supervising ecologist or landscape architect.

The following management approach will apply to the swamp forest restoration planting:

Pest and livestock management

- Prior to planting, all livestock will be removed from planting sites and goat and pig numbers reduced to low levels in and around the planting areas and surrounding habitat (refer to Chapter 9 – Pest Management). See Section 4.6.2.4 below for details.

Plant specifications

- All plant material will be eco-sourced as prescribed in Section 4.6.1.
- Trees and shrubs grown for the kahikatea / swamp forest restoration planting will be grown to sizes that are larger / taller than is typical for new road revegetation planting. Upright growing species will stand at least 50cm above the planter bag or pot to be suitable for planting. This is because the majority of the kahikatea / swamp forest plants will be planted in amongst existing vegetation (mostly rushes and sedges) and will need this height to avoid being overgrown.
- All plants will be:
    - grown to specification;
    - well grown with well-formed root systems that fill the growing container but that are not root bound, and with well-formed foliage above ground; and
    - well-hardened before delivery to the planting site.
- All plants will be inspected at the supply nursery prior to delivery and any not meeting specifications will be rejected.

Planting requirements

- The full swamp forest planting area will have the planting zones pegged prior to the commencement of planting. Four main planting zones will be pegged:

i. Zone 1: Areas that are permanently covered in water or have saturated and sticky clay soils (gley soils) and have a dominance (>50%) of indigenous plants such as *Carex virgata* and *Juncus edgariae*. No planting is required in these zones.

ii. Zone 2: Areas that are permanently covered in water or have saturated sticky clay soils (gley soils) and are dominated (>50%) by exotic plant species. The species chosen will be tolerant of being planted in shallow open water areas. Only sedge and

rush species known to survive in shallow water will be planted into areas covered in water, to a maximum depth of 30cm.

iii. Zone 3: Areas that are in transitional zones which are intermittently wet (but not covered in water for prolonged periods). These areas will be planted in swamp / wetland shrub and early successional species, with a gradient of wetland shrubs close to the wettest edge. Where planting conditions are suitable (ie. sheltered from wind and frost) swamp forest tree species including swamp maire, pukatea and kahikatea will be inter-planted with the other species. In more exposed sites, tree species will be inter-planted amongst the hardier species, such as manuka, between years three and five, following the initial planting. No tree species will be planted into open water (because they would die). If areas within this zone are saturated, planting will be delayed until dry.

iv. Zone 4: Imperfectly drained with recent silty and mottled fluvial soils will be planted valley floor podocarp forest species. In areas sheltered from wind and hard frost, tree and later successional species including kahikatea, kaikomako, occasional matai and rimu, cabbage tree and ramarama will be inter-planted with the hardier shrubs; otherwise, they will be inter-planted three to five years following the initial planting when some shelter has developed.

Any areas with moderately well drained soils (i.e. lower soil moisture) will instead be used for "replacement mitigation" planting. Planting of most significant tree species will be focused in these areas. If excessive failure of plant establishment occurs for hydrological reasons such as excessive flooding, species more suited to the conditions will be planted.

Spacings of plantings

- Plant spacings will vary across the different planting zones and depending on the amount of native vegetation already present. However, for areas planted in trees and shrubs, the aim will be for plants not to be further apart than 2m, and in sedge and rushland areas plants should not be further apart than 1.5m. In some zones canopy tree species may be spaced out through the planting at 4 to 6m spacings with shrubs in between, whereas kahikatea may be planted in small discrete groves where the trees are only 1.5m apart, such as on imperfectly drained soils.
- The detail of plant spacings will be prescribed in the swamp forest design specifications.

Planting site weed management and releasing

- All invasive weed species and those likely to compete with the newly planted natives will be controlled to zero-density with herbicide or mechanically removed prior to planting. Herbicides that are likely to be harmful to adjacent existing native plant species, or those that contain a residual factor that may be harmful to natives, will not be used. Mechanical removal of weed species will occur if it is unsafe to use herbicides.
- See also Section 4.6.2.6 for weed management requirements in the wider area.
- All planted seedlings will be released from weed competition for six years following planting. Dead plants will be replaced (blanking) annually throughout the six year period.

- While some of the releasing may be achieved by the application of herbicide some zones may require mechanical releasing because of the intolerance of many native wetland rush, sedge and reed species to chemical herbicide exposure. It may also be necessary to trim sedges and faster growing native shrubs to promote the growth of slower growing shrub and canopy tree species.

Timing of planting

- The period suitable for kahikatea / swamp forest planting is narrow and will vary from year to year depending on the wetness of the winter and spring seasons, because of the variable hydrology and soil moisture conditions in the Mangapepeke and Mimi valleys. Almost all nursery raised native plant species (with the exception of some rushes, sedges and reeds) will not survive planting into open water. As they grow they will become increasingly tolerant of prolonged saturated conditions, particularly once they are established and have developed good root systems, pneumatophore 'air roots' and mycorrhizal associations. Consequently, the swamp forest area will be planted in the narrow window when the soil moisture conditions are no longer fully saturated or water covered and before ground conditions become too dry and hard. In 2017, the ideal planting time was in the last week of October and the first week in November but this is likely to vary from year to year.

Site biosecurity

- A comprehensive biosecurity plan for the Project (refer to Chapter 11) has been produced to minimise the risk of myrtle rust spread and to reduce the likelihood of importation of other problematic pest animals, weeds and diseases to the Project and offset sites. All aspects of the Biosecurity Plan will be adhered to by everyone involved in the Project.

4.6.2.4 Livestock and ungulate pest animal exclusion

All farm livestock (cattle, horses, sheep and domestic pigs) must be permanently removed from the planting site – that is, the Mangapepeke Valley – before planting can commence. Cattle and horses currently have access along the full length of the Mangapepeke valley.

The removal of cattle from the valley floor areas too long in advance of planting may create weed and plant competition problems, as invasive weed species will rapidly occupy open grass areas when grazing pressure is removed. Ideally, as much of the kahikatea / swamp forest planting as possible should be undertaken immediately after cattle removal. The construction programme may, however, prevent this from occurring in which case a concerted and regular weed management programme will need to be undertaken from the time cattle are removed until all planting is concluded.

Control of feral goats and pigs within the Project footprint and offset planting areas (as part of the goat and pig management programme for the whole PMA will need to begin well before the commencement of any planting to minimise goat damage, especially to new seedlings. Goat numbers are currently at a high density in the forested sections of the Mangapepeke and Mimi valleys (reportedly similar densities to 20 'kills' /man-day[4]). Goat

[4] Paul Pripp pers. comm. (via Richard Nichol).

densities in the vicinity of the planting area will be reduced to <5 kills / man-day before planting is recommended. The medium and long term target for goats over the PMA is 1 kill / man-day or less.

Where goat and pig reinvasion from unmanaged adjacent land is a risk, boundary fences may need to have appendages added that will stop or reduce the rate of reinvasion. Details of the fence appendage requirements to exclude goats can be found in Chapter 9: Pest Management.

4.6.2.5 Small mammal pest and pukeko management

Possums and rats are unlikely to cause any major damage to newly planted seedlings and both will be substantially reduced in numbers when the pest management programme commences. For this reason, these pests will not cause a significant problem to the kahikatea / swamp forest restoration programme.

Pukeko, while currently not particularly abundant in either the Mangapepeke or upper Mimi valleys, can occasionally be problematic when new plantings occur in wetland and wet margin areas. They have the habit of pulling out small seedlings and large pukeko populations can extract many hundreds of seedlings over a few days if given the opportunity. This is only likely to be a problem in wetland planting areas where smaller grade plants will be used. Pukeko are game birds so can be hunted during the game season to reduce this pressure if it arises.

4.6.2.6 Pre-planting weed management

Weed management will commence within the proposed swamp forest planting areas as soon as the land is made available to the Project, and will extend to all adjacent parts of the Mangapepeke and upper Mimi catchments (if the latter is included in the planting area). Invasive weed management of biosecurity threats such as wild ginger and pampas is additional to this and is described in Chapter 11. Invasive weed species currently present, and if not appropriately managed, will pose a significant threat to the success of these plantings.

The objective of this wider weed management effort is to prevent the establishment of any problematic or invasive weed species up until the commencement of kahikatea / swamp forest planting. Once planting starts within the planting area, the releasing and maintenance programme will keep any weeds that establish to very low levels.

4.6.2.7 Kahikatea / swamp forest restoration performance measures

The performance targets for the kahikatea / swamp forest restoration plantings are:

i. 80% canopy cover six years following planting in the zones where trees and shrubs are planted
ii. Kahikatea forming 65% of the tree canopy (ie. 65% of the area where trees are planted, excluding those areas where trees are not planted) by year 35
iii. 90% of the full diversity of species planted remain in the planted areas six years following planting

iv. The absence of any significant exotic weed infestations

v. No livestock are present in the kahikatea / swamp forest areas and mammalian pests are held to low densities causing minimal damage to swamp forest flora and fauna.

4.6.3 Replacement mitigation planting

The Mitigation and Offset Report (December 2017) and subsequent Supplementary report (February 2018) recommends one-for-one replacement mitigation planting for all early successional indigenous dominant vegetation that will be lost or affected by the Project. This planting is mitigation, not offset, because the species composition, age and habitat value of this vegetation can be replicated or even improved reasonably quickly.

The area required for this planting, as stated in the Supplementary Mitigation and Offset Report (February 2018), is 9ha.

4.6.3.1 Potential replacement mitigation planting locations

There will be two distinct types of replacement mitigation planting:

1. Replacement planting along the margins of the Project footprint that have retained the same or similar soil characteristics with respect to topsoil and hydrology to those pre-construction
2. New planting areas beyond the Project footprint that are suitable for the establishment of early successional species similar to those removed from the Project footprint.

Project footprint margins

The sites along the Project footprint margins that are suitable for mitigation planting will not be known until road construction is well advanced and the impact of construction can be assessed. The area available for replacement planting along the road margins is likely to be only a small proportion of the 9ha required in total.

New replacement mitigation planting areas

Most of the mitigation planting will need to occur on new sites. Ideally, to magnify the ecological benefits, this planting will occur on land adjoining the new road margins and the kahikatea / swamp forest and riparian restoration areas. For this reason, the lower Mangapepeke Valley (Figure 4.5) is the preferred mitigation planting location. The valley area between the proposed kahikatea / swamp forest restoration zones and the existing SH3 is sufficient area for all of the mitigation planting to be accommodated (after road margin replacement planting is undertaken) and should result in the Mangapepeke Valley floor being fully planted.

Several potential alternative replacement mitigation planting sites exist within 2 or 3km of the Project footprint if the Mangapepeke Valley is not available, although none are physically connected to the footprint. A combination of any of these sites would be appropriate if required.

4.6.3.2 Nature of the replacement mitigation planting and likely outcomes

5.467ha of predominantly indigenous vegetation that will be removed or disturbed by the Project will not be offset by pest management or kahikatea / swamp forest restoration planting. This vegetation consists of early successional plant material including manuka-treefern scrub, manuka scrub, treefern scrub and manuka succession vegetation and will be mitigated for by one-for-one replacement planting.

In addition, 5.826ha of exotic rushland will be mitigated for by replacement planting at a ratio of 0.5ha replacement planting for every hectare removed. Although comprised of almost entirely exotic species, 50% replacement planting is considered appropriate because the exotic rushland vegetation has some value as habitat, especially for wetland birds.

The aim of the replacement mitigation planting is to plant species equivalent to those lost and, where possible, interplant with the next stage of successional species (i.e. those that would be expected to next arrive in time naturally). In other words, the objective is to speed up the successional process where growing conditions are suitable. The long-term aim is to set these newly planted areas on a course to becoming indigenous dominant forest, except where permanently saturated ground conditions exist, which are more suitable for non-forest sedge and rush wetland habitat.

Planting conditions are likely to consist of open pasture, low quality pasture / rushland mosaic, exotic, mixed native wetland margins, and within open remnant manuka stands. The species selected for planting will match the growing conditions.

4.6.3.3 Replacement mitigation planting specifications

Details of the site-specific planting zones, plant mixes for each zone, planting prescription (including species specific planting spacings), and pre- and post-planting maintenance treatment will be contained in the replacement mitigation planting design specifications.

The replacement mitigation planting will include the following aspects:

<u>Pest and livestock management</u>

- Prior to planting, all livestock will be removed from planting sites and goat and pig numbers reduced to low levels in and around the planting areas and surrounding habitat (refer to Chapter 9 – Pest Management). See Section 4.6.2.4 below for details.

<u>Plant specifications</u>

- All plant material will be eco-sourced as prescribed in Section 4.6.1.
- Standard revegetation grade plants (grown in 1 and 2 litre containers) will be suitable for the replacement mitigation planting areas.
- All plants will be:
    - grown to specification;
    - well grown with well-formed root systems that fill the growing container but that are not root bound;
    - no shorter than 30cm above the growing container (for upright plants); and
    - well-hardened before delivery to the planting site.

- All plants will be inspected at the supply nursery prior to delivery and any not meeting specifications, including biosecurity requirements (Chapter 11), will be rejected.

Planting requirements

- The Replacement mitigation planting zones will be physically pegged out prior to planting by an appropriately experienced ecologist or landscape architect.
- The species mixes for each planting zone will be as specified in the replacement mitigation planting design specifications. Zones will be determined by soil conditions, wetness and exposure to wind and frost.
- Manuka will form the basis of much of the replacement mitigation planting because it is the early successional species that will be removed from the Project footprint in greatest quantities. The spread of myrtle rust may influence this, though it is preferable to plant manuka which has a level of natural resistance, than not plant it entirely. A mix of additional coloniser and early successional native plant species will be selected to match the growing conditions of each planting zone.
- Hardier canopy and sub-canopy tree species will be inter-planted in more sheltered sites. These species will include totara (thin-barked/Hall's totara), rewarewa, white maire, pigeonwood, hinau, kamahi, tanekaha (in the drier soils), pokaka, northern rata, kahikatea and rimu. Species will be matched to zones with appropriate growing conditions.
- Plant spacings for areas planted in trees and shrubs will be at 1.5m. In some zones canopy tree species may be spaced out through the planting at 4 to 6m spacings with shrubs in between.

Planting site weed management and releasing

- All invasive weed species and those likely to compete with the newly planted natives will be killed with herbicide or mechanically removed prior to planting. Herbicides likely to be harmful to adjacent existing native plant species, or those that contain a residual factor that may be harmful to natives, will not be used. Mechanical removal of weed species will occur if it is unsafe to use herbicides.
- See also Section 4.6.2.6 for weed management requirements in the wider area.
- All planted seedlings will be released from weed competition for five years following planting. Dead plants will be replaced (blanking) annually throughout the five-year period.

Timing of planting

- Late spring (late September to late October) is the preferred season for the replacement mitigation planting in areas exposed to winter flooding (e.g. the lower Mangapapeke valley) or likely to experience hard winter frosts. Autumn planting will also be possible on drier, elevated sites not prone to hard frosts.

Site biosecurity

- A comprehensive biosecurity management plan for the Project (refer to Chapter 11) has been produced to minimise the risk of myrtle rust spread and to reduce the likelihood of importation of other problematic pest animals, weeds and diseases to the

Project and offset sites. All aspects of the biosecurity management plan will be adhered to by everyone involved.

Planting zone marking

- An appropriately experienced restoration ecologist or landscape architect will determine and mark out the planting zones for the replacement mitigation planting sites.

4.6.3.4 Livestock and ungulate pest animal exclusion

Refer to Section 4.6.2.4 for details on livestock and ungulate management.

4.6.3.5 Small mammal pest and pukeko management

Refer to Section 4.6.2.5 for information about small pest management.

4.6.3.6 Replacement mitigation planting performance measures

The performance targets for the replacement mitigation planting are:

i. 80% indigenous plant cover at six years following planting;
ii. 90% of the full diversity of species planted remain in the planted areas six years following planting;
iii. very low significant exotic weed infestations with most invasive species managed to zero-density; and
iv. livestock are excluded from the replacement mitigation areas and mammalian pests are held to sufficiently low densities to allow seedlings to flourish.

4.6.4 Riparian offset restoration planting

The waterways that will be affected by the Project have been assessed in the Freshwater Ecology Technical Report using the Stream Ecological Valuation (SEV) calculator. Technical Report 7b – Freshwater Ecology (December 2017) assessed that 3361 square metres of stream surface area of variable ecological value will be adversely affected by the construction and operation of the Project. The SEV model has calculated that restoration (fencing and planting) of 8,153 square metres of stream will be necessary to offset those impacts. This equates to approximately 8,455 lineal metres of stream length (generally the streams affected have an average width of just under 1m). This equates to approx. 16.91ha of terrestrial riparian margin required.

4.6.4.1 Potential stream restoration planting locations

As is the case for all biodiversity offsetting, it is best practice to undertake stream restoration efforts close to the affected area and in similar environmental conditions. Suitable stream restoration sites exist in the areas adjacent to and near the Project but all will require landowner approval to be used.

The following areas, in descending order of preference, are considered suitable sites for stream-riparian restoration:

- 2600m length of the Mangapepeke Stream that passes through pasture and exotic rushland on Ngāti Tama land (1000m) and the Pascoe property (1600m).

- Up to 800m of tributary streams that flow into the Mangapepeke Stream, mostly on the Pascoe property, that are currently in pasture or sedges/rushes.
- Approximately 1000m of the eastern branch of the Mimi Stream on DOC land and on the Thomson property down to where the branch of the stream meets SH3.
- Up to 3500m of the Mimi Stream, through multiple properties (Thomson, Anglesey and Scott), as it flows south parallel to SH3.
- Up to 2100m of main channel along the western branch of the Mangapepeke Stream on the Washer and Pascoe properties, an additional 1400m along the western secondary channel (assuming it is practical to fence and plant both this and the main channel), and a further 2700m of tributaries flowing into both channels from the bush.

All riparian restoration areas used will require the Transport Agency to acquire the necessary rights to implement the restoration programme.

4.6.4.2 Nature of the stream restoration and likely outcomes

Stream restoration work will consist of planting a 10m buffer (on average) on each side of the channel and fencing of the stream and buffer plantings from livestock. None of the streams under consideration are currently fenced.

Stream buffer plantings will consist of a mix of indigenous riparian margin sedges, shrubs and trees. The primary objective will be to provide shade and organic matter to the stream channel to improve the quality of habitat for native fish and invertebrates. A reduction of sediment and nutrient loads entering the streams will also be achieved by fencing and planting, especially along the stream sections that pass unfenced through farmland.

With the necessary rights to implement the restoration programme, swamp forest restoration planting and stream restoration planted in adjoining areas will provide greater ecological outcomes than either in isolation. Potential sites where this could likely occur include along the Mangapepeke Stream valley (through Ngāti Tama and Pascoe land) and the eastern branch of the Mimi Stream valley (through Thomson land and immediately adjacent to public conservation land). The net ecological benefit will be substantial and will result in the restoration of entire valley floors, connecting swamp and riparian forest with hill-slope forest and the elimination of forest edge.

Not all of the 8.455km of stream length required for riparian retirement will lie adjacent to kahikatea / swamp forest or replacement mitigation planting. Where this is the case the objective will be to attempt to secure those riparian areas closest to the Project footprint, and contiguous sections of stream that link to existing headwater bush areas. This will, in turn, provide the greatest ecological benefit for aquatic life, especially for whitebait fish species that struggle to move between isolated shaded stream sections when water temperature exceeds 22 to 23 degrees in mid-summer.

4.6.4.3 Individual property Riparian Fencing and Planting Plans

The proposed stream restoration works will be designed and managed by an appropriately qualified and experienced ecologist or landscape architect who also has considerable practical experience in restoring waterways in challenging natural conditions.

The required 8.455km of stream length in proximity to the Project needed to meet the offset requirement for effects on stream ecology will, predominantly, need to involve multiple properties of private farmland. In most cases, landowners will be providing their land voluntarily with the retired riparian area remaining part of the property but protected by way of an enduring encumbrance attached to the land title.

On many of the farms, the streams meander through relatively narrow pasture-covered flood plains. To facilitate continued ease of operation of each farm, or conversely, to prevent the creation of significant stock and vehicular access problems, detailed site-specific design of each fence line and planting area needs to be undertaken with each property owner and/or farm manager. This detailed design will include stock crossings (ie. culverts) where these are necessary; narrowing of the margin between fence and stream where this needs to occur to allow continued vehicle and stock access; provision for water passage out into secondary flood channels and back into the main stream to prevent accentuated flooding during heavy rain events; and widening of the riparian margin in places (eg oxbows) to facilitate stock movement.

The details of the fence lines, planting areas, site preparation activities (including willow removal or retention and existing weed removal), plant species mixes, post-planting maintenance programme and a programme and schedule of works will be included in separate Riparian Fencing and Planting Plans for each property. Each property owner will have the opportunity to review the plan and propose changes where farming or domestic activities are compromised. The final approved property plan will then form part of a legal agreement between the Transport Agency and the property owner.

In some sections of stream it will be necessary to reduce riparian widths to less than 10 metres to accommodate farm operational requirements. Where this occurs, the restoration ecologist designing the riparian planting areas and writing the plan will endeavour to create effective riparian habitat (shade and habitat) on the opposite side of the stream to create favourable instream conditions. Where effective stream shading cannot be achieved, and fences need to be close to the stream edge, that section of stream will not be counted as part of the 8.455km offset requirement.

Elsewhere there will be opportunities to fence and plant riparian margins that are wider than 10m (eg. on the inside bends of stream meanders or to join other vegetation fragments). The restoration ecologist will propose widened riparian areas where appropriate with the aim overall to achieve an average 10m of riparian width along all 8.455km of restored stream length.

4.6.4.4 Plant specifications

Species mixes

Two main plant mixes will be used for most of the riparian planting.

Sedges (*Carex* spp.) and rushes will be planted on steeper erosion prone and flood prone river banks and in secondary flood channels. These monocots are tolerant of periodic immersion in flood waters and sediment deposits and do not greatly restrict flood flows, unlike woody species.

Riparian shrubs and small trees along with whararikiki flax and toetoe will be planted on the upper river banks and terraces where they can provide good shade to the water column but are less likely to constrain flood flows.

In wider planting areas (such as oxbows) a greater diversity of tree species will be included (such as kahikatea and Hall's totara).

All species used will need to be tolerant of frosts and wet conditions in winter and dry, and of hot and windy conditions in summer.

Plant grades

Plant grades will vary from plants in 1 litre pots to 3 litre pots, depending on the species and competition from existing vegetation.

Timing of fencing and planting

Spring (September to November) will be the period when most planting is undertaken but the timing of planting of the riparian areas will depend to a large extent on soil wetness and stream flows.

Within the range of suitable planting months, the property owner will determine when he/she would like the fencing and planting done and the decision about timing will be governed by farming activities, especially calving. The determination of suitable fence stripping, fence construction and planting times will be undertaken by agreement between the landowner and the Alliance restoration ecologist leading the riparian offset works.

Supervision of planting

An ecologist, landscape architect or professional experienced in riparian restoration and fencing and with knowledge of farming systems and farm requirements will oversee all riparian works on private properties and will liaise on a day to day basis with each affected landowner.

4.6.4.5 Livestock and ungulate pest animal exclusion

All riparian areas adjoining farmland will be permanently fenced with 7- or 8-wire post and batten fencing to exclude all stock.

Where feral goats are likely to be a persistent problem (especially distant from the PMA) changes to fence design to reduce goat passage will be necessary (eg. box stays and an electric hot wire).

4.6.4.6 Small mammal pest and pukeko management

While possums and rats are not likely to cause damage to new plantings, pukeko may pull new plantings especially in damp pasture areas. Larger grade plants (2 and 3 litre containers) will be used where this is determined to be a likely problem.

4.6.4.7 Pre and post-planting site preparation

Where vegetation has established, spot spraying with approved herbicide will be required at least one month before planting. The spot spraying shall be 50% of the planting spacings ie

1m planting centres equals 0.5m spot spray; 0.75m planting centres equals 0.375m spot spray. Where desirable natives have naturally established, these shall be retained and released, clearing them of competing vegetation.

The riparian planting sites will require releasing from weed competition and periodic blanking to replace plants that have died, over at least six years following planting.

Most of the releasing will be done with the application of herbicide although some zones, especially those where existing native sedge and rush vegetation occurs, may require mechanical releasing because of the intolerance of many native wetland rush, sedge and reed species to exposure to chemical herbicides.

4.6.4.8 Riparian restoration offset planting performance measures

The performance targets for the riparian restoration are:

i. 80% indigenous plant cover from one metre inside the fence line (ie. out of cattle browsing reach) to the top of the bank or to the water's edge, whichever is appropriate for planting) six years following planting
ii. at least 50% effective shading of the water column (measured from sunrise to sunset in midsummer) by year 15;
iii. the absence of any significant exotic weed infestations; and
iv. no livestock are present in the riparian areas.

If excessive failure of plant establishment occurs for hydrological reasons such as excessive flooding, species more suited to the conditions will be planted and these areas will be omitted from the six year performance target mentioned above.

4.6.5 Addressing the loss of significant trees (200 seedlings programme)

The loss of long-lived significant trees will be addressed by planting 200 seedlings of the same species for every significant tree felled within the Project footprint. The Ecology Supplementary Report – Vegetation (February 2018) states that up to 17 significant trees may have to be removed during road construction. While efforts will be made to reduce the number of these trees, if all 17 are lost, 3400 seedlings will be required to be planted in their place. Technical Report 7a – Vegetation (December 2017) identified 11 tree species that qualified within the three criteria as being significant (hinau, kahikatea, miro, narrow-leaved maire, maire taike, northern rata, rimu, thin-barked totara and hybrids with lowland totara, white maire, swamp maire and very large pukatea). In addition kohekohe also meets the three criteria definition. If additional significant trees of these 12 species (that meet the definition) are discovered these will also be similar compensated for.

As described in section 4.5 of this report, the significant tree species that may be removed are rimu (11), totara (2), and one each of matai, hinau, miro, and pukatea. Every endeavour will be made to avoid removing these trees and it is possible that fewer than 17 will ultimately be felled.

Most of these tree species have quite specific site preferences. There are only limited suitable sites for rimu in particular; selection of suitable planting sites will be undertaken by an experienced field botanist or restoration ecologist and it may be necessary to plant some early successional species in advance, or with these to provide the necessary shelter.

The deforested tributary valleys of the Mangapepeke, especially along the forest edges, offer the best planting sites for these seedlings including the margins and beneath areas of existing manuka and kanuka, especially on shallow sloping hillslopes, and in small gullies and sites with shelter and dappled light.

Details of where and when these seedlings will be planted will be provided in the kahikatea / swamp forest and replacement mitigation planting design specifications.

4.6.6 Rehabilitation plant establishment within Project footprint

The rehabilitation of the earthworks within the project footprint will encompass the sites that have been disturbed during the road construction. This includes all cut and fill embankments, stream diversion areas and plant establishment associated with storm-water components, the integration of structures and requirements for amenity, screening and cultural expression, to be confirmed in conjunction with Ngāti Tama. This also includes all areas used for temporary work and construction yards accommodated within the final project footprint that are not suitable for replacement mitigation planting.

A suite of plant establishment techniques will be used, as required, to ensure a successful outcome to achieve coverage or canopy closure performance measures. These techniques will include, but are not limited to, addition of site won top soil and organic matter integrated as mulch, use of manuka slash, forest duff, ponga logs, transplanting or direct transfer of nikau palms, manipulation of final formations of earthworks to encourage natural regeneration and planting. Plants used in these areas will be grown from propagation material sourced from naturally occurring plants in the North Taranaki Ecological District and include early succession species tolerant of exposed locations and raw and disturbed soils.

4.6.6.1 Rehabilitation Strategy

The ecological objective for the site rehabilitation work is to repair some ecosystem processes on altered landscapes. The trajectory and endpoint may well be different from any previous state because of the works required to create the road.

The rehabilitation strategy shares a common aim with the ecological restoration work of revegetating unpaved terrestrial areas. Specific objectives that support the aim of ‘rehabilitation’ are:

- to support natural regeneration and succession to native shrubland and eventually forest and eventually forest, and
- to minimise medium-term maintenance.

The rehabilitation strategy aims to work with the natural landscape, taking opportunities to harness and speed up natural processes, including the use of salvaged material to better the chance of successfully rehabilitating areas affected by the works.

Details of the site-specific planting zones, plant mixes for each zone, planting and plant establishment methods (including species and specific plant spacings), and pre- and post-planting maintenance treatment will be contained in the landscape specification for rehabilitation. This will include a site responsive process to confirm the rehabilitation approach through the construction programme using insitu trials, as required to enhance coverage and/or canopy closure.

All rehabilitation works are to consider important views and comply with relevant roading safety standards and best practice CPTED (Crime Prevention through Environmental Design).

4.6.6.2 Fill slopes

The fill slopes (see Technical Report 8b – Section 5.1.5), visible from the road will be planted to provide amenity and as a form of 'assistance' planting; to provide quick seed source for the lower slopes. A limited number of plant species will be planted initially. Suitable fill batter plants include manuka, toetoe and whaririki. Site specific planting plans will be developed to achieve amenity and cultural expression outcomes as agreed with Ngāti Tama, for stopping places, where they are confirmed, and possible constructed ponds within the northern disposal sites (see Technical Report 8b). This may include, for example, direct transfer of nikau palms recovered from Project footprint and smaller groups of signature species such as kahikatea and ti kouka. Over time this planting will be colonised by a wider range of early succession forest species such as tree ferns with management to ensure sightlines and safety. Topsoil, with site won organic material integrated, will be applied over all fill slopes to encourage natural regeneration.

4.6.6.3 Cut slopes

Due to the steepness, the main cut slopes will not be planted (see Technical Report 8b – Section 5.1.3). The final 'earthworks finish' of the larger cut face will be modified to encourage natural regeneration and to mimic the natural horizontal strata of the rock formation. Top of cut areas – with and without soil nails – will be planted with 'assistance' dry and wet cliff top species and/or laid with manuka slash and forest duff. Suitable cliff plants include kiokio and koromiko for wet cliff areas and whaririki and native broom for dry cliff areas.

4.6.6.4 Areas around major structures

This includes: areas around the major structures including the tunnel portal, bridge embankments, tunnel control buildings, hydrant tanks and MSE walls. The main reason for planting and plant establishment around these built features is to reduce the visual impact of these structures within the landscape including screening of the tunnel control building and hydrant tanks. Site specific planting and plant establishment plans will be developed to achieve amenity, screening and cultural expression outcomes in these areas (see Technical Report 8b) including the use of ponga logs, forest duff and planting of aspect appropriate fill slope species with reduced spacing and larger grade plants used where possible to shorten times to achieve coverage or canopy closure targets.

4.6.6.5 Swales - Vegetated

Where the gradient allows and the swales can have a soil bottom and sides, these swales shall be planted out with low growing riparian type species such as *Cyperus ustulatus* and *Carex geminata*, as is appropriate to achieve stormwater outcomes and access for ongoing maintenance.

4.6.6.6 Stream Diversions and Constructed Wetlands

The stream diversions and constructed wetlands will be planted up with riparian type plants such as carex, whararikí, toetoe and koromiko, as required to achieve access for ongoing maintenance and stormwater outcomes.

4.6.6.7 Rehabilitation Process

Successful rehabilitation of areas affected by site works requires strategic planting. Initial planting will help provide shelter and shade for supplementary planting of the more shade tolerant plants later in the maintenance period.

