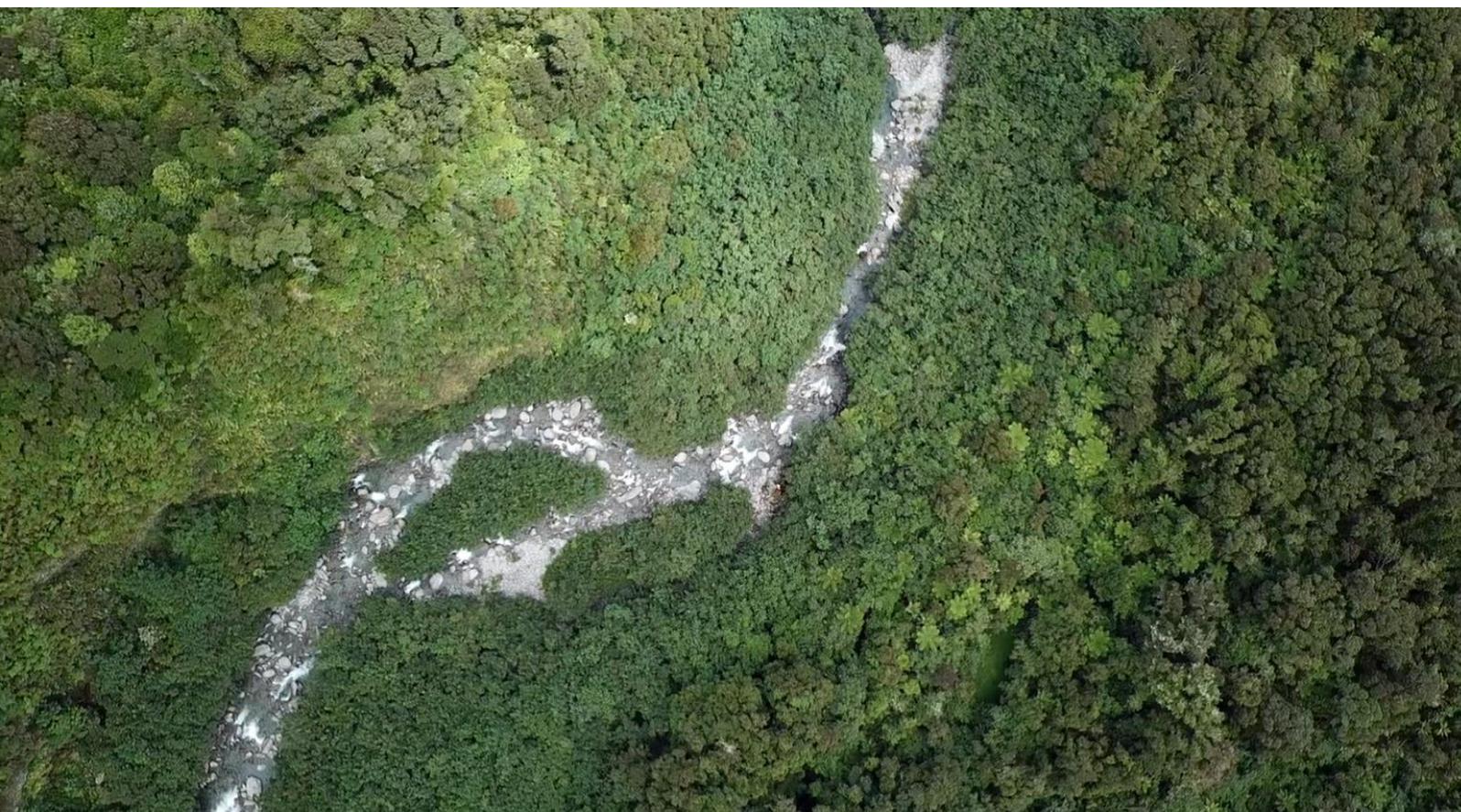


McCulloughs Creek Hydropower Scheme Supplementary Ecology Report

Report Number: 1708124

Prepared for No. 8 Limited

22 August 2018



CONTENTS

1.0	Introduction	4
1.1	Purpose and Scope	4
1.2	Summary of Proposal	4
1.3	Overview of Current Ecological Investigations	4
2.0	Request For Further Information	5
3.0	Terrestrial Vegetation	5
3.1	Nature of The Pipeline Corridor	5
3.2	Significant Tree Removal	6
3.3	Below Ground Impacts	7
4.0	Terrestrial Fauna	8
4.1	Bats	8
4.2	Herpetofauna	11
4.3	Avifauna	14
5.0	Freshwater Habitat	17
5.1	Desktop Review	17
5.2	Evaluation	17
6.0	Fish	21
6.1	Desktop Review	21
6.2	Evaluation	21
7.0	Macroinvertebrates	28
7.1	Desktop Review	28
7.2	Evaluation	28
8.0	Assessment of Potential Effects	29
8.1	Freshwater Ecology	29
9.0	Recommendations	32
9.1	Supplementary Ecological Investigations	32
9.2	Design Updates	32
9.3	Monitoring and Management	32
10.0	Conclusions	33
	Appendix A Report Limitations	34
	Appendix B Department of Conservation Request for Further Information	35
	Appendix C Penstock Options and Tree Heights	43
	Appendix D Complete List of Avifauna Documented in The Wider Landscape	45

Project Team:

Marc Choromanski, Senior Ecologist – Report Author

Connor Whiteley, Senior Ecologist – Report Author

1.0 INTRODUCTION

1.1 Purpose and Scope

This report¹, prepared by Ecology New Zealand Limited (ENZL) for No. 8 Limited ('the client'), presents the results of supplementary ecological assessments undertaken as part of the proposed McCulloughs Creek Hydropower scheme ('the Project') located in Whataroa, Westland. The preparation of this report has been contracted by the client following a request for further information (RFI) by the Department of Conservation (DOC) who are recognised as the landowners/administrators of the subject site. It is intended that this report be read in conjunction with the principal Ecological Assessment (EA) report prepared by Wildland Consultants Limited (Wildlands) to support the clients resource consent and concession application which are required to authorise the Project to proceed².

1.2 Summary of Proposal

The project currently proposes to install and operate an 1,890 kW run-of-river hydropower scheme located on McCulloughs Creek, Whataroa. The intake of the scheme would be located on the upper reach of McCulloughs Creek at an approximate elevation of 520 m above sea level. Water would be diverted from this intake by means of a penstock which would convey water to a powerhouse located west of the intake at approximately 120 m above sea level. The penstock would run parallel to the creek, transporting water to the powerhouse before returning it to McCulloughs creek approximately 3 km downstream from the intake. Hydrological and associated freshwater impacts are expected to be focal within this 3 km reach.

As described in the Environmental Impact Assessment report (No. 8 Ltd EIA) prepared by the client, the proposal will involve approximately 0.5 ha of vegetation clearance³. This vegetation clearance will principally include only smaller vegetation (<30cm Diameter at Breast Height) to avoid impacts on significant specimen trees with high ecological value. Construction methodologies utilising a cableway and helicopters are proposed to mitigate the extent of potential impacts on terrestrial values.

1.3 Overview of Current Ecological Investigations

The EA prepared by Wildlands provides an overarching assessment of potential ecological effects associated with the construction and operation of the proposed hydropower scheme. The ecological field investigations undertaken by Wildlands were conducted in May 2017 with particular focus on freshwater fish, aquatic macroinvertebrates, and terrestrial vegetation. Opportunistic observations of terrestrial fauna were additionally documented. Based on the infield data obtained for freshwater fish and vegetation during these investigations, the Wildlands EA assesses the site as 'significant' against criterion detailed within the Westland District Plan (section 4.9 Natural Habitats and Ecosystems).

¹ This report is subject to the Report Limitations provided in Attachment A.

² Wildland Consultants Ltd, August 2017. Ecological Assessment For The Proposed McCulloughs Creek Hydropower Project, Whataroa, Westland. Contract Report No. 4205

³ No.8 Ltd 2017: McCulloughs Creek Hydropower Project, Whataroa, Westland, New Zealand. Environmental Impact Assessment in support of No.8 Limited - Department of Conservation Concession Application. 7 September 2017.



The conclusions drawn within the Wildlands EA, describing the key areas of impacts during the construction phase, are associated with terrestrial vegetation clearance. Conversely, the most impacting potential ecological effects associated with the operational phase are related to freshwater habitats, fish and aquatic macroinvertebrates. Without mitigation these impacts are summarised as ranging from *less than minor* to *significant*. The more significant potential impacts are identified in the Wildlands EA are summarised as follows:

- *Cumulative vegetation clearance associated with the construction of the cableway, foot access track, pipeline, penstock and desander which will require 2,953 m² in indigenous forest; and*
- *Operational structures with potential associated impacts on freshwater values including prevention of fish passage, injury/mortality of fish, erosion of the waterway and/or its banks at discharge/spillway points, and flow on effects associated with increases in the number of low flow days per year (e.g. modified connectivity, habitat availability, water quality, algal growth etc).*

In context of these potential impacts, a series of site specific ecological management measures are currently recommended by Wildlands for the project. Following the full implementation of these measures, the Wildlands EA assesses the hydropower scheme as having adverse effects likely being reduced to *minor* or *less than minor*.

2.0 REQUEST FOR FURTHER INFORMATION

Given the size and nature of the proposed Project, DOC have indicated that the client has not provided enough information to sufficiently determine the potential environmental effects associated with the Project. On this basis, an RFI has been submitted by DOC to enable a more informed decision on the application to be determined. A full description of DOCs RFI is detailed within Appendix B of this report. The main themes within this information request relate to potential impacts on freshwater values, terrestrial fauna and vegetation; it is these themes which are the core focus of this report and are explored in detail within each of the following sections.

3.0 TERRESTRIAL VEGETATION

3.1 Nature of The Pipeline Corridor

The proposed pipeline corridor will prioritise the retention of vegetation during construction and will synonymously deliver provision of foot access into the site. This associated foot access will cater for contractors with backcountry experience to undertake required construction, routine maintenance and monitoring checks between the powerhouse and intake. It is envisioned that the foot access track will be naturally formed and maintained over time from routine walking.

As specified under the Standards New Zealand Handbook 8630:2004 (Tracks and Outdoor Visitor Structures), the corridor would not be subject to factors such as maximum grades, the provision of steps, minimum walking surface widths, or contain structures such as boardwalks, guardrails or viewing platforms. The surface of the route would be left in a natural state and not require formation through means such as scraping or benching.



3.2 Significant Tree Removal

It is proposed that the penstock will be constructed from steel material. Due to the required use of this more linear restricted material for the penstock, the selected corridor in which it is located should prioritise the avoidance of areas containing significant trees or specimen mature trees within the Project area. Since the initial lodgement of the McCulloughs Creek Hydropower Scheme application, ENZL has worked with the client to re-align the previously proposed route to take advantage of a more sensitive corridor with less impact on significant trees. This has been achieved through the assessment of high aerial lidar mapping which has provided detail into tree heights for the subject penstock area. As depicted in Appendix C, Alignment Option 2 has been identified as the most sensitive route which is considerate to significant areas of mature trees within the Project area. Though in comparison to Alignment Option 1, this corridor will require the powerhouse to be located approximately 150m further downstream, it is considered that the terrestrial values able to be avoided outweigh the extended area of impacted stream reach.

The low-pressure pipeline is proposed to be constructed with high density polyethylene (HDPE) material. The use of this more flexible material in addition to the pipeline being constructed in sections approximately 12m long (which are then plastic welded together) will enable manoeuvrability to avoid significant trees within the proposed corridor. This has been successfully demonstrated in the Inchbonnie hydropower scheme, located in a very similar West Coast environment (Plate 1). As recommended within the Wildlands EA, the alignment of this pipeline will be refined during installation under the supervision of an experienced ecologist to enable the avoidance of significant trees, and in any instance where avoidance cannot be achieved, the selection of which tree to be pruned or felled can be recommended based on multiple significance factors (e.g. threat status, structural integrity, fauna habitat).



Plate 1: Example of HDPE pipeline installed for the Inchbonnie Hydropower scheme. The flexibility in piping materials enables avoidance of larger specimen trees and root impacts across the pipeline corridor.

3.3 Below Ground Impacts

Potential below ground impacts are exclusively linked to the construction phase of the project and are limited to the establishment of the powerhouse and lower penstock.

As described within the Wildlands EA and No. 8 Ltd EIA, the greatest extent of vegetation clearance for the project is associated with the creation of the GRP/Steel Penstock and HDPE pipeline corridor. The potential for below ground forest impacts are largely avoided in these areas by their above ground nature (see section 3.1). Given that these structures do not require benching to be installed, below ground impacts are further mitigated.

