

BEFORE AN EXPERT PANEL
Lake Pūkaki Hydro Storage and Dam Resilience Works

FTAA-2510-1120

Under the

FAST-TRACK APPROVALS ACT 2024

In the matter of

an application for taking additional water from
Lake Pūkaki and installing rock armouring on
Pūkaki Dam

By

MERIDIAN ENERGY LIMITED

Applicant

STATEMENT OF EVIDENCE OF SUSAN WALKER

TERRESTRIAL ECOLOGY

08 April 2026

Introduction

1. My full name is Susan Walker.
2. I have been asked by the Department of Conservation (DOC) to provide expert evidence on the actual and potential effects of the Lake Pūkaki Hydro Storage and Dam Resilience Works on vegetation and plant species.
3. I am a terrestrial ecologist and Principal Researcher in the Manaaki Whenua Group within the Crown-owned Bioeconomy Science Institute (formed July 2025). I am based in Dunedin, where I also worked for the predecessor organisation Manaaki Whenua – Landcare Research from 1997 to June 2025.
4. I have MSc (1994) and PhD (1997) degrees from the University of Otago. I have published more than 60 peer-reviewed scientific journal papers and book chapters in international and national literature and produced more than 50 internally peer-reviewed contract reports.
5. My fields of expertise most relevant to this application include:
 - a. The botany, ecology, and conservation management of modified indigenous ecosystems of the dry eastern rain-shadow zone of the South Island including the Upper Waitaki (Mackenzie) Basin;
 - b. Biodiversity assessment, including measurement and reporting of the biodiversity and conservation outcomes and achievements of policies (and incentives);
 - c. Quantitative field sampling and measurement of biodiversity components and assessment of ecological significance;
6. I have also researched, published scientific papers and written reports about national and regional long-term changes in New Zealand's land cover and indigenous bird fauna; movements of inland-migrant birds, the dynamics of introduced rodents across New Zealand forests, the ecology and conservation of

threatened plants, evolutionary patterns of plant richness, radiation and endemism and effects of climate change on New Zealand's indigenous biodiversity, among other subjects.

7. I am often engaged to provide ecological advice in reports or oral presentations to central and local government agencies on matters of ecology and biodiversity assessment and protection. In 2018, I received the New Zealand Ecological Society's Ecology in Action award which recognises contribution to the application of ecological knowledge, including communication, education and transfer of ecological science.
8. I have particular expertise and field experience in the plant ecology of dryland ecosystems on the floor of the Upper Waitaki basin (in Waitaki and Mackenzie districts) and the basin floors of Central Otago and Queenstown Lakes districts. Since 2009 I have provided expert evidence for several RMA hearing panels, the Environment Court and the High Court concerning ecology, ecological changes and development proposals in the Mackenzie Basin, which is the location of Lake Pūkaki. I provided expert terrestrial ecological evidence before the Environment Court for Plan Change 13 (2016) and Plan Change 18 (2019 to 2025) to the Mackenzie District Plan.
9. I am familiar with the history of Lake Pūkaki (including the history of lake raising) and with the ecological communities and character of the lake perimeter at different times of year and different lake levels. I contributed to the design of vegetation sampling on the Tasman River Delta in 2014, 2015 and 2016 and reviewed the resulting reports. I revisited the Tasman River Delta and the eastern lakeshore in most recently in early March 2026, while preparing for writing this evidence.

Code of Conduct

10. I have read the Environment Court code of conduct for expert witnesses, and I have prepared this evidence in accordance with that code. I confirm that my evidence is within my area of expertise, except where I state I am relying on the

evidence of another person. I have acknowledged the material and expertise relied on in the preparation of this evidence and in forming my opinions. To my knowledge I have not omitted to consider any material facts known to me that alter or detract from the opinions I express in this evidence.

Summary

11. The Ecological Impact Assessment (EIA)¹ refers to the Tasman River Delta and 16 ‘other’ wetlands around the perimeter of Lake Pūkaki that are hydrologically connected to the lake. However the EIA provides no information on the lake margin turf wetlands of the eastern nearshore shelf of the Lake Pūkaki shoreline (the ‘eastern lake margin turf wetlands’).
12. Like the Tasman River Delta wetland, the eastern lake margin turf wetlands have very high hydrological connectivity with the lake, are ecologically significant, and support Threatened and At-Risk plant species.
13. Wetland plant communities of both the Tasman River Delta and the eastern lake margins are low-growing turfs that occur between 525 m and 530 m. They require both sufficient periods of inundation (which exclude taller, smothering exotic plants) and periods of drawdown to persist, and depend on dynamic lake levels continuing within the elevation range in which they occur.
14. Periods of high lake levels are also likely to be important to maintain the functioning of many of the other 16 ‘other’ wetlands adjacent to Lake Pūkaki that may interact with the lake somewhat less regularly.
15. I therefore disagree with the Substantive Application² (p. 38) that ‘for the purposes of assessing wetland effects associated with this proposal, the only relevant wetland is the Tasman Delta’.

¹ Appendix M Ecological impact assessment Lake Pūkaki (PDF, 14 MB) ([a8e1d21420ff0734786f01daa6e917d24f5d4e05.pdf](#))

² Substantive application final (PDF, 12.3MB) ([12656630-Substantive-Application-Final-Redacted_Redacted.pdf](#))

16. The proposed consent conditions for eased access will not prevent a new and different lake level regime which has lower average levels and more protracted periods of drawdown. Such a regime could have serious adverse effects on many of the ecologically significant wetlands around the lake.
17. Baseline surveys and monitoring of ecological values are needed to allow adverse effects on the significant ecological values of the wetlands to be assessed and detected. No such survey or monitoring is currently proposed in the conditions.
18. I recommend an additional consent condition to protect the shoreline and delta ecology modelled on guidelines for Lakes Te Anau and Manapouri which have similar turf wetlands. The condition should:
 - a. require best efforts to maintain the lake within the 20th to 80th percentile of the operating range over the last 20 years (i.e. 525.4 to 531.0 m) and to maintain an annual mean level within this range
 - b. define one-metre 'level ranges' below the lower 20th percentile of lake levels over the last 20 years (525.4 m) down to the minimum in the new low operating range
 - c. set a maximum number of consecutive days that the lake can be held within each level range in the new low operating range
 - d. set the maximum number of consecutive days within the 518.4 to 517.4 m level range to 39 days, consistent with the duration assumed in the assessment of effects.
19. To help to ensure that the lake is returned to its previous normal operating range as assumed in the EIA, I recommend that the condition also specifies a minimum interval of at least 8 months between any drawdowns below 518.4 m.
20. I recommend a new condition requiring baseline survey and regular monitoring of the vegetation the eastern lake margin turf wetlands (which have not been

identified in the EIA), of the Tasman River Delta, and a selection of the 16 ‘other’ wetlands around the perimeter of Lake Pūkaki. DOC and Canterbury Regional Council (CRC) should be consulted on the survey and monitoring methods.