- Initial Planting – plants that can establish in the open, in direct sun light and exposed to the wind. Note: Assistance Planting – includes planting a portion of the planting zone with signature or harder to establish species and species that are easily propagated and established to encourage seed spread downhill and a natural regeneration process.
- Replacement Planting – plants that require protection and shelter, planted later in the maintenance period once the initial planting has established and can provide some protection and shelter.

4.6.6.8 Plant specifications

<u>Pest and livestock management</u>

- Prior to planting, all livestock will be removed from planting sites and goat and pig numbers reduced to low levels in and around the planting areas and surrounding habitat (refer to Chapter 9 – Pest Management). See Section 4.6.2.4 below for details.

<u>Plant specifications</u>

- All plant material will be eco-sourced as prescribed in Section 4.6.1.
- All plants will be:
    - grown to specification;
    - well grown with well-formed root systems that fill the growing container but that are not root bound, and with well-formed foliage above ground and well-hardened before delivery to the planting site.
- All plants will be inspected at the supply nursery prior to delivery and any not meeting specifications will be rejected.

Species mixes

The species mixes will be suited to the locations that the plants are to be planted in and to achieve roading standards for safety and sightlines. The final ground conditions will have to be examined once ground works have been finished and a plant list confirmed prior to planting by the Landscape Architect and Ecologists.

In open sites the plant species will need to be able to withstand exposure to direct sunlight and wind. On top of the cuts above the road and on the upper slopes of the fill embankments, the plant species will include plants that will help provide a seed source for the slopes below.

Plant grades

Plant grades will vary from plants in 0.5 litre pots to 3 litre pots depending on the species and where they are to be planted.

Timing of planting

Late winter to spring planting (July to November) will be the period when most planting is undertaken but the timing of planting will depend to a large extent on soil wetness and stream flows and access to the sites.

Replacement plants

Where plants have failed and replacements are required, and the failure of one species is greater than 50%, another species shall be chosen with the approval of the Landscape Architect or the Ecologists to replace losses.

Once the initial planting is providing shelter and protection plant losses can be replaced with more tender plants including the significant tree species.

Supervision of planting

A qualified Landscape Architect or Ecologist will oversee the planting of the rehabilitation areas.

4.6.6.9 Pre- and post-planting site preparation

Where vegetation has established within planting areas, spot spraying with approved herbicide shall be required at least one month before planting. Including any pest plants or invasive pest weeds ie pampas, gorse, broom, blackberry etc.

The spot spraying shall be 50% of the planting spacings i.e. 1m planting centres equals 0.5m spot spray. Where desirable natives have naturally established these shall be retained and released; cleared of competing vegetation.

Plant spacings	Area spot sprayed
0.75m	0.375 x 0.375m
1.00m	0.500 x 0.500m
1.20m	0.600 x 0.600m

The Rehabilitation planting sites will require releasing from weed competition and blanking to replace plants that have died for a period of at least six years following planting.

Most of the releasing will be done with the application of herbicide although some zones, especially those where existing native sedge and rush vegetation occurs, may require mechanical releasing because of the intolerance of many native wetland rush, sedge and reed species to exposure to chemical herbicides.

4.6.6.10 Rehabilitation plant establishment performance measures

The performance targets for the Rehabilitation plant establishment, to be confirmed through the construction programme:

i. 80% indigenous plant cover six years following planting for all rehabilitation zones excluding cut slopes;
ii. 90% of the diversity of species planted remain in the planted areas six years following planting;
iii. The absence of any significant exotic weed infestations in all rehabilitation areas; and
iv. No livestock are present and mammalian pests are held to very low densities where the planting areas adjoin the PMA.

4.7 Programme

To provide eco-sourced plants in time for the Project, seed collection started in February 2018 from within the area. The timing of the planting will be governed by when areas become available for planting plant establishment. The planting or seed dispersal at the top of the cuts may happen as the cuts are gradually lowered to avoid working at heights above the full cut.

Every year after planting, replacement plants will be planted to fill in any gaps that occur. Once the initial planting is providing shelter and shade other species that are desirable but hard to establish can be planted.

The maintenance period will be for up to six years. Maintenance shall be carried out every year after planting to provide the optimal conditions for plant growth. This will include the control and removal of unwanted exotic weeds/plants and releasing/removing competing growth around desirable plants.

4.8 Supervision protocols for vegetation and habitat clearance and potential impacts to associated species

Table 4.1 summarises the ecological management protocols which will be implemented to minimise vegetation loss within the AWA and damage to adjoining areas. It also provides details for the specific removal of species of value within the Project footprint.

Table 4.1 - Ecological Management Protocols

Ecological Protocol	Protocol Details
Vegetation clearance	• Methodology for the removal and pruning of vegetation, and protection of vegetation to be retained during construction includes: o Physical delineation (such as fencing or flagging tape) of both the road margin and the AWA to show the extent of vegetation clearance and where vegetation should preferentially be retained. o Physical delineation within the works area of sites suitable for placement of small wind-rows of vegetation will occur prior to vegetation clearance. o Vegetation will be cleared only prior to construction works beginning in the Project footprint in order to reduce habitat effects and reduce the potential for erosion and sediment generation. o Vegetation will be directionally felled away from the physically marked edge, to prevent vegetation damage to the AWA and high ecological value area, unless deemed to be unsafe and hazardous. Methods for undertaking vegetation removal will be site specific and commonly will include use of an excavator, grapple and chainsaw on suitable land, and directionally felling trees using experienced tree-fellers. o Vegetation removal will be minimised within the AWA and will include only areas and trees which are essential for construction purposes. Where the AWA adjoins high value areas, ideally minimal vegetation removal will occur within the AWA. o Within the AWA vegetation removal will be managed by experienced arborists to reduce tree damage and to accommodate construction. This will preferentially involve pruning branches of large trees rather than felling where this would accommodate the construction requirements. o Supervision of vegetation clearance will also be undertaken by a suitably qualified ecologist. o Upon completion of each vegetation removal stage the actual vegetation loss will be re-measured allowing the update of the Biodiversity Offsets Accounting Model. • Methodology for the removal and relocation of forest resources includes: o Fallen decaying logs of greater than 50cm diameter and shall be placed in-situ. o Forest resources such as the heads of trees containing large epiphyte loads and logs deposited in-situ shall be managed so as to minimise indigenous vegetation damage, e.g. by placing logs perpendicular to the slope so they don't roll down hill and placing logs within canopy gaps.

Ecological Protocol	Protocol Details
	○ Propagules of any threatened or regionally distinctive plant within the Project footprint will be harvested and material cultivated from these plants will be returned within restoration planting areas. Plant survival and health will be monitored 1 year after planting. ○ Any Gahnia plants known or found within the Project footprint will be harvested, cultivated and returned to suitable restoration areas, such as at the top of cliff batters. ○ Stock piles of logs and forest resources shall be placed within canopy gaps and clearings. Stock piles shall be proportional to the size of the gap, of a relatively low height (<2m) and be contained to minimise the footprint. ○ Forest resources will not be placed into water courses unless this is by design for stream restoration purposes. • Methodology for mulching and stockpiling wood/topsoil includes: ○ Mulching will be undertaken in a manner to prevent wood chips entering streams and ephemeral gullies. ○ Stockpiles will be managed to prevent anaerobic conditions and leachate developing. ○ Stockpiles will be located away from drains and streams and managed with sediment control measures to prevent sediment entering waterways. ○ Weed management will occur on soil stockpiles to zero-density at least every six months to prevent weed spread into rehabilitation areas where soil will be reused.
Herpetofauna Management	• Methodology for salvage and relocation to minimise loss of herpetofauna within the Project footprint, including timing and construction supervision details. • Relocation / Mitigation site selection based on habitat suitability assessment and capability of supporting additional herpetofauna.
Bat Management	• Protocols for identification of potential bat roost habitat. • Implementation of modified tree removal protocols when clearing vegetation which could potentially offer roosting habitat for bats. • Protocols for bat injury and mortality.
Avifauna Management	• Pre-construction surveys to detect the presence of avifauna species, and the habitats they occupy. • Vegetation clearance methodology (links to the vegetation clearance protocol). • Specific management to avoid or mitigate effects on the North Island Kiwi.
Fish Rescue and Relocation Protocols	• Methodology to minimise direct effects of construction on fish, kōura and kākahi (freshwater mussels) prior to works instreams. This will address: ○ Recovery of fish prior to instream works ○ Rescue of fish from any spoil ○ Relocation of fish ○ Reporting.

Ecological Protocol	Protocol Details
	Note: The CWMP and SCWMPs will detail the protocols for works in streams including the diversion and realignment of watercourses and activities such as culverting and the installation of erosion protection structures.

5 Bat Management Plan

5.1 Introduction

5.1.1 Purpose and Objectives

The overarching ecological aim for the Mt Messenger Bypass (the Project) is to ensure, at a minimum, there is no net loss of biodiversity values, or to achieve a net benefit of biodiversity values, within the medium term.

To this end, the purpose of this Bat Management Plan (BMP) is to specify procedures to avoid, remedy or mitigate adverse impacts on Long-tailed bats (*Chalinolobus tuberculatus*) and central lesser short-tailed bats (*Mystacina tuberculata rhyacobia*) that may be affected by construction and operation of the Mt Messenger Bypass.

The BMP includes the following:

- a summary of the current knowledge of bat populations within the area surrounding the Project;
- potential adverse effects on bats that may eventuate during construction; and
- measures to avoid, remedy or mitigate potential adverse effects where possible.

Key objectives of the BMP include the establishment of procedures and protocols to guide impact management during vegetation clearance.

The BMP has been guided by recommendations within the Mt Messenger 'Assessment of Ecological Effects – Bats' (Chapman and Choromanski 2017) and the Ecology supplementary report – Bats (Chapman, 2018). The NZ Transport Agency (the Transport Agency) research report 623 'Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature' (Smith et al. 2017) has been considered during the development of this BMP.

5.2 Responsibilities and competencies

Appropriately qualified and experienced bat ecologist(s) will implement this BMP and various phases of bat-related work on this Project. The bat ecologist(s) will have the relevant competency classes for the type of bat work being undertaken, as listed in Appendix B of the ELMP (Smith et al. 2017).

5.3 Regulatory framework

All bats are protected under the Wildlife Act 1953 (Wildlife Act) (s 3). The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna (including native bats) is a matter of national importance in the Resource Management Act 1991 (s 6(c)).

Wildlife Act permits issued by the Department of Conservation (DOC) will be required in order to undertake vegetation clearance during enabling works, to allow for the possibility

of accidental mortality of bats. These permits will have conditions attached, which may necessitate revision of this plan.

5.4 Baseline survey

Initial acoustic survey efforts focused on detecting the presence and broad-scale habitat use by long-tailed bats and short-tailed bats in the area surrounding several early alignment options that were under consideration at that stage. Additional areas, most notably areas east of the existing SH3 alignment, were surveyed for bat activity as Project alignment options were refined. Data from those acoustic surveys were used to inform the design of a subsequent radio telemetry study undertaken at the end of 2017, aimed at locating and describing active bat roosts within the Project footprint and wider Project area, and identifying important foraging and commuting habitat.

For further information regarding the baseline bat surveys refer to the Mt Messenger 'Assessment of Ecological Effects – Bats' (Chapman and Choromanski 2017) and Ecology supplementary report – Bats (Chapman, 2018). These reports describe the locations of surveys within the wider Project area, the methodologies used, the timing of the surveys and results.

5.5 Current understanding of Mt Messenger bats

The results of bat survey work undertaken within the Project footprint and wider Project area in the last 12 months confirm that:

- Short-tailed bats have not been detected and are unlikely to be present in the immediate vicinity of the Project footprint, but their presence cannot be ruled out.
- Long-tailed bats are present, and their activity is widespread within the Project footprint and wider Project area.
- Multiple potential long-tailed bat roost trees are present in the wider area; it is possible that some exist within or near the Project footprint.
- Despite significant effort, the failure to capture and radio-track long-tailed bats has contributed to a lack of knowledge regarding active roost locations, specifics of bat habitat use (e.g. commuting routes) and population demographics which could be used as baseline information.

5.6 Summary of potential effects on bats

Potential adverse effects of the Project on bats were assessed in the Mt Messenger 'Assessment of Ecological Effects – Bats' (Chapman & Choromanski 2017) and Ecology supplementary report – Bats (Chapman, 2018). Key potential adverse effects include:

- loss of unoccupied roost habitat;
- mortality and injuries through clearance of occupied bat roosts;
- loss of foraging habitat;
- habitat fragmentation; and
- effects of night works and lighting.

This chapter describes mitigation measures aimed at addressing the potential loss of unoccupied roost habitat, mortality and injuries through clearance of occupied bat roosts, and effects of night works and lighting. Potential habitat loss and fragmentation effects on all species are addressed elsewhere in this ELMP.

5.7 Management of effects on bats

5.7.1 Vegetation Removal Protocols

Vegetation Removal Protocols (VRP) will be used to avoid effects on occupied bat roosts, and will detail the techniques that will be used to detect roosting activity (including the use of ABMs, visual and roost emergence surveys) prior to clearance of vegetation, and procedures to guide the clearance process.

The VRP therefore aim to:

1. locate bat colonial (and where possible, solitary) roost trees that exist within the alignment prior to tree removal;
2. provide clear, concise procedures that are to be followed prior to removal of all trees along the Project alignment, with the aim of avoiding mortality or injury to bats in the event that they are found; and
3. Set out how any bat injury or mortality that does occur will be dealt with.

The following protocols (DH.1 – DH.6) have been extracted and modified from Annex DH: Vegetation Removal Protocol (VRP) from the *Effects of Land Transport Activities on New Zealand's Endemic Bat Populations: review of ecological and regulatory literature* (October 2017).

All parts of the vegetation removal protocol (VRP) below apply to all trees > 80cm diameter at breast height (dbh) and trees between 50cm dbh and 80cm dbh which are classified as having features suitable for bat roosting as identified by the Supervising Bat Ecologist (SBE). In this instance suitable bat roosting features include five or more nested epiphytes located on horizontal branches or sufficient damage to the tree crown or truck that provide roosting voids.

5.7.2 DH.1 Definitions

- Dawn and dusk are defined as starting and ending 0.5 hours either side of the closest sunrise and sunset times provided by LINZ27.
- Visual surveys include a visual inspection of potential roost sites to confirm the presence of bats and/or bat signs, i.e. guano.
- SBE is defined as Class C bat ecologist competency level (Appendix B), dependent on project size and complexity. Class A and B bat ecologists may form part of their team and undertake tasks outlined within this VRP (as defined by Table 5.1) under supervision from the SBE. The SBE is not required to be present at the site all the time but must retain sufficient oversight of their team to be confident good decisions are being made regarding presence/absence of bats and potential roost sites. However, the SBE is expected to be available to oversee vegetation removal.

5.7.3 DH.2 Introduction

Bat activity, emergence times and whether bats emerge from their roosts at all, can be influenced by temperature, humidity, invertebrate activity and light levels (O'Donnell 2005). Consequently bat survey protocols should consider these factors. Recent research into long-tailed bats activity suggests long-tailed bats are more likely to be detected when the temperature 1-4 hours after sunset is greater than 6°C and particularly when temperatures are in the range of 10 to 17°C, with humidity ≥70%. Long-tailed bats did not emerge from roosts in a study based near Geraldine, South Canterbury, when temperatures were less than 5°C (Griffith 2007). However further work is required to understand how these factors should be accounted for in this protocol. Application of this protocol will require refinement to reflect current knowledge and project characteristics, particularly with respect to the size and type of tree the protocol applies to, precipitation conditions for surveys and contact details in annex DH.

5.7.4 DH.3 Quality Assurance

- The relevant provisions of DOC's Best practice manual of conservation techniques for bats (Sedgeley et al 2012) should be followed in general accordance for all aspects of bat work.
- The vegetation removal protocol (VRP) will apply to all trees > 80cm dbh and trees between 50cm dbh and 80cm dbh which are classified as having features suitable for bat roosting as identified by the SBE.
- All practicable efforts must be undertaken to ensure that no trees or vegetation containing bats are removed.
- Prior to the commencement of surveys, automated bat monitoring devices or units (ABMs) shall be checked for correct operation at a site where bat activity is known to be high. Faulty or suspect ABMs are not to be deployed.
- ABM data from each pre-felling survey shall be reviewed without unnecessary delay. If no bat activity at potential roost trees is identified and the SBE determines the vegetation can be removed, this information should be relayed to the contractors in sufficient time to allow contractors to clear vegetation prior to dusk the same day.
- No trees or associated vegetation identified as potential roosts can be felled or cleared without the approval of the SBE.
- Once the results of the visual surveys and ABM data have been reviewed by the SBE the following communication procedures shall be implemented.

    a If no bats are sighted or detected, the SBE shall call the vegetation clearance supervisor to give permission for the affected tree(s) and/or vegetation to be removed. In addition, at the completion of felling works, an email report shall be sent to the Environmental Manager and a representative of both the local council and DOC.

Table 5.1 Details for key project contacts

	Name	Contact Details
Environmental Manager	Ed Breese	021 333 726
DOC representative		
Council representative		

b If bats are sighted or detected the SBE shall call the vegetation clearance supervisor to inform them that the affected vegetation cannot be cleared. In addition, an email shall be sent to the Environmental Manager, and a representative of both the local council and DOC detailing the results of the survey and outlining measures for on-going visual surveys.

c Additionally, the results of the roost surveys and ABM data shall either be reported or reviewed by the SBE. The report should include the presence and/or absence of bat roosts within the proposed clearance areas including the size, location and type of trees or vegetation. The report shall be forwarded to the above representatives: within 15 days following completion of the survey or if appropriate, or required by consent conditions within an annual monitoring report.

5.7.5 DH.4 Roost Identification

DH.4.1 Potential roost identification – habitat assessment.

a) All potential roost trees in the site must be clearly marked.

b) All locations where trees are >80cm dbh and trees between 50cm dbh and 80cm dbh which are classified as having features suitable for bat roosting as identified by the SBE. Bat roosts are likely to have one or more of the following attributes:

- cracks, crevices, cavities, fractured limbs, or other deformities, large enough to support roosting bat(s);
- sections of loose flaking bark large enough to support roosting bats;
- a hollow trunk, stem or branches; and
- deadwood in canopy or stem of sufficient size to support roost cavities or hollows.

Trees or vegetation with minimal potential as roosts will have:

- No cracks, crevices cavities, fractured limbs, or other deformities, large enough to support roosting bat(s).
- No substantial section of deadwood in the canopy or stem of sufficient size to support roost cavities or hollows.
- No sections of loose flaking bark large enough to support roosting bat(s).

5.7.6 DH.4.2 Roost Confirmation

Once potential roosts have been identified, the use of a tree as a roost can be confirmed by visual confirmation alone or by using a combination of ABMs and visual confirmation.

5.7.7 DH.4.2.1 ABMs

This section discusses the use of ABMs to confirm roost occupancy.

1 To determine if trees or other types of vegetation are roosts they should be monitored overnight (including sampling dusk + 3.5 hours and dawn) between September and April using an ABM or several ABMs for a minimum of three days.
2 The ideal time to undertake surveys is when temperature ranges between 10 and 17°C.
3 Surveys are optimal when relative humidity is c.>70%.
4 Little precipitation should occur within the first two hours after dusk. The amount of precipitation allowed during this period is TBC.
5 Monitoring during a full moon should be avoided.
6 The ABM(s) should be placed so that detection of bats is likely if they are using the potential roosts.
7 ABM data should be analysed to indicate the potential for roosts. It should be noted that based on the current understanding of bat calls near roosts, it is possible that roosts will not be detected. In these cases, the criteria outlined in section 5.7.8 should be followed.
8 In the event ABM data and/or observations indicate bat roosting before the two-night monitoring duration has been completed no further monitoring is necessary and the vegetation used for roosting may not be removed.

5.7.8 DH.4.2.2 Visual

Each tree or vegetation with features that make it a potential roost may be inspected to confirm the site as a roost. This may be subsequent or prior to ABM monitoring depending on the method of roost confirmation chosen and is at the discretion of the SBE.

1 Potential roost locations can either be visually inspected from the ground by using, for example, roost emergence watches, or trees must be climbed and inspected by an arborist or trained climber.
2 To undertake an inspection while climbing, the arborist or trained climber will relay any potential evidence of bats (eg staining, cavities, guano) by way of live audio-visual equipment and/or photographs for review by a SBE prior to removal. The arborist or trained climber will also check for signs of bats using a bat detector (to detect social and echolocation calls from roosting bats, under supervision of the SBE).
3 If potential roost locations are within tree ferns or other ‘delicate’ vegetation, climbing should only be undertaken if it is safe to do so for the climber and if this will not reduce the likelihood of the roost being used in the future. All climbing must take place under the careful supervision of the SBE to prevent roost damage.

In some instances bats do not always call when emerging from their roost (Borkin pers comm). If a potential roost site has been identified in habitat and it is considered highly likely to contain a roost, but could not be confirmed using ABMs or external visualisation of the roost, observations of bats leaving their roosts provides an alternative roost confirmation methodology. In this instance, the following methodology should be implemented:

1 Bats begin to leave roosts while there is still light outside therefore there is potential to observe bats without the aid of cameras of video equipment.
2 Observations should begin before sunset. Ambient temperature should be >10°C and there should be no precipitation (otherwise bats may not emerge).
3 Observations shall be carried out close to potential roost sites where flying bats are back-lit against the sky. It may be useful to have more than one person observing potential roost sites from different angles to determine precise trees or vegetation and exit holes.
4 Hand-held bat detectors may also be useful to alert the ecologist(s) to the presence of bats nearby, narrowing down the potential roost site locations and allowing roosts to be confirmed.
5 Infrared cameras and video recorders may also be used to confirm the presence of bats leaving potential roost sites.

5.7.9 DH.5 Vegetation Removal

1 Trees ideally should not be removed from May – September when bats could be hibernating or torpid.
2 If bats are confirmed in a tree, then that tree should not be felled.
3 All potential roost trees and vegetation to be removed within the calendar year must be clearly marked by the SBE and distinguished from trees to be retained. To determine roosting, all potential bat roost trees and vegetation must be inspected for the presence of bats immediately prior to any proposed felling using DH.4.
4 If >80 cm dbh trees and 50cm -80cm dbh (potential roosting) trees are surveyed in appropriate conditions (as outlined in 5.7.8) and no bat activity is recorded, or the level and activity patterns do not indicate roosting according to the interpretation of the SBE, then the tree or vegetation may be removed – removal must occur on the same day the survey ends. Trees identified as <50cm dbh and 50cm to 80cm dbh without bat roosting features by the SBE can be removed at any time of the year. The SBE should be available for the duration of vegetation clearance operations in all areas where vegetation is >80cm dbh and between 50cm and 80 cm dbh where trees are deemed to have bat roosting features. The SBE shall advise staff should bats be detected (leaving trees or injured) and to inspect each felled tree or vegetation for signs of bat roosts.
5 If no bat activity is recorded and a roost has not been found visually (Section 5.7.8) or by observation (Section 5.7.7) then the tree or vegetation can be cleared.
6 If bat activity is observed during vegetation clearance, then clearance should stop immediately and should not commence until further monitoring confirms that the bats have abandoned the roost. Trees and vegetation should be marked and site

staff briefed immediately to indicate a roost is present. If bats are found injured or dead DH6 (Section 5.7.10) should be implemented.

7 If bats are detected while felling is in progress, felling must stop long enough to allow any uninjured bats to escape (if it is safe to do so). Every effort should be made to relocate the section of trunk/branch where the bats are roosting before felling may commence (if it is safe to do so).

8 If bats are confirmed to still be roosting by following DH4 after seven days then an agreed team including the SBE and contractor representatives will be contacted to re-assess and consider alternative methods to progress vegetation removal. This will be a risk assessment-based approach dependent on the type of roost identified.

5.7.10 DH.6 Bat Injury or Mortality

In the event of finding a dead or injured bat(s) the following procedures should be implemented:

1 Injured bats should be taken immediately to the following location, approved by DOC for assessment:

Table 5.2: Contact information for approved contact in the event bat injury occurs

Vet clinic / zoo or other specialist	
Name	Contact to be confirmed by DOC
Contact details	
Address	

2 Bats should be placed in a cool dark material-lined box/bag by or under the direction of the SBE to ensure the animal is handled appropriately.

3 The local DOC office or DOC hotline (if after hours) should be contacted no longer than two hours after the injured or dead bat is found.

Local DOC office	
After hours	0800 DOCHOTLINE (0800 362 486)

4 DOC and veterinary advice shall be sought in conjunction with the SBE when considering the rehabilitation requirements of any injured bats (for example legislative requirements will need to be considered). Once the vet has made an assessment the SBE and vet will determine any rehabilitation action required and the longer-term future for the bat/s.

5 Bats confirmed as injured should be sent to the Massey University Wildbase hospital for rehabilitation. It should be noted that release after rehabilitation is unlikely due to the risk of disease being transferred back into the local bat population.

6 If the animal is dead or euthanised by the vet, it must be taken to the local DOC office as soon as practicable. The bat/s must be stored in a fridge at less than 4c.

5.7.11 Night works and lighting

Night works are planned. The requirement for lighting along roads is governed by the following standards:

- AS/NZS 1158.1.1:2005 Lighting for Roads and Public Spaces – Vehicular Traffic
- AS/NZS 1158.6:2010 Lighting for Roads and Public Spaces – Luminaires
- NZTA M30:2014 Specification and Guidelines for Road Lighting Design
- CIE 88 – Guide for the Lighting of Roads Tunnels and Underpasses

The effects of particular lighting regimes are likely to be species-specific (e.g. Stone et al., 2012). However, where required, LED lighting should be highly directional (baffled if necessary) to minimise light spill into the surrounding environment, as well as of low intensity, longer-wavelength and lower colour temperature if practicable.

Shorter-wavelength, whiter LEDs should be avoided as these attract more invertebrates. LED colour temperature may not influence the attraction of invertebrates to LEDs in New Zealand (eg Pawson and Bader, 2014).

If technological advances allow, the use of LED lights that mix coloured light from three or more monochromatic LED sources will be investigated as this would potentially provide a high level of control over emitted wavelengths to allow adjustment if necessary. Ultimately, however, lighting design will be determined by human health and safety considerations.

5.7.12 Reporting

Regular reporting will be an important component of the management process during construction. A summary letter will be provided to TRC, NPDC and DOC every six months detailing any specific findings from the above VRP in relation to the specific wildlife permit for bats.

5.8 References

Chapman, S. and Choromanski, M. 2017. Assessment of Ecological Effects – Bats. Technical Report 7f, Volume 3 of Assessment of Ecological Effects, Mt Messenger Bypass project.

Chapman, S. 2018. Ecology supplementary report – Bats.

Pawson, S.M. and Bader, M.K.-F. 2014. LED lighting increases the ecological impact of light pollution irrespective of color temperature. *Ecological applications* 24(7): 1561-1568.

Smith, D., Borkin, K., Jones, C., Lindberg, S., Davies, F. and Eccles, G. 2017. Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature. NZ Transport Agency research report 623. 249pp.

Stone, E.L., Jones, G. and Harris, S. 2012. Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats. *Global Change Biology* 18: 2458-2465.

6 Avifauna Management Plan

6.1 Introduction

6.1.1 Scope and purpose

The purpose of this Avifauna Management Plan (AMP) is to specify additional procedures to avoid, remedy or mitigate potential adverse effects on native birds that may be affected by construction and operation of the Project.

Ongoing intensive pest control in the Pest Management Area (PMA, see Figure 9.1 in Chapter 9), and restoration planting, are proposed as the main methods to address residual effects on birds that cannot otherwise be avoided or completely mitigated. Full details of the overall mitigation approach for the Project and pest management plan are provided in chapters 3 and 9 of this ELMP respectively.

The populations of at least eight native bird species currently resident within the proposed PMA (whitehead, tūī, bellbird, kererū, long-tailed cuckoo, North Island brown kiwi, fernbird, and NI robin) are likely to increase significantly within the first decade of pest control, with kiwi potentially being the single largest respondent. A further four native bird species (kākā, falcon, kōkako and rifleman; all *Threatened* or *At risk*) may also benefit, if colonists from nearby populations move into the treatment area following the onset of predator control.

6.1.2 Statutory context

The provision of management to avoid, minimise and mitigate adverse effects on native wildlife and associated habitat is a requirement under the Resource Management Act 1991 (RMA) and all native birds are legally protected under the Wildlife Act 1953 (Wildlife Act).

6.1.3 Identification of key species

Key *Threatened* and *At Risk* species of interest for which breeding habitat occurs within the Project footprint are (Baber and McLennan 2017, Opus 2017):

- North Island brown kiwi (*Apteryx mantelli*);
- North Island fernbird (*Megalurus punctatus vealeae)*;
- North island Robin (*Petroica longipes)*;
- Whitehead (*Mohoua albicilla*); and
- Long tailed cuckoo (*Eudynamys taitensis*).

6.1.3.1 Kiwi

The Project footprint is likely to encroach on or bisect the territories of approximately 10-15 pairs of North Island brown kiwi. These pairs are likely located in both the Mangapepeke and Mimi catchments (Ecology supplementary report - Avifauna; McLennan 2018).

6.1.3.2 Fernbird

Based on detailed surveys, six pairs of fernbird were confirmed in wetlands within the Mimi Stream catchment, mainly in a tributary immediately below the southern end of the proposed alignment (see Figure 2.2, Section 2.3.1.3 in McLennan 2018). No fernbird were found in the Mangapepeke Stream catchment or elsewhere within the Project footprint.

6.1.3.3 Robin, Whitehead, Long tailed cuckoo

North Island robin, whitehead and long-tailed cuckoo are distributed widely throughout the project area, in all forest types. NI robin are relatively abundant in the Project area, despite being near a distributional limit (Ecology supplementary report - Avifauna; McLennan 2018).

6.1.3.4 General forest bird community

The bird community within the Project footprint, proposed PMA, and wider Project area has a diverse and near complete assemblage of small forest insectivores, with rifleman (*Acanthisitta chloris*) the only notable absence. Kererū (*Hemiphaga novaeseelandiae*) and nectarvores were recorded in moderate numbers. No surveys detected falcon (*Falco novaeseelandiae*), kākāriki (*Cyanoramphus novaezealandiae*), kākā (*Nestor meridionalis*) or kōkako (*Callaeas cinerea wilsoni*). By national standards, the bird count results are generally typical of those in large forest tracts elsewhere in the North Island, and they are dominated by 'widespread and secure' species.

6.2 Potential ecological effects on avifauna

The Project's potential effects on avifauna as a result of construction include (Technical Report 7e, Volume 3 of the AEE; Baber and McLennan 2017) and Ecology supplementary report – Avifauna (McLennan 2018):

- direct removal or degradation of habitat used for nesting or foraging;
- the creation of habitat edge effects;
- direct mortality of nests and their contents;
- habitat fragmentation and isolation;
- construction noise disturbance; and
- sediment runoff to wetlands and watercourses affecting the quality of wetland bird habitat.

Potential ongoing effects resulting from operation and maintenance of the road include:

- effect of vehicle noise on birds;
- decreased landscape and habitat connectivity through fragmentation;
- mortality or injury on roads through bird strike or road kill;
- potential effects associated with the increased presence of people and introduced species in previously less accessible areas;
- lost opportunities for creating wildlife corridors; and
- degradation of the quality of the wetland and riparian habitat of wetland bird species.