It is proposed that the lower penstock will lie above ground and rest on small concrete supports at 12m centres. These supports consist of small concrete plinths (0.75 m x 0.75 m) on the surface, tied into rock with rock anchors. Heights will be dependent on the vertical alignment and correspond with the relative grade. Where bends in the penstock are needed, larger concrete thrust blocks up to 1.5 m x 1.0 m anchored into rock may be required. Similarly, support will be required for the installation of the cableway. Under the two cableway supports, a basic concrete slab (0.5 m x 0.5 m x 0.25 m deep) with a steel plate will act as a foundation. The cableway support will be additionally anchored by guy ropes, fastened to the adjacent rock with a rock-anchor provided. Given the need to establish these supports, interspersed below ground impacts can be expected. As shown in Plate 1 which reflects a similar innovative design, required stability for the HDPE pipeline is even less intrusive needing only wooden stakes for support.

The second area where below ground impacts are anticipated to occur is at the powerhouse. The powerhouse will be located at the lower extent of the McCulloughs creek valley and within an area of riparian vegetation. The construction of the powerhouse will require enabling works consisting of vegetation clearance and benching to enable the building platform. Given the contiguous nature of the surrounding vegetation in this area, a degree of below ground impacts will occur as it can be expected that roots from surrounding retained trees will overlap into this works area. As per information on tree heights provided by the client, trees in this area are classified as between 2.5 – 10m in height with no significant specimen trees in the direct vicinity (Appendix C).

Though these expected below ground impacts are relatively localised and non-extensive, mitigation can be undertaken to further reduce any potential impacts on significant trees or cumulative impacts on smaller vegetation. It is recommended that the removal of vegetation is to be undertaken by trained and experienced individuals and in a manner, which causes no unnecessary damage or disturbance to any retained vegetation and their root zones. During the establishment of the powerhouse, the lower penstock supports and cableway, a works arborist should be contracted to supervise and guide these works. The role of this works arborist will be to ensure that below ground root impacts are appropriately managed (e.g. through root retention, selective pruning and protection). The guidance and supervision of the works arborist would be most beneficial where below ground impacts are expected in the rootzone of significant mature trees (e.g. >50 cm DBH and/or >25 m in height) which will be retained.



4.0 TERRESTRIAL FAUNA

4.1 Bats

4.1.1 Desktop Review

In addition to wider background searches, the following information sources were consulted to determine the potential for bat presence and distribution within the Project area:

- Department of Conservation bat distribution database (50km radius from Whataroa, 2017);
- Buckingham, R. 2014. Assessment of the Potential Effects of the Proposed Waitaha Hydro Scheme on Vertebrate Fauna (Birds and Bats). Report for Westpower Ltd.; and
- O'Donnell, C.F.J.; Borkin, K.M.; Christie, J.E.; Lloyd, B.; Parsons, S.; Hitchmough, R.A. 2018. Conservation status of New Zealand bats, 2017. New Zealand Threat Classification Series 21. Department of Conservation, Wellington. 4 p.

4.1.2 Bat Diversity

New Zealand's native mammal diversity includes five Threatened or At-Risk microbat taxa and one vagrant megabat species⁴. Within the South Island of New Zealand, these species include the long-tailed bat (*Chalinolobus tuberculatus*, Nationally Critical) and the southern lesser short-tailed bat (*Mystacina tuberculata tuberculata*, Recovering). A review of the bat records from the DOC national bat database in addition to the results of the field work undertaken by Buckingham (2014)⁵, indicates the historic presence of both short-tailed bats and long-tailed bats within the local environment of McCulloughs Creek (within 50km of the Project area).

Evidence for the potential presence of short-tailed bats in the local environment is limited to several observations of unknown species as close as 5km from the McCulloughs Creek, and a single documentation of a short-tailed bat/s in Okarito approximately 20km west of the Project area. This short-tailed bat record is sourced from an unknown observer sometime in the early 1900s; henceforth lessening the degree of confidence that can be placed on it. The documented observations of unknown species are likely due to these records being from incidental reported observations of bats in flight and being indeterminant to species level by the observer. Though these observations are expected to be long-tailed bats, due to their higher utilisation of areas outside of intact indigenous forest and thus higher likelihood of being observed, the potential of these records being short-tailed bats cannot be completely discounted. However, short-tailed bat populations are considered sparse across the South Island of New Zealand^{6,7}. Notable populations are located a substantial distance away from the Project area; being documented near Te Miko (~200km northeast) and Eglington (~350km southwest)⁹. It is considered that there is a very low likelihood of this species being present within the vicinity of the Project area, but if found present, this would mark a significant discovery.

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

⁵ Buckingham, R. (2014). Assessment of the Potential Effects of the Proposed Waitaha Hydro Scheme on Vertebrate Fauna (Birds and Bats). Report for Westpower Ltd.

⁶ 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.

⁷ Lloyd, B. D. 2005. Lesser short-tailed bat. 'The handbook of New Zealand mammals'. C. King. Melbourne, Oxford University Press: 110-126.

⁸ Lloyd, B.D. 2009. Acoustic survey of the Oparara Basin for lesser short-tailed bats *Mystacina tuberculata*: October 2009. Lloyds Ecological Consulting. For: Department of Conservation Buller Kawatiri Area Office. 11 pp.

⁹ Department of Conservation national bat distribution database



Long-tailed bat records appear to be scattered across the local environment, with records existing within 50km of the Project area to the northeast and southwest. There is a lack of long-tailed bat records at higher altitude alpine areas with their presence being more synonymous with lower elevation. Given that Whataroa is largely converted into farmland depauperate in potential roosting habitat, it is likely that any local bats would be roosting in more intact indigenous forest; as seen in the McCulloughs Creek catchment and its contiguous surrounds. The results of the Waitaha River bat study undertaken by Buckingham (2014) demonstrates the use of riverine and forest-edge habitats by long-tailed bats. Of further note, this study summarises a significant population of long-tailed bats being present within the Waitaha Valley which demonstrated higher pass rates than other parts of the West Coast. Based on the results of this desktop review, there is a high likelihood of long-tailed bats being present within the vicinity of the Project area. Due to the 30km distance from the Waitaha Valley, if found present within the McCulloughs Creek catchment, it is expected that these bats will represent a separate colony; potentially part of a wider metapopulation.

4.1.3 Assessment of Potential Impacts

As described in section 4.1.2, there is a very low likelihood for short-tailed bats to be found present within the McCulloughs Creek Catchment and a high likelihood for long-tailed bat presence. On this basis, the following assessment of potential impacts is strictly associated with long-tailed bats; noting that recommended in-field surveys will act to refine this assessment.

Potential direct and indirect impacts on long-tailed bats are associated with both the construction and operational phase of the proposed hydropower scheme. These impacts can be categorised into roost impacts, flight paths, and foraging.

Impacts on bat roosts are likely to be largely limited to the construction phase of the project, where there is a potential for roost trees to be felled to enable the installation of new structures. Long-tailed bats are a colonial species which generally roost in mature trees with suitable cavities, crevice, fractured limbs and/or large epiphyte loads. These roosts are normally synonymous with mature trees greater than 80 cm in diameter (DBH) and within the South Island environment, found to largely occur within 500m from the forest edge¹⁰. Given that vegetation clearance required for this project is located in this 500m forest edge, careful consideration of potential roost trees is required. The proposed clearance of vegetation associated with the Project aims to prioritise avoidance of trees greater than 30 cm in diameter. This has been achieved through the selection of a lower penstock which avoids significant trees and the use of manoeuvrable material in the upper pipeline corridor which is able to be guided around mature trees.

Where the removal of mature trees bearing characteristic roost features cannot be avoided, potential risks may arise in the instance where bats may be occupying it. If unmitigated, these impacts can be substantial where multiple individuals could be injured or killed. The nomadic nature of long-tailed bats roosting behaviour means colonies frequently shift roosts and utilise a large pool of roosts. The use of a large pool of roosts dissipates the chance of a single tree being occupied at any one time, however further means that any single roosting tree could be occupied at one time. To mitigate this potential risk, bioacoustic monitoring should be undertaken prior to the removal of any potential roost tree requiring felling to ensure the absence of bat roosting activity. Though this is not expected to be a large number of trees, this management is recommended due

¹⁰ Sedgely, J. A., & O'Donnell, C. F. (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. *Biological conservation*, 88(2), 261-276.



to the proportionally high number of a Nationally Critical species potentially occupying a single tree. Though the bat breeding season falls within the recommended timing of tree felling (October – April), vegetation clearance during winter is not appropriate as bats enter a state of torpor (short term hibernation) which reduces the likelihood of them being able to escape tree clearance.

Long-tailed bats are known to utilise linear forest edges and watercourses as both flight paths and foraging habitat. Unlike short-tailed bats, which are known for their forest floor foraging behaviours, long-tailed bats forage exclusively on the wing; preying on a variety of volant invertebrates¹¹. It is not expected that terrestrial invertebrates will be significantly impacted by the project. Further surveys will be required to assess the potential degree of impacts on aquatic macroinvertebrates and determine to what extent bats are utilising the impact reach for foraging. The vegetation clearance required for the penstock and pipeline will create a small linear corridor within the forest interior. It is expected that if anything, bats may begin to utilise this area for commuting and foraging, especially in instances of marginal weather (rainfall and high winds) where they will be sheltered. Recommended surveys to be undertaken to refine this assessment will enable the identification of any potential feeding hotspots for bats. Though it is not expected significant impacts are to occur as part of this project, site specific insights at these hotspots will enable refinement of these expectations where required.

Due to the autonomous nature of the Hydropower scheme, no continuous lighting is expected to be required during the operational phase of the project. Similarly, if lighting is required during the construction phase (due to working in the forest interior and or early morning/night) lighting requirements will be minimal and localised. It is not expected that lighting will impact local bats.

During the construction phase, noise from operating machinery and contractors is expected to occur. This required level of noise will again be localised and limited in duration to the construction period. Due to the projects direct association with the McCulloughs Creek, it is expected that the high velocity water across the impact reach will facilitate the drowning out of any foreseeable noise impacts. The rapids located directly adjacent to the powerhouse will further act to muffle the predicted hum of the operational powerhouse. As such, these impacts are not considered significant.

¹¹ Gillingham, N. J. 1996. The behaviour and ecology of long-tailed bats (*Chalinolobus tuberculatus* Gray) in the central North Island. Unpublished MSc thesis, Massey University, Palmerston North, New Zealand.



4.2 Herpetofauna

4.2.1 Desktop Review

In addition to wider background searches, the following information sources were consulted to determine the herpetofauna diversity potentially present within the Project area:

- Department of Conservation herpetofauna database (50km radius from Whataroa, 2018);
- Whitaker, A.H. 2013. An Assessment of the Potential Effect of the Proposed Waitaha Hydro Scheme on the Lizard Fauna of the Lower Waitaha River, Westland. Whitaker Consultants Limited;
- Whitaker, T.; Lyall, J. 2004. Conservation of lizards in West Coast/Tai Poutini Conservancy. Department of Conservation, Wellington. vii + 93 p;
- Hitchmough, R.; Barr, B.; Lettink, M.; Monks, J.; Reardon, J.; Tocher, M.; van Winkel, D.; Rolfe, J. 2016. Conservation status of New Zealand reptiles, 2015. New Zealand Threat Classification Series 17. Department of Conservation, Wellington. 14 p; and
- Newman, D.G.; Bell, B.D.; Bishop, P.J.; Burns, R.J.; Haigh, A.; Hitchmough, R.A. 2013. Conservation status of New Zealand frogs, 2013. New Zealand Threat Classification Series 5. Department of Conservation, Wellington. 10 p.

4.2.2 Herpetofauna Diversity

The most recent conservation status of New Zealand's reptile diversity recognises 117 taxa which include eight species of Non-Resident Native snakes and turtles and one species of Introduced and Naturalised skink¹². In addition to these taxon, New Zealand further hosts four native *Leiopelma* frog species (further split by evolutionary significant units and taxonomically indeterminate)¹³.

The Lizards of the West Coast/Tai Poutini Conservancy publication (Whitaker and Lyall, 2004) provides a species list of known and expected lizards for the Franz Josef/Waiapu Region in which the Proposed hydropower scheme is located. This list includes reference to the broad-cheeked gecko/Okarito forest gecko (*Mokopirirakau* "Okarito", Data Deficient); currently known from only three observations and having a national range limited to a single locality. A review of the Department of Conservation's national herpetofauna data base within 50km of the Project area indicates an additional gecko and turtle species within the local environment. Based on these desktop searches and the suitability of habitat onsite, a list of potential species and their current conservation status is provided in Table 1 below. These species include forest dwelling geckos (*Naultinus tuberculatus* and *Mokopirirakau* spp), saxicolous gecko (*Woodworthia* "Southern Alps") and terrestrial *Oligosoma* skinks generally associated with open structured habitats.

