REPORT

Tonkin+Taylor

Lake Pūkaki Fast-track Consent Substantive Application

Ecological Impact Assessment

Prepared for
Meridian Energy Limited
Prepared by
Tonkin & Taylor Ltd
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Table of contents

Executive summary

Meridian Energy Limited (Meridian) hold consents to operate the Waitaki Power Scheme (WPS) for hydroelectric power generation. Lake Pūkaki is part of the WPS and is in the Mackenzie Basin of the South Island of New Zealand.

Merdian is seeking to authorise (through the Fast-track Approvals Act) the operation of Lake Pūkaki below the current normal minimum level of 518 metres (m) above mean sea level (RL), for a three-year period (2026, 2027 and 2028), and for civil works at Pūkaki Dam to improve the structure's resilience to wave action during lower lake operational levels.

This ecological impact assessment assesses the likely ecological impacts from the following proposed activities:

- Eased access to enable the operation of Lake Pūkaki between 518 and 513 m RL intermittently for three consecutive years being 2026, 2027 and 2028.
- Completing required dam armouring works at the dam face of Lake Pūkaki.

A desktop assessment and high-level field assessment were undertaken to determine the ecological values at the site. An assessment of the potential ecological impacts of the two activities was undertaken in general accordance with Environment Institute of Australia and New Zealand (EIANZ) guidelines (Roper-Lindsay et al. 2018). The guidelines provide a standardised framework and matrix allowing a consistent and transparent approach to assess ecological values and the magnitude of impacts to reach an overall conclusion on ecological impacts.

Ecological values assessment

The following ecological values are present within Lake Pūkaki and its connected areas:

- The environment is highly modified by human activity and the Waitaki power scheme, while also being compatible with a range of ecological values that have adapted to the modifications and variability of scheme operation.
- The Tasman River, the alpine and hill fed tributary rivers, and the hydrologically linked wetlands are ecologically significant per the Canterbury Regional Policy Statement (CRPS) Policy 9.3.1.
- The Tasman River and the alpine and hill fed tributary river habitats are of very high freshwater habitat value. This is primarily due to their upland natural state, rarity within the landscape and provision of habitat for species with some level of conservation concern.
- The littoral zone within Lake Pūkaki is considered to provide some beneficial biological function, which includes a low abundance and diversity of biofilm and macrophyte habitat that provides a food resource for macroinvertebrates and fish. The littoral zone of Lake Pūkaki is considered to have moderate – high ecological value, with value spatially variable and dependent on the bathymetric features of the lake. A higher value is attributed to areas where a larger and more stable littoral zone can develop.
- The Pūkaki zone (i.e., Lake Pūkaki and its tributary rivers) supports a low diversity of fish species, however several species present are of ecological, conservation or recreational value. However, the overall value of the fish community in Lake Pūkaki is moderate.
- Wetland ecological values associated with Lake Pūkaki range from moderate to very high. Most wetlands have limited hydrological connectivity to the lake, however the Tasman River Delta has a 'high' hydrological connectivity to the lake.

- Avifauna ecological values associated with Lake Pūkaki range from low to very high. Highest value species include kakī (*Himantopus novaezelandiae*) and Australasian bittern (*Botaurus poiciloptilus*), which are classified as Threatened – Nationally Critical.
- Lizard and invertebrate ecological values range from low to very high. Highest value species include Lakes skink (*Oligosoma aff. chloronton*; Threatened – Nationally Vulnerable), Mackenzie skink (*O. prasinum*; Threatened – Nationally Vulnerable), and scree skink (*O. waimatense*; Threatened – Nationally Vulnerable).

Potential impacts of eased access

This proposal anticipates a 3 % to 4 % probability that the lake level in any given week will be below 518 m RL over the next three years (which equates to an average of 39 days over the three year period). The potential impacts of the temporary change to the low water threshold on freshwater, wetland and terrestrial values are summarised below:

- The temporary exposure of otherwise submerged river channels due to the changes in water level is likely to have a net 'no change' impact on the high value Tasman River and the alpine and hill fed tributaries, and their associated fauna. This equates to a negligible level of impact and an overall very low level of impacts to the Tasman River and the tributaries from changes to the Lake Pūkaki water level.
- The littoral zone within Lake Pūkaki is of moderate – high ecological value. Impacts from the eased access are expected to only result in a minor shift from baseline conditions. This is due to the rate and/ or magnitude of lake level variability being the major driver in littoral habitat productivity. This variability will occur no matter the minimum operational level of the lake and is primarily due to the current operation of Lake Pūkaki which is likely having a low magnitude of effect on the productivity of the littoral zone and its associated food chains. A low magnitude of effect on a moderate – high ecological value results in an overall low level of effect.
- A moderate value fish community is present within Lake Pūkaki, and the population and community structure is compatible with a highly variable lake level. The impact of the eased access will be discernible in terms of temporary changes to the littoral zone, but any impact on the underlying species composition and known range of fish species will be minor. This negligible magnitude of effect results in an overall very low level of effect on the fish community within Lake Pūkaki.
- Extended eased access could result in adverse impacts to hydraulically connected wetlands. However, the overall effect is expected to be very low to low due to:
  - The short duration of the eased access;
  - Wetlands, except the Tasman Delta, only interact with the lake at approximately 525 m RL and above;
  - The fact that existing wetlands are adapted to fluctuating lake levels associated with the existing environmental hydrological management; and
  - Natural inputs extrinsic to the lake (such as upstream snowmelt/rainfall or groundwater inputs).
- Impacts of the eased access could affect wetland and riverine habitat quality and therefore avifauna. Due to the short duration of the eased access, a low overall low level of effect is expected.
- Native lizards and invertebrates are not expected to be impacted by the activity.

Potential impacts from dam armouring works

Armouring works will be undertaken on the Lake Pūkaki side of the dam during low lake levels. Access tracks will be required to access the works area through existing riprap. Native vegetation is sparsely distributed across the proposed access tracks. Potential impacts of the dam armouring works on freshwater, wetland and terrestrial values are summarised below:

- Potential impacts of sediment entering or resuspended within the lake may affect lake littoral zone communities.
- Sparsely distributed native vegetation is present in the proposed access track footprint ranging in value from low to high. Native vegetation will need to be removed to facilitate armouring works. The area of clearance will include 915 m^2 of short grass with occasional native shrubs.
- Habitat is considered low-value and largely unsuitable for native avifauna nesting and no direct impacts are expected.
- Native lizards (of low to very high ecological value) may be present either within the direct project footprint or at a nearby material stockpile site. Impacts to lizards could include disturbance, injury or incidental morality during the construction phase. Lizards could also lose potential habitat and be displaced to surrounding habitats. A pre-construction survey is proposed to assess lizard presence and species composition[1].

Impact on significant indigenous vegetation and significant habitat of indigenous biodiversity

It is expected that the significant ecological attributes (per Policy 9.3.1 of the Canterbury Regional Policy Statement) present in the Tasman River, the tributary rivers, and the hydrologically linked wetlands (in particular the Tasman River Delta wetland) will be managed so that no net loss of indigenous biodiversity or indigenous biodiversity values will result from the proposed eased access and dam armouring works.

Impact management recommendations:

For most ecological features, no direct impacts are expected. Management of lizards will however be undertaken in accordance with a Lizard Management Plan (LMP). A lizard survey is required in appropriate weather conditions to determine which lizard species (if any) are present. If lizards are recorded, a suite of effects management scenarios have been recommended to manage adverse effects on lizards and based on the Conservation Status (Hitchmough et al. 2021) of species present. These include selective use of rock material to the extent practicable, and a compensation fund to target lizard monitoring and management in the area. In the unlikely case that pre-construction surveys detect Threatened species, a one-off salvage to secure the population is proposed as outlined in the LMP.

No targeted management of the braided, alpine and hill-fed tributary river, and lake littoral habitats is proposed on the basis that the overall level of effects have been assessed to be very low – low.

During the dam armouring works erosion and sediment control (ESC) measures should be implemented to manage the impacts of sedimentation on wetlands and the lake littoral zone.

Based on our assessment and with the implementation of proposed management measures, the extended lake lowering and armouring works are not expected to result in significant adverse ecological effects.

[1] A pre-construction survey has not yet been undertaken due to being outside the active lizard season but is planned for the 2025/2026 season.

1 Introduction

Meridian Energy Limited (Meridian)has engaged Tonkin & Taylor Ltd (T+T), to assist with obtaining approvals to authorise the operation of Lake Pūkaki below the current normal minimum level of 518 m above mean sea level (m RL), for a three-year period, and for civil works at Pūkaki Dam to improve the structure's resilience to wave action during lower lake operational levels.

1.1 Project Background

1.1.1 Waitaki Power Scheme

The Waitaki Power Scheme (WPS) is a nationally and regionally significant component of New Zealand's electricity supply infrastructure. It is New Zealand's largest and most flexible hydroelectricity power scheme and therefore has a critical role to play in the electricity system and economy. It consists of eight power stations (two owned by Genesis Energy and six owned by Meridian Energy), commissioned between 1935 and 1985, together having an installed capacity of 1,761 MW, being ~32 % of New Zealand's installed hydro capacity.

Lake Pūkaki is a modified natural lake and is managed as part of the WPS. It is New Zealand's largest hydro storage lake and provides an average of 1,767 GWh of stored water in normal operating conditions, with an additional 545 GWh available du-ring a national electricity shortage.

Meridian is currently authorised to dam the Pūkaki River to control and operate Lake Pūkaki between the levels of 518 m RL (normal consented minimum lake level) and 532.5 m RL (maximum consented storage level).

1.1.2 Previous Plan Changes - Waitaki Catchment Allocation Regional Plan

The Waitaki Catchment Allocation Regional Plan (WAP) is a sub-regional plan and provides objectives, policies and rules for the use and development of water resources within the Waitaki Catchment. Prior to 2012, it was a prohibited activity in the WAP for Meridian to draw the lake level below 518 m RL.

1.1.2.1 Plan Change 1 (PC1)

In 2012, Meridian initiated Plan Change 1 (PC 1) to the WAP which sought to introduce a new minimum lake level for Lake Pūkaki during circumstances when the System Operator (SO) had commenced an Official Conservation Campaign (OCC) regarding electricity supply. PC1 allowed additional water from Lake Pūkaki to be used for generating electricity as a permitted activity when an OCC is declared by the SO.

When assessing the potential operation of Lake Pūkaki below 518m for PC1, the duration of an entire event (time below 518 m RL) was considered likely to be between 4-7 months (this includes the time spent operating below 518 m RL, as well as the time required to restore the lake level to above 518 m RL once an electricity supply emergency ended). Supporting technical effects assessments were submitted as part of this plan change process. It was ultimately concluded that allowing access for electricity generation purposes to water stored between 513 and 518 m RL, as a permitted activity once an electricity supply emergency had been declared, was appropriate and promoted the sustainable management purpose of the RMA. PC1 was adopted by Environment Canterbury on 27 September 2012.

This report relies on the PC1 2012 effects assessments as being appropriate and focuses on both the changes that have occurred since 2012, and the differences between the activities permitted by PC 1 and the proposed activities. This is the 'Baseline' that is referred to throughout this report.

Furthermore, Meridian will carry out all existing ecological mitigation and monitoring from PC1 and the consent into the FTAA. Where lowering below 518 m RL is required, kakī/black stilt monitoring will be undertaken as per the agreement between DOC and Meridian.[2]

1.1.2.2 Plan Change 3 (PC3)

PC3 included a new rule regarding the use of Lake Pūkaki between 518 m RL and 515 m RL. In addition to the PC1 Permitted Activity rule, at times of a Security of Supply Alert (SSA) initiated by the SO, the lake may be operated between the alert minimum control level of 515 m RL and 518 m RL as a discretionary activity. Meridian applied for and was a granted resource consent in relation to this activity in 2018 (CRC185833). This consent expired on 30 April 2025 but has been granted a section 124 continuance while the new replacement consent (CRC240441) is being processed.

1.1.3 Meridan's Application

Meridian is seeking approvals under the Fast Track Approvals Act (FTAA) to enable access to water stored in Lake Pūkaki below 518 m RL, without the currently applicable security of supply triggers, thereby enabling the better planning and utilisation of the available stored generating capacity. Further information on the background to the proposal and the benefits of allowing access to additional water is provided in the Substantive Application Report of the FTAA application.

Meridian is proposing to access the additional storage for a time-bound period of three years, until the end of 2028. For the purpose of this report 'Eased Access', refers to the ability to use water from Lake Pūkaki between 513 m RL and 518 m RL without a SSA or OCC being initiated by the SO. The ability to access stored water below 518 m RL will be incorporated into Meridian's electricity generation models and water stored in Lake Pūkaki (both above and below 518 m RL) will continue to be managed to supply the market. The three-year period is to allow for additional generation capacity that is currently being built, to come online. For further clarification, the existing lake operation framework and proposed activity is detailed below in Table 1.1.

Table 1.1: Proposed Activity – Eased Access

Existing Framework	Proposed Activity
Operation of Lake above 518 m RL (CRC905321.7).	Operation of Lake above 518 m RL (CRC905321.7). UNCHANGED.
Operation of Lake between 518 m RL and 515 m RL as a discretionary activity at times of a Security of Supply Alert initiated by the System Operator (CRC185833).	Operation of Lake between 518 m RL and 513 m RL for a period of 3 years without a Security of Supply Alert or Official Conservation Campaign being initiated by the System Operator.
Operation of Lake between 518 m RL and 513 m RL as permitted activity during an Official Conservation Campaign initiated by the System Operator (Permitted Activity).	

In addition to the temporary ability to lower the lake level, Meridian seeks consent for the installation of rip-rap on the upstream face of the Pūkaki dam and its left and right abutments to provide protection from wave erosion, when operating the lake below 518 m RL. Rip-rap will be placed to a maximum depth of 510.5 m RL, with earthworks/site preparation activities extending to a maximum depth of 509.6 m RL. Rock armouring will take a total of 12-18 weeks to complete but is

[2] Emergency Electircity Supply Agreement between the Director-General of Conservation and Meridian Energy Limited, 2012.

expected to be done over multiple stages over several years as lower lake levels permit, and works may be required to be completed beyond 2028.

Meridian has stockpiled rock for this purpose on its land adjacent to the Pūkaki dam since 2014, but the rock armouring has not been undertaken due to the existing supply triggers never being initiated by the SO, with the result that the lake level has not been low enough over that period to allow the works to be completed.

1.2 Scope

The purpose of this report is to provide an ecological impact assessment (EcIA) to inform the Meridian FTAA substantive application to:

- Enable eased access to water between 518 and 513 m RL intermittently for a 3-year period following approval.
- Complete required rock armouring works at the Lake Pūkaki dam face and abutments.

This EcIA will form part of a suite of technical reports/memos that will inform Meridian's FTAA substantive application and has been prepared in accordance with the Tonkin & Taylor Ltd (T+T) variation order dated 27 June 2025.[3]

1.3 Report structure

The report is structured as follows:

- Introduction (Section 1).
- Description of the proposed works (Section 2).
- Assessment methods (Section 3).
- Freshwater and terrestrial ecology characteristics and values (Section 4).
- Ecological impact assessment (Section 5).
- Residual effects management (Section 6).
- Summary and conclusion (Sections 7 and 8).

1.4 Report Author and Contributions

The qualifications and experience of the report authors are set out in Section 9. The authors confirm that they have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2023) and agree to comply with it. In that regard the lead authors confirm that this report is written within their expertise, except where stated that the author is relying on the assessment of another person. The author confirms that they have not omitted to consider material facts known to them that might alter or detract from the opinions expressed.

1.5 Geographical and ecological context

Lake Pūkaki is part of the Waitaki Power Scheme (WPS) and is in the Mackenzie Basin of New Zealand's South Island (Figure 1.1) and is located in the Tekapō Ecological District (ED).

Historically, and post human settlement, the Tekapō ED was comprised of red tussockland. Presently, red tussockland is confined to remnants in depressions and watercourses, and pest plants and grasses intentionally sown to replace former tussockland dominate much of the former red tussockland habitat. Key fauna characteristics of the ED include wetland, riverine and lake-associated birds, including the Threatened – Nationally Critical black stilt/kakī (*Himantopus*

[3] T+T (27 June 2025). Variation Order 01: Fast Track Substantive Reporting.

navaezelandiae) and Australasian bittern (*Botaurus poiciloptilus*) (Robertson et al. 2021). Braided riverbed habitats in the ED also provide roosting and nesting habitat for a variety of At Risk and Threatened braided river birds. Various native lizard species are present in the ED, and a number of endemic and rare invertebrates are also present. In addition, the headwaters of various tributary rivers provide habitat for several native fish species with some level of conservation concern.

Ecological information on the Tasman River including its delta and its connected habitats, the alpine and hill fed river tributaries, and the wetlands that are hydrologically linked with Lake Pūkaki was reviewed against Policy 9.3.1 and Appendix 3 of the Canterbury Regional Policy Statement (CRPS) to determine if associated habitat for indigenous biodiversity meet significance criteria. The Tasman River is the main inflow to Lake Pūkaki. It is a large, braided river with its catchment extending into the Aoraki/Mount Cook National Park which incorporates the Tasman, Murchison, Hooker and Mueller glaciers. Similarly, the alpine and hill fed tributaries are largely natural with catchments extending into areas primarily comprised of indigenous vegetation cover. The hydrologically linked wetlands support some indigenous species (flora and fauna), but many have been degraded by introduced plant species invasions. An assessment of ecological information for these areas against the significance criteria is provided in Appendix A. Overall, the Tasman Rivers, the alpine and hill fed tributaries, and the hydrologically linked wetland ecosystem were determined to meet several of the specified criteria. Including for representativeness, rarity/distinctiveness, diversity and pattern, and ecological context (Appendix A). Therefore, in our view these habitats should be considered a significant habitat of indigenous biodiversity. The Project River Recovery' (PRR) programme (manged by DOC and funded by Meridian (and Genesis) has supported the maintenance of the indigenous biodiversity across these areas.

Lake Pūkaki has a typical surface area of approximately 179 km^2 and is used for water storage as part of the WPS. Prior to the Pūkaki dam being built, the lake's natural surface level was c. 484 m RL. Two periods of dam building have resulted in the lake level being elevated. The initial Pūkaki dam raised the lake by c. 10 m, while the second dam increased the normal lake operating range to be between 518 – 532.5 m RL. Lake Pūkaki water levels are today therefore between c. 34 and 47 m higher than its 'natural' level (Barrel et al. 2013).

The lake's 'operating range' is provided in Figure 1.2. The lake is principally fed by the Tasman River and the Tekapō hydro scheme and bordered by the Ben Ohau Mountain range and farmland. The Pūkaki River downstream of Lake Pūkaki is considered a 'Site of Natural Significance' (SONS) under the Mackenzie District Plan.

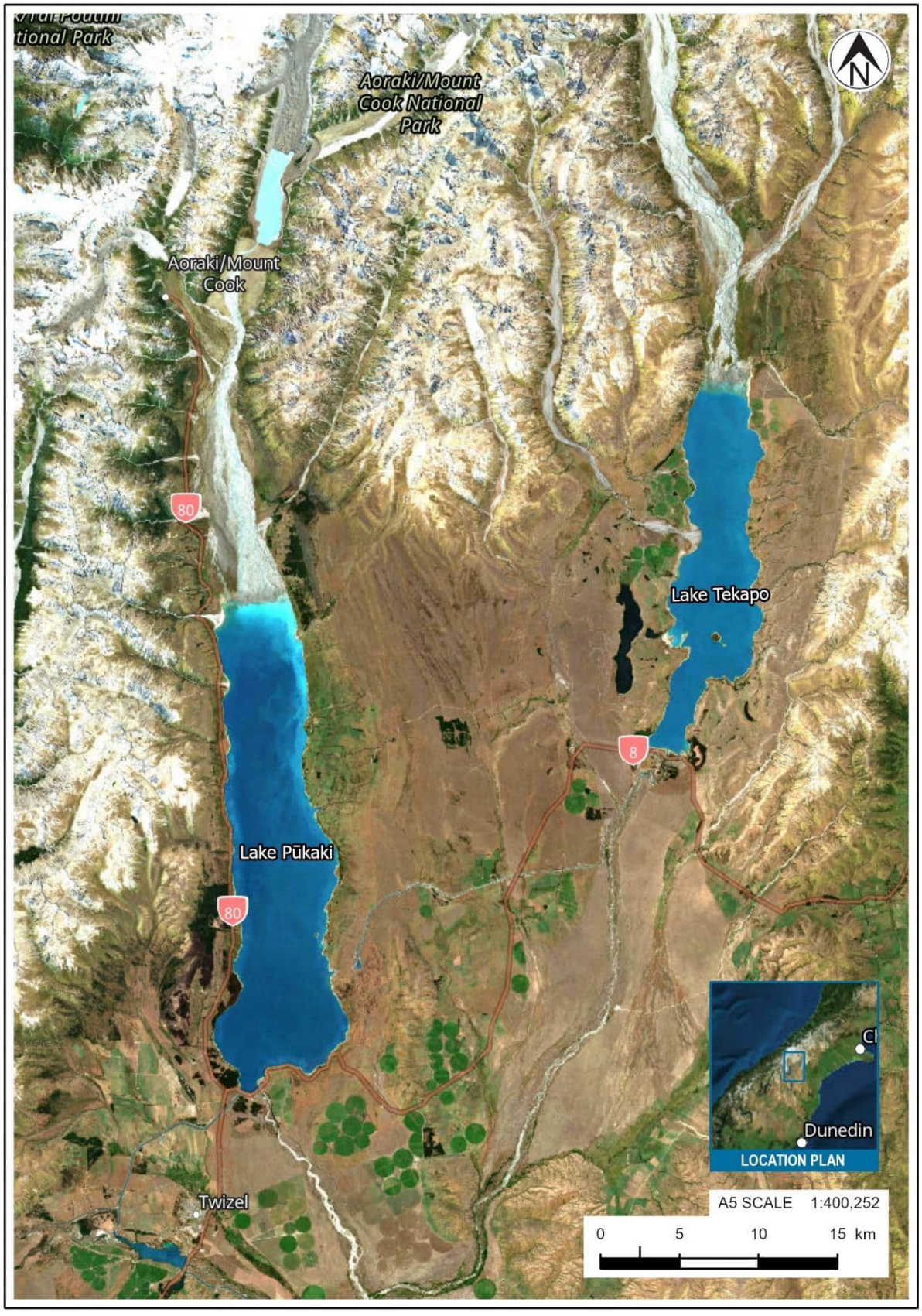


Figure 1.1: Lake Pūkaki location within the Mackenzie Basin.