6.3 Managing effects

Measures to avoid, minimise and mitigate potential effects of the Project on the key native bird species identified from the baseline surveys are set out below. The key focal area for avifauna management has been identified as North Island brown kiwi management. All other bird species are covered under the accidental bird injury protocol (Section 6.4).

Acoustic monitoring in the Mimi and Mangapekeke catchments (one recorder each catchment) for Australasian bittern (*Botaurus poiciloptilus*) will be undertaken during spring 2018. If Australasian bittern are detected in close proximity to the alignment then a low fence between the alignment and this area of marshland will be erected, forcing bittern to fly over the road above vehicle height.

If a kōkako is encountered in or near the Project footprint during road construction, DOC will be notified but no further action will be taken because:

1) if kōkako want to settle in the Project area it should be left to do so, given that it may eventually benefit from pest control in the wider PMA; and

2) if it is a transient, it will move away naturally, potentially back to its release site in Parininihi.

These are additional to the pest management and restoration planting measures set out elsewhere in the ELMP, which will have significant positive effects on native birds.

6.3.1 Kiwi Management

6.3.1.1 Pre-construction kiwi management

Kiwi catching and kiwi radio tracking programme

A pre-construction kiwi catching programme will be undertaken with certified specialist kiwi dogs to locate and catch those kiwi known from the December (2017) nocturnal surveys to be living in or near the Project footprint. The Ecology Constraints Map in Appendix A to the ELMP shows the high-risk habitat areas for kiwi where these surveys will occur. Trained dogs are a long-established means of locating kiwi. Most dogs are used solely for finding kiwi in their daytime shelters, but a small number of dogs are specifically certified to be used at night to indicate the presence of kiwi nearby (Robertson and Colbourne 2017).

The catching effort will be undertaken by experienced kiwi dogs and handlers, working closely with survey staff, who will listen for calling kiwi in the last few hours of darkness of each night, then direct the dog teams to locations where kiwi are known to be roosting. Department of Conservation (DOC) regards the handler and dog as a team, and this team must be duly certified and permitted under the Wildlife Act before working with kiwi. The certification process, standard operating procedures and reporting forms are available in DOC's *Conservation Dog/Handler Standard Operating Procedure* (DOC 2016). Full details of kiwi dog requirements and best practice methods are provided in the *Kiwi Best Practice Manual* (Robertson and Colbourne 2017), which will be followed during the catching effort.

Once caught, each kiwi will be radio-tagged with a 'smart egg-timer' transmitter, using standard methods of attachment. On adult kiwi, the radio transmitters will be checked and

replaced after 12 months: on juveniles, the transmitter and straps will be checked and changed more frequently, depending on the age of the juvenile and its rate of growth. Transmitters that are specially designed for kiwi have been developed in New Zealand and will be used in this programme.

The Project is anticipated to take four years to construct, meaning that some kiwi along or near the alignment could be radio-tagged for that period. Paired adults usually lay two clutches of two eggs between July and February, with the main egg-laying season being mid-June to December (Table 6.1). The 'egg-timer' transmitters signal when males start to incubate, and thus enable observers to detect the onset of breeding without actually approaching (and potentially disturbing) nests. Best practice radio tracking protocols will be followed, as detailed in Neill and Jansen (2014). Full details of handling, measuring and marking requirements that will be followed are provided in the *Kiwi Best Practice Manual* (Robertson and Colbourne 2017).

Once tagged, each kiwi will be tracked during the day and night for approximately one month (dependent on how long it takes to locate the birds) to determine the approximate shape and size of its territory, and the extent to which its territory overlaps with the alignment. Within the one month tracking period, a total of 50 independent locations will be obtained for each kiwi, in order to establish whether or not each kiwi resides predominately inside or outside the Project footprint. These tracking locations will also reveal the whereabouts of its daytime shelters, information that could prove useful if the birds ever have to be moved out of harm's way during the construction process (see below). Kiwi change roosts regularly, often re-using roosts that they occupied some days or weeks ago, but seldom using the same one for two days in a row. The pre-construction monitoring of kiwi will show where the kiwi territories are and associated maps will be produced to guide further work. Once any at risk kiwi within the Project footprint have been identified and located, these birds will become the focus of monitoring during construction.

Timing

The catching effort for radio tagging kiwi began over autumn 2018 and will re-start in Spring 2018. The first round of transmitter replacements will be undertaken in autumn 2019.

Kiwi capture techniques

Catching kiwi is stressful for the birds, and can cause injury to the bird or handler, or the desertion of nests. The activities in this management plan will require appropriate permits issued by DOC under the Wildlife Act, and will be carried out in accordance with those permits. All captures must be made by suitably accredited handlers. Full details of capture, handling, radio tracking and translocation techniques are documented in the *Kiwi Best Practice Manual* (Robertson and Colbourne 2017).

6.3.1.2 During-construction kiwi management

The main objective of the during-construction kiwi management protocols is to prevent kiwi and their eggs and chicks from being harmed or killed by machinery during vegetation clearance and substrate disturbance.

The following protocols will be followed and undertaken by Project ecologists and appropriately trained contractors:

Kiwi relocation

When machines are working within or in close proximity (within 40m) to a known kiwi territory, the kiwi resident in that territory will be radio-tracked each day to ensure they are not in the critical path of clearance works.

These safety checks will be undertaken at dawn, in a 30 minute to 60 minute window, when kiwi have ceased moving and settled in daytime roosts, but before the onset of the day's construction activities.

If kiwi are found to be at risk of harm, they will be physically picked up and moved immediately in an approved kiwi box to another roost in a safe location (at least 40m away) in another part of their territory. The location of alternative roosts will be identified by pre-construction kiwi territory mapping (see section 6.3.1.1).

At the same time as the above safety checks mentioned above, a trained kiwi dog and handler will be used to search for dispersing juveniles in the area that is to be cleared within the same day. If juvenile kiwi at risk of harm, they will be physically picked up and moved immediately in an approved kiwi box to another roost in a safe location (at least 40m away).

Construction team members appropriately trained in radio tracking and kiwi handling will be responsible for the daily radio tracking checks and for moving the birds (see section 6.7).

Nesting kiwi and eggs

Throughout the kiwi breeding season (July to February) the signals from egg timer transmitters on male kiwi will be checked weekly to determine which birds are incubating and when they began doing so. Nesting kiwi potentially at risk of disturbance (i.e. within 40m of construction activities) will be identified and left to incubate naturally until the risk of disturbance triggers the intervention threshold (ie construction activities approach within 40m).

Where construction activities encroach within 40m, the nests will then be located exactly, and their contents removed, following the procedures and protocols recommended in the *Kiwi Best Practice Manual* (Robertson and Colbourne 2017). All eggs and young chicks recovered from nests will be taken to a permitted incubation and chick-rearing facility, most likely Kiwi Encounter in Rotorua. Later, the resulting offspring will be released back into the PMA, or elsewhere. Release sites will be determined by the Project ecologists taking into account Ngāti Tama and DOC advice.

In all cases, eggs will be uplifted only when they have been incubated naturally for at least 40 days.[5] If a recently established nest is found in a disturbance zone, construction activities (within 40m) in that area will cease until the eggs can be safely uplifted at 40+ days of age.

[5] Eggs taken before this time (i.e. within three weeks of laying) generally have low hatch rates, or sometimes produce young with development problems (DOC 2017).

6.3.1.3 Post-construction kiwi management

The information gathered from the pre-construction kiwi territory mapping will be used to identify where fencing may be required. Pairs with territories that straddle the new road are likely to be at greatest risk. The fencing will serve two functions:

1) to stop kiwi accessing the road, and

2) to guide the birds to culverts which will allow them to pass safely under the road during normal low flow conditions.

In these cases, 1.2m high fences with kiwi-proof mesh netting may be erected along the road edge to restrict the birds to one side of the road, or to guide them to culverts which will enable them to travel safely under the road without risk of harm. The final design and placement of the kiwi protection fencing will discussed with DOC during the design phase of the project. In the first year following road completion, trial cameras will be placed above some of the culvert entrances to check that kiwi are using them.

Road signage will be erected along the alignment alerting motorists to the possible presence of kiwi. The number of signs used and specific physical locations will be determined at the detail design phase of the Project.

6.4 Accidental bird injury and mortality during construction

In the event of finding a dead or injured native bird during construction of the Project, the following procedures will be implemented:

(i) Injured native birds will be taken immediately to a vet approved by DOC for assessment (see Table 6.1 for details).
(ii) Birds will be placed in a cool, dark, material-lined box/bag by or under the direction of a Project ecologist to ensure the bird is handled appropriately.
(iii) The local DOC office or DOC hotline (if after hours) will be contacted no longer than two hours after the injured or dead bird is found (see Table 6.2 for details).

Table 6.1 - Contact information for approved contact in the event of native bird injury or mortality

Vet clinic/zoo or other specialist	
Name	To be advised by DOC
Contact details	
Address	

Table 6.2 - DOC contact information

Local DOC office	
After hours	0800 DOCHOTLINE (0800 362 468)

DOC and veterinary advice shall be sought in conjunction with a suitably trained Project ecologist when considering the rehabilitation requirements of any injured native birds (for

example, legislative requirements will need to be considered). Once the vet has made an assessment, the Project ecologist will, taking into account the advice from the vet, determine any rehabilitation action required and the longer-term future for the bird/s.

If the bird is dead or euthanised by the vet, it will be taken to the local DOC office as soon as practicable.

6.5 Reporting

Regular reporting will be an important component of the management process during construction. A summary letter will be provided to TRC, NPDC and DOC every six months during construction detailing any specific data from the proposed kiwi management in relation to the specific wildlife permit for kiwi.

6.6 Permitting requirements

Permits are to be obtained for any manipulation of kiwi under the application of the Wildlife Act. The activities involved in executing this management plan are indicated in Table 6.3.

Table 6.3 - Kiwi activities involved in this Project for which DOC requires a Wildlife Permit

Kiwi activity that require Wildlife Permit	Activity involved in this Project
Using dogs to locate kiwi	✓
Catching and handling kiwi	✓
Marking kiwi with bands, wing tags or transponders	✓
Attaching radio-transmitters to kiwi	✓
Taking blood or feather samples from kiwi	✓
Transferring kiwi to a new site	✓
Uplifting eggs or chicks from a nest as part of Operation Nest Egg™ (ONE)	✓
Holding dead kiwi, including for kiwi aversion training	
Holding kiwi in captivity	

6.7 Training requirements

Training / accreditation requirements for Project team members involved in the management of kiwi are as follows:

- Accredited handlers will be involved in the kiwi radio tracking programme detailed in section 6.3.1.
- Project ecologists and contractors involved in relocating kiwi during construction works will be formally trained in handling kiwi and radio tracking techniques and shall

be officially accredited. The Kiwi Recovery Group maintains a register of accredited handlers trained to ensure the welfare of kiwi is the top priority when they are being manipulated in any way.

- To be added to the register of accredited handlers, the Project ecologists and contractors will declare that they have and will comply with the relevant sections of the *Kiwi Best Practice Manual* (Robertson and Colbourne 2017), and will also supply a letter of recommendation from an accredited trainer for the particular task(s) being registered for, e.g. catching, holding, measuring or blood sampling kiwi.
- Two members of the team undertaking kiwi handling and radio tracking activities shall be approved trainers.
- The Project ecologists and contractors will be made aware of the health and safety considerations and risks associated with kiwi handling, as documented in the *Kiwi Best Practice Manual* (Robertson and Colbourne 2017).

6.8 References

Baber, M and McLennan, J.A. 2017. Technical Report 7e Assessment of Ecological Effects - Avifauna, in Volume 3 of the Assessment of Effects on the Environment, SH3 Mt Messenger Bypass

Dawson, D.G and Bull, P.C. 1975. Notornis. Vol 22. Part 2. 101-109.

Department of Conservation 2016. Conservation Dog-Handler Team Standard Operating Procedure. DOCDM-749.423.doc. 24 p.

McLennan, 2018. Ecology supplementary report - Avifauna. February 2018.

Neill, E. and Jansen, P. 2014: Ground-based radio tracking: a best practice protocol. Department of Conservation, Wellington, 19 p

Opus 2017. Mt Messenger Bypass Investigation: Bird Baseline Survey and Preliminary Assessment of Effects. New Zealand Transport Agency.

Robertson, H. and Colbourne, R. 2017: Kiwi Best Practice Manual. Department of Conservation, Wellington, 113 p

7 Herpetofauna Management Plan

7.1 Introduction

This Herpetofauna Management Plan (HMP) includes:

- A summary of the potential effects of the Project on indigenous lizards within the Project footprint;
- Methods for the salvage and recovery of indigenous lizards present within identified habitats within the Project footprint;
- Specified protocols for salvage and release of indigenous lizards (including 'At Risk' and 'Threatened' lizard species) captured within the Project footprint;
- Details of a lizard release site preparation (excluding location); and
- Accidental discovery protocols for native frogs.

Some of the lizard species present in the wider Project area are also likely to benefit from the broader pest management, restoration planting and other general measures set out elsewhere in this ELMP (see chapters 3 and 9 for an overview).

All indigenous herpetofauna species are legally protected under the Wildlife Act 1953 (Wildlife Act), and the importance of vegetation and landscape features that provide significant habitat for native herpetofauna are recognised by the Resource Management Act 1991.

This HMP will be used to support a Wildlife Act permit application to the Department of Conservation (DOC) to authorise the following:

- Handling of lizards (including non-threatened, 'At Risk' and 'Threatened' lizard species);
- Capture, relocation, temporary holding and release of lizard species from the Project footprint; and
- Accidental lizard injuries and mortality during construction.

7.2 Baseline lizard survey results

Baseline lizard survey results are included within the Assessment of Ecological Effects – Herpetofauna (Technical Report 7d, Volume 3 of the AEE), with updated information within the Ecology supplementary report – Herpetofauna. The methodologies employed for the baseline lizard surveys are set out in those reports.

The ecosystem types in which the Project footprint sits provide suitable habitats for a number of indigenous lizard species. These onsite habitat types range from terrestrial forest floor micro-habitats including woody debris items, clumping vegetation and dense litter, to arboreal micro-habitats including epiphytes, canopy foliage and loose bark. Habitat

assessments conducted during the 2017 field seasons identified the following broad habitat types:

- Mature/late regenerating forest;
- Early successional/scrub;
- Wetland; and
- Rank pasture grass.

As described in the above-mentioned reports, intensive targeted surveys utilizing multiple survey techniques failed to detect the presence of herpetofauna species within the Project footprint.[6] The lack of lizard detections within the Project footprint does not provide evidence for their absence, but can be interpreted as local lizard populations being at or below levels of detectability.

Due to no known native frog habitat being identified within the Project footprint, they have been included under an accidental discovery protocol below. However, the presence of the 11 indigenous lizard species (skinks and geckos) cannot be ruled out. Potential effects on these species will be mitigated based on a conservative approach that assumes that any or all of those species may be present within the Project footprint.

7.3 Potential adverse effects on lizards

The potential effects of the Project on lizards have been assessed as:

- lizard injury or death, including during construction activities;
- disturbance; and
- loss of habitat.

The protocols set out in this plan, together with the broader measures described in Chapter 3 of the ELMP, address those potential effects.

7.4 Protocols

7.4.1 Introduction

The protocols specified below are consistent with standard methodologies from DOC's *Inventory and Monitoring Toolbox: Herpetofauna* (DOC 2012), and have been applied successfully on many NZ Transport Agency road construction projects. The protocol methodologies have been adapted for local site conditions.

7.4.2 Project lizard ecologist

The Project ecologist responsible for leading all lizard surveys and salvage will be a suitably qualified lizard ecologist. More than one Project lizard ecologist may be appointed to work on the Project. All decision-making and technical inputs on fieldwork will be the responsibility of the Project lizard ecologist(s). All ecologists and sub-contractors that will

[6] A copper skink (*Oligosoma aenea*) population was detected less than 1km from the Project footprint, where four adults were observed, including a gravid (pregnant) adult female.

contribute to the herpetofauna work required before, during and after construction shall be suitably experienced in lizard surveys and safe handling of lizards.

7.4.3 Protocol A: Identification of lizard habitats

All high risk habitats along the Project alignment will be delineated and surveyed by the Project lizard ecologist(s) prior to vegetation clearance. High risk habitat for native lizards will be limited to selected individual trees with high epiphyte loading (five or more perched nested epiphytes located on horizontal branches), areas of native scrub, wood piles and existing sheds and other structures proposed for demolition. Trees with high epiphyte loading will potentially overlap with trees that are considered potential roost trees or labelled as significant trees within this ELMP. All high risk habitat will be determined by the Project lizard ecologist(s).

A high resolution Ecology Constraints Map for each vegetation removal area will be developed prior to vegetation removal and will be used to guide the selection and location of the salvage methodologies as described in Section 7.4.4. The locations of all high risk epiphyte trees and areas of native scrub (also identified by the survey) will be recorded with hand-held GPS units and incorporated onto the Ecology Constraint Map and, where appropriate, clearly marked with flagging tape and/or fluorescent spray paint.

7.4.4 Protocol B: Lizard salvage

Salvage methodologies will only be undertaken during the period from 1st September to 30th April inclusive. Lizard salvage will be undertaken using the methodologies described below. Specific salvage methodologies to be utilised will be guided by the Project lizard ecologist.

7.4.4.1 Nocturnal searches

All areas of native scrub areas within the Project footprint identified by the Project lizard ecologist as 'High Risk' habitat will be searched on a minimum of two separate nights during the four weeks leading up to the commencement of vegetation clearance. Nocturnal searches will be undertaken by using powerful torches and binoculars to 'spotlight' and capture lizards. The focus of nocturnal searches will be on selected individual trees and shrubland edges, and any other habitat features deemed by the Project lizard ecologist to be suitable for nocturnal searching.

An initial 10 person-hours of nocturnal searching per hectare will be undertaken within native scrub deemed to be 'High Risk' lizard habitat. No further nocturnal searching will be undertaken in any habitat areas where no lizards are found during the initial 10 hours of nocturnal searching in areas. If one or more lizards are found in a hectare of ' 'High Risk' habitat, then further searching will be carried out in that area until no further lizards have been found for 10 person-hours of searching. If lizards continue to be found, then a maximum of 50 person-hours of searching per hectare will be applied for each area of 'High Risk' lizard habitat.

7.4.4.2 Manual, destructive and machine-assisted salvage

Systematic manual, destructive and/or machine-assisted searches will be undertaken during vegetation clearance and immediately following vegetation clearance. These methodologies will be used where deemed appropriate by the Project lizard ecologist and will include trees identified with high epiphyte loading are felled and within wood piles and existing sheds and other structures proposed for demolition.

The Project lizard ecologist will be present during the felling of any trees identified as having high epiphyte loading. When a 'High Risk' tree has been felled, and the supervisor of the vegetation clearance contractors has deemed it safe to approach the felled tree, the Project lizard ecologist will immediately commence searching the felled epiphytes for lizards. The tree may be cut into sections to facilitate safe searching and/or destructively searched (e.g., by manually dismantling epiphyte clumps). Where it is not safe to search a felled tree, the tree will instead be cut into sections that will be positioned and stored adjacent to suitable lizard habitat to maximise the likelihood that any lizards present will find their way back to habitat outside the Project footprint.

To minimise mortality and injury to indigenous lizard not detected during the above salvaging operations, high risk felled trees may be cut into sections and stockpiled at the edge of remaining native vegetation for a minimum of one month, or until all foliage has fallen off. It is expected that most indigenous lizards will disperse out of stockpiles and into the adjacent forest. However stockpiles will be searched for lizards at the time of removal/mulching in case any lizards have not dispersed or have colonised the piles.

7.4.5 Protocol B: Capture, handling and release

The following steps will be undertaken by the Project lizard ecologist to ensure appropriate handling of lizards occurs. Capture, handling and release of lizards will be undertaken in accordance with the below methodologies:

- All field equipment that indigenous lizards may come into contact with (e.g., plastic enclosures, collection bags, scales, etc.) will be sterilized, as well as hand sterilisation. All equipment used in their capture will subsequently be disinfected before reuse;
- Salvaged lizards will be either transported in cloth bags (only during salvage, not during transportation) or in suitable ventilated plastic containers. Care will be taken so that the bags and containers will be kept at a constant ambient temperature;
- Where practical, indigenous lizards will be placed individually in ventilated two litre plastic containers for no longer than 8 hours and will be released in the relocation /mitigation site; and
- Salvaged lizards will be released into appropriately prepared and protected habitat (see 7.4.7 below), with the exception of copper skink which will be immediately released within suitable habitats that are not being disturbed alongside the alignment.

7.4.6 Protocol C: Lizard injury or death

The following steps will be implemented if any injured or dead lizards are found during lizard salvage:

- The Environmental Manager and relevant representatives of DOC, TRC and NPDC will be notified at the earliest opportunity within 24 hours after an injured or dead lizard found.
- Injured lizards found during salvage will be taken to a suitably qualified vet as soon as possible for assessment and treatment. Injured lizards will be kept in an appropriate portable enclosure (i.e., a clean, well-ventilated plastic container) under the direction of the Project lizard ecologist to ensure the animal is handled appropriately until the lizard(s) can be assessed and treated. The initial contact vet is:

  Dr Andrew Gore
  Hamilton Zoo
  Brymer Road
  Hamilton
  07 838 6720

  The initial vet contact may refer the lizard assessment and treatment to an alternative specialist if appropriate.
- An injured lizard may be euthanised immediately if it is deemed by the Project lizard ecologist that the injuries are not survivable, and that maintaining the lizard alive is highly likely to cause it inhumane levels of pain and stress. An appropriate euthanasia method will be selected by the Project lizard ecologist.
- Any lizard that is found dead or injured and subsequently euthanised will be returned to DOC as required by the Wildlife permit.
- Lizards assessed by the vet or alternative specialist as uninjured, or otherwise in suitable condition for release, will be transported to the lizard release site in the portable enclosure and released into habitat suitable for the species being released.

7.4.7 Protocol D: Relocation / mitigation site

Suitable relocation / mitigation sites have been identified[7] outside of the project alignment which have known populations of indigenous lizards that can be predator-proof fenced. A process is currently under way to rationalise these sites in order to find an appropriate site of approximately 1ha containing suitable habitat that can be used as both a relocation and mitigation site. Once identified, the relocation / mitigation site will be used in part to offset any unavoidable residual effects on potential indigenous lizard populations within the project alignment.

Indigenous lizards (except copper skink) will be released into suitable habitat within the 1ha predator-proof fenced which has full pest control (including mice) (Section 7.1).

[7] Predator-Proof Fenced Lizard Sanctuary Options, Mount Messenger Bypass Project. Prepared for the Mt Messenger Alliance by Simon Chapman, dated 14 June 2018.

The key aspects of the physical indigenous lizard relocation / mitigation site are:

- Farm livestock will be excluded completely by the construction of the predator-proof fence;
- The predator-proof area will be constructed from wire mesh, shade cloth and a 500mm Colorsteel® section with rolled hood (similar to the schematic shown in Figure 7.1). The fence will be 2000mm high, with a 300 - 400mm skirt pinned to the soil surface;
- The identified relocation / mitigation site will contain suitable habitat for indigenous lizards (ground skinks and arboreal skink and gecko species);
- Any indigenous lizards salvaged will be relocated to suitable habitat(s) within the release site; and
- No pre and post indigenous lizard monitoring is proposed within the relocation / mitigation site. This is because of the inherent difficulties associated with obtaining and interpreting meaningful 'before' and 'after' comparative data on lizard population densities. It is assumed that removing any relic population of indigenous lizards from predator pressure will result in extra carrying capacity to accommodate the release of any salvaged indigenous lizards.

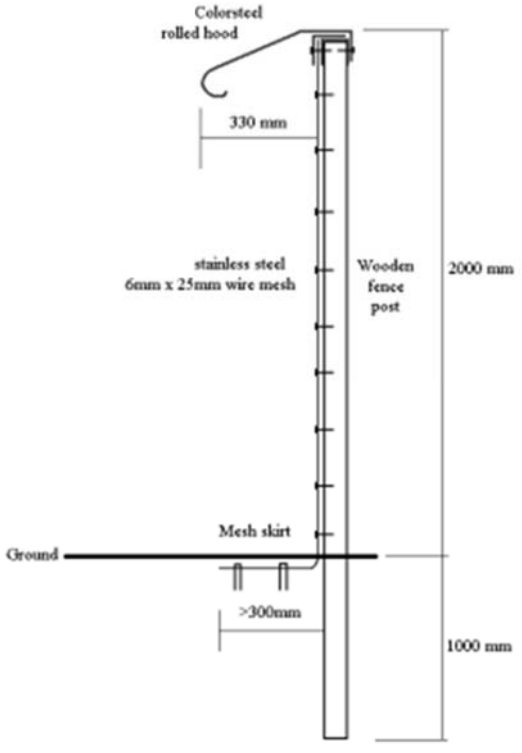

Figure 7.1- Mouse, rat, mustelid, possum and cat proof fence design

7.5 Accidental discovery protocol

Hochstetter's frog (*Leiopelma aff. hochstetteri*) and Archey's frog (*Leiopelma archeyi*) have not been found within the Project footprint during surveys, which may be due to limited habitat availability. Although they are highly unlikely to be found within the Project footprint, their presence cannot be ruled out. If they are found then a Native Frog Management Plan will be developed in consultation with DOC, and will be implemented wherever appropriate across the Project footprint.

7.6 Reporting and communication

The following data will be recorded for all lizards captured:

- Capture location and release location (GPS coordinates)
- Date and time of capture;
- Species;
- Capture methodology;
- A minimum of one photograph of the lizard including at least one photograph showing the dorsal surface clearly;
- Sex and age class;
- Weight;
- Snout to vent length (SVL);
- Health/condition;
- Weather conditions at time of capture; and
- Habitat type at capture location.

Copies of all records will be submitted to DOC's national data repository for lizard records (the BioWeb Herpetofauna database) no later than the 20th day of the month following the month of capture. In addition, if lizards are found within the project area, every six months from the commencement of vegetation clearance, the above data will be compiled, summarised and submitted to DOC, TRC and NPDC in a letter or memorandum which, as a minimum, will include the following information:

- DOC Wildlife Act authority number and Project name and location;
- A summary of the species, numbers and age/sex classes of lizards captured;
- Locations of lizards captured; and
- Summary of salvage methodologies, effort and success;

Six monthly reporting will cease once lizard salvage has been completed and all captured lizards have been released into the release pen. A final report summarising the outcomes of LMP implementation will then be prepared and submitted to DOC, TRC, NPDC and iwi within three months following the final lizard release.

7.7 References

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8 Freshwater Ecology Management Plan

8.1 Introduction

This Freshwater Ecology Management Plan outlines the management processes required to mitigate adverse effects on freshwater ecology as a result of the Project, including minimising effects on aquatic habitats and fauna, aquatic habitat restoration, like-for-like mitigation (new stream diversions) and ecological compensation to address residual habitat loss.

Freshwater effects and mitigation are also considered in the following chapters of this ELMP and other plans:

- Construction Water Management Plan (CWMP) (covers managing construction water discharges, including erosion and sediment control, that could result in adverse effects on water quality);
- Ecological mitigation strategy and framework (ELMP Chapter 3); and
- Landscape and Vegetation Management Plan (ELMP Chapter 4).

The locations of monitoring sites referred to in this plan are provided in the Water Sampling Plan (Appendix C to this ELMP).

8.2 Baseline freshwater ecology

All baseline information pertaining to freshwater ecology in the Project footprint, including the results of field surveys, is included in the following reports:

- Technical Report 7b – Freshwater Ecology (December 2017); and
- Ecology supplementary report – Freshwater Ecology (February 2018).

8.3 Mitigation and offset measures

8.3.1 Fish Recovery and Rescue Protocols (FRRP)

Works within waterways have the potential to cause the direct removal/stranding of or injury to aquatic life. In particular, work in low gradient streams could affect species including inanga, longfin eel, redfin bully, giant kōkopu, kōura and kākahi; and work in steeper gradient streams could affect banded kōkopu, longfin eel, redfin bully and kōura.

The direct effect of earthworks on freshwater species (ie fish, kōura and kākahi) can be considerably minimised and mitigated by implementing FRRP prior to dewatering, diverting or excavating streams.

The FRRP are provided in Appendix D to the ELMP. These protocols describe the methods that will be undertaken to minimise direct effects of construction on fish, kōura and kākahi (freshwater mussels) in waterways affected by the Project. They cover procedures and locations for:

- recovery of fish prior to instream works;

- rescue of fish from any spoil; and
- relocation of fish.

8.3.2 Sediment control – Mimi swamp forest

Fine sediment is a typical feature of the substrate in streams around Mt Messenger due to the papa mudstone geology. However, construction activities have the potential to accelerate erosion and sedimentation, with consequential adverse effects on aquatic life.

Erosion and sediment deposition will be minimised and mitigated by ensuring good Erosion and Sediment Control (E&SC) practices, as described in the CWMP.

The part of the Project area most sensitive to additional sedimentation is the tributary of the Mimi Stream draining the southern tunnel portal (monitoring site E6 in the Freshwater Ecology Report).) The tributary runs into the Mimi wetland which supports raupo reedland / rautahi swamp and adjacent kahikatea / swamp maire forest. The kahikatea swamp maire forest is a pristine example of this habitat type. Although the raupo reedland buffers the kahikatea swamp maire forest from sediment, particular care will be taken at this location to ensure appropriate E&SC as set out in the CWMP. Additional monitoring will be undertaken here, to confirm that the Project will minimise sediment deposition within the swamp forest (refer to Section 8.4).

8.3.3 Vegetation Clearance Protocols

Vegetation clearance can have a number of potential effects on streams. Felling and removal of trees can expose soil, making it more prone to erosion. In addition, the accumulation or storage of sawdust, chip or mulch near or over waterways can leach dissolved organic matter that can promote heterotrophic growths or deplete dissolved oxygen in stream water.

Any adverse effects arising from vegetation clearance will be minimised by following procedures in the Landscape and Vegetation Management Plan and associated Vegetation Clearance Protocol (Chapter 4 of this ELMP). This includes procedures for:

- minimising the area and duration of soil exposure from vegetation clearance;
- minimising the volume of vegetation to be mulched;
- locating wood residue piles with an appropriate separation distance from any waterways (either permanent, intermittent or ephemeral); and
- setting aside sections of trees to be used as part of restoration work (e.g. root balls, trunks and branches).

If vegetation clearance adjacent to streams occurs prior to fish recovery, then care will be taken to ensure direct effects on the stream are minimal and logs and branches do not prevent access to the stream (see Chapter 4).

8.3.4 Fish passage

Many New Zealand fish are diadromous and need to migrate between fresh water bodies and the sea in order to complete their life-cycle. The upstream migration seasons for the

migratory fish species present in the Mimi Stream and Mangapepeke Stream span most of the year (August to April inclusive), but for most of these species, the peak migration occurs during spring to early summer (August to December).

Project work includes the installation and/or extension of culverts and the diversion of waterways resulting in the loss of existing stream habitat. The potential effects of these works on fish passage will be minimised by following procedures described in Chapter 6.6 of the CWMP. This includes:

- timing of online stream diversion works to avoid peak fish migration and spawning seasons as practicable;
- where possible, timing works for a suitable fine weather window forecast;
- providing appropriate fish passage for culverts;
- undertaking work offline (outside the active stream channel) where practical; and
- following the FRRPs.