Based on high resolution aerial imagery of the Project area, site photographs and descriptions of vegetation detailed within the Wildlands EA report, the likelihood of each species being present within the project footprint is further described in Table 1. These likelihoods are based on expert opinion and are suggested on a conservative basis as lizards are often scattered across the landscape and not necessarily evenly spread.

¹² Hitchmough, R.; Barr, B.; Lettink, M.; Monks, J.; Reardon, J.; Tocher, M.; van Winkel, D.; Rolfe, J. 2016. Conservation status of New Zealand reptiles, 2015. New Zealand Threat Classification Series 17. Department of Conservation, Wellington. 14 p

¹³ Newman, D.G.; Bell, B.D.; Bishop, P.J.; Burns, R.J.; Haigh, A.; Hitchmough, R.A. 2013. Conservation status of New Zealand frogs, 2013. New Zealand Threat Classification Series 5. Department of Conservation, Wellington. 10 p.



Table 1 Native herpetofauna diversity potentially present within the Project area

Scientific Name	DOC Conservation Status	West Coast/Tai Poutini Conservation Priority ¹⁴	Likelihood of on site Presence
<i>Mokopirirakau</i> "Okarito" ⁰⁺	Data Deficient	Moderate	Very Low
<i>Mokopirirakau granulatus</i> ⁰⁺	Declining	Low	High
<i>Naultinus tuberculatus</i> ⁰	Nationally Vulnerable	Low	Moderate
<i>Oligosoma infrapunctatum</i> ⁰⁺	Declining	Moderate	Moderate
<i>Oligosoma polychroma</i> "Clade 4" ^{1*}	Declining	Moderate	Very Low
<i>Oligosoma polychroma</i> ⁰⁺	Not Threatened	Moderate	Moderate
<i>Woodworthia</i> "Southern Alps" ⁰⁺	Not Threatened	Moderate	Low - Moderate

* Species observations documented within the Department of Conservation herpetofauna database

⁰ Species described within the Franz Josef/Waiapu Region in Whitaker and Lyall, 2004

The findings described within the DOC national herpetofauna database and those within the Whitaker and Lyall (2004) report provide a robust indication of potential species within the local environment (Table 1). Recent advances in taxonomy have been considered on review of the results of historic data sources. With respect to these changes, species such as *O. aff. infrapunctatum* "Chesterfield" and *O. aff. infrapunctatum* "crenulate" are now recognised as occupying distinct ranges/localities that do not include Whataroa. Both these species have previously been considered as potentially occupying a range within 50km of the project area¹⁵.

W. "Southern Alps" have been recorded within 25km of the project area in high elevation areas. This is a species of the dryer eastern-slopes in open rocky areas and dry open forest; with no authenticated records existing west of the main divide (R. Hitchmough, personal communication, August 2018). It is therefore very unlikely that this species will be present within the project area.

The species with the highest threat status potentially found within the Project areas is the West Coast green gecko (Nationally Vulnerable). This species is sparsely distributed from the Lewis Pass area to northern Westland, with notable populations occurring in Stockton and Denniston¹⁶. This species has not been recorded within 50km of the project area nor do substantiated recent records of green gecko exist this far south on the West Coast (R. Hitchmough, personal communication, August 2018). Strewn unproven records of green geckos (expectantly *N. Tuberculatus s.l*) exist southward to Haast potentially demonstrating a range expansion for this species rather than a new taxa or westward range expansion of *Naultinus gemmeus* which is currently distributed east of the southern alps^{17,18}. This species is found occupying a range of habitats including scrubland, fernland, shrubland and mature forest where they usually inhabit the forest canopy. With the exception of the notable populations above, populations generally occur in low densities but are expected to occur semi-contiguously across the above-stated habitat types across their range¹⁹.

¹⁴ Whitaker, T.; Lyall, J. 2004: Conservation of lizards in West Coast/Tai Poutini Conservancy. Department of Conservation, Wellington. vii + 93 p.

¹⁵ Whitaker, A.H. 2013. An Assessment of the Potential Effect of the Proposed Waitaha Hydro Scheme on the Lizard Fauna of the Lower Waitaha River, Westland. Whitaker Consultants Limited;

¹⁶ Department of Conservation Atlas Species information. <https://www.doc.govt.nz/our-work/reptiles-and-frogs-distribution>

¹⁷ Whitaker, A.H. 2013. An Assessment of the Potential Effect of the Proposed Waitaha Hydro Scheme on the Lizard Fauna of the Lower Waitaha River, Westland. Whitaker Consultants Limited;

¹⁸ Whitaker, T.; Lyall, J. 2004: Conservation of lizards in West Coast/Tai Poutini Conservancy. Department of Conservation, Wellington. vii + 93 p.

¹⁹ Whitaker, A.H. 2013. An Assessment of the Potential Effect of the Proposed Waitaha Hydro Scheme on the Lizard Fauna of the Lower Waitaha River, Westland. Whitaker Consultants Limited;



4.2.3 Assessment of Potential Effects

Ground dwelling species, which may inhabit the riparian edges of the McCulloughs stream, are expected to be habituated to the dynamic nature of this environment where water levels are ever changing. As the hydropower scheme will not markedly influence hydropeaking above what is naturally occurring, nor does it intend to dam extents of the watercourse (see section 5.0), hydrological influences are not anticipated to impact these species.

The greatest relative impact to resident herpetofauna species (should they be present) will be during the construction phase of the project where it is expected that there will be a degree of habitat loss and disturbance mainly associated with vegetation removal activities. As noted within the DOC RFI, lizard populations are not necessarily evenly spread across the landscape, therefore scattered concentrated densities may occur within a given area. Noting this, the proposed scale of vegetation clearance is still considered inconsequential when taken in context of the vast expanse of surrounding contiguous forest environment. Due to the narrow linear nature of the penstock/pipeline corridor, vegetation clearance avoids concentrated disturbance at any one given area. This limited swath of clearance is also not expected to notably impact resources (e.g. micro-habitats and food sources) for potential resident herpetofauna.

The clearance of vegetation to enable the construction of the Hydropower scheme is largely to be undertaken by hand clearance. This approach reduces the risk of injury/death of the more arboreal species (e.g. *Naultinus tuberculatus* and *Mokopirirakau sp*) which are more at risk to clearance by means of machinery such as mulch head mounted excavators. By limiting vegetation clearance corridors to <2m in width, ecological connectivity within the forest environment where the bulk of clearance is to occur will be avoided. Likewise, with birds, it is not expected that this width will hinder connectivity either side of cleared areas for mobile species.

Though it is anticipated that there will only be slight adverse impacts on native herpetofauna, a site-specific survey is recommended to be undertaken to refine and validate this assessment. In the instance where notable species/populations are detected, this could dictate requirements for species specific mitigation measures to be incorporated prior to and/or during vegetation removal works.



4.3 Avifauna

4.3.1 Desktop Review

In addition to wider background searches, the following information sources were consulted to determine the avifauna diversity potentially present within the Project area:

- Buckingham, R. 2014. Assessment of the Potential Effects of the Proposed Waitaha Hydro Scheme on Vertebrate Fauna (Birds and Bats). Report for Westpower Ltd.;
- Ebird international bird database (Whataroa and surrounds);
- Wildland Consultants Ltd. 2017. Ecological Assessment For The Proposed McCulloughs Creek Hydropower Project, Whataroa, Westland. Contract Report No. 4205; and
- McEwen, W. M. 1987. Ecological regions and districts of New Zealand. New Zealand Biological Resources Centre Publication, 5, 63. – Data from – Harihari, Willberg and Waiho

4.3.2 Avifauna Diversity

A total of 46 native and 15 exotic avifauna species have been recorded in the wider landscape surrounding McCulloughs Creek. Though this diversity is seemingly high, factors including species' range restrictions, behavioural traits and habitat preference limit the actual diversity of species most likely found within the Project area. The density at which avifauna are found within the local environment is further described as moderate; likely attributed to the uniformity of vegetation and the presence of introduced predators²⁰.

Based on high resolution aerial imagery, field photography and vegetative descriptions provided in the Wildlands EA, the key avifauna habitat types documented within the Project area include:

- Riverine: High velocity riverine habitat exists within the upper catchment of McCulloughs Creek; and
- Indigenous Forest: McCulloughs Creek bisects an area of mature contiguous forest

Of these 46-native species, it is expected that the more common and 'Not Threatened' species will be ubiquitous across the landscape. This would include species such as South Island fantail (*Rhipidura fuliginosa fuliginosa*), bellbird (*Anthornis melanura melanura*), brown creeper (*Mohoua novaeseelandiae*), grey warbler (*Gerygone igata*), silvereye (*Zosterops lateralis lateralis*), and South Island tomtit (*Petroica macrocephala macrocephala*). A total of 15 notable species with a threat status greater than 'Not Threatened' have been identified as being potentially present within the Project area (Table 2). As further described in Table 2, these species have varying likelihoods of presence ranging from low to high. For species such as black shag (*Phalacrocorax carbo novaehollandiae*), blue duck (*Hymenolaimus malacorhynchos*) and falcon (*Falco novaeseelandiae s.l.*), if they are present within the sites, their territoriality and solitary behaviours will ultimately mean that the actual number of individuals that may be present within the McCulloughs creek catchment will be low.

The presence of kiwi within the project area is considered very unlikely, with both taxa described in Table 2 distributed outside of the project area. If found within the project footprint, this would pose relatively higher conservation significance, but would also indicate a range expansion in the distribution of these species. This means that the large tract of contiguous forest adjoining the project area would constitute a substantially larger range for these species than currently known.

²⁰ •McEwen, W. M. (1987). Ecological regions and districts of New Zealand. New Zealand Biological Resources Centre Publication, 5, 63. – Data from – Harihari, Willberg and Waiho



There is a potential for the presence of two duck species within the Project area. Blue ducks are known to inhabit high quality, fast flowing rivers such as those found in high altitude headwater systems. The McCulloughs creek provides suitable habitat for this species, and its presence is thought to be likely. However, it is noted that blue duck has not been detected within the impact reach during no less than five field visits undertaken by the client; all of which were accompanied by environmental professionals. Grey ducks are currently classified as 'Nationally Critical' due to extensive hybridisation with mallards (*Anas platyrhynchos*)²¹. It is suggested that one of the few places to observe phenotypically 'pure' grey ducks exist within forested headwater catchments on the West Coast which are away from human settlement²¹. Therefore, there is a moderate probability of this species being associated with the riverine habitats provided by McCulloughs Creek.

Table 2 Native avifauna diversity with a conservation status higher than Not Threatened and considered potentially within the Project area.

Common Name	Scientific Name	Conservation Status ²²	Likelihood of on site Presence
Black Shag	<i>Phalacrocorax carbo novaehollandiae</i>	Naturally Uncommon	Low - Moderate
Blue Duck	<i>Hymenolaimus malachorhynchos</i>	Nationally Vulnerable	Moderate
Great Spotted kiwi	<i>Apteryx haastii</i>	Nationally Vulnerable	Very Low
Grey Duck	<i>Anas superciliosa</i>	Nationally Critical	Moderate
Kea	<i>Nestor notabilis</i>	Nationally Endangered	Moderate
Long-tailed Cuckoo	<i>Eudynamys taitensis</i>	Naturally Uncommon	Moderate
New Zealand Falcon	<i>Falco novaeseelandiae s.l</i>	Recovering	Moderate
New Zealand Pipit	<i>Anthus novaeseelandiae novaeseelandiae</i>	Declining	Low - Moderate
Okarito Brown Kiwi	<i>Apteryx rowi</i>	Nationally Vulnerable	Very Low
South Island Fernbird	<i>Bowdleria punctata punctata</i>	Declining	Low - Moderate
South Island Kaka	<i>Nestor meridionalis meridionalis</i>	Nationally Vulnerable	Low - Moderate
South Island pied Oystercatcher	<i>Haematopus finschi</i>	Declining	Low
South Island Robin	<i>Petroica australis australis</i>	Declining	Moderate - High
Variable Oystercatcher	<i>Haematopus unicolor</i>	Recovering	Low

²¹ Williams, M.J. 2013. Grey duck. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

²² Robertson, H.A.; Baird, K.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; McArthur, N.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2017. Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. Department of Conservation, Wellington. 23 p.



4.3.3 Assessment of Potential Effects

During the construction phase of the project, localised disturbance is anticipated by means of vegetation clearance, construction, noise and human presence. This has the potential to disturb local avifauna, with the largest relative impacts occurring during the breeding season where disturbance may exclude nesting across the project area (specifically, areas where work is occurring). Due to the contiguity of available forest habitat available for forest dwelling species, this localised impact in space and time is not considered to have a significantly adverse impact. Due to the more limited riverine habitat available however, this impact could be more damaging on species such as blue duck which nest in riparian margins. Given that physical construction works in or near the creek are limited to only the powerhouse/tailrace and intake area; this limits these potential areas of impact.