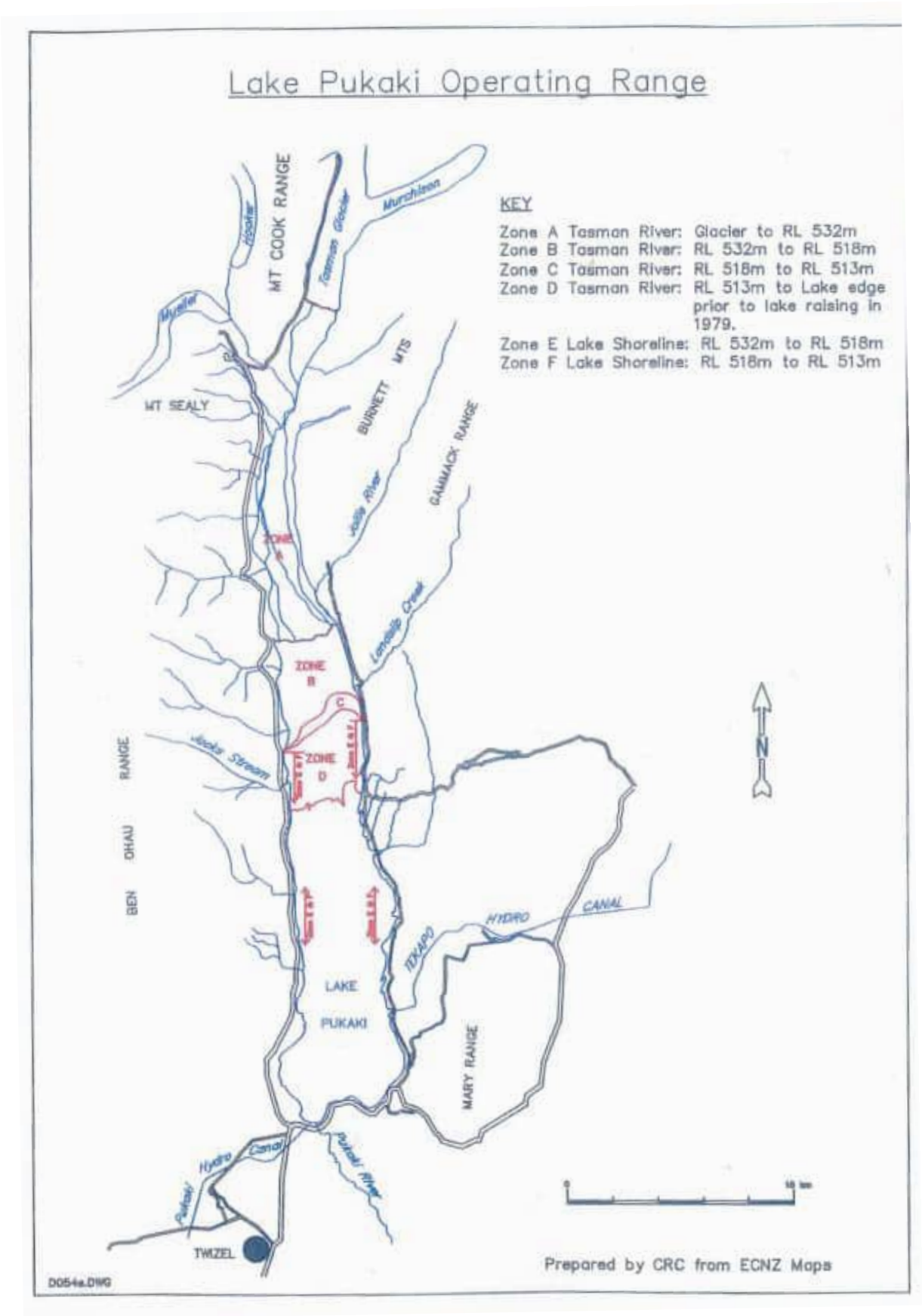


Figure 1.2: Expected water level change at Lake Pūkaki, showing drawdown impacts on lake shoreline. Note: for the purpose of this report "Zone C" is the zone of interest. Figure supplied by Meridian.

1.6 Re-consenting background and ecological context

Meridian has submitted resource consent applications to Canterbury Regional Council (CRC), for the period 2025 – 2060, to continue operation of the WPS. This includes to dam Pūkaki River and to operate Lake Pūkaki at the previously consented range of 518 and 532.5 m RL (i.e., per resource consent CRC905321.7). Meridian has requested the suite of consent applications (which includes CRC240441) be directly referred to the Environment Court, which Environment Canterbury (ECan) has accepted. The current status of that consent applications is that it will be heard and decided by the Environment Court.[4] The resource consent application included a suite of ecological reports[5] and assessments, including freshwater, wetland and terrestrial reports.[6]

Kahu Ora is a proposed 35-year Indigenous Biodiversity Enhancement Programme (IBEP) developed through an agreement between Department of Conservation (DOC), Meridian Energy, and Genesis Energy as part of the reconsenting for the WPS. To manage potential adverse ecological effects of continued operation of the WPS, Kahu Ora includes:

- A compensation package to address adverse effects of the WPS on ecological values. This replaces and adds to the previous 'Project River Recovery' (PRR) programme. The PRR is a DOC administered programme and was originally established in 1991 as a compensatory funding agreement for the adverse impacts of the WPS on braided river and wetland ecosystems.
- Having the Kahu Ora proffered as a condition of consent[7] and that the consent holder's contribution to the IBEP must have a minimum annual value of $2.01 M.
- Development of a 10-year Strategic Plan. A draft Kahu Ora Strategic Plan has been developed (DOC, 2025).
- Implementation of Kahu Ora for the life of the consent (35 years).

A compensation approach has been agreed through the re-consenting process as an appropriate means to address residual effects due to the difficulty in determining specific cause and effect of the WPS, given the numerous external environmental drivers impacting the ecological values. The proposed Revised Draft Kahu Ora Strategic Action Plan (DOC, 2025) provides compensation investment divided across four zones (Figure 1.3):

- Upper catchment rivers, lakes and associated wetlands (33.2% contribution).
- Mid-catchment rivers and associated wetlands (34.1% contribution).
- Lakes Ruataniwha, Benmore, Aviemore and Waitaki and associated wetlands (2.1% contribution).
- The lower Waitaki River and associated wetlands (30.6% contribution).

The proposed Revised Draft Kahu Ora Strategic Action Plan (DOC, 2025) outlines key management actions. These include the following measures across the various zones:

- Weed control.
- Predator control.
- Grazer and browser control.
- Education and advocacy.
- Enhancement of habitats.

[4] Per ECan's publicly notified applications website (accessed 9 July 2025) - ecan.govt.nz - notifications and submissions
[5] Authored by NIWA and Boffa Miskel Ltd ecologists.
[6] Where specific ecology reports have been used to inform this report, they are referenced accordingly, and full references are available in the Section 6.
[7] See condition 120 of the proposed consent conditions within the Meridian resource consent application.

- Filling of knowledge gaps.
- Monitoring of success.

Overall, the plan provides a holistic and integrated plan to safeguard and enhance biodiversity, including fish, birds, lizards and invertebrates across a number of catchments.

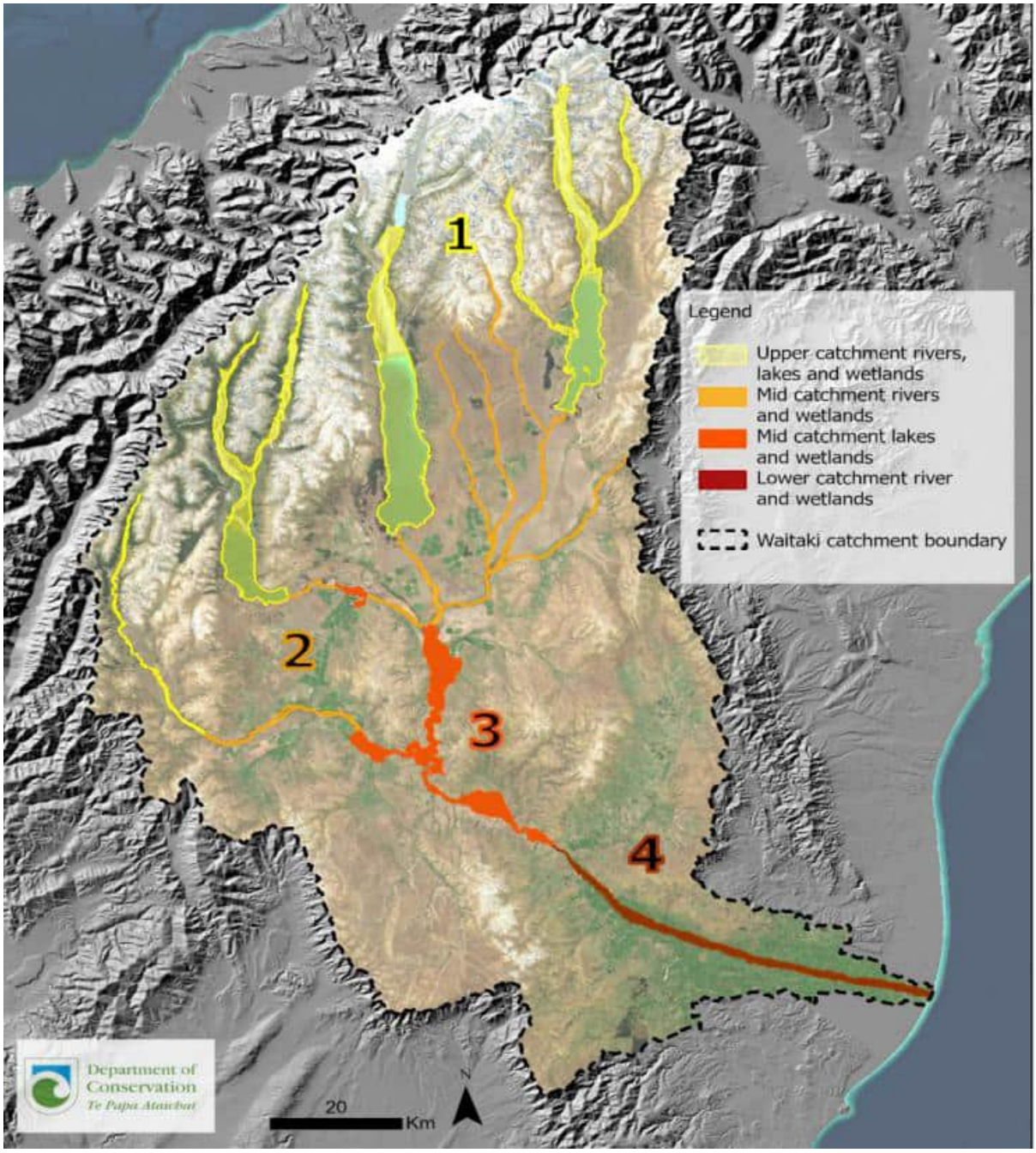


Figure 1.3: The Waitaki catchment divided into four geographical zones based on current ecological and cultural values, the impacts from the combined WPS and geography. From the proposed Revised Draft Kahu Ora Strategic Plan 2025 (DOC, 2025). Note: Lake Pūkaki and its inflow tributaries are in geographical zone 1.

2 Description of the proposed activities

Meridian is proposing two activities, being:

- Over a three-year period, having the ability to lower the lake levels below 518 m RL to a minimum level of 513 m RL, so that stored lake water can be used to generate electricity.
- When the lake levels are low, this enables civil works on the upstream face of the Pūkaki Dam and abutments, specifically extending rip-rap armouring to reduce the risk of wave erosion on the dam face and other critical infrastructure when lake levels are low.

2.1 Short-term change to lake operating level

Meridian undertook modelling to understand potential changes to lake levels from the proposed activity (Meridian, 2025). The modelling draws on 91 years of hydrological and meteorological data for the lake, and the current understanding of the NZ energy system (supply and demand analysis) resulting in forecasts of stored water (energy), which can be used to understand potential changes to lake levels). The Meridian modelling indicates the following:

Modelled First Year of Eased Operation (2026)

- Under eased conditions of operation, typically lake levels are held lower, but still within the normal operating range above 518 m RL most of the time, only falling below 518 m RL on occasion.
- There is approximately a 3 % probability that lake levels in any given week will be below 518 m RL. Therefore, on average the lake level will be below 518 m RL for approximately 1.5 weeks in the first year of operation.
- 23 % of the modelled hydrological sequences dip below 518 m RL in the first year. However, most instances are short duration and not deep. Of the 91 hydrological sequences modelled, 21 sequences fall below 518.0 m and of these 21 sequences:
  - 9 fall between 518 – 517 m
  - 6 fall between 517 m – 516.5 m
  - 3 fall between 516.5 m – 516 m
  - 2 fall between 516 m - 515 m
  - 1 falls below 515 m
- In terms of duration, in the worst-case scenario, the lake level falls below 518 m RL in early September and does not return above 518 m RL until December (a duration of no more than 4 months). However, the likelihood of this scenario is extremely low – approximately 1% (1 of the 91 hydrological sequences modelled).

Modelled Subsequent Years of Eased Operation (2027 and 2028)

The pattern is broadly the same in subsequent years although the probability of falling below 518 m RL in any given week increases very slightly to 3.5% in 2027 and 4% in 2028.

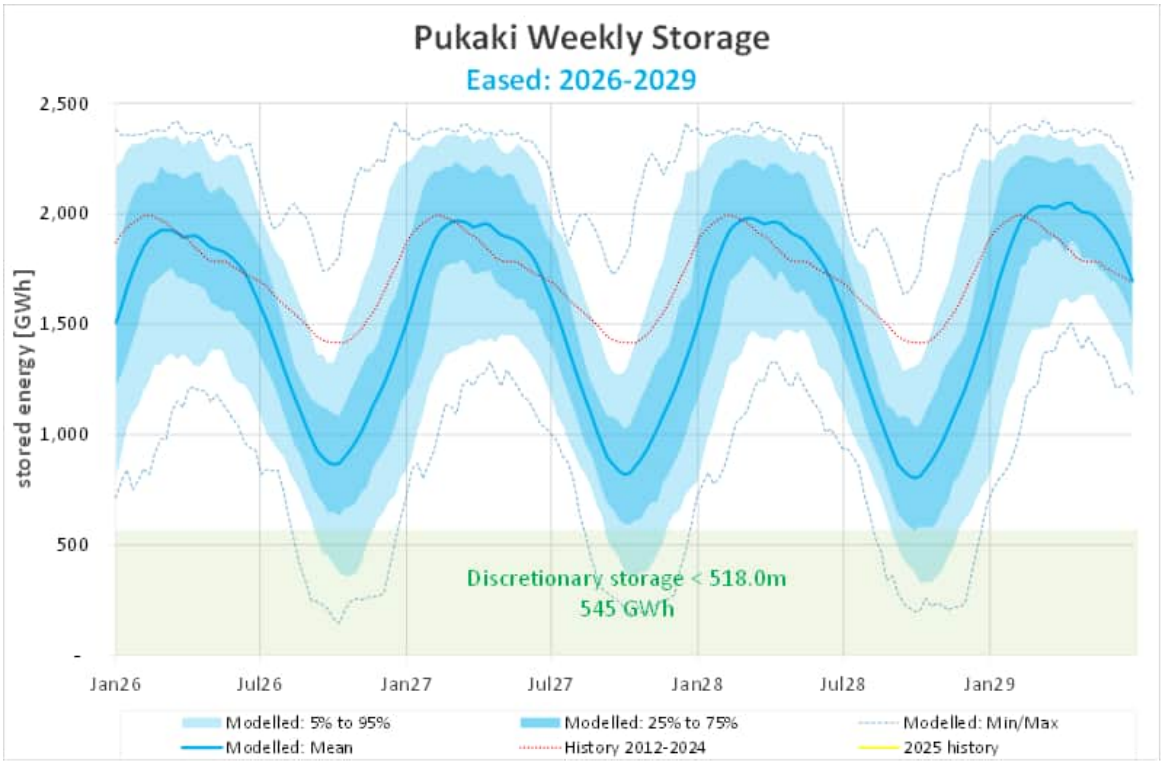


Figure 2.1: Meridian (2025) modelling results for stored lake water

2.2 Plan Change 1

The PC1 application stated:

- The duration of an event (time below 518 m RL) is likely to be between 4-7 months, with 7 months being an extreme scenario. Refilling of the lake to return above 518 m RL was by late December and sometimes into early January.
- The rate of drawdown of lake levels was estimated to be 1.5 m to 3 m per month in low flow conditions.
- The PC1 application did not consider the frequency of lake levels going below 518 m RL.

PC1 occurred prior to the National Environmental Standards for Freshwater (2020) therefore, impacts on natural inland wetlands were not explicitly assessed, but were considered as part of the overall assessment.

2.3 Armouring Pūkaki Dam

To enhance the Pūkaki Dam's resilience to wave action, protective rip rap will be installed on the slopes of the Pūkaki Dam's Main Dam Face (High Dam) and Left and Right Abutments (Figure 2.2). Construction works will involve the following:

- Site establishment, including temporary building.
- Constructing access tracks and ramps.
- Transporting rock armour from the current location to a designated stockpile area.
- Constructing work benches.
- Constructing toe/key along High Dam.
- Rock placement on High Dam.
- Rock placement on abutments.

- Stockpile access for rock material.
- Decommission of site.

These works are proposed to occur during periods where the dam water level is at a sufficiently low level to access the works area. As a result:

- Construction activities may be short in duration (a few weeks) and occur over multiple stages.
- It may take multiple years to complete all required works.

Material for the riprap will be sourced from nearby stockpile areas located off Twizel Town Tracks and Tekapo-Twizel Road (Appendix C2). The stockpile areas are approximately 6.3 ha and 0.8 ha in size respectively and comprise rock that has been brought into the area for the purpose of placement on the Pūkaki Dam face.

Figure 2.2: Dam armouring works preliminary design footprint and stockpile locations (GHD, August 1, 2025).

2.4 Statutory context

A number of national and regional policy documents are relevant to determining the ecological values and constraints that apply to the site and the Project. A thorough assessment against the relevant national and regional objectives, policies, and rules is likely to be required as part of the preparation of any FTAA application/s. It is not expected that this ecology report provides that assessment. However, to provide context to this report, a summary of the relevant statutory framework has been provided.

The FTAA, imports the RMA documents discussed below but the purpose of the FTAA receives greater weight than RMA considerations.

Under the National Policy Statement for Freshwater Management (NPS-FM – amended January 2024) the effects management hierarchy requires that effects (impacts) are avoided where practicable, minimised or remedied. Where there are more than minor residual adverse effects following the above, then offsetting or compensation may be provided.

The CRPS and the Canterbury Land and Water Regional Plan (CLWRP) set out objectives, policies and methods to achieve the integrated management of the natural and physical resources of Canterbury. The CRPS/ CLWRP identifies that particular adverse effects to be managed include the loss and degradation to indigenous vegetation and habitats of indigenous fauna; and river margins and wetland values. In addition, the CRPS requires 'no net loss' of significant indigenous biodiversity.

All indigenous terrestrial vertebrate fauna species (e.g., lizards, bats, birds) and some indigenous invertebrate species are protected under the Wildlife Act 1953 (Wildlife Act). Management of protected wildlife (such as handling, relocation and accidental killing) can be approved through the Fast Track Approvals Act 2024.

3 Assessment methods

3.1 Desktop review of available information

A desktop assessment and review of relevant ecological information of the Lake Pūkaki catchment was undertaken. Historic reports and data relating to the wider WPS were provided by Meridian and were reviewed. Extensive information is available as a result of work undertaken to inform the reconsenting of the WPS. In addition, a further search of publicly available scientific reports and journal articles was also completed (see Section 3.1.1 below for a list of references used).

The assessment included a review of public databases including:

- DOC Bat Database (updated 23 August 2024).
- eBird (eBird.org) (accessed 27 January 2025).
- DOC Herpetofauna Database (updated 5 December 2024).
- iNaturalist (iNaturalist.org) (accessed 27 January 2025).
- New Zealand Freshwater Fish Database (NZFFD; accessed 28 January 2025).
- Canterbury Maps and various associated environmental and historic aerial layers (accessed 28 January 2025).