The specific design to enable fish passage will be confirmed prior to construction. In addition, Specific Construction Water Management Plans (SCWMPs) will be prepared for stream works to confirm:

- design details, including fish passage provisions (refer sections 8.3.4.1, 8.3.4.2 and 8.3.4.3) ;
- the method of construction;
- stream dewatering and reclamation;
- stream diversion method (online or offline) to allow construction near or within the active stream channel; and
- timing of works to avoid peak fish migration and spawning as practicable.

8.3.4.1 Timing of works

One way to reduce the potential effects of earthworks on fish spawning and migration is to avoid or minimise works during months when key fish species in the catchment may be migrating or spawning. For the Project there are practical constraints in seasonally stopping work across the whole site and it may increase the risk of erosion if it means the construction phase takes appreciably longer. However, there may be opportunity to adjust the timing of works in particular catchments.

Generally, it is more important to maintain unimpeded fish passage during peak migration periods for streams with larger upstream catchments than those with small upstream catchments. This principle can be used to direct the timing of works in different parts of the catchment. Where practicable, avoid large scale instream works during August to October and April to June (inclusive). These are the spawning seasons for redfin bully and giant kōkopu respectively. This condition particularly applies to the large areas of fill required near the tunnel portals but should be applied flexibly to avoid the work being left incomplete over the winter.

8.3.4.2 Fish passage through temporary culverts

Measures to mitigate the short-term effects of culvert construction on fish passage are described in the Construction Water Management Plan (CWMP). These include minimising the length of time construction activities cause a fish passage barrier by constructing culverts and diversions in the dry, where possible.

In the large area of fill near the tunnel portals, the short-term effects on fish passage will be mitigated either by installing spat rope through the culvert or by implementing trap and transfer. The approach is dependent on the timing and duration of works, and on physical stream characteristics such as stream flow. The method will be detailed within the SCWMP.

Where spat rope is used to provide short-term fish passage they will be installed in the following way:

- A minimum of three rope lines are used.
- Ropes will be installed so that they are tight and flush with the base of the culvert through the entire length of the culvert and not out of the water.
- Ropes will be set out to provide 'swimming lanes' between the ropes.
- Knots (half hitches) will be tied along the sections of rope in the culvert barrel to break up the flow.
- Non-loop rope types will be used to reduce the likelihood of debris snagging on the ropes.

8.3.4.3 Fish passage through permanent culverts

A description of culvert design and approach to fish passage for each culvert is provided in the Culvert Schedule and Typical Drainage Details (Drawing Number MMA-DES-DNG-CO-DRG-4006), and Tables 1 and 2 attached in Appendix E. This includes culvert dimensions, length, grade and general approach to fish passage.

Priorities for fish passage at specific culvert locations has been assessed by the Project Freshwater Ecologist, and has been used to inform fish passage design taking into account the NIWA, New Zealand Fish Passage Guidelines, April 2018. Table C-1 summarises these design considerations.

At all other culvert locations, improvements for fish passage will be designed in general accordance with the NZ Transport Agency fish passage guidance for state highways (2013), where:

- Type 1 Culvert, steep gradient (ca. >1%): fish passage will be provided by installing baffles within the culvert. Baffles will be appropriately spaced for the culvert gradient to ensure continuous fish passage.
- Type 2 Culvert, shallow gradient (ca. <1%): the culverts will be sufficiently sized to allow for fish passage. The culvert's downstream invert will be set below the existing stream bed by at least 25% of the culvert diameter and not less than 200mm. This is to help retain stream substrate in the base of the culvert.

- Type 2 culverts with a grade between 0.5% and 1% will have spoiler type baffles or equivalent features to retain substrate and ensure fish passage.

  If practicable, the final design of Type 2 culverts will reduce the grade to less than 0.5% and preferably closer to 0.3% grade, unless the natural stream channel is steeper.
- Culvert outlets will provide a resting pool (>300mm deep) and ensure at least 100mm of water depth is retained at the culvert outlet and over the apron.
- Energy dissipation structures or erosion protection structures at culvert inlets and outlets shall not impede fish passage.
- Where large diameter rock is used for erosion protection on the streambed this shall be either set below the natural stream bed level or layered with fine gravels (e.g. gap 40) to ensure that voids are sufficiently filled so that stream water flows over the rock rather than through the rock.

The detailed design of culverts shall be confirmed prior to construction. This shall include details to ensure fish passage:

- Permanent culvert dimensions, grades, inverts, and improvements for fish passage.
- The type and spacing of any baffles.
- Identification of locations where spat rope approach will be used. This will be limited to situations where other solutions are not practicable and where natural barriers (waterfalls) restrict the upstream fish community to climbing species.
- Outlet structure design to provide a resting pool near the outlet and ensure at least 100mm of water depth is retained at the culvert outlet and over the apron.

8.3.5 Minimising adverse effects from in-stream works

During construction, the Project Freshwater Ecologist will communicate with the Construction Manager to discuss optimisation regarding fill disposal sites, to attempt to reduce the overall length of culverts and stream diversions if practicable.

8.3.5.1 Stream diversion design

The detailed design of stream diversions is in progress. The aim of the design to match existing habitat types and follow the general principles that are provided in Stream Ecological Design Principles (section 7 of Landscape and Environmental Design Principles (LEDP)). These general principles address:

- structure and morphology;
- substrate on stream bed and banks;
- stream bank stabilisation; and
- riparian vegetation.

8.3.5.2 Stream Rehabilitation

Some stream sections will temporarily piped through culverts to allow access tracks to be built. The temporary access track culverts over the main stem of the Mangapepeke Stream and south of site Ea10 will be removed at the end of the Project. The stream sections affected by these culverts will be restored by following the same principles as described in the Stream Ecological Design Principles, chapter 7 of the LEDF.

8.3.6 Offsets of stream loss

8.3.6.1 Restoration to offset stream loss

This Project has included measures to avoid, minimise and mitigate effects on freshwater ecology; however, biodiversity offsets are required to achieve 'no net loss of ecological values' or a 'net positive gain'. This will take the form of riparian restoration on streams outside of the directly-affected area to improve ecological functions at those locations. The amount of stream restoration work required to offset effects on waterways was calculated using the Stream Ecological Valuation (SEV) approach. This needs to be confirmed when the areas being used for restoration are known or if there are substantial design changes during the consent process.

The overall mitigation approach for the Project and the restoration work being used for the purposes of offsetting are described in Chapter 3 of this ELMP.

The amount of stream offset required to address stream loss will be confirmed when the detailed designs are completed. The stream offset requirements will be recalculated using the same method as described in the AEE Freshwater Ecology and in the Freshwater Ecology Supplementary Report. It is envisaged that the recalculation will consist of updating the length of stream affected to reflect the final design and the corresponding changes to the offset.

The stream offset package developed for the Project was based on stream length rather than stream area. This was conservative, it resulted in more stream restoration than if area was used because the stream reaches being restored are on average about 10% wider than the affected streams. The same approach will be used for the recalculation, i.e. the recalculated offset will be based on stream length.

8.3.6.2 Stream Restoration Plan (SRP)

A Stream Restoration Plan (SRP) was recommended in the AEE to guide restoration and improve certainty that the assumed restoration outcomes will be achieved. However, there is considerable spatial overlap between restoration of stream diversions and restoration undertaken for the purpose of offset mitigation. To avoid duplication and inconsistencies, a stand-alone Stream Restoration Plan is not proposed, as the content of an SRP is captured in the Ecological Design Principles (Chapter 7 of the LEDF) and in Chapter 4.6 of this ELMP (Landscape and Vegetation Management Plan).

8.3.7 Water takes

8.3.7.1 Water take

The Project requires two water takes for the purpose of dust suppression. The potential adverse effect of the water takes on stream habitat will be minimised by limiting the rate of the water take, monitoring water take volume, monitoring stream flow and ceasing the water abstraction when flow drops below a critical level. The critical level for ceasing the water takes is based on maintaining greater than two thirds of instream habitat available at mean annual low flow (MALF).

For the Mangapepeke Stream:

- The volume of water abstracted shall not exceed 300m^3/day, at an instantaneous rate of less than 5 L/s.

For the Mimi Stream:

- The volume of water abstracted shall not exceed 150 m^3/day, at an instantaneous rate of less than5 L/s.

8.3.7.2 Water intake structure

The water intakes (e.g. for dust suppression or when pumping to dewater an area) will be designed to exclude fish. This will include:

- an equivalent screen mesh size 3mm or less (side of square); and
- an intake surface area of sufficient size that water velocities through the intake are less than 0.12m/s.

8.3.7.3 Weir structure

Temporary weirs may be installed on the Mangapepeke Stream and Mimi Stream to create a small head pond to assist with water abstraction. The weirs will only be constructed if necessary for the water take or monitoring. The weirs will be constructed of sand bags or similar material. The height of the weir will be as low as practical and will not exceed 1m. The weirs will not restrict natural fish passage past them.

In order to provide fish passage over the weirs the following guidelines will be applied:

- The downstream edge of the crest should be rounded and consist of a rock ramp.
- The downstream slope should be gentle, and less than 1:30 to provide passage for inanga.
- The weir should have a V-shaped lateral profile, sloping up at the banks and providing a low-flow channel in the centre (about 5-10° lateral cross-section slope).
- The weir should create a hydraulically diverse flow environment including continuous low velocity wetted margins and resting areas.

8.4 Monitoring

This section describes monitoring that will be undertaken to assess potential effects of the Project on stream habitat and aquatic life. Baseline ecological information has been collected for the Mangapepeke Stream and Mimi Stream during field investigations in February 2017, June 2017, August 2017 and November 2017.

Monitoring will comprise:

- pre-construction monitoring - baseline;
- construction monitoring – routine; and
- construction monitoring – event based.

8.4.1 Monitoring sites

Monitoring site locations (see Ecology Constraints Map, Appendix A to the ELMP) and methods are summarised in Table 8.1. Coordinates represent the proposed water quality sampling point. Coordinates for the exact survey reaches will be collected during the first survey round.

The downstream ecology monitoring site on the Mangapepeke Stream was placed at site E2 rather than further downstream because the habitat at this site is better matched with the control site. Similarly, the downstream site on the Mimi Stream was placed at site Ea26 rather than further downstream at site E7 because the tributary is expected to be more sensitive to any effects than the main stem of the Mimi Stream.

Table 8.1 – Stream monitoring locations and method summary

Monitoring ID	Site	Catchment	Coordinates (NZTM)		Type	Description and notes
			Latitude	Longitude		
EM1	Ea10a	Mangapepeke	38.883153	174.605548	M, F	Control site, on an unnamed tributary 40 m upstream of the confluence with the Mangapepeke stream.
EM2	E2	Mangapepeke	38.875669	174.600579	M, F	Downstream ecology site on Mangapepeke Stream.
EM3	u/s E4	Mangapepeke	38.888551	174.601769	M,F	Downstream of fill 12 (40 m u/s of E4). Grid reference for most downstream end of the reach.
EM4	u/s Ea25	Mimi	38.902360	174.597168	M, F	Control site, upstream of works. Potential restoration area.
EM5	d/s E6	Mimi	38.902147	174.596495	Se	Event based sediment deposition monitoring site (330 m d/s of E6).
EM6	Ea25	Mimi	38.903034	174.594584	F	Event based monitoring downstream of fill 13 (in Mimi swamp forest).
EM7	d/s E6	Mimi	38.900135	174.596815	M	Downstream of fill 13 (100 m d/s of E6).
EM8	Ea26	Mimi	38.903309	174.591411	W, M, F	Downstream sites located on tributary to the Mimi Stream (just upstream of confluence).

Notes F = fish, M = Macroinvertebrates, Se = Sedimentation Plates, W = water quality

8.4.2 Pre-construction monitoring - baseline

8.4.2.1 Water quality during rain events

Water quality during rain events is currently being monitored in the Mangapepeke Stream and the Mimi Stream using passive samplers. In each catchment there is a site near downstream of the extent of works and a control site in an adjacent paired catchment. All of these sites provide a preconstruction baseline water quality data set. This water quality monitoring is described in the CWMP.

8.4.2.2 Sediment deposition

Sediment plates[8] have been established at the end of the stream channel downstream of site E6 (monitoring ID EM5). This site is within the raupo reedland, downstream of the Mimi Stream tributary draining the tunnel portal, located upstream of the Mimi swamp forest.

The purpose of the sediment plates is to monitor any sediment deposition that might extend from the end of the stream to the Mimi swamp forest. The plates will be monitored following heavy rain events during the baseline period and weekly during construction but are primarily intended to be monitored if there is a sediment release event in the upstream catchment.

8.4.2.3 Fish monitoring

Fish monitoring will be undertaken during a flow period at least two weeks following any large flood event. The sampling will occur biannually for one summer period immediately prior to earthworks (spring sampling – October to December and summer sampling February to April).

The sites sampled for fish monitoring will be:

Managapepeke catchment:

- EM1 at site Ea10a (control);
- EM3 at site u/s E4 (downstream of fill 12); and
- EM2 at site E2 (downstream).

Mimi catchment:

- EM4 at site u/s Ea25 (control);
- EM6 at site Ea25 (Mimi swamp forest); and
- EM8 at site Ea26 (downstream). [9]

[8] The sediment plates used are artificial astroturf attached to a tray on and placed on the sediment surface; accumulation is measured within and above the astroturf. Fine sediment is measured as millimetres deposited on the plate, recorded as the average of three readings per plate.

[9] Fish monitoring is not proposed for site d/s E6 due to very low fish abundance found in previous surveys (e.g. 2 banded and 1 longfin in a 220m reach during November 2017). The natural low fish abundance at this site makes it an unreliable measure for assessing effects. Monitoring fish at site Ea25 prior to construction provides a better baseline for event-based monitoring.

Fish surveys will use methods consistent with the New Zealand freshwater fish sampling protocols (Joy et al. 2013). At most sites sampling will occur with fine-mesh fyke nets and gee minnow traps. At each site a minimum of six fyke nets will be deployed over an ca. 150m reach.

At the site u/s E4 fish will be surveyed over a ca. 150m reach using the backpack electro-fishing method. This site has gravel substrate and relatively shallow water suited to electro-fishing.

Fish will be identified, counted and lengths recorded. The results will be reported as total caught and in terms of catch per unit effort (CPUE).

8.4.2.4 Aquatic macroinvertebrate monitoring

Aquatic macroinvertebrate monitoring will be undertaken during base flow conditions at least two weeks following any large flood event. The sampling will occur biannually for one summer period immediately prior to earthworks (spring sampling – October to December and summer sampling February to April).

The sites sampled for aquatic macroinvertebrate monitoring will be:

Managapepeke catchment:

- EM1 at site Ea10a (control), soft-bottom, one replicate;
- EM3 at site u/s E4 (downstream of fill 12), hard-bottom, five replicates; and
- EM2 at site E2 (downstream), soft-bottom, one replicate.

Mimi catchment:

- EM4 at site u/s Ea25 (control), soft-bottom, one replicate;
- EM7 at site d/s E6 (downstream fill 13), hard-bottom, five replicates ; and
- EM8 at site Ea26 (downstream), soft-bottom, one replicate.

Aquatic macroinvertebrate surveys will use methods consistent with Protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). At most sites (i.e. Ea10, E2, u/s Ea25 and Ea26) the sampling will use the semi-quantitative method for soft-bottomed streams (Protocol C2). A single replicate will be collected from stable habitat (e.g. bank margins, wood, macrophytes) sampled along a 50m to 100m reach. A consistent sampling effort will be applied at each site as described in Protocol C2. Samples from these sites will be processed using Protocol P2 – 200 Individual Fixed Count with Scan for Rare Taxa.

At the sites u/s E4 and d/s E6 sampling will use the quantitative method for hard-bottomed streams (Protocol C3). Five replicates will be collected along a 50m to 100m reach from riffle habitat using a Surber sampler[10]. These sites have gravel substrate suited to using hard-bottomed sampling protocol. Samples from these sites will be processed using Protocol P3 – full count with subsampling option.

[10] Quantitative sampling of aquatic macroinvertebrates is only proposed at the two sites downstream of the fill (u/sE4 and d/s E6) because these sites more sensitive and have hard-bottomed substrate. Quantitative sampling methods are more consistent and reliable for hard-bottom sites compared to the soft-bottom sites which have variable instream habitat and often lack macrophytes.

For each site the area sampled and type of stable habitat sampled will be recorded. The following metrics will be calculated from the aquatic macroinvertebrate data: taxa richness, Macroinvertebrate Community Index (MCI), Quantitative Macroinvertebrate Community Index (QMCI), %EPT taxa and %EPT abundance. EPT (Ephemeroptera-Plecoptera-Trichoptera) metrics will exclude the species *Oxyethira* and *Paroxyethira*.

Habitat and sediment characteristics will be measured along each reach where aquatic macroinvertebrate samples are collected.

The habitat measures shall include:

- Macrophyte cover assessed using the rapid assessment protocol in the 'Regional Guidelines for Ecological Assessment of Freshwater Environments: aquatic plant cover in wadeable streams' (Collier et al. 2014). This involves assessing emergent and submerged macrophyte cover and type occupying a one metre wide belt across the stream at five transects spaced along the reach;
- Sediment cover: bankside visual estimate of percent cover, Sediment Assessment Method 1 in Clapcott et al. (2011);
- Substrate size – wolman pebble count, Sediment Assessment Method 3 in Clapcott et al. (2011); and
- Resuspendable sediment (Shuffle Index), Sediment Assessment Method 5 in Clapcott et al. (2011).

8.4.3 Monitoring during construction

Construction monitoring will commence when construction begins upstream of a section of stream and finish when construction activities affecting any given catchment are complete.

8.4.3.1 Fish monitoring

Fish monitoring will be undertaken during a flow period at least two weeks following any large flood event. The sampling will occur biannually for one summer period immediately prior to earthworks (spring sampling – October to December and summer sampling February to April).

The sites sampled for fish monitoring will be:

Managapepeke catchment:

- EM1 at site Ea10a (control);
- EM3 at site u/s E4 (downstream of fill 12 only during filling activity); and
- EM2 at site E2 (downstream).

Mimi catchment:

- EM4 at site u/s Ea25 (control);
- EM6 at site Ea25 (downstream fill 13 only during filling activity); and

- EM8 at site Ea26 (downstream). [11]

It is noted that sampling at site u/s E4 and Ea25 will only occur during the fill activity. It is also noted that following at least one year of baseline monitoring and one year of construction monitoring, aquatic macroinvertebrate monitoring will be reduced from to twice yearly (spring and summer) to annual monitoring during summer. This reduction in frequency may occur at all sites if the first year of monitoring finds only small changes in the fish community compared to baseline sampling after accounting for any variation at the control site.

Fish surveys will use methods consistent with the New Zealand freshwater fish sampling protocols (Joy et al. 2013). At most sites sampling will occur with fine-mesh fyke nets and gee minnow traps. At each site a minimum of six fyke nets will be deployed over an ca. 150m reach.

At the site u/s E4 fish will be surveyed over a ca. 150m reach using the backpack electro-fishing method. This site has gravel substrate and relatively shallow water suited to electro-fishing.

Fish will be identified, counted and lengths recorded. The results will be reported as total caught and in terms of catch per unit effort (CPUE).

8.4.3.2 Aquatic macroinvertebrate monitoring

Aquatic macroinvertebrate monitoring will be undertaken during base flow conditions at least two weeks following any large flood event. The sampling will occur biannually for one summer period immediately prior to earthworks (spring sampling – October to December and summer sampling February to April).

The sites sampled for aquatic macroinvertebrate monitoring will be:

Managapepeke catchment:

- EM1 at site Ea10 (control), one replicate;
- EM3 at site u/s E4 (downstream of fill 12 only during filling activity), five replicates; and
- EM2 at site E2 (downstream), one replicate.

Mimi catchment:

- EM4 at site u/s Ea25 (control), one replicate;
- EM7 at site d/s E6 (downstream fill 13 only during filling activity), five replicates; and
- EM8 at site Ea26 (downstream), one replicate.

It is noted that sampling at site u/s E4 and d/s E6 will only occur during the fill activity. It is also noted that following at least one year of baseline monitoring and one year of construction monitoring, aquatic macroinvertebrate monitoring will be reduced from twice

[11] Fish monitoring is not proposed for site d/s E6 due to very low fish abundance found in previous surveys (e.g. 2 banded and 1 longfin in a 220m reach during November 2017). The natural low fish abundance at this site makes it an unreliable measure for assessing effects.

yearly (spring and summer) to annual monitoring during summer. This reduction in frequency may occur at all sites if the first year of monitoring finds only small changes in the aquatic macroinvertebrate community, e.g. a less than 20% change in QMCI or MCI compared to baseline sampling.

Aquatic macroinvertebrate surveys will use methods consistent with Protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). At most sites (i.e. Ea10, E2, Ea27 and Ea26) the sampling will use the semi-quantitative method for soft-bottomed streams (Protocol C2). A single replicate will be collected from stable habitat (e.g. bank margins, wood, macrophytes) sampled along a 50m to 100m reach. A consistent sampling effort will be applied at each site as described in Protocol C2. Samples from these sites will be processed using Protocol P2 – 200 Individual Fixed Count with Scan for Rare Taxa.

At the sites u/s E4 and d/s E6 sampling will use the quantitative method for hard-bottomed streams (Protocol C3)[12]. Five replicates will be collected along a 50m to 100m reach from riffle habitat using a Surber sampler. These sites have gravel substrate suited to using hard-bottomed sampling protocol. Samples from these sites will be processed using Protocol P3 – full count with subsampling option.

For each site the area sampled and type of stable habitat sampled will be recorded. The following metrics will be calculated from the aquatic macroinvertebrate data: taxa richness, Macroinvertebrate Community Index (MCI), Quantitative Macroinvertebrate Community Index (QMCI), %EPT taxa and %EPT abundance. EPT (Ephemeroptera-Plecoptera-Trichoptera) metrics will exclude the species *Oxyethira* and *Paroxyethira*.

Habitat and sediment characteristics will be measured along each reach where aquatic macroinvertebrate samples are collected.

The habitat measures shall include:

- Macrophyte cover assessed using the rapid assessment protocol in the 'Regional Guidelines for Ecological Assessment of Freshwater Environments: aquatic plant cover in wadeable streams' (Collier et al. 2014). This involves assessing emergent and submerged macrophyte cover and type occupying a one metre wide belt across the stream at five transects spaced along the reach;
- Sediment cover: bankside visual estimate of percent cover, Sediment Assessment Method 1 in Clapcott et al. (2011);
- Substrate size – wolman pebble count, Sediment Assessment Method 3 in Clapcott et al. (2011); and
- Resuspendable sediment (Shuffle Index), Sediment Assessment Method 5 in Clapcott et al. (2011).

[12] Quantitative sampling of aquatic macroinvertebrates is only proposed at the two sites downstream of the fill (u/sE4 and d/s E6) because these sites more sensitive and have hard-bottomed substrate. Quantitative sampling methods are more consistent and reliable for hard-bottom sites compared to the soft-bottom sites which have variable instream habitat and often lack macrophytes.

8.4.4 Event based monitoring

Event-based monitoring will occur in response to an event such as heavy rainfall, exceedance of a trigger (25mm of rainfall within 24 hours and/or 15mm of rainfall within 1 hour) as defined in the CWMP, an unscheduled event like a failure of sediment control devices, or a chemical spill or construction accident.

Water quality monitoring during rain events and monitoring associated with chemical spills is outlined in the CWMP. The CWMP treats the whole construction site as high risk of erosion events; however, some receiving environments are more sensitive to sedimentation, in particular the kahikatea swamp forest in the Mimi catchment downstream of the tunnel portal. Additional event-based monitoring will therefore occur in this area if triggered by an event. The CWMP provides trigger values for when additional ecological monitoring will be required.

Event-based monitoring will take place (as described below) when there is:

- risk of sediment deposition in the Mimi Swamp Forest (Mimi Stream); and / or
- major spill or leaching of contaminants.

Risk of sediment deposition in the Mimi Swamp Forest (Mimi Stream)[13]

Trigger: 25mm of rainfall within 24 hours and/or 15mm of rainfall within 1 hour, or exceedance of management thresholds at upstream sediment retention ponds.

Monitoring action 1: Visual inspection of extent of sediment deposition in Raupo reedland and around the stream. Measure sediment deposition on sediment deposition plates. If an event causes sediment deposition greater than 6mm at any point along the line shown in Figure 8.1 and it is likely to be associated with the Project, then undertake further ecological monitoring in the Mimi swamp forest. The amount of sediment deposition shall be recorded and sediment plates shall be renewed after each event.

Monitoring action 2: The additional monitoring in the Mimi swamp forest will involve suitably qualified Project ecologists assessing the extent of any effect on the Mimi swamp forest including: visual inspection of any sediment deposition, vegetation condition survey, and fish survey. The suitably qualified ecologists shall prepare a report that includes an assessment of the overall magnitude of any effects associated with the Project on the Mimi

[13] Event based monitoring is not proposed for aquatic macroinvertebrates or fish other than that described for downstream of the Mimi Swamp Forest (Mimi Stream). This is in part because of the importance of this area, but also because sediment events are highly correlated with floods, which themselves have large natural effects on fish and macroinvertebrate communities. In the absence of closely matched control sites this makes it difficult to distinguish the effect of a sediment event from that of the flood and making it difficult to meet standard sampling criteria.

swamp forest (ie 'negligible', 'very low', 'low', 'moderate', 'high', 'very high') and recommendations for further monitoring or remedial actions.

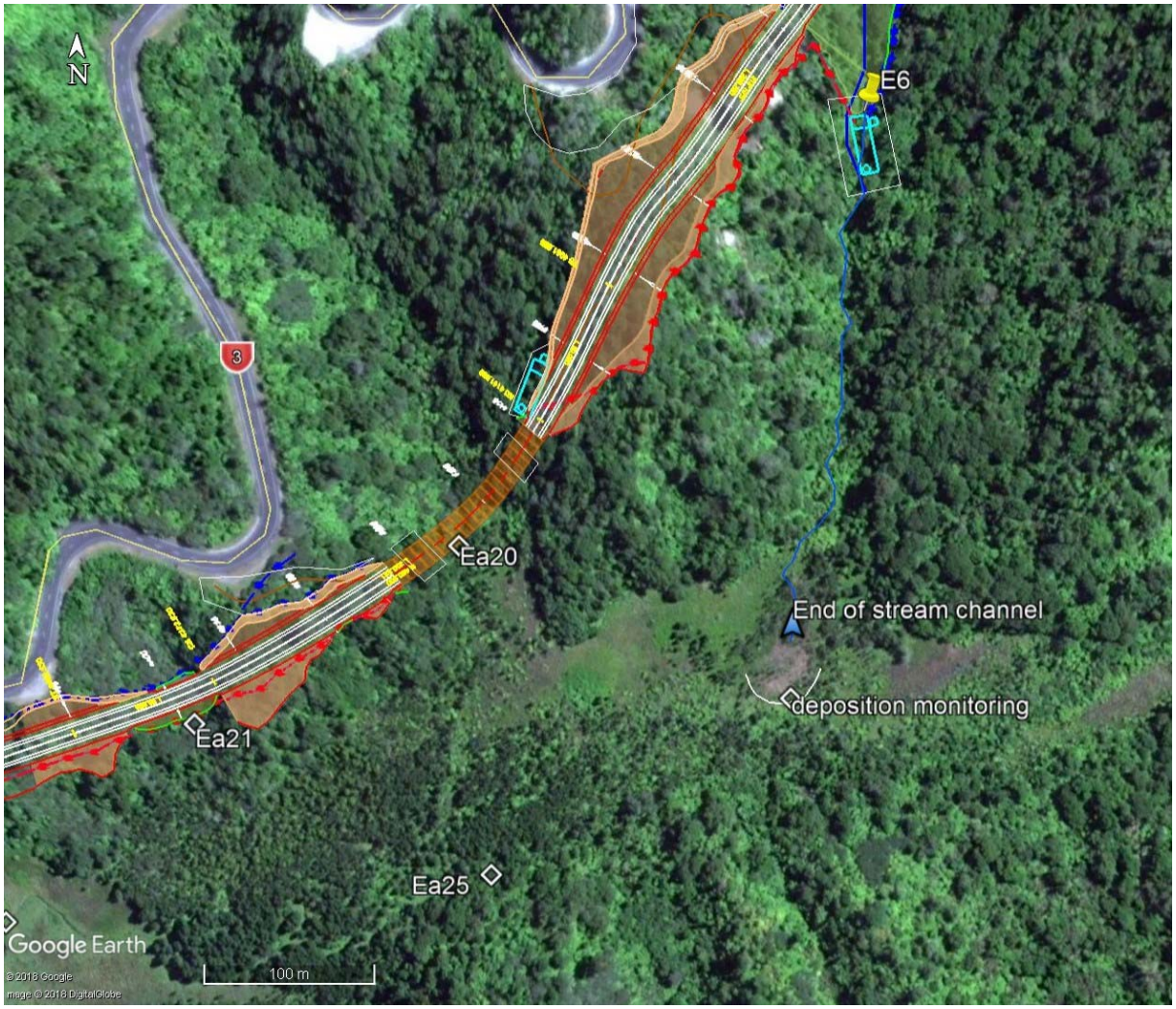

Figure 8.1 – Location of stream channel entering raupo wetland and location of event-based sediment deposition monitoring near the northern extent of the Mimi kahikatea swamp forest

8.4.4 Fish passage through culverts

8.4.4.1 Post construction inspection

All permanent and temporary (where feasible) culverts have been designed to provide for fish passage. All permanent culverts, and associated inlet and outlet structures, shall be inspected following their construction to ensure that they meet the design requirements to provide for fish passage. The inspection shall be done by a suitably qualified ecologist or engineer. The inspection shall assess installation and spacing of baffles or spat rope, sediment retention and water depth within the culvert, water depth over aprons and outlet structures, potential barriers in the form of shallow water, high water velocity or perches. A

report shall be prepared identifying whether the culverts meet their design specification, any potential fish passage barriers and recommendations on how to rectify any potential fish passage barriers.

8.4.4.2 Fish passage monitoring

Actual fish passage through culverts shall be monitored at the three culverts with the largest upstream catchments. These are:

- culvert 9 (site Ea10a) with a 67ha catchment upstream;
- culvert 15 (site Ea16) with a 36ha catchment upstream; and
- culvert 18 (site Ea23) with a 25ha catchment upstream.

Fish passage monitoring will occur after peak upstream migration (August – December) upstream of culverts 9, 15 and 18 annually for two years after construction is completed. The monitoring will be used to determine if recruitment is occurring by assessing if a suitable age structure (juvenile and adult fish) is present within the fish population above culvert 9 and culvert 15.

Baseline fish monitoring has occurred at site Ea10a and Ea23a but has not occurred at site Ea16 due to safety constraints involving climbing a waterfall downstream of the site. Prior to the culverts being installed a fish survey will occur at site Ea16 to provide a baseline information on fish species and age structure. This may occur in association with fish recovery prior to operations.

If after 2 years the recruitment of young fish is not occurring then refinements to the culverts fish passage devices will be made, where practicable, to remedy any barriers to upstream fish migration.

