IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	applications for resource consents in relation to Te Ahu a Turanga; Manawatū Tararua Highway Project
BY	**NEW ZEALAND TRANSPORT AGENCY**
	Applicant

TE AHU A TURANGA: TECHNICAL ASSESSMENT F

TERRESTRIAL ECOLOGY

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INTRODUCTION

1. My name is Matthew James Baber. 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**").

Qualifications and experience

2. My previous employment and associated positions include:

    (a) Tonkin + Taylor (2011 - 2019)

        (i) Technical Director/Project Director (Ecology) (2019)

        (ii) Discipline Manager (Ecology)/Principal Ecologist (2017-2018)

        (iii) Team Leader Ecology/Principal Ecologist (2016)

        (iv) Principal Ecologist (2014 - 2015)

        (v) Senior Ecologist (2011 - 2014)

    (b) Auckland Council (2010 - 2011): Team Leader Biodiversity

    (c) Auckland Regional Council (2007 - 2010): Natural Heritage Scientist

    (d) Ecovision (2004 - 2007): Ecologist/Director

    (e) Postdoctoral Research Scientist, University of New Hampshire (2001 - 2004).

3. I hold the qualifications of Bachelor of Science (Zoology) from Otago University, Master of Science (Hons) (Conservation Ecology) from Auckland University, and Doctor of Philosophy (Ecology) from Florida International University (Miami, Florida, USA).

4. I have completed the Ministry for the Environment Making Good Decisions course (September 2019) and have been certified as an Independent Hearing Commissioner.

5. I am on the approved panel of technical expert service providers for the Environmental Protection Authority (**EPA**) as a provider of technical services (in terrestrial ecology) for the assessment of resource consent applications lodged with the EPA or called in by the Minister.

6. I am a member of the New Zealand Ecological Society, the Environmental Institute of Australia and New Zealand (EIANZ) and I am a Department of Conservation permitted herpetologist.

7. I have 19 years' experience as a professional ecologist. My work experience includes assessments of environmental effects; input into statutory and non -statutory policies, plans, and strategies; and the design and implementation of mitigation/biodiversity offset packages, ecological restoration initiatives, and biodiversity research and monitoring programmes. I have worked in a variety of forest, riparian, wetland, and coastal ecosystem types and on a diversity of taxa in New Zealand and abroad. I have authored more than 20 international and national peer-reviewed scientific publications and numerous technical reports on the above subject matters. I have led or been involved in the assessment of ecological effects for a number of large infra-structure projects including appearance as an expert witness for various council hearings, environment court hearings and a Board of Inquiry. Specifically, I have:

   (a) Appeared as the expert witness on behalf of Auckland Council for the Onehunga Foreshore Rehabilitation Hearings on terrestrial ecology and coastal bird matters (2011);

   (b) Appeared as the expert witness for the Department of Conservation on terrestrial ecology and coastal bird matters for the Transmission Gully Motorway Board of Inquiry (2011);

   (c) Appeared as the expert witness for the Department of Conservation on terrestrial, wetland and freshwater ecology (excluding long-tailed bats) for the joint hearing for the Hamilton Section of the Waikato Expressway Resource Consent Application and the East-West Tamahere Link Notice of Requirement ("**NOR**") and for the Southern Links Section of the Waikato Expressway Resource Consent application (2014);

   (d) Appeared as an expert witness on behalf of the West Coast Regional Council and Buller District Council on terrestrial ecology matters for the Mt William North mine (Solid Energy) hearing (2014);

   (e) Appeared as an expert witness before Council Hearings and Environment Court in relation to consent applications for quarrying and

residential developments in terrestrial and coastal environments (Various);

(f) Led the assessment of ecological effects on the terrestrial and wetland ecology components of the Huntly Section of the Waikato Expressway on behalf of the New Zealand Transport Agency (2014);

(g) Led the development and implementation of ecological management plans for Puhoi to Warkworth Road of National Significance for NX2 on behalf of the New Zealand Transport Agency (2015 - 2016);

(h) Led the ecology inputs during the Multi-Criteria Assessment ("**MCA**") phase for the Mt Messenger SH3 Project (2017) on behalf of the New Zealand Transport Agency;

(i) Led the terrestrial ecology inputs for the assessment of effects for the Auckland Regional Landfill Project for Waste Management New Zealand, including the development of offsetting and compensation models (2019 - ongoing);

(j) Led and managed ecological input into the resource consent process, policy review, and the development and implementation of biodiversity management initiatives for Auckland Council (2010 - 2011); and

(k) Co-authored the Peacocke's Structure Plan Area Effects Management Framework for Hamilton City Council, which includes the application of offset and compensation models.

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

9. My contributions include:

(a) Preparing an assessment of the Project's effects on terrestrial vegetation and fauna based on the now-proposed alignment and level of design; and

(b) Assistance with the preparation and review of the Ecological Management Plan ("**EMP**") proposed for the Project, which includes the following subsidiary plans: Vegetation Clearance Management Plan, Lizard Management Plan, Avifauna Management Plan, and Residual Effects Management Plan.

Code of conduct

10. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. This assessment has been prepared in compliance with that Code, as if it were evidence being given in Environment Court proceedings. In particular, unless I state otherwise, this assessment 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 assessment

11. The purpose of this evidence is to assess 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). This includes:

    (a) Characterisation and assessment of terrestrial and wetland habitat types and associated flora and fauna within the Project 'main works' footprint and immediate surrounds;

    (b) An assessment of the potential for adverse effects on vegetation/habitat types, bird and lizard values after measures to avoid or minimise adverse effects have been undertaken; and

    (c) Provision of proposed habitat restoration and enhancement measures for addressing residual effects that cannot be avoided or minimised.

12. In undertaking this assessment I have reviewed the description of the existing environment as set out in the Transport Agency's Technical Assessment 6: Terrestrial Ecology, prepared by Dr Adam Forbes and lodged with the Notices of Requirement ("**NoRs**") for designations for the Project ("**Technical Assessment 6**"). That description remains applicable to the resource consent applications, subject to small adjustments to the description of 'Ecological Values' (discussed in this report) following the change to the Project alignment and additional survey work, and to include areas of work that are located beyond the proposed designation boundaries (notably spoil sites).

13. The Tonkin & Taylor ("**T+T**") ecology team has verified the information presented by the Transport Agency and its NoR experts through site visits,

additional survey data and a detailed assessment of the potential effects of the Project on terrestrial ecology with respect to long-tailed bats (refer to the Assessment of Effects on Bats Report prepared by **Ms Cummings**, included at **APPENDIX F.1**) and invertebrates (refer to Assessment of Effects on Terrestrial Invertebrates Report prepared by **Dr Curry** at **APPENDIX F.2**). In this assessment I present (in summary form) the results in respect of bats and invertebrates as set out by Ms Cummings and Dr Curry. That said, I have discussed these findings with Ms Cummings and Dr Curry and I have undertaken site walkovers to verify these assessments myself.

14. I have consulted with Dr Forbes to verify my assessment and conclusions with respect to the 'Level of Effects' assessment and residual effects management.

15. In this evidence, I highlight instances where my assessment of the potential effects of the Project differs from the assessment at the NoR stage. In most instances those differences result from additional or more detailed information being obtained, or the more detailed level of design now confirmed and proposed through the resource consent applications.

16. This assessment provides a verification, update and expansion on the information provided during the NoR process on the basis that:

    (a) Ecological characteristics and values within the designation have been verified.

    (b) Further surveys and assessments have been undertaken where information gaps existed.

    (c) The potential effects can now be assessed against a design that is significantly more advanced than the indicative design information that was available during the NoR process. This design includes all Project elements and associated works (e.g. the precise location of the alignment and spoil sites, earthworks design, stormwater wetland design and bridge design) as described in the DCR.

    (d) I provide an assessment of Project effects against the 'effects envelopes', which constitute the maximum allowable habitat loss for each ecosystem type as set out in the designation conditions.

    (e) I assess the adequacy of measures to minimise adverse effects as set out in the Ecology Management Plan ("**EMP**"), which has now been

developed. Specifically, this includes, but is not limited to, an assessment of the Vegetation Clearance Management Plan ("**VCMP**"), Lizard Management Plan ("**LMP**") and Avifauna Management Plan ("**AMP**").

(f) I summarise and assess the adequacy of the biodiversity offsetting and compensation measures that have been developed to address residual adverse effects that cannot be avoided or minimised and that are discussed in detail in Mr Markham's Technical Assessment H.

17. This assessment is limited to the potential effects on terrestrial and wetland vegetation and associated fauna. For assessments relating to other ecological matters refer to:

(a) **Mr Markham's** Terrestrial Offset and Compensation assessment (Technical Assessment G).

(b) **Ms Quinn's** assessment of ecological effects on aquatic ecology (Technical Assessment H).

Assumptions and exclusions in this assessment

18. My assessment addresses the potential for adverse effects on terrestrial and wetland habitat types and associated flora and fauna that are anticipated from the 'main works' of the Project as detailed on the Project drawing set (provided in Volume III of the resource consent application) and summarised in the DCR.

19. The effects 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 (described below), henceforth referred to as the "**Project footprint**".

20. The construction buffer comprises setbacks from the physical work needed to allow for all construction activities and access (which are described in the DCR). The buffer width differs across locations and construction activities, as outlined below:

(a) 10 m buffer at top of cuts (including those associated with stormwater ponds/ devices, stream diversions and the share use path), except 5 m between chainage (5400-6200);

(b) 10 m buffer at bottom of fills (including those associated with stormwater ponds/ devices, stream diversions and the shared use path), except 5 m between chainage (5400-6200);

(c) 5 m buffer along all temporary access tracks, excluding BR03; except existing Te Āpiti Wind Farm access tracks;

(d) 2 m buffer at BR03 including the temporary access tracks;

(e) No buffer on temporary staging;

(f) 2 m buffer around the BR03 pile caps;

(g) 10 m buffer at spoil sites;

(h) 10 m buffer at top of cuts and 10 m buffer at bottom of fills for all Te Āpiti wind farm access tracks, except 5 m between chainage (5400-6200);

(i) 5 m from the temporary and final car parking / western gateway areas; and

(j) 5 m buffers for stockpile, laydown and construction compounds.

Some enabling works consents have been applied for independently of the main works consents. These works are subject to a separate consenting, as described in the Assessment of Effects on the Environment (Volume I). That said, habitat loss specific to enabling works is incorporated in the Project footprint habitat loss totals. That enabling works habitat loss includes:

(k) Western Access Track Stage 1 (consented APP-2019202470.00): 0.287 ha of manuka kanuka shrublands;

(l) Geotechnical Investigations (consent application APP-2019202606.00): 0.006 ha of raupo dominated seepage wetland (high value) and 0.0185 ha of secondary broadleaved forest and scrublands;

(m) Western Access Track Stage 1 Extension (draft consent application): 0.272 ha of secondary broadleaved forest and scrublands, 0.018 ha of kanuka forest and0.0635 ha of exotic dominated wetland (low value); and

(n) Abstraction of Construction Water (draft consent application): 0.02 ha of secondary broadleaved forest and scrublands.

21. **Mr Markham** includes in his offsetting and compensation package the habitat restoration and enhancement measures that are required by the above enabling works impacts. This approach is allowed for in the conditions of those enabling works and promotes the development of an integrated and comprehensive approach to addressing effects which is more meaningful and beneficial than addressing effects on an ad hoc basis.

22. I acknowledge the cultural values that underpin this Project, particularly those with relevance to the importance of water to tangata whenua. Cultural impact assessments have been prepared in respect of the Project and these address ecology impacts from a mana whenua perspective.

SUMMARY AND KEY CONCLUSIONS

24. 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 Range.

25. The 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 designation includes about 41.85 ha of indigenous vegetation and wetland habitats.

26. The 195 ha 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.

27. Of particular note, the Project footprint and immediate surrounds includes high value old growth forest and indigenous wetland habitat types, and includes, or possibly includes, several nationally 'Threatened' or 'At Risk' fauna species, including 10 plant species, the long-tailed bat (noting that the closest confirmed record is 13 km away), up to 23 bird species, up to 6 lizard species, and up to 7 species of invertebrates.

28. 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.

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

    (a) The selection of a preferred alignment option that have considerably lower ecological effects that 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 amount of forest and wetland loss is16.79 ha, compared to a total loss of 31 ha provided for by the original NoR effects envelopes, and 27.85 ha provided for in the (post-mediation) designation conditions effects envelopes.

30. 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 draft EMP and associated management plans for vegetation clearance, long-tailed bats, birds, lizards, and invertebrates.

31. Despite efforts to avoid or minimise effects, the Project footprint is still expected to result in the loss of 11.82 ha of indigenous dominated forests shrublands, and 4.97 ha of wetlands and associated flora and fauna.

32. 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) (Herein EcIAG 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.

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

34. 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 Effects' on the following local biodiversity values after avoidance and minimisation measures, include:

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

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

(c) 0.11 ha of indigenous dominant seepage wetland (raupo); and

35. Importantly, no residual adverse effects are deemed to be 'Very High'.

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

37. As detailed in **Mr Markham's** 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) A Biodiversity Offset Accounting Model (Maseyk et al. 2016) applied where offsets can be verified based on quantifiable data at the impact sites, and at the proposed habitat restoration and enhancement site.

(b) A Biodiversity Compensation Model (Tonkin + Taylor 2019[1]) where offsetting cannot be verified, to provide an indication of the level of benefit associated with the proposed habitat restoration or enhancement activity

38. Based in large part on these models, 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 felled/fallen log deployment, stock exclusion fencing;

(b) 48.7 ha of native forest will be retired from stock grazing through stock exclusion fencing;

(c) 300 ha of mammalian pest control will be undertaken for a period of 10 years within the ecologically significant Northern Block of the Manawatu Gorge Scenic Reserve to help address effects on flora and fauna in the short to medium term; and

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

(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.

39. In addition to the above, riparian planting along streams (indicatively modelled at approximately 23 km in length with an average of 20 m width on each bank) and along stream diversions (indicatively modelled at 8 km with an average of 10 m width on each bank), as explained in Ms Quinn's Technical Assessment H). Native landscape planting plantings are also proposed. These measures have not been taken into account when undertaking the offset and compensation calculations but will provide benefits to terrestrial and wetland biodiversity values through the provision of habitat and buffering and connectivity across the landscape.

40. The assessment of values, assessment of effects and measures to address effects is in general accordance with the NoR assessment. Where differences did occur, this predominately reflected the significantly reduced areal impact associated with the Project footprint compared to the NoR, as well as some minor differences in assessment approach.

41. 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, minimise, offset or compensate for adverse ecological effects.

REPORT STRUCTURE

42. The remainder of this report is structured as follows:

(a) Project description;

(b) Site description (terrestrial ecology overview);

(c) Assessment of effects methodology;

(d) Ecological characteristics;

(e) 'Ecological Values' assessment (EcIAG step 1);

(f) Assessment of Statutory Significance of Terrestrial Habitats;

(g) Ecological 'Magnitude of Effects' assessment (EcIAG step 2);

(h) Ecological 'Level of Effects' assessment (EcIAG step 3); and

(i) Residual Effects Management (Offsetting and Compensation).

PROJECT DESCRIPTION

43. 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 Range. The purpose of the Project is to replace the indefinitely closed existing State Highway 3 ("**SH3**") through the Manawatū Gorge.

44. The Project comprises a median separated carriageway that includes two lanes in each direction over most of the route. The new highway will connect with State Highway 57 ("**SH57**") east of Ashhurst and SH3 west of Woodville (via proposed roundabouts). A shared use path for cyclists and pedestrian users is proposed as well as a number of new bridge structures including a bridge crossing over the Manawatū River.

45. The design and detail of each of the elements of the Project are described in:

    (a) Section 3 of the Assessment of Effects on the Environment ("**AEE**") (Volume I);

    (b) The DCR contained at Volume II; and

    (c) The Drawing Set (contained in Volume III).

46. The elements of the Project that are particularly relevant to this assessment are:

    (a) The vegetation/ habitat clearance and landform modification required to construct the alignment and associated works;

    (b) The spoil site areas; and

    (c) Construction and operational activities associated with the Project (as listed above) that could degrade the habitat remaining, and result in disturbance, mortality, or isolation of flora and fauna.

SITE DESCRIPTION (TERRESTRIAL ECOLOGY OVERVIEW)

47. The proposed alignment traverses three ecological districts: Manawatū Plains, Manawatū Gorge North and Woodville. 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., 2005).

48. The proposed designation corridor covers 340 ha, of which 41.85 ha comprises indigenous-dominated habitat types and wetlands (both native and exotic dominated). The balance largely includes grazed pasture, exotic-dominated vegetation (namely plantation forest and broom/gorse weed fields), farm ponds, and anthropogenic structures such as roads and dwellings.

49. Parts of the Project footprint, namely spoil sites and the replacement Bolton Airstrip, extend beyond the designation corridor. The footprint outside of the designation covers 12.9 ha, of which 0.56 ha and 1.16 ha comprises mānuka and kānuka shrublands and pasture wetlands respectively. The remainder comprises grazed pasture.

50. In total, the Project footprint covers 214 ha, of which 16.79 ha comprises indigenous-dominated habitat types and wetlands (both native and exotic dominated). Again, the balance largely includes grazed pasture, exotic-dominated vegetation (namely plantation forest and broom/gorse weed fields), farm ponds, and anthropogenic structures such as roads and dwellings.

51. The previous surveys undertaken during the NoR process identified 12 habitat types within the designation corridor. These habitat types are listed below and discussed further in later sections of this report (in terms of areas affected and updates occurring since Technical Assessment 6 was completed):

    (a) Old-growth forest alluvial;

    (b) Old-growth forest hill country;

    (c) Secondary broadleaved forests with old-growth signatures;

    (d) Old-growth treelands;

    (e) Kānuka forest;

    (f) Advanced secondary broadleaved forest;

    (g) Indigenous dominated seepage wetlands (high value);

    (h) Indigenous dominated seepage wetlands ('Moderate' value);

(i) Exotic wetlands low value;

(j) Secondary broadleaved forests and scrublands;

(k) Mānuka and kānuka shrublands; and

(l) Divaricating shrublands;

52. With the exception of the Eastern and Western QEII covenants,[2] all of the indigenous vegetation remnants and wetlands assessed have been modified to varying degrees through the effects of livestock (tramping and grazing).

53. The above habitat types have the potential to support a diversity of flora and fauna (refer to the methodology section for a list of literature review sources).

54. Particularly notable plant species present include swamp maire and giant maidenhair. Eight other plant species have also been assigned a Threat Classification, despite being common, due to the potential impacts of Myrtle rust.

55. Long-tailed bats have been detected in the wider landscape with the closest recorded sighting approximately 13 km away from the Project footprint.

56. Notable bird species previously identified within the wider landscape include:

(a) Pōpokotea (whitehead), kārearea (New Zealand falcon), riflemen, kakariki, long-tailed cuckoo, North Island robin, kaka, New Zealand pipit; and

(b) Cryptic wetland birds: matuku-hūrepo (Australasian bittern), pūweto (spotless crake), and koitareke (marsh crake).

57. Lizard species previously identified within the wider landscape include: barking gecko, ngahere gecko, Raukawa gecko, Pacific gecko, glossy brown skink, ornate skink, northern grass skink (refer to the lizard values section below).

58. While surveys are currently in progress, no empirical invertebrate data have been collected from within the Project footprint though several species and their habitats may be present within the Project footprint, including *Megadromus* turgidceps (beetle), *Meterana grandiosa* and *M. exquisita*

[2]Two forested gullies that are subject to QEII Trust open space covenants. They both extend to the south of the proposed alignment between CH 5500 - CH 6200 to the Manawatū Gorge Scenic Reserve.

(moths), *Powelliphanta* snails *(marchanti*, *traversi traversi, and tarevrsi tararuaensis)* and *Wainuia urnula* (snail).

59. In addition to these habitat types, the Project traverses the Manawatū River which is a known nesting and foraging habitat for a number of native birds such as pohowera (banded dotterel), black-fronted dotterel, tarāpuka (black-billed gull), tarāpunga or akiaki (red billed gull), taranui (Caspian tern) and kawau (black shag), kāruhiruhi (pied shag), and kawau tūi (little black shag).

60. Significant Natural Areas located in close proximity to the project footprint include the Manawatū Gorge Scenic Reserve and the Ruahine Forest Park, as follows:

    (a) The Manawatū Gorge Scenic Reserve is located immediately to the south of a large part of the Project route. The reserve is approximately 1,000 ha in size and is generally characterised by podocarp-hardwood forest. The reserve likely provides an important source habitat for indigenous flora and fauna found within the Project footprint and the wider landscape.

    (b) The southern extent of the Ruahine Forest Park is located approximately 4.5 km to the north of the Project and stretches almost 100 km north along the Ruahine Range to the Tararua River. As with the Manawatū Gorge Scenic Reserve, the Ruahine Range is likely a source habitat for the Project footprint, at least for mobile species.

61. Several native bush remnants of ecological significance, outside the Project footprint and designation corridor, are likely to provide stepping stone habitats between the Manawatū Gorge Scenic Reserve and the Ruahine Forest Park. Notable remnants are the QEII covenant called Bolton's Bush (on Cook Road), and the forested catchment located in the Catchment 9 valley system.

ASSESSMENT OF EFFECTS METHODOLOGY

62. I structure my assessment of effects methodology as follows:

    (a) Consideration of the NoR process

    (b) Further literature review

    (c) Further field investigations

(d) Overarching approach to the assessment of effects

(e) Application of EcIAG guidelines

Consideration of the NoR process

63. As noted above, this report relates directly to the consideration of the effects of the Project on terrestrial ecology values through the NoR process.

64. I have familiarised myself with the technical assessments previously prepared by the Transport Agency in support of the NoRs in relation to terrestrial ecology, including:

(a) Technical Report 6: Terrestrial Ecology, and its primary appendices.

(i) Assessment of Terrestrial Vegetation and Habitats (Forbes Ecology, 2018) ("**Technical Assessment 6A**");

(ii) Report 6B: Terrestrial Fauna Ecological Effects Assessment Technical Report (Boffa Miskell 2018, prepared by Mr Andrew Blayney and Ms Karin Sievwright) ("**Technical Assessment 6B**");

(b) The surveys and assessments included as appendices to Technical Assessments 6A and 6B, listed below:

(i) Manawatū Gorge Road Realignment Threatened Plant Survey (Nicholas Singers Ecological Solutions Limited, 2018)

(ii) Manawatū Gorge SH3 - Summer Ecology Survey - Herpetofauna (Boffa Miskell Limited, 2018)

(iii) GHD & NZTA Manawatū Gorge Realignment. Option 3: South of Saddle Road Bats & Bird Habitat and Species Surveys (Kessels Ecology, 2018)

(iv) Ornithological Society of New Zealand ("**OSNZ**") Bird Atlas Squares that Encompass the Designation Corridor (Robertson et al, 2007)

(v) Project Te Āpiti Saddle Road, Manawatū - ecological assessment (Boffa Miskell Limited, 2003)

(vi) Report on Avian Mortality at Te Āpiti Wind Farm (Boffa Miskell Limited & Golder Associates, 2009)

64. I am also familiar with the key relevant evidence presented at the council-level hearing on the NoRs, by the Transport Agency and others and am in general agreement with the evidence as presented, including in particular:

    (a) Statement of Evidence of **Dr Forbes** dated 8 March 2019, and the addendum dated 25 March 2019.

    (b) Statement of Evidence of **Mr Andrew Blayney** (who focused on terrestrial fauna) dated 8 March 2019, and the addendum dated 25 March 2019.

    (c) Statement of Section 42A Technical Evidence of **Mr James Lambie** dated 1 March 2019.

    (d) Statement of Evidence of **Mr Timothy Martin** on behalf of the Director-General of Conservation dated 15 March 2019, and the addendum dated 4 April 2019.

    (e) The Joint Witness Statements prepared by **Forbes** and **Martin** (22 February 2019) and by **Forbes**, **Blayney** and **Lambie** (18 March 2019).

65. I have read the recommendation of the council-level hearing panel to the Transport Agency in respect of the NoRs; as well as the Transport Agency's subsequent decision to confirm the NoRs subject to conditions dated 7 June 2019, and the accompanying condition set. A number of those conditions relate directly to terrestrial ecology matters.

66. Following Environment Court mediation processes, the Transport Agency has asked the Court to modify the NoRs to reflect the now proposed 'Northern Alignment'. Dr Forbes and Mr Blayney prepared an addendum to Technical Report 6 addressing the Northern Alignment (as compared to the originally confirmed designation corridor). That addendum report, which I have reviewed; represents the last substantive assessment of terrestrial ecology effects carried out during the NoR process.

67. The Transport Agency has also agreed amendments to the decision-version of the designation conditions with the territorial authorities and other parties to the Environment Court appeals.

68. The updated agreed conditions were lodged with the Environment Court on 15 October 2019; these conditions are referred to in this report as the

"Designation Conditions". I have been advised that the Transport Agency is committed to meeting the obligations in the Designation Conditions and as such I have used the Designation Conditions as a basis for my assessment. The following designation conditions are particularly relevant to terrestrial and wetland habitats and associated flora and fauna:

(a) Condition 3 - Ecological Management Plan Certification Process;

(b) Condition 19 - Planting Establishment Management Plan;

(c) Condition 20 - Lizard Management Plan;

(d) Condition 21 - Bat Management Plan;

(e) Condition 22 - Avifauna Management Plan;

(f) Condition 23 - Terrestrial Invertebrate Management Plan;

(g) Condition 24 - Ecology, Ecological Management Plan and offset and/or compensation measures; and

(h) Condition 25 - At Risk or Threatened flora and fauna discovery protocol.

69. I am also familiar with further ecological site investigations that have been undertaken to inform the enabling works consent applications (separate from the main works), including the Te Ahu a Turanga - Enabling Works: Terrestrial Ecological Impact Assessment (Boffa Miskell, 2019).

70. On consideration of measures to address the effects of the Project on ecological values, I have referred to the measures required through the Designation Conditions. I explain this further below.

71. I have also reviewed the DCR for the Project. This DCR sets out the Project design and alignment in greater detail than was available at the NoR council-level hearing stage, and also reflects the change to allow for the Northern Alignment. A primary role of my assessment has been to refine and update the assessment of effects on terrestrial ecology from the NoR assessments (and the Designation Conditions) to reflect the updated and more detailed Project design as per the Project drawings and DCR.

72. Overall, this assessment expands on Technical Assessment 6 by addressing information gaps and refines that previous assessment of ecological effects based on:

    (a) The updated alignment and significantly more detailed design information;

    (b) The regional consents being sought to enable the Project;

    (c) Management actions to avoid or minimise effects as set out in the EMP and related Management Plans; and

    (d) The offset and compensation package that is intended to address residual adverse effects that cannot be avoided or minimised as outlined within Mr Markham's Technical Assessment H.

Further literature review

73. Information used to inform the effects assessment outlined above was gathered through a combination of literature review and site investigations. As explained above, Technical Assessment 6 and the other NoR material has been central to my assessment.

74. Multiple Project-specific ecological surveys have now been undertaken across the Project designation corridor. Review of these survey reports formed the basis of my understanding of the vegetation, lizard and bird values across the site.

75. Additional, targeted fauna surveys have been undertaken to inform the enabling works consent applications for five access tracks (Boffa Miskell, 2019). The results of this survey have also been reviewed.

76. In addition to the reports included with Technical Assessment 6, 6A and 6B (listed above), the ecological databases listed below were also reviewed to ensure the most recent data available was included in this assessment. The databases reviewed are:

    (a) The DOC BioWeb Herpetofauna Database (last accessed December 13 2019);

    (b) The DOC National Bat Database (last accessed December 17 2019);

    (c) Nature Watch (birds and invertebrate records, last accessed December 17 2019); and

(d) National Vegetation Survey RECCE data (data owned by DOC and administered by Landcare Research, last accessed 14 October 2019).

Further field investigations

77. As described in Technical Assessments 6, 6A and 6B, extensive site investigations were carried out to inform the assessment of effects for the NoR process. Additional investigations have also accompanied consent applications for the enabling works.

78. The Designation Conditions specify how the management of the potential ecological effects will be undertaken including further fauna surveys to inform the detailed management approach. Requirements for additional surveys included:

(a) Lizard surveys (as part of the salvage methodologies prior to potential habitat removal; survey methodologies are set out in the Lizard Management Plan);

(b) Avifauna nesting surveys (specifically for dotterel, whitehead and New Zealand pipit; survey methodologies are set out in the Avifauna Management Plan); and

(c) Invertebrate surveys across forest and shrubland habitat types (as described by Dr Curry in Appendix F.2; surveys are currently underway with detailed methodologies set out in the Invertebrate Management Plan).

79. A review of the surveys specified in the NoR Conditions formed the baseline of our site investigation planning. Findings from the surveys outlined above will be completed and made available once they are available, with the detailed survey methodology included in the draft EMP.

80. Specialist T+T ecological staff undertook site investigations to verify the habitat types reported by Dr Forbes, and the availability of habitat for and presence of birds and lizards (and other taxonomic groups). This included:

(a) Thirty-two vegetation plots across all impacted ecosystem types (See **APPENDIX F.3** for detailed methodology and results);

(b) Twenty-two 5-minute bird counts to determine the presence of diurnal birds (See **APPENDIX F.4** for detailed methodology and results);

(c) Avifauna observations across the designation corridor including where the alignment traverses Parahaki Island; and

(d) Acoustic recording for cryptic wetland birds (See **APPENDIX F.4** for detailed methodology).

81. Site investigations additional to the surveys undertaken to inform the NoR have not been undertaken for herpetofauna. The previous surveys did not detect the present of any lizard species.[3] Drawing conclusions on which species are present or absent within the footprint through surveys is notoriously difficult as lizards are small, cryptic and secretive and only a small proportion of potential lizard habitat is able to be surveyed. As such, I have applied a precautionary approach in terms of lizard values and potential effects by assuming that all species known to be present in the wider landscape are potentially present on site in low densities. Based on this assumption, I have then assessed the likelihood of different ecosystem types supporting lizards based on the ecology of the different lizard species, and the habitat value and landscape context of the ecosystem types. The same assessment methodology was undertaken in Technical Assessment 6B.

Overarching approach to my assessment of effects

82. I have adopted a best practice approach to my assessment of ecological effects on the basis that:

(a) My assessment follows the Environment Institute of Australia and New Zealand ("**EIANZ**") Ecological Impact Assessment Guidelines ("**EcIAG**") (Roper-Lindsay et al., 2018) (Herein "**EcIAG 2018**"). The EcIAG (2018) provides a systematic, robust and transparent approach to assessing ecological effects.

(b) As appropriate for effects assessments on threatened or otherwise significant vegetation/ habitat types and species, my 'Level of Effects' assessment relates primarily to the level of adverse effects at a local scale, i.e. a landscape scale for habitat types and local population scale for species.

[3] For details of previous lizard surveys undertaken across the Designation refer to Section 3.3 (pg 13) of Appendix 6.B.1 of Technical Assessment 6 "Manawatū Gorge SH3 - Summer Ecology Survey - Herpetofauna - Boffa Miskell Limited 2018"

(c) As appropriate for effects assessments on threatened species, our assessment is precautionary in assuming that all species that are likely or possibly present in the footprint, but not recorded, are present.

(d) The approach to residual effects management in respect of 'rare', 'threatened' and 'at risk' habitats addresses key biodiversity offsetting principles (Maseyk et al. 2018). This includes:

(i) Adoption of an effects management hierarchy i.e. avoid, mitigate, offset, compensate in descending order.

(ii) Adherence to No Net Loss or preferably Net Gain outcomes, including the use of offset models to demonstrate verifiable No Net Loss or Net Gain outcomes and the use of compensation models to determine expected No Net Loss or Net Gain outcomes (as detailed in Mr Markham's Technical Assessment H).

(iii) Offsetting or compensation measures that result in long-term tangible biodiversity outcomes and that are additional i.e. would not have happened anyway.

Application of EcIAG

83. As per the previous technical assessments prepared during the NoR process, I have characterised and assessed the terrestrial ecological values, and the 'Level of Effects' of the Project on these values, using current best practice methods outlined in EcIAG (2018).

84. The EcIAG (2018) were prepared to provide nationally consistent direction on the approach to be adopted when assessing ecological impacts.

85. In brief the EcIAG approach involves four steps, summarised as follows:

(a) Assigning the level of 'Ecological Value' of the areas of vegetation, habitats, and species present in the Project footprint and immediate surrounds (**Step 1**). The 'Ecological Value' is scored on a scale of "Negligible" to 'Very High' (Table F.5.1, **APPENDIX F.5**) and is assessed in terms of:

(i) Representativeness of the habitat, including species assemblages;

(ii) Rarity/distinctiveness, whether the area represents a threatened ecosystem (naturally or induced), rarity of the species the area supports;

(iii) Diversity and Pattern, biotic and abiotic diversity; and

(iv) Ecological Context, how the area contributes to ecosystem functioning through its relationship with the surrounding landscape.

(c) Assigning the 'Magnitude of Effect' from the proposed activity on the environment after efforts to avoid or minimise potential adverse effects have been exhausted (**Step 2**). 'Magnitude of Effect' is a measure of the extent or scale of the effect of an activity and the degree of change that it will cause. The 'Magnitude of Effect' is scored on a scale of "Negligible" to 'Very High' (Table F.5.4, **APPENDIX F.5**) and is assessed in terms of:

(i) Level of confidence in understanding the expected effect;

(ii) Spatial scale of the effect;

(iii) Duration and timescale of the effect (Table F 5.5, **APPENDIX F.5**);

(iv) The relative permanence of the effect; and

(v) Timing of the effect in respect of key ecological factors.

(d) An overall level of residual effects that cannot be avoided or minimised for each habitat or species value is determined using a matrix approach that combines the 'Ecological Values' with the 'Magnitude of Effects' resulting from the activity (Table F.5.6, **APPENDIX F.5**).

(i) The matrix describes an overall 'Level of Effect' on a scale from "Negligible" to 'Very High'.

(ii) I have followed the matrix in the EcIAG except where habitats or species assigned an 'Ecological Value' of 'High' and for which the 'Magnitude of Effects' is assessed as 'Low'. In such instances, the EcIAG matrix assigns an overall 'Level of Effect' as 'Low' whereas I have taken a more conservative approach and assigned an overall 'Level of Effect' as 'Moderate'. I have also

taken a different approach in respect of plant species with a threat status that is based on potential susceptibility to myrtle rust, as described below.

