IN THE ENVIRONMENT COURT OF NEW ZEALAND
WELLINGTON REGISTRY

I MUA I TE KŌTI TAIAO O AOTEAROA
TE WHANGANUI-Ā-TARA ROHE

ENV-2020-WLG-00014

UNDER	the Resource Management Act 1991
IN THE MATTER OF	a notice of motion under section 87G of the Act seeking the grant of resource consents to Waka Kotahi NZ Transport Agency for Te Ahu a Turanga: Manawatū-Tararua Highway

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STATEMENT OF EVIDENCE OF MATTHEW BABER ON BEHALF OF WAKA KOTAHI NZ TRANSPORT AGENCY

TERRESTRIAL ECOLOGY

12 June 2020

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INTRODUCTION

1. My full name is **Matthew James Baber**.

2. I hold the position of Principal Ecologist / Director at Alliance Ecology Ltd, which I have held since May 2019. I also hold the position of independent contractor for Tonkin + Taylor Ltd ("**T+T**").

3. I prepared Technical Assessment F: Terrestrial Ecology ("**Technical Assessment F**") as part of Volume V of the Assessment of Environmental Effects ("**AEE**"), which accompanied the application for resource consents lodged with Manawatū-Whanganui Regional Council ("**Horizons**") on 11 March 2020 in respect of Te Ahu a Turanga: Manawatū Tararua Highway Project (the "**Project**").

4. My qualifications and experience are set out in paragraph 2 of Technical Assessment F.

5. In preparing Technical assessment F and my evidence:

   (a) I have provided advice on terrestrial ecology matters related to the proposed Te Ahu a Turanga Project ("**Project**") to the Alliance, and ultimately to Waka Kotahi NZ Transport Agency ("**Transport Agency**"), since January 2020.

   (b) I have participated in ongoing engagement with iwi Project partners, Horizons, the Department of Conservation / Director-General of Conservation (referred to collectively in my evidence as "**DOC**"), the Queen Elizabeth II National Trust ("**QEII Trust**"), the Royal Forest and Bird Protection Society of NZ ("**Forest and Bird**"), and Meridian Energy Limited ("**Meridian**"). I summarise below the engagement I have been involved in since the consent applications were lodged.

   (c) Since the consent applications were lodged I have carried out additional site visits to further analyse the wetland and forest habitats within the Project footprint and the proposed offset and compensation sites, including the proposed bush retirement, native revegetation sites and the northern block of the Manawatu Scenic Reserve ("**NMGSR**");

   (d) I was involved in the preparation of the version of the Ecology Management Plan ("**EMP**") that was lodged with the consent applications. Since lodgment, I have recommended updates to the EMP (including its constituent individual chapters / plans as required),

and reviewed the updated EMP that is being lodged with the Transport Agency's evidence, as discussed below.

(e) In preparing my evidence I have reviewed the Te Ahu a Turanga: Manawatū Tararua Highway Project Supplementary Long-tailed Bat Report ("**Supplementary Bat Report**") prepared by Ms Georgia Cummings (**Attachment MB.1** of my evidence).

6. I have assisted with the response to a number of questions in the section 92 further information request from Horizons related to Technical Report F.

Code of conduct

7. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. This evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my area of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Purpose and scope of the evidence

8. Technical Assessment F assesses the effects of the Project on terrestrial and wetland habitat types and associated flora and fauna to inform the resource consent applications for the Project 'main works', as detailed in the Design Construction Report ("**DCR**") (provided in Volume II of the application materials).

9. My evidence does not repeat in detail the matters discussed in Technical Assessment F. Rather, in this evidence I:

(a) Present the key findings of Technical Assessment F, updated to take into account information received more recently and further investigations in an executive summary;

(b) Comment on issues raised in submissions received in respect of the Project; and

(c) Comment on the section 87F report prepared by Horizons, and in particular the report prepared by Mr James Lambie in respect of terrestrial ecology, which is Appendix 4 to the overall section 87F report ("**Terrestrial Ecology 87F Report**").

EXECUTIVE SUMMARY

10. As noted above, in this section of my evidence I summarise the key matters addressed in my Technical Assessment F.

11. The Project comprises the construction, operation, use, maintenance and improvement of approximately 11.5 km of state highway connecting Ashhurst and Woodville via a route over the Ruahine Range.

12. The 195 ha Project footprint occurs within the 340 ha proposed designation corridor, with the exception of 12.9 ha of spoil sites that are outside but immediately adjacent to the designation corridor. The designations include approximately 41.85 ha of indigenous vegetation and wetland habitats.

13. The Project footprint occurs within a predominately agricultural landscape dominated by grazed pastureland and exotic-dominated plantation forests or exotic shrublands (e.g. gorse and broom). However, the Project footprint does include 11.82 ha of indigenous forest and shrublands and a number of small wetlands totalling 4.97 ha. These terrestrial and wetland habitat types have been further split into 12 vegetation/habitat types and include or potentially include a number of nationally 'Threatened' and 'At Risk' species.

14. Of particular note, the Project footprint and immediate surrounds include ‘High’-value old growth forest and indigenous wetland habitat types, and include, or possibly include, several nationally 'Threatened' or 'At Risk' fauna species. Specifically, ten plant species, the long-tailed bat (noting that the closest confirmed record is 13 km away), up to 23 native bird species, five lizard species, and up to seven invertebrate species.

15. In general terms, the actual and potential adverse ecological effects within the Project footprint include the loss, fragmentation and degradation of habitats for flora and fauna as well as harm to species and individuals within these habitats.

16. Considerable efforts have been undertaken to avoid potential adverse ecological effects, including:

    (a) The selection of a preferred, overall alignment option (prior to the lodgement of the Project notices of requirement ("**NoRs**") that has considerably lower ecological effects than other potential alignment options.

    (b) Constraining the designation footprint to minimise potential impacts on ecologically significant areas through the NoR process.

(c) The development of the Project design leading up to this application for regional resource consents to further minimise impacts on key ecological areas. The total area of forest and wetland loss is now 16.79 ha, compared to a total maximum loss of 31 ha provided for by the original NoR effects envelopes, and 27.85 ha provided for in the designation conditions effects envelopes confirmed by the Environment Court.

17. In addition to the avoidance measures summarised above, a number of measures will be undertaken to minimise those adverse ecological effects that cannot be avoided. These measures are detailed in the Ecology Management Plan ("**EMP**") and associated management plans for vegetation clearance, long-tailed bats, birds, lizards, and invertebrates.

18. The assessment of effects for the Project has been undertaken in accordance with the Environment Institute of Australia and New Zealand ("**EIANZ**") Ecological Impact Assessment Guidelines ("**EcIAG**") (Roper-Lindsay et al., 2018). In general accordance with EcIAG, the 'Level of Effect' on each habitat type and associated species was assessed based on:

(a) The 'Ecological Value' category assigned to each vegetation/habitat type or species; and

(b) The potential 'Magnitude of Effect' on each of the vegetation/habitat or species value after efforts to avoid or minimise potential effects.

19. The assessment of values, assessment of effects and measures to address effects is in general accordance with the NoR assessment undertaken by Dr Adam Forbes (vegetation) and Mr Andrew Blayney (terrestrial fauna).

20. Through avoidance and minimisation measures, a number of ecological effects associated with the Project will largely be managed to 'Negligible' or 'Low' levels, though some effects have been assessed as having 'Moderate' or 'High' levels of effects on local biodiversity values. Most notably, I expect the Project to have a 'High' 'Level of Effect' on the following local biodiversity values after avoidance and minimisation measures:

(a) 0.1 ha of old growth forest (alluvial);

(b) 0.85 ha of old growth forest (hill country); and

(c) 0.11 ha of indigenous dominant seepage wetland (raupo).

21. Importantly and in respect of the appropriateness of offsetting and compensating, no residual adverse effects are deemed to be 'Very High'.

22. Residual effects that are assessed as 'Moderate' or 'High' on local biodiversity values, after effects avoidance and minimisation measures, will be addressed through a suite of habitat restoration and enhancement measures.

23. As detailed in **Mr Joshua Markham's** evidence and his Technical Assessment G, the quantum of habitat restoration and enhancement activities for addressing residual adverse effects was determined using the following models as decision support tools:

    (a) Biodiversity Offset Accounting Models (Maseyk et al. 2016) to demonstrably verify a Net Gain outcome (offset) or an expected Net Gain outcome (compensation). This is based on the use of quantifiable data at the impact sites and at the proposed habitat restoration and enhancement sites for each biodiversity attribute.

    (b) Biodiversity Compensation Models (Tonkin + Taylor 2019[1]) where offsetting cannot be verified, to provide an indication of expected Net Gain associated with the proposed habitat restoration or enhancement activity.

24. Based in large part on these models and informed by ecological assessments, to offset or compensate for the loss of 11.82 ha of indigenous forested habitats and wetlands and effects on associated species:

    (a) 45.62 ha of native forest will be restored through native revegetation coupled with:

        (i) felled/fallen log deployment;

        (ii) stock exclusion fencing;

        (iii) a 10-year mammalian pest control programme (which now includes mustelid control);

        (iv) a 35-year red deer-control programme (which has been added since lodgement);

        (v) enrichment planting of shade-tolerant canopy species after 5 years;

    (b) 48.3 ha of native forest will be retired from stock grazing through stock exclusion fencing coupled with:

[1] Peacocke Structure Plan Area: Draft Ecological Effects Management Framework. Report for Hamilton City Council Prepared by Tonkin & Taylor Ltd. Job no 1007479.

(i) felled/fallen log deployment;

(ii) a 10-year mammalian pest control programme and a 35-year deer control programme;

(iii) Enrichment planting of shade-tolerant canopy species at 1 year;

(c) Approximately 300 ha of mammalian pest control will be undertaken for a period of 10 years and deer control will be undertaken for 35 years within and adjacent to the northern block of the Manawatū Gorge Scenic Reserve ("**NMGSR**") to kick-start the recovery of vulnerable native flora and fauna on a large-scale. This is proposed to complement and improve biodiversity gains in the native revegetation and bush retirement sites in the short- to medium-term.

(d) 6.55 ha of wetland habitat will be restored through native revegetation of existing wetlands coupled with a 10 m wetland margin buffer and stock exclusion fencing.

25. All of the above terrestrial and wetland offset and compensation measures are as proposed in the consent application documents and Technical Assessments F and G, with the exception of the addition of mustelid control and proposed deer control which has been added following further investigations. The methodology for these offset and compensation measures has been further developed since lodgement of the consent application, as discussed below and in the evidence of **Mr Markham**.

26. In addition to the above, riparian planting along streams (indicatively modelled at approximately 34.3 km in length with an average of 20 m width on each bank) and along stream diversions (indicatively modelled at 6 km with an average of 10 m width on each bank) is proposed, as explained in **Ms Justine Quinn's** evidence and Technical Assessment H). Native terrestrial landscape plantings are also proposed. These measures have not been taken into account in the offset and compensation calculations but will provide benefits to terrestrial and wetland biodiversity values through the provision of habitat, buffering and connectivity across the landscape.

27. My assessment of values, assessment of effects, and recommended measures to address effects generally accord with the work carried out by other ecologists in relation to the NoR process. Where there are differences, these predominantly reflect the significantly reduced areal impact associated with the Project footprint compared to the NoR, as well as some minor differences in assessment approach.

28. In conclusion, I consider that all adverse effects on all biodiversity values associated with the Project have been adequately addressed through actual or proposed measures to avoid, mitigate offset or compensate for adverse ecological effects.

WORK SINCE LODGEMENT

29. Since the application was lodged, I have been involved in further work related to terrestrial and wetland ecology as set out below.

Response to section 92 request for further information

30. I have assisted with the response to a series of further information requests from Horizons related to Technical Report F. A key part of this was to provide further information on the potential for hydrological effects on the raupo wetland associated with the construction of the 'eco bridge' structure (BR03) on the northern bank of the Manawatū River; this information informed the memorandum that was Attachment 8 to the response to the section 92 request.

Further bat and invertebrate survey work and results

31. Additional bat surveys were completed in mid-February 2020. When the application for resource consents was lodged (along with Technical Assessment F and the appended Long-tailed Bat Report prepared by my colleague Ms Georgia Cummings), the final results of those surveys were not available. The results of the surveys are now available; no bats were detected. Correspondingly, there are no changes to the assessment of effects on bats. The results of these surveys are detailed in **Attachment MB.1** to my evidence.

32. Additional invertebrate surveys have also been completed. These include invertebrate assemblage surveys carried out in February 2020 and targeted surveys for an 'At Risk' moth species (*Meterana grandiosa*) between 25 – 29 May 2020.

33. Surveys[2] carried out in late May revealed the presence of *M. grandiosa*. This species is associated with small-leaved tree daisy species including twiggy tree daisy (*Olearia virgata*), and possibly coastal tree daisy (*O. solandri*) (herein "**host shrubs**"), both of which are present within the Project footprint and in the surrounding landscape. These host shrubs are found in various habitat types within the Project footprint and surrounding landscape,

[2] Two survey techniques were used: Heath traps and manual, generator-powered blacklight trapping.

including, but not limited to: secondary broadleaved forest, divaricating shrublands; and manuka/kanuka shrublands. During surveys:

(a) One adult moth was caught near several host shrubs amongst secondary broadleaved scrub on Meridian land.

(b) One adult moth was caught at the generator-powered blacklight sited amongst divaricating shrubland containing 10+ host shrubs on Meridian land.

(c) One probable *M. grandiosa* larva was found on a host shrub on the edge of secondary broadleaved forest/scrubland on Andrew Bolton's property, in the foothills of the Ruahine Range towards the eastern end of the Project.

34. Within the Project footprint and surrounding landscape the host shrubs are found in open areas and shrubland where they occur as single shrubs (for example, a single host shrub on Stuart Bolton's property, at the western end of the Project) or in small clusters of host shrubs (for example an area of 10+ host shrubs on Meridian land). These host shrubs are uncommon within the Project footprint, but are abundant and in places dominant on Ratahiwi and Beagley farms north-east of the Project footprint. That said, further mapping is needed to determine the location and abundance of these host shrubs both within and in close proximity to the Project footprint. Surveys for these shrubs should target areas of shrubland, treeland, edges of forest and any patches of shrubs growing in open farmland.

35. Measures to avoid, remedy or mitigate adverse effects on these moths will be set out in the Terrestrial Invertebrate Management Plan ("**TIMP**") as required by the Designation Conditions, and by proposed Consent Condition EC11.

36. These measures to address effects on *M. grandiosa* are likely to include:

(a) Surveys and delineation of host shrubs within and in close proximity to the Project footprint to:

(i) better understand the magnitude of effects; and

(ii) identify larvae salvage operation requirements and the locations of potential relocation site(s).

(b) Avoidance of host shrub clearance to the extent possible, and seasonal restrictions on clearance, e.g. avoidance of clearance between May and July to minimise moth egg mortality.

(c) Salvage and relocation of larvae and host shrubs (on which moth pupae will be attached) prior to clearance. The TIMP is likely to provide that:

(i) Pupae will be translocated following clearance via translocation of host shrubs.

(ii) Clearance dates will be established and, prior to clearance, the shrubs will be 'beaten' and searched at night, with any collected moth larvae transferred to a designated translocation site.

(iii) Host shrubs will be cut, sectioned (if necessary) and transferred to the relocation site to allow for the completion of pupation.

(d) Monitoring for adults and larvae will be undertaken at relocation sites. The TIMP is likely to provide that this will involve nocturnal light trapping during the adult flight period (mid-April to early June), and beating of host plants for larvae. Trapping should be carried out twice during this period with trapping dates at least one week apart.

37. As an 'At Risk (relict) species, *M. grandiosa* is assigned an Ecological value of 'Moderate' in accordance with ECIAG and I have assessed the 'Magnitude of Effect' as 'Moderate' after efforts to avoid, remedy or mitigate effects, acknowledging that this assessment is preliminary. This 'Magnitude of Effects' assessment is on the basis that:

(a) Proposed measures to avoid, remedy or mitigate effects summarised above will go some way towards reducing the 'Level of effect';

(b) While the abundance of host plants is generally low, host plants are likely to be present in select locations within the 10.42 ha of potentially suitable habitat that will be lost as a result of the Project.

38. A 'Moderate' ecological value and a 'Moderate' 'Magnitude of Effect' corresponds to a 'Moderate' 'Level of Effect' after measures to avoid, remedy or mitigate effects. As explained in Technical Assessment F, I consider a 'Moderate' 'Level of Effect' or higher to require measures to offset or compensate for effects to a Net Gain standard. To this end, the two host shrub species will be planted at the relocation sites. The number of host plants to be planted at the relocation site(s) will need to exceed the number of plants lost to ensure there is a net habitat gain for the species (as determined by the application of a BOAM once field data has been collected). Plantings will replicate the typical habitat of host plants in the area (i.e.

divaricating shrubland) and may be additional to the 0.65 ha of divaricating shrubland plantings already proposed to offset the loss of this habitat type.

39. Again, the TIMP will be updated to include measures to avoid, remedy or mitigate the potential adverse effects on this species.

40. Other moth species were captured and observed during the May surveys, and these will be identified in coming weeks with findings and implications detailed in a Supplementary Moth Report. I intend to provide that to the Court, Horizons and other parties as soon as possible.

41. Surveys for an additional moth species, *Meterana exquisita*, will be carried out in September 2020. If detected, similar mitigation measures will need to be implemented for that species. *M. exquisita* has a long adult flight window (August to December) so the timing of egg laying, hatching and pupation is likely variable, making the species less vulnerable to population-level impacts of vegetation clearance. Restrictions on the timing of vegetation clearance are therefore not required for this species, provided larval and pupal translocation protocols are followed.

Site visits and other work in respect of offsetting and compensation

42. I have undertaken further site visits in May 2020 together with Mr Markham and Mr MacGibbon[3] to assess the ecological condition and appropriateness of the proposed retirement site(s) and the NMGSR for addressing residual effects.

43. I have contributed to the addendum report which provides supplementary information on the biodiversity offset and compensation models as summarised in the evidence of **Mr Markham** and detailed in Attachment JM.1 of **Mr Markham's** evidence. Details of associated restoration and habitat enhancement measures and monitoring requirements are set out in the updated draft Residual Effects Management and Monitoring Plan ("**REMMP**"), which is part of the EMP.[4]

Engagement with stakeholders

44. I have also been involved in ongoing post-lodgment engagement with iwi partners, DOC, Horizons and other stakeholders. Since the consent applications were lodged, this has included:

[3] Mr MacGibbon is the primary author of the Pest Management Plan that has been included in the updated EMP.
[4] The word 'Monitoring' has been added to this management plan since the consent lodgement version to reflect the fact that monitoring measures to verify intended management, offset and compensation outcomes are a key component of the plan.

(a) Weekly Project team meetings with iwi partners;

(b) Several meetings with DOC representatives (including DOC's consultant ecologists Dr Tim Martin, Mr Nick Goldwater and Ms Jacqui Wairepo), to discuss:

(i) The overall terrestrial ecology assessment and proposed offset and compensation package (including the models) on 20 March and 14 May 2020;

(ii) The Lizard Management Plan on 3 June 2020;

(c) A meeting with Mr James Lambie, Horizons, on 30 March 2020 to discuss the terrestrial assessment of ecological effects;

(d) A joint meeting with Forest and Bird and QEII Trust on 1 April 2020;

(e) A meeting with QEII Trust on 15 May 2020;

(f) Meetings with Meridian on 15 April, 24 April, 13 May, 29 May and a site visit to the Te Āpiti Windfarm with Meridian's consultant ecologist Dr Leigh Bull on 20 May 2020 to discuss Meridian's concerns surrounding the potential for planting associated with Project activities to increase the risk of bird turbine collisions (and therefore create 'reverse sensitivity' effects for Meridian). As discussed below, these plantings relate to the creation of stormwater wetlands, wetland swales and conveyance channels, landscaping and stormwater diversion.

Updated EMP

45. The EMP lodged with the consent application has been updated in response to matters raised by Horizons, DOC, QEII Trust, Forest and Bird, and Meridian as well as information obtained from further site visits and assessments, and further work to secure or finetune the offset and compensation sites. The updates to the EMP since the lodgment version are shown as tracked changes in the version attached to my evidence as **Attachment MB.2.** The updates are summarised below, by reference to each individual management plan within the EMP.

Introduction and Ecological Values and Effects

46. This section has been updated including to account for the recently confirmed presence of the 'At Risk' moth species *M. grandiosa*.

Vegetation Clearance Management Plan (Chapter 3)

47. Minor updates have been made to the Vegetation Clearance Management Plan.

Planting Establishment Management Plan (Chapter 4)

48. Minor updates have been made to the Planting Establishment Management Plan, including to address matters raised in submissions and in the 87F Terrestrial Ecology Report.

The Biosecurity Management Plan (Chapter 5)

49. The Biosecurity Management Plan has been updated to include reference to pest plants currently known to be present in the Project footprint,[5] and to refer to obligations to manage potential weed incursions associated with construction-related activities (including under Horizon's Regional Pest Management Strategy).

Lizard Management Plan (Chapter 6)

50. The Lizard Management Plan ("**LiMP**") has been updated primarily in response to DOC's submission (and subsequent discussions), to include:

    (a) Search of stockpiled vegetation prior to mulching, and to address DOC concerns that skinks may be present underneath stockpiles;[6] and

    (b) Further detail on the characteristics and appropriateness of the proposed lizard relocation site in the NMGSR. This includes the deployment of artificial cover objects ("**ACOs**"), logs and log discs to serve as refugia for lizards; and cell foam covers around larger native trees to provide additional refugia for gecko species.

51. I discuss these matters further below in response to DOC's submission.

52. I note that specific provision for control of mice within the proposed relocation site has now been provided for. This is a proactive response to the fact that mice numbers will increase due to rat and mustelid control.[7]

Bat Management Plan (Chapter 7)

53. The Bat Management Plan has been updated to include the results of acoustic bat surveys undertaken in February – March 2020, in which no bats were detected (as set out in **Attachment MB.1**).

[5] And their associated status under the Regional Pest Management Plan 2017-2037.
[6] DOC submission paragraphs 27-30.
[7] The mouse control is addressed both in the LiMP and in the Pest Management Plan.

Avifauna Management Plan (Chapter 8)

54. Minor updates have been made to the Avifauna Management Plan.

Terrestrial Invertebrate Management Plan (Chapter 9)

55. The TIMP has been updated to include preliminary / placeholder measures for managing *M. grandiosa*. As discussed above, further updates will reflect any additional management implications or requirements relating to recently completed surveys, and those planned for September 2020.

Freshwater Ecology Management and Monitoring Plan and Fish Recovery Protocols (Chapters 10 and 11)

56. The updates made to the Freshwater Ecology Management and Monitoring Plan and the Fish Recovery Protocols are discussed in the evidence of **Ms Quinn**.

Residual Effects Management and Monitoring Plan (Chapter 12)

57. The REMMP has been updated to:

    (a) Remove detail now included in the separate Pest Management Plan;

    (b) Provide the necessary details of the proposed offset and compensation monitoring (discussed further in the evidence of **Mr Markham**); and

    (c) Reflect changes made to offset planting for streams on proposed offset sites following further discussion with landowners (discussed in the evidence of **Ms Quinn**).

Pest Management Plan (Chapter 13)

58. The Pest Management Plan and the updates and detail added to the proposed pest control programme are discussed in more detail in the evidence of **Mr Markham**.

59. In summary, the Pest Management Plan includes the methods that will be used to control mammalian pests at specified native bush sites and planted areas, as part of the offset and compensation package to address residual adverse effects associated with the Project. The pest management programme will consist of:

    (a) Ten years of mammalian pest control (which now includes control of mustelids in addition to rats and possums) within approximately 300 ha of old growth forest (hill country) in and adjacent to the NMGSR;

(b) Thirty-five years of deer control over approximately 300 ha of NMGSR and adjacent land (which has been added since lodgement);

(c) Ten years of mammalian pest control over 48.3 ha of bush and 0.4 ha of existing wetland that will be fenced to exclude livestock and legally protected;[8] and

(d) Ten years of mammalian pest control over 45.6 ha of planted indigenous forest and 6.55 ha of planted wetland (including 10 m buffer plants).[9]

Training (Chapter 14)

60. No notable updates have been made to this chapter.

COMMENTS ON SUBMISSIONS AND ON THE SECTION 87F REPORT

61. I comment below on the Terrestrial Ecology 87F Report and on submissions on matters relating to Technical Assessment F as made by:

(a) DOC (including comments from DOC's ecology advisors Wildland Consultants);

(b) QEII Trust;

(c) Forest and Bird;

(d) Meridian; and

(e) Dr Samuel Hill.

62. Responses to submissions related to the adequacy of the offset and compensation measures and the use and application of the Biodiversity Offset Accounting Model ("**BOAM**") and the Biodiversity Compensation Models ("**BCM**") are addressed in the evidence of **Mr Markham**.

63. Additionally, Mr Markham and I have discussed matters relating to conditions and the planning framework that apply to terrestrial ecology and offset and compensation actions with **Ms McLeod** and **Mr McGahan**. Those matters are addressed primarily by those planning witnesses; I have commented as appropriate below.

64. Freshwater ecology matters are addressed in the evidence of **Ms Quinn**.

65. In light of the above, the scope of my evidence is to address concerns relating to the assessment of terrestrial and wetland ecological values,

[8] Plus deer control over the bush area.
[9] Plus deer control over the planted forest.

assessment of effects on those values and measures to further avoid, remedy or mitigate effects at the point of impact.

Submission by DOC

66. As noted above, I have been part of an ongoing engagement process between the Transport Agency / Alliance and DOC, and have had various discussions with Wildland Consultants ("**Wildlands**"; DOC's consultant ecologists in respect of the Project). I wish to acknowledge the efforts and constructive advice from Wildlands, which has helped to inform and refine my overall assessment. Importantly, my understanding is that there are no outstanding matters of concern in regard to the level of effects assessment.

67. Notwithstanding the above, DOC raises outstanding matters of concern regarding lizard management both in its submission and the accompanying memorandum prepared by Wildlands.[10] I address these matters below. DOC's submission points in respect of lizard management are that:

    (a) Stockpiles of felled trees should be searched immediately prior to mulching (to check for skinks);

    (b) Further detail and justification (and a map) should be provided in respect of proposed lizard relocation sites in the NMGSR;

    (c) Pest control of a 10-year duration will be of very limited benefit for lizards, as lizards are long-lived; and

    (d) Monitoring of lizards should be included to determine the success of mitigation, offsetting and compensation efforts.

68. I agree it would be appropriate to carry out lizard searches of stockpiles immediately before mulching, and the proposed conditions and the LiMP in the EMP have been updated accordingly.

69. Further details in respect of the lizard relocation site have been developed, and added to the LiMP**.** In brief:

    (a) The proposed relocation site has been selected within the NMGSR as detailed in the LiMP. This relocation site was selected on the basis that it includes a diversity of adjoining habitats, namely rank grassland, regenerating shrublands, and mature native forest and is readily accessible.

[10] Department of Conservation submission paragraphs 27 – 30.

(b) Within this relocation site approximately 100 ACOs and 16 m of felled logs of suitable size and 4 m of log discs[11] will be deployed to serve as refugia for lizards. Moreover, cell foam covers will be placed around larger native trees (approximately 20) to provide additional refugia for gecko species. Although the cell foam covers will not be used by the elegant gecko, this species inhabits foliage and thus there is considerable habitat available for this species.

70. I do not agree with the comment by Ms Wairepo (from Wildlands) that the 10-year duration of rat and possum control (as it was then referred to) in the NMGSR as well as in retired and planted areas will be of only '*limited benefit*' to relocated and resident lizards[12]. In my view, a 10-year programme will provide more than just a '*limited benefit*' for lizards and is fit for purpose since:

(a) The pest control programme for lizards is intended to improve the likelihood that relocated lizards will successfully establish at the release site(s) by reducing predation risk from introduced predatory mammals. A temporary pest control approach (sometimes as short as one year) is commonly used for this reason on lizard salvage and relocation operations and I consider the period of 10 years to be adequate in this regard.

(b) The pest control is also expected to provide a large scale, albeit short-term increase in the numbers of lizards in the NMGSR, and within the 48.3 ha of existing habitat proposed for retirement from stock grazing. While uncertainties do exist surrounding the response of lizards to pest control, in my opinion, this increase is very likely to exceed the loss of lizard populations within the affected habitats (11.82 ha), much of which is likely to be of low value for lizards, and likely to include high numbers of predatory mammals.

(c) Also, as outlined in the evidence of **Mr Markham** and in the Pest Management Plan, the 10-year pest control programme has been updated, in that:

(i) pest control efforts are now proposed to be undertaken annually rather than every two years to improve the likelihood that

[11] Logs and log disks will be a minimum of 40 cm dbh and logs will be cut into 2-3 m sections (approximately 6-7 sections) and log discs will cut into 30-50mm (approximately 100 log discs in total)
[12] Wildland Consultants memo April 2020, page 6, final paragraph

mammalian pest reduction targets will be achieved over the 10-year period;

(ii) The pest control programme has also been updated to also include the control of deer over a 35-year period. This addition is likely to provide additional refugia and to increase the potential carrying capacity of lizards in the understory, mid-story and sub-canopy, which have been impacted by deer; and

(iii) The pest control programme now includes mouse control at the lizard relocation site only. This is to address the expectation that mice, which also prey on lizards, will increase in response to the rat and mustelid control.

(d) Finally, the adequacy of the pest control for lizards should not be assessed in isolation, as a combination of measures is proposed to address potential residual effects on lizards. Efforts to address residual effects also include the creation or enhancement of habitats that will be protected in the long-term. This includes:

(i) the creation of 45.6 ha of potential lizard habitat through native revegetation and associated habitat enhancement for lizards (i.e., pest control and the deployment of logs and log discs to provide additional habitat diversity, including for lizards); and

(ii) the enhancement of 48.3 ha of existing lizard habitat through exclusion of stock, pest control, and the deployment of logs to provide additional habitat diversity, including for lizards.

Monitoring of released lizards

71. In regard to lizard monitoring, Ms Wairepo states[13] :

> *"if unexpectedly high numbers of lizards are caught, these contingencies should be extended to include a capture threshold for post-relocation monitoring. For example, if 10 or more 'At Risk' lizards are captured, this could serve as a trigger to undertake monitoring"*

and that:

> *"the difficulty with identification of lizards could potentially be addressed through the use of a soft-release pen."*

[13] Wildlands Consultants memorandum April 2020, page 7 paragraph 3.

72. At a conceptual level, I agree with Ms Wairepo that monitoring is an important component of ecological management programmes. A well-designed monitoring programme helps determine the effectiveness of a management programme, informs adaptive management responses and can contribute to applied conservation management knowledge well beyond the specific project. However, as set out below, I do not agree that a capture threshold of 10 is appropriate and nor am I supportive of a soft-release pen for the purposes of identifying lizards.

73. The purpose, objectives and intended outcomes of a monitoring programme for lizard salvaging and relocation hinge on scientifically robust experimental design, which includes the ability to distinguish relocated individuals from residents and an adequate dataset (to determine statistical significance). Of key importance this requires:

    (a) a large number of individuals to be captured and relocated;

    (b) the ability to reliably differentiate between relocated and resident individuals;

    (c) re-capture of a large number of individuals; and

    (d) a closed population in which individuals are confined, that is also sufficiently large to provide the full suite of resource requirements to survive.

74. If these monitoring requirements are not met, then robust conclusions or the correct adaptive management response cannot be determined. This is perhaps the key reason why, despite numerous lizard salvage and relocation monitoring programmes across the country, there is a paucity of evidence to indicate success or failure of a salvage and relocation programme and/or the effectiveness of pest control.

75. To elaborate, if the number of individuals captured through monitoring at the relocation site(s) is low, then differences in the number of captures between monitoring periods cannot be determined statistically and will be influenced more by chance than by actual changes in population size. Further, simply increasing the sampling effort to increase the number of captures is also problematic as this may cause adverse behavioural and/or health effects on the population being monitored. Most salvage and relocation programmes are hampered specifically by this issue.

76. A monitoring programme to determine the success of the Project lizard salvage and relocation operations would be similarly hindered unless a very

large number of lizards are captured and relocated (e.g. a minimum of several hundred per species, which is well above the capture threshold proposed by Ms Wairepo). Several hundred individuals are likely required because lizards are proposed for release into the NMGSR which is a large site with considerable habitat diversity, and monitoring efforts would amount to searching for needles in a very large haystack.

77. Interpreting monitoring results can be challenging even if the number of individuals captured during monitoring is high. If relocated and resident lizards cannot be distinguished from one another, then it is difficult to draw conclusions on the effectiveness of the relocation programme or of the pest control *per se*. Furthermore, if the population is closed, i.e. if relocated lizards are placed in an enclosure pen or 'soft' pen, then it is unclear if failure to capture relocated individuals is due to programme failure or because the availability of resources within the enclosure may be insufficient for the long-term persistence of the relocated population. In that case, use of the pen may influence the likelihood of success independent of the salvage and relocation operations).

78. To illustrate the points above, the largest national salvage and relocation of the elegant gecko (a species potentially present in the Project footprint) included the relocation of over 100 individuals that were released into tall kanuka and mixed broadleaved forest subject to intensive pest control. The total number of re-captures was four individuals over three years of intensive monitoring. The success of the salvage and relocation was inconclusive because it was unclear whether the relocated population declined to extinction; whether the geckos persisted but were not detected (e.g. were located in the canopy where they could not be seen from the ground); or whether they simply moved away from the relocation/monitoring site.

79. In conclusion, I see little value in developing and implementing a lizard monitoring programme to determine the effectiveness of the salvaging and relocation operations and/or pest control for this Project. That said, and as described above, it is now proposed to deploy refugia into the relocation site in the form of ACOs, log sections and log discs and cell foam covers, and these will be checked as part of the offset and compensation monitoring programme, as summarised in the evidence of Mr Markham and detailed in the REMMP.

Forest and Bird submission

80. The Forest and Bird submission expresses general concerns or disagreement regarding terrestrial ecology matters and related conditions.[14] Below I respond in particular to the submission points made under the heading "*Adverse effects of the proposal and protection of significant indigenous vegetation and significant habitats of indigenous fauna*".[15]

81. The concerns raised are broad, and relate to the overall approach used to assess adverse effects on terrestrial ecology. The exact nature of some concerns is unclear as few specific examples are provided. As discussed by **Mr Dalzell**, Forest and Bird have declined to discuss their submission. Nevertheless, in broad terms, the Forest and Bird submission appears to suggest that:

    (a) The assessment of ecological characteristics and values of the ecosystems, communities and species affected by the Project is inadequate[16];

    (b) The impact assessment does not follow best practice[17];

    (c) The level of effects on some values are unacceptable due to the rarity, irreplaceability, or vulnerability of those values, (i.e., 'limits to offsetting' meaning that any adverse effects on these values must and should be avoided)[18]; and

    (d) A number of proposed conditions are inappropriate, uncertain or inadequate.

82. As discussed above and in Technical Assessment F, I consider my values and effects assessment to be comprehensive and conservative. I note in particular that:

    (a) Beyond the information provided at lodgment there are ongoing efforts to assess effects. For example, and as discussed above, since lodgment results from a fourth bat survey (refer **Attachment MB.1**) have become available, as have preliminary results of two additional invertebrate surveys; with a final invertebrate survey planned for September (as discussed above). Moreover, further work has been

[14] Forest and Bird submission pages 3-5; 7-9 and 10 – 12 and paragraph 42 (Appendix 2).
[15] Forest and Bird submission paragraphs 10 – 19: noting that as discussed conditions and planning matters are addressed primarily by Mr McGahan and Ms McLeod and concerns relating to the offsetting and compensation approach are addressed by Mr Markham.
[16] Forest and Bird submission paragraphs 10-13 and 15.
[17] Forest and Bird submission paragraph13 (in part).
[18] Forest and Bird submission paragraph 17.

undertaken to quantify and assess vegetation/habitat characteristics and condition within old-growth forest habitats in the Project footprint, within the proposed bush retirement and wetland offset and compensation sites, and in and adjacent to the NMGSR. These additional assessments have continued to inform and refine our assessment of effects, proposed consent conditions and the EMP.

(b) Importantly, I consider it highly improbable that the Project activities will have unknown significant effects on biodiversity values based on the survey work completed or to be completed prior to commencement of Project activities. For example:

(i) For lizards we have conservatively assumed species to be present and have accounted for this in our effects management regime.

(ii) Similarly for invertebrates, we have identified nationally 'Threatened' or 'At Risk' species that could potentially be present and undertaken targeted surveys. The likelihood of significant adverse effects on a nationally 'Threatened' or 'At Risk' species that we have not accounted for is low based on the region's natural history, the habitat types affected, and the proportional loss resulting from the project. This is in contrast to other NZ ecosystem types (e.g. Buller coal measures on the Denniston plateau, or for other regions such as Nelson or Northland where invertebrate diversity and endemism is particularly high).

83. Similarly, in my view my impact assessment has followed best practice.[19] In part the impact assessment hinges on adequacy of the characterisation and assessment of ecological values, which I have addressed above. It also depends on characterisation of the 'Magnitude of Effects' and in my view, this has been done appropriately and in accordance with established best practice, i.e., the EcIAG. Specifically, for all values potentially affected by the Project I have provided information on:

(a) The spatial extent of the effect *per se* (areal extent in ha or m^2).

(b) The permanence of the effect.

(c) The intensity of the effect within the Project footprint (e.g. total loss versus partial loss).

[19] I note that neither the Terrestrial Ecology 87F Report nor DOC's submission suggested otherwise.

(d) The potential for indirect effects.

(e) The proportional effect relative to availability in the immediate surrounds, surrounding landscape and/or the region.

84. Forest and Bird raises concerns about the limits to offsetting and the importance of avoiding inappropriate levels of effects on values due to rarity, irreplaceability or vulnerability.[20] In my view there was no instance in which I consider the level of residual effects arising from the Project meets a threshold whereby effects cannot be offset or compensated for. I have provided detail on this in my response to the Terrestrial Ecology 87F Report prepared by Mr Lambie.

85. I have provided input on a number of proposed changes to conditions set out in Appendix 2 of the Forest and Bird submission that relate specifically to the scope of my evidence, i.e. efforts to avoid, remedy or mitigate for effects on terrestrial biodiversity values. My input is generally included in the response to Forest and Bird's proposed changes as detailed in the evidence of **Ms McLeod.** That said, I do make the following specific points, primarily relating to substantive matters (as opposed to condition drafting points):

(a) In reference to EC1, I agree that there should be a clause to provide protocols for removing stockpiled vegetation to protect species, but consider this is better placed in EC9 which specifically relates to lizards (and condition EC9 has been updated accordingly);

(b) In reference to EC2, I agree that further detail/direction is required on where the planting of threatened plants will occur and the need for replacement plantings if plantings do not survive (noting that there is no intent for removal of ramarama or swamp maire). This matter is now addressed in proposed changes to EC2 through the addition of EC2 (g) which states that:

> *'Recipient sites for the salvage and replacement of threatened plant species must be identified and managed in accordance with the Vegetation Clearance Management Plan'*;

(c) In reference to EC4 I agree with the need to provide direction if nests are discovered outside of surveys. This matter is now addressed in EC4 (c) through the addition of the words 'or by other means' as per below.

[20] Forest and Bird submission paragraphs 17, 34-37

Where an active nesting site is identified by the pre-construction survey required by clause (a) (<u>or by other means</u>), a fifty (50) metre exclusion zone (measured from the nest) must be established within which no person or machinery may enter, until the chicks have fledged or the nest has failed.

(d) In reference to the term 'unduly impacted' for EC4, EC5 and EC6, I consider it necessarily practicable and appropriate to depend on the discretion of the onsite ecologist in this regard and disagree that this wording needs to change;

(e) In reference to EC6 and the fact that the condition does not provide protection for bird species outside of September to January, I consider that the residual potential for effects outside of peak breeding season is addressed through the proposed offset and compensation measures;

(f) In reference to EC7 I agree that the condition does not provide any direction for the retention of pipit habitat or for accounting of its loss in offset requirements. However, I disagree with the recommendation to address this because:

  (i) much of the pipit habitat that will be affected by construction activities will be reinstated in grassland once construction activities have been completed, and;

  (ii) The 'Level of Effects' after measures to avoid, remedy or mitigate for effects on pipits is considered to be 'Low' and therefore specific additional efforts to offset or compensate for effects are not considered warranted.

(g) In reference to EC8 I agree that the condition does not provide any direction for the retention of coot and dabchick habitat or for accounting of loss in offset requirements. However, I disagree with the recommendation to address this because the affected coot and dabchick habitat is limited to a small quantum of open water farm ponds and the 'Level of Effects' after measures to avoid, remedy or mitigate for effects are considered to be 'Low'. Therefore, specific additional efforts to offset or compensate for effects are not considered warranted.

(h) In reference to EC11, Forest and Bird considers the condition inadequate for the protection of 'At Risk' or nationally 'Threatened' terrestrial invertebrates. I disagree, and consider that the condition

coupled with the TIMP will ensure that measures to avoid (where practicable) or mitigate for effects will be undertaken and can be enforced. Moreover, I consider that residual effects will also be adequately addressed, as per conditions and management plans requiring the implementation of offset and compensation actions.

86. Other proposed changes to conditions as set out in Appendix 2 to the Forest and Bird submission are addressed in the evidence of **Mr Markham**, **Ms Quinn**, or **Ms McLeod**.

QEII Trust submission

87. The QEII Trust submission states that "*the loss of 11.82 ha of native forest and shrubland is a significant adverse effect on ecology and indigenous biodiversity"*.[21]

88. From an ecological standpoint and strictly within the bounds of my expertise as an ecologist, I agree with this, as I believe is reflected in my assessment and in the efforts undertaken to avoid, remedy, mitigate, offset or compensate for effects.

89. QEII Trust states that "*the assessment of ecological significance undervalues/fails to identify some vegetation and habitat that should be assessed as significant, in particular 'advanced secondary broadleaved forest. This leads to the magnitude of effects and offset/compensation package being undersized"*[22]*.*

90. In case there is any doubt, while I have categorised vegetation / habitat types as either 'Significant' or 'Not Significant' in One Plan terms, my assessment of effects is based on the EcIAG guidelines. My assessment of ecological values, the 'Magnitude of Effects' on those values, and measures to address effects (including residual effects) gives no regard to my assessment of significance against Policy 13-5 and Schedule F of the One Plan.

91. To illustrate, I have assessed advanced secondary broadleaved forest as having a 'Very High' Ecological Value (the highest 'Ecological Value' category) notwithstanding that it is considered 'Not Significant' when assessing against Policy 13-5 and Schedule F of the One Plan. As such, I do not agree that my 'Magnitude of Effects' assessment, or the measures subsequently recommended to address those effects, is "*undersized*".

[21] QEIINZ Trust submission paragraph 5a.
[22] QEIINZ Trust submission paragraph 5b.

Meridian submission

92. None of the proposed offsetting or compensation measures for addressing residual adverse effects on terrestrial ecological values are proposed to be undertaken on Meridian land. However, Meridian is concerned that Project-related planting and habitat creation relating to stormwater management, stream diversion plantings and landscape plantings will create additional wetland or forest bird habitat that could potentially result in significant adverse effects on wetland and forest birds through turbine collisions.[23]

93. As noted above, **Ms Quinn** and I have discussed this matter with Meridian and in particular with Meridian's consultant ecologist Dr Bull via meetings and emails. In response to Meridian's concerns, the Transport Agency has proposed a significant reduction in the quantum of stream diversion plantings (as set out in the evidence of **Ms Quinn**) and a reduction in the quantum of stormwater wetland creation on Te Āpiti Wind Farm land. In summary, the updated quantums of potential habitat created by Project activities on Te Āpiti Wind Farm land includes:

    (a) A total of 0.325 ha of stormwater wetland devices (0.75 ha was originally proposed); and

    (b) A total of 2.60 ha of stream diversion plantings (11.48 ha was originally proposed).

94. To my understanding, Meridian is now satisfied that the proposed magnitude of potential bird habitat creation through Project activities is unlikely to result in an increased risk of turbine collisions for native forest or wetland birds. I agree with this on the basis that:

    (a) There has not been a single incidence of turbine collision recorded for nationally 'Threatened' or 'At Risk' species on the Te Āpiti Wind Farm (or on other non-coastal windfarms) despite the fact there is likely to already be a high diversity and abundance of nationally 'Threatened' or 'At Risk' birds utilising the Meridian site. This is due to the presence of existing habitat for forest and wetland birds including:

        (i) Approximately 238 ha of forest, including approximately 81 ha of 'High' value mature native forest;

        (ii) Approximately 10.5 ha of wetland habitat that ranges from 'Low' to 'High' value; and

[23] Meridian submission page 3, point 1.

(iii) The presence of the adjoining Manawatū Gorge Scenic Reserve, which provides significant habitat for forest birds.

(b) There will be negligible change to the carrying capacity of wetland or forest birds on the Te Āpiti Windfarm i.e. the numbers of wetland or forest birds present, on the basis that habitat types created by Project activities are all considered to be of 'Low' value for nationally 'Threatened' or 'At Risk' wetland species.

95. I agree with Dr Bull that the most significant potential risk relates to the nationally 'Threatened' Australasian bittern, of which only ca 500 remain in New Zealand.[24] However, while this species may have used the site more frequently in the past when the population was considerably larger,[25] it is unlikely they now only use this site occasionally, if at all. This is on the basis that:

(a) The last known recording of a bittern in close proximity to the Te Āpiti Wind Farm was a sighting in 1970 near Ashhurst on the valley floor (approximately 1 km away). Further afield, the next closest sighting was adjacent to the Manawatū River near Palmerston North, approximately 16 km from the wind farm, which was recorded in 2019[26].

(b) Bittern prefer large, complex, valley floor/lowland wetland habitat types, which are not present on the Te Āpiti Wind Farm. However, there are two wetlands on the Te Āpiti Wind Farm that provide suitable habitat for bittern and would likely have been used in past years when the bittern population was larger (neither of these wetlands will be directly affected by Project activities).

96. In addition, the quality of habitat to be created by Project activities on the Te Āpiti Wind Farm is very low with respect to nesting, foraging and ecologically connectivity/flyways for this species (as discussed and agreed with bittern expert Mr John Cheyne),[27] and that the quantum of this habitat creation will result in negligible change to the potential carrying capacity of bittern on wind farm.

[24] Meridian submission: Boffa Miskell report Te Ahu a Tauranga stormwater wetlands sections 4.3 and 5.0
[25] Personal Communication with Graham Bolton on 8 June, 2020, who has been present on the land since the 1950's and stated that he frequently saw a bird that fit the general description of a bittern though hasn't seen one in a number of years.
[26] Ebird Map, 3 June 2020.
[27] John Cheyne, personal communication during a site visit on 8 June. Mr Cheyne is the principal ecologist at Wetland Works Limited and before that the Wildlife Service, the Department of Conservation and Fish and Game. Mr Cheyne is a national expert on Australasian bittern and is an author of number of technical reports and peer-reviewed publications relating to the conservation management and monitoring of this species.

97. Of key relevance and particularly in light of the proposed potential habitat reductions stated above, I consider it highly unlikely that bittern would be attracted to the site and/or be more at risk of turbine collision as a result of the habitats created by Project activities.

Dr Samuel Hill Submission

98. I agree with Dr Hill that some of the values that will be affected by the Project are significant. However, I do not agree that the Project will "*lead to the extinction, destruction or endangerment of a mass of endemic flora and fauna*", for the reasons detailed in my assessment of effects report and related documents.

COMMENTS ON SECTION 87F REPORT

99. Based on my review of the Terrestrial Ecology 87F Report, and my discussions with Mr Lambie, it is my understanding that Mr Lambie has no concern with:

    (a) The assessment of ecological value, which is considered sound and is consistent with the EcIAG and New Zealand Threat Classification System (NZTCS);[28]

    (b) The assessment of statutory significance;[29]

    (c) The assessment of effects 'Magnitude';[30]

    (d) The assessment of residual effects after measures to avoid, remedy and mitigate effects are considered;[31] or

    (e) The conclusion that there is a need to offset or compensate for potentially 'Moderate' or higher residual effects.[32]

"Limits to offsetting" analysis

100. Mr Lambie does express concern that the proposal may not have adequately demonstrated that the limits to offsetting have been addressed in the first instance.[33] He correctly points out that an assessment of the limits to offsetting should run independently of the BOAM following a process such as that laid out by Pilgrim et al. 2013.

101. Mr Lambie is comfortable that the effects on the seven habitat types for which calculated net gains have been assessed as 'verifiable' are within the

[28] Terrestrial Ecology 87F Report paras 30, 31.
[29] Terrestrial Ecology 87F Report paras 32-34.
[30] Terrestrial Ecology 87F Report paras 37-39.
[31] Terrestrial Ecology 87F Report para 41.
[32] Terrestrial Ecology 87F Report para 42.
[33] Terrestrial Ecology 87F Report paras 49 – 50.

limits of offsetting.[34] However, Mr Lambie expresses reservations in respect of the five habitat types for which there is an 'expected net gain' (by reference to the level of conservation concern for these five habitats). These five relevant habitat types are old growth forest (alluvial), old growth forest (hill country), indigenous-dominated seepage wetlands ('High' value), indigenous dominated seepage wetlands ('Moderate' value) and exotic wetlands ('Low' value).

102. I note that Technical Assessments F and G classed the measures proposed to achieve 'expected net gain' as compensation; Mr Lambie considers that the proposed measures are more akin to offsets, especially in One Plan Policy 13-4 terms.[35] I agree with that observation, particularly in light of Mr Lambie's comment that the focus on Policy 13-4 is on outcomes that successfully address residual effects, and on the likelihood of success of the proposed measures (as opposed to the technical distinction between 'offset' and 'compensation').[36]

103. That said, Mr Lambie considers it remains necessary to test whether offsetting is an appropriate response by reference to the rarity, vulnerability and irreplaceability of the five relevant habitat types. I have carried out an analysis of the limits of offsetting in respect of the five 'expected net gain' habitat types following the Pilgrim et al. 2013 approach. I set out my analysis below.

104. The process developed by Pilgrim et al. 2013[37] centres on assessing whether effects on a given biodiversity value should be avoided because it 'exceeds the limits of offsetting'. An assessment of 'limits to offsetting' or 'offsetability' for a given biodiversity value is broadly based on '*Combining biodiversity conservation concern with the likelihood of offset success in a burden of proof framework.*'[38] The process includes a sequential assessment of:

    (a) The biodiversity concern, which is based on vulnerability and irreplaceability:

        (i) Vulnerability equates to Threat Status with Pilgrim *et al*. 2013 assigning five vulnerability categories aligned with International

[34] Terrestrial Ecology 87F Report, para 46.
[35] Terrestrial Ecology 87Report, para 48.
[36] Terrestrial Ecology 87F Report at 92.
[37] Pilgrim, J. D., Brownlie, S., Ekstrom, J. M., Gardner, T. A., von Hase, A., Kate, K. T., Savy, C. E., Stephens R. T. T., Temple, H. J., Treweek, J., Ussher, G. T. & Ward, G. (2013). A process for assessing the offsetability of biodiversity impacts. Conservation Letters, 6(5), 376–384.
[38] Pilgrim et al. 2013, pg 382.

Union for the Conservation of Nature (IUCN) red-list categories[39] in descending order of vulnerability, namely:

(1) Critically endangered;

(2) Endangered;

(3) Vulnerable;

(4) Near Threatened/ Least Concern; and

(5) Data deficient/ Not evaluated.

(ii) Irreplaceability equates to the importance of sites to the global persistence of the ecosystem type or species, i.e. the percentage of the global range or population of a biodiversity feature sustained by the area of analysis. However, I have undertaken my assessment of irreplaceability of the three wetland and two old growth forest habitats in relation to their regional irreplaceability. I consider this to be more conservative and more ecologically appropriate given that these habitat types are, to varying degrees, regionally distinct. Categories include:

(1) ≥ 95%;

(2) ≥ 10%;

(3) ≥ 1%;

(4) ≥ 0.1%; and

(5) < 0.1%.

(b) The 'Magnitude of Effects' in relation to the global/entire range or population of a biodiversity feature. Again, I have assessed the 'Magnitude of Effects' in relation to regional availability of the wetland and old growth forest habitats. Again, I consider this more conservative and more ecologically appropriate because these habitat types are expected to be regionally distinct.

(c) An assessment of offset opportunities defined as '*the availability of areas or actions that offer suitable opportunities for achieving comparable, additional, lasting gains to compensate for impacts through offsets*'[40].

[39] IUCN (2001). IUCN Red List Categories and Criteria—Version 3.1. International Union for Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland and Cambridge, UK.
[40] Pilgrim et al 2013, p379

(d) An assessment of offset feasibility in regard to confidence in offset techniques and certainty of implementation.

105. Under this process:

(a) Old growth forest (alluvial) and wetland habitats affected by this Project are assessed as being of 'High' biodiversity concern, whereas old growth forest (hill country) is assessed as being of 'Low' biodiversity concern. This is on the basis that:

(i) I have assessed the vulnerability status of old growth forest (alluvial) and wetlands as 'Critically Endangered' because only approximately 3% of these habitats remain in the region (Maseyk 2007).

(ii) I have assessed the vulnerability status of old growth forest (hill country) to be 'Vulnerable' largely because approximately 19% remains in the region.

(iii) The irreplaceability status for all old growth forest and wetland habitats is expected to be ≥ 0.1%, i.e. across the region ≥ 0.1% but ≤ 1% of these habitat types are found within the area affected by the Project.

(b) I expect the 'Magnitude of Effects' to be 'Negligible' relative to what is available within the region[41] and almost certainly <0.01% for old growth forest (alluvial) and wetland habitat types and considerably less than this for old growth forest (hill country).

(c) I consider the potential offsetability to be 'High', particularly because the ecological integrity of available old growth forest and wetland habitat types adjoining or in close proximity to the Project footprint are compromised by the impacts of livestock grazing, deer, possums and rats, and weeds. As such, there are considerable opportunities to enhance or restore existing nearby habitats through habitat restoration and enhancement activities centred on native revegetation, retirement from livestock grazing and pest control.

(d) I consider offset feasibility to be 'High' in that:

[41] In contrast, the 'Magnitude of Effects' assessed in accordance with EcIAG was 'High' for the indigenous-dominated seepage wetlands ('Moderate' value) and 'Moderate' for the other four habitat types. This is because the 'Magnitude of Effect' was assessed against the availability or proportion of each habitat in the local landscape for the EcIAG rather than against the availability or proportion of each habitat type in the region as for the 'Limits to Offsetting' assessment.

(i) There is strong evidence from the literature that proposed habitat restoration and enhancement activities will generate significant biodiversity benefits as discussed in the sections above; and

(ii) The likelihood that these habitat creation and enhancement activities will be implemented is high as implementation would be required as a matter of compliance with consent conditions and the EMP. The activities will take place either on land that will be acquired by the Transport Agency (as consent holder), or where formal agreements to provide for and secure the activities will be entered into with willing third-party landowners.

106. In conclusion, I consider offsetting to be appropriate and in alignment with the 'limits to offsetting' principle.

Conditions

107. I am in general agreement with Mr Lambie in respect of a number of proposed changes to conditions set out in the Terrestrial Ecology 87F Report that relate specifically to the scope my evidence, i.e., direct efforts to avoid, remedy or mitigate for effects on terrestrial biodiversity values.

108. Specifically, this includes Mr Lambie's recommendations in items 109(e), 109(f), 109(i), and 109 (m), [42]which include:

(a) 109(e): The addition to EC1 of the need for edge-effects enrichment (mitigation) planting associated with the edges caused by loss of vegetation (in addition to the offsets/compensation plantings). However, I only consider this appropriate where edge effects are likely to be a notable issue, i.e., where interior old growth forest has been affected. To this end, a new condition (EC21) is proposed entitled *Edge Enrichment Planting (Old-Growth Forest (Hill Country)*, which states that:

> *In addition to planting required by Condition EC12, edge enrichment planting must be provided to a minimum width of ten (10) metres where old-growth forest (hill country) is removed between CH5500-CH5600*.

(b) 109(f): The recommendation to revise the EMP to include the recommendation proposed in 109(e), this has been addressed in the EMP as above.

[42] Terrestrial Ecology Section 87F Report para 109.