8.5 Reporting

Annual freshwater ecology reporting will be completed at the end of pre-construction monitoring – baseline and at the end of each earthworks season (June) during construction. Annual reporting will be provided in memorandum format to Taranaki Regional Council (TRC) and include:

- fish rescued as described in the FRRP;
- location and description of culverts installed;
- location and description of stream diversions stated; and
- an assessment of the overall magnitude of any effects associated with the Project on the streams (ie. ‘negligible’, ‘very low’, ‘low’, ‘moderate’, ‘high’, ‘very high’). The assessment shall consider the effects on the stream as a whole, including spatial extent, persistence, frequency and the extent to which effects cascade through the ecosystem (e.g. effects on substrate, macrophytes, invertebrates and fish). The effects shall be interpreted in the context of results from baseline monitoring, control sites, and water quality monitoring.

Event-based reporting will be provided to TRC within 15 working days of ecological response to an event, and will include the following information:

- the causes of the discharge, the response to remedy the cause and measures proposed to avoid a recurrence of this cause; and
- an assessment undertaken by a suitably qualified and experienced aquatic ecologist which details any effects of the exceedance.

The report required above will detail what remedial and mitigation measures are proposed and the timeframes for implementing those measures.

8.6 Training

A suitably qualified practitioner in freshwater ecology (SQP-E) shall oversee the implementation of management measures and monitoring outlined in this management plan.

The SQP-E will also train construction teams in appropriate implementation of the Fish Rescue and Recovery Protocols.

8.7 References

Clapcott, J.E., Young, R.G., Harding, J.S., Matthaei, C.D., Quinn, J.M. and Death, R.G. 2011. Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, Nelson, New Zealand.

Collier K., Hamer M., Champion, P. 2014. Regional guidelines for ecological assessments of freshwater environments: Aquatic plant cover in wadeable streams – version 2. Environment Waikato Technical Report 2014/03.

Joy M, David B, Lake M 2013. New Zealand Freshwater Fish Sampling Protocols: Part one – wadeable rivers and streams. Massy University, Palmerston North.

New Zealand Transport Agency 2013. Fish passage guidance for state highways. Version 1.0. ISBN 978-0-478-40716-7

Stark, J. D.; Boothroyd, I. K. G; Harding, J. S.; Maxted, J. R.; Scarsbrook, M. R. 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

9 Pest Management Plan

9.1 Introduction

The ecology technical reports prepared for the Project (Volume 3 of the AEE) have identified introduced animal pests as having significant impact on the indigenous plants and animals in the forest and wetland areas within and adjacent to the Project footprint. Intensive, enduring pest management is therefore the priority focus for offsetting as it will result in the most immediate and largest net ecological gain.

9.2 Pest management programme overview – expected results and outcomes

The intention is to intensively manage target pest species to low densities in perpetuity (or until such time as pest management is no longer necessary) over a 3650ha largely forested area (the Pest Management Area – PMA) (Figure 9.1).

The Pest Management Programme will target rats, possums, mustelids (stoats and ferrets), cats, goats and pigs. Hedgehogs are also likely to be effectively controlled as a result of the Pest Management Programme but they are not target pests for this programme because their impact is likely to be less significant. Farm livestock will also be excluded by the construction of permanent fencing where necessary.

Intensive, effective and enduring pest management, with a focus on controlling all target pest species, can be expected to generate biodiversity benefits across a wide range of plants and animals. Long-tailed bats, many forest bird species including kiwi, and most wetland bird species will increase in number as predatory pressures are greatly reduced and habitat recovery increases local carrying capacities. The extension of the PMA to 3650ha has been proposed to improve the likelihood increase in the population levels of the long-tailed bat.

Reptiles and invertebrates will benefit from the increased diversity and abundance of habitat but may not benefit from the management of possums, rats, mustelids and ungulates to the same extent as birds and bats.

Rapid recovery of palatable sub-canopy, canopy and emergent forest giants, such as kamahi, northern rata and totara, is expected to occur within 10 years, as a result of possums being controlled to very low levels. As grazing and browsing pressure is reduced on the forest floor as a result of ungulate removal, the abundance of palatable shrub and fern species and tree seedlings is also expected to rapidly improve.

With habitat improvements in a low-pest environment, the carrying capacity within the PMA for many indigenous animal species will increase substantially. This will result in spill over benefits for surrounding areas as juvenile birds and bats disperse.

The pest management proposed is in perpetuity (or until such time as pest management in the form we know of it today is no longer necessary to sustain the levels of biodiversity created). This will result in permanent ecological benefits within the PMA. When combined

with the pest management occurring at Parininihi, some wider benefits will also accrue such as increasing the area of suitable habitat for kōkako.

The western Ngāti Tama block (Parininihi) has been intensively managed for pests for 15 years now and the evidence of the value of an intensive pest management approach is visually very apparent, with the canopies of “old man” rata and totara in good condition and the diversity and volume of forest regeneration far greater than in the unmanaged Ngāti Tama Eastern Forest block.

9.3 Pest Management Area

The Biodiversity Offset Calculation supplementary report (February 2018) determined that an area of 230ha was required to be managed for pests to offset the vegetation loss that will occur as a result of the Project and achieve a high level of ecological integrity. A preferred PMA to meet the offset requirements for the Project was selected in the upper Mimi catchment to the east of SH3 (on a small area of Ngāti Tama land in the northwest corner and a larger block of DOC managed Mt Messenger Conservation Area to the south of the Ngāti Tama block). This area had been selected as the preferred area of pest management because it includes sufficient areas of all of the vegetation communities required for offset, including the required 22ha of swamp forest habitat in the Mimi Catchment, 190ha of tawa, kamahi, rewarewa forest and 18ha of hard beech dominant forest.

With the expansion of the PMA to 3650ha to stimulate bat population recovery the area of vegetation now proposed for pest management far exceeds that necessary for vegetation offset (but still includes all of the 230ha initial pest management area that was previously identified). While the outer edges of the 3650ha PMA will serve as a pest management buffer where pest densities may exceed the performance targets, the area receiving all of the benefits of permanent intensive pest management (resulting in significantly improved ecological integrity) will be at least 2590ha in size (after deduction of a 200m deep buffer around the full PMA perimeter).

The extra 3420ha of PMA, in excess of the 230ha required to meet offset requirements, and the ecological benefits this larger area provides, ensures that the ecological effects of the Project are appropriately addressed.

9.4 Proposed pest management strategy

The pest management will include:

- A combined aerial and ground-based approach over the full PMA to reduce and maintain rats, possums, mustelids and cats to low levels in perpetuity; and
- A hunting programme to reduce and maintain feral goats and pigs to low densities in perpetuity.

9.4.1 Pest management methodology

9.4.1.1 Adaptive management approach

The long term strategy for possum, rat and mustelid control will be based on achieving very low pest densities from three-yearly aerial 1080, and maintenance of the low densities in the years between 1080 applications by a ground based bait station and trap network across the entire PMA. An adaptive management approach will be adopted for each animal pest in the choice of pest management methods used and trap and/or bait station intensity. If target, or near target, pest density performance standards are not achieved with one method for two consecutive years (after excluding years when targets are not met due to severe natural events or circumstances beyond the Alliance's control), the method or approach will be varied, based on experience and research, until target levels are consistently achieved.

Methods that have been successful at other New Zealand sites may not be as successful at Mt Messenger due to factors such as the nature of the terrain and weather conditions. An adaptive management approach will result in the determination of the best combination of methods for the PMA and will also allow for continuous improvement as new pest management technology becomes available.

9.4.1.2 Aerial toxin programme

Pest management will begin with an aerial 1080 toxic bait application to quickly reduce possums, rats and predators to low levels over the full 3650ha PMA. This operation will involve a minimum of one pre-feed with non-toxic bait followed by toxic bait application ideally 10 days after. Aerial 1080 operations will be timed to coincide with the start of the bird breeding season (July to September) to ensure pest densities are as low as possible early in the season. Aerial application will ensure even coverage of toxin across the entire treatment area including areas where extremely steep terrain prevents the safe establishment of control devices. This is expected to result in a uniform reduction of pests which is critical for the ongoing success of ground-based control methods, to maintain possums, rats and predators to below target densities between aerial applications.

Aerial 1080 operations will be repeated on a three-yearly time frame and ideally will be synchronised with the current cycle applied to the adjoining Parininihi pest management area.

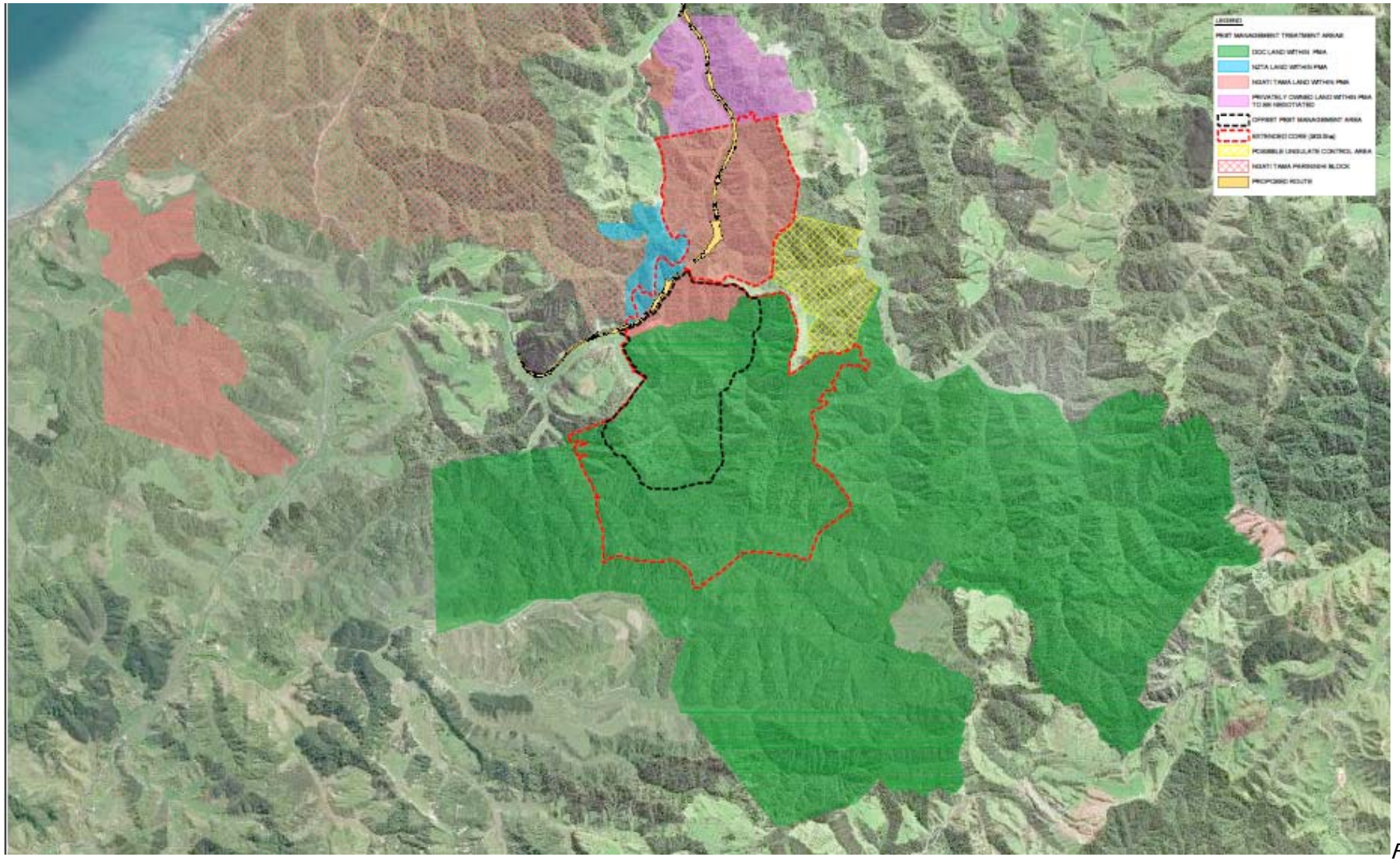

Figure 9.1 – Proposed pest management treatment areas. The areas in solid colour comprise the 3650ha PMA. The red cross-hatched area is the currently pest managed Parininihi block (Refer to Appendix F for full scale drawing).

9.4.1.3 Ground-based bait station and trap grid for rats, possums and mustelids

An intensive ground-based bait station and trap grid network will be established and used to hold pest densities down to target levels between the three yearly aerial 1080 drops. The grid will consist of cut and marked trap-lines which have been specifically located to ensure adequate coverage of pest control devices.

The likely initial pest management strategy to be adopted is outlined below, however a detailed Pest Management Operational Plan will be developed by the appointed pest management contractor(s) in consultation with the Pest Management Review Panel and as approved by the Alliance prior to the commencement of the pest management programme. This Plan will apply recognised best practice approaches to all aspects of the programme and may be altered or refined adaptively by the Pest Management Review Panel in the early stages of the pest management programme in response to performance monitoring results and contractor feedback.

The initial approach to pest management in the PMA is likely to be:

- Rats to be managed using a mix of bait stations (with first generation anticoagulants) and A24 Goodnature traps. A24's to be used where access may be limited and as an alternate treatment every few years to prevent build-up of generally bait shy rats. Aim is for devices to be at 1 per ha (and as close as physically possible to 100 x 100 m spacings where the terrain allows).
- Possums: Feratox complemented by kill traps (Trapinator traps or equivalent) where needed and especially around the bush perimeter where toxins may pose risk to animals and people on adjacent land.
- Stoats: double set DOC 200's with traps at 100m spacings along lines that are between 1km and 500m apart. A24 Goodnature traps will be used where access may be limited or challenging in poor weather.
- Ferrets: single set DOC 250's set around the bush – pasture margins.
- Feral cats: Kill traps set around the bush perimeter, possibly supplemented with PAPP if considered necessary.

The Goodnature A24 traps are self-resetting (up to 24 resets per CO_2 canister) multi-species kill traps that have proven very effective as rat and stoat traps. The traps will be visited every 4 months (at least initially while pest densities are high) to refresh the lure and 6-monthy to replace the CO_2 canisters that drive the trap mechanism.

The Goodnature A24 kill traps have proven to be effective tools for the control of rats and stoats, and DOC 150, 200 and 250 traps are recognised effective and humane mustelid kill traps when set in prescribed trap-set tunnels. Fresh or salted rabbit meat, Erayz® dried rabbit lures or fresh hen eggs will be used to bait the DOC traps.

Rats will get caught in stoat traps so to optimise effort against stoats it is recommended that trap sets for stoats follow the initial rat knock down effort so that there is less rat interference with the traps.

Between periods of 1080 use (by air or in bait stations) first generation anti-coagulants particularly diphacinone and pindone will be applied in bait stations for rat control. Because these toxins are cumulative and the animals do not feel ill-effects for some time after consumption they do not associate the bait with the effects and so are less likely to build up an aversion. For this reason pre-feeding is not required. Rats need to feed on this bait type for between 3 and 7 days before a fatal dose is consumed so bait stations need to be filled on a daily basis especially if rat numbers are high. First generation anticoagulants begin to lose their potency after about 3 days, another reason why a daily bait replenishment programme is required. If bait stations are used repeatedly, annual rotation of toxin types used will be necessary to reduce the likelihood of aversion to a particular toxin/bait type developing. Animals, especially rats, that survive poisoning from one bait type can develop a strong aversion to that bait type, hence the need to rotate bait types from season to season.

First generation anticoagulants are considerably less effective against possums. Consequently, an alternative cyanide based toxin will be used for possum control when 1080 is not being used. Feratox Strikers (a biodegradeable bait station containing encapsulated potassium cyanide) can be used in conjunction with the permanent bait station regime to control possums and minimise the amount of anti-coagulant bait that possums eat before rats can get to it. Feratox Strikers are highly effective on possums, with possums needing to consume only one pill for a fatal dose.

PAPP (para-aminopropriophenone) is a toxin that has shown potential in the control of stoats and feral cats and may offer an alternative to trapping if additional tools are needed to lower stoat numbers to the performance targets set. A Controlled Substances Licence is required to use PAPP, and will be obtained if necessary.

9.4.1.4 Hunting and the use of Judas animals

Goats and pigs will need to be controlled by hunting.

Goats

Goat densities across the Pest Management Area are considered to be high currently. Initially, an experienced goat culler should be able to reduce goat numbers to moderately low levels with concerted effort. Further reduction of goats to target levels below 1 goat kill per hunter day is likely to be more challenging and require the use of additional tools to locate and kill those remaining. These will include (as required):

- Judas goats -Judas goats are animals that have been caught and fitted with a radio collar before being released back into the target area. These goats usually link up with other goats and can be tracked to find their location.
- Dogs can be used in more open areas and pasture margins to flush out goats but this method tends to be less effective in thick bush on steep terrain.
- Aerial thermal imaging -Thermal imaging and drone technologies have advanced considerably over the past decade to the point where it is now possible to detect warm-blooded animals the size of a possum and larger through a forest canopy. Drone mounted thermal imaging will be used periodically to detect residual feral goats, pigs and deer (if any) across the Pest Management Area.

- Fencing -Reinvasion by goats from unmanaged neighbouring scrubland may be an occasional problem around the perimeter of the Pest Management Area, especially along the north-eastern and southern boundaries. The addition of goat proof appendages to boundary fences will be undertaken if the risk of goat reinvasion from unmanaged neighbouring properties is considerable. Determination of where goat-proof fencing is required will be confirmed when the land areas that will be used for all of the offset and mitigation works are confirmed. To be effective against goats:
    - the fence needs to be an 8 or 9 wire post and batten fence with posts at 4 or 5m spacings and battens at 1m spacings;
    - box stays rather than angle stays are needed to prevent goats climbing the fence and an electric hot wire may be needed near the top of the fence;
    - tie-downs need to be installed at every depression to prevent goats pushing under the fence; and
    - well-tensioned wire netting can also be used instead of 8 or 9 single wire strands but this must be well pinned to the ground.

Pigs

Pigs will be managed by hunting using experienced pig hunters and with the assistance of good pig dogs. Because pigs often occupy thick bush pig dogs are needed to find and flush out pigs. The appointed contract pig culler will need to be experienced at operating in steep, mudstone country such as that found in the Mt Messenger area. The Pest Management Area has many hidden, slippery bluffs that are dangerous for hunters and pig dogs.

As for goats, there are additional tools that can be used to find and cull pigs that remain hard to find. The decision as to which of these tools are used and where and when they are used will occur after the effectiveness of initial hunting efforts are evaluated, and will be made by the Alliance manager in charge of pest management following discussions with the pig control contractor and the Department of Conservation. Additional expertise may be consulted where necessary.

The additional tools that could be implemented for pig management include:

- Trapping - Specialised pig traps can be used particularly if pigs come out on open pasture at predictable locations. Captured pigs need to be head shot by an experienced and licensed shooter. This method will be used if there are locations where it can be used cost-effectively.
- Aerial thermal imaging - As for goats, thermal imaging and drone technology is likely to be very useful in detecting remaining pigs in steep and bush covered terrain and will be adopted on the Project Pest Management Area.
- Toxins - Sodium nitrite is the only toxin currently registered for pig control in New Zealand and it may be useful if other techniques fail to eliminate some individuals. Secondary poisoning of pigs can occur following possum poisoning using 1080 but the general consensus is that secondary poisoning has relatively little effect on pig populations.

- Judas pigs - The use of Judas pigs is generally only an effective technique when densities are very low and dogs have been unable to find the last animals present. It is not effective against older boars who tend to be less sociable than other pigs.
- Fencing - Effective pig barrier fences can be built along boundaries by appending materials to existing boundary fences. This may be necessary where unmanaged pig populations occur on neighbouring land. Chainlink mesh is the most effective material to use on a pig barrier fence. Steel standards (Waratahs) need to be rammed into the ground at 1 metre spacings; the chainlink needs to be well pinned to the ground and a tensioned barbed wire is required along the base of the fence at ground level. The fence also needs to be held down into all depressions by tie-downs.

9.4.1.5 Wasp management

To address the adverse effects of the creation of new forest edge and general forest disturbance as a result of the road, monitoring and response strategies for *Vespula* wasps along the new road margins will be implemented during construction. *Polistes* wasps' nests will be destroyed when found using appropriate measures.

9.4.2 Timing of pest management

Aerial and/or ground based toxin pest management programmes are most effective in very late winter or early spring when possums and rats are most hungry and natural food supplies are at their lowest. Pests are more inclined to eat baits when hungry and in quantities that will lead to their death. Autumn and early winter should be avoided because forest foods are abundant at this time.

In the Mt Messenger area the optimum time for each toxin-based control effort is likely to be from late August and through September.

Trapping effort can occur all year round and this should be the case initially until pest numbers are reduced to target levels. When pest densities are low focused pest management in spring immediately preceding bird and bat breeding season will help to improve breeding success and recruitment. Continued pest management effort through the summer, especially targeting rats, will reduce predatory pressure on lizards and insects especially and aid increased breeding success.

Goat and pig control effort can occur throughout the year but control will be easier to undertake in the Pest Management Area when ground conditions are drier. Goat control will commence in areas adjacent to the offset and mitigation areas well before any planting is planned. This is because goats have a preference for several of the plant species likely to be included in the planting mixes and will cause considerable damage to new plantings if they are present when planting begins.

9.5 Performance standards and monitoring

9.5.1 Existing pest densities

Monitoring data from pest animal surveys undertaken within the Pest Management Area from November 2017 to February 2018 suggest moderately high to high densities of both

rats and possums[14]. Possum chew card activity (CCI) has ranged from 25% to 67% for each of the three survey periods, possum tracking tunnel activity (RTI) has ranged from 4 to 36%, and rat tracking tunnel activity (RTI) has ranged between 53% and 71%. The highest rat activity occurred in January and February surveys (both 71%).

Chew card indices from monitoring undertaken by the Department of Conservation at Mt Messenger for the 2013-2016 period[15] yielded an index of 39.2% for possum presence, apparently amongst the highest CCI measures recorded nationally.

Mustelid tracking peaked at 50% in early January 2018 (range: 10 to 50%). Tracking indices of 50% are considered to be typical for unmanaged pest populations in forest types similar to those at Mt Messenger.

Mouse tracking of 5% was recorded in the February tracking tunnel survey, the only time mice were detected.

Local goat hunting specialists have suggested that current goat densities could be equivalent to around 20 kills/man day[16].

9.5.2 Pest management targets

The performance targets for effective pest management within the Pest Management Area are as listed below. The targets set are performance indices of relative pest density for each species adopted by DOC and other agencies when undertaking pest control activities. Achievement and maintenance of pest densities below or near to these target indices is expected to result in substantial ecological recovery across the Pest Management Area and achieve the biodiversity outcomes outlined in the Ecological Mitigation and Offset Reports. The targets will also serve as performance targets for the pest management contractors employed to deliver the pest management programme.

The pest management performance targets for the PMA are:

- Possums –5% or lower RTC (Residual Trap Catch Index) or 5% or lower CCI (Chew Card Index).
- Rats – 5% or lower RTI (Residual Trapping Tunnel Index).
- Goats – less than 1 kill/man day.
- Mustelids– no detections.
- Cats – no detections.
- Pigs – less than 1 kill / man day then no fresh pig sign or pig detections.
- Farm livestock – zero presence

[14] WSP-Opus. 2018. Mt Messenger Baseline Monitoring for Vertebrate Pests. Survey design and baseline monitoring (2017/2018)

[15] http://www.doc.govt.nz/2017-annual-report-factsheets/?report=NationalPossumFactsheetWeb

[16] Paul Prip, Taranaki Regional Council pers comm via Richard Nichol

The objective will be to achieve the target pest densities immediately prior to the breeding season (for bats and birds) and to hold densities at low levels through the critical stages when young remain in the nest.

Achieving and holding rat densities to the target 5% residual rat tracking index (RTI) threshold will be the most challenging target and it is likely, based on the experiences of other large-scale NZ rat control programmes undertaken in challenging terrain, that rat densities will not be lowered to 5% in some seasons due to weather or indeterminate reasons. Achievement of 10% rat RTI or lower is generally accepted as a successful outcome. While 5% RTI will remain the target for rats in the PMA, tracking indices above 10% in two consecutive years will trigger the need to review the method used.

9.5.3 Performance and compliance monitoring

9.5.3.1 Pest density performance monitoring

Pest density performance monitoring will be undertaken in the PMA annually for 5 years following the commencement of the pest management programme. Annual monitoring in the first 5 years will include 3 sample points – the first immediately prior to the commencement of the bird/bat breeding season and two more through the summer period.

After 5 years from the commencement of the programme monitoring will occur once annually immediately prior to breeding season. Annual monitoring is necessary to assist in the determination of the level of additional effort needed to achieve the performance targets.

In situations where the performance target indices for a target species are exceeded in two consecutive years, triggering the need for a review and possible change to the pest management methodology, the monitoring regime will revert back to that required for the first 5 year period (ie. 3 monitoring points per year) until performance targets are achieved (for rats this is less than 10%).

Performance monitoring indices will be generated from the area of the PMA excluding a 200 metre deep buffer around the full perimeter of the PMA. Pest densities can be expected to be higher in the buffer as a result of incursions from the surrounding unmanaged landscape.

Compliance monitoring of contractors will be undertaken by insisting that all contractors undertaking pest control activities maintain GPS logs of daily activity. This information must be provided to the project manager and will be a requirement of payment. This also will ensure that all lines are being visited.

Pigs will be excluded from pest density performance monitoring once they have been reduced to low densities. This is because there are no reliable methods for determining relative pig density when numbers are low. Instead pig hunters will be called in when fresh pig sign is detected by those undertaking independent monitoring of the other pest species.

All monitoring will be undertaken only by personnel certified by the National Pest Control Agencies (NPCA) as trained monitoring personnel, and monitoring will be undertaken in accordance with the NPCA Standard National Protocol.

9.5.3.2 Outcome monitoring within the PMA

Outcome monitoring will be undertaken for vegetation and selected forest bird species. The primary objectives of outcome monitoring are to measure the (expected) positive trends in ecological integrity indices resulting from pest management.

Outcome monitoring for bird species

The purpose of outcome monitoring for bird species is to provide sufficient evidence that the stated benefits of the pest control programme on those species affected by the project will be achieved.

Bird monitoring will focus on kiwi, whitehead, long-tail cuckoo, kereru, bellbird, tui, fernbird and NI robin. These species are commonly used as biodiversity outcome indicators for pest management programmes on the basis that:

- They are of high ecological importance: kiwi are nationally 'Threatened' and while not 'Threatened' bellbird, tui and kereru provide critical pollination and seed dispersal services. In doing so these species are essential to the ecological health of forest ecosystems and serve as surrogates for the overall integrity of forest ecosystems
- There is evidence to suggest that these species respond positively to pest control through reduced predation pressure and/or increased food or habitat availability
- These species can be readily monitored through standardised and commonly used techniques to detect statistically measurable trends in relative abundance
- These species that can be monitored in a cost-effective and efficient manner, i.e. forest bird monitoring that can be covered in the same technique (five-minute bird counts).

The performance target for birds is set at a 20% increase in relative abundance within 12 years of road construction for all eight indicator species within the PMA.

Kiwi monitoring

A kiwi survey will be conducted every three years for 12 years following completion of road construction. Nocturnal kiwi surveys will be undertaken following the same method used in the baseline survey (see Baber and McLennan 2017 for detailed methods) and the locations of calling kiwi at different stations around the completed road will be mapped. These data will then be compared against the baseline survey results documented in Baber and McLennan (2017).

Forest bird monitoring

Outcome monitoring of selected forest birds will occur within the 230ha offset area of the PMA (refer to Appendix F) and will be conducted for up to 12 years, at 3-yearly intervals, following the onset of integrated pest control. The main focus will be on measuring changes in abundance of functionally important pollinator and seed dispersal species including tui, bellbird and kererū. Daytime bird counts will occur at the 355 bird count stations using the standard 5-minute bird count methodology (Dawson and Bull, 1975), which will also be used for the baseline pre-construction surveys. These data will then be compared against

baseline survey results documented in Baber and McLennan (2017). It is expected that forest bird monitoring will also provide the opportunity to pick up the presence and increase of kōkako when they disperse from the adjacent Parininihi Reserve

Vegetation monitoring

Outcome monitoring for vegetation will focus on measuring the recovery of palatable species within the ungulate browse tier and improvements in canopy condition from a reduction in possum abundance. Specific outcome objectives of pest control include; seedling recruitment of species, such as tawa, hinau and kamahi which currently are suffering recruitment failure.

Vegetation monitoring will be established prior to any control of ungulates and will measure the survival and growth of indicator species within the understorey tier and sapling tiers in permanent plots. A sample of seedlings will be tagged and may also fenced (ungulate excluded) seedlings as a control group. Indicator species should focus on highly palatable species such as species for monitoring trends in condition (Monks et al. 2010). These will likely include; tawa, hinau, kamahi, mahoe, hangehange, large-leafed coprosma shrubs, toropapa, pate and pikopiko — species which represent most tiers of the forest structure. The target performance outcome will be >75% of tagged palatable individual plants showing no sign of animal pest browsing 5 years after the completion of road construction. Tagged plants will also show positive growth (changes in average height) over sampling periods in trait groups (e.g. highly palatable understorey species).

Canopy health monitoring will likely use a combination of methods including FBI (foliar browse index; Payton et al. 1999) monitoring of palatable species and significant trees such as swamp maire, northern rata, thin-barked totara, mahoe, kaikomako, pate. General measurements of canopy density (by measuring chlorophyll) will be trialled using drone imagery. The outcome performance target is to achieve a statistically significant improvement in canopy density and mean browse scores are below a 1 (1-25%) by year 5.

Within the valley floor areas, additional monitoring plots will be placed as the recovery of these (kahikatea, pukatea and riparian forest) communities from pest management has not been commonly monitored. In these communities additional indicator species will likely be measured, such as pukatea which seedling regeneration is currently being suppressed by cattle browsing, though this species is known to recruit in the presence of goats.

These monitoring performance targets should allow success of the offset to be determined resulting in improved plant and population health (e.g. recovery towards expected demography distributions such as reverse J-shaped curve for tawa). The forecast measures of ecological integrity used within the offset calculator were +5% and +5.25% by year 10 (no net loss) and +8% and 9% by year 15 (net gain) (Singers 2018). It is considered that if the performance targets described above are met or exceeded, then no net loss and net gain will have occurred.

9.5.3.3 Adaptive pest management response to monitoring targets

In the event that pest density targets are not achieved and/or more than one of the biodiversity outcome monitoring targets are not met, for reasons associated with the impact

of pests or the effects of the road, the pest management programme will be reappraised and the intensity or methods used changed to be more effective at addressing the pests or aspects of biodiversity that have not reached the outcome targets. The pest management methods and intensity will continue to be adapted until all pest density targets and biodiversity indicator targets have been met.

It is conceivable that variables not associated with the relative effectiveness of the pest management programme or the effects of the road (eg plant or animal disease, or extreme weather events) may be contributing to poorer than anticipated recovery of one or more of the monitored biodiversity indicators. These situations are considered to be beyond the control of the Alliance and will not trigger any adaptive management response. Adaptive improvement of the pest management programme will only occur where less than expected monitoring outcomes are likely to be the result of continued animal pest impacts or the direct effects of the road.