Due to being extremely mobile, vegetation clearance activities are likely to pose the most direct injury/mortality threats to native birds during the breeding season where active nests bear eggs and/or non-volant chicks. Given the limited swath of clearance, impacts on forest nesting birds are likely limited, with most impacts associated with species that nest in lower growing trees as larger trees bearing hollows and epiphyte nesting habitat have been prioritised for avoidance. It is recommended that vegetation clearance is considerate to the main bird breeding season and that the selective timing of these activities is used to avoid and mitigate the scale of potential impacts.

The project will require the creation of a small pool above the intake and would not lead to the creation of any large dammed areas or the notable expansion of habitat types that would facilitate the establishment of mallard ducks into the area. As forested headwater systems on the West Coast are one of the last known strongholds for phenotypically 'pure' grey ducks, it is important that the project does not increase the risks for hybridisation for this Nationally Critical species that may be present within the Project area.

The operation of the Hydropower scheme may cause localised reductions of instream habitat quality if aquatic macroinvertebrate density and diversity is significantly modified (see section 7.0). Blue ducks are identified as species being the most reliant on aquatic macroinvertebrates that may be present within the project area. Blue ducks are generally found in low densities due to being notoriously territorial; with pairs successively claiming territories at an average 1km spacings across waterways²³. It is therefore expected that only significant impacts on aquatic macroinvertebrates may cause a degree of resource reduction for this species. Potential impacts on grey duck food resources are predicted to be even less adverse as they are considered largely omnivorous wetland feeders with animal matter only making up 10% of their diet²⁴.

²³ Williams, M.J. 2013. Grey duck. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

²⁴ Williams, M.J. 2013. Grey duck. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz



5.0 FRESHWATER HABITAT

5.1 Desktop Review

To further assess the habitat of McCulloughs Creek, an in-depth desktop assessment was carried out to establish the various abiotic and biotic factors that compose its freshwater habitat. The assessment was carried out by viewing high-resolution aerial imagery and videos of the site, captured by No. 8 Ltd; evaluation of the existing site photos; evaluation of existing environmental data sets (i.e. flow); and assessment of various geographical data. The following documents were additionally reviewed:

- Porteous, J.; Henderson, R. 2018. McCulloughs Creek Low Flow Estimation, NIWA;
- Hutchison, M.; McCaughan, H.; Patrick, B. 2017. Ecological Assessment for the Proposed McCulloughs Creek Hydropower Project, 4205 Wildlands; and
- No 8 Limited. 2017. McCulloughs Creek Hydropower Project Environment Impact Assessment.

5.2 Evaluation

5.2.1 Wider connectivity

The subject stream forms part of the wider Whataroa River catchment. From the site edge at the downstream end, the stream flows a further ~2km in a westerly direction before the confluence with the Whataroa River. Throughout that reach, the stream flows along a gentle gradient compared to the majority of the impact reach. The Whataroa River then flows for a further 28km in a north-western direction, as a braided river system before terminating into the Tasman Sea. Connectivity to the base of the site appears to be well-established with no notable limitations.

5.2.2 Impact Site

The impact site presents the typical characteristics of an upland alpine valley stream system located on the west coast of the South Island. The source of the majority of the stream system is the drainage off the surrounding forested valley, located on the south-eastern flank of the Adams Range, which forms the watershed of the McCulloughs Stream. The catchment at the proposed intake site is 4.49 km², with the wider catchment ~8 km². The stream commences at ~1500 masl draining the upper catchment until reaching the impact site at ~550 masl. The impact reach flows for 3km to ~100 masl, at which point the powerhouse is to be located and flow to be returned. The average flow varies with the median being recorded at 0.975 m³/s and the mean at 1.175 m³/s. The seven-day mean annual low flow has been calculated at 0.601 m³/s; this was derived from 388 days of hourly flow monitoring and correlated with long-term monitored sites within the Poerua River and Hokitika River²⁵. The gauging recorder placed at McCulloughs Creek indicates that ~4,600mm of rainfall occurs per year at 110 masl with slightly more, ~4,900mm, occurring within the higher elevation of the impact reach and the wider catchment. Based on the rapid L/s increase after rainfall, the catchment presents a fast response system with minimal retention by the surrounding valley.

Given the distinct change in gradient throughout the impact reach, there are two very distinct physical habitat types present. The first type occurs in the lower energetic reach at ~150 masl to

²⁵ Porteous, 2018, McCulloughs Creek Low Flow Estimations



below the powerhouse. The second occurs above ~150 masl and is characterised as significantly higher energetic flows.

The lower energetic reach is dominated by a more standard riffle-run-pool system. The stream widens significantly, dispersing the water over a shallow pool system and creating areas of slack water. This reduction in energy within the flow allows for the depositing of coarse sands and small gravel beds (Plate 2). The variation in inorganic particle size increases, resulting in a more diverse beneficial substrate (Plate 3 and Plate 5). There is still an absence of woody debris within the channel and organic debris presence is unable to be made out from the various footage. Connectivity to the flood plain is significantly greater, with areas of "sluggish backwater" being formed in previous high-flow events.



Plate 2 Photo of the stream immediately downstream of the powerhouse. Coarse Sand and small gravel depositions can be noted within the bottom right of the photo. Significant variation of particle size is visible.



Plate 3 Photo of the stream located at the potential discharge point of the tailrace outfall. Additionally, demonstrating the variety of benthic heterogeneity.

The higher energetic reach is dominated by cascade waterfalls and deep, narrow pools. The stream width is constricted by the steep valley systems, which also increases the general depth of the water column in comparison to the lower energetic system (Plate 4). Due to this increase, energy settlement of fine particles (i.e coarse sands and small gravel) is less likely. Reduction of variation in inorganic particle size is likely to reduce the benthic variation. The retention of organic debris (both leaf litter and woody debris) is expected to be significantly less than the lower energetic reach. Connectivity to the flood plain is significantly restricted by the steep valley wall.



Plate 4 Photo looking upstream of the intake demonstrating a very narrow channel with a series of cascades, pools and waterfalls.

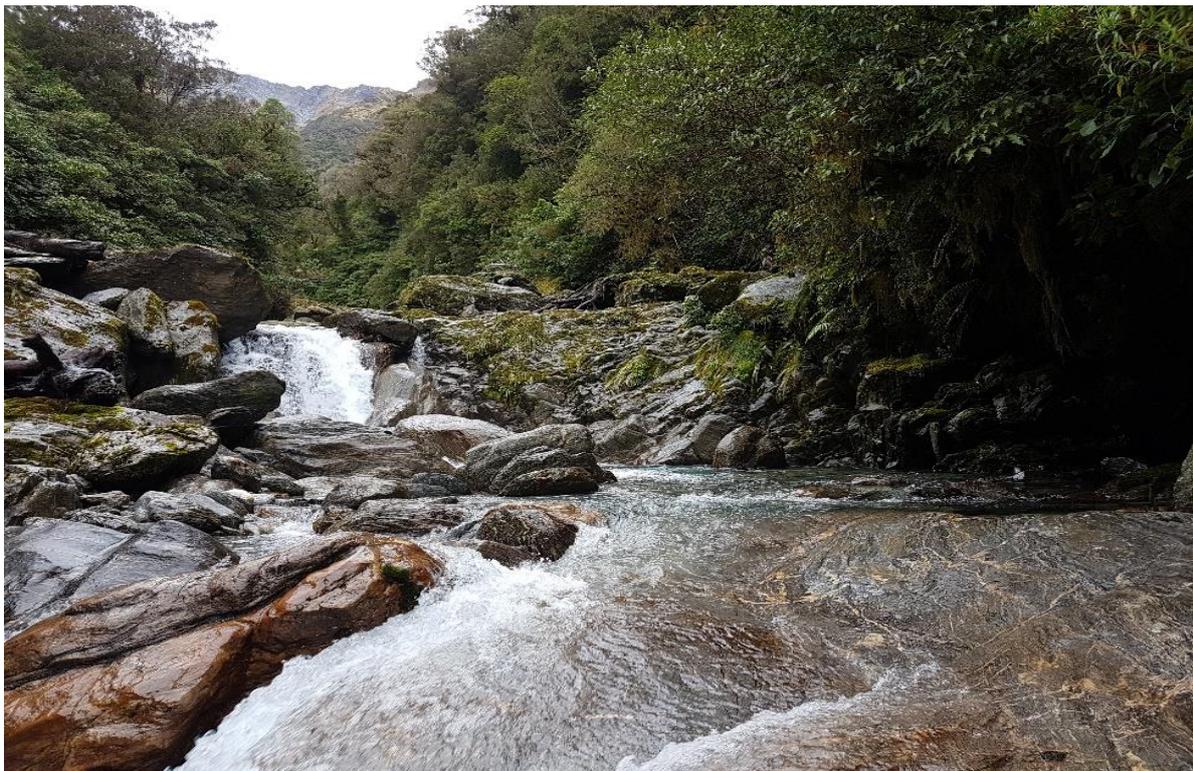


Plate 5 Photo of the cascade system at the intake. Particle size appears to be more uniform varying from large cobbles to boulders.

6.0 FISH

6.1 Desktop Review

In addition to general background searches, the following sources were consulted to establish a comparison between similar projects within the general vicinity. Further to this, communications with industry leading experts were undertaken to establish behaviour patterns by the various species and relations to habitat:

- NIWA, New Zealand Freshwater Fish Database, 2018 (July);
- Hutchison, M.; McCaughan, H.; Patrick, B. 2017. Ecological Assessment for the Proposed McCulloughs Creek Hydropower Project, 4205 Wildlands;
- Drinan, T.; McMurtrie, S.; Rowe, D. 2014. Proposed Waitaha Hydro Scheme Assessment of Environmental Effects: Fish of the Waitaha Catchment, 06003 ELE01-03, EOS Ecology; and
- Goodman, J.M.; Dunn, N.R.; Ravenscroft, P.J.; Allibone, R.M.; Boubee, J.A.T.; O. David, B.; Griffiths, M.; Ling, N.; Hitchmough, R.A.; Rolfe, J.R. 2014. Conservation status of New Zealand freshwater fish, 2013. New Zealand Threat Classification Series 7

6.2 Evaluation

The wider Whataroa River catchment has been known to support 10 species of fish (Table 3) with only three caught within the subject catchment by Wildlands during their site investigations. There has been minimal surveying throughout the wider catchment, resulting in species potentially being missed. The relatively high diversity of freshwater species is indicative of the variety of freshwater ecosystems found throughout the Whataroa River catchment.

Table 3 Detail of all fish species found within the wider Whataroa River catchment with species caught within the impact

Species	Common Name	Caught on site	Native/non-native	National Threat Status
<i>Anguilla australis</i>	Shortfin eel	No	Native	Not Threatened
<i>Anguilla dieffenbachii</i>	Longfin eel	No	Native	At Risk- Declining
<i>Cheimarrichthys fosteri</i>	Torrentfish	Yes	Native	At Risk- Declining
<i>Galaxias argenteus</i>	Giant Kokopu	No	Native	At Risk- Declining
<i>Galaxias brevipinnis</i>	Koaro	Yes	Native	At Risk- Declining
<i>Galaxias fasciatus</i>	Banded kokopu	No	Native	Not Threatened
<i>Galaxias maculatus</i>	Inanga	No	Native	At Risk- Declining
<i>Gobiomorphus cotidianus</i>	Common bully	No	Native	Not Threatened
<i>Paranephrops planifrons</i>	Koura	No	Native	-
<i>Salmo trutta</i>	Brown Trout	Yes	Non-native	Naturalised Introduced
<i>Neochanna apoda</i>	Brown Mudfish	No	Native	At Risk- Declining



6.2.1 Species Description, Migratory Behaviour, Habitat Preference

The following section will describe the species found within the wider Whataroa River catchment, migratory behaviour, habitat preference and inter-species competition. The species are detailed as distance recorded from the intake site.

Inanga (*Galaxias maculatus*)

Inanga are found within most stream and river systems throughout New Zealand and, where present, form a majority of galaxiid juveniles returning from the coastal environment^{26,27}. This species typically do not migrate far inland due to poor climbing ability and inability to deal with higher velocities. They are often located in low flows or back water pools where they are regularly found shoaling. They rely on a well-connected flood plain, ensuring that they can spawn within dense bankside vegetation. Considering their affinity for lowland systems, it is highly unlikely that inanga would be found within the vicinity of the impact site; as such, the species will not be considered further.