(c) 109(i): The recommendation as per the clarification sought by Forest and Bird (in relation to EC2) to identify recipient sites for salvaging species as well as translocation of salvaged species to translocation sites (in relation to EC16). This has now been updated in the respective consent conditions.

(d) 109(m): The need in EC11 to describe the monitoring and reporting requirements of the Terrestrial Invertebrates Management Plan for each 'At Risk' or 'Threatened' taxon present. This has now been updated in consent condition EC11 through the addition of clause EC11(b)(vi): '*describe monitoring and compliance reporting requirements for each 'at-risk' or 'threatened' taxa present'*.

109. However, I disagree with Mr Lambie's recommendation in 109(k) to remove allowance for small-scale vegetation clearance of up to 100 m² during peak bird breeding season (in proposed Condition EC6). From an ecological standpoint, I consider the potential adverse effects associated with this activity to be negligible due to the effects management efforts described in the AMP.

110. Moreover, if any residual effects do occur, (e.g. active bird nests are not detected and protected), then these effects will be addressed through the type and quantum of proposed offsetting and compensation measures as set out in the evidence of **Mr Markham**.

111. Other proposed changes to conditions as set out in the 87F report are addressed in the evidence of **Mr Markham**, **Ms McLeod** or **Mr McGahan**.

Dr Matthew Baber

12 June 2020

ATTACHMENT MB.1: SUPPLEMENTARY LONG TAILED BAT REPORT

[Provided separately]

ATTACHMENT MB.2: UPDATED EMP

[Provided separately]

WAKA KOTAHI NZ TRANSPORT AGENCY

Te Ahu a Turanga Manawatū Tararua Highway

Te Ahu a Turanga: Manawatū Tararua Highway

Supplementary Long-tailed Bat Report

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Table of Contents

1 Introduction

Waka Kotahi NZ Transport Agency proposes to construct and operate a new highway (Te Ahu A Turanga: Manawatū Tararua Highway Project) between Ashurst and Woodville, to the north-east of Palmerston North, Manawatū. The proposed highway construction is hereafter referred to as the Project. For a detailed description of the Project and the existing environment refer to the "Project description" and "Existing environment" sections of Technical Assessment F Terrestrial Ecology.

The purpose of this supplementary report is to report on the results of the 2020 long-tailed bat surveys undertaken to support the assessment of effects of the Project on native bats. Due to timing constraints, these results were not included in assessment of effects on Bats (Appendix F.1 of Technical Assessment F, referred to hereafter as "Appendix F.1") that formed part of the resource consent application for the Project 'main works' lodged in March 2020.

As explained in Appendix F.1, the additional 2020 survey was carried out because of the discovery of a bat record from the national bat database in close vicinity to the Project designation corridor, approximately 250 m to the north in Catchment 9. This record was collected in November 2018, around the time that the first Boffa Miskell bat survey was undertaken across the designation corridor. However, it appears that the record was recently added to the bat database as it is not discussed in the NoR reports or in evidence during the NoR hearing. As noted in Appendix F.1, this record was queried with DOC and has since been removed from the database as an error (M Pryde (DOC) pers. comm. February 2020).

2 Methodology

See Appendix F.1 of Technical Assessment F for a description of previous acoustic bat surveys undertaken across the Project designation.

The February 2020 survey comprised eight[1] frequency compression acoustic recorders manufactured by DOC (v1.0) deployed in the vicinity of the old-growth forests, mature pine and the Manawatū- and Pohangina river corridors (Appendix A shows these locations). These locations were chosen to target potential long-tailed bat habitat and river corridors that could provide landscape connectivity between the Project area and the closest confirmed bat habitat in the Pohangina Valley area.

If bats are active in the vicinity of the acoustic recorders, they record echolocation calls of both native bat species on two concurrently operating frequency channels. They operate remotely by recording and storing each echolocation call (bat pass), along with the date and time of occurrence.

The overall monitoring period for all acoustic recorders was between 10 and 25 of February 2020. Acoustic recorders were deployed for between 11 and 15 consecutive nights and set to record from one hour prior to sunset to one hour after sunrise.

Bat activity is influenced by overnight weather conditions and therefore weather data during the deployment period was sourced from the nearest weather station (www.cliflo.niwa.nz). As outlined in the Boffa Miskell automatic bat survey report to inform the Notice of Requirement for the Project designations (Boffa Miskell, 2019), preferential weather nights for bat activity have the following characteristics:

- Minimum temperature above 10°C in the first four hours after sunset;
- ≤ 2.5 mm of rainfall during the first two hours after dusk;

[1] Nine acoustic recorders were deployed but one recorder experienced an unknown malfunction and did not record for the duration of the survey.

- An average overnight wind speed of < 20 km/h, and wind gust not exceeding 60 km/h

The overnight weather data is presented in Appendix B, but because this survey was a presence absence survey all nights were analysed regardless of weather conditions.

3 Results

See Appendix F.1 for the results of previous acoustic bat surveys undertaken across the Project designation corridor as well as records from the National Bat Database administered by DOC.

As a brief recap, three acoustic surveys had previously been undertaken across the Project designation corridor to date and no bat calls were recorded. As described in the Introduction, the now-removed a long-tailed bat record in close vicinity to the site prompted an additional acoustic survey in the interim.

Nights with weather conditions preferential for bat activity were observed on 14 of the 15 nights surveyed (Appendix B). The average surface wind speed exceeded recommended guidelines for bat monitoring on one night, 14 February 2020.

The acoustic recorder data was analysed using BatSearch v3.12 (Department of Conservation) and uncertain files were reviewed internally by experienced bat ecologists certified at Level B (refer to Appendix C).

Four uncertain calls were recorded at three of the eight locations. These uncertain calls had spectrogram signatures resembling, but not typical of a long-tailed bat search phase call. Examples of the calls are included in Appendix D. Given the uncertainty as to whether the recordings in question were faint bat calls or insect noise, they were sent to the Stuart Cockburn[2] from DOC for an external second opinion. Mr Cockburn provided feedback that while the recordings had similarities with bat calls, he considered they were most likely to be insects (S Cockburn (DOC) pers. comm. May 2020).

Given the above it was concluded that no bat passes were recorded at any of the survey locations, the results of this are summarised in Table 3-1.

Table 3-1: Summary of acoustic bat survey effort and results of the most recent acoustic bat survey undertaken in February 2020

No. of acoustic recorders deployed	Survey dates	Duration of survey	Bats detected
8	10-13 February - 24/25 February	11 - 15 nights	No bats detected

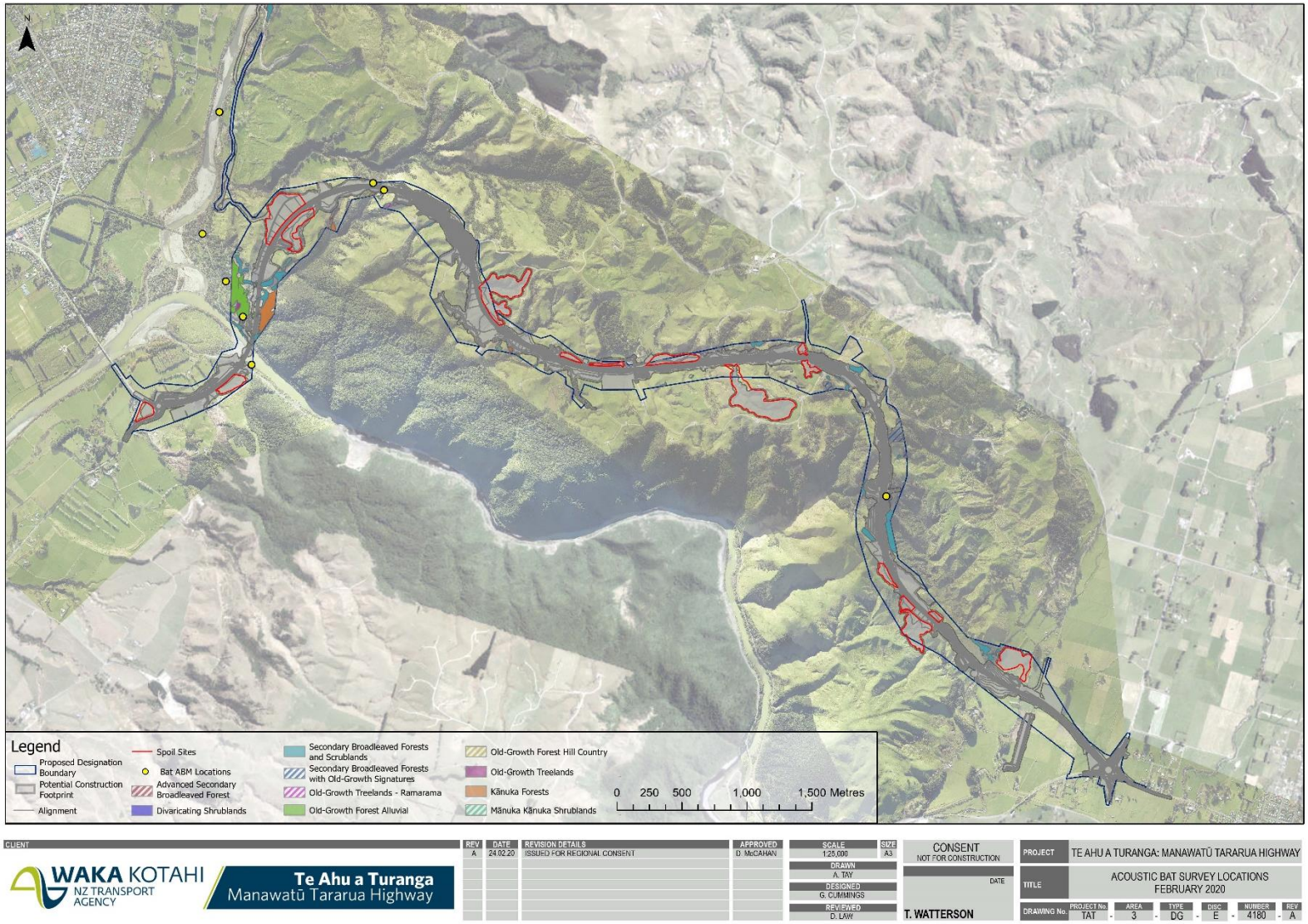
4 Conclusion

Appendix F.1 was prepared under the assumption that the additional February 2020 surveys would produce the same results as the previous bats surveys undertaken across the Project designation corridor. Otherwise if the surveys did record regular bat activity, the assessment of effects would be updated accordingly in this addendum.

[2] Stuart Cockburn is a member of the DOC electronics team and designed the BatSearch software used to analyse the spectrograms produced by the acoustic bat recorders used in this survey.

As no bats were recorded in the most recent survey, the conclusions drawn in Appendix F.1 remain appropriate. In summary, the overall level of effect of the Project on long-tailed bats is assessed as Low. The annual pre-construction surveys outlined in the Bat Management Plan (part of the overall Ecology Management Plan for the Project), which will trigger the requirement for the vegetation clearance protocols if necessary, is considered appropriate management in the unlikely event that bats known to occupy the wider landscape begin to use the Project footprint regularly during construction. I have prepared minor updates to the Bat Management Plan, simply to record the results of the latest February – March survey.

Appendix A: 2020 Bat Survey Locations



Appendix B: Overnight weather data from the survey period

Table B-0-1: Overnight weather data for the duration of the February 2020 bat survey sourced from NIWA cliflo station Palmerston North Ews. Weather parameters that are less preferential for bat activity are marked in red (refer to Section 2 for more detail).

Survey Night	Date	Time	Average wind speed per hour (km/h)	Nightly average wind speed (km/h)	Maximum wind gust (km/h)	Rainfall (mm)	Minimum Temperature (°C)
Night 1	10/02/2020	19:00	11.5	7.1	20.2	0	19.4
	10/02/2020	20:00	9.4		18.7	0	16.5
	10/02/2020	21:00	5.0		11.5	0	14.9
	10/02/2020	22:00	2.9		5.4	0	12.8
	10/02/2020	23:00	2.9		4.7	0	12.1
	11/02/2020	00:00	1.1		5.0	0	11.9
	11/02/2020	01:00	1.1		5.4	0	14
	11/02/2020	02:00	5.8		11.5	0	15
	11/02/2020	03:00	7.9		14.0	0	15.5
	11/02/2020	04:00	8.6		14.8	0	15.7
	11/02/2020	05:00	9.7		18.4	0	15.3
	11/02/2020	06:00	10.1		18.7	0	14.6
	11/02/2020	07:00	11.2		22.0	0	14.6
	11/02/2020	08:00	12.6		22.0	0	15.1
Night 2	11/02/2020	19:00	11.9	3.9	19.4	0	19.2
	11/02/2020	20:00	9.0		16.2	0	16.5
	11/02/2020	21:00	6.8		14.8	0	14.8
	11/02/2020	22:00	1.8		5.8	0	12.9
	11/02/2020	23:00	3.6		7.2	0	11.5
	12/02/2020	00:00	3.6		5.8	0	10.9
	12/02/2020	01:00	2.9		7.9	0	10.2
	12/02/2020	02:00	3.6		5.8	0	9.8
	12/02/2020	03:00	2.2		4.7	0	9.4
	12/02/2020	04:00	2.5		6.5	0	11.4
	12/02/2020	05:00	1.4		5.0	0	12.6
	12/02/2020	06:00	1.4		4.7	0	11.7
	12/02/2020	07:00	1.1		3.6	0	11.6
	12/02/2020	08:00	2.2		10.1	0	13.8

Survey Night	Date	Time	Average wind speed per hour (km/h)	Nightly average wind speed (km/h)	Maximum wind gust (km/h)	Rainfall (mm)	Minimum Temperature (°C)
Night 3	12/02/2020	19:00	16.9	11.8	26.6	0	19.4
	12/02/2020	20:00	15.8		24.8	0	16.9
	12/02/2020	21:00	14.8		26.6	0	16.7
	12/02/2020	22:00	8.6		18.0	0	17.1
	12/02/2020	23:00	9.4		16.9	0	17
	13/02/2020	00:00	6.8		14.4	0	16.7
	13/02/2020	01:00	5.4		9.4	0	16.7
	13/02/2020	02:00	7.2		12.6	0	16.6
	13/02/2020	03:00	9.0		15.8	0	16.7
	13/02/2020	04:00	8.3		15.5	0	16.6
	13/02/2020	05:00	11.9		20.9	0	16.6
	13/02/2020	06:00	13.0		21.6	0	16.5
	13/02/2020	07:00	16.9		28.1	0	16.6
	13/02/2020	08:00	20.5		36.7	0	17.1
Night 4	13/02/2020	19:00	10.1	9.3	17.6	0	18
	13/02/2020	20:00	6.5		13.3	0	16.7
	13/02/2020	21:00	2.5		6.1	0	15.7
	13/02/2020	22:00	1.8		6.1	0	15.3
	13/02/2020	23:00	3.2		6.8	0	15.6
	14/02/2020	00:00	2.2		6.8	0	15.4
	14/02/2020	01:00	4.3		10.4	0	15.6
	14/02/2020	02:00	10.8		25.9	0	15.9
	14/02/2020	03:00	10.8		23.8	0	17.2
	14/02/2020	04:00	11.9		23.8	0	16.7
	14/02/2020	05:00	15.1		34.6	0	16.5
	14/02/2020	06:00	14.0		31.0	0	16.2
	14/02/2020	07:00	16.9		32.4	0	16.4
	14/02/2020	08:00	19.4		34.6	0	17.3
Night 5	14/02/2020	19:00	22.3	20.0	41.8	0	20.4
	14/02/2020	20:00	19.8		36.4	0	18.3
	14/02/2020	21:00	19.8		38.2	0	17.4
	14/02/2020	22:00	18.7		34.6	0	16.9
	14/02/2020	23:00	21.2		43.9	0	16.8
	15/02/2020	00:00	21.2		45.4	0	16.5
	15/02/2020	01:00	20.9		39.2	0	16.4
	15/02/2020	02:00	20.2		41.4	0	16.4
	15/02/2020	03:00	19.1		35.6	0	16.5
	15/02/2020	04:00	18.7		33.1	0	16.4
	15/02/2020	05:00	19.4		32.0	0	16.4
	15/02/2020	06:00	18.0		32.8	0	16.3
	15/02/2020	07:00	20.2		34.6	0	16.5
	15/02/2020	08:00	19.8		34.2	0	17.4

Survey Night	Date	Time	Average wind speed per hour (km/h)	Nightly average wind speed (km/h)	Maximum wind gust (km/h)	Rainfall (mm)	Minimum Temperature (°C)
Night 6	15/02/2020	19:00	6.8	4.4	14.4	0	21.9
	15/02/2020	20:00	5.4		18.0	0	20.4
	15/02/2020	21:00	5.0		12.6	0	20
	15/02/2020	22:00	7.6		14.8	0	19.8
	15/02/2020	23:00	6.5		12.2	0	19.1
	16/02/2020	00:00	4.3		10.4	0	18.2
	16/02/2020	01:00	2.9		5.8	0	16.8
	16/02/2020	02:00	4.3		8.6	0	16.9
	16/02/2020	03:00	4.0		7.9	0	17.4
	16/02/2020	04:00	2.5		6.5	0	17.1
	16/02/2020	05:00	2.5		6.5	0	15.4
	16/02/2020	06:00	3.6		7.6	0	15.3
	16/02/2020	07:00	2.2		6.1	0	15.8
	16/02/2020	08:00	4.3		9.0	0	17.2
Night 7	16/02/2020	19:00	13.3	6.8	25.6	0	22.6
	16/02/2020	20:00	9.7		18.0	0	21.8
	16/02/2020	21:00	10.4		18.0	0	21.7
	16/02/2020	22:00	7.2		15.8	0	21.3
	16/02/2020	23:00	7.6		11.5	0	20.5
	17/02/2020	00:00	5.0		11.2	0	20.2
	17/02/2020	01:00	6.8		17.3	0	20.1
	17/02/2020	02:00	7.2		11.9	0	20.3
	17/02/2020	03:00	5.8		12.6	0	20.3
	17/02/2020	04:00	4.3		9.7	0	19.5
	17/02/2020	05:00	3.6		9.4	0	19.6
	17/02/2020	06:00	5.0		10.1	0	20.1
	17/02/2020	07:00	4.0		7.9	0	20.2
	17/02/2020	08:00	4.7		8.6	0	20.4
Night 8	17/02/2020	19:00	12.6	6.2	22.7	0	21.2
	17/02/2020	20:00	11.2		18.0	0	20.4
	17/02/2020	21:00	9.4		16.6	0	20.4
	17/02/2020	22:00	9.4		16.6	0	20
	17/02/2020	23:00	9.0		15.1	0	19.9
	18/02/2020	00:00	6.5		11.2	0	19.2
	18/02/2020	01:00	5.4		9.4	0	19.1
	18/02/2020	02:00	6.5		11.9	0	19
	18/02/2020	03:00	5.8		11.2	0	19.3
	18/02/2020	04:00	4.0		7.6	0	19.2
	18/02/2020	05:00	1.1		5.0	0	18.5
	18/02/2020	06:00	1.1		6.5	0	18.4
	18/02/2020	07:00	0.7		4.3	0	18.3
	18/02/2020	08:00	4.7		10.1	0	19.3

Survey Night	Date	Time	Average wind speed per hour (km/h)	Nightly average wind speed (km/h)	Maximum wind gust (km/h)	Rainfall (mm)	Minimum Temperature (°C)
Night 9	18/02/2020	19:00	4.7	1.6	9.4	0	19
	18/02/2020	20:00	5.0		8.6	0	18.8
	18/02/2020	21:00	1.1		5.8	0	18.7
	18/02/2020	22:00	1.1		5.0	0	17.9
	18/02/2020	23:00	0.0		0.0	0	17.6
	19/02/2020	00:00	0.7		4.0	0	17.5
	19/02/2020	01:00	0.7		2.9	0	17.2
	19/02/2020	02:00	0.0		0.0	0	17.2
	19/02/2020	03:00	0.7		5.8	0	17.4
	19/02/2020	04:00	4.0		17.3	0.3	17.5
	19/02/2020	05:00	1.4		8.3	0	17.6
	19/02/2020	06:00	0.0		0.0	0	17.6
	19/02/2020	07:00	0.0		2.5	0	17.8
	19/02/2020	08:00	3.6		17.3	0	18.2
Night 10	19/02/2020	19:00	12.2	5.1	24.5	0	19.6
	19/02/2020	20:00	9.7		16.6	0	19.3
	19/02/2020	21:00	7.6		16.2	0	17.8
	19/02/2020	22:00	1.4		6.8	0	17.3
	19/02/2020	23:00	4.3		7.9	0	18.2
	20/02/2020	00:00	4.7		10.8	0	18.5
	20/02/2020	01:00	4.3		10.1	0	18.5
	20/02/2020	02:00	4.3		10.8	0	18.4
	20/02/2020	03:00	5.4		12.2	0	18.5
	20/02/2020	04:00	5.0		10.1	0	18.4
	20/02/2020	05:00	4.7		12.2	0	17.6
	20/02/2020	06:00	3.2		6.8	0	15.6
	20/02/2020	07:00	3.6		10.4	0	15.3
	20/02/2020	08:00	1.4		6.5	0	16.9
Night 11	20/02/2020	19:00	10.4	3.4	21.2	0	18.4
	20/02/2020	20:00	6.5		11.5	0	17.6
	20/02/2020	21:00	3.6		9.0	0	16.8
	20/02/2020	22:00	4.3		9.0	0	16.7
	20/02/2020	23:00	4.0		9.4	0	15.8
	21/02/2020	00:00	0.4		5.0	0	14.6
	21/02/2020	01:00	2.9		7.9	0	13.6
	21/02/2020	02:00	2.9		5.8	0	12.5
	21/02/2020	03:00	5.0		9.0	0	12.9
	21/02/2020	04:00	2.2		7.2	0	11.7
	21/02/2020	05:00	0.0		0.0	0	10.8
	21/02/2020	06:00	0.4		5.0	0	10.3
	21/02/2020	07:00	2.9		7.2	0	10.3
	21/02/2020	08:00	1.8		7.9	0	13

Survey Night	Date	Time	Average wind speed per hour (km/h)	Nightly average wind speed (km/h)	Maximum wind gust (km/h)	Rainfall (mm)	Minimum Temperature (°C)
Night 12	21/02/2020	19:00	13.3	9.4	29.5	0	23.3
	21/02/2020	20:00	2.5		13.0	0	21.4
	21/02/2020	21:00	10.8		26.6	0	21.8
	21/02/2020	22:00	8.6		17.3	0	22.7
	21/02/2020	23:00	7.9		18.7	0	22.4
	22/02/2020	00:00	7.9		15.1	0	21.9
	22/02/2020	01:00	10.4		23.8	0	20.9
	22/02/2020	02:00	13.3		26.6	0	20.1
	22/02/2020	03:00	8.3		15.8	0	19.4
	22/02/2020	04:00	13.3		27.4	6	18.4
	22/02/2020	05:00	9.7		21.6	6.3	18.2
	22/02/2020	06:00	9.4		25.2	6.4	18
	22/02/2020	07:00	8.3		18.4	3.1	17.7
	22/02/2020	08:00	7.2		15.1	2.2	17.8
Night 13	22/02/2020	19:00	15.1	9.3	31.0	0	18.6
	22/02/2020	20:00	9.4		20.9	0	16.6
	22/02/2020	21:00	1.1		7.9	0	15.7
	22/02/2020	22:00	8.6		26.6	0.6	16.2
	22/02/2020	23:00	11.2		29.2	0.2	15.8
	23/02/2020	00:00	7.9		18.4	0.8	15.3
	23/02/2020	01:00	7.6		17.6	0.2	14.6
	23/02/2020	02:00	6.1		16.2	0	14.1
	23/02/2020	03:00	7.9		17.3	0	14.2
	23/02/2020	04:00	8.6		15.8	0	13.9
	23/02/2020	05:00	8.3		18.4	0	13.4
	23/02/2020	06:00	11.9		25.2	0	13.4
	23/02/2020	07:00	11.5		30.6	0	14.2
	23/02/2020	08:00	14.4		34.6	0	14
Night 14	23/02/2020	19:00	11.5	8.9	22.0	0	16.1
	23/02/2020	20:00	13.3		23.4	0	14.3
	23/02/2020	21:00	9.7		22.0	0	13
	23/02/2020	22:00	9.0		19.8	0	12.4
	23/02/2020	23:00	7.6		15.1	0	12.1
	24/02/2020	00:00	8.3		18.0	0	12.1
	24/02/2020	01:00	5.8		10.1	0	12.1
	24/02/2020	02:00	5.4		10.8	0	12.5
	24/02/2020	03:00	7.2		11.5	0	12.7
	24/02/2020	04:00	9.7		16.6	0	13
	24/02/2020	05:00	12.2		18.7	0	13.2
	24/02/2020	06:00	11.2		20.5	0	12.9
	24/02/2020	07:00	5.4		14.4	0	12.9
	24/02/2020	08:00	7.9		19.4	0	14

Survey Night	Date	Time	Average wind speed per hour (km/h)	Nightly average wind speed (km/h)	Maximum wind gust (km/h)	Rainfall (mm)	Minimum Temperature (°C)
Night 15	24/02/2020	19:00	16.9	14.3	31.7	0	17.5
	24/02/2020	20:00	15.1		31.0	0	16.1
	24/02/2020	21:00	16.2		31.7	0	15.4
	24/02/2020	22:00	14.0		25.9	0	14.8
	24/02/2020	23:00	14.8		26.6	0	14.7
	25/02/2020	00:00	13.3		27.4	0	14.4
	25/02/2020	01:00	13.3		24.1	0	13.8
	25/02/2020	02:00	11.5		20.9	0	13.2
	25/02/2020	03:00	11.5		19.1	0	13.1
	25/02/2020	04:00	13.3		23.4	0	13.1
	25/02/2020	05:00	13.3		26.3	0	13
	25/02/2020	06:00	14.8		26.3	0	13
	25/02/2020	07:00	15.8		31.7	0	12.8
	25/02/2020	08:00	16.2		31.7	0	14.1

Appendix C: Bat competency classes

Table C-1: Bat competency classes, adapted from the DOC bat ecologist competency framework (currently under review).

Class	Field activity	Competency
A	Acoustic monitoring	Setting up acoustic bat monitors (ABMs) for pre-felling surveys.
B	Analysing acoustic monitoring data	Setting up ABMs and analysing/interpreting results.
C1	Identifying short-tailed-bat roosts	Finding and identifying short-tailed bat roosts that are either occupied or unoccupied. This competency may also include arborists.
C2	Identifying long-tailed-bat roosts	Finding and identifying long-tailed bat roosts that are either occupied or unoccupied. This competency may also include arborists.
D	Handling bats	Handling bats (using one or more field methods) as outlined in DOC's best practice manual[3]
E	Training	Approved trainer for bat competencies A-D.

[3]Sedgeley, J. & O'Donnell, Colin & Lyall, J. & Edmonds, H. & Simpson, W. & Carpenter, Jo & Monks, Joanne & Mcinnes, Kate. (2013). DOC best practice manual of conservation techniques for bats.

Appendix D: Spectograms of uncertain recordings (potential bat calls) sent to DOC electronics team for a second opinion

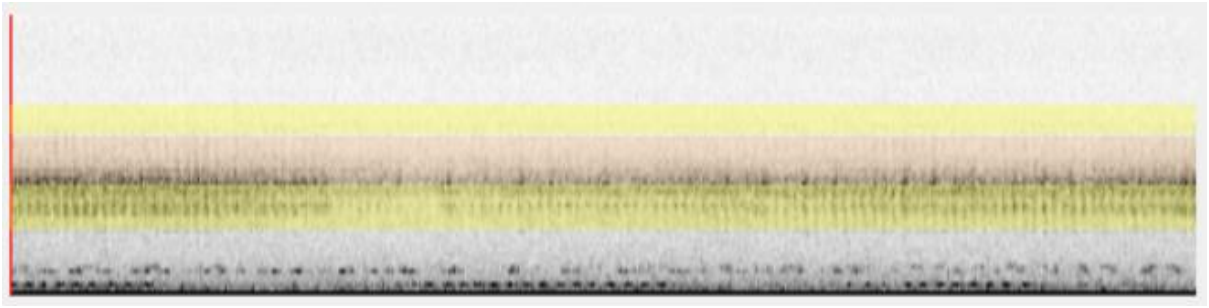


Figure 1: Uncertain recording (potential bat call) recorded at KB17 on 15 February at 6:09 am.

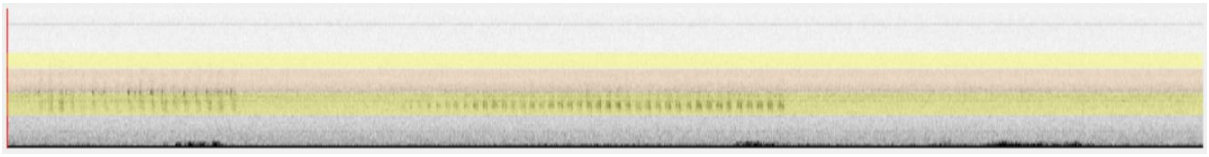


Figure 2: Uncertain recording (potential bat call) recorded at KB22 on 21 February at 5:50 am.

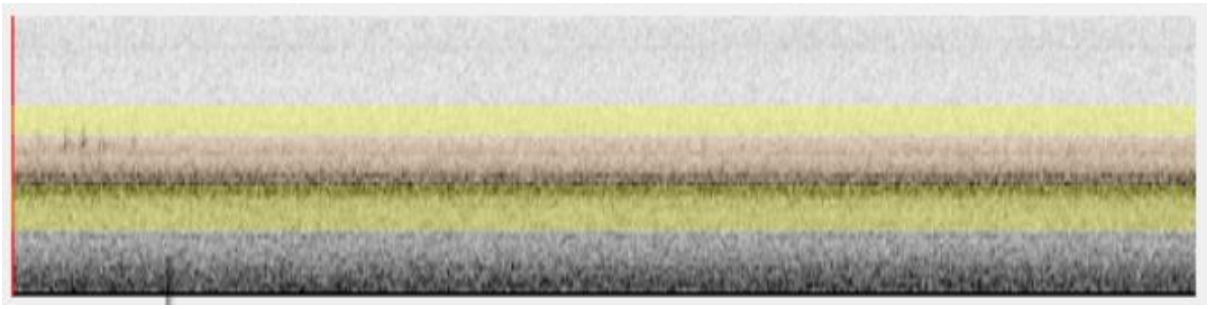


Figure 3: Uncertain recording (potential bat call) recorded at KB24 on 17 February at 5:32 am.

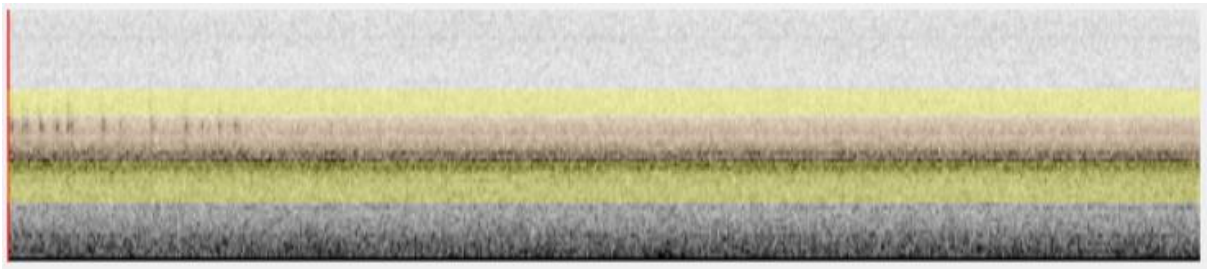


Figure 4: Uncertain recording (potential bat call) recorded at KB24 on 17 February at 5:37 am.

WAKA KOTAHI NZ TRANSPORT AGENCY

Te Ahu a Turanga Manawatū Tararua Highway

Te Ahu a Turanga: Manawatū Tararua Highway ~~Project~~

Ecology Management Plan

Document Number	TAT-0-EV-06030-CO-RP-0011
Revision	~~Resource Consent Application Version~~B
Date	~~4/03~~12/06/2020

Karakia

Tūtawa mai I raro
Tūtawa mai I roto
Tūtawa mai I waho
Kia tau ai te mauri tū,
Te mauri ora ki te katoa
Hāumi e, hui e, tāiki e

I summon from above
I summon from below
I summon from within
And the surrounding environment
The universal vitality and energy to infuse
And enrich all present
Unified, connected and blessed

Preface

This document represents the ongoing development of the management of ecological values in the Te Ahu a Turanga Manawatū Tararua Highway Project. This EMP recognises that Te Āpiti Manawatū Gorge taonga, with taonga species therein, and contains key landmarks in the cultural and ecological landscape, including the Manawatū River, the Manawatū Gorge, Moutere / Parahaki Island and the Tararua and Ruahine Ranges.

The importance of recognising Māori cultural values alongside ecological values was acknowledged in the early stages of the Project.

A core part of the partnership process to date has been the development of a productive and respectful working relationship between the Iwi-Transport Agency representatives and the Project team technical experts and designers who have worked together to develop towards strategies to support ecological restoration of the Manawatū and Tararua landscape. The foundation of the working project relationship with Iwi Project Partners is Te Tiriti o Waitangi.

This EMP acknowledges the principles of kaitiakitanga, placing the environment and sustainability at the heart of our work, and recognising our role as stewards for future generations, as well as the interconnection of all things, which means the well-being of any part of the environment will have a direct impact on the well-being of people.

The Project endeavours to tread lightly, where possible, to protect our natural world, by minimising construction footprints where they impact on indigenous forest, wetlands and streams. This endeavour is represented in this Ecology Management Plan that seeks to optimise and preferably maximise environmental and cultural benefits, including hydrology, habitat and ecological connectivity and enhancing iwi community connection with Te Āpiti Manawatū Gorge.

Document Control

Document History and Status

Revision	Date Issued	Author	Reviewed By	Approved By	Status
A	4/03/2020	Sam Heggie-Gracie Kylie Park Georgia Cummings Susan Jackson Peter Handford	Josh Markham Matt Baber Justine Quinn	Damien McGahan	~~DRAFT~~Draft
B	12/06/2020	Sam Heggie-Gracie Kylie Park Georgia Cummings Susan Jackson Peter Handford Roger MacGibbon	Josh Markham Matt Baber Justine Quinn	Damien McGahan	Draft
	Role:	Ecology	Ecology	Planning	
	Signatures:				

Revision Details

Revision	Details
A	First draft for resource consent application
B	Second draft for evidence submission

Table of Contents

Glossary

~~Glossary~~ Acronym / Term	Definition
ABM	Acoustic Bat Monitor
ACO	Artificial Cover Objects
AEE	Assessment of Environmental Effects
AEMP	Aquatic Ecological Monitoring Protocols
AMP	Avifauna Management Plan
ARD	Acoustic Recording Device
BMP	Bat Management Plan
CEDF	Cultural and Environmental Design Framework
CEMP	Construction Environmental Management Plan
CH	Chainage
DBH	Diameter at Breast Height
Designation Conditions	[The updated proposed conditions to the Project designations, agreed by most parties to the appeals against the designations, and dated 15 October 2019.]
DOC	Department of Conservation
ECR	Environmental Compensation Ratio
EFM	Electric Fishing Machine
EMP	Ecology Management Plan
FIT	Flight Interceptor Trap
FEMMP	Freshwater Ecology Monitoring and Management Plan
FRP	Fish Recovery Protocols
Ha	Hectares
Herpetologist	A specialist in the study of reptiles and amphibians
Horizons	Manawatū-Whanganui Regional Council, also known as Horizons Regional Council.
IPM	Integrated Pest Management
LMP	Landscape Management Plan
LiMP	Lizard Management Plan
MGSR	Manawatū Gorge Scenic Reserve
NG	Net gain
NMGSR	Northern Manawatū Gorge Scenic Reserve. This area is defined as the extent of the Manawatū Gorge Scenic Reserve which lies to the north of the Manawatū River.~~North Manawatū Gorge Scenic Reserve~~
NNL	No net loss
NPBV	Net positive biodiversity value
NoR	Notices of Requirement
~~NZTA~~Transport Agency	~~New Zealand~~Waka Kotahi NZ Transport Agency
PEMP	Planting Establishment Management Plan
PMA	Pest Management Area

PMP	Pest Management Plan
QEII	Queen Elizabeth the Second National Trust, also known as the QEII National Trust
REMMP	Residual Effects Management and Monitoring Plan
RMA	Resource Management Act 1991
RPA	Ramarama Protection Area
RTC	Residual Trap Catch Index
RTI	Residual tracking index
SEV	Stream Ecological Valuation
SSESCP	Site Specific Erosion and Sediment Control Plan
TAWFMP	• Te Āpiti Wind Farm Management Plan
Territorial Authorities	Palmerston North City Council, Manawatū District Council and Tararua District Council
The Project	Te Ahu a Turanga: Manawatū Tararua Highway
TIMP	Terrestrial Invertebrate Management Plan
TWVMMP	• Tangata Whenua Values Monitoring and Management Plan
VCMP	Vegetation Clearance Management Plan
Wildlife Act	Wildlife Act (1953)

1 Introduction

Te Ahu a Turanga: Manawatū Tararua Highway Project (the Project) comprises the construction, operation, use, maintenance and improvement of approximately 11.5 km of State highway connecting Ashurst and Woodville via a route over the Ruahine Ranges. The purpose of the Project is to replace the indefinitely closed existing State highway 3 (SH3) through the Manawatū Gorge.

The 195 ha Project footprint occurs within a predominately agricultural landscape dominated by grazed pastureland and exotic-dominated plantation forests or exotic shrublands. The Project footprint include 11.82 ha of indigenous forest and shrublands and a number of small wetlands totalling 4.97 ha. These terrestrial and wetland habitat types have been further split into 12 vegetation/habitat types and include or potentially include a number of nationally 'Threatened' and 'At Risk' species.

The Manawatū River and a number of its tributaries that are crossed by the Project, which are for the purposes of this Project named catchments 1 through 9. Catchment 2C (part of the Mangamania Stream) Catchment 5, 6 and 7, are considered to have high ecological value. Tributaries of the Manawatū River crossed by the Project with moderate value include Catchment 3 and 4 and the other parts of Catchment 2 (parts of Mangamania). Catchment 1 and 8 have low value. Catchment 9 which is a tributary of the ~~Pohingina~~Pohangina River is considered to have high ecological value, but the areas within which work is being undertaken is low value. The Project mainly traverses land that is in productive pastoral land use and at this more local level, the stream reaches are of lesser quality and show signs of degradation through stock access and fragmented riparian margins. Most of the streams within the Project area have evidence of fine sediment deposition, which has altered the naturally hard bottom substrates of the streams.

This Ecology Management Plan (EMP) sets out how actual and potential adverse ecological effects associated with the Project will be addressed.

1.1 Purpose and objectives of the EMP

The EMP has been prepared to identify how the Project will avoid, remedy, mitigate, offset and compensate potential adverse effects on the ecological and biodiversity values within the Project area and its surrounds, including:

- Vegetation and wetlands;
- Bats;
- Avifauna;
- Lizards;
- Terrestrial invertebrates; and
- Freshwater ecology.

The EMP also provides detail on the habitat restoration and enhancement measures to be implemented as part of the biodiversity offset and compensation package for the Project (the residual effects management framework). The package includes:

- Revegetation of 52.2 ha to reconnect a mosaic of existing vegetation remnants from the alluvial flats associated with the Manawatū River (including wetlands) through to hill country forest (refer Drawing Set in Volume 3, TAT-3-DG-E-4150, TAT-3-DG-E-4161-2), ~~comprising~~including weed and mammalian pest control, stock exclusion fencing and forest resource reuse in:
    - 45.6 ha terrestrial revegetation; and
    - 6.6 ha wetland revegetation (~~including~~plus 10 m wetland buffer planting);

- ~~Protection of the revegetated areas through~~Stock exclusion (with weed ~~control~~ and mammalian pest control ~~for a 10 year period, stock exclusion~~) within 48.3 ha of existing bush retirement and ~~permanent legal protection;~~

- ~~Enhancement~~0.4 ha of existing ~~vegetation remnants by way of stock exclusion, infill planting, weed control, pest control for a 10 year period and permanent legal protection;~~wetland habitat;
- Mammalian pest control within mature indigenous forest habitat over approximately ~~300ha~~300 ha in the ~~northern part of the~~Northern Manawatū Gorge Scenic Reserve~~, in close proximity to the Project alignment;~~ and adjacent landholdings, and within the 45.6 ha of native terrestrial revegetation and 48.3 ha of stock exclusion sites, including:
  - Annual rat, mustelid and possum control for 10 years; and
  - Annual deer control for 35 years; and
- Creation of ~~8~~6 km of stream diversions, and stream enhancement (riparian planting, stock exclusion and permanent legal protection) indicatively modelled to total ~~10,137~~17,386 m^2 streambed area of existing stream in the wider catchment to offset the loss of freshwater habitat.

1.2 Status of the EMP

This EMP is a fulsome draft, intended to be considered, updated and ultimately approved through the Project resource consent process. The EMP will then be reconfirmed for the purposes of ~~the Notices of Requirement (NoRs) for~~compliance with the designations through the certification and outline plan processes set out in the ~~draft~~ designation conditions~~ agreed by most parties to the appeals against the designations, dated 15 October 2019 (Designation Conditions).~~. It has been prepared following discussions with representatives of the Project's Iwi partners, the Department of Conservation (DOC) and representatives of Te Āpiti Manawatū Gorge Governance Group.

The EMP is a 'living document' and will be reviewed and updated as necessary over the course of the Project in accordance with the Designation Conditions and Project resource consent conditions, and to reflect changes associated with construction techniques, communication, mitigation or the natural environments.

Management of amendments to the EMP is the responsibility of the Transport Agency and must demonstrate how the outcomes of consultation with the Project Iwi Partners and the Department of Conservation have been taken into account.

1.3 EMP Structure

The EMP provides an overview of the ecological values within the Project area, along with the general approach for managing the ecological effects resulting from construction activities. This is followed by a series of discipline-specific management plan sections that outline in detail the measures to be implemented during and after the works to avoid, minimise, offset or compensate for ecological effects.

Each ~~chapter~~section is a standalone management plan (in line with the Designation Conditions). The Designation Conditions and resource consent conditions set out processes for certifying and updating the EMP (if required).

The EMP is set out as follows:

Section #	Heading	Document Control #
Section 1	Introduction (this section)	TAT-0-EV-06030-CO-RP-0011
Section 2	Ecological values and effects, offset and compensation for the Project	
Section 3	Vegetation Clearance Management Plan	TAT-0-EV-06030-CO-RP-0014
Section 4	Planting Establishment Management Plan	TAT-0-EV-06030-CO-RP-0015
Section 5	Biosecurity Management	TAT-0-EV-06030-CO-RP-0013
Section 6	Lizard Management Plan	TAT-0-EV-06030-CO-RP-0016

Section #	Heading	Document Control #
Section 7	Bat Management Plan	TAT-0-EV-06030-CO-RP-0017
Section 8	Avifauna Management Plan	TAT-0-EV-06030-CO-RP-0018
Section 9	Terrestrial Invertebrate Management Plan	TAT-0-EV-06030-CO-RP-0019
Section 10	Freshwater Ecology Monitoring and Management Plan	TAT-0-EV-06030-CO-RP-0020
Section 11	Fish Recovery Protocols	TAT-0-EV-06030-CO-RP-0021
Section 12	Residual Effects Management and Monitoring Plan	TAT-0-EV-06030-CO-RP-0022
Section 13	Pest Management Plan	TAT-0-EV-06030-CO-RP-0024
Section ~~13~~14	Training	TAT-0-EV-06030-CO-RP-0011

The EMP also refers to the ecology drawing provided in Volume 3, namely:

- TAT-3-DG-E-4131 to 4137 Terrestrial Ecosystem Plans;
- TAT-3-DG-E-4141 to 4147 Freshwater Ecosystem Plans; and
- TAT-3-DG-E-4150, TAT-3-DG-E-4161-2 Proposed Ecological Offset / Compensation.

Prior to construction, a set of Ecological Constraints Maps will be developed that outline important ecological values and constraints within the Project footprint, including significant vegetation and clearance restrictions, potential fauna habitat and salvaging, and monitoring locations.

1.4 Associated Documents

1.4.1 Technical reports

The EMP has been informed by the documents listed in the table below.

Table 1.1: Technical reports that have informed this EMP

Project Phase	Report
Regional Consenting	Technical Assessment F - Terrestrial Ecology; Technical Assessment G – Terrestrial Ecology Offset and Compensation Response; Technical Assessment H - Freshwater Ecology; Design and Construction Report (DCR);
Enabling works consent documents	Ecological Impact Assessment – Geotechnical Investigations (November 2019) Enabling Works Lizard Management Plan (February 2020)
Notice of Requirement Phase and related documents	Assessment of Effects on the Environment Report (November 2018) Preliminary Cultural and Environmental Design Framework (attached to the closing submissions); Technical Report 6: Terrestrial Ecology (2018) Assessment of Terrestrial Vegetation and Habitats (Forbes Ecology, 2018) (Technical Assessment 6A); Technical Report - 6.B Terrestrial Fauna Ecological Effects Assessment Technical Report – 6.B.1 Summer Ecology Survey –Herptofauna (March 2018) Technical Report – 6.B.4 Project Te Āpiti Saddle Road, Manawatū– Ecological Assessment (June 2003) Technical report – 6.B.2 GHD & NZTA Manawatū Gorge Realignment Option 3: Bats & Bird Habitat & Species Surveys (Kessels Ecology, 2018); and Te Ahu a Turanga – Manawatū Tararua Highway Project: Automatic bat surveys report and bat management recommendations (Boffa Miskell Limited, 2019). Technical report – 6.B.5: Report on Avian Mortality at Te Āpiti Wind Farm (2009)

Project Phase	Report
	Technical report – 6.B.3: OSNZ Bird Atlas (2007) Technical report – 6.A.G Threatened Plant Species (2018) Technical report – 6.C. Freshwater Ecological Impact Assessment (October 2018) Technical Assessment 4: Landscape, Natural Character and Visual (and its appendices). Evidence of Dr Forbes, Mr Blayney and Mr Miller dated 8 March 2019 and the addenda dated 25 March 2019. The Notices of Requirement for Designations Territorial Authority Recommendation Report, the Notice of Decision including the condition set dated 7 June 2019 (noting those conditions have now been updated following mediation as discussed earlier in this EMP). 'Northern Alignment' addendum to Technical Assessment 6 (Forbes and Blayney, 21 August 2019)

1.4.2 Management plans

Implementation of this EMP and the management of ecological effects has a number of links to other management plans that have been prepared or are under preparation for the Project, including:

- The Construction Environmental Management Plan and its appendices (TAT-0-EV-06030-CO-RP-0001);
- Erosion and Sediment Control Management Plan and its appendices (TAT-0-EV-06030-CO-RP-0003);
- The Landscape Management Plan;
- Streamworks Procedures (TAT-0-EV-06030-CO-RP-0009);
- Hazardous Substances Procedures (TAT-0-EV-06030-CO-RP-0010);
- The Tangata Whenua Values Monitoring and Management Plan; and
- Te Āpiti Wind Farm Management Plan.

1.5 Project Iwi Partners input to EMP implementation

The Transport Agency has consulted, and worked collaboratively, with its Project iwi partners through the process of developing the Project and this EMP. The Project iwi partners are:

- Rangitāne o Manawatū;
- Rangitāne o Tamaki nui-ā-Rua;
- Ngāti Kahungunu ki Tāmaki nui-a-Rua; and
- Ngāti Raukawa/ Ngāti Kauwhata.

Ongoing engagement with the Project Iwi partners will occur as the Project progresses to enable the partners to provide their kaitiaki inputs into the design, construction and operational phases of the Project.

For ecological matters, a qualified representative of the Project iwi partners (Rangitāne o Manawatū, Ngāti Raukawa/ Ngāti Kauwhata, Ngāti Kahungunu ki Tāmaki nui-a-Rua, Rangitāne o Tamaki nui-ā-Rua) or cultural monitoring advisor, shall be invited to attend at the time of the following tasks, with a suitably qualified ecologist, in all or selected areas of the alignment:

- Development of protocols, for example vegetation clearance, and restoration plans including riparian enhancement programs;
- Vegetation clearance on site, including epiphyte salvage and translocation;
- Daytime manual destructive habitat searches and salvaging;

- Nocturnal spotlight searches and salvaging;
- Fish capture and release and ensuring fish passage provision;
- Replacement and mitigation planting;
- Cultural monitoring;
- Fencing;
- Pest and weed control; and
- Eco-sourcing and development of restoration plant species mix.

A process for addressing and incorporating kaitiaki inputs ~~will be~~is being developed with the Iwi partners. The process will likely involve establishment of a specific forum for Iwi partners and the Transport Agency to work collaborative on kaitiaki matters, and will progress requests and recommendations, such as those outlined below:

- An integrated catchment approach to restoration connecting bush remnants and headwaters to the Manawatū River is imperative to account for ~~this loss.~~effects of the Project.
- Where practicable use of local taonga species that are eco sourced from within the Manawatū region rather than species sourced from wider Aotearoa.
- Iwi project partners are generally opposed to sourcing seed and species from outside of their rohe.
- Iwi project partners see a need to treat soils that have leaf litter, and thus a special mauri, differently than those that are mainly grassed or bare.
- Iwi project partners would like to sustainably harvest resources from their maunga and traditional harvesting grounds into the future.
- Iwi project partners mātauranga at the centre of restoration planning for the confluence including the development of the wetland park.
- Weed control in the wider landscape is undertaken early within the construction program to minimise weed spread into construction and restoration areas specifically adjacent to Parahaki/Motuere Island where practicable.
- Weed and mammalian pest control is undertaken early in the construction program where practicable.
- Seed collection includes eco-sourcing from the bush remnants adjacent to the confluence
- Fencing and plantings are undertaken early in the construction program where practicable.
- The LINZ land block have diverse forest remnants that are currently poorly protected. The status of this area should be reviewed in aim of applying a more appropriate land protection status that recognised cultural and ecological values.
- Where practicable the use of locally sourced indigenous species for all aspects of wetland creation, enhancement and filtration capability.
- Consideration of fish community values in stream restoration offset sites to ensure that these values are accounted for in at least a portion of stream enhancement plantings.

This kaitiaki process and associated recommendations will be reflected in the implementation of this EMP.

1.6 Relevant RMA conditions

The Designation Conditions set out requirements for this EMP, the Project resource consent conditions will also set out additional requirements (including in particular in respect of freshwater effects). The tables below identify the key Designation Conditions and resource consent conditions relevant to this EMP and identify where they are addressed in the document.