(iii) The level of residual effect that cannot be avoided or minimised is then used to guide the type and quantum of offsetting or compensation measures that are proposed to adequately address residual adverse effects associated with the Project.

86. It is important to note that while offsetting and compensation form a key component of the effects management framework for this Project, these measures do not reduce the overall 'Level of Effect'. However, offsetting and compensation measures do have a role in the decision making framework when looking at the adequacy of addressing adverse effects.

TERRESTRIAL AND WETLAND ECOLOGICAL CHARACTERISTICS

87. I structure the terrestrial and wetland ecological values section as follows

(a) Terrestrial and wetland habitat values;

(b) Plant values;

(c) Long-tailed bat values;

(d) Avifauna (bird) values;

(e) Lizard values;

(f) Invertebrate values; and

(g) Key changes from the NoR assessment.

88. Summary data is provided within the following sections and full species lists and surveys results are presented in **APPENDIX F .6**.

Terrestrial and wetland habitat values

89. Table 1 below provides a description of the habitat types present within the designation. The habitat type categories and descriptions and calculated quantums within the designation and Project align with those described by Dr Forbes at the NoR stage with some exceptions as set out below.

Table 1: Notable habitat types within the Project footprint and immediate surrounds.

Habitat types	Habitat description [1]
Old-growth forest (alluvial)	Old-growth forest with a canopy dominated by tawa with occasional kahikatea, pukatea and mātai. Kaikomako, lacebark, cabbage tree and māhoe are present at the edge of this forest type. The understorey is degraded due to stock access, and consists of sparsely distributed *Coprosma rhamnoides*, *Coprosma aereolata*, kawakawa, *Urtica ferox*, and *Rhabdothamnus solandri*. A fragment of remnant swamp maire (Nationally Critical) forms part of the old-growth forest matrix. *Astelia hastata*, *Griselina lucida* epiphytes as well as *Metrosideros* spp. and supplejack vines are present.
Old-growth forest (hill country)	Old-growth forest dominated by tawa with the occasional emergent rewarewa, podocarp, and pukatea. The presence of old-growth ngaire is notable. The sub-canopy is characterised by tawa, miro, matai and various broadleaved species including māhoe*, Coprosma areolata*, kaikōmako, *Melicope simplex*, pigeonwood and lancewood. The presence of both *Lophomyrtus* species is notable as they have been elevated to a threat status of Nationally Critical due to the risk of myrtle rust. The understorey is relatively sparse, containing seedlings and saplings of the species listed above as well as other common broadleaved species including kawakawa and hangehange. Ground cover includes various fern species but is dominated by a mat of *Icarus filiformis*. A number of epiphytes were also recorded including *Astelia hastata*, epiphytic orchids and climbing *Metrosideros* species.
Secondary broadleaved forests with old-growth signatures	Māhoe, kawakawa and young tawa form the dominant canopy of this forest type. Exotic conifers overtop the canopy on the edges, while rewarewa is the primary emergent within the interior of the forest. The understorey is relatively intact, with rangiora, hangehange, kanono, *Coprosma rhamnoides,* heketara, silverfern, pigeonwood and notably, Nationally Critical ramarama present. Ground cover includes various fern species including *Microsorum pustulatum*, *Polystichum neozelandicum, Asplenium oblongifolium,* hen and chicken fern and button fern. *Metrosideros* spp., *Rubus* spp., New Zealand jasmine, and supplejack vines are present.

Habitat types	Habitat description [1]
Old-growth treelands	Old-growth treelands are represented by sparsely distributed remnant māhoe, pigeonwood and kaikomako. Subcanopy and understorey species are absent due to full stock access and the dominance of exotic grasses. Epiphytic *Microsorum pustulatum*, *Metrosideros diffusa* and *Pyrrosia eleagnifolia* are present. A ramarama treeland area is also present. The ramarama area is composed of a sparse treeland of mature ramarama, rohutu, lancewood, kaikomako and lacebark, with kānuka shrubs interspersed. The understorey predominantly consists of exotic pasture grass due to stock access. The pest plant barberry is present.
Advanced secondary broadleaved forest	Advanced secondary broadleaf canopy consists of broadleaved species such as kawakawa, kanono, māhoe and hangehange. Rewarewa and tawa emergents are present within some areas of this forest type which distinguish it from secondary broadleaved forests and shrublands. The understorey and ground cover are dominated by hen and chicken fern and *Icarus filiformis*, with scattered saplings and seedlings of pigeonwood, *Rhabdothamnus solandri*, patē, kaikomako, lacebark, tōtara, and tawa. Native vines are abundant, such as supplejack, New Zealand passionfruit and New Zealand jasmine.
Kānuka forests	Kānuka forests on site are typified by a mature kānuka canopy and sparse understorey degraded by stock access. Other canopy species present include tawa, pukatea and māhoe. Species resilient to stock browse such as C*oprosma aereolata, Coprosma rhamnoides*, and soft mingimingi are typical understorey species of this forest type, although more palatable species such as māhoe and hangehange are also present. Ground cover ferns include kiokio and *Icarus filiformis*, while the epiphyte community is typically composed of *Metrosideros* spp., *Microsorum pustulatum*, *Pyrrosia eleagnifolia* and vines (supplejack and New Zealand jasmine).

Habitat types	Habitat description [1]
Secondary broadleaved forests and scrublands	Secondary broadleaved forests and scrublands are typified by a canopy consisting of māhoe, broadleaved *Coprosma* species, kawakawa and occasionally kānuka. The understorey composition varies depending on stock accessibility, however generally divaricating shrubs such as small-leaved milk tree, *Coprosma* species and kaikomako are present, alongside seedlings of the canopy species, and other broadleaved shrubs and trees such as red matipo, karaka, tītoki, hangehange, heketara and marbleleaf. Fern species present in this ecosystem include tree and ground ferns, such as silver fern, rasp fern, creek fern, and gully fern. The At Risk - Relict giant maidenhair fern (*Adiantum formosum*) was indentified in this habitat type at Chainage 3800 - 3900. Vines present include New Zealand jasmine, *Clematis* spp., and *Metrosideros* spp. Dense mats of *Tradescantia flumensis* are inhibiting natural regeneration in some areas, while gorse and exotic broom are present along the edges of some of these scrublands.
Mānuka and kānuka shrublands	Mānuka, kānuka shrublands differ from kānuka forests mainly by the lower height of the canopy (less than 4.5 m). The species composition is typical of regenerating scrub with stock access, and generally is composed of short-stature kānuka with scattered māhoe, small-leaved divaricating coprosmas, hangehange, kaikomako, and ground ferns such as creek fern, rasp fern, ring fern and prickly shield fern. Additional ground cover species include *Hydrocotyle* spp. and bidibid spp. Frequently the ground cover is dominated by exotic pasture grasses. Of note, orchid species *Pterostylis graminea* and *Microtis unifolia* were observed in this ecosystem type, in areas sheltered from stock browse.
Divaricating shrublands	Divaricating shrublands on site have been highly degraded by stock browse and the diversity of divaricating shrubs is lower than what would be expected without stock access. The shrubalnds are dominated by *Coprosma rhamnoides,* with scattered kānuka and lacebark. Broadleaf seedlings, ferns and ground covers are present at the bases of divaricating shrubs out of reach of stock and include māhoe, hangehange, kaikomako, rasp fern, kiokio and Mercury Bay weed. Occasional native and exotic *Juncus spp.*, are present within these scrublands.
Raupō-dominated seepage wetlands (high value)	Raupō-dominated seepage wetlands are dominated by raupō with emergent kānuka, mānuka and lancewood present. These habitats are low-lying and fed by surrounding hillside seepages. Occasional sedges (*Carex secta*) and ferns (bracken, kiokio and sickle spleenwort) are present. Vines *Metrosideros diffusa* and New Zealand jasmine are present in low abundance. This wetland area has been modified by stock access and farm modifications, however it remains in good overall condition, with little stock damage or weed invasion (some broom and pampas present on the edges).

Habitat types	Habitat description [1]
Indigenous-dominated seepage wetlands ('Moderate') value)	Indigenous-dominated seepage wetlands are dominated by *Carex geminata* and native *Juncus spp.*, typically *J. edgariae.* Exotic *J. effusus* is occasionally present, and invasion of exotic grass occurs at drier margins. Some stock access has degraded these wetlands, however weed invasion is generally low.
Pasture wetlands, Referred to as exotic dominated wetlands in the NoR documents.	Exotic wetlands are typically dominated by exotic pasture grass and associated exotic herbs including buttercups (*Ranunculus repens, R. flammula*). We have reclassified 'Exotic dominated wetlands as Pasture wetlands because further field investigations revealed that while all of the wetlands where in pasture some of them were native species dominated with a high abundance of native *Juncus edgariae* present, and occasionally contain patches of native *Carex* sedges. Stock access and farming modifications have resulted in the degradation of these seepage wetlands.

[1] See **APPENDIX F.3** for full species lists, photos and RECCE data for each habitat type.

Plant values

90. Myrtle rust is a serious fungal disease that affects plants in the myrtle family. A number of plant species in the Myrtacaeae family are present within the Project footprint, including common species such as kanuka, Manuka, ramarama and several species of rata. These species have been assigned a threat status in accordance with the DOC threatened classification system based on potential threat to myrtle rust.[4]

91. Notable findings from recent site investigations are the identification of the Threatened rōhutu (*Lophomyrtus obcordata*), and At Risk giant maidenhair (*Adiantum formosum*), neither of which were previously confirmed on the site.

92. 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. 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.

101. Giant maidenhair was recorded in the Secondary Broadleaved Forests and Scrublands on the northern margin of the Manawatū River (CH 3800 - CH 3900). Giant maidenhair is classified as At Risk - Relict and in the region

[4] De Lange, P. J., Rolfe, J. R., Barkla, J. W., Courtney, S. P., Champion, P. D., Perrie, L. R., Beadel, S. M., Ford, K. A., Breitwieser, I., Schönberger, I., Hindmarsh-Walls, R., Heenan, P. B. & Ladley, K. (2017). Conservation status of New Zealand indigenous vascular plants. New Zealand Threat Classification Series 22. 82 p.

it is believed to now be restricted to the Manawatū Gorge and Woodville areas.

Long-tailed bat values

102. Ms Cummings describes the potential for ecological values in regard to long-tailed bats in Appendix F.1 and is summarised below:

(a) Long-tailed bats are wide ranging and utilise a number of habitat types including rural landscapes containing mature forest remnants required for roosting and breeding. The Project is largely comprised of grazed pasture but is interspersed with a number of native and exotic vegetation patches that could provide high value habitat to long-tailed bats if they occur in the area.

(b) Multiple acoustic bat surveys (including through the NoR process) have been undertaken across the Designation and no bat activity has been detected. As reported through the NoR process, the results of the Project-specific acoustic surveys and the desktop review strongly suggest that that a long-tailed bat population is not present in the study area. However, bats are wide ranging and known to be present in the wider landscape. The closest records are located approximately 13 and 23 km from the Project and recorded in 1994 in the Pohangina Valley area, and in October 2019 along the Mangaone Road west of Fielding, respectively.

(c) On this basis, the assessment of effects undertaken by Ms Cummings (**APPENDIX F.1**) assumes that bats may move through the area on occasion.

Avifauna (bird) values

103. An extensive literature review and bird survey was undertaken to inform the NoR process, and during this process habitats were identified across the Project footprint that could support Threatened or At Risk avifauna species. This information has been reproduced from the Boffa Miskell (2018) report in APPENDIX F.6 with the results of the most recent site investigations added.

104. The most recent bird surveys undertaken by T+T ecologists 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. These surveys identified a single species (the black-fronted

dotterel) that had not been recorded during previous surveys (as described further below).

105. Forested habitats, in particular more mature habitat types potentially support Threatened or At Risk wetland birds and the latter contain confirmed records of At Risk pōpokotea (whitehead, Declining), At Risk rifleman (Declining) and kārearea (New Zealand falcon, Recovering), while also being likely to occasionally support other wide-ranging species such as North Island kaka.

106. Nationally 'Threatened or 'At Risk' cryptic wetland bird matuku-hūrepo (Australasian bittern), pūweto (spotless crake), and koitareke (marsh crake) may also occur in wetlands within the Project footprint, particularly the raupo and carex dominated wetlands. Three acoustic recorders were deployed within potential habitat for cryptic wetland birds, and or waterfowl for a total of 102.5 recording hours (**APPENDIX F.4**). No wetland birds or notable waterfowl (e.g., the New Zealand dabchick) were recorded. A summary of the survey effort at each habitat is provided in Table F.4.1, **APPENDIX F.4**.

107. In addition to these habitat types, the Project traverses the Manawatū River which is a known nesting and foraging habitat for a number of native birds such as pohowera (banded dotterel), black-fronted dotterel, tarāpuka (black-billed gull), tarāpunga or akiaki (red billed gull), taranui (Caspian tern) and kawau (black shag), kāruhiruhi (pied shag), and kawau tūi (little black shag).

108. The shingle/gravel of the Manawatū riverbed is also a key avifauna habitat. Previous surveys have confirmed three Threatened and At Risk bird species in the riverbed downstream of proposed BR02 location (Boffa Miskell, 2018). These are banded dotterel and Caspian tern (both Threatened - Nationally Vulnerable), and black shag (At Risk - Naturally Uncommon).

109. During the most recent investigations, Parahaki Island (in the vicinity of proposed BR02, being the main bridge crossing the Manawatū River), was visited on three occasions during the week of 4 November 2019. Two of these occasions were in the afternoon and the third in the morning, and each visit was approximately 30 to 60 minutes. The objective was to check if braided river birds were potentially prospecting for nesting sites.

110. During these visits to Parahaki Island, black shags were also observed moving along the river corridor in the vicinity of BR02 in both the upstream and downstream directions.

111. A pair of black-fronted dotterel were observed on the island on all three occasions 600m to the west of the proposed Manawatū River Bridge (BR02) footprint. Their behaviour suggested that they were prospecting but had yet to establish a nest.

112. There have also been unconfirmed reports of black-billed gulls nesting on the western edge of Parahaki Island, approximately 600 m from the BR02 footprint.

Lizard values

113. Lizard species previously identified within the wider landscape include: barking gecko, ngahere gecko, Raukawa gecko, Pacific gecko, glossy brown skink, ornate skink, northern grass skink.

114. No lizards have been detected within the Project footprint and for reasons discussed I have assumed that all seven lizard species recorded within the wider landscape (within 50 km of the Project) are present within the Project footprint, albeit at low densities. This includes several 'At Risk' species recorded within the wider landscape.

115. Three native lizard species are confirmed in the adjacent Manawatū Gorge Scenic Reserve which is contiguous with a number of the habitat types occurring within the Project footprint. These records are within 1 km of the Project footprint at the closest point. It is highly likely that these species are present in the footprint. An additional three native species have been recorded in the wider landscape (within 50 km of the Project footprint).

116. While the species listed have differing habitat preferences, they are generally either arboreal or ground-dwelling (species dependent), in forest, scrub, rock piles and crevices, grassland (ungrazed) and wetlands. All of these habitat types are present within the Project footprint.

117. The most recent review of the DOC Bioweb Database did not identify any new species in the vicinity of the Project footprint compared to the database review undertaken by Boffa Miskell in 2018 to inform the NoR process.

Invertebrate values

118. Dr Curry has, by reference to the work done through the NoR process, carried out an assessment of the potential for ecological values in regard to invertebrates (**APPENDIX F.2**). In summary:

    (a) To date, no empirical invertebrate data have been collected from within the Project footprint though a field study is in progress and results will be provided as a supplementary report in due course.

    (b) 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's New Zealand Threat Classification System (APPENDIX F.6).

    (c) Notable species that may be present include *Megadromus turgidceps* (beetle), *Meterana grandiosa* and *M. exquisita* (moths), *Powelliphanta snails (marchanti, traversi traversi*, and *tarevrsi tararuaensis*) and *Wainuia urnula* (snail). Associated habitats that will be impacted include old-growth forest hill country and alluvial forest, secondary broadleaved forests and shrublands, including advanced broadleaved forests and broadleaved forests with old-growth signatures and divaricating shrubland.

Key changes from NoR assessment

119. In this section, I set out instances where my assessment of the ecological characteristics or values within the Project differs from the assessment at the NoR stage. It is important to note that in all instances I agree with Dr Forbes' characterisation of ecological values and that where differences in characterisation or quantification of ecological values exists, this simply reflects additional information being obtained, or the more detailed level of design now proposed through the resource consent applications.

120. Technical Assessment 6A identified 10 ecosystem types across the proposed designation corridor. These habitat types have been refined through the NoR hearing process, resulting in the 12 habitat types listed in Table 1 (page 11) of the Addendum to Technical Assessment 6 (Forbes and Blayney, 2019).

121. The habitat types characterized in this report closely align with the habitat types provided in the Addendum to Technical Assessment 6 with a single minor change:

    (a) The habitat type 'exotic dominated wetlands' is now referred to as 'pasture wetlands' on the basis that these wetlands occur within a grazed pasture mosaic and the associated vegetation can be either exotic or native dominated. The most abundant native species present includes Edgar's rush (*Juncus edgariae*).

122. The areal extent of loss for each vegetation/habitat type was reviewed and ground-truthed during more recent site investigations (**APPENDIX F.3** for detailed methodology), across the whole Project footprint (including impacted areas such as indicative spoil sites outside the proposed designation corridor).

123. Some of the areas/sites have been reclassified into different habitat types based on the additional data collected during recent site investigations. Key changes are briefly described below and shown in **APPENDIX F.7**:

    (a) The area classified as 'Mānuka, Kānuka Shrublands' at CH 5400 - CH 5600 has been reclassified as Kānuka Forest;

    (b) One area of the previously classified Mānuka, Kānuka Shrublands at CH 5400 - CH 5600 has been removed because native canopy is no longer present, which is likely a result of herbicide application (not undertaken as part of the Project). This area is now rank grass, gorse and broom;

    (c) The area classified as Mānuka, Kānuka Shrublands at CH 9900 - CH 10000 has been reclassified as Divaricating Shrublands due to loss of the mānuka/kānuka canopy after spray application;

    (d) Some areas that were not previously mapped during the NoR process have also been included. This includes small areas of Secondary Broadleaved Forests and Scrublands in the gully located between CH 11300 - CH 11700. These additional areas were identified through field assessments. Furthermore, die-off of the willow canopy (likely caused by herbicide application) has exposed small vegetation patches dominated by native broadleaved plants which were previously unmapped. Examples are included in **APPENDIX F.7**.

124. Additional pasture wetlands were detected during field investigations, noting that this was expected to occur and is provided for in the Designation Conditions.[5]

ASSESSMENT OF 'ECOLOGICAL VALUES'

125. Table 2 and Table 3 below provides an EcIAG 'Ecological Values' assessment for each habitat type and species that are known or likely to be present within the Project footprint.

126. In the instances where site-specific information of species distributions is limited and surveys have not yet been undertaken, a conservative approach has been applied. Accordingly, the species identified in the literature review (see above) are assumed present in all of the habitat types that contain suitable habitat.

[5] Designation Condition 18(e) allows for the maximum area of exotic dominated seepage wetland able to be removed to be updated to include any additional exotic dominated seepage wetland identified in pre-construction surveys.

Table 2: 'Ecological Values' assessment (as per EclA guidelines) for each notable habitat present in the Project footprint

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EclAG)
Old growth forest (alluvial)	Representativeness: **High** • Dominated by indigenous species. • Generally a typical structure and composition with the exception of the lower tiers which have be grazed by stock. • However, the impacts of grazing on the lower tiers and the absence of mammalian pest control suggest that the area may not support a full fauna assemblage, but will be more representative than many habitats given that old growth forest is now rare across the Region. Rarity/distinctiveness: **High** • Old growth hardwood forest is threatened in the Manawatū Region (Maseyk, 2007). • The alluvial old growth forest occurs within a land environment where only 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). • Includes a stand of Threatened - Nationally Critical swamp maire. • At Risk - Declining whitehead birds have been confirmed in this forest type. • Likely to support At Risk and Not Threatened gecko species including: – Barking gecko, Ngahere gecko, Raukawa gecko, Pacific gecko, glossy brown skink, ornate skink, northern grass skink. – Note, this habitat is less likely to support ground-dwelling skinks due to stock access. Diversity and Pattern: **High** • A diverse indigenous vegetation assemblage but browsing pressure has resulted in decreased diversity the lower tiers. • Unlikely to support sensitive ground-dwelling invertebrates due to stock degradation. Ecological context: **High** • Relatively large tract of forest with connectivity to the Manawatū Scenic Reserve. • Part of a mosaic of alluvial habitats including raupō wetlands and swamp maire forest. • The diverse, old-growth canopy suggests the area could be effectively restored via stock exclusion and targeted weed control/suppression.	**Very High**: High for 3 or all of the four assessment matters

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
Old-growth forest (hill country)	Generally as above but noting: • The hill country forest is located within a QEII covenant, grazing pressure is still evident in the lower tiers but notably less degradation compared to the alluvial forest described above. • Swamp maire not present but Threatened - Nationally Critical *Lophomyrtus* species observed as well as Threatened - Nationally Vulnerable rata species. • Historically hill country forest has not been under as much clearance pressure for agricultural purposes, however, it is old-growth tawa forest and still considered threatened in the region. • This forest patch is not part of the alluvial mosaic but directly buffers a high value watercourse.	**Very High:** High for 3 of the assessment matters
Secondary broadleaved forests with old-growth signatures	Representativeness: **High** • Dominated by indigenous species. • Secondary forest subject to prior modification, but with old-growth characteristics demonstrating an advanced successional stage on a trajectory towards representative old-growth forest. Rarity/distinctiveness: **High** • These remnants occur across land environments where either, <10%, or 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). • Given advanced successional stage, I have assessed this habitat type as old-growth and is thus considered threatened under the One Plan. • Threatened - Nationally Vulnerable rata species recorded in this habitat. Diversity and Pattern: **High** • Generally high flora diversity but does not contain the full range of old growth species present in the habitat types above. • All of the fauna species described in the 'old-growth forest alluvial' habitat type above could potentially inhabit the patches of this forest type also. • With the exception of the larger remnant (CH 10400 - CH 10500), the size of the patches and their isolation from the Manawatū Gorge Scenic Reserve suggest that the areas are less likely to support less mobile species such as lizards and ground-dwelling invertebrates. Although remnant populations could exist.	**Very High**: High for 3 of the assessment matters, 'Moderate' for the remainder

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
	Ecological context: **'Moderate'** • The patches of this habitat vary in size but three of the four patches are less than 0.5 ha. • The sensitivity to edge effects of these small patches is somewhat mitigated because they are located within a mosaic of habitat types. • The fourth remnant (CH 10400 - CH 10550) is part of an assemblage covering approximately 8.5 ha. • The old growth trees are likely an important seed source for the less advanced habitat types within the mosaics. • Only one small patch (CH 7300 - CH 7400) has direct connectivity to the Manawatū Gorge Scenic Reserve. • These patches sit with an agricultural matrix and likely provide stepping stone habitat for mobile species when dispersing between the Scenic Reserve and forest patches to the north.	
Old-growth treelands	Representativeness: **'Moderate'** • Canopy dominated by indigenous species • Understory and ground tiers essentially absent thus structure and composition is not representative of pre-human old-growth forest. • The limited structural and flora diversity suggests that these areas are unlikely to support the typical fauna assemblage expected of old-growth vegetation. • The likelihood of the treeland patches supporting a representative fauna assemblage if further limited by the small size of the patches. • The areas are not subject to pest control. Rarity/distinctiveness: **High** • Although the treelands are not representative of pre-human old-growth forest, old-growth treeland is still considered threatened under the One Plan. • The treeland remnants all occur across land environments where 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). • Threatened - Nationally Critical ramarama recorded in the habitat patch between Chainage 5700 - 5800. The threat status of ramarama was elevated from Not Threatened due the risk imposed by myrtle rust. There is evidence to suggest the *Lophomyrtus* species are particularly susceptible to myrtle rust. • Threatened - Nationally Vulnerable rata species recorded in this habitat.	**'Moderate':** High for one matter, 'Moderate' and 'Low' for the remainder

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
	• The treeland areas are likely to be used, at least occasionally by mobile At Risk species such as whitehead but the limited flora diversity indicates that these areas are unlikely to support a diverse invertebrate assemblage and thus, are unlikely to be core habitat insectivorous species such as whitehead. • Remnant populations of arboreal lizards such as Barking gecko, Ngahere gecko, Raukawa gecko and Pacific gecko could occur in this habitat. This is more likely in the patch between CH 4050 - CH 4150 because of its connectivity to the more intact old-growth forest. • The heavily grazed ground tier suggests it is unlikely to support populations of Threatened or At Risk ground dwelling lizards or invertebrates. Diversity and Pattern: **Low** • The absence of all structural tiers except the canopy limits the diversity of these areas. • The generally small size of the patches suggests the areas are subject to limited underlying abiotic diversity. Ecological context: **'Moderate'** • The individual patches (all smaller than 0.2 ha) are small and have limited structural and flora diversity to represent key source habitats in the landscape. • However, the old-growth trees provide habitat characteristics such as cavities which are rare, and often a limiting resource for native species such as cavity-nesting birds and bats. • These the mature trees will also provide a seed source to more intact habitat types in the surrounding landscape as well as a fruit source for birds.	
Kānuka Forests	Representativeness: **Low** • Dominated by indigenous species. • Limited diversity of native broadleaved species in the canopy and in lower tiers. • The understory and ground tiers are modified by ungulate grazing, the extent of stock damage varies between areas. • kānuka forest occurring across the Project is an artefact of stock degradation suppressing broadleaved species from establishing. Kānuka forest would not have occurred in the area naturally.	'**Moderate**': high for one matter, 'Moderate' and 'Low'for the remainder

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
	• The limited structural and flora diversity suggests that these areas are unlikely to support the typical fauna assemblage expected of forest at this successional stage in the absence of ungulate browsing pressure. • Only the area between CH 5100 - CH 5200 is subject to pest control. Rarity/distinctiveness: **High** • Kānuka is Threatened - Nationally Vulnerable. • Given the direct connectivity to the Manawatū Gorge Scenic Reserve it is likely that the At Risk whitehead use the habitat at least occasionally. However, it is unlikely to be preferred habitat when compared to the old-growth forest types in close proximity. • It is likely that At Risk lizards occur in this habitat given its direct connectivity to the Manawatū Gorge Scenic Reserve. This is particularly the case for arboreal lizards such as: Barking gecko, Ngahere gecko, Raukawa gecko, and Pacific gecko. • Mature kānuka forest has been demonstrated to support a similar invertebrate assemblage to old-growth forest (but this is not case for less mature grazed stands). This forest type has the potential to support At Risk invertebrates such as *Meterana* species. • Kānuka forest is considered threatened in the Horizons One Plan, but as above, kānuka forest would not have occurred in the area naturally. • The Kānuka Forest patches all occur across land environments where 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). Diversity and Pattern: **Low** • The diversity in this habitat type is limited. • As discussed above, the vegetation assemblage does not reflect underlying abiotic patterns, instead it is likely a result of heavy ungulate browse suppressing broadleaved species. Ecological context: **'Moderate'** • All kānuka forest patches are either contiguous with, or in close vicinity, to the Manawatū Gorge Scenic Reserve or the Western QEII covenant. • The patch between CH 3900 - CH 4300, is large (approximately 3 ha) and forms part of the much large forest assemblage of the Scenic Reserve. • The patch between CH 3900 - CH 4300 buffers to the raupō wetland immediately to the west.	

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
	• The other patches are smaller and limited in width but provide buffering to stream corridors. The sensitivity to edge effects is somewhat mitigated by the fact that these patches sit within a mosaic of habitat types. • If protected from browsers these areas could be effectively restored. Succession towards broadleaf forest was observed in the patch between CH 5400 - CH 5600 which is fenced.	
Advanced Secondary Broadleaved Forest	Representativeness: **High** • Dominated by indigenous species • Diversity generally representative of the successional stage of the habitat type but lacking the diversity of the old-growth forest. • The flora diversity indicative that the area will support a typical fauna assemblage for the successional stage of the vegetation. • The area is fenced and subject to pest control which indicates a higher likelihood of more sensitive fauna occurring in these areas. Rarity/distinctiveness: **High** • Although generally comprised of mid-successional species, the vegetation is not characteristic of old-growth forest types classified as threatened in the Horizons One Plan. • These remnants occur across land environments where either, <10%, or 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). • Although not recorded during site investigations, Threatened kānuka and rata species may be present. • Given the direct connectivity to the Manawatū Gorge Scenic Reserve it is likely that the At Risk whitehead use the habitat. • It is highly likely that At Risk lizards (both arboreal and ground-dwelling) occur in this habitat given its connectivity to the Manawatū Gorge Scenic Reserve, stock exclusion and predator control. • Potential to support Threatened or At Risk invertebrate species, both aerial and ground dwelling. Diversity and Pattern: **'Moderate'** • Diversity generally representative of the successional stage of the habitat type but lacking the diversity of the old-growth forest.	**Very High**: high for 3 or all of the four assessment matters

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
	Ecological context: **High** • Both advanced broadleaved areas are part of a larger vegetation mosaic that is contiguous with the Manawatū Scenic Reserve. • These patches all occur along the edges of these mosaics, providing buffer functionality but are subject to increase edge effects. • The area sit within the Western QEII covenant which is legally protected and is less impacted by stock access.	
Secondary Broadleaved Forests and Scrublands	Generally as assessed for 'Advanced Secondary Broadleaved Forest' except that Ecological Context Diversity and Representative are assessed as 'Moderate' because: • Areas of this habitat type are scattered across the Project footprint and have various patch sizes and levels of connectivity to old-growth habitats. • Represent an earlier successional stage and thus have a less diverse flora assemblage and structure. • Many of these patches sit with an agricultural matrix and have been more modified by stock degradation and likely subject to higher pest pressure.	**'Moderate':** High for 1 of the assessment matters, 'Moderate' or 'Low' for the remainder
Mānuka, Kānuka Shrublands	Representativeness: '**Low**' • Generally dominated by indigenous species (kānuka) but exotic broom is a notable canopy component in some areas. • All mānuka, kānuka shrubland patches are highly modified by stock access. Consequently the understorey and groundcover tiers do not have a representative species assemblage and are often absent except for pasture grass. • The low flora diversity and lack of habitat complexity suggests that the remnants are unlikely to support the full species assemblage that would be expected in a less modified early successional habitat type. Rarity/distinctiveness: '**Moderate**' • Mānuka and kānuka are both Threatened - Naturally Vulnerable however this status has been applied as a precautionary measure due to the currently unquantified risk myrtle rust poses to species in the Myrtaceae family. This conservation status does not reflect actual declines in either mānuka or kānuka. • Manuka, kānuka shrublands occur across land environments where either, <10%, or 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015).	'**Moderate**' (High for one assessment matter and low for the other three)

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
	• Scrub and shrubland, not identified has being in the Manawatu-Wanganui Region historically. Mānuka, kānuka shrublands are a common early successional habitat types and not considered rare or threatened in the Region. • It is unlikely that Threatened or At Risk birds, lizards or terrestrial invertebrates occupy the patches given their small size, fragmentation, low flora diversity, and lack of understorey habitat for ground dwelling species. • Notwithstanding the above, remnant populations of immobile species such as geckos are can sometimes occur such habitat. I consider this likelihood very low because of the evidence of herbicide application in these areas to prevent the encroachment of regenerating scrub across productive land. • The habitat patches may be used as stepping stone habitat for mobile species but are unlikely to provide important breeding or foraging habitat for threatened or At Risk birds. Diversity and Pattern: **'Low'** • Low native diversity, limited to early successional species. • Grazing regimes preventing advancement to a more diverse, later-successional assemblage. Ecological context: **'Low'** • A number of small vegetation patches, primarily occurring within grazed pasture, subject to stock modification and edge effects. • The spread of the shrubland across the landscape suggest that that the patches contribute to landscape linkages for mobile species.	
Divaricating Shrublands	Representativeness: **'Low'** • Canopy generally dominated by indigenous species but canopy cover is low and the areas are interspersed with exotic pasture. • The divaricating shrubland patches appear to be induced through human modification, namely grazing pressure and aerial herbicide application to suppress mānuka/kānuka regeneration. • The low flora diversity and lack of habitat complexity suggests that the remnants are unlikely to support the full assemblage of fauna that would be expected in a less modified early successional habitat type. Rarity/distinctiveness: **'High'** • The occasional mānuka and kānuka (both Threatened - Naturally Vulnerable) were recorded in these areas. However, this status has been applied as a precautionary measure due to the unquantified risk Myrtle rust currently poses to species in the	**'Moderate'** (high for one assessment matter and 'Low' for the remaining 3)

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
	Myrtaceae family. This conservation status does not reflect actual declines in either mānuka or kānuka. • No other Threatened, At Risk, or locally uncommon plant species have been identified in the shrublands. • All of the divaricating shrubland patches occur within land environments where only 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). • Scrub and shrubland, has not been identified as being in the Manawatū-Wanganui Region historically (Maseyk, 2007). Thus, divaricating shrubland is not considered rare or threatened in this Region. • Divaricating shrubs are known to support a diversity of invertebrates often with specific host plant associations. • Literature reviews undertaken during the NoR process identified two At Risk moths (*Meterana exquisita* and *M. grandiosa*) could inhabit the Project footprint and the divaricating shrublands could support these species. • The lack of understorey refugia suggests limited habitat for ground-dwelling invertebrates and lizards but remnant populations of At Risk arboreal geckos, including barking gecko and Ngahere gecko, could be present. • As described above, the application of herbicide suggests the persistence of any remnant populations of immobile species is unlikely. • The limited structural integrity of the shrublands suggests that they are unlikely to provide important breeding or foraging habitat for Threatened or At Risk birds with the exception of NZ pipit (At Risk - Declining). Diversity and Pattern: '**Low'** • Low native diversity, limited to early successional species. • Grazing regimes and herbicide application are preventing advancement to a more diverse, later-successional assemblage. Ecological context: '**Low'** • A number of small vegetation patches, primarily occurring within grazed pasture, subject to stock modification and edge effects. • Unlike the mānuka, kānuka shrubland described above, the distribution of the divaricating shrubland patches is largely limited to a single sub-catchment and, therefore, the contribution to connective linkages on a landscape scale is limited.	