Common Bully (*Gobiomorphus cotidianus*)

Similar to inanga, common bully are found within most stream and river systems throughout New Zealand. The species is adept at penetrating deep through a watercourse, however do not often venture further than approximately 300 km inland and rarely greater than 680 metres above sea level (masl)^{25,26}. Habitat preference could be described as rather general as this species occurs within habitats from wetlands through to middle gravel-bedded rivers. The closest recorded population within the wider Whataroa catchment is located 10 km downstream of the proposed powerhouse location, within a wetland system. Their presence within the bottom section of the impact reach cannot be discounted, however common bully was not detected during the Wildlands survey despite electrofishing being known to detect this species. Should the species be present, they are unlikely to be further than the 150 masl point, given the change in habitat type; common bullies are well-documented as average climbers and would be unable to penetrate further upstream.

Brown Mudfish (*Neochanna apoda*)

Brown mudfish occur on the west coast of both the North and South Islands. The individual found within the wider Whataroa River catchment is likely one of the most southern populations of brown mudfish. They are extremely poor climbers, occurring only within lowland systems. The species is a specialist in slow flowing wetlands, swampy forests and shallow puddles. Due to the aforementioned habitat preferences, the species is highly unlikely to occur within the impact site and will not be considered further.

Banded Kokopu (*Galaxias fasciatus*)

Banded kokopu are generally the most common of the three kokopu species within New Zealand. Within the South Island, this species is often more frequent on the west coast due to the presence of canopy covered stream systems. The species is a strong climber as a juvenile and have been located above steep waterfalls. Adults prefer lower energetic waters, as opposed to the high energetic flow within the impact site^{28,29}, and are often found within lowland wetlands or slow flow pools. For this reason, it is unlikely that banded kokopu are present within the impact reach.

²⁶ McDowall, 1990, New Zealand Freshwater fishes; A Natural History and Guide

²⁷ McDowall, 2000, The Reed Field Guide to New Zealand Freshwater fishes.

²⁸ Rowe, Hicks, Richardson, 2000, Reduced abundance of banded kokopu (*Galaxias fasciatus*) and other native fish in turbid rivers of the North Island of New Zealand

²⁹ Richardson, Rowe, Smith, 2001, Effects of turbidity on the migration of juvenile banded kokopu (*Galaxias fasciatus*) in a natural stream



However, their presence cannot be fully discounted as banded kokopu are a nocturnal feeder and can often be difficult to detect with electrofishing, where habitat complexity provides significant refuge.

Longfin Eel (*Anguilla dieffenbachii*)

Longfin eel are endemic to New Zealand and are found throughout the country. The species is very mobile throughout any catchment that it is located within. Juveniles return from sea in early spring and migrate into river systems. They have been documented as very good climbers, demonstrating the ability to leave the water and travel across terrestrial environments to bypass instream barriers, a trait common to all freshwater eels. Habitat preference changes throughout the life of these eels, with younger individuals (<350mm) tending to inhabit boulder and cobble riffles, not dissimilar to the bottom of the impact reach. Larger individuals tend to switch habitat preference to large pools or slow-flowing water, with significant habitat cover, i.e. undercut banks and woody debris. These habitat types are typically found within lowland sections of river systems or within the flood plains. Several longfin eels have been recorded within the Whataroa River catchment; all have been located within the lower section of the river system of the main channel. Given the habitat type of the impact site, it is unlikely that any large individuals would be found, the same cannot be stated for individuals <350mm. However, longfin eels are often detected with electrofishing when present within a survey site so given that they were not detected during the Wildlands survey, the chance of detection on any additional survey is considered low.

Shortfin Eel (*Anguilla australis*)

Shortfin eels have a similar habitat preference and life history to longfin eels as described above. The main difference between the two species is the age length with shortfin maturing much quicker (15+ years) compared to longfin eel (25+ males, 35+ female). Again, smaller individuals (<300mm) are located within the fast-flowing riffles and the larger individuals within features typical of lowland systems. Given the habitat type of the impact site, it is unlikely that any large individuals would be found; the same cannot be stated about individuals <300mm. Likewise with longfin eels, shortfin eels are often detected with electrofishing when present within a survey site so given that they were not detected during the Wildlands survey, the chance of detection on any additional survey is considered low.

Giant Kokopu (*Galaxias argenteus*)

Giant kokopu are common throughout most of the west coast of the South Island. As their name suggests, they are the largest of the native Galaxiidae family found within New Zealand freshwater systems. Within the whitebait catch, juvenile giant kokopu are uncommon. Very little is known about their breeding behaviour, however current research efforts by NIWA hope to provide more information on this behaviour. Unlike banded kokopu and koaro, the returning whitebait are not great climbers. This is likely reflective of their habitat preference which leans strongly to low-flowing waters that occur in lowland runs and pools. They exhibit the behaviours of ambush predators, using the cover of overhanging vegetation, undercut banks, logs, or debris clusters to hide their presence. While there is a significant population of giant kokopu found within the Whataroa River catchment, these identified populations are all present within the lowland areas (from aerial imagery, it is expected to be slow-flowing streams and wetlands). Due to the above habitat preference, the species is highly unlikely to occur within the impact site and will not be considered further.



Torrentfish (*Cheimarrichthys fosteri*)

While found throughout New Zealand, torrentfish are nationally an 'At Risk- Declining' species. This species undertakes a seasonal migration for spawning, with males traveling into the lower section of a catchment to establish breeding grounds before the females arrive; upon spawning, both the males and females return to the upper environment. Contrary to expectations, torrentfish are relatively poor climbers, yet prefer fast-flowing water and are predominately caught within riffles in any river system. Torrentfish were caught during the survey assessing the impact reach. They were only caught within the reach around the powerhouse. Given their poor climbing ability and their absence from the survey site at the intake, it can be expected that torrentfish do not occur throughout the entire impact reach. It is expected that torrentfish exclusion is likely to occur quickly after 150 masl, given the change in stream type and occurrence of cascades and waterfalls. Additional surveys throughout the impact reach will be able to identify the likely natural barrier within the reach. This will allow for a more significant assessment of the actual impact on the torrentfish population within the impact reach.

Brown Trout (*Salmo trutta*)

Brown trout are the only non-native species found within the wider Whataroa River catchment based on the information drawn from NZFFD. They are a widely distributed non-native species, that has become naturalised throughout the majority of New Zealand after their introduction in the late 1860s. Brown trout have a generalist habitat selection ranging from estuaries and lowland lakes through to fast flowing boulder streams up in the head waters. The limit on their range is largely affected by two aspects. The first being the requirement of cool, well-oxygenated water and natural or man-made barriers. Given the impact reach has a cool temperature (5°C - 8°C) during the initial survey, temperature would not appear to have any limiting factor on brown trout distribution.

Brown trout require the presence of redds (clean well oxygenated gravel beds) to spawn in. Spawning occurs within autumn to early winter months and eggs hatch within 1 to 2 months depending on the water temperature. The eggs cannot be exposed to the air as they will desiccate and die. After hatching the fry remain near the redds until they have fully absorbed the yolk sac. The impact reach close to the powerhouse appears to present a habitat type suitable for redd presence, however, redd location can be difficult to identify from photos and aerial footage. Following yolk sac absorption, the fry will leave the redd and shoal together. Some individuals will head out to sea to develop while others will remain within the freshwater environment. The reasoning for the behaviour split is still poorly understood. The individuals that remain generally begin to occupy larger and larger pool systems. It is a regular occurrence to find a large pool which will have one large brown trout that maintains the pool as its territory.

Brown trout do demonstrate some mobility outside of breeding cues. Studies within European individuals found that they will move through the catchment to establish new territories and that these movements will often occur around higher than normal flow events. Brown trout possess very strong swimming abilities compared to New Zealand native species. Unlikely New Zealand species which migrate through the catchment using their climbing abilities, brown trout navigate through a river system by jumping over barriers. Generally, it is detailed that salmonids have a 3:1 ratio in relation to water column distance (run up) to jump height. Any barrier greater than 1.8m is considered a significant barrier; from the photos and aerial footage, there appear to be several significant barriers to jumping species throughout the impact reach. These barriers begin to appear after the 150 masl point. Given the absence of brown trout at the intake site, it is expected that there is some natural barrier between the powerhouse survey site and the intake survey site.



Establishing where the natural exclusion occurs is important to provide a greater understanding of the potential impact on brown trout and the impact on native species that interact with brown trout.



Plate 6 Photo of the impact reach above 150 masl - the photo shows a cascade followed by a pool. Of note, the cascade is likely passable by Brown trout



Plate 7 Photo of the impact reach above 150 masl - the photo shows a cascade followed by a pool. Of note, the cascade is likely unpassable by brown trout given the height of the cascade





Plate 8 Photo of the impact reach above 150 masl, the photo shows a waterfall. Of note, the waterfall is likely unpassable in nature to all but the best of climbers.

Koaro (*Galaxias brevipinnis*)

Koaro (Plate 9) are known for their climbing abilities with individuals recorded climbing up vertical concrete and buckets. These fish have also been known to scale waterfalls in excess of 60m. This climbing ability is due to a special adaptive trait of backwards facing ridges along the pectoral and pelvic fins. This species is able to penetrate deep inland and to significant elevation. Koaro uses the marginal habitat of gravel and litter, inundated in high flow, to spawn in. The eggs hatch approximately a month later on the next high flow event. Habitat selection is affected by the presence of salmonids. When salmonids are present within a reach the koaro will frequently be located within the faster flowing riffle system, most likely to avoid predation from the large salmonid species. Interestingly when salmonids are not present within a reach, koaro are found using pool systems as the main habitat preference. Given that koaro are the only species found throughout the impact reach it is important to identify the true extent of brown trout to establish the impact of the proposed hydropower scheme.



Plate 9 Photo of koaro caught at the intake site

7.0 MACROINVERTABRATES

7.1 Desktop Review

In addition to wider general background searches, the following information sources were consulted to establish a comparison between similar projects within the general vicinity.

- Freshwater Biodata Information System (FBIS);
- Shearer, K. 2016. Cawthron Institute freshwater invertebrate data. v1.1. The National Institute of Water and Atmospheric Research (NIWA). Dataset/Occurrence. https://gbifipt.niwa.co.nz/resource?r=cawthron_invertebrates&v=1.1;
- New Zealand Adult Caddisfly Database. nzcaddis.massey.ac.nz;
- Suren, A.; McMurtrie, S.; James, A. 2014. Proposed Waitaha Hydro Scheme Assessment of Environmental Effects: Benthic Ecology of the Waitaha Catchment, 06003 ELE01-02, EOS Ecology; and
- Hutchison, M.; McCaughan, H.; Patrick, B. 2017. Ecological Assessment for the Proposed McCulloughs Creek Hydropower Project, 4205 Wildlands

7.2 Evaluation

There was a significant data gap within the published data for macroinvertebrate within the upper section of the Whataroa River catchment. The only recorded data was for the lower catchment within the wetland habitat. This data is therefore not correlatable to the project area. Additionally, the FBIS has ceased as of 30 June 2018.

In comparison to a similar scheme within the Waitaha catchment, the biodiversity from the previous survey appears to be very low. The survey effort, while significantly greater, on the Waitaha catchment managed to return 104 taxa from 16 invertebrate groups (Figure 10). In comparison, the survey within the impact reaches only identified 5 distinct taxa (Figure 11 **Error! Reference source not found.**). While this is not a realistic comparison due to the difference in survey effort there is a clear difference in biodiversity. With an increased survey effort greater understanding of the macroinvertebrates would be achieved. Based on the analysis of the methodologies deployed in both assessments, intensity is the only difference. As such, any additional surveys should be able to gather species diversity.

Table 9 Summary of the 16 invertebrate groups identified in the 373 samples collected from 31 sites in the Waitaha catchment and seven sites in the Wanganui catchment during September 2007. The number of taxa identified within each invertebrate group is also indicated.

Invertebrate Group	Number of Taxa	Invertebrate Group	Number of Taxa
Acarina (mites)	1	Mollusca (snails)	2
Anisoptera (dragonflies/damselflies)	1	Megaloptera (dobsonflies)	1
Coleoptera (beetles)	5	Nematoda	1
Crustacea (e.g., shrimp)	4	Nematomorpha	1
Diptera (true flies)	31	Oligochaeta (worms)	1
Ephemeroptera (mayflies)	10	Platyhelminthes (flatworms)	1
Hemiptera (true bugs)	3	Plecoptera (stoneflies)	8
Hexapoda (e.g., springtails)	1	Trichoptera (caddisflies)	34

Figure 10 Extract of table 9 from the assessment of Waitaha catchment macroinvertebrates



Table 3: Freshwater macroinvertebrates found in McCulloughs Creek on 14 December 2016.