Table 1.2: Designation Conditions relevant to this EMP

Condition No.	Condition	Relevant EMP Section
19	**Planting Establishment Management Plan** a) The Planting Establishment Management Plan covers the establishment of planting and (where required) the on-going legal protection of that planting. Planting required by Conditions of this designation must: i) When required by Condition 24, not be located within a portion of the Te Āpiti wind farm indicated by property reference numbers 8, 9, 10, 11, and 12 on Land Requirement Plans TAT-2-DG-E-0100-A to TAT-2-DG-E-0108-A dated 14 October 2019 except where: A) Meridian provides the Requiring Authority with its written consent to such planting; or B) The planting is for the restoration of areas subject to QEII Trust open space covenants at 31 October 2018 and shown on Plan C-06 dated October 2018 (where the planting is in a similar location as exists on 31 October 2018 and Meridian and the QEII Trust are consulted in respect of the species proposed to be planted); ii) When required by the Landscape Management Plan within a portion of the Te Āpiti wind farm indicated by property reference numbers 8, 9, 10, 11, and 12 on Land Requirement Plans TAT-2-DG-E-0100-A to TAT-2-DG-E-0108-A dated 14 October 2019 must: A) be within the Designation boundary; and B) not exceed a height of 1.5 metres at maturity except where: 1. the planting is for the restoration of areas subject to QEII Trust open space covenants at 31 October 2018 and shown on Plan C-06 dated October 2018 (where the planting is in a similar location and as exists on 31 October 2018 and Meridian is consulted in respect of the species proposed to be planted); or 2. the requirements of clauses A) or B) are not met and Meridian provides the Requiring Authority with its written consent to such planting; or 3. the planting is within areas of existing vegetation habitat types that are expected to grow higher than 1.5m. iii) Be completed within the three planting seasons following the completion of construction works, except where succession planting is being undertaken in accordance with the Planting Establishment Management Plan; iv) Be undertaken with plants eco-sourced from the Manawatū Gorge Ecological Region, where reasonably available, or be locally extinct species introduced for cultural or genetic reasons; v) Be protected from livestock grazing by fencing or other physical works; vi) Over a 5-year period, include the replacement of plants that fail to establish; vii) in respect of planting required by Condition 24(a), achieve 80% canopy cover and, in the period until this canopy cover is achieved, manage possums and rats to achieve and maintain a 5% or better residual trap catch/tracking index score (or equivalent monitoring method); viii) not include kōwhai, tawa, harakeke, rimu, kahikatea, mātai planted within 20 metres of the formed carriageway of the new road; b) Planting required by condition 24, or the conditions of any regional resource consents granted for the Project, must be legally protected in perpetuity; c) The objective of the Planting Establishment Management Plan is to ensure that any planting required by Conditions of this Designation is undertaken in a manner that achieves the standards set out in clause (a) and (b) above and the outcomes required by Conditions 17 and 24. d) The Planting Establishment Management Plan forms part of the Ecological Management Plan required by Condition 24 and must: i) Be prepared by an independent, suitably qualified and experienced expert or experts (which must include a terrestrial ecologist and may include other experts such as an arborist or landscape architect) in consultation with the Department of Conservation and the Project Iwi Partners; ii) Take into account the outcomes of that consultation with the Department of Conservation and the Project Iwi Partners;	Section 3

Condition No.	Condition	Relevant EMP Section
	iii) Identify areas (including legal boundaries) where planting is to occur including: A) where planting is to be staged with reference to the construction works programme; and B) canopy gap planting in retired areas and any areas of edge buffer planting; C) areas for planting required by Conditions 17 and 24; iv) Describe where the plants will be eco-sourced from (including species genetic source and propagation methodology); v) Describe plant species mixes; plant spacing, density and layout; plant size (at time of planting); and planting methods (including ground preparation, mulching and trials); vi) Describe fencing, stock exclusion, or any other physical works necessary to protect planted areas from livestock; vii) Describe the legal arrangements (land purchase, covenanting or similar registered title instrument) to be entered into in order to ensure the planted areas are retained in perpetuity; viii) Include a plant pest management programme that as a minimum targets species that threaten new or replacement plantings, forest regeneration, wetland restoration, forest succession, and the regeneration of any retirement areas; ix) Include an animal pest management programme to manage possums and rats to achieve and maintain a 5% or better residual trap catch/tracking index score (or equivalent monitoring method); x) Describe the ongoing maintenance and management of planted areas, including a requirement that over a 5-year period plants that fail to establish are replaced; and, in the case of planting required under Condition 24, until 80% canopy cover is achieved; xi) Describe how the potential for bird strike from vehicles using the road will be reduced through plant species selection in proximity of the new road; xii) Include a species list for divaricating shrubland replacement planting that has a high representation of the indigenous plant genera/species *Coprosma rhamnoides, Melicytus, Olearia virgata, Olearia solandri, Muehlenbeckia, Parsonsia and Rubus*, (subject to the reasonable availability of those genera/species). ***Advice Note:*** *Additional requirements for the Planting Establishment Management Plan may be contained in regional consents necessary to provide for the construction of the Project.*	
20	**Lizard Management Plan** a) The objective of the Lizard Management Plan is to achieve the standards set out in Condition 24(a) and to avoid, remedy or mitigate the potential adverse effects of the Project on lizards. b) The Lizard Management Plan forms part of the Ecological Management Plan required by Condition 24 and must: i) Be prepared by an independent, suitably qualified and experienced ecologist in consultation with the Department of Conservation and the Project Iwi Partners; ii) Take into account the outcomes of any consultation with the Project Iwi Partners and the Department of Conservation; iii) Describe the methodology for survey, salvage, transfer and release, including the identification of potential habitats for survey and planned and opportunistic relocations; iv) Identify release sites that can support additional released individuals (which may include, if suitable, the Manawatū Gorge Scenic Reserve, subject to permission being granted by the Department of Conservation) and confirm any works necessary to protect such sites from predation or disturbance (when the sites are not in the Manawatū Gorge Scenic Reserve); and v) Be updated to achieve consistency with any authorisation given by the Director-General of Conservation under section 53 of the Wildlife Act 1953 where any such authorisation is required. ***Advice Note:*** *Additional requirements for the Lizard Management Plan may be contained in regional consents necessary to provide for the construction of the Project.*	Section 6

Condition No.	Condition	Relevant EMP Section
21	**Bat Management Plan** a) The objective of the Bat Management Plan is to achieve the standards set out in Condition 24(a) and to avoid, remedy or mitigate the potential adverse effects of the Project on bats. b) The Bat Management Plan forms part of the Ecological Management Plan required by Condition 24 and must: i) Be prepared by an independent, suitably qualified and experienced ecologist in consultation with the Department of Conservation and the Project Iwi Partners; ii) Include procedures for the removal of any bat roosts (including measures to retain and monitor any active roosting site) identified in the Designation; iii) Where necessary, set out an approach to habitat replacement and pest control; and iv) Be updated to achieve consistency with any authorisation given by the Director-General of Conservation under section 53 of the Wildlife Act 1953 where any such authorisation is required. ***Advice Note:*** *Additional requirements for the Bat Management Plan may be contained in regional consents necessary to provide for the construction of the Project.*	Section 7
22	**Avifauna Management Plan** a) The objective of the Avifauna Management Plan is to achieve the standards set out in Condition 24(a) and to avoid, remedy or mitigate the potential adverse effects of the Project on avifauna. b) The Avifauna Management Plan forms part of the Ecological Management Plan required by Condition 24 and must: i) Be prepared by an independent, suitably qualified and experienced ecologist in consultation with the Department of Conservation and the Project Iwi Partners; ii) In the Manawatū River riverbed: A) describe the measures necessary (prior to the July to March breeding season) to deter black-fronted dotterels and banded dotterels from nesting; B) set out the methodology for a pre-construction survey to identify any nesting dotterels; C) if nesting dotterels are present, in accordance with the NZTA's 'Guidance in relation to New Zealand dotterels on NZTA land' dated November 2012: 1. require the establishment an exclusion area around the nesting area within which works may not be undertaken until nesting activities are completed;~~ and~~ 2. provide for the relocation (by driving away under the supervision of an suitably qualified and experienced person) of the dotterels that are not actively nesting; iii) For any vegetation clearance between the months of September and January in potential whitehead nesting habitats: A) set out the methodology for a pre-construction survey to identify any nesting whiteheads; B) if nesting whiteheads are present, require the establishment of an exclusion area around the tree containing the nest and immediately adjacent trees within which works may not be undertaken until nesting activities are completed. iv) For any clearance of old-growth forest or secondary broadleaved forests occurring between the months of September and December (inclusive): A) set out a methodology for a pre-construction survey to identify any indigenous nesting birds protected by the Wildlife Act 1953; and B) if indigenous nesting birds protected by the Wildlife Act 1953 are present, require the establishment of an exclusion area around the nesting area within which works may not be undertaken until nesting activities are completed and all chicks have fledged. v) For any clearance or mowing of rank grass between the months of August and March: A) set out the methodology for a pre-construction survey to identify any nesting pipit;	Section 8

Condition No.	Condition	Relevant EMP Section
	B) if nesting pipit are present, require the establishment of an exclusion area around the nesting area within which works may not be undertaken until nesting activities are completed. vi) Prior to any works occurring in the raupō dominated seepage wetlands, as shown on Designation Plan TAT-2-DG-E-0111-A dated 14 October 2019: A) set out the methodology for a pre-construction survey for cryptic bird species; B) if nesting cryptic bird species are present, require the establishment of an exclusion area around the nesting area within which works may not be undertaken until nesting activities are completed. vii) Minimise disturbance as far as is practicable to the freshwater ponds located between CH9200 and CH9600 in order to maintain possible habitat for Australian coot and New Zealand dabchick. viii) Be updated to achieve consistency with any authorisation given by the Director-General of Conservation under section 53 of the Wildlife Act 1953 where any such authorisation is required. ***Advice Note:*** *Additional requirements for the Avifauna Management Plan may be contained in regional consents necessary to provide for the construction of the Project.*	
23	**Terrestrial Invertebrate Management Plan** a) The objective of the Terrestrial Invertebrate Management Plan is to achieve the standards set out in Condition 24(a) and to avoid, remedy or mitigate the potential adverse effects of the Project on At-Risk or Threatened terrestrial invertebrates. b) The Terrestrial Invertebrate Management Plan forms part of the Ecological Management Plan required by Condition 24 and must: i) Be prepared by an independent, suitably qualified and experienced ecologist in consultation with the Department of Conservation and the Project Iwi Partners; ii) Require, prior to the commencement of construction works, pre-construction surveys to determine: A) invertebrate community composition; B) the presence of 'At Risk' or 'Threatened' taxa (as defined by the Department of Conservation's New Zealand Threat Classification System). iii) Inform any mitigation monitoring and any offsetting or compensation proposed under Condition 24(b) or 24(c); iv) Define the timing and locations of surveys intended to identify the presence of At-Risk or Threatened terrestrial invertebrates (including periods between August and December for *Meterana exquisita*; periods between April and June for *Meterana grandiosa*; and shrubland habitats that may support these species); v) Set out the appropriate levels of taxonomic resolution and/or community composition indices to be applied if At-Risk or Threatened terrestrial invertebrates are identified; vi) Where the pre-construction surveys detect the presence of 'At-Risk' or 'Threatened' taxa: A) identify the vegetation or habitats that should be avoided in the first instance; B) outline the optimal timing of vegetation clearance based on the 'At-Risk' or 'Threatened' taxa present; C) where appropriate, describe the methods of direct invertebrate management; D) identify areas where measures to manage enabling or construction works activities apply; E) set out approaches to the restoration of invertebrate taxa/community composition in planting and retirement areas required by Condition 24, including but not limited to: 1. wood disk stepping stones and long grass or shrubland corridors; 2. the salvage and transfer of soils, coarse woody material or debris and leaf litter; and 3. detailed measures to create and/or restore habitats for populations of 'At-Risk' or 'Threatened' taxa impacted by the Project;	Section 9

<table>
<tr><th>Condition No.</th><th>Condition</th><th>Relevant EMP Section</th></tr>
<tr><td></td><td>4. monitoring protocol for populations of ‘At-Risk’ or ‘Threatened’ taxa impacted by the Project, where monitoring forms part of the measures determined by Condition 24(b); and
5. biosecurity measures required in carrying out these activities.
Advice Note: Additional requirements for the Terrestrial Invertebrate Management Plan may be contained in regional consents necessary to provide for the construction of the Project.</td><td></td></tr>
<tr><td>24</td><td>Ecology, Ecological Management Plan and offset and/or compensation measures
a) The following standards apply in respect of terrestrial ecology (and natural character in respect of clause (v)):
i) The area of wetlands, indigenous vegetation or habitats removed must not exceed the maximum areas provided for in Table 1: Vegetation Removal, except that the maximum area of exotic dominated wetlands able to be removed must be updated to take into account any additional exotic dominated wetlands identified in pre-construction surveys undertaken by the Requiring Authority;
Table 1: Vegetation Removal
<table>
<tr><th>Ecosystem type</th><th>Maximum area of vegetation or habitat able to be removed (ha)</th></tr>
<tr><td>Secondary broadleaved forests with old-growth signatures</td><td>2.39</td></tr>
<tr><td>Old-growth treelands</td><td>0.26</td></tr>
<tr><td>Kānuka forests (CH4000 – 4400)</td><td>1.00</td></tr>
<tr><td>Kānuka forests (elsewhere)</td><td>0.59</td></tr>
<tr><td>Advanced secondary broadleaved forests (CH5600 -5800)</td><td>0.09</td></tr>
<tr><td>Advanced secondary broadleaved forests (elsewhere)</td><td>0.41</td></tr>
<tr><td>Secondary broadleaved forests and scrublands (CH6100 – 6400)</td><td>0.03</td></tr>
<tr><td>Secondary broadleaved forests and scrublands (elsewhere)</td><td>14.12</td></tr>
<tr><td>Mānuka and kānuka shrublands (CH6100 – 6400)</td><td>0</td></tr>
<tr><td>Mānuka and kānuka shrublands (elsewhere)</td><td>3.63</td></tr>
<tr><td>Divaricating shrublands</td><td>0.33</td></tr>
<tr><td>Old-growth forests (alluvial)</td><td>0.15</td></tr>
<tr><td>Old-growth forests (hill country)</td><td>0.86</td></tr>
<tr><td>Raupō dominated seepage wetlands (high value)</td><td>0.13</td></tr>
<tr><td>Indigenous-dominated seepage wetlands (moderate value)</td><td>1.12</td></tr>
<tr><td>Exotic-dominated wetlands (low value)</td><td>2.74</td></tr>
</table>
ii) Swamp maire must be planted at the following rates:
A) 100 swamp maire trees for any existing swamp maire tree affected by more than 10% of live growth pruning as determined by an independent, suitably qualified and experienced arborist;
B) 200 swamp maire trees for any existing swamp maire tree that dies as a result of enabling or construction works activities, as determined by an independent, suitably qualified and experienced arborist;
iii) Where any ramarama greater than 15 centimetres tall is removed as a result of enabling or construction works activities, replacement planting of ramarama must be undertaken at a rate of 1:100;
iv) Planting must be provided in order to mitigate edge effects associated with indigenous vegetation removal;
v) That the maximum length of the following streams (shown on Drawing C-10) permanently disturbed by diversion or other physical modifications is minimised as far as practicable and does not exceed:
A) QEII Trust west (stem 7A): 350m in total;
B) QEII Trust east (stems 6A, 6B and 6C): 100m in total;
vi) Pre-construction surveys must be undertaken in the relevant habitats to detect the presence of:
A) lizards;
B) At Risk or Threatened terrestrial invertebrates;
C) cryptic bird species;</td><td>All Sections</td></tr>
</table>

Condition No.	Condition	Relevant EMP Section
	D) nesting dotterels, pipit and whiteheads; E) indigenous nesting bird species that are protected by the Wildlife Act 1953 and are in old-growth forest or secondary broadleaved forest that is to be cleared between the months of September and December; The pre-construction surveys required by C) to E) above must be undertaken within 2 working days before the relevant proposed habitat clearance works; vii) Any bat roosting site that is discovered must be retained when active; viii) Lizards discovered, including through pre-construction surveys of lizard habitats, must be salvaged and released to an identified release site; ix) Active nesting sites of bird species identified by the pre-construction surveys required by clause (a)(vi) above, or active nesting sites of the species listed in clause (a)(vi)(C) and (D) that are identified during construction works, must not be disturbed and must be protected by the establishment of an exclusion area within which works cannot be undertaken; x) Within the areas subject to the QEII Trust open space covenants (shown on Plan C-06 dated October 2018) that are within the Designation: A) a pre-construction baseline survey of pest plants must be undertaken; and B) all new pest plants must be controlled both during construction and for five years following the completion of construction works to the same level or better than found in the pre-construction baseline survey; xi) Where more than minor adverse effects on indigenous biological diversity are not reasonably avoided, remedied or mitigated, they are offset and, if they cannot be offset, they are compensated to result in a net indigenous biological diversity gain. The offset and compensation measures must be described in the Ecological Management Plan in accordance with clause (d) and (e) including in respect of effects of enabling works on indigenous biological diversity and wetlands. b) The Requiring Authority must confirm to the Responsible Officer(s) prior to the commencement of construction that it has secured the legal agreements and/or other authorisations necessary to carry out, continue and maintain, as required, all the measures provided for in the Ecological Management Plan. c) The Objective of the Ecological Management Plan is to achieve the standards set out in clause (a) and address the potential adverse effects of the Project on ecological and biodiversity values. d) The Ecological Management Plan must be certified in accordance with Condition 3 and form part of the Construction Environmental Management Plan required by Condition 14. It must: i) Be prepared by an independent, suitably qualified and experienced ecologist(s); ii) As a minimum: A) summarise the terrestrial ecology and biodiversity values and effects of the Project; B) take into account the outcomes of any consultation with the Project Iwi Partners, the Department of Conservation, the Te Āpiti Manawatū Gorge Governance Group and any other party having a direct interest in the land subject to any replacement, offset or compensation planting required; C) include the Planting Establishment, Bat, Lizard, Avifauna, and Terrestrial Invertebrate Management Plans required by Conditions 19, 20, 21, 22 and 23; D) detail how vegetation to be removed will be identified on site; E) set out site staff induction procedures in respect of ecological requirements, including measures to prevent the introduction of pest plants and pest animals; F) consider opportunities for: 1. the reuse of natural materials and felled trees by the Project Iwi Partners; and 2. community participation in planting; G) provide for the salvage and transfer of soils, coarse woody material or debris and leaf litter for use in areas of replacement and retirement planting; H) confirm the location of any areas to be retired from grazing. e) The Requiring Authority must, in consultation with the Project Iwi Partners, the QEII National Trust (where relevant to the management of existing or proposed open space	

Condition No.	Condition	Relevant EMP Section
	covenants) and the Department of Conservation describe in the Ecological Management Plan the extent of any offsetting or compensation necessary to achieve a net indigenous biological diversity gain (including in respect of residual adverse effects of enabling works) with reference to: i) the direction given by the relevant provisions of Policy 13-4 of the One Plan – Part II; ii) the conditions of any regional resource consents granted for the Project; iii) '*Biodiversity Offsetting under the Resource Management Act: A guidance document*', published by Local Government New Zealand in September 2018; f) Where offsetting or compensation is necessary, and requires measures additional to those required by these conditions, this may include (but not be limited to): i) the retirement of areas (where available) within the areas shown for this purpose in Appendix C to the Statement of Evidence of Dr Forbes dated 8 March 2019, provided additionality can be achieved in those areas; ii) the retirement of additional areas in an alternative location, offset or compensation planting and/or additional pest management measures; iii) funding provided to the Manawatū Gorge Governance Group to undertake activities described in the 'Te Āpiti – Manawatū Gorge Biodiversity Management Plan' dated 8 August 2017 including, but not limited to, items that are consistent with the section 4 of that Plan and the following items listed in section 6.1 of that Plan: A) weed and animal pest survey and planning; B) weed control; C) animal control; D) monitoring and reporting; E) biodiversity enhancement; F) landscape level linkages. iv) the use of restoration planting techniques to: A) improve native species diversity; B) mimic native succession; C) accelerate succession; D) achieve self-sustaining, successional native ecosystems; and/or E) restore ecological linkages, buffers and corridors. g) The required offsetting or compensation activities must be managed, where appropriate, in accordance with the management framework set out in the Ecological Management Plan. h) The Requiring Authority must not submit a finalised Ecological Management Plan for certification under Condition 3, or as part of an Outline Plan under Condition 9, until regional resource consents necessary to provide for the construction of Project have been granted and are beyond challenge (in respect of ecological matters).	
25	**At risk or threatened flora and fauna discovery protocol** a) In the event of discovery or any 'At-Risk' or 'Threatened' flora or fauna (as defined by the Department of Conservation's New Zealand Threat Classification System) within the Designation that is not specifically addressed by Conditions 20, 21, 22, 23 or 24, the Requiring Authority must determine a course of action: i) Based on the advice of an independent, suitably qualified and experienced ecologist; ii) With reference to the Ecological Management Plan framework; and iii) Taking into account the outcomes of any consultation the Project Iwi Partners and the Department of Conservation. The Requiring Authority must provide written advice to the Responsible Officer(s) setting out the course of action determined in accordance with clause (a).	Section 3 Section 6-11

Table 1.3: Resource Consent conditions relevant to this EMP [Placeholder]

Condition No.	Condition	Relevant EMP Section

2 Ecological values and effects of the Project

2.1 Summary of ecological values

The Ecological values of the Project footprint and immediate surrounds are described in detail in the 'regional consenting' reports listed in Section 1.4.1 and are summarised here.

The effects of the Project are based on the potential habitat removal and modification associated with the proposed road alignment and all associated temporary and permanent infrastructure, including a construction buffer (setbacks from the physical work needed to allow for all construction activities and access), henceforth referred to as the "Project footprint".

The 195 ha Project footprint traverses three ecological districts (ED): Manawatū Plains, Manawatū Gorge North and Woodville ED. Prior to human modification, it is predicted that the area would have been covered in podocarp-hardwood forest types with kahikatea-dominated swamp forest on the alluvial flats (Leathwick et al., 2004). The Project footprint occurs within a predominately agricultural landscape dominated by grazed pastureland and exotic-dominated plantation forests or exotic shrublands (e.g. gorse and broom). However, the Project footprint does include 11.82 ha of indigenous forest and shrublands and a number of small wetlands totalling 4.97 ha.[1] These terrestrial and wetland habitat types have been further split into 12 vegetation/habitat types and include or potentially include a number of nationally 'Threatened' and 'At Risk' species. The Project footprint is largely but not entirely within the proposed designation corridor for the Project.

The vegetation within the Project footprint has the potential to support multiple indigenous fauna groups. Notable species identified within the Project ~~designation~~footprint include: kārearea (New Zealand falcon), New Zealand pipit ~~and~~, whitehead and the moth *Meterana grandiosa*. In addition to the above, cryptic wetland birds (Australasian bittern, spotless and marsh crakes) and several 'Threatened' and 'At Risk' lizard and invertebrate species have been previously recorded in the wider landscape and may be present. The Project footprint also traverses the Manawatū River which is a known nesting and foraging habitat for banded ('Nationally Vulnerable') and black-fronted dotterels ('Naturally Uncommon') and black-billed gulls ('Nationally Critical').

Table 2.1 below outlines the key ecosystem types in the Project footprint and the associated ecological values; Figure 2.1 outlines the Project footprint and surrounds, including streams, QEII Covenants and the Manawatū Gorge Scenic Reserve.

[1] These figures include terrestrial and wetland habitat impacts associated with enabling works necessary for the Project.

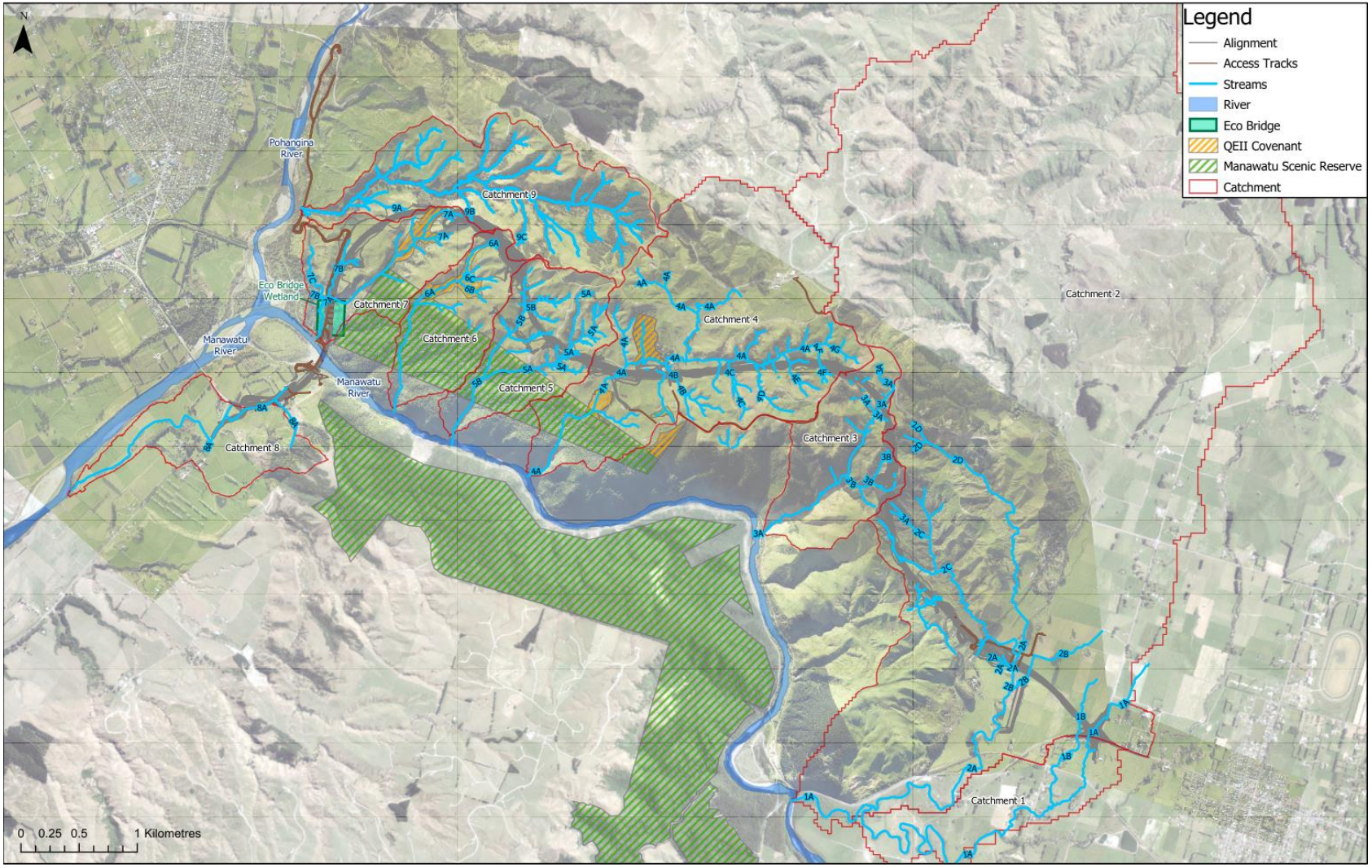


Figure 2.1: Aerial plan of the Project footprint and surrounds, showing catchments and streams, QEII covenants, Manawatū Gorge Scenic Reserve and the Eco-bridge (BR03)

Table 2.1: Ecosystem types and associated ecological values

Ecosystem types	Area scheduled for removal within the Project footprint (ha)	Ecological value[2]	Assessment of significance as per Horizons One Plan Policy 13-5	Schedule F classification (if available)[3][4]
Old-growth forest (alluvial)	0.1	**Very High**	Significant	Threatened
Old-growth forest (hill country)	0.85	**Very High**	Significant	Threatened
Secondary broadleaved forests with old-growth signatures	0.25	**Very High**	Significant	Threatened
Old-growth treelands	0.13	**Moderate**	Significant	Threatened
Kānuka forests	1.3	**Moderate** (assuming the presence of At Risk - Declining fauna)	Significant	Threatened
Advanced secondary broadleaved forest	0.04	**Very High**	Not significant	Not Threatened
Secondary broadleaved forests and scrublands	6.71	**Moderate**	Not significant	n/a
Mānuka, kānuka shrublands	2.11	**Moderate**	Not significant	Not threatened
Divaricating shrublands	0.33	**Moderate** (assuming presence of At Risk - Relict invertebrates)	Not significant	Not threatened
Raupō-dominated seepage wetlands (high value)	0.11	**High**	Significant	Rare
Indigenous-dominated seepage wetlands (moderate value)	0.44	~~**High**~~**Moderate**	Significant	Rare
Pasture wetlands, dominated by exotic species or the common native rush *Juncus edgariae* (low value)	4.42	**Moderate**	Exotic dominated: Not significant Native dominated: Significant	Native dominated: Rare

Across the alignment, 194 reaches of stream have been assessed over nine catchments (refer Drawing Set in Volume 3, TAT-3-DG-E-4141-7). For the most part, the streams have been subject to some agricultural land use and consequently have degraded riparian margins and stream banks resulting from stock access and inputs of nutrients and fine sediments.

Most of the stream catchments are short and steep, with un-vegetated headwaters, modified through agricultural land use. The lower reaches of these sub-catchments are within the Manawatū Gorge Scenic

[2] The ecological values have been determined using the Ecological Impact Assessment guidelines (EcIAG) for use in New Zealand: terrestrial and freshwater ecosystems (prepared by the Environment Institute of Australia and New Zealand (EIANZ) in 2018. For further information on the application of the guidelines for this Project refer to Technical Assessment F – Terrestrial Ecology.
[3] Does not include Schedule F classification for Exotic-dominated wetlands and lakes and lagoons and their margins.
[4] Assuming conditions outlined in Table F.2 (Schedule F) do not result in exclusions – see TAT-3-DG-E-4131 to 4137 Terrestrial Ecosystem Plans for full breakdown of Schedule F classifications on site.

Reserve (MGSR) and of markedly higher quality. QEII open space covenants over areas of bush within catchment 7, 6 and 4 are also of high quality and effects within these are, for the most part, avoided.

Catchments 1 and 8 are highly modified through agricultural land use and the ecological values reflect this degradation. Catchment 5 is of surprisingly good quality reflected in good SEV scores and macroinvertebrate indices. Much of the Project footprint interacts with highly modified, degraded stream systems, however there are isolated areas of better aquatic values.

2.2 Summary of ecological effects

Through the design process, the Alliance has strived to reduce the magnitude of the ecological effects compared to what was presented during the NoR hearing. This is described in detail in Section 2.3.

The actual and potential ecological effects of the Project on ecology are summarised as follows; refer to the specific management plans within this EMP for more detail:

Effects on terrestrial vegetation and habitats:	**Effects on terrestrial fauna:**

• Clearance or modification of indigenous vegetation and habitats;
• Habitat fragmentation and isolation; and
• Edge effects on retained vegetation and habitats; Creation of new edges resulting in a shift in microclimate condition. The quality of remaining habitat along these new edges may be degraded as a result of:
• Increased exposure to light and wind;
• Increased incursions from pest plants and animals; ~~and~~
• Dust deposition; and.
• Sediment runoff to wetlands and watercourses that may affect the quality of wetland habitat.
	• Injury or mortality during vegetation clearance and earthworks;
	• Disturbance during critical nesting periods (birds);
	• Permanent loss of habitats; and
	• Modification of habitats in the form of:
	  • increased fragmentation and isolation due to reduced habitat connectivity;
	  • creation of edge effects and consequential effects to composition, structure and food sources in retained habitats; and
	  • invasions and corresponding impacts of non-native plant and animal species.

Effects on freshwater habitats:	**Effects on freshwater fauna:**
• Removal of vegetation can expose soil making it more prone to erosion, resulting in increased sedimentation into wetlands (and streams); • Changes to hydrology; • Modification and loss of stream ecological function and habitat area;	• Injury or mortality during vegetation clearance and earthworks; • Effects on fish passage; • Water quality effects;

2.3 General approach and guiding principles of effects management

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.

A range of measures to avoid, remedy or mitigate adverse effects have been applied (with many of those measures detailed in this EMP~~)).~~ However, it is not possible to avoid, minimise or fully mitigate the net residual ecological effects within the Project footprint. ~~Significant~~Residual ecological effects created by the construction and operation of the Project will ~~need to~~ be offset or compensated for. The approach to offset and compensation has been that offset is preferable, and compensation should only be used after appropriate offset measures have been applied.

The approach to addressing effects, and in particular to offsetting and compensation, has been developed by reference to the Horizons One Plan, and to the document 'Biodiversity Offsetting Under the Resource Management Act 2018' (BOURMA) (Maseyk *et al*., 2018). BOURMA is nationally recognised and applied throughout New Zealand and is referenced in the Designation Conditions.

~~BOUMRA~~BOURMA defines biodiversity offsetting as "*a measurable conservation outcome resulting from actions designed to compensate for residual, adverse biodiversity effects arising from activities after appropriate avoidance, remediation, and mitigation measures have been applied. The goal of a biodiversity offset is to achieve no-net-loss, and preferably a net-gain, of indigenous biodiversity values*"; it also sets out eleven principles of biodiversity offsetting.

The Designation Conditions define compensation as meaning "*positive actions (excluding biodiversity offsets) to compensate for residual adverse biodiversity effects arising from activities after all appropriate avoidance, remediation, mitigation and biodiversity offset measures have been applied*".

2.4 Avoidance of effects

The nature and extent of potential adverse ecological effects associated with the Project 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 (refer to Volume Two: Design and Construction Report (DCR): TAT-0-DM-06001-CO-RP-0001). The assessment of effects of the various options played an important part in route selection. The options assessment process has meant routes affecting MGSR have been avoided.

Subsequently, significant alterations to the Project design have occurred to minimise the likely effects. These include:

- Lengthening the viaduct across the Western Rise (BR03) and location of bridge piers to avoid old-growth swamp maire and to minimise impacts on the high value raupō wetland CH 4000 - CH 4200;
- Shifting the alignment further north between CH 5400 – CH 6000 so the road traverses the northern edge of the Western QEII covenant rather than the middle reaches of the gully. This shift, referred to as the 'Northern Alignment' reduces the area of forest directly impacted and also avoids severance of the western QEII gully.
- The batters on the alignment traversing the Western QEII covenant have also been steepened to further reduce encroachment into this high value habitat.
- Shifting the alignment further north between CH 6000 - CH 6600 to avoid severance of the eastern QEII gully and significantly reducing the extent of impact on this ecosystem.
- Reduction in the physical extent of impact on the old growth treeland containing ramarama (CH 5700 - CH 5800) through the reshaping of stormwater wetland 5.
- One of the proposed spoil sites has been moved, resulting in avoidance of 89% of the divaricating shrubland habitat mapped in the Project area compared to what was proposed during the NoR;
- Terrestrial effects envelopes agreed during the NoR process have been adhered to so as to avoid additional impact on high values habitats not envisioned during the NoR process;
- Introduction of construction techniques to reduce effects. For example, BR03 mentioned above has been designed in a way that will allow it to be constructed from the staging running adjacent to the alignment, 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;

- 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; and
- A spoil site selection process was undertaken to determine the preferred location for spoil sites (outlined in Appendix C in Volume Two: DCR, TAT-0-CP-06001-CO-RP-0002), including consideration of ecological impacts.

- Further to the above, this EMP sets out further management actions to avoid and minimise adverse effects during construction and operation including:
- Designing a planting mix adjacent to the carriageway to reduce likelihood of bird mortality through vehicle collision;
- 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; and
- Having Project Ecologists and Cultural Monitoring Advisors on site to advise the construction teams and recover important flora and fauna, when vegetation is being cleared.

2.5 Minimisation of effects

Effects minimisation will be implemented 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 quickly. These measures are detailed in in later ~~chapters~~sections in the EMP, and in other management plans, but broadly include:

- Vegetation clearance protocols to be implemented to manage the potential effects of run off from cleared vegetation;
- Staged approach to earthworks and sediment and erosion controls to be consistent with GD05: Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (Leersnyder et al., 2018);
- Searching for native bird nests prior to vegetation removal to minimise the likelihood of eggs and unfledged chicks being harmed when trees are felled;
- Annual long-tailed bat surveys and a defined management escalation process if bats are recorded in the area. The escalation process entails the implementation of the bat vegetation removal protocol to minimise the likelihood of bats being harmed when trees are felled;
- Design of culverts for fish passage (where applicable);
- Stormwater management approach to include swales and wetlands designed to ~~NZTA~~Transport Agency standards.
- Salvage and relocation of ‘Threatened’, ‘At Risk’ or otherwise legally protected native lizards, invertebrates and fish from the Project footprint;
- Removal and stockpiling of topsoil from vegetated areas for use in replanting areas;
- Removal and stockpiling of coarse woody debris and felled logs for habitat enrichment in replanting areas and in-stream habitat enhancement;
- Translocation of nest epiphytes from the area of old-growth forest (hill country) scheduled for removal onto trees in adjacent forest; and
- Stream diversion design to mimic existing stream habitats, comprising three types (Type 1 Lowland Stream, Type 2 Steep Stream and Type 3 Intermittent Stream~~); and~~).

2.6 Offsetting and compensation for residual effects on ecology

Following efforts to avoid or mitigate effects, the Project is still expected to result in the loss of 16.79 ha of indigenous dominated forest shrublands and wetlands and associated flora and fauna, as well as impacts on 13.65 km intermittent and permanent streams. Offset and compensation for residual effects is outlined below, and a summary map is presented in the Drawing Set in Volume 3, TAT-3-DG-E-4150, TAT-3-DG-E-4161-2.

2.6.1 Terrestrial offset and compensation ~~model~~models

The quantum of habitat restoration and enhancement activities for addressing residual terrestrial effects was determined through application of a Biodiversity Offset Accounting Model (Maseyk et al., 2016) and a Biodiversity Compensation Model (Tonkin & Taylor Ltd, 2019). The Models are a transparent accountancy framework in order to determine an appropriate offset or compensation which achieves a Net Gain (NG) in Net Present Biodiversity Value (NPBV). The ~~Model has~~Models have been constructed for ecosystem types and terrestrial fauna species as described in detail in the resource consent document Technical Assessment G - Terrestrial Ecology Offset and Compensation Response.

In summary, the offset and compensation response addresses' residual ecological effects in order to achieve a net biodiversity gain. The actions proposed are:

- Revegetation of 52.2 ha to reconnect a mosaic of existing vegetation remnants, comprising:
  - 45.6 ha terrestrial revegetation; and
  - 6.6 ha wetland revegetation (~~including~~plus 10 m wetland buffer planting);
- Retirement of 48.3 ha of existing native bush (and 0.4 ha of existing wetland);
- Restoration and habitat enhancement measures within those planted and retirement areas including the exclusion of livestock and the direct transfer of forest resources;
- Intensive pest management over approximately 300 ha of the NMGSR and adjacent landholdings, 48.3 ha of bush retirement and 45.6 ha of forest habitat type restoration areas ~~for a 10-year period; and~~, including:
  - Annual control of rats, mustelids, possums~~,~~, rabbit and hare for 10-year period; and
  - Annual deer control for 35 years; and
- Performance standards and targeted outcome monitoring apply in respect of these measures.

The revegetation and retirement measures proposed ~~is~~are intended to be undertaken within the locations identified (refer Drawing Set in Volume 3, TAT-3-DG-E-4150, TAT-3-DG-E-4161-2) with similar underlying geology, soil characteristics and wind protection from surrounding vegetation. It is predicted that the ecosystem succession trajectory will result in a similar community assemblage to what is being impacted within a 35-year period due to restorative plantings be undertaken within natural non engineered soils.

2.6.2 Freshwater offset

Residual adverse effects resulting from the culverting and diversion of streams will be addressed by additional measures aimed at achieving no net loss of ecological function.

The SEV method has been used to quantify the enhancement measures required to achieve no net loss of ecological function by assessing the ecological gains resulting from the creation of new stream habitat through diversions and enhancement of existing, degraded headwater catchments.

Impacts on 13.~~65~~ 207 km intermittent and permanent stream will be addressed through creation of ~~8~~ 6.021 km new stream diversion channel and an indicatively modelled ~~23.4~~34.3 km / ~~10,137~~ 17,386 m^2 streambed area offset enhancement planting. ~~Two~~Four offset sites have been identified ~~for modelling~~

~~purposes, with the majority of modelled stream~~as probable offset ~~intended to be located in the headwaters of the Mangamanaia Stream catchment (on the south eastern side of the Ruahine Ranges) (~~sites as follows (also refer Drawing Set in Volume 3, TAT-3-DG-E-4150, TAT-3-DG-E-4161-2~~). ~~):

- Horizons Farm Limited (“Ratahiwi Farm”) in the upper Mangamanaia catchment, with a small amount in the upper Mangapapa catchment;
- Sproull Farm (“Sproull Farm”), along the Manawatū River;
- Wharite-Beagley Farm ("Beagley Farm") in the upper Mangapapa catchment; and
- Massey Tuapaka Farm ("Tuapaka Farm") along the Manawatū River.

Riparian enhancement plantings will consist of a mix of indigenous riparian margin sedges, shrubs and trees. Fencing from stock as well as permanent legal protection will accompany the planting measures. 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.

During the construction process efforts will focus on further reducing effects on streams. Conversations with landowners are ongoing to finalise the location and ~~additional sites may be identified which provide equivalent ecological benefit. Accordingly, the~~extent of available streams for restoration, and to secure the necessary streams for restoration activities. The final amount of stream offset required will be calibrated to reflect the effects of the Project and the ecological gains that are achieved.

3 Vegetation Clearance Management Plan

3.1 Introduction

This section outlines the management processes to avoid, remedy, minimise or mitigate adverse effects on vegetation and habitat values during construction as a result of the Project. The Project is expected to result in the loss of 16.79 ha of mature and regenerating native forest, divaricating scrublands and wetland habitats. Habitats classified as 'Threatened' or 'Rare' within Schedule F of the One Plan, as well as ~~a number of~~several nationally 'At Risk' and 'Threatened' plant species are present within the Project footprint.

Management actions recommended in order to avoid, remedy and minimise effects on vegetation include design measures, vegetation mapping, vegetation clearance protocols, vegetation salvage and eco-sourced replacement planting. All proposed management actions outlined in this report shall take into account the outcomes of consultations with the DOC and the Project Iwi Partners.

The following table sets out the purpose, specific objectives, performance measures and monitoring relevant to vegetation management.

Purpose	This section of the EMP outlines how vegetation management during the Project meets the requirements of Conditions 24 and 25 of the ~~draft NoR~~confirmed designation Conditions~~, date 15 October.~~ (March 2020). This section will be updated to incorporate any requirements of Regional Council resource consents.
Specific Objectives	[Placeholder – to be updated]
Performance Outcomes	[Placeholder – to be updated]
Monitoring	[Placeholder – to be updated]

3.1.1 Baseline vegetation ecology survey results

All information pertaining to vegetation clearance management, and habitat restoration and enhancement measures for addressing residual effects is included in the reports listed in Section 1.4.1.

Baseline vegetation surveys were undertaken in October and November 2019 and May 2020 to inform the offset and compensation models to determine the quantum of offset planting required for each habitat type being lost. The vegetation types identified, their ecological value, and their threat classification under the One Plan are presented in Section 2.1 above.

Furthermore, a number of 'Threatened' and 'At Risk' species were identified during vegetation surveys, for which specific management actions are required to address adverse effects. These species and details of their management are in subsequent sections of this plan.

3.2 Responsibilities and competencies

Delivery of, and compliance with, the Vegetation Clearance Management Plan (VCMP) will be the responsibility of the Environmental Manager who will liaise with the Project Ecologist – Terrestrial and specialist ecologists as required.

It will be important for the construction contractor to read and understand this section so that the protocols are adhered to correctly during construction works. The responsibilities of the construction contractor include, but are not limited to:

- Reading and understanding the VCMP;
- Facilitating a project start-up meeting with the Project Ecologist - Terrestrial and the Site Manager before vegetation clearance commences for each stage of the Project. The objective of this meeting will be to determine habitats scheduled for clearance each season, enabling forward planning and avoiding delays in the construction schedule;
- Contacting the Project Ecologist - Terrestrial and Cultural Monitoring Advisor a minimum of 3 weeks before any of the areas outlined in an Ecological Constraints Maps [to be developed prior to construction] are scheduled for clearance;
- Inviting Project iwi partners to participate in and support any vegetation or habitat salvaging and relocation as deemed necessary, to ensure appropriate exercise of kaitiakitanga responsibilities and to ensure that cultural concerns are addressed;
- Maintaining clear lines of communication with the Project Ecologist - Terrestrial regarding changes in the works schedule; and,
- Briefing new personnel about the contractor's responsibilities under this plan.

All personnel working on site are responsible for alerting the Project Ecologist – Terrestrial and the site manager in the discovery of any 'At Risk' or 'Threatened' flora and fauna not otherwise identified in this management plan.

The Environmental Manager is responsible for reporting the discovery of 'At Risk' or 'Threatened' flora and fauna to the DOC Local Area Manager and the Cultural Monitoring Advisor and for maintaining a database with an incident register and file log of actions taken for each discovery of a Threatened' or 'At Risk' fauna.

3.2.1 Summary of ecological values, effects on vegetation and effects management

3.2.2 Vegetation values

Habitats of ecological value present within the Project footprint are described in Section 2 above and will be outlined in ~~an~~ Ecological Constraints Maps [to be developed prior to construction]. The site consists predominantly of farmland, however native vegetation and wetlands are present in fragments within the Designation.

~~A number of~~ 'At Risk' and 'Threatened' plant species are present in and around the Project footprint, outlined in Table 3-1. These include 'Threatened – Nationally Critical' ramarama, rōhutu and swamp maire, as well as giant maidenhair ('At Risk – Relict'), which is now restricted in the region to the Manawatū Gorge and Woodville areas, having previously had a much wider distribution.

Table 3-1 Threatened plant species observed within the Project footprint and wider area

Common name	Species name	Threat status (De Lange et al., 2017)
Giant maidenhair	*Adiantum formosum*	At Risk - Relict
Mānuka	*Leptospermum scoparium*	At Risk - Declining
Kānuka	*Kunzea robusta*	Threatened – Nationally Vulnerable
Akatea	*Metrosideros perforata*	Threatened – Nationally Vulnerable
White rātā	*Metrosideros diffusa*	Threatened – Nationally Vulnerable
Climbing rātā	*Metrosideros fulgens*	Threatened – Nationally Vulnerable

Common name	Species name	Threat status (De Lange et al., 2017)
Rātā	*Metrosideros colensoi*	Threatened – Nationally Vulnerable
Ramarama	*Lophomyrtus bullata*	Threatened – Nationally Critical
Rohutu	*Lophomyrtus obcordata*	Threatened – Nationally Critical
Swamp maire	*Syzigium maire*	Threatened – Nationally Critical

3.2.3 Effects on vegetation

The Project is expected to result in the loss of 16.79 ha of mature and regenerating native forest, divaricating scrublands and wetland habitats.

A summary of actual and potential impacts of the Project on vegetation include:

- Vegetation and habitat loss through vegetation clearance and earthworks;
- Creation of new edge microclimates, altering the composition and health of adjacent vegetation (edge effects), which may affect habitat suitability for flora (and fauna);
- Changes in hydrology of wetland areas as a result of construction which may affect the habitat suitability of these wetland habitats; and
- Uncontrolled discharge of sediment and/or wood waste leachate to aquatic receiving environments that may affect the quality of wetland (and stream) habitats.

3.3 Effects management

A range of measures will be undertaken during construction to avoid and minimise adverse effects on vegetation, including on 'Threatened', 'At Risk' or 'Rare' ecosystems and species. These include:

- Vegetation clearance protocols (Section 3.3.1);
- Addressing the loss of 'Threatened' plant species (Section 3.3.2)
- Vegetation salvaging, including removal and relocation of forest resources (Section 3.3.3 and 3.3.4); and
- Mulching and storage of wood and soil material (Section 3.3.4).

Removal of vegetation can expose soil, making it more prone to erosion, resulting in increased sedimentation into wetlands (and streams). 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.

Prior to vegetation clearance, sediment control measures will be undertaken to avoid or minimise effects on wetland birds and aquatic species due to effects on water quality. Procedures for minimising the area and duration of soil exposure from vegetation clearance will be outlined in Site Specific Erosion and Sediment Control Plans (SSESCP).

Any adverse effects arising from vegetation clearance will be minimised by following 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).

Vegetation clearance will only commence after all pre-clearance management measures have been undertaken or are in place and these measures confirmed by the Project Ecologist - Terrestrial, Project Ecologist – Freshwater and the Cultural Monitoring Advisor.

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 (refer to Section 10 Freshwater Ecology Management Plan).

During vegetation clearance activities, construction methodology refinements, maintenance of physical delineation barriers and erosion and sediment control measures, as described within this VCMP, will be ongoing.

3.3.1 Vegetation clearance protocols

3.3.1.1 Appropriately experienced arborists

Within native regenerating and mature forest habitat types, vegetation removal will be undertaken by suitably experienced arborists to reduce tree damage[5] and to accommodate construction.

3.3.1.2 Minimisation of clearance extent

This vegetation clearance protocol applies only to old-growth forest and treelands in the chainages listed below:

- Old-growth forest (alluvial) – CH 4,000
- Old-growth forest (hill country) – CH 5,500-5,600
- Old-growth treelands – CH 6,500-6,600

Where construction requirements can be accommodated by the pruning of large trees, pruning will be undertaken instead of complete removal of trees.

This will be facilitated during the demarcation of the clearance extents. During the demarcation process, the Project Ecologist – Terrestrial (or designated suitably qualified ecologist) will walk the area with the Site Manager, Environmental Manager to ensure the clearance extent is within the boundaries [to be demarcated~~]~~. in Ecological Constraints Maps]. Where it is decided by the Project Ecologist – Terrestrial and suitably experienced arborist that pruning can be undertaken as opposed to felling, the boundary will be shifted to ensure the trunks of these trees sit outside of the clearance extent.

3.3.1.3 Demarcation of clearance extent

To ensure native vegetation outside of the areas marked in the Ecological Constraints Maps ~~–~~are not mistakenly removed or damaged, the extent of vegetation clearance will be clearly physically delineated. The boundaries will be delineated by temporary fencing such as the netting shown in Figure 3.1 below. Project arborists and all construction contractors will be informed that no vegetation will be removed outside of this boundary. Furthermore, no construction materials or waste will deposited into vegetation outside of the fencing.

Project arborists and construction contractors will also ensure that vegetation is felled into the Project footprint to minimise impacts on the remaining vegetation.

[5] Reduction to tree damage is in relation to adjoining trees outside the Project footprint.

Figure 3.1: Example of the type of temporary fencing that will be used to delineate the vegetation clearance boundaries.

3.3.1.4 ~~Restrictions~~Seasonal restrictions on vegetation clearance

Vegetation clearance should be undertaken during the earthworks season (1 October – 1 May) due to seasonal constraints for salvaging and relocating lizards and invertebrates.

Vegetation clearance should also be undertaken:

- Outside of peak bird breeding season to avoid and minimise potential direct mortality or injury to eggs, nesting chicks and fledglings (including on breeding whitehead (*Mohoua albicilla*~~).~~)). The peak bird breeding season is different for the different avifauna groups inhabiting various habitats across the Project. Consequently, the vegetation clearance constraints vary across habitats as outlined in Table 3.2~~Table 3.2.~~.
- ~~If~~In the event that some vegetation clearance ~~outside of the timeframes in Table 3.2 cannot be achieved~~is required during peak bird breeding season, refer to Section 8: Avifauna Management Plan for further additional management actions that will need to be implemented.

Additional to the bird breeding constraints, clearance of certain habitat types will also be limited to suitable weather as defined in Sections 6 (LiMP) and 7 ~~where~~(BMP) when lizards and bats are likely to be more active (and therefore more likely to be detected if present).

Refer to Table 3.2 below for specific seasonal vegetation restrictions for each fauna group.

Table 3.2: Seasonal vegetation clearance for each taxon group. Green cells = no constraints on vegetation clearance, orange cells = clearance allowed subject to management requirements, red cells = no vegetation clearance

Taxa		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Constraints
Lizards (see LiMP; Section 6)[1]														Vegetation clearance to occur between 1 October and 30 April when the weather is warmer and lizards are likely to be more active (and therefore more likely to be detected if present).
Bats (see BMP; Section 7)[2]											8			Vegetation clearance to occur between 1 October and 30 April when the weather is warmer and bats are likely to be more active (and therefore more likely to be detected if present).
Birds (see AMP; Section 8)	Forest birds (including whiteheads and kārearea)[3]	7								7	7	7	7	Vegetation clearance to occur outside of peak bird breeding season for native forest birds including whitehead (*Mohua albicilla*) to avoid and minimise potential direct mortality or injury to eggs, nesting chicks and fledglings. The peak breeding season is 1 September to 31 January. If clearance outside of this timeframe cannot be achieved, refer to Section 8 AMP for further additional management actions that will need to be implemented.
	Cryptic wetland birds[4]									7	7	7	7	Vegetation clearance to occur outside of peak bird breeding season for native wetland birds to avoid and minimise potential direct mortality or injury to eggs, nesting chicks and fledglings. The peak breeding season is 1 September to 31 December. If clearance outside of this timeframe cannot be achieved, refer to Section 8 AMP for further additional management actions that will need to be implemented.
	Braided river birds[5]													Habitat removal and construction disturbance to occur outside of bird breeding season for native braided river birds to avoid and minimise potential direct mortality

Taxa		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Constraints
														or injury to eggs, nesting chicks and fledglings. The breeding season is 1 July to 31 March. If clearance outside of this timeframe cannot be achieved, refer to Section 8 AMP for further additional management actions that will need to be implemented.
	New Zealand pipit (and pied stilt)[6]													Habitat removal to occur outside of bird breeding season for New Zealand pipit to avoid and minimise potential direct mortality or injury to eggs, nesting chicks and fledglings. The breeding season is 1 August to 31 March. If clearance outside of this timeframe cannot be achieved, refer to Section 8 AMP for further additional management actions that will need to be implemented.
Invertebrates (see TIMP; Section 9)														[PLACEHOLDER] This section will be updated based on the outcome of baseline invertebrate surveys.

[1] Constraints limited to specified vegetation types, refer to Table 6-2~~Table 6.2~~ (noting that measures have been put in place to limit the extent of rank grass available in the improved pasture, Section 8.3.5).

[2] Constraints limited to specific vegetation types, refer to Table 7.3~~Table 7.3~~ – total area 6.26 ha.

[3] Limited to specific vegetation types, refer to section 8.3.2.

[4] Limited to specific vegetation types, refer to section 8.3.4.

[5] Limited to habitat disturbance in the Manawatū riverbed.

[6] Limited to specific vegetation types, refer to section 8.3.5.

[7] Clearance limited to < 100 m^2 which will be subject to management requirements, refer to section 8.3.1.

[8] Vegetation clearance restricted until bat surveys completed by the Project Ecologist – Terrestrial.

3.3.1.5 Minimising impacts on adjacent vegetation

In addition to the above, the methodology to further reduce effects during vegetation clearance for the removal and pruning of vegetation includes:

Vegetation will be directionally felled away from the physically marked boundary (refer to Section 3.3.1.3), to prevent vegetation damage to the vegetation immediately adjacent to the Project footprint, 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 arborists;

Vegetation clearance/habitat loss activities in old growth forest (alluvial and hill country), raupō-dominated seepage wetlands (high value), and indigenous-dominated seepage wetlands (moderate value) will be overseen by the Project Ecologist – Terrestrial (or designated suitably qualified ecologist) and Cultural Monitoring Advisor. Note this includes vegetation clearance within 30 m of the wetland vegetation types. Also note that ecologists and ~~cultural monitors~~Cultural Monitoring Advisors / kaitiaki will need to be present for the clearance of other vegetation types as required for fauna management in other sections of this EMP.

3.3.2 Addressing the loss of threatened plant species

The Project footprint and wider area contains a number of 'At Risk' and 'Threatened' plants (Table 3-1). Of note, ramarama, rōhutu and swamp maire are classified as 'Threatened – Nationally Critical' due to the threat myrtle rust (*Austropuccinia psidii*) poses to these species. Due to their high threat status, unavoidable loss of these individuals will incur additional offset planting (NoR Condition 24 and [draft] consent condition [EC1]), including:

- For each ramarama or rōhutu individual above 15 cm in height that is lost as a result of enabling or construction works, a total of 100 ramarama seedlings shall be planted as replacement; and
- Any existing swamp maire tree which has been affected by pruning of more than 10% of live growth shall be replaced at a ratio of 1:100, while any existing swamp maire tree that dies as a result of enabling or construction works activities shall be replaced at a ratio of 1:200.

Addressing the loss of ramarama, rōhutu and swamp maire is outlined in the ~~REMP~~REMMP (Section 12.2.1.3).

Giant maidenhair (*Adiantum formosum*) is present on floodplains adjacent to the Manawatū River. It is now only found within the Manawatū Gorge (Ch 3,800 – 3,900) and around Woodville, and a translocation plan is outlined in Section 3.3.3.2. The death of any translocated individuals will be replaced at a ratio of 1:15 (refer to Section 12; ~~REMP~~REMMP).

Loss of mānuka and kānuka species will be addressed through the offset ~~model calculations~~actions for these ecosystem types. ~~With the notable exception of giant maidenhair, and swamp maire (which will not be affected), specific~~Specific management will not be undertaken as these species are common in the landscape and their threat status has been elevated due to the potential impacts of Mrytle Rust.

Metrosideros vines are expected to naturally reinstate within established replacement plantings– there are abundant seed sources close to the footprint (e.g. Manawatū Gorge Scenic Reserve).

3.3.3 Vegetation and habitat salvaging

3.3.3.1 Salvage of nest epiphytes

This vegetation salvaging action applies only to clearance within the vegetation types listed below[6]:

- Old-growth forest (alluvial) – Ch 4000
- Old-growth forest (hill country) – Ch 5500-5,600
- Old-growth treelands – Ch 6500-6600

Prior to vegetation clearance commencing in the vegetation types, the Project Ecologist – Terrestrial (or designated suitably qualified ecologist) will undertake a ground-based survey using binoculars to identify any trees scheduled for removal that support nest epiphytes (*Astelia* species). Any such trees will be clearly demarcated (e.g. with flagging tape or spray paint).

During clearance, the supervising Project Ecologist – Terrestrial (or designated suitably qualified ecologist) will direct the arborists to fell these trees in such a way that will minimise damage to the epiphytes. Immediately after felling, these epiphytes will be removed from the trees and temporarily placed on the ground, under the canopy of adjacent vegetation but outside of the clearance extent.

The nest epiphytes will be relocated into mature trees in the old growth forest (alluvial) offset area (refer Drawing Set in Volume 3, TAT-3-DG-E-4131-7) within two weeks. The nest epiphytes will be placed in forks between large branches and the trunk of recipient trees by an arborist (or qualified tree climber) under the supervision of the Project Ecologist – Terrestrial (or designated suitably qualified ecologist) and Cultural Monitoring Advisor (if requested). They will be secured in place with biodegradable material such as coconut fibre filled with organic material such as sphagnum moss. The recipient trees will be clearly marked and GPS located and the survival and health of the plants will be documented one year following translocation.

The above measures will also be undertaken in the event that any 'Threatened' epiphytes are observed during clearance.

3.3.3.2 Salvage of giant maidenhair fern

Giant maidenhair (*Adiantum formosum*) is classified as 'At Risk – Relict' as it is believed to now be restricted to the Manawatū Gorge and Woodville areas. During site investigations giant maidenhair were recorded in the secondary broadleaved forests and scrubland located at CH 3900 – CH 4400.

This species is easily grown from rooted pieces and consequently salvage and relocation to adjacent protected habitat is recommended.

Prior to vegetation clearance commencing in the secondary broadleaved forests and scrubland located at CH 3900 – CH 4400, the Project Ecologist – Terrestrial (or designated suitably qualified ecologist) will undertake a survey in this area and identify all giant maidenhair occurring within the area scheduled for clearance. Each individual (or clump) identified will be marked (e.g. with flagging tape) with an individual ID. Habitat notes and photos of each individual (or clump) will be recorded and used to identify appropriate micro-siting of the translocated plants prior to clearance. Translocation sites will be marked using a stake labelled with the individual (or clump) ID prior to translocation so that plants can be translocated to the recipient site as efficiently as possible.

[6] Nest epiphytes are only associated with mature / old-growth vegetation types.

The recipient site will be the closest area of secondary broadleaved forests and scrubland that is scheduled for protection under the ~~REMP~~REMMP (refer to Section 12), providing appropriate microsites[7] are identified.

Prior to vegetation clearance commencing, the Project Ecologist - Terrestrial will relocate maidenhair ferns to the pre-determined translocation site.

Photos will also be taken of the relocation site and submitted with the monitoring report. The relocation areas will be clearly marked and GPS located, and the survival and health of the plants will be documented one year following translocation.

If giant maidenhair fern are accidentally discovered outside of CH3900 - CH4400 (e.g. during pre-clearance fauna salvage), the above protocols will also apply before vegetation clearance commences in the area.

3.3.3.3 Salvage of coarse woody debris, felled vegetation and top soil

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 are sites for plant regeneration.

Large fallen and decaying logs and as much vegetation as reasonably practicable shall remain *in situ* until it can be relocated to offset sites. Suitable areas for placement of vegetation will be physically delineated prior to vegetation clearance occurring. Relocated vegetation may be placed within planting sites, or within existing forests with sparse understorey. Vegetation relocation will be undertaken under the supervision of the Project Ecologist – Terrestrial (or designated suitably qualified ecologist) to aid the micro-siting of habitat enhancement features, and to minimise unintended injury to ground dwelling fauna in the relocation sites.