21. I recommend removal of proposed condition 13d in CRC262541 ‘*Re-grassing of any remaining areas of bare ground to match the surrounding existing land*’ which will be potentially damaging. Ecologically appropriate conditions would be prior survey and (where practical) avoidance of significant ecological values along the proposed access track, followed by management of weed reinvasion to promote natural re-establishment of indigenous species.

Scope

22. This evidence covers matters relating to:
- a. missing and incomplete ecological information on the ecological values of the lakeshores of Lake Pūkaki
 - b. potential adverse effects of ‘eased access’ (lake lowering below 518 m) on lake margin turf wetland communities on the eastern shores of Lake Pūkaki (the ‘eastern lake margin turf wetlands’), on the turf wetlands of the Tasman River Delta, and on ‘other’ wetlands
 - c. proposed conditions for CRC262540³ and for CRC262541⁴.
23. Statistics in my evidence rely on daily lake level data for Lake Pūkaki from 1 January 1980 to 28 February 2026, which were provided by Meridian Energy (hereafter ‘Meridian’) on request.

The Project site and proposal

24. The project seeks resource consents for water takes from Lake Pūkaki. Takes would occur over three consecutive winters from winter 2026 at levels lower than

³ Section 14 Consent – to take, use, dam or divert water for hydroelectricity generation (Operation of Lake Pūkaki below 518 m). [Version 2 Lake Lowering \(PDF, 69KB\)](#)

⁴ Section 15 Consent – Discharge of Contaminants to Land or Water ([Version-2-Section-15-Discharge-of-Contaminants-to-Land-and-Water.pdf](#))

the present minimum permitted level of 518 metres RL to a minimum level of 513 metres RL (hereafter I refer to levels simply in meters or 'm').

25. It is also proposed to undertake armouring on the Lake Pūkaki side of the dam during low lake levels and to create access tracks to access the works area through existing riprap. Native vegetation with Threatened and At Risk plant species occurs on the proposed access tracks and will be cleared.

Turf wetlands of the Tasman River Delta and eastern lake margins

26. Lake margins are wetlands (classified as marshes⁵) and naturally uncommon ecosystems in New Zealand (Williams et al. 2007)⁶ and are ranked as Vulnerable according to IUCN criteria⁷.
27. Both the Tasman River Delta at the head of Lake Pūkaki and parts of the lake margin around the eastern shores of Lake Pūkaki support indigenous short turf vegetation. These are associations of indigenous species that are highly distinctive, of restricted occurrence and occur within an originally rare ecosystem (i.e. on lake margins) and have developed as a result of unusual environmental factors (i.e. seasonal inundation followed by exposure).
28. Turf communities on the eastern shores of Lake Pūkaki ('eastern lake margin turf wetlands'; Attachment 1) and on the Tasman River Delta (Attachment 2) meet the definition of indigenous vegetation in the Mackenzie District Plan⁸, are consistent

⁵ In New Zealand, a marsh is a mineral-soil wetland characterized by high nutrient levels, neutral pH, and significant water level fluctuations. Marshes are found on valley margins, around lake edges, or along rivers. They are dominated by non-woody vegetation (Johnson P, Gerbeaux P 2004. Wetland types in New Zealand. Wellington, New Zealand: Department of Conservation).

⁶ Williams, P.A.; Wiser, S.; Clarkson, B.; Stanley, M.C. 2007. New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. *NZ Journal of Ecology* 31: 119-128.

⁷ Holdaway, R.J.; Wiser, S.K.; Williams, P.A. 2012. Status assessment of New Zealand's naturally uncommon ecosystems. *Conservation Biology* 26: 619-629.

⁸ In the definitions, indigenous vegetation 'means a community of vascular plants, mosses and/or lichens that includes species native to the ecological district and many include exotic species.'

with multiple significance criteria in the Canterbury Regional Policy Statement (CRPS)⁹, and are significant under the Mackenzie District Plan¹⁰.

29. The eastern lake margin turf wetlands of Lake Pūkaki occur below about 530 m, within an elevation range that is likely to be identical to the turf vegetation on the Tasman River Delta. Eastern lake margin turf wetlands occur on the lake's nearshore shelf, which slopes gently down to an 'offshore break' that then drops off steeply into deep water¹¹.
30. The most detailed recent survey of eastern lake margin turf vegetation was undertaken by Mr Richard Ewans¹² in early November 2017 with the lake at 526.5 m, and his photographs are shown in Attachment 1. The turfs had developed on the nearshore shelf through the spring following drawdown of the lake to about 523 m in July 2017, and in early November the upper portion of the turfs on the nearshore shelf were still exposed¹³.

⁹ Notably Criterion 6 of Appendix 3 to Policy 9.3.1 in the CRPS is '*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*'. Criterion 4 is '*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*'. The turfs are habitat for a number of threatened and at risk plant species and are feeding habitat for threatened and at risk wading birds, terns and gulls. Criterion 7 is '*Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients*'. Criterion 8 is '*Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function*' and Criterion 10 is '*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*'. Lakeshore turfs are likely to meet all of these criteria.

¹⁰ In the Mackenzie District Plan Significant indigenous vegetation and significant habitats of indigenous fauna means areas of indigenous vegetation or habitats of indigenous fauna which meet the criteria listed in the Canterbury Regional Policy Statement's Policy 9.3.1 and Appendix 3; or are listed in Appendix I as a Site of Natural Significance.

¹¹ James, M. 2012. Assessment of the impacts of lowering Lake Pūkaki below its consented level. Unpublished report for Meridian Energy, Aquatic Environmental Sciences Ltd. The report notes that shorelines have been developing towards a new equilibrium following the raising of the lake in the 1970s.

¹² Mr Ewans is a Senior Technical Advisor at the Department of Conservation.

¹³ Observations at that time (1-3 November 2017) also suggested that the offshore break also occurs at around 524 to 525 m and represents the lower bound of the turf communities. A profile on the western lakeshore ('Profile 7' reproduced as Figure 4 of James 2012) shows the offshore break at between 524 and 526 m between 2003 and 2011.