3.1.1 Reliance on previous reporting

This assessment included a review of various technical reports prepared for Meridian for the re-consenting of the WPS and as stand alone technical reports. For the purpose of this EcIA, the findings of these technical reports have been relied on to inform the assessment. These include:

- The prepared Impact Assessments on:
  - Wetlands (Boffa Miskell, 2023).
  - Freshwater birds (NIWA, 2023).
  - Native fisheries (NIWA, 2023a).
  - Salmonid fisheries (NIWA, 2023b).
  - River geomorphology (NIWA, Hoyle, 2023c).
  - Benthic ecology (NIWA, 2023d).
  - Water quality (NIWA, 2023e).
- Lakeshore geomorphology and processes (Shore Processes and Management Ltd, 2022).
- The requests for further information per s.92 of the RMA:
  - Native fish (NIWA, 2024).
  - Salmonids (NIWA, 2024a).
- Statements of Evidence (various).
- Technical reports and memos prepared for Meridian:
  - Water quality and periphyton in the Waitaki catchment (NIWA, 2024b).
  - Terrestrial ecology of braided rivers (Boffa Miskell, 2022).
  - Reconnoitre for submerged macrophytes at Lake Pūkaki (NIWA, 2021).
  - Native fish species in the Upper Waitaki Catchment from 2019 – 2020 (NIWA, 2020a).
  - Diverted Rivers – Additional macroinvertebrate survey Tasman River (NIWA, 2020b).
  - The current status of salmonid populations and fishery values in the Waitaki catchment (NIWA, 2019).

- Pūkaki Enhancement Project. Terrestrial Ecology Assessment (Boffa Miskell, 2011).
- Pūkaki Enhancement Project: assessment of effects on fish stocks and fisheries (NIWA, 2011).
- Pūkaki Hydro Scheme, Lake Pūkaki: Ecology assessment (Boffa Miskell, 2010).

3.2 Field assessment

A site visit was undertaken by T+T ecologists on 23 and 24 January 2025. Lake levels were high during the site visit and were above 531 m RL. Weather conditions during the site visit were warm (> 24 °C) and calm on 23 January, a period of overnight rain occurred until the early morning of 24 January.[8] The remainder of 24 January was mild (> 19 °C) and calm.

The site visit included a general visual assessment of Lake Pūkaki and its connected areas, as well as key streams and wetlands highlighted by the various NIWA (2023) and Boffa Miskell (2023) reports. A visual assessment of the proposed armouring works zone was also undertaken. It should be noted that any specific habitats and work zones that may be present when the lake level is < 518 m RL were submerged at the time of the site visit.

A targeted survey for lizards was not undertaken as part of this assessment due to seasonal limitations. While initial site visits occurred during the appropriate survey window (summer), the need to assess the stockpile areas for lizards was identified after this period following a later understanding of the construction methodology and use of the stockpiles. Seasonal conditions were no longer suitable for effective lizard survey.

3.3 Approach to ecological impact assessment

The method applied to this ecological impact assessment report broadly follows the Ecological Impact Assessment Guidelines (EcIAG) published by the Environment Institute of Australia and New Zealand (EIANZ) (Roper-Lindsay et al., 2018) (Appendix B). The guidelines provide a standardised framework and matrix allowing a consistent and transparent assessment of ecological effects. These guidelines have historically been used as a guide to assess ecological effects within the standard regulatory framework and were not originally developed with the FTAA in mind. Therefore, for the purpose of this EcIA, deviations from the EIANZ guidelines may be necessary.

3.3.1 Residual effects approach

It is generally accepted in the EIANZ guidelines that if, after all efforts to avoid, minimise, and remedy effects, there remains an overall effect of **moderate** or higher, further efforts are required to be considered to address these residual adverse effects in the form of offset or compensation.

3.3.2 Fast-Track Approvals Act 2024 terminology

A FTAA panel can decline an application where significant adverse impacts are out of proportion to the project's regional or national benefits (as per Section 85 (3) of the FTAA). The EIANZ guidelines provides guidance for assessing effects under the standard regulatory framework. As stated in Section 3.3.1, the guidelines consider that significant adverse impacts are generally those that result in an overall level of effect of 'moderate' or higher following avoidance, minimisation and remediation actions; and offset and compensation measures.

However, for the purpose of this EcIA, the substantive application and FTAA expert panel will form a judgement based on the impacts of the proposed activities and the project's regional and national benefits. It may eventuate that a moderate or greater overall level of adverse effect (i.e., a

[8] 6.8 mm of rain, recorded at Twizel (AWS-93737).

significant adverse impact) could be approved if regional or national benefits are substantial, while the same overall level of impact may not be approved if a more modest regional and national benefit is realised from the project.

To reflect this, a statement is provided after each impact assessment on whether significant adverse impacts are expected.

3.3.3 Assessment environment

For this assessment, the potential impacts from the proposed eased access scenario (i.e., the removal of the contingent storage operating restrictions) were assessed against the environment that currently exists at Lake Pūkaki. From here on, this is termed the "existing environment". Essentially, the existing environment includes the ecological values and condition of Lake Pūkaki and its connected area as currently present.

For clarity, our assessment considers whether the removal of the lower operating restriction of 518 m RL will result in significant adverse impacts on ecological values beyond that considered as part of PC1.

4 Freshwater and terrestrial ecology characteristics and values

This section describes the nature, condition, and sensitivity of the freshwater and terrestrial environments in terms of the ecological values within, on, and connected to Lake Pūkaki. The available data were compared, where relevant, against national and regional guidelines to establish a baseline condition from which to assess the magnitude of impacts on ecology from the implementation of the modelled eased scenario.

4.1 Freshwater

The natural freshwater ecosystems within the Pūkaki zone[9] include the spring, alpine and hill fed tributary rivers of both the lake and the Tasman River; the braided river environments of the Tasman River (including the Tasman River delta), and Lake Pūkaki and its connected habitats (Appendix C1). The rivers upstream of the Tasman River delta are unaffected by any changes in the water level of Lake Pūkaki and are therefore not considered further in this assessment.

The following sections provide a summary of the river tributary and lake ecosystems and the freshwater faunal community present within the Pūkaki zone.

4.1.1 River ecosystems

The alpine and hill fed tributary rivers are largely considered to be natural with minimal land-use changes within their respective catchments. However, the eastern tributaries of Lake Pūkaki do have catchments consisting of high and low producing grassland supporting various agricultural activities. All of these tributaries provide important habitat for freshwater species, especially during specific life cycle behaviours (such as fish spawning and young of year[10] habitat).

At a coarse scale the tributary habitats consist of either semi confined or confined valleys in the lower to upper stream catchment before merging into small to medium alluvial fans at the stream's confluence with the lake. Stream substrates consisted of gravels, cobbles, and boulders; with some periphyton growth present where substrate stability was observed. Vegetation cover is dependent on catchment locality and use, where the western tributaries are predominantly sited within steep high energy catchments with a greater proportion of native vegetation cover (all be-it naturally sparse of tall stature vegetation). While the eastern side tributaries have a relatively lower gradient (than the western tributaries), with the catchment cover consisting of a greater proportion of agricultural land.

In some tributaries, consented stream works within the bed of the river have been undertaken by New Zealand Transport Agency Waka Kotahi (NZTA), adjacent landowners, and Meridian. These works primarily appear to be to remove aggraded river sediments from roading structures and to direct high flow events from infrastructure and/or populated areas, and for gravel extraction purposes. It is not expected that works in the beds of these tributaries has occurred or will occur in association with or due to changes in lake water level and therefore works in the bed of a river are not considered further.

The braided river environments of the Tasman River are considered '*priorities for protection*' in the CRPS (Policy 9.3.2). This is due to the braided river system being a '*naturally uncommon*' ecosystem type both nationally and within the Tekapō ED and providing habitats for threatened and at-risk indigenous species. Generally, braided river environments with natural sources of flow (such as the Tasman River) are categorised as being ecologically significant. For this EcIA the Tasman River (and its delta) is considered a significant habitat of indigenous biodiversity (per Policy 9.3.1 and Appendix 3 of the CRPS) and should be protected to ensure no net loss of indigenous biodiversity or

[9] The natural inflow catchments (i.e., tributaries) flowing into Lake Pūkaki, and is dominated by the Tasman River.
[10] Young of year fish are those that are less than one year old.

indigenous biodiversity values (Appendix A). Indigenous biodiversity in the local surrounds is being maintained by the PRR ecological measures, managed by DOC and funded by Meridian (and Genisis).

As stated above, braided river habitats with natural sources of flow are ecologically significant and are of high value. Therefore, the Tasman River and its associated delta is of **very high** freshwater habitat value. This is primarily due to its rarity within the landscape and its provision of ecological services for species with a level of conservation concern. The active management to control weeds and pests in this area under the PRR has also maintained the area to a very high ecological value level.

Similarly, the alpine and hill fed tributary rivers are also considered to be of **very high** freshwater habitat value. This is primarily due to their natural state, provision of ecological services, and that only low impact land use changes have occurred in their respective catchments.

4.1.2 Lake ecosystems

Since the construction of the first dam in the 1950's, no large-scale land use changes have occurred within the Lake Pūkaki catchment and there have been negligible catchment scale impacts from agricultural and residential development on the lake receiving waters. Recent assessments of water quality data (e.g., NIWA, 2023e; and Bayer and Merideth, 2020) showed that the lake has a very low nutrient state (ultra-microtrophic to oligotrophic nutrient state) and there has been no change in the microtrophic Trophic Level Index[11] (TLI) score over the assessed years (i.e., 2005/2006 to 2021/2022).

Turbidity (and water clarity) in Lake Pūkaki is strongly linked with the amount of glacial melt (and as such glacial flour[12] in the water column in the Tasman River) entering the lake. Overall, a decreasing trend in turbidity in Lake Pūkaki has been observed since 2011 and is likely a consequence of glacier recession upstream and the formation of large upstream lakes (i.e., Tasman and Hooker lakes) that are trapping sediment (NIWA, 2023e; Bayer and Meredith, 2020).

The proposed changes to lake water level are unlikely to substantially change the overall trophic state of the lake and the water quality components that make up TLI, therefore these are not discussed any further within this EcIA.

In microtrophic lakes with a natural water level regime, most of the biological production to support higher trophic organisms (such as fish) occurs in the littoral zones (i.e., lake edge habitats). A stable littoral zone helps in the production of diverse biofilms (algae, fungi, and microbes) and macrophytes, which provides a structured zone for macroinvertebrates that in turn provides food for fish. In a lake with a high rate of both spatial and temporal water level change (such as Lake Pūkaki), the habitat conditions required to produce a diverse biofilm and macrophyte community may constantly change, therefore, impairing the production of food chains to support fish communities (Evtimova and Donohue 2014, Carmignani and Roy 2017). This is relevant to the proposal and is considered later in Section 5.2.

The littoral zone within Lake Pūkaki is considered to provide some beneficial biological function, providing habitat and food resources for macroinvertebrates and fish. However, due to the existing environment's high rate and magnitude of water level change, a diverse and abundant littoral zone may not develop depending on local conditions. Where an intact littoral zone is present and able to develop and be sustained, these areas are providing important habitat functions and ecosystem services at a local scale for macroinvertebrates and fish. Therefore, it is considered that the

[11] Trophic Level Index (TLI) is a method of characterising the ecological health of lakes based on the amount of nutrients (nitrogen and phosphorus) and algae (chlorophyll a), and water clarity level. A microtrophic level equates to a TLI score of 0 – 2 and is described as being a lake that is very clean with very low levels of nutrients and algae and is generally a lake with snow or glacial sources.

[12] Very fine particles of sediments produced by glacial erosion that is easily transported by and suspended in water.

ecological value of the littoral zone of the lake is **moderate – high** and is spatially dependent on the bathymetrical features of the lake. Where a higher value is attributed to areas where a stable, larger and more intact littoral zone can develop and is of lower value where a small littoral zone is present.

4.1.3 Benthic ecology

The benthic ecology of the Pūkaki zone includes the species composition and distribution of biofilms (algae, fungi, and microbes), macrophytes, and macroinvertebrates which either reside in the littoral zone of the lake, or the tributary rivers.

4.1.3.1 River benthic ecology

Any future lake operations that reduce the water level in Lake Pūkaki are not expected to affect the benthic ecology of spring-fed upland, alpine, or hill fed tributaries that flow into larger river tributaries before flowing into the lake or flow directly into the lake in the Pūkaki zone. Therefore, these are not discussed any further.

The Tasman River and its associated delta is located at the head of Lake Pūkaki and is affected by changes in the water level of the lake. The Tasman River is classed as an '*Alpine – Upland*' river in the CLWRP and a minimum Quantitative Macroinvertebrate Community Index (QMCI) score of 6 is attributed to this river class.[13]

The macroinvertebrate community in the Tasman River, monitored upstream of the confluence with Jollie Creek (NIWA, 2020b) is generally comprised of mayflies and dipterans (chironomids). The composition (diversity and abundance) of macroinvertebrate species within the Tasman River is influenced by the river conditions prior to sampling being completed. Where samples were collected after a stable period of weather, the macroinvertebrate community was comprised of a greater abundance of mayflies. Where floods or disturbance had occurred the macroinvertebrate community was more variable, with a greater proportion of 'low quality taxa'.[14] These fluctuations are natural and are due to the type and nature of habitats within the braided river ecosystem.

Overall, the macroinvertebrate community health of the Tasman River, as indicated by the Macroinvertebrate Community Index (MCI) and its quantitative variant (QMCI), ranged from 85 – 99 and 3.3 – 6.5 respectively. This indicates that Tasman River varies from 'Poor' to 'Fair' quality (per Table 2 in Stark and Maxted, 2007), only periodically meets the CLWRP QMCI outcome for Alpine Upland rivers, and ranges between Attribute Bands B and C in the NPS FM. It should be noted that due to the natural braided river characteristics of the Tasman River, fluctuations in the macroinvertebrate community structure are natural and expected.

The periphyton community of the Tasman River is of low abundance/biomass and dominated by films and sludges and occasional filamentous algae (NIWA, 2020b). No detections of didymo (*Didymosphenia geminata*) have occurred within the Tasman River. Subsequently the diversity and abundance of the periphyton communities is largely influenced by the natural fluctuations in water quality, flow, substrate and ecological processes (e.g., grazing, predation) that occur in the Tasman River.

The Tasman River environments (including the delta) have been assessed as being of **very high** ecological value (Section 4.1.1).

4.1.3.2 Lake benthic ecology

The aquatic plant community that is present within Lake Pūkaki is characterised by being widespread within the littoral zone of the lake but at a very low abundance and generally does not exceed 10%

[13] See Table 1a Freshwater Outcomes for Waitaki Rivers in the CLWRP, page 462.
[14] Taxa that are tolerant of degraded water quality and habitat conditions.

cover (NIWA, 2021). Any increase in macrophyte cover appears to coincide with an extended period of low water levels and increased water clarity. During these periods, a reduction of glacial flour results in an increase in water clarity and as such improved conditions for macrophyte growth. In all, macrophyte assemblages have low diversity and abundance/cover within Lake Pūkaki and do not provide a significant ecological role in the lake.

No specific assessments of the biofilm (e.g., periphyton) and bryozoan communities have been completed to date in Lake Pūkaki. Where data are available this has been collected as part of macrophyte surveys completed within the littoral zone (e.g., NIWA, 2021). This data indicates that the communities growing on the soft sediments to a depth > 15 m within the lake appear to be primarily composed of various algal species and patches of bryozoans, whilst at a depth of c. 5 m, the rocks are primarily covered with algae.

No recent macroinvertebrate data are available for the littoral habitats of Lake Pūkaki. However, macroinvertebrate populations within lakes (such as Lake Pūkaki) are often associated with aquatic plant and biofilm communities. Therefore, it is expected that macroinvertebrate richness and abundance will be low in Lake Pūkaki, reflecting the low abundance of aquatic plants and biofilms (due to the historically natural low water clarity due to the glacial flour). Historical assessments of the aquatic macroinvertebrate community showed that Lake Pūkaki had an *"exceptionally depauperate benthic fauna"* (Timms, 1982).

As stated in Section 4.1.2, the ecological value of the littoral zone of Lake Pūkaki ranges from **moderate – high**. This value range is variable spatially and dependent on the local lakebed bathymetry and lake water level which provides a favourable condition for periphyton and macrophytes to establish.

4.1.4 Fish

The Pūkaki zone contains six native and three introduced fish species (Table 4.1). Overall, Lake Pūkaki and its tributaries can be described as having a low diversity of native fish. Of the native species historically identified within the Pūkaki zone, four have either an 'At Risk – declining' (longfin eel (*Anguilla dieffenbachii*), Kōaro (*Galaxias brevipinnis)* and Canterbury galaxias (*G. vulgaris*)) or 'Threatened – Nationally Vulnerable' (upland longjaw galaxias (*G. aff. prognathus "Waitaki'*)) conservation threat status (Dunn *et al*. 2018; Table 4.1). It should be noted, that within Lake Pūkaki itself native fish expected to be regularly present include kōaro, upland (*Gobiomorphus breviceps*) and common bully, and it is likely that longfin eel population has substantially declined since 1990 (Appendix D3).

A contextual summary of the fish species found within the Pūkaki zone and wider WPS is provided in Appendix D.

Table 4.1: Fish species present in the Lake Pūkaki Zone

Māori/Common name	Scientific name	Threat status [1]	Pūkaki Zone Location
Upland longjaw galaxias	*Galaxias aff. prognathus "Waitaki'*	Threatened - Nationally Vulnerable	Tributaries
Longfin eel/tuna	*Anguilla dieffenbachii*	At Risk - declining	Lake and tributaries
Kōaro	*Galaxias brevipinnis*	At Risk - declining	Lake and tributaries
Canterbury galaxias	*Galaxias vulgaris*	At Risk - declining	Tributaries
Upland Bully	*Gobiomorphus breviceps*	Not threatened	Lake and tributaries
Common bully	*Gobiomorphus cotidianus*	Not threatened	Lake and tributaries
Brown trout	*Salmo trutta*	Introduced	Lake and tributaries

Māori/Common name	Scientific name	Threat status [1]	Pūkaki Zone Location
Rainbow trout	*Oncorhynchus mykiss*	Introduced	Lake and tributaries
Sockeye salmon	*Oncorhynchus nerka*	Introduced	Lake and tributaries

Note: 1 - Per Dunn *et al.* 2018.

The low abundance and diversity of native fish in the lake is matched by a low productivity (in terms of abundance and size/age diversity) salmonid fishery. Although there is low diversity of native fish species, several of these have an 'At risk' or 'Threatened' conservation status, meaning that although the fish community is sparce, the species present should be protected so that the populations present in the catchments are not reduced.

Overall, the wider Pūkaki zone supports a low diversity of fish species, of which several species are of high ecological, conservation or recreational value (i.e., salmonids). However, within Lake Pūkaki itself, the native fish community is sparse and is likely only comprised of kōaro, and upland and common bully. Of these lake species, only kōaro have an 'At risk' conservation status, but local populations appear to be being sustained, with low between-year variability in abundances (NIWA, 2023). Therefore, it is considered that Lake Pūkaki fish community is of **moderate** value.

4.2 Wetlands

4.2.1 Summary of previous assessments and wetland ecological values

A wetland survey and assessment was undertaken by Boffa Miskell (2023) to inform the re-consenting of the WPS. Desktop surveys were conducted through a review of aerials from 2017 to 2020. The desktop survey was followed up with field investigations using either rapid or full wetland survey methods between 2019 and 2020. Wetland vegetation and fauna were assessed. The full methods and results are described in detail in Boffa Miskell (2023).

A total of 17 wetlands connected to Lake Pūkaki and comprising 645 ha were assessed and delineated by Boffa Miskell (2023) (Table 4.2; Appendix C1) (the 17 wetlands excludes an additional four downstream wetlands associated with the Pūkaki River detailed further below). All wetlands were considered 'Significant' in accordance with the Canterbury Regional Policy Statement (CRPS) definitions. Wetlands vary in their typology, and include floodplain, shore, lacustrine, palustrine, riverine, marsh, delta, terrace, depression, shallow water and seepages. Wetlands support some indigenous species, but many have been degraded by introduced plant species invasions. Only Wetland 1 (Glentanner Wetland), Wetland 2 (Tasman River Delta), Wetland 5 (Boltons Gully 1) and Wetland 17 (Lower Pūkaki 2) support large tracts of indigenous vegetation. In addition, only Wetland 1 (Glentanner Wetland) and Wetland 2 (Tasman River Delta), currently receive targeted ecological management as part of Project River Recovery (PRR)[15] (Boffa Miskell, 2023).

Boffa Miskell (2023) assessed wetland values in accordance with EIANZ criteria (Roper-Lindsay et al. 2017). We largely agree with the values assessment results. However, we consider the site wetlands assessed and classified as 'low' value by Boffa Miskell (2023) to be of moderate ecological value. The justification for this difference in value is based on the 'rarity/distinctiveness' matter, as outlined in detail in Appendix G.

As such, the wetland values are as follows (Table 4.2; Appendix C):

- One wetland is considered of **very high** ecological value (Tasman River Delta).
- Four wetlands of **high** value.

[15] PRR mmaintains and restores braided river and wetland habitat in the South Island's upper Waitaki Basin, funded by Meridian Energy Limited and Genesis Energy. Likely being replaced with the Kahu Ora (DOC, 2025). Additional wetlands have been selected for targeted restoration under the proposed Kahu Ora (DOC, 2025).

- Twelve wetlands of **moderate** value.[16]

The 17 wetlands were assessed by Boffa Miskell (2023) as being hydrologically connected to Lake Pūkaki (Table 4.2). Of the 17 wetlands, 16 were assessed as having a 'low' level of hydrological connectivity to the lake. Wetland 2 (Tasman River Delta) was assessed as having a 'high' level of connectivity to the lake.