To minimise harm or injury to nationally 'At Risk' geckos and to the extent feasible, felled mature or regenerating native vegetation will be de-limbed (main trunk only) and stockpiled adjacent to remaining mature or regenerating forest for a minimum of ~~1 month~~4 weeks prior to mulching (refer to Section 6.6 in the LiMP). This will enable geckos not detected during salvaging operations to disperse from felled vegetation into surrounding habitats.

However, where it is not possible to stockpile felled native vegetation, this material will be mulched and removed or 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, may also be used for sediment control as required.

Vegetation left *in~~-~~ situ* will be placed into small and compact windrows within defined areas. Windrows will not be placed in locations where material could move and enter streams or wetlands. 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 50 cm ~~diameter~~dbh or more than 5 m long) will be cut into manageable sections.

Priority plant material for leaving *in~~-~~ situ* includes:

- Large (>50 cm diameter) fallen (rotting) logs — these offer suitable habitat for invertebrates and lizards;

[7] A microsite describes a pocket within an environment with unique features, conditions or characteristics.

- Logs to be cut into discs (20-50 mm thick) for deployment into the lizard relocation site to provide refugia for lizards and lizard prey (refer to Section 6.5.2); and
- Large tree trunks (>~~50cm~~50 cm diameter), especially any which are partially rotten and contain cavities. These should be cut up into manageable portions (3 – 5 m sections).

If required, planting of suitable species will also occur within gaps and on margins to hasten regeneration. ~~A minimum of 20 m / ha of cut up stockpiled logs (> 60 cm DBH) will be deployed into terrestrial and wetland offset sites.~~

3.3.4 Setting aside wood for stream restoration

Large wood objects are an important component of natural stream channels, providing habitat and food for insects, kōura, fish and birds. In low gradient streams with fine sediment substrate, large wood is an important stable microhabitat. Large wood is usually defined as >100 mm diameter and >1 m 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 tree tops which cover a range of sizes in diameter classes of 150-300 mm, 300-600 mm and >600 mm. Some lengths should be long, i.e. about 6 m. The number of logs required in each size class will be finalised as part of the detailed design, to allow for 1 to 5 pieces of wood per 20 m of stream length. The ratio of each log size will be determined based on the type and size of the streams being created, where for example smaller logs are more appropriate in narrower, intermittent streams.

The harvest of wood for in-stream work will focus on denser woods such as tawa, ~~hinau~~hīnau, and maire (*Nestegis spp.*). Additionally, large mānuka and kānuka (approximately 100-200 mm diameter, and >1.2 m long) will be harvested for in-stream enhancement.

3.3.5 Mulching and storage of wood and soil

Vegetation which is not left in-situ will be mulched on site. This process will result in mulch being distributed across the Project area. Forest duff and top soil layers will be harvested together and stored in windrows for site rehabilitation and selected ecological restoration use, such as offset planting areas. Larger trees not able to be mulched on-site will be felled and removed, with some being used for stream habitat restoration, for placement in restoration areas, or sediment and erosion control purposes.

Mulching trees can potentially result in mulch entering small streams, resulting in the smothering of stream habitat, and deoxygenation as green leaf and woody material decomposes. This may cause adverse effects on stream invertebrates and fish. To avoid this occurring, mulching will be undertaken in a manner that prevents mulch entering small streams. Where necessary, this will involve manually chipping into the back of a truck, removing any vegetation that falls within 10–20 m of a stream and mulching this at a suitable location.

Mulched wood and soil will be placed into stockpiles. Through this process the focus will be on removing the A (organic) and B (organic stained subsoil) soil horizons. Care will be taken to minimise the incorporation of subsoil with parent material layers.

Invasive weeds are likely to grow on soil stock piles, especially species which are currently known from the Project area such as broom (*Cytisus scoparius*), tradescantia (*Tradescantia flumenensis*), blackberry (*Rubus fruticosus agg.*) and gorse (*Ulex europaeus*). Wind dispersed species such as pampas grass (*Cortaderia selloana*) 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, as outlined in Section 5.3.3 ~~(refer to Horizons Regional Council, 2017).~~ Pest plant management.

3.4 Cultural use of significant trees

Harvesting and milling of native timber is administered by the Ministry of Primary Industries (MPI). An application for a milling statement under the Forests Act to enable timber to be utilised for cultural purposes will occur prior to vegetation removal as appropriate, following discussions with Project iwi partners. The application for a milling statement requires information about landownership, tree species, location, volume, proof of entitlement, and preferably photos of each tree.

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

4 Planting Establishment Management Plan

4.1 Introduction

This section sets out management requirements in respect of planting measures required to offset and compensate for residual effects of the Project on terrestrial, wetland and freshwater ecological values.

This Planting Establishment Management Plan (PEMP) should be read in conjunction with the Residual Effects Management Plan (~~REMP~~REMMP) (Section 12).

Management actions recommended include eco-sourced replacement planting, selection of appropriate plant species mixes and appropriate exclusion measures. All proposed management actions outlined in this PEMP shall take into account the outcomes of consultations with the Department of Conservation and the Project Iwi Partners.

~~The following table sets out the purpose, specific objectives, performance measures and monitoring relevant to this PEMP.~~

This section of the EMP outlines how planting management during the Project meets the requirements of Conditions 19 and 24 of the draft NoR Conditions, ~~date~~dated 15 October.

This section will be updated to incorporate any requirements of Regional Council resource consents

4.2 Responsibilities and competencies

Delivery of, and compliance with, the ~~Planting Establishment Management Plan~~PEMP will be the responsibility of the Environmental Manager who will liaise with the Project Ecologist – Terrestrial and specialist ecologists as required. Final sign-off of the PEMP will be the responsibility of the Project Ecologist – Terrestrial and the Project Landscape Architect.

It will be important for the lead contractor to read and understand the planting management requirements so that the protocols are adhered to correctly during construction works. The responsibilities of the construction contractor include but are not limited to:

- Reading and understanding the ~~Planting Establishment Management Plan~~PEMP;
- Ensuring the nursery providers adhere to relevant biosecurity protocols (Section Nursery requirements~~4.3.4)~~)
- Contacting the Project Ecologist - Terrestrial and Cultural Monitoring Advisor regarding planting management requirements otherwise not listed in this Section.

4.3 Vegetation type planting descriptions

A short description of each vegetation type for planting is provided below. These are grouped into ~~similar~~ broadly similar vegetation structural types (forest, wetland, and shrubland ~~in terms~~restoration targets of the 12 habitat types for which offset / compensation planting is required, and stream planting). ~~These descriptions start by describing the~~ The intended ~~final~~ restoration outcome for each vegetation type~~. This is what you should see when you visit the site~~ once the plantings have reached maturity (i.e. in 50~~ or ~~100 years~~ following planting. General information on site influences and the~~) is also described. The requirement for more specific vegetation establishment plans are also identified.

Performance measures are then set out for each group of vegetation types. These performance measures are based on outcomes to be achieved 1, 3, 5 and 10 years from planting (refer to Section 4.5).

To ensure low mortality of plantings, plantings will be established through a staged approach, consisting of a starting crop followed by enhancement plantings. For each terrestrial ecosystem type where planting is required, the mix of species shall be composed of three phases of planting:

1. Starting Crop: consisting of a nursery crop of early-successional, shade intolerant species for initial planting;
2. Enrichment understorey: consisting of shade-tolerant understorey or subcanopy species to be inter-planted once the 'Starting Crop' has established; and
3. Enrichment canopy: consisting of late-successional, shade tolerant canopy or emergent species, to be inter-planted once the 'Starting Crop' has reached 80% canopy cover (expected to take 5 years).

The starting crop species composition has been selected to be early successional species capable of surviving when planted immediately into pasture. They grow quickly and establish suitable conditions for enrichment plantings to commence. Preference is given to fast growing, drought tolerant species that grow well in full sun and potentially windy conditions. Species included within the starting crop composition will provide food for birds to encourage natural seed dispersal. The selection of plants will also consider factors such as frost risk and animal damage.

Enrichment plantings are shade-tolerant species which will be inter-planted once the starting crop species have created suitable environmental conditions for their survival. Many of the enrichment plantings will form the final climax community of the forest.

4.3.1 Forest planting

Intended restoration outcomes for forest plantings generally include a closed canopy layer with subcanopy and understorey layers successfully regenerating. Ground covers (e.g. *Oplismenus hirtellus subsp. imbecillis*) and ground ferns are expected to be present having naturally colonised through seed rain. Epiphytes and vines are expected to be established at 50-100 years, and late successional enhancement plantings maturing (e.g. tawa).

Pest plant presence is expected to be low or minimal due to initial control and established plantings are expected to be resilient to weed invasion due to the shading out of shade-intolerant weeds.

Pest mammal control will decrease seed predation, promoting natural regeneration, and enable palatable late successional species such as tawa to reach a height where they are no longer at risk from deer browse. Refer to the Pest Management Plan for further detail.

4.3.1.1 Intended Restoration Outcomes

Below is a brief description of the intended composition of the ecosystem types once they have reached maturity, noting that the majority of the ecosystem types being impacted are primary or secondary forest types and are not currently at a climax state. The management outlined in this plan is proposed for 10 years, while some ecosystem types below are likely to reach the outcomes within 10 years, other later-successional forest types will take longer to reach the state described below. The 10 years of management will ensure each revegetation area is on the trajectory to reaching the outcome(s) described below.

- *Old Growth Forest (Alluvial) Compensation.* ~~Swamp forest~~Forest canopy dominated by kahikatea and pukatea~~.~~ in areas with poor drainage. Tawa is common on the drier, better drained or raised areas. ~~Matai~~Mataī, rimu and ~~totara~~tōtara are present but restricted to areas of better-drained soils. ~~Titoki~~Tītoki are also ~~be~~ common.
- *Old Growth Forest (Hill Country) Compensation.* Forest dominated by ~~rimu,~~ tawa and kamahi~~.~~ ~~Hinau~~, with occasional mature rimu which are expected to eventually become emergent. Māhoe is expected to be common in the subcanopy, and hīnau, rewarewa ~~or mahoe are common. Rimu~~, miro and ~~totara are~~ tōtara will be present ~~with kahikatea and matai likely to be less common.~~but

uncommon. Common indigenous broadleaved species are also likely to be present in the understorey~~.~~ such as kawakawa and hangehange having colonised naturally. Ramarama and rohutu replacement plantings will be present in the understorey.

- *Old Growth Treelands Offset.* A closed canopy consisting of a range of medium sized broadleaved species such as karamu, ~~shining karamu, wine berry,~~wineberry, kaikomako and mahoe as well as ~~totara~~tōtara, tawa, rimu, ~~matai~~mataī and ~~hinau~~hīnau.

~~• *Broadleaved Forest Offset.* A closed canopy consisting of a range of medium sized broadleaved species as well as totara, tawa, rimu, matai and hinau.~~

- *Secondary Broadleaved Forest with Old Growth Signatures Offset*. A closed canopy consisting of a range of medium sized broadleaved species such as māhoe, as well as ~~totara~~tōtara, tawa, rimu, ~~matai~~mataī and ~~hinau~~hīnau.
- *Secondary Broadleaved Forest and ~~Scrublands~~Shrublands Offset.* A closed canopy consisting of a range of medium sized broadleaved species such as māhoe and lemonwood, as well as ~~totara~~tōtara, tawa, rimu, ~~matai and hinau. This forest type is patchy~~mataī and ~~interspersed with~~hīnau. Species assemblages will differ between ridgetops and gullies, and divaricating ~~species forming scrublands.~~shrubs are expected in the understorey and on the edges of this habitat type.
- *Advanced Secondary Broadleaved Forest Offset*. A closed canopy consisting of a range of medium sized broadleaved species such as māhoe as well as ~~totara~~tōtara, tawa, rimu, ~~matai~~mataī and ~~hinau~~hīnau.
- *Kānuka Forest Offset.* Kānuka forest or treelands are dominated by almost pure stands of well-developed kānuka. This habitat type is differentiated from kānuka scrub by size (greater than 4.5 m tall or 20 cm diameter measured at 1.4 metres above the ground). Mānuka and typical indigenous broadleaved species can also be present scattered through the canopy or understorey but will not be dominant.

4.3.1.2 Vegetation establishment plans

~~Vegetation~~To help ensure plantings are established in optimal microclimates to allow for fast growth and low mortality, vegetation establishment plans will be prepared ~~for groups of similar sites or larger individual sites, taking into account different~~. These will incorporate various site conditions~~,~~ such as frost risk, aspect, soil type, potential weed ~~issues etc.~~incursions and drainage. A wide range of different planting locations ~~are~~have been identified for forest plantings~~.~~ which will be established where it best suits their environmental tolerances.

~~The approach taken to~~ Forest planting establishment ~~on broad groups of~~will be focussed through three approaches which are:

- planting into pasture sites,
- planting into shrub and vine weed sites; and
- through forest ~~sites is set out below.~~interplanting.

4.3.1.2.1 Predominantly pasture sites

~~Starting crop species are chosen based on their presence as natural early succession species in the development of particular forest types. They have the ability to grow quickly and establish suitable conditions for enrichment planting to commence and for natural regeneration of species from the intended final forest type. Preference is given to fast growing, drought tolerant species that grow well in full sun and potentially windy conditions. Some species included with the~~ The starting crop ~~species~~ will ~~provide food for birds to help encourage natural seed spread as well.~~be planted immediately into pasture, with weeds and pest mammals controlled to ensure low mortality rates. ~~The selection of plants will also consider factors such as frost risk and animal damage.~~

Weed control will ~~need to~~ occur over ~~at least~~ the first ~~three~~five years after planting to help ensure good survival and growth and appropriate vegetation cover.

Stock will be excluded from these planting areas, and enhancement plantings will be established after year 3 when suitable growing conditions are expected to be available.

4.3.1.2.2 Shrub and vine weed sites

These are sites dominated by tree, shrub and vine weed species. ~~This may~~Pest plants include willow, blackberry, old mans beard, broom ~~etc~~and gorse. These sites ~~are likely to~~will require major mechanical and chemical weed control for between 1 and 3 years prior to planting. This site preparation stage will be critical to ~~success.~~planting establishment success and the projected forest trajectories.

An ecological approach to weed control will be undertaken, including consideration of:

- Identifying any existing native species that may be encouraged through selective control;
- Undertaking a range of ~~a~~ weed control and management activities to establish a new successional pathway that can be managed to establish the desired forest crop~~.~~;
- Ensuring removal of major weed seed burden and weed re-invasion sources.

Vegetation establishment plans for these areas will include detail of the approach to site preparation.

Establishment on these sites is likely to involve the use of a rapidly growing starting crop to occupy the site and suppress weed growth. Enrichment planting will then occur from ~~around Year 3.~~Year 3 where suitable growing conditions allow.

4.3.1.2.3 Forest interplanting

Offset planting sites include some areas where there are gaps in mature native forest. These gaps have occurred over time due to grazing, trampling, pest mammal impacts, exposure and other ~~impacts.~~modifications. Gaps ~~can~~ vary from individual tree canopy gaps to areas of 0.1 ha or greater. More sheltered conditions are generally present in these sites and ~~a process of~~ forest gap regeneration rather than new forest establishment is required. ~~Features~~In order to ensure plantings successfully establish at these sites, features of forest interplanting sites will include:

- Ongoing weed control (~~over a 10-year period)~~for up to 5 years following the completion of each planting stage) to prevent weed invasion and encourage natural regeneration into these areas;
- Planting of enrichment species into smaller gaps;
- Planting starting crop species in some larger areas and around wind exposed areas of existing forest stands;
- Early interplanting of enrichment species within starting crop ~~on some more~~in sheltered mid-sized gaps.

4.3.2 Wetland Planting

4.3.2.1 Intended Restoration Outcomes

- *Potential ~~HFL~~Beagley Farm Raupō Compensation.* ~~Raupō dominated seepage, with a~~Large wetland complex and associated smaller seepages, range of ~~other~~existing native wetland ~~species interspersed throughout.~~vegetation.
- *Indigenous and Exotic Wetland Compensation.* Dense ~~carex and~~ sedgelands including makura interspersed by larger wetland trees and shrubs~~.~~

- ~~*Exotic Wetlands Compensation.* Raupō and harakeke dominated, with a range of other native species interspersed throughout,~~ such as ~~rautahi, makura,~~ cabbage ~~tree, giant umbrella sedge, wiwi, kānuka and pukatea~~trees and kahikatea.

To buffer wetland areas from exposure and nutrient run-off, native plantings will be established around the edges of wetlands.

4.3.2.2 Vegetation establishment plan

Planting establishment plans will be prepared for groups of similar sites or larger individual sites. The approach taken to establishment on wetland sites is set out below.

1. Selective weed control to remove invasive weed species such as blackberry;
2. Investigation and careful maintenance ~~/~~and management of wetland hydrology; and,
3. Careful matching of plant species to hydrology, with planting of raupō in very wet areas.

Through these measures it is expected that wetland plantings will successfully establish. Enrichment species will be interplanted and weed control will continue until enrichment species are established.

4.3.3 Shrublands Planting

4.3.3.1 Intended Restoration Outcomes

- *Mānuka and Kanuka Shrublands Offset*. Mānuka or kānuka scrub less than 4.5 m tall or less than 20 cm diameter measured at 1.4 metres above the ground.
- *Divaricating Shrublands Offset.* Relatively dry open country, dominated by ~~coprosma~~*Coprosma* and ~~muehlenbeckia~~*Muehlenbeckia* species, while also including *Rubus* and *Olearia* species.

4.3.3.2 Vegetation establishment plan

Vegetation establishment plans will be prepared for groups of similar sites ~~or~~and larger individual sites.

Shrublands ~~are~~form on relatively dry, usually steep country with poor soils. They are often a result of previous land use and ~~can be seen as~~are generally a transitional ecotype as they ~~will eventually likely~~can grow into forests as conditions allow. DOC has requested that these ecotypes are maintained through grazing to support two species of native moth.

Weed control will need to occur over the ~~first three~~five years following completion of each planting stage to enable the plantings to ~~get to~~ establish well~~. There is also likely to be an ongoing weed control requirement as these areas will have lower stature and an ongoing risk of shrub weed invasion~~.

However, for Divaricating Shrublands, occasional sheep browse is expected to reduce the likelihood of pest plant impacts (sheep browse is proposed to ensure Divaricating Shrublands remain in this stable state).

Careful grazing management of these areas with sheep is likely to be required to maintain the presence of shrublands rather than natural succession to forest.

4.3.4 Stream Planting

4.3.4.1 Intended Restoration Outcomes

- ~~*Streams*~~*All offsite streams Offset Planting.* Streams will be mostly or full shaded, with a range of medium sized trees interspersed with kahikatea and ~~totara~~tōtara. Aim to establish gully scale, connected riparian corridors.

- ~~*Potential SFL Stream Offset Planting.* Streams will be mostly or full shaded, with a range of medium sized trees interspersed with kahikatea and totara.~~
- ~~*Potential HFL Stream Offset Planting.* Streams will be mostly or full shaded, with a range of medium sized trees interspersed with kahikatea and totara.~~

Of note, all stream restoration plantings proposed on Te Apiti Wind Farm land will be less than 1.5 m in height, and therefore the planting establishment plan and intended restoration outcomes from these plantings will differ from stream plantings outside of Wind Farm land. Native species such as toetoe will be used to provide stream benefits as opposed to larger trees such as tōtara.

4.3.4.2 Vegetation establishment plan

Planting establishment plans will be prepared for groups of similar sites ~~or~~and larger individual sites. ~~The approach taken to establishment on stream sites is set out below.~~

Stream plantings are focussed on fast growing, moisture tolerant species designed to shade the stream as soon as possible and reduce weed invasion. Plantings will be tailored to suit the stream proposed for restoration. For instance, plantings for intermittent streams in hill country will require different requirements than permanent streams on alluvial flats. Planting establishment plans will outline these specifics to ensure plantings are suited to the local microclimate.

4.4 Planting guide

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, to ensure the species selected are tolerant of the site conditions ~~through 12 months of~~throughout the year.

Outcomes are the key focus of this PEMP. A considerable amount of development and research in native tree planting has taken place over recent years and this management plan is not intended to be overly prescriptive in terms of inputs. This also means that more emphasis is put on monitoring and reporting of outcomes at key points.

4.4.1 Propagation material and eco-sourcing

All native plants produced for restoration planting (ecological restoration) must be grown from propagation material sourced from naturally occurring plants as close as possible to the planting site (no more than 10 km away from the planting site in any direction). This ensures propagation material used for rehabilitation, restorative planting and plant establishment is genetically suitable for the local environment.

The Western part of the ~~project~~Project footprint crosses both the North Manawatū Gorge Ecological District (hill country) and the Manawatū Plains Ecological District (Manawatū River level). It may be appropriate for some species to be moved between the two districts, noting that the boundaries between ecological districts should be considered as transition zones rather than barriers.

The whakapapa of plants established on this site is culturally important to Project iwi partners. All plants must be able to be traced back to their local collection location. Some plant species may be chosen for cultural purposes and could be sourced from other ecological districts if they cannot be sourced locally.

Plants should be grown from seed. For those species that are not easily propagated from seed, production of plants from cuttings or naturally occurring seedlings is acceptable where these seedlings 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.

Where practicable seeds eco-sourced from the Ruahine Forest Park will be used for Mangamanaia Stream restoration, subject to discussions with Iwi Partners.

~~4.4.2 Planting specifications~~

~~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.~~

~~4.4.3~~4.4.2 Plant species mixes

The composition of restoration planting will be as specified in the planting design specifications, and shall be specific to each ecosystem type being lost as a result of the Project. ~~The replacement planting species mix for Divaricating Shrubland ecosystem includes a high representation of key indigenous species *Coprosma rhamnoides, Melicytus, Olearia virgata, Olearia solandri, Muehlenbeckia* spp., *Parsonsia heterophylla* and *Rubus* spp.~~

~~For each terrestrial ecosystem type lost where planting is required, the mix of species shall be composed of three phases of planting:~~

1. ~~Starting Crop consisting of a nursery crop of early-successional, shade intolerant species for initial planting;~~
2. ~~Enrichment understorey; and~~
3. ~~Enrichment canopy, consisting of late-successional, shade tolerant species, to be inter-planted once the 'Starting Crop' has established.~~

Planting zones will be delineated prior to the commencement of planting ~~begins~~, and zones will be assessed for soil conditions, wetness and exposure to frost. The species mixes for each planting zone will be as specified in the replacement mitigation planting design specifications and shall be appropriate to the environmental conditions present within each zone.

The Divaricating Shrublands species mix is prescribed and includes a high representation of key indigenous species *Coprosma rhamnoides, Melicytus, Olearia virgata, Olearia solandri, Muehlenbeckia* spp., *Parsonsia heterophylla* and *Rubus* spp.

~~4.4.3.1~~4.4.2.1 Planting requirements

The following shall be applied to all plantings to ensure replacement plantings meet performance targets:

- All plant material will be eco-sourced as prescribed in Section 4.4.1;
- An appropriately experienced restoration ecologist will determine and mark out the planting zones for the replacement mitigation planting sites.
- Trees and shrubs grown for restoration planting will be grown to sizes that are larger / taller than is typical for new road revegetation planting. Plants will be a minimum of ~~PB 3 or root trainers;~~PB3 for forest canopy species;
- 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.
- A random subset (no less than 10%) of plants will be inspected at the supply nursery by an appropriately experienced restoration ecologist prior to delivery and any not meeting specifications will be rejected; and

- Within 20 m of the formed carriageway of the new road, plantings will only include flowering plants primarily pollinated by wind or insects and will not include plants with large berries or prolific fruiting such as tawa, hīnau, rimu, kahikatea, miro or mātai. The reason for this specification is to reduce the attraction of the carriageway to birds that feed on these plants and hence mitigate for potential bird strike. A 20 m buffer to the carriageway of the new road will be delineated to ensure these specific species are not planted in this exclusion zone.
- Plantings on Te Apiti Windfarm land will be less than 1.5 m in height and selected to be of low attractiveness to birds where possible.

~~4.4.3.2~~4.4.2.2 Spacings of plantings

Plant spacings will vary according to different planting zones, amount of native vegetation already present, wetland or terrestrial system, and the specific species being planted (e.g. large trees shall be planted at a relatively lower density, in order to provide sufficient space for growth).

However, in general, for areas planted in trees and shrubs, the aim will be for plants to be no further apart than 2 m, and in wetland areas plants should not be further apart than 1.5 m. In some zones canopy tree species may be spaced out at 4 to 6 m spacings with shrubs in between.

~~4.4.3.3~~4.4.2.3 Planting methods

All planting shall be undertaken by experienced personnel in accordance with the recognised best horticultural practice.

All plants shall be planted into holes so that the soil level after settlement shall match the original soil mark on the stem of the plant. The bottom of each hole shall be loosened to allow root penetration and free drainage. Holes shall be approximately one and half times the width of the root ball and a fertiliser tab added immediately prior to planting. Plants are to be ‘heeled in’ by lightly stamping on the soil surrounding the plant.

~~4.4.3.4~~4.4.2.4 Timing of planting

~~Replacement planting~~Planting shall be undertaken between late September to late October in areas exposed to winter flooding or likely to experience hard winter frosts. Autumn planting (e.g. March, April and May) shall be undertaken on drier, elevated sites not prone to hard frosts. Winter planting can be undertaken where planting areas are outside flood zones.

~~Replacement planting~~Planting in late summer shall be undertaken for wetland species which grow in standing water, when water levels are suitably low.

~~4.4.4~~4.4.3 Nursery requirements

Pre-determined nurseries are selected to provide plants for restoration planting in the Project and offset areas. When acquiring plants from the nursery, the lead contractor must ensure the following:

- Nurseries growing *Myrtaceae* plants are expected to follow and use NZPPI Myrtle Rust Protocols to minimise the risk of spreading myrtle rust, including:
  - Nursery protocols[8]; and-,
  - Plant Transport Protocol[9];

[8] NZPPI (n.d.). Myrtle Rust. Nursery Management Protocol.
[9] NZPPI (2017). Myrtle Rust & Plant Transport Protocol.

- Inspection of potted plant selection for rainbow skink eggs. Potting mix and plant material are the most frequent vectors of plague skinks and their eggs. All potting mix and plant material shall be inspected for plague skinks and eggs prior to importation to site.

~~4.4.5~~4.4.4 Livestock and ungulate pest animal exclusion

All farm livestock (cattle, horses, sheep and domestic pigs) will be permanently removed and excluded from planting sites before planting commences at each site. In the Divaricating Shrublands, stock will have access once plants have established to keep this ecosystem type in a stable state.

Cattle currently have access to some of the intended planting areas. Cattle should be removed as soon as possible to allow ~~for~~ natural regeneration to begin. Invasive weed species may rapidly occupy open grass areas when grazing pressure is removed. However, removing grazing should not be delayed, but rather linked to immediate weed management. ~~Allowing early establishment of weed species allows these to be controlled and the weed burden to be reduced prior to planting. Controlled use of herbicides is more straightforward before new plants are present.~~It is expected that this method will facilitate regeneration, while weeds can be actively managed.

A concerted and regular weed management programme will need to be undertaken from the time cattle are removed until all planting is concluded and invasive weeds no longer present a risk to forest and wetland establishment (Section 4.4.6).

Permanent stock-proof fencing shall be erected where necessary to exclude stock from replacement planting sites. At a minimum this fence will be 7-wire post and batten with 5 m post spacing.

~~4.4.6~~4.4.5 Small mammal pest and ~~pukeko~~pūkeko management

Possums and rats are less likely to cause any major damage to newly planted seedlings compared to other pest mammals, and both will be substantially reduced in numbers when the pest management programme commences (as outlined in the PMP, Section ~~12.2.3.1~~13). Some targeted control of possums will occur if required, otherwise these species will be controlled as part of the wider pest management programme.

~~Pukeko~~Pūkeko, rabbits or hares can ~~occasionally be problematic when~~inhibit new plantings ~~occur. They have the habit of~~through foliar browse, pulling out or ring barking small seedlings, and large pest populations can damage many hundreds of seedlings over a short time period (e.g. a few days ~~if given the opportunity. This is only likely to be a problem if large populations are present~~). Pūkeko, rabbit and or hare control ~~measures~~ will be ~~implemented if needed.~~required to ensure successful establishment of plants. Control of rabbits and hares is outlined in the Pest Management Plan.

Larger plants (e.g. PB3) are less prone to being pulled or damaged by pūkeko. However, pūkeko control will be undertaken where populations are deemed to be adversely impacting plant establishment by the Environmental Manager and Project Ecologist – Terrestrial. DOC will be consulted to discuss options for the prevention of pūkeko damage including live capture and relocation of birds.

~~4.4.7~~4.4.6 Pest plant management

~~The~~One objective of the pest plant management effort is to prevent the establishment of any problematic or invasive weed species ~~up~~ until the commencement of replacement planting. Once replacement planting commences, a plant release and maintenance programme will ensure any pest plants that establish are controlled to very low levels. A number of invasive pest plant species are currently present in and around the Project footprint such as broom and gorse, and if not appropriately managed, will pose a significant threat to the success of replacement plantings. Pest plants are defined by those listed as such within the

Regional Pest Management Plan[10], and those considered by the Project Ecologist – Terrestrial (or designated suitably qualified ecologist) as capable of inhibiting replacement plantings, forest regeneration, wetland restoration, forest succession and the regeneration of any retirement areas.

Some high-value vegetation areas within the designation corridor are subject to QEII Trust open space covenants (QEII Trust west and east within catchment 6 and 7). Within these areas:

- A pre-construction baseline survey of pest plants shall be undertaken to inform pest plant management effectiveness;
- The baseline survey shall report on the species composition, and locations of pest plants; and,
- All pest plants within the QEII Trust open space covenants (QEII Trust west and east within catchment 6 and 7) will be controlled during construction and for five-years following the completion of construction works to the same level or better than found during the baseline surveys.

Furthermore, pest plants will be controlled to ensure replacement plantings are not inhibited, and performance targets are met. Therefore:

- All pest plants 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. Manual or mechanical removal of weed species will occur if it is unsafe to use herbicides; and
- 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 to achieve offsetting targets.

4.5 Plant establishment performance measures

Successful planting establishment performance measures are outlined in Table 4~~.~~.1 below and the ~~REMP~~REMMP (Section 12). These standards aim to ~~support a mimicking but acceleration of~~both mimic and accelerate natural regeneration processes.

~~These~~Performance measures include basal area, tree height, species richness, ~~plant density~~canopy and understorey cover and fauna habitat proxy targets as outlined in Te Ahu A Turanga: Technical Assessment G: Terrestrial Offset and Compensation report.

Post-planting monitoring will be undertaken at the end of year 1, 3, 5 and 10 until replacement planting meets the specified performance measures. Monitoring in years 1, 3~~,~~ and 5 will allow assessment of progress of the plantings towards the year 10 ~~measures~~targets, which are ultimately the key performance measures for planting to be assessed against.

[10] Horizons Regional Council (2017). Regional Pest Management Plan (2017-2037).

Table 4.1: Ecosystem types, intended restoration outcomes and performance measures from Year 1 to Year 10. Note: not all vegetation types include enrichment planting.

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
Old Growth Forest (Alluvial) Compensation	~~Swamp forest~~Forest canopy ~~will be~~ dominated by kahikatea and pukatea~~.~~ in areas with poor drainage. Tawa ~~will be~~is common on the drier, better drained or raised areas. ~~Matai~~Mataī, rimu and ~~totara will be~~tōtara are present but restricted to areas of better-drained soils. ~~Titoki will~~Tītoki are also ~~be~~ common.	• 75% survival • Invasive weeds absent or at low levels. • ~~•~~ Animal browse has no significant impact •	• 75% survival • 80% of original diversity • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • ~~Canopy cover around 60%~~ • Natural regeneration occurring • Enrichment species 80% of original diversity • Enrichment 75% survival	• ~~Starting crop have formed 80% canopy~~ • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type. • Natural establishment of native species has begun through seed rain and colonisation. Ground covers establishing.
Old Growth Forest (Hill Country) Compensation	Forest dominated by ~~rimu,~~ tawa and kamahi~~. Hinau~~, with occasional mature rimu which are expected to eventually become emergent. Māhoe is expected to be common in the subcanopy, and hīnau, rewarewa ~~or mahoe will be common. Rimu~~, miro and ~~totara~~tōtara will be present ~~with kahikatea and matai likely to be less common.~~but uncommon. Common indigenous broadleaved species are also likely to be present in the	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact	• 75% survival • 80% of original diversity • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • ~~Canopy cover around 60%~~ • Natural regeneration occurring	• ~~Starting crop have formed 80% canopy~~ • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type.

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
	understorey such as kawakawa and hangehange having colonised naturally. Ramarama and rohutu replacement plantings will be present in the understorey.			• Enrichment species 80% of original diversity • Enrichment 75% survival	• Natural establishment of native species has begun through seed rain and colonisation. Ground covers, establishing.
Secondary Broadleaved Forests with Old Growth Signatures Offset	A closed canopy consisting of a range of medium sized broadleaved species such as māhoe, as well as ~~totara~~tōtara, tawa, rimu, ~~matai~~matai and ~~hinau~~hīnau.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact •	• 75% survival • 80% of original diversity • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • ~~Canopy cover around 60%~~ • Natural regeneration occurring • Enrichment species 80% of original diversity • Enrichment 75% survival	• ~~Starting crop have formed 75% canopy~~ • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type. • Natural establishment of native species has begun through seed rain and colonisation. Ground covers, establishing.
Old Growth Treelands Offset	A closed canopy consisting of a range of medium sized broadleaved species such as karamu, wineberry, kaikomako and māhoe as well as ~~totara~~tōtara, tawa, rimu, ~~matai~~matai and ~~hinau~~hīnau.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact •	• 75% survival • 80% of original diversity • Canopy beginning to close • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • ~~Canopy cover around 60%~~	• ~~Starting crop have formed 80% canopy~~ • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy • A clear trajectory towards the outcome

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
				• Natural regeneration occurring • Enrichment species 80% of original diversity • ~~Enrichment~~ 75% survival •	state described for this vegetation type. • Natural establishment of native species has begun through seed rain and colonisation. Ground covers, establishing.
Kānuka Forest Offset	Kānuka forest or treeland will be dominated by almost pure stands of well-developed kānuka. This habitat type is differentiated from kānuka scrub by size (greater than 4.5 m tall or 20 cm diameter measured at 1.4 metres above the ground. Mānuka and typical indigenous broadleaved species could also be present scattered through the canopy or understorey but will not be dominant.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact	• 75% survival • 80% of original diversity • Canopy beginning to close • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • ~~Canopy cover around 60%~~ • Natural regeneration occurring	• ~~Starting crop have formed 80% canopy~~ • Grass and weeds are now suppressed • A clear trajectory towards the outcome state described for this vegetation type. • Natural establishment of native species has begun through seed rain and colonisation. Ground covers establishing. • 90% canopy closure expected by this stage.
~~Broadleaved Forest Offset~~	~~A closed canopy consisting of a range of medium sized broadleaved species as well as totara, tawa, rimu, matai and hinau.~~	~~• 75% survival~~ ~~• Invasive weeds absent or at low levels~~ ~~• Animal browse has no significant impact~~	~~• 75% survival~~ ~~• 80% of original diversity~~ ~~• Canopy beginning to close~~ ~~• Invasive weeds absent or at low levels~~	~~• Starting crop FTG~~ ~~• Weeds under control and not spreading~~ ~~• Animal browse has no significant impact on planting~~ ~~• Canopy cover around 60%~~ ~~• Natural regeneration occurring~~	~~• Starting crop have formed 80% canopy~~ ~~• Grass and weeds are now suppressed~~ ~~• Enrichment species are well established in the understorey and subcanopy~~ ~~• A clear trajectory towards the outcome~~

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
				~~• Enrichment species 80% of original diversity~~ ~~• Enrichment 75% survival~~	~~state described for this vegetation type.~~
• Advanced Secondary Broadleaved Forest Offset	A closed canopy consisting of a range of medium sized broadleaved species such as māhoe as well as ~~totara~~tōtara, tawa, rimu, ~~matai~~mataī and ~~hinau~~hīnau.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact	• 75% survival • 80% of original diversity • Canopy beginning to close • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy ~~• Canopy cover around 60%~~ • Natural regeneration occurring • Enrichment species 80% of original diversity • Enrichment 75% survival	~~• Starting crop have formed 80% canopy~~ • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type. • Natural establishment of native species has begun through seed rain and colonisation. Ground covers establishing.
Raupō Dominated Seepage Wetland Compensation	Raupō dominated seepage, with a range of other native wetland species interspersed throughout.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact	• 75% survival • 80% of original diversity • Canopy beginning to close • Plants removed by pūkeko replaced • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting ~~• Canopy cover around 60%~~ • Starting crop have formed 80% canopy • Natural regeneration occurring	~~• Starting crop have formed 80% canopy~~ • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy ~~• A clear trajectory towards the outcome state described for this vegetation type.~~ Complete canopy

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
				• Enrichment species 80% of original diversity • Enrichment 75% survival	cover of raupō expected by this stage
~~Potential HFL Raupō Compensation~~	~~Raupō dominated seepage, with a range of other native wetland species interspersed throughout.~~	~~• 75% survival~~ ~~• Invasive weeds absent or at low levels~~ ~~• Animal browse has no significant impact~~	~~• 75% survival~~ ~~• 80% of original diversity~~ ~~• Canopy beginning to close~~ ~~• Plants removed by pūkeko replaced~~ ~~• Invasive weeds absent or at low levels~~	~~• Starting crop FTG~~ ~~• Weeds under control and not spreading~~ ~~• Animal browse has no significant impact on planting~~ ~~• Canopy cover around 60%~~ ~~• Natural regeneration occurring~~ ~~• Enrichment species 80% of original diversity~~ ~~• Enrichment 75% survival~~	~~• Starting crop have formed 80% canopy~~ ~~• Grass and weeds are now suppressed~~ ~~• Enrichment species are well established in the understorey and subcanopy~~ ~~• A clear trajectory towards the outcome state described for this vegetation type.~~
Indigenous Dominated Seepage Wetland Offset	Dense carex and sedgelands interspersed by larger trees and shrubs.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact	• 75% survival • 80% of original diversity • Canopy beginning to close • Plants removed by pūkeko replaced • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 75% canopy • Canopy cover around 60% • Natural regeneration occurring	• Starting crop have formed 75% canopy • Grass and weeds are now suppressed • A clear trajectory towards the outcome state described for this vegetation type.
Indigenous and Exotic Wetland Compensation	Dense carex and sedgelands interspersed by larger trees and shrubs.	• 75% survival	• 75% survival	• Starting crop FTG	• Starting crop have formed 80% canopy

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
		• Invasive weeds absent or at low levels • Animal browse has no significant impact	• 80% of original diversity • Canopy beginning to close • Plants removed by pūkeko replaced • Invasive weeds absent or at low levels	• Weeds under control and not spreading • Animal browse has no significant impact on planting • Canopy cover around 60% • Natural regeneration occurring	• Grass and weeds are now suppressed • A clear trajectory towards the outcome state described for this vegetation type. • At least 25 species established in these areas.
Secondary Broadleaved Forest and ~~Scrublands~~Shcrublands Offset	A closed canopy consisting of a range of medium sized broadleaved species such as māhoe and lemonwood, as well as tōtara, tawa, rimu, mataī and hīnau. Species assemblages will differ between ridgetops and gullies, and divaricating shrubs are expected in the understorey and on the edges of this habitat type.A closed canopy consisting of a range of medium sized broadleaved species as well as totara, tawa, rimu, matai and hinau.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact	• 75% survival • 80% of original diversity • Canopy beginning to close • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Canopy cover around 60% • Natural regeneration occurring • Enrichment species 80% of original diversity • Enrichment 75% survival	• Starting crop have formed 80% canopy • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type. • Natural establishment of native species has begun through seed rain and colonisation. Ground covers, vines and epiphytes establishing.
Mānuka and kānuka Shrublands Offset	Mānuka or kānuka scrub less than 4.5 m tall or less than 20 cm diameter measured at 1.4 metres above the ground.	• 75% survival • Invasive weeds absent or at low levels	• 75% survival • 80% of original diversity • Canopy beginning to close	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting	• Starting crop have formed 80% canopy • Grass and weeds are now suppressed • A clear trajectory towards the outcome

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
		• Animal browse has no significant impact	• Invasive weeds absent or at low levels • Sheep reintroduced to keep grass down.	• Starting crop have formed 80% canopy • Canopy cover around 60% • Natural regeneration occurring	state described for this vegetation type. • Natural establishment of native species has begun through seed rain and colonisation. Ground covers, vines and epiphytes establishing. • 90% canopy closure expected by this stage.
Divaricating Shrublands Offset	Relatively dry open country dominated by coprosma and muehlenbeckia species. Divaricating shrublands also required to have a proportion of appropriate *Rubus*, *Melicytus* and *Olearia* species.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact	• 75% survival • 80% of original diversity • Canopy beginning to close • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • Canopy cover around 60% • Natural regeneration occurring • Plantings lightly grazed by sheep to ensure divaricating shrublands are not transitioning to mature forest types.	• Starting crop have formed 80% canopy • Grass and weeds are now suppressed • A clear trajectory towards the outcome state described for this vegetation type. • Plantings continue to be lightly grazed by sheep to ensure divaricating shrublands do not transition to mature forest types.
Exotic Wetlands Compensation	Raupō dominated seepage, with a range of other native species interspersed throughout. Where hydrology not suited to raupō then replacement with	• 75% survival • Invasive weeds absent	• 75% survival • 80% of original diversity	• Starting crop FTG • Weeds under control and not spreading	• Starting crop have formed 80% canopy • Grass and weeds are now suppressed

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
	appropriate native wetland species.	or at low levels • Animal browse has no significant impact	• Canopy beginning to close • Plants removed by pūkeko replaced • Invasive weeds absent or at low levels	• Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • Canopy cover around 60% • Natural regeneration occurring	• A clear trajectory towards the outcome state described for this vegetation type.
Streams Offset Planting NB - planting on Te Apiti wind farm will be a species assemblage <1.5 m in height and will not include bird pollinated and/or dispersed species.	Streams will be mostly or full shaded, with a range of medium sized trees interspersed with kahikatea and totara.	• 75% survival • Invasive weeds absent or at low levels • Animal browse has no significant impact	• 75% survival • 80% of original diversity • Canopy beginning to close • Invasive weeds absent or at low levels	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • Canopy cover around 60% • Natural regeneration occurring • Enrichment species 80% of original diversity • ~~Enrichment~~ 75% survival •	• Starting crop have formed 80% canopy • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type.
Potential HFL Stream Offset Planting Potential SFL Stream Offset Planting	Streams will be mostly or fully shaded, with a range of medium sized trees interspersed with kahikatea and tōotara.Streams will be mostly or full shaded, with a range of medium sized trees interspersed with kahikatea and totara.	• 75% survival • Invasive weeds absent or at low levels 75% survival	• 75% survival • 80% of original diversity • Canopy beginning to close	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting	• Starting crop have formed 80% canopy • Grass and weeds are now suppressed • Enrichment species are well established

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
		• Invasive weeds absent or at low levels • Animal browse has no significant impact •	• Invasive weeds absent or at low levels 75% survival • 80% of original diversity • Canopy beginning to close • Invasive weeds absent or at low levels	• Starting crop have formed 80% canopy • Canopy cover around 60% • Natural regeneration occurring • Enrichment species 80% of original diversity • Enrichment 75% survivalStarting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting • Starting crop have formed 80% canopy • Canopy cover around 60% • Natural regeneration occurring • Enrichment species 80% of original diversity • Enrichment 75% survival	in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type. Starting crop have formed 80% canopy • Grass and weeds are now suppressed • Enrichment species are well established in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type.
Potential HFL Stream Offset Planting	Streams will be mostly or ~~full~~fully shaded, with a range of medium sized trees interspersed with kahikatea and ~~totara~~tōotara.	• 75% survival • Invasive weeds absent or at low levels	• 75% survival • 80% of original diversity • Canopy beginning to close	• Starting crop FTG • Weeds under control and not spreading • Animal browse has no significant impact on planting	• Starting crop have formed 80% canopy • Grass and weeds are now suppressed • Enrichment species are well established

Vegetation / ecosystem type	Restoration Outcome	Outcome performance measures			
		End of Year 1	**End of Year 3**	**End of Year 5**	**End of Year 10**
			• Invasive weeds absent or at low levels	• Starting crop have formed 80% canopy • Canopy cover around 60% • Natural regeneration occurring • Enrichment species 80% of original diversity • Enrichment 75% survival	in the understorey and subcanopy • A clear trajectory towards the outcome state described for this vegetation type.

Definitions

FTG = Free to Grow: All species ahead of weed competition ~~and~~ will grow and overtop any remaining weeds without management. Pest animal species at low levels and are not affecting growth or achievement of FTG state.

HFL = Horizons Farm Limited, also referred to as Ratahiwi Farm.

SFL = Sproull Farm Limited.

% survival: Number of individual plants still alive compared to number originally planted, as a percentage.

% of original diversity remaining: Number of planted species present compared to the number of planted species, as a percentage.

% canopy cover: Percentage of the planted site covered by crowns of plants

4.6 Monitoring of outcome performance measures

Monitoring will involve a combination of:

- Qualitative assessment: this will involve ~~inspection to assess issues of weed or stock presence etc~~a visual inspection of planting areas of each replacement forest type to determine potential stock incursions, weed presence (with species and overall abundance noted) and potential pest mammal, pūkeko or disease issues;
- Survival and diversity assessment through standard sample counts and or bounded plots, such as through RECCE plots (refer to Section 12.7 for detail);
- Assessment of canopy cover through techniques such as bounded plots or drone photogrammetry.

4.6.1 Timing

Frequent inspections will be required through the first year of establishment and these will reduce as plantings develop.

~~Where survival~~In the first year of establishment, an assessment of plantings will be undertaken once every three months. Post-planting monitoring will be undertaken at the end of year 1, 3, 5 and 10 until replacement planting meets the specified performance measures (the End of Year 10 measures in Table 4.1). Survival and growth assessments ~~are undertaken, these should~~will be completed in autumn, as this will allow an assessment of plant health following ~~any losses through~~the summer period, where die-off can occur because of drought. ~~-~~This allows ~~any planning~~ for potential replacement ~~in~~plantings during the winter ~~planting~~.

~~4.6.2 Amount~~

Adaptive management will be undertaken where plantings are not meeting performance measures. This will include identifying the limiting factor and addressing it so that performance measures are met.

4.6.2 Monitoring ~~will be at a level that allows~~effort

See the Residual Effects Monitoring Management Plan (REMMP) for ~~the performance measures~~ detailed information on the monitoring regime. The monitoring approach is summarised below.

Monitoring includes baseline and 2-yearly 10 x 10 m plots for the first 10 years which involve:

- 10 forest biodiversity plots within the 48.3 ha of forest and shrubland subject to ~~be measured~~bush retirement
- 10 forest biodiversity plots within the 45.6 ha of pasture habitat subject to ~~an acceptable precision.~~native revegetation
- 10 wetland biodiversity plots within the 6.55 ha of degraded pasture wetlands subject to habitat enhancement and 0.4 ha of raupo wetlands subject to stock exclusion.

Monitoring will include vegetation, bird and reptile monitoring. After 10 years, which corresponds to the end of the rat, possum and mustelid pest control programme, monitoring of birds will discontinue and vegetation monitoring will be undertaken every five years until termination at 35 years from commencement of offset and compensation measures.

4.7 Programme

To provide eco-sourced plants in time for the Project, seed collection, which has already commenced, will be undertaken within the vegetation types listed in Table 2.1, in and adjacent to the Project footprint prior to construction commencing.

The timing of replacement planting will be governed by when areas become available for planting. Notwithstanding this, all ~~Starting Crop~~starting crop replacement plantings shall be established within three planting seasons of construction of the Project being completed. Planting or seed sowing at the top of cuts may occur as cuts are gradually lowered to avoid working at heights above the full cut.

Any plants that have not survived within five years of initial planting shall be replaced by the same species. Once the ~~Starting Crop~~starting crop has reached approximately 80% canopy cover, as is expected by year five, Enhancement ~~Planting~~Plantings shall be interspersed within the ~~Starting Crop~~starting crop.

Enhancement Plantings will be established where there is shade or semi-shade (depending on species preferences) and where suitable environmental conditions exist. Gap formation (trimming of branches) may be required to create optimal light levels for Enhancement Plantings.

The maintenance period of replacement plantings will be for ~~ten~~five (5) years~~.~~ following the completion of planting in each planting stage. Enrichment planting is expected to be completed within the five years of planting commencing, hence the total maintence period is expected to be 10 years for each planted area. Maintenance shall be carried ~~out every year~~annually after planting commences for the duration of the maintenance period to provide optimal conditions for plant growth. This will include the control and removal of unwanted exotic plant species, releasing and removing competing growth around desirable plants and identifying failed plants or disease threats (e.g. myrtle rust). If 80% native canopy cover is not met then replacement planting and maintenance will continue beyond year ~~10~~five until this performance target is achieved.

5 Biosecurity Management Plan

5.1 Introduction

~~There are a range of invasive plant and animal species, and diseases of native plants and animals that are not currently present in the Project area. The purpose of this biosecurity management section~~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~~invasive plant and animal species, and diseases of native plants and animals as a result of Project-related activities.

The management of pest plants and animals already present in the Project area is addressed in section 4.4.5 – 4.4.7 of the EMP ~~(pest species management).~~. This ~~chapter~~section addresses the following specific biosecurity issues, not currently present in the Project area:

- Myrtle rust~~;~~ management (Section 5.3.1); and
- Plague ~~skinks.~~skink management (Section 5.3.2); and
- Pest plant management (Section 5.3.3).

This section of the EMP outlines how biosecurity management will be carried out during Project activities.

5.2 Responsibilities and competencies

Delivery of, and compliance with, this Biosecurity Management Plan will be the responsibility of the Environmental Manager and lead contractor who will liaise with the Project Ecologist – Terrestrial and Project Ecologist – Freshwater as required.

It will be important for the lead contractor to read and understand the biosecurity management requirements so that the protocols are adhered to correctly during construction works. The responsibilities of the lead contractor include but are not limited to:

- Reading and understanding the relevant biosecurity protocols;
- Implementing training as required to personnel to identify biosecurity risks;
- Communicating discovered biosecurity risks in the Project footprint to the Environmental Manager, Project Ecologist – Terrestrial / Freshwater and the Cultural Monitoring Advisor.

The Project Environmental Manager is responsible for alerting the lead contractor to new biosecurity risks that have relevance to the Project area that arise during the construction period.

5.3 Measures to avoid and minimise adverse effects

5.3.1 Myrtle rust management

The Project footprint will be constructed through landscapes which contains many Myrtaceae species susceptible to myrtle rust. Moreover, as part of the Project's ecological effects management framework, many of these species will be required to be replanted after the road has been built (i.e. ramarama).

Myrtle rust is a serious fungal disease that affects plants including New Zealand's native pōhutukawa, mānuka, rātā, and some common ornamental garden plants- like bottlebrush and lilly pilly. 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 restoration areas as possible.

Myrtle rust has not been identified in the Project footprint and is assumed absent, however biosecurity measures to reduce the risk of myrtle rust entering the site as a result of restoration planting are outlined in Section 4.4.3~~4.4.4.~~. The discovery protocol and management approach should myrtle rust be identified on site is outlined below.

5.3.1.1 Discovery protocol and management approach

If myrtle rust is discovered on site, the Environmental Manager and Project Ecologist – Terrestrial should be notified. The Environmental Manager must ensure that the Ministry for Primary Industries is notified through the Exotic Pests and Diseases hotline (0800 80 99 66), and that a photo of the infected plant is recorded. The infected plant should not be touched, as this may increase the spread of the disease~~).~~.

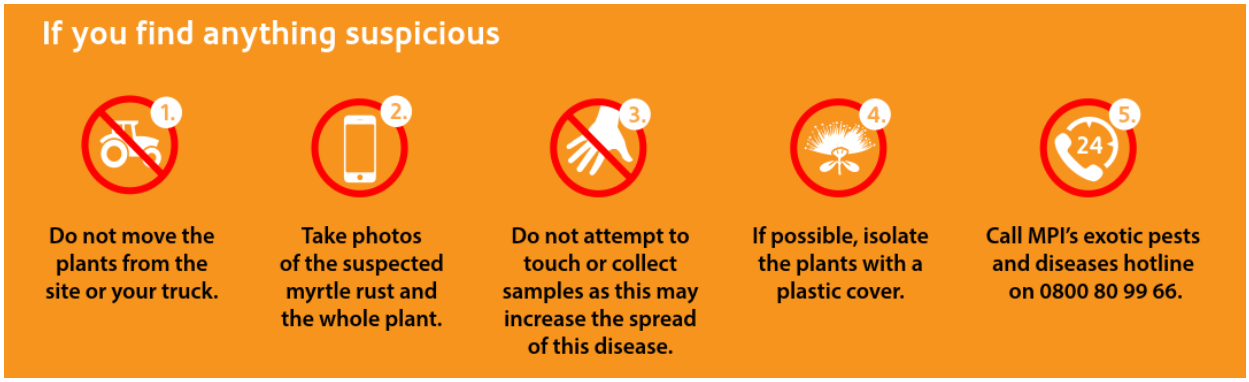


Figure 5.1: Discovery protocol if myrtle rust suspected on site [NZPPI website, accessed 23 Jan 2020]

If vegetation is not required to be cleared for Project construction purposes~~–~~, it is not required to remove infected plants. The plant can be left in place and ~~monitor~~ the progress of myrtle rust on the infected plant can be monitored.

- If vegetation is required to be cleared for Project construction purposes:
  - Bury the infected material on site (at 50 cm depth), or
  - Take the ~~Myrtle~~myrtle rust infected material to a landfill or transfer station provided that it is securely enclosed in a sealed bag or other container during transport and is disposed as general ~~was~~waste (and not green waste).

5.3.2 Plague ~~skinks~~skink management

Plague skinks (*Lampropholis delicate*) are a pest animal species which is presumed absent in the Project footprint, has high invasion potential, and whose invasion may cause particular ecological harm.

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. To minimise introduction of plague skinks to the Project area, nursery requirements are outlined in Section 4.4.3~~4.4.4~~ during transport of restoration plants to the Project area.

5.3.2.1 Discovery protocol and management approach

Any suspected sign of plague skinks shall immediately be reported to DOC and the Environmental Manager. A number of precautionary measures are to be undertaken to prevent the spread of these organisms:

- 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~~, and pictures of plague skinks and their eggs 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.
- Imported potting mix and plant material - Potting mix and plant material are the most frequent vectors of plague skinks and their eggs. All potting mix and plant material shall be inspected for plague skinks and eggs prior to importation to site.

5.3.3 Pest plant management

Pest plants are detrimental to human health, the economy and the environment. 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.

The construction of roads can result in the spread of pest plants and can create 'corridors' for weeds to move along. 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.

5.3.3.1 Manawatū context

The biodiversity value of habitats in the project footprint require stringent precautionary biosecurity measures to ensure these values are not compromised by the accidental introduction of pest plants and animals, and to ensure existing pest plants are controlled to low levels. A number of invasive pest plants are present in and adjacent to the Project footprint.

5.3.3.2 Pest plants in the Project footprint

The Project footprint occurs within a predominantly agricultural landscape dominated by grazed pastureland, exotic-dominated plantation forests and exotic shrublands (e.g. gorse and broom). However, the Project footprint includes 11.82 ha of indigenous forest and shrublands and a number of small wetlands. Through site walkovers and vegetation plots a total of 14 ecological pest plants have been identified an some areas, outlined in Table 5.1.

Table 5.1: Key ecological pest plant species in and around the Project footprint and their Regional Pest Management Plan status[11]

Common name	Species name	RPMP status	Location
Barberry	*Berberis glaucocarpa*	n/a	Stuart Bolton wetland area
Old man's beard	*Clematis vitalba*	Progressive containment (Horizons/Occupier)	Stuart Bolton wetland area, Western QEII covenant
Pampas	*Cortaderia selloana*	n/a	Manawatū Gorge carpark. Stuart Bolton wetland area.
Blackberry	*Rubus fruticosus agg.*	Progressive containment (Occupier)	Stuart Bolton wetland area, Meridian landholdings
Wild broom	*Cytisis scoparius*	Progressive containment (Occupier)	Stuart Bolton wetland area, Meridian landholdings, AgResearch landholdings
German ivy	*Delairea odorata*	n/a	Northern area of AgResearch property. Scattered individuals throughout Meridian landholdings.
Himalayan honeysuckle	*Leycesteria formosa*	n/a	Secondary broadleaf forest adjacent to Old Growth Forest (hill country)
Lotus	*Lotus pedunculatus*	n/a	Stuart Bolton wetland area
Inkweed	*Phytolacca octandra*	n/a	Stuart Bolton wetland area
Crack willow	*Salix x fragilis*	n/a	Manawatū Gorge carpark. Eastern side of alignment.
Tradecantia	*Tradescantia flumenensis*	n/a	Scattered populations throughout Meridian landholdings.
Gorse	*Ulex europaeus*	Progressive containment (Occupier)	Scattered throughout the alignment.
Hanging sedge	Carex pendula	n/a	Individaul on access track to Stuart Bolton property.
Periwinkle	Vinca major		Extensive area on access track to Stuart Bolton property.