31. The primary ecological driver of both the eastern lake margin turf wetlands and the turfs of the Tasman River Delta is periods of lake inundation followed by periods of exposure when lake levels are low. These turf communities therefore have very high connectivity with the lake, both ecologically and hydrologically.

Absence of information on eastern lake margin turf wetlands

32. Information on Lake Pūkaki's eastern lake margin turfs appears to be missing from the EIA. I reach this conclusion because
- a. The EIA refers only to 17 wetlands (the Tasman River Delta plus 16 'others') that were mapped by Boffa Miskell in 2019¹⁴ and were judged by Boffa Miskell at that time to have some degree of hydrological connectivity with lake¹⁵.
 - b. I was provided with the Boffa Miskell (2020)¹⁶ rapid wetland assessment report on request. The author (Dr Jaz Morris) visited and mapped wetlands between 2 and 14 December 2019 during a period of high and quickly rising lake levels (median level over the 12 days was 532.2 m)¹⁷. The report states that Tasman River Delta was under water and unable to be accessed. Similarly, the eastern lake margin turf wetlands of Lake Pūkaki (shown in my Attachment 1) would have been deeply submerged: lake levels at least 6 metres lower would have been needed to expose the turfs so that they could be observed and mapped.
 - c. The EIA states that the Tasman River Delta (with a minimum elevation estimated by GHD (2025)¹⁸ to be '~515 to 525 m') is the only wetland around

¹⁴ Boffa Miskell, 2020. Upper Waitaki Wetlands Rapid Assessment of Accessible Wetlands. Prepared for Meridian Energy Limited.

¹⁵ Boffa Miskell, 2023. Assessment of Environmental Effects of the Waitaki Power Scheme – Wetlands. Prepared for Meridian Energy Limited.

¹⁶ Boffa Miskell, 2020. Upper Waitaki Wetlands Rapid Assessment of Accessible Wetlands. Prepared for Meridian Energy Limited.

¹⁷ Boffa Miskell add that 'One wetland inundated during the [2 to 14 December] survey period was briefly revisited on 23 January 2020'. However, Lake Pūkaki remained high on 23 January 2020 (at 532.4 m) so the lakeshore turfs would still have been deeply submerged.

¹⁸ Table 8 Summary of the wetland analysis in GHD, 2025. Lake Pūkaki Reservoir Hydro Storage and Dam Resilience Works Groundwater Assessment. Prepared for Meridian Energy Limited 16 September 2025.

Lake Pūkaki with *high* hydrological connectivity to the lake. The remaining 16 wetlands identified in the EIA are said to have *low* hydrological connectivity with the lake. Hydrological connectivity for these 16 ‘other’ wetlands is judged to be *low* because (according to GHD 2025) only one (Glentanner Airstrip) interacts with the lake at levels of 525 m and above. The remaining 15 wetlands are said to interact with the lake only at higher levels (530 m and above¹⁹) which is higher than the 525 to 530 m elevation range of lake margin turf wetlands.

33. In Attachment 3, I map the locations of three examples (Sites A, B and C) of lake margin turf wetlands below 530 m on the eastern shore of Lake Pūkaki and list the plant species present in Attachment 4. Seven Threatened or At-Risk vascular plant species were recorded at Sites A, B and C in 2017²⁰: *Crassula peduncularis* (Threatened – Nationally Critical); *Leptinella maniototo*, *Montia angustifolia*, *Veronica lilliputiana* and *Epilobium angustum* (all At Risk – Declining); and *Juncus pusillus* and *Centrolepis minima* (both At Risk – Naturally Uncommon)²¹. The EIA mentions only two of these 7 species (*Leptinella maniototo* and *Montia angustifolia*, which also occur on the Tasman River Delta²²).
34. Aerial images from periods of low lake levels show additional locations supporting (or potentially supporting) lake margin turf wetlands between about 525 and 530 m elevation along the eastern shores of Lake Pūkaki. I have indicated these additional likely locations of turf wetlands on the map in my Attachment 3.

Appendix J 12656630 RPT Lake Pūkaki Groundwater (PDF, 6 MB) ([Appendix-J-12656630-RPT_Lake-Pūkaki-Groundwater_Rev01_FINAL_251030_Redacted.pdf](#))

¹⁹ Table 8 Summary of the wetland analysis in GHD (2025)

²⁰ Based on walk-through survey notes collected and photographs taken and supplied to me by Richard Ewans (Senior Technical Advisor, Department of Conservation).

²¹ A higher number of Threatened or At-Risk vascular plant species is likely to be present because this list relies on a single walk-through survey and not quantitative sampling. In successive quantitative sampling of the Tasman River Delta by Lee et al. (2014 & 2015) and Brownstein et al. (2016) the data in each successive year resulted in a longer list.

²² EIA Appendix C Figure C1.

Incomplete information on the Tasman River Delta flora

35. The list of 5 Threatened or At Risk plant species for the Tasman River Delta in the EIA is incomplete and out of date. There are at least 16 Threatened or At Risk plant species are present (Lee et al. 2014; 2015; Brownstein et al. 2016)²³.

Threats to lake margin turf wetlands from greater lake drawdown

36. Plant species and communities of the Tasman River Delta and the eastern lake margin turf wetlands are vulnerable to weed invasion of their habitats when lake levels are low. Inundation when high lake levels are high suppresses weed invasion, and resets the habitat through disturbance, reworking of the substrates, and deposited veneers of fresh silt. When lake levels fall again each year, the turfs re-establish on freshly disturbed and temporarily weed-free substrate.
37. The indigenous plant species of the Tasman River Delta and eastern lake margin turf wetlands are quick to re-establish on the fresh surfaces, but the plants are small and low growing (see Attachment 1) and compete poorly for light. Extended periods of low lake levels allow time for the substrates to stabilise and for taller weed species (such as pasture grasses and tall herbs) to invade from the surrounding environment and competitively exclude the small indigenous plant species.
38. Regular inundation of the turfs is needed to exclude taller invasive weed species and maintain suitable habitat. However, 'dead zones' can also result if the lake remains at high levels for too long, and freshly exposed surfaces for the turf