9.6 Appointment of pest management contractors and development of a Pest Management Operational Plan

Experienced, appropriately qualified pest control contractors will be appointed at the commencement of the Project to undertake the Pest Management Programme. One or several separate contractors may be appointed to undertake individual components or all components of the Pest Management Programme. The components will include:

- Ground-based management of rats, possums and mustelids using traps (and possibly toxins);
- Aerial application(s) of 1080;
- Ground-based hunting of goats and pigs;
- Possible aerial hunting of goats and pigs; and
- Fencing to exclude farm livestock and possibly goats and pigs, where necessary.

The Pest Management Contractor will produce a Pest Management Operational Plan in accordance with DOC requirements (note that all pest control operations on DOC land require an operational plan). This plan will detail all aspects of the intended pest management programme including:

- the location of the planned pest management;
- control methods to be used;
- timing of the programme elements;
- legislation and regulations that need to be complied with, consents, approvals and permits that need to be obtained;
- evidence of adherence to industry best practice;
- resources to be used;
- health and safety provisions;
- details of a public consultation and communications plan; and
- performance and outcome monitoring and independent auditing and reporting.

Each pest management contractor will be required to achieve the pest density performance standards and adhere to all consent and permit conditions, access agreements, and rules and regulations.

As the Pest Management Programme will continue in perpetuity (or until such a time that pest management is no longer required to sustain biodiversity values), it is envisaged that new / replacement contractors will be employed from time to time. A review of the Operational Plan will occur each time the principal contractor is replaced or every 5 years, whichever occurs sooner.

9.7 Legal mechanisms and governance

Pest management activities are governed by several Acts and legal requirements including Hazardous Substances and New Organisms Act 1996 (HSNOA), the Agricultural Compounds and Veterinary Medicines Act 1997, the RMA, the Trespass Act 1980, and the Wild Animal Control Act 1977. Adherence to all relevant clauses in these Acts will be required, and addressed in the Pest Management Operational Plan.

All approvals, particularly those relating to toxin use, will be obtained prior to the commencement of control work. The following approvals are likely to be needed to implement the Pest Management Plan at the Project site:

- Ministry of Health / Public Health Unit approval/consent to use a vertebrate toxin (with associated requirements for public notification and communication);
- DOC approval for application of a vertebrate toxic agent (VTA) on DOC estate (under Section 95A of the HSNOA), assuming some of the Pest Management Area will be on DOC estate;
- Access permission from all landowners to undertake pest management activities on their land; and
- Consents from the Taranaki Regional Council and/or New Plymouth District Council.

9.8 Management of farm livestock

While the focus of the Pest Management Plan is to reduce the densities of mammalian pests, the removal and exclusion of farm livestock (cattle and horses) is also critical if the proposed ecological recovery is to be achieved.

Cattle have grazed the unfenced upper Mangapepeke Valley for decades and have contributed to the current denuded state of the forest understorey on and adjacent to the valley floor in a major way. Cattle also have access to the parts of the Mimi catchment and will need to be adequately excluded through fencing. All stock will need to be removed from the Pest Management Area before toxin application commences. The current plan assumes no livestock will be farmed in the Mangapepeke Valley and will also be excluded from the Mimi catchment.

9.9 Programme

The timing of the Pest Management Programme cannot be confirmed until the required land access is obtained and a construction start date is determined. However, the broad sequence of pest management related events will be as follows (assuming a spring or early summer 2018 start to works):

i) First summer (2018-19)
   - Establishment of baseline vegetation and bird monitoring prior to commencement of pest control.
   - Appointment of goat and pig cullers and commencement of goat and pig control in and adjacent to the swamp, mitigation and riparian (where possible) planting areas, with the initial effort to serve as the baseline population density estimate.
   - Appointment of the Principal Pest Management Contractor and development and submission of the Pest Management Operational Plan.
   - Commencement of cutting and marking of the ground-based bait station and trap lines (this is likely to take 2 (and possibly 3) years to complete over the full 3680ha PMA.
   - Pre-control tracking tunnel and chew card monitoring of rats, possums and mustelids to serve as the baseline for pest management performance.

ii) Late winter – early spring, start of year 2 (2019):
   - Pre-control (and pre-breeding season) tracking tunnel and chew card monitoring of rats, possums and mustelids to serve as the baseline for pest management performance.

iii) Second summer (2019-20)
   - Completion of cutting and marking of the bait station and trap grid network.
   - Possible commencement of planning for the first 1080 drop if that is to occur in August/September at the end of the second construction year.
   - Continuation of ground- hunting effort for pigs and goats.

iv) Late winter – early spring, start of year 2 (2020):
   - Aerial 1080 drop (if one is scheduled) followed by commencement of ground-based trapping effort.

v) September, start of year 3 (2020)
   - First pest management independent performance monitoring survey.

9.10 References

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10 Peripatus Management Plan

10.1 Introduction

10.1.1 Scope and objectives

The purpose of this Peripatus Management Plan is to specify procedures to avoid, remedy or mitigate adverse effects associated with the construction and operation of the Project on peripatus species.

Key objectives of the Peripatus Management Plan are to:

- outline potential impacts on peripatus that may eventuate during- and post-construction; and
- outline management measures to avoid, minimise and mitigate potential adverse effects of the Project on peripatus.

10.1.2 Survey overview and results

As documented in the Ecology supplementary report – Terrestrial invertebrates (Watts, 2018), the following peripatus species were found during baseline invertebrate surveys along the Project footprint conducted in November 2017:

- Two individual Peripatoides suteri (Figure 10.1).
- One individual Peripatoides novaezealandiae (Figure 10.2).

Figure 10.1 – P. suteri found within the Project footprint

Figure 10.2 – P. novaezealandiae found within the Project footprint

The locations of the peripatus specimens found within the Project footprint are documented in the Ecology supplementary report – Terrestrial invertebrates (Watts, 2018).

10.2 Statutory context

The provision of management to avoid, minimise and mitigate adverse effects on native wildlife and associated habitat is a requirement under the Resource Management Act 1991 (RMA).

P. suteri is not included on the New Zealand Threat Classification System listing as a threatened species. However, it is listed as 'Vulnerable' in the IUCN Red List of Threatened Species (2012). *P. novaezealandiae* is considered widespread throughout New Zealand (Department of Conservation 2014) and is not currently included in the New Zealand Threat Classification System listing as a threatened species.

Peripatus are not specified in Schedule 7 of the Wildlife Act 1953 and therefore are not deemed to be "animals" subject to protection under the Act.

10.3 Ecological impacts on peripatus

The Ecology supplementary report – Terrestrial invertebrates (Watts, 2018) has identified the following potential effects of the construction and operation of the Project on peripatus:

- direct mortality of peripatus during vegetation clearance and/or earthworks;
- habitat loss; and
- habitat modification and disturbance.

10.4 Peripatus Ecology

Peripatus are classified in the distinct phylum Onychophora. They are considered to be a possible ancient link between worms (Annelida) and insects, spiders and centipedes (Arthropoda). In New Zealand, nine species within two genera have been described, and another 20–30 species await formal description (Gleeson and Ruhberg, 2010). Few studies have been conducted on the ecology or biology of peripatus species (including *P. suteri* and *P. novaezealandiae*), or on their threats.

Peripatus are forest floor dwellers that occupy rotting or decaying logs, tree stumps, wood and leaf material on the forest floor. The specific habitat preferences of New Zealand

peripatus remain unknown. However, we do know they are vulnerable to dehydration when exposed to open areas and sunlight (since they are unable to control bodily water loss), and so generally require cool, constantly moist conditions year-round to survive. Consequently, forested or bush-covered south-facing slopes that remain moist all year round provide ideal habitat. They can also be found in marginal habitats, such as in logs in tussock grassland and exotic plantations, and under rocks near glaciers (see references in Department of Conservation (2014)). The abundance of decaying woody debris and stumps on the forest floor may contribute to the density of the population. The cracks and crevices that develop in stumps and logs provide moist, cool conditions for peripatus and possibly equally critically, safe refuge from introduced mammalian predators, especially rodents and hedgehogs (Department of Conservation 2014).

The only estimation of the dispersal ability of peripatus (20 m per year) has been reported for a Tasmanian species inhabiting suitable habitat (Fox et al. 2004). In New Zealand, peripatus are often found in decaying logs as individuals or occasionally in clusters especially when nurseries are formed (Department of Conservation 2014). One notable exception is *P. novaezealandiae* in Caversham Valley, where large clusters (of up to 2000 individuals) have been observed.

DOC (2014) reviewed the potential threats to New Zealand peripatus and suggested that habitat loss was a significant threat to their survival. At a microhabitat scale, the removal of intact tree canopy can be a major cause of peripatus decline. Removal of trees greatly alters the moisture and temperature regimes at ground level. Increased exposure to frost and sunshine increases moisture loss and daily temperature fluctuations – conditions that cannot be tolerated by peripatus. Consequently, peripatus populations are vulnerable to becoming isolated when tree cover is removed (Department of Conservation 2014).

Applying the limited knowledge that exists on peripatus, the most favourable habitat is likely to include all of the following:

- south-facing moist slopes;
- contiguous stands of forest trees with a well formed, linked canopy;
- abundant decomposing woody material and organic matter on the forest floor;
- plenty of cracks and crevices that are not accessible to rodents; and
- minimal disturbance (ie low levels of human activity).

10.5 Peripatus management within Project footprint

10.5.1 Avoidance, minimisation and mitigation

Effects on peripatus will be avoided or minimised through salvaging peripatus and relocating peripatus habitat elements into a suitable relocation site outside of the Project footprint. The measures that will be employed to avoid or minimise effects on peripatus are:

1. conduct a pre-construction habitat assessment;
2. execute a peripatus translocation plan (PTP); and

3. relocate habitat elements suitable for peripatus outside of the Project footprint.

10.5.2 Pre-construction habitat assessment

A peripatus habitat assessment will be conducted along the Project footprint prior to construction in order to:

1. establish 'high risk' habitat areas within the Project footprint where peripatus salvage efforts will be focussed;
2. gain an estimate of the quantity of peripatus habitat to be translocated so that suitable release sites can be prepared; and
3. determine the nature of the habitat occupied by peripatus, enabling the logistics of transporting habitat features to a new site to be planned (so as to minimise potential animal disturbance and reduce the likelihood of habitat translocation failure).

A detailed walk-through survey in areas within the Project footprint that are deemed 'high risk' potential habitat for peripatus and are safely accessible will be conducted by the Project Invertebrate Ecologist to identify key habitat for peripatus.

The potential habitat areas for peripatus are outlined in the Ecology Constraints Map (Appendix A to the ELMP). Habitat features will be clearly marked using flagging tape or mesh and will be the focus of the pre-translocation search and salvage effort and the habitat salvage operation outlined in the PTP.

10.5.3 Peripatus Translocation Plan (PTP)

10.5.3.1 Purpose and objectives

Translocation of peripatus found within the Project footprint will be undertaken in accordance with this PTP to maximise the likelihood of success. The PTP provides guidelines for the successful search, capture, translocation and release of peripatus from within the Project footprint to suitable alternative habitats.

The intention of the peripatus translocation is to locate and capture as many peripatus as possible from the proposed Project footprint, and to successfully release them at predetermined release sites, immediately adjacent to the Project footprint, with minimal stress caused to the animals.

There is only one example of a planned and documented peripatus translocation in New Zealand. This PTP has been developed and refined on the basis of existing knowledge of the Caversham peripatus (*P. novaezealandiae*) and the well-documented *Caversham Valley Safety Improvements Peripatus Translocation Plan* and associated monitoring (MacGibbon 2012; Connolly 2013; Randle 2014; MacGibbon 2017).

The following sections outline procedures for:

- site preparation;
- timing of translocations;
- peripatus and habitat transportation; and
- the re-positioning of peripatus-occupied material/habitat elements.

10.5.3.2 Pre-translocation survey in 'high risk' habitat areas

- Following the pre-construction habitat assessment, areas of potentially 'high-risk' habitat (that is, habitat that offers high potential for peripatus) will be the focus of a pre-translocation survey. A thorough walk-through survey of the Project footprint will be conducted by the Project invertebrate ecologist to identify these habitat features.
- A total of 32 person hours will be spent demarcating suitable peripatus habitat across the entire Project footprint during a walk-over survey, in safe to access areas, prior to commencement of vegetation clearance. This survey will involve a thorough search of substrates that may offer potential habitat for peripatus. These potential habitat elements will be carefully examined until peripatus are found or it becomes apparent that they are not present. Typical search areas will include tree stumps, decaying logs and branches, within stacks of wood, and under any objects or material lying on or near the ground where cool, moist conditions are likely to prevail.
- When the first peripatus is found, no further disturbance of that site will occur within a 5m radius. The locations of any peripatus found within the Project footprint will be clearly marked using flagging tape or fleuro mesh, so that there is no risk of habitat damage. Before construction begins, demarcation of all surrounding (within 5m) habitat elements (identified as suitable for peripatus) will take place. These habitat elements will then be relocated to an appropriate release site outside the Project footprint (refer to Section 10.5.3.4).
- If no peripatus are found during the pre-construction habitat assessment, any potential (unoccupied) habitat will be marked with mesh and moved with a digger to an appropriate site outside the Project footprint prior to any vegetation clearance activities. These meshed habitat features will be deposited either side of the Project footprint in similar habitat they were removed from.

10.5.3.3 Pre-translocation survey timing

Pre-translocation surveys will be carried out in spring to early summer (September - December) and / or during autumn (April-May) when the ground and habitat conditions are warmer and moist (Department of Conservation 2014).[17]

10.5.3.4 Translocation release site

- A survey of potential release sites immediately adjacent to the Project footprint will be undertaken by the Project Invertebrate Ecologist two weeks before the commencement of the pre-translocation survey. The Project Invertebrate Ecologist will identify appropriate options for the translocation release site, taking into account the following:
    - Ideally sites will have a provision of woody material in various stages of decay for medium- to long-term occupation by peripatus and their food. Peripatus

[17] In cold (winter) and dry (summer) ground conditions, peripatus move further into logs and stumps where they become increasingly hard to find.

appear to be unaffected by habitat edges, so suitable logs can be placed up to the edge of an area (Department of Conservation 2014). It is essential that there are less-decayed wood supplies adjacent to the release sites, as these will provide suitable future habitat.

- To maximise the success of the peripatus translocations, translocations should if reasonably practicable occur into the Pest Management Area (PMA, see Chapter 9).

10.5.3.5 Peripatus search, capture and translocation process

In the event that peripatus are found during the pre-translocation survey in high-risk habitats (as outlined above), the process of search, capture, transport and release is documented below.

- Peripatus are nocturnally active, so search and release will occur within daylight hours when they are least active. The period between the capture and release of each animal should be kept to a minimum (up to four hours maximum).
- The extraction and translocation of peripatus and their habitat, especially those to be moved by digger, can occur once contractor machinery is moved to the site to commence site clearance. However, translocation must occur before any site clearance begins to ensure no habitat is inadvertently damaged. It is essential that the logs and stumps marked for translocation are not disturbed at all until extraction and transport occurs, and each log or stump must be repositioned at the release site quickly (not more than four hours following extraction).
- To align with the planned staging of site clearance along the Project footprint, it will be acceptable to also translocate peripatus in stages, provided all material occupied by peripatus in any particular section is moved to the release site before that section of the footprint is cleared of vegetation.
    - It is also essential that the Project invertebrate ecologist is informed in advance of the intention to clear a section of the Project footprint and an experienced invertebrate ecologist is always present on site when peripatus are translocated.
- Wherever reasonably practicable, peripatus will be translocated with their habitat (e.g. whole stumps and logs relocated using a digger). In this way all peripatus located in the stump and log are likely to be translocated with minimal disruption.
- Some of the marked woody habitat in the Project footprint may be too fragile and will need to first be wrapped in breathable material (ie cloth) to minimise breakage. Some sections of the Project footprint may be inaccessible by digger, and habitat elements within these areas will need to be sectioned and moved manually.
- The extraction and transport of woody habitat containing peripatus will need to be done as gently as possible so as not to force the animals to leave, and completed quickly (ie within four hours) before environmental conditions (eg temperature and moisture) in the wood change significantly. Extra care will also need to be taken when moving peripatus and habitat by digger so not to cause unacceptable damage to the release site, especially to what may be existing peripatus habitat.

- Moving individual peripatus by hand is the least favourable option for translocation. However, if this is necessary, each peripatus will be placed in a container (such as a 2L ice-cream container), which is rodent proof and has small air holes inserted into the lid.
    - A thick wad of damp paper towel should be placed on the bottom of the container, and a piece of decaying woody material added for the peripatus to hide in. Soil should not be included.
    - It is very important that peripatus are kept cool and out of direct sunlight.
    - Noise and vibrations should be minimised and boxes kept upright and moved with care.
    - Cupboard cat boxes or chilly bins are ideal for carrying a number of peripatus containers.

Release procedure

- Where reasonably practicable, peripatus will be deposited at the release site in their woody habitat. Once the logs or stumps are positioned at the designated locations, organic material and leaves should be pushed up around the logs and stumps to seal in moisture. Each piece of translocated habitat should be numbered and its origin recorded with a GPS.

10.5.3.6 Salvage of habitat elements

The exact locations of habitat elements suitable for peripatus will be confirmed during the pre-translocation habitat assessment outlined above. In the event that no peripatus are found and salvaged during the pre-translocation survey, vacant habitat elements that are demarcated will be transferred to the release sites identified immediately adjacent to the Project footprint.

10.5.3.7 Potential risk and risk management

The translocation of peripatus from the Project footprint to a new site will create some risks to those animals captured and moved. To minimise the risk of peripatus mortality during translocation, experienced invertebrate ecologists will be involved in the translocation exercise and will contribute to the refinement of the methodology adopted for search, capture and handling; the selection of release sites and animal release.

The plan and translocation procedure will be reviewed and if necessary, updated as work is undertaken.

10.5.3.8 Post-translocation monitoring

Anecdotal information derived from informal, localised 'translocations' suggests that there is no guarantee that released peripatus will remain at the release site; consequently, it may not be possible to determine the success of translocation.

MacGibbon (2017) confirmed the presence of peripatus in artificial monitoring stacks in Caversham Valley two years after their translocation, during post-translocation monitoring

surveys. This population, however, was isolated in an urban area within habitat dominated by introduced tree species (eg *Pinus* and *Eucalyptus* species).

In contrast, since the wider Mt Messenger Project area is located within a large tract of native forest habitat, post-translocation monitoring is not necessary given the considerable amount of available habitat in which any translocated peripatus could thrive.

10.6 Reporting

The following reports (and associated data) will be prepared and made available to the Department of Conservation (DOC) and Taranaki District Council following completion of associated work activities, as outlined in previous sections of this management plan:

1. An annual peripatus management report during-construction.
2. A one-off post-translocation peripatus report providing an overall summary of the peripatus management activities undertaken once the Project has reached completion.

10.7 Permitting requirements

As indicated in section 10.2 above, peripatus are not specified in Schedule 7 of the Wildlife Act 1953 and are thereby not declared to be animals under the Act. A wildlife permit is therefore not required for the protocols outlined in this management plan.

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11 Biosecurity Management Plan

11.1 Introduction

There are a range of invasive plant and animal species, and diseases of native plants and animals that are either not currently present in the Project Area, or not present throughout the Project Area. The purpose of this Biosecurity Management Plan is for all people involved in the Project to be aware of and implement procedures that will minimise the likelihood of spread or introduction of these invasive organisms as a result of Project-related activities.

This plan does not include management of pest organisms that are already present and widespread in the Project Area. Several of these, especially mammalian pests and invasive weed species, will be managed as part of the Project ecological mitigation and offsets programme, as described in chapters 3 and 9 of this ELMP.

This management plan contains three sections, each of which sets out monitoring requirements and protocols for managing biosecurity for the Project:

- Myrtle rust management (section 11.2)
- Plant pest management (section 11.3)
- Pest animal management (section 11.4).

11.2 Myrtle rust management

11.2.1 Myrtle rust and the Project

The Mt Messenger bypass will be constructed through forest which contains many Myrtaceae species susceptible to myrtle rust, such as ramarama, northern rātā, mānuka, kānuka, swamp maire and other *Metrosideros* species (especially climbing ratas). Ecological values within and around the Project area are described in detail in the AEE and supporting technical reports (in particular Technical Report 7h – Ecological Mitigation and Offset). Moreover, as part of the Project's mitigation and offsetting, many of these species will be required to be replanted after the road has been built.

Myrtle rust has the potential to attack new growth on plants, therefore the cost of planting, plant growth and establishment is highly conditional on ensuring that myrtle rust is kept out of as much of the Project footprint and offset restoration areas as possible.

We recognise the significance of myrtle rust, however due to recent discovery of myrtle rust within the Project area and the potential breadth of that incursion, the development of the myrtle rust management plan will take place over the coming months. This will be developed in conjunction with Ministry of Primary Industries (MPI) and DOC.

11.3 Pest plant management

11.3.1 Purpose of pest plant management

The purpose of this pest plant management section is to:

- Provide background information on pest plants in the Project footprint and potential invasive pest plants;
- Describe how pest plants may affect the ecological values of the Project area;
- Describe actions to be undertaken as part of the Project to minimise the likelihood of pest plants spreading or invading; and
- Recommend actions to take in the case of new pest plant incursions.

11.3.2 Pest plant adverse effects

Pest plants or weeds are detrimental to human health, the economy and the environment (Williams & Timmins, 1990). Pest plants continue to invade and spread in New Zealand, and invasion pathways tend to be facilitated by human mediated dispersal and other anthropogenic activities. In addition, with the onset of climate change, it is predicted that the rate of pest plant naturalisation in New Zealand is likely to increase (Sheppard *et al.*, 2016).

The construction of roads can lead to the loss of native vegetation, increase in habitat fragmentation and forest edges, and increased movement of vehicles and personnel throughout an area. Altogether, these effects can substantially increase the spread and establishment of pest plants (Murcia, 1995; Meunier & Lavoie, 2012). Construction projects also result in areas left ungrazed, unmowed or unplanted which can be readily invaded by pest plants. Any movement of soil also has the potential to spread pest plants, as pest plant seeds may remain viable in soils for decades.

Pest plants have the potential to smother, shade or outcompete native vegetation. Freshwater pest plants degrade New Zealand's wetlands and waterways. A reduction in the function of waterways can have many flow-on effects, such as reducing oxygen levels in streams which adversely effects freshwater faunal communities.

11.3.3 Mt Messenger context

The Mt Messenger Bypass is located in an area of high ecological value, which hosts large tracts of mature forest and an array of nationally threatened animal and plant species (NSES Ltd, 2017). The high biodiversity value of Mt Messenger requires stringent precautionary biosecurity measures to ensure these values are not compromised by the accidental introduction of pest plants and animals.

11.3.3.1 Pest plants at Mt Messenger

The current Project footprint is dominated by native forest, however a number of highly invasive pest plants are present in some areas, including African clubmoss (*Selaginella kraussiana*) and tradescantia (*Tradescantia fluminensis*) in the undergrowth, pampas (*Cortaderia selloana*) and gorse (*Ulex europaeus*) on newly created slips, and wild ginger (*Hedychium gerdnerianum*) on the edge of the existing SH3 bypass. Other pest plants include exotic willow weed (*Persicaria* sp.), Spanish heath (*Erica lusitanica*), Chinese privet (*Ligustrum sinense*), cotoneaster (*Cotoneaster franchetii*), arum lily (*Zantedeschia aethiopica*) and exotic grasses (NSES Ltd, 2017). The location of known pest plant eradication sites can

be seen in Figure 11.1. These locations are also marked on the Ecology Constraints Map in Appendix A to the ELMP.

Altogether these pest plants are comparatively uncommon in the Project footprint. However, it is predicted that constructing the alignment without preventative measures would facilitate the spread of weeds. Given the low density of pest plants currently, the high ecological value of the area and the importance of mitigation/off-set plantings, restricting the spread of pest plants is of high importance.

11.3.4 General biosecurity management

The Alliance shall appoint an appropriately qualified senior manager as Alliance Biosecurity Coordinator (ABC) prior to the commencement of construction. The ABC will be responsible for coordinating pest plant, skink and ant prevention and management activities required on the Project and will be the primary point of contact for the Alliance management team and the Transport Agency on all matters related to pest plant, skink and ant management.

To ensure pest plant control and mitigation is undertaken safely and effectively, the following general guidelines are to be adhered to:

- all weed management shall be carried out by suitably qualified weed management staff;
- herbicide use shall only be undertaken in fine weather to prevent spray drift;
- herbicide use shall be undertaken predominantly between the months of November through April when pest plants are actively growing;
- manufacturer's guidelines are to be adhered to regarding mixing and application;
- care is to be taken around new plantings, and herbicides shall be marked with a dye to indicate spray coverage;
- herbicides shall be used with appropriate safety gear to prevent any health and safety issues;
- pest plants shall be disposed of on-site (unless specifically determined otherwise by the ABC); and
- spray used within 10 m of any waterway, or in areas where there is high potential for spray to runoff into waterways shall be undertaken only with those herbicides approved for use around waterways.

11.3.5 Pest plant prevention measures

Pest plants shall be controlled to prevent their spread and to prevent any new introductions of pest plants. Along the entire alignment, pest plant growth will be prevented as far as practicable in order to produce a clean edge. In addition, pest plants shall be controlled to a low level throughout the Project area and mitigation planting areas. As it is more cost-effective to prevent pest plant invasions with a number of prevention measures than to control infestations once establishment has occurred (Tane's Tree Trust, 2011), emphasis is on the prevention of pest plants spreading and establishing.

Pest plant species identified within the Project footprint can spread via plant fragments (tradescantia and African clubmoss), wind (pampas), animals (Chinese privet) and seed capsule explosion and soil movement (gorse), therefore any preventative methods must be robust to different methods of pest plant movement. Pest plant preventative actions are outlined in Table 11.1.

Table 11.1- Tools and hygiene protocols to be adhered to in order to mitigate the establishment and spread of pest plants throughout the Project.

Tools and potential weed vectors	Actions to be undertaken
Inductions	• All personnel (including visitors) to be inducted on cleaning protocols and the importance of cleaning gear to prevent the spread of weeds.
Vehicles and machinery	• Provision of vehicle wash-down facilities at Project site entry/exit locations to be used by all vehicles entering and leaving the Project site to remove any soil and plant material. • Soil and plant material to be removed from vehicles when exiting or entering the work site. Where diggers and other construction vehicles are required to move between sites, soil and plant material is to be cleaned off.
Personnel and equipment	Provision of hoses and foot wash stations at site entrances for cleaning gear and equipment of soil and plant matter for when moving between the northern Mangapepeke catchment and the southern Mimi catchment.
Restricted access	In the case of an incursion of a significant pest plant species, exclusion zones with fencing and signage may be required to restrict access into these areas until eradication has taken place.
Mulch, topsoil and potting mix	• There is a high chance that site-won soil will contain tradescantia or African clubmoss fragments. An appropriate pre-emergent herbicide shall be used before soil that has been taken from areas containing these plant species is reused on site. • Breaking up existing soil may also release pest plants in the seed bank such as gorse. Where gorse has been previously identified, such soil such be treated with appropriate herbicides. All invasive weed species that germinate in placed mulch or topsoil will be treated with the appropriate herbicide.
Design controls	• Design of an interface area between road side barriers, swales and chip seal area that minimises weed growth. • Swales and drainage sediment traps to be treated with pre-emergent herbicide. • Swales shall be lined with geo-fabric, rocks, concrete or grass to reduce the need for spraying. • Sediment shall be removed from sediment traps to avoid a medium for weed growth. • Where weeds are unable to be inhibited fully by design, they shall be managed and controlled with herbicide and manual removal.

Tools and potential weed vectors	Actions to be undertaken
	The Project area and all Project related plantings will be managed for pest plants and general weeds throughout the construction phase and for 5 years following construction.
Control of existing weeds	Refer to Section 11.3.7
Mitigation and off-set planting pest plant guidelines	Refer to Section 11.3.9

11.3.6 Controlling pest plants around waterways

For staff undertaking works in or around waterways, all equipment and gear (including waders) shall be checked for plant material, cleaned (preferably with Sterigene), and dried before and after accessing waterways.

11.3.7 Pest plant control

Control of pest plants shall consist of chemical and physical control. Chemical control relates to the use of herbicides to control pest plants. This is usually the most effective method for controlling pest plants; however, overuse of herbicides may have adverse impacts on the environment. Chemical control can be undertaken by spraying, 'cut and paste' or 'drill and fill/injection of herbicides' or the use of granules. Each method of chemical control may be suitable for different species/age classes. Aerial spray is not necessary for the weeds currently present in the Project area. Physical control refers to using physical means to remove pest plants, such as shading, hand weeding, ring barking, grubbing, felling and mulching.

Control of pest plants shall follow best-practice for the particular species, as well as take into account effects on the local environment (eg some herbicides are more persistent in the soil and can limit future planting success). Some species (such as gorse) may require a combination of chemical and physical control (Tane's Tree Trust, 2011). Weed contractors are to refer to the Weedbusters Weed Control Handbook (2011) for best practice control of each species.

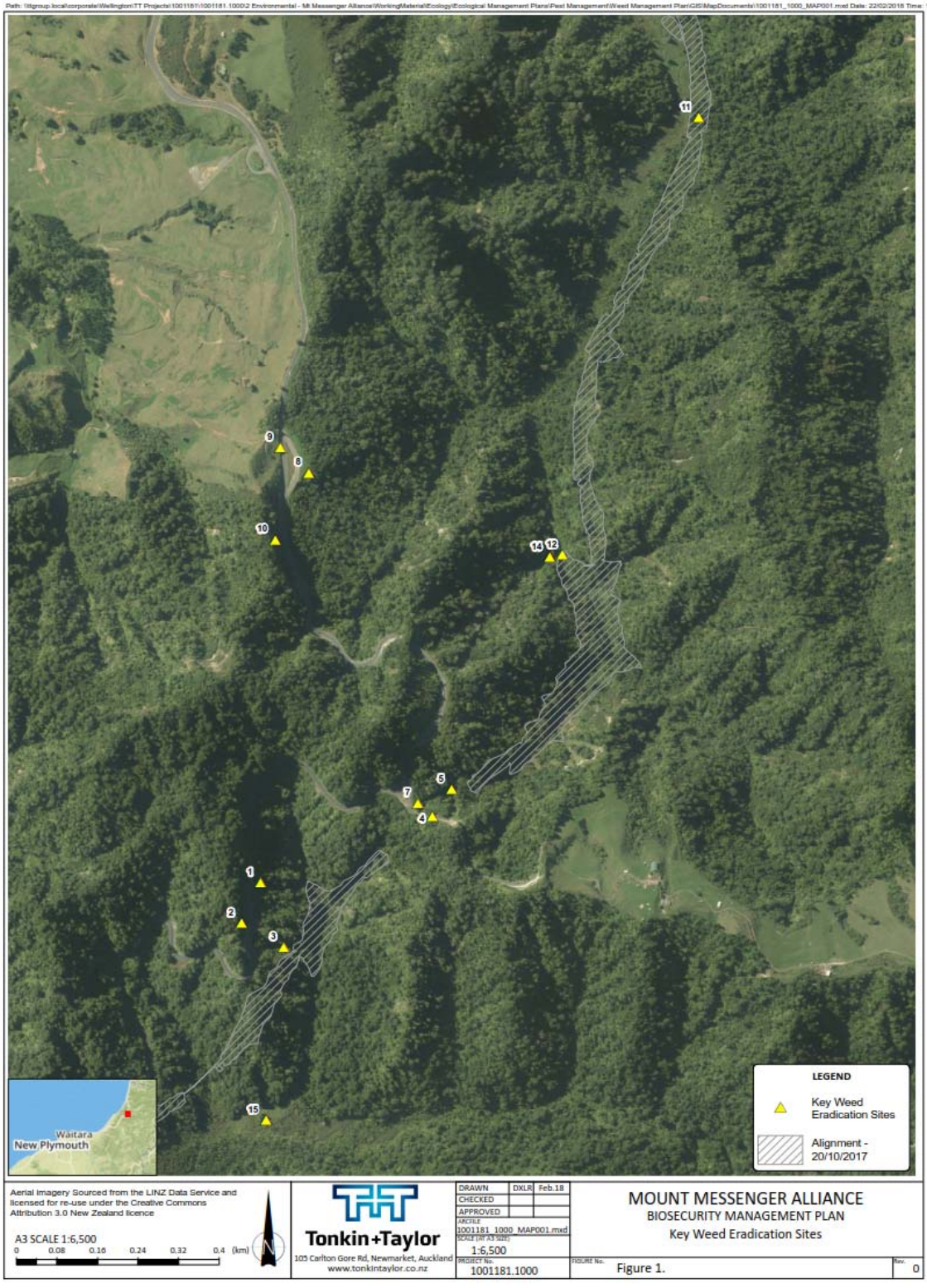

Figure 11.1 – Approximate locations of key pest plant eradication sites to prevent further pest plant issues. 1 = cotoneaster, 2 = gorse and pampas, 3 = pampas, 4 = wild ginger, 5 = wild ginger, 7 = tradescantia, 8 = Chinese privet, 9 = barberry, 10 = Spanish heath, 11 = wild ginger, tradescantia, 12 = tradescantia, 14 = arum lily, 15 = gorse and pampas.