5.3.3.3 Pest plant biosecurity management

The Alliance will 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, pest animal and myrtle rust 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 management.

To ensure pest plant prevention and control in relation to construction activities is undertaken safely and effectively, pest plant management will be undertaken under the following requirements:

- Horizons Regional Council Regional Pest Management Plan 2017-2037 (RPMP);

[11] Horizons Regional Council (2017). Regional Pest Management Plan 2017-2037.

- Biosecurity Act (1993); and
- NZTA P39 Standard Specification for Highway Landscape Treatments.

~~5.3.3~~5.3.4 Freshwater

Freshwater biosecurity includes the management of pest fish species and transferral of pest plants and weeds (including the pest organism *Didymosphnia geminata*, known as didymo) between freshwater bodies and catchments. Processes to avoid and minimise adverse effects on freshwater biosecurity are included in Section 11.3.6.

6 Lizard Management Plan

6.1 Introduction

The Lizard Management Plan (LiMP) describes measures to avoid, remedy or mitigate potential adverse effects of the Project on lizards, including measures to salvage and relocate native lizard species that are likely to be adversely affected by the Project.

All native lizards on site are protected by the Wildlife Act (1953). Additionally, the Resource Management Act (RMA) 1991 affords protection to significant habitats of indigenous fauna including lizards. Furthermore, several species identified on as potentially on site are classified as 'At Risk' under the Department of Conservation (DOC) National Threat Classification System (NZTCS). The LiMP is also intended to support a Wildlife Authority Application to DOC.

The following table sets out the purpose, specific objectives, performance measures and monitoring relevant to the LiMP.

Purpose	This section of the EMP outlines how lizard management during the Project meets the requirements of Condition 20 and 25 of the ~~draft~~ NoR Conditions~~, date 15 October~~. This section will be updated to incorporate any requirements of ~~Regional Council resource consents.~~Condition [EC9] of the [draft] Resource Consent Conditions [12 June 2020].
Specific Objectives	The LiMP addresses the provision for salvage effort for lizards that may be located on vegetation cleared within the Project footprint, focusing on high value habitat. The provisions also include details on the relocation and release of lizards to a selected site in the MGSR.
Performance Outcomes	The performance measures for lizards will be achieved by the successful implementation of salvage and relocation measures (if required) as outlined.
Monitoring	The LiMP includes provision for recording the details of any salvaged lizards, including: species, sex, age class, weight, snout to vent length, and location of capture and release. All records shall be reported to the BioWeb Herpetofauna database.

6.2 Responsibilities and competencies

Delivery of, and compliance with this LiMP will be the responsibility of the Environmental Manager who will liaise with the Project Ecologist – Terrestrial and a specialist ecologist (herpetologist) as required. The implementation of the LiMP will be under the direct supervision of a specialist ecologist(s)/herpetologist. The specialist ecologist(s) will be suitably qualified and experienced~~,~~ and hold a current Wildlife Act Authority for lizard salvage and relocation operations.

It will be important for the lead contractor to read and understand the LiMP so that the protocols are adhered to correctly during construction works. The responsibilities of the construction contractor include but are not limited to:

- Reading and understanding the LiMP;

- Facilitating a project start-up meeting with the Project Ecologist - Terrestrial and the site manager before the earthworks season commences each year to determine habitats scheduled for clearance each season to enable forward planning and avoid delays in the construction schedule;
- Contacting the Project Ecologist – Terrestrial and the Cultural Monitoring Advisor a minimum of ~~3 weeks~~3weeks before any of the areas outlined in the Terrestrial Ecosystems and Survey Locations Maps [TAT-3-DG-E-4131 to 4137] and Table 6-2 below are scheduled for clearance;
- Inviting iwi partners to participate in and support any translocation deemed necessary, to appropriate exercise of kaitiakitanga responsibilities and that cultural concerns are addressed;
- Maintaining clear lines of communication with the Project Ecologist - Terrestrial and the Cultural Monitoring Advisor regarding changes in the works schedule; and,
- Briefing new personnel about the contractor's responsibilities under this plan.

All personnel working on site are responsible for alerting the Project Ecologist – Terrestrial and the site manager in the discovery of any 'At Risk' or 'Threatened' flora and fauna not otherwise identified in this management plan.

The Environmental Manager is responsible for reporting the discovery of 'At Risk' or 'Threatened' flora and fauna to the Local Area Manager (DOC) and the Cultural Monitoring Advisor and for maintaining a database with an incident register and file log of actions taken for each discovery of a 'Threatened' or at Risk' fauna.

6.3 Summary of ecological values, effects on lizards and effects management

6.3.1 Lizard values

The lizard values of the Project were assessed by way of:

- A literature review to determine lizard species present in the landscape surrounding the proposed designation;
- A qualitative assessment of potential lizard habitats across the Project;
- Day-time and night-time visual encounter surveys of six potentially high value, representative habitats identified as described above; and
- Spotlighting for geckos in the aforementioned habitats.

Detailed information on the ecological values within the road corridor and effects on lizards is provided in Technical Assessment F – Terrestrial Ecology and is summarised below, along with baseline lizard results (refer to reports listed in Section 1.4.1).

Database records show that barking gecko, ngahere gecko and raukawa gecko have been recorded in the adjacent Manawatū Gorge Scenic Reserve. Additionally, glossy brown skink, ornate skink and northern grass skink have been identified within 15 km of the Project area in the last 20 years (DOC BioWeb Database).

Gecko and skink habitats of varying quality were identified across the Project area (refer Drawing Set in Volume 3, TAT-3-DG-E-4131-7, for survey locations), however no lizards were observed during surveys. Due to the cryptic nature of lizards, surveys across large areas where lizards occur at low densities often do not yield positive results.

Table 6.1: Lizard species recorded within 15 km of the road alignment in the previous 20 years.

Common name	Scientific name	Threat status (Hitchmough *et al*., 2015)
Barking gecko	*Naultinus punctatus*	At Risk - Declining
Ngahere gecko	*Mokopirirakau* "southern North Island"	At Risk - Declining
Raukawa gecko	*Woodworthia maculatus*	Not Threatened
Glossy brown skink	*Oligosoma zelandicum*	At Risk – Declining
Ornate skink	*Oligosma ornatum*	At Risk – Declining
Northern grass skink	*Oligosoma ~~polychroma~~polychrome*	Not Threatened

6.3.2 Effects on lizards

Lizards are expected to be directly and indirectly affected by the construction of the Project. Potential effects of the Project on lizards as a result of vegetation loss and construction include:

- Injury or death as a result of vegetation clearance and construction activities;
- Construction noise, light and dust disturbance;
- Habitat fragmentation, isolation and an increase in habitat edge effects; and,
- Loss of lizard habitats, including regenerating kānuka, secondary forest, old growth forest and divaricating shrublands.

Potential ongoing effects resulting from the operation the road include:

- Decreased landscape and habitat connectivity through fragmentation; and
- Mortality or injury through lizard strike or road kill.

Table 6-2 Summary of lizard habitats affected by the Te Ahu A Turanga: Manawatū Tararua Highway Project and total area affected (including construction buffers)

Lizard habitats affected by the project	Summary of potential lizard habitat loss across the Project
Old growth forest Alluvial	0.1 ha of habitat loss
Old growth forest hill country	0.85 ha of habitat loss
Old growth treelands	0.13 ha of habitat loss
Secondary broadleaf forest with old growth signatures	0.25 ha of habitat loss
Kānuka forest	~~0.91~~1.3 ha of habitat loss
Advanced secondary broadleaved forest	0.04 ha of habitat loss
Secondary broadleaved forests and scrublands	6.71 ha of habitat loss
Mānuka and kānuka shrublands	2.11 ha of habitat loss
Divaricating shrublands	0.33 ha of habitat loss
Rank grass component of improved pasture	

Lizard habitats affected by the project	Summary of potential lizard habitat loss across the Project
Total	**Approximately 11.~~43~~82 ha of vegetated habitat loss + indirect effects**

6.3.3 Effects management for lizards

Potential construction-related adverse effects on lizards will primarily occur through habitat loss associated with vegetation clearance and earthworks. Potential adverse ecological effects will be avoided, remedied or mitigated through:

- Refinement of the Project footprint through detailed design and construction methodology where possible;
- Seasonal constraints on vegetation clearance (vegetation clearance only during earthworks season – during these warmer months lizards are more active and easier to capture) (refer to Table 3.2);
- Surveys and salvage operations prior to vegetation clearance for native lizards (refer to protocols in Section 6.4);
- Lizard relocation to a pre-approved relocation site(s) (refer to Section 6.5); and
- Vegetation clearance protocols (refer to protocols in Section 6.6).

For residual adverse effects on lizards that cannot be avoided or minimised and to improve nearby lizard habitat values, the following offset and compensation measures are proposed:

- Indigenous revegetation and enhancement of 45.6 ha of terrestrial habitat and 6.6 ha wetland planting (including 10 m buffer planting);
- Retirement and enhancement of 48.3 ha of native bush;
- Deployment of logs (> 50 cm diameter cut into 3-5 m sections) and log discs (20-50 mm cross-sections) into indigenous revegetation and enhancement areas to provide refugia for lizard prey and lizards; and
- Pest control over ~~planting~~revegetation and retirement areas~~,~~ and approximately 300 ha in and adjacent to the Northern Manawatū Gorge Scenic Reserve~~; and~~, including rat, mustelid , and possum control for ten years, and deer control for 35 years.

These measures to address residual effects on lizards are detailed in the Vegetation Clearance Management Plan (Section 2~~) and the~~), Residual Effects Management Plan (Section 12~~),~~) and Pest Management Plan (Section 13), which provides detail on the location, type and magnitude of introduced mammalian predator control, as well as restoration and enhancement proposed, in order to offset or compensate for residual effects associated with the Project.

6.4 Lizard salvaging protocols

The protocols for lizard salvaging and relocation specified below are consistent with standard methodologies from DOC's Inventory and Monitoring Toolbox: Herpetofauna (Lettink, 2012) and are commonly used on many construction projects. The methodologies have been adapted for local site conditions.

6.4.1 Salvaging footprint

Lizard salvage is proposed in order to prevent mortality or injury to lizards during vegetation clearance. Field surveys, aerial photographs and assessment of habitat types have been used to identify possible lizard habitats within the Project footprint (refer Drawing Set in Volume 3, TAT-3-DG-E-4131-7).

Lizard habitats identified shall be subject to salvaging protocols, as described below, and the specific salvage methodologies used will be guided by the Project Ecologist - Terrestrial with advice from a herpetologist based on their assessment of lizard habitat. The Project Ecologist - Terrestrial has discretion to include or exclude areas for specific methodologies based on the type and quality of habitat being cleared.

6.4.2 Salvaging protocol

Salvaging will include a range of techniques as described below and will be undertaken only during warmer months (October – April inclusive) when lizard species are more active and therefore more likely to be detected during salvaging operations.

Suitable weather

For the purpose of this management plan, suitable weather is defined as minimum temperatures of 10°C for night time salvaging, and 15°C for daytime salvaging, with light winds and fine weather.

The decision to deploy Artificial Cover Objects (ACO) and/or undertake manual habitat searching shall be at the discretion of the Project Ecologist - Terrestrial and will depend on the habitat present and likelihood of lizard salvaging.

6.4.3 Artificial cover objects

ACOs will be used to monitor and/or capture native lizards within potential lizard habitat. Each ACO will consist of two stacked Onduline sheets measuring approximately 500 mm x 450 mm.

Approximately 550 ACOs (ca 50 ACOs per ha) will be deployed six months prior to vegetation removal within the 11.43 ha of vegetated lizard habitat that is present within the Project footprint. Each ACO will be deployed in suitable microhabitat along transects containing 20 ACOs spaced at 5 to 20 m apart.

Checking of ACOs will commence four weeks prior to vegetation clearance and checked at 2 week intervals up to and immediately prior to vegetation clearance (i.e. 3 checks per ACO). ACO checks will be undertaken during weather conditions and timeframes deemed by the Project Ecologist - Terrestrial to be suitable for ACO-based lizard capture.

6.4.4 Daytime salvaging

Systematic manual, destructive, and/or machine-assisted salvaging will be undertaken from two weeks prior to vegetation clearance, and during and immediately following vegetation clearance in habitat deemed to have high lizard values by the Project Ecologist - Terrestrial.

Where deemed necessary by the Project Ecologist – Terrestrial, manual and destructive salvaging before vegetation clearance will include:

- Turning over or pulling apart cover objects (e.g. coarse woody debris or rocks);
- Raking of leaf litter or ground cover (e.g. pampas or tradescantia); and
- Habitat searches of low growing epiphytes, dense low-growing vegetation, loose tree bark, fern skirts and woody debris.

Construction (machinery) assisted salvaging during vegetation clearance activities shall be undertaken in conjunction with:

- Removal of large cover objects that cannot be searched manually (e.g. large decomposing logs~~).~~);

- Mulching of rank grass or other low-stature vegetation using a mulching head or a scrub cutter as appropriate in high value lizard habitat. This action will help reduce habitat and therefore will improve catch rate and / or render habitat unsuitable so that lizards will move outside the Project footprint;
- Manual and destructive salvaging after vegetation clearance will include:
  - Turning over or pulling apart cover objects (e.g. coarse woody debris or rocks);
  - Raking of leaf litter or ground cover (e.g. pampas or tradescantia); and
  - Searching of felled vegetation and associated epiphytes.

6.4.5 Nocturnal salvaging

Where deemed necessary by the Project Ecologist – Terrestrial, vegetated sites deemed to include high value suitable and searchable gecko habitat will be searched on a minimum of three separate nights during the four weeks leading up to the commencement of vegetation clearance. Nocturnal searches will be undertaken using powerful torches (minimum 800 lumens) and binoculars to 'spotlight' and capture lizards. Nocturnal searches will focus on native vegetation edges, which provide suitable habitat for lizards and in which lizards are most readily detected. Nocturnal salvaging will also be undertaken in habitat away from the forest edge where this is considered by the Project Ecologist - Terrestrial to be suitable for salvaging.

6.4.6 Salvaging effort

The protocol for the salvaging effort in potential high value lizard habitat is as follows:

- An initial 10 person-hours (e.g. 2 people for 5 hours) per 10,000 m2 of daytime salvaging and an initial 10 person-hours of nocturnal salvaging per 10,000 m2 will be undertaken in potential lizard habitat prior to vegetation clearance;
- If no lizards are found within the allocated time for daytime or nocturnal salvaging, no further salvaging will be undertaken and clearance can commence without Project Ecologist supervision, and without post-clearance surveys;
- If lizards are found during pre-clearance surveys, construction-assisted salvaging will be undertaken during clearance of potential lizard habitat (i.e., vegetation clearance will be supervised by a permitted ecologist, and any native lizards sighted during clearance will be salvaged);
- Where lizards have been found during pre-clearance salvaging, an additional systematic daytime salvage will be undertaken immediately after woody vegetation has been felled. This will take an indeterminate amount of survey effort, until all felled vegetation has been searched;
- After this final post-clearance salvage has taken place, all woody vegetation will be carefully stacked adjacent to the closest vegetation edge and left in-situ for a minimum of three days and night before mulching can be undertaken; and
- If one or more lizards are found in a 10,000 m2 area of native forest habitat within the allocated time of daytime or nocturnal salvaging, then further daytime or nocturnal salvaging will be carried out in that area until no further lizards have been found after 4 additional person-hours of salvaging. If lizards continue to be found, then a maximum of 60 person-hours of salvaging per 10,000 m2 will be applied for each area of lizard habitat and for each salvaging method (i.e. manual and/or nocturnal).

Where 60 person-hours per 10,000 m^2 of habitat has been undertaken and lizards continue to be found, changes to salvage and relocation protocol may be undertaken in consultation with DOC.

6.4.7 Data collection

Each individual lizard will be assigned a number and the following information will be recorded:

- Date and time of capture and weather conditions;
- Capture methodology;

- Capture location (GPS coordinates) capture methodology, habitat type; and
- Species, sex (reproductive status for females), age class and Snout to Vent Length (SVL) and tail status (regenerating versus original tail) and overall health and condition.
- A minimum of one photograph of each captured lizard, including at least one photograph showing the dorsal surface clearly.

6.5 Lizard relocation protocol

6.5.1 Capture, handling and transport

The following steps will be overseen by the Project Ecologist - Terrestrial to ensure appropriate handling of lizards occurs. The transportation of all lizards will comply with the Animal Welfare (Transport within New Zealand) Code of Welfare (Ministry for Primary Industries, 2018).

Capture, handling and relocation 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 sterilised;
- Hand sterilisation will be undertaken;
- Salvaged lizards will either be 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 – vegetation/leaf litter will be added to plastic containers to shelter and protect lizards during transportation;
- Where practical, indigenous lizards will be placed into ventilated two litre plastic containers for no longer than 8 hours for transportation and relocation to the relocation site(s); and
- Salvaged lizards will be released into appropriately prepared and protected habitat suitable for the species being translocated.

6.5.2 Relocation site~~(s)~~

Native lizards will be relocated to a ~~suitable~~pre-determined relocation site that ~~will be as part of process of securing Wildlife Permits. Suitable locations in proximity of salvaging sites are available~~has been selected in the NMGSR. A map of the proposed relocation site is provided in Figure 6.1~~Manawatū Gorge Scenic Reserve.~~ below.

Key aspects of the lizard relocation site(s) are:

- It includes a diversity of adjoining habitats, namely rank grassland, regenerating shrublands and mature native forest, and is readily accessible.
- The proposed relocation site ~~consists of a 17 ha~~is located in the NMGSR. It is 1000 m^2 in size (with an additional 100 m buffer) and is located across a gully and ridge formation comprised of mature indigenous forest protected by stock-proof fencing;
- The site forms part of a larger area of native ~~riparian~~ vegetation of approximately 300 ha which is intended to be subject to pest control for a 10 year period (rats, mustelids and possums) and 35 years of deer control as part of the offset and compensation measures for the Project. The relocation site will also be subject to relocation site specific mouse control to address expected increases in mice numbers in the absence of rats (as outlined in Section 13.6.4~~;~~ in the PMP);
- ~~Any indigenous lizards salvaged will be relocated into suitable micro-habitat within the relocation site(s);~~
- ~~Farm livestock exclusion;~~
- ~~Any pest control requirements at the relocation site to be confirmed through the Wildlife Authority Permit.~~

Within the relocation site(s) we will deploy approximately 100 ACO's, and 16 m of felled logs of suitable size and 4 m of log discs[12] will be deployed to serve as refugia for lizard prey and for lizards. Cell foam covers will be placed around all native trees larger than 50cm dbh in the relocation site (approximately 20) to provide additional refugia for gecko species. The cell foam covers will not be used by the elegant gecko but this species inhabits foliage and thus there is a considerable amount of habitat for this species).

For each lizard the following information will be recorded upon release:

- Date and time of release and weather conditions;
- Release location (GPS coordinates), habitat type; and
- Release photograph(s).

[12] Logs and log discs will be > 50 cm diameter and logs will be cut into 3-5 m sections (approximately 5-6 sections) and log discs will be cut into 20-50 mm sections.

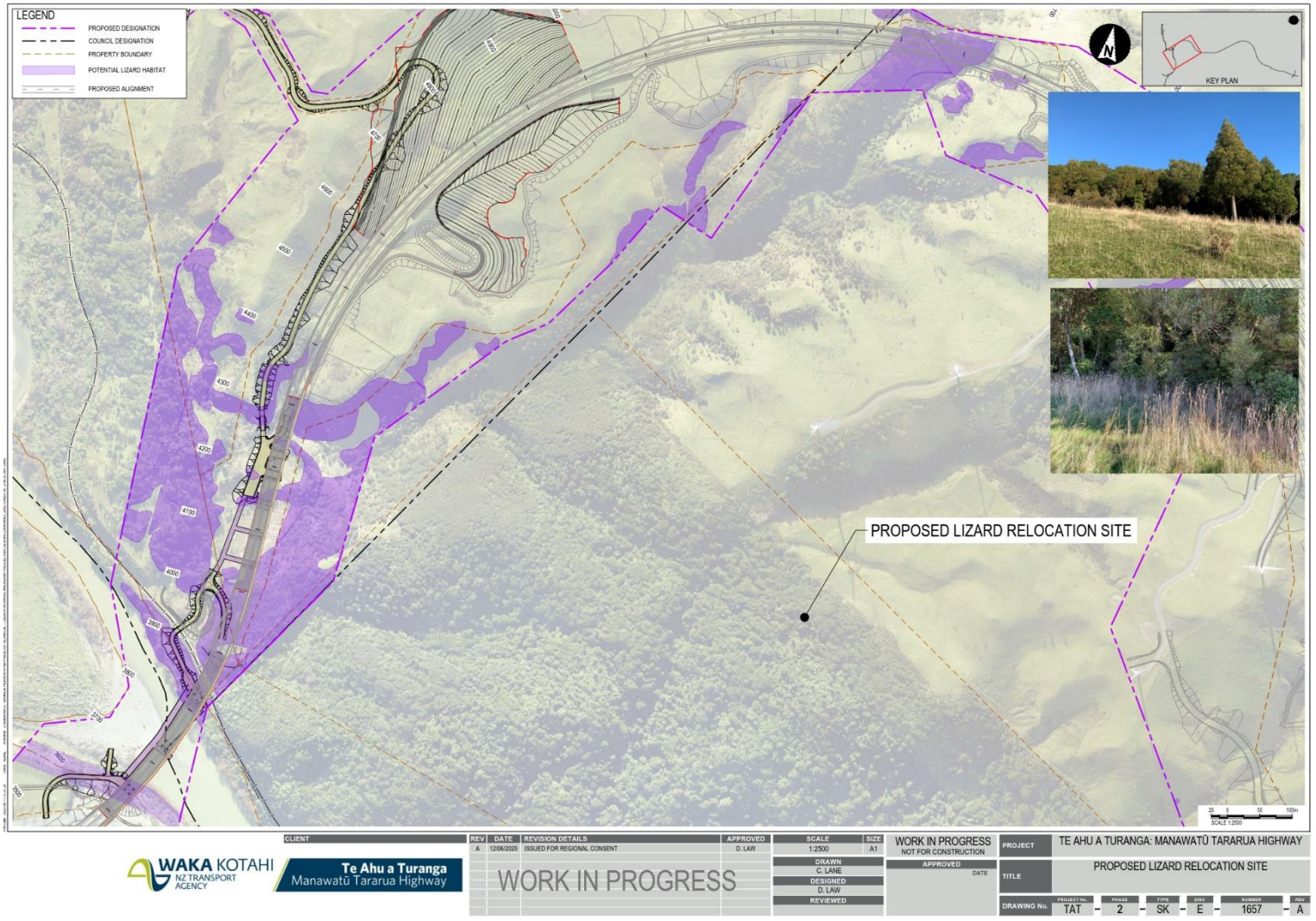


Figure 6.1: Proposed lizard relocation site in the NMGSR

6.5.3 Lizard injury or death

The following steps will be implemented if any injured or dead native lizards are found during lizard salvage as per Wildlife Act Authority Permit (Authorisation no. XXXX-FAU) [PLACEHOLDER]:

- The Environmental Manager and relevant representatives of DOC, Horizons and the Territorial Authorities will be notified at the earliest opportunity within 24 hours after an injured or dead lizard found;
- Any lizard death of 'Threatened', 'At Risk', or 'Data Deficient' species shall be sent to Massey University Wildlife Post Mortem Service for necropsy[13];
- Appropriate measures shall be undertaken to minimise further lizard deaths;
- 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 Ecologist – Terrestrial (or designated suitably qualified ecologist) to ensure the animal is handled appropriately until the lizard(s) can be assessed and treated;
- Lizards assessed by the vet or alternative specialist as uninjured, or otherwise in suitable condition for release, will be transported to the lizard relocation site in the portable enclosure and released into habitat suitable for the species being relocated; and
- Euthanasia of an injured lizard shall only be undertaken under direction from DOC.

6.6 Vegetation clearance protocols

Vegetation clearance protocols shall be used to avoid, remedy and minimise adverse effects to lizards, which shall be overseen by the Project Ecologist – Terrestrial with the assistance of ecologists named on the appropriate Wildlife Act Authority. In order to minimise mortality and injury to indigenous lizards not detected during the above salvaging operations, felled trees deemed to be suitable for indigenous lizards shall be cut into sections and stockpiled at the edge of remaining native vegetation for a minimum of one month. It is expected that indigenous lizards will disperse out of the felled vegetation and into adjacent habitat. The stockpiled vegetation can then be used as habitat enrichment in planting areas~~, removed from the site and/or mulched with no further restrictions.~~ (cut into sections and also into discs), removed from the site and/or mulched. Immediately prior to removal and/or mulching of stockpiled vegetation, stockpiles will be inspected by the Project Ecologist – Terrestrial or other named ecologists on the appropriate Wildlife Act Authority to check for skinks.

6.7 Monitoring and reporting

6.7.1 Compliance monitoring report

A compliance monitoring report will be submitted annually to Horizons and the Territorial Authorities. The compliance monitoring report will be submitted within ~~60~~20 working days of completion of salvaging and relocation operations for each earthworks season.

This report shall include:

- Confirmation that lizard salvaging and relocation operations were undertaken in accordance with the LiMP and associated consent conditions;
- Salvage and relocation results; and
- Recommendations for potential changes to improve the effectiveness of lizard management in relation to the LiMP scope.

[13] The body is to be chilled if it can be delivered within 24 hours, frozen if longer than 24 hours to deliver.

Notable changes to salvage and relocation protocol will be undertaken in consultation with Horizons, DOC, the Territorial Authorities, iwi project partners, and/or stakeholders (as required). Resulting changes and updates to the LiMP, following consultations, will be effective upon confirmation with all respective groups.

The compliance monitoring report shall also include representative photos showing:

- Representative photos of the salvaging methodologies; and
- Photos of lizards captured including salvage site photos and relocation site photos.

Annual reporting will cease once lizard salvage has been completed and all captured lizards have been relocated to the release site. A final report summarising the outcomes of LiMP implementation will then be prepared and submitted to Horizons and the Territorial Authorities within three months following final lizard release.

No post-monitoring of lizards is proposed within the relocation site to determine if relocation has been successful. This is due to the inherent difficulties associated with marking individuals and with obtaining and interpreting meaningful data on the expectation that the number of lizards salvaged will be low, the lizards are difficult to detect and absence of detection does not constitute confirmation of relocation failure (e.g. lizards may all survive but may disperse away from the relocation site and outside of the monitoring footprint).

6.7.2 Outcome Monitoring Reporting

ACOs and cell-foam covers placed at the lizard relocation site and offset and compensation monitoring sites will be surveyed to determine presence / absence of lizards. Outcome monitoring for lizards that includes specific targets to determine success and adaptive management requirements (if applicable) is not proposed. However, presence / absence monitoring for lizards within biodiversity outcome monitoring plots will be undertaken as set out in the methods section of the REMMP.

~~6.7.2~~6.7.3 Wildlife Act Authority Permit Reporting

Reporting requirements outlined in Wildlife Act Authority Permit (Authorisation no. XXX-FAU) will be adhered to. Lizard capture and relocation data will also be compiled, summarised and submitted to DOC's national data repository for lizard records (the Bioweb Herpetofauna database) annually. As a minimum, the report 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.

7 Bat Management Plan

7.1 Introduction

This Bat Management Plan (BMP) describes measures to avoid, remedy or mitigate potential adverse effects of the Project on long-tailed bats (*Chalinolobus tuberculatus*) that may be adversely affected by the construction and operation of the Project.

Native bats are absolutely 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 Authorities issued by the Department of Conservation (DOC) will be required in order to undertake vegetation clearance during enabling works. These Authorities will have conditions attached specific to long-tailed bats, which may necessitate revision of this plan.

The following table sets out the purpose, specific objectives, performance measures and monitoring relevant to the BMP.

Purpose	This section of the EMP outlines how bat management during the Project meets the requirements of Condition 21 and 25 of the ~~draft~~ Designation Conditions~~, dated 15 October 2019.~~ ~~This section will be updated to incorporate any requirements~~; and Condition [EC10] of ~~Regional Council resource consents.~~the [draft] Resource Consent Conditions (12 June 2020).
Specific Objectives	The objective of this BMP, as set out in draft NoR Condition 21 is to avoid, remedy or mitigate the potential adverse effects of the Project on bats.
Performance Outcomes	The performance outcomes for bats will be achieved by the successful implementation of tree removal protocols (if required).
Monitoring	There are no specific post-management monitoring requirements for bats.

7.1.1 Baseline bat survey results

Baseline bat survey results were sourced from the reports listed in Table 1.1 and are summarised in Table 7.1 below:

Table 7.1: Summary of survey effort and results from three separate baseline bat surveys undertaken across the Project.

No. of acoustic recorders deployed	Survey dates	Report reference	Bats detected
12	27 February - 13 March 2018	Kessels Ecology, 2018	No bats detected
20	27/28 November - 10/11 December 2018	Boffa Miskell, 2018	No bats detected
20	26/27 March -	Boffa Miskell, 2019	No bats detected

No. of acoustic recorders deployed	Survey dates	Report reference	Bats detected
	09/10 April 2019		
8	10-13 February - 24/25 February	Tonkin + Taylor, 2020	No bats detected

Additional to the above site-specific surveys, a review of the national bat database administered by DOC was undertaken. There are records of long-tailed bats in the wider landscape. The closest record is approximately 13 km from the Project in the Pohangina Valley (recorded in 1994). There are also more recent records from 2019 occurring both west and east of the Project, and located approximately 22 km and 32 km from the site respectively.

The results of the Project-specific bat surveys strongly suggest that a long-tailed bat colony is not present in the study area. However, bats are known to occur in the wider landscape and there is potential bat habitat available in the study area. Given the mobility of long-tailed bats, bats may occasionally move through the area.

7.1.2 Responsibilities and competencies

Delivery of, and compliance with this BMP will be the responsibility of the Environmental Manager who will liaise with the Project Ecologist – Terrestrial and an appropriately qualified and experienced bat ecologist(s) to implement this BMP. Henceforth these personnel are referred to as the 'Project bat ecologist'.

The Project bat ecologist(s) will have the relevant competency classes (Table 7.2) for the type of bat work outlined in Section 7.5.

Table 7.2: Bat competency classes, adapted from the current DOC bat ecologist competency framework[14].

Class	Field activity	Competency
A	Acoustic monitoring	Setting up acoustic bat monitors (ABMs) for pre-felling surveys.
B	Analysing acoustic monitoring data	Setting up ABMs and analysing/interpreting results.
C1	Identifying short-tailed-bat roosts	Finding and identifying short-tailed bat roosts that are either occupied or unoccupied. This competency may also include arborists.
C2	Identifying long-tailed-bat roosts	Finding and identifying long-tailed bat roosts that are either occupied or unoccupied. This competency may also include arborists.
D	Handling bats	Handling bats (using one or more field methods) as outlined in DOC's best practice manual (Sedgeley *et al.,* 2012)
E	Training	Approved trainer for bat competencies A-D.

[14] The Department of Conservation's bat ecologist competency framework is currently under review. As such the relevant competency classes may change following review.

It will be important for the construction contractor to read and understand the BMP so that the protocols are adhered to correctly during construction works. The responsibilities of the construction contractor include but are not limited to:

- Reading and understanding the BMP including tree removal protocols;
- Meet with the Project bat ecologist and Cultural Monitoring Advisor to establish the areas scheduled for vegetation clearance during the upcoming earthworks season;
- Inviting iwi to participate in and support any survey deemed necessary, to appropriate exercise of kaitiakitanga responsibilities and that cultural concerns are addressed;
- Maintaining clear lines of communication with the Project bat ecologist and Cultural Monitoring Advisor regarding changes in the works schedule; and,
- Briefing new personnel about the contractor's responsibilities under this plan.

All personnel working on site are responsible for alerting the Project bat ecologist and the Site Manger in the discovery of any bat (i.e. during tree felling or vegetation clearance).

The Environmental Manager is responsible for reporting the discovery of 'At Risk' or 'Threatened' flora and fauna to the Local Area Manager (DOC) and the Cultural Monitoring Advisor and for maintaining a database with an incident register and file log of actions taken for each discovery of a 'Threatened' or at Risk' fauna.

7.2 Summary of ecological values, effects on bats and effects management

Detailed information on the ecological values for bats within the road corridor and effects on bats is provided in Technical Assessment F - Terrestrial Ecology: Appendix F.1: Bats[15]. This is summarised below.

There are two extant native species of bat in New Zealand, the long-tailed bat and the lesser short-tailed bat.

Lesser short-tailed bats (*Mystacina tuberculata*) occur in only a few sites across the country and are limited to areas with very large tracts (> 1000 ha) of old-growth forest[16]. The Project footprint is characterised by agricultural land and does not provide suitable habitat for lesser short-tailed bats. Hence, they are not considered further in the BMP.

Conversely long-tailed bats (*Chalinolobus tuberculatus*) are widely distributed across the country with populations occurring across a wide range of habitats from large tracts of old-growth forest, to rural landscapes and urban fringes. The Project area includes potential high value habitats for long-tailed bats if they are present in the landscape. Although long-tailed bats are currently widely distributed, the species is classified as 'Threatened - Nationally Critical'. This is due to their slow reproduction rates, predation by introduced mammals, and habitat loss and fragmentation.

7.2.1 Ecological values of the Project for bat species

Three acoustic bat surveys have been undertaken targeting potential long-tailed bat habitat across the Project area between February 2018 and ~~April 2019.~~February 2020. The surveys are summarised in Table 7.1 above.

[15] Note an addendum to Appendix F.1 of Technical Assessment F was also prepared to include the results of the February 2020 long-tailed bat surveys. This report is appended to Dr Baber's evidence in chief (June 2020).
[16] Lloyd B.D. (2001) Advances in New Zealand mammalogy 1990–2000: Short-tailed bats. Journal of the Royal Society of New Zealand, 31:1, 59-81.

No bats were detected during any of the baseline surveys. These baseline surveys involved a high level of survey effort and the results strongly suggest that neither bat species is present in in the Project area. However, the Project area contains potential habitat for long-tailed bats and a review of the national bat database administered by DOC shows that long-tailed bats are present in the wider landscape (the closest record is approximately 13 km away from the Project). As long-tailed bats are highly mobile, we cannot rule out that they may occasionally move through the area.

Conversely the closest lesser short-tailed bat record is approximately 74 km from the Project.

The results indicate that the Project area is unsuitable for short-tailed bats~~,~~ and has limited ecological values for long-tailed bats. Although a long-tailed bat colony is not currently present in the area, they are highly mobile and individual bats present in the wider landscape may occasionally use the area. Given the threat status of long-tailed bats, it has been considered prudent to include management measures to reduce the risk of injury/mortality of bats that could occasionally roost in the Project area.

7.2.2 Potential roost habitat in the Project footprint

Mature trees have been identified within the Project footprint and wider landscape which contain characteristics of bat roost trees. These include generally large, tall, trees with the following features:

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

7.3 Effects on bats

The baseline long-tailed bat surveys strongly suggest that the Project is not located within the home range of a bat population. However, bats may occasionally disperse through the area. Hence this bat management plan focusses on regular surveys and management of the potential direct effect of injury or death through clearance of occupied roost trees.

Table 7.3 below lists the vegetation types containing potential roost habitat along with the area of each of these vegetation types expected to be removed as part of the Project.

Table 7.3: Vegetation types identified across the Project footprint that provide potential long-tailed bat roost habitat, and with the area proposed for removal.

Vegetation type	Chainage (refer to Project drawing set - Terrestrial Ecosystems and Survey Locations)	Area within the designation corridor (ha)	Area removed across Project footprint (ha)
Old-growth forest (alluvial)	CH 4000	4.04	0.10
Old-growth forest (hill country)	CH 5500 - CH 5600	1.23	0.85
Secondary broadleaved forests with old-growth signatures	CH 7300 CH 10400 - CH 10500	2.37	0.25
Old-growth treelands	CH 5800	0.56	0.13

Vegetation type	Chainage (refer to Project drawing set - Terrestrial Ecosystems and Survey Locations)	Area within the designation corridor (ha)	Area removed across Project footprint (ha)
	CH 6500 - CH 6600		
Exotic forest / treeland	CH 4300 - CH 4400 CH 4900 CH 8700 - 8800 CH 9300 - CH 9700 CH 10400 - CH 11000 CH 11400 - CH 13300	10.90	4.93

All other vegetation types can be removed without the requirement for the bat management protocols listed below to be undertaken.

7.4 Effects management for bats

Potential adverse effects on bats will be avoided or minimised through:

- Refinement of the Project footprint through detailed design and construction methodology;
- Tree removal protocols for bats (refer to Section 7.5.2); and
- Seasonal constraints for vegetation clearance (refer to Section 7.5.2);

Long-tailed bats are highly mobile and the range of an individual bat, or a population, could shift to include all or part of the Project footprint over the course of construction, although this is considered highly unlikely. To manage this risk, annual pre-clearance surveys will be undertaken as opposed to defaulting to a very resource intensive vegetation removal protocol.

7.5 Protocols for managing effects on bats

The protocols outlined below only apply to the vegetation types listed in Table 7.3, all other areas are considered to be unlikely to contain high quality roost trees. Given the lack of bat activity recorded across the Project area to date, it is very unlikely that the less preferential roost habitats will be occupied by bats.

Vegetation clearance of the other habitat types (not listed in Table 7.3) can be undertaken with no further bat management.

7.5.1 Focussed bat surveys

1. Prior to vegetation clearance commencing each construction season the following will occur:
   - The Project Bat Ecologist will meet with the lead construction contractor to establish the areas scheduled for vegetation clearance during the upcoming earthworks season, and if any of these clearance areas include the vegetation types listed in Table 7.3;
   - The Project Bat Ecologist will undertake a presence/absence acoustic survey within the vegetation types listed in Table 7.3 that are scheduled for clearance that season;
     a. The survey intensity (i.e. density of acoustic recorders deployed) will be determined by the Project Bat Ecologist; and
     b. Acoustic recorders will be deployed for a minimum of 14 nights and surveys will only be undertaken between October and April (inclusive~~)~~).

2. If no bat activity is recorded during the focussed bat surveys, vegetation scheduled for clearance that season can be undertaken with no further bat management required.

3. If bat activity is recorded, the Project Bat Ecologist will determine whether the bat activity record constitutes likely roosting behaviour. Generally speaking the following will be taken into account:
   - Was the activity recorded within two hours of either dusk or dawn;
   - The level of activity i.e.:
     a. Occasional bat activity during the middle of the night; or
     b. Clustered activity at any time of night but particularly near dusk or dawn; or
     c. Regular activity across multiple survey nights.

4. If, based on the activity patterns recorded, the Project Bat Ecologist is comfortable that the activity was highly likely to be an individual bat dispersing through the area on occasion, scheduled clearance for that season can be undertaken with no further bat management required.

5. If based on the activity patterns recorded, the Project Bat Ecologist cannot rule out that either a bat may be roosting on the site, or multiple bats appear to be active in the area regularly, the tree removal protocols outlined in Section 7.5.2 will be undertaken in the area where the bat activity was recorded.

6. If any additional area of vegetation types listed in Table 7.3 get added to the vegetation clearance schedule during the season, these areas will require a focussed bat survey prior to clearance. Alternatively, the lead construction contractor can opt to go immediately into the vegetation removal protocols outlined below.

7. The above focussed bat survey protocols will be undertaken at the beginning of each season of vegetation clearance, noting that acoustic surveys can only be undertaken between October and April (inclusive).

8. The lead construction contractor may elect not to undertake focussed bat surveys. In this instance the tree removal protocols outlined in Section 7.5.2 will be undertaken in any area (within vegetation types listed in Table 7.3) where surveys are not carried out.

7.5.2 Tree removal protocols

Tree removal protocols (TRP) only apply to the vegetation types listed in Table 7.3, and will be implemented only if required following focussed bat surveys each construction season (refer to section 7.5.1 above).

7.5.2.1 Purpose

TRPs will be used to avoid injury or mortality to bats arising from the felling of occupied trees during tree clearance. The protocols below detail the techniques that will be used to detect roosting activity prior to clearance of vegetation, and procedures to guide the clearance process. The protocols are consistent with

best practice methodologies and have been commonly used on many large infrastructure construction projects[17]. The methodologies have been adapted for local site conditions.

The TRP aims to:

- identify potential bat roost trees that exist within key habitats within the Project footprint prior to vegetation clearance;
- provide clear, concise procedures that are to be followed prior to removal of all trees within the Project footprint, with the aim of avoiding mortality or injury to bats in the event that they are found; and

Set out how any bat injury or mortality that may occur will be dealt with.

There are three protocols to be followed, which are set out below:

- Protocol A: Identification of Potential Bat Roost Habitat;
- Protocol B: Pre-Felling Procedures; and
- Protocol C: Bat Injury or Mortality.

7.5.2.2 Definitions

7.5.2.3 'High Risk' Roost Trees

For the purpose of this protocol, trees offering high potential as bat roosts will be considered 'High Risk'. High Risk trees are those positively identified by the Project Bat Ecologist and defined as being ≥15cm Diameter at Breast Height (DBH), with one or more of the following features:

- ~~cracks~~Cracks, crevices, cavities and/or fractured limbs large enough to support roosting bat(s);
- ~~sections~~Sections of loose flaking bark or epiphytes large enough to support roosting bat(s);
- ~~a~~A hollow trunk, stem or branches;
- ~~deadwood~~Deadwood in a canopy or stem of sufficient size to support roost cavities or hollows; and
- ~~bat~~Bat droppings, grease marks and/or urine staining around the aforementioned features.

Trees with evidence of bat droppings, grease marks and/or staining around cavities will be noted and investigated as High Risk probable roost trees, regardless of size.

7.5.2.4 'Low Risk' Roost Trees

All trees ≤15 cm DBH that lack the potential roost features above will be considered 'Low Risk' and may be felled at any time, without the need for further assessment or monitoring, and without the need for an approved Project Bat Ecologist to be present.

7.5.2.5 Dusk and Dawn

For the purposes of the TRP, 'dusk' and 'dawn' are defined as official civil dusk and dawn times.

[17] Smith, D, K Borkin, C Jones, S Lindberg, F Davies and G Eccles (2017) Effects of land transport activities on New Zealand's end This report has been produced by Wildland Consultants Ltd for Department of Conservation Waikato Area Office, Department of Conservation Wildlife Health Unit, The Wildlife Society of the New Zealand Veterinary Association, New Zealand Transport Agency emic bat populations: reviews of ecological and regulatory literature. NZ Transport Agency research report 623. 249pp.

7.5.2.6 Project Bat Ecologist

All pre-felling tree assessments, and assessments of acoustic monitoring data and behavioural observations will be made by an appropriately qualified and experienced bat ecologist/s (competency level C2), as defined in Section 7.1.2. A Level D bat ecologist is required to be on site during the removal of all High Risk trees.

7.5.2.7 TRP Protocol A: Identification of Potential Bat Roost Habitat

1. Pre-felling tree assessments and acoustic monitoring shall be undertaken by an appropriately qualified bat ecologist (refer to Section 7.1.2).
2. All trees to be removed in the vegetation types listed in Table 7.3 will be visually assessed prior to vegetation clearance and classed as either High Risk or Low Risk by the Project Bat Ecologist in terms of providing potential bat roost habitat (refer to Section 7.5.2.2 for definitions of High and Low Risk).
3. All High Risk trees shall be subjected to a pre-felling assessment using acoustic surveys in the first instance (refer to Protocol B).
4. Low Risk trees can be felled at any time, without the need for further assessment or monitoring, and without the need for an approved Project Bat Ecologist to be present.
5. There are some areas proposed for clearance where identification of potential roost trees via visual assessment will be either too difficult (e.g. due to the height of the trees), or very time consuming. In these cases, it is at the Project Bat Ecologist's discretion to classify and entire area as High Risk habitat and proceed directly to the pre-felling procedures for High Risk trees.

7.5.2.8 TRP Protocol B: Pre-Felling Procedures

1. High Risk trees will be removed during suitable weather conditions as outlined in point 4 below.
2. All Low Risk trees may be felled at any time without the need for acoustic survey.
3. The Project Bat Ecologist(s) (competency level D) will be on site for removal of all High Risk trees but is not required to be present for removal of Low Risk trees.
4. All High Risk trees or areas of High Risk trees to be removed will be clearly marked by the Project bat ecologist(s) in advance of removal. To determine roosting activity, High Risk trees will be acoustically monitored with acoustic bat monitors (ABM) overnight (from one hour before official dusk to one hour after official dawn) for a minimum of two consecutive nights (with suitable weather conditions) immediately prior to removal. Suitable weather conditions during this time must include:
   - overnight minimum temperature no less than 10 degrees Celsius; and
   - mean overnight wind speed no greater than 20 km/h; and
   - maximum overnight wind gust of no greater than 60 km/h; and
   - ≤2.5mm rainfall during the first two hours after dusk.
5. No monitoring should take place during a full moon, or one night either side of a full moon. Where a night of monitoring is lost or interrupted due to non-suitable weather conditions, a further night of monitoring must take place to compensate, until a total of two consecutive nights of monitoring is achieved.
6. All ABM data gathered during the pre-felling survey shall be reviewed the same morning the survey specified in Protocol B ends, in order to give the tree felling contractor sufficient time to fell trees prior to dusk if no bats are recorded.
7. If no bat activity is recorded during the two nights of acoustic monitoring, the bat ecologist(s) shall inform the lead construction contractor within one hour of reviewing the data to give permission for the affected tree(s) to be felled.
8. If the bat ecologist considers that bat activity patterns recorded on the ABM(s) suggest that bats may be roosting in the vicinity of the ABM, or if a bat roost is observed, the bat ecologist shall inform the lead construction contractor, within one hour that the affected tree(s) cannot be felled until further

investigations of the trees have been undertaken. In this case the tree will be identified as a 'likely roost tree'.

9. If considered appropriate by the Project Bat Ecologist(s), likely roost trees will be climbed by an arborist under the supervision of the Project Bat Ecologist. The arborist must take care when climbing so as not to harm or disturb any roosting bats. The arborist will take photographs of any roosts or roost evidence found. If necessary, an endoscope and hand-held bat detector will be used to examine potential roost features suspected of housing bats.
10. If climbing is not considered safe or appropriate by the arborist or the Project Bat Ecologist(s), the likely roost tree or trees may be observed by the Project Bat Ecologist(s) with hand-held bat detectors over the first two hours following dusk and the four hours prior to dawn on the next two consecutive suitable nights, to observe bats leaving or entering a roost within the tree or group of trees. If the check or observations over the two consecutive nights reveals no bats are roosting in the tree/s at present, the lead construction contractor will be informed that the tree/s can be felled on the morning after the second night of observation.
11. If bats are confirmed to be roosting within the tree, the following actions shall be taken:
    i. It will not be removed until further acoustic monitoring (a minimum of two consecutive nights) confirms that the bats have abandoned the roost.
    ii. Trees should be clearly marked and all relevant staff briefed to ensure the tree is not removed.
    iii. The immediate area will be cordoned off with safety fencing and signage erected in a 10 m radius around the suspected roost, alerting any person approaching the area that a bat roost is present and to stay clear.
    iv. All adjacent construction and vegetation removal activities (within 100 m) will be assessed for noise and vibration and where, in the opinion of the Project Bat Ecologist, the method of construction may disturb the roost, steps will be taken to eliminate, isolate or minimise the disturbance where possible.
    v. Representatives of DOC, the territorial authorities, and the Project Iwi partners will be informed by email with relevant information and photos if applicable.
    vi. If bats are still roosting in the tree after seven nights, the bat ecologist will contact the Environmental Manager and representatives of DOC, the territorial authorities, and the Project Iwi partners to arrange a meeting or teleconference to be held within seven working days to decide an appropriate way forward.
12. Immediately after tree felling, all High Risk trees will be inspected for bats and evidence of bat roosts by the Project Bat Ecologist(s).

7.5.2.9 TRP Protocol C: Bat Injury and Mortality

1. Any living bats found during vegetation clearance and construction works will be captured, placed in a dark cotton bag under the direction of the Project Bat Ecologist, and taken to a veterinarian immediately for assessment. Handling and assessment will be undertaken as outlined in the "Initial veterinary care for New Zealand bats document"[18]. A DOC approved veterinarian from the Massey University Wildbase Hospital will be contacted and informed of the captured bat. If unable to contact the veterinarian, the bat will be taken immediately to the Wildbase Recovery Centre for inspection.

    Central Energy Trust Wildbase Recovery
    Esplanade, West End
    Palmerston North 4410
    06 356 8199

[18] Borkin, K. 2019. *Initial veterinary care for New Zealand bats*. Report prepared by Wildland Consultants Ltd for Department of Conservation Waikato Area Office, Department of Conservation Wildlife Health Unit, The Wildlife Society of the New Zealand Veterinary Association, and New Zealand Transport Agency.

2. The Construction Manager or Environmental Manager and relevant representatives of DOC, the territorial authorities, and the Project iwi partners will be notified at the earliest opportunity within 24 hours after an injured or dead bat is found.

   DOC Manawatū District Office – 06 350 9700

   After Hours – 0800 DOC HOT (0800 362 468)

3. Any bat that is found dead or injured and subsequently euthanized by a veterinarian will be returned to DOC.

4. Bats assessed by the vet as uninjured will be kept in a dark cloth bag hung in a dark, quiet, place until dusk when it will be released along the closest corresponding edge of the Manawatū Gorge Scenic Reserve to where the animal was found.

7.5.3 Vegetation retention

Where possible, any standing dead trees that do not need to be removed during vegetation clearance activities are to remain in situ, as these offer good potential habitat for roosting bats.

7.5.4 Monitoring and reporting

7.5.4.1 Incident monitoring and reporting during vegetation clearance

Refer to Protocol B (Section 7.5.2.4) and Protocol C (Section 7.5.2.5) for actions required following findings of an active roost site or accidental death or injury to any bats found during vegetation clearance works.

7.5.4.2 Compliance monitoring

A compliance monitoring report will be submitted annually to Horizons and the Territorial Authorities. The compliance report will be submitted within ~~60~~20 working days of completion of clearance of the habitats listed in Table 7.3 each earthworks season.

This report shall include:

- Results of the annual bat presence surveys and whether or not said results triggered the initiation of the tree removal protocols;
- If the requirement for tree removal protocols is triggered the report will also include:
  - Confirmation that vegetation removal operations were undertaken in accordance with the BMP protocols and associated designation and resource consent conditions;
  - Details of work undertaken prior to removal of all potential High Risk roost trees under the requirements of the TRP, including the areas, the dates, and the results of acoustic monitoring undertaken, along with details of any climbing or visual emergence surveys undertaken; and
  - Recommendations for any potential changes to improve the effectiveness of bat management in relation to the scope of this BMP.

7.5.4.3 Wildlife Act Authority Reporting

Reporting requirements outlined in Wildlife Act Authority (Authorisation no. XXX-FAU) [PLACEHOLDER] will be adhered to. Confirmation that vegetation removal operations were undertaken in accordance with the BMP protocols and associated conditions outlined in the Wildlife Act Authority will be submitted to DOC annually.

This report shall include:

- Confirmation that vegetation removal operations were undertaken in accordance with the BMP protocols and Wildlife Authority conditions;
- Details of work undertaken prior to removal of all potential High Risk roost trees under the requirements of the TRP, including the areas, the dates, and the results of acoustic monitoring undertaken, along with details of any climbing or visual emergence surveys undertaken; and
- Recommendations for potential changes to improve the effectiveness of bat management in relation to the scope of this BMP; and
- Any other information DOC ~~require~~requires.

8 Avifauna Management Plan

8.1 Introduction

This Avifauna Management Plan (AMP) sets out how the Transport Agency proposes to avoid or minimise potential adverse effects on avifauna as a result of the Project. Ongoing pest control and restoration planting are proposed as the main methods to address residual effects on birds that cannot otherwise be avoided or mitigated (refer to Section 2 for details on required offset and compensation).

Most native avifauna on site are protected by the Wildlife Act (1953), and the Resource Management Act (RMA) 1991 affords protection to significant habitats of indigenous fauna. Furthermore, several species identified on site are classified as 'Threatened' or 'At Risk' under the Department of Conservation (DOC) National Threat Classification System (NZTCS) (Robertson *et al*., 2016).

This section of the EMP outlines how avifauna management during the Project meets the requirements of Condition 22 and 25 of the ~~draft~~ NoR Conditions~~, date 15 October.~~ , and [draft (12 June 2020)] Resource Consent Conditions [EC4, EC5, EC6, EC7, EC8].

This section will be updated to incorporate any requirements of Regional Council resource consents

8.1.1 Baseline avifauna surveys

Avifauna information from the Project and the wider landscape were sourced from the reports listed in Section 1.4.1, with an overall summary presented in Technical Assessment F – Terrestrial Ecology.

In summary, numerous bird surveys have been undertaken in indigenous and exotic forest, wetland, farmland, and braided river habitat within and adjacent to the Project footprint (refer Drawing Set in Volume 3, TAT-3-DG-E-4131-7). These consisted of:

- 22 5-minute bird counts in 2019;
- ~~10~~ 5-minute bird counts to inform the NoR process;
- Deployment and analysis of four ARDs (Automatic Recording Devices) in 2019; and~~,~~
- Deployment and analysis of five ARDs to inform the NoR process.

During other ecological surveys and site walkovers, incidental observations of avifauna were also made.

8.1.2 Responsibilities and competencies

Delivery of, and compliance with, this AMP will be the responsibility of the Environmental Manager who will liaise with the Project Ecologist – Terrestrial and specialist ecologist(s) as required.

Furthermore, the construction contractor will be involved in measures to avoid, remedy and mitigate impacts to avifauna during construction. The responsibilities of the construction contractor include but are not limited to:

- Reading and understanding the AMP;
- Facilitating a project start-up meeting with the lead Project Ecologist – Terrestrial, other relevant project ecologists, the Cultural Monitoring Advisor and the site manager before vegetation clearance commences for each construction stage (annually at a minimum). The purposed of this meeting is to establish the areas scheduled for clearance each season to enable forward planning and avoid delays in the construction schedule;
- Contacting the Project Ecologist – Terrestrial and Cultural Monitoring Advisor a minimum of 3 weeks before any of the areas outlined in areas outlined in the Terrestrial Ecosystems and Survey Locations Maps [TAT-3-DG-E-4131 to 4137] and Section 8.3.1 are scheduled for clearance;

- Inviting Project iwi partners to participate in and support any survey deemed necessary, to appropriate exercise of kaitiakitanga responsibilities and that cultural concerns are addressed;
- Maintaining clear lines of communication with the Project Ecologist - Terrestrial and the Cultural Monitoring Advisor regarding changes in the works schedule; and,
- Briefing new personnel about the contractor's responsibilities under this plan.

All personnel working on site are responsible for alerting the Project Ecologist - Terrestrial and the Site Manager in the discovery of any 'At Risk' or 'Threatened' flora and fauna not otherwise identified in this management plan.

The Environmental Manager is responsible for reporting the discovery of 'At Risk' or 'Threatened' flora and fauna to the Local Area Manager (DOC) and the Cultural Monitoring Advisor and for maintaining a database with an incident register and file log of actions taken for each discovery of a 'Threatened' or at Risk' fauna.

8.2 Summary of ecological values and effects

Detailed information on avifauna ecological values, effects and effects management is provided in the Technical Reports listed in Table 1.1 and is summarised below.

8.2.1 Avifauna ecological values

The avifauna assemblage in the Project area consists of native and introduced species present in agricultural, forest and wetland ecosystems. In total, 40 species have been observed during site investigations, while an additional 29 species have been identified as possibly using the area through desktop assessment.