Further assessment has been undertaken by GHD (2025) on wetland hydrology and groundwater effects. Their analysis concluded that the 17 wetlands are occasionally inundated by the lake. With the exception of the Tasman Delta, these wetlands interact with lake at approximately 525 m RL and above. Given the large range of lake levels that occur now (518 to 532.5 m RL), it is considered unlikely that there will be a change to wetland hydrology if the lake operates between 518 and 513 mRL for limited periods of time. They also found that the effect of lake lowering would result in no change to groundwater for all wetlands.

4.2.1.1 Wetlands with a 'low' hydrological connection to Lake Pūkaki

Wetlands with a 'low' hydrological connectivity are not expected to be adversely impacted by the change to drawdown. This is due to:

- The low level of hydrological connectivity to the lake. These wetlands only interact with the lake at approximately 525 m RL and above.
- Lake levels will return to the existing environment levels for much of each year.
- The short and temporary lake lowering duration.

Analysis by GHD (19 August 2025) determined there would be no impact on groundwater as a result of temporary lake lowering for all wetland habitats. As such any impact on these wetlands is expected to be negligible and they are not considered further.

4.2.1.2 Wetlands downstream of Lake Pūkaki and associated with Pūkaki and Lower Tekapō Rivers

There are an additional four wetlands located downstream of Lake Pūkaki and hydrologically connected to the Pūkaki and Lower Tekapō Rivers (Wetlands 19-22; Table 4.2). These wetlands receive input only during infrequent spill releases from Gate 19 to the Pūkaki River (see Appendix C1 for the location of Gate 19). The importance of the rivers and Lake Pūkaki spill events to the wetlands is considered to be low due to the frequency of spill events (which are rare) (Boffa Miskell, 2023; Hooson, 2025). These wetlands include one **moderate** (Wetland 19) and three **high** (Wetlands 20-22) value wetlands.

Operation of the Lake Pūkaki spillway is not expected to be affected by the proposed lowering of the minimum operating lake level. As such any impact to wetlands downstream of Lake Pūkaki are expected to be negligible when compared to the existing environment and they are not assessed further.

[16] Boffa Miskell, (2023) classified three as moderate, nine as low value. This assessment considers low value wetlands are of moderate value.

Table 4.2: Wetland ecological values and hydrological linkage at Lake Pūkaki. Shaded cells indicate a difference in value between Boffa Miskell (2023) and this report

Wetland number	Wetland name	Ecological value (Boffa Miskell, 2023)	Ecological value (T+T, 2025)	Relative importance of hydrological linkage for wetland hydrology (Boffa Miskell, 2023)	Hydrological connection to the lake description (GHD, 19 August 2025)
1	Glentanner Wetland	High	High	Low	Lake Inundation at high lake levels
2	Tasman River Delta	Very High	Very High	High	Lake Inundation
3	Glentanner Airstrip	Moderate	Moderate	Low	Lake Inundation at high lake levels
4	North Camp	Low	Moderate	Low	Lake Inundation at high lake levels
5	Boltons Gully 1	High	High	Low (probable)	None
6	Boltons Gully 2	Low (probable)	Moderate	Low	Lake Inundation at high lake levels
7	Boltons Gully 3	Low	Moderate	Low	Lake Inundation at high lake levels
8	Boltons Gully 4	Low (probable)	Moderate	Low (probable)	Lake Inundation at high lake levels
9	Hayman Road 1	Moderate	Moderate	Low	Lake Inundation at high lake levels
10	Hayman Road 2	High	High	Low	Lake Inundation at high lake levels
11	Hayman Road 3	Low	Moderate	Low	None
12	Boundary Stream South	Low	Moderate	Low	Wave Inundation possible
13	Hayman Road 4	Low	Moderate	Low	Lake Inundation at high lake levels
14	Hayman Road 5	Low	Moderate	Low	None
15	Hayman Road 6	Low (probable)	Moderate	Low	Wave Inundation possible at high lake levels
16	Jack Steel Stream	Moderate	Moderate	Low	Lake Inundation at high lake levels
17	Lower Pūkaki 2	High	High	Low	Lake Inundation at high lake levels
19	Pūkaki River True Right wetland	Moderate	Moderate	Low	Lake inundation via waves may also be possible

Wetland number	Wetland name	Ecological value (Boffa Miskell, 2023)	Ecological value (T+T, 2025)	Relative importance of hydrological linkage for wetland hydrology (Boffa Miskell, 2023)	Hydrological connection to the lake description (GHD, 19 August 2025)
20	Pūkaki True Left Wetland	High	High	Low	Lake inundation via waves may also be possible
21	Lower Tekapō River True Right	High	High	Low	None
22	Lower Tekapō River True Left	High	High	Low	None

Note: Wetland 18 has been excluded as it has no hydrological connectivity to Lake Pūkaki. It was included in earlier reporting due to a perceived hydrological connection, which was later confirmed as having no connection (Boffa Miskell, 2023).

4.2.2 Wetland plants

A variety of native wetland plants occur in the wetlands surrounding or linked to the lake, including nationally At Risk and Threatened species (Boffa Miskell, 2023; de Lange et al. 2024).

Isolepis basilaris (At Risk – Naturally Uncommon) is present in the Tasman River Delta and has been subject to monitoring of its distribution in response to lake level changes (Boffa Miskell, 2011). Other species on the Tasman River Delta include turf marsh arrow grass (*Triglochin palustris;* Threatened – Nationally Endangered), *Montia angustifolia* (At Risk – Declining), *Leptinella maniototo* (At Risk – Relict) and Buchanan's sedge (*Carex buchananii*; At Risk – Declining) (Table Appendix E.1). A variety of nationally Not Threatened and Introduced species are also present.

Wetland plants on the Tasman River Delta rely on a regular disturbance regime consisting of upstream snowmelt/rainfall inputs, and Lake Pūkaki inundation. Wetland plant distribution and persistence on other wetlands around the lake or associated with the Pūkaki River would also rely on underlying hydrological drivers including upstream inputs and Lake Pūkaki inundation.

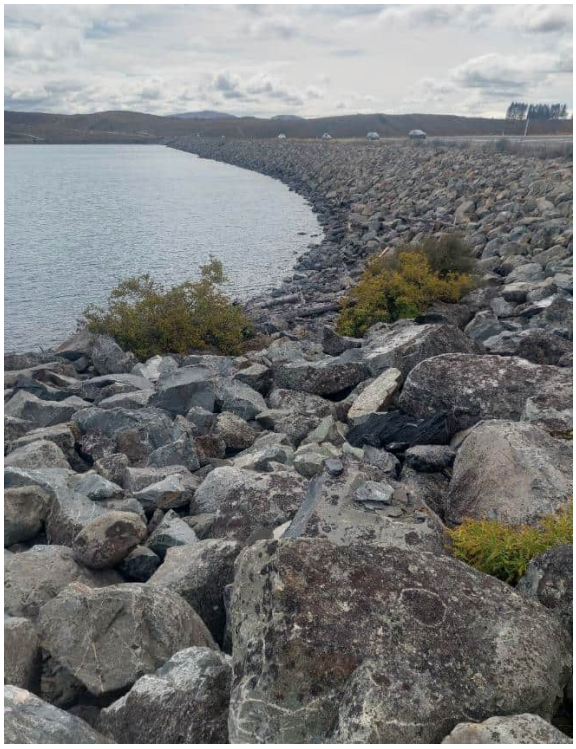
Due to their conservation status, turf marsh arrow grass is of **very high** ecological value, *Montia angustifolia* and Buchanan's sedge are of **high** ecological value, while *Isolepis basilaris* and *Leptinella maniototo* are of **moderate** ecological value. Not Threatened vegetation is of **low** ecological value.

4.3 Terrestrial

4.3.1 Riparian vegetation

Riparian vegetation surrounding Lake Pūkaki comprises a mix of native and exotic vegetation. Riparian vegetation occurs across ecosystems including stonefield, boulderfield, herbfield, mossfield, lichenfield, shrubland and forest, many areas of which are considered 'Significant' under the CRPS (Boffa Miskell, 2024). These ecosystems are present on riverbeds, active floodplains and terraces. Where these ecosystems are exotic-dominated they are typically of low-moderate value, and where native-dominated, are of moderate to very high ecological value. Riparian habitats support nationally At Risk and Threatened flora (e.g. Alexandra cress (*Lepidium kirkii;* Threatened – Nationally Critical; Boffa Miskell, 2024) and fauna (e.g. avifauna, lizards and invertebrates, refer to Sections 4.3.3, 4.3.4, 4.3.5).

The proposed access track footprint and temporary building area are largely dominated by constructed riprap and exotic grasses. The area is actively maintained free of vegetation for dam safety reasons. However, native terrestrial plants are sparsely distributed within the proposed access track (Photograph 4.1 and 4.2). Notable species in or within proximity to the proposed footprint include *Sophora prostrata* (At Risk – Declining; de Lange et al. 2023)*, Olearia lineata* (At Risk – Declining) and *Olearia odorata* (At Risk – Declining). Native Not Threatened species are also present (Table Appendix E.2). At Risk species are of **high** ecological value, while Not Threatened species are of **low** ecological value in accordance with EIANZ EcIAG criteria (Appendix B).



Photograph 4.1: Proposed access track with sparsely distributed vegetation.

Photograph 4.2: Sparsely distributed vegetation located adjacent to existing dam wall.

4.3.2 Bats

A total of seven acoustic survey records are located within 10 km of Lake Pūkaki. Records are relatively recent (between 2015 and 2021). No bats have been identified through these surveys. The nearest bat record is a long-tailed bat (*Chalinolobus tuberculatus*; Threatened – Nationally Critical (O'Donnell et al. 2022)) record located 27 km from the Tasman River Delta recorded in 1981[17]. Based on these findings, native bats are unlikely to be using Lake Pūkaki or surrounding habitats and are not considered further in this assessment.

4.3.3 Avifauna

Avifauna habitat in and around Lake Pūkaki includes a variety of bird habitats such as open water, wetlands, braided rivers, herbfields, shrubland and forest.

A total of 36 bird species have been identified in and around Lake Pūkaki (NIWA, 2023; refer to Table Appendix E.3 for the full list of species). Of these, a high proportion (50%) are listed as nationally At Risk or Threatened (Robertson et al. 2021) (Table 4.3). Two species have the highest-risk conservation status of Threatened – Nationally Critical –black stilt/kaki (*Himantopus navaezelandiae*) and Australasian bittern/matuku hūrepo (*Botaurus poiciloptilus*).

Avifauna habitat in the proposed rock armouring area (Figure 2.2) is limited to marginal shrubland, open grassland and rock revetment adjacent to the existing carpark (Appendix C). Due to the general disturbance in this area (people and cars) it is unlikely this area would be preferentially used by native avifauna for nesting given wider habitat availability.

[17] ID3094

Based on their conservation status, nationally Threatened species are of **very high** ecological value, At Risk – Declining species of **high** ecological value, At Risk – Naturally Uncommon/Relict of **moderate** ecological value and Not Threatened species of **low** ecological (in accordance with EIANZ EcIAG criteria, refer to Table Appendix B.1).

Table 4.3: Nationally At Risk or Threatened native freshwater birds recorded during formal surveys since 2010 in the Waitaki catchment (NIWA, 2023), conservation status and ecological value

Common name	Species name	Conservation status (Robertson et al. 2021)	Ecological value
Wrybill / Ngutuparore	*Anarhynchus frontalis*	Threatened – Nationally Vulnerable	Very high
New Zealand pipit / Pīhoihoi	*Anthus novaeseelandiae*	At Risk – Declining	High
Grey duck / Pārerea	*Anas superciliosa*	Threatened – Nationally Vulnerable	Very high
Australasian bittern / Matuku hūrepo	*Botaurus poiciloptilus*	Threatened – Nationally Critical	Very high
Banded dotterel / Tūturiwhatu	*Charadrius bicinctus bicinctus*	At Risk – Declining	High
Black-fronted tern / Tarāpirohe	*Chlidonias albostriatus*	Threatened – Nationally Endangered	Very high
Australian coot	*Fulica atra australis*	At Risk – Naturally Uncommon	Moderate
South Island pied oystercatcher / Tōrea	*Haematopus finschi*	At Risk – Declining	High
Variable oystercatcher / Tōrea pango	*Haematopus unicolor*	At Risk – Recovering	Moderate
Black stilt / Kāki	*Himantopus novaezelandiae*	Threatened – Nationally Critical	Very high
Caspian tern	*Hydroprogne caspia*	Threatened – Nationally Vulnerable	Very high
Black-billed gull / Tarāpuka	*Larus bulleri*	At Risk – Declining	High
Red-billed gull / Tarāpunga	*Larus novaehollandiae scopulinus*	At Risk – Declining	High
Southern crested grebe / Kāmana	*Podiceps cristatus australia*	Threatened – Nationally Vulnerable	Very high
Black shag / Māpunga	*Phalacrocorax carbo*	At Risk – Naturally Uncommon	Moderate
Spotted shag / Kawau tikitiki	*Phalacrocorax punctatus*	Threatened – Nationally Vulnerable	Very high
Little shag /Kawaupaka	*Phalacrocorax melanoleucos brevirostris*	At Risk – Relict	Moderate

Common name	Species name	Conservation status (Robertson et al. 2021)	Ecological value
White-fronted tern / Tarā	*Sterna striata striata*	At Risk – Declining	High

4.3.4 Lizards

Potential lizard habitat on the margins of Lake Pūkaki and Pūkaki River (downstream of Lake Pūkaki) includes forest, shrubland, wetland margins, grasslands, tussockland, boulderfields, stonefields, and dry river beds. During the site visit, an unidentifiable skink species was observed on the eastern side of the lake and unidentifiable skink and gecko individuals were observed near Wetland 1 (Appendix C). High quality lizard habitat has been recorded in habitats adjacent to the Pūkaki River (Figure 4.1; Boffa Miskell, 2022)

A total of 11 species of lizards are potentially present in and around Lake Pūkaki (Boffa Miskell, 2022; Table 4.4). Of the 11 species, three have been recorded on the DOC Herpetofauna Database in proximity to the works area - McCann's skink (*Oligosoma maccanni;* Not Threatened) (Hitchmough et al. 2021), Canterbury grass skink (*O. aff. polychroma* Clade 4*;* At Risk – Declining) and Southern Alps gecko (*Woodworthia* "Southern Alps"; At Risk – Declining). In addition, DOC has noted populations of Mackenzie skink (*Oligosoma prasinum;* Threatened – Nationally Vulnerable) and lakes skink (*Oligosoma aff. chloronoton "west Otago";* Threatened – Nationally Vulnerable) within 100 m of the stockpiles[18].

The potential lizard species include nationally Not Threatened, At Risk and Threatened species. As a result of their conservation status, lizard species range in ecological value from **low to very high** (in accordance with EIANZ EcIAG criteria, refer to Table Appendix B.1; Table 4.4).

The rock armouring footprint comprising sparsely distributed shrubs and short grasses and boulders provide marginal lizard habitat (refer to Photograph 4.1 and Photograph 4.2). In addition, two stockpile areas comprising 6.3 ha and 0.8 ha of boulder materials set aside for construction use may also provide opportunistic, artificial, but moderate value lizard habitat (Photograph 4.3; Appendix C2), particularly for McCann's skink, Canterbury grass skink and Southern Alps gecko.

A lizard survey has not yet been undertaken, but is planned to be undertaken during the 2025/2026 season when weather conditions are suitable in accordance with a Lizard Management Plan (LMP).

[18] Fast-track Pre-lodgement Consultation Summary.

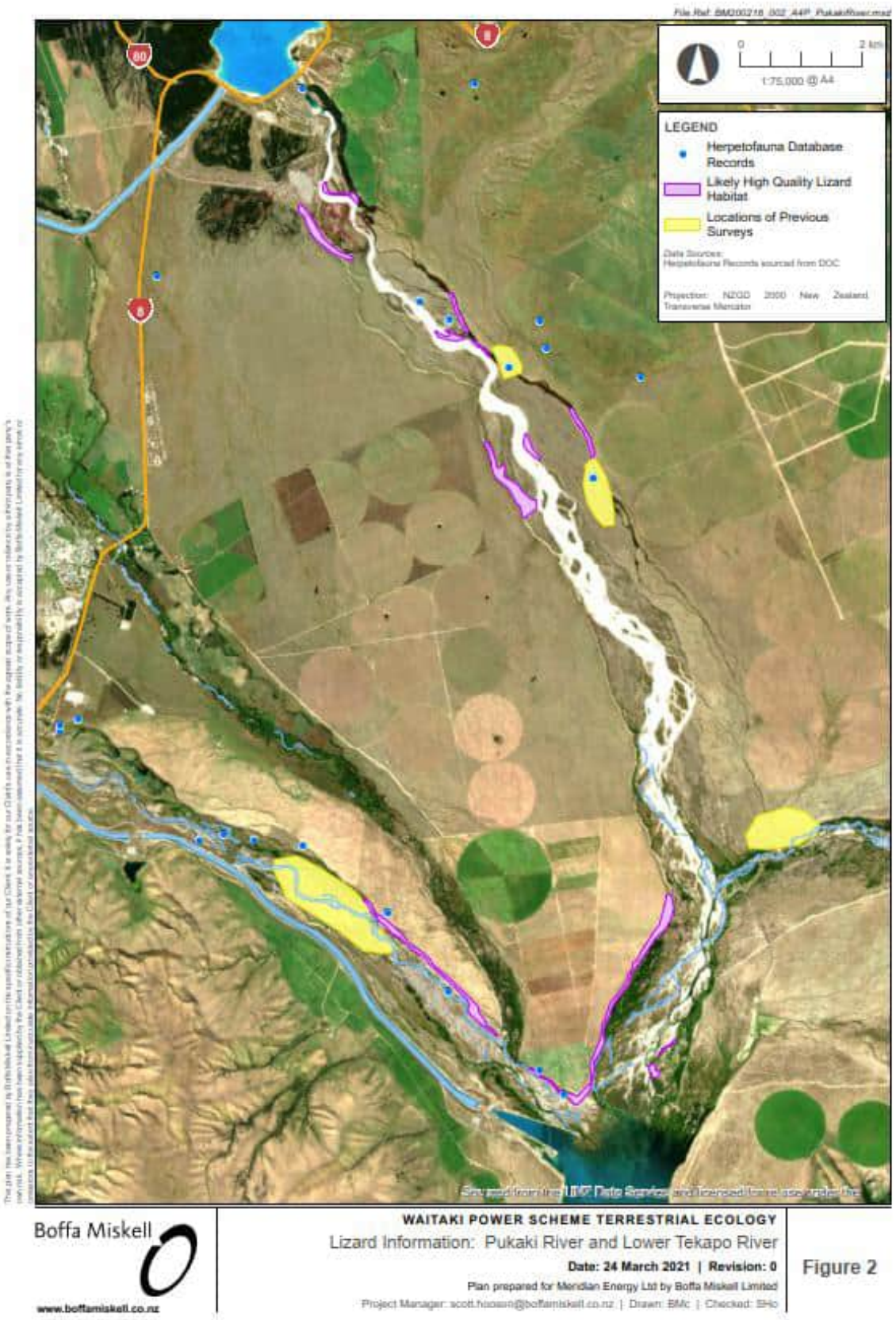


Figure 4.1: Lizard habitat mapped along the Pūkaki River (from Boffa Miskell, 2022).

Table 4.4: Lizard species list recorded on Pūkaki River and wider area (30 km radius) (Boffa Miskell, 2022), conservation status and ecological value

Common name	Species name	Conservation status (Hitchmough et al. 2021)	Ecological value	Habitat preference (from NZHS, 2025)	Likely presence in rock armouring or stockpile footprint
Lakes skink	*Oligosoma* aff. *chloronoton* "West Otago"	Threatened – Nationally Vulnerable	Very high	Terrestrial/ saxicolous, and typically inhabit lowland or alpine tussock grassland, riverine debris (eroded stone), and screes/talus with woody vegetation.	Potential, not recorded on Pūkaki River but records in wider area. DOC has stated records within 100 m of stockpiles.
Southern long-toed skink/ Roamatimati skink	*Oligosoma* aff. *chloronoton* "southern"	At Risk - Declining	High	Saxicolous, rocky habitats in alpine environments (screes, gravel or boulder talus slopes, dry streambeds, and rock piles amongst low growing vegetation).	Unlikely, not recorded on Pūkaki River but records in wider area.
Cryptic skink	*Oligosoma inconspicuum*	At Risk - Declining	High	Terrestrial, variety of habitats. Rocky habitats, including rocky beaches, shrubland, screes, and tallus, although they do also occur in heavily-vegetated habitats.	Unlikely, not recorded on Pūkaki River but records in wider area.
McCann's skink	*Oligosoma maccanni*	Not Threatened	Low	Inhabit rock tor systems, boulderfields, tallus, scree, rocky herbfield, exotic grasses, herbfield, and tussockland.	Likely – nearby records and common in the local environment
Mackenzie skink	*Oligosoma prasinum*	Threatened – Nationally Vulnerable	Very high	Open/sunny areas such as open grassy areas, tussock grassland, rock piles, and scree slopes.	Potential, known from Pūkaki River. DOC has stated records within 100 m of stockpiles.
Canterbury grass skink	*Oligosoma* aff. *polychroma* Clade 4	At Risk - Declining	High	Rock piles, grassland, tussock, shrubland, screes, forest margins tussock and modified agricultural habitats where there is sufficient cover.	Likely – nearby records and common in the local environment.
Southern grass skink	*Oligosoma* aff. *polychroma* Clade 5	At Risk - Declining	High	Wetlands, grassland, shrublands, rocky shrubland/herbfield, screes, tussock, stony river beds.	Unlikely, not recorded on Pūkaki River.