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
Indigenous Dominated Seepage Wetland (raupō wetland)	Representativeness: **'Moderate'** • Canopy dominated by indigenous species. • The remnant swamp maire is representative of the swamp forest that would have likely occurred in the area prior to human modification but the remainder of the wetland is less representative of a pre-human assemblage. • The limited structural diversity compared to the pre-human swamp forest suggests that the area is unlikely to support the typical fauna assemblage expected of intact wetland habitat. • The area is not subject to pest control. Rarity/distinctiveness: '**High'** • Swamp maire is classified as Threatened - Nationally Critical (the threat status of Swamp maire was elevated from Not Threatened due the risk imposed by myrtle rust). • The raupō seepage occurs within a land environment where only 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). • Native-dominated seepage wetlands are classified as rare under the One Plan. • Intact wetlands generally are considered threatened with less than 5% remaining from pre-human extent (Maseyk, 2007). • Several threatened wetland bird species potentially present though no wetland birds have been recorded during the acoustic monitoring and wetlands lack open water which lowers the value of this habitat for some wetland bird species • New Zealand pipit which inhabit open habitats including rough grassland and may nest under amongst rushes or rank grass. Diversity and Pattern: **'Moderate'** • Low native diversity compared to the swamp forest that would have occurred on the alluvial soils originally. However, 'Moderate' diversity of native flora and fauna known or likely to be present Ecological context: '**High'** • Forms part of a mosaic of habitats with connectivity to old-growth forest and the Manawatū Gorge Scenic Reserve. • Given the threat status of wetlands generally due to specific hydrological requirements, the protection and restoration of wetlands is a priority under the RMA (Section 6) and the Draft National Policy Statement for Indigenous Biodiversity (Policy 12). • The intact hydrology and its proximity to alluvial forest suggests that the area could be effectively restored if retired from grazing.	**'High'** ('High' for two matters and 'Moderate' or 'Low' for other matters)

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
Indigenous Dominated Seepage Wetland - (*Carex* dominated wetlands)	Representativeness: **'Moderate'** • Canopy dominated by indigenous species and known or likely to include flora and fauna typical of Carex dominated wetlands. • The size of these seepage wetlands suggests that prior to forest clearance and stock degradation these seepage areas would likely have been characterised by lowland forest surrounding watercourses. • The limited structural diversity compared to the pre-human swamp forest suggests that the area is unlikely to support the typical fauna assemblage expected of intact wetland habitat. • The area are not subject to pest control Rarity/distinctiveness: '**High'** • The 'Moderate' value seepage wetlands occur within a land environment where only 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). • Native-dominated seepage wetlands are classified as rare under the One Plan. • Intact wetlands generally are considered threatened with less than 5% remaining from pre-human extent (Maseyk, 2007). • Several threatened wetland bird species potentially present though no wetland birds have been recorded during the acoustic monitoring and wetlands lack open water which lowers the value of this habitat for some wetland bird species • New Zealand pipit which inhabit open habitats including rough grassland and may nest within or adjacent to the wetland. Diversity and Pattern: '**Low'** • Native component largely limited to *Carex geminata*, likely induced by prolonged stock access. Low native diversity compared to forest habitat that would have occurred in these areas originally. Ecological context: '**High'** • Given the threat status of wetlands generally due to specific hydrological requirements, the protection and restoration of wetlands is a priority under the RMA (Section 6) and the Draft National Policy Statement for Indigenous Biodiversity (Policy 12). • The intact hydrology of these wetland areas suggests that the area could be effectively restored if retired from grazing.	**'High'** ('High' for 2 matters and 'Low' or 'Moderate' for the remainder)

Ecosystem types	Value of Vegetation/habitats (as per EIANZ guidelines)	'Ecological Value' (EcIAG)
Exotic Wetland (including pasture wetlands dominated by *Juncus edgariae*)	Representativeness: **'Low'** • Dominated by exotic pasture species, or occasionally the common native rush *Juncus edgariae* which often invades rough pasture. • The size of these seepage wetlands suggests that prior to forest clearance and stock degradation these seepage areas would likely have been characterised by lowland forest surrounding small tributaries. • The extent of modification to these areas resulting in a very limited structural diversity and a degraded hydrological system suggests that these areas are highly unlikely to support the typical fauna assemblage expected of intact wetland habitat. • The areas are not subject to pest control. Rarity/distinctiveness: '**High'** • Wetlands, irrespective of condition are a threatened habitat type and the protection and restoration of wetlands is a priority under the RMA (Section 6) and the Draft National Policy Statement for Indigenous Biodiversity (Policy 12). • The pasture wetlands occur within a land environment where only 10 - 20% of indigenous cover remains (LENZ Level IV - Walker et al., 2015). • Native-dominated seepage wetlands are classified as rare under the One Plan but exotic dominated wetlands are not considered threatened under the One Plan. • Although pasture wetlands score highly as an ecosystem type, the extensive modification of these areas suggests are very low likelihood of supporting Threatened or At Risk fauna. Diversity and Pattern: '**Low'** • Native component largely limited to a low cover of common rushes but generally characterised by pasture species. • Heavily degraded by stock resulting in minimal habitat complexity. Ecological context: **'Moderate'** These wetlands are likely to constitute important stepping stones and provide habitat for mobile species such as pied stilt or pukeko and aquatic invertebrates that are dependent on wetlands with ephemeral or intermittent hyperiods to complete their life cycle.	**'Moderate' (**High for one matter, 'Moderate' and 'Low' for the remainder),

Table 3: 'Ecological Value' assessment (as per EcIA guidelines) for each notable fauna species confirmed or potentially present in the Project designation.

Terrestrial fauna	Conservation status (based on the most recent report issued for each fauna group)	Observed within, or close to the Project footprint	'Ecological Value' of species (as per EIANZ guidelines)
Plant species			
Giant maidenhair*	At Risk - Relict	Yes	'Moderate'
Kānuka**	Threatened - Nationally Vulnerable	Yes	'Very high'
Mānuka**	At Risk - Declining	Yes	'High'
Ramarama**	Threatened - Nationally Critical	Yes	'Very high'
Rohutu**	Threatened - Nationally Critical	Yes	'Very high'
Rātā**	Threatened - Nationally Vulnerable	Yes	'Very high'
White rātā**	Threatened - Nationally Vulnerable	Yes	'Very high'
Climbing rātā**	Threatened - Nationally Vulnerable	Yes	'Very high'
Akatea**	Threatened - Nationally Vulnerable	Yes	'Very high'
Swamp maire	Threatened - Nationally Critical	Yes	'Very high'

Terrestrial fauna	Conservation status (based on the most recent report issued for each fauna group)	Observed within, or close to the Project footprint	'Ecological Value' of species (as per EIANZ guidelines)
Native bats			
Long tailed bat	Threatened - Nationally Critical	No (closest record 13 km from footprint)	'Very High'
Native forest birds of 'Moderate' or higher value that are present or potentially present within the Project footprint			
Pōpokatea (Whitehead)	At Risk - Declining	Yes	'High'
Rifleman	At Risk - Declining	Yes	'High'
New Zealand pipit	At Risk - Declining	Yes	'High'
New Zealand robin	At Risk - Declining	No (but within 55 km of footprint)	'High'
Kārearea (New Zealand Falcon)	At Risk - Recovering	Yes	'Moderate'
Kaka	At Risk - Recovering	No	'Moderate'
Kākāriki (*Cyanoramphus novaezelandiae*)	At Risk - Relict	No (but possible sighting within 55 km of footprint)	'Moderate'
Long-tailed cuckoo	At Risk - Naturally Uncommon	No	'Moderate'
Kereru	Not Threatened	Yes	'Moderate'
Tui	Not Threatened	Yes	'Moderate'
Bellbird	Not Threatened	Yes	'Moderate'
Native wetland birds of 'Moderate' or higher value that are present or potentially present within the Project footprint			
Matuku hūrepo (Australasian bittern)	Threatened - Nationally Critical	No	'Very High'

Terrestrial fauna	Conservation status (based on the most recent report issued for each fauna group)	Observed within, or close to the Project footprint	'Ecological Value' of species (as per EIANZ guidelines)
Pūweto (spotless crake)	At Risk - Declining	No	'High'
Koitareke (marsh crake)	At Risk - Declining	No	'High'
Native river birds of 'Moderate' or higher value that are present or potentially present within the Project footprint			
Banded dotterel	Threatened - Nationally Vulnerable	Yes	'Very high'
Black-fronted dotterel	At Risk - Naturally Uncommon	Yes	'Moderate'
Red-billed gull	At Risk - Declining	No	'High'
Black-billed gull	Threatened - Nationally Critical	Yes (Parahaki Island ca 600 m from BRO2 footprint)	'Very High'
Taranui (Caspian tern)	Threatened - Nationally Vulnerable	Yes	'Very High'
Tūturiwhatu (banded dotterel)	Threatened - Nationally Vulnerable	Yes (ca 600 m from BR02 footprint)	'Very High'
Pied shag	At Risk - Recovering	No	'Moderate'
Little black shag	At Risk - Naturally Uncommon	No	'Moderate'
Kawau (black shag)	At Risk - Naturally Uncommon	Yes	'Moderate'
Open water (pond) dwelling birds that are present or potentially present within the Project footprint			
Australian coot	At Risk - Naturally Uncommon	No	'Moderate'
New Zealand dabchick	At Risk - Recovering	No	'Moderate'

Terrestrial fauna	Conservation status (based on the most recent report issued for each fauna group)	Observed within, or close to the Project footprint	'Ecological Value' of species (as per EIANZ guidelines)
Native lizards of 'Moderate' or higher value that are present or potentially present within the Project footprint			
Barking gecko (Naultinus punctatus)	At Risk - Declining	Yes	'High'
Ngahere gecko (Mokopirirakau "southern North Island")	At Risk - Declining	Yes	'High'
Raukawa gecko (Woodworthia maculatus)	Not Threatened	Yes	'Low'
Glossy brown skink (Oligosoma zelandicum)	At Risk - Declining	No	'High'
Ornate skink (Oligosoma ornatum)	At Risk - Declining	No	'High'
Pacific gecko (Dactylocnemis pacificus)	At Risk - Relict	No	'Moderate'
Native invertebrates of 'Moderate' or higher value that are present or potentially present within the Project footprint			
Megadromus turgidceps (beetle)	Not classified - possibly locally uncommon	No	'Moderate'
Meterana grandiosa (moth)	At Risk - Relict	No	'Moderate'
Meterana exquisita (moth)	At Risk - Relict	No	'Moderate'
*Powelliphanta traversi traversi (*snail)	Threatened - Nationally Endangered	No	'Very high'
Powelliphanta traversi tararuaensis (snail)	Threatened - Nationally Endangered	No	'Very high'
Powelliphanta marchanti (snail)	Threatened - Serious Decline	No	'Very high'

Terrestrial fauna	Conservation status (based on the most recent report issued for each fauna group)	Observed within, or close to the Project footprint	'Ecological Value' of species (as per EIANZ guidelines)
Wainuia urnula (snail)	Not classified - possibly locally uncommon	No	'Moderate'

*Species not identified during NoR investigations **Common species that have been assigned a Threat status due to the potential impacts of Mrytle Rust.

ASSESSMENT OF STATUTORY SIGNIFICANCE OF TERRESTRIAL HABITATS

128. The 12 vegetation types listed above were also assessed against Policy 13-5 and Schedule F of the Horizons One Plan. In doing so I have split the pasture dominated wetlands habitat into two: indigenous dominated and exotic dominated.

129. Schedule F of the One Plan provides a list of all indigenous vegetation types in the Manawatū Region that are considered either Threatened or Rare. Under Policy 13-5, any Threatened or Rare habitat is considered significant.

130. Of the 13 vegetation types assessed for Policy 13-5 and Schedule F of the One Plan, I have assessed eight as significant based on my interpretation of the wording in Policy 13-5:

    (a) Old-Growth Forests (Alluvial);

    (b) Old-Growth Forests (Hill Country);

    (c) Secondary Broadleaved Forests with Old-Growth Signatures;

    (d) Old-Growth Treelands;

    (e) Kānuka Forests;

    (f) Raupō-dominated Seepage wetlands; and

    (g) Indigenous-dominated seepage wetlands.

    (h) Indigenous-dominated pasture wetlands

131. My assessment of significance under the One Plan is consistent with Dr Forbes' assessment undertaken to inform the NoR with a single exception. This exception stems from Dr Forbes considering all of the

pasture wetlands to be exotic dominated, based on the information available at that time. Further site investigations showed that some of the modified pasture wetlands are in fact dominated by a native rush *Juncus edgariae*. These wetlands are degraded by stock access and were assessed as having a 'Moderate' 'Ecological Value' using the EcIAG methodology. However, the criteria in Schedule F only takes into account native or exotic vegetation dominance as opposed to habitat intactness measures. Consequently these wetlands are considered Rare in Schedule F, and therefore significant under the One Plan.

132. A summary of this assessment is provided in Table 4 below.

Table 4: Assessment of ecological significance of vegetation types in the Project designation through the application of criteria in Schedule F and Policy 13-5 of the Horizons One Plan.

Ecosystem type	Equivalent vegetation type listed in Table F.1 in Schedule F and threat classification	Assessment as per Horizons One Plan Policy 13-5	Notes
Old-Growth Forests (Alluvial)	Kahikatea - pukatea - tawa forest or treeland Threatened	Significant Policy 13-5 (a)(i)(A)	
Old-Growth Forests (Hill Country)	Podocarp/tawa - mahoe forest or treeland Threatened	Significant Policy 13-5 (a)(i)(A)	
Secondary Broadleaved Forests with Old-Growth Signatures	Podocarp/tawa - mahoe forest or treeland Threatened	Significant Policy 13-5 (a)(i)(A)	
Secondary Broadleaved Forest and scrublands	Does not represent pre-human forest compositions defined in Schedule F Not threatened	Not significant Policy 13-5 (a)	
Old-Growth Treelands	Podocarp/tawa - mahoe forest or treeland Threatened	Significant Policy 13-5 (a)(i)(A)	I have assessed the individual treeland areas against the criteria in Tables F.2(a) and F.2(b) in Schedule F for determining the significance.

Ecosystem type	Equivalent vegetation type listed in Table F.1 in Schedule F and threat classification	Assessment as per Horizons One Plan Policy 13-5	Notes
Advanced Secondary Broadleaved Forests	Does not represent pre-human forest compositions defined in Schedule F Not threatened	Not significant Policy 13-5 (a)	
Kānuka Forests	Kanuka forest or Treeland Threatened	Significant Policy 13-5 (a)(i)(A)	
Mānuka and Kānuka Shrublands	Does not represent any of the shrubland definitions compositions outlined in Schedule F Not threatened	Not significant Policy 13-5 (a)	
Divaricating Shrublands	Does not represent any of the shrubland definitions outlined in Schedule F Not threatened	Not significant Policy 13-5 (a)	
Indigenous Dominated Seepage Wetland – High Value (raupō wetland)	Seepage and spring wetland Rare	Significant Policy 13-5 (a)(ii)(E)	I have assessed the individual treeland areas against the criteria in Tables F.2(a) and F.2(b) in Schedule F for determining the significance.
Indigenous-Dominated Seepage Wetlands	Seepage and spring wetland Rare	Significant Policy 13-5 (a)(ii)(E)	
Indigenous dominated Pasture wetlands dominated by *Juncus edgariae*	Seepage and spring wetland Rare	Significant Policy 13-5 (a)(ii)(E)	The criteria in Schedule F does not distinguish between more intact wetlands dominated by native vegetation and highly degraded pasture wetlands dominated by native rushes.

Ecosystem type	Equivalent vegetation type listed in Table F.1 in Schedule F and threat classification	Assessment as per Horizons One Plan Policy 13-5	Notes
Exotic-dominated Pasture wetlands	Not dominated by indigenous vegetation thus does not represent any of the wetland definitions outlined in Schedule F Not threatened	Not significant Policy 13-5 (a)	

MAGNITUDE OF EFFECTS' ASSESSMENT

133. The 'Magnitude of Effects' section is set out as follows:

    (a) General overview of potential effects;

    (b) Effects avoidance measures (Project shaping and refinement);

    (c) Effects minimisation measures (development and implementation of management plans); and

    (d) EcIAG 'Magnitude of Effects' Assessment after avoidance and minimisation measures (**Step 2**).

General overview of potential effects

134. The terrestrial and wetland habitat loss has the potential to create a range of adverse effects on ecological values, both during enabling works construction (resulting from direct physical disturbance), seasonal construction, and potentially on an ongoing basis from operations that involve vegetation removal or habitat disturbance.

135. Potential adverse effects on terrestrial and wetland values during and after construction may include:

    (a) Vegetation and habitat loss through vegetation clearance and earthworks;

    (b) The creation of habitat edge effects, altering the composition and health of adjacent vegetation (i.e. habitat degradation), which may affect habitat suitability for flora and fauna;

    (c) Direct mortality or injury to species, for example all plants and most of the smaller less mobile species (e.g. lizards or invertebrates) that may be harmed during vegetation clearance or earthworks activities. Outside of bird breeding season, bird mortality would be low though disturbance can still be an issue. During breeding season, vegetation removal has the potential to result in the destruction of nests, eggs and fledglings;

    (d) Habitat fragmentation and isolation due to the loss and reduction of available habitat types and by reducing the ability for plants and animals to disperse across the landscape for food, shelter, and

breeding purposes, i.e. severing or partially severing access to habitats that would otherwise be suitable;

(e) Construction and operations related noise and vibrations or dust effects; and

(f) Sediment runoff to wetlands and watercourses that may affect the quality of wetland habitat.

136. Potential long-term ongoing adverse effects on vegetation, lizard and avifauna values may include:

(a) Ongoing habitat degradation associated with habitat loss, edge effects and fragmentation, permanently affecting movement of some species, with possible effects on meta-population dynamics and increased vulnerability to local extinction;

(b) Ongoing disturbance effects, particularly on habitat margins/edges, through noise and lighting associated with operational activities;

(c) Mortality or injury on roads through strike or road kill for some species;

(d) Degradation of wetland and riparian habitat quality through:

(i) Altered hydrology of wetlands;

(ii) Contaminated stormwater runoff (sediment, heavy metals and elevated temperature) from road surface to wetlands; and

(iii) Risk of spills of potential toxins (for example, oil or chemicals) from cartage vehicles.

Avoidance of adverse ecological effects

137. Considerable effort has been undertaken through various phases and stages of the Project to avoid adverse effects as detailed in the AEE and DCR and as summarised below.

Assessment of alignment options

138. A multi-criteria analysis ("**MCA**") was undertaken during earlier stages of the Project. Although I was not involved in the Project at the time, my understanding is that a number of potential route options were excluded from further consideration due in whole or in part to high levels of ecological risk or

effects. This MCA process facilitated early avoidance of key ecological values.

Refinement of the Project designation corridor and Project alignment

139. The Project designation was shaped during the NOR process which included constraining the designation to avoid potential impacts on key areas such as Parahaki Island, the Western QEII and Eastern QEII covenant areas, Bolton's Bush and regenerating forest adjacent to the Manawatū Gorge Scenic Reserve.

140. As discussed above, the 'Northern Alignment' now proposed by the Transport Agency reduces the effects of the Project on terrestrial ecology values, as compared to the NoRs as confirmed by the Transport Agency in June 2019, by significantly reducing the affected areas within the Western QEII and Eastern QEII covenants.

141. The Designation Conditions (which provide for the Northern Alignment) prescribe a range of specific measures that the Transport Agency will take (including for example the imposition of effects 'envelopes' for various habitat types, which was a focus of the NoR process and Dr Forbes' reporting during that process) to seek to avoid and minimise the potential effects of the Project on terrestrial ecological values.

142. Since the NoRs were confirmed in June 2019, the Project design process has focused on avoidance and minimisation of ecological effects through the following key measures (which capture but go well beyond the introduction of the Northern Alignment):

    (a) Lengthening 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;

    (b) Locating the wetland walking track along the BR03 staging to avoid the need for additional vegetation clearance;

    (c) 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 reduces the area of forest directly impacted and also avoids severance of the western QEII gully.

(d) The batters on the alignment traversing the Western QEII covenant have also been steepened to further reduce encroachment into this high value habitat.

(e) 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.

(f) 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.

143. The design changes outlined above to reduce impacts on the aforementioned QEII covenants have required increased scale of earthworks and hence a larger amount of spoil for disposal. 32 spoil site locations were considered and shortlisted to 8 based on a number of considerations including ecological effects (details of this assessment are provided in the DCR).

NoR effects envelopes

144. Finally, it is important to emphasise that the effects envelopes agreed during the NoR process have been adhered to so as to avoid additional impact on high value habitats not envisioned during the NoR process.

145. During the NoR process effects envelopes (i.e. maximum area of removal permitted for each habitat type) were developed as a way of ensuring effects in the high value areas would be appropriately minimised. These effects envelopes were outlined in Table 1 of Condition 18 in the Transport Agency decision version of the designation conditions (June 2019). They have since been updated as part of the Environment Court appeals, to reflect the reduced 'Level of Effects' associated with the Northern Alignment. The updated NoR effects envelopes are set out in Condition 24 in the Designation Conditions, and replicated in Table 5 in this report).

146. As detailed above, the construction design has resulted in reductions to the impact area for most habitat types as compared to the NoR effects envelopes. When all relevant ecosystem types are added together, total habitat loss across the Project footprint is 16.79 ha. That figure includes the area outside the designation boundaries.

147. This compares to a total allowable loss of 31 ha, provided for by the original NoR effects envelopes, reduced to 27.85 ha through mediation. This is a

significant reduction of effects compared to what was anticipated through the NoR process. Importantly, there have been reductions in the impacted areas of a number of the High Value / significant habitat types.

148. The only instance in which the area proposed for removal is above the effects envelope is for 'exotic wetlands' now defined as 'pasture wetlands'. However, this was specifically provided for in the conditions on the understanding that further wetlands would likely be identified or impacted. Further survey work has identified additional pasture wetlands within the Project footprint, which have been included in the updated total.

149. In addition, the exotic wetlands habitat type occurs in a number of the proposed spoil sites, many of which extend beyond the designation boundaries (the NoR effects envelopes are limited to within the designation).

150. Table 5 summarises the areal extent of habitat within the designation boundaries, and the now-proposed extent of vegetation clearance (across the full Project footprint) compared to the effects envelopes as set out in the Designation Conditions.

Table 5: Extent of vegetation clearance relative to respective effects envelopes set out in the NOR

Name	Area within proposed Designation boundaries	Maximum area of vegetation able to be removed in accordance with Designation Condition 24 (ha)	Total area impacted by Project footprint
Secondary broadleaved forests with old growth signatures	3.07	2.39	**0.25**
Old growth Treeland (including Ramarama Area)	0.41	0.26	**0.13**
Kānuka forests (CH4000 - 4400)	4.52	1	**0.91**
Kanuka forests (elsewhere)		0.59	**0.39**
Advanced secondary broadleaved forest (CH5600 -5800)	2.93	0.09	**0.04**
Advanced secondary broadleaved forest (elsewhere)		0.41	**0**
Secondary broadleaved forests and scrublands (CH6100 - 6400)	16.32	0.03	**0.025**
Secondary broadleaved forests and scrublands (elsewhere)		14.12	**6.68**
Mānuka and kānuka shrublands (CH6100 -6400)	4.12	0	**0**
Mānuka and kānuka shrublands (elsewhere)		3.63	**2.11**
Divaricating shrublands		0.33	**0.33**
Old growth forest alluvial	4.23	0.15	**0.10**
Old growth forest hill country	1.78	0.86	**0.85**

Name	Area within proposed Designation boundaries	Maximum area of vegetation able to be removed in accordance with Designation Condition 24 (ha)	Total area impacted by Project footprint
Indigenous Dominated Seepage Wetlands High Value	0.55	0.13	**0.11**
Indigenous Dominated Seep Wetlands 'Moderate' Value	0.66	1.12	**0.44**
Exotic Wetlands Low Value* (Pasture wetlands)		2.74	**4.42***
Totals		27.85	**16.79**

* condition 18(e) of the NoR allows envelope for wetland areas to be increased and so exceeding quoted level is not a breach.

Measures to minimise adverse effects that cannot be avoided

151. The Designation Conditions stipulate the requirement for an Ecology Management Plan ("**EMP**"). The draft EMP has been prepared and appended to this document. The EMP covers all of the condition requirements outlined in the Designation Conditions as well as additional minimisation measures including, but not limited to, translocation of nest epiphytes from removed vegetation and the translocation of *Adiantum formosa*.

152. Refer to the Ecology Management Plan (refer to Volume VII) for a detailed outline of the avoidance and minimisation measures provided through the Designation Conditions. The plan includes sub-plans that have been developed, including for vegetation clearance, bats, avifauna, lizards and invertebrates. The key mitigation measures are also summarised below.

153. Key aspects of the Vegetation Clearance Management Plan include:

    (a) Clearly delimiting the extent of vegetation clearance and ensuring vegetation is felled into the Project footprint to minimise impacts on the remaining vegetation;

    (b) Retention of high-value felled vegetation for use as habitat enhancement (e.g. woody debris) in restoration areas where practicable;

    (c) Weed control and infill planting along newly created edges;

    (d) Removal and storage of top soil from impacted vegetation areas to be relocated to offset planting areas;

    (e) Fencing, predator control, weed control in restoration and enhancement areas;

    (f) Cultural and eco-sourcing requirements and propagation of seed collected from site for the planting in the offset areas; and

    (g) Specific replacement ratios for the removal of selected Threatened plant species: swamp maire, ramarama, rōhutu, and *Adiantum formosum*.

154. The Bat Management Plan focuses primarily on annual monitoring and implementing Tree Removal Protocols, where bat activity is identified to ensure any occupied roosts are not removed.

155. Key aspects of the Avifauna Management Plan include:

    (a) A restriction on vegetation clearance during peak breeding season from September through to December inclusive unless a pre-clearance survey for indigenous birds protected by the Wildlife Act is undertaken to minimise impacts on nesting birds (note if nesting birds are found then an exclusion zone will be established until nesting activities are completed);

    (b) Pre-construction surveys for braided river birds (black-billed gulls, black-fronted dotterel and banded dotterel) on the unvegetated area of Parahaki Island in the vicinity of the BR02 footprint;

    (c) Establishment of deterrents to prevent native braided river birds from nesting in the Project footprint during construction;

    (d) Exclusion zones established around dotterel nests if nests established;

    (e) Ongoing surveys during construction to ensure new dotterel nests are quickly identified and exclusion zones established;

    (f) Pre-clearance nest surveys for native indigenous birds protected by the Wildlife Act in woody vegetation;

    (g) Surveys for the presence of cryptic wetland birds in the high value raupō prior to works in the area;

    (h) Grazing and/or mowing regimes to prevent NZ pipit nesting in rank grass prior to commencement of construction activities; and

    (i) Exclusion zones around farm ponds to prevent unnecessary disturbance to waterfowl.

156. Key aspects of the Lizard Management Plan include:

    (a) Salvage of lizards prior to vegetation removal;

    (b) Vegetation removal protocols to minimise harm to lizards that were not located during pre-clearance surveys including:

        (i) Supervision of vegetation clearance by an ecologist; and

(ii) Stockpiling vegetation adjacent to retained habitat to allow remaining lizards to disperse prior to mulching.

(c) Location of the proposed lizard relocation site and habitat enhancement actions (this may be updated to be consistent with permit requirements).

157. Key aspects of the Invertebrate Management Plan (refer to Dr Curry's commentary in Appendix F.2 for more detail) include:

(a) The requirement, prior to the commencement of construction works, preconstruction surveys to determine invertebrate community composition and the presence of 'At Risk' or 'Threatened' taxa;

(b) Once the surveys are completed, the Management Plan will be updated as appropriate.

'Magnitude of Effects' assessment after effects avoidance and minimisation

158. The proposed designation covers 340 ha, of which 41.85 ha (12.31 %) comprises the 12 habitat types described in detail above. Of the 41.85 ha of habitat identified in the designation corridor, 15.11 ha (36% of that available in the designation) will be directly removed under the Project footprint (which includes the alignment, spoil sites, the shared use path, temporary clearance required for construction and enabling works). A further 0.56 ha of Manuka and kanuka shrubland and 1.12 ha of pasture wetlands will be lost in areas associated with spoil sites outside the designation corridor (but within the Project footprint).

159. This equates to a total loss of 11.82 ha of indigenous terrestrial habitats and 4.97 ha of wetland habitats as a result of the Project or 16.79 ha overall.

160. The tables below provide a summary of effects associated with the Project footprint, and using the EcIAG methodology, assign a 'Magnitude of Effect' for each habitat type and species (or groups of species where the 'Magnitude of Effects' is similar). The tables also include a summary of measures to avoid, remedy and mitigate these effects and provide a final 'Magnitude of Effect', taking into account the mitigation proposed. As explained above, these tables take into account only those measures proposed to avoid or minimise and mitigate adverse effects. This does not include habitat restoration or enhancement that is associated with proposed offsetting or compensation measures.

Table 6: 'Magnitude of Effect' for each habitat type in the Project footprint assessed using EcIAG methodology

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
Old-growth forest (alluvial)	0.10 ha, which equates to 2.4% of what is available within the designation corridor and noting that this habitat type is down to 2.5% of its original extent in the Region. This habitat lies within the construction footprint and will be replaced in the long-term	Potential edge effects resulting from the proposed design have been assessed as **"Negligible"** for the following reasons: - A very small area proposed for removal along an existing edge, minimising changes in exposure to the biotic and abiotic factors listed above; - The proposed alignment is located downwind of the prevailing winds hence dust deposition during construction will be limited. - Further fragmentation avoided as an existing edge is being removed.	- Physical delineation to ensure no over clearance of vegetation. - Clearance extent minimised through pruning as opposed to felling of old-growth trees where possible. - Clearance extent along habitat edges, avoiding fragmentation. - Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to native fauna including native snails, lizards, and birds (Refer to the EMP in Volume VII). - Epiphyte and coarse woody debris relocation will reduce harm to invertebrates and provide habitat enhancement in adjacent forest (Refer to the EMP in Volume VII). - Dust suppression is proposed across the Project footprint during construction and monitoring will be undertaken at old-growth forest adjacent to Project footprint (refer to Technical Assessment E).	**'Moderate'**
Old-growth forest (hill country)	Permanent loss of 0.85 ha. This equates to 48% of what is available in the designation corridor and < 1% of what is available on the local landscape (i.e.,	Potential edge effects resulting from the proposed design have been assessed as **'Low'** for the following reasons: - Shifting the impact area to the head of the Western QEII gully avoids fragmentation and results in the shifting of an existing edge rather than the creation of two new edges in addition to the existing edge. - The vegetation adjacent to the new edge is currently less than 100 m in width and		**'Moderate'**

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
	the adjacent Manawatū Scenic Reserve but noting that it is threatened ecosystem type in the region with 19% of its former extent remaining.	therefore is likely already exposed to edge effects, albeit at a lesser extent. - The existing alignment is located upwind of the prevailing wind and therefore dust deposition is more likely to occur during construction.	- Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII). - Replacement planting at a scale of 1:100 for any swamp maire pruned, or 1:200 for swamp maire felled. - Replacement planting at a scale of 1:100 for any ramarama felled.	
Secondary broadleaved forests with old-growth signatures	Long-term loss of 0.04 ha, which equates to 1.3% of availability within the designation corridor and noting that this habitat type is uncommon in the wider landscape	Potential edge effects resulting from the proposed design have been assessed as **"Negligible" - 'Low'** for the following reasons: - The impact areas are either already fragmented and exposed to edge effects (CH 7300 - CH 7400) or a very small area proposed for removal along an existing edge. Hence both areas are already exposed to edge effects, albeit at a lesser extent. - The existing alignment is located upwind of the prevailing wind at both impact areas and therefore dust deposition is likely to occur during construction. It is noted that the area located at CH 7300 - CH 7400 is already exposed to some dust deposition effects from an unsealed farm track that exists along this edge.	- Physical delineation to ensure no over clearance of vegetation. - Clearance extent along habitat edges, avoiding fragmentation. - Areas of the forest remnant between CH 10400 - CH 10600 that actually contain old-growth trees are avoided. - Seasonal restrictions and/or pre-clearance protocols will be implemented to minimise harm to native fauna including native snails, lizards, and birds (Refer to draft EMP in Volume VII). - Dust suppression proposed across the footprint during construction (refer to Technical Assessment E)	**'Low'**

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
			- Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII).	
Old-growth treelands	Permanent loss of 0.13 ha, which equates to 32% of availability within the designation corridor and noting that this habitat type is common in the wider landscape	Potential edge effects resulting from the proposed design have been assessed as **"Negligible"** for the following reasons: - The treeland remnants are very small and open (< 30 m at the widest point) and hence will already be exposed to high levels of edge effects; and - The understory is already dominated by exotic plants.	- Physical delineation to ensure no over clearance of vegetation. - Clearance extent minimised through pruning as opposed to felling of old-growth trees where possible. - The stormwater wetland proposed for the area has been modified to almost completely avoid the ramarama area. - Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to native fauna including: lizards and birds (Refer to the EMP in Volume VII). - Dust suppression is proposed across the Project footprint during construction (refer to Technical Assessment E)	**'Low'**
Kānuka forests	1.3 ha, which equates to 29% of availability within the designation	Potential edge effects resulting from the proposed design have been assessed as **'Negligible' - 'Low'** for both impact areas for the following reasons:	- Physical delineation to ensure no over clearance of vegetation. - Seasonal restrictions and/or pre-clearance protocols will be put in	**'Moderate'**

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
	corridor. Although kānuka forest is considered threatened regionally, the kānuka forest available in the designation corridor appears to be created as a product of sustained grazing pressure, and is likely to be common in the surrounding rural landscape.	- The areas impacted are along existing edges. However in the case of CH 3900 - CH 4300, vegetation clearance will shift this edge considerably (>50 m), exposing an area of canopy that has previously been relatively protected from the abiotic effects. Notwithstanding this the area is grazed underneath and the understory is dominated by exotic plants. Hence the impacts of light-demanding pest plants colonising the new edge will be minimal; and - The proposed alignment is located upwind of the prevailing wind but the construction of the viaduct will not create a large area of exposed earth, limiting dust deposition potential. - At CH 5400 - CH 5600, a small area is proposed for removal and the proposed alignment is located downwind of the prevailing winds hence dust deposition during construction will be limited.	place to minimise harm to native fauna including: lizards, birds and bats (Refer to the EMP in Volume VII). - Dust suppression is proposed across the Project footprint during construction (refer to Technical Assessment E) - Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII).	
Advanced secondary broadleaved forest	Long-term loss of 0.04 ha, which equates to 1.4 % of availability within the designation corridor.	Potential edge effects resulting from the proposed design have been assessed as **'Low'** for the following reasons: - A small area is proposed for removal and this habitat type is located along an existing gully edge, limiting changes in exposure to the biotic and abiotic factors listed above; and	- Physical delineation to ensure no over clearance of vegetation. - Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to native fauna including: lizards, birds and bats (Refer to the EMP in Volume VII).	**'Low'**

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
	Regenerating broadleaved forest at various stages of succession are common in the surrounding landscape and are not listed as threatened in the region.	- The proposed alignment is located upwind of the prevailing wind and therefore dust deposition is likely to occur during construction.	- Dust suppression is proposed across the Project footprint during construction (refer to Technical Assessment E) - Weed control and enrichment planting to be undertaken in newly created edges, including temporary edges (Refer to the EMP in Volume VII)	
Secondary broadleaved forests and scrublands	6.44 ha which equates to 39% of availability within the designation corridor. As above, regenerating broadleaved forest at various stages of succession are common in the surrounding landscape and are not listed as threatened in the region.	Potential edge effects resulting from the proposed design have been assessed as **Negligible' - 'Low'** all of the impact locations with the exception of two (details below). The reasoning is below: - the secondary broadleaved forests and scrublands are comprised relatively early successional species that are robust to increased exposure abiotic factors listed above; - Many of these areas are already small, fragmented by the existing land use, and interspersed with pest plants, namely broom. - In most cases further fragmentation avoided as existing edges is being removed. - These patches occur at different positions relative to the proposed alignment and thus will be impacted by dust deposition	- Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to native fauna including: lizards and birds (Refer to the EMP in Volume VII). - Dust suppression is proposed across the Project footprint during construction (refer to Technical Assessment E) - Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII). - Translocation of *Adiantum formosum* located at CH 3800 - CH 4000 and additional planting of 1:15 for each relocated plant.	**'Moderate'**

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
		differently. However dust is unlikely to cause more than a 'Low'level effect in any instance. The potential edge effects have been assessed as **'Moderate'** for the secondary broadleaved forest patches at CH 9800 - CH 10000 and CH 10800 - CH 11400. The following reasons apply: - At CH 9800 - CH 10000 a large proportion of this patch is proposed to be removed. Moreover the proposed alignment bisects the patch, resulting in the creation of a large amount of new edge and further fragmentation. However, the patch is less than 100 m in width and so is likely to be exposed to some level of edge effects already; - A large proportion of the patches at CH 10800 - 11400 is proposed to be removed creating a large amount of new edge. However all of the areas removed occur along existing edges, avoiding fragmentation and shifting existing edges as opposed the creation of additional edges.At: - The mitigating factors listed above e.g. the high proportion of early-successional species applies to these areas, hence why they have been assessed as 'Moderate' as opposed to high.		