²³ The vascular plant species recorded on the Tasman River Delta between 2014 and 2016 were *Triglochin palustris* (Threatened - Nationally Endangered), *Luzula celata* (Threatened - Nationally Vulnerable), *Carex buechananii*, *Carmichaelia petriei*, *Koeleria antarctica*, *Leptinella maniototo*, *Leptinella pusilla*, *Lobelia ionantha*, *Montia angustifolia*, *Poa maniototo*, *Raoulia australis* and *Rytidosperma thomsonii* (all At Risk – Declining) and *Euchiton delicatus*, *Isolepis basilaris*, *Juncus pusillus* and *Ranunculus maculatus* (all At Risk – Naturally Uncommon). The relevant reports are: Lee W, Hayman E, Monks A 2014. *Isolepis basilaris* on the Tasman River delta, Lake Pūkaki. Monitoring establishment – summer 2014. Landcare Research Contract Report LC1908. Prepared for Meridian Energy; Lee W, Hayman E, Monks A 2015. *Isolepis basilaris* on the Tasman River delta, Lake Pūkaki. Monitoring report, year two – summer 2015. Landcare Research Contract Report LC2261. Prepared for Meridian Energy; Brownstein G, Lee W, Monks A 2016. *Isolepis basilaris* on the Tasman River delta, Lake Pūkaki. Monitoring report, year three – summer 2016. Landcare Research Contract Report LC2644. Prepared for Meridian Energy.

communities to establish on are not provided regularly enough. Therefore, retaining the turf communities requires retaining dynamic lake levels within the elevation range in which they occur. This elevation range (about 525 to 530 m) has been inundated on up to 82.9% of days over the last 20 years and falls largely within the 20th to 80th percentiles (the ‘middle 60%’) of lake levels over the last 20 years (as shown in Figure A5.1 in my Attachment 5)²⁴.

39. A change to the present dynamic lake level range, and especially extended periods of lake drawdown, could be seriously detrimental to the ecologically significant turf wetlands. For example, research on the Tasman River Delta from 2014 to 2016²⁵ confirmed that the current levels of inundation and disturbance were important for the persistence of the disturbed habitat of the turf plant pygmy clubrush (*Isolepis basilaris*, which is At Risk – Naturally Uncommon). Brownstein et al (2016) concluded that
- a. ‘*Isolepis basilaris* is well adapted to moderate disturbance, including silt deposition and water inundation. These disturbances prevent dominance of many taller pasture species that could likely outcompete *I. basilaris* under more stable and benign conditions...’ and
 - b. ‘If for some reason the delta system was stabilised, limiting flooding and sediment deposition, *I. basilaris* could struggle to persist amidst invading taller vegetation, including tall weed species, especially lupins (*Lupinus polyphyllus*), broom (*Cytisus scoparius*), gorse (*Ulex europeaus*), and mat grass (*Nardus stricta*), which are controlled in the Mackenzie Basin’
40. Greater periods of lake drawdown would lead to adverse effects on the eastern lake margin turf wetlands similar to those anticipated on the Delta. Eastern lake margin turf wetlands are likely to be even more vulnerable to weed invasion than

²⁴ Lake level data from Lake Pūkaki were provided by Meridian on request.

²⁵ Note that the EIA refers only to research by Boffa Miskell (2011) and not to the more recent and detailed research undertaken by Manaaki Whenua – Landcare Research for Meridian by Lee et al. (2014 & 2015) and Brownstein et al. (2016).

the wetlands of the Tasman River Delta because they occur in closer proximity to weed sources and to a more diverse range of potentially invasive plant species.

41. Retaining dynamic lake levels within the present elevation range is also likely to be important to maintain the functioning of the other 16 ‘other’ wetlands adjacent to Lake Pūkaki. Compared to the turfs, the ‘other’ wetlands are expected to interact with the lake at somewhat higher lake levels (mostly from 530 m according to GHD 2025²⁶) and therefore less frequently (the lake was above 530 m on 30.4% of days over the last 20 years). However, 30.4% of days is far from a negligible fraction ecologically. In my opinion, this amount of periodic inundation in this ecological context may play a crucial ecological role, for example by periodically setting back weed invasion.
42. Of the ‘other’ 16 wetlands the most dependent on lake dynamism within the present range is the Glentanner Airstrip wetland, which GHD (2025)²⁷ estimated to be affected by the lake at ‘~525-530 m’ (which represents up to 82.9% of days over the last 20 years).
43. I therefore disagree with the substantive application (p. 38), that *‘for the purposes of assessing wetland effects associated with this proposal, the only relevant wetland is the Tasman Delta.’* To the contrary, lower average levels and more protracted periods of drawdown could have serious adverse effects on many of the ecologically significant wetlands around the lake, including (but not limited to) the Tasman River Delta and eastern lake margin turf wetlands.

Lake drawdown scenarios under ‘eased access’

44. Based on modelling by Meridian Energy²⁸, the application *‘anticipates a 3 % to 4 % probability that the lake level in any given week will be below 518 m RL over the*

²⁶ Table 8 Summary of the wetland analysis in GHD (2025) Lake Pūkaki Reservoir Hydro Storage and Dam Resilience Works Groundwater Assessment. Prepared for Meridian Energy Limited 16 September 2025. Appendix J 12656630 RPT Lake Pūkaki Groundwater (PDF, 6 MB) ([Appendix-J-12656630-RPT_Lake-Pūkaki-Groundwater_Rev01_FINAL_251030_Redacted.pdf](#))

²⁷ Table 8 Summary of the wetland analysis in GHD (2025).

²⁸ The EIA page 9 states that ‘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

next three years (which equates to an average of 39 days over the three year period)'. The EIA concludes that the lake would operate at levels between 518 m and 513 m RL for only 'limited periods of time'. It states that 'the proposed eased access activity is temporary with lower water levels likely to occur for up to approximately 39 days over the 3 years.'

45. I have reservations about the reliability of the low water level durations predicted by Meridian's model. If I understand correctly, the model assumes that hydrological and meteorological conditions in future will be within the probability distribution of the past 91 years²⁹. Yet the climate is changing directionally rather than varying around some historic mean. Therefore, lake levels in future years will not necessarily fall within the probability distribution calculated across most of the last century.
46. Relevantly, I note there is no consent condition proposed³⁰ that would require Meridian to return the lake level to above the previous minimum (518 m) at any time. The assessments of effects in the EIA therefore rely wholly on the back-casting assumption (that the future will mimic the past) and not on any proposed consent condition³¹.
47. Regardless of the duration of lower water levels, an ecologically important additional effect of eased access (not emphasised in the EIA) is that the average lake level will be lower. That is, it is anticipated that dynamic lake levels will not stay within the current elevation range but shift downslope. This is evident in the figures provided in the application and is confirmed in the peer review of the

demand analysis) resulting in forecasts of stored water (energy), which can be used to understand potential changes to lake levels).'