Common name	Species name	Conservation status (Hitchmough et al. 2021)	Ecological value	Habitat preference (from NZHS, 2025)	Likely presence in rock armouring or stockpile footprint
Scree skink	*Oligosoma waimatense*	Threatened – Nationally Vulnerable	Very high	Boulderfields, screes, tallus, stoney river terraces and banks, rocky shrubland, and rocky bluffs.	Potential, known from Pūkaki River.
Jewelled gecko	*Naultinus gemmeus*	At Risk - Declining	High	Indigenous forests, shrublands, and tussock grasslands.	Unlikely – unsuitable habitat.
Southern Alps gecko	*Woodworthia* "Southern Alps"	At Risk - Declining	High	Terrestrial and saxicolous. Stable bases of scree slopes, rocky river terraces and shattered outcrops in dry sub-alpine.	Likely – nearby records and common in the local environment.
Korero gecko	*Woodworthia* "Otago/Southland Large"	At Risk - Declining	High	Beech forest, podocarp/hardwood forests, rocky grasslands, and rocky alpine areas.	Unlikely – unsuitable habitat.

Photograph 4.3: Stockpile area where material will be sourced from for rock armouring works, which may provide lizard habitat.

4.3.5 Terrestrial invertebrates

The wider environment around Lake Pūkaki provides habitat for a variety of native terrestrial invertebrate species, including At Risk and Threatened species (Trewick et al. 2022). Through desktop assessment, 11 species of At Risk and Threatened invertebrates were recorded as likely to be present in proximity to Lake Pūkaki (Table 4.5). At Risk and Threatened species likely to be present in the Pūkaki Riverbed include robust grasshopper (*Brachaspis robustus*), minute grasshopper (*Sigaus minutus*) and beetle *Metagymma tersatum* (Boffa Miskell Ltd. 2010). Intensive invertebrate surveys have not been undertaken in this specific reach, however. Of note, the robust grasshopper (*Sigaus robustus*; Threatened – Nationally Endangered), is protected by the Wildlife Act 1953.

Due to their conservation status, native invertebrates range in value from **low to very high** (Table 4.5) and in accordance with EIANZ EcIAG criteria (Table Appendix B.1).

The rock armouring habitat of sparse native shrubs, short grassland beside a carpark and large boulders are unlikely to support any At Risk or Threatened invertebrates. Similarly, the material

stockpiles (Photograph 4.3) are also unlikely to support At Risk or Threatened invertebrates given the modified nature of the habitat in this area (deposited boulders surrounded by short-stature grasslands). At Risk and Threatened invertebrates are more likely to be present in more intact habitats in the surrounding landscape.

Table 4.5: At Risk and Threatened invertebrates recorded in the Waitaki Power Scheme wider area (note few targeted surveys have been undertaken at Lake Pūkaki or Pūkaki River) (Boffa Miskell, 2022)

Common name	Species name	Conservation status (Hoare et al. 2017; Trewick et al. 2022)	Ecological value	Habitat preference	Likely presence in wider area
Darkling beetle	*Artystona lata*	At Risk – Naturally Uncommon	Moderate	No readily available information.	Potential, known from the Upper Waitaki Catchment.
Looper moth	*Asaphodes stinaria*	Threatened – Nationally Vulnerable	Very high	Wetlands, tussock country, open non-forest habitat.	Potential, known from the Upper Waitaki Catchment.
Robust grasshopper*	*Brachaspis robustus*	Threatened – Nationally Endangered	Very high	Braided riverbeds, stony floodplain terraces and fluvioglacial outwash surfaces.	Known from the Pūkaki River bed.
Canterbury knobbled weevil	*Hadramphus tuberculatus*	Threatened – Nationally Vulnerable	Very high	High-altitude tussock grasslands.	Potential, known from the Upper Waitaki Catchment.
Ground wētā	*Hemiandrus 'furoviarius'*	Threatened – Nationally Critical	Very high	Requires fine silty soils for burrowing. Includes river margins and terraces.	Potential, known from the Upper Waitaki Catchment.
Ground beetle	*Holcaspis abdita*	Threatened – Nationally Critical	Very high	Open, stony, degraded herb field habitats along river escarpments.	Potential, known from the Upper Waitaki Catchment.
Giant speargrass weevil	*Lyperobius carinatus*	At Risk – Naturally Uncommon	Moderate	Sub-alpine and alpine grassland.	Potential, known from the Upper Waitaki Catchment.
Ground beetle	*Megadromus crassalis*	At Risk – Relict	High	River flat scrub.	Potential, known from the Upper Waitaki Catchment.
Grass moth	*Orocrambus fugitivellus*	Threatened – Nationally Critical	Very high	Indigenous and exotic grasses in the Mackenzie Basin.	Unlikely – known from a small area of the Mackenzie Basin.
Grass moth	*Orocrambus* 'Mackenzie Basin	Threatened – Nationally Vulnerable	Very high	Stony, dry valley-floor areas with few sparse vascular plants.	Unlikely – known from a small area of the Mackenzie Basin.
Minute grasshopper*	*Sigaus minutus*	Threatened – Nationally Vulnerable	Very high	Dry river terraces and outwash plains, habitat dominated by mat daisies.	Known from the Pūkaki River bed.

Note:* = Likely to be present on the Pūkaki Riverbed (Boffa Miskell, 2022).

4.4 Ecologically significant vegetation or habitat for indigenous biodiversity

Sections 4.1 to 4.3 refer to the ecological value of specific fauna and their habitats assessed using the EcIAG (Roper-Lindsey, 2018). Even though the EcIAG is a non-statuary guideline it provides guidance for assessing ecological values. However, within the RMA, Section 6(c) requires identification of sites of significant vegetation and significant habitats of indigenous fauna. For this EcIA, a high-level assessment against the relevant significance criteria is provided in Appendix A, where ecological significance is assessed against the relevant statutory requirements in the CRPS (e.g., Policy 9.3.1).

Several areas adjacent to and connected to Lake Pūkaki have been assessed within this EcIA as including significant vegetation or providing significant habitat for indigenous biodiversity (Appendix A). The outcomes of this significance assessment, broadly align with the WPS reconsenting significance assessment undertaken by Boffa Miskell (2023). Overall, our assessment showed that habitats within these areas were determined to meet several of the specified criteria. Including for representativeness, rarity/distinctiveness, diversity and pattern, and ecological context (Appendix A).

5 Ecological impact assessment

5.1 Proposed activities and summary of actual and potential ecological impacts

The proposed activities and a summary of actual and potential ecological impacts are described for eased access to stored water below 518 m RL (Section 5.1.1) and dam armouring works (Section 5.1.2).

5.1.1 Eased Access

The change to lake operations as result of the proposed eased access is likely to marginally reduce the frequency of inundation for some wetlands and temporarily expose more of the lake bed for a short period of time relative to the existing environment. Spill events through Gate 19 are expected to occur at a similar frequency to the existing environment operational regime (which are rare), as stated elsewhere in this EcIA (Section 2), the impacts on spill events are only considered for wetlands within this impact assessment.

Potential adverse impacts of the change to the lake level threshold (over and above normal operational impacts) could include:

- Temporary changes to the quality and quantity of Lake Pūkaki littoral zone habitat.
- Temporary impacts on fish distribution and abundance.
- Temporary Impacts to fish passage into lake tributaries.
- Temporary impacts to wetlands including shifts in wetland extent, changes to wetland hydrological regime and functioning, changes to groundwater discharge and increased dryland plant or pest plant invasions.
- Temporary shifts in wetland plant distributions. Potential loss of individual wetland plants where wetland areas are less frequently inundated.
- Temporary and indirect impacts to wetland and riverine-associated avifauna as a result of changes to wetland quality and extent.
- Temporary impacts on nesting habitat where fluctuations of lake levels occur during the bird breeding season resulting in nest inundation/drowning. However, fluctuations of lake levels occur during the bird breeding season during the existing operational regime.

The existing wetland and fauna communities are well adapted to the existing dynamic fluctuations levels of Lake Pūkaki. Impacts are also confounded by factors in the surrounding catchments including:

- The normal operation of the WPS (existing environment).
- Upstream inputs such as rainfall and snowmelt.
- Surrounding land use change.
- Pest plant and animal levels in the surrounding catchment.

Given these confounding factors, it will be difficult to attribute potential adverse impacts (if they occur) directly to the proposed eased access, in particular due to the predicted short duration of lower lake levels.

5.1.2 Dam armouring works

The proposed works include dam armouring of Pūkaki Dam's Main Dam Face (High Dam) and Left and Right Abutments (Figure 5.1), and sourcing boulder material from a nearby stockpile as described in Section 2.3.

Without impact management measures, the works will comprise the following potential impacts:

- Temporary loss of 915 m^2 of sparsely distributed shrubland and short-stature exotic grassland.
- Temporary loss of 1,200 m^2 of exposed boulder rock revetment to be remediated / re-constructed following works.
- Rock material sourced from existing boulder stockpiles (6.3 ha and 0.8 ha) for revetment works. The use of the stockpile may affect native lizards (if present).
- Temporary sedimentation impacts.
- Construction-phase disturbance, injury or mortality to native fauna.

5.2 Comparison to PC1

Sections 2.1 and 2.2 describe the proposed activities for this application and what was considered as part of PC1. PC1 anticipated lake levels below 518 m RL for 4 to 7 months, with 7 months considered an extreme scenario. In comparison, this proposal anticipates a 3% to 4% probability that the lake level in any given week will be below 518 m RL over the next three years (which equates to an average of approximately 39 days over the three year period), and a low probability worst case scenario of less than 4 months (Section 2.1). The analysis undertaken in Sections 5.3 to 5.6 of this report assess the impact of the proposed anticipated lake level outlined in Meridian (2025).

5.3 Freshwater

Temporary changes to the quality and quantity of Lake Pūkaki littoral zone and its impacts on fish abundance.

Lake Pūkaki littoral zone values range from moderate to high and are spatially variable and dependent on the bathymetric features of the lake. Where a higher value is attributed to areas where a larger and more stable littoral zone can develop. These areas provide important habitat and ecological functions for any macroinvertebrate and fish species that may be present or that rely on these areas to undertake important life cycle behaviours (e.g., spawning, feeding, young of year habitat). The value of the fish community in the Lake Pūkaki is considered moderate.

The hydrological model (Section 2.1; Meridian, 2025) predicts that lake levels would drop below 518 m RL (normal consented minimum lake level) for up to approximately 39 days between 2026 and 2028. This would result in a **low** overall level of effect (Table Appendix B.5) on the existing environments lake littoral zones and fish communities.

If lake levels drop for longer than the expected modelled period, the overall level of effect on the lake littoral zones and fish communities is also expected to remain as **low** (Table Appendix B.5). This is due to the ongoing rate and / or magnitude of lake level variability being the main driver of littoral habitat production and therefore fish community abundance and diversity, as opposed to the drawdown extent. For clarity, a lake with a high variability in lake level will result in the continual alteration of the quantity and quality of wetted habitat within the littoral zone. This can affect the coverage of periphyton and macrophytes, the diversity and abundance of macroinvertebrate communities, which in turn can affect the food supply of fish communities. The rate and / or magnitude of lake level variability will occur no matter the minimum operational level of the lake and is primarily due to the current operation of Lake Pūkaki which is likely having a **low** magnitude of effect (Table Appendix B.4) on the productivity of the littoral zone food chains.

As set out in Section 6, no residual adverse effects management is required as the overall level of impacts on the existing environments littoral zone and fish community from a potential extended drawdown period below 518 m RL is low and impacts are not considered to be significantly adverse.

Temporary Impacts to fish passage into lake tributaries.

Lake level changes result in large areas of the lake shore becoming exposed. This can result in the potential for inflowing tributaries to become disconnected from the lake and impacting fish access to these tributary habitats. Kōaro are the species most likely to utilise both the lake and these connected tributary habitats during their lifecycle. This is due to kōaro moving between tributary habitats to spawn and utilising the lake as larval rearing habitat (see Appendix D for information on kōaro lifecycles within the WPS).

Lake Pūkaki is an artificially raised lake and it has effectively inundated former river/stream channels and their associated alluvial fans.[19] An indicative review of aerial imagery, showed surface water connections of tributaries appear to remain available at low lake levels (Figure 5.1 to Figure 5.3). It is therefore appropriate to conclude that surface water connection will remain and kōaro can still access potential spawning tributaries at lower lake levels.

Even though access into and out of tributaries is unlikely to be restricted, the distance that migrating fish must travel through the *"exposed"* [20] alluvial fan will increase. Subsequently potentially increasing the risk of predation or decreasing the potential for fish passage of any migrating fish. However, the substrate size present within the alluvial fans consists of gravels, cobbles and boulders (Photograph 5.4) and it is expected that this will form the basis of the instream habitat of the wetted stream channel of the alluvial fan. A stream substrate size consisting of this diversity will maintain and provide areas where migrating fish can rest and as a refuge from predator interactions. Any changes away from the existing environment will be minor as the underlying character (of the stream) and fish communities' range is unlikely to change from those observed in the existing environment.

The hydrological model predicts that lake levels would drop below 518 m RL for approximately 39 days between 2026 and 2028 (Meridian, 2025). This would likely result in a net 'no change' impact on fish passage into the Tasman River and is not expected to influence the alpine and hill fed tributaries. This equates to a **negligible** magnitude of effect (Table Appendix B.4) on the moderate value fish fauna known to utilise these areas, and results in an overall **very low** level of effects (Table Appendix B.5).

If lake levels drop for longer than the expected modelled period, the overall level of impact is expected to remain as low. This is due to the connection between the tributaries and the lake being driven by water flow within the tributaries and not the length of time the lake is at a certain water level.

[19] Prior to human control, the lake surface was c. 484.3 m RL, referred to as the 'natural' level.

[20] Where exposed is in relation to the open tributary alluvial fan that connects to the lake, rather than the largely confined to semi confined stream channels of the lower to mid reaches of these tributaries.

Figure 5.1: Boltons Gully as of July 2020 (a; low lake level) and July 2018 (b; high lake level).

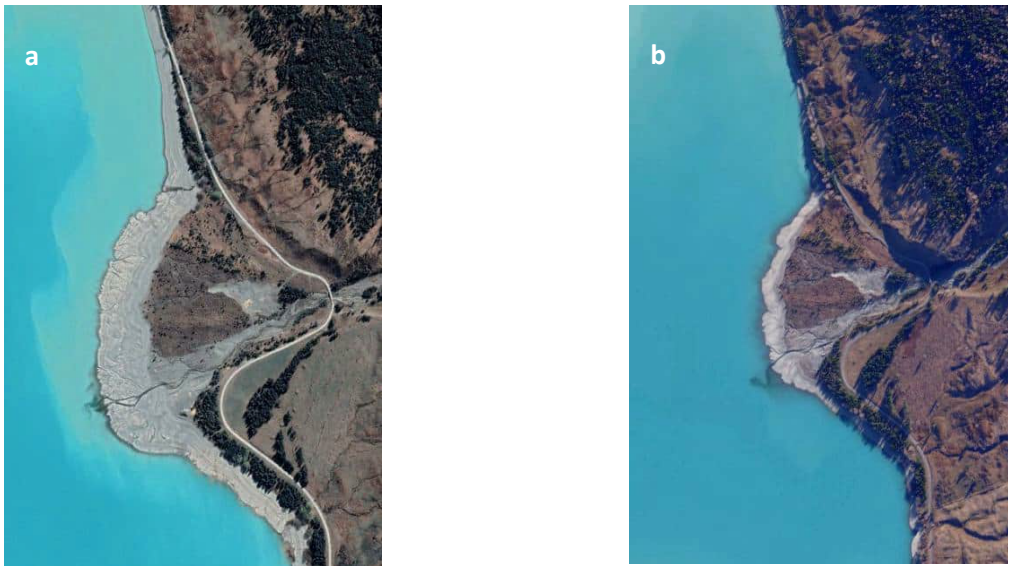


Figure 5.2: Landslip Creek as of July 2020 (a; low lake level) and July 2018 (b; high lake level).

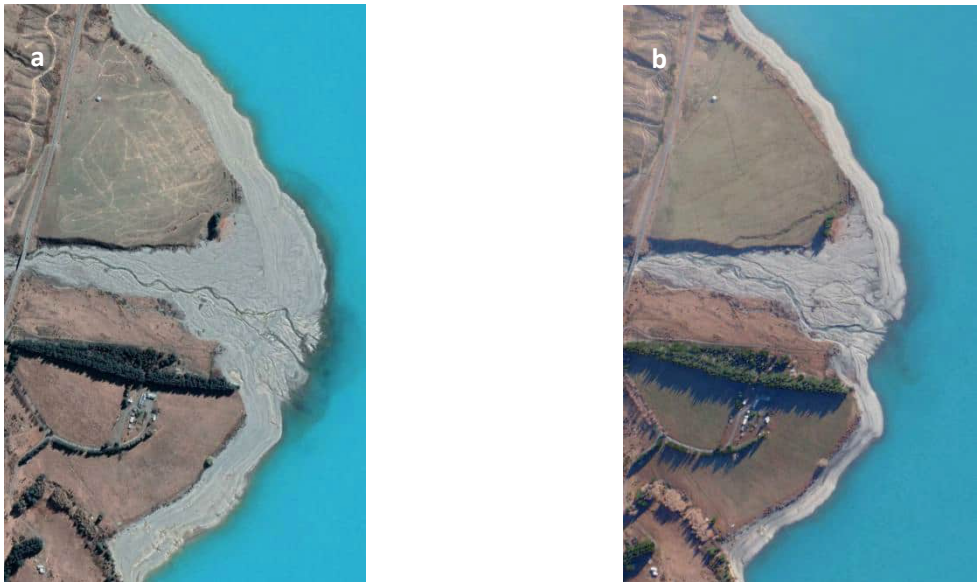


Figure 5.3: Whale Stream as of July 2020 (a; low lake level) and July 2018 (b; high lake level).

Photograph 5.4: General characteristics of a tributary alluvial fan. Photograph taken at the approximate mid-point of the Landslip Creek alluvial fan (see Figure 5.2). Showing the open channel habitat and substrate characteristics and availability of the alluvial fan. Photograph taken 23 January 2025 by T+T.

Dam armouring works – Temporary sedimentation impacts

Dam armouring works are expected to occur on the northern face of the Pūkaki dam and abutments. The proposed construction methodology is not expected to have any ongoing impacts on the littoral zone of Lake Pūkaki. Any change in littoral habitats from the proposed construction works is expected to have a negligible magnitude of effect (Table Appendix B.4). This is due to there being only a very slight change in the existing baseline sediment condition and is approximate to a no change situation once construction is completed. It will be expected that any temporary construction impacts from sediment entering or being resuspended in the littoral zone will be managed through a construction methodology that includes approved erosion and sediment control (ESCP) measures.

As identified in Section 4.1.3.2, the littoral habitats of Lake Pūkaki range from **moderate – high**, where dam armouring works are to occur, the littoral habitats are of **moderate** ecological value. A negligible magnitude of effect (Table Appendix B.4) and a moderate ecological value result in an overall level of effect on the existing environment of **very low** (Table Appendix B.5).

5.4 Wetlands

5.4.1 Eased Access - temporary modification of wetland habitat

5.4.1.1 Tasman River Delta

The proposed eased access is predicted to occur for up to approximately 39 days over three years (GHD, 2025). Potential adverse impacts of the eased access are only likely to adversely impact

wetlands hydrologically connected to Lake Pūkaki. Only the Tasman River Delta (Wetland 3; Table 4.2) was assessed as having a 'high' hydrological connectivity to Lake Pūkaki. All other wetlands only interact with the lake at approximately 525 m RL and above and therefore have a 'Low' hydrological connectivity to the lake (refer to Section 4.2.1.1).

For the Tasman River Delta, the proposed eased access could result in increased lake bed/shore exposure (Boffa Miskell et al. 2023). For example, a 1 m drop in lake level can result in as much as 100 m of shore exposure. The wetland extent of the Tasman River Delta may respond by a temporary shift downslope. The extent to which this could occur (if it occurs) is uncertain due to a variety of factors which influence wetland extent and range shifts. For example, the Tasman River Delta receives upstream input from rainfall and snowmelt, confounding potential impacts.

Under the normal operational range of the lake, the Tasman River Delta wetland naturally fluctuates in extent - aerials show changes in extent of 100s of metres (refer to Photograph 5.5 and Photograph 5.6). In addition, the return to existing environment hydrological fluctuations for the vast majority of the year minimises potential adverse impacts of any temporary eased access.

The existing environment inundation frequency is expected to minimise any temporary adverse impacts of additional shoreline exposure and ensure the existing wetland immersion/emersion disturbance regime is continued. Approximately 23% of modelled hydrological sequences in the first year resulted in lake levels falling below 518 m RL. Where this does occur, the dips below 518 m RL are short in duration and are not deep (GHD, 2025). In subsequent years of operation, the same general pattern of lake level distribution is repeated. Where the water level is lowered for the modelled duration of approximately 39 days over 3 years, the duration of the eased access is expected to be so short as to not impact the Tasman River Delta habitats (which are adapted to natural disturbance regimes). Furthermore, assessment by GHD (19 August 2025) showed that no change to the wetland groundwater is expected.

For the Tasman River Delta, which is the only wetland with a direct hydrological connection to the lake the magnitude of impact is negligible given:

- The short duration of any additional eased access requirements.
- Wetland habitats being adapted to the existing environments operational disturbance regime of immersion/emersion.
- No change to groundwater.