The most recent bird surveys undertaken in 2019 identified 23 native bird species, 4 of which were categorised as At Risk: whitehead, NZ pipit, black shag and black fronted dotterel all classified as At Risk - Declining.

Bird species observed or expected to be present, with their preferred habitat and threat status (Robertson et al., 2016) are presented in Drawing Set in Volume 3, TAT-3-DG-E-4131-7. A total of eight 'Threatened' or 'At Risk' species have been observed onsite (Table 8-1), with an additional ten 'Threatened' or 'At Risk' species potentially present onsite (identified through desktop surveys; Table 8-2).

Table 8-1 Nationally Threatened or At Risk avifauna observed within or adjacent to the Project footprint.

Common name	Threat status	Habitat preference(s) in the Project area	Area of potential habitat removed as result of the Project (ha)
Black-billed gull (*Larus bulleri*) **Tarāpuka**	Threatened – Nationally Critical	River corridor	[TBC]
Caspian tern (*Hydroprogne caspia*) **Taranui**	Threatened – Nationally Vulnerable	River corridor	
Banded dotterel (*Charadrius bicinctus*) **Tūturiwhatu**	Threatened – Nationally Vulnerable	River corridor	
Black-fronted dotterel (*Elseyornis melanops*)	At Risk – Naturally Uncommon	River corridor	
New Zealand pipit (*Anthus novaeseelandiae*) **Pīhoihoi**	At Risk – Declining	Pasture	

Common name	Threat status	Habitat preference(s) in the Project area	Area of potential habitat removed as result of the Project (ha)
Whitehead (*Mohoua albicilla*) **Pōpokatea**	At Risk – Declining	Old-growth forest	
Black shag (*Phalacrocorax carbo*) **Kawau**	At Risk – Recovering	River corridor	
New Zealand falcon (*Falco novaeseelandiae*) **Kārearea**	At Risk – Recovering	Old-growth forest	

Table 8-2 Nationally Threatened or At Risk avifauna identified through desktop surveys which could potentially use the habitats available on site.

Common name	Threat status	Habitat preference(s)	Area of potential habitat removed as result of the Project (ha)
Australasian bittern (*Botaurus poiciloptilus*) **Matuku hūrepo**	Threatened – Nationally Critical	Wetland	[TBC]
Red-billed gull (*Larus novaehollandiae*) **Tarāpunga**	At Risk – Declining	River corridor	
Spotless crake (*Porzana tabuensis*) **Pūweto**	At Risk – Declining	Wetland	
South Island pied oystercatcher (*Haematopus finschi*) **Tōrea**	At Risk – Declining	River corridor	
Marsh crake (*Porzana pusilla*) **Koitareke**	At Risk – Declining	Wetland	
North Island kākā (*Nestor meridionalis*) **Kākā**	At Risk – Recovering	Old-growth forest	
New Zealand dabchick (*Poliocephalus rufopectus*) **Weweia**	At Risk – Recovering	Farm pond	
Pied shag (*Phalacrocorax varius*) **Kāruhiruhi**	At Risk – Recovering	River corridor	
Australian coot (*Fulica atra*)	At Risk – Naturally Uncommon	Farm pond	
Little black shag (*Phalacrocorax sulcirostris*) **Kawau tūi**	At Risk – Naturally Uncommon	River corridor	

8.2.2 Avifauna ecological effects

A summary of impacts to key native avifauna as a result of the Project is presented in the (Resource Consent) Technical Assessment F – Terrestrial Ecology. Overall, birds present in terrestrial, wetland and braided river habitats are expected to be impacted by the Project.

Potential effects on avifauna as an immediate result of construction include:

- Direct mortality of nests and their contents;
- Direct removal or degradation of habitat used for nesting and or foraging;
- Habitat fragmentation and isolation;
- The creation of habitat edge effects;
- Construction noise, light and dust 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 Project include:

- Effect of vehicle noise and disturbance on birds;
  - Noise effects are expected to be most impactful during bird breeding season, when masking of calls between conspecifics may reduce breeding success;
  - This effect is likely to be more pronounced for birds which call within a similar frequency to that of construction or vehicle noise (e.g. Australasian bittern booming).
- Decreased landscape and habitat connectivity through fragmentation;
- Mortality or injury on roads through bird strike or road kill; and,
- Degradation of the quality of the wetland and riparian habitat of wetland bird species through:
  - Altered hydrology of wetlands;
  - Contaminated stormwater runoff (sediment, heavy metals and elevated temperature) from road surface to wetlands;
  - Risk of spills of potential toxins (for example, oil or chemicals) from cartage vehicles; and,
  - Dust deposition during the construction phase.

8.3 Avifauna effects management

Potential adverse effects associated with the Project and associated construction works will primarily occur through harm to eggs and unfledged chicks during breeding season, habitat removal, sedimentation effects on wetlands and potential effects on breeding success and habitat use through noise-related disturbance on sensitive wetland bird species.

Measures to avoid, minimise and mitigate potential effects of the Project on key native bird species identified from baseline surveys are set out below, and follow best practice management of avifauna. Native terrestrial habitats, wetland habitats and the margins and bed of the Manawatū River are focal areas for managing effects on native birds.

These effects will be avoided or mitigated through the management measures outlined in Sections 8.3.1 to 8.3.7 and summarised in ~~.~~Table 8.3.

Residual effects on avifauna (as outlined in Technical Assessment F - Terrestrial Ecology) are addressed through habitat creation (including 45.6 ha terrestrial revegetation and 6.6 ha wetland revegetation), 48.3 ha of existing native bush retirement, pest control and the associated recovery of bird populations susceptible to introduced predatory mammals, as described further in the REMMP (Section 12) and PMP (Section 13).

8.3.1 Constraints on vegetation clearance

Adult avifauna are expected to fly away during vegetation clearance and habitat removal activities and are therefore unlikely to be harmed during these activities. However, during breeding season there is the potential for vegetation clearance and habitat removal to result in direct harm to nests, eggs and unfledged chicks. Various avifauna taxa groups breed in different habitats and have differing peak breeding seasons.

Therefore, the following protocols are specific to different avifauna and will be undertaken to avoid or minimise and mitigate effects on native birds:

Forest birds

- Vegetation clearance and habitat removal during the peak bird breeding season (**September to January inclusive**) will be avoided in the habitats listed below unless managed as described in section 8.3.2[19]:
  - Old-growth forest (alluvial)
  - Old-growth forest (hill country)
  - Secondary broadleaved forests with old-growth signatures
  - Old-growth treelands
  - Kānuka forests
  - Advanced secondary broadleaved forest
  - Secondary broadleaved forests and scrublands

Braided river birds

- Vegetation clearance and river bed disturbance during the peak bird breeding season (**July to March inclusive**) will be avoided in the riverbed of the Manawatū River unless managed as described in 8.3.3.

Cryptic wetland birds

- Vegetation clearance and habitat removal during the peak bird breeding season (**September to December inclusive**) will be avoided within 30 m of the habitats listed below unless managed as described in section 8.3.4 [20]:
  - Raupō-dominated seepage wetlands (high value)
  - Indigenous-dominated seepage wetlands (moderate value)

In the event that vegetation clearance or habitat removal is required during the peak breeding season associated with the vegetation/habitats listed above, clearance and/or removal will be subject to the constraints outlined in Sections 8.3.2 to 8.3.4 below.

Note that further restrictions for other avifauna habitats (rank grass and pasture wetlands potentially used by NZ pipit and pied stilt for breeding) are also outlined below. While habitat removal does not need to be avoided at any time, management constraints are outlined in Section 8.3.5 below which during the NZ pipit breeding season.

8.3.2 Forest bird management

In special circumstances, small scale vegetation clearance (< 100 m^2) may need to be undertaken during peak bird breeding season (September to January inclusive).

To avoid the loss of native bird nests, eggs and chicks associated with woody vegetation clearance during the peak breeding season, the following management protocols will be followed where clearance is required between September to January (inclusive) in the habitat types listed below:

- Old-growth forest (alluvial)
- Old-growth forest (hill country)
- Secondary broadleaved forests with old-growth signatures
- Old-growth treelands

[19] Note that this is additional to the vegetation clearance restrictions outside of earthworks season (1 May to 1 October inclusive)
[20] Note that this is additional to the vegetation clearance restrictions outside of earthworks season (1 May to 1 October inclusive)

- Kānuka forests
- Advanced secondary broadleaved forest
- Secondary broadleaved forests and scrublands

Refer to areas outlined in the Terrestrial Ecosystems and Survey Locations Maps [TAT-3-DG-E-4131 to 4137] to see the vegetation types listed above.8.3.18.3.5

Management protocols:

- During the peak breeding season (September to January inclusive), clearance of more than 100- m^2 of contiguous vegetation of the habitats listed above will be avoided, unless under extraordinary circumstances (critical path due to programming) the Project Ecologist – Terrestrial is consulted, and deems that potential effects can be appropriately managed and authorises that vegetation clearance;
- Where clearance of less than 100 m^2 of contiguous vegetation of the habitats listed above cannot be avoided (due to programming reasons) during the peak breeding season, bird nest surveys in the proposed clearance area shall be undertaken by the Project Ecologist - Terrestrial, or another suitably experienced ecologist;
- Prior to bird nest surveys, a surveyor will mark out the required area of vegetation clearance;
- Arborists may be required to assist with bird nest surveys where trees are too tall or dense to effectively assess from the ground. If no active nests are found, trees may be felled within 24 hours; and,
- Where active nests are found, then individual trees and immediate surrounding vegetation are to be left in situ, clearly marked and cordoned off until nesting birds have fledged or nests naturally abandoned, as verified by a suitably experienced ecologist;
- If nesting whiteheads are found then the tree will be marked and an exclusion zone established. The exclusion zone will cover a 50 m radius of forested area[21] with the nest in the centre. No clearance will be undertaken within this area until whitehead chicks have fledged or the nest has been naturally abandoned, as verified by a suitably experienced ecologist.

8.3.3 Braided river bird management

The management outlined in this section is specific to vegetation/habitat clearance in the habitats listed below:

- The exposed Manawatū riverbed

Within the Project footprint, black-billed gulls, banded and black-fronted dotterels, and other native birds (e.g. pied stilts) may nest on open shingle/gravel bed habitat along the Manawatū River and the eastern edge of Parahaki Island. Some birds such as dotterels will respond to nest loss from flooding or predation by continuing to opportunistically nest throughout their breeding season (July to March inclusive).

The choice of nest sites may be influenced by physical nest site parameters, including distance to the nearest potential cover (e.g. woody weeds used by predators such as cats, rats and mustelids). Dotterels have been shown to construct nests a mean distance of 20 m from the nearest low cover (>30 cm height) (Rebergen *et al*., 1998)

Nesting deterrents (e.g. silt fences or similar) can be used to block the birds' line of sight and deter dotterels and other birds from nesting based on the above predator avoidance mechanism stated above. These deterrents will need to be established prior to the breeding season, or during breeding season if it is confirmed that no birds are nesting in the area (see below for further detail).

[21] If the nest is not 50 m from the forest edge, the exclusion zone will end at the forest edge.

The following procedures shall apply if works are conducted in potential nesting habitat during the nesting season for these species (July to March inclusive) and are generally in accordance with the ~~NZTA's~~Transport Agency's 'Guidance in relation to New Zealand dotterels on NZTA land' dated November 2012[22]:

1. Prior to the breeding season (July to March inclusive), the Project Ecologist – Terrestrial or a suitably qualified ecologist shall check for black-billed gull, dotterel and other native braided river bird nests prior to the deployment of nesting deterrents across the unvegetated area of Parahaki Island in the vicinity of the BR02 footprint, covering both the construction footprint and a 50 m buffer zone. They shall use binoculars to assess the behaviour of any birds present to determine if any are nesting over a two-hour period. If nesting birds are detected:
    a. A 50 m exclusion zone should be erected around the nest (the nest shall be in the centre of the zone), and works shall not be conducted in the area until nesting activities are completed. No person or machine is to enter the exclusion zone unless the nest is established following the commencement of works within the 50 m zone and the birds are monitored and assessed by the Project Ecologist – Terrestrial as not being unduly affected by the activities.
    b. The nest shall be monitored weekly from a distance of at least 50 m and work will only re-commence in this area once a suitably qualified ecologist (or personnel trained by the Project Ecologist - Terrestrial) confirms the chicks have fledged, or the nest has failed (due to predation or flooding events).
    c. If the status of the nest cannot be determined from 50 m, then the ecologist shall slowly move closer to the position of the nest until they can successfully determine its status (e.g. active, failed, fledged).
    •
2. Where no nests have been found, nest deterrents shall be deployed on potential dotterel nesting habitat (i.e. unvegetated areas) along Manawatū River and the eastern edge of Parahaki Island.
    a. Nest deterrents shall be constructed 15 m apart and erected at knee-height;
    b. Fences shall be constructed parallel to the direction of the river;
    c. Each nest deterrent shall be firmly secured in position. Where deterrents have come loose, been washed away by flooding or have degraded to the point of insufficiently blocking the dotterels' line of site, they shall be immediately replaced;
    d. Nesting deterrents shall be constructed on and adjacent to the proposed access track, including 50 m either side of the track, if these areas are not vegetated; and,
    e. Nesting deterrents shall be constructed within the main construction area as well as within a 50 m buffer to this area, where these areas are not vegetated.

Following the construction of nesting deterrents, whilst construction is underway dotterels will be monitored during the nesting season and discouraged from establishing any nests within 50 metres of the Project Footprint by a qualified avifauna ecologist and cultural monitor. A monthly survey for potential nests shall be undertaken during the breeding season. If active nests are found, steps outlined in point 1 above shall be undertaken.

48 hours prior to construction, a final survey for nesting birds shall be undertaken and if no nesting birds are found then construction can commence within the 48 hour period. If construction activities halt within the potential nesting habitat during the nesting season (July to March inclusive) for three or more

[22] Acknowledging that this document was produced for a different species of native dotterel, however we consider it to be fit for purpose for management of Black-fronted dotterel.

consecutive days then another survey will need to be undertaken prior to construction works commencing again.

Furthermore, fliers shall be provided to the bridge construction crew and others working in the vicinity of the Manawatū River to identify dotterels.

8.3.4 Cryptic wetland bird management

The management outlined in this section is specific to vegetation/habitat clearance in the habitats listed below:

- Raupō-dominated seepage wetlands (high value)
- Indigenous-dominated seepage wetlands (moderate value)

Acoustic monitoring of swamp and wetlands habitats across the alignment to identify cryptic bird species has been undertaken during wetland bird breeding season (September to December inclusive). Acoustic Recording Devices (ARDs) were deployed for a six week period in raupō dominated wetlands, set to record at dawn and dusk. No 'Threatened' or 'At Risk' cryptic wetland birds were detected following analysis of the data. However, they may be intermittently present in these wetlands, therefore the following methodology shall be followed to avoid, remedy, or mitigate adverse effects:

Raupō vegetation clearance or works within 30 m of wetlands (areas outlined in Drawing Set in Volume 3, TAT-3-DG-E-4131-7) during the peak wetland bird breeding (September to December inclusive) season shall not be undertaken, unless a cryptic wetland bird nest survey has been undertaken and effects managed as described below.

Prior to any works occurring in the habitats listed above, a cryptic wetland bird nest survey shall be undertaken by the Project Ecologist - Terrestrial or another suitably experienced ecologist within two working days of the relevant habitat clearance in that area. This will consist of a suitably qualified ecologist undertaking a survey within the proposed area of clearance and surrounds. The protocols are as follows:

- Playback calls and observation of bird behaviour from a distance to determine wetland bird nest presence. This survey will be undertaken within two hours of dawn, and will entail a minimum of one hour of observation;
- If birds are identified, careful and thorough transect walks through accessible habitat will be undertaken searching for nests and eggs;
- If active nests are found, then an exclusion zone of 50 m radius shall be established and marked. No works or personnel are to be enter within the exclusion zone until chicks have fledged or the nest has been naturally abandoned, unless the nest is established following the commencement of works within the 50- m zone and the birds are monitored and assessed by the Project Ecologist – Terrestrial as not being unduly affected by the activities.
- If the area is deemed free of active nests by the Project Ecologist - Terrestrial, vegetation clearance or works may commence within two working days of the survey. If this timeframe is not achieved, the above survey will need to be repeated; and,
- If birds are identified during the pre-clearance, vegetation clearance in the wetland and wetland margin where the birds were observed shall be overseen by the Project Ecologist - Terrestrial or another suitably experienced ecologist.

8.3.5 New Zealand pipit management (also covers potential pied stilt breeding habitat)

The management outlined in this section is specific to vegetation/habitat clearance in the habitats listed below:

- Pasture wetlands, dominated by exotic species or the common native rush *Juncus edgariae* (low value)

- Pasture grassland

New Zealand pipit have the potential to use the Project site for nesting if suitable habitat is available within the designation. Pipits generally nest in long grasses or tussock. The overall aim of managing NZ pipit breeding within the Project area will be to limit the nesting habitat available, but where any nesting pipit are found they will be protected via exclusion zones. Minimising potential nesting habitat will be achieved by grazing and/or mowing pasture areas prior to construction activities being mobilised within the specific construction areas.

To determine if NZ pipit breeding habitat is available within the Project area, prior to, and at monthly intervals during the peak pipit breeding season (August to March inclusive) the Project Ecologist(s) - Terrestrial will undertake a site survey to determine if any long grass habitat is present within the construction footprint.

Prior to the breeding season, if suitable breeding habitat is identified, the area will be grazed by stock to limit potential breeding habitat. If the current grazing regime cannot be maintained then the areas will be mown, imitating the same stoking regime that was previously being undertaken in the area.

During the breeding season (August to March inclusive), if potential habitat is identified and mowing or construction activities are programmed to commence, a pre-clearance pipit survey will be undertaken within two working days before the relevant proposed habitat clearance works to locate existing nests (if any are present). If breeding pipits are identified then then an 50 m exclusion area will be implemented around the nest and construction activities will not be allowed to commence in that area until nesting activities are completed.

8.3.6 Waterfowl management

The following protocols are to be implemented in order to minimise disturbance to freshwater ponds and potential habitat of Australian coot and New Zealand dabchick located between CH9200 and CH9600.

A 30 m setback fencing shall be established from the edge of the freshwater ponds located between CH9200 and CH9600 during bird breeding season (September to December inclusive) to minimise disturbance to Australian coot and New Zealand dabchick. No construction works shall be undertaken within these setbacks.

8.3.7 Accidental harm during construction

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

- Injured native birds will be taken immediately to a vet approved by DOC for assessment;
- Birds will be placed in a cool, dark, material-lined box/bag by or under the direction of a suitably qualified Project Ecologist to ensure the bird is handled appropriately; and
- 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. The DOC hotline is 0800 DOC HOT (0800 362 468).

The name of the contact information for approved contact in the event of native bird injury or mortality shall be advised by DOC.

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 – Terrestrial, or designated suitably qualified ecologist, will determine any rehabilitation action required and the longer-term future for the bird/s, taking into account the advice from the vet, If the bird is dead or euthanized by the vet, it must be taken to the local DOC office as soon as practicable.

8.3.8 Management summary

Given the variety of different bird species inhabiting different habitat types across the Project area, a summary table of bird management is provided in Table 8.3. Effects to avifauna are to be managed through the avoidance of vegetation clearance during bird breeding season where possible, and the use of bird nest checks if required.

Table 8-3 Avifauna effects management summary

Avifauna	Effect to be managed	Key timeframes	Management actions	Relevant Management plans
Forest avifauna (old-growth and secondary broadleaved native forests) Refer to NoR Condition 22.b) iii – iv.	Vegetation clearance. Impacts to whitehead and other native birds.	Breeding season September to January inclusive.	Avoid native terrestrial vegetation clearance during forest bird breeding season.	AMP
			Bird nest checks during bird breeding season where native terrestrial vegetation cleared. Exclusion zones where whitehead nests found.	
Cryptic wetland avifauna NoR Condition 22.b) vi.	Vegetation clearance.	Breeding season September to December inclusive.	Cryptic wetland bird surveys in raupō dominated wetlands.	
			Where cryptic wetland birds found, wetland clearance undertaken outside wetland bird breeding season unless unforeseen circumstances arise. 30 m wetland exclusion fencing during breeding season.	
			Bird nest survey and checks prior to any wetland clearance during breeding season.	
			Erosion and Sediment controls for wetlands	CEMP
New Zealand pipit NoR Condition 22.b) v.	Vegetation clearance/ earthworks	Breeding season August to March inclusive.	Maintenance of grazing / mowing regime to limit available rank grass nesting habitat prior to clearance/construction. Nesting bird surveys	AMP
Braided-river nesting birds, including black-billed gull, banded and black-fronted dotterel. NoR Condition	Disturbance to nesting birds.	July to March.	Nesting bird surveys, deterrence fencing, dotterel identification training sessions for construction workers.	AMP

22.b) ii.				
Australian coot and New Zealand dabchick NoR Condition 22.b) vii.	Disturbance.	All year	Exclusion zones.	AMP
All avifauna	All residual effects.	All year.	Restoration plantings, enhancement and pest control of wetland and forest habitats.	PEMP, ~~REMP~~REMMP, PMP

8.4 Monitoring and reporting

Compliance or incident reports will be submitted to Horizons. Reporting will be undertaken annually and submitted within two months of the completion of vegetation/ habitat clearance (listed in Sections 8.3.1 to 8.3.5) that year. The Project Ecologist - Terrestrial, or an appropriately qualified and experienced ecologist(s) nominated by the Project Ecologist, shall certify that the works have been carried out in accordance with the approved AMP, and shall provide details of the outcomes of any bird nest checking, or instances of native bird mortality.

In light of findings and results, all proposed changes in management approaches will be undertaken in consultation with Horizons, DOC and Project Iwi partners. Specialist and expert advice will be sought as appropriate to improve management approach, if findings and results deem certain management actions non-effective. Changes and updates to the AMP, following consultations, will be effective upon confirmation from the Requiring Authority.

The compliance monitoring report will be submitted annually within ~~60~~20 working days of completion of vegetation/habitat clearance of the habitats listed in Sections 8.3.1 to 8.3.5 each earthworks season. It will include:

- An updated Project footprint and ecological constraints map that illustrates site specific avifauna clearance effects management measures;
- Representative photos showing physical delineation of vegetation within the project footprint, high value wetland bird habitat immediately adjacent to the footprint, and erosion and sediment control measures to protect wetlands; and,
- Details of any bird nest surveys undertaken.

For all bird nest surveys, the following variables will be recorded:

- Date and time;
- GPS location and/or area of checking; and,
- Outcome of bird nest check (e.g. presence or absence of active nests).

The Project Ecologist – Terrestrial, or designated suitably experience ecologist will assess the establishment and delineation of any 30 m wetland buffer areas prior to the wetland bird breeding season commencing.

Compliance reporting on restoration planting and pest control that will address residual effects on avifauna are addressed in the ~~PAPMP~~REMMP. The AMP shall be updated to achieve consistency with any

authorisation given by the Director-General of Conservation under section 53 of the Wildlife Act 1953 where any such authorisation is required.

8.4.1 Incident monitoring and reporting during vegetation clearance

Incident-based reporting will be provided to Horizons and DOC within 15 working days of an unforeseen event (e.g. notable compliance failure that results in adverse ecological effects), and will include the following information:

- The causes of the incident, the emergency response measures (if applicable) and the response proposed to avoid a recurrence of the issue;
- An assessment undertaken by a suitably qualified ecologist which details any adverse effects of the exceedance; and
- Proposed~~,~~ measures to avoid, remedy or mitigate effects or to offset or compensate for residual effects that cannot be avoided, remedied or mitigated.

8.4.2 Biodiversity outcome monitoring

Biodiversity outcome monitoring will be undertaken to verify offsetting of forest bird values using indicator species.

Further details, including reporting requirements, are provided in Section 12.7 of the REMMP.

9 Terrestrial Invertebrate Management Plan

9.1 Introduction

The purpose of this Terrestrial Invertebrate Management Plan (TIMP) is to specify procedures to achieve the standards set out in NOR Conditions 23, 24(a) and 25 and Resource Consent Condition EC11 [reference here is to proposed 12 June 2020 version] and to avoid, remedy or mitigate the potential adverse effects of the Project on 'At Risk' or 'Threatened' terrestrial invertebrates.

This section of the EMP outlines protocols for managing adverse effects on terrestrial invertebrates during the Project, as per the requirements of Condition 23, 24(a) and 25 of the ~~draft~~ NoR Conditions, ~~date 15 October.~~and [draft] Resource Consent Condition [EC11] [12 June 2020].

~~This section will be updated to incorporate any requirements of Regional Council resource consents.~~

9.2 Responsibilities and competencies

Delivery of, and compliance with this TIMP will be the responsibility of the Environmental Manager who will liaise with the Project Ecologist – Terrestrial and suitably qualified and experienced ecologists. While the Project Ecologist - Terrestrial will be responsible for coordinating the activities in this TIMP, the undertaking of these activities may be delegated to other suitably qualified and experienced ecologists associated with the Project. If necessary, the ecologists will hold a current Wildlife Act Authority for *Powelliphanta* salvage and relocation operations.

It will be important for the construction contractor to read and understand the TIMP so that the protocols are adhered to correctly during construction works. The responsibilities of the construction contractor include but are not limited to:

- Reading and understanding the TIMP;
- Facilitating a project start-up meeting with the Project Ecologist - Terrestrial and the site manager before the earthworks season commences each year to determine habitats scheduled for clearance each season to enable forward planning and avoid delays in the construction schedule;
- Contact Project Ecologist - Terrestrial a minimum of 3 weeks before any significant areas of invertebrate habitat[23] are scheduled for clearance;
- Inviting iwi to participate in and support any survey deemed necessary, to appropriate exercise of kaitiakitanga responsibilities and that cultural concerns are addressed;
- Maintaining clear lines of communication with the Project Ecologist - Terrestrial regarding changes in the works schedule; and,
- Briefing new personnel about the contractor's responsibilities under this plan.

All personnel working on site are responsible for alerting the Project Ecologist - Terrestrial and the Site Manager in the discovery of any 'At Risk' or 'Threatened' flora and fauna not otherwise identified in this management plan.

[23] Significant areas of invertebrate habitat will be determined based on the conclusions of the terrestrial invertebrate surveys described in Section 9.5 and will be outlined in the Ecological Constraints Maps [PLACEHOLDER – to be developed prior to construction].

The Environmental Manager is responsible for reporting the discovery of 'At Risk' or 'Threatened' terrestrial invertebrates to the Local Area Manager (DOC) and the Cultural Monitoring Advisor and for maintaining a database with an incident register and file log of actions taken for each discovery of a Threatened' or at Risk' terrestrial invertebrate.

9.3 Summary of terrestrial invertebrate values and effects

The terrestrial invertebrate values within the Project footprint were assessed by way of:

- A literature review to determine ~~Threatened~~'Threatened' and 'At ~~Risk~~Risk' species present in the landscape surrounding the Project footprint (Blayney and Sievwright, 2018);
- A qualitative desktop assessment of invertebrate habitats; and
- Incidental observations during nocturnal surveys for other taxa.

To date, no empirical invertebrate data have been collected from within the Project footprint due to time constraints. Preliminary desktop invertebrate assessments show that several species and their habitats may be present within the Project footprint, including species that are classified as 'Threatened' or 'At Risk' under the Department of Conservation (DOC) National Threat Classification System (NZTCS) (Hoare et al., 2007, ~~Hitchmough~~Hitchmough et al., 2007).

9.3.1 Habitat values

Several potentially high-quality habitats for terrestrial invertebrates present near or within the Project corridor (refer Drawing Set in Volume 3, TAT-3-DG-E-4131-7) were identified within Technical Report 6B: Terrestrial fauna ecological effects assessment technical report, as follows (Blayney and Sievwright, 2018):

- Mature forest in the western rise section (CH 4100 – 5900).
    - The established tawa forest (CH 5500 – 5900) contains a diversity of ground cover habitats and epiphytes, and is well-connected to the Manawatū Gorge Scenic Reserve.
    - The area of grazed mature forest (CH 4100 – 4500) contains limited ground cover other than graze tolerant shrubs and small areas of ferns where stock cannot access.
- Older regenerating secondary forest which has achieved canopy closure in the eastern rise section (CH 9900 – 12800).
    - The more mature and intact secondary forest patches have little grazing pressure, good canopy closure, some ground flora, leaf litter and woody debris.

During the NOR process, divaricating shrublands (CH 9300 - 9600) were also identified as potentially having ecological value for invertebrates. These shrublands may be host to At Risk *Meterana* moth species, whose larvae feed on certain species of small-leaved *Olearia*.

9.3.2 Species values

A range of common and 'Not ~~Threatened~~Threatened' invertebrate species were observed during nocturnal surveys for other taxa, comprising stick insects (*Acanthoxyla* sp., *Clitarchus hookeri*) and tree wētā (*Hemideina crassidens*). Several 'Threatened' or 'At Risk' terrestrial invertebrates were also identified during desktop surveys as possibly present within or near the Project corridor. The 'Not Threatened' peripatus species *Peripatoides novaezealandiae* has also been observed in the MGSR. Key invertebrate species and their habitats are summarised in Table 9.1.

Table 9.1: Summary of notable invertebrates and associated habitats that may be present in the Project area.

Species	Conservation Status	Habitat preferences	Chainages of potentially suitable habitat
Megadromus turgidceps (beetle)	Not classified	Native forest with an intact understorey	CH 5500 – 5900
Meterana grandiosa (moth)	At Risk - Relict	~~Divaricating shrubs including *Olearia* species~~The host plants of these species are small-leaved *Olearia* shrubs[24], which within the Project corridor are found in open areas and scrubland.	~~CH 9300 - 9600~~ Potentially in any open area or forest edge throughout the alignment. Confirmed observations of host species are at the following chainages: CH 4400; CH 9250 – 10000; CH 11050 – 11300.
Meterana exquisita (moth)	At Risk - Relict		
Powelliphanta traversi traversi (snail)	Threatened - Nationally Endangered	*Powelliphanta* snails are generally associated with forest areas with large accumulations of moist leaf litter. Also closely associated with calcium rich soils	CH 5500 – 5900
Powelliphanta traversi tararuaensis (snail)	Threatened - Nationally Endangered		
Powelliphanta marchanti (snail)	Threatened – Serious Decline		
Wainuia urnula (snail)	Not classified	Recorded in damp leaf litter and stable rock piles in intact and modified forest	CH 4100 – 4500; CH 5500 – 5900; CH 9900 – 12800

9.3.3 Baseline invertebrate surveys

Additional surveys prior to the commencement of construction works, which are required as per ~~draft~~ NoR condition ~~23b,~~23 (b), will provide further information on invertebrate community composition and the potential presence of 'At Risk' or 'Threatened' taxa. These surveys are detailed in Section 9.5. Once these surveys are completed, this management plan will be updated with appropriate effects management measures.

If invertebrate species protected by the Wildlife Act, such as *Powelliphanta* snails, are found during pre-construction surveys, this TIMP will also be updated to support a Wildlife Authority Application to DOC for the capture and relocation of these species.

[24] To date, two small-leaved *Olearia* species have been found within the designation (*O. solandri* and *O. virgata*). *Olearia virgata* is a known host-species of *M. grandiosa*. *Olearia solandri* is a known host species to other *Meterana* species (including *M. exquisita*; Patrick, 2000), so may also be a host for *M. grandiosa*.

9.3.4 Effects on terrestrial invertebrates

The potential effects on terrestrial invertebrates as an immediate result of construction and the ongoing operation of the road include:

- ~~Direct mortality;~~
- during construction and road operation;Construction noise, vibration, light and dust disturbance;
- Noise, vibration and light disturbance during road operation;Permanent loss of habitats; and
- Modification of remaining habitat through:
  - Fragmentation and isolation;
  - Edge effects; and
  - Increased presence of and likelihood of invasion by non-native plant and animal species.

9.4 Effects management for terrestrial invertebrates

Potential adverse effects associated with the Project and associated construction works will primarily occur through habitat loss and alteration.

Measures set out in the Vegetation Clearance Management Plan (VCMP) (refer Section 2 of the EMP) are designed to minimise unnecessary habitat removal, minimise effects on adjacent vegetation remaining, and protect and enhance remaining habitat and replacement plantings. These measures are summarised below and will benefit all fauna (including terrestrial invertebrates) using these habitats:

- Clearly delimiting the extent of vegetation clearance and ensuring vegetation is felled into the Project footprint to minimise impacts on the remaining vegetation;
- Retention of high-value felled vegetation for use as habitat enhancement (e.g. woody debris) in restoration areas where practicable;
- Weed control and infill planting along newly created edges;
- Removal and storage of ~~top soil~~topsoil from impacted vegetation areas to be relocated to offset planting areas in the vicinity; and
- Translocation of epiphytes from felled trees onto established trees in enhancement areas to promote diversity and old-growth flora characteristics in these areas.

Further measures that will have benefits for invertebrates are detailed in the Pest Management Plan (~~REMP;~~ Section 12~~)~~3) and the Planting Establishment Management Plan (Section ~~).~~4). These plans provide detail on the location, type and magnitude of introduced mammalian predator control, as well as mitigation and offset restoration and enhancement proposed in order to offset or compensate for residual effects on invertebrates associated with the project.

Draft NoR Condition 23 requires this TIMP to be updated following pre-construction surveys in respect of measures to address effects on terrestrial invertebrates – refer to section 9.5.3.1 below.

9.5 Terrestrial invertebrate surveys

~~To date, invertebrate surveys have not been undertaken and knowledge of species potentially present on site is based on desktop review information and incidental observations only. Condition 23 b of the NOR requires~~NOR Condition 23(b) and Resource Consent Condition [EC11] require additional terrestrial invertebrate surveys prior to the commencement of construction works to determine:

- Invertebrate community composition; and
- The presence of 'At Risk' or 'Threatened' taxa (as defined by the Department of Conservation's New Zealand Threat Classification System).

To date, flight intercept trapping of invertebrates, snail habitat surveys and surveys for *Meterana grandiosa* have been undertaken (25 – 29 May, 2020); however, results have not yet been finalised. Preconstruction terrestrial invertebrate survey methodologies and, where available, preliminary results are described in the following sections. This management plan will be updated once survey results are available.

9.5.1 Flight intercept trapping

Flight intercept traps (FITs) ~~will be~~were deployed in areas identified as potentially ~~value~~valuable habitat ~~value~~ for invertebrates to determine species composition and the presence of 'At Risk' or 'Threatened' taxa. FITs will be deployed to capture both ground-dwelling and flying invertebrates.

Ten FITs ~~shall be~~were deployed within suitable habitat within each of the following vegetation types (refer to Drawing Set in Volume 3, TAT-3-DG-E-4131-7 for locations):

- Selected areas of old-growth forest (alluvial) (CH 4000 – 4400; 4.0 ha), focusing on areas of ferns and ground flora that have not been impacted by stock;
- Old-growth forest (hill country) (CH 5500 – 5700; 1.2 ha); and
- Selected areas of secondary broadleaved forests and shrubland - Eastern rise (CH 11000 – 11400; approximately 4 ha), focusing on more mature and intact secondary forest patches with little grazing pressure, good canopy closure, ground flora, leaf litter and woody debris.

~~Fewer than ten FITs may be deployed at each of these sites if conditions are considered unsuitable for deployment (e.g. steep terrain).~~ Many of the areas where the FITs ~~will be~~were deployed are accessible by stock. As such, fencing protection around the traps ~~is~~was required to prevent trampling and damage.

FITs ~~shall be~~were deployed for a ten~~-~~ to fourteen day ~~to two-week~~ period ~~in a summer prior to construction commencement. The ideal sampling period is December to February; these surveys commenced in~~during February 2020. Each trap ~~will contain~~contained propylene glycol as a preservative and following collection, samples ~~will be~~were stored in 70% ethanol ~~after collection.~~.

Specimens ~~will be~~are currently being counted and identified by a suitably qualified taxonomist (Stephen Thorpe). Invertebrates identified to any families expected to contain local 'Threatened' or 'At Risk' species will be identified to species level, where possible.

Figure 9.1: Flight intercept trap. Source: Deakin EL 2013. Impacts of land-use intensification on forest remnants embedded within production landscapes. PhD thesis, Canterbury University.

9.5.2 Light trapping

9.5.2.1 Methodology

During the NOR process, divaricating shrublands (CH 9300 - 9600) were identified as potentially providing habitat for 'At Risk' *Meterana* moth species. Light trapping will be carried out to detect the presence of 'At Risk' or 'Threatened' moth taxa in this habitat type.

Light trapping involves using a light source to attract night-flying insects. A light trap consists of a ~~mercury vapour or actinic~~UV bulb which is attractive to moths. As moths fly towards the light, moths are deflected down a funnel and into the base. The light trap used for these surveys will meet DOC invertebrate light trapping specifications (Patrick, 2016).

Light trapping shall be carried out on warm, calm, humid nights with cloud cover. Nights that are clear, cold, windy, very wet or fall on a full moon shall be avoided. Trapping for *Meterana exquisita* will be carried out from August to December 2020, preferably in September or October when adults of the species are most abundant. Trapping for *M. grandiosa* will be carried out from mid-April to early June 2020. Traps will be placed downwind in an elevated site within divaricating shrubland habitats containing small-leaved *Olearia* species (refer Drawing Set in Volume 3, TAT-3-DG-E-4131-7). Traps shall be located away from artificial lights and freshwater bodies. The traps will be checked early morning and moths will be stored in a cool place until they are identified by a suitably qualified taxonomist. The moths will then be released.

Specimens will be identified to species level and trapping will be carried out until a 'Threatened' or 'At Risk' *Meterana* species is found, for up to a maximum of three nights.

9.5.2.2 Preliminary results [as at 12 June 2020]

Surveys for *M. grandiosa* were carried out between 25 and 29 May 2020. Two adult moths and one probable larva were found, all near *Olearia virgata* and/or *O. solandri* on the edge of divaricating shrubland and secondary scrublands. Other moth species were captured and observed during these surveys. These will be identified over the coming weeks and may also include 'Threatened' or 'At Risk' species. Measures to manage effects on *M. grandiosa* are outlined in Section 9.6.1. This section will be updated once full survey results are available.

9.5.3 Snail surveys

9.5.3.1 Methodology

A habitat assessment ~~will be~~was undertaken within the established old growth forest (CH 5500 – 5700; refer Drawing Set in Volume 3, TAT-3-DG-E-4131-7) to determine the suitability of the site for *Powelliphanta* snails. These surveys ~~are currently being~~were undertaken ~~(~~in February 2020~~)~~ and ~~will involve~~involved identification of moist areas with abundant leaf litter, debris and/or low growing vegetation that may provide suitable snail habitat. Areas with very little leaf litter, debris and low growing vegetation, or that are dry or permanently wet are not considered suitable snail habitat.

9.5.3.2 ~~If~~Preliminary results

No snails were located during the habitat assessments; however, potentially suitable ~~snail~~ habitats ~~are~~for *Powelliphanta* snail species were identified ~~during these surveys~~within the Project footprint. As such, a Wildlife Authority Application to DOC for the capture and relocation of *Powelliphanta* snails will be applied for~~.~~ on a precautionary basis. Areas identified as suitable snail habitat will be searched for snails once authorisation to do so is granted by DOC. If snails are then found during these surveys, the TIMP will be updated accordingly.

~~Incidental observations of *Wainuia* snails will also be recorded while carrying out surveys for other invertebrate species and their habitats.~~

9.6 Survey outcomes and management plan updates

~~If~~Where these ~~pre-construction~~ surveys detect the presence of 'At Risk' or 'Threatened' invertebrate species, this ~~management plan~~TIMP will be updated to address the matters set out in draft NoR condition 23 b vi and [draft] Resource Consent Condition [EC11] as follows, and as necessary, to supplement the measures already set out in the VCMP and ~~REMP~~REMMP:

1. *Identify vegetation or habitats that should be avoided in the first instance;*
2. *Outline the optimal timing of vegetation clearance;*
3. *Describe the methods of direct invertebrate management;*
4. *Identify areas where measures to manage enabling or construction works activities apply;*
5. *Set out approaches to the restoration of invertebrate taxa/community composition in planting and retirement areas required by NOR Condition 24, including but not limited to:*
    1. *Wood disk stepping stones and long grass or shrubland corridors;*
    2. *The salvage and transfer of soils, coarse woody material or debris and leaf litter; and*
    3. *Detailed measures to create and/or restore habitats for populations of 'At-Risk' or 'Threatened' taxa impacted by the Project;*
    4. *Monitoring protocol for populations of 'At-Risk' or 'Threatened' taxa impacted by the Project, where monitoring forms part of the measures determined by Condition 24(b); and*
    5. *Biosecurity measures required in carrying out these activities.*

Depending on survey results, updates may include:

- Constraints on vegetation clearance
    - Identification of any further vegetation or habitats that should, where practicable, be avoided;
    - Identification of vegetation or habitats where measures to manage construction work activities shall apply;
    - Limiting the timing of vegetation clearance depending on habitat type and species. For example, the removal of divaricating shrubs that are host to *Meterana* species are best removed when the adult moths are active rather than when the larvae are feeding on the plants;
- Direct invertebrate management, if applicable (e.g. search, capture and relocation of *Powelliphanta* and *Wainuia* snails from the footprint to neighbouring forest, if they are found during surveys); and
- The improvement of habitat suitable for invertebrates in planting and retirement areas, as per NOR condition 24.

~~9.6.1 Monitoring and reporting~~

Where pre-construction surveys detect the presence of 'At Risk' or 'Threatened' invertebrates, this management plan will be updated to outline appropriate monitoring and reporting requirements~~.~~ (as per Resource Consent Condition [EC11]).

9.6.1 *Meterana grandiosa* effects management (INCOMPLETE)

9.6.1.1 Constraints on vegetation clearance (INCOMPLETE)

Clearance of *M. grandiosa* host plant species should not be carried out during late autumn and winter (dates yet to be defined) in order to minimise egg mortality.

9.6.1.2 Translocation of larvae and pupae (INCOMPLETE)

Prior to vegetation clearance, host shrubs destined for clearance shall be identified. Host shrubs outside of the alignment will also be identified to serve as a translocation site or sites. Prior to clearance, the

shrubs destined for clearance shall be 'beaten' and searched at night, with any collected larvae transferred to a designated translocation site. Where practicable, during vegetation clearance host plants shall be cut, sectioned (if necessary) and transferred to the translocation site to allow for the completion of pupation.

9.6.1.3 Planting (INCOMPLETE)

Host plant species shall be planted at the offset site. The number of plants planted shall exceed the number of plants destroyed to ensure there is a net habitat gain for the species. Plantings should aim to replicate the typical habitat of host plants in the area (i.e. divaricating shrubland).

9.6.1.4 Monitoring and reporting (INCOMPLETE)

Annual monitoring will be carried out at translocation sites for adults and larvae. Monitoring protocols are yet to be determined but will likely involve nocturnal light trapping during the adult flight period (mid-April to early June), and beating of host plants for larvae.

10 Freshwater Ecology Monitoring and Management Plan

10.1 Introduction

This Freshwater Ecology Monitoring and Management Plan (~~FEMP~~FEMMP) outlines the management processes required to avoid, remedy, minimise, mitigate and offset adverse effects on freshwater ecology as a result of the Project, including minimising effects on aquatic habitats and fauna, aquatic habitat restoration and like-for-like offset (new stream diversions and enhancement planting) to address residual habitat loss. Fish Recovery Protocols (Section 11) are provided separately but are fundamental to managing potential effects on freshwater fauna.

This section of the EMP outlines how freshwater ecology will be managed during the Project ~~and will be updated to incorporate any requirements of Regional Council resource consents.~~including in accordance with the Resource Consent Conditions [EC13 and EC15] [12 June proposed version).

10.2 Baseline freshwater ecology surveys

All baseline information pertaining to freshwater ecology in the Project area, including the results of field surveys, is included in the reports listed in Table 1.1.

Field surveys were undertaken in 2018 to inform NOR reporting. This involved fishing, stream ecological valuations and macroinvertebrate sampling at eight sites across six sub-catchments.

Further field surveys were undertaken between August and November 2019 following refinement of the alignment and Project footprint. Stream ecological valuations (SEV) and macroinvertebrate sampling was conducted at 26 sites. Fish surveys were undertaken at six sites. Stream classifications and basic descriptions were undertaken for almost all stream length under the footprint. SEVs were undertaken at representative proposed offset sites to inform offset modelling.

10.3 Responsibilities and competencies

Delivery of, and compliance with, this ~~FEMP~~FEMMP will be the responsibility of the lead Project Ecologist - Freshwater who will liaise with other specialist ecologists as required.

It will be important for the lead construction contractor to read and understand the ~~FEMP~~FEMMP so that the protocols are adhered to correctly during construction works. The responsibilities of the lead construction contractor include but are not limited to:

- Reading and understanding the ~~FEMP~~FEMMP;
- Facilitating a Project start-up meeting with the Project Ecologist - Freshwater, the Cultural Monitoring Advisor and the site manager before streamworks commences for each stage of the Project. The objective of this meeting will be to determine watercourses scheduled for streamworks each earthworks season or stage, enabling forward planning and avoiding delays in the construction schedule;
- Contacting the Project Ecologist – Freshwater and the Cultural Monitoring Advisor a minimum of 3 weeks before streamworks are scheduled across the Project footprint;
- Inviting iwi partners to participate in and support any translocation deemed necessary and to observe construction of stream diversions, to allow for the appropriate exercise of kaitiakitanga responsibilities and ensure that cultural concerns are addressed;
- Maintaining clear lines of communication with the Project Ecologist-Freshwater regarding changes in the works schedule; and

- Briefing new personnel about the contractor's responsibilities under this plan.

10.4 Summary of ecological values, effects on freshwater ecology and ~~effects~~effect management

Detailed information on freshwater ecological values, effects and effects management is provided in Technical Assessment H – Freshwater Ecology, and summarised below.

10.4.1 Freshwater ecological values

Freshwater fauna species recorded during field surveys in the Project area consist of the following native and exotic freshwater fish species, and one native invertebrate species:

- Longfin eel (*Anguilla dieffenbachii*) (At Risk – Declining);
- Shortfin eel (*Anguilla australis*) (Not Threatened);
- Unidentified eel (*Anguilla* sp.);
- Common bully (*Gobiomorphus cotidianus*) (Not Threatened);
- Redfin bully (*Gobiomorphus huttoni*) (Not Threatened);
- Upland bully (*Gobiomorphus* aff. *breviceps*) (Not Threatened);
- Unidentified bully (*Gobiomorphus* sp.);
- Brown trout (*Salmo trutta*) (Introduced and naturalised); and
- Kōura (*Paranephrops planifrons*) (Not Threatened).

Furthermore, in addition to the above freshwater fauna species, the following native species have been identified through desktop surveys or modelled data as being present or possibly present within the wider Manawatū River and adjoining watercourses:

- Torrentfish (Cheimarrichthys fosteri) (At Risk – Declining);
- Banded kokopu (Galaxias fasciatus) (Not Threatened);
- Brown mudfish (Neochanna apoda) (At Risk – Declining);
- Common smelt (Retropinna retropinna) (Not Threatened);
- Inanga (Galaxias maculatus) (At Risk – Declining);
- Cran's Bully (Gobiomorphus basalis) (Not Threatened);
- Dwarf galaxias (Galaxias aff. divergens) (At Risk – Declining);
- Kākahi (Echyridella menziesi) (At Risk – Declining);
- Perch (Perca fluviatilis) (Introduced and naturalised); and
- Unidentified salmonid (Salmo sp.).

The conservation status for fish was sourced from Dunn *et al.* (2018) and for kōura and kākahi from Grainger *et al.* (2018).

For the most part, macroinvertebrates from within the proposed alignment were indicative of poor to fair water and habitat quality. This was evident at sites where riparian margins were absent, streams were low lying and margins were impacted by agricultural land-use. The highest MCI and SQMCI scores were recorded from within stream reaches dominated by relatively intact riparian margins and cobble stream systems.

SEV scores across the alignment ranged from 0.29 to 0.79, indicating a wide fluctuation in the level of impact and degree of naturalness.

10.4.2 Freshwater ecological effects

The potential effects on freshwater ecology resulting from the Project have been assessed in terms of short- and long-term effects (refer to Section 2.2 above) and are summarised here:

- Short-term effects relate to the effects during the construction phase which could include fish injury and/or mortality, temporary fish passage restrictions, and water quality effects resulting from sedimentation, hazardous substances and cut vegetation storage
- Potential long-term effects anticipated to occur from the project include reduced fish passage, water quality effects, changes to hydrology and loss of stream ecological function and habitat area.

The most substantial effects on freshwater ecology will occur from the reduced habitat quality and availability resulting from culverting or stream infilling. Based on the DCR alignment in the order of 13.~~365~~207 km of stream across the alignment is proposed to be impacted. This has been calculated by GIS analysis and based on all stream length located under the project footprint including a buffer (width from 7 m to 20 m depending on location) around the edge. Culverts comprising approximately 2,~~300~~250 m will be constructed and ~~8,014~~6,021 m stream diversions (~~11,429~~8,087 m^2 stream bed area) will be put in place.

10.4.3 Effects management for freshwater ecology

A range of mitigation measures are proposed throughout the life of the Project. Some measures are identified which relate to best practice site management approaches which will mitigate some of the freshwater fauna effects anticipated from the project.

The following measures will be undertaken to minimise and mitigate effects on freshwater fauna within the impact footprint and in the receiving environment.

Fish Recovery Protocols to salvage and relocate fish and fauna from within works footprints (detailed in Section 12 of the EMP);

- Culverts designed for fish passage as appropriate (addressed in this ~~FEMP~~FEMMP);
- Vegetation clearance protocols to manage the potential effects of run off from cleared vegetation (addressed in Section 3 of the EMP);
- Staged approach to earthworks and sediment and erosion controls to be consistent with GD05 and outlined in the Erosion and Sediment Control Management Plan (ESCMP), with detail in:
- Site Specific Erosion and Sediment Control Plans (SSESCP);
- Streamworks Procedures (appended to the ESCMP); and
- Hazardous Substances Procedures (appended to the ESCMP).
- Further design refinement to avoid further stream length loss or modification, to be achieved through detailed design and on site avoidance during construction.
- Stream diversions to be designed and constructed to optimise habitat values and ecological function, where possible.
- Stormwater management approach to include swales and wetlands designed to NZTA standards.

While many of the potential effects from the Project have been avoided, or minimised and mitigated to the extent possible as outlined above, there are residual adverse effects resulting from the culverting and diversion of streams. Loss of stream habitat will be offset through creation of stream diversions designed to replicate existing habitat where possible and through enhancement (riparian planting and fencing) in the wider catchment (addressed in this ~~FEMP~~FEMMP). These residual effects are aimed at achieving no net loss of ecological function and are outlined in Section 2.6.2.

10.5 Fish passage

Many New Zealand fish are diadromous and need to migrate between freshwater bodies and the sea in order to complete their life-cycle. The upstream migration seasons for the migratory fish species expected to be present in the Project span most of the year (August to May inclusive), but for most of these species, the peak migration occurs during spring to early summer (August to December).

Project work includes the installation of culverts and the diversion of waterways resulting in the loss of access to existing stream habitat. The potential effects of these works on fish passage could be temporary (during construction) or permanent (following construction) and will be minimised by the procedures described below.

This includes:

- Timing of online streamworks to avoid peak fish migration and spawning seasons if the Project Ecologist – Freshwater deems there to be suitable fish habitat upstream of the works area;
- Timing of works will be during a suitable fine weather window;
- Providing appropriate fish passage for culverts;
- Where practicable, undertaking work offline (outside the active stream channel). In circumstances where online works are proposed, the Project Ecologist - Freshwater will consult with site engineers to determine the best practicable method for undertaking the works incorporating best practice methodologies; and
- Follow the FRPs.

In addition, SSESCPs will be prepared to confirm specific streamworks procedures and:

- Design details, including fish passage provisions;
- The method of construction;
- Stream dewatering and infilling;
- Stream diversion and culverting methods (online or offline) to allow construction near or within the active stream channel; and
- Timing of works to avoid peak fish migration in areas where the Project Ecologist - Freshwater deems there to be suitable fish habitat upstream of the works area.

10.5.1 Timing of works

One way to reduce the potential effects of streamworks on fish passage 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, where there is an opportunity to adjust the timing of works in particular catchments to reduce effects on fish spawning and migration, that will be explored.

Generally, it is more important to maintain unimpeded fish passage during peak migration periods for streams with larger upstream catchments than those with small or intermittent upstream catchments. This principle can be used to direct the timing of works in different parts of the catchment but should be applied flexibly to avoid the work being left incomplete over the winter season. Many of the affected catchments have smaller or intermittent upstream catchments which may be dry during works and temporary fish passage requirements may not be required. Notable exceptions to this are the Mangamanaia Stream (Catchment 2), Manawatū River and parts of Catchment 4.

10.5.2 Fish passage through temporary works area

Where practicable fish passage will be provided on diversions and culverts for temporary works of greater than two days in duration during the migration period for target fish species. Where temporary culverts and/or diversions will result in short-term effects on fish passage, these effects 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, on physical stream characteristics such as stream flow and the quality and quantity of suitable fish habitat determined by the Project Ecologist - Freshwater upstream of the temporary works.

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; and
- Non-loop rope types will be used to reduce the likelihood of debris snagging on the ropes.

10.5.3 Fish passage through permanent culverts

Where practicable culverts will be constructed to provide fish passage and in general accordance with New Zealand fish passage guidelines. Fish passage must be provided for all culverts where there is permanent upstream habitat. In some instances, fish passage is not required on the basis that the upstream habitat is a small area of intermittent or constructed channel. A description of ~~culvert design and~~the approach to fish passage for each culvert is provided in Table 10-1~~the culvert schedule (Drawing TAT-3-DG-H-1441-C Cross Culverts Schedule).~~. This includes ~~culvert dimensions, length, grade and~~ the general approach to fish passage with detailed design regarding grade and length being finalised through the detailed design. The detailed design of culverts shall be confirmed prior to construction in consultation with the Project Ecologist – Freshwater and iwi partners.

Priorities for fish passage at specific culvert locations have been assessed by the Project Ecologist - Freshwater, and have been used to inform fish passage design taking into account the New Zealand fish passage guidelines (NIWA, 2018).

Table 10-1 – Fish passage detail for permanent culverts.

Culvert ID	FISH SPECIES	FISH PASSAGE TREATMENT	ADDITIONAL TREATMENT	STREAM CATCHMENT
CU-01	NOT REQUIRED	N/A	N/A	8A
CU-02	NOT REQUIRED	EMBEDMENT	N/A	8A
CU-03	CLIMBERS	EMBEDMENT	SPAT ROPE	7B
CU-04	CLIMBERS	EMBEDMENT	BAFFLE	5B
CU-05	NOT REQUIRED	N/A	N/A	5B
CU-06	NOT REQUIRED	N/A	N/A	5B
CU-07	CLIMBERS	EMBEDMENT	SPAT ROPE	5A

CU-08	SWIMMERS	EMBEDMENT	BAFFLE	4A
CU-08A	CLIMBERS	EMBEDMENT	SPAT ROPE	4A
CU-09	CLIMBERS	EMBEDMENT	SPAT ROPE	4C
CU-10	NOT REQUIRED	N/A	N/A	4D
CU-11	NOT REQUIRED	N/A	N/A	4A
CU-12	CLIMBERS	EMBEDMENT	BAFFLE	4E
CU-13	NOT REQUIRED	NOT REQUIRED	N/A	4F
CU-14	NOT REQUIRED	N/A	N/A	3A
CU-15	CLIMBERS	EMBEDMENT	SPAT ROPE	3A
CU-16	NOT REQUIRED	N/A	N/A	3B
CU-17	CLIMBERS	EMBEDMENT	SPAT ROPE	2C
CU-17A	SWIMMERS	EMBEDMENT	BAFFLE	2B
CU-17B	SWIMMERS	EMBEDMENT	BAFFLE	1B
CU-18	SWIMMERS	EMBEDMENT	BAFFLE	1B
CU-19	SWIMMERS	EMBEDMENT	BAFFLE	1A
CU-20	SWIMMERS	EMBEDMENT	BAFFLE	1A
ACU-01	CLIMBERS	EMBEDMENT		8A
ACU-03	CLIMBERS	EMBEDMENT	SPAT ROPE	5B
ACU-04	NOT REQUIRED	N/A	N/A	5B
ACU-05	SWIMMERS	EMBEDMENT	BAFFLE	4A
ACU-05A	SWIMMERS	EMBEDMENT	BAFFLE	4B
ACU-06	CLIMBERS	EMBEDMENT	BAFFLE	4B

ACU-07	CLIMBERS	EMBEDMENT		3A
ACU-08	NOT REQUIRED	N/A	N/A	3A

10.6 Stream creation and enhancement

10.6.1 Stream diversions

Stream diversion channels are required to manage effects from culverts and stream infilling. The stream diversion channel details for the Project are provided in the stream diversion schedule (refer to ~~Technical Assessment B (Stormwater Management Design Report), Appendix B.2)].~~[placeholder for final design details])]. There are three stream diversion design 'types', with the type to be used for each location identified in the diversion schedule. Figure 10.1–3 below show the design for Type 1, 2, and 3 and further detail is provided in Table 10.1. Additional cut off drains are 'type 4' and these are not considered as 'stream diversions'. The overall aim of the stream diversions is that they replicate as much as practicable the pre-development ecological and hydraulic condition to replace that being lost. Stream diversion design principles are provided in this section. All diversion channels will have riparian planting intended to provide shade, filtration and organic matter input. The maximum planting width will be ~~will be~~ 20m each bank unless restricted by proximity to other infrastructure (refer to Table 10.1 for an estimated planting width).