11.3.8 Control of novel pest plants

Monitoring for newly arrived pest plant species shall be undertaken every quarter by the Ecology Team and other environmental personnel active on the Project.

If a newly suspected pest plant has been identified, the following protocols are to be adhered to:

- ABC notified immediately who will then inform the wider Alliance team;
- GPS coordinates of the weed species or infestation noted;
- Species cross-checked with the National Pest Plant Accord to determine its legal status;
- If determined to be an unwanted or notifiable species, (or determined to have the potential to have significant adverse ecological effects) a delineating survey undertaken to assess the extent of infestation;
- Eradication undertaken (if considered feasible by ABC);
- Monitoring and further control at infected site 3 months after eradication, and then scaled back to 6 months and 1 year after eradication assuming no new infestations.

These steps may require a temporary halting of construction within 100m of the affected site, and additional cleaning protocols may be required depending on the weed species identified. Any eradication attempted of novel pest plants shall be undertaken with regard to specific life-history traits and best-practice techniques.

The presence of the following species within the Project footprint should be noted as a high priority:

- Woolly nightshade (Solanum mauritianum);
- Barberry (Berberis glaucocarpa); and
- Climbing spindle berry (Celastrus orbiculatus).

These species are located relatively close to the Project footprint, and any sign of their presence requires control.

In addition, the proposed Regional Pest Management Plan for Taranaki (May 2017) contains objectives to eradicate certain pest species. The Taranaki Regional Council Biosecurity Strategy 2017-2037 states a goal of eradicating:

- Climbing spindle berry;
- Giant reed;
- Madeira (mignonette) vine;
- Moth plant (RFB); and
- Senegal tea.

Any sign of these species within the Project footprint shall require eradication if feasible, and if not, control to a low level. TRC should be advised of the presence of these species.

11.3.9 Mitigation and offset plant maintenance

Poor pest plant control has resulted in the highest death rate of planted native trees and shrubs in planting programmes throughout New Zealand over the last century (Bergin and Gea, 2007). Plantings can become overrun and impacted by weed growth, therefore a pest plant management programme is required to ensure plant health is maintained, and mitigation and off-setting targets are achieved. Sites to be planted are likely to be highly variable; from weed-ridden farm tracks to engineered fill. Weed control regimes will need to incorporate timelines for site preparations to take into account any likelihood of re-infestation.

To ensure healthy plant growth and prevent adverse effects of pest plants, sites for mitigation planting will be prepared, planted and maintained in accordance with Chapter 4: Landscape and Vegetation Management Plan.

11.4 Pest animal management

11.4.1 Purpose of pest animal management

The purpose of the pest animal management section of this plan is to:

- provide background information on pest animals currently absent in the Project footprint with potential to adversely affect the ecological values there;
- describe how an incursion of new pest animals may affect the ecological values of the Project area; and
- describe actions to be undertaken as part of the Project to minimise the likelihood of pest animals invading.

11.5 Pest animals absent in Mt Messenger

The management of pest mammals already present on the Project is addressed in the Pest Management Plan (Chapter 9, ELMP). There are two pest animal species which are not present in Mt Messenger which have high invasion potential, and whose invasion may cause particular ecological harm. These are plague skinks (*Lampropholis delicate*) and argentine ants (*Linepithema humile*).

11.5.1 Plague skinks

Plague skinks (also known as rainbow skinks) are native to Australia and first recorded in Auckland in the 1960s. Their range encompasses Northland, Waikato, Bay of Plenty and outlying populations in Whanganui, Palmerston North and Foxton Beach (Department of Conservation, n.d.). A single plague skink can lay up to 24 eggs per year (over five times more than native skinks). Plague skink eggs readily spread in potting mix and other soil movement. They can reach high population densities in short timeframes, and compete with native lizards and other native fauna for food and habitat.

11.5.2 Argentine ants

Argentine ants are an introduced ant species ranked as one of the world's 100 worst invaders (Global Invasive Species Database, 2018) and have the ability to form large 'supercolonies' which can outcompete New Zealand's native ant species. Their current distribution in New Zealand ranges from Northland, Auckland, Bay of Plenty, Hawke's Bay, Wellington, Nelson and Christchurch, and in 2006 were found in Taranaki (Waitara, Bell Block, Oakura, New Plymouth, Patea and Waverly; Taranaki Regional Council, n.d.). They spread predominantly via the transportation of queens and nests, often when a potted plant is moved with a nest in its soil, or if nests establish on vehicles and freight. Human mediated dispersal has resulted in their long distance spread in New Zealand (Ward *et al.*, 2005). Argentine ants pose a threat to native invertebrates and other fauna present at Mt Messenger, and have been known to kill baby birds (Moller, 1996).

11.6 Prevention of pest animal invasions

Any suspected sign of plague skinks or argentine ants shall immediately be reported to the ABC. A number of precautionary measures are to be undertaken to prevent the spread of these organisms (Table 11.2).

Table 11.2- Actions to be undertaken to prevent the introduction of plague skinks or argentine ants to the Project Area.

Tools and potential plague skink / argentine ant vectors	Action for plague skinks	Action for argentine ants
Inductions	All personnel (including visitors) to be inducted on cleaning protocols and the importance of cleaning gear to prevent the spread of plague skinks. Pictures of plague skinks and their eggs presented.	All personnel (including visitors) to be inducted on cleaning protocols and the importance of cleaning gear to prevent the spread of argentine ants. Description of argentine ants presented.
Restricted access	In the case of an incursion of plague skinks, exclusion zones with fencing and signage may be required to restrict access into these areas until eradication has taken place.	In the case of an incursion of argentine ants, exclusion zones with fencing and signage may be required to restrict access into these areas until eradication has taken place.
Imported potting mix	Potting mix is one of the most frequent vectors of plague skinks and their eggs. All potting mix shall be inspected for plague skinks and eggs prior to importation to site. No mulch or topsoil be will brought on to site.	All potting mix shall be inspected for argentine ants prior to importation to site. No mulch or topsoil be will brought on to site.

11.7 Adaptive management

Pest plants and animals can spread rapidly, and have the potential to a) prevent mitigation and off-setting success, and b) compromise the health of the high ecological values in Mt Messenger. Adaptive management will be essential in ensuring pest plants and animals do not have an adverse effect on the environment, and that the Project does not facilitate their spread. Adaptive management will be undertaken by:

- keeping up-to-date with any new scientific papers and guidelines to stay on top of current best practice;
- ensuring any updates regarding pest plants and organisms from MPI and TRC are adhered to; and
- adapting prevention and control behaviours to any new or particularly severe pest plant or animal infestations on the project.

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12 Roles, Responsibilities and Training

12.1 Roles and Responsibilities

This section outlines the roles and responsibilities of the key organisations in relation to this ELMP.

Table 12.1 - Key organisational roles and responsibilities

Organisation	Responsibilities
Transport Agency	• Overall responsibility for compliance with the Resource Management Act 1991 (RMA) and conditions of the designation and resource consents • Review of ELMP as required during construction
Mt Messenger Alliance	• Overall responsibility for environmental management during construction • Implementation of this ELMP • Review of this ELMP, and consequential changes to other management plans • Training of staff, including sub-contractors, in relation to this ELMP • Inspection of works to assess compliance with this ELMP • Monitoring and reporting in accordance with this ELMP
Taranaki Regional Council and New Plymouth District Council	• Review and comment on the draft ELMP • Compliance monitoring / auditing during construction to check compliance with this ELMP
Department of Conservation	• Review and comment on the draft ELMP • Authority responsible for administering Wildlife Permits in accordance with the Wildlife Act 1953
Te Runanga o Ngāti Tama	• Review and comment on the final ELMP • Advising on relevant cultural protocols

12.2 Training

This section provides an overview of training requirements in relation to the ecological and landscape aspects of the Project. Detail on other Project training requirements is outlined in the CEMP.

12.2.1 Inductions

All people working on-site, or with site responsibilities shall undertake a formal site induction as outlined in the CEMP. No person will be permitted to work on the site until they have completed the induction process.

Part of this induction process will be based on environmental management. The induction will include information on:

- the ecological, landscape and cultural values of the area;
- sensitive areas within the Project footprint; and
- the suite of management plans, including this ELMP, that shall be implemented during construction works to avoid, remedy, mitigate or offset adverse effects.

12.2.2 Training

The Alliance Management Team, Construction Manager, Site Managers, superintendents and environmental and ecology team members (responsible for implementation of this ELMP), will undergo environmental awareness training to make all aware of their responsibilities relating to this ELMP.

Training requirements are described in further detail within the CEMP with specific training requirements relating to this Plan including:

- the ecological, landscape and cultural values of the area;
- sensitive areas within the Project footprint;
- key ecological protocols / environmental control measures outlined in the ELMP that shall be implemented to avoid, remedy, mitigate or offset adverse effects; and
- Ecology Constraints Map that accompanies this ELMP (refer Appendix A).

It should be noted that a number of ecological aspects, such as bat surveys, lizard salvage and relocation, kiwi management, fish capture and relocation, peripatus management will only be undertaken by suitably qualified ecologists as outlined in the specific management plan chapters, hence are not included in Table 12.2 below.

Table 12.2 - Ecological Training

Environmental Aspect	Specific Training
Vegetation Clearance	• A briefing on the values of any significant areas of vegetation that are to be retained. • Briefing of the Project Vegetation Clearance Protocol: o the methods that shall be used to protect vegetation remaining during construction o the removal and relocation of forest resources o methodology for mulching and stockpiling wood and topsoil
Stream works	• Briefing on the values of waterbodies within and downstream of the Project area and the sensitivity of the receiving environment to sediment discharges. • The objectives of the stream design including fish passage requirements. • Briefing on the Project Fish Rescue and Relocation Protocol, which contains the methodology to minimise direct effects of construction on fish, kōura and kākahi (freshwater mussels) prior to draining, diverting or excavating streams. • Construction method requirements for stream works (stream diversions, culverting or other in-stream work), including the set-up of fish passage barriers for isolating sites prior to in stream works (for those involved in this work)

Environmental Aspect	Specific Training
Erosion and Sediment Control / Construction Water Management	• Relevant TRC and Transport Agency erosion and sediment control guidelines. • Design details for the erosion and sediment control and construction water management measures and associated methodologies during construction. • The performance standard as defined in the CWMP to be achieved by all erosion and sediment controls on site. • The sensitivity of the receiving environment to sediment discharges. • Understanding the construction water risk for specific activities and/or locations. • SCWMP requirements.

A record shall be kept of all training, including the information presented and a list of attendees (refer to the CEMP for further detail).

The Environmental Manager will identify staff that require additional training in relation to their roles and responsibilities for specific aspects of this ELMP.

12.2.3 Toolbox talks

Environmental issues, including ecological management, will form a regular part of toolbox meetings to ensure all workers are aware of the key issues.

13 ELMP Review

13.1 Review process

A review of the ELMP will be undertaken at least annually until completion of construction works. The management review will be organised by the Environmental Manager and the Project team will be informed of any changes to this ELMP through the regular Project communications processes. The review will take into consideration:

- Compliance with the Project consent / designation conditions, the CEMP and other management plans (including timeframes).
- Any significant changes to construction activities or methods that require the description of construction activities to be updated and/or any unanticipated more than minor adverse effects resulting from the Project.
- Key changes to roles and responsibilities within the Project team.
- Changes in industry best practice standards.
- Results of inspections, monitoring and reporting procedures associated with the management of adverse effects during construction.
- Relevant comments or recommendations from TRC or NPDC on all other management plans.
- Comments or recommendations from TRC, NPDC, Ngāti Tama and DOC regarding the ELMP and the PMP.
- Unresolved complaints and any response to complaints and remedial action taken to address the complaint.

The outcomes of any review will be provided to TRC and NPDC.

Where the ELMP is updated as part of a review, the on-site version shall be updated promptly and prior to any works associated with the amendment being implemented.

13.2 Minor amendment

In accordance with the designation and consent conditions, minor amendments may be made to the final ELMP at any time. Minor amendment is any amendment where the adverse environmental effect arising from the amendment is the same or less than the effect that would result in the absence of the amendment.

Any changes to the ELMP shall remain consistent with the overall intent of the original version of the final ELMP.

The Alliance shall provide TRC and NPDC with a copy of any amendment as soon as practicable and before any construction works associated with that amendment are implemented.

13.3 Material Amendment

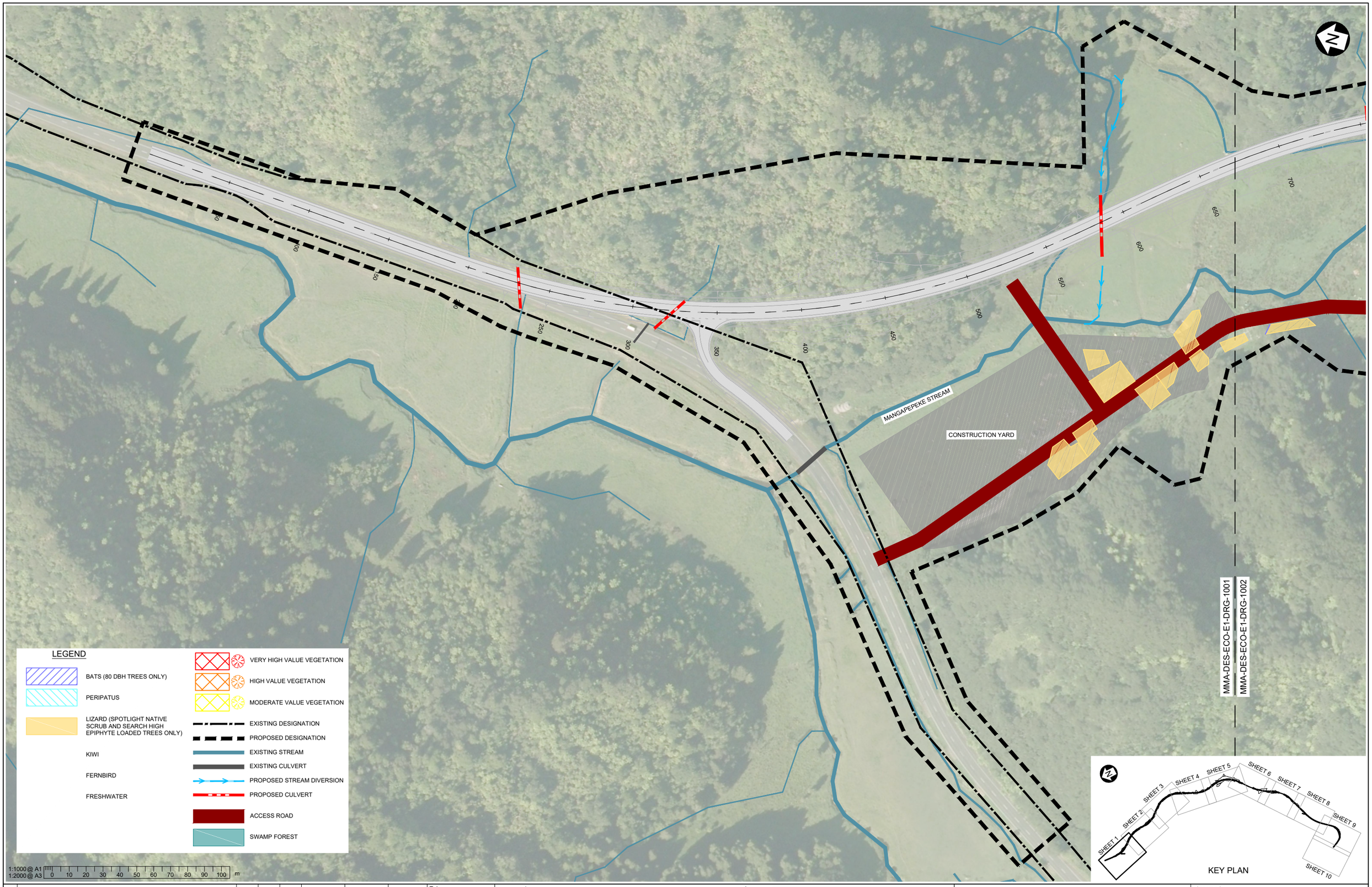
Material amendments to this ELMP may be made at any time subject to certification by TRC and NPDC (in accordance with the designation and consent conditions). Material amendments are any amendments that are consistent with the overall intent of the original version of the final ELMP, but that are not minor amendments in accordance with Section 13.2.

In the event of material amendment the amendment shall be submitted to TRC and NPDC for certification 20 working days before the commencement of works to which the amendment applies.

Works unaffected by the material amendment may continue during the certification process.

Appendices

Appendix A: Ecology Constraints Map



Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
A	FOR INFORMATION	QDO'S	GGC*	JM	LJG	LJG	17/07/2018

Tab MMA-DES-ECO-E1-DRG-1001

Scales 1:2000 (A3) 1:1000 (A1)

Original Size A1

Te Ara o Te Ata

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ECOLOGY CONSTRAINTS MAP - FAUNA SHEET 1

Approved NOT FOR CONSTRUCTION

Status FOR INFORMATION

Drawing Number MMA-DES-ECO-E1-DRG-1001

Revision A

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MMA-DES-ECO-E1-DRG-1001
MMA-DES-ECO-E1-DRG-1002
MMA-DES-ECO-E1-DRG-1002
MMA-DES-ECO-E1-DRG-1003

600 650 700 750 800 850 900 950 1000 1050 1100 1150 1200 1250 1300 1350 1400

MANGAPEPEKE STREAM

LEGEND

- BATS (80 DBH TREES ONLY)
- PERIPATUS
- LIZARD (SPOTLIGHT NATIVE SCRUB AND SEARCH HIGH EPIPHYTE LOADED TREES ONLY)
- KIWI
- FERNBIRD
- FRESHWATER
- VERY HIGH VALUE VEGETATION
- HIGH VALUE VEGETATION
- MODERATE VALUE VEGETATION
- EXISTING DESIGNATION
- PROPOSED DESIGNATION
- EXISTING STREAM
- EXISTING CULVERT
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- ACCESS ROAD
- SWAMP FOREST

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10

KEY PLAN

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
A	FOR INFORMATION	QDO'S	GGC*	JM	LJG	LJG	17/07/2018

Tab: MMA-DES-ECO-E1-DRG-1002
Scales: 1:2000 (A3) 1:1000 (A1)
Original Size: A1

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ECOLOGY CONSTRAINTS MAP - FAUNA SHEET 2

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Status: FOR INFORMATION
Drawing Number: MMA-DES-ECO-E1-DRG-1002
Revision: A

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MMA-DES-ECO-E1-DRG-1002

MMA-DES-ECO-E1-DRG-1003

MMA-DES-ECO-E1-DRG-1003

MMA-DES-ECO-E1-DRG-1004

MANGAPEPEKE STREAM

1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 2050 2100

SEE INSET A

INSET A

LEGEND

- BATS (80 DBH TREES ONLY)
- PERIPATUS
- LIZARD (SPOTLIGHT NATIVE SCRUB AND SEARCH HIGH EPIPHYTE LOADED TREES ONLY)
- KIWI
- FERNBIRD
- FRESHWATER
- VERY HIGH VALUE VEGETATION
- HIGH VALUE VEGETATION
- MODERATE VALUE VEGETATION
- EXISTING DESIGNATION
- PROPOSED DESIGNATION
- EXISTING STREAM
- EXISTING CULVERT
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- ACCESS ROAD
- SWAMP FOREST

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
A	FOR INFORMATION	QDO'S	GGC*	JM	LJG	LJG	17/07/2018

Tab: MMA-DES-ECO-E1-DRG-1003

Scales: 1:2000 (A3) 1:1000 (A1)

Original Size: A1

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ECOLOGY CONSTRAINTS MAP - FAUNA SHEET 3

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Status: FOR INFORMATION

Drawing Number: MMA-DES-ECO-E1-DRG-1003

Revision: A

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MMA-DES-ECO-E1-DRG-1004

MMA-DES-ECO-E1-DRG-1004

MMA-DES-ECO-E1-DRG-1005

MANGAPEPEKE STREAM

1950 2000 2050 2100 2150 2200 2250 2300 2350 2400 2450 2500 2550 2600 2650 2700

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

LEGEND

- BATS (80 DBH TREES ONLY)
- PERIPATUS
- LIZARD (SPOTLIGHT NATIVE SCRUB AND SEARCH HIGH EPIPHYTE LOADED TREES ONLY)
- KIWI
- FERNBIRD
- FRESHWATER
- VERY HIGH VALUE VEGETATION
- HIGH VALUE VEGETATION
- MODERATE VALUE VEGETATION
- EXISTING DESIGNATION
- PROPOSED DESIGNATION
- EXISTING STREAM
- EXISTING CULVERT
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- ACCESS ROAD
- SWAMP FOREST

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
A	FOR INFORMATION	QDO'S	GGC*	JM	LJG	LJG	17/07/2018

Tab: MMA-DES-ECO-E1-DRG-1004

Scales: 1:2000 (A3) 1:1000 (A1)

Original Size: A1

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ECOLOGY CONSTRAINTS MAP - FAUNA SHEET 4

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Drawing Number: MMA-DES-ECO-E1-DRG-1004

Revision: A

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MMA-DES-ECO-E1-DRG-1005

MMA-DES-ECO-E1-DRG-1005

MMA-DES-ECO-E1-DRG-1006

2600 2650 2700 2750 2800 2850 2900 2950 3000 3050 3100 3150 3200 3250 3300 3350 3400 3450

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

LEGEND

- BATS (80 DBH TREES ONLY)
- PERIPATUS
- LIZARD (SPOTLIGHT NATIVE SCRUB AND SEARCH HIGH EPIPHYTE LOADED TREES ONLY)
- KIWI
- FERNBIRD
- FRESHWATER
- VERY HIGH VALUE VEGETATION
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- MODERATE VALUE VEGETATION
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- PROPOSED DESIGNATION
- EXISTING STREAM
- EXISTING CULVERT
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- ACCESS ROAD
- SWAMP FOREST

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
A	FOR INFORMATION	QDO'S	GGC*	JM	LJG	LJG	17/07/2018

Tab: MMA-DES-ECO-E1-DRG-1005

Scales: 1:2000 (A3) 1:1000 (A1)

Original Size: A1

Te Ara o Te Ata

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ECOLOGY CONSTRAINTS MAP - FAUNA SHEET 5

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Drawing Number: MMA-DES-ECO-E1-DRG-1005

Revision: A

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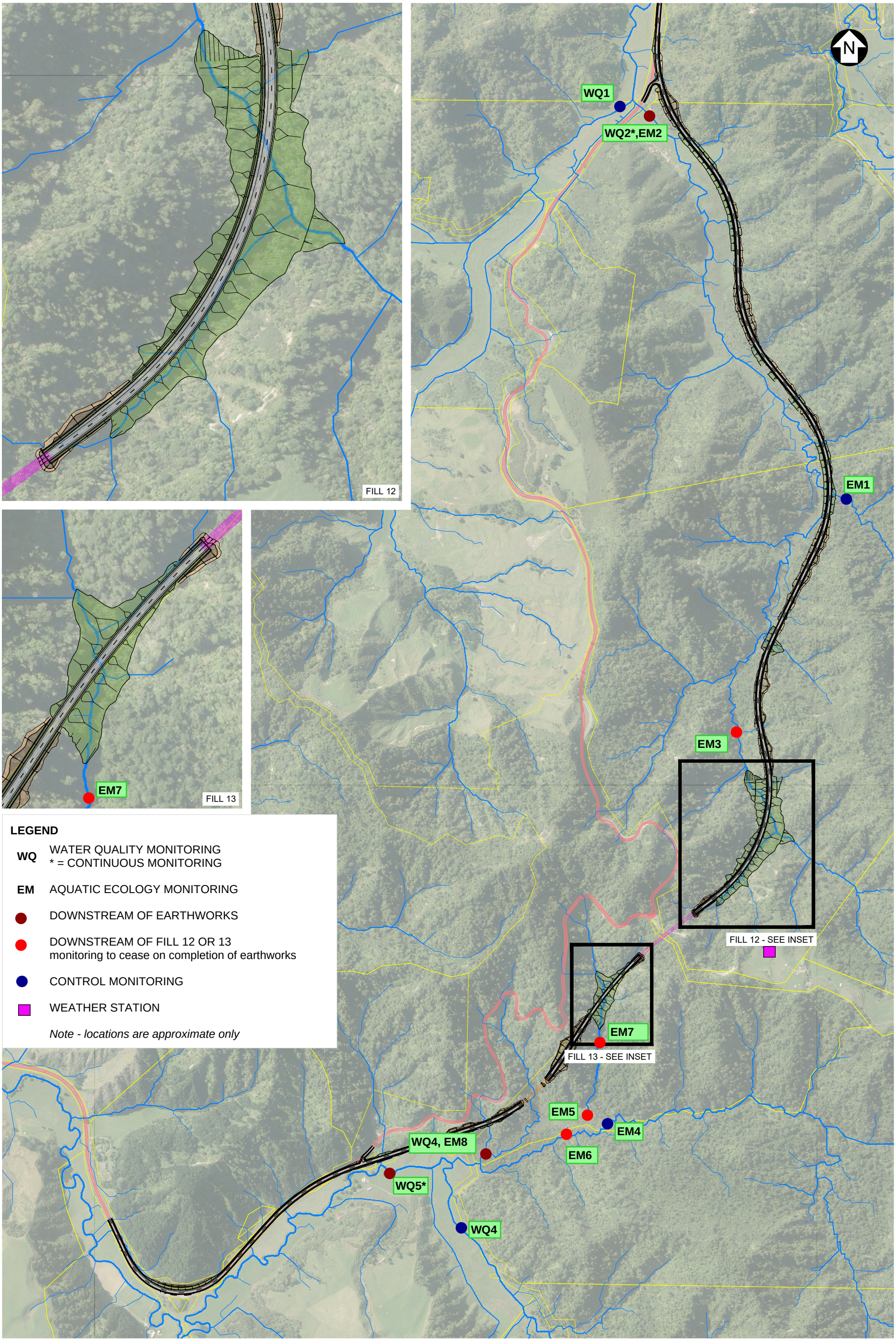
Appendix B: Bat competency classes table

- **From Smith et al. (2017)**

Class	Key Field Activity	Competency	Individual experience/knowledge
A	ABMs	Setting up automatic bat detector systems (ABMS)	Recent previous experience in installing ABMS in at least 2 comprehensive surveys.
B	Analysing ABM data	Setting up ABMS, and analysing and interpreting results.	Recent previous experience at analysing and interpreting ABMS results in at least 2 comprehensive surveys.
C1	Identifying bat roosts (short-tailed bats)	Finding and identifying short-tailed bat roosts that are either occupied or unoccupied. This competency may also include arborists.	Recent extensive experience in searching for and finding active and inactive roosts (by radio tracking, exit observations, and/or visual inspections)
C2	Identifying bat roosts (long-tailed bats)	Finding and identifying short-tailed bat roosts that are either occupied or unoccupied. This competency may also include arborists.	Recent extensive experience in searching for and finding active and inactive roosts (by radio tracking, exit observations, and/or visual inspections)
D	Handling bats	Handling bats (in one or more field methods), as outlined in DOC's best practice manual (Sedgeley et al 2012).	Has undertaken field training from a competent trainer demonstrating the required technique to the trainer's satisfaction and meets DOC's best practice manual standards (Sedgeley et al 2012) to carry out one or more of the following specialised field methods: • extracting bats from mist nets • using harp traps at roost sites • handling bats • marking bats (eg forearm band, temporary marks) • using wing biopsies for genetic sampling • attaching transmitters • inserting transponder tags • applying release techniques.
E	Trainer for class	Competent at the relevant class plus capable of training staff.	Has a high level of knowledge and experience regarding the competency they are training people in.
F	Bat management	• Survey/monitoring programme design (may be individual or a team) • Survey data analysis and interpretation • Preparation of bat effects assessment reports • Can recommend impact management strategies (eg mitigation) for projects • Prepare, co-author, or certify the appropriateness of BMMPs	• Competency in 3 or more of class A/B/C/D activities (field experience relating to competency classes A/B/C/D activities). • Experience writing ecological assessments and/or species restoration or recovery plans. • Thorough knowledge of available bat survey techniques and methodology, and their limitations. • Thorough knowledge of the threats bats face and national recovery

Class	Key Field Activity	Competency	Individual experience/knowledge
		• Presentation of expert evidence for projects impacting bats.	actions. • Thorough knowledge of measures to avoid, mitigate or compensate for impacts of infrastructure projects on bat populations. • Understands seasonality and conditions of bat activity, and how these might affect surveys. • Can recognise and articulate how the practical constraints of a survey affect the conclusions in an impact assessment. • Understand the importance of sampling design and sample size (effort) in determining whether monitoring results will have sufficient statistical power to detect changes in the variable of interest.

Appendix C: Water Sampling Plan


N
WQ1
WQ2*,EM2
EM1
FILL 12
FILL 13
EM7
EM3
FILL 12 - SEE INSET
FILL 13 - SEE INSET
EM5
EM4
EM6
WQ4, EM8
WQ5*
WQ4
LEGEND
WQ
WATER QUALITY MONITORING
* = CONTINUOUS MONITORING
EM
AQUATIC ECOLOGY MONITORING
DOWNSTREAM OF EARTHWORKS
DOWNSTREAM OF FILL 12 OR 13
monitoring to cease on completion of earthworks
CONTROL MONITORING
WEATHER STATION
Note - locations are approximate only

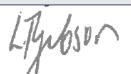
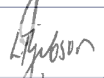
Appendix D: Fish Recovery and Rescue Protocols

Fish Recovery and Rescue Protocols

July 2018

Mt Messenger Alliance

MMA-ENV-ECL-RPT-2858

Quality Assurance Statement			
Prepared by:	 pp	Keith Hamill	Mt Messenger Alliance
Reviewed by:	 pp	Josh Markham	Mt Messenger Alliance
Approved for release:		Hugh Milliken	Mt Messenger Alliance

Revision schedule		
Rev. Number	**Date**	**Description**
A	4 May 2018	Draft for discussion.
B	25 May 2018	Updated for Council
C	July 2018	Updated for Council Hearing

Contents

1 Introduction

1.1 Purpose and scope of work

The purpose of these Fish Recovery and Rescue Protocols (FR&RP) is to minimise the direct loss of native freshwater fish as a consequence of works in waterway.