A **very high** ecological value for the Tasman River Delta, combined with a **negligible** magnitude of effect (Table Appendix B.4), results in an overall level of effect of **low** (Table Appendix B.5)**.**

Any additional drawdown period longer than 3% to 4% modelled (i.e. 39 days over 3 years), would be generally of a short duration (days) and not deep (GHD, 19 August 2025). Therefore, in the unlikely scenario of an increased drawdown duration, the above impacts assessment would still hold, given the justifications outlined above.

Photograph 5.5: Tasman River Delta wetland extent January 2023 level.

Photograph 5.6: Tasman River Delta wetland extent March 2024 level. A lower water level has resulted in the exposure of a larger extent of the Tasman River Delta wetland. The aerial suggests vegetation has likely colonised this area (or survived inundation) since the January 2023 level. The wetland vegetation is adapted to the dynamic changes of Lake Pūkaki water levels. With further lake lowering, it is likely the Tasman River Delta would extend southwards further.

5.4.2 Eased Access - impact on wetland plants

The proposed eased access could potentially impact wetland plants on the Tasman River Delta. Less frequent inundation could increase dryland plant/weed invasions, and changes to wetland extents could alter existing plant distributions. However, adverse impacts are expected to be unlikely given the following:

- A short duration of eased access, with existing environment hydrological regime and associated disturbance occurring for the vast majority of each year.
- Specific population monitoring has been undertaken to assess the operational impacts on *I. basilaris* (Boffa Miskell, 2011). Findings concluded that standard operational fluctuations were likely driving the persistence of *I. basilaris*. The species is a colonising plant which relies on regular disturbance for persistence. Populations require inundation over a 3-5 year period to suppress competitors.
- Other key species on the Tasman River Delta include marsh arrow grass, *Montia angustifolia* and Buchanan's sedge (*Carex buchananii*) (Table Appendix E.1). Each species has adapted or tolerated normal operation lake fluctuations.
- The existing operational range of lake level fluctuation would not change habitat options for *I. basilaris* and other wetland plants given extensive habitat availability at higher elevations (Boffa Miskell, 2011).

Given the above justifications, the magnitude of effect on wetland plants is considered to be **negligible** (Table Appendix B.4) when compared to the existing environment. The overall level of effect is therefore **very low to low** for all species (Table 5.1; (Table Appendix B.5)).

Table 5.1: At Risk and Threatened wetland plant value, magnitude of effect and overall level of effect

Common name	Species name	Ecological value	Magnitude of effect	Overall level of effect
Buchanan's sedge	*Carex buchananii*	High	Negligible	Very low
Pygmy clubrush	*Isolepis basilaris*	Moderate		Very low
-	*Leptinella maniototo*	Moderate		Very low
Montia	*Montia angustifolia*	High		Very low
Turf marsh arrow grass	*Triglochin palustris*	Very high		Low
Not Threatened species	-	Low		Very low

5.4.3 Dam armouring works

Dam armouring works are proposed to be undertaken outside the direct extent of any recorded wetlands (the nearest wetland (Wetland 17) is located approximately 3.4 km from the works). Works are expected to be undertaken following lake lowering. Works are expected to be temporary (construction phase only).

Potential adverse effects as a result of construction include the potential for uncontrolled sediment discharges. Increased sediment to wetlands hydrologically connected to Lake Pūkaki could smother and impact wetland plants. The only wetland with a 'high' hydrological connectivity to the lake is the Tasman Delta, located more than 30 km from the works area. This risk of excess sediment affecting this wetland is therefore considered very low and a negligible magnitude of effect. Nonetheless the implementation of Erosion and Sediment Control measures will be undertaken, further reducing sedimentation effects.

A **very high** ecological value for the Tasman Delta and wetland plants combined with a **negligible** magnitude of effect (Table Appendix B.4) results in an overall level of effect of **low** (Table Appendix B.5) from dam armouring works.

5.5 Terrestrial

5.5.1 Impacts on riparian vegetation

5.5.1.1 Eased Access

Riparian vegetation is situated outside Lake Pūkaki boundaries. The magnitude of impact on riparian vegetation is therefore likely to be **negligible** (Table Appendix B.4). Spills from Gate 19 are expected to be at a similar frequency to the existing environment operational levels, and therefore the magnitude of effect on riparian vegetation along the Pūkaki river is expected to be **negligible** (Table Appendix B.4).

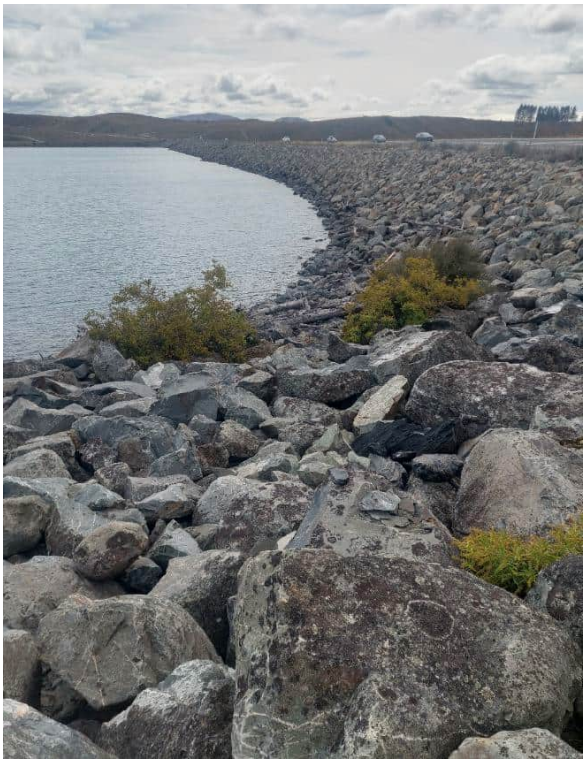
A **low to very high** ecological value for riparian vegetation combined with a **negligible** magnitude of effect results in an overall **very low to low** level of effect (Table Appendix B.5).

5.5.1.2 Dam armouring works

The proposed armouring access tracks and temporary building area are located on the periphery of the Lake Pūkaki carpark (Figure 2.2; Appendix C). The works will comprise the temporary loss of approximately 915 m^2 of exotic grassland with occasional native shrubs.

Vegetation is sparse at the top of the existing dam wall (Photograph 5.8) and purposely kept as such to allow access to the dam face. It is recommended that works areas are reinstated to a similar condition to the current state. Remediation planting can be undertaken as required following the completion of works and decommissioning of the access track.

Without remediation planting, the magnitude of effect would be **moderate** (Table Appendix B.4) resulting in an overall **low to high** level of effect (Table Appendix B.5). Remediation planting to a similar condition to its current state reduces the magnitude of effect to **low**. A **low to high** ecological value for riparian vegetation, combined with a **low** magnitude of effect, results in an overall **very low to low** level of effect.



Photograph 5.7: Proposed access track with sparsely distributed vegetation.

Photograph 5.8: Sparsely distributed vegetation located adjacent to existing dam wall.

5.5.2 Impacts on avifauna

5.5.2.1 Eased access

The proposed eased access has the potential to temporarily affect wetland/riverine bird foraging and breeding habitat through a modification of wetland habitats.

However, the bird community is tolerant of, and has adapted to, wetland fluctuations under the existing environment operational regime. The proposed eased access is not expected to affect the existing wetland habitat quantity or quality for avifauna given the short duration. The proposed eased access is therefore considered to have a **negligible** magnitude of impact on avifauna.

Spill events to Pūkaki River are not guaranteed under the existing operational regime. Spill events are also not expected to increase as a result of the lower drawdown level. As a result, no increased disturbance of nesting birds along Pūkaki River is expected compared to the existing environment operational levels.

Kakī are a Threatened – Nationally Critical species with a population of approximately 141 adult birds. It should be noted that, under the existing PC1 agreement between Meridian and DOC, kakī monitoring will continue to be undertaken, focused on the Tasman Delta (or elsewhere if the birds shift in response to changing lake levels) when the lake level drops below 518 m RL. In the unlikely event that additional lowering impacts this threatened bird species, this monitoring will detect any change and management may be undertaken under the existing agreement.

As a result, eased access activities are expected to have a **negligible** magnitude of impact on avifauna**.** A **low to very high** ecological value combined with a **negligible** magnitude of effect (Table Appendix B.4) results in a **very low to low** overall level of impact (Table Appendix B.5).

5.5.2.2 Dam armouring works

Pūkaki Dam armouring works are located across a zone that is typically inundated. Given lake lowering is likely to be over short periods with a high level of construction-related disturbance during that period, the lowered lake construction area is not considered likely to provide bird nesting habitat.

In addition, the existing Pūkaki carpark area and surrounds are highly disturbed with people and vehicles regularly accessing the area. The stockpile areas also provide low-quality nesting habitat due to short exotic grasses and stockpiles preventing effective line-of-sight nesting habitat[21].

The magnitude of impact as a result of dam armouring works on native birds is expected to be **negligible.** A **low to very high** value combined with a **negligible** magnitude of effect (Table Appendix B.4) results in a **very low to low** overall level of effect (Table Appendix B.5)..

5.5.3 Impacts on lizards

5.5.3.1 Eased Access

The proposed eased access is unlikely to impact native lizards which are located outside Lake Pūkaki margins. However, current spill events through Gate 19 (Appendix C1) impacts terrestrial habitats along the Pūkaki River. Native lizards have been recorded on the Pūkaki River and are likely well-adapted to the current spill regime. Spill events are rare and the frequency of spill events is likely to remain similar to the existing operational regime.

Native lizards have been monitored during operational spills from Gate 19 (Muchna, 2025). During monitoring, the water level slowly increased in the study river, allowing Southern Alps gecko to naturally self-relocate out of the inundation zone. Muchna (2025) considered lizards to be capable of swimming to shore in the low-velocity/ramping operational spill events under the existing operational regime (and concluded an overall negligible impact). In considering continued spill events for the proposed eased access, the magnitude of impact on native lizards is also expected to be **negligible**.

A **low to very high** ecological value for lizards combined with a **negligible** magnitude of effect (Table Appendix B.4) results in an overall **very low to low** level of effect (Table Appendix B.5).

[21] Braided river nesting birds typically require 'line-of-sight'/open habitats so they can observe predators in the surrounding environment.

5.5.3.2 Potential impacts of dam armouring works

If present, potential impacts of dam armouring works on native lizards include:

- Temporary loss of marginal habitat comprising 915 m^2 of exotic short-stature grassland and sparsely distributed shrubland (Appendix C Figure 3). The area will be remediated following works.
- Temporary impacts to 1,200 m^2 of exposed boulder rock revetment to be remediated following works (Appendix C Figure 3).
- Taking of rock material from two stockpiles (6.3 ha and 0.8 ha) required for construction use. The area comprises grassland interspersed with boulder piles which may comprise artificial lizard habitat. Machinery accessing the boulder material may disturb, injury or kill lizards if they currently use the stockpiles as habitat. Note that the stockpiles were installed during 2014 and since then may have resulted in benefited local lizard populations due to the provision of temporary rock habitat.
- Disturbance, injury or mortality during the construction phase (across the rock armouring and/or stockpile areas).
- Displacement of lizards into nearby habitats.

The dam armouring works are located in an area usually inundated and unsuitable as lizard habitat. An access track across the existing dam revetment will need to be constructed to access the works area. The access track area comprises marginal lizard habitat. Furthermore, materials for the armouring will be taken from both a 6.3 ha and 0.8 ha area of stockpiled boulders (Appendix C2). This area may also comprise lizard habitat.

A Lizard Management Plan has been developed to outline lizard survey methods and effects management options depending on survey findings. The LMP includes methods for a pre-construction lizard survey to be undertaken to determine if lizards are present in the project footprint or within the material stockpile area. If no lizards are recorded during pre-construction surveys, no further lizard management is required, and impacts are considered to be negligible. However, if lizards are recorded, the magnitude of effect on lizards could be potentially **moderate** (Table Appendix B.4) due to injury or mortality during construction. In addition, native lizards are protected by the Wildlife Act 1953.

A **low to very high** ecological value for lizards combined with a potentially **moderate** magnitude of effect results in an overall **low to high** level of effect (depending on the species) (Table 5.2; Table Appendix B.5).

Lizard salvage has not been proposed for the dam armouring works for the following reasons:

- The scale of material being established and removed from each of the dam armouring works area and stockpile area. Material will be taken from the stockpile area (7.1 ha) through regular machine and truck operations, resulting in continual disturbance to the area for the period of armouring works and consenting period which is 35 years. This would make any salvage impractical.
- Works will be undertaken whenever the lake is low enough to support the construction of the armouring works. This means that works may occur at any time of year over multiple years. Lizards are not typically salvaged during winter months due to being in a state of torpor.
- Salvage would need to occur in summer with works typically occurring in the winter. Given the scale of the stockpiles (7.1 ha), it would be impractical to exclude lizards following a summer salvage, from re-entering stockpile areas.
- The period in which stockpile material may be used is unknown. It would not be practical to salvage each year in anticipation that stockpile material may be used that winter.

- Material will need to be sourced from the stockpile at all times of the year to support construction.
- Difficulty in salvaging native lizards from existing rock piles (which would require extensive machine-assisted salvage).
- Potential continual re-invasion of lizards to stockpiles from nearby stockpiles and habitats. Given the size of the stockpile sites, exclusion fencing is not a practical option.

However, where a nationally Threatened species is recorded during the proposed survey, measures are proposed in the LMP to avoid, remedy and minimise impacts. These include selective use of material to avoid areas where Threatened species are detected to the extent practicable. In the unlikely case that pre-construction surveys detect Threatened species, a one-off salvage to secure the population is proposed as outlined in the LMP.

An overall level of effect of **low** would not constitute a significant adverse impact (i.e. if Not Threatened species were recorded). However, an overall level of effect of **high** (i.e. if At Risk or Threatened species were identified) could constitute a significant adverse impact without residual impacts management.

If required, residual effects management as outlined in Section 6 proposed to ensure that impacts to fauna protected by the Wildlife Act 1953, and adverse impacts are adequately managed.

A summary of avoid, minimise, remedy, offset and compensation approaches for native lizards provided in Table 5.3.

Table 5.2: Lizard species list recorded on Pūkaki River and wider area (30 km radius) (Boffa Miskell, 2022), conservation status, ecological value, magnitude of impact and overall level of impact

Common name	Species name	Ecological value	Magnitude of effect (if present)	Potential overall level of effect (if present)
Lakes skink	*Oligosoma* aff. *chloronoton* "West Otago"	Very high	Moderate	High
Southern long-toed skink/ Roamatimati skink	*Oligosoma* aff. *chloronoton* "southern"	High	Moderate	High
Cryptic skink	*Oligosoma inconspicuum*	High	Moderate	High
McCann's skink	*Oligosoma maccanni*	Low	Moderate	Low
Mackenzie skink	*Oligosoma prasinum*	Very high	Moderate	High
Canterbury grass skink	*Oligosoma* aff. *polychroma* Clade 4	High	Moderate	High
Southern grass skink	*Oligosoma* aff. *polychroma* Clade 5	High	Moderate	High
Scree skink	*Oligosoma waimatense*	Very high	Moderate	High
Jewelled gecko	*Naultinus gemmeus*	High	Moderate	High
Southern Alps gecko	*Woodworthia* "Southern Alps"	High	Moderate	High
Korero gecko	*Woodworthia* "Otago/Southland Large"	High	Moderate	High

Table 5.3: Effects management summary for native lizards

Effects management	Action	Justification
Avoid and minimise	Where an At Risk or Threatened species is recorded, avoidance and minimisation measures will include provision of a distribution map to the construction team. Stockpile materials will be removed from stockpile areas not hosting lizards to the extent practicable. In the unlikely case that pre-construction surveys detect Threatened species, a one-off salvage to be implemented as outlined in the LMP.	There are limited opportunities to avoid impacts: • Stockpiles have been placed specifically for dam armouring works and over time all rock held in the stockpiles will be used for dam armouring works. • Works may occur in any given year, at any time (likely winter) i.e. whenever the dam is low enough to access the armouring works area.
Remedy	Remediation of the access tracks and any stockpile laydown/temporary building areas will be remediated following works. No remediation proposed for the stockpile area.	All rock material will be needed for dam armouring works. Rock material may need to be established and sourced from this area for a long time (period of consent – 35 years).
Offset	No offset is proposed.	Implementing offset for native lizards is difficult due to their cryptic nature and the difficulty in obtaining robust, quantifiable information required for offsetting.
Compensate	Compensation fund to support a targeted lizard monitoring and management in the local area. Increased compensation amounts have been provisioned for species with a higher Conservation Status.	Compensation measures have been proposed to address impacts to native lizards protected by the Wildlife Act 1953. Refer to Section 6.

5.5.4 Impacts on terrestrial invertebrates

5.5.4.1 Eased Access

The proposed eased access is unlikely to adversely impact terrestrial invertebrates which are located outside of Lake Pūkaki. Spill events through Gate 19 (Appendix C2) under the current regime could impact invertebrates along the Pūkaki River. Spill events are rare and the frequency of spill events is likely to remain similar to the existing operational regime.

As such, compared to the existing environment/current operational regime, the proposed eased access is expected to have a **negligible** magnitude of effect (Table Appendix B.4) on terrestrial invertebrates located on the Pūkaki River. As a result, a **low to very high** ecological value for terrestrial invertebrates combined with a **negligible** magnitude of effect results in an overall **very low to low** level of effect (Table Appendix B.5).

5.5.4.2 Dam armouring works

Key At Risk and Threatened invertebrate species are unlikely to be present on the periphery of Lake Pūkaki (DOC, 1994; Boffa Miskell Ltd., 2010). This includes in and around the proposed works area which comprises modified habitats. These include robust grasshopper which is known in the local area from the lower Pūkaki River only (DOC, 1994; Boffa Miskell Ltd., 2010).

Other At Risk and Threatened species are unlikely to readily colonise a zone that is devoid of any vegetation or substrate structure due to regular inundation and artificially constructed revetment. The key At Risk and Threatened invertebrates are known from the nearby dry river terraces associated with the Pūkaki River and less modified habitats (Table 4.5).

Similarly for the material stockpile area, short grass and deposited rock boulder stockpiles are unlikely to provide impactive habitat for key At Risk and Threatened invertebrates.

The magnitude of effect of the dam armouring works on invertebrates is expected to be **negligible** (Table Appendix B.4). A **low to very high** ecological value for terrestrial invertebrates combined with a **negligible** magnitude of effect results in an overall **very low to low** level of effect (Table Appendix B.5).

5.6 Impacts on significant indigenous vegetation and significant habitat of indigenous biodiversity

Section 4.4 and Appendix A describe that the Tasman River, the natural alpine and hill fed river tributaries, and the Glentanner and Tasman River Delta wetlands have been assessed as having significant vegetation present or provide significant habitat for indigenous biodiversity.

As outlined in Section 5.3 to 5.5, the proposed eased access and the dam armouring works are unlikely to result in a substantial change to the ecological attributes present in the areas identified as being significant (as detailed in the ‘very low – low’ overall level of effects). Therefore, the areas identified as being significant will be managed so that a no net loss of indigenous biodiversity or indigenous biodiversity values will result due to the proposed activities.

6 Residual impact management

Residual adverse impacts of moderate or higher will be addressed through compensation measures as discussed below. In general, compensation measures meet the principles for compensation as outlined in the NPS-IB (refer to Appendix F). By implementing the following residual impact management recommendations, significant adverse impacts are considered adequately addressed.

6.1 Dam armouring works

Due to potential injury or mortality associated with dam armouring works, the overall level of impact on native lizards could be low to high (depending on which species are present). A pre-construction survey will be undertaken to determine if native lizards are present. If lizards are detected, measures will be required to address residual adverse impacts on fauna protected by the Wildlife Act 1953.

Where lizards are recorded during pre-surveys, and disturbance of the areas where they are recorded cannot be practicably avoided, financial compensation is proposed to address residual adverse impacts of moderate or higher and address impacts to fauna protected by the Wildlife Act 1953.

The financial contribution proposed is proportional to the costs associated with a typical one-off salvage effort. Increasing contributions reflect increasing impacts due to species conservation statuses. Recommended compensation amounts are presented in Table 6.1. The financial contributions proposed are considered appropriate and proportionate compensation for the size of the project footprint and potential lizard population size. It is also relevant that the rock stockpiles are opportunistic and temporary habitat, and the rocks were placed with the intention that they would be reclaimed and used for armouring the dam face and abutments as is now proposed.

The compensation fund should be used to implement targeted lizard management and/or monitoring of key native lizard species in proximity to the works area. The details of the use of the fund will be confirmed following the pre-construction survey and determination of which species are present (if any).

Table 6.1: Proposed lizard compensation financial contribution

Pre-construction survey results	Proposed financial contribution (one-off payment)
No lizards recorded	No financial contribution required
Not Threatened species recorded	$20,000
At Risk species recorded	$30,000
Threatened species recorded	$40,000

7 Summary of ecological values, impacts and management measures

A summary of ecological values, proposed management measures and resulting overall level of effects are provided in Table 7.1. Ecological characteristics affected by the works include freshwater, wetland and terrestrial characteristics which range in value from low to very high.

7.1 Eased Access

Most impacts on the identified ecological values can be managed to a very low or low level of effect following measures to avoid, minimise, or remedy impacts.

No additional targeted management of freshwater, wetland or terrestrial values is required as any temporary or potential adverse impacts are expected to be low. The overall level of effect of low does not constitute a significant adverse impact.

7.2 Dam armouring works

Ecological values associated with dam armouring works can generally be managed to a very low or low level of impact following measures to avoid, remedy or minimise impacts. However, potential adverse impacts of moderate or higher may occur for native lizards (if present) due to potential construction-phase disturbance, injury and mortality. Avoidance and minimisation measures are targeted towards nationally Threatened species if present. Residual adverse impact management measures for native lizards includes compensation measures in the form of a financial contribution to fund a lizard monitoring/management regime in the local area.