²⁹ Appendix B to the application states that "modelling was based on 91 years of catchment hydrological and meteorological data."

³⁰ I refer to proposed conditions in CRC262540 Version 2, which relates to the operation of Lake Pūkaki below the normal minimum level of 518.0 m above mean sea level to a minimum of 513.0 m during times of electricity shortage.

³¹ For example, their assessments of effects are based on a conclusion that future conditions will mimic past conditions so that '*lake levels will return to the existing environment levels for much of each year*' and there will be a '*return to existing environment hydrological fluctuations for the vast majority of the year [which] minimises potential adverse impacts of any temporary eased access*' (EIA page 40)

model³². There is no proposed condition that would require Meridian to manage the lake to any parameters (such as past maximum, average or median lake levels) that would help to retain some of the ecologically important lake level dynamism within the current range.

48. In contrast, Meridian's management of water levels for lakes Manapouri and Te Anau is regulated by the current Operating Guidelines Notice 2025³³. These guidelines are designed to protect the ecological stability and recreational values of the shorelines while optimising energy output for the Manapouri Power Station.
49. Lakes Manapouri and Te Anau have ecologically significant lakeshore turf communities which depend on periodic inundation and are ecologically analogous to those at Lake Pūkaki³⁴. The Operating Guidelines recognise that retaining the turf communities requires maintaining dynamic lake levels within the elevation range in which those turfs occur. Furthermore, there is five-yearly monitoring of those turfs to ensure that ecological stability has been achieved and (if not) inform changes to the guidelines.
50. The Lakes Manapouri and Te Anau guidelines define three distinct ranges for each lake: main, high, and low³⁵, and define management constraints (conditions) within each.
 - a. Within the high operating range (levels above the main range) durations are strictly limited and there are three parameters (*maximum duration, minimum*

³² See page 5 of Sapere (2025). Modelling outcomes with and without access to contingent storage at Lake Pūkaki. Peer review. Report prepared for Meridian Energy, 31 March 2025. The review was not included with the application, but was provided by Meridian on request

³³ [https://gazette.govt.nz/notice/id/2025-go2889#:~:text=\(b\)%20the%20level%20of%20Lake,SIMON%20WATTS,%20Minister%20for%20Energy.](https://gazette.govt.nz/notice/id/2025-go2889#:~:text=(b)%20the%20level%20of%20Lake,SIMON%20WATTS,%20Minister%20for%20Energy.)

³⁴ Macmillan BH 1979. Shore line flora and vegetation of Lake Pūkaki , South Canterbury, New Zealand. *New Zealand Journal of Botany* 17: 23-42; Johnson PN. Applied ecological studies of shoreline vegetation at lakes Manapouri and Te Anau, Fiordland: Part 1: Vegetation of Lake Manapouri shoreline. In: *Proceedings (New Zealand Ecological Society) 1972 Jan 1* (pp. 102-119). New Zealand Ecological Society (Inc.); Johnson PN. Applied ecological studies of shoreline vegetation at lakes Manapouri and Te Anau, Fiordland: Part 2: the lake edge flora–habitats and relations to lake levels. In: *Proceedings (New Zealand Ecological Society) 1972 Jan 1* (pp. 120-142). New Zealand Ecological Society (Inc.).

³⁵ The main operating ranges for Lake Manapouri are 176.8m to 178.6m and for Lake Te Anau are 201.5m to 202.7m.

interval, and *specified ratio* of maximum interval:minimum duration) for a set of levels³⁶.

- b. Within the main operating range Meridian must endeavour to maintain continuous variation within the range and must aim to achieve an annual mean level within this range.
- c. Within the low operating range (i.e. levels below the main range) there is an absolute minimum level, and Meridian must also not exceed maximum durations for individual ranges of levels specified. For example, Lake Te Anau can only be drawn below 201.1 m for a maximum of 21 days, and the absolute minimum level is 200.86 m.

Recommended conditions

Lake Pūkaki levels

- 51. As explained above I consider that the levels of Lake Pūkaki might *not* return to high enough levels regularly enough to maintain the values of the Delta and lakeshore turf wetlands³⁷ if the consent CRC262540 is granted with only the conditions that are now proposed. Furthermore, the average lake level and dynamic range is likely to drop, reducing the inundation frequencies and durations that presently maintain the lakeshore turfs within the elevation zone that they now occupy.
- 52. My advice to the Department of Conservation is that additional conditions are needed in CRC262540 to provide assurance that environmental conditions necessary to maintain the wetlands will continue. Those conditions should ensure that dynamic lake levels are maintained within the elevation range in which those turfs presently occur.

³⁶ For example, Lake Te Anau can only be at its maximum recorded level of 204.3m for a maximum of 7 days, with a 100-day minimum interval required before returning to that level; and it can only be above 204.2m for a maximum of 10 days.

³⁷ Specifically the Tasman River Delta, the eastern lake margin turf wetlands, and the Glentanner Airstrip wetland.

53. Lake level data from Lake Pūkaki were provided by Meridian on request. My Attachment 5 (Figure A5.1) plots the median levels for each calendar year along with the annual 20 to 80% range, and extreme low (1st percentile) and high (99th percentile) levels in each year since the lake was last raised.
54. The lake level data show that
- a. between 1 January 1980³⁸ and 31 December 2025,
 - i. the median lake level was 528.3 m (i.e. the lake spent half of all days above 528.3 m).
 - ii. The mean level (527.9 m) was slightly lower than the median due to anomalously low lake levels in 1992.
 - b. Over the last 20 years (1 January 2006 to 31 December 2025)
 - i. the median and mean lake levels (both 528.1 m) have been slightly higher than the mean over the 45 years since lake raising.
 - ii. lake levels were above 525.4m for 80% of days, and levels were above 531.0 m on 20% of days (the bounds of this ‘middle 60%’ are shown in my Attachment 5 Figure A5.1).
 - iii. the lake has not been drawn below 520 m. It was drawn below 521 m only very rarely and for very little time (<0.5% of days) (Attachment 5).
55. These levels were evidently sufficient to allow new lake margin and new delta turf wetlands to develop after the lake was raised (in the late 1970s), and for those wetlands to be maintained in recent decades.
56. To provide assurance that the ecologically significant shoreline turfs are maintained and protected despite eased access, I have suggested that a new condition should be modelled along the lines of the guidelines for Lakes Manapouri and Te Anau. The condition should (i) define a main range for Lake

³⁸ I selected this date to ensure adjustment of lake management to the high dam.