These widths are required to be planted to align with the offset calculations. Any modifications to the planted widths would need to be reflected in updated offset calculations .Performance standards are provided in Table 10.1 and in the Planting Establishment Management Plan (Section 4 of this EMP). The Project Ecologist – Freshwater will be required to oversee final design, construction and sign off on permanent stream diversions prior to completion~~..~~

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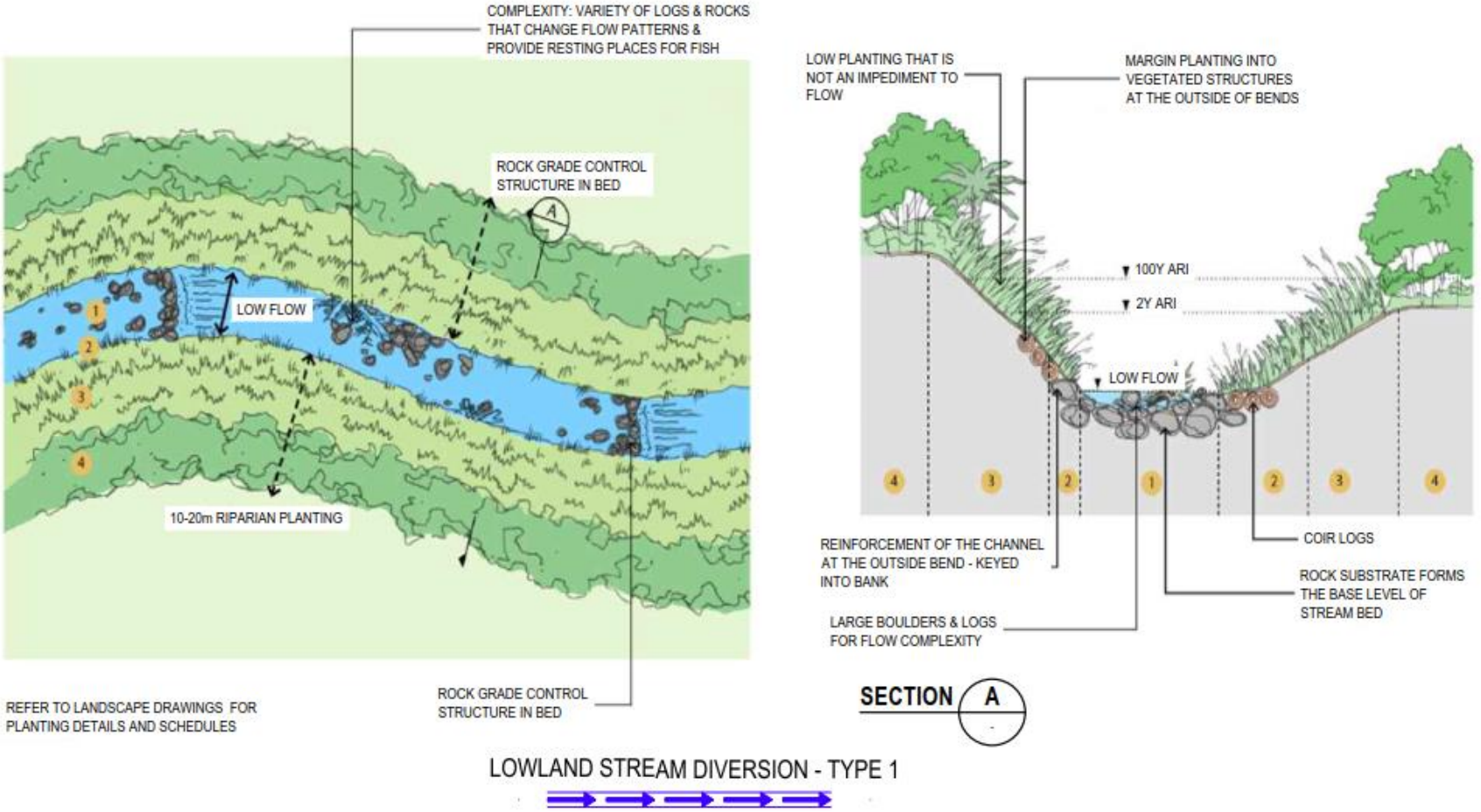


Figure 10.1: Type 1 Stream Diversions as per drawing TAT-3-DG-H-1451-C

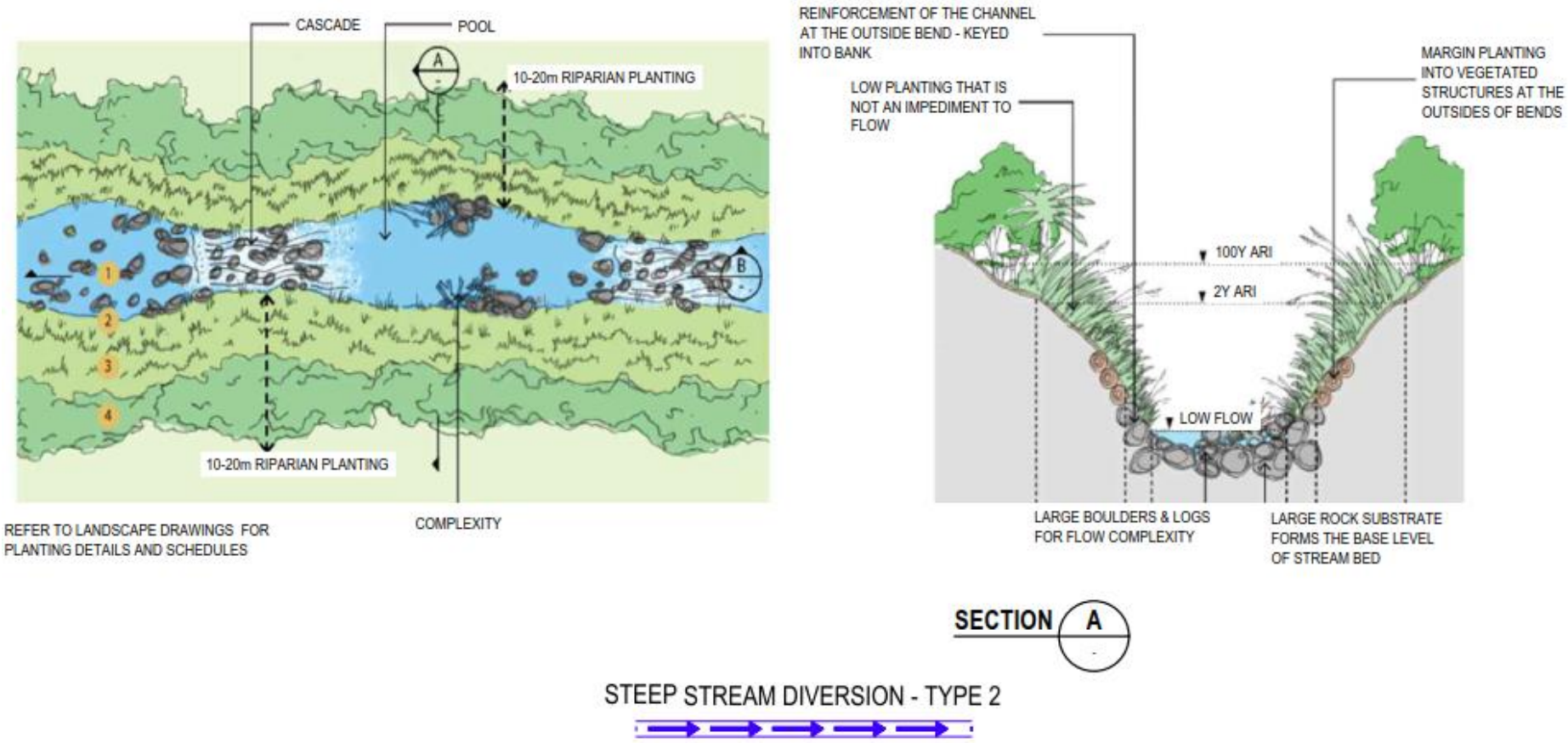


Figure 10.2: Type 2 Stream Diversions as per drawing TAT-3-DG-H-1451-C

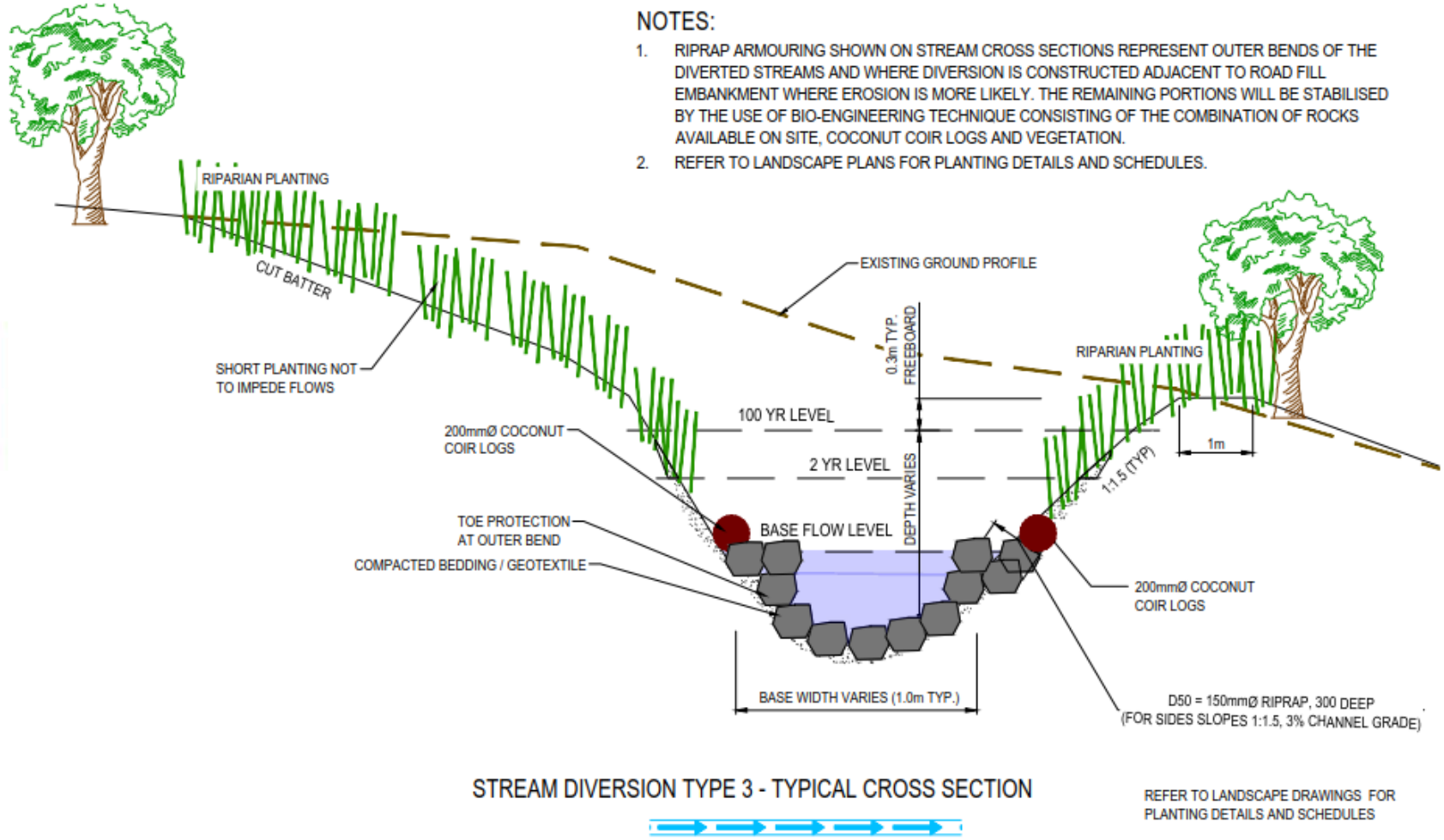


Figure 10.3: Type 3 Stream Diversions as per drawing TAT-3-DG-H-1451-C

Table 10-2 – Stream diversion schedule (see also Technical Assessment B (Stormwater Management Design Report, Appendix B.2)). Note this table only includes stream diversions that are quantified as part of the ecological offset package. Additional stream diversions shown in Technical Assessment B will also be constructed however do not contribute to the offset package.

Diversion ID	CHANNEL LENGTH (m)	CHANNEL TYPE	BASE WIDTH (m)	Stream Catchment	Riparian width (m each bank)
SD-AC01-05	59	TYPE 3	1	8A	15
SD-AC01-04	805	TYPE 1	1.5	8A	15
SD-MC03-05	620	TYPE 2	1.5	7B	20
SD-MC03-08	519	TYPE 3	1	7B	5
SD-MC03-01	191	TYPE 2	1.5	7B	5
SD-MC03-09	161	TYPE 2	1.5	7B	5
SD-AC03-02	278	TYPE 2	1.5	5B	10
SD-MC07-02	39	TYPE 2	1.5	5A	20
SD-MC07-05	22	TYPE 2	2	5A	20
SD-AC05A-01	289	TYPE 1	2	4B	10
SD-AC05-01	140	TYPE 1	2	4B	10
SD-AC05-02	62	TYPE 1	2	4A	10
SD-AC06-02	61	TYPE 2	1.5	4B	10
SD-MC09-03	28	TYPE 2	1.5	4C	20
SD-MC10-03	309	TYPE 2	2	4A	10
SD-MC11-03	26	TYPE 3	1	4A	10
SD-MC16-04	111	TYPE 3	1	3B	20
SD-MC17-05	220	TYPE 2	1.5	2C	20
SD-MC17-01	393	TYPE 2	1	2C	20
SD-DS20-01	340	TYPE 2	1.5	2E	20
SD-MC17A-02	161	TYPE 1	1.5	2B	15
SD-MC17B-02	35	TYPE 3	1	1B	5
SD-MC18A-01	89	TYPE 1	2	1B	20
SD-MC18-01	134	TYPE 1	2	1B	10
SD-MC18-02	119	TYPE 1	1.5	1A	10
SD-MC18-03	91	TYPE 1	1.5	1A	15
SD-MC18B-01	69	TYPE 3	1	1A	5
SD-MC20-01	21	TYPE 3	1	1A	5
SD-MC20-02	64	TYPE 1	1.5	1A	5

While stream diversions can be relatively easy to construct, it is much more difficult to construct a stream that has a good level of ecological functionality. This is because diversions may be constructed into engineered materials, be in steep terrain, require stabilisation along the bed or be primarily for a

conveyance purpose. The following design principles draw upon work completed for the Transport Agency's Mt Messenger Bypass Project and intend to provide direction to the types of ecological and hydraulic features to be incorporated into stream diversions. The final design and composition of habitat features will be collaboratively developed for each stream diversion with the lead contractor, design engineers, iwi partners and Project Ecologist – Freshwater.

10.6.1.1 Structure and morphology

- Structure and morphology should reflect a more natural stream structure and be reflective of the streams within the affected sub-catchment.
- Create a stream profile which provides for a base flow (low flow) channel, bank-full channel and a floodplain. This should reflect the intermittent or permanent nature of the catchment being affected and the relative catchment location and topography (as to whether a floodplain is appropriate, for instance). The shape of the channel will need to be consistent with the natural channels, and may include key-hole channels, rather than strictly trapezoidal.
- The stream profile should be consistent with the hydrological regime and should be sufficiently sized to maintain and allow development of instream habitat features, avoid excessive erosion and provide for flow conveyance.
- Incorporate meanders in situations where the stream would naturally meander. This will help to increase complexity of the instream habitat and hydraulic regimes and improve hydraulic functions.
- The constructed channels should provide a range of instream habitat types as appropriate for the relative stream gradient and catchment location. This may include chutes, riffles, rapids, runs, pools, backwaters.
- Many of the constructed stream channels will be steep. Provision of instream features that aim to moderate flow velocities, provide wetted margins and areas of refugia will aid in fish passage.
- Incorporate woody debris within the stream channel as this provides habitat and increases the retention of leaves. The size of the logs should be commensurate with the size of the stream channel, and should be embedded in the banks or bed (refer to Section 3.4.4).
- Where practicable, the constructed channels should have some ability to move over time. This may be only at a very small scale (i.e. a low flow channel within a wider flow conveyance channel).

10.6.1.2 Bed and banks

- Use similar substrate to the streams present within the affected catchment and of a size consistent with natural sources (e.g. gravel, cobble, boulders etc). This should also take into consideration the gradient of the stream and its ability to 'hold' substrates.
- In order to maintain as much connectivity with the hyporheic zone as possible, constructed stream channels should not be lined with impermeable material. Conversely, the substrates should be sized to avoid water flowing under the rock instead of over it.
- If the stream bed needs to be armoured, then care is need to layer finer material (e.g. < 20mm) to fill voids. The design should allow for more natural material above any stream bed armouring. The extent of armouring should be minimised as much as possible, to ensure as much natural bank as practicable.
- Stream substrates should be of a mixed size, to ensure substrates move through the system to scour periphyton growth, but not so small that they are washed out of the system entirely.
- The mix of substrates and habitat features will be driven by the gradient and type of stream diversion. Substrates may be added to create riffles in lowland streams, but these may not be appropriate in the steeper stream systems.
- Boulders and wood can provide habitat diversity or bank protection.
- New stream banks will need to be stabilised – biodegradable matting may be appropriate but materials containing plastic should be avoided.

- Wherever practicable, banks should not be lined with rock or other armouring as it reduces the potential for riparian connectivity with the stream channel.

10.6.1.3 Riparian margins

- Riparian vegetation provides a wide range of ecological benefits to stream ecosystem health including shade, overhanging vegetation and habitat for aquatic fauna. Riparian margins also provide for overland flow filtration, can reduce flow velocities and provide habitat for adult insects and terrestrial fauna.
- Riparian vegetation will be planted close to the edge of the baseflow channel and consistent with the overall methods outlined in the PEMP (Section 4 of this EMP).
- The riparian planting should occur within the immediate and wider stream margin, as indicated within the stream diversion channels schedule (Table 10-2
- Species should be selected in consultation with iwi partners, to be reflective of relevant ecological districts, eco-sourcing and cultural drivers.
- Stock exclusion fencing should be provided for all margins where stock could be present.
- Plant and animal pest management should be undertaken in accordance with the protocols outlined within the PEMP (Section 4 ~~of this EMP).~~) and the PMP (Section 13).
- Stream banks may need to be stabilised prior to planting, using a biodegradable matting.
- When considering species selection and planting densities, the type and quality of stream bank soil should be considered, particularly if planting is to occur into engineered materials.

10.6.2 Planting at offset sites

Riparian enhancement measures at offset sites will address the residual effects following the implementation of Type 1, 2 and 3 stream diversions (described above). The quantum of planting and enhancement required at offset sites ~~is~~has been determined using the SEV and ECR methodology. Any additional offset planting that may be required will be determined using the same approach. This may result in small changes to the quantum of planting required at each site and as anticipated by condition [Placeholder].

Table 10-3 –Planting requirements at each of the stream offset sites. [PLACEHOLDER]

Farm	Length of stream	Figure reference	Comments
Ratahiwi Farm			
Sproull Farm			
Beagley Farm			
Tuapaka Farm			

At a conceptual level, the riparian planting and enhancement actions are anticipated to include the following key features to improve aquatic ecosystem function:

- ~~[Placeholder - Performance standards to be confirmed following landowner discussions];~~
- Planted riparian margins ~~to~~ up to 20 m on each bank and as specified on figures referred to in Table 10-3~~;~~;

- Plants to be eco-sourced (in discussion with Iwi Partners), with selection of appropriate plant species mixes and exclusion measures. Where conditions allow, mid and later successional native plant species to be mixed in with early successional species; this will promote a quicker transition to a forest state than would otherwise occur;
- Legal protection;
- Fencing for stock exclusion; and
- Possible remediation of fish passage barriers and provision of instream habitat features (site dependent).

~~This~~The detail for each site will be ~~achieved through~~developed in a Site Specific Ecological Offset/Compensation Plan (SSEOCP) consistent with the measures of the PEMP, outlined in Section 4 of this EMP. Monitoring of the success of the planting will be undertaken as described in the REMMP, outlined at Section 12 of this EMP.

10.7 Aquatic Ecological Monitoring Protocols

This section describes monitoring that will be undertaken to assess potential effects of the Project on stream habitat and aquatic life. Some baseline ecological information has been collected for the Project during field investigations in between December 2018 and September 2019 (James, 2019).

Monitoring will comprise:

- Pre-construction monitoring - baseline;
- Construction monitoring – routine; and
- Construction monitoring – event based.

The scope of the AEMP is determined by consent requirements, the key values of the stream receiving environments, the nature of those receiving environments and key potential issues arising from the proposed works.

Uncontrolled discharges of sediment laden water are an inherent risk associated with earthworks, particularly at this scale. The works cross over multiple sub-catchments therefore have the potential to impact tributaries and main streams. Some of the streams across the footprint are sensitive to sediment as are macroinvertebrates and some fauna present. An uncontrolled discharge of sediment could fundamentally change the character and composition of the stream systems present. The emphasis of the monitoring programme is therefore on construction effects and specifically those associated with potential sediment discharges.

Construction works are predominantly being undertaken at the top of catchments in headwater streams. As such, the monitoring of effects cannot rely on upstream control sites from which to compare downstream monitoring results, as is commonly the case for many construction projects. The monitoring will provide robust “before” and “after” data, and monitor sites in paired catchments to use as controls. Paired catchment controls will help interpret the data in the context of interannual and seasonal variability.

The objective of the routine monitoring component of the plan, and in particular the additional baseline monitoring, will be to ensure a comprehensive water quality and aquatic community structure dataset is available and covers the range of habitats potentially affected by the project.

Further to the above, the overall objectives of this AEMP are to collect monitoring data that support the protection of important values of the Manawatū River catchments and enable the effects of construction activities on high value stream receiving environments to be managed and evaluated.

This is to be achieved by:

- Collection of robust “before” data in respect of parameters that might be affected by the project for comparison of during construction monitoring;
- Measurement of the effects of the project during construction;
- Providing warning of any potential effects or recorded exceedances with performance requirements that require remedial action; and
- Providing data to support the development of response actions as part of the development and review of the AEMP.

10.7.1 Structure of the AEMP

The AEMP is set out as follows:

- Monitoring sites
- Monitoring methods
- Sampling protocols and frequency
- AEMP review process
- Reporting
- Figure 10.4 outlines the aquatic ecological monitoring, management and responses and should be read in conjunction with the ESCMP.

10.7.2 Monitoring sites

Monitoring site locations will be added to the Ecological Constraints Maps [PLACEHOLDER – to be developed prior to construction]. Coordinates for the exact survey reaches will be collected during the first survey round.

No sites are included on the Manawatū River itself as the potential effects resulting from the Project are not anticipated to be seen within the Manawatū River, given the large contributing catchment.

Control sites will be established in the upper Mangamanaia Stream (existing site C2A-US) and a new site within Catchment 9. The intermittent upper reaches of sub-catchment 5A which are not being impacted by works may also be a control site (new site to be established).

Sites downstream of construction discharges will be located within each of the following Catchments

- Catchment 2 (existing site C2A-DS2 downstream of the construction discharges)
- Catchment 3 (**new site**, to be located downstream of confluence of sub-catchments 3A and 3B)
- Catchment 4 (existing sites C4A-DS3 which is downstream of the construction area and C4H-US which is an upstream, contributing catchment to act as a control for the catchment).
- Catchment 5 (existing sites C5A-DS1 and C5B-DS which are downstream of works in the two sub-catchments and C5A-DS which is a sensitive area and downstream of the two sub-catchment specific sites).
- Catchment 6 (existing site 6A-DS2 which is a sensitive site and downstream of the extent of influence of agricultural land and construction works).
- Catchment 7 (existing sites C7A-DS1 which is a sensitive site and downstream of works in upper catchment and C7A-DS3 which is downstream site within Catchment 7 and captures all potential effects within the catchment.

10.7.3 Monitoring methods

10.7.3.1 Rainfall monitoring

Two telemetered rainfall monitoring stations will be installed on site to provide real-time continuous rainfall intensity and volume data which will be able to be observed online by Project personnel. Details are provided in the Erosion and Sediment Control Monitoring Plan (ESCMP) Appendix B.

10.7.3.2 Water quality

Water quality samples will be collected at each monitoring site. The samples will be placed on ice as soon as possible after collection and delivered to an accredited laboratory ~~-~~for testing. Water samples will tested for the following parameters:

- Total suspended solids (TSS)
- Turbidity
- pH

Temperature, pH and dissolved oxygen (% and mg/l) will be measured using calibrated handheld meters at time of sampling[25]. Turbidity may be measured on site using calibrated handheld meters that will be administered by the project team.

Continuous turbidity will also be monitored at two sites, in catchment 2 and 7, for the duration of the Project.

10.7.3.3 Sediment deposition

Procedures for monitoring fine sediment deposition and guidelines for interpreting the measurement data have been developed for New Zealand streams (Clapcott et al. 2011). These procedures and guidelines are for “hard-bottomed” streams with gravel, cobble, and boulder-dominated beds.

The Quorer technique is a method used to measure settled sediment. To reduce the potential for reproducibility issues with the Quorer methodology, the instructions are provided for the Quorer method which must be followed. An additional visual assessment will also be undertaken.

The Quorer method will be used at all sites where substrates allow. The visual assessment method will be used at all sites.

10.7.3.3.1 Quorer methodology

Where ~~appropriate~~the stream environment allows resuspendible sediment monitoring will follow Sediment Assessment Method 4 (Quorer Methodology) from Clapcott et al. (2011), as set out below. At some sites the Quorer method may not be appropriate or possible (e.g. streams too small and/or shallow).

[25] pH may be measured in the laboratory instead of using a field meter.

Sediment Assessment Method 4 – Resuspendible sediment (Quorer method)

Rationale	Quantitative measure of total suspendible solids deposited on the streambed. Six samples are collected from a single habitat. Samples are processed in the laboratory for Total Inorganic/ Organic Sediment by area (SIS and SOS, respectively) or Suspendible Benthic Solids by Volume (SBSV).
Equipment required	• Cylindrical tube (*e.g.*, 45 cm length of 35 cm diameter plumbing tube for gravel bed streams, or 60 cm length of 50 cm diameter metal tube for cobble bed streams) • 7 x >120 ml screw topped sample bottles • Stirrer • Ruler (*e.g.*, broom handle marked with 1 cm graduations) • Field sheet
Application	Hard-bottomed streams
Type of assessment	State of the environment (broad-scale survey) Assessment of effects
Time to complete	30 minutes
Description of variables	
Sample	Sample number
Average water depth (m)	The average of five water depths inside the cylinder in metres.
Average stirred depth (m)	The average of five water depths inside the cylinder in metres to the depth that the sediments were stirred. Measured after water sample collection.
Useful hints	A split garden hose placed around the top of the tube aids with the insertion into coarse substrates. Welded handles at hand-height assist with use of large diameter corers used in cobble bed rivers. This method is not suitable for streambeds dominated by large boulders. Large cobbles can be removed from the corer prior to stirring. Do not over-fill sample bottles because they expand when frozen (samples should be frozen until analysis).

Field procedure

- Collect a background water sample (*i.e.*, control sample).
- Insert an open-ended cylinder into the streambed in a run and measure water depth at five random locations within the cylinder. Record average water depth. Stir the upper 5-10 cm of sediment for 15 seconds.
- Collect a sample of slurry (dirty water) and label.
- Estimate average stirred depth (sediment + water).
- Repeat Quorer method at five more locations.
- Freeze the six slurry samples and one background sample per site until laboratory analysis.

Sample	Average water depth (m)	Average stirred depth (m)
Control	na	na
1		
2		
3		
4		
5		
6		

Notes

- Suspendible inorganic sediment (SIS) and suspendible organic sediment (SOS) are determined using the standard protocol for Total Suspended Solids (TSS method 2540D in APHA 1998) and Volatile Suspended Solids (VSS method 2540E in APHA 1998).
  - o SIS (g/m^2) = ($TSS_{(sample-control)} - VSS_{(sample-control)}$) x average depth (m) in cylinder
  - o SOS (g/m^2) = $VSS_{(sample-control)}$ x average depth (m) in cylinder
- Stirred depth (m) is used to calculate SIS or SOS in g/m^3.
- Suspendible benthic sediment volume (SBSV) is determined using a settling assay (See Appendix 6.4 for details).
- The average value is calculated for each site.

Sediment Assessment Method 4 – Resuspendible sediment (Quorer method)

Rational	Quantitative measure of total suspendible solids deposited on the streambed. Six samples are collected from a single habitat. Samples are processed in the laboratory for Total Inorganic/Organic Sediment by area (SIS and SOS, respectively) or Suspendible Benthic Solids by Volume (SBSV).
Equipment required	• Cylindrical rude (e.g. 45 cm length of 35 cm diameter plumbing tube for gravel bed streams, or 60 cm length of 50 cm diameter metal tube for cobble bed streams). • 7 x > 120 ml screw topped sample bottles. • Stirrer. • Ruler (e.g. broom handle market with 1 cm graduations). • Field sheet.
Application	Hard-bottomed streams.
Type of assessment	State of the environment (broad-scale survey). Assessment of effects.
Time to complete	30 minutes.
Description of variables	Sample number
Average water depth (m)	The average of five water depths inside the cylinder in metres.
Average stirred depth (m)	The average of five water depths inside the cylinder in metres to the depth that the sediments were stirred. Measured after water sample collection.
Useful hints	A split garden hose placed around the top of the tube aids with the insertion into coarse substrates. Welded handles at hand-height assist with the use of large diameter corers used in cobble bed rivers. This method is not suitable for streambeds dominated by large boulders. Large cobbles can be removed from the corer prior to stirring. Do not over-fill sample bottles because they expand when frozen (samples should be frozen until analysis).

Field procedure

- Collect a background water sample (i.e. control sample).
- Insert an open-ended cylinder into the streambed in a run and measure water depth at five random locations within the cylinder. Record average water depth. Stir the upper 5 – 10 cm of sediment for 15 seconds.
- Collect a sample of slurry depth (sediment + water).
- Estimate average stirred depth (sediment + water).
- Repeat Quorer method at five more locations.
- Freeze the six slurry samples and one background sample per site until laboratory analysis.

Sample	Average water depth (m)	Average stirred depth (m)
Control	na	na
1		
2		
3		
4		
5		
6		

Notes

- Suspendible inorganic sediment (SIS) and suspendible organic sediment (SOS) are determined using the standard protocol for Total Suspended Solids (TSS method 2450D in APHA 1998) and Volatile Suspended Solids (VSS method 2450E in APHA 1998).
  - SIS (g/m^2 = (TSS (sample – control) – VSS (sample – control) X average depth (m) in cylinder
  - SOS (g/m^2 = (VSS (sample – control) – VSS (sample – control) X average depth (m) in cylinder
- Stirred depth (m) is used to calculate SIS or SOS in g/m^3
- Suspendible benthic sediment volume (SBSV) is determined using a settling assay (see Appendix 6.4 for details).
- The average value is calculated for each site.

10.7.3.3.2 Visual cover observation

Sedimentation monitoring will be based on Sediment Assessment Method 2 – In-stream visual estimate of % sediment cover (Clapcott et al. 2011) which includes a minimum of 20 estimates over a reach of run habitat at each site. If streams are too small for measurements across transects, deposited fine sediment cover percentage will be recorded within 20 quadrats along a 50 m stream reach. Representative photographs of the stream bed will be collected.

For soft bottomed stream habitats representative photographs of the stream bed will be collected for later comparison.

10.7.3.4 Macroinvertebrate community structure

Macroinvertebrate sampling will be timed to avoid any two-week period following any flow event estimated by the ecologist to have resulted in bed movement (significant habitat disturbance that reduces macroinvertebrate abundance and diversity).

Macroinvertebrate sampling will be in accordance with Protocols C1 (hard bottomed, semi-quantitative) or C2 (soft bottomed, semi-quantitative) of the standard national protocol (Stark et al. 2001) with no less than three replicate samples collected at each site on each sampling occasion.

Samples will be processed in accordance with standard protocol P2 (200 fixed count with scan for rare taxa).

10.7.3.5 Periphyton

Periphyton monitoring will be undertaken using visual methods to inform macroinvertebrate community assessments.

Visual periphyton will be assessed following Horizons protocol for routine visual assessments of periphyton in rivers (Kilroy et al., 2008[26]). The percent coverage of each periphyton category will be visually assessed on the streambed using an underwater viewer at five equally spaced replicates along four transects running across the wetted channel in run habitat (twenty replicates in total per site). Twenty replicates will be collected longitudinally where streams are too small to apply the transect approach.

10.7.4 Sampling protocols and frequency

Baseline monitoring will commence in March 2020 to build upon the existing data collected in 2019 and will continue until works commence in each of the affected catchments.

Monitoring of construction related discharges shall commence at the start of bulk earthworks. The start date of this may vary across the catchments depending on the timing of the construction.

10.7.4.1 Baseline monitoring

The baseline monitoring work will aim to capture stream water quality conditions during a range of weather events.

The objectives of the baseline monitoring programme are to:

- Characterise baseline community structure conditions in the range of aquatic habitats potentially impacted by the proposed development.
- Establish a network of water quality monitoring sites that can be efficiently accessed for event-based response monitoring.
- Characterise baseline wet weather water quality conditions in key catchment receiving waters for later comparison and assessment of construction phase effects.
- Provide sufficient data to establish initial thresholds and targets that are appropriate to the receiving environments for use in the construction phase adaptive effects and erosion and sediment control programmes.

10.7.4.1.1 Wet weather water quality monitoring

Water quality sampling will be undertaken at all sites targeting a total of six wet weather events over a six month period. For the baseline monitoring period this will be based on weather forecasting as opposed to responding to rainfall of a specific intensity or duration.

10.7.4.1.2 Routine monitoring

Routine monitoring will be undertaken quarterly at all sites during dry weather conditions and at least two weeks following any flow event estimated by the ecologist to have resulted in bed movement. Routine monitoring will include:

- Macroinvertebrate sampling on ~~two~~four occasions, ~~one in winter (June/July) and one at~~ to represent each of the ~~beginning of summer (December).~~ seasons.

[26] Kilroy, C., Biggs, B. J. F., Death, R. (2008). A periphyton monitoring plan for the ~~Manawatu~~Manawatū-Wanganui Region

- Sediment deposition monitoring on ~~two~~four occasions at the same time macroinvertebrate and periphyton cover monitoring is undertaken.

10.7.4.2 Construction phase monitoring and management response

This section sets out the proposed construction phase aquatic ecology monitoring programme and how the monitoring data will be used to evaluate, manage and respond to any effects of construction activities. Refer also Figure 10.4 Aquatic ecological monitoring, management and responses.

The objectives of the construction phase monitoring programme are to:

- Collect monitoring data to enable appropriate responses to protect key aquatic ecology values of stream receiving environments;
- Collect monitoring data that provides feedback to the erosion and sediment control programme; and
- Set out how the event based and routine monitoring data will be analysed and reviewed to identify any variance from established baseline conditions and set out management responses to address and any identified water quality or ecological effects.

10.7.4.3 Event based monitoring

Exceedances of established rainfall triggers[27] will lead to inspections of erosion and sediment controls to ensure that all controls have performed as expected and to identify any maintenance requirements.

Triggered rainfall inspections will be undertaken by the Environmental Manager and / or Environmental Supervisor / ESC Technical Specialist as outlined in the ESCMP Appendix B. Subject to health and safety restrictions, inspections will be made of all SRPs and DEBs, with manual turbidity and pH testing of the inlet and outlet flows undertaken along with a general inspection of the sediment control devices.

Event based monitoring of other discharges such as spills from plant concrete wastewater will occur following a similar process but with a focus on the contaminant of concern.

Event based water quality monitoring will be undertaken at the relevant catchment and control sites as appropriate in terms of the works in progress at any one time. The Project Ecologist – Freshwater will be involved in the determination of which sites should be sampled within the affected receiving environments. Event based monitoring can be extended to other sites if this becomes necessary.

In addition to the treatment efficiency exceedance responses detailed in the ESCMP, if one of the following cases occur, additional management responses will be triggered. In some instances, responses may need to be discussed and agreed with Horizons and Project team.

- A failure of perimeter control that has resulted in visible discharge of sediment to a stream.
- A failure of a SRP or DEB that has resulted in a visible discharge of sediment to a stream.
- Slumping or mass movement or erosion associated with the works but which is outside the catchment of a sediment control device or has resulted in a device being overtopped by sediment where that sediment has discharged to a stream.

[27] Rainfall forecasts and records at Project telemetered rainfall monitoring gauges will be monitored by Project Engineers, Site Engineers and Site Supervisors daily throughout the construction period. This process and the rainfall triggers are outlined in the ESCMP Appendix B.

The response will include immediately remedying the failure or event to prevent further uncontrolled discharges. and consider implementing the Event Based ecology and water quality monitoring described in this Aquatic Ecology Monitoring Plan and Figure 10.4~~.~~.

10.7.4.3.1 Water quality monitoring

Turbidity will be used as the key parameter for monitoring construction effects on waterways, and trigger levels for further construction effects monitoring and investigation are based on turbidity. Turbidity can be measured by field meters and loggers and therefore allows more rapid feedback compared to a sample collection and testing approach.

Continuous turbidity monitoring will be undertaken at the inlet and outlet of two SRPs (refer ESCMP Appendix B). The continuous turbidity data will enable the duration and scale of any discharge event to be assessed retrospectively.

Continuous turbidity monitors are also located within Catchment 2 and Catchment 7. These will provide some additional information pertaining to the response of the catchments to varying flow conditions. These monitors have been in place since pre-construction and inform the baseline data.

Rainfall trigger inspections will be carried out by the Project team and will follow the process outlined in Section 1.4.1 of ESCMP Appendix B. Briefly this involves turbidity, clarity and pH sampling at all erosion and sediment control devices.

Additional responsive ecological water quality monitoring will ~~only~~ be undertaken if the 'failures' outlined in section 10.7.4.3 above occur or as outlined in Figure 10.4~~.~~.

10.7.4.3.2 Deposited sediment

Event based deposited sediment monitoring shall occur at all established monitoring sites downstream of a discharge if the 'failures' outlined in section 10.7.4.3 above occur.

Exceedance of the following deposited sediment trigger will result in an assessment of the ecological effects of the discharge and ~~potentially~~ remedial and/or mitigation measures if required:

- Any noticeable increase (>20%) in the median visual sediment coverage relative to the ~~highest~~ baseline visual estimate for that site; or
- An increase (>20%) of median site resuspendable sediment from Quorer sampling compared to the ~~highest~~ median at the site from baseline monitoring.

Macroinvertebrate sampling in accordance with the methods in Section 10.7.3.4 may form part of an assessment of ecological effects of the discharge if determined appropriate by the Project Ecologist and as outlined in Figure 10.4~~.~~.

10.7.4.4 Routine monitoring

Routine water quality monitoring will focus on sites where there is potential for contaminant discharges other than sediment.

Routine deposited sediment and in-stream community structure monitoring will be undertaken during dry weather and following a dry period of two weeks following high flows likely to move bedload (actual trigger flows or rainfall will be determined following baseline monitoring~~)..~~). Routine monitoring will be undertaken quarterly while works are in progress in any particular catchment and comprise water quality, macroinvertebrate and sediment deposition sampling as outlined in Section10.7.3.

Exceedances of the established triggers will result in an assessment of the cause of the effect including any remedial and/or mitigation measures as outlined in Figure 10.4~~.~~. The outcomes of the assessment will be provided in the quarterly report to Horizons.

10.7.4.4.1 Water quality sampling

Routine water quality grab sampling shall occur on a monthly basis initially and be subject to review on the basis of the results.

Continuous turbidity monitors in Catchment 2 and Catchment 7 will also be reviewed to inform the water quality sampling.

10.7.4.4.2 Deposited sediment

Routine deposited sediment monitoring will be undertaken in conjunction with macroinvertebrate monitoring. Exceedances of the following deposited sediment triggers will result in an assessment of the cause of the effect including any remedial and/or mitigation measures~~.~~:

- An increase in the median visual sediment coverage of 20 % or more relative to the highest baseline visual estimate for that site for two or more consecutive quarterly monitoring occasions~~.~~ and/or when. compared to same season baseline data (i.e. to compare summer baseline data with summer monitoring etc.).
- An increase in median sediment coverage or re-suspendible sediment of 20 % or more relative to the highest measurement from baseline monitoring that persists for two or more consecutive quarterly monitoring occasions~~.~~ and/or when. compared to same season baseline data (i.e. to compare summer baseline data with summer monitoring etc.)

10.7.4.4.3 Macroinvertebrates

For the routine quarterly monitoring we recommend that exceedances of the following triggers result in an assessment of the cause of the effect including an assessment of any remedial and/or mitigation measures~~.~~:

- A ~~20~~15 % or greater decrease in the mean Quantitative Macroinvertebrate Community Index (QMCI) relative to the lowest score from the baseline monitoring that persists for 2 or more quarterly monitoring occasions~~;~~ and/or when. compared to same season baseline data (i.e. to compare summer baseline data with summer monitoring etc.); or
- A decline in the median % of EPT taxa richness of ~~20~~15 % or more compared to baseline monitoring scores that persists for 2 or more quarterly monitoring occasions~~.~~ and/or when. compared to same season baseline data (i.e. to compare summer baseline data with summer monitoring etc.).

10.7.4.4.4 Vegetation and topsoil storage sites

The baseline data collection programme is proposed to cover representative headwater streams for each of the catchments potentially impacted by project works, including vegetation and topsoil storage.

Vegetation and topsoil storage sites will be captured in the construction phase monitoring through the event and routine monitoring described in the preceding sections.

These sites will also be subject to erosion and sediment controls which will be checked and inspected on a routine basis and following rainfall trigger events.

10.7.4.5 Post-construction monitoring

The post-construction monitoring programme will be confirmed immediately following completion of construction of any particular stage and submitted to Horizons for approval.

Post construction monitoring will likely follow the routine monitoring programme ~~outlined in this report~~ for one year following completion of works but refined to any particular sites / effects observed during construction and with a potentially reduced frequency. Additional mitigation or offset shall only be recommended for effects that persist for more than a year (and monitoring indicates that the effect is likely to persist) where those effects are additional to those already anticipated by the AEE, and are additional to effects that are being offset or compensated through the REMMP (Section 12).

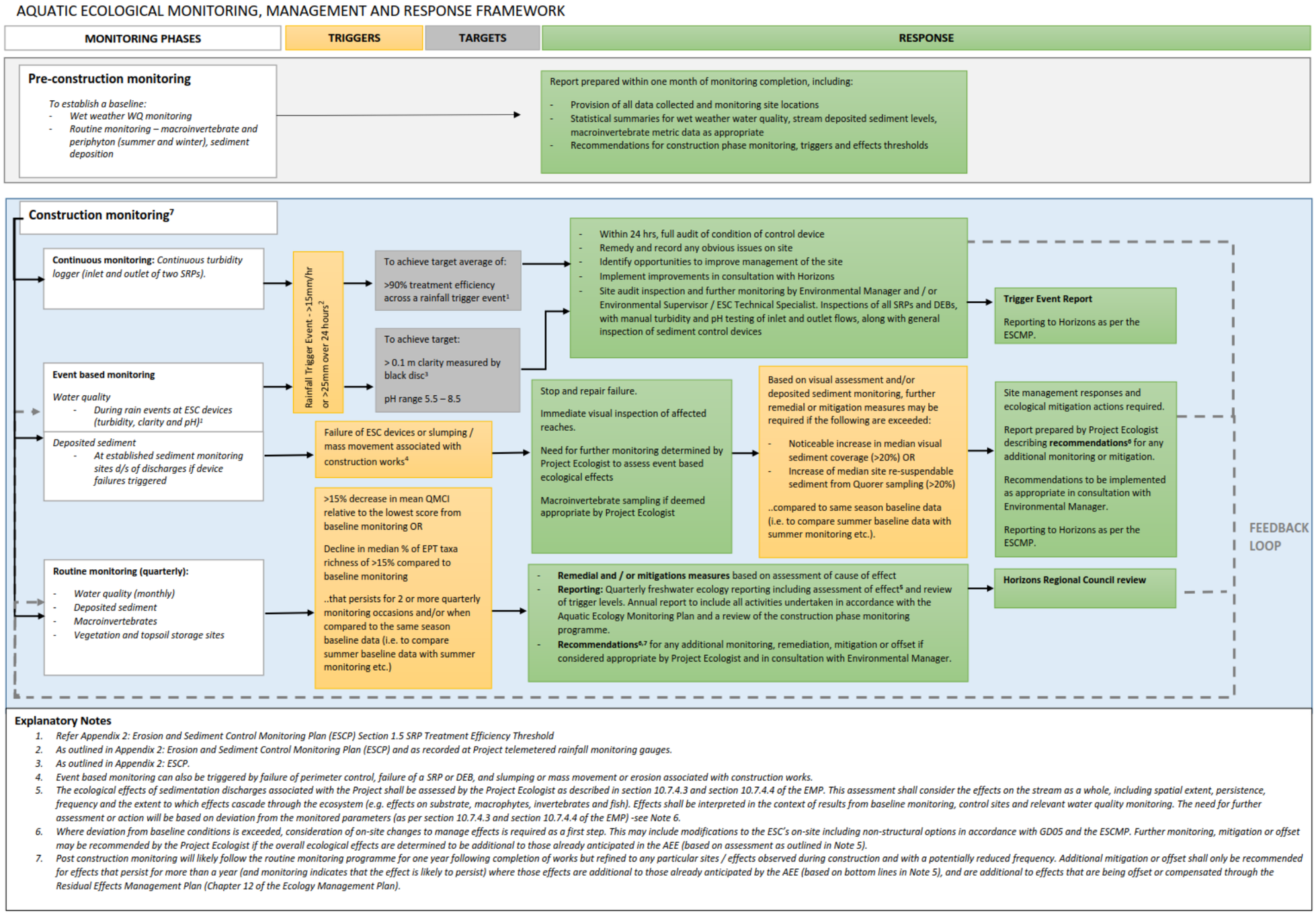


Figure 10.4: Aquatic Ecological Monitoring, Management and Responses

10.7.5 AEMP review

This AEMP will be reviewed at key points in the Project timeline to ensure the programme is adequate to achieve the objectives and as more information become available. Appropriate review points will include but not be limited to:

- Following completion of detailed design and the erosion and sediment control plan to ensure the monitoring of the AEMP and erosion and sediment control plan are aligned.
- Trigger levels will be reviewed as part of the quarterly reports.
- A wider review of the construction phase monitoring programme will occur as part of the annual report.

10.7.6 Reporting

10.7.6.1 Baseline monitoring reporting

A baseline monitoring report will be prepared within one month of completion of the baseline monitoring programme. The monitoring report will include but not be limited to:

- Provision of all data collected as part of the baseline monitoring to Horizons in electronic format;
- Details on site locations and access;
- Statistical summaries for wet weather water quality, stream deposited sediment levels, macroinvertebrate metric data as appropriate;
- Recommendations in regard to the construction phase monitoring on the basis of the baseline data (i.e. recommended modifications to the construction phase monitoring programme set out in the following section); and
- Recommendations on monitoring triggers and effects thresholds for use in the erosion and sediment control monitoring and in the AEMP.

10.7.6.2 Construction phase reporting

Submission of all monitoring results collected in accordance with this AEMP to Horizons on a quarterly basis. The quarterly reporting will cover event based and routine monitoring, include the results and outcomes of any triggered investigations, including any remedial and/or mitigation measures and a review of monitoring triggers.

All activities undertaken in accordance with this AEMP will be summarised and presented in an annual report and submitted to Horizons in the month of July each year.

Table 10-4 - Stream monitoring locations and method summary [PLACEHOLDER]

Monitoring ID	Site	Catchment	Coordinates (NZTM)		Type	Description and notes
			Latitude	Longitude		

11 Fish Recovery Protocols

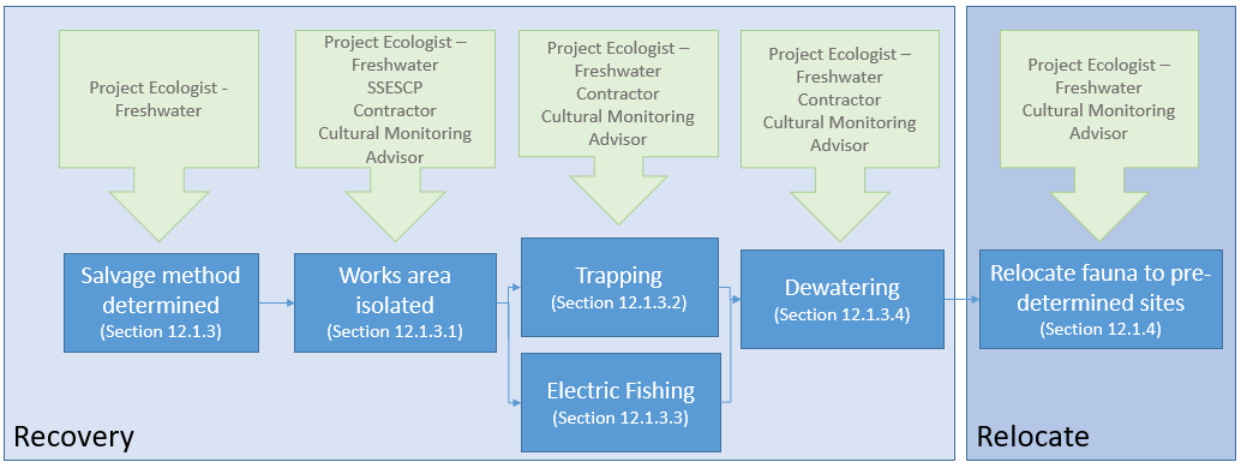
Legislation affords protection to native freshwater fish. All native freshwater fish on site are protected by the Freshwater Fisheries Regulations 1983, which prohibits intentionally killing or destroying indigenous fish. Furthermore, one freshwater fauna species identified on site is classified as 'At Risk' (NZTCS).

The direct effects of stream works on freshwater fauna can be minimised and mitigated by implementing the Fish Recovery Protocols (FRP) prior to and during dewatering or excavating streams and wetlands. A summary of the FRP is presented in Figure 11.1, including the relevant input required from the Project Ecologist – Freshwater, the contractor and with reference to SSESCP.

A combination of fish recovery methods (trapping, electric fishing, dewatering and muck out) will be applied in different habitats as appropriate. Each of these methods has inherent advantages and disadvantages. Once the proposed construction methods are finalised, site-specific freshwater fauna salvage plans will be prepared and implemented by the Project Ecologist Freshwater for each individual works area to minimise potential additional effects on fish during recovery and to provide for the most effective recovery approach.

Appropriate fish recovery measures will be applied across the site, with intensity of effort in any given area dictated by the likelihood of 'At Risk' species or type of habitat present.

These FRPs also include a relocation protocol for captured freshwater fauna.



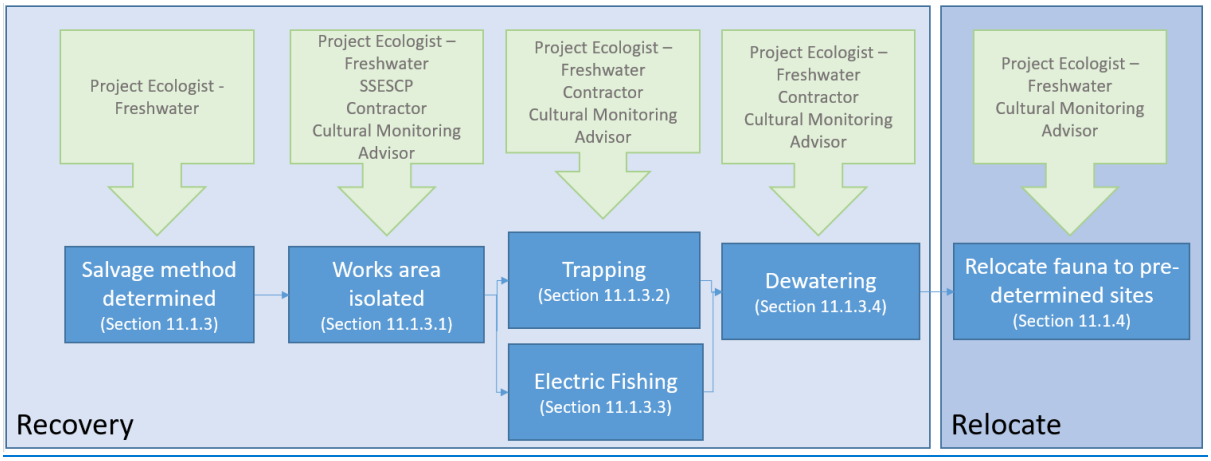


Figure 11.1: Fish Recovery Protocols process, including relevant input required by the Project Ecologist - Freshwater, the contractor and with reference to SSESCP. Section 11.3.5 refers to specific recovery methods for kōura and kākahi.

11.1 Salvaging timing

The timing of freshwater fauna salvage work will depend on the construction schedule and weather conditions. The Project Ecologist - Freshwater shall consult with the earthworks contractor and/or engineers to plan the staging and sequence for work area isolation (fish exclusion screens), freshwater fauna salvage and dewatering.

Approximately 70 % of the affected stream length across the Project is intermittent. Undertaking stream dewatering and construction during summer months when these intermittent streams are dry, where practicable, is a way of reducing potential effects on fish. It is also preferable to undertake salvage during summer months, where practicable, as fish are more likely to avoid capture during winter months and to avoid the peak spawning period for a number of native freshwater fish species expected to be present (Joy *et al.,* 2013)[28].

11.2 Salvaging footprint

Freshwater fauna salvage is proposed to reduce the potential effects of mortality or injury during construction. Desktop and field assessments have confirmed that freshwater fauna are present within the Project footprint. Therefore, salvage will be undertaken in all areas within the Project footprint that contain suitable habitat for freshwater fauna.

Freshwater fauna salvage will be undertaken using methodologies in Section 12.1.3. The specific salvage methodologies will be guided by the Project Ecologist - Freshwater based on their assessment of the freshwater habitat. The Project Ecologist - Freshwater has discretion to include or exclude areas based on the type and quality of habitat being impacted.

11.3 Salvaging protocol

The lead Project Ecologist – Freshwater must be suitably qualified and experienced in freshwater fauna salvage and relocation operations.

Native freshwater fauna salvage requires a Ministry for Primary Industries (MPI) Special Permit under Section 97 of the Fisheries Act 1996. An authorisation from DOC is required under section 26ZM (2) (a) of the Conservation Act 1987 to transfer any freshwater aquatic life to an appropriate freshwater waterbody in the same catchment. DOC approvals are also required ~~to transfer fish to public conservation land~~under section 26ZR of the Conservation Act 1987 and ~~for~~Section 51 of the Freshwater Fisheries Regulations 1983 to undertake electric fishing. A Fish & Game New Zealand permit might also be required for salvage of brown trout, subject to discussions with the local Fish & Game Council (Wellington Region).