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
Mānuka, kānuka shrublands	2.11 ha, which equates to > 50 % of the availability within the designation corridor. This shrubland type is common in the surrounding landscape and appears to readily establish in pasture. It is not threatened in the region.	Potential edge effects resulting from the proposed design have been assessed as **"Negligible"** for the following reasons: - All mānuka, kānuka shrubland patches are small, isolated and regularly impacted by stock. Consequently, the areas are already exposed to edge effects and are currently comprised of early successional species that are robust to increased exposure abiotic factors listed above.	- Physical delineation to ensure no over clearance of vegetation. - Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to native fauna including: lizards and birds (Refer to the EMP in Volume VII). - Dust suppression is proposed across the Project footprint during construction (refer to Technical Assessment E) - Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII).	**'Moderate'**
Divaricating shrublands	0.33 ha, which equates to > 50 % of the availability within the designation corridor. The divaricating shrublands within the designation corridor appear to be closely	Potential edge effects resulting from the proposed design have been assessed as **"Negligible"** for the following reasons: - All divaricating shrubland patches are small, isolated and regularly impacted by stock. Consequently, the areas are already exposed to edge effects and are currently comprised of early successional species that are robust to increased exposure abiotic factors listed above.	- Physical delineation to ensure no over clearance of vegetation. - Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to native fauna including: lizards, birds and terrestrial invertebrates (Refer to the EMP in Volume VII). - Dust suppression is proposed across the Project footprint during construction (refer to Technical Assessment E)	**Low**

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
	associated with the manuka, kanuka shrubland. It appears to be common in the landscape. It is not threatened in the region.		- If *Meterana* spp. Recorded in the area - a grazing or mowing regime will be continued across the remaining divaricating shrubland patches within the designation to promote the areas remaining in a stalled successional trajectory dominated by divaricating shrubs (Refer to the EMP in Volume VII).	
Raupō-dominated seepage wetlands (high value)	0.11, which equates to 20 % of the availability within the designation corridor. Raupō wetlands appear to be rare in the wider landscape and in the region noting that only 3% of wetlands remain in the region.	**High** - The raupō wetland occurs within a matrix of forest, scrub and grassland and is generally quite open. The dominant wetland component, raupō, is adapted to open environments and are robust to increased exposure abiotic factors associated with the creation of new edge. - Wetlands are naturally fragmented across the landscape due to the specific landforms they occur within. Hence the species that inhabit wetlands are generally mobile and fragmentation resulting from the Project is unlikely to impact the movement of fauna or dispersal of seed more than the existing agricultural matrix. - Notwithstanding the above, fragmentation of the high value raupō wetland has been	- Physical delineation to ensure no over clearance of vegetation. - The staging piles will be capped to ensure artesian aquifer is not ruptured, thus maintaining the current hydrology. - Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to native wetland birds potentially nesting in the area (Refer to the EMP in Volume VII).	**'Moderate'**

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
		avoided by the extension of BR03 to limit impacts in the area. An indirect impact specific to wetland habitat types is changes in hydrology impacting species assemblages. - The hydrology of the raupō appears to be somewhat impacted by stock access but is generally intact. Geotechnical investigations have found that the raupō wetland is located above an artesian aquifer. Construction of the Project has the potential to rupture this aquifer which would change the hydrology of the raupō wetland considerably.		
Indigenous-dominated seepage wetlands ('Moderate' value)	0.44 (which equates to 66.7 % of this type of wetland available in the designation corridor) Indigenous dominated seepage wetlands appear to be rare in the surrounding	**"Negligible"** - All of the 'Moderate' and 'Low' value wetlands on the site occur in open areas and the species inhabiting the different wetland types are adapted to open environments and are robust to increased exposure abiotic factors associated with the creation of new edge. - Wetlands are naturally fragmented across the landscape due to the specific landforms they occur within. Hence the species that inhabit wetlands are generally mobile and fragmentation resulting from the Project is unlikely to impact the movement of fauna or	- Physical delineation to ensure no over clearance of vegetation. - Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to native lizards, and birds potentially nesting in the area (Refer to the EMP in Volume VII).	**'High'**

Vegetation/ habitat type	Direct impact (extent of vegetation removal)	Indirect impacts (the quality of remaining habitat may be degraded due to changes in edge microclimate as a result of increased exposure to light and wind, increased incursions of pest plants, and from dust deposition)[1]	Minimisation measures	Magnitude of effect
	landscape and in the region.	dispersal of seed more than the existing agricultural matrix.		
Pasture wetlands, dominated by exotic species or the common native rush *Juncus edgariae* (low value) Numerous locations across the Footprint	4.23 ha, which constitutes an unknown but likely high proportion of wetlands in the designation corridor. Wetlands in improved pasture are common in the surrounding landscape, but noting that freshwater wetlands are down to 3% of their formal extent in the region.	An indirect impact specific to wetland habitat types is changes in hydrology as well as sedimentation and pollution impacting species assemblages. - The hydrology of the 'Moderate' and 'Low'value wetlands appear to be impacted by stock pugging and the native species dominating these wetlands (*Juncus edgariae* and *Carex geminata*) are not limited to strict hydrological conditions. Consequently it is unlikely that any hydrological changes caused by the Project will have a discernible impact on these wetland assemblages.	- Physical delineation to ensure no over clearance of vegetation. - Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to pipit eggs and unfledged chicks (Refer to the EMP in Volume VII).	**'Moderate'**

Table 7: 'Magnitude of Effect' for flora, long-tailed bat, bird, lizard and invertebrate species potentially occurring in the Project footprint assessed using EcIAG methodology.

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
Giant maidenhair	Plants could be lost due to vegetation clearance activities within secondary broadleaf forest adjacent to the Manawatū River.	**Direct impacts** • Loss of individuals during vegetation clearance; and • Loss of potential habitat; **Indirect impacts** • Edge effects degrading remaining habitat; and • Fragmentation due to potential road barrier.	- Dust suppression is proposed across the Project during construction (refer to Technical Assessment E) - Weed control and enrichment planting to be undertaken in newly created edges (Refer to theEMP in Volume VII). - Translocation of *Adiantum formosum* located at CH 3800 - CH 4000 and additional planting of 1:15 for each relocated plant	**'Moderate'**
Kānuka*/ mānuka*	Up to 3.41 ha of kānuka forest and mānuka, kānuka shrublands (as addressed at ecosystem level in Table 6); and other scattered individuals within other forests, shrublands and wetlands	**Direct impacts** • Loss of individuals during vegetation clearance; and • Loss of potential habitat; **Indirect impacts** • Edge effects degrading remaining habitat; and • Fragmentation due to potential road barrier.	- Dust suppression is proposed across the Project during construction (refer to Technical Assessment E) - Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII).	**'Moderate'**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
Ramarama* rohutu (*Lophomyrtus spp.*) and swamp maire	Small numbers of plants could potentially be removed during vegetation clearance activities within treeland or old growth forest habitats	**Direct impacts** • Loss of individuals during vegetation clearance; and • Loss of potential habitat; **Indirect impacts** • Edge effects degrading remaining habitat; and • Fragmentation due to potential road barrier.	- Clearance extent minimised through pruning as opposed to felling of old-growth trees where possible. - Clearance extent along habitat edges, avoiding fragmentation. - Dust suppression is proposed across the Project during construction and monitoring will be undertaken at old-growth forest adjacent to Project footprint (refer to Technical Assessment E). - Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII). - Replacement planting at a scale of 1:100 for any swamp maire pruned, or 1:200 for swamp maire felled. - Replacement planting at a scale of 1:100 for any ramarama and rohutu felled. - Ramarama area identified in NoR reporting avoided (which contained ramarama and rohutu individuals)	**'Low'**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
Rātā vines* (*Metrosideros spp.*)	All rata vines that are present in Old growth forest types in the footprint will be lost noting that this will constitute < 1% of available loss withi - n the surrounding landscape (which includes the Manawatu Gorge Scenic Reserve).	**Direct impacts** • Loss of individuals during vegetation clearance; and • Loss of potential habitat; **Indirect impacts** • Edge effects degrading remaining habitat; and • Fragmentation due to potential road barrier;	- Dust suppression is proposed across the Project during construction (refer to Technical Assessment E) - Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII).	**'Moderate'**
Long-tailed bat (refer to Appendix F.1)	Based on survey findings it is assumed that bats do not regularly use habitats within the Project footprint but the possibility that they move through the landscape on occasion cannot be ruled out. Correspondingly impacts associated with habitat loss are expected to be negligible	Impacts associated with habitat loss or other indirect effects are not expected. Despite this, monitoring will be undertaken and management measures initiated if bats begin to use the area over the course of construction. The reasoning for this precautionary approach is the high threat status of long-tailed bats,	Pre-clearance protocols will be put in place to minimise potential harm to long-tailed bats potentially roosting in the area (refer to the EMP in Volume VII). Fragmentation effects minimised in key areas through: • BR03 will facilitate the potential dispersal of long-tailed bats along the Manawatū River corridor. • The shift of the alignment to the northern extent of the western QEII gullies avoids fragmentation of the gully.	**'Negligible'**
Birds associated with forest and shrublands	11.82 ha of forest and shrublands, which equates to 32% of available habitat within the designation corridor and approximately 2% of the habitat	**Direct impacts** • Decreased breeding success (mortality of eggs during vegetation	Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to birds potentially nesting in	**'Moderate'** for resident birds

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
Confirmed resident in surrounding landscape: Kereru, bellbird, tui, whitehead, rifleman, tomtit Potential occasional visitors: Kaka, kakariki, North Island Robin, long-tailed cuckoo	available in the surrounding landscape (due to the presence of the Manawatu Gorge Scenic Reserve). The impact extent above includes: • 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; • Mānuka, kānuka shrublands; • Divaricating shrublands; and • Mature exotic forest and treelands It is assumed that these species could potentially use all forest and shrubland types in the Project footprint. However the more intact, old-growth areas are likely to be preferred habitat.	clearance if undertaken during the nesting season); • Loss of breeding and foraging habitat; and • Mortality from vehicle strike (low-level impact). **Indirect impacts** • Edge effects degrading remaining habitat. • Fragmentation due to potential road barrier. • Fragmentation due to removal of some stepping stone habitat.	the area (refer to the EMP in Volume VII). Weed control and enrichment planting to be undertaken in newly created edges to minimise edge effects (refer to the EMP in Volume VII). Planting adjacent to carriageway designed to discourage native birds from using the area, thus minimising potential for vehicle strike. Fragmentation effects minimised in key areas through: • BR03 will facilitate dispersal of birds between the Manawatū Gorge Scenic Reserve and the Old-growth forest to the east. • The shift of the alignment to the northern extent of the western QEII gullies avoids fragmentation of the gully.	**Low** for occasional visitors (e.g. kaka and kakariki)
Kārearea (bush falcon)	Kārearea are wide ranging habitat generalists, they occur in agricultural areas where suitable forest remnants remain and forage over grassland.	**Direct impacts** • Decreased breeding success (mortality of eggs during vegetation clearance if undertaken during the nesting season);	Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to birds potentially nesting in	**'Moderate'**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
	Consequently it is conservatively assumed that falcon use all vegetated areas available in the designation corridor, including the improved pasture. Habitat loss is estimated at 42.94 ha. This includes all forest and shrubland habitat types (11.82 ha), exotic pine forest (1.12 ha) and approx 30 ha of pasture that will not be reinstated. Proportionally, this loss equates to <1% of forest or shrubland habitat within the surrounding landscape (due to the presence of the Manawatu Gorge Scenic Reserve) and a 'Negligible' proportion of available pine forest or pasture habitat in the surrounding landscape.	• Loss of breeding and foraging habitat; and • Mortality from vehicle strike (low-level impact). **Indirect impacts** • Edge effects degrading remaining habitat. • Fragmentation due to potential road barrier. • Fragmentation due to removal of some stepping stone habitat.	the area (refer to the EMP in Volume VII). Weed control and enrichment planting to be undertaken in newly created edges to minimise edge effects (refer to the EMP in Volume VII). Planting adjacent to carriageway designed to discourage native birds from using the area, thus minimising potential for vehicle strike. Fragmentation effects minimised in key areas through: • BR03 will facilitate dispersal of birds between the Manawatū Gorge Scenic Reserve and the Old-growth forest to the east. • The shift of the alignment to the northern extent of the western QEII gullies avoids fragmentation of the gully.	
New Zealand pipit	4.97 ha of wetlands (of all types) and ca 30 ha of pasture that will be permanently lost (i.e., pasture that lies under the road footprint as opposed to the construction footprint). This is approximately	**Direct impacts** • Decreased breeding success (Mortality of eggs during vegetation clearance/earthworks, if undertaken during the nesting season);	A grazing and/or mowing regime will be adhered to across the currently grazed pasture areas located in the Project footprint. The purpose of this is to prevent currently	**Low**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
	10% of the pasture habitat available habitat within designation corridor and a very low proportion of what is available in the surrounding landscape.	• Loss of breeding and foraging habitat; and • Mortality from vehicle strike. **Indirect impacts** • Fragmentation due to potential road barrier. Pipit nest in rough grassland where they can conceal their nests under vegetation. Given the majority of the grassland habitat within the Project footprint is grazed, it is unlikely that there is significant breeding habitat within the footprint. An exception is the pasture wetland areas. Pipit also forage over open pasture. The prevalence of pasture grassland in the surrounding landscape means that the removal of these areas, although large, is unlikely to reduce the pipit population in the area. Given the prevalence of open habitat across the Project footprint, pipit do not have the same requirements as forest dwelling birds such as whitehead to move between isolated habitat patches. Hence the impacts of habitat fragmentation are likely to be 'Negligible'.	unsuitable nesting habitat going rank and becoming preferential pipit nesting habitat prior to construction commencing. Pre-clearance protocols in place in potential pipit nesting areas will be put in place to minimise harm to birds potentially nesting in the area (refer to draft EMP in Volume VII). Priority habitat is the 'Moderate' and 'Low' value wetlands where the water table is low but there is increased rush and sedge cover for nesting.	
All wetland birds potentially present within impacted freshwater wetlands (e.g.	0.55 ha of temporary loss, which equates to 45% of available potential habitat within the designation corridor.	**Direct impacts** • Decreased breeding success (mortality of eggs during vegetation clearance if undertaken during the nesting season); and	Seasonal restrictions and/or pre-clearance protocols will be put in place to minimise harm to birds potentially nesting in	**Low**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
Australian bittern, spotless crake, marsh crake)	The impact extent above includes: • Raupō-dominated seepage wetlands; • Indigenous-dominated seepage wetlands; and It is assumed that these wetland birds could potentially use all wetland types in the Project footprint. It should be noted that this is a conservative assumption given none of these species have been observed in the designation corridor despite wetland bird surveys.	• Loss of breeding and foraging habitat. **Indirect impacts** • Edge effects degrading remaining habitat. • Fragmentation due to potential road barrier. • Fragmentation due to removal of some stepping stone habitat. A small area (0.55 ha) of indigenous dominated seepage wetland is proposed for removal. The remaining wetland removal is characterised by highly modified pasture wetlands that are unlikely to provide important habitat for any of the above species. Given that none of the wetland species in question have been recorded in the designation corridor after targeted acoustic surveys indicates that the wetland removal will be unlikely to have population-level effects on the wetland bird populations in the wider landscape.	the area (Refer to the EMP in Volume VII). Weed control and enrichment planting to be undertaken in newly created edges (Refer to the EMP in Volume VII). Fragmentation effects have been minimised at the key raupo wetland through the extension of BR03. This will facilitate dispersal of birds through the habitat mosaic that characterises the Western Rise area.	
Native ducks potentially present in farm ponds (New Zealand dabchick and Australian coot)	2 ha of open water farm ponds, which likely equates to a 'Moderate' proportion of available pond habitat within the designation corridor and a very small proportion of pond habitat within the wider landscape The impact extent above includes:	**Direct impacts** • Decreased breeding success (mortality of eggs during vegetation clearance if undertaken during the nesting season); and • Loss of breeding and foraging habitat. **Indirect impacts**	Exclusion zones set-up around the farm ponds that are in the Designation but outside of the Construction Footprint (refer to the EMP in Volume VII).	**"Negligible"**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
	• Farm ponds A subset of the farm ponds across the designation corridor were opportunistically surveyed for notable native waterfowl. Neither of these species were identified, but I have assumed that they may occasionally use these habitats.	• Fragmentation due to potential road barrier. • Fragmentation due to removal of some stepping stone habitat. The small area of impact in combination with the fact that neither of these species have been confirmed in the designation indicates that this impact is unlikely to have population level effects. Edge effects are not considered here given that pond are small habitats located within a pasture matrix.		
Threatened or At Risk birds potentially nesting on the exposed gravel riverbed Confirmed prospecting in the Project footprint: Black-fronted dotterel Confirmed resident in surrounding landscape: Black-billed gull, banded dotterel, and Caspian tern. Potentially present:	No potential nesting habitat will be lost	**Direct impacts** • Decreased breeding success (Abandonment of nests due to disturbance during construction, if undertaken during the nesting season); and **Indirect impacts** • Noise disturbance of nesting pairs during construction. Noise disturbance considered 'Moderate'. It is unknown how black-fronted dotterels respond to construction-related disturbance while nesting. NZ dotterels however, are known to be resilient to such disturbance and regularly breed successfully in construction sites. Black-billed gulls likely to be robust to disturbance given the instance of a	Deterrence mechanisms to be employed to deter river birds from nesting in the vicinity of the BR02 footprint. If birds do nest in the vicinity of the BR02 footprint, a 50 m exclusion zone will be put in place until the chicks have fledged, or the nest fails.	**"Negligible"**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
Red-billed gull.		successful nesting colony in downtown Christchurch. Furthermore, closest sightings of black-billed gulls have been approximately 600 m downstream.		

At Risk native lizards	11.82 ha of forest and shrublands, which equates to 32% of available habitat within the designation corridor and approximately 2% of the habitat available in the surrounding landscape (due to the presence of the Manawatu Gorge Scenic Reserve); and improved pasture. The impact extent above includes: • 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; • Mānuka, kānuka shrublands; • Divaricating shrublands; and • Improved pasture To date no lizards have been identified in the designation corridor, however there are inherent limitations to surveying for lizards over large areas. Hence it is conservatively assumed that At Risk lizards are present a low densities across all of the forest and shrubland	Direct impacts • Injury or mortality during vegetation clearance and earthworks; and • Removal of habitat leading to decreased population size. Indirect impacts • Edge effects degrading remaining habitat; and • Fragmentation of remaining habitat. Due to the limited mobility of lizards they have an increased risk of mortality during vegetation clearance and earthworks. The habitat proposed for removal is of varying quality for lizards with the highest quality habitat being 2.5 ha of old-growth forest and kānuka forest. Without mitigation / offset / compensation, the removal of these areas could pose a population-level effect for at least some of the lizard species assumed to be present. The key area where edge effects will occur is likely to be the new edge created within the old-growth hill country forest, kānuka forest and the secondary broadleaf forest and shrublands. All other areas impacted are already small in size and likely subject to edge effects already. Again, because of the limited mobility of lizards, fragmentation of habitats can lead to populations becoming isolated. However in this instance this is considered to be a 'Low' level effect because most of the habitats being impacted are already located within an agricultural matrix. Hence, if populations	Seasonal restrictions and/or pre-clearance salvage protocols will be put in place to minimise harm to lizards occupying habitat with the Project footprint (refer to the EMP in Volume VII). A grazing and/or mowing regime will be adhered to across the currently grazed pasture areas located in the Project footprint. The purpose of this is to prevent grazed pasture which is currently unsuitable for northern grass skink becoming rank and skinks moving into this habitat prior to construction commencing Weed control and enrichment planting to be undertaken in newly created edges (refer to the EMP in Volume VII). Dust control being undertaken across the Project.	**'Moderate'**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
		are occurring in these habitats, they will already be isolated to a large extent.		
All invertebrates potentially present in forest and scrubland habitats (See Appendix F.2)	11.82 ha of forest and shrublands, which equates to <1% of the habitat available in the surrounding landscape (due to the presence of the Manawatu Gorge Scenic Reserve	**Direct impacts** • Injury or mortality during vegetation clearance and earthworks; and • Removal of habitat leading to decreased population size. **Indirect impacts** • Edge effects degrading remaining habitat; and • Fragmentation of remaining habitat. Due to the limited mobility of invertebrates they have an increased risk of mortality during vegetation clearance and earthworks. The habitat proposed for removal is of varying quality for invertebrates with the highest quality habitat being 2.5 ha of old-growth forest and kānuka forest. Without mitigation, the removal of these areas could pose a population-level effect for at least some of the invertebrate species assumed to be present. The key area where edge effects will occur is likely to be the new edge created within the old-growth hill country forest, kānuka forest and the secondary broadleaf forest and shrublands. All other areas impacted are already small in size and likely subject to edge effects already.	Seasonal restrictions and/or pre-clearance salvage protocols will be put in place to minimise harm to invertebrates occupying habitat with the Project footprint (refer to the EMP in Volume VII). Weed control and enrichment planting to be undertaken in newly created edges (refer to the EMP in Volume VII). Dust control being undertaken across the Project.	**'Moderate'**

Species	Extent of habitat removal	Potential impacts[1]	Avoidance and minimisation measures	'Magnitude of Effect'
		Again, because of the limited mobility of invertebrates, fragmentation of habitats can lead to populations becoming isolated. However in this instance this is considered to be a 'Low' level effect because most of the habitats being impacted are already located within an agricultural matrix. Hence, if populations are occurring in these habitats, they will already be isolated to a large extent.		

*Common species that were formerly classified as 'Not Threatened' but that have been assigned national threat categories due to risks associated with Myrtle rust but that are common in the landscape and for which Myrtle rust does not appear to result in significant adverse impacts will not be specifically addressed through effects management despite their assessed 'Level of Effects' category.

'Level of Effects' after avoidance and minimisation

160. The 'Level of Effects' section is structured as follows

    (a) 'Level of Effects' after avoidance and minimisation; and

    (b) Key changes from the NoR assessment.

161. The table below uses the EcIAG matrix to assign an overall 'Level of Effect' of the Project on terrestrial and wetland habitats and associated species. This matrix is based on the assessed values of the habitat types and the species of interest in combination with the assessed 'Magnitude of Effects' after avoidance and minimisation measures (refer to **APPENDIX F.5**, Tables F.5.1 - F.5.6).

162. Through avoidance and minimisation measures, a number of ecological effects will largely be managed to '"Negligible" or 'Low" levels, though there some effects on local biodiversity values that have been assessed as being 'Moderate" or "High'. Most notably, I expect the Project to have 'potentially High' or 'High' level of residual effects 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);

    (c) 6.71 ha of secondary broadleaf forest;

    (d) 0.55 ha of indigenous dominant seepage wetland; and

    (e) Up to 11.82 ha of potential habitat for the nationally 'At Risk' whitehead and rifleman, up to four 'At Risk' lizard species and up to seven nationally 'Threatened' or 'At Risk' invertebrates if present.

163. Importantly, no residual adverse effects are deemed to be 'Very High'.

164. Where the 'Level of Effects' is assessed at being 'potentially' 'Moderate' or higher after practicable measures to minimise effects have been undertaken, and in accordance with the EcIAG guidelines, I consider it appropriate to offset or compensate for these residual effects through habitat restoration and enhancement measures.

165. The 'Level of Effects' for terrestrial and wetland habitats and associated species, after effects and avoidance measures, is set out in Table 8 below.

Table 8. Level of residual effects for terrestrial and wetland habitats and associated species after effects avoidance and minimisation measures (as per EcIAG step 3)

Biodiversity value within the Project footprint (ha)	'Ecological Value'	'Magnitude of Effect' after avoidance and minimisation	'Level of Effect' after avoidance and minimisation
Vegetation/ habitat type			
Old-growth forest (alluvial)	'Very High'	'Moderate'	'High'
Old-growth forest (hill country)	'Very High'	'Moderate'	'High'
Secondary broadleaved forests with old-growth signatures	'High'	'Moderate'	'High'
Old-growth treelands (+ ramarama)	'High'	'Low'	'Moderate'*
Kānuka Forests	'Moderate'	'Moderate'	'Moderate'
Advanced Secondary Broadleaved Forest	'High'	'Low'	'Moderate'*
Secondary Broadleaved Forests and Scrublands	'Moderate'	'Moderate'	'Moderate'
Mānuka, Kānuka Shrublands	'Moderate'	'Moderate'	'Moderate'
Divaricating Shrublands	'Moderate'	'Moderate'	'Moderate'
Indigenous Dominated Seepage Wetland - High Value (raupō wetland)	'Very High'	'Moderate'	'High'
Indigenous Dominated Seepage Wetland - 'Moderate' Value (*Carex* dominated wetlands)	'Moderate'	'High'	'Moderate'
Exotic Wetland (including pasture wetlands dominated by *Juncus edgariae*)	'Moderate'	'Moderate'	'Moderate'
Plant species			
Giant maidenhair	'High'	'Moderate'	'Moderate'

Biodiversity value within the Project footprint (ha)	'Ecological Value'	'Magnitude of Effect' after avoidance and minimisation	'Level of Effect' after avoidance and minimisation
Kānuka**	'Very High'	'Moderate'	Low'***
Mānuka**	'Very High'	'Moderate'	Low***
Ramarama**	'Very High'	'Low'	Low'***
Rohutu	'Very High'	'Low'	Low***
Rātā**	'Very High'	'Low'	Low'***
White rātā**	'Very High'	'Low'	Low***
Climbing rātā**	'Very High'	'Low'	Low'***
Akatea**	'Very High'	'Low'	Low***
Swamp maire	'Very High'	'Low'	Low'***
Bats			
Long-tailed bat	'Very High'	'Negligible'	Low
Bird species			
Australasian bittern	'Very High'	Potentially 'Low'	'Moderate'
Banded dotterel	'Very High'	'Negligible'	Low
Black-billed gull	'Very High'	'Negligible'	Low
Caspian tern	'Very High'	'Negligible'	Low
Red-billed gull	'High'	'Negligible'	Very 'Low'

Biodiversity value within the Project footprint (ha)	'Ecological Value'	'Magnitude of Effect' after avoidance and minimisation	'Level of Effect' after avoidance and minimisation
Whitehead	'High'	'Moderate'	'Moderate'
Spotless crake	'High'	Potentially 'Low'	'Moderate'
NZ pipit	'High'	Very 'Low'	'Low'
Marsh crake	'High'	Potentially 'Low'	'Moderate'
Rifleman	'High'	'Moderate'	'Moderate'
North Island robin	'High'	'Moderate'	'Moderate'
Kakariki	'Moderate'	'Low'	'Low'
Kaka	'Moderate'	Low	'Low
Australian coot	'Moderate'	'Negligible'	'Very Low'
NZ dabchick	'Moderate'	'Negligible'	'Very Low'
Bush falcon	'Moderate'	'Moderate'	'Moderate'
Long-tailed cuckoo	'Moderate'	'Moderate'	'Moderate'
Pied shag	'Moderate'	'Negligible'	'Very Low'
Black shag	'Moderate'	'Negligible'	'Very Low'
Little black shag	'Moderate'	'Negligible'	'Very Low'
Black-fronted dotterel	'Moderate'	"Negligible"	'Low'
Kereru	'Moderate'	'Moderate'	'Moderate'

Biodiversity value within the Project footprint (ha)	'Ecological Value'	'Magnitude of Effect' after avoidance and minimisation	'Level of Effect' after avoidance and minimisation
Bellbird	'Moderate'	'Moderate'	'Moderate'
Tui	'Moderate'	'Moderate'	'Moderate'
Lizard species			
Barking gecko	'High'	Potentially 'Moderate'	Potentially 'Moderate'
Ngahere gecko	'High'	Potentially 'Moderate'	Potentially 'Moderate'
Raukawa gecko	'Low'	Potentially 'Moderate'	'Low'
Pacific gecko	'Moderate'	Potentially 'Moderate'	Potentially 'Moderate'
Glossy brown skink	'High'	Potentially 'Moderate'	Potentially 'Moderate'
Ornate skink	'High'	Potentially 'Moderate'	Potentially 'Moderate'
Invertebrate species			
*Powelliphanta traversi traversi (*snail)	'Very high'	Potentially 'Moderate'	Potentially 'High'
Powelliphanta traversi tararuaensis (snail)	'Very high'	Potentially 'Moderate'	Potentially 'High'
Powelliphanta marchanti (snail)	'Very high'	Potentially 'Moderate'	Potentially 'High'

Biodiversity value within the Project footprint (ha)	**'Ecological Value'**	**'Magnitude of Effect' after avoidance and minimisation**	**'Level of Effect' after avoidance and minimisation**
Megadromus turgidceps (beetle)	'Moderate'	Potentially 'Moderate'	Potentially 'Moderate'
Meterana xquisite (moth)	'Moderate'	Potentially 'Moderate'	Potentially 'Moderate'
Meterana xquisite (moth)	'Moderate'	Potentially 'Moderate'	Potentially 'Moderate'
Wainuia urnula (snail)	'Moderate'	Potentially 'Moderate'	Potentially 'Moderate'

*High values with 'Low' 'Magnitude of Effects' were assessed as having 'Moderate' 'Level of Effects' despite the EcIAG guidelines table assessing High value and 'Low' 'Magnitude of Effects' as a 'Low' 'Level of Effect'

**Species that have been assigned national threat categories due to risks associated with Myrtle rust but that are common in the landscape and not known to be adversely affected Myrtle Rust will not be specifically addressed through effects management despite their 'Level of Effects' category.

*** In accordance with '**' above, the project is assessed as having a 'Low' 'Level of Effect' for these species. This is despite a higher 'Level of Effect' outcome that results from strict adherence to the EcIAG. The 'Low' 'Level of Effect' assigned was on the basis that that these are common species for which the potential impact of Myrtle rust, based on observations, is seemingly not as high as anticipated during the assignment of Threat Classifications by DOC.

Key changes from the NOR assessment

166. Table 9 below sets out the overall assessed 'Level of Effects' for each habitat through the NoR process, as compared to the overall 'Level of Effects' set out in this report.

167. The assessed potential 'Level of Effects' associated with each habitat type was the same between the NoR assessments and the assessment of effects associated with the Project footprint for:

    (a) Kanuka forests;

    (b) Secondary broadleaved forests;

    (c) Old-growth forest (alluvial);

    (d) Divaricating shrubland; and

    (e) Indigenous dominated wetland (High value).

168. In two instances, the 'Level of Effects' as assessed in this report is reduced as compared to the NoR assessments, driven by a substantial reduction in the areal extent of habitat loss. This related to:

    (a) Secondary broadleaved forest and scrublands (6.93 ha to be removed as opposed to a 14.15 ha Designation Condition effects envelope); and

    (b) Advanced secondary broadleaved forest (0.04 ha to be removed as opposed to a 0.5 ha Designation Condition effects envelope).

169. For old growth forest (hill country) despite a similar quantum of loss and both assessments assigning an 'Ecological Value' of 'Very High', I assessed the overall 'Level of Effects' as 'High" which was lower than the 'Level of Effects' assessment of 'Very High' for the NoR. In large part, I consider the 'Magnitude of Effects' to be lower because the loss of 0.85 ha of forest constitutes < 1% of the Old Growth Forest in the immediately surrounding landscape (i.e., within the Manawatu Gorge Scenic Reserve).

170. For wetland habitat types, I assessed the 'Level of Effects' as higher for both Indigenous Dominated Seep Wetlands 'Moderate' Value Exotic Wetlands (Low Value) (Pasture wetlands). This was largely on the basis that wetlands are a Threatened ecosystem type with only 3% remaining on the ecological district so I assigned a higher 'Ecological Value' that was given in the NoR assessment. Furthermore for Pasture wetlands, additional wetlands were

found within the Project footprint following field investigations and thus the 'Magnitude of Effect' was higher.

171. Importantly, in respect of the differences in the 'Level of Effects' assessments for wetlands and old growth forest (hill country), none of the differences affected the effects management outcomes, i.e., no 'Level of Effects' that were assessed as 'Moderate' or 'High' were lowered to 'Low' or 'Negligible' (or vice versa) which would typically indicate that offsetting or compensation measures for addressing residual adverse effects were not warranted.