In summary:

- Potential adverse impacts can be adequately managed to a low to very low level for freshwater values. Minimisation through ESC measures is the key management measure proposed to manage adverse impacts to freshwater values.
  - Preparation of an LMP to describe: pre-construction lizard survey methods to determine presence, species and distribution.
  - Other recommended measures to avoid, minimise, remedy and compensate effects on lizards (if detected during proposed survey).
- Impacts to native lizards could be negligible (if no native lizards are present), or low to high depending on species present. Avoid, minimisation, remediation and compensation measures have been proposed to manage residual adverse impacts on native lizards (if present) in accordance with the LMP.

Through following the proposed impact management measures, no significant adverse impacts are expected as a result of the proposed works.

Table 7.1: Summary of ecological characteristics, values, predicted level of effect of proposed activities. Proposed measures to avoid, remedy, minimise impacts, as well as residual impact management

Ecological characteristic	Ecological value	Activity	Impact management measures (avoid, minimise, remedy)	Overall level of effect following avoid, minimise, remedy measures	Approach to residual impact management
Tasman River environments (including the delta)	Very high	Change to threshold	Not required.	Low	-
Alpine and hill fed tributary rivers	Very high	Change to threshold	Not required.	-	-
Lake Pūkaki fish community	Moderate	Change to threshold	Not required.	Very low	-
Lake Pūkaki littoral habitat	Moderate to High	Change to threshold	Not required.	Low	-
	Moderate	Dam armouring	Potential minimisation measures include: • To avoid excess sediment entering or being resuspended throughout the littoral zone the implementation of a construction management plan that includes an approved ESC measures should occur.	Very low	-
Wetlands	Low to very high	Change to threshold	Where practicable and as is already recommended under the existing environment operational regime: • Periodic raising of the lake level to inundate wetland areas to maintain relatively normal hydrological conditions at connected wetlands.	Low to very low	-
		Dam armouring	Erosion and Sediment Control plan	Very low to low	-

Ecological characteristic	Ecological value	Activity	Impact management measures (avoid, minimise, remedy)	Overall level of effect following avoid, minimise, remedy measures	Approach to residual impact management
Wetland plants	Low to very high	Change to threshold	Where practicable and as is already recommended under the existing environment operational regime: • Allow for existing operational range of water levels. • Allow for inundation of wetlands at least annually (i.e. allow high lake levels).	Very low to low	-
		Dam armouring	Erosion and Sediment Control plan	Very low to low	-
Terrestrial ecosystems including riparian vegetation	Low to high	Change to threshold	Not required.	Negligible	-
		Dam armouring	Avoidance of native vegetation where practicable. Where vegetation cannot be avoided, re-instatement of vegetation following works.	Very low to low	-
Avifauna	Low to very high	Change to threshold	Potential minimisation measures include the following which are consistent with existing measures proposed for the re-consenting of the Waitaki Power Scheme: • Avoid extreme low levels during freshwater bird breeding season (September to December) where possible. • Gate 19: For gate testing releases that exceed 120 m^3/s, use reasonable endeavours to not undertake these when braided river birds are nesting.	Very low to low	-
		Dam armouring	None likely to be required.	Very low to low	-
Lizards	Low to very high	Change to threshold	None likely to be required.	Very low to low	-
		Dam armouring	Pre-construction lizard survey to determine species presence. If Threatened species present, management measures in the form of selective use of rock material to avoid and minimise impacts lizard populations to the extent practicable. A one-	Negligible (if no lizards present) or low to high	If native lizards are recorded, financial contribution (compensation) to be ring-

Ecological characteristic	Ecological value	Activity	Impact management measures (avoid, minimise, remedy)	Overall level of effect following avoid, minimise, remedy measures	Approach to residual impact management
			off limited salvage is recommended to manage Threatened species if present.	(depending on species present).	fenced for lizard monitoring/ management.
Invertebrates	Low to very high	Change to threshold	Not required.	Very low to low	-
		Dam armouring	Not required.	Very low to low	-

8 Summary and conclusion

Meridian is seeking approval to be able to operate Lake Pūkaki between 518 m and 513 m RL until the end of 2028, if this is required. Meridian also seeks to enhance the Pūkaki Dam's resilience to wave action through the placement of protective rip rap on the Dam face and abutments. A desktop assessment and review of relevant ecological information of the Lake Pūkaki catchment was undertaken. Key findings are as follows:

- Riverine and lake littoral (including fish species), as well as wetland and terrestrial ecological values associated with Lake Pūkaki range from low to very high. Very high value characteristics include braided, alpine, and hill fed riverine habitats; wetland habitats, threatened birds, lizards and invertebrates.
- Potential overall adverse impacts to freshwater environments and fauna from the proposed eased access (i.e., within the modelled eased scenario; Section 2) are expected to be very low - low. No further management measures in response to an extended low lake water level are required for freshwater environments as no significant adverse effects are expected.
- Potential adverse impacts on wetlands from the proposed eased access of lake water level include changes to wetland and wetland plant extent and condition, and potential modification of resources for wetland/riverine-associated birds.
- Potential adverse impacts are confounded by a range of factors that influence wetland extent and condition, such as upstream inflows, surrounding weed burden and pest animal presence. Furthermore, the proposed eased access activity is temporary with lower water levels likely to occur for up to approximately 39 days over the 3 years.
- Nonetheless, an overall very low to low level of impact is expected for wetlands and wetland/riverine birds.
- Where the modelled scenario is exceeded (such as below 518 m for more than 39 days over three years), any extension is expected to be of short-duration and the overall level of effect for the assessed ecological features is considered to be the same.
- Terrestrial (terrestrial birds, lizards and invertebrates) and the alpine and hill -fed riverine characteristics are not considered to be adversely affected by the extended lowering of the lake water level.
- Regarding the proposed dam armouring:
  - Potential adverse impacts can be adequately managed to a low to very low level for freshwater values. Minimisation through ESC measures is the key management measure proposed to manage adverse impacts to freshwater values.
  - Impacts to native vegetation will be managed through remediating the site following construction works.
  - Impacts to native lizards could be negligible (if no native lizards are present), or low to high depending on species present. Compensation is proposed to manage residual adverse impacts on native lizards (if present), while also managing impacts on fauna protected by the Wildlife Act 1953. A pre-construction survey is proposed to assess lizard presence and extent of potential impacts and level of compensation.
- Where At Risk or Threatened lizard species detected, avoidance and minimisation measures have been recommended, which include avoiding rock material which host Threatened species to the extent practicable. A one-off salvage is recommended where Threatened species are impacted by works, to secure an off-site population, in accordance with the LMP.

Overall, it is considered potential adverse ecological impacts of both proposed activities can be adequately managed through proposed ecological impact management measures and proposed

consent conditions. Therefore, based on our assessment and with the implementation of proposed effects management measures, the extended lake lowering and armouring works are not expected to result in significant adverse ecological effects.

9 Applicability

This report has been prepared for the exclusive use of our client Meridian Energy Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application under the Fast-track Approvals Act 2024 and that an Expert Panel as the consenting authority will use this report for the purpose of assessing that application. We understand and agree that this report will be used by the Expert Panel in undertaking its functions.

Compliance with the Environment Court Practice Note 2023: Sam Heggie-Gracie

I confirm that, in my capacity as author of this report, I have read and abided by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses contained in the Practice Note 2023.

I am a Senior Ecologist at Tonkin & Taylor Ltd (T+T), where I specialise in terrestrial and wetland ecology. I have worked at T+T since 2017. Prior to joining T+T, I was an ecologist at Auckland Council.

I have 10 years' experience in terrestrial and wetland ecology. I am a Member of Birds New Zealand and the New Zealand Plant Conservation Network (NZPCN).

Recent relevant projects and services that I have been involved with include:

- Belfast to Pegasus Motorway and Wooded Bypass Project Fast-track application.
- Auckland Regional Landfill consent application.
- The reconsenting of the water discharge consents at the NZ Steel Glenbrook Steel Mill.

Compliance with the Environment Court Practice Note 2023: **Patrick Lees**

I confirm that, in my capacity as author of this report, I have read and abided by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses contained in the Practice Note 2023.

I am a Senior Freshwater Ecologist at Tonkin & Taylor Ltd (T+T), where I specialise in stream and lake freshwater ecology. I have worked at T+T since 2019. Prior to joining T+T, I was a Freshwater Ecologist at Pattle Delamore Partners Ltd.

I have 15 years' experience in freshwater ecology. I am a Member of New Zealand Freshwater Science Society and the Environment Institute of Australia and New Zealand.

Relevant projects and services that I have been involved with include:

- Water take and water quality ecological effects at Lake Hood and Pegasus Lake.
- Technical reviewer on the Otaki to North of Levin, Mount Messenger, and Te Ara Tupua and Tupua Horo Nuku projects.
- Lead ecologist for the Belfast to Pegasus Motorway and Wooded Bypass Project Fast-track application.
- The reconsenting of the water discharge consents at the NZ Steel Glenbrook Steel Mill.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

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Report prepared by:

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Rob Van de Munckhof
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Sam Heggie-Gracie
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Appendix A Criteria for determining significance per CRPS Policy 9.3.1

Appendix A Table 1: CRPS Appendix C category and criteria for determining significant indigenous vegetation and significant habitat of indigenous biodiversity

CRPS significance category	Criteria if significant (per Appendix C of the CRPS)	Habitats assessed within this EcIA by T+T which meet the criteria+
Representativeness	Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas. Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.	• Tasman River and its Delta. • Alpine and hill fed river tributaries. • Hydrologically linked wetlands (particularly Glentanner Wetland, Tasman River Delta). The braided, alpine, and hill fed river and delta wetland habitats provide habitat for indigenous river and wetland birds and fish, and plants that are representative, typical or characteristic of the natural diversity of the area. Representative areas include: • The mudflats with turf species at Tasman River Delta. • Glentanner Wetland supports indigenous vegetation; or • is habitat for indigenous fauna and is a large example of their type within the relevant ecological district. • The Tasman River is a natural braided river. The Indigenous vegetation and habitat of indigenous fauna located within the above areas is significant as it is a large example of representative and characteristic natural diversity of the ecological district.
Rarity/Distinctiveness	Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the region, or relevant land environment, ecological district, or freshwater environment.	• Tasman River and its Delta. • Alpine and hill fed river tributaries.

CRPS significance category	Criteria if significant (per Appendix C of the CRPS)	Habitats assessed within this EcIA by T+T which meet the criteria+
	Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.	• Hydrologically linked wetlands (particularly Glentanner Wetland, Tasman River Delta). As noted in this EcIA, natural wetlands in Canterbury (and wider New Zealand) generally have been reduced to less than 20% of their former extent regionally and / or nationally. In addition to this, many habitats identified in this EcIA support nationally Threatened and At Risk plant, bird, or fish species. Of which many species are considered likely to be uncommon in their relevant Ecological District. Wetlands support plant species (e.g., marsh arrow grass, *Montia angustifolia*, and *Leptinella maniototo*) that are considered likely to be uncommon or threatened within their relevant Ecological District. Fauna species include: • Kakī which are regionally endemic. • Upland longjaw galaxias, a non-migratory galaxiid is found exclusively in the headwater tributaries or in side-channels of braided rivers within the Alpine and hill fed tributaries. • Tasman River and its Delta provides habitat for threatened and at risk flora and fauna. The Indigenous vegetation and indigenous fauna located within the above areas is significant as it is comprised of: • Threatened, at risk, or uncommon, nationally or within the relevant ecological district. • Habitats less than 20% of its former extent in the region. • Is distinctive and is of restricted occurrence (i.e., upland longjaw galaxias).
	The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.	
	Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combinations of factors.	
Diversity and Pattern	Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has	• Tasman River and its Delta. • Alpine and hill fed river tributaries.

CRPS significance category	Criteria if significant (per Appendix C of the CRPS)	Habitats assessed within this EcIA by T+T which meet the criteria+
	changes in species composition reflecting the existence of diverse natural features or ecological gradients.	• Hydrologically linked wetlands (particularly Glentanner Wetland, Tasman River Delta). River and wetlands habitats described in this study are highly diverse and contain a range of indigenous vegetation and fauna types. Some wetlands and rivers contain clear gradients and zonation of habitat depending on relative elevation and inundation regime, especially when surrounding indigenous dryland vegetation types are also considered. The Indigenous vegetation and habitat of indigenous fauna located within the above areas is significant as it contains indigenous taxa and a species composition reflecting the existence of diverse natural features or ecological gradients.
Ecological Context	Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function. A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system. Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.	• Tasman River and its Delta. • Alpine and hill fed river tributaries. • Hydrologically linked wetlands (particularly Glentanner Wetland, Tasman River Delta). The wetland systems (Glentanner and Tasman River Dela) are productive ecosystems that form an interface between terrestrial (dryland) habitats with lake and river / stream habitats. Wetlands and the braided river systems often form important ecological linkages and networks. Wetlands are often of importance for hydrological buffering of adjacent water bodies (by providing water or soaking excess water), and both wetlands and rivers are often important feeding habitats. The habitats assessed in this study, collectively and including any connected waterbodies, are an important ecological network, spanning lakes, alpine and hill fed river basin streams, to the glacial headwater habitats. Many of these habitats play an important hydrological, biological and ecological role in the functioning of the Pūkaki Lake system. The Indigenous vegetation and habitat of indigenous fauna located within the above areas is significant as it contributes an important

CRPS significance category	Criteria if significant (per Appendix C of the CRPS)	Habitats assessed within this EcIA by T+T which meet the criteria+
		ecological linkage and network, while providing important buffering functions. Similarly, these areas provide important seasonal or permanent habitat for indigenous species. And the hydraulically linked wetlands play an important ecological role in the natural functioning of the Tasman River and its delta system.

Note: CRPS Policy 9.3.1 states:

1. Significance, with respect to ecosystems and indigenous biodiversity, will be determined by assessing areas and habitats against the following matters:
    a. Representativeness
    b. Rarity or distinctive features
    c. Diversity and pattern
    d. Ecological context

The assessment of each matter will be made using the criteria listed in Appendix 3.

2. Areas or habitats are considered to be significant if they meet one or more of the criteria in Appendix 3.

3. Areas identified as significant will be protected to ensure no net loss of indigenous biodiversity or indigenous biodiversity values as a result of land use activities.

+ Where appropriate the significance criteria for wetlands that was completed by Boffa Miskell (2023) has been used to inform the assessment.

Appendix B EIANZ criteria

Table Appendix B.1: Criteria for assigning ecological value to marine, freshwater and terrestrial species

Ecological Value	Species
Very High	• Internationally or 'Nationally Threatened' species (Nationally Critical, Nationally Endangered, Nationally Vulnerable) found in the ZOI* either permanently or seasonally.
High	• Species listed as Internationally or Nationally At Risk – Declining, found in the ZOI either permanently or seasonally.
Moderate	• Locally uncommon or distinctive species; or • Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally.
Low	• Nationally and locally common indigenous species.
Negligible	• Exotic species, including pests, species having recreational value.

*In this case the Zone of Influence (ZOI) refers to all estuarine and marine water bodies and environments that could be potentially impacted by the Project. It includes the project footprint and any environments beyond the project footprint Area where 'indirect effects' such as discharges may extend.

Table Appendix B.2: Ecological values assigned to freshwater ecology

Value	Explanation	Characteristics
Very High	A reference quality watercourse in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants from human induced activities including agriculture. Negligible degradation e.g. stream within a native forest catchment.	Benthic invertebrate community typically has high diversity, species richness and abundance. Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments. Benthic community typically with no single dominant species or group of species. MCI scores typically 120 or greater. EPT richness and proportion of overall benthic invertebrate community typically high. SEV scores high, typically > 0.8. Fish communities typically diverse and abundant. Riparian vegetation typically with a well-established closed canopy. Stream channel and morphology natural. Stream banks natural typically with limited erosion. Habitat natural and unmodified.
High	A watercourse with high ecological or conservation value but which has been modified through loss of riparian vegetation, fish barriers, and stock access or similar, to the extent it is no longer reference quality. Slight to moderate degradation e.g. exotic forest or mixed forest/agriculture catchment.	Benthic invertebrate community typically has high diversity, species richness and abundance. Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments. Benthic community typically with no single dominant species or group of species. MCI scores typically 80 - 100 or greater. EPT richness and proportion of overall benthic invertebrate community typically moderate to high. SEV scores moderate to high, typically 0.6-0.8. Fish communities typically diverse and abundant. Riparian vegetation typically with a well-established closed canopy. No pest or invasive fish (excluding trout and salmon) species present. Stream channel and morphology natural. Stream banks natural typically with limited erosion. Habitat largely unmodified.
Moderate	A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Moderate to high degradation e.g. high-intensity agriculture catchment.	Benthic invertebrate community typically has low diversity, species richness and abundance. Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. Benthic community typically with dominant species or group of species. MCI scores typically 40 - 80. EPT richness and proportion of overall benthic invertebrate community typically low. SEV scores moderate, typically 0.4 - 0.6.

Value	Explanation	Characteristics
		Fish communities typically moderate diversity of only 3 - 4 species. Pest or invasive fish species (excluding trout and salmon) may be present. Stream channel and morphology typically modified (e.g. channelised). Stream banks may be modified or managed and may be highly engineered and/or evidence of significant erosion. Riparian vegetation may have a well-established closed canopy. Habitat modified.
Low	A highly modified watercourse with poor diversity and abundance of aquatic fauna and significant water quality issues. Very high degradation e.g. modified urban stream.	Benthic invertebrate community typically has low diversity, species richness and abundance. Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. Benthic community typically with dominant species or group of species. MCI scores typically 60 or lower. EPT richness and proportion of overall benthic invertebrate community typically low or zero. SEV scores moderate to high, typically less than 0.4. Fish communities typically low diversity of only 1 - 2 species. Pest or invasive fish (excluding trout and salmon) species present. Stream channel and morphology typically modified (e.g. channelised). Stream banks often highly modified or managed and maybe highly engineered and/or evidence of significant erosion. Riparian vegetation typically without a well-established closed canopy. Habitat highly modified.

Table Appendix B.3: Ecological values assigned to vegetation, habitats and communities

Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community.	
Matters	**Attributes to be considered**
Representativeness	Attributes for representative vegetation and aquatic habitats: • Typical structure and composition. • Indigenous species dominate. • Expected species and tiers are present. Attributes for representative species and species assemblages: • Species assemblages that are typical of the habitat. Indigenous species that occur in most of the guilds expected for the habitat type.

Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community.	
Matters	**Attributes to be considered**
Rarity/distinctiveness	Attributes for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity. • Amount of habitat or vegetation remaining. • Distinctive ecological features. • National priority for protection. Attributes for rare/distinctive species or species assemblages: • Habitat supporting nationally Threatened or At-Risk species, or locally uncommon species. • Regional or national distribution limits of species or community. • Unusual species or assemblages. Endemism.
Diversity and Pattern	• Level of natural diversity, abundance and distribution. • Biodiversity reflecting underlying diversity. • Biogeographical considerations – pattern, complexity. Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation.
Ecological context	• Site history, and local environmental conditions which have influenced the development of habitats and communities. • The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA). • Size, shape and buffering. • Condition and sensitivity to change. • Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material. • Species role in ecosystem functioning – high level, key species identification, habitat as proxy.

Table Appendix B.4: Summary of the criteria for describing the magnitude of effect

Magnitude	Description
Very High	Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature.
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature.
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature.
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature.

Table Appendix B.5: Criteria for describing overall level of ecological effects

Magnitude of effect	Ecological Value				
	Very High	High	Moderate	Low	Negligible
Very High	Very High	Very High	High	Moderate	Low
High	Very High	Very High	Moderate	Low	Very Low
Moderate	High	High	Moderate	Low	Very Low
Low	Moderate	Low	Low	Very low	Very Low
Negligible	Low	Very low	Very low	Very low	Very Low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

Overall level-of-effect categories are used to determine if residual effects management is required over and above measures to reduce the severity of effects through efforts to avoid, remedy or minimise adverse effects. Usually, if the level of residual effect is assessed as being "Moderate" or greater, this warrants efforts to offset or compensate for these effects.