Pūkaki; (ii) require endeavours to maintain continuous variation within that range and to achieve an annual mean level within that range; and (iii) set limits on duration within a low operating range³⁹.

57. The ‘middle 60%’ from the last 20 years (525.4 m to 531.0 m) would be an ecologically sensible main range for the condition⁴⁰.
58. I suggest that each metre below 525.4 m (within the low operating range) should be assigned a number of allowable days per year that progressively decreases with distance from 525.4 m. As context, Table A5.1 in Attachment 5 shows the maximum number of consecutive days that the lake spent in level ranges below 525.4 m starting in each year between 1980 to 2025⁴¹.
59. Environmental effects were assessed as *low* in the EIA based on the assumption that lake levels would drop below 518 m for ‘up to approximately 39 days’ between 2026 and 2028. I suggest the maximum allowable days for the range from 518.4 to 517.4 m should therefore be no greater than 39 over the three years⁴². Progressively fewer allowable days should be assigned to each lower-level range (i.e. 517.4 to 516.4 m, 516.4 to 515.4 m and so on).
60. To help to ensure that the lake is returned to its ecologically important normal operating range, as assumed in the EIA, I also recommend that the condition specifies a minimum interval of at least 8 months between any drawdowns below 518 m.

³⁹ I understand that there is scope in this application to set any maximum duration for low lake levels if the lake is 518 m or higher, if the controls on lake levels are required to manage an effect that results from (or is exacerbated by) levels going below 518 m. I have not considered limits on durations in a high operating range here because the upper range is not intended to be altered through this consent.

⁴⁰ It is ecologically sensible because the shoreline turfs occur within this main range, and the lower limit of the main range is above the offshore break. The main range being above the offshore break is also likely to be important to limit slumping of the delta and erosion of the nearshore shelf as sediment loses its hydraulic support through longshore transport. For example, James (2012) warned that ‘lowering Lake Pūkaki a further 3-5 m for any significant length of time or rapidly is likely to increase the chances of significant slumping in the delta region’ and also discusses longshore transport. Both slumping and longshore transport would reduce the area of turf habitat over time.

⁴¹ Days in the following year are counted if they are consecutive with drawdown starting in the listed year.

⁴² A worst-case scenario of ‘under 4 months’ is referred to in the EIA, but this is seen as an extremely low (1%) probability event and could be allowed for (only) under certain defined extreme conditions.

61. My recommendations are consistent with the EIA (in its Table 7.1) which proposes '*Periodic raising of the lake level to inundate wetland areas to maintain relatively normal hydrological conditions at connected wetlands*' to avoid, remedy, or minimise impacts, and to manage residual impacts on the wetlands.

Vegetation monitoring at times of low lake levels

62. With or without constraints on duration, drawdown of the lake to levels below 518 m represents a new and substantial shift in the lake level regime with potentially major adverse effects on many wetlands around the lake.
63. I have therefore advised the Department of Conservation that a regular vegetation monitoring regime should be established as a condition of consent CRC262540 with the results reported to Canterbury Regional Council (CRC). Without that monitoring, any adverse effects of the altered lake level regime on the turf wetland habitat and vegetation will not be able to be detected or remedied, and CRC would be unable to give effect to proposed condition 6⁴³.
64. It will be necessary first to undertake a comprehensive survey for lake margin turf wetlands along the eastern shoreline, because the locations of the turfs do not appear to have been fully documented yet (see Attachment 3). Quantitative baseline vegetation measurement of both the Tasman River Delta and the eastern lakeshore lake margin turf wetlands will then be needed. I recommend formal measurement of the current lower and upper levels of lake margin turf

⁴³ i.e. CRC262540 – Section 14 Consent – to take, use, dam or divert water for hydroelectricity generation (Operation of Lake Pūkaki below 518 m)

...

6. The Canterbury Regional Council may, once per year, on any of the last five working days of May or November, serve notice of its intention to review the conditions of this consent for the purposes of:
- a. Dealing with an adverse effect on the environment occurring as a result of the exercise of this resource consent; or
 - b. Requiring best practicable options to be adopted by the consent holder to remove or reduce any adverse effect on the environment as a result of the exercise of this resource consent; or
 - c. Requiring the consent holder to carry out monitoring and reporting instead of, or in addition to, that required by the resource consent; or
 - d. Requiring the consent holder to comply with a relevant rule in an operative regional plan.

wetlands at the same time so that these levels can be better considered in any future lake management changes.

65. The lakeshore survey and the baseline vegetation measurement work should commence in the next period of low lake levels (i.e. 525.4 m or below). Low lake levels are most often experienced in the early spring (as shown in Figure A5.2 in Attachment 5). Remeasurement (i.e. monitoring) should then be repeated after 2 years for a minimum of a decade (assuming the consent is not extended beyond the proposed 3 years).
66. Baseline survey and thereafter 2-yearly wetland vegetation monitoring should also be established in a subset of the 16 'other' wetlands around the perimeter of Lake Pūkaki. This monitoring data (in combination with lake level data) will provide information that is a basis for understanding how ecologically important the interaction with the lake is for the 'other' wetlands in future. The Boffa Miskell (2020, 2023) and GHD (2025) assessments do not provide that information or understanding.
67. The Department of Conservation and CRC should both be consulted on appropriate and adequate vegetation monitoring design and methodology.

Proposed access track footprint for dam armouring works

68. It is proposed that armouring works will be undertaken on the Lake Pūkaki side of the dam during low lake levels; that access tracks will be required to access the works area through existing riprap; and that native vegetation is sparsely distributed across the proposed access tracks⁴⁴. Species in or adjacent to the proposed track include at least five At Risk - Declining species (4 shrubs and 1

⁴⁴ EIA pages iii and 24.

cushion herb)⁴⁵. The area proposed to be disturbed is therefore ecologically significant⁴⁶.