172. Comparisons between the 'Level of Effects' assessments for species cannot easily be undertaken because the NoR assessment of effects for species values was focused on site specific values and an overall assessment of potential effects for each species was not provided. The site-based assessment of effects undertaken for the NoR phase was entirely appropriate as the focus at that stage of the Project was on site-specific effects avoidance recommendations during the resource consenting phase (i.e., the development of a concept alignment that avoids significant adverse ecological effects to the extent possible).

173. A 'Level of Effects' assessment comparison between the NoR and this consents assessment (after avoidance and minimisation measures) is set out in Table 9 below.

Table 9. 'Level of Effects' comparison between the assessment undertaken at the NoR and this assessment after avoidance and minimisation of effects (as per EcIAG step 3, and for 'Moderate' and 'High' assessments)

Name	Maximum removal (NOR condition 24) (ha)	'Level of Effect' (NoR)*	Project footprint (ha)	'Level of Effect' (Consent)
Secondary broadleaved forests with old growth signatures	2.39	'Very High'	0.25	'High'
Old growth Treeland (including Ramarama Area)	0.26	Not assessed	0.13	'Moderate'
Kānuka forests	1.59	'Moderate'	1.3	'Moderate'
Advanced secondary broadleaved forest	0.5	Very high	0.04	'Moderate'
Secondary broadleaved forests and scrublands	14.15	'Moderate'	6.93	'Moderate'
Mānuka and kānuka shrublands	3.63	'Moderate'	2.11	'Moderate'
Divaricating shrublands	0.33	'Moderate'	0.33	'Moderate'
Old growth forest alluvial	0.15	'High'	0.10	'High'
Old growth forest hill country	0.86	'Very High'	0.85	'High'
Indigenous Dominated Seepage Wetlands ('High' Value)	0.13	'High'	0.11	'High'
Indigenous Dominated Seepage Wetland ('Moderate' Value)	1.12	'Moderate'	0.44	"High'
Exotic Wetlands Low Value* (Pasture wetlands)	2.74	'Low'	4.42	'Moderate'

Name	Maximum removal (NOR condition 24) (ha)	'Level of Effect' (NoR)*	Project footprint (ha)	'Level of Effect' (Consent)
Secondary broadleaved forests with old growth signatures	2.39	'Very High'	0.25	'High'
Old growth Treeland (including Ramarama Area)	0.26	Not assessed	0.13	'Moderate'
Kānuka forests	1.59	'Moderate'	1.3	'Moderate'
Totals	27.85 ha		**16.79 ha**	

- 'Level of Effect' assessment excludes separate 'Level of Effects' assessment for fragmentation effects and edge effects which were assessed separately

MEASURES TO ADDRESS RESIDUAL EFFECTS THAT CANNOT BE AVOIDED OR MINIMISED

174. The residual effects management section is structured as follows:

(a) Residual effects management requirements;

(b) Habitat restoration and enhancement measures

(c) Approach for determining the type and quantum of habitat restoration and enhancement measures; and

(d) Type and quantum of proposed habitat restoration and enhancement measures.

Residual effects management requirements

175. Residual effects that are assessed as 'Moderate' or 'High' on local biodiversity values after effects avoidance and minimization measures will be addressed through a suite of habitat restoration and enhancement measures to offset or compensate for effects. The effects specifically being addressed through that suite of measures are set out in Table 10.

Table 10: 'Vegetation/habitat types, plant species and fauna species with a 'Moderate' or 'High' assessed 'Level of Effect'

Biodiversity value	**Level of residual effect after effects avoidance and minimisation measures (EcIAG)**
Habitat types	
Old-growth forest (alluvial)	'High'
Old-growth forest (hill country)	'High'
Secondary broadleaved forests with old-growth signatures	'High'
Old-growth treelands (+ ramarama)	'Moderate'
Kānuka Forests	'Moderate'
Advanced Secondary Broadleaved Forest	'Moderate'
Secondary Broadleaved Forests and Scrublands	'Moderate'
Divaricating Shrublands	'Moderate'

Biodiversity value	**Level of residual effect after effects avoidance and minimisation measures (EcIAG)**
Indigenous Dominated Seepage Wetland (raupō wetland)	'High'
Indigenous Dominated Seepage Wetland (*Carex* dominated wetlands)	'Moderate'
Pasture Wetlands	'Moderate'
Plant species	
Giant maidenhair	'Moderate'
Birds	
Australasian bittern	'Moderate'
Whitehead	'Moderate'
Spotless crake	'Moderate'
Marsh crake	'Moderate'
Rifleman	'Moderate'
North Island robin	'Moderate'
Bush falcon	'Moderate'
Long-tailed cuckoo	'Moderate'
Kereru	'Moderate'
Bellbird	'Moderate'
Tui	'Moderate'
Lizards	
Barking gecko	Potentially 'Moderate'
Ngahere gecko	Potentially 'Moderate'
Pacific gecko	Potentially 'Moderate'
Glossy brown skink	Potentially 'Moderate'
Ornate skink	Potentially 'Moderate'

Biodiversity value	Level of residual effect after effects avoidance and minimisation measures (EcIAG)
Invertebrates	
Powelliphanta traversi traversi	Potentially 'High'
Powelliphanta traversi tararuaensis	Potentially 'High'
Powelliphanta marchanti	Potentially 'High'
Megadromus turgidceps	Potentially 'Moderate'
Meterana grandiosa	Potentially 'Moderate'
Meterana exquisita	Potentially 'Moderate'
Wainuia urnula	Potentially 'Moderate'

Proposed restoration and habitat enhancement measures

Revegetation and associated habitat enhancement

176. A range of restoration and habitat enhancement measures are proposed to offset or compensate for residual adverse effects that cannot practicably be avoided or minimised. The suite of habitat restoration and enhancement measures proposed focus on:

    (a) Forest and wetland revegetation and buffer plantings;

    (b) Deployment of felled or fallen logs, forest duff and epiphytes into revegetation sites will be undertaken. Felled trees and fallen logs in various states of decomposition are ecologically important to forest regeneration processes and as habitat for a wide range of flora and fauna; and

    (c) Stock exclusion and control of mammalian predators and browsers at revegetation sites and across existing high value forest and wetland habitats.

177. Forest and wetland revegetation will offset or compensate for habitat loss and degradation by providing habitat for forest and wetland plants and

associated fauna that have been affected by the Project. Revegetation efforts will focus on:

(a) Replacing plant species and to the extent possible habitat types that have been affected by the Project;

(b) Having a high chance of survival and establishment within planted areas;

(c) Providing a diversity and early supply of resources for flora and fauna (e.g., year-round availability of fruits and flowers for native birds;

(d) Optimising ecological benefits through improving ecological connectivity and sequences among habitat types; and

(e) Protecting significant habitat types through buffer/margin plantings.

178. Proposed revegetation sites will be managed for a minimum of 10 years and until 80% native canopy cover is achieved to improve the likelihood that the revegetation plantings persist in the long-term. Management activities will include exclusion of livestock, and 10 years of weed and animal pest management and infill planting as required.

179. Forest and wetland revegetation will include:

(a) Site preparation, including weed management and stock exclusion fencing (where necessary) and the deployment of felled or fallen logs into revegetation sites to improve biodiversity values. A minimum of 20 m of logs (> 60 cm DBH) per ha of revegetation will be deployed;

(b) Planting of eco-sourced native species;

(c) 10 years of plant maintenance, including weed management and infill planting (where necessary);

(d) For wetland revegetation only, 10 m of wetland buffer planting around wetland margins; and

(e) Long-term legal protection of revegetated habitats.

180. By itself, the forest native revegetation will take significant time to replace the majority of biodiversity values affected. This is particularly true for older vegetation types and associated species that will be lost and that will take a long time to establish in revegetation sites, e.g. mature native trees within old

growth forest that are up to several hundred years old and associated species that require those trees for habitat (e.g., many of the invertebrates, lizards and birds found in old-growth forests).

181. Consequently for a number of biodiversity values and irrespective of the revegetation quantum, there will be a long-period of 'Net Loss' and a degree of uncertainty that impacted biodiversity values will be reinstated as detailed in Mr Markham's Technical Assessment G. To address these issues retirement of forests from grazing and control of introduced mammalian pests within the northern block of the Manawatu Gorge Scenic Reserve is also proposed.

Exclusion of livestock from existing forest and shrubland habitats

182. Grazing by livestock is known to have direct adverse effects on indigenous forest habitats. Release from these effects through stock exclusion leads to partial or full recovery of some key indicators (i.e. increased indigenous plant regeneration and cover, increased invertebrate populations and litter mass, decreased soil fertility and increased bird nesting success (Dodd et al. 2010)).

Control of mammalian pests in existing old growth forest

183. The control of introduced predatory mammals over a 10 year period within existing high value vegetation/ habitat types is proposed to improve the ecological integrity of recipient habitat and facilitate the recovery of a number of associated native plant and animal species. This will or is likely to include nationally 'Threatened' or 'At Risk' fauna that are affected to varying degrees by the Project. It will also likely benefit biodiversity that is not affected by the Project.

184. The proposed size, duration, frequency and intensity of pest control is intended to ensure that pest control will result in an overall expected net benefit for biodiversity value until restoration sites reach maturity. Once the pest control programme is discontinued, the benefits from the pest control will diminish at varying rates, noting that some of the benefits will last for a long time, e.g., native seedlings that establish as a result of pest control and live for hundreds of years.

Determining the quantum of residual effects management

185. The quantum of habitat restoration and enhancement activities was determined through application as decision support tools of:

(a) A Biodiversity Offset Accounting Model (Maseyk et al. 2016) where offsets can be verified based on quantifiable data at the impact sites and at the proposed habitat restoration and enhancement sites

(b) A Biodiversity Compensation Model (Tonkin + Taylor 2019). Some old-growth forest will be impacted. The time lag between mitigation plantings reaching a similar habitat structure and complexity, including important habitat features such as epiphyte growth and roosting cavities in mature trees, is likely to be upwards of 100 years. Such a timeframe is too long to provide effective offset for fauna dependent on old-growth forest habitats that will be potentially impacted by this habitat removal. This was anticipated through the NoR process and consequently, an overall package has been created to address the residual effects that cannot be offset in an effective timeframe (refer to Mr Markham's report).

Habitat restoration and enhancement quantum

186. As set out in Table 10 and Table 11 below, to address residual effects associated with the loss of 16.79 ha of terrestrial and wetland habitats in the long term, a total of 52.15 ha of native revegetation and 48.7 ha of bush retirement will be undertaken. Moreover, mammalian pest control is also proposed for a 10 year period within the Northern Block of the Manawatu Gorge Scenic Reserve (ca 300 ha), with approval to be confirmed.

Table 10: Proposed habitat restoration and enhancement activities

Restoration and habitat enhancement activities	**Total area (ha)**
Revegetation of 45.6 ha of native terrestrial vegetation coupled with felled/fallen log deployment, stock exclusion fencing, salvaging of fallen or felled logs, weed and mammalian pest management for a 10 year period and long term legal protection.	45.6 ha
Planting of 6.55 ha of native wetland vegetation within available wetlands coupled with felled/fallen log deployment, stock exclusion fencing, weed and animal pest management for a 10 year period and long term legal protection. Planting of 10 m of wetland margin to improve the quality of wetlands by buffering them from the potential effects of surrounding land uses	6.55 ha

Restoration and habitat enhancement activities	Total area (ha)
Livestock exclusion (Bush retirement) and weed and mammalian pest management for a 10 year period within 48.7 ha of forest comprising a mix of forest types including Old Growth Alluvial Forest.	48.7 ha
Ten years of pest control on a 2-yearly rotation from July - December inclusive in the northern block of the Manawatu Gorge Scientific Reserve, which is dominated by Old Growth Hill Country forest.	300 ha

Table 11. Proposed habitat restoration and enhancement measures for addressing residual adverse effects on terrestrial and wetland values.

Biodiversity type	Habitat loss (ha) and associated indirect effects	Revegetation (ha) to address adverse residual effects in the long term	Retirement to address adverse residual effects in the long-term	Pest control to compensate for short-term Net Loss of biodiversity values
Forest and shrubland habitat and species				
Old growth treelands	0.13 ha	0.6 ha	0 ha	approximately 300 ha annual pest control for 10 years within the Northern Block Manawatu Scenic reserve Pest control would be pulsed every two years during peak bird and fruiting breeding season (July - December inclusive)
Kānuka forest	1.3 ha	2.3 ha	6.4 ha	
Advanced secondary broadleaved forest	0.04 ha	0.17 ha	0 ha	
Secondary broadleaved forest and scrublands	6.71 ha	24 ha	12.6 ha	
Mānuka and kānuka shrublands	2.11 ha	5.7 ha	12.8 ha	
Divaricating shrublands	0.33 ha	0.65 ha	0 ha	
Secondary broadleaved forest with old growth signatures	0.25 ha	1.3 ha	0 ha	
Old growth forest (alluvial)	0.10 ha	0.9 ha	8.9 ha	
Old growth forest (hill country)	0.85 ha	10 ha	0 ha	
Exotic scrublands	0 ha	0 ha	7.6 ha	
Forest and shrubland species(plants, birds, lizards, invertebrates)	11.82 ha	45.6 ha	48.3 ha	

Biodiversity type	Habitat loss (ha) and associated indirect effects	Revegetation (ha) to address adverse residual effects in the long term	Retirement to address adverse residual effects in the long-term	Pest control to compensate for short-term Net Loss of biodiversity values
Wetland habitats and species				
Raupō dominated seepage wetlands	0.11	0.35 ha + 10 m wetland margin	0.4	Mammalian pest control not proposed
Indigenous dominated seepage wetlands	0.44	1.2 ha + 10 m wetland margin	0	
Exotic wetlands	4.42	5 ha + 10 m wetland margin	0	
Wetland birds	4.97 ha	6.55 ha + 10 m wetland margin	0.4	

187. In addition to the above, there will be riparian planting along streams (indicatively modelled to be 23 km with an average of 20 m width on each bank) and 8 km of stream diversion planting (with an average of 10 m width on each bank). This is set out in detail in Ms Quinn's Technical Assessment H. Native landscape planting is also proposed.

188. These measures are excluded from the terrestrial and wetland offset and compensation model; in particular the riparian planting is being undertaken to account for effects on streams. However, these other forms of offsetting or compensation will confer benefits to terrestrial and wetland biodiversity values through the provision of habitat and buffering and connectivity across the landscape.

SUMMARY AND CONCLUSION

191. Considerable effort has been undertaken through Project shaping and Project refinement to avoid the potential for very high levels of effects on indigenous biodiversity, and generally to reduce the level of habitat loss from an initially assumed maximum envelope of 31 ha during the NoR process to 16.79 ha.

192. A number of effects associated with the Project that cannot be avoided will be minimised through the development and implementation of a suite of sub-plans that are centred on vegetation clearance management and flora and fauna salvaging and relocation protocol.

193. Despite avoidance and minimisation measures the Project will still result in a residual adverse effects on forest and wetland habitats and associated species that cannot be avoided or minimised.

Biodiversity type	**Habitat loss (ha)**
Forest and shrublands	
Old growth treelands	0.13 ha
Kānuka forest	1.3 ha
Advanced secondary broadleaved forest	0.04 ha
Secondary broadleaved forest and scrublands	6.71 ha
Mānuka and kānuka shrublands	2.11 ha
Divaricating shrublands	0.33 ha
Secondary broadleaved forest with old growth signatures	0.25 ha
Old growth forest (alluvial)	0.10 ha
Old growth forest (hill country)	0.85 ha
Forest fauna (birds, lizards, invertebrates)	11.82 ha
Wetlands	
Raupō dominated seepage wetlands	0.11
Indigenous dominated seepage wetlands	0.44
Exotic wetlands	4.42
Wetland birds	4.97 ha

194. These residual adverse effects will be addressed through a suite of habitat restoration and habitat restoration measures, including:

(a) Native revegetation of pasture land and degraded pasture wetlands (including livestock exclusion fencing, weed management, mammalian pest management for a 10 year period, log deployment and covenanting);

(b) Exclusion of livestock from existing old growth forest to arrest the ongoing biodiversity decline in these forests and facilitate their recovery (including weed management, mammalian pest management for a 10 year period, log deployment and covenanting);

(c) 10 years of introduced predatory mammal control within existing old-growth forest in the ca 300 ha northern block of the Manawatu Gorge Scenic Reserve to provide temporary to medium term benefits to forest biodiversity. The key purpose of this pest control is to bridge the expected Net Loss deficit that is expected until native revegetation sites establish and bush retirement sites recover.

195. Additional biodiversity benefits will also result from native landscape plantings, however, these are excluded from the forest and wetland residual effects management package.

196. I consider the approach to assessing the 'Level of Effects' associated with this Project and to determining the type and quantum of residual effects management to be consistent with the approach taken in the NoR reporting, and to meet the requirements of the Designation Conditions.

197. I consider potential adverse ecological effects on forest and wetland biodiversity values associated with this Project to be adequately addressed through efforts to avoid or minimise the 'Level of Effects' and through efforts to offset or compensate for residual effects that cannot be avoided or minimised.

Matt Baber

APPENDIX F.1: ASSESSMENT OF EFFECTS ON BATS

WAKA KOTAHI NZ TRANSPORT AGENCY

Te Ahu a Turanga Manawatū Tararua Highway

Te Ahu a Turanga: Manawatū Tararua Highway

Bat Ecology

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A	26/02/2020	Georgia Cummings	Dr Liz Curry	Josh Markham	Final Draft
	Role	Bat ecologist	Senior terrestrial ecologist	Senior ecologist	
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Executive Summary

This report provides an assessment of potential effects of the Te Ahu a Turanga: Manawatū Tararua Highway Project (Project) on native long-tailed bats to inform the resource consent applications for the Project 'main works'.

Bat values

As reported on through the Notices of Requirement (NoR) process for the Project, multiple acoustic bat surveys have been undertaken across the Designation and no bat activity has been detected.

Project-specific acoustic surveys strongly suggest that that a long-tailed bat population is not present in the Project area. However, bats are wide ranging and known to be present in the wider landscape (with the closest recorded sighting being 13 km away). On this basis my assessment of effects has been undertaken on the assumption that bats move through the area on occasion. This is a conservative assumption, however a precautionary approach is warranted given the high threat status of the species.

Effects avoidance and mitigation

Avoidance of potential high quality bat habitat within the designation corridor has been achieved through adjustments to the Project design to minimise removal and fragmentation of old-growth forest remnants.

Effects minimisation will occur through the development and implementation of a Bat Management Plan (BMP). This BMP stipulates that annual surveys are undertaken to record bat activity in the Project footprint during the construction phase. If these surveys indicate that bats are present and potentially roosting in the Project footprint, the BMP outlines management actions that will be undertaken. These measures are designed to minimise potential injury or mortality to roosting bats during vegetation clearance.

Magnitude of effect

1.33 ha of indigenous old-growth forest and treeland is scheduled for removal along with a further 4.9 ha of mature exotic forest and treeland. These areas may be occasionally used by long-tailed bats for foraging and potentially roosting, but the absence of bat activity in previous surveys demonstrates that these habitats are not important for any long-tailed bat populations occurring in the wider landscape.

Given the above, the potential magnitude of effect of the Project on long-tailed bats has been assessed as Negligible following the EcIAG methodology.

Assessment of effects with mitigation

Following the EcAIG methodology and considering proposed mitigation (the BMP to minimise potential of injury or mortality), the overall level of effect of the Project on long-tailed bats is assessed as being Low. In accordance with the EcIAG, effects levels of Very Low to Low constitute a ‘not more than minor’ effect. Consequently, there are no recommendations for additional management of residual effects. Notwithstanding this, I note that the offset and compensation package created for the Project (refer to Technical Assessment H), while not needed to manage effects for bats, will likely benefit any bats occasionally using the area through habitat restoration and enhancement, and pest control.

1 Introduction

1.1 Purpose and scope of this assessment

The purpose of this report is to provide an assessment of effects of the Project on native bats to inform the resource consent applications for the Project 'main works'.

The scope of this report includes:

- Description of the habitats available across the designation corridor and Project footprint and an assessment of their potential habitat value for bats;
- Summarises the results of previous bat survey efforts;
- Describes the potential impacts of the Project based on the more detailed design of the Project as it now stands as compared to at the council-level hearing on the NoRs. I also clearly outline how the updated design has minimised potential impacts through changes in the updated design (Project shaping);
- Outlines the additional management measures proposed to further avoid and/or minimise potential impacts on bats;
- Provides an assessment of potential effects of the Project on bats, taking into account the avoidance and minimisation measures described throughout the report; and
- Finally, a summary of how measures to address potential effects on other aspects of terrestrial ecology (as outlined in Technical Assessment H - Terrestrial offset and compensation), while not required for bats, are expected to have a positive effect on any bats occasionally using the area.

The main purpose of this assessment has been to refine and update the assessment of effects on bats from the NoR assessments to reflect the updated and more detailed Project design as per the Project drawings and Design and Construction Report (DCR). Overall, this assessment refines the previous assessment of effects on bats based on:

- the updated alignment and detailed design information;
- the regional consents being sought to enable the Project;
- the effective management actions outlined in the proposed management plans, especially the BMP; and
- the terrestrial ecology offset and compensation package outlined in Technical Assessment H (Terrestrial offset and compensation).

This assessment is limited to the potential effects on native bats; refer to the following technical assessments for information on other aspects of terrestrial ecology:

- Terrestrial vegetation, lizards and avifauna - Technical Assessment F by Dr Baber; and
- Terrestrial invertebrates - Technical Assessment F.2 by Dr Taylor-Smith and Ms Cummings.

1.2 Project Description

Refer to the “Project description” section in Technical Assessment F.

1.3 Existing environment

Refer to the “Existing environment” section in Technical Assessment F.

1.4 Assumptions and data limitations of this assessment

This assessment addresses the effects on native bats anticipated from the 'main works' of the Project as detailed in the Project Drawing Set and summarised in the DCR. The impacts are based on the potential habitat removal and modification associated with the Project footprint (as that term is explained in Technical Assessment F).

In addition to Project-specific bats surveys, data from the national bat database administered by DOC has been relied upon to inform this assessment of effects. The information in this database comes from a number of different sources including: DOC-led monitoring projects, local and regional councils, ecological consultants, community groups and casual observations. The data from some of the sources is likely to be more reliable than others and it is difficult to determine the accuracy of individual records from the information available in the database. When there has been reason to doubt the accuracy of a particular record, DOC have been contacted to request more information.

2 Methodology

2.1 Application of Ecological Impact Assessment Guidelines

Refer to the “methodology” section in Technical Assessment F for a detailed explanation of the application of the Ecological Impact Assessment Guidelines (EcIAG). The guidelines have generally been applied for the assessment of effects on bats as described in Technical Assessment F. A single departure is the criteria used to assign habitat value. Instead of using the criteria in Table 4 in the EcIAG [1], I have used the known habitat preferences of long-tailed bats to make a qualitative assessment (Low, Moderate, High) of the values of the available habitats to long-tailed bats. I have departed from the EcIAG methodology in this instance because long-tailed bats are habitat generalists and the criteria used in the EcIAG such as “diversity and pattern”, “rarity/distinctiveness” and “representativeness” of species assemblages, does not effectively capture potential high value long-tailed bat habitat.

It should be noted that while offsetting and compensation form a key component of the effects management framework for this Project, these measures do not reduce the overall level of effect of the Project on bats as determined using the EcIAG methodology.

2.2 Literature review

2.2.1 Information from the NoR

This assessment relates directly to the consideration of the effects of the Project on bats through the NoR process. Multiple Project-specific acoustic bat surveys have also been undertaken to inform the NoR. The reports detailing these surveys were reviewed. These reports are listed below:

- GHD & NZTA Manawatū Gorge Realignment. Option 3: South of Saddle Road Bats & Bird Habitat and Species Surveys (Kessels Ecology, 2018);
- Technical Report 6B: Terrestrial Fauna Ecological Effects Assessment Technical Report (Boffa Miskell 2018, prepared by Mr Andrew Blayney and Ms Karin Sievwright); and
- The supplementary bat report provided during the NoR hearing: Boffa Miskell Limited 2019. *Te Ahu a Turanga – Manawatu Tararua Highway project: Automatic bat surveys report and bat management recommendations*. Report prepared by Boffa Miskell Limited for NZ Transport Agency.

[1] refer to Table F.5.1 in Appendix F.5 of Technical Assessment F

I have also reviewed the relevant evidence presented at the council-level hearing on the NoRs, by the Transport Agency and others, including in particular:

- Statement of Evidence of Mr Andrew Blayney (who focused on terrestrial fauna) dated 8 March 2019, and the addendum dated 25 March 2019.
- Statement of Evidence of Dr Forbes dated 8 March 2019, and the addendum dated 25 March 2019.
- Statement of Section 42A Technical Evidence of Mr James Lambie dated 1 March 2019.
- Statement of Evidence of Dr Timothy Martin on behalf of the Director-General of Conservation dated 15 March 2019, and the addendum dated 4 April 2019.
- The Joint Witness Statements prepared by Forbes and Martin (22 February 2019) and by Forbes, Blayney and Lambie (18 March 2019).

I have read the recommendation of the council-level hearing panel to the Transport Agency in respect of the NoRs; as well as the Transport Agency's subsequent decision to confirm the NoRs subject to conditions dated 7 June 2019.

Following Environment Court mediation processes, the Transport Agency has asked the Court to modify the NoRs to reflect the now proposed 'Northern Alignment'. I have reviewed the proposed conditions to the Project designations, as agreed with the main parties to the Environment Court appeals on the designations, and dated 15 October 2019 (Designation Conditions). I have prepared the draft BMP required by Condition 21 of the Designation Conditions. The avoidance and minimisation measures in this BMP are taken into account in this assessment of effects.

2.2.2 Information updated since the NoR

A review of the vegetation and habitats as described in Technical Assessment F was undertaken to provide background on the potential bat habitat available across the study area and the quality of these habitat features.

I have also reviewed the DCR, which sets out the Project design and alignment in greater detail than was available at the NoR council-level hearing stage (and reflects the change to allow for the Northern Alignment).

The National Bat Database administered by DOC was accessed on December 17 2019 to determine the presence of bats in the wider landscape surrounding the Project area.

2.2.3 Site investigations

As described in NoR Technical Assessments 6A and 6B, extensive site investigations were carried out to inform the assessment of effects for the NoR process. Three bat surveys, primarily targeting long-tailed bats, have been undertaken in 2018 and 2019 to inform the NoR process (Kessels Ecology, 2018; Boffa Miskell 2019). No bats were detected during any of the surveys. I consider the previous acoustic bat surveys have covered the Project footprint thoroughly.

A walkover of the Project site was undertaken in October and November 2019 to verify the habitat available for bats across the Project footprint.

An additional acoustic bat survey commenced in February 2020. This survey comprised nine acoustic recorders deployed in the vicinity of the old-growth forests, mature pine and the Manawatū River corridor. The results of this survey are not yet available but will be issued in a supplementary report.

The reason for the further survey is because of the recent discovery of a bat record from the national bat database in close vicinity to the 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 (refer to Table 1). 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. This record was queried with DOC and has since been removed from the database as an error (M Pryde (DOC) pers. comm. February 2020).

Given the above, the assessment outlined below assumes the results of the survey currently in progress will yield the same negative results as previous surveys across the area. If this is not the case, the assessment of effects of the Project on bats will be updated as is appropriate in the supplementary report.

3 Bat Values

3.1 National bat database records

The review of the national bat database found 161 records of long-tailed bats within 50 km of the Project. A further seven records detected an 'unknown bat species'. No short-tailed bats have been recorded within 50 km of the Project.

Additionally, there are 725 records of surveys located within 50 km of the Project that did not detect either bat species. These surveys are dated between 1997 and October 2019 with the closest surveys being undertaken across the designation corridor to inform the NoR.

The closest records are located approximately 13 and 23 km from the Project and recorded in 1994 in the Pohangina Valley area, and in October 2019 along the Mangaone Road north of Fielding, respectively. As noted above, a previous record much closer to the Project footprint has been removed from the database.

3.2 NoR bat surveys

As indicated above, three acoustic long-tailed bat surveys have been specifically undertaken across the Designation since 2018 to inform the NoR process. The survey effort is summarised in the table below.

Table 1: Summary of acoustic bat survey effort undertaken across the Project Designation to inform the NoR

No. of acoustic recorders deployed	Survey dates	Duration of survey	Report reference	Bats detected
12	27 February - 13 March 2018	2 weeks	Kessels Ecology, 2018	No bats detected
20	27/28 November - 10/11 December 2018	2 weeks	Boffa Miskell, 2018	No bats detected
20	26/27 March - 09/10 April 2019	2 weeks	Boffa Miskell, 2019	No bats detected

I provided advice to Mr Blayney (who advised on actual and potential effects on bats to during the NoR hearings phase) about the placement of the bat recorders for the Boffa Miskell 2018/19 surveys and I have reviewed the placement of the monitors as shown in Figure 2 in the Kessels (2018) report. I consider:

- all previous bat surveys targeted correct habitat for long-tailed bats;
- the survey effort (duration and number of monitoring locations) was sufficient to effectively cover habitats most likely to be used by long-tailed bats; and

- the surveys were undertaken during appropriate periods to maximise the likelihood of detecting long-tailed bats in the Project area. Such periods include the warmer months when bats are generally more active, while also targeting different time periods within the warmer months when: females are occupying maternity roosts (late spring - early summer), young bats are flying independently and establishing territories (mid-summer), and during mating (late summer - autumn).

3.3 2020 bat surveys

As described in Section 2.2.3 the now-removed a long-tailed bat record in close vicinity to the site prompted an additional acoustic survey in the interim. The results of this survey were not available at the time of finalising this report but they will be issued in a supplementary report once available.

The assessment below assumes the results of the survey currently in progress will yield the same negative results as previous surveys across the area. If this is not the case, the assessment of effects of the Project on bats will be updated as is appropriate in the supplementary report.

3.4 Potential bat habitats available in the study area

There are two extant native bats species in New Zealand, the long-tailed bat and the short-tailed bat. Short-tailed bats occur in large (>1000 ha) tracts of native old-growth forest and rarely move into modified areas (Lloyd, 2001). The Tararua- and Ruahine Forest Parks, which occur to the south and north of the study area respectively, both contain suitable habitat for short-tailed bats. However, the habitat in the Project footprint is comprised of a modified agricultural landscape and is unsuitable for short-tailed bats. This conclusion is supported by both the Project-specific acoustic surveys and the data from the national bat database where no short-tailed bats have been recorded in 50 km of the Project.

Conversely, long-tailed bats are habitat generalists and populations occur across a range of habitat types from unmodified old-growth forest, to agricultural and peri-urban landscapes (O'Donnell, 2001). The Project traverses a rural landscape containing habitat features preferentially used by long-tailed bats including old-growth forest remnants, forest - grassland interface, rivers and wetlands. Consequently, I consider that the habitat available across the Project footprint and the wider landscape is suitable for long-tailed bats.

No long-tailed bats have been recorded in the designation corridor over multiple recent surveys, yet they are known to occur in the wider landscape. Long-tailed bats are wide ranging species and hence I have conservatively assumed that they may occasionally move through the Project area.

Given the above, Table 2 summarises the potential value of habitats within the Designation for long-tailed bats, if they were to use the area. For a more detailed assessment of the indigenous-dominated habitat types refer to Technical Assessment F (Terrestrial vegetation, lizards and avifauna) prepared by Dr Baber.

EcIAG methodology was not used to assign the potential bat habitat values presented in Table 2. Instead a qualitative assessment based on known long-tailed bat preferences was used. The reasoning for this is that long-tailed bats are generalist species and the criteria used in the EcIAG such as diversity and pattern, and representativeness of species assemblages, does not effectively capture potential high value long-tailed bat habitat.

Table 2: Summary of habitats in the Project footprint and an assessment of their potential value to long-tailed bats, assuming bats occasionally use the area

Potential long-tailed bat habitat in the Project footprint	Habitat description	Qualitative assessment of potential habitat value for long-tailed bats (assuming bats occur in the area)
Manawatū river corridor	The proposed BR02 crosses the Manawatū River immediately upstream of Parahaki Island. In this location the northern margin of the river is characterised by old-growth forest of the Manawatū Gorge Scenic Reserve. The southern riverbank is comprised of a mix of native forest, rural land and the existing SH3.	**High** Long-tailed bats move along linear corridors such as rivers and feed over open water. In modified environments where long-tailed bat populations occur, river corridors are often key movement corridors and foraging habitat for these bat populations. Notable examples include the Waikato River for the Hamilton long-tailed bat population, and the Opihi River for the Hanging Rock population in South Canterbury (Griffiths, 2007; Dekrout et al., 2014).
Mature forest remnants	There are a number of native old-growth forest remnants located in the Project footprint, the various types as described in Technical Assessment F are listed below: • Old-growth (alluvial) • Old growth (hill country) • Old growth treeland • Secondary broadleaved forests with old-growth signatures	**High** Long-tailed bats preferentially roost in large, cavity bearing trees, most of which occur in old-growth forest. Such trees also form maturity roosts which have specific thermal properties which are required for reproductive success (Sedgeley & O'Donnell, 1999; Sedgeley & O'Donnell, 2004). Long-tailed bats also forage along the edges and above the canopy of such forest patches.
Exotic forest	Discrete patches of *Pinus radiata* and other exotic trees including specimen trees occur across the farmland.	**High** As above, long-tailed bats also utilise exotic trees for roosting, foraging, and breeding. However, these trees are generally considered less preferential than native old-growth forest (Sedgeley & O'Donnell, 2004).
Regenerating forest and shrubland	There are a number of patches of regenerating forest and shrubland located in the Project footprint, the various types as described in Technical Assessment F are listed below:	**Moderate** Long-tailed bats may forage around these bush patches also but they do not contain preferential roosting or foraging habitat compared to the old-growth remnants.