These FR&R Protocols do not cover mitigation for loss of stream habitat, fish passage through culverts or habitat enhancement of culverts. These issues are addressed separately.

2 Approach to fish recovery and fish rescue

2.1 Fish recovery, rescue and relocation

Construction works undertaken in the bed of streams causes a level of risk to native freshwater fish of mortality or injury. The magnitude of risk is determined by the nature of the activity, the area of the stream disturbed, density of fish present in the stream, and the ability of fish to escape the disturbance. These FR&R Protocols describe practicable measures to minimise the mortality of native fish.

The general approach is:

- These FR&R Protocols describe multiple methods for fish recovery, the methods applied to any particular waterway will depend on the nature of the stream.
- The FR&R Protocols take a risk based approach to match the level of effort with the risk of native fish mortality. More intensive fish recovery measures and effort will be applied to waterways where there is expected to be more native fish present.
- The Fish Rescue Protocol will apply to all waterways containing water at the time of the work.
- Fish Relocation Protocols will be followed for handling and transferring fish to appropriate alternative sites – typically a reach of similar habitat on the same stream.

The fish recovery methods are grouped as three different protocols:

- Protocol A requires netting/trapping prior to dewatering.
- Protocol B includes fish recovery measures that can occur on the day that a stream is dewatered. Where practical, and to minimise injury to fish, preference will be given to encouraging fish to voluntary leave the stream section prior to netting and electro-fishing.
- Protocol C relates to recovery of kākahi.

Some methods of fish recovery cannot be applied to some habitats, as follows:

- Fyke nets requires sufficient water depth (about 35-40 cm) and sufficient stream width (about >55 cm) free of snags.
- Gee minnow traps require about 15 cm of water depth, though they can be dug into the sediment in shallower water (Ling et al 2013).

- Backpack electric fishing requires about 10cm of water depth, but is ineffective and unsafe in deep water (e.g. about 60cm), or where there is soft deep sediment or dense aquatic vegetation.

Allowing fish to passively vacate a stream during dewatering poses the least risk of injury to fish compared to other methods, but it's effectiveness depends on the stream morphology, vegetation density and method of dewatering. Any pools remaining after dewatering will need to be actively fished.

2.2 Location of culverts and stream diversion requiring Fish Recover and Fish Rescue

The Project involves installing 21 culverts, and multiple stream diversions. A number of culverts will be newly installed or extended to upgrade the access track up the Mangapepeke Stream valley (temporary culverts). The locations where the particular fish recovery and rescue protocols that will be applied to each stream affected by the Project is described in Table 1 below. The recovery and rescue protocols shall also apply to staged or temporary culverts installed at these locations.

A number of the streams affected are seasonally intermittent or ephemeral. Fish Rescue Protocols will be followed if water is present in these streams at the time of works.

Table 2.1 - Fish recovery and rescue protocol to be applied at each stream affected by a culvert or stream diversion.

Site	Catchment	catchment area (ha)	ID culvert / diverson	Chainage	Project impact	Fish Recovery Protocol	Fish Rescue	Comment
Ea1	Mangapepeke trib	3.82	1	250	Widen existing culvert 1	N	Y	Ephemeral
Ea2	Mangapepeke trib	1.80	2	300	Widen existing culvert 2	N	Y	Ephemeral cut-off drain
Ea3	Mangapepeke trib	6.3	3	570	Culvert 3	Y (B)	Y	run
Ea3a	Mangapepeke trib	1.2		650	Drain replaced with new swale	N	Y	Recently dug drain lacking fish cover.
Ea4	Mangapepeke trib	1.8	4	750	Shift cut-off drain upslope.	N	Y	Shallow ephemeral drain lacking fish cover.
Ea5	Mangapepeke trib	4.2	5	870	Culvert 5	Y (B)	Y	intermittent
E2	Mangapepeke	306			Access track crosses main stream about 3 times	Y (B,C)	Y	Meander
Ea6	Mangapepeke trib	4.4	SD2 swale	1050	Stream cut-off at the top of the cut and directed to stormwater.	Y (B)	Y	Intermittent
Ea7	Mangapepeke trib	6.8	6	1300	Culvert 6 + stream diversion. Road drainage runs to treatment pond.	Y (B)	Y	Kōura and banded kōkopu present.
Ea8	Mangapepeke trib	5.8	7	1500	Culvert 7 + stream diversion.	Y (B)	Y	Shallow step pool lackiy (b)g ficu cover.
Ea9	Mangapepeke trib	7.9	8	1700	Culvert 8	Y (B)	Y	
Ea10a	Mangapepeke trib	67	9	1850	Culvert 9 for tributary	Y (A,B,C)	Y	kōkopu, giant kōkopu,
Ea10b	Mangapepeke	149	SD5	1850-1950	Stream diversion	Y (A,B,C)	Y	redfin bully, inanga,
E3	Mangapepeke	133		1680	Stream diversion for wetland W2 near culvert 8.	Y (A,B,C)	Y	Main stem of stream
Ea11	Mangapepeke trib	2	10	2220	Culvert 10. Stream to man hole, conveyed back to existing stream.	N	Y	Ephemeral, step-pool
Ea12	Mangapepeke trib	1.6	11	2300	Culvert 11	N	Y	Ephemeral, step-pool
Ea13	Mangapepeke trib	9.8	12	2400	Bridge	N	Y	No direct impact
E4	Mangapepeke	116			Inside temporary footprint	Y (A,B,C)	Y	
Ea14	Mangapepeke trib	1.7	13	2700	Culvert 13	N	Y	Ephemeral, step-pool
E5	Mangapepeke	64	SD6	2800-2900	Culvert + stream diversion	Y (A,B,C)	Y	
Ea15	Mangapepeke trib	5	14	2900	Culvert 14	Y (B)	Y	Ephemeral, step-pool
Ea16	Mangapepeke trib	36	15	2960	Culvert 15	Y (B)	Y	
Ea17	Mangapepeke trib	17	SD7	3000-3350	Stream diversion	Y (B)	Y	

Table 2.1 continued

Site	Catchment	catchment area (ha)	ID culvert / diverson	Chainage	Project impact	Fish Recovery Protocol	Fish Rescue	Comment
Ea18	Mimi trib	6	SD8	3650-3930	Stream diversion	Y (B)	Y	
Ea19	Mimi trib	10	16	3800	Culvert 16	Y (B)	Y	
E6	Mimi trib	21			Culvert 16	Y (B)	Y	
Ea20	Mimi trib	15	Bridge		Bridge	N	Y	No direct impact
Ea21	Mimi trib	3	17	4440	Culvert 17	Y (B)	Y	Intermittent. Fish survey found only kōura.
Ea22	Mimi trib	1.5	swale		Grass swales to stormwater pond.	N	Y	Intermittent drain.
Ea23	Mimi trib	25	18	4750	Culvert 18/19	Y (B)	Y	Banded kōkopu, kōura, redfin
Ea24	Mimi trib	13	20	5150	Extend/replace existing culvert.	N	Y	Drain. Short impact length.
Ea29	Mimi trib	12	21	5650	Replace existing culvert with Culvert 21	N	Y	Ephemeral drainShort impact length.
Ea30	Mimi trib	2			Main stream avoided. Cut-off drain replaced.	N	Y	Recently dug drain, no fish cover.
Ea31	Mimi trib	4.1	SD	5225-5300	Cut-off drain shifted, main tributary avoided.	N	Y	Ephemeral drain. No direct impact
E TL1	Mangapepeke trib	1.3			Access track culvert extension	N	Y	Short impact length, poor habitat
E TL2	Mangapepeke trib	1.9			Access track culvert extension	N	Y	Intermittent drain, poor habitat, short impact length.
E TL3	Mangapepeke trib	2.1	SD3	1050	Fill - diversion section.	Y (B)	Y	
E TL4	Mangapepeke trib	6.6	SD4	1100	Fill - diversion section.	Y (B)	Y	
E TL5	Mangapepeke trib	32			Access track. Potential restoration site	N	Y	Short impact length, degraded fish habitat in affected section
E TL6	Mangapepeke trib	3.1			Access track culvert extension	N	Y	Short impact length, poor habitat, intermittent.

Fish Recovey Protocol: Y= yes, N= only fish rescue, A= Protocol A, B = Protocol B, C = Protocol C for kākahi

2.3 Roles and responsibilities

All fish capture and relocation work is to be undertaken by experienced ecologists who have the appropriate training, knowledge, skills, and ability to ensure safe handling of fish and the safety of staff conducting the operations. In some cases, such as for carrying out the earthwork monitoring and Fish Rescue Protocols, the ecologists can train the Environmental Team or appointed contractor's staff.

In the case of seasonally intermittent streams, the decision as to whether a stream is dry will be made by the Environmental Manager in association with an appropriately trained ecologist who is familiar with the sites. Photographs of the stream will be taken.

2.4 Biosecurity

When nets and traps are re-used at different sites, there is a risk of weed species being introduced to new areas. Care must be taken to clean and thoroughly dry nets between sites. De Winton et al. (2010) reviewed potential decontamination treatments for algae, plant fragments and seeds. They found seeds and plant propagules to be more difficult to remove. They recommended increasing levels of hygiene effort for increasing levels of risk

to the environment:

- Where risk is considered to be low (e.g. movement between sites on the same Project), equipment shall at a minimum be disassembled and cleaned on site, followed by visual inspection before moving.
- Where risk is considered to be moderate, equipment will be cleaned in a containment area using a water blaster, followed by visual inspection. All nets shall be thoroughly dry for at least 24 hours before transferring between catchments. Alternatively, nets shall be soaked for one hour in a 7% salt solution, repeatedly rinsed, then dried. Residual dirt on footwear and other equipment shall be scrubbed off with detergent.

2.5 Timing of works

The timing of work will depend on the construction schedule and weather conditions.

2.6 Permits

Permitting requirements for fish transfers depend on the species and location of transfer. In order to capture and relocate native species, a permit will be required from the Ministry of Primary Industries (MPI), and/or the Department of Conservation (DOC) under section 26ZM and 26ZR of the Conservation Act 1987:

A Special Permit from MPI is required to capture fish, regardless of whether they will be transferred and where they will be transferred to (Fisheries Act 1996, s97).

- A permit is required from DOC and Fish and Game in order to use an electro fishing machine.
- A permit from MPI will be required if a fish species is to be released in a different catchment or within the same catchment if there is a significant barrier in place (weir, dam or waterfall) and the species could not get there of its own accord. A permit would not be required if a species is to be released within the same catchment and the species could normally get there of its own accord.
- A permit from DOC will be required if a fish species is to be released into a site where it doesn't currently exist. Not applicable for this Project.

3 Fish recovery, rescue and relocation

The protocols describe multiple measures for recovering fish. Preference is given to allowing fish to voluntarily leave a section of stream as water recedes and rescuing any fish remaining in pools. This involves encouraging fish to swim out of the affected section of stream on their own accord in preference to use of electric fishing or setting nets overnight. Allowing fish to passively leave a site can be very effective in many streams and it avoids the inherent risk of fish injury/death involved with nets, traps and electric fishing methods.

Protocol A is particularly effective in large waterbodies and waterways with dense macrophyte cover. Protocol A is applied in addition to Protocol B when there is water depth sufficient for fyke nets and a high likelihood of encountering numerous indigenous fish due to either a larger area being disturbed or the presence of

moderate to high quality fish habitat.

3.1 Fish recovery

3.1.1 Staging of works

- Fish capture and relocation will be undertaken in the days prior to the stream diversion or dewatering. Fish barriers will be in place for as short a time as practical to reduce the risk of barrier failure, and usually will occur immediately before the works occur. Some in-stream works, if required sheet piling (or similar) of the upstream end may be undertaken prior to fish capture.
- The managing ecologist shall work with the contractor's Environmental Manager and construction staff (as required) to plan the staging and sequence for work area isolation, fish recovery and dewatering.

3.1.2 Isolate the work area

- Prior to recovering fish from a section of stream the stream reach shall be appropriately isolated. This will mean isolating both ends of the channel affected by the works using block nets or other suitable means depending on site conditions.
- Fish barriers shall be installed to minimise the ability of fish to swim under, or around the net, but shall not impede water flow. The net will extend well above the water surface in case of fluctuating water levels and to prevent fish swimming over the net. They often need to be secured mid-stream as well as on the banksides.
- Block nets shall preferably be constructed from fine mesh (4 mm) material, but larger mesh (e.g. 8 mm) will be used if there is a risk of the net blocking. It is easy for fine mesh nets to block from plant debris in streams with dense macrophyte cover during high flows.
- Fish barriers shall be checked daily by a representative of the construction team who has been trained by the Project ecologist to recognise the signs of barrier failure. Any failure should be rectified immediately.

3.1.3 Fish Recovery Protocol A: Overnight netting prior to works

- Fyke nets and gee-minnow traps (as appropriate) will be placed at intervals along the length of the stream and left in place over night. Nets and traps will be deployed in general accordance with the New Zealand Freshwater Fish Sampling Protocols (Joy et al. 2013).
    - Gee minnow traps will be set at a density of 12 traps per 100 m and fyke nets will be set at a density of 6 per 100 m of stream if the channel is deep enough.
    - Gee-minnow traps will have a minimum mesh size of 6.4 mm (1/4 inch). Gee minnow traps are not required if the fyke nets are fine-meshed (e.g. mesh size <6.4mm) and incorporate a fish exclusion barrier (see Joy et al. 2013).
- Where water is at risk of night time anoxia (e.g. in ponds with very little flow), the nets /traps will be only partially submerged, or floats will be included in some net

compartments to keep sections near the water surface.

- Nets / traps shall be deployed overnight and checked the following morning and any captured fish will be relocated according the Fish Relocation Protocols.
- If native fish with a conservation status of 'Threatened' or 'At-Risk – Declining' are found in densities greater than 0.5 fish per trap/net then netting/trapping will be carried out until catch rates fall below an average of 0.5 fish per trap/net (excluding juveniles). Up to three nights of netting in total will be carried out, checking the traps for fish each morning. Further nights trapping increase the risk of net failure during rain events and blocking fish passage.
- If moderate to high destinies of indigenous fish are found (e.g. >3 per net/trap on average), then nets / traps shall be deployed for a minimum of two nights.
- If the ecologist considers the site suitable, then the second or third night of netting prior to dewatering may be replaced by overnight netting / trapping after partial dewatering has occurred following Protocol B (below). This has been found to be a very effective method for fish recovery in macrophyte dominated streams if fyke nets / traps can be placed in confined channels where the water is draining.

3.1.4 Fish Recovery Protocol B: Electric fishing and voluntary leaving

- Stream dewatering can commence with an ecologist present to search the stream and substrate during dewatering, capturing any fish that are present.
- The safest way to remove fish from a stream (without damage from nets or electo-fishing) is to allow them to swim downstream as water recedes. If the isolated section does not need to be pumped, then as water levels recede the downstream block net will be removed to allow fish to escape.
- If the isolated section needs water to be pumped out (e.g. in low gradient streams), the pump will be placed in a pool at the downstream end of the reach. This pool / channel may need to be created /dug out with minor earth works after the channel is isolated. Access to the pump will be blocked using nets or exclusion barriers to detain and/or trap fish. If possible, fyke nets will be set in a herring bone pattern to capture any fish swimming downstream as the water level in a stream recedes.
- The rate at which water recedes will be managed to minimise any risk of fish being stranded out of water. This is a low risk in U-shaped cannels but is possible in wide or braided channels. In general, this risk will be managed by ensuring that the rate at which water recedes occurs over a period of greater than one hour (e.g. by temporarily pumping water over the upstream block).
- As water levels recede, the original channel and pools will be searched for any remaining fish. Fish will be removed using hand held nets. In some streams (e.g. streams with dense aquatic macrophytes) a channel / pools may need to be formed to assist fish movement. Any macrophytes or sediment moved to create the channel will remain in the stream during the dewatering.

- If other capture methods are likely to be ineffective and stream conditions are appropriate for safe and effective electric fishing, then the stream will be electric fished using a back pack electric fishing machine. Electric fishing will occur as a single pass and particular attention will be given to the machine settings to minimise damage to fish. The suitability for electric fishing will be decided by the Project Freshwater Ecologist and will not occur if the stream is too shallow (<10cm), too deep (<60m) or if soft sediment and/or dense aquatic vegetation prevents effective recovery of fish. It may occur following partial dewatering if considered a more effective.
- Any fish caught will be captured and relocated according the Fish Relocation Protocols.
- Any pump used to dewater the stream channel must have an intake screen with a maximum mesh size of 4 mm, and intake velocities of less than 0.15 m/sec. This can be achieved using slotted pipes or nets placed around the pump area in order to isolate the pump intake. Pumps will be positioned on a scour protection pad (e.g. geotextile fabric) or attached to floats in order to minimise the level of sediment mobilised by the outflow.
- Once dewatering is complete in a section of stream, and the ecologist is satisfied that all practicable steps have been taken to capture fish, then earthworks can commence in the channel.

3.1.5 Protocol C: Kākahi recovery

- In streams where kākahi may to be present, then streams will be searched for presence of kākahi.
- Searches for kākahi will be carried out by hand as they are found in varying habitats including under undercut banks and in fine sediment. Searching can also be carried out visually using a bathyscope or similar.
- Any kākahi found will be placed in a container filled with water and remain in the shade until they are relocated to another suitable section of the stream following the Fish Relocation Protocol.

3.2 Fish rescue during earth works

Fish Rescue Protocols will be followed to rescue any fish found in the stream or on the bankside at the time of earthworks. They are intended to apply to all streams containing water at the time of earthworks and provide an additional backstop to rescue native fish that might still remain after applying the Fish Recovery Protocols (described above). These Fish Rescue Protocols are not intended to apply to small pest fish such as Gambusia.

Fish Rescue Protocols to be followed when sediment is being excavated from a stream:

- Examine stream and recover fish, koura observed in the stream with dip nets. Transfer to recovery bin or directly to the steam outside of the work area. Native threatened or At-Risk species will be prioritised for capture followed by non-threatened native fish and then introduced species.

- When soft sediment or aquatic vegetation is being removed, the top 0.5m of spoil from excavation of stream channels will be spread out in a thin layer for inspection. When safe to access the spoil, it will be visually checked for any fish, koura or kākahi. Where practical, this will occur near the stream but in some situations, this may have to be at the disposal site (e.g. if the spoil is very liquid and needs removal from site). In some cases, excavated material may be temporarily left to dewater within the isolated stream channel to allow examination and fish rescue.
- Fish caught from the spoil will be handled and released according to the Fish Relocation Protocols.
- Any fish, koura, or kākahi rescued will be photographed, counted and the numbers recorded.
- Earthworks monitoring and Fish Rescue Protocols will be overseen by the Project Ecologist but may be carried out by the ecologist or appropriately trained members of the Environmental Team or contractor's staff.

3.3 Fish Relocation

Fish Relocation Protocols cover the handling, holding and release of fish. The following procedures will be followed:

- After capture native fish shall be placed in a lidded container of appropriate volume for the number of fish and part filled with clean stream water. Fish will be held in containers for as short a time as practicable.
- If release cannot occur immediately, the fish will be stored in the shade and kept below 20°C. Fish density and behaviour shall be monitored regularly for any signs of distress (e.g. air gulping). Water shall be changed at least every two hours and battery-operated aerators used to oxygenate the water if required. Fish, kōura or kākahi will typically be relocated within an hour, and they shall not be kept in containers for more than 3 hours.
- Containers shall not be overstocked and larger eels (>500 mm) and kōura shall be kept in separate containers to other captured fish to avoid injury or predation. Eels can be temporarily (up to three hours) held in wet sacks as long as they are kept wet, cool and shaded, or in the water.
- Native fish, kōura and kākahi will be relocated to suitable habitats within the same stream system with similar flow conditions and similar or better habitat. To avoid further permitting requirements, fish must be able to move between sites on their own (i.e. sites must not be separated by any natural or man-made barriers). Fish may be relocated either upstream or downstream of the capture site.
- Upon release fish shall be distributed over a similar length of stream as they were caught, with small fish released first. Large numbers of fish shall not be released in one location to minimise the risk of short term overstocking or predation.
- Any pest fish captured will be euthanized.

- Fish shall be handled with wet hands or gloves to reduce the risk of injury to fish.

3.3.1 Procedures for dealing with pest fish

Any captured fish species managed as pests will be humanely euthanised. The preferred methods include adding clove oil (50 ml per 10 L water) or benzocaine (3.3% solution in ethanol, 50 ml per 10 L water) to a container holding the fish. Large pest fish may be killed by a sharp blow to the back of the head.

Pest fish include: brown bullhead catfish (*A. nebulous*), koi carp (*Cyprinus carpio*), gambusia (*Gambusia affinis*), wild goldfish (*Carassius auratus*), perch (*Perca fluviatilis*), tench (*Tinca tinca*) and rudd (*Scardinius erythrophthalmus*).

Pest fish have not been caught in streams affected by the Project.

3.4 Reporting

A summary of the results from fish recovery will be provided to Taranaki Regional Council annually. The summary will include the following:

- Fish capture methodologies used;
- Species, number and size categories of native aquatic life captured and relocated; and
- Known fish fatalities during capture and relocation.

4 References

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Joy, M., David, B. & Lake, M., 2013. *New Zealand Freshwater Fish Sampling Protocols: Part one – wadeable rivers and streams*. Massy University, Palmerston North.

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Appendix E: Culvert Summary Tables

Table 1: Culverts Amendments Design following *New Zealand Fish Passage Guidelines for Structures up to 4 Metres* (2018).

Culvert	Chainage (m)	Priority for fish passage[1] *	Catchment size (ha)	AEE Design	Amended Solution			
					Hierarchy achieved Fish passage type		Bridge/ Culvert type	Design Comments
8	1700	Moderate	7.95	1200 mm Dia Pipe Culvert 35 m long 4.0% Grade Fish Baffle	3	Hydraulic Design Culvert >1.3 bank width	1500 mm Dia Pipe Culvert 45 m long 3.0% Grade 30% Embedment	Existing bank width ranges from 1.0 to 1.5 m. Typical bankfull width approximately is 1.1 m. AEE design included providing a fish baffle for fish passage. Amended design increases culvert diameter to 1500 mm and provides embedment depth to 30% of the culvert height. Change in culvert length is due to design development. The culvert grade is reduced from 4% to 3%, improving low flow velocities for fish passage. This culvert provides hydraulic design for fish passage and in addition a culvert width of 1.3 x bankfull width.
9	1850	High	66.8	4 x 1350 mm Dia Circular Culverts 56 m long 0.5% Grade 20% Embedment	2	Stream simulation	3000-4000 mm span Arch/Box Culvert 43 m long 0.3% Grade Stream Bed	The existing stream is an incised channel with steep / near vertical sides. Typical stream dimensions are 1.7 m wide x 0.8 m deep. AEE design comprised of 4 pipe culverts installed with 20% embedment depth of culvert height. The culvert size was limited by fill embankment height. Geotechnical investigations indicate geometry can be raised to allow an arch/box culvert to be used. An arch or box culvert with a bottom below the created streambed is equivalent to a bottomless arch culvert for stream simulation. Final design will require assessment of ground conditions. Design of culvert sized to achieve stream simulation

[1] Relative Priority as advised by ecology expert

Culvert	Chainage (m)	Priority for fish passage[1] *	Catchment size (ha)	AEE Design	Amended Solution			
					Hierarchy achieved Fish passage type		Bridge/ Culvert type	Design Comments
12	2400	Moderate	9.84	1200 mm Dia Circular Culvert 74 m long 7.0% Grade Fish Baffle	1	Bridge	Bridge	Existing stream top water surface width = 0.65 m with gradient approximately 6%. Design amended to bridge span to provide highest level of fish passage design. Erosion protection above stream bankfull width for bridge abutments to be provided if required.
14	2900	Low	4.72	900 mm Dia Circular Culvert 117 m long 16% Grade Fish Baffle	3	Hydraulic Design Culvert >1.3 bank width	1500 mm Dia Circular Culvert 140 m long ≤1.0% 30% Embedment	Existing stream top water surface width = 0.4 m. AEE design included providing a fish baffle for fish passage. Amended design increases culvert diameter to 1500 mm and provides embedment to 30% of the culvert height. Change in culvert length is due to design development and improves fish passage by significantly reducing culvert gradient from 16% to 1%. This culvert provides hydraulic design for fish passage and in addition a culvert width of >1.3 x bankfull width.
15	2960	High	50.5	2550 mm Dia Circular Culvert 210 m long 1% Grade 20% Embedment	3	Hydraulic design	2500 mm Dia Circular Culvert 250 - 280 m long 1% grade 25% Embedment	Existing stream width varies from 1.0 to 2.5 m wide with a gradient between waterfalls of 3 – 4% according to LiDAR survey. Existing waterfalls up to 5.5 m in height. AEE culvert design provided 20% embedment of the culvert height for fish passage. The proposed SH3 alignment runs along the stream for > 300 m in length approximately 40 m above the streambed at the greatest height difference and therefore a bridge is not considered practically feasible. Construction of a stream simulation within a culvert /250 m long would be difficult and costly to construct and maintain. Therefore, hydraulic design for fish passage has been adopted. The proposed culvert solution has been modified from AEE by increasing embedment to 25% of the culvert height. This culvert provides hydraulic design for fish passage and a culvert width similar to the bankfull width at the proposed culvert inlet. The proposed culvert grade is significantly lower than the existing stream grade reducing velocities to aid fish passage.

Culvert	Chainage (m)	Priority for fish passage[1] *	Catchment size (ha)	AEE Design	Amended Solution			
					Hierarchy achieved Fish passage type		Bridge/ Culvert type	Design Comments
16	3800	Moderate	13.6	1500 mm Dia Circular Culvert 115 m long 3% Grade Fish Baffle	3	Hydraulic Design	2100 mm Dia Circular Culvert 147 m long <1% Grade 30% Embedment	Existing channel maximum width is approximately 2.1 m narrowing to 1.5 m where incised. Mountain stream with drops and small waterfalls. Upgrade can be achieved providing a flatter gradient and a wider embeded substrate. Amended design increases culvert diameter to 1500 m, and provides 30% embedment of the culvert height. Change in culvert length is due to design development and improves fish passage by reducing culvert gradient from 3% to <1%. This culvert provides hydraulic design for fish passage and in addition a culvert width similar to the bankfull width.
17	4400	Low	3.04	825 mm Dia Circular Culvert 22 m long 14% Grade Fish Baffle	3	Hydraulic Design Culvert >1.3 bank width	900 mm Dia Circular Culvert 22 m long 14.0% Grade 30% Embedment	Existing channel is 0.4 m with a bankfull width of approximately 0.6 m. Amended design increases culvert diameter to 900 mm and provides 30% embedment of the culvert height at the culvert outlet. This culvert provides fish baffles and a culvert width of >1.3 x bankfull width.
18	4750	High	25.5	2100 mm Dia Circular Culvert 29 m long 1.0% Grade 20% Embedment	2	Stream simulation	2500 -3000 mm span Arch/Box Culvert 29 m long 1.0% Grade Stream bed	Existing stream is an incised channel with steep / near vertical sides. Width is approximately 0.5 m -1.2 m as measured on site with bankfull width assessed as 1.2 m. The existing stream does not currently connect directly to the main stream, but runs over land across pasture and through a small farm culvert. An arch or box culvert with a bottom below the created streambed is equivalent to a bottomless arch culvert for stream simulation. Final design will require assessment of ground conditions. Design of culvert sized to achieve stream simulation.
19	4750		25.5	2100 mm 1.0% Grade	No longer required for project. Refer to Mr Peter Roan's evidence for reasons of removal of the associated fill site.			

Table 2 Summary of Project Culverts

Culvert	Chainage (m)	Fish Passage	Size (mm)	Gradient (%)	Length (m)	Fish Passage Type
1	250	Yes	1050 dia	0.5	24	Hydraulic Design
2	300	No	825 dia	1.0	26	Not Required
3	570	Yes	1500 dia	0.3	67	Hydraulic Design
4	750	Yes	600 dia	1.0	81	Hydraulic Design
5	870	Yes	1350 dia	2.0	87	Hydraulic Design
6	1300	Yes	1350 dia	0.5	27	Hydraulic Design
7	1500	Yes	1200 dia	3.0	36	Hydraulic Design
8	1700	Yes	1500 dia	3.0	45	Hydraulic Design
9	1850	Yes	3000 to 4000 span arch/box culvert	0.3	43	Stream Simulation
10	2220	No	750	1.0	37	Not Required
11	2300	Yes	750	17	15	Steep culvert with baffles
12	2400	Yes	Culvert Replaced with a bridge			Bridge
13	2700	No	600	14	25	Not Required
14	2900	Yes	1500	≤1.0	140	Hydraulic Design
15	2960	Yes	2500	1.0	250-280	Hydraulic Design
16	3800	Yes	2100	< 1.0	147	Hydraulic Design
17	4400	Yes	900	14	22	Steep culvert with baffles
18	4750	Yes	2500 to 3000 span arch/box culvert	1.0	29	Stream Simulation
19	4750	Culvert removed from project				
20	5150	Yes	1650	1.0	40	Hydraulic Design
21	5650	Yes	1650	1.0	34	Hydraulic Design

Appendix F: Pest Management Area Plan

LEGEND

PEST MANAGEMENT TREATMENT AREAS

- DOC LAND WITHIN PMA
- NZTA LAND WITHIN PMA
- NGATI TAMA LAND WITHIN PMA
- PRIVATELY OWNED LAND WITHIN PMA TO BE NEGOTIATED
- OFFSET PEST MANAGEMENT AREA
- EXTENDED CORE (903.5ha)
- POSSIBLE UNGULATE CONTROL AREA
- NGATI TAMA PARININIHI BLOCK
- PROPOSED ROUTE

N

1:20000 @ A1
1:40000 @ A3
0 200 400 600 800 1000 1200 1400 1600 1800 2000 m

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	OFFSET PEST MANAGEMENT AREA ADDED	QDO'S	-	RMG	LG	BS	05/07/2018
B	TOPO MAP BASE ADDED	QDO'S	-	RMG	LG	BS	18/06/2018
A	FOR INFORMATION	QDO'S	-	RMG	LG	BS	07/06/2018

Tab: MMA-DES-ECO-E1-FIG-1023

Scales: 1:40000 (A3) 1:20000 (A1)

Original Size: A1

Te Ara o Te Ata

NZ TRANSPORT AGENCY WAKA KOTAHI

Mt Messenger Bypass

MT MESSENGER BYPASS

ECOLOGY
PROPOSED PEST MANAGEMENT AREA (3368ha)
PREFERRED OPTION

Approved: **NOT FOR CONSTRUCTION**

Status: **FOR INFORMATION**

Drawing Number: **MMA-DES-ECO-E1-FIG-1023**

Revision: **C**

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