69. A proposed condition of CRC262541 to manage the clearance of an estimated 915 m² of '*short grass with occasional native shrubs*' is (13d) '*Re-grassing of any remaining areas of bare ground to match the surrounding existing land*'.
70. In my experience, re-grassing is usually undertaken with exotic pasture species. In this context, exotic pasture grass species are weeds that limit natural regeneration of indigenous shrubs, grasses, and mat/cushion herbs. Also in this context, disturbance by tracking often promotes the growth of competitive weeds in subsequent seasons, and machines can introduce and spread new weeds.
71. To provide the best prospect of natural regeneration of indigenous grasses and shrubs on the tracked area, I recommend deleting the requirement to re-grass the access track through the '*short grass with occasional native shrubs*'. I recommend a different condition that requires
 - a. a survey for weeds and indigenous shrubs along proposed track(s) prior to disturbance
 - b. routing of access tracks to avoid indigenous shrubs where practicable
 - c. a programme of follow-up weed survey and weed removal by ecologically appropriate methods on the tracked areas for 5 years following disturbance

Susan Walker

8 April 2026

⁴⁵ Table Appendix E.2 of the EIA lists the shrubs *Carmichaelia petriei*, *Olearia lineata*, *O. odorata*, *Sophora prostrata* and the scabweed *Raoulia australis*.

The table lists 'little hard fern' *Blechnum penna-marina* as At Risk – Declining, which appears to be an error. I assume the species referred to is the little hard fern *Austroblechnum penna-marina* subsp. *alpina* which is not a Threatened or At-Risk species.

⁴⁶ It is '*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*' (Criterion 4 in the CRPS Chapter 9 Appendix 3).

Attachments

Attachment 1. Photographs showing examples of turf vegetation communities found on the Tasman River Delta.

Attachment 2. Photographs showing examples of lake margin turf wetlands with turf vegetation on the eastern shores of Lake Pūkaki.

Attachment 3. Three known sites (A, B and C) with lake margin turf communities around the eastern shores of Lake Pūkaki, and other likely locations of turf communities on Lake Pūkaki's eastern lakeshore sites identified from aerial imagery.

Attachment 4. Botanical composition of eastern lakeshore turfs from a walk through survey in November 2017.

Attachment 5. Lake level data from 1980 to 2025 (45 years).

Attachment 1

Photographs showing examples of lake margin turf wetlands and close-ups of turf plant communities on the eastern shores of Lake Pūkaki in November 2017, when the lake level was between 526.53 and 526.59 m.







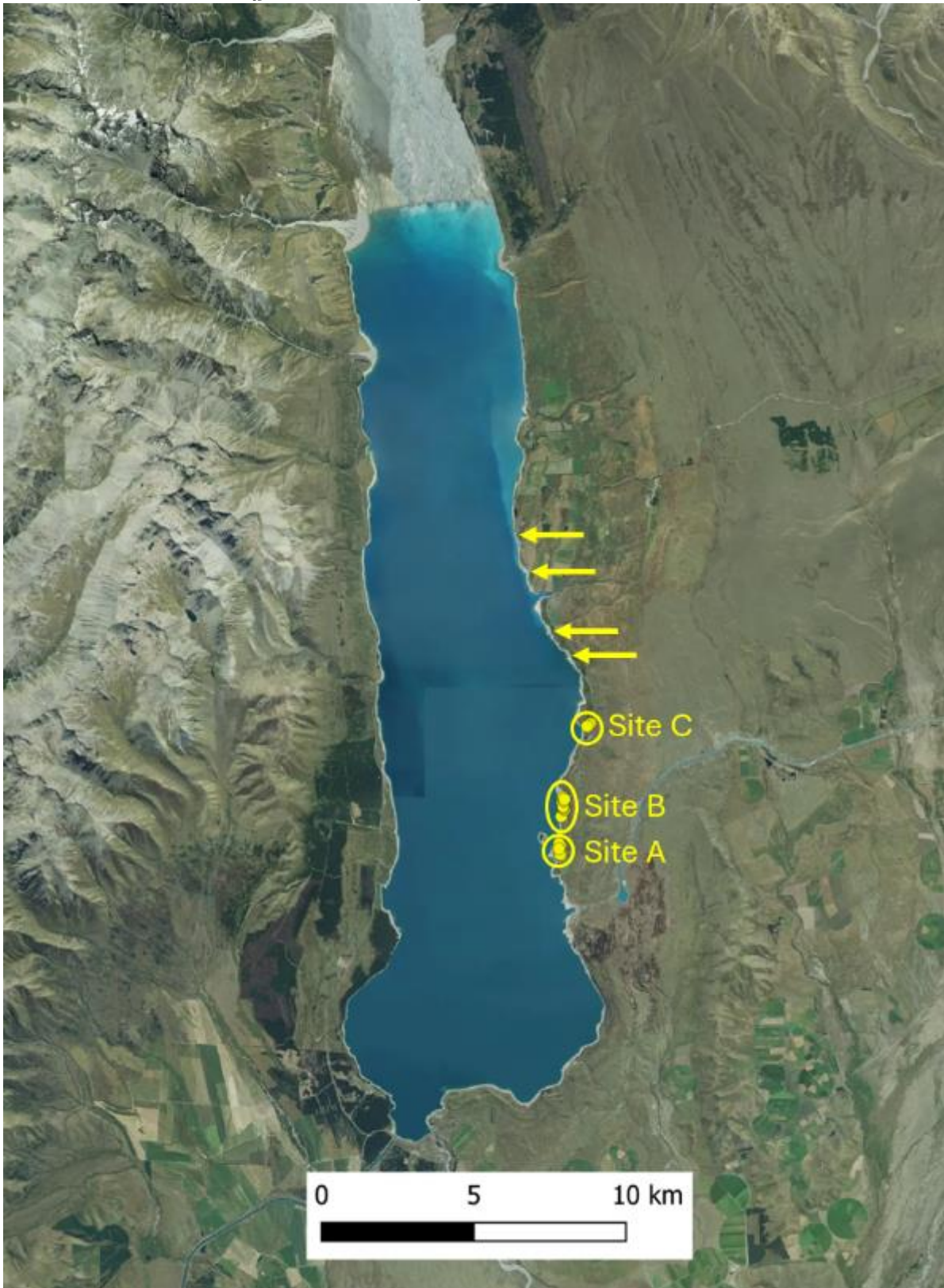


Attachment 2
Photographs showing examples of turf vegetation communities on the Tasman River Delta in 2011 and 2016



Attachment 3

Map showing three known sites (A, B and C) of lake margin turf wetlands (yellow circles containing yellow waypoint dots) and other likely locations of lake margin turf wetlands (yellow arrows) on Lake Pūkaki's eastern lakeshore.