Potential long-tailed bat habitat in the Project footprint	Habitat description	Qualitative assessment of potential habitat value for long-tailed bats (assuming bats occur in the area)
	• Secondary broadleaved forests and shrublands • Mānuka and kānuka shrubland • Divaricating shrubland	
Ponds and wetlands	A number of wetlands occur across the Project footprint, the various types as described in Technical Assessment F are listed below: • Raupō-dominated seepage wetlands • Indigenous-dominated seepage wetlands • Pasture wetlands A number of farm ponds are also located in the study area. Abundant invertebrates gather over open water and long-tailed bats often forage over ponds and wetlands to utilise the high abundance of prey.	**Moderate - Low** While large, intact wetlands containing areas of open water would be considered high-value foraging habitat, the ponds and wetlands in the Project footprint are modified and are unlikely to be preferential foraging habitat (Griffiths, 2007).
Agricultural grassland	The Project area is characterised by patches of woody vegetation, ponds or wetlands within an extensive matrix of pasture grazed by both cattle and sheep.	**Low** Long-tailed bats are edge adapted, and preferentially forage along grassland - forest interfaces as well as other linear features within grassland such as shelterbelts (O'Donnell, 2000). However open grassland is not commonly used by long-tailed bats and is often avoided (Griffiths, 2007).

3.5 Summary of bat values across the study area

The habitat available in the Project footprint is unsuitable for short-tailed bats and no short-tailed bat records are known from within 50 km of the site despite previous survey effort. Consequently short-tailed bats are not considered further in this assessment.

The study area is located in a landscape that has the potential to support the more generalist long-tailed bats, including preferred habitat such as old-growth native forest adjacent to a large river corridor. Notwithstanding the above, considerable survey effort has been undertaken across the Designation in 2018 - 2019 and no bats have been recorded.

The results from both the project-specific bat surveys and the review of the national bat database suggest that, while a bat population is not present in the Project area, long-tailed bats are known to use the wider landscape. Taking a conservative approach (despite the absence of any such records), I have assumed that long-tailed bats may occasionally move through the Project footprint. I consider this precautionary approach is warranted given the high threat status of the species.

This conclusion was also drawn during the NoR process, and consequently the Designation Conditions include the requirement for a BMP which includes procedures for the removal of bat roosts. I agree that this is an appropriate way to manage the potential effects arising from the occasional presence of long-tailed bats in the Project footprint.

The details of the BMP are described in section 5.2 and the draft BMP is included as part of the overall Ecology Management Plan in Volume VII.

Table 3: Summary of bat values in the Project area

Species	Conservation status[1]	Ecological value of species (as per EIANZ guidelines)	Preferred habitat available in the study area	Observed within, or in vicinity to Project area
Short-tailed bats (*Mystacina tuberculata rhyacobia*)	At Risk - Declining	High	No	No
Long-tailed bats (*Chalinolobus tuberculatus*)	Threatened - Nationally Critical	Very High	Yes	No Known to occur in the wider landscape based on review of the national bat database: • 161 records within 50 km of the Project. • The closest record is approximately 13 km from the Project.

[1] C.F.J. O'Donnell, K.M. Borkin, J.E. Christie, B. Lloyd, S. Parsons and R.A. Hitchmough (2018). Conservation status of New Zealand bats, 2017. New Zealand Threat Classification Series 21. Published by the Department of Conservation, Wellington, NZ. 4 p.

4 Potential Effects

The magnitude of potential effects of the Project on long-tailed bats was assessed following EcIAG methodology.

Potential adverse effects of the Project on long-tailed bats, if any are present, include:

- Construction phase effects
    a. permanent loss of habitats;
    b. injury or mortality during vegetation clearance and earthworks; and
    c. disturbance during critical breeding periods.
- Operational phase effects
    a. injury or mortality due to vehicle strike;
    b. habitat fragmentation due to potential for the road to form a barrier to dispersing bats; and
    c. disturbance or avoidance resulting from street and vehicle lights.

I stress that a broad range of potential effects are listed above, many of these are not likely to be applicable to the Project given there is no evidence that bats regularly use the area. An example is disturbance during breeding, given that there is no evidence that bats regularly use the area, it is extremely unlikely that they will be breeding in the Project footprint. The extremely low likelihood of these potential effects being realised is captured in the magnitude of effects assessment below.

I also note that the creation of new edges and the corresponding edge effects have not been considered as a potential adverse effect for long-tailed bats because they preferentially use habitat edges.

5 Effects Avoidance and Minimisation

5.1 Project shaping and avoiding and minimising effects

A detailed account of the Project shaping measures are included in Technical Assessment F.

The management measures most pertinent to minimising potential effects on long-tailed bats is the reduction in impact on old-growth habitats, these measures are summarised below:

- Shifting the alignment further north between CH 5400 - CH 6000 so the road traverses the northern edge of the Western QEII[2] covenant than the middle reaches of the gully. This shift reduces the area of forest directly impacted and also avoids severance of the western QEII covenant;
- The batters on the alignment traversing the Western QEII covenant have 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 covenant and significantly reducing the extent of impact on this ecosystem; and
- 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.

[2] The Eastern and Western QEII covenants are two forested gullies that are subject to QEII Trust open space covenants. They both extend to the south of the proposed alignment between CH 5500 - CH 6200 to the Manawatū Gorge Scenic Reserve. They are shown in Project Drawing Set

5.2 Avoidance and minimisation of effects through the Designation Conditions

The Designation Conditions stipulate the requirement of a BMP, to form part of an overall Project EMP. A draft EMP has been prepared which includes a draft BMP (refer to Volume VII - Management Plans). The key aspects of the BMP are summarised as follows:

- Annual pre-clearance bat surveys;
- Dependent on the outcome of the above surveys, tree removal protocols will be undertaken to minimise the risk of mortality to bats during vegetation clearance.

Further to the measures outlined specifically in the BMP, other measures are included in the Vegetation Clearance Management Plan that are designed to minimise unnecessary habitat removal, minimise effects on adjacent vegetation remaining, and protect and enhance remaining habitat, and restoration plantings.

These measures are summarised below and will benefit all fauna 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 from impacted vegetation areas to be relocated to offset planting areas; and
- Translocation of nest epiphytes from felled trees onto established trees in enhancement areas to promote diversity and old-growth flora characteristics in these areas.

6 Magnitude of effects

The table below provide a summary of effects of the Project on the key potential long-tailed bat habitats and uses the EcIAG guidelines to assign a magnitude of effect of the Project on long-tailed bats.

It should be noted that although a number of potential impacts are listed in Table 4 below, the magnitude of effect takes into account that there is no evidence that bats use the Project footprint area. Accordingly, although potential long-tailed bat habitat is available in the area, these habitats do not constitute important habitat for a long-tailed bat population.

Table 4 also includes a summary of measures to avoid, remedy and mitigate these effects and provides a final magnitude of effect taking into account the avoidance and minimisation measures proposed. As explained in the methodology above, the magnitude of effect only takes into account the measures proposed to avoid and minimise impacts. It does not include any replacement or restoration planting. Restoration and enhancement measures are considered as part of the proposed terrestrial ecological offset and compensation package (Technical Assessment H).

Table 4: Magnitude of effects of the Project on long-tailed bats

Description of habitats and extent of impact	Potential impacts on long-tailed bats	Avoidance and minimisation measures	Magnitude of effect
6.49 ha of potentially **high** value habitat: • Old-growth forest (alluvial); • Old-growth forest (hill country); • Secondary broadleaved forests with old-growth signatures; • Old-growth treelands; • Mature exotic forest and treelands; and • Manawatū River. The above habitats provide potential roosting, breeding and foraging habitat. An exception is the Manawatū River which provides a potential movement corridor as well as foraging habitat. Extent of vegetation removal of the above habitat types combined is 6.5 ha (of which 4.9 ha is exotic forest) of 21.2 ha mapped in the designation corridor. i.e. 31%. 10.85 ha of potentially **moderate** value habitat:	Direct impacts • Mortality of roosting bats during vegetation clearance; • Decreased breeding success (if maternity roosts are felled or disturbed during vegetation clearance; • Loss of breeding and foraging habitat; and • Mortality from vehicle strike. Indirect impacts • Habitat fragmentation due to potential road barrier; and • Disturbance and potential barrier effect from street and vehicle lights.	• Clearance extent minimised through pruning as opposed to felling of old-growth trees where possible. • Clearance located along existing habitat edges, avoiding additional fragmentation. • Seasonal restrictions and pre-clearance protocols will be put in place to minimise harm to bats potentially roosting in old-growth vegetation. These measures will be undertaken dependent on the results of the annual pre-clearance presence/absence surveys (Refer to the draft BMP in Volume VII). • The construction of a bridge over the Manawatū River provides commuting bats with the option of moving either under or over the carriageway - reducing potential barrier effects. • Minimisation measures for indirect impacts such as specialised lighting design have not been deemed necessary given as bats are not using the area regularly and hence this impact is likely to be minimal.	**Negligible** Although a number of potential impacts have been described, the impacts would only contribute a notable effect on long-tailed bats if a population was resident in the area and regularly using these habitats. There is no evidence to suggest this is the case, instead a conservative assumption has been made that bats occasionally move through the area and use these habitats intermittently. The measures outlined in the BMP appropriately respond to the very low risk of bat injury or mortality associated with vegetation clearance. The removal of 6.5 ha of potentially high value habitat assumed to be used on occasion, will constitute only a very slight change from the existing baseline conditions. Furthermore, as there is no evidence to suggest that a population is present in the area, the removal of this habitat is assessed as having a negligible effect at the population level. This assessment also considers the context that over 1000 ha of old-growth forest comprising the Manawatū Gorge Scenic Reserve is located adjacent to the Designation that will not be impacted.

Description of habitats and extent of impact	Potential impacts on long-tailed bats	Avoidance and minimisation measures	Magnitude of effect
• Kānuka forests; • Advanced secondary broadleaved forest; • Secondary broadleaved forests and scrublands; • Mānuka, kānuka shrublands; • Divaricating shrublands; and • Farm ponds. 186.31 ha (of which 181.34 ha is improved pasture[3]) of potentially **low** value habitat: • Raupō-dominated seepage wetlands; • Indigenous-dominated seepage wetlands; • Pasture wetlands; and • Improved pasture			

[3] Note that the areal extent of improved pasture includes a small amount of other land use types such as farm tracks and weed field but these areas are very small.

7 Assessment of effects with mitigation

Based on the ecological value and magnitude of effects outlined above, the overall level of effect of the Project on long-tailed bats is assessed as Low following the EcIAG matrix [4]. Table 5 below summarises how the EcIAG matrix is used to assign an overall level of effect of the Project on long-tailed bats.

Table 5: Assessment of effects of the Project on long-tailed bats, assessed using EcIAG methodology

	Ecological value	**Potential magnitude of effect (after avoidance and minimisation measures)**	**Level of residual effect with mitigation (as per the EcIAG matrix)**
Long-tailed bat	Very High	Negligible	Low

8 Additional effects management

As per the EcIAG (p 84 of the guidelines), effects levels of Very Low to Low constitute a 'not more than minor' effect. Consequently, there are no recommendations for additional management of residual effects.

Notwithstanding the above, long-tailed bats are highly mobile and are known to occur in the wider landscape. I am unable to rule out that a population will not shift its range to include the Project footprint, although it is extremely unlikely to occur during the course of construction.

If this does happen it will be picked up in the annual pre-construction surveys outlined in the BMP and the vegetation clearance protocols will be triggered accordingly.

I note that an offset and compensation package has been developed to address residual adverse ecological effects potentially arising from the Project (refer to Technical Assessment H - Terrestrial ecology offset and compensation response for details).While this response was not prepared to address long-tailed bat effects (given the lack of residual effects), many of the measures proposed will benefit bats, in the unlikely event that they do move into the area. Below is a summary of the aspects of the offset and compensation package particularly relevant to improving long-tailed bat values:

- Revegetation of old-growth treelands;
- Revegetation of old-growth forest, alluvial and hill country;
- Restoration of existing degraded wetlands to improve their condition towards a like-for-like condition compared with the indigenous wetlands impacted; and
- Integrated pest management, across the revegetation areas and existing forest in the surrounding landscape.

The EMP provides details on how restoration and enhancement planting required as part of the offset and compensation package will be achieved, in summary revegetation will include:

- Site preparation, including:
  a. weed management
  b. stock exclusion fencing (where necessary)
  c. the deployment of felled or fallen logs into revegetation sites
  d. Relocation of nest epiphytes from felled trees to mature trees in the enhancement sites

[4] Refer to Appendix F.5 of Technical Assessment F

- Planting of eco-sourced native species;
- 10 years of plant maintenance, including weed management and infill planting (where necessary); and
- Covenanting to ensure long-term protection of revegetated habitats.

9 Bibliography

Dekrout A.S., B.D. Clarkson & S. Parsons (2014) Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (Chalinolobus tuberculatus). New Zealand Journal of Zoology, 41:4, 285-295, DOI: 10.1080/03014223.2014.953551

Griffiths R.W. (2007) Activity patterns of long-tailed bats (Chalinolobus tuberculatus) in a rural landscape, South Canterbury, New Zealand. New Zealand Journal of Zoology, 34:3, 247-258, DOI: 10.1080/03014220709510083

Leathwick, J., McGlone, M., Walker, S., & Briggs, C. 2004. Predicted Potential Natural Vegetation of New Zealand. Landcare Research, Lincoln New Zealand. Manaaki Whenua Press.

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, DOI: 10.1080/03014223.2001.9517639

Maseyk F.J.F., Barea L.P., Stephens R.T.T., Possingham H.P., Dutson G., & Maron M. (2016) A disaggregated biodiversity offset accounting model to improve estimation of ecological equivalency and no net loss. Biological Conservation, 204, 322–332.

O'Donnell C.F.J. (2000) Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity of the New Zealand long-tailed bat (Chalinolobus tuberculatus). New Zealand Journal of Zoology, 27, 207-221.

O'Donnell C.F.J. (2001) Advances in New Zealand mammalogy 1990–2000: Long-tailed bat. Journal of the Royal Society of New Zealand, 31:1, 43-57, DOI: 10.1080/03014223.2001.9517638

O'Donnell C.F.J., K.M. Borkin, J.E. Christie, B. Lloyd, S. Parsons and R.A. Hitchmough (2018). Conservation status of New Zealand bats, 2017. New Zealand Threat Classification Series 21. Published by the Department of Conservation, Wellington, NZ. 4 p.

Sedgeley J.A & C. F. J. O'Donnell. (1999) Roost selection by the long-tailed bat, Chalinolobus tuberculatus, in temperate New Zealand rainforest and its implications for the conservation of bats in managed forests. Journal of Biological Conservation, 88, 261-276.

Sedgeley J.A & C. F. J. O'Donnell. (2004) Roost use by long-tailed bats in South Canterbury: examining predictions of roost-site selection in a highly fragmented landscape. New Zealand Journal of Ecology, 28(1), 1-18.

APPENDIX F.2: ASSESSMENT OF EFFECTS ON TERRESTRIAL INVERTEBRATES

WAKA KOTAHI NZ TRANSPORT AGENCY

Te Ahu a Turanga Manawatū Tararua Highway

Te Ahu a Turanga: Manawatū Tararua Highway

Assessment of effects on terrestrial invertebrates

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Table of Contents

Executive Summary

This report provides an assessment of potential effects of the Project on terrestrial invertebrates to inform the resource consent applications for the Project 'main works'.

To date, no empirical invertebrate data have been collected from within the Project footprint. However, 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’s New Zealand Threat Classification System.

Notable species that may be present include *Megadromus turgidceps* (beetle), *Meterana grandiosa* and *M. exquisita* (moths), *Powelliphanta* snails (*P. marchanti*, *P. traversi traversi*, and *P. traversi tararuaensis*) and *Wainuia urnula* (snail). Associated habitats that will be impacted include grazed mature native forest (0.35 ha proposed for removal), intact tawa forest (0.89 ha proposed for removal, including a small area of contiguous secondary forest), secondary forest with variable grazing pressure (8.01 ha proposed for removal), and divaricating shrubland (0.33 ha proposed for removal).

Ecological values have been assigned to all of the taxa identified in the desktop assessment using the Ecological Impact Assessment Guidelines (EcIAG) prepared by the Environment Institute of Australia and New Zealand (EIANZ). The habitats on the site have also been assigned a value using a combination of the EcAIG methodology and a qualitative habitat assessment developed during the Project Notice of Requirements for designations (NoR) process (Technical Assessment 6B - Boffa Miskell, 2018). As such, all species known to occur in the wider region in habitats that are present within the Project footprint, have been conservatively assessed as being present.

The paucity of site-specific information regarding the presence of terrestrial invertebrates makes assessing the actual and potential effects of the Project on invertebrates difficult. To this end, a consent condition was agreed during the NoR process that terrestrial invertebrate surveys would be undertaken prior to construction. Invertebrate surveys commenced in February 2020 and a supplementary report will be provided, detailing the results and any corresponding changes in the effects assessment within this report.

In the meantime, a conservative effects assessment has been undertaken. The overall level of effect of the Project on the potentially present ‘Threatened’ or ‘At Risk’ terrestrial invertebrates, and on the terrestrial invertebrate habitat values is assessed as being potentially Moderate to High (varying by species / habitat).

Based on the assumption that ‘Threatened’ or ‘At Risk’ terrestrial invertebrates are indeed present, a suite of effects avoidance and minimisation measures are proposed. Furthermore, an offset and compensation package, which focuses on managing residual effects associated with the loss of potential invertebrate habitat is also proposed. This package proposes a total of 45.62 ha of restoration and enhancement planting (excluding wetlands), with the exception of divaricating shrublands, all of which will be excluded from stock. Additional to this, approximately 300 ha of pulsed mammalian pest control will be undertaken across the restoration areas and into adjacent mature forest for 10 years.

Currently only small areas of forest and shrubland habitat are available within the Project footprint and designation corridor where the understorey is not heavily degraded by stock. Stock degradation likely limits the habitat availability for many of the species identified during the literature review. Consequently, we consider that the restoration and enhancement of 45.62ha of fenced-off habitat in combination with predator control will appropriately address the potential effects of the Project on terrestrial invertebrates.

1 Introduction

1.1 Purpose and scope of assessment

The purpose of this report is to assess the effects of the Project on terrestrial invertebrates to inform the resource consent applications for the Project 'main works'.

There was a fulsome assessment of most aspects of terrestrial ecology (excluding invertebrates[1]) and testing of the Project's ecological effects as part of the process of considering the NoRs. These NoRs are currently under appeal. The Transport Agency has asked the Environment Court, as part of those appeals, to modify the NoRs to provide for the 'Northern Alignment' on which the Project's design (and the resource consent applications) is based.

In undertaking this assessment, we have reviewed the relevant information presented through the NoR process, by the Transport Agency, the territorial authorities that processed the NoRs, and submitters on the NoRs (as listed in the 'methodology' section below). The information presented by the Transport Agency and its NoR experts has been verified through site visits and literature review. An assessment of potential effects of the Project on native terrestrial invertebrates has also been undertaken.

Further invertebrate surveys are required in order to determine the full extent of the effects. Proposed designation conditions (dated 15 October 2019) require these to be undertaken prior to the commencement of Project construction works, which is scheduled to occur later in 2020.

Beyond verifying assessments carried out by the Transport Agency and its NoR experts, this assessment takes into account more detailed Project information now available, and measures to address potential effects, including:

- The updated and more detailed design of the Project as it now stands as compared to at the council-level hearing on the NoRs, including the updated Project alignment, as well as the design of associated works (shared use path, spoil sites, and lookouts) as described in the Design and Construction Report (Volume II) and shown in the Project Drawing Set;
- The regional consents being sought to enable the Project;
- The management actions outlined in the proposed management plans, particularly the Terrestrial Invertebrate Management Plan (TIMP) included within the overall Ecology Management Plan (EMP); and
- The terrestrial ecology offset and compensation package outlined in Technical Assessment H (Terrestrial offset and compensation).

Instances where this assessment of the potential effects of the Project differs from the assessment at the NoR stage are highlighted. Such differences result from new information being obtained, and the more detailed level of design now confirmed and proposed through the resource consent applications.

This assessment is limited to the potential effects on native terrestrial invertebrates; refer to the following technical assessments for information on other aspects of ecology:

- Terrestrial vegetation, lizards and avifauna - Technical Assessment F by Dr Baber; and
- Bats - Technical Assessment F.1 by Ms Cummings; and
- Aquatic ecology - Technical Assessment G by Ms Quinn

[1] To date, no empirical invertebrate data have been collected from within the Project footprint and further surveys are required. Preliminary desktop invertebrate assessments show that several 'Threatened' and 'At Risk' invertebrate species and their habitats may be present within the Project footprint.

1.2 Project description

Refer to the “Project description” section in Technical Assessment F.

1.3 Existing environment

Refer to the “Project description” section in Technical Assessment F.

1.4 Assumptions and exclusions in this assessment

This assessment addresses the effects on native bats anticipated from the 'main works' of the Project as detailed in the Project Drawing Set and summarised in the Design and Construction Report (DCR). The impacts are based the potential habitat removal and modification associated with the proposed road alignment plus all associated temporary and permanent infrastructure, and includes a construction buffer (described in Technical Assessment F), henceforth referred to as the “Project footprint”.

2 Methodology

2.1 Application of Ecological Impact Assessment Guidelines

As per the previous technical assessments prepared during the NoR process, the invertebrate species values have been characterised and assessed, along with the effects of the Project on these values, using current best practice methods outlined in the Environmental Institute of Australia and New Zealand (EIANZ) Ecological Impact Assessment Guidelines (EcIAG) document (EIANZ, 2018).

Refer to the "methodology" section in Technical Assessment F for a detailed explanation of the application of the EcIAG. The guidelines have generally been applied for this assessment as described in Technical Assessment F. A single departure is the criteria used to assign habitat value. Instead of using the criteria in Table 4 in the EcAIG, the ecological value scoring process described in Technical Assessment 6B (Boffa Miskell, 2018) has been used (Table 2-1). This involves using the known habitat preferences of terrestrial invertebrates to make a qualitative assessment (Low, Moderate, High) of the habitat available on site.

This method is considered appropriate given that no targeted surveys of terrestrial invertebrates have been undertaken since the Boffa Miskell assessment was carried out. The factors considered by the Boffa Miskell scoring process are:

- Extent of browsing/grazing;
- Vegetation patch size, shape and associated edge effects;
- Vascular plant diversity;
- Isolation;
- Invasion by non-native plants;
- Presence of mammalian predators; and
- "Spill over effects" (i.e. movement of invertebrates) from forest patches into adjacent exotic pasture.

Where desktop review has suggested that notable terrestrial invertebrate species may be utilising a given habitat, the habitat value assigned in Technical Assessment 6B (Boffa Miskell, 2018) has been updated to reflect the potential presence of this notable taxa. This updated value is based on methods in the EcAIG, and takes into account the individual threat status of each invertebrate species.

It is important to note that while offsetting and compensation form a key component of the effects management framework for this Project, these measures do not reduce the overall level of effect as determined using the EcIAG methodology.

Table 2-1: Assignment of values within the subject site to habitats (from Technical Report 6B - Boffa Miskell, 2018).

Terrestrial invertebrate ecological value attributed to habitat	Habitat attributes:
Very High	– Habitat as described below for high ecological value but contains confirmed at-risk or threatened species.
High	– Mature forest ecosystem with high naturalness, diversity and pattern. – Established and protected remnant natural wetland. – Little to no grazing pressure (effectively fenced from stock). – Intact sub-canopy, epiphyte, and ground cover flora composition. – Intact and undisturbed forest floor with leaf litter, woody debris, and high habitat complexity. – Ecological context: Large patch size of compact shape connected to, or linked by corridors, to established intact forest ecosystem (such as the MGSR).
Moderate	– Secondary forest ecosystems with moderate-low naturalness, diversity and pattern. – Grazing pressure low or large discrete areas protected from grazing by topology/stock access. – Developing sub-canopy and ground cover flora composition with large areas of full canopy closure and absence of pasture grasses. – Forest floor with small amounts of leaf litter, woody debris. – Ecological context: Small-medium patch size or complex of patches. Poor linkage to established intact forest ecosystem (such as the MGSR).
Low	– Regenerating scrub or broadleaved ecosystems with low naturalness, diversity and pattern. – Regenerating or remnant wetland in poor condition. – Grazing pressure moderate to high with possible small discrete areas protected from grazing by topology. – Little to no sub-canopy and ground cover other than pasture grasses or bare open ground. – Disturbed forest floor with negligible amounts of leaf litter, woody debris. – Ecological context: Small-medium patch size or complex of patches. Poor linkage to established intact forest ecosystem (such as the MGSR).
Negligible	– Short grazed pasture or widely spaced grazing tolerant shrubs with low-negligible naturalness, diversity and pattern. – Pine plantations. – High grazing pressure. – No sub canopy or ground cover. – Ground cover dominated by pasture grasses and occasional graze tolerant shrub or bare due to grazing pressure. – Ecological context: Predominately grazed pasture matrix between forest patches.

2.2 Literature review

2.2.1 Information from the NoR

As noted above, this report relates directly to the consideration of the effects of the Project on terrestrial invertebrates through the NoR process. As such, the reports below have been reviewed:

- Technical Report 6: Terrestrial ecology, and its primary appendices.
  - a Assessment of Terrestrial Vegetation and Habitats (Dr Adam Forbes, Forbes Ecology, 2018) ("Technical Assessment 6A");
  - b Report 6B: Terrestrial Fauna Ecological Effects Assessment Technical Report (Boffa Miskell 2018, prepared by Mr Andrew Blayney and Ms Karin Sievwright) ("Technical Assessment 6B");

Relevant evidence presented at the council-level hearing on the NoRs, by the Transport Agency and others has also been reviewed, including:

- Statement of Evidence of Dr Forbes dated 8 March 2019, and the addendum dated 25 March 2019.
- Statement of Evidence of Mr Andrew Blayney (who focused on terrestrial fauna) dated 8 March 2019, and the addendum dated 25 March 2019.
- Statement of Section 42A Technical Evidence of Mr James Lambie dated 1 March 2019.
- Statement of Evidence of Dr Timothy Martin on behalf of the Director-General of Conservation dated 15 March 2019, and the addendum dated 4 April 2019.
- The Joint Witness Statements prepared by Forbes and Martin (22 February 2019) and by Forbes, Blayney and Lambie (18 March 2019).

The following have also been reviewed:

- The recommendation of the council-level hearing panel to the Transport Agency in respect of the NoRs; and
- The Transport Agency's subsequent decision to confirm the NoRs subject to conditions dated 7 June 2019, and the accompanying condition set.

Following Environment Court mediation processes, the Transport Agency has asked the Court to modify the NoRs to reflect the now proposed 'Northern Alignment'. Dr Forbes and Mr Blayney prepared an addendum to Technical Report 6 addressing the Northern Alignment (as compared to the originally confirmed alignment) including in respect of invertebrates. That addendum report has been reviewed; it represents the last substantive assessment in respect of invertebrates carried out during the NoR process.

The Transport Agency has also agreed amendments to the decision-version of the designation conditions with the territorial authorities and other parties. The updated agreed conditions were lodged with the Environment Court on 15 October 2019; these conditions are referred to in this report as the "Designation Conditions". The Designation Conditions have been reviewed and a draft TIMP has been prepared based on Condition 23 of the Designation Conditions. The avoidance and minimisation measures in the TIMP are taken into account in thee assessment of effects outlined this report.

Overall, this assessment updates NoR Technical Assessment 6 based on:

- the updated alignment and more detailed design information;
- the regional consents being sought to enable the Project; and
- management actions to avoid or minimise effects as set out in the TIMP, the EMP more broadly, and related management plans.

2.2.2 Information updated since the NoR

As noted above, this report relates directly to the consideration of the effects of the Project on terrestrial invertebrates through the NoR process. As such, the reports below have been reviewed:

In addition to Technical Assessment 6B (Boffa Miskell, 2018), the ecological databases listed below were also reviewed to ensure the most recent data available was included in this assessment. The databases reviewed were:

- iNaturalist invertebrate records (accessed on 17 December 2019); and
- NZ mollusca (accessed on 21 January 2020).

2.3 Site Investigations

As described in Technical Assessments 6A (Forbes Ecology, 2018) and 6B (Boffa Miskell, 2018), extensive habitat investigations were carried out to inform the assessment of effects for the NoR process.

No empirical invertebrate data have been collected from within the Project footprint and, to date, no 'Threatened' or 'At Risk' invertebrate species have been observed within the Project footprint.

As per the Designation Conditions, further invertebrate surveys prior to the commencement of construction works are being undertaken 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).

If 'At Risk' or 'Threatened' invertebrate taxa are found to be present, the draft TIMP will be updated to detail management actions applicable to these taxa.

2.4 Determining invertebrate values

For the purpose of this assessment, a precautionary approach has been applied in terms of determining invertebrate values and potential effects by assuming that all 'Threatened' and 'At Risk' species that are potentially present in the wider area (as determined through desktop review), may be present on site.

Based on this assumption, the likelihood of different ecosystem types supporting invertebrates has been assessed. This assessment is based on the ecology of the different invertebrate species, and the habitat value and landscape context of the ecosystem types.

3 Terrestrial invertebrate values

There is limited information available on the invertebrate community in the area. Therefore, a conservative approach has been taken to assess terrestrial invertebrate species and habitat values within the Project area in the absence of survey work to determine the invertebrate community assemblage.

This approach is consistent with the method applied during the NoR process, in advance of the results of surveys being available. Once those results are available the intention is that an addendum report will be produced to update the invertebrate values as presented in this report.

3.1 Species values

Literature review has shown that several 'Threatened' or 'At Risk' terrestrial invertebrates may be present in the Project area. These are listed in Table 3-1.

Following the EIANZ guidelines, the ecological value of terrestrial invertebrate species that are At Risk – Relict is considered as 'Moderate'. The ecological value of terrestrial invertebrate species that are Threatened – Nationally Endangered or Threatened – Serious Decline is considered as 'Very High'.

Two invertebrate species (both of which have not been formally assigned a threat status) were addressed in Technical Assessment 6B (Boffa Miskell, 2018) (*Megadromus turgidceps*, a beetle) and the evidence of Dr Martin (paragraphs 3.4 and 7.16; *Wainuia urnula*, a snail[2]). These two species have been included in the assessment of ecological effects and for the purpose of this assessment, these species have been assigned the threat status 'Locally Uncommon'.

The moth species *Asaphodes stinaria* (Threatened – Nationally Vulnerable) was mentioned in Dr Martin's NoR evidence (paragraph 7.19) and Mr Blayney's rebuttal evidence stated that the TIMP would include surveys for this species (paragraph 11). The One Plan 2014 (Schedule F: Indigenous Biological Diversity) does not make any reference to this species. Although this species was formerly widespread, there is no evidence to suggest that this moth is currently present in the vicinity of the Manawatū Gorge[3,4]. For these reasons, this species has been excluded in this assessment of effects.

[2] Note that Dr Martin referred only to '*Wainuia*'; NZ Mollusca indicates that *Wainuia urnula* is the only *Wainuia* species present in the Manawatū region.
[3] Patrick, B; Dugdale, J.S. (2000). Conservation status of the New Zealand Lepidoptera. Wellington, New Zealand: Department of Conservation. p. 20.
[4] Hoare, R. (2020) Pers. comm. "I don't think *A. stinaria* is likely to be present in the Manawatu-Wanganui region, although it probably was in the past. It seems to have retreated completely to strongholds in the western South Island where it is very local."

Table 3-1: Summary of notable invertebrates that could be present in the Project area based on literature review.

Species	Conservation Status	NoR reference	Habitat preferences	Chainages of potentially suitable habitat	Ecological value of species (as per EIANZ guidelines)
Megadromus turgidceps (beetle)	Not classified – possibly locally uncommon	Technical Assessment 6B (Boffa Miskell, 2018)	Native forest with an intact understory[1].	Chainage: 5500 – 5900	Moderate
Meterana grandiosa (moth)	At Risk - Relict	Dr Martin's evidence, paragraph 7.19. Mr Blayney's rebuttal evidence paragraph 11.	Divaricating shrubs including Olearia species[2].	Chainage 9300 - 9600; 9900 - 10000	Moderate
Meterana exquisita (moth)	At Risk - Relict				Moderate
Powelliphanta traversi traversi (snail)	Threatened - Nationally Endangered	Dr Martin's evidence, paragraph 3.4. Mr Blayney's rebuttal evidence paragraph 11.	Powelliphanta snails are generally associated with forest areas with large accumulations of moist leaf litter. Also closely associated with calcium rich soils[3].	Chainage 5500 – 5900	Very high
Powelliphanta traversi tararuaensis (snail)	Threatened - Nationally Endangered			Chainage 5500 – 5900	Very high
Powelliphanta marchanti (snail)	Threatened – Serious Decline			Chainage 5500 – 5900	Very high
Wainuia urnula (snail)	Not classified – possibly locally uncommon	Dr Martin's evidence, paragraph 3.4. Mr Blayney's rebuttal evidence paragraph 11.	Recorded in damp leaf litter and stable rock piles in intact and modified forest[4].	Chainage: 4100 – 4500; 5500 – 5900; 9900 – 12800	Moderate

[1]Cartellieri & Gabor (2003). Seasonal dynamics and reproductive phenology of ground beetles (Coleoptera, Carabidae) in fragments of native forest in the Manawatu, North Island, New Zealand, New Zealand Journal of Zoology, 30:1, 31-42.

[2]Patrick B. (2000). Lepidoptera of small-leaved divaricating Olearia in New Zealand and their conservation priority. Science for Conservation 168. Department of Conservation, Wellington, NZ.

[3]M. J. Meads , K. J. Walker & G. P. Elliott (1984) Status, conservation, and management of the land snails of the genus Powelliphanta (Mollusca: Pulmonata), New Zealand Journal of Zoology, 11:3, 277-306.

[4]Efford, M. (1998). Distribution and status of native carnivorous land snails in the genera Wainuia and Rhytida. Science for Conservation 101. Department of Conservation, Wellington, NZ.

3.2 Habitat values

The approach used in Technical Assessment 6B (Boffa Miskell, 2018) for the assessment of terrestrial invertebrate habitat values has been reviewed and is considered a sound methodology in the absence of site surveys.

The areas of ecological value with regard to terrestrial invertebrates are summarised in Table 3-2. This table is a summary of:

- The summary of terrestrial invertebrate habitat values in Technical Assessment 6B (Boffa Miskell, 2018).
- Updated to include a higher ecological value for divaricating shrubland given the potential records of At Risk Meterana species being associated with this habitat (paragraph 7.19 of Dr Martin's evidence, paragraph 18 of Mr Blayney's rebuttal evidence).
- The potential for these vegetation types to support 'Threatened' or 'At Risk' fauna (as per Table 5 of the EcIAG).

As discussed in section 6 below, these habitats make up only a small proportion of the overall Project footprint.