Freshwater fauna salvage and relocation will be carried out in accordance with the above required permits and authorisations.

Salvaging will include a range of methodologies as described below, and will be in general accordance with standard survey protocols for New Zealand freshwater fish (Ling *et al.,* 2013).

[28] Note that October to December (inclusive) is peak spawning season for upland bullies. Smith, J. (2015). Freshwater fish spawning and migration periods, National Institute of Water and Atmosphere. MPI Technical Paper No: 2015/17.

Once the work area is isolated, salvage will generally occur as a two-stage process, starting with trapping and/or electric fishing, followed by dewatering and muck out where site constraints allow.

11.3.1 Work area isolation

Prior to setting traps for fish capture, streams and wetlands affected by works are to be isolated using fish exclusion screens preventing native fish migrating into the designated works area. This means isolating both upstream and downstream extents of the works area, unless the full upstream extent is to be affected. The locations of the exclusion screens will be agreed with the earthworks contractor and Project Ecologist - Freshwater once the relevant SSESCP streamworks procedure has been prepared.

Fish exclusion screens are intended to be temporary, and therefore will be installed immediately prior to fish salvage and streamworks. This reduces the risk of the screens being compromised, for example due to a wet weather event.

In brief:

- The temporary exclusion screens will be installed to minimise the ability of fish to swim under, or around the net, but shall not impede water flow. The exclusion screens will be embedded in the stream bed and banks and firmly secured.
- The top of the exclusion screens will extend well above the water surface to allow for increases in water level.
- Exclusion screens will preferably be constructed from fine (4 mm) mesh, although larger mesh (e.g. 8 mm) may be used if there is a risk of the mesh blocking due to instream organic debris. The mesh material will be supported by wire netting, with construction being similar to a super silt fence.
- Each exclusion screen will be inspected and, where required, maintained daily by the contractor to ensure the screen's structural integrity is maintained until the works in that section are completed.
- If an exclusion screen fails or becomes over topped with water the methodology outlined within this report will need to be repeated.

11.3.2 Trapping

Depending on water depth and area of wetted habitat, the trap density used will be nine fyke nets and 18 gee minnow traps per 150 m stream reach. This is a higher density than recommended in the New Zealand native fish monitoring protocols (Joy *et al*., 2013), because the objective of this exercise is fauna salvage rather than monitoring. The actual trap density used in each reach will depend on the available habitat, channel size and water depth. For example, fewer traps will be set in the reach if channel width is narrow and pool habitats are small.

For trapping in areas where there is insufficient water depth or channel width to deploy fyke nets, gee minnow traps will be deployed with the methodology similar to mudfish survey and monitoring protocols (Ling *et al*., 2013).

All fyke nets used will have an internal exclusion system to separate larger fish from smaller fish and reduce risk of predation. Fine mesh fyke nets should be used (where appropriate) to reduce potential injury or mortality and as outlined.

Where there is a risk of ~~nighttime~~night time anoxia (e.g. slow flowing streams), traps will not be fully submerged to allow the fish to have the ability to surface breathe.

Each trap will be checked the following morning, with any captured fish recovered, held and relocated according to the relocation protocol below.

Trapping effort for each 150 m reach will be set to a minimum of one night for stream reaches and will then proceed, depending on the following situations:

- If native fish with a conservation status of 'Threatened' or 'At Risk – Declining' are captured, trapping will continue until no further 'Threatened' or 'At Risk – Declining' individuals are captured.
- If native fish without the above conservation status are captured at densities of greater than 10 fish per 150 m reach, then trapping will continue until a reduction of > 50% between the highest and the lowest number of individuals captured on any one night is achieved.
- If the Project Ecologist - Freshwater considers the site suitable, then the second or third night of trapping prior to dewatering may be done after partial dewatering has occurred in accordance with the dewatering protocol (Section 12.1.3.4).

Reduction rates are based on those consented for the Pūhoi to Warkworth project, and on our experience undertaking freshwater fauna salvage for this and other large development projects. In all cases, traps will be deployed for a maximum of four nights. This is because further nights trapping increase the risk of exclusion screen failure during rain events and we consider four nights will be sufficient to capture the majority of individuals present across the life stage/population spectrum.

11.3.3 Electric fishing

Electric fishing may be carried out instead of fish trapping in sections of streams where water depth is between approximately 100 mm and 600 mm, and where stream conditions are more suitable to this method (such as suitable flow rate and low macrophyte density).

This approach is only for use where trapping is unachievable. It may also occur following partial dewatering if considered more effective than trapping.

In brief, the electric fishing protocols are:

- Electric fishing will occur for a minimum of three passes.
- After three passes, if the number of captured fish has decreased by > 50% between each of the three passes, then it will be considered appropriate to begin dewatering (Section12.1.3.4).
- If native fish with a conservation status of 'Threatened' or 'At Risk – Declining' are captured, then further electric fishing passes will be undertaken until no further 'Threatened' or 'At Risk – Declining' individuals are captured.
- For native freshwater fish without the above conservation status, if the number of fish captured between any two consecutive passes decreases by < 50% then further electric fishing passes will be undertaken until the decrease is > 50% or < 10 individuals are captured.

11.3.4 Dewatering and muck out

On the completion of fish trapping or electric fishing efforts to the satisfaction of the Project Ecologist - Freshwater, dewatering can commence. The Project Ecologist - Freshwater must confirm that the dewatering can commence.

For stream reaches, the Project Ecologist – Freshwater, or suitably qualified and experienced freshwater ecologist, will be present during stream dewatering activities to inspect the streambed and channel base, under-bank margins and any other instream habitats for freshwater fauna that may have been missed.

In brief, the dewatering protocol is as follows:

- A fish exclusion screen will be installed on all pumps used during dewatering activities. This screen will have a maximum mesh size of 3 mm and will have intake velocities of < 0.3 m3/ sec.
- If the isolated section does not need to be pumped then fish may be allowed to swim downstream, outside of the impact reach, as water recedes. This is less damaging to the fish than catching them with hand nets or electric fishing. As the water level recedes the downstream fish exclusion screen will be removed to allow the fish to escape.
- In streams with dense aquatic macrophytes, a channel / pools may need to be formed to assist fish movement. Any macrophytes or instream sediment moved to create the channel will remain in the stream during dewatering.
- Once stream dewatering is complete and the Project Ecologist - Freshwater is satisfied with the level of fish capture effort, approved and consented streamworks can commence.

In streams and wetlands containing water at the time of consented streamworks, The Project Ecologist – Freshwater, or a suitably qualified and experienced freshwater ecologist will be present when sediment (spoil) is being mucked out (excavated) from a stream. This provides an additional backstop to salvage freshwater fauna that might remain after applying the salvage protocols described above.

In brief, the freshwater fauna salvage procedure for muck outs are:

- An excavator will spread out at least the top 300 mm layer of spoil in a thin layer on the bank near the stream for inspection by the Project Ecologist - Freshwater.
- When it is safe to access the spoil, it will be visually checked for any fish, kōura 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).

Any fauna captured during dewatering and/or muck out will be relocated using the relocation protocols in Section 11.4.

11.3.5 Kōura and kākahi

All kōura captured during trapping, electric fishing and/or dewatering and muck out activities will be relocated following the protocols in Section 11.4. Specific reduction rates are not considered necessary for kōura.

Kākahi inhabit stream beds where they are embedded within soft sediments. Kākahi will be salvaged using the following protocol:

- In wadeable streams and/or during dewatering, soft bed and bank sediments will be searched for kākahi by hand. A benthic viewer may also be used in deeper waters where visibility is adequate.
- Search efforts will target likely kākahi habitat, which includes soft sediments under undercut banks and submerged logs, and on the edges of large pools.
- Specific reduction rates are not provided for kākahi. However, kākahi will be salvaged from all suitable kākahi habitat where it is accessible.
- Salvaged kākahi will be relocated following the protocols in Section 11.4.

11.3.6 Biosecurity and pest fish

Unless being redeployed in the same sub-catchment, all nets and/or traps used will be clean, sterilised and allowed to dry for no less than one week prior to use ensuring that all plant material (seeds or plant material that is able to regenerate) is either removed or dead, reducing the risk of transferring freshwater

pest plants (including the pest organism *Didymosphenia* ~~*geminate*~~*geminata* known as 'didymo' and *Equisetum arvense* known as mare's tail) to new locations[29].

Any pest fish caught will be humanely euthanized using clove oil (50 mL per 10 L of water) or benzocaine (3.3% solution in ethanol, 50 mL per 10 L of water). All euthanized pest fish will be buried within the riparian margin of the stream in which they were caught.

For some fish relocation programmes, it is necessary to recycle stream water to reduce the risk of transporting unwanted organisms. For this site, it is not considered necessary as the trapping and relocation sites are highly connected therefore any unwanted organisms are likely to be present at both sites.

11.4 Relocation protocol

11.4.1 Handling, transport and relocation

Following capture, all freshwater fauna will be translocated in a lidded container of an appropriate volume of clean stream water for the number of fish caught. An aerator will be installed into the container and transferred to the relocation site within approximately one hour of capture[30].

Whilst contained, fish will be constantly monitored and if any individual fish show signs of stress (e.g. loss of righting response, gulping air, and/or gaping) the water will be changed to provide more oxygen and / or the fish will be moved to the relocation site immediately. Sensitive fish species, e.g. galaxiidae or gobiidae species, will be kept in a separate bucket to eels and kōura, to avoid any further disturbance to these species.

Large eels (> 500 mm) will be contained separately within wetted mesh sacks and kept hydrated to avoid injury to other smaller captured fish. https://www.biosecurity.govt.nz/travel-and-recreation/outdoor-activities/check-clean-dry/

Fish will be handled with wet hands at all times. Handling of freshwater fauna will be minimised in order to reduce stress.

11.4.2 Relocation sites

The freshwater fauna relocation site(s) will predominantly be located within the catchment of capture. Freshwater fauna will be released as close as possible to the capture site, depending primarily on availability of habitat.

Preference will be given to relocation site(s) within the same catchment as the capture site, however depending on quantities of freshwater fauna salvaged and habitat availability, relocation into the adjacent sub-catchment or catchment may be necessary.

Key aspects of the freshwater fauna relocation site(s) are that they have abundant habitat and connectivity to upstream and downstream environments. In all cases freshwater fauna will not be released into areas within Project footprint, even if construction has not yet begun in these areas at the time of release.

[29] Refer to notices and guidelines issued by Biosecurity New Zealand (www.biosecurity.govt.nz/ travel-and-recreation/outdoor-activities/check-clean-dry/) in relation to the spread of pest organisms.

[30] The relocation method for brown trout (if applicable) will be subject to discussion with the relevant Fish & Game Council (Wellington Region) and any associated Fish & Game New Zealand permit.

The Project Ecologist - Freshwater will ensure that fish caught are released in a distributed manner within the relocation site(s), particularly when releasing a large quantity of freshwater fauna at one time. This will avoid or reduce the risk of any predation risks or overstocking at a single release site.

Kākahi will be released in wadeable stream habitats with similar characteristics to the capture site(s). Kākahi will be preferentially relocated to suitable habitat in areas where pest control is being undertaken. Preferably, these relocation site(s) will be well-shaded and slow flowing, with soft bed and bank sediments and suitable kākahi habitat features such as undercut banks. Due to the risks associated with burying kākahi, they will be placed on the stream sediments and allowed to bury themselves.

11.5 Reporting

For all native freshwater fauna the following information will be recorded:

- Date and time of capture and release;
- Capture method;
- Capture and release locations (GPS coordinates); and
- Number and size of individuals of each species released

Fish data will be reported as required by the permit holder in accordance with the obligations of those permits.

12 Residual Effects Management and Monitoring Plan

12.1 Introduction

This Residual Effects Management and Monitoring Plan (~~REMP~~REMMP) sets out the methods that will be used to offset and compensate for residual effects on ecological values associated with the Project, which cannot be avoided or minimised. The ~~REMP~~REMMP also outlines the performance standards and monitoring and reporting requirements.

This section of the EMP outlines how residual effects on ecological values will be managed and will be updated to incorporate any requirements of Regional Council resource consents.

As the residual effects are being managed through a variety of approaches on different properties, Site Specific Ecology Offset and Compensation Plan/s (SSEOCP) will be prepared for each landowner/enhancement site (described in Section 12.3).

Detailed information on ecological values, effects and effects management is provided in the Technical Assessments and is summarised in Section 2 of this EMP.

12.2 Summary of residual ecological effects management

In summary the offset and compensation response address residual ecological effects which results in:

45.6~~2~~26 ha of forest revegetation and 6.5~~5~~56 ha of wetland revegetation including an additional 10 m buffer planting area as offset and compensation for various habitat types as specified by the BOAM and BCM models;

Restoration and habitat enhancement measures within those planted areas including the exclusion of livestock and the direct transfer of forest resources;

- 48.3 ha of bush retirement and 0.4 ha of existing wetland retirement (including restoration and habitat enhancement measures);
- Intensive mammalian pest management over the 300 ha NMGSR, 48.3 ha of bush and 0.4 ha of wetland retirement and 45.6 ha of forest ~~and~~ 6.5~~5~~56 ha of wetland (including 10 m buffer ~~plantings~~planting) habitat type restoration areas ~~for a 10-year period resulting in a biodiversity gain both short and long term; and~~, including
  - Annual rat, possum and mustelid pest control for 10 years; and
  - Annual deer control for 35 years; and
- Performance standards and targeted outcome monitoring of specific restoration and habitat enhancement measures and pest control.

Offset and compensation locations are outlined in Drawing Set in Volume 3, TAT-3-DG-E-4150, TAT-3-DG-E-4161-2.

The following summary of residual ecological effects and associated offsetting or compensation actions is divided into terrestrial and wetland biodiversity (Section 12.2.1~~),~~) and aquatic habitat (Section 12.2.2~~)~~ ~~and pest control (Section~~).

12.2.1 Terrestrial and wetland biodiversity

As explained in Technical Assessment G (Terrestrial Offset and Compensation), offset and compensation actions to address residual effects on terrestrial and wetland ecology have been derived using a Biodiversity Offset Accounting Model (BOAM) and Biodiversity Compensation Model (BCM) as decision supports tools. Table 12.1 and Table 12.2 set out the outputs from the application of the BOAM and BCM, which together form the basis of the measures proposed to address residual adverse effects.

Table 12.1: Summary of the Offset Model inputs and results

Biodiversity type	Impact to be offset (ha)	Offsetting actions
Old growth treelands	0.13 of vegetation loss + indirect ecological effects	0.6 ha of restoration planting which includes: • Fencing to exclude livestock. • Artificial cavity provision. • Enhancement plantings. • Re-use of forest material (e.g. seeding of logs ~~and tree crowns~~)
Kānuka forest	1.3 of vegetation loss + indirect ecological effects	2.3 ha of restoration planting which includes: • Fencing to exclude livestock. • Artificial cavity provision. • Enhancement plantings. • Re-use of forest material (e.g. seeding of logs ~~and tree crowns~~)
Advanced secondary broadleaved forest	0.04 of vegetation loss + indirect ecological effects	0.17 ha of restoration planting which includes: • Fencing to exclude livestock. • Artificial cavity provision. • Enhancement plantings. • Re-use of forest material (e.g. seeding of logs ~~and tree crowns~~)
Secondary broadleaved forest and scrublands	6.71 of vegetation loss + indirect ecological effects	24 ha of restoration planting which includes: • Fencing to exclude livestock. • Artificial cavity provision. • Enhancement plantings. • Re-use of forest material (e.g. seeding of logs ~~and tree crowns~~)
Mānuka and kānuka shrublands	2.11 of vegetation loss + indirect ecological effects	5.7 ha of restoration planting which includes: • Fencing to exclude livestock. • Artificial cavity provision. • Enhancement plantings. • Re-use of forest material (e.g. seeding of logs ~~and tree crowns~~)
Divaricating shrublands	0.33 vegetation loss + indirect ecological effects	0.65 ha of restoration planting which includes: • Fencing to exclude livestock~~.~~ (noting these areas will be intermittently grazed by sheep to maintain ecosystem type). • Artificial cavity provision.
Secondary broadleaved forest with old growth signatures	0.25 of vegetation loss + indirect ecological effects	1.3 ha of restoration planting which includes: • Fencing to exclude livestock. • Artificial cavity provision. • Enhancement plantings. • Re-use of forest material (e.g. seeding of logs ~~and tree crowns~~)

Table 12.2: Summary of the Compensation Model and results

Biodiversity type	Impact to be compensated (ha)	Compensation actions
Old growth forest (alluvial)	0.10 of vegetation loss + indirect ecological effects	0.9 ha of restoration planting which includes: • Fencing to exclude livestock. • Artificial cavity provision. • Enhancement plantings. • ~~CWD provision.~~Re-use of forest material (e.g. seeding of logs)
Old growth forest (hill country)	0.85 of vegetation loss + indirect ecological effects	10 ha of restoration planting which includes: • Fencing to exclude livestock. • Artificial cavity provision. • Enhancement plantings. • ~~CWD provision.~~Re-use of forest material (e.g. seeding of logs)
Raupō dominated seepage wetlands	0.11 of vegetation loss + indirect ecological effects	0.35 ha of restoration planting which includes: • Fencing to exclude livestock. • Restoration will be undertaken on an existing online farm pond.
Indigenous dominated seepage wetlands	0.44 of vegetation loss + indirect ecological effects	1.2 ha of restoration planting which includes: • Fencing to exclude livestock. • Restoration will be undertaken on existing wetland seepages.
Exotic wetlands	4.42 of vegetation + indirect ecological effects	5 ha of restoration planting which includes: • Fencing to exclude livestock. • Restoration will be undertaken on existing wetland seepages.

12.2.1.1 Wetlands

As outlined in Technical Assessment G – Terrestrial Offset and Compensation, an exchange in wetland extent for wetland condition has been applied.

Indigenous dominated seepage wetland (moderate value) and pasture wetland (low value) restoration will be undertaken on existing wetland seepages, with the raupō dominated wetland (high value) restoration intended to be undertaken on an existing online farm pond. After restoration the compensation wetlands will be restored to kahikatea dominant seepage wetlands and a raupō dominated wetland including a 10 m wide buffer planting providing further positive indirect ecological net gain. Both proposed restored wetland types have a much higher biodiversity value than the wetlands impacted. In this instance the proposed wetland compensation is considered a trade-up in wetland condition, resulting in a better conservation outcome.

12.2.1.2 Old growth forest (alluvial and hill country)

As outlined in Technical Assessment G – Terrestrial Offset and Compensation, compensation has been applied to old growth (alluvial) and old growth forests (hill country) on the basis that a like for like exchange is not feasible within a 35-year timeframe.

The Compensation Model has been applied, resulting in a mid-successional broadleaf species composition that is able to be achieved within a 35-year timeframe. The old growth (alluvial and hill country) restoration is proposed to be undertaken within gaps of an existing old growth forest which is expected to provide further indirect ecological benefits.

12.2.1.3 Addressing the loss of threatened plant species

The Project footprint and wider area contains a number of 'At Risk' and 'Threatened' plants (Table 3-1) that will be lost as a result of construction. Specific offset planting requirements have been outlined in NoR Condition 24 ~~of the~~ and draft ~~NoRs,~~Consent Condition [EC1], including:

- For each ramarama or rōhutu individual above 15 cm in height that is lost as a result of enabling or construction works, a total of 100 ramarama seedlings shall be planted as replacement[31]. Ramarama and rōhutu shall be distributed within Enhancement Plantings in appropriate areas once the Starting Crop has established.
- Any existing swamp maire tree which has been affected by pruning of more than 10% of live growth shall be replaced at a ratio of 1:100, while any existing swamp maire tree that dies as a result of enabling or construction works activities shall be replaced at a ratio of 1:200. The swamp maire remnant will be monitored annually for 5 years post the completion of BR03 to monitor for dead trees.
- Giant maidenhair (*Adiantum formosum*) is present on floodplains adjacent to the Manawatū River. It is now only found within the Manawatū Gorge (Ch 3,800 – 3,900) and around Woodville, and a translocation plan is outlined in Section 3.3.3.2. The death of any translocated individuals shall be replaced at a ratio of 1:15.
- Loss of mānuka and kānuka species are addressed through the offset model calculations for these ecosystem types. *Metrosideros* vines are expected to naturally reinstate within established replacement plantings– there are abundant seed sources close to the footprint (e.g. Manawatū Gorge Scenic Reserve).

12.2.1.4 Pest control

Pest animal control is proposed as compensation to account for residual direct and indirect adverse effects which have not been accounted for within the Offset Model for each ecosystem type, including effects on fauna species.

The Pest ~~animal control~~ Management Plan (PMP) in Section 13~~New Zealand is relatively prescribed with known conservation outcomes, therefore~~ sets out the ~~focus on the control of pest animals to low densities as assumed in the Compensation Model is considered an achievable outcome with a high degree of confidence (75% - 90%)~~methods that ~~an expected net gain~~ will ~~result.~~

~~Additional compensation is proposed in the form of:~~

- ~~Ten years of~~ be used to control mammalian ~~pest control within approximately 300 ha of old growth forest (hill country) in the NMGSR;~~
- ~~48.3 ha of~~pests at specified native bush sites and ~~0.4 ha of existing wetland retirement including stock exclusion, 10 years of mammalian pest and weed control and legal protection; and~~

[31] Rōhutu is closely related to ramarama and its threat status has been elevated from 'Not Threatened' to 'Threatened - Nationally Critical' because of its susceptibility to myrtle rust (De Lange et al., 2017). Rōhutu was confirmed along with ramarama in the Old Growth Treeland area at CH 5700 - CH 5800 and in the Old Growth Forest - Hill Country. For completeness, the management measure for ramarama has been applied to rōhutu.

- ~~Ten years of mammalian pest control over 45.6 ha of forest and 6.55 ha of wetland (including buffer plants) revegetation~~planted areas~~.~~

~~To achieve the required outcome, pest animal control is likely~~ as part of the package to ~~consist of:~~

- ~~A 1 ha ground-based grid-network across (where practicable due the steepness of the landscape) the approximately 300 ha NMGSR area of poison and trap stations with a 11 km perimeter control of 1 poison and trap station every 100 m;~~
- ~~A 1 ha ground-based grid-network of poison and trap stations across 48.7 ha of bush and 0.4 ha of existing wetland retirement areas;~~
- ~~A 1 ha ground-based grid-network of poison and trap stations across 45.6 ha of forest and 6.55 ha of wetland d(including buffer plantings) revegetation areas;~~
- ~~All of the above poison stations are to be pulsed every two years for a 6-month period over winter months when bait take is at the highest level due to the shortage of alternative food sources and prior to bird breeding season (July – December inclusive) for a 10-year period.~~

~~The above pest control approach will need to be undertaken for 10-years in order to achieve up to a 5% improvement in biodiversity values as predicted by the BCM.~~address the residual ecological effects associated with the Project. The ~~proposed pest control approach should be undertaken for 10 years unless superseded by a better pest management solution, approach or management framework in the future that results in the same or higher biodiversity outcome predicted by the BCM.~~ PMP also outlines the performance standards and monitoring and reporting requirements.

12.2.2 Aquatic habitat

As outlined in Technical Assessment H – Freshwater Ecology, for those effects on aquatic habitat that cannot be avoided, remedied or mitigated, offsetting is to be provided following the Environmental Compensation Ratio (ECR) methodology and comprising:

- Construction of Type 1, 2 and 3 stream diversions riparian planting to a width of up to 20 m (as specified in Table 10-2~~:~~); and
- Riparian planting and fencing of intermittent and permanent streams to an average width of 20 m.

A summary of each catchment, the area of streambed impacted and the proposed quantum of offset is provided in Table 12.3.

Table 12.3: Summary of streambed area impacted and proposed offset for each catchment.

Catchment	Streambed area impacted (m^2) ('loss')	Proposed offset measures ('gain')	ECR range
Catchment 1	~~974~~922	1,~~102~~581 m^2 streambed enhancement via riparian planting ~~700~~567 m^2 new stream creation	1.09 to 2.91
Catchment 2	1690	~~2,831~~3,132 m^2 streambed enhancement via riparian planting 1,~~491~~492 m^2 new stream creation	1.28 to 5.32
Catchment 3	181	~~346~~348 m^2 streambed enhancement via riparian planting	2.03 to 5.36

Catchment	Streambed area impacted (m^2) ('loss')	Proposed offset measures ('gain')	ECR range
		~~102~~112 m^2 new stream creation	
Catchment 4	~~2583~~ 2560	~~3370~~7,742 m^2 streambed enhancement via riparian planting ~~2970~~1,547 m^2 new stream creation	1.41 to 6.60
Catchment 5	1349	~~2,010~~3,871 m^2 streambed enhancement via riparian planting ~~1,692~~653 m^2 new stream creation	2.10 to 6.62
Catchment 6	39	~~119~~191 m^2 streambed enhancement via riparian planting	3.7 to 5.25
Catchment 7	639	~~172 m²~~177m^2 streambed enhancement via riparian planting 1,410 m^2 new stream creation	1.97 to 2.98
Catchment 8	794	23 m^2 streambed enhancement via riparian planting 1,~~155~~133 m^2 new stream creation	1.01 to 2.06
Catchment 9	55	~~161~~286 m^2 streambed enhancement via riparian planting	5.25

The final composition of the offset package will be determined following further discussions with landowners and further design refinement.

~~12.2.2.1 Pest Management Plan~~

~~A Pest Management Plan (PMP) will be developed prior to restoration planting commencing.~~

~~Pest mammals shall be targeted in replacement planting areas and maintained at a 5% or better residual trap catch/tracking index score. Pest mammals to be targeted include rabbits, possums, rats, and ungulates (if required) such as deer and goats. The PMP will include details of pest mammal control timings, control methods, appropriate monitoring and location maps.~~

~~Control of mammalian pests within the offset / compensation areas will improve the ecological integrity of recipient habitat s and facilitate the recovery of a number of native plant and animal species. This will or is likely to include nationally 'Threatened' or 'At Risk' fauna to varying degrees by the Project. Control of mammalian pests will include the control of mustelids (stoats, ferrets, weasels), feral cats, rats, possums, goats and pigs for the term of the consents using typical residual trap catch measures and standard practice methods.~~

~~In order to achieve the best responsive approach, baseline pest density surveys are required to be undertaken in order to revise the approach in the PMP based actual data on pest animal and densities within the above zones.~~

12.3 ~~Performance~~Site Specific Ecology Offset and Compensation Plans

As the residual effects are being managed through a variety of approaches on different properties, Site Specific Ecology Offset and Compensation Plan/s (SSEOCP) will be prepared for each landowner/enhancement site. The specific details of these will be developed in consultation and discussion with relevant landowners, iwi Project Partners and DOC.

SSEOCP are standard alone documents which will outline:

- A description of the offset or compensation measures to be implemented;
- A site plan clearly outlining the location of the offset or compensation measures;
- A programme for undertaking fencing, planting and pest control measures;
- Vegetation Establishment Plans required by the Planting Establishment Plan (where relevant);
- Relevant performance standards as they relate to the Transport Agency and ongoing obligations.

~~12.3~~12.4 Performance standards

Performance standards will be used to validate the Offset and Compensation Model outputs~~.~~ ~~Performance standards for planting include:~~ and the outcomes proposed through each SSEOCP.

Performance standards for riparian, terrestrial and wetland planting include:

- 80% canopy formed by starting crop species five years following planting;
- Grass and weeds suppressed to low densities;
- Minimum of 20 m of logs (> 60 cm DBH) per ha of revegetation will be deployed;
- Establishment of enrichment species measured by 90% survival in the understory and subcanopy at year 10; and
- The required DBH of pukatea, miro, matai and kahikatea within the old growth (alluvial and hill country) habitat types.

12.5 Performance Standards for Freshwater Offset sites

Outcomes and performance standards for ecosystem types are provided in Table 4.1 in ~~Section~~the PEMP.

Performance standards for riparian planting of existing streams and stream diversions to include (with reference to specific SEV variables (V_{xx}) associated with the restoration interventions):

- Planting (as specified above) to margin widths as specified the relevant SEVm-P (V_{ripar});
- Planting of species to achieve the V_{rough} outcome anticipated in the relevant SEVm-P;
- Planting to achieve the density and shading as expected by the relevant SEVm-P (specifically $V_{ripfilt}$, V_{shade});
- Stock exclusion fencing along all riparian planting.

Performance standards for stream diversions include:

- Riparian planting (as specified above) to margin widths as specified within Table 10-2~~.~~.
- Implementation of stream design guidelines as appropriate for the relevant SEVm-P ($V_{physhab}$, V_{surf}).

12.6 Performance standards for pest control

Performance standards for pest control have been adopted which include:

- 5 % increase from a pre pest control baseline in forest bird (tui, bellbird, kererū, whitehead and rifleman) relative abundance using 5-minute bird count methodology after each pulsed pest control effort; and
- ~~10~~5 % or lower Chew Card Index (“CCI”) or Residual Trap Catch (“RTC”) for possums ~~10~~and5 % or lower Tracking Tunnel Index (“TTI”) for rats after each pulsed pest control effort.

12.7 Biodiversity outcome monitoring for Terrestrial Offset and Compensation sites

12.7.1 Purpose and scope

The purpose of the biodiversity outcome monitoring programme is to verifiably demonstrate Net Gain outcomes for a suite of biodiversity values impacted by Project activities.

Objectives and intended outcomes include:

- Baseline quantification of representative vegetation and avifauna characteristics within impact and offset/compensation sites;
- Determination of the time taken to demonstrably verify Net Gain outcomes associated with proposed habitat restoration and enhancement activities; and
- The provision of early warnings and corresponding adaptive management requirements in the event that projected/expected Net Gain outcomes may not be achieved.

12.7.2 Methods

12.7.2.1 Monitoring plot site selection

33 monitoring plots have already been selected within impacts sites to quantify vegetation characteristics and inform the BOAM.

A total of 50 monitoring plots will be selected within the proposed offset and compensation sites using a randomised spatially stratified approach to ensure representative coverage across the sites and habitat types. This will include the selection of:

- 20 forest biodiversity plots within the approximately 300 ha NMGSR pest management area (including a single plot with the reptile relocation site)
- 10 forest biodiversity plots within the 48.3 ha of forest and shrubland subject to bush retirement
- 10 forest biodiversity plots within the 45.6 ha of pasture habitat subject to native revegetation
- 10 wetland biodiversity plots within the 6.6 ha of degraded pasture wetlands subject to habitat enhancement and 0.4 ha of raupō wetlands subject to stock exclusion.

12.7.2.2 Monitoring plot design

Each monitoring plot will be 10 m x 10 m and delineated with permanent stakes at the four corners and within the centre and numbered.

Baseline monitoring will be undertaken in all plots (prior to small scale vegetation clearance activities < 100 m^2 at select sites) at both impact[32] and offset/compensation sites and plots will be divided into 2 m x 2 m number grids for ease of data collection.

12.7.2.3 Monitoring methodology

12.7.2.4 Forest and wetland vegetation monitoring methods

Within each forest monitoring plot, the suite of measurable biodiversity 'attributes' that have already been measured at the impacts sites to inform the BOAMs will be used. This includes:

[32] Baseline vegetation data has already been gathered from impact sites, however fauna monitoring will be added to existing data.

- Canopy (height and % indigenous cover);
- Understorey (% indigenous cover < 1.35m high);
- Indigenous diversity (indigenous species richness);
- Seedling and sapling counts and diameter at breast height ("DBH") measurements:
    - For forest monitoring plots this will include tawa, kahikatea, pukatea, miro, and matai. Seedling, sapling and DBH measurements.
    - For wetland monitoring plots this will include kahikatea, pukatea, and swamp maire (for plots that will be restored to swamp forest).
- Fauna habitat and food provision (fruiting, course woody debris, flaky bark).

In addition to these measurements, information on the relative abundances of indicator bird species and information on reptiles will also be obtained as set out below.

12.7.2.5 Bird monitoring

Five-minute bird counts will be undertaken from the centre of each forest monitoring plot except where vegetation plots are less than 200 m apart to avoid spatial autocorrelation of bird monitoring data. The 5-minute count methodology used was based on Dawson & Bull (1975). Observers will record all native birds seen or heard during 5 minutes while stationary at each count station (unbounded counts, Dawson & Bull 1975; Hartley & Greene 2012). Counts will be undertaken by a single observer at a time. When trainee observers are paired with experienced observers, only those birds seen or heard by the experienced observer will be recorded. Counts will be postponed if there is persistent rain or strong winds.

12.7.2.6 Reptile monitoring

Four ACOs and four cell foam covers will be placed in suitable habitat within each of the forest monitoring plots and will be checked during each monitoring event. Additional ACOs and cell foam covers and logs will be placed in the lizard relocation site monitoring plot as detailed in the LiMP.

12.7.3 Monitoring frequency

Baseline monitoring will be undertaken in all plots prior to small scale vegetation clearance activities < 100 m^2 at select sites at both impact and offset/compensation sites and plots will be divided into 2 m x 2 m number grids for ease of data collection.

Monitoring of offset and compensation sites will be undertaken at year 1, 3, 5 and 10, following commencement of offset and compensation measures at each site, and will include vegetation, bird and reptile monitoring.

12.7.4 Reporting

A BOAM report will be provided following monitoring in years 1, 3, 5 and 10 years (after the last planting season of a terrestrial offset site) to confirm that offsets have been demonstrably achieved and/or are on track for a clear trajectory towards the outcome state to confirm a Net Gain at year 10.

The report will include an assessment of how biodiversity outcomes are tracking against BOAM projections Reporting at the end of each monitoring event will include an assessment against BOAM projections and adaptive management recommendations (if necessary) to ensure the Net Gain outcomes are achieved. If a clear trajectory towards the outcome state does not confirm a Net Gain at year 10 then further adaptive management and monitoring recommendations will be required in order to reach the desired Net Gain outcome.

12.412.8 Monitoring and reporting requirements

12.4.112.8.1 CompliancePerformance standard compliance confirmation report

A compliance confirmation report will be submitted to Horizons and the Territorial Authorities within 30 working days of completion of the restoration and enhancement activities to confirm that all enhancement and restoration planting activities have been completed in accordance with this REMPREMMP. The report shall include, but not be limited to, confirmation on:

- Planting species matrix and number of plants planted;
- Areal extent and location of plantings;
- Stock exclusion fencing locations; and
- A tally of the number of individuals of swamp maire, ramarama and giant maidenhair affected; and
- Felled log deployment locations in terrestrial, riparian margin, and wetland offset and compensation sites.

12.8.2 Performance monitoring

Annual inspection surveys shall be undertaken during normal conditions (i.e. not during flooding events) to monitor the following:

- Identify weeds;
- Identify pest animal damage;
- Estimate planting survival and densities of facultative wetland species in wetlands and all terrestrial plants within compensation sites; and
- Estimate canopy coverage.

Findings will inform the types of weed and pest animal management requirements for the next subsequent year.

Compliance monitoring reports will be submitted to Horizons on the first, third, fifth year after planting until canopy closure, i.e. once all plantings are 5 years in age and native canopy closure targets have been met. The monitoring report shall include:

- Representative photos showing progress of terrestrial, riparian and wetland revegetation, including photos of sites where plantings are 5 years in age and canopy closure has been achieved (where applicable);
- Information/data on plant survival, infill planting, and progress towards 80% canopy closure targets and weed and animal pest management requirements; and
- Information on incidents and adaptive management responses.

12.4.212.8.3 Incident reporting

Incident-based reporting will be provided to Horizons within 30 working days of an unscheduled event that causes ecological harm (e.g. flood, fire, and disease) or event that sets back an element of the ecological enhancement and restoration programme by a season or more. Reporting will include the following information:

- The causes of the incident, the emergency response measures (if applicable) and the response proposed to avoid a recurrence of the issue;
- An assessment undertaken by a suitably qualified ecologist which details any adverse effects of the exceedance;

- Proposed, measures to avoid, remedy or mitigate effects or to offset or compensate for residual effects that cannot be avoided, remedied or mitigated; and
- Incident resolution will be tracked through the site's compliance management system.

13 Pest Management Plan

13.1 Introduction

This Pest Management Plan (PMP) sets out the methods that will be used to control mammalian pests (rats, mustelids, possums, mice[33], rabbit and hare, and deer) at specified native bush sites and planted areas as part of the package to address the residual ecological effects associated with the Project. The PMP also outlines the performance standards and monitoring and reporting requirements.

Detailed information on ecological values, effects and effects management is provided in the Technical Assessments.

13.2 Summary of residual ecological effects management

In summary, the offset and compensation measures to address residual ecological effects include:

- 45.62 ha of forest revegetation and 6.55 ha of wetland revegetation including an additional 10 m buffer planting area as offset and compensation for various habitat types;
- Restoration and habitat enhancement measures within those planted areas including the exclusion of livestock and the direct transfer of forest resources;
- 48.3 ha of bush retirement and 0.4 ha of existing wetland retirement (including restoration and habitat enhancement measures);
- Intensive mammalian pest management over the approximately 300 ha NMGSR (and adjacent land), 48.3 ha of bush and 0.4 ha of wetland retirement, and 45.6 ha of forest and 6.55 ha of wetland (including 10 m buffer planting) habitat type restoration areas, including:
  - annual rat, mustelid and possum control for 10 years;
  - annual rabbit and hare control in revegetation areas for up to 10 years, and
  - annual deer control for 35 years.
- Performance standards and targeted outcome monitoring of specific restoration and habitat enhancement measures and pest control.

Offset and compensation locations are outlined in Drawing Set in Volume 3, TAT-3-DG-E-4150, TAT-3-DG-E-4161-2.

13.3 Pest management programme overview and purpose

Pest animal control is proposed to account for residual effects on terrestrial and wetland ecology that cannot be fully addressed by other offset and compensation measures. Pest animal control is intended to 'kick-start and supplement the long-term gains associated with the native revegetation and bush retirement measures, by delivering almost immediate benefits to a range of biodiversity values.

The objective of the Pest Management Plan is to restore a range of ecosystem processes within existing forest and wetland habitat that have been degraded by the impact of animal pests, and to facilitate the successful establishment of areas that will be revegetated as part of the Project offset and compensation programme.

Rats and mustelids (stoats, ferrets, weasels) are major predators of birds, lizards and invertebrates in New Zealand forest and wetland habitats, and are the major reason for the continued decline of many native animal species. Possums (canopy foliage) anddeer (seedlings and saplings on the forest floor),

[33] Note that mouse control will only be undertaken in proximity to the lizard release location (refer to the Lizard Management Plan)

and rats (seeds and foliage) cause significant damage to forest canopies and seedlings and by doing so prevent the regeneration of many palatable plant species and reduce the health and amount of habitat available for native fauna.

Pest animal control is widely used on conservation land throughout New Zealand to generate ecological benefits for indigenous flora and fauna, and has known and documented conservation outcomes particularly for birds[34,35, 36, 37, 38]. Several species known to be present in the bush areas adjacent to the road footprint (e.g. whitehead, North Island robin, kākāriki, tui and kereru) have shown population level recovery in areas subject to intensive pest control.

Plant biomass and diversity will also increase as grazing and browsing pressure is reduced and the diversity and abundance of more palatable species will increase as seedling survival improves. Māhoe, hangehange, pate, wineberry, tawa and large leaved coprosma species are ungulate palatable species that will benefit from deer control, while swamp maire, māhoe and kaikomako (amongst others) will show canopy foliage density recovery as a result of possum control.

As vegetation health improves in a reduced pest density environment, the carrying capacity for many indigenous animal species will increase. This will result in spill over benefits for surrounding areas, including the 650 ha of bush on the south side of the Manawatū River of which approximately 400 ha is the MGSR, as juvenile birds, lizards and larger invertebrates disperse. Lizards and invertebrates will benefit from the increased diversity and abundance of habitat but may not benefit from the management of possums, rats, mustelids and deer to the same extent as birds.

13.4 Pest management area and duration

The pest management programme will consist of:

- Ten years of multi-species mammalian pest control within approximately 300 ha of old growth forest (hill country) in the NMGSR and ~~in~~ adjacent land ~~railway~~;
- Thirty-five years of deer control over the above 300 ha of NMGSR and adjacent land~~, railway forest~~;
- Ten years of mammalian pest control over 48.3 ha of bush and 0.4 ha of existing wetland that will be fenced to exclude livestock and legally protected; and
- Ten years of mammalian pest control over 45.6 ha of planted indigenous forest and 6.6 ha of planted wetland (and the 10 m buffer planting which is additional to the 6.6 ha wetland area).
- Ten years of intensive mouse control in the bush areas extending up to 100 metres from the lizard release location within NMGSR (if any lizard relocation occurs - refer to Section 6.5.2 in the LiMP).

[34] Byrom, A. E., Innes, J., & Binny, R. N. (2016). A review of biodiversity outcomes from possum-focused pest control in New Zealand. Wildlife Research, 43(3), 228-253.
[35] Fea, N., Linklater, W., & Hartley, S. (2020). Responses of New Zealand forest birds to management of introduced mammals. Conservation Biology.
[36] Miskelly, C. M. (2018). Changes in the forest bird community of an urban sanctuary in response to pest mammal eradications and endemic bird reintroductions. Notornis, 65, 132-151.
[37] Armstrong, D. P., Raeburn, E. H., Powlesland, R. G., Howard, M., Christensen, B., & Ewen, J. G. (2002). Obtaining meaningful comparisons of nest success: data from New Zealand robin (Petroica australis) populations. New Zealand Journal of Ecology, 1-13.
[38] O'Donnell, C.F.J. and Hoare, J. M. (2012). Quantifying the benefits of long-term integrated pest control for forest bird populations in a New Zealand temperate rainforest. New Zealand Journal of Ecology 36 (2): 131-140

The location and extent of the areas that will receive pest management can be seen in Figure [Placeholder - map to be created prepared prior to construction once sites confirmed]. This area is collectively referred to in this Pest Management Plan as the Pest Management Area ("**PMA**").

Thirty-five years of deer control is proposed to enable the increased diversity of seedling regeneration to grow above deer browse height. This can take as long as 35 years for slow growing canopy species such as tawa.

13.5 Current pest densities

No baseline surveys of pest densities have been undertaken in the PMA, however, walk-through assessments of several sections of the NMGSR suggest that deer densities are moderate as determined by the amount of fresh sign (chew marks and browsed forest floor vegetation) and have been for some time. Seedlings of palatable species that are present in the area or in the canopy and would be expected to be regenerating under the canopy are less common than would be expected in a low pest environment. There are very few hangehange, māhoe, pate and broad-leaved coprosma species in the understorey – all of which are palatable to ungulates – and very few regenerating canopy species such as tawa.

There is also evidence of moderate possum presence (bark teeth and claw marks) although the canopy does not show the magnitude of canopy browse that would suggest very high possum densities.

A baseline pest density survey will be undertaken prior to the commencement of the pest management programme at various locations through the PMA to develop an understanding of where the highest pest densities are and especially to determine relative rat densities. The information gained from the survey will assist the refinement of the appropriate pest management strategy.

13.6 Target pest species and control methodology

13.6.1 Mature forest and wetland areas

The pest management programme in the established forest and wetland areas within the PMA will target deer, possums, , mustelids (ferrets, stoats and weasels), and rats (ship and swamp rats).

The objective of pest control effort in the mature forest and wetland areas is to reduce the target pest densities to the target thresholds by the commencement of the bird breeding season and to hold densities at low levels through the critical stages when young remain in the nest. Therefore, the pest management programme will operate from July to December each year.

The pest control targets for the mature forest and wetland areas are:

1. Predators

- Rats – 5% or lower RTI (Residual Trapping Tunnel Index) by the commencement of the bird breeding season.
- Mustelids – low densities at the commencement of bird breeding season
- Mice – 10% RTI (at the lizard release site only)

2. Grazing and browsing pest species

- Possums – 5% or lower RTC (Residual Trap Catch Index) or 5% or lower CCI (Chew Card Index).
- Deer – low densities / no fresh sign.

To achieve the required pest density targets, pest animal control will consist of:

- A 100m by 100m ground-based trap and bait station grid network (where practicable due the steepness of the landscape) across the approximately 300 ha of bush that includes the NMGSR and the bush covered railway land along the gorge. This equates to one set of trap and bait station devices every hectare;
- A 100m by 100m ground-based trap and bait station grid network across the 48.7 ha of bush and 0.4 ha of existing wetland retirement areas;
- Doubling of the trap and bait station intensity (to 50m x 100m) along sections of the perimeter of each target area where pest reinvasion pressure is likely to be greatest. This will include perimeter sections that adjoin forested areas, bush or scrub-filled gullies, or vegetated wetland or stream margins.
- The trapping – bait station network will be set and operated from July to December during each of the 10 years of the pest management programme. This will target predators when they are most hungry and ensure densities are reduced to target levels immediately prior to the commencement of bird breeding season.
- Twice yearly hunting efforts for deer, once in the late winter-early spring period prior to the commencement of bird breeding season, and the second effort in autumn after birds have fledged. The duration of each hunting effort will depend on the densities of deer present and the effort required to bring densities down to target levels.

The 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) and approved by the Consent Holder 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 throughout the duration 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 (or equivalent). A24s are 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). The traps will be serviced and replaced as per the manufacturer's recommendations.
- Possums: Feratox complemented by kill traps and other devices (that are DOC approved) where needed and especially around the bush perimeter.
- Stoats and weasels: double set DOC 200's (or equivalent) with traps at 100m spacings along lines that are approximately 500m apart. A24 Goodnature traps (or equivalent) will be used where access may be limited (due to steepness) or challenging in poor weather.
- Ferrets: single set DOC 250's set around the bush – pasture margins.

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 need to be set with full CO2 canisters at the start of the control effort in July and will need to be visited at least once (and no longer than 4 months) after the initial set in July to refresh the lure.

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 trap sets for stoats (using different lures) will follow the initial rat knock down effort so that there is less rat interference with the traps.

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 regular basis during each pulse of activity. First generation anticoagulants begin to lose their potency after about 3 days, so bait replenishment within each pulse needs to occur at least every 3 days, and more regularly if rat densities (and therefore bait consumption) are high. It is recommended that rat bait is administered in three week pulses - three weeks where bait is replenished every three days, followed by a three week period when no bait is applied. This approach allows time for the animals to die before new bait is applied and serves as a useful indicator of remaining rat densities.

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.

Diphacinone, administered in bait stations, is also effective for the mouse control that will be undertaken around the lizard release locations (see Section 13.6.4), but pindone is not effective as a toxin to control mice and should not be used for that purpose. Effective mouse control will also require alternate use of baits and snap traps. Proven, heavy duty snap traps (such as Victor traps) should be used.

First generation anticoagulants are considerably less effective against possums. Consequently, an alternative cyanide based toxin will be used for possum control. Feratox Strikers (a biodegradable 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.

Deer control will be undertaken by hunting. Deer are likely to move in and out of the pest management area from surrounding bush areas so control efforts will need be responsive to detected increases in activity.

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 these target indices is expected to result in biodiversity outcomes outlined in Section 12.7. The targets will also serve as performance targets for the pest management contractors employed to deliver the pest management programme.

13.6.2 Revegetated areas

Pest animal pressures will be different in the planted areas compared to the existing forest and wetland areas. Rabbits and hares will provide the main threat to newly planted seedlings with deer also likely to cause damage if they are resident in the bush areas. Possums do not generally browse on freshly planted seedlings in the open although they may cause some damage where plantings adjoin bush areas.

There will be constant rabbit and hare reinvasion pressure from the surrounding farmland, especially in the autumn, winter and early spring periods when there are less alternative food sources for these pests, so rabbit and hare control intensity should be at its greatest during this period and especially

immediately preceding intended planting efforts. Damage to seedlings will reduce once the plants exceed 600 to 700mm in height, so control intensity can be reduced accordingly.

Rats and mustelids are unlikely to cause serious predation damage in the open dryland planted areas during the 10 year pest management programme because the planted vegetation will not have grown to a size that is used as nesting habitat by birds. However, the planted wetland areas, especially those areas planted in sedges and rushes, may reach a size and density suitable for bird nesting as early as 5 years after planting. Because of this, rat and mustelid control will be commenced in the planted wetland areas when conditions become suitable for nesting (as determined by the project ecologist).

The objective of pest control in the planted areas is to reduce, as much as possible, damage and mortality to planted seedlings and to minimise predation once nesting commences in the planted wetland areas.

The pest control targets for the revegetated areas are:

1. Grazing and browsing pest species:

- Rabbits and hares – minimal fresh sign and plant damage
- Deer – low densities/no fresh sign.
- Possums - 5% or lower RTC (Residual Trap Catch Index) in bush areas adjoining planted areas.

It is likely that rabbit and hare control will only be necessary for the first five years following planting.

2. Predators:

In wetland areas only after the planted vegetation has become established:

- Rats – 5% or lower RTI (Residual Trapping Tunnel Index) by the commencement of bird breeding season
- Mustelids – low densities at the commencement of bird breeding season.

To achieve the required pest density targets, pest animal control will consist of:

- Control of hares and rabbits by hunting (shooting) and the application of pindone poison (for rabbits only). The use of other restricted toxins (to be used by licensed operators only) may be necessary if rabbit numbers are high.
- Deer control by hunting in adjacent bush areas.
- Ground-based trap and bait station grid network to control possums in bush areas that adjoin planted areas (if access to these bush areas has been granted) or along the margins of planted areas where they adjoin possum habitat (where access to the bush areas has not been agreed to by the landowner). The grid spacings to be determined by the severity of the possum risk and sufficient to achieve the pest density targets. Ground-based trap and bait station grid network to control mustelids and rats in the planted wetland areas once the habitat becomes suitable for nesting birds. The grid spacings to be sufficient to achieve the required pest density targets.

13.6.3 Revegetated riparian areas

Pest control will be undertaken where necessary in revegetated riparian areas sufficient to enable the 80% plant canopy cover performance target to be achieved. Rabbits and hares are likely to provide the greatest browsing pressure on newly planted native seedlings and possums may cause some damage where planted areas are close to existing native bush. The nature and intensity of pest control in each revegetated riparian area should be varied to match the pest animal densities in the area.

Pūkeko (a native species) may pose some risk to newly planted native seedlings in wetland areas and along riparian margins. Damage to new plantings (mostly in the form of plants pulled from the ground) can be reduced by planting larger grades of plants with sizeable root masses (PB2 plant grade or larger). If pūkeko damage is substantial, DOC should be consulted to discuss options for the prevention of pūkeko damage including live capture and relocation of birds.

13.6.4 Lizard relocation site(s) in NMGSR

Lizards captured during vegetation clearance will be relocated to a selected appropriate habitat site in the NMGSR (refer to the Lizard Management Plan). To enhance the likelihood of survival of the relocated animals and to increase the lizard carrying capacity at the release site, mouse control will be undertaken for 10 years in the forested areas within 100 metres of the release site(s). This will be in addition to the rat, mustelid, possum and deer control already occurring and equates to a total approximate area of up to 2.5 ha of mouse control.

Mouse occupy small areas (home ranges) in bush areas and so control devices need to be at close spacings to ensure mice encounter at least one device. Bait stations should be set at 25m spacings in the bush areas and ungrazed pasture surrounding the lizard release points with the network extending up 100 metres out from each release point. Bait application should be pulsed as for rat control with snap traps set between bait pulses to pick up those mice that may have an aversion to bait.

Mouse control should be commenced two months after the commencement of rat control (ie. July start for rats and September start for mice) because medium to high rat densities can inhibit mouse foraging behaviour thereby reducing bait take. However, once rat densities are lowered mice are more inclined to move further across the forest floor which increases the chance of them encountering a bait station. Mouse control should continue until February of each year to improve survival rates.

13.6.5 Adaptive management

An adaptive management approach will be adopted for each animal pest regarding pest management methods used and trap and/or bait station intensity. If target pest density performance standards are not achieved with one method, the method or approach will be varied, based on experience and research, until target levels are consistently achieved. An adaptive management approach will also require that traps and toxins will need to be alternated periodically for possums and rats to reduce bait shyness and trap aversion. The type of toxin used will also need to be changed periodically, especially for rats.

13.7 Pest density performance monitoring

Pest density performance monitoring will be undertaken once per year immediately prior to the commencement of bird breeding season at selected locations across the PMA to assess whether pest densities have been reduced to target levels.

The monitoring methodology will align with recognised best practice and all monitoring will be undertaken by personnel certified by the National Pest Control Agencies (NPCA) as trained monitoring personnel, and in accordance with the NPCA Standard National Protocol. Those undertaking the monitoring will be independent of any of the contractors delivering the pest management programme.

If target pest densities are not achieved for a pest species over a period of two consecutive years the pest control methodology and intensity will be reviewed, and if determined to be necessary, amended to improve the likelihood of achieving the targets in subsequent years. The review will be undertaken by the Lead Pest Contractor in conjunction with the Transport Agency or its appointed representative, and a copy of the review and proposed changes to the programme will be provided to Manawatu-Whanganui Regional Council at least two months prior to the July commencement of the next pest management season.

All monitoring data, including trap catch and bait consumption information, will be made available to the Horizons Regional Council within three months of each monitoring survey.

13.7.1 Outcome monitoring

Refer to Section 12.7~~Compliance monitoring report~~ for the biodiversity outcome monitoring framework designed to measure the benefits of the pest control and habitat enhancement on target fauna populations and the native plant communities.

13.8 Pest Management Operational Plan

As noted above, the lead Pest Management Contractor will produce a Pest Management Operational Plan (PMOP) in accordance with the provisions of this Pest Management Plan (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 adhere to all aspects of the PMOP and all consent and permit conditions, access agreements, and rules and regulations.

13.9 Legal mechanisms

Pest management activities are governed by several Acts and legal requirements including the 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 PMOP.

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);
- Access permission from all landowners to undertake pest management activities on their land; and
- Separate RMA approvals may be needed.

~~13~~14 Training

~~13.1~~14.1 Introduction

This section provides an overview of training requirements in relation to this EMP.

~~13.2~~14.2 Inductions

All people working on-site, or with site responsibilities shall undertake a formal site induction as outlined in Section 4.2 of 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 and cultural values of the area;
- Sensitive areas within the Project footprint; and
- The suite of management plans, including this EMP, which will be implemented during construction works to address adverse effects.

~~13.3~~14.3 Specific training requirements

The Management Team, Construction Manager, Site Managers, Cultural Monitoring Advisors and environmental and ecology team members (responsible for implementation of this EMP), will undergo environmental awareness training to make all aware of their responsibilities relating to this EMP.

Training requirements are described in further detail within the CEMP with specific training requirements relating to this Plan including:

- The ecological and cultural values of the area;
- Sensitive areas within the Project area;
- Accidental discovery protocols for 'Threatened' and 'At Risk' species not otherwise identified in specific management plans in this EMP, including a briefing to report any unusual or uncommon plant or animals that may warrant identification;
- Key ecological protocols / environmental control measures outlined in the EMP that shall be implemented to address adverse effects; and
- Ecological Constraints Map [PLACEHOLDER – to be developed prior to construction].

It should be noted that a number of ecological aspects, such as bat surveys, lizard salvage and relocation, invertebrate management, fish capture and relocation, will only be undertaken by suitably qualified ecologists as outlined in the specific management plan ~~chapters~~sections, hence are not included in Table 14.1~~Table 14.1~~ below.

Table ~~.~~14.1: Ecological Training

Environmental Aspect	Specific Training
Vegetation clearance	A briefing on the values of any significant areas of vegetation that are to be retained. A briefing to report any unusual or uncommon plant or animals that may warrant identification; Briefing of the Project Vegetation ~~Removal Protocol:~~Clearance Protocols:

Environmental Aspect	Specific Training
	• the methods that shall be used to protect vegetation remaining during construction • the removal and relocation of forest resources • methodology for mulching and stockpiling wood and topsoil
Biosecurity	• A briefing on biosecurity risks for the Project (refer to Section 5): • Myrtle rust management; • Plague skink management; and • Pest plant management.
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. • A briefing to report any unusual or uncommon plant or animals that may warrant identification; • The objectives of the stream design including fish passage requirements. • Briefing on the Project Fish Recovery 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)
Erosion and Sediment Control	• Relevant Council 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 ESCP 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. • Specific requirements set out in ~~SSESCPs.~~Site Specific Erosion and Sediment Control Plans (SSESCP).

A record shall be kept of all training, including the information presented and a list of attendees (refer to Section 4.2 of 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 EMP.

~~13.4~~14.4 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.

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