Appendix C Figures

C1 Pūkaki zone rivers and connected habitats

C2 Lizard management

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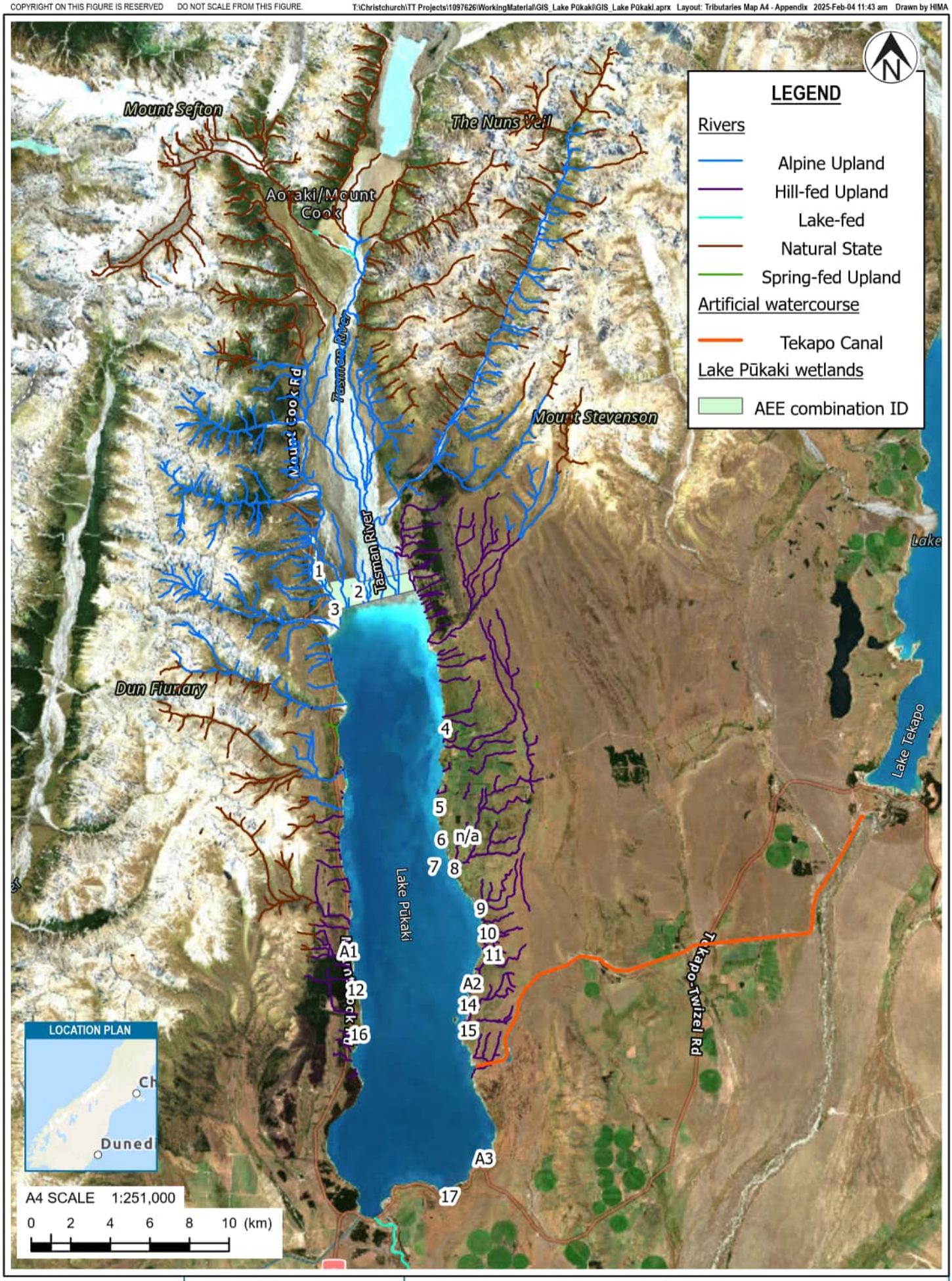

PROJECT No.	1097626	
DESIGNED	HIMA	FEB.25
DRAWN	HIMA	JAN.25
CHECKED	RANI	
RANI		FEB 25
APPROVED		DATE

Tonkin+Taylor
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CLIENT **MERIDIAN ENERGY LIMITED**
PROJECT **PROJECT BLUE CASCADE**
TITLE TRIBUTARIES OF LAKE PŪKAKI
SCALE (A4) 1:251,000 FIG No. FIGURE 1. REV 0

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NOTES:

Basemap NZ Hybrid Reference (Vector): Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors.. NZ Navigation Map: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors.. NZ Imagery: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

REV	DESCRIPTION	GIS	CHK	DATE
0	First version	SHEG	JORB	8/8/25

LOCATION PLAN

PROJECT No.	1097626	
DESIGNED	PALE	OCT.25
DRAWN	PALE	OCT.25
CHECKED	JORB	OCT.25
APPROVED	JORB	OCT.25

CLIENT **GHD LIMITED**

PROJECT **LAKE PŪKAKI**

TITLE PROJECT AREAS

SCALE (A3) 1:6,000 FIG No. FIGURE C2. REV 0

Appendix D Summary of fish species within the Pūkaki Zone

D1 Galaxias species

Canterbury galaxias and Upland longjaw galaxias:

The upland longjaw galaxias (*Galaxias aff. prognathus "Waitaki')* belongs to the 'pencil-galaxias' group, while the Canterbury galaxias (*Galaxias vulgaris)* is a larger fish which grows to a greater maximum size than the pencil-galaxias. Both species are non-diadromous and will form resident populations throughout the Pūkaki zone where appropriate and sufficient habitat is available for their entire life cycle.

The upland longjaw galaxias is found exclusively in the headwater tributaries or in side-channels of braided rivers within the Pūkaki zone. The preferred habitat type of this species includes small, shallow, flowing streams or permanent reaches. Their distribution throughout the Pūkaki zone may be limited by temperature.

Canterbury galaxias is generally widespread throughout the Pūkaki zone due to having a broad habitat and hydraulic preferences. This species is usually found in moderately swift, bouldery or gravel streams and in the channels of larger braided rivers.

Kōaro:

Kōaro (*Galaxias brevipinnis*) is a diadromous galaxias that can form non-diadromous populations that use lakes as larval rearing habitat instead of the ocean. Within the Pūkaki zone, kōaro were generally found in Lake Pūkaki and its tributaries encompassing a wide size range.

Recent evidence suggests that lakes can cause a split in the genetic distribution of kōaro populations upstream of lakes (Hicks et al. 2021, Campbell et al. 2022, Darestani et al. in press). This showed that there was a genetic split between below lakes kōaro populations (which were dominated by marine recruitment populations) and kōaro populations upstream of lakes (which were generally dominated by lake-derived recruitment populations). In addition, NIWA (2024) outline that prior to the construction of the dams the nature of the braided rivers present in the wider Waitaki River catchment may have also restricted the distribution of any marine recruitment populations. Therefore, it can be concluded that the kōaro population present in the Pūkaki zone will be a non-diadromous population which uses the lake as larval rearing habitat and was largely genetically isolated prior to the building of the Lake Pūkaki dam (NIWA (2024) for further discussion).

D2 Bully species

Upland bully:

Upland bully (*Gobiomorphus breviceps*) occur in most river and stream sites but were generally uncommon in Lake Pūkaki. Upland bully will form resident populations in tributary habitats, including where wetland or other shallow lentic habitats are connected to either the Lake Pūkaki or its tributaries.

Common bully:

Common bully (*Gobiomorphus cotidianus)* is widespread across the Lake Pūkaki zone, and is generally found within Lake Pūkaki and the lower parts of lake tributaries. Where they inhabit the lake, common bully are usually found within the littoral zone in and around the lake edge.

In Lake Pūkaki common bully spawn under hard substrates of the shallow littoral zone during spring-early summer. Littoral zone quantity and quality variability due to the ongoing lake drawdowns may have a detrimental impact on the spawning and recruitment of common bullies. However, if suitable habitat is available (e.g., water flow, cobble/ gravel substrates) within the lower parts of lake tributaries (where common bully are known to be abundant) spawning may still occur in these areas.

D3 Eel species

Longfin eels (tuna; *Anguilla dieffenbachii*) have not been identified in Lake Pūkaki since 1993. Further to this, within the Pūkaki zone, there is no evidence of commercial eel fishing having occurred in the zone since 1990 and the Migrant Trap and Transfer (MTAT)[22] programme have never caught eels, or even attempted to, from this zone. Nor has there been stocking of tuna within Lake Pūkaki through the Elver Trap and Transfer (ETAT)[22].

Therefore, the available evidence suggests that the tuna population within the Pūkaki zone has declined since 1990, this is caveated by the fact that tuna populations would already have been low within the Pūkaki zone due to the longfin eel upstream migration being compromised due to the construction of the Pūkaki Dam.

D4 Introduced Salmonid

Lake Pūkaki is known to support low density of trout (both brown (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss)*) and sockeye salmon (*Oncorhynchus nerka)*. The lake is not regarded as an important recreational fishery. However, the Tasman River and some of the larger tributaries (i.e., Jollie River) do provide spawning habitat for trout and sockeye salmon found in Lake Pūkaki. Recent observations of sockeye salmon spawning densities indicate that the number of adult sockeye spawning in the Tasman River and its tributaries may be increasing (NIWA, 2019).

[22] Which is conducted as part of the wider Wataki Power Scheme's mitigation programme.

Appendix E Wetland and terrestrial species lists

Table Appendix E.1: Tasman River Delta At Risk and Threatened wetland plant species list (Boffa Miskell, 2023)

Common name	Species name	Conservation status (de Lange et al. 2023)	Ecological value
Buchanan's sedge	*Carex buchananii*	At Risk – Declining	High
Pygmy clubrush	*Isolepis basilaris*	At Risk – Naturally Uncommon	Moderate
-	*Leptinella maniototo*	At Risk - Relict	Moderate
Montia	*Montia angustifolia*	At Risk – Declining	High
Turf marsh arrow grass	*Triglochin palustris*	Threatened – Nationally Endangered	Very high

Table Appendix E.2: Native plant species recorded within or in proximity to proposed access track footprint for dam armouring works

Common name	Species name	Conservation status (de Lange et al. 2023)	Ecological value
Little hard fern*	*Blechnum penna-marina*	At Risk – Declining	High
Desert broom*	*Carmichaelia petriei*	At Risk – Declining	High
-	*Coprosoma rugosa*	Not Threatened	Low
Small-leaved pohuehue	*Muehlenbeckia complexa*	Not Threatened	Low
-	*Olearia lineata*	At Risk – Declining	High
Scented tree daisy	*Olearia odorata*	At Risk - Declining	High
Common scabweed*	*Raoulia australis*	At Risk – Declining	High
Cotton fireweed*	*Senecio quadridentatus*	Not Threatened	Low
Prostrate kōwhai	*Sophora prostrata*	At Risk – Declining	High
Hebe*	*Veronica pauciramos*	Not Threatened	Low
Koromiko	*Veronica salicifolia*	Not Threatened	Low

Note:* = in proximity but not observed in current design footprint.

Table Appendix E.3: Native freshwater birds recorded during formal surveys since 2010 in the Waitaki catchment (NIWA, 2023)

Common name / Māori name	Species name	Conservation status (Robertson et al. 2021)	Ecological value
Wrybill / Ngutuparore	*Anarhynchus frontalis*	Threatened – Nationally Vulnerable	Very high
Grey duck / Tete	*Anas gracilis*	Not Threatened	Low
Australasian shoveler	*Anas rhynchotis*	Not Threatened	Low

Common name / Māori name	Species name	Conservation status (Robertson et al. 2021)	Ecological value
Grey duck / Pārera	*Anas superciliosa*	Threatened – Nationally Vulnerable	Very high
New Zealand pipit / Pīhoihoi	*Anthus novaeseelandiae*	At Risk – Declining	High
New Zealand scaup / Pāpango	*Aythya novaeseelandiae*	Not Threatened	Low
Australasian bittern / Matuku hūrepo	*Botaurus poiciloptilus*	Threatened – Nationally Critical	Very high
Banded dotterel / Tūturiwhatu	*Charadrius bicinctus bicinctus*	At Risk – Declining	High
Black-fronted tern / Tarāpirohe	*Chlidonias albostriatus*	Threatened – Nationally Endangered	Very high
Swamp harrier / Kāhu	*Circus approximans*	Not Threatened	Low
Black swan / Kakīānau	*Cygnus atratus*	Not Threatened	Low
White-faced heron / Matuku	*Egretta novaehollandiae*	Not Threatened	Low
Australian coot	*Fulica atra australis*	At Risk – Naturally Uncommon	Moderate
South Island pied oystercatcher / Tōrea	*Haematopus finschi*	At Risk – Declining	High
Variable oystercatcher / Tōrea pango	*Haematopus unicolor*	At Risk – Recovering	Moderate
Black stilt / Kāki	*Himantopus novaezelandiae*	Threatened – Nationally Critical	Very high
Hybrid black stilt	*Himantopus novaezelandiae x Himantopous leucocephalus*	-	-
Pied stilt / Poaka	*Himantopous leucocephalus*	Not Threatened	Low
Welcome swallow / Warou	*Hirundo neoxena neoxena*	Not Threatened	Low
Caspian tern	*Hydroprogne caspia*	Threatened – Nationally Vulnerable	Very high
Black-billed gull / Tarāpuka	*Larus bulleri*	At Risk – Declining	High
Red-billed gull / Tarāpunga	*Larus novaehollandiae scopulinus*	At Risk – Declining	High
Southern crested grebe / Kāmana	*Podiceps cristatus australis*	Threatened – Nationally Vulnerable	Very high
Black shag / Māpunga	*Phalacrocorax carbo*	At Risk – Naturally Uncommon	Moderate
Spotted shag / Kawau tikitiki	*Phalacrocorax punctatus*	Threatened – Nationally Vulnerable	Very high

Common name / Māori name	Species name	Conservation status (Robertson et al. 2021)	Ecological value
Pūkeko	*Poryphyrio melanotus melanotus*	Not Threatened	Low
Little shag /Kawaupaka	*Phalacrocorax melanoleucos brevirostris*	At Risk – Relict	Moderate
White-fronted tern / Tarā	*Sterna striata striata*	At Risk – Declining	High
Paradise shelduck / Putākitāki	*Tadorna variegata*	Not Threatened	Low
New Zealand kingfisher / Kōtare	*Todiramphus sanctus*	Not Threatened	Low
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened	Low

Table Appendix E.4: Lizard species list recorded on Pūkaki River and wider area (30 km radius) (Boffa Miskell, 2022)

Common name	Species name	Conservation status (Hitchmough et al. 2021)	Ecological value
Lakes skink	*Oligosoma* aff. *chloronoton* "West Otago"	At Risk - Declining	High
Southern long-toed skink/Roamatimati skink	*Oligosoma* aff. *chloronoton* "southern"	At Risk - Declining	High
Cryptic skink	*Oligosoma inconspicuum*	At Risk - Declining	High
McCann's skink	*Oligosoma maccanni*	Not Threatened	Low
Mackenzie skink	*Oligosoma prasinum*	Threatened – Nationally Vulnerable	Very high
Canterbury grass skink	*Oligosoma* aff. *polychroma* Clade 4	At Risk - Declining	High
Southern grass skink	*Oligosoma* aff. *polychroma* Clade 5	At Risk - Declining	High
Scree skink	*Oligosoma waimatense*	Threatened – Nationally Vulnerable	Very high
Jewelled gecko	*Naultinus gemmeus*	At Risk - Declining	High
Southern Alps gecko	*Woodworthia* "Southern Alps"	At Risk - Declining	High
Korero gecko	*Woodworthia* "Otago/Southland Large"	At Risk - Declining	High

Table Appendix E.5: At Risk and Threatened invertebrates recorded in the Waitaki Power Scheme wider area (note few targeted surveys have been undertaken at Lake Pūkaki or Pūkaki River) (Boffa Miskell, 2022)

Common name	Species name	Conservation status (Hoare et al. 2017; Trewick et al. 2022)	Ecological value
Darkling beetle	*Artystona lata*	At Risk – Naturally Uncommon	Moderate
Looper moth	*Asaphodes stinaria*	Threatened – Nationally Vulnerable	Very high
Robust grasshopper*	*Brachaspis robustus*	Threatened – Nationally Endangered	Very high
Canterbury knobbled weevil	*Hadramphus tuberculatus*	Threatened – Nationally Vulnerable	Very high
Ground wētā	*Hemiandrus* 'furoviarius'	Threatened – Nationally Critical	Very high
Ground beetle	*Holcaspis abdita*	Threatened – Nationally Critical	Very high
Giant speargrass weevil	*Lyperobius carinatus*	At Risk – Naturally Uncommon	Moderate
Ground beetle	*Megadromus crassalis*	At Risk – Relict	High
Grass moth	*Orocrambus fugitivellus*	Threatened – Nationally Critical	Very high
Grass moth	*Orocrambus* 'Mackenzie Basin	Threatened – Nationally Vulnerable	Very high
Minute grasshopper*	*Sigaus minutus*	Threatened – Nationally Vulnerable	Very high

Note:* = Likely to be present on the Pūkaki Riverbed (Boffa Miskell, 2022).

Appendix F Principles for compensation (NPS-IB)

Table Appendix F.1: Principles for compensation as outlined in NPS-IB in relation to potential residual adverse impacts of the proposed activities

Principle	Compensation measures for native lizards
Adherence to effects management hierarchy	As discussed in-text, efforts to avoid, minimise and remedy are restricted by the proposed activity which will occur at all times of the year. Avoid, minimse and remediation measures have been proposed to the extent possible given the activity requirements. Offsetting is impractical due to the cryptic nature of native lizards and robust data required for offsetting.
When biodiversity compensation is not appropriate	Native lizards are expected to be present in surrounding habitats. Habitat in the project footprint provides potentially marginal habitat.
Scale of biodiversity compensation	The positive impacts of the financial contribution targeting lizard monitoring/management is expected to result in positive impacts that outweigh adverse impacts.
Additionality	Additionality requirements are considered to be met.
Leakage	Funds will be used to benefit native lizards and unlikely to displace or harm other indigenous biodiversity.
Long-term outcomes	The financial contribution will be used to secure long-term benefits for native lizards.
Time lags	The financial contribution will be provided as soon as practicable following identification of native lizards.
Trading up	The contribution will be ring-fenced for native lizards (not trading up).
Financial contributions	The financial contribution is considered to be the most effective means for delivering biodiversity gains on the ground. The fund will go to an existing scheme that has already been tested against the compensation principles.
Science and mātauranga Māori	Any use of the fund will be informed by science and mātauranga Māori.
Tangata whenua and stakeholder participation	Any use of the fund will provide for tangata whenua and stakeholder participation.
Transparency	The contribution will be provisioned in a transparent way.

Appendix G Wetland values justification and table

Boffa Miskell (2023) scored wetlands 4, 6, 7, 8, 11, 12, 13, 14 and 15 a low or moderate value for the 'rarity/distinctiveness' criteria of the CRPS and EIANZ habitat criteria. 'Rarity/distinctiveness' is based on matters such as 'naturally uncommon or induced scarcity', 'amount of habitat remaining', 'national priority for protection' and 'habitat supporting Threatened or At Risk species, or locally uncommon species'.

Less than 10% of the historical extent of wetlands remain. Furthermore, wetlands have been identified as a national and regional priority for protection as underpinned by legislation such as the NPS-FM and as outlined in the CRPS. Wetlands associated with Lake Pūkaki are relatively large, and, although degraded by weeds, support the mosaic of available wetland habitats for Threatened and At Risk species, particularly avifauna (such as Australasian bittern, grey duck and black stilt/kakī among others).

Therefore, we consider all wetlands at the site as having a 'high' value for rarity/distinctiveness (Table Appendix G.1). This difference, combined with the three other matters (representativeness, diversity/pattern and ecological context), increases previously 'low' value wetlands to 'moderate' ecological value.

Table Appendix G.1: Wetland values table from Boffa Miskell (2023). Bold values indicate a difference in value between Boffa Miskell (2023) and this assessment and grey cells indicate a difference in the overall value.

Wetland name	Representativeness	Rarity/distinctiveness	Diversity/pattern	Ecological context	Overall value (Boffa Miskell, 2023)	Overall value (T+T, 2025)	Significant CRPS
1 – Glentanner Wetland	Moderate–High	Moderate–High	Moderate–High	High	High	High	Yes
2 – Tasman River Delta	High	High	High	High	Very high	Very High	Yes
3 – Glentanner Airstrip	Moderate	Moderate **(High)**	Moderate	Low	Moderate	Moderate	Yes
4 – North Camp	Low–Moderate	Low **(High)**	Low	Low	Low	Moderate	Yes
5 – Boltons Gully 1	Moderate	Moderate–High	Moderate–High	Moderate–High	High	High	Yes
6 – Boltons Gully 2	Low	Low **(High)**	Low	Low	Low	Moderate	Yes
7 – Boltons Gully 3	Low–Moderate	Low **(High)**	Low	Low	Low	Moderate	Yes
8 – Boltons Gully 4	Uncertain (**Moderate**)	Uncertain **(High)**	Uncertain (**Low**)	Uncertain **(Low)**	Low	Moderate	Yes
9 – Hayman Road 1	Moderate–High	Moderate–High	Moderate–High	Moderate	Moderate	Moderate	Yes
10 – Hayman Road 2	High	High	Moderate–High	Moderate–High	High	High	Yes
11 – Hayman Road 3	Low	Moderate **(High)**	Low	Low	Low	Moderate	Yes
12 – Boundary Stream South	Low	Low **(High)**	Low	Low	Low	Moderate	Yes

Wetland name	Representativeness	Rarity/distinctiveness	Diversity/pattern	Ecological context	Overall value (Boffa Miskell, 2023)	Overall value (T+T, 2025)	Significant CRPS
13 – Hayman Road 4	Low	Low **(High)**	Low	Low	Low	Moderate	Yes
14 – Hayman Road 5	Low	Low **(High)**	Low	Low	Low	Moderate	Yes
15 – Jack Steel Stream	Uncertain	Uncertain **(High)**	Uncertain	Uncertain	Low (probable)	Moderate	Yes
16 – Lower Pūkaki 1	Moderate	Moderate **(High)**	Moderate	Moderate	Moderate	Moderate	Yes
17 – Lower Pūkaki 2	Moderate–High	High	Moderate	Moderate	High	High	Yes
19 – Pūkaki River True Right	Moderate	Low–Moderate **(High)**	Moderate	Low	Moderate	Moderate	Yes
20 – Pūkaki River True Left	High	High	High	Moderate–High	High	High	Yes
21 – Lower Tekapō River True Right	Moderate–High	High	High	High	High	High	Yes
22 – Lower Tekapō River True Left	Moderate–High	High	High	High	High	High	Yes

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