Table 3-2: Summary of the ecological value of vegetation types in the Project footprint with regard to terrestrial invertebrates. Ecological values were assigned based on the methodology in Technical Report 6B (Boffa Miskell, 2018) and EIANZ guidelines.

Vegetation types	Habitat attributes as per NoR Technical Assessment 6B (Boffa Miskell, 2018)	Value as per NoR Technical Assessment 6B (Boffa Miskell, 2018 and Mr Blayney's rebuttal evidence)	'Threatened' or 'At Risk' species that may be present within this habitat	Ecological Value (if 'Threatened' or 'At Risk' invertebrates from Table 3-1 are present). See methodology section for how ecological value was assigned.
Grazed mature native forest[5]: • Old-growth forest alluvial • Secondary broadleaved forests with old-growth signatures	Grazing pressure high, but some areas possibly protected. Disturbed forest floor with little debris. Small-medium size, poor linkage. Large areas of full canopy closure, developing sub-canopy and ground flora, pasture grasses absent.	Moderate – low	*Wainuia urnula* (snail – possibly locally uncommon). Found in forest habitats with accumulation of some leaf litter only.	Moderate
Intact tawa forest: • Old-growth forest hill country • Advanced secondary broadleaved forest[6]	Mature forest with high naturalness, diversity and pattern. Little grazing pressure.	High	*Megadromus turgidceps* (beetle; possibly locally uncommon); *Powelliphanta traversi traversi* (snail; Threatened – Nationally Endangered); *Powelliphanta traversi tararuaensis* (snail; Threatened - Nationally Endangered); *Powelliphanta marchanti*	Very High

[5] Note that Technical Report 6B (Boffa Miskell, 2018) included wetland and mānuka kānuka shrublands within this category. Given that the literature review has found no evidence that 'Threatened' or 'At Risk' terrestrial invertebrate species are present within wetland or mānuka kānuka shrubland habitats within the vicinity of the Project area, these two habitat types have been excluded from this category, and are combined with 'the rest of the designation'.

[6] Included because the area impacted has direct connectivity to the old-growth forest (hill country) and stock are excluded.

Vegetation types	Habitat attributes as per NoR Technical Assessment 6B (Boffa Miskell, 2018)	Value as per NoR Technical Assessment 6B (Boffa Miskell, 2018 and Mr Blayney's rebuttal evidence)	'Threatened' or 'At Risk' species that may be present within this habitat	Ecological Value (if 'Threatened' or 'At Risk' invertebrates from Table 3-1 are present). See methodology section for how ecological value was assigned.
	Intact sub-canopy, abundant epiphytes and ground flora. Undisturbed forest floor with abundant debris. Compact shape and linked to intact forest.		(snail;Threatened – Serious Decline); *Wainuia urnula* (snail; possibly locally uncommon).	
Secondary forest with variable grazing pressure: • Secondary broadleaved forests and shrublands • Kānuka forests	Secondary forest with moderate to low naturalness, diversity and pattern. Grazing pressure generally low although some areas appear more degraded by stock access, particularly around the western rise area (chainage 3900 - 4400). Developing sub-canopy and ground flora, pasture grasses prevalent in some areas. Forest floor with some debris.	Moderate	*Wainuia urnula* (snail; possibly locally uncommon).	Moderate

Vegetation types	Habitat attributes as per NoR Technical Assessment 6B (Boffa Miskell, 2018)	Value as per NoR Technical Assessment 6B (Boffa Miskell, 2018 and Mr Blayney's rebuttal evidence)	'Threatened' or 'At Risk' species that may be present within this habitat	Ecological Value (if 'Threatened' or 'At Risk' invertebrates from Table 3-1 are present). See methodology section for how ecological value was assigned.
Divaricating shrublands	Grazed pasture or graze-tolerant shrubs. Grazing pressure moderate to high. Little to no sub-canopy and ground cover other than pasture grasses and bare ground.	–High (Mr Blayney's rebuttal evidence, paragraph 18).	*Meterana grandiosa* (moth; At Risk - Relict); *Meterana exquisita* (moth; At Risk - Relict)	High
Rest of designation, including: wetlands, mānuka kānuka shrublands, and old-growth treelands	Grazed pasture or graze-tolerant shrubs. Grazing pressure moderate to high. Little to no sub-canopy and ground cover other than pasture grasses and bare ground.	Low – negligible	NA	Low – negligible

3.3 Value assessment limitations

Assigning ecological value based on the potential presence of 'Threatened' or 'At Risk' species in

Table 3-1 represents a highly conservative approach. This is given that many of the species identified during the literature review are only known from isolated populations across the wider region that have never been observed within the Project area, or from old records.

Through our more detailed literature review we have identified no further invertebrate taxa than those discussed during the NoR process. However, we have used the literature to pinpoint to species level the taxa that are most likely to be present within the Project area that were only identified to genus level during the NoR process.

Designation Condition 23 (agreed between the Transport Agency, territorial authorities, DOC and others) requires terrestrial invertebrate surveys to be undertaken prior to construction, in order to allow a more specific assessment of terrestrial invertebrates values and effects.

3.4 Proposed terrestrial invertebrate surveys

To fulfil the aforementioned condition, a draft methodology for invertebrate surveys has been prepared and these surveys are being undertaken in 2020. The objectives of these surveys are to determine:

- Invertebrate community composition;
- The presence of 'At Risk' or 'Threatened' taxa (as defined by the Department of Conservation's New Zealand Threat Classification System).

Following a precautionary approach, these surveys will be undertaken within representative vegetation with invertebrate habitat values of moderate and above (see Table 3-2). These vegetation types are:

- Old-growth forest alluvial (part of the 'grazed mature native forest' habitat type, 0.10 ha proposed for removal of 0.35 ha of the broader habitat type)
- Old-growth forest hill country (part of the 'intact tawa forest' habitat type, 0.85 ha proposed for removal of 0.89 ha of the broader habitat type);
- Secondary broadleaved forests and shrublands (part of the 'secondary forest with variable grazing pressure' habitat type, 6.71 ha proposed for removal of 8.01 ha of the broader habitat type); and
- Divaricating shrubland (0.33 ha proposed for removal).

Technical Assessment F (Terrestrial vegetation, lizards and avifauna) describes in more detail the habitat types occurring across the Project footprint.

The draft invertebrate survey methodology is included in the TIMP, which is part of the overall EMP (refer to Volume VII - Management Plans). Three specific types of surveys are proposed:

- Flight intercept trapping, in the old-growth forest and secondary broadleaved forests and shrublands;
- Light trapping, in respect of Metarana grandiosa and Meterana exquisita moth species in divaricating shrubland; and
- Powelliphanta snail habitat surveys in in the old-growth forest hill country.

Flight intercept trapping and snail habitat surveys are currently being undertaken (February 2020). Surveys for *Meterana* moths will be undertaken from mid-April to early June (for *M. grandiosa*) and August to December 2020 (for *M. exquisita*). *M. exquisita* surveys will take place preferably in September or October 2020 when adults of this species are most abundant.

4 Potential effects

The magnitude of potential effects of the Project on terrestrial invertebrates was assessed following a combination of the EcIAG methodology and the methodology used in Technical Assessment 6B (Boffa Miskell, 2018). This method is considered appropriate in the absence of further field surveys. See section 2.1 for further detail.

The magnitude of effects assessment has been undertaken taking into account a suite of effects avoidance and minimisation measures (see section 5).

Potential adverse effects of the Project on terrestrial invertebrates include:

- direct mortality;
- construction noise, vibration, light and dust disturbance;
- permanent loss of habitats; and
- modification of remaining habitat through:
  a fragmentation and isolation;
  b edge effects; and
  c increased presence of and likelihood of invasion by non-native plant and animal species.

5 Effects avoidance and minimisation

5.1 Project shaping and avoidance and minimising effects

A detailed account of the Project shaping measures are included in Technical Assessment F.

The management measures most pertinent to minimising potential effects on terrestrial invertebrates is the reduction in impact on old-growth habitats. The relevant measures in this regard are summarised below:

- Shifting the alignment further north between CH 5400 - CH 6000 so the road traverses the northern edge of the Western QEII covenant than the middle reaches of the gully. This shift reduces the area of forest directly impacted and also avoids severance of the western QEII covenant.
- The batters on the alignment traversing the Western QEII covenant have been steepened to further reduce encroachment into this very high value habitat.
- Shifting the alignment further north between CH 6000 - CH 6600 to avoid severance of the Eastern QEII covenant and significantly reducing the extent of impact on this ecosystem.
- Avoidance of the gully at CH 9200 - CH 9400, which contains a number of divaricating shrubland patches. This gully is no longer the location of an indicative spoil site.
- 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.

5.2 Avoidance and minimisation of effects through the Designation Conditions

Further to requiring surveys to be carried out, the Designation Conditions require that, If 'At-Risk' or 'Threatened' terrestrial invertebrates are detected during pre-construction invertebrate surveys, the TIMP will be updated with measures to avoid and/or minimise adverse impacts on terrestrial invertebrates.

In particular, following the pre-construction surveys Designation Condition 23 b) vi) requires the TIMP to be updated as follows:

- Identify vegetation or habitats that should be avoided in the first instance;
- Outline the optimal timing of vegetation clearance;
- Describe the methods of direct invertebrate management;
- Identify areas where measures to manage enabling or construction works activities apply; and
- Set out approaches to the restoration of invertebrate taxa/community composition in planting and retirement areas required by Designation Condition 24, including but not limited to:
  - a Wood disk stepping stones and long grass or shrubland corridors;
  - b The salvage and transfer of soils, coarse woody material or debris and leaf litter;
  - c Detailed measures to create and/or restore habitats for populations of 'At-Risk' or 'Threatened' taxa impacted by the Project;
  - d 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
  - e Biosecurity measures required in carrying out these activities.

Subject to the results of the pre-construction surveys (discussed above), the TIMP will be updated accordingly (at this stage the TIMP is focussed primarily on the methodology for the pre-construction surveys).

Other measures are included in the Vegetation Clearance Management Plan that 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 from impacted vegetation areas to be relocated to offset planting areas; and
- Translocation of epiphytes from felled trees onto established trees in enhancement areas to promote diversity and old-growth flora characteristics in these areas.

6 Assessment of effects with mitigation

6.1 Magnitude of effects

The proposed designation corridor covers 340 ha, while the Project footprint covers 195 ha[7]. The key habitats for terrestrial invertebrates are listed below, making up a small proportion of the overall Project footprint (less than 10 ha) (refer to Table 3-2 and Table 6-1 for more detail):

- Grazed old-growth forest, including secondary broadleaved forests with old-growth signatures (0.35 ha proposed for removal);
- Intact old-growth forest, including advanced secondary broadleaved forest (0.89 ha proposed for removal)
- Secondary forest with variable grazing pressure (8.01 ha proposed for removal comprising the habitat types: secondary broadleaved forests and shrublands, and kānuka forests)
- Divaricating shrublands (0.33 ha proposed for removal);

Table 6-1 uses the EcIAG guidelines to provide a summary of the magnitude of the effects of the Project on these potential terrestrial invertebrate habitats, as well as on the specific terrestrial invertebrates discussed above.

Measures to avoid, remedy and mitigate potential effects on terrestrial invertebrates are summarised as follows:

- Clearance extent minimised through pruning as opposed to felling of old-growth trees where possible;
- Clearance extent along habitat edges, avoiding fragmentation;
- Seasonal restrictions and/or pre-clearance protocols will be put in place;
- Epiphyte and coarse woody debris relocation will reduce harm to invertebrates and provide habitat enhancement in adjacent forest (Refer to draft EMP in Volume VII);
- Dust suppression is proposed across the Project during construction and monitoring will be undertaken at old-growth forest (hill country) adjacent to Project footprint (refer to Technical Report E);
- Weed control and enrichment planting to be undertaken in newly created edges (Refer to draft EMP in Volume VII); and
- Replacement planting of indigenous vegetation.

Note that these measures may be updated following the baseline invertebrate surveys.

Table 6-1 provides a magnitude of effect taking into account the mitigation proposed. As explained in the methodology above, the magnitude of effect only takes into account the measures proposed to avoid, minimise and mitigate for effects. It does not include any replacement or restoration planting as these measures are considered as part of the proposed offset and compensation measures.

Again, this is a conservative assessment of effects, in advance of specific survey results. The intention is that this effects assessment will be updated via an addendum report once survey results are available.

[7] Note that part of the Project footprint, namely some of the spoil sites, extend beyond the Designation. The only habitat types impacted outside of the Designation are grassland and mānuka and kānuka shrublands.

Table 6-1: Magnitude of effect on terrestrial invertebrates

Value (Noteworthy terrestrial invertebrate species and key habitats) [8]	Description of habitats and extent of impact	Potential direct impacts on invertebrates	Potential indirect impacts on invertebrates	Avoidance, minimisation and mitigation measures	Magnitude of effect (after avoidance and minimisation measures)
Invertebrate Species					
Megadromus turgidceps (beetle)	Removal of 0.89 ha of old growth tawa forest including the contiguous advanced secondary broadleaved forest (Chainage 5500 – 5900)	Mortality, disturbance to foraging and breeding behaviours through dust, light and vibration, loss of habitat	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.	Clearance extent minimised through pruning as opposed to felling of old-growth trees where possible. Clearance extent along habitat edges, avoiding fragmentation. Seasonal restrictions and/or pre-clearance protocols will be put in place. Epiphyte and coarse woody debris relocation will reduce harm to invertebrates and provide habitat enhancement in adjacent forest (Refer to draft EMP in Volume VII). Dust suppression is proposed across the Project	Potentially[9] Moderate
Powelliphanta snails					Potentially Moderate
Meterana moths	Removal of 0.33 ha of divaricating shrubland (Chainage 9300 - 9600)				Potentially Moderate
Wainuia urnula (snail)	Removal of 9.24 ha of intact and modified forest with an accumulation of some leaf litter. This is a combination of invertebrate habitats described in Table 3-2 (and below) and				Potentially Moderate

[8] Note that these habitat types have been included within this assessment because of the potential that terrestrial invertebrate species not previously identified during the NoR and consenting processes may be found within these habitats.

[9] The term 'potentially' has been used to describe the magnitude of effect, as it is unclear whether these species are present, and, if they are present, details of their population sizes and habitat utilization within the area are unknown.

Value (Noteworthy terrestrial invertebrate species and key habitats) [8]	Description of habitats and extent of impact	Potential direct impacts on invertebrates	Potential indirect impacts on invertebrates	Avoidance, minimisation and mitigation measures	Magnitude of effect (after avoidance and minimisation measures)
	comprises these ecosystem types: • Old-growth forest (alluvial) • Old-growth forest (hill country) • Secondary broadleaved forests with old-growth signatures • Advanced secondary broadleaved forest • Secondary broadleaved forests and scrublands • Kānuka forest (CH 4100 – 4500; 5500 – 5900; 9900 – 12800)			during construction and monitoring will be undertaken at old-growth forest (hill country) adjacent to Project footprint (refer to Technical Report E) Weed control and enrichment planting to be undertaken in newly created edges (Refer to draft EMP in Volume VII). If *Meterana* spp. recorded in the area - a grazing or mowing regime will be continued across the remaining divaricating shrubland patches within the designation to promote the areas remaining in a stalled successional trajectory dominated by divaricating shrubs .	

Value (Noteworthy terrestrial invertebrate species and key habitats) [8]	Description of habitats and extent of impact	Potential direct impacts on invertebrates	Potential indirect impacts on invertebrates	Avoidance, minimisation and mitigation measures	Magnitude of effect (after avoidance and minimisation measures)
Key Invertebrate Habitats[10]					
Grazed mature native forest[11]: • Old-growth forest alluvial • Secondary broadleaved forests with old-growth signatures	Extent of vegetation removal of this habitat is 0.35 ha of 6.41 ha mapped in the Designation i.e. 5.4%. Areas of impact: • Old growth forest alluvial (CH 4100 – 4500); • Secondary broadleaved forests with old-growth signatures (CH 7300, CH 10400 - 10600)	As above	As above	As above	Potentially Moderate

[10] These habitats have been included in the effects assessment to recognise that there may be other notable invertebrate species that have been not been captured in the literature review and therefore not accounted for above. Hence the removal of these habitats may have additional impacts on the invertebrate community not captured by a species-specific assessment approach.

[11] Note that Technical Report 6B (Boffa Miskell, 2018) included wetland and mānuka kānuka shrublands within this category and referred to it as "grazed mature native forest and scrub". Given that the literature review has found no evidence that Threatened or At Risk terrestrial invertebrate species are present within wetland or mānuka kānuka shrubland habitats within the vicinity of the Project area, these two habitat types have been excluded from this category, and combined with 'the rest of the designation'.

Value (Noteworthy terrestrial invertebrate species and key habitats) [8]	Description of habitats and extent of impact	Potential direct impacts on invertebrates	Potential indirect impacts on invertebrates	Avoidance, minimisation and mitigation measures	Magnitude of effect (after avoidance and minimisation measures)
Intact tawa forest: • Old-growth forest hill country • Advanced secondary broadleaved forest[12]	Extent of vegetation removal of the above habitat types combined is 0.89 ha of 1.79 ha mapped in the Designation i.e. 49.7%. Note that the designation has been specifically constrained around the old-growth forest hill country and thus this is a highly conservative representation of the % impact on these habitat types in the immediate area. Areas of impact: • Old-growth forest hill country (CH 5500 - 5700) • Advanced secondary broadleaved forest (CH 5500 - 5600)				Potentially Moderate

[12] Included because the area impacted has direct connectivity to the old growth forest hill country and stock are excluded.

Value (Noteworthy terrestrial invertebrate species and key habitats) [8]	Description of habitats and extent of impact	Potential direct impacts on invertebrates	Potential indirect impacts on invertebrates	Avoidance, minimisation and mitigation measures	Magnitude of effect (after avoidance and minimisation measures)
Divaricating shrublands	Extent of vegetation removal is 0.33 ha of 0.50 ha mapped in the Designation i.e. 66.5% Area of impact: CH 9300 - 9600; 9900 - 10000				Potentially Moderate
Secondary forest with variable grazing pressure: • Secondary broadleaved forests and shrublands • Kānuka forest	Extent of vegetation removal is 8.01 ha of 18.68 ha mapped in the Designation i.e. 43%. Ares of impact: • Secondary broadleaved forests and shrublands (CH 3800 - 4400; 9800 – 12600) • Kānuka forest (CH 3900 - 4100; 5500; 7200 - 7300)				Potentially Moderate

6.2 Overall level of effects

As set out in Table 6-1 above, the magnitude of effect of the Project on terrestrial invertebrates has been assessed as potentially **Low** to **Moderate** using the EcIAG methodology. The term 'potentially' has been used to describe the magnitude of effect, as it is unclear whether these species are present, and, if they are present, details of their population sizes and habitat utilization within the area are unknown.

Based on the ecological vale and magnitude of effects outlined above, the overall level of effect of the Project on terrestrial invertebrates is assessed as potentially **Moderate to High** using the EcIAG matrix. Table 6-2 below summarises how the EcIAG matrix is used to assign an overall level of effect of the Project on terrestrial invertebrates.

Table 6-2: Assessment of effects of the Project on terrestrial invertebrates

Species/habitat	**Ecological value (as per EIANZ guidelines)**	**Potential magnitude of effect (after avoidance, minimisation and mitigation measures)[9]**	**Level of residual effect[13]**
Megadromus turgidceps (beetle)	Moderate	Potentially Moderate	Potentially Moderate
Meterana grandiosa (moth)	Moderate	Potentially Moderate	Potentially Moderate
Meterana exquisita (moth)	Moderate	Potentially Moderate	Potentially Moderate
Powelliphanta traversi traversi (snail)	Very high	Potentially Moderate	Potentially High
Powelliphanta traversi tararuaensis (snail)	Very high	Potentially Moderate	Potentially High
Powelliphanta marchanti (snail)	Very high	Potentially Moderate	Potentially High
Wainuia urnula (snail)	Moderate	Potentially Moderate	Potentially Moderate
Grazed mature native forest and scrub[5]: • Old-growth forest alluvial • Secondary broadleaved forests with old-growth signatures	Moderate	Potentially Moderate	Potentially Moderate
Intact tawa forest: • Old-growth forest hill country • Advanced secondary broadleaved forest[12]	Very High	Potentially Moderate	Potentially High
Divaricating shrublands	High	Potentially Moderate	Potentially High
Secondary forest with variable grazing pressure: • Secondary broadleaved forests and shrublands • Kānuka forest	Moderate	Potentially Moderate	Potentially Moderate

[13] The term 'potentially' has been used to describe the magnitude of effect, as it is unclear whether these species are present, and, if they are present, details of their population sizes and habitat utilization within the area are unknown.

7 Measures to address residual effects that cannot be avoided or minimised

As per the EcIAG (p 84 of the guidelines), effects levels of Moderate and above constitute residual effects that should be either reduced through further avoidance and minimisation, or offset or compensation.

Some old-growth forest will be impacted (0.95 ha of alluvial and hill country forest combined). The time lag between mitigation plantings reaching a similar habitat structure and complexity, including important habitat features such as epiphyte growth, is likely to be upwards of 100 years. Consequently, an offset and compensation package has been created to offset the residual effects that cannot be mitigated in an effective timeframe (refer to Technical Assessment G).

In addition to habitat replacement and reconnection of remaining vegetation patches, the offset and compensation plan also proposes pest management and protection and enhancement of existing vegetation. Such measures will effectively increase the carrying capacity of the existing habitats over a much shorter time period. This will provide habitat within the Project area for terrestrial invertebrates potentially displaced by habitat removal.

Refer to Technical Assessment G for further detail of the offset and compensation package.

8 Summary of effects and conclusion

To date, no empirical invertebrate data have been collected from within the Project footprint. However, 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'.

Notable species that may be present include *Megadromus turgidceps* (beetle)*, Meterana grandiosa* and *M. exquisita* (moths), *Powelliphanta* snails *(marchanti*, *traversi traversi, and tarevrsi tararuaensis)* and *Wainuia urnula* (snail). Associated habitats that will be impacted by the Project include old-growth forest hill country and alluvial forest (0.96 ha proposed for removal), secondary broadleaved forests and shrublands, including advanced broadleaved forests and broadleaved forests with old-growth signatures (7.0 ha proposed for removal) and divaricating shrubland (0.33 ha proposed for removal).

The assumption that these species are present in Project footprint has led to a conservative effects assessment. Impacts of the Project on these species and associated habitats have been assessed as being potentially Moderate to High, depending on the species and habitat available within the Project footprint.

Invertebrate surveys commenced in February 2020 and a supplementary report will be provided, detailing the results and any corresponding changes in the effects assessment. The Project TIMP will also be updated once survey results are available.

Based on the assumption that 'Threatened' or 'At Risk' terrestrial invertebrates are indeed present, a suite of effects avoidance and minimisation measures are proposed. Furthermore, an offset and compensation package, which focusses on managing residual effects associated with the loss of associated invertebrate habitat is also proposed. This package includes a total of 45.62 ha of restoration and enhancement planting (excluding wetlands). Stock will be excluded from all of these plantings, except for divaricating shrublands. Additional to this, 300 ha of mammalian pest control will be undertaken across the restoration areas and into adjacent mature forest for 10 years.

Currently only small areas of forest and shrubland habitat are available within the designation where the understorey is not heavily degraded by stock. Stock degradation likely limits the habitat availability for many of the species identified during the literature review. Consequently we consider that the restoration and enhancement of 45.62 ha of fenced-off habitat in combination with predator control will appropriately address the potential effects of the Project on terrestrial invertebrates.

APPENDIX F.3: VEGETATION SURVEY METHODOLOGY AND RESULTS

Between 14 October and 8 November, vegetation field surveys were undertaken across the Project using a simplified version of The Recce Method (see Hurst & Allen, 2007 for a full description of the methodology), to provide data specific to offset models and to ground-truth ecosystem types classified in previous surveys. The simplified version of The Recce Method is summarised below.

A total of 32 points were randomly assigned across ecosystems (Table 6) within the Project footprint (e.g. impact areas) using ArcGIS Desktop (ESRI, 2011). In the field, points were located using their associated GPS coordinates. In general, a 10 x 10 m plot was undertaken in areas with dense vegetation cover, with 20 x 20 m plots chosen for sparsely covered vegetated areas (e.g. treelands) and in old growth forest.

The GPS-located corner was marked with flagging tape,[6] and the bearing to an adjacent corner recorded on a location diagram. This method allows each plot to be returned to in the future, delineated and repeated. Where plot locations were deemed to not encompass the classified ecosystem (as ArcGIS ecosystem overlays were not always aligned to the ecosystem type on the ground), the plot was relocated to the nearest location which represented the ecosystem type being assessed, and a new GPS coordinate recorded.

Each plot was delineated in the field with a measuring tape. Within each plot, standard descriptors were measured as per The Recce Method, and recorded on Recce field sheets (see Hurst & Allen, 2007 for examples of field sheets):

- Date;
- GPS location;
- Elevation;
- Aspect;
- Slope;
- Drainage;
- Location diagram; and
- Stock access and browse

Within each plot, ground cover (below 1.35 m) was estimated visually (to the nearest 5%), for: vascular vegetation, non-vascular vegetation, litter, bare ground and rock. The average height of the dominant vegetation was estimated for canopy vegetation. The total canopy cover and native species canopy cover (above 1.35 m) was also assessed. Any emergent vegetation was also noted.

All native and exotic live vascular plant species were identified in each plot, and recorded in fixed height tiers as per the Recce field sheets.

To determine basal area, the diameter of all woody vegetation taller than 1.35 m and with a diameter at breast height (DBH) above 2.5 cm were measured (and species identified) within each plot. Basal area for each tree is then calculated through the formula $A=\pi r^2$, (where A = basal area), summed for the basal area per plot, and extrapolated to basal area per ha.

Vegetation characteristics associated with native fauna were assessed in order to provide a set of proxy measures relating to the capacity of each ecosystem to

[6] Wetland plots were not marked as there was nothing appropriate to attach flagging tape to.

support native fauna. These included quantitative and qualitative assessments within each plot consisting of:

- Coarse woody debris (CWD) above 10 cm DBH. The DBH of each piece was recorded at the thickest point and the length measured. This was later converted into volume of CWD per ha;
- Number of mature fruit-bearing trees specifically: tawa, miro, mataī, kahikatea, and hīnau;
- Number of trees containing cavities, categorized by cavity entrance size (>10 cm, 5-10 cm and <5 cm);
- Number of trees supporting habitat-providing epiphytes: perching epiphytes and climbing rata;
- Number of trees with flaky bark, categorised by proportion of trunk with flaky bark (<10%, 11-50%, >50%);
- A total of five litter depth measurements (at each corner of a plot, and one at the centre of each plot); and
- For wetlands plots a % cover for complex habitat was visually assessed to determine nesting bird habitat. Complex habitat included rushes, long grass or other clumped vegetation which may provide bird nesting habitat.

A series of photographs was taken for each plot and any other pertinent observations recorded.

Table F.3.1: Ecosystem types surveyed via randomly located simplified Recce plots.

Ecosystem type[1]
Old-growth forests (hill country)
Secondary broadleaved forests with old-growth signatures
Old-growth treelands
Advanced secondary broadleaved forests
Secondary broadleaved forests and scrublands
Kānuka forests
Mānuka and kānuka shrublands
Divaricating shrublands
Raupō-dominated seepage wetlands
Indigenous-dominated seepage wetlands
Exotic-dominated wetlands

[1] Note that no plots were undertaken in the old-growth (alluvial) habitat type.

References

ESRI (2011). ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.

Hurst, J.M. & Allen, R.B. (2007). The Recce Method for Describing New Zealand Vegetation: Field Protocols. Manaaki Whenua-Landcare Research.

Table F.3.2: Habitat example photos.

Secondary broadleaved forest and scrublands

Figure 1: Photo taken in Plot 8 showing dense regeneration.

Figure 2: Photo taken in Plot 20.

Figure 3: Photo taken in Plot 24.

Figure 4: Photo taken in Plot 25.

Old growth treelands

Figure 5: Photo taken in Plot 16 showing sparse remnant vegetation with no understorey.

Figure 6: Photo taken in Plot 13 (ramarama treeland).

Kānuka forest

Figure 8: Photo taken in Plot 14, note stock access has resulted in a damaged and sparse understorey.

Figure 7: Photo taken in Plot 07, note stock access has resulted in a damaged and sparse understorey.

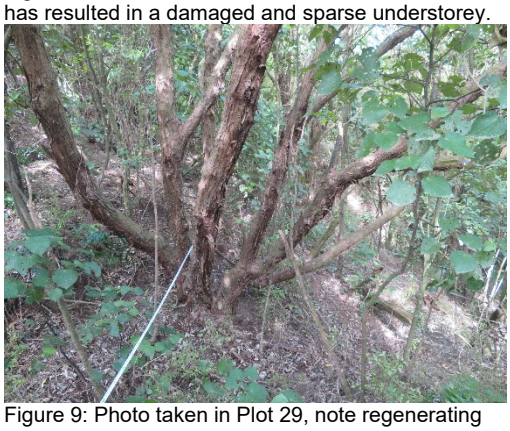

Figure 9: Photo taken in Plot 29, note regenerating understory with stock exclusion.

Figure 10: Photo taken in Plot 29, note presence of palatable broadleaved species such a māhoe in subcanopy.

Advanced secondary broadleaved forest

Figure 11: Photo taken in Plot 12a, note that although the area is contiguous with the old-growth forest (hill country) the composition appears to be relatively early successional.

Figure 12: Photo taken in Plot 12a, note that although the area is contiguous with the old-growth forest (hill country) the composition appears to be relatively early successional.

Secondary broadleaved forest with old growth signatures

Figure 13: Photo taken in Plot 23, note area impacted by the Project footprint does not contain old-growth vegetation.

Figure 14: Photo taken in Plot 23, note area impacted by the Project footprint does not contain old-growth vegetation.

Figure 15: Photo taken from farm track looking east towards Plot 23, note area impacted by the Project footprint does not contain old-growth vegetation.

Mānuka and kānuka shrublands

Figure 16: Photo taken in Plot 15, note stock access and sparse understorey.

Figure 17: Photo taken in plot 31, note stock access, pugging, and sparse vegetation cover.

Figure 18: Photo taken in Plot 9, note limited understorey regeneration due to sheep access.

Divaricating shrublands

Figure 19: Photo taken in Plot 22. This plot was classified as Mānuka Kānuka Shrubland, but changed to Divaricating Shrubland as the canopy has been sprayed.

Figure 20: Photo taken in Plot 18, note stock access has resulted in sparse vegetation cover.

Old growth forest (alluvial)

Figure 21: No plots were undertaken in the Old Growth Forest - Alluvial. Stock access has inhibited regeneration and resulted in a sparse understorey.

Figure 22: Landscape photograph of the Old Growth Forest - Alluvial, showing large trees and intact canopy. Photo source Forbes, 2018.

Old growth forest (hill country)

Figure 23: Photo taken in Plot 6 showing large tawa with moderately dense understorey dominated by small-leaved shrubs.

Figure 24: Photo taken in Plot 006 showing typical dense canopy cover.

Figure 25: Photo taken in Plot 30 showing large tawa trees and moderately dense understorey.

Figure 26: Photo taken in Plot 30 showing typical dense canopy cover.

Raupō dominated seepage wetlands

Figure 27: Photo taken in Plot 3. Despite stock access, the raupō wetland is intact with high canopy cover and little stock damage.

Figure 28: Aerial photograph showing part of the Raupō dominated seepage wetland (photo source Forbes, 2018).

Indigenous dominated seepage wetlands

Figure 29: Photo taken in Plot 21. Wetland dominated by *Carex geminata.* Stock have access to this wetland area, but *Carex geminata* has shown resilience to the light browse.

Pasture wetlands

Figure 30: Photo taken in Plot 5 showing typical pasture wetland.

Figure 31: Photo taken in Plot 010.

Figure 32: Photo taken in Plot 27, note woody debris present.

Figure 33: Photo taken in Plot 28, note occasional exotic willow.

Table F.3.3: Raw data results from RECCE plot surveys with plot numbers, their associated ecosystem type and other recorded ecosystem metrics.

	General plot descriptors					Canopy		Understory	Litter
Plot number	Ecosystem type	Elevation (m)	Aspect (°)	Size (m^2)	Size (ha)	% cover indigenous	Average height (m)	% cover indigenous	Average Litter Depth (mm)
Plot 001	Secondary Broadleaved Forests and Scrublands	79	187	100	0.01	50	5.5	30	2
Plot 002	Secondary Broadleaved Forests and Scrublands	67	116	100	0.01	80	6	80	4.2
Plot 003	Indigenous Dominated Seepage Wetlands High Value	60	0	100	0.01	100	2.5	100	0
Plot 004	Exotic wetland	115	270	100	0.01	7	1.3	7	0
Plot 005	Exotic wetland	116	244	100	0.01	10	1.2	10	0
Plot 006	Old Growth Forest Hill Country	204	98	400	0.04	85	20	50	32
Plot 007	Kānuka Forests	70	180	100	0.01	55	4	0	0.4
Plot 008	Secondary Broadleaved Forests and Scrublands	49	210	100	0.01	80	4	40	18
Plot 009	Mānuka, Kānuka Scrublands	66	270	100	0.01	50	6	0	0
Plot 010	Exotic wetland	316	20	100	0.01	5	0.8	5	0
Plot 011	Exotic wetland	316	290	100	0.01	2	1	2	0
Plot 012	Exotic wetland	300	340	100	0.01	3	0.6	3	0
Plot 012a	Advanced Secondary Broadleaved Forest	170	290	100	0.01	90	5	50	10
Plot 013	Ramarama area	209	140	400	0.04	25	2.5	5	0
Plot 014	Kānuka Forests	274	210	100	0.01	50	5	5	1

Plot 015	Mānuka, Kānuka Scrublands	282	120	100	0.01	40	4	1	0
Plot 016	Old Growth Treelands	283	70	400	0.04	25	6	1	0
Plot 017	Exotic wetland	269	270	100	0.01	20	1	20	0
Plot 018	Divaricating Shrublands	319	25	100	0.01	25	0.8	25	0
Plot 019	Divaricating Shrublands	321	270	100	0.01	65	1	65	0
Plot 020	Secondary Broadleaved Forests and Scrublands	303	230	100	0.01	60	5	70	9.1
Plot 021	Indigenous Dominated Seep Wetlands Moderate Value	281	99	100	0.01	90	0.45	90	0
Plot 022	Divaricating Shrublands (originally classified as: Mānuka, Kānuka Scrublands)	317	260	100	0.01	5	1.5	25	0.4
Plot 023	Secondary Broadleaved Forests with Old-Growth Signatures	270	57	100	0.01	40	4.5	70	29.4
Plot 024	Secondary Broadleaved Forests and Scrublands	189	235	100	0.01	90	4.5	15	16
Plot 025	Secondary Broadleaved Forests and Scrublands	205	149	100	0.01	100	5.5	60	29
Plot 026	Secondary Broadleaved Forests and Scrublands	251	206	100	0.01	95	4	50	29
Plot 027	Exotic wetland	121	0	100	0.01	4	1.1	4	0
Plot 028	Exotic wetland	132	0	100	0.01	6	0.2	6	0
Plot 029	Mānuka, Kānuka Scrublands	225	296	100	0.01	95	6	30	41
Plot 030	Old Growth Forest Hill Country	209	116	400	0.04	85	16	55	46.6
Plot 031	Mānuka, Kānuka Scrublands	205	265	100	0.01	35	3.6	10	0

Table F.3.4: Presence or absence of vegetation in each plot (1 = present, 0 = absent), with scientific name, indigenous status (e.g. native or exotic) and totals (Part 1 of 2).