Family	Scientific Name	Common Name	Conservation Status (Granger <i>et al.</i> 2014)
Plecoptera	<i>Stenoperla prasina</i>	Green stonefly	Not Threatened
Plecoptera	<i>Zelandoperla fenestratā</i>	Stonefly	Not Threatened
Plecoptera	<i>Acroperla trivacuata</i>	Stonefly	Not Threatened
Ephemeroptera	<i>Deleatidium lillii</i>	Mayfly	Not Threatened
Diptera	<i>Neocurupia tonnoiri</i>	Net-winged midge	Not assessed

Figure 11 Extract of table 3 from the ecological assessment of Whataroa catchment

8.0 ASSESSMENT OF POTENTIAL EFFECTS

8.1 Freshwater Ecology

The hydropower scheme will see the gradual abstraction of flow from the 2.8km impact reach of McCullough Creek from 60L/s up to 600L/s. The abstraction of 25% of the MALF is accepted as permissible, resulting in the permissible theoretical low flow being 252L/s. This low flow will be maintained as the abstraction increases to the upper intake level of 600L/s. This gradual abstraction up to 600L/s from the impacted reach of McCulloughs creek will result in a significant shift in flow dynamics with the majority of flows leaving the abstraction site at 252L/s.

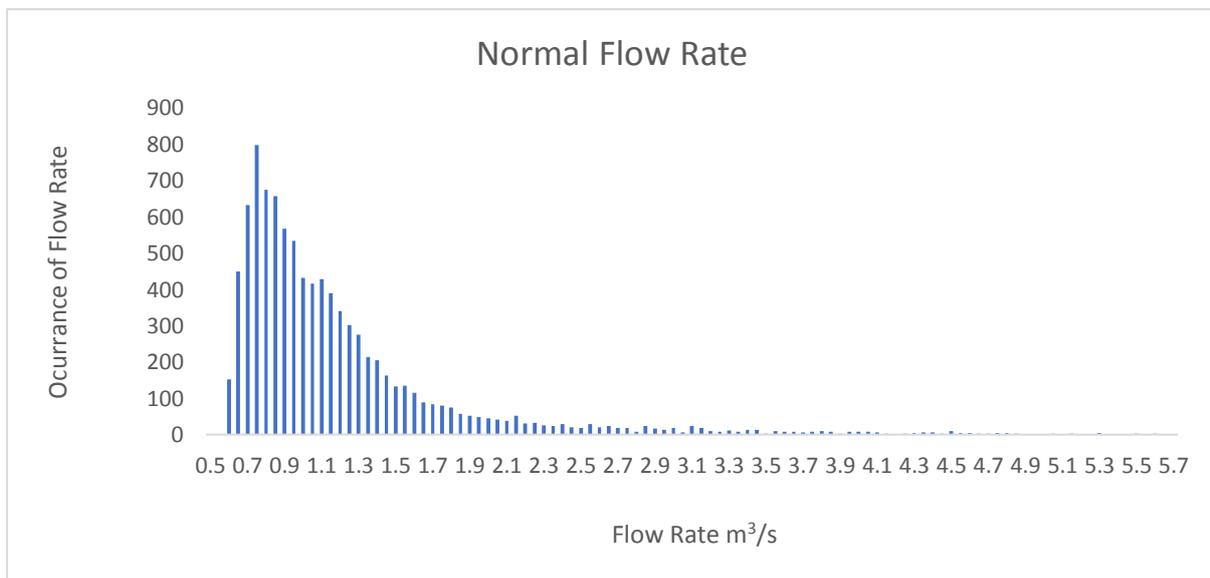


Figure 12 Graph of the normal flow rate passing the powerhouse site. The majority of the flow rated occurs between 0.7m³/s to 1.1m³/s

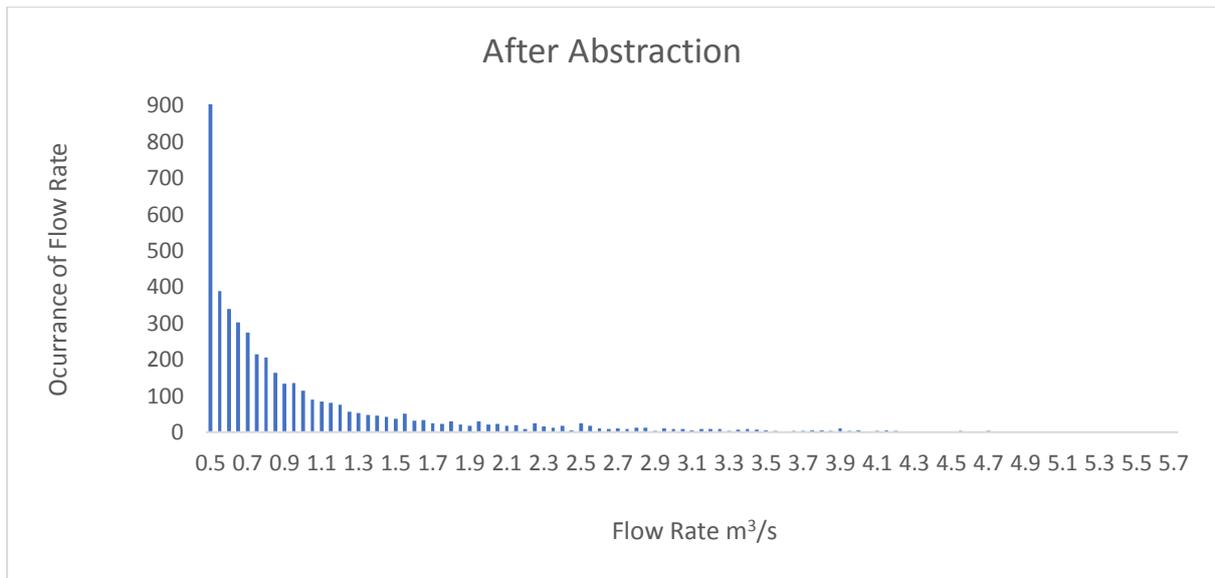


Figure 13 Graph of the theoretical flow rate after abstraction passing the powerhouse site. The majority of the flows now occur below the MALF <0.6.

This significant shift in flow characteristics can have a varying degree of impact, based on the following:

- The stream bed profile and distribution
- The point of salmonid exclusion from the impact reach

The loss of potential habitat with flow reduction cannot truly be assessed without a further assessment of the stream bed cross sectional model. Should, as expected, the cross-section analysis using a 1D model find that the majority of the impacted reach resembles the characteristic V shape of an upland stream system the reduction in available habitat is expected to be less than if the majority of the reach is a shallow U-shaped system. The justification for this statement is that a pool cascade system provides the majority of available habitat within the pools for the various species found within, which are not greatly impacted by the reduction in flow volume. Additionally, V-shaped stream systems present a reduced surface area to depth ratio resulting in less benthic habitat being exposed as the water levels drop. In comparison, the U-shaped stream system generally presents the pool-riffle-run sequence, as found within the lower reaches of the impact reach. These systems are generally impacted more as they present a greater surface area to depth ratio resulting in more benthic area being exposed by a reduced water level. Additionally, pools, riffles and runs all contribute to effective habitats for the variety of species. To fully assess the impact of the reduction in the flow it is recommended further 1D modelling is undertaken to provide details on habitat reductions.

The survey undertaken by Wildlands indicates that there is likely a natural barrier preventing all but koaro from accessing the upper reaches. While brown trout are notable for penetrating into the headwaters of a stream system their climbing methodology has the limitation that koaro can overcome. This is further supported when comparing to the Waitaha Hydro Scheme Assessment which again demonstrates a natural barrier to all but koaro. It is unlikely that the reduction in volume will create any natural barrier to koaro as they only require a wetland margin to climb passed barriers which will still be present within the stream channel. Reduction in volume within the impact reach may change the natural barrier to brown trout which could further restrict them from the

upper reach or may allow them to penetrate further or maintain the natural barrier in its current position. To assess impacts further an assessment of all perceived barriers within the lower reach will be undertaken. Barriers to fish migration will be identified and defined as either velocity barriers or height barriers. This assessment will be further supported by the 1D modelling. To ensure that the hydropower scheme is not affecting fish population distributions, it is recommended that a five-year fish monitoring programme is implemented after construction is completed.

The effect on the impact site with regards to hydro-peaking is considered to be minimal if not non-existent. This is due to the natural status of the stream system being a fast response system. Over the 388 days of flow recording, the stream volume dropped greater than 600L/s over an hour on over 68 occasions, with the highest drop being >2900L/s. This likely means that species present within the impact reach are well-adapted to rapid flow changes. To mitigate any further impacts, it is recommended that abstraction or shut down occurs in half an hour step down/ step up increments.

Fish passage around the weir structure will be facilitated by the secondary channel indicated within figure 6 of Wildlands EA. It is expected that at the time of writing, the construction of the Coanda style weir will result in a small pool developing behind the weir. This pool will then divert the remaining 252L/s base flow through the secondary channel. This flow will provide sufficient wetted margins for koaro to ascend around the weir. In periods of higher flow, flow on top of the base flow and upper abstraction limit, will be diverted through the secondary channel and over the top of the weir. To ensure koaro are traversing the secondary channel during operation, it is recommended that instream monitoring is undertaken above the weir system to confirm the fish passage.

The potential for fish injury and mortality due to interactions with the fish screen is considered low as the Coanda screen is designed in a way that sweeping velocity carries fish instantly off the screen³⁰. There is potential for this methodology to occasionally result in skin abrasion. The current research shows promising results on salmonid passing over the screens without any major effects on the individuals. It is recommended that as part of the live monitoring koaro caught around the intake site should be additionally monitored for signs of injury potentially associated with the Coanda screen.

The species located within the lower reaches will likely be drawn to the tailrace at the discharge point. In previous reports and articles, species found to be drawn to tailrace include koaro, bullies, eels, lamprey (*Geotria australis*), and salmonids. Given juvenile individuals generally migrate along the stream margin (lower velocities), there is potential that juveniles are more susceptible to being misdirected. The current design at the time of writing sees a single discharge point. To mitigate the potential misdirection, it is proposed to disperse the flow discharge through several discharge points reducing the volume entering the stream at any one point along the stream system, blurring a specific point source. This should reduce the flow trigger that may result in species being drawn to the discharge point(s). At current, it is impossible to estimate the level of effect the tailrace discharge will have on misdirecting migrating species. Further surveys will confirm the population utilising the upstream habitat and determine the likely effect.

³⁰ NIWA, 2007, Fish Screening: good practise guidelines for canterbury



9.0 RECOMMENDATIONS

9.1 Supplementary Ecological Investigations

Additional in-field surveys should be conducted across the project area outside of winter months. These surveys will aim to validate and refine ecological assessments undertaken by Wildlands and desktop investigations undertaken in this report. The following works are recommended:

- Supplementary fish surveys throughout McCulloughs Creek. This survey should utilise survey methods including gee-minnow traps, fyke nets, electrofishing and spotlighting;
- Investigation of natural fish passage barriers. This investigation should aim to identify at least the first three barriers from the powerhouse in an upstream direction that provide exclusion to all fish species but koaro;
- 1D habitat modelling across the impact reach (SEFA methodology to be used);
- Supplementary aquatic macroinvertebrate surveys using recommend practises for hard bottom stream systems. This should ensure a variety of instream habitats are surveyed;
- Herpetofauna surveys across the project area which at a minimum include targeted manual habitat searches and nocturnal spotlighting. Where present, key microhabitat areas should also be identified;
- Bats should be confirmed present or absent across the project area by means of acoustic surveys across the McCulloughs Creek catchment;
- Avifauna surveys should be undertaken by means of representative 5-minute-bird-count methodologies across all habitat types on site. Call playback methodologies could be used for appropriate species, including nocturnally for kiwi.

9.2 Design Updates

- It is recommended that the tailrace design is updated to disperse the terminating flow through several discharge points; reducing the volume entering the stream at any one point alone. This would act to reduce the flow trigger that may result in species being drawn to the discharge point(s); and
- The selected route of the lower penstock shall be updated from the previous alignment lodged within the original consent application to that of the design detailed in Route B, Appendix C. This new design is more considerate to large trees within the project area which contain higher botanical and fauna habitat values.

9.3 Monitoring and Management

- If bats are detected within the McCulloughs creek catchment, bat management will be required during the removal of any high-risk roosting trees. The specifics of this management are outside of the scope of this report but will be detailed in further reporting following the recommended supplementary surveys above;
- Where vegetation removal protocols are required for bat management, monitoring of the population over a specified period may be deemed appropriate if specified triggers are hit. These triggers can be negotiated with DOC and could include monitoring where vegetation removal protocols (VRPs) identify an active roost within the alignment, or if more than 10 trees > 80 cm DBH are to be felled;



- DOC will need to permit recommended herpetofauna surveys for this project. During the permit application process, DOC should be consulted as to whether they would benefit from genetic samples to be taken from any individual lizard species that are captured during survey works associated with the project. This provision of data will act to support research into these relatively understudied species, providing further insights into taxonomy and distribution (R. Hitchmough, personal communication, August 2018); and
- The bulk of vegetation removal which is to comprise of lower growing vegetation, should be undertaken outside of the main bird breeding season (October to January inclusive) to mitigate potential impacts on nesting avifauna species. If bats are found to be present within the McCulloughs Creek catchment, all larger trees with the potential to host roosting bats shall be left standing until the warmer months (October – April) where VRPs can be implemented to ensure these trees are free of bats before being felled. Due to the likely characteristics of these trees, a climbing arborist may be required to also check for the presence of birds such as falcon, yellow-crowned kakariki and kaka which may be nesting in tree holes and epiphytes.