Scientific name	Native	Plot 001	Plot 002	Plot 003	Plot 004	Plot 005	Plot 006	Plot 007	Plot 008	Plot 009	Plot 010	Plot 011	Plot 012	Plot 012a	Plot 013
Acaena pusilla	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adiantum cunninghamii	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alectryon excelsus	Yes	1	0	0	0	0	1	0	1	0	0	0	0	0	0
Aristetelia serrata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asplenium bulbiferum	Yes	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Asplenium flaccidum	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Asplenium flabellifolium	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Asplenium gracillimum	Yes	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Asplenium oblongifolium	Yes	1	1	1	0	0	1	0	1	0	0	0	0	0	0
Asplenium polyodon	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Astelia hastata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beilschmiedia tawa	Yes	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Bellis perennis	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Berberis glaucocarpa	No	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Blechnum chambersii	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blechnum filiforme	Yes	0	1	0	0	0	1	0	0	0	0	0	0	1	1

Scientific name	Native	Plot 001	Plot 002	Plot 003	Plot 004	Plot 005	Plot 006	Plot 007	Plot 008	Plot 009	Plot 010	Plot 011	Plot 012	Plot 012a	Plot 013
Blechnum fluviatile	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blechnum novae-zelandiae	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Blechnum parisiae	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachyglottis repanda	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex geminata	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Cardamine hirsuta	No	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Carex secta	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Carpodetus serrata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex uncinata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex virgata	Yes	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Clematis foetida	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Clematis vitalba	No	1	1	1	0	0	0	1	1	0	0	0	0	0	0
Coprosma areolata	Yes	1	1	0	0	0	1	1	1	0	0	0	0	0	1
Coprosma dumosa	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coprosma grandifolia	Yes	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Coprosma rhamnoides	Yes	0	0	0	0	0	1	1	0	1	1	0	1	0	0
Coprosma robusta	Yes	0	0	1	0	0	0	0	1	0	0	0	1	0	0
Coprosma rotundifolia	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0

Scientific name	Native	Plot 001	Plot 002	Plot 003	Plot 004	Plot 005	Plot 006	Plot 007	Plot 008	Plot 009	Plot 010	Plot 011	Plot 012	Plot 012a	Plot 013
Cordyline australis	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corynocarpus laevigatus	Yes	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Cranfilla fluviatilis	Yes	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Cyathea dealbata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyathea medularis	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyathea spp	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyathea smithii	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyperus eragrostis	No	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Cytisus scoparius	No	1	1	1	0	0	0	1	0	0	0	0	0	0	0
Delairea odorata	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichondra repens	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicksonia squarrosa	Yes	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Digitalis species	No	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Digitalis purpurea	No	0	0	0	0	0	0	1	0	0	0	1	1	0	1
Doodia australis	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Earina spp.	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Eleocharis acuta	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eleocharis gracilis	Yes	0	0	0	0	0	0	0	0	0	1	1	0	0	0

Scientific name	Native	Plot 001	Plot 002	Plot 003	Plot 004	Plot 005	Plot 006	Plot 007	Plot 008	Plot 009	Plot 010	Plot 011	Plot 012	Plot 012a	Plot 013
Foeniculum vulgare	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium aparine	No	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Geniostoma ligustrifolium	Yes	0	0	0	0	0	1	0	1	0	0	0	0	1	0
Exotic grass	No	1	1	0	1	0	0	1	0	0	1	1	1	0	1
Hedycarya arborea	Yes	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Hoheria sexstylosa	Yes	1	1	0	0	0	0	0	1	0	0	0	0	1	1
Holcus lanatus	No	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Hydrocotyle spp	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hymenophyllum spp	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Juncus australis	Yes	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Juncus edgariae	Yes	0	0	1	1	1	0	0	0	1	1	0	0	0	0
Juncus effusus	No	0	0	1	1	1	0	0	0	1	1	1	1	0	0
Juncus pallidus	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Juncus sarophorous	Yes	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Juncus species	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knightia excelsus	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Kunzea robusta	Yes	1	0	1	0	0	0	1	0	1	0	0	0	0	1
Lastreopsis glabella	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Scientific name	Native	Plot 001	Plot 002	Plot 003	Plot 004	Plot 005	Plot 006	Plot 007	Plot 008	Plot 009	Plot 010	Plot 011	Plot 012	Plot 012a	Plot 013
Laurelia novaezelandiae	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptospermum scoparium	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Leucopogan fasciculatus	Yes	0	1	1	0	0	0	1	0	0	0	0	0	0	0
Leycesteria formosa	No	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Lophomyrtus bullata	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Lophomyrtus obcordata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lotus pedunculata	No	0	1	1	0	0	0	1	0	1	1	0	0	0	1
Melicope simplex	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melicytus ramiflorus	Yes	1	1	0	0	0	1	1	1	0	0	0	1	1	0
Metrosideros diffusa	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Metrosideros fulgens	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Metrosideros perforata	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Microsorum pustulatum	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Microsorum scandens	Yes	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Microtis unifolia	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Muehlenbeckia australis	Yes	1	1	0	0	0	1	0	1	1	0	0	1	0	0
Myoporum laetum	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myrsine australis	Yes	0	0	1	0	0	0	0	1	0	0	0	0	0	0

Scientific name	Native	Plot 001	Plot 002	Plot 003	Plot 004	Plot 005	Plot 006	Plot 007	Plot 008	Plot 009	Plot 010	Plot 011	Plot 012	Plot 012a	Plot 013
Nasturtium officinale	No	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Corybas trilobus	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nertera spp.	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nestegis spp.	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Olearia rani	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paesia scaberula	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parsonsia heterophylla	Yes	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Passiflora tetrandra	Yes	1	1	0	0	0	1	0	1	0	0	0	0	1	0
Pellaea rotundifolia	Yes	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Pennantia corymbosa	Yes	1	1	0	0	0	1	0	0	0	0	0	0	1	1
Phytolacca octandra	No	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Piper excelsum	Yes	1	1	0	0	0	1	0	1	0	0	0	0	1	0
Pneumatopteris pennigera	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Podocarpus tōtara	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polystichum neozelandicum subsp. zerophyllum	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Polystichum vestitum	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Prumnopitys ferroginosa	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Prumnopitys taxifolia	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	0

Scientific name	Native	Plot 001	Plot 002	Plot 003	Plot 004	Plot 005	Plot 006	Plot 007	Plot 008	Plot 009	Plot 010	Plot 011	Plot 012	Plot 012a	Plot 013
Prunella vulgaris	No	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pseudopanax crassifolius	Yes	1	0	1	0	0	1	0	0	0	0	0	0	0	1
Pteridium esculentum	Yes	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Pterostylis graminea	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteridium macilenta	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyrrosia eleagnifolia	Yes	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Ranunculus flammensis	No	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ranunculus spp	No	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Rhabdothamnus solandri	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhopalostylis sapida	Yes	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Ripogonum scandens	Yes	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Rubus cissoides	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus fruticosus	No	1	1	1	0	0	0	1	1	0	0	0	0	0	0
Rumex obtusifolius	No	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Salix x fragilis	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schefflera digitata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shoenus spp	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sellaria media subsp. Media	No	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Scientific name	Native	Plot 001	Plot 002	Plot 003	Plot 004	Plot 005	Plot 006	Plot 007	Plot 008	Plot 009	Plot 010	Plot 011	Plot 012	Plot 012a	Plot 013
Solanum nigrum	No	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Streblus heterophyllus	Yes	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Cirsium species	No	1	1	1	1	1	0	0	0	1	0	0	0	0	1
Tradescantia flumenensis	No	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Trifolium repens	No	0	0	0	1	1	0	0	0	1	1	1	1	0	0
Typha orientalis	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Urtica ferox	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	No. native spp.	17	13	17	2	2	32	5	14	4	3	2	5	14	10
	Total no. of species	25	21	24	7	5	32	12	19	9	9	8	12	14	16
	Proportion native	0.68	0.62	0.71	0.29	0.40	1.00	0.42	0.74	0.44	0.33	0.25	0.42	1.00	0.63

Table F.3.5: Presence or absence of vegetation in each plot (1 = present, 0 = absent), with scientific name, indigenous status (e.g. native or exotic) and totals (Part 2 of 2).

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Acaena pusilla	Yes	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Adiantum cunninghamii	Yes	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0
Alectryon excelsus	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Aristetelia serrata	Yes	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Asplenium bulbiferum	Yes	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	1	0
Asplenium flaccidum	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Asplenium flabellifolium	Yes	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Asplenium gracillimum	Yes	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0
Asplenium oblongifolium	Yes	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	1	1	0
Asplenium polyodon	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astelia hastata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Beilschmiedia tawa	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Bellis perennis	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Berberis glaucocarpa	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blechnum chambersii	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blechnum filiforme	Yes	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Blechnum fluviatile	Yes	0	0	0	0	0	0	1	0	1	0	1	1	1	0	0	0	0	0
Blechnum novae-zelandiae	Yes	1	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0
Blechnum parisiae	Yes	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachyglottis repanda	Yes	0	0	0	0	0	0	1	0	0	1	1	1	1	0	0	0	0	0
Carex geminata	Yes	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Cardamine hirsuta	No	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0
Carex secta	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carpodetus serrata	Yes	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Carex uncinata	Yes	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	0
Carex virgata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Clematis foetida	Yes	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0
Clematis vitalba	No	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0
Coprosma areolata	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coprosma dumosa	Yes	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Coprosma grandifolia	Yes	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0
Coprosma rhamnoides	Yes	1	1	1	0	1	1	1	0	1	1	0	1	1	1	0	1	1	1
Coprosma robusta	Yes	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coprosma rotundifolia	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordyline australis	Yes	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Corynocarpus laevigatus	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cranfilla fluviatilis	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyathea dealbata	Yes	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0
Cyathea medularis	Yes	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Cyathea spp	Yes	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Cyathea smithii	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Cyperus eragrostis	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cytisus scoparius	No	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Delairea odorata	No	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Dichondra repens	Yes	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicksonia squarrosa	Yes	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Digitalis species	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Digitalis purpurea	No	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Doodia australis	Yes	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	1	0
Earina spp.	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Eleocharis acuta	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Eleocharis gracilis	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Foeniculum vulgare	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium aparine	No	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Geniostoma ligustrifolium	Yes	1	1	0	0	1	1	1	0	1	1	1	1	1	0	0	1	1	0
Exotic grass	No	0	1	1	1	0	1	0	1	0	0	0	0	1	1	1	0	0	1
Hedycarya arborea	Yes	1	1	1	0	1	0	0	0	0	1	1	1	1	0	0	1	0	0

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Hoheria sexstylosa	Yes	1	0	0	0	1	0	1	0	0	1	1	1	1	1	0	1	1	0
Holcus lanatus	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrocotyle spp	Yes	0	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0
Hymenophyllum spp	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Juncus australis	Yes	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Juncus edgariae	Yes	0	0	1	1	1	1	0	1	0	0	0	0	0	1	1	0	0	1
Juncus effusus	No	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1
Juncus pallidus	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Juncus sarophorous	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Juncus species	Yes	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Knightia excelsus	Yes	0	0	0	0	0	0	10	0	0	0	0	0	1	0	0	0	1	0
Kunzea robusta	Yes	0	1	0	0	1	1	1	0	1	0	1	0	1	1	0	0	1	1
Lastreopsis glabella	Yes	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0
Laurelia novaezelandiae	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptospermum scoparium	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucopogan fasciculatus	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Leycesteria formosa	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lophomyrtus bullata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Lophomyrtus obcordata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lotus pedunculata	No	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melicope simplex	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Melicytus ramiflorus	Yes	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	1	1	0
Metrosideros diffusa	Yes	1	0	1	0	0	1	1	0	0	1	0	0	1	0	0	0	1	0
Metrosideros fulgens	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Metrosideros perforata	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Microsorum pustulatum	Yes	1	0	1	0	0	0	1	0	1	1	1	0	1	0	0	1	1	0
Microsorum scandens	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Microtis unifolia	Yes	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Muehlenbeckia australis	Yes	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Myoporum laetum	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Myrsine australis	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Nasturtium officinale	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corybas trilobus	Yes	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Nertera spp.	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nestegis spp.	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olearia rani	Yes	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0	1	0

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Paesia scaberula	Yes	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Parsonsia heterophylla	Yes	0	0	0	0	0	1	1	0	0	1	1	1	1	0	0	1	0	0
Passiflora tetrandra	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Pellaea rotundifolia	Yes	1	1	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0
Pennantia corymbosa	Yes	1	0	1	0	1	0	0	0	1	0	1	0	0	0	0	1	1	0
Phytolacca octandra	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Piper excelsum	Yes	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0
Pneumatopteris pennigera	Yes	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
Podocarpus tōtara	Yes	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Polystichum neozelandicum subsp. zerophyllum	Yes	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	0
Polystichum vestitum	Yes	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Prumnopitys ferroginosa	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Prumnopitys taxifolia	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prunella vulgaris	No	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Pseudopanax crassifolius	Yes	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0
Pteridium esculentum	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterostylis graminea	Yes	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Pteridium macilenta	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Pyrrosia eleagnifolia	Yes	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0
Ranunculus flammensis	No	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus spp	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Rhabdothamnus solandri	Yes	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Rhopalostylis sapida	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Ripogonum scandens	Yes	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0
Rubus cissoides	Yes	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0
Rubus fruticosus	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumex obtusifolius	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salix x fragilis	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Schefflera digitata	Yes	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0
Shoenus spp	Yes	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Sellaria media subsp. Media	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum nigrum	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streblus heterophyllus	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Cirsium species	No	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Tradescantia flumenensis	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium repens	No	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Scientific name	Native	Plot 014	Plot 015	Plot 016	Plot 017	Plot 018	Plot 019	Plot 020	Plot 021	Plot 022	Plot 023	Plot 024	Plot 025	Plot 026	Plot 027	Plot 028	Plot 029	Plot 030	Plot 031
Typha orientalis	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urtica ferox	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	No. native spp.	20	12	13	1	16	14	30	4	21	20	21	24	29	9	2	20	43	3
	Total no. of species	23	18	18	4	18	17	34	5	21	21	22	25	31	12	7	21	45	6
	Proportion native	0.87	0.67	0.72	0.25	0.89	0.82	0.88	0.80	1.00	0.95	0.95	0.96	0.94	0.75	0.29	0.95	0.96	0.50

APPENDIX F.4: AVIFAUNA SURVEY METHODOLOGY

(REFER TO TABLE F.6.2 IN APPENDIX F.6 FOR RESULTS)

Five minute bird counts

Field surveys during the spring period were undertaken to target the bird breeding season. The area north of the Western QEII Covenant was also targeted as this is where the alignment has shifted notably compared to the previous NoR alignment.

Twenty two (22) five-minute bird counts ("5MBC") were undertaken across the Project during the weeks of 7 October 2019 (western side) and the week of 4 November (eastern side), following the methodology of Dawson and Bull (1975). Bird counts targeted a variety of habitats, including mature forest, secondary broadleaf forest, mānuka/kānuka scrubland, as well as wetlands and farm ponds (Terrestrial Ecology Drawing Set), and were undertaken during fine weather. Incidental bird observations were also recorded and added to an overall species list if previously unrecorded.

Automatic recording devices for cryptic birds

Automatic Recording Devices ("ARD") were deployed across wetland and lake ecosystems within and adjacent to the Project footprint between 10 and 25 October 2019 (Terrestrial Ecology Drawing Set). Automatic Recording Devices ARDs passively record noise, and were deployed in these locations in order to record the calls of cryptic wetland bird species potentially present. The ARDs were programmed to record 2 hours either side of dawn and dusk, refer to Table F.4.1for total hours of survey at each location. Analysis of recordings was undertaken in Raven Lite 2.0 Console. In total, three ARDs were deployed, and a total of 150 hours of data analysed.

F.4.1: Summary of survey effort using acoustic bird recorders at wetland and pond habitat in the Project footprint

Recorder no.	Location deployed	Dusk survey dates	Dawn survey dates	Total dusk survey hours	Total dawn survey hours	Total survey hours
ARD 1	Raupō reedland (large)	08.10.19 - 17.10.19	09.10.19 - 18.10.19	40	37	77
ARD 4	Pond	07.11.19 - 10.11.19	08.11.19 - 11.11.19	8	12	20
ARD 8	Raupō reedland (small)	07.10.19	10.10.19 - 11.10.19	4	1.5	5.5

APPENDIX F.5: ECOLOGICAL IMPACT ASSESSMENT GUIDELINES

Table F.5.1: Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community.

Matters	Attributes to be considered
Representativeness	Criteria for representative vegetation and aquatic habitats: • Typical structure and composition • Indigenous species dominate • Expected species and tiers are present • Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: • Species assemblages that are typical of the habitat • Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	Criteria for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity • Amount of habitat or vegetation remaining • Distinctive ecological features • National priority for protection Criteria for rare/distinctive species or species assemblages: • Habitat supporting nationally Threatened or At Risk species, or locally[1] uncommon species • Regional or national distribution limits of species or communities • Unusual species or assemblages • Endemism
Diversity and Pattern	• Level of natural diversity, abundance and distribution • Biodiversity reflecting underlying diversity • Biogeographical considerations – pattern, complexity • Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	• Site history, and local environmental conditions which have influenced the development of habitats and communities • The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA) • Size, shape and buffering • Condition and sensitivity to change

	• Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material • Species role in ecosystem functioning – high level, key species identification, habitat as proxy

[1] Locally – defined as within Ecological District.

Table F.5.2: Scoring for sites or areas combining values for four matters in Table F.5.1.

Value	Description
Very high	Area rates High for 3 or all of the four assessment matters listed in **Table F.5.1**. Likely to be nationally important and recognised as such.
High	Area rates High for 2 of the assessment matters, Moderate and Low for the remainder, or Area rates High for 1 of the assessment maters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder Likely to be important at the level of the Ecological District.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder.

Table F.5.3: Factors to consider in assigning value to terrestrial species for EcIA.

Species values	Habitat values
Nationally Threatened species, found in the zone of influence ("ZOI") either permanently or seasonally.	**Very high**
Species listed as At Risk – Declining, found in the ZOI, either permanently or seasonally.	**High**
Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally.	**Moderate**
Locally (Ecological District) uncommon or distinctive species (e.g. kererū, tūī, bellbird).	**Moderate**
Nationally and locally common indigenous species.	**Low**
Exotic species, including pests, species having recreational value.	**Negligible**

Table F.5.4: Criteria for describing 'Magnitude of Effect'

Magnitude	Description
Very high	Total loss of, or very major alteration to, key elements/features/ of the existing baseline[1] conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature
'Moderate'	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a 'Moderate' proportion of the known population or range of the element/feature

Magnitude	Description
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature
'Negligible'	Very slight change from the existing baseline condition. Change barely distinguishable, approximating the 'no change' situation; AND/OR Having 'Negligible' effect on the known population or range of the element/feature

[1] Baseline conditions are defined as 'the conditions that would pertain in the absence of a proposed action' (Roper-Lindsay *et al*., 2018).

Table F.5.5: Timescale for duration of effects

Timescale	Description
Permanent	Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years)
Long-term	Where there is likely to be substantial improvement after a 25 year period (e.g. the replacement of mature trees by young trees that need > 25 years to reach maturity, or restoration of ground after removal of a development) the effect can be termed 'long term'
Temporary[1]	Long term (15-25 years or longer – see above) Medium term (5-15 years) Short term (up to 5 years) Construction phase (days or months)

[1] Note that in the context of some planning documents, 'temporary' can have a defined timeframe.

Table F.5.6: Criteria for describing overall levels of ecological effects[1].

Ecological value / Magnitude	Very high	High	Moderate	Low	'Negligible'
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	'Moderate	Low	Very low

Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

[1] Note that for the purpose of this effects assessment, the matrix has been modified, namely any attribute assigned a 'High' ecological value and a 'Low' magnitude of effect have been assigned a 'Moderate' level of effect as opposed to 'Low' as shown in the matrix above.

Tables F.5.1 - F.5.6 reproduced from Roper-Lindsay, J., Fuller, S.A., Hooson, S., Sanders, M.D., and Ussher, G.T. (2018). Ecological Impact Assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

APPENDIX F.6: TERRESTRIAL AND WETLAND ECOLOGICAL VALUES

Table F.6.1: Nationally 'Threatened' or 'At Risk' plants known to be present in the Project footprint.

Common name	Species name	Habitat Type						'Ecological Value' (EIANZ)	Threat status
		Old growth	Kānuka forest	Secondary broadleaved forest and shrublands	Mānuka / kānuka shrublands	Divaricating Shrublands	Wetland		
Giant maidenhair	Adiantum formosum							High value	At Risk - Relict
Kānuka	Kunzea robusta							Very High value	Threatened - Nationally Vulnerable
Mānuka	Leptospermum scoparium							High value	At Risk - Declining
Ramarama	Lophomyrtus bullata							Very High value	Threatened - Nationally Critical
Rohutu	Lophomyrtus obcordata							Very High value	Threatened - Nationally Critical
Rātā	Metrosideros colensoi							Very High value	Threatened - Nationally Vulnerable

White rātā	Metrosideros diffusa							Very High value	Threatened - Nationally Vulnerable
Climbing rātā	Metrosideros fulgens							Very High value	Threatened - Nationally Vulnerable
Akatea	Metrosideros perforata							Very High value	Threatened - Nationally Vulnerable
Swamp maire	*Syzigium maire*							Very high value	Threatened – Nationally Critical

Table F.6.2: Native birds observed within a 200 km^2 surrounding the Project footprint (source: OSNZ atlas squares, Robertson et al., 2007): Bird habitat preferences and observations within the Project footprint from multiple survey sources. Note this table has been adapted from Table 6.B.6 provided in Appendix B of the NoR Volume 3.6 Terrestrial Ecology Assessment (Boffa Miskell, 2018) with the addition of bird observations from the most recent T+T surveys undertaken in 2019 (final column).

Common name	Scientific Name	Threat status (Robertson et al., 2017)	Habitat Type (dark green is primary habitat and light green indicates other habitat used less preferentially)						Survey Obs.		
			Native Forest	Exotic Forest	Shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ Estuary	Previous Surveys	Boffa Miskell (2018)	T + T (2019)
Australasian bittern	*Botaurus poiciloptilus*	Threatened - Nationally Critical									
White heron	*Ardea alba*	Threatened - Nationally Critical									
Grey duck	*Anas superciliosa*	Threatened - Nationally Critical									
Black-billed gull	*Chroicocephalus bulleri*	Threatened - Nationally Critical									
Banded dotterel	*Charadrius bicinctus*	Threatened - Nationally Vulnerable									
Caspian tern	*Hydroprogne caspia*	Threatened - Nationally Vulnerable								Y	

Common name	Scientific Name	Threat status (Robertson et al., 2017)	Habitat Type (dark green is primary habitat and light green indicates other habitat used less preferentially)						Survey Obs.		
			Native Forest	Exotic Forest	Shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ Estuary	Previous Surveys	Boffa Miskell (2018)	T + T (2019)
Red-billed gull	*Chroicocephalus novaehollandiae scopulinus*	At Risk - Declining									
Whitehead	*Mohoua albicilla*	At Risk - Declining									Y
North Island robin	*Petroica longipes*	At Risk - Declining							Y		
Spotless crake	*Porzana tabuensis*	At Risk - Declining									
NZ pipit	*Anthus novaeseelandiae*	At Risk - Declining							Y	Y	Y
Rifleman	*Acanthisitta chloris*	At Risk - Declining							Y		
Marsh crake	*Porzana pusilla*	At Risk - Declining									
NZ dabchick	*Poliocephalus rufopectus*	At Risk - Recovering									

Common name	Scientific Name	Threat status (Robertson et al., 2017)	Habitat Type (dark green is primary habitat and light green indicates other habitat used less preferentially)						Survey Obs.		
			Native Forest	Exotic Forest	Shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ Estuary	Previous Surveys	Boffa Miskell (2018)	T + T (2019)
Kākā	*Nestor meridionalis*	At Risk - Recovering									
Bush falcon	*Falco novaeseelandiae*	At Risk - Recovering							Y	Y	
Pied shag	*Phalacrocorax varius*	At Risk - Recovering									
Long-tailed cuckoo	*Eudynamys taitensis*	At Risk - Naturally Uncommon							Y		
Black shag	*Phalacrocorax carbo*	At Risk - Naturally Uncommon							Y		Y
Little black shag	*Phalacrocorax sulcirostris*	At Risk - Naturally Uncommon									
Black-fronted dotterel	*Elseyornis melanops*	At Risk - Naturally uncommon									Y
Royal spoonbill	*Platalea regia*	At Risk - Naturally Uncommon							Y		

Common name	Scientific Name	Threat status (Robertson et al., 2017)	Habitat Type (dark green is primary habitat and light green indicates other habitat used less preferentially)						Survey Obs.		
			Native Forest	Exotic Forest	Shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ Estuary	Previous Surveys	Boffa Miskell (2018)	T + T (2019)
Australian coot	*Fulica atra australis*	At Risk - Naturally Uncommon									
Kākāriki spp. (unknown)	*Cyanoramphus spp.*	Not Threatened (*C. auriceps*)/At Risk – Relict (*C. novaezelandiae*)							Y		
Australian pied stilt	*Himantopus leucocephalus*	Not Threatened							Y		Y
Little shag	*Phalacrocorax melanoleucos brevirostris*	Not Threatened									
White-faced heron	*Egretta novaehollandiae*	Not Threatened							Y	Y	
Black swan	*Cygnus atratus*	Not Threatened									

Common name	Scientific Name	Threat status (Robertson et al., 2017)	Habitat Type (dark green is primary habitat and light green indicates other habitat used less preferentially)						Survey Obs.		
			Native Forest	Exotic Forest	Shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ Estuary	Previous Surveys	Boffa Miskell (2018)	T + T (2019)
Paradise shelduck	*Tadorna variegata*	Not Threatened							Y	Y	Y
Grey teal	*Anas gracilis*	Not Threatened									Y
Australian harrier	*Circus approximans*	Not Threatened							Y	Y	Y
Pukeko	*Porphyrio melanotus*	Not Threatened							Y	Y	Y
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened							Y	Y	Y
Southern black-backed gull	*Larus dominicanus*	Not Threatened							Y	Y	Y
Morepork	*Ninox novaeseelandiae*	Not Threatened							Y		Y
New Zealand scaup	*Aythya novaeseelandiae*	Not Threatened									

Common name	Scientific Name	Threat status (Robertson et al., 2017)	Habitat Type (dark green is primary habitat and light green indicates other habitat used less preferentially)						Survey Obs.		
			Native Forest	Exotic Forest	Shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ Estuary	Previous Surveys	Boffa Miskell (2018)	T + T (2019)
Kereru	*Hemiphaga novaeseelandiae*	Not Threatened							Y	Y	Y
Shining cuckoo	*Chrysococcyx lucidus*	Not Threatened							Y		Y
New Zealand kingfisher	*Todiramphus sanctus*	Not Threatened							Y	Y	Y
Welcome swallow	*Hirundo neoxena*	Not Threatened							Y	Y	Y
Grey warbler	*Gerygone igata*	Not Threatened							Y	Y	Y
North Island fantail	*Rhipidura fuliginosa*	Not Threatened							Y	Y	Y
North Island tomtit	*Petroica macrocephala*	Not Threatened							Y		
Silvereye	*Zosterops lateralis*	Not Threatened							Y	Y	Y
Bellbird	*Anthornis melanura*	Not Threatened							Y	Y	Y

Common name	Scientific Name	Threat status (Robertson et al., 2017)	Habitat Type (dark green is primary habitat and light green indicates other habitat used less preferentially)						Survey Obs.		
			Native Forest	Exotic Forest	Shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ Estuary	Previous Surveys	Boffa Miskell (2018)	T + T (2019)
Tui	*Prosthemadera novaeseelandiae*	Not Threatened							Y	Y	Y
New Zealand shoveler	*Anas rhynchotis*	Not Threatened							Y	Y	Y

Table F.6.3: Native lizard species recorded within 50 km of the Project. Data sourced from the BioWeb Herpetofauna Database (administered by DOC) in December 2019.

Species and Conservation Status	Habitat preferences[1]	Known population in the MGSR(within 1 km of Project footprint)	Individuals recorded in last 20 years (all records)	Most recent record
Barking gecko[2] (*Naultinus punctatus*) At Risk - Declining	Arboreal species generally observed amongst the foliage of trees in forest, scrub and shrublands.	Yes	28 (62)	2019
Ngahere gecko[3] (*Mokopirirakau* "southern North Island") At Risk - Declining	Generally arboreal (but occasionally found in crevices in banks). Most often observed amongst trunks and larger branches in forest trees, shrubs and scrub.	Yes	3 (8)	2014
Raukawa gecko[4] (*Woodworthia maculatus*) Not Threatened	Arboreal or terrestrial. Observed beneath loose bark or in crevices in forest trees. Otherwise in rock crevices and rock piles often associated with open or scrub areas.	Yes	3 (25)	2019
Pacific gecko (*Dactylocnemis pacificus*) At Risk - Relict	Arboreal or terrestrial, very similar habitat preferences to Ngahere gecko described above but largely restricted to hill country forest in the southern North Island.	No	0 (4)	1965
Glossy brown skink (*Oligosoma zelandicum*) At Risk- Declining	Ground-dwelling. Prefers damp lowland areas that are densely vegetated. Found in forest, scrub and farmland.	No	3 (22)	2005
Ornate skink (*Oligosoma ornatum*) At Risk - Declining	Ground-dwelling. Occurs in forest and open habitats where there is established cover such as deep leaf litter, logs, rock piles and anthropogenic debris.	No	11 (29)	2012

Species and Conservation Status	Habitat preferences[1]	Known population in the MGSR(within 1 km of Project footprint)	Individuals recorded in last 20 years (all records)	Most recent record
Northern grass skink (*Oligosoma polychroma*) Not Threatened	Ground-dwelling. Occurs in grassland, scrub, wetlands and rock piles.	No	8 (25)	2018

[1]Habitat preferences sourced from the *Atlas of the amphibians and reptiles of New Zealand*, DOC: https://www.doc.govt.nz/our-work/reptiles-and-frogs-distribution/atlas/

[2] Also known as Wellington green gecko.

[3] Also known as Southern North Island forest gecko.

[4]Also known as common gecko or matua gecko.

Table F.6.4: Summary of notable invertebrates that could be present in the Project footprint based on literature review.

Species	Conservation Status	NoR reference	Habitat preferences
Megadromus turgidceps (beetle)	Not classified – possibly locally uncommon	Technical Assessment 6B (Boffa Miskell, 2018)	Native forest with an intact understory[1].
Meterana grandiosa (moth)	At Risk - Relict	Dr Martin's evidence, paragraph 7.19	Divaricating shrubs including Olearia species[2].
Meterana exquisita (moth)	At Risk - Relict		
*Powelliphanta traversi traversi (*snail)	Threatened - Nationally Endangered	Dr Martin's evidence, paragraph 3.4	Powelliphanta snails are generally associated with forest areas with large accumulations of moist leaf litter. Also closely associated with calcium rich soils[3].
Powelliphanta traversi tararuaensis (snail)	Threatened - Nationally Endangered		
Powelliphanta marchanti (snail)	Threatened – Serious Decline		
Wainuia urnula (snail)	Not classified – possibly locally uncommon	Dr Martin's evidence, paragraph 3.4	Recorded in damp leaf litter and stable rock piles in intact and modified forest[4].

[1] Cartellieri & Gabor (2003). Seasonal dynamics and reproductive phenology of ground beetles (Coleoptera, Carabidae) in fragments of native forest in the Manawatu, North Island, New Zealand, New Zealand Journal of Zoology, 30:1, 31-42.

[2] Patrick B. (2000). Lepidoptera of small-leaved divaricating Olearia in New Zealand and their conservation priority. Science for Conservation 168. Department of Conservation, Wellington, NZ.

[3] M. J. Meads , K. J. Walker & G. P. Elliott (1984) Status, conservation, and management of the land snails of the genus Powelliphanta (Mollusca: Pulmonata), New Zealand Journal of Zoology, 11:3, 277-306.

[4] Efford, M. (1998). Distribution and status of native carnivorous land snails in the genera Wainuia and Rhytida. Science for Conservation 101. Department of Conservation, Wellington, NZ.

APPENDIX F.7: PHOTOGRAPHIC EXAMPLES OF KEY CHANGES IN HABITAT CLASSIFICATIONS FROM NOR ASSESSMENT

Figure F.7.1: Examples of areas previously classified as mānuka, kānuka shrublands at CH 5400 - CH 5600 that has been reclassified as kānuka forest due to the maturity of the kānuka canopy.

Figure F.7.2: An area previously classified as mānuka, kānuka shrublands at CH 5400 - CH 5600 that has been removed because native canopy is no longer present, which is likely a result of herbicide application (not undertaken as part of the Project).

Figure F.7.3: An area previously classified as mānuka, kānuka shrublands at CH 9900 - CH 10000 that has been reclassified as divaricating shrublands as the mānuka, kānuka canopy has been removed leaving divaricating shrubs underneath.

Figure F.7.4: Examples of small areas of secondary broadleaved scrub located at CH 11400 - CH 11600 that were not mapped in the NoR that have since been mapped and included in this assessment.

Figure F.7.5: Examples of wetlands in the Project footprint which are at least partially dominated by native rushes but are subject to stock degradation. These wetlands are characterised as exotic wetlands in the NoR.