10.0 CONCLUSIONS

It is recognised that the Project area is located within a large tract of mature indigenous forest containing a high-quality headwater system. The construction and operation of a hydropower scheme will undoubtedly require a degree of modification within the local environment, therefore consideration of such a scheme by DOC would be reliant on its environmental sensitivity. This project takes heed of the rugged West Coast environment in which it is situated and aims to provide innovative design and management practices to avoid, mitigate and remediate foreseeable potential impacts.

This report provides detail on the expected impacts on terrestrial fauna and freshwater values in relation to the proposed construction and operation of the McCulloughs Creek hydropower scheme and provides practical and effective means to manage specified ecological impacts. Further investigations have been recommended within this report to validate expected impacts and where necessary refine assessment and conclusions.



APPENDIX A

Report Limitations

This Report/Document has been provided by Ecology New Zealand Limited (ENZL) subject to the following limitations:

- i) This Report/Document has been prepared for the particular purpose outlined in ENZL's proposal and no responsibility is accepted for the use of this Report/Document, in whole or in part, in other contexts or for any other purpose.
- ii) The scope and the period of ENZL's services are as described in ENZL's proposal and are subject to restrictions and limitations. ENZL did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report/Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by ENZL in regards to it.
- iii) Conditions may exist which were undetectable given the limited nature of the enquiry ENZL was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Report/Document. Accordingly, if information in addition to that contained in this report is sought, additional studies and actions may be required.
- iv) The passage of time affects the information and assessment provided in this Report/Document. ENZL's opinions are based upon information that existed at the time of the production of the Report/Document. The Services provided allowed ENZL to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.
- v) Any assessments, designs and advice made in this Report/Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Report/Document.
- vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by ENZL for incomplete or inaccurate data supplied by others.
- vii) The Client acknowledges that ENZL may have retained subconsultants affiliated with ENZL to provide Services for the benefit of ENZL. ENZL will be fully responsible to the Client for the Services and work done by all of its subconsultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from ENZL and not ENZL's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against ENZL's affiliated companies, and their employees, officers and directors.
- viii) This Report/Document is provided for sole use by the Client and is confidential to it. No responsibility whatsoever for the contents of this Report/Document will be accepted to any person other than the Client. Any use which a third party makes of this Report/Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. ENZL accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Report/Document.



APPENDIX B

Department of Conservation – Request for further information





File Ref: 53660-OTH

12 June 2018

No 8 Hydro Ltd
103 Carlton Gore Road
New Market
Auckland 1023

Dear Jeremy

Re: CONCESSION APPLICATION 53660-OTH REQUEST FOR FURTHER INFORMATION, SUBMISSIONS RECEIVED AND PROPOSED HEARING.

Following your provision of further information on 16 March 2018, your application was publicly notified. This letter outlines the process that will follow, and requests further information.

Your application was notified on 24 April 2018, with the submission period closing on 24 May 2018.

Submissions Received

Three submissions have been received and are attached to this letter. As detailed below, two submitters wish to be heard in support of their submission:

- | | | |
|---|-------------------------------------|-------------------------|
| 1 | Federated Mountain Clubs | Wish to be heard |
| 2 | Forest and Bird – West Coast Branch | Wish to be heard |
| 3 | New Zealand Canyoning association | Do not wish to be heard |

Hearing

Submitters raised a number of concerns, including insufficient information. The further information request below will assist with these issues. The hearing has been delayed until the further information has been provided. Any further information will be provided to the submitters. If a hearing is still required details will be communicated at the time.

Further Information Required

Thank you for providing the further information in relation to our request of 23 January.

A more thorough assessment of your application has now been undertaken to determine the effects of the proposed activity. Given the size and nature of the proposal, the Department considers that you have not provided enough information to sufficiently determine what the effects of the proposed hydro scheme would be and at this point we do not have sufficient information to make a decision. It is acknowledged that this is a significant amount of further information, and I am happy to discuss this, and the options from here with you further.

The proposed methods to avoid, remedy and mitigate effects provided in your Environmental Impact Assessment and those recommended by the Wildlands Consultants are acknowledged, but can't be assessed properly without better information on the values and potential effects.

I also note that the Wildlands Consultants recommend a range of measures that would help to avoid, remedy and mitigate the effects of the proposed scheme. However, these recommendations do not appear to be reflected in your application. If these measures are proposed, you need to confirm that these have been included in your application or amend your scheme design.

Detailed below is a list of further information required:

1 Construction methods

To fully understand the construction footprint of the proposed access tracks and whether the footprint is feasible in that environment, please provide a concept design which includes a detailed description of the construction methods and footprint of the proposed route of the access tracks and penstocks, desander, tailrace and power house. This information should also show where the proposed access track would deviate from the penstock route. This information must be prepared by an appropriately qualified person (civil engineer) with input from a geotechnical expert in relation to this specific site.

This is very relevant in assessing the effects on flora/ecological values for the reasons noted in item 6 below.

I note that page 28 of the Wildlands Report states that *“destruction of and disturbance to indigenous vegetation during construction of the access road, pipeline/penstock, powerhouse and helicopter landing pad must be minimised by keeping the construction footprints as small as possible. Mechanical excavation (with a digger) should not be used for construction of the pipeline and penstock corridor, except where lower-impact methods (e.g. manual clearance with chainsaws and hand tools) are not possible or practical. Most of the pipeline and penstock route is very steep, and excavated materials (rocks, soil, vegetation) must be contained, by the use of appropriate tree felling methods, barriers and fences, and carefully disposed of during construction in order to ensure that debris does not fall downslope onto adjacent vegetation or end up in McCulloughs Creek.”*

Please provide an assessment of effects from the construction methods utilised at each part of the access track/penstocks.

2 Risk to Public

In your application you propose signage and fencing to mitigate ‘risks’ (hazards) to the public however there is no assessment of what the hazards are. There is no detail on what areas are proposed to be fenced.

Please provide an assessment of the hazards to the public in and around the proposed structures and methods proposed to mitigate those risks.

3 Freshwater

The Department’s freshwater specialist has stated that the effect of hydrological alteration and potential fish passage issues have not been adequately assessed. Further survey work for aquatic values present and more accurate hydrological data is required.

- **Freshwater biodiversity surveys**

- a. Aquatic macroinvertebrate sampling should be undertaken at a number of sites within the abstraction reach to determine the extant macroinvertebrate composition and community structure.
- b. Targeted macroinvertebrate sampling should occur in a range of habitats along the abstraction reach such as; seepage areas, lateral pool habitat, etc... which are most likely to harbor rarer macroinvertebrate taxa of greater conservation value.
- c. Malaise trapping should be undertaken at a number of sites along the abstraction reach to complement the above. This is needed to positively identify many of New Zealand’s aquatic invertebrates to species level (IDing to species often requires adults).
- d. Fish surveys should be repeated at a number of sites within the affected reach at a more appropriate time of the year (i.e., as recommended in Joy et al. [2013]). Additional survey methods (e.g., Gee’s minnow traps, fyke nets, spotlighting) should also be considered to complement electrofishing surveys (to provide an increased level of certainty).

- **Hydrological information**

- a. Further hydrological data should be collected from the abstraction reach, especially over the summer to autumn low-flow period, to provide greater accuracy and certainty of the hydrological estimates (especially low flow indices such as MALF).
- b. An assessment should be undertaken to determine how flow measured near the proposed powerhouse site compares with that at the point of take (e.g., simultaneous flow gaugings at both sites).

- **Assessment of Effects on freshwater biodiversity values**

- a. The proposed activity represents a large-scale diversion (diverting >50% of estimated average flow and increasing low flow duration significantly [at the intake]). A more detailed assessment should be undertaken to provide more certainty around the flow alteration effects on aquatic biota (once the surveys mentioned above have been undertaken). Technical method selection to determine ecological flow requirements should follow the values and risk-based framework described in the Beca (2008) 'Draft Guidelines for the Selection of Methods to Determine Ecological Flows and Water Levels'.
- b. An assessment should be undertaken to determine the potential effects of the abstraction on fish passage throughout the abstraction reach.
- c. Further detail is needed on the additional outlet at the intake weir that is proposed to "*allow fish to pass the weir, both up and downstream during low flows*".
- d. Potential fish injury/mortality rates (e.g., descaling, impingement) need to be assessed relative to the depth of water over the bottom of the screen.
- e. More detail is needed regarding operation of the intake to ensure minimum flow in the abstraction reach (as well as sufficient water depth over the weir) is maintained.
- f. Fish (especially migrating kōaro larvae and elvers) would likely be attracted to the tailrace outfall, and this effect needs to be assessed.
- g. Hydropeaking-related effects need to be assessed. Operational shutdown periods etc. can lead to hydropeaking-related effects (stranding and displacement due to down- and up-ramping, respectively).
- h. Clarify inconsistencies in the EIA (section 4.1), about how much water will be abstracted versus how much will be retained as residual flow in the 2.8-km abstraction reach. For example, statements such as the following appear erroneous "*This represents an average change of flow of 250 l/s at the intake location, or a 25% reduction in average flow*", considering the next paragraph states "*The current design flow represents 54% of the average flow*".

- **Application under Freshwater Fisheries Regulations 1983**

This application will require further approvals including under section 43 of the Freshwater Fisheries Regulations 1983. These relate to the weir construction and associated fish facility.

New Fish Passage Guidelines have recently been developed and can be found on the NIWA website at <https://www.niwa.co.nz/static/web/freshwater-and-estuaries/NZ-FishPassageGuidelines-upto4m-NIWA-DOC-NZFPAG.pdf>

An application for approvals under the Freshwater Regulations can be processed in parallel with the concession application or after a concession has been granted (if it was to be granted). The application form for this is attached.

4 Fauna

The Wildlands Consultants' report (August 2017) states in the introduction on page 1 of the Ecological Assessment - , "*Potential effects on birds, lizards, bats, and the marine ecosystem were not assessed*". It is noted that previous Department correspondence during the pre-application phase in June 2016 set out the requirement to provide an AEE which included flora and fauna survey. This

is still required and should include an assessment of the values and potential effects on birds, bats and lizards and any methods to avoid, remedy and mitigate these effects. Specifically;

- **Birds**

A number of nationally ‘Vulnerable’, ‘Critical’, ‘Recovering’ and ‘At Risk’ bird species are likely to be present in the area under application. Without bird surveys being undertaken there is insufficient data to assess this application for effects on birds.

- **Bats**

There is the potential for long tailed bats to be present in the area. If they are in the area there is the potential risk of them being killed, injured or displaced. The information is insufficient to assess the effects on bats because there is no survey provided on bats at the site.

Please provide an assessment of effects on bats including an assessment of the values, potential effects from the proposed scheme and any methods proposed to avoid remedy and mitigate these effects. This assessment would need to include a bat survey in the application area. A bat survey needs to be done in the correct conditions (temperature >7 degrees) between the period of September to May to assess the likelihood of risk to bats. The survey should have an adequate number of survey nights in optimum conditions and follow DOC’s best practice surveying guidelines:

<http://www.doc.govt.nz/getting-involved/run-a-project/our-procedures-and-sops/biodiversity-inventory-and-monitoring/bats/>

The Department strongly recommends a radio tracking study is done and that you should follow the overview diagram of the Bat Management Framework included in attachment 1 below.

- **Lizards**

A lizard survey over the application area by a Department approved lizard specialist is required to assess the area. It is likely that there would be a range of lizards in the area. However, it is impossible to accurately state the likely nature and size of lizard populations in the project footprint without proper survey. As lizards require specific habitat and are not evenly spread through the landscape, clearing areas could potentially harm a high number of lizards. This could cause ranging effects.

6 Flora/Ecological Assessment

- **Below ground effects on forest**

You have proposed mitigation measures you would carry out to minimise the above ground impacts on the indigenous forest but have not provided any mitigation measures for the below ground impacts (i.e. the tree roots).

In your application, you have provided an image (Figure 15) on page 20 of your EIA as an example of the proposed penstock access track. This clearly shows a benched track of 1.5m width. To build such a track, you would have to cut through at least the upper soil layer, causing potentially significant damage to tree roots in the process. You have not addressed this potential impact in your application, nor have you given any indication of mitigation measures in relation to it. Please assess this.

- **Not addressed- Containment of spoil while building penstock track**

The terrain in the upper part of the proposed penstock route is very steep and a large amount of spoil would have to be removed to build a track of the dimensions specified in your application. The Wildlands Consultants environmental impact assessment included the following statement:

“Construction of the access road, pipeline and penstock will produce substantial amounts of cleared material (rocks, soil and vegetation) that must be disposed of. Inappropriate disposal of this material (e.g. dumping it on indigenous vegetation outside the corridor) could greatly increase the size of the

designated construction footprints and result in more than minor adverse effects on indigenous vegetation.”

This impact has not been adequately addressed in your application, as there is no information as to how the risk of spillage of rock and soil downhill from the penstock would be mitigated.

It seems unlikely that you would be able to contain spoil and cut plant material within the specified width of the track. If you were not able to do so, this would cause adverse effects on the indigenous vegetation in the area, as the area of affected forest would be much larger than specified in your application. It is expected that this information will be addressed in your construction methodology and footprint requested in point 1 above.

- **Clarification around exact area of impact**

Throughout the application it is stated that the temporary cableway to be built to service the penstock installation would follow the exact path of the penstock, thus minimising damage to forest. However, when examining the maps in Appendix A of the application, these clearly show that the cableway would not follow the exact path of the penstock track, thus potentially increasing the impacted area substantially. Clarification is needed around the exact location of the cableway in relation to the penstock track, and the associated effects. It is also expected that this information will be addressed in your construction methodology and footprint requested in point 1 above.

- **Weeds - Clarification needed around cleaning of building material such as concrete aggregate**

The application states you would clean all building materials entering the site to reduce the risk of weed invasion. Please clarify how you are proposing to clean building products such as concrete aggregate and provide mitigation measures in terms of storage and movement of aggregate around the site to ensure that exotic weed spread would be minimised.

The application leaves room for interpretation in relation to removal of large trees.

The application states that trees >30cm DBH (Diameter at breast height) would only be removed if not practicable to retain them. This statement, if kept is too open to interpretation, and could lead to the potential removal of significant numbers of large trees. You will need to define what ‘not practicable’ means or state a maximum number of large trees that would be acceptable to remove.

Peer Reviews

The Department will be obtaining technical reviews of the visual assessment and the engineering concept design. This will require input from external consultants and will be cost recovered as part of the application.

Changes to Cost Estimate

I have updated the cost estimate based on the recent assessments by our technical experts, the time taken so far and the likely time that will be required to assess further information and the need for a further information request along with the submissions and need for a hearing.

The new cost estimate is \$36 000

All requested information must be provided by 28 September 2018. Please provide the requested information to Diana Clendon at dclendon@doc.govt.nz If you require additional time to provide this information, please contact Diana Clendon immediately to negotiate a different time frame.

Going Forward

Under section 17SD(5)(a) of the Conservation Act you can (within the specified time frame given for the further information) advise the Department that some or all of the information will not be

provided and request that the application be considered, and a decision made without the information requested.

If you wish to withdraw your application at any time you may do so in writing; you will be charged for all costs incurred until such notice is received.

Please contact Diana Clendon at dclendon@doc.govt.nz 03 7569170 if you have any questions about this letter or the on-going application process.

Yours sincerely



Mark Davies
Director Operations, Western South Island
Hokitika Office

Attachment 1 – Submissions

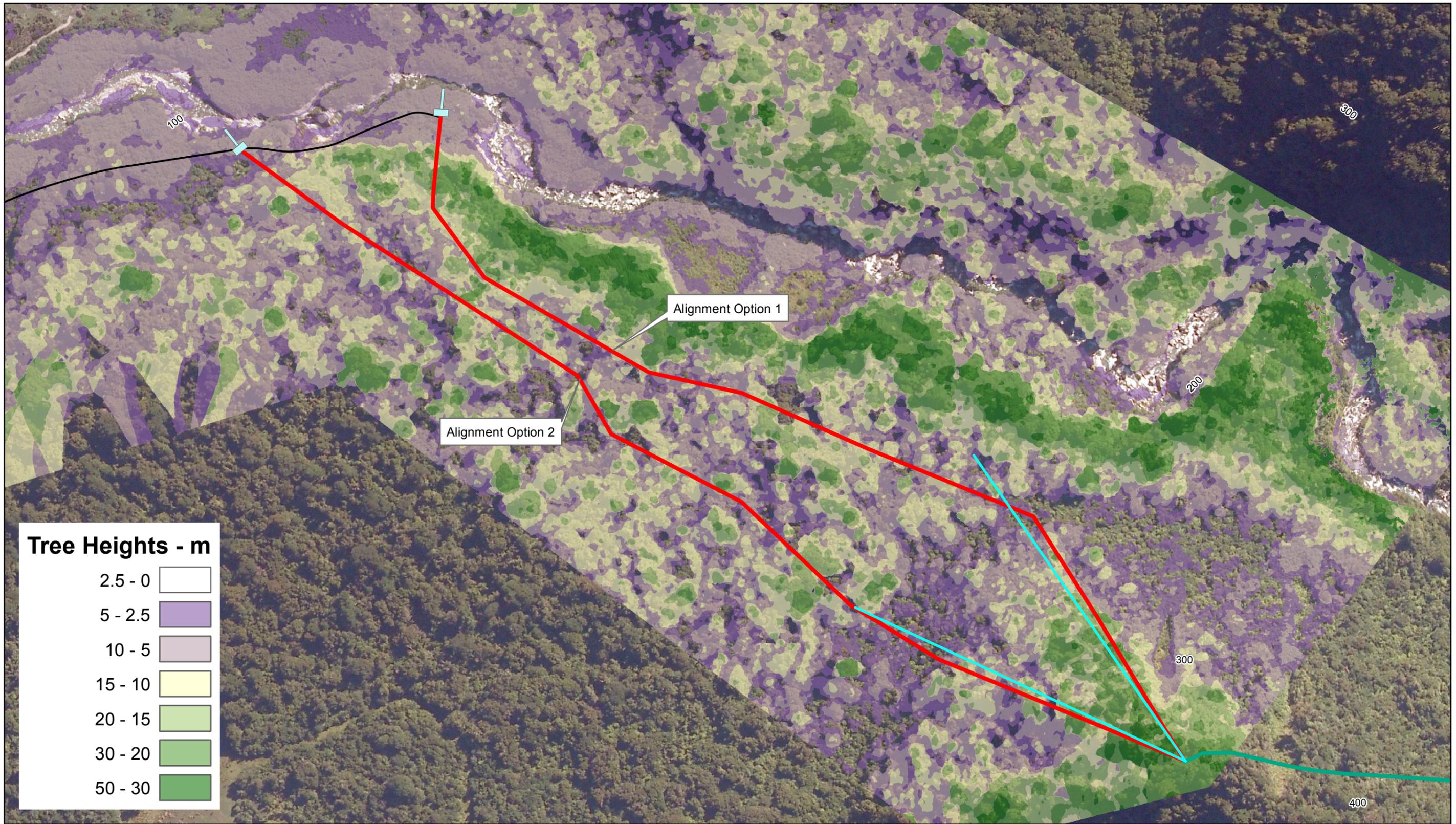


No 8 hydro
submissions - DOC-

APPENDIX C

Penstock Options and Tree Heights





No.8 Limited

McCulloughs Creek Hydropower Project
 Penstock Options and Tree Heights



Date	16/08/2017
Drawn	JKJ
Scale	1:2,500
Projection	NZGD 2000 NZTM



APPENDIX D

Complete List of Avifauna Documented in The Wider Landscape

The below table summarises a complete list of native avifauna documented from data sources described in section 4.3 of this report. This list includes documented avifauna from Harihari, Waiho, and Wilberg Ecological Districts.

Common Name	Scientific Name	Conservation Status ³¹
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Nationally Critical
Southern Crested Grebe	<i>Podiceps cristatus australis</i>	Nationally Vulnerable
Bellbird	<i>Anthornis melanura melanura</i>	Not Threatened
Black Shag	<i>Phalacrocorax carbo novaehollandiae</i>	Naturally Uncommon
Black Swan	<i>Cygnus atratus</i>	Not Threatened
Black-billed Gull	<i>Larus bulleri</i>	Nationally Critical
Blue Duck	<i>Hymenolaimus malachorhynchus</i>	Nationally Vulnerable
Brown Creeper	<i>Mohoua novaeseelandiae</i>	Not Threatened
Great Spotted kiwi	<i>Apteryx haastii</i>	Nationally Vulnerable
Grey Duck	<i>Anas superciliosa</i>	Nationally Critical
Grey Warbler	<i>Gerygone igata</i>	Not Threatened
Kea	<i>Nestor notabilis</i>	Nationally Endangered
Southern Blue Penguin	<i>Eudyptula minor minor</i>	Declining
Long-tailed Cuckoo	<i>Eudynamys taitensis</i>	Naturally Uncommon
Marsh Crake	<i>Porzana pusilla affinis</i>	Declining
Morepork	<i>Ninox novaeseelandiae novaeseelandiae</i>	Not Threatened
New Zealand Falcon	<i>Falco novaeseelandiae</i>	Recovering
New Zealand Pigeon	<i>Hemiphaga novaeseelandiae</i>	Not Threatened
New Zealand Pipit	<i>Anthus novaeseelandiae novaeseelandiae</i>	Declining
New Zealand Scaup	<i>Aythya novaeseelandiae</i>	Not Threatened
Okarito Brown Kiwi	<i>Apteryx rowi</i>	Nationally Vulnerable

³¹ Robertson, H.A.; Baird, K.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; McArthur, N.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2017: Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. Department of Conservation, Wellington. 23 p.



Common Name	Scientific Name	Conservation Status
Paradise Shelduck	<i>Tadorna variegata</i>	Not Threatened
Pukeko	<i>Porphyrio melanotus melanotus</i>	Not Threatened
Red-Crowned Kakariki	<i>Cyanoramphus novaezelandiae novaezelandiae</i>	Relict
Royal Spoonbill	<i>Platalea regia</i>	Naturally Uncommon
Shining Cuckoo	<i>Chrysococcyx lucidus lucidus</i>	Not Threatened
Silvereye	<i>Zosterops lateralis lateralis</i>	Not Threatened
South Island Fantail	<i>Rhipidura fuliginosa fuliginosa</i>	Not Threatened
South Island Fernbird	<i>Bowdleria punctata punctata</i>	Declining
South Island Kaka	<i>Nestor meridionalis meridionalis</i>	Nationally Vulnerable
South Island pied Oystercatcher	<i>Haematopus finschi</i>	Declining
South Island Rifleman	<i>Acanthisitta chloris chloris</i>	Not Threatened
South Island Robin	<i>Petroica australis</i>	Declining
South Island Tomtit	<i>Petroica macrocephala macrocephala</i>	Not Threatened
Southern Black-backed Gull	<i>Larus dominicanus dominicanus</i>	Not Threatened
Spur-winged plover	<i>Vanellus miles</i>	Not Threatened
Swamp Harrier	<i>Circus approximans</i>	Not Threatened
Tui	<i>Prosthemadera novaeseelandiae novaeseelandiae</i>	Not Threatened
Variable Oystercatcher	<i>Haematopus unicolor</i>	Recovering
Welcome Swallow	<i>Hirundo neoxena neoxena</i>	Not Threatened
Western Weka	<i>Gallirallus australis australis</i>	Not Threatened
White faced heron	<i>Egretta novaehollandiae</i>	Not Threatened
White Fronted Tern	<i>Sterna striata striata</i>	Declining
White Heron	<i>Ardea modesta</i>	Nationally Critical
Yellow-Crowned Parakeet	<i>Cyanoramphus auriceps</i>	Not Threatened
Yellowhead	<i>Mohoua ochrocephala</i>	Recovering



Common Name	Scientific Name	Conservation Status
Australian Magpie	<i>Gymnorhina tibicen</i>	Introduced and Naturalised
Canada goose	<i>Branta canadensis</i>	Introduced and Naturalised
Common Chaffinch	<i>Fringilla coelebs</i>	Introduced and Naturalised
Common redpoll	<i>Carduelis flammea</i>	Introduced and Naturalised
Common Starling	<i>Sturnus vulgaris</i>	Introduced and Naturalised
Dunnock	<i>Prunella modularis</i>	Introduced and Naturalised
Eurasian Blackbird	<i>Turdus merula</i>	Introduced and Naturalised
European goldfinch	<i>Carduelis carduelis</i>	Introduced and Naturalised
European greenfinch	<i>Carduelis chloris</i>	Introduced and Naturalised
House Sparrow	<i>Passer domesticus</i>	Introduced and Naturalised
Little Owl	<i>Athene noctua</i>	Introduced and Naturalised
Mallard	<i>Anas platyrhynchos</i>	Introduced and Naturalised
Skylark	<i>Alauda arvensis</i>	Introduced and Naturalised
Song Thrush	<i>Turdus philomelos</i>	Introduced and Naturalised
Yellowhammer	<i>Emberiza citrinella</i>	Introduced and Naturalised