Attachment 4

Botanical composition of lake margin turf wetlands at sites A, B and C in November 2017, provided by Richard Ewans, Senior Technical Advisor, Department of Conservation. Asterisks indicate non-indigenous species.

Site A

Important species present are *Crassula sinclairii*, *Montia angustifolia* (At Risk – Declining), *Leptinella maniototo* (At Risk – Declining) and *Limosella lineata*.

Other species present are *Lobelia perpusilla*, *Crassula peduncularis* (Threatened – Nationally Critical), *Juncus pusillus*, *Asperula* (formerly *Galium*) *perpusillum*, *Glossostigma elatinooides*, *Juncus novae-zelandiae*, tarn speedwell (*Veronica lilliputiana*) (At Risk – Declining), *Epilobium angustum* (At Risk – Declining), *Gratiola sexdentata* and *Glossostigma diandrum*.

Species present on the drier lake margins are Californian stinkweed* (*Navarretia squarrosa*), sand spurrey* (*Spergularia rubra*), turf speedwell* (*Veronica serpyllifolia*), *Carex gaudichaudiana*, *Juncus edgariae*, toad rush* (*Juncus bufonius*), Curnow's curse* (*Calandrinia menziesii*), curled dock* (*Rumex crispus*), sheep's sorrel* (*Rumex acetosella*), parsley piert* (*Aphanes arvensis*), *Muehlenbeckia axillaris*, suckling clover* (*Trifolium dubium*), selfheal* (*Prunella vulgaris*) and *Carex leporina**.

Site B

Important species present are *Crassula sinclairii*, *Montia angustifolia* (At Risk – Declining), *Ranunculus limosella*, *Myriophyllum triphyllum*, *Juncus pusillus* (At Risk – Naturally Uncommon), *Leptinella maniototo* (At Risk – Declining), *Limosella lineata*, *Glossostigma diandrum* and *Glossostigma elatinooides*.

Other species present are *Lobelia perpusilla*, willow weed (*Persicaria decipens*), Curnow's curse* (*Calandrinia menziesii*), seedlings of crack willow* (*Salix fragilis*), *Epilobium angustum* (At Risk – Naturally uncommon), *Myriophyllum propinquum*, white clover (*Trifolium repens*), *Centrolepis minima* (At Risk – Naturally Uncommon) and *Hydrocotyle hydrophila*.

Species present on the drier lake margins are Californian stinkweed* (*Navarretia squarrosa*), sand spurrey* (*Spergularia rubra*), turf speedwell* (*Veronica serpyllifolia*), *Carex gaudichaudiana*, *Juncus edgariae*, toad rush* (*Juncus bufonius*), Russell lupin* (*Lupinus polyphyllus*) and *Juncus novae-zelandiae*.

Site C

Important species present are *Carex gaudichaudiana*, *Juncus pusillus* (At Risk – Naturally Uncommon), *Hydrocotyle sulcata*, an unidentified species of moss, *Epilobium angustum* (At Risk – Declining), sharp spike-sedge (*Eleocharis acuta*), *Montia angustifolia* (At Risk – Declining), *Crassula sinclairii*, jointed rush* (*Juncus articulatus*), *Leptinella maniototo* (At Risk – Declining) and *Ranunculus limosella*.

Other species present were seedlings of crack willow* (*Salix fragilis*), curled dock* (*Rumex crispus*), parsley piert* (*Aphanes arvensis*), *Myriophyllum triphyllum*, *Callitriche petriei* and *Lilaeopsis ruthiana*.

Summary of Threatened and At-Risk plant species present

- *Crassula peduncularis* (Threatened – Nationally Critical)
- *Leptinella maniototo* (At Risk – Declining)
- *Montia angustifolia* (At Risk – Declining)
- *Veronica lilliputiana* (At Risk – Declining)
- *Epilobium angustum* (At Risk – Declining)
- *Juncus pusillus* (At Risk – Naturally Uncommon)
- *Centrolepis minima* (At Risk – Naturally Uncommon)

Attachment 5 Lake level data from 1980 to 2025 (45 years)

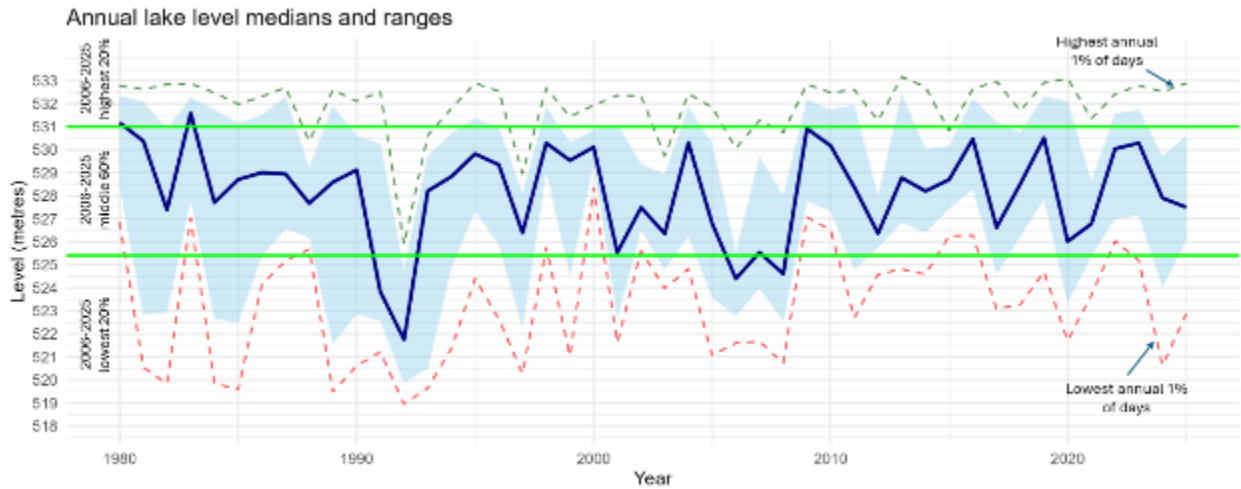


Figure A5.1. Graph of Lake Pūkaki levels grouped by calendar year from January 1980 to December 2025, showing the median levels for each year (linked by the dark blue line), the annual 20 to 80% ranges (blue shading), and the extremes in each year (1st and 99th percentiles of levels as red and green dashed lines). The horizontal green lines show the boundaries of the 20th to 80th percentiles (the ‘middle 60%’) across the last 20 years of lake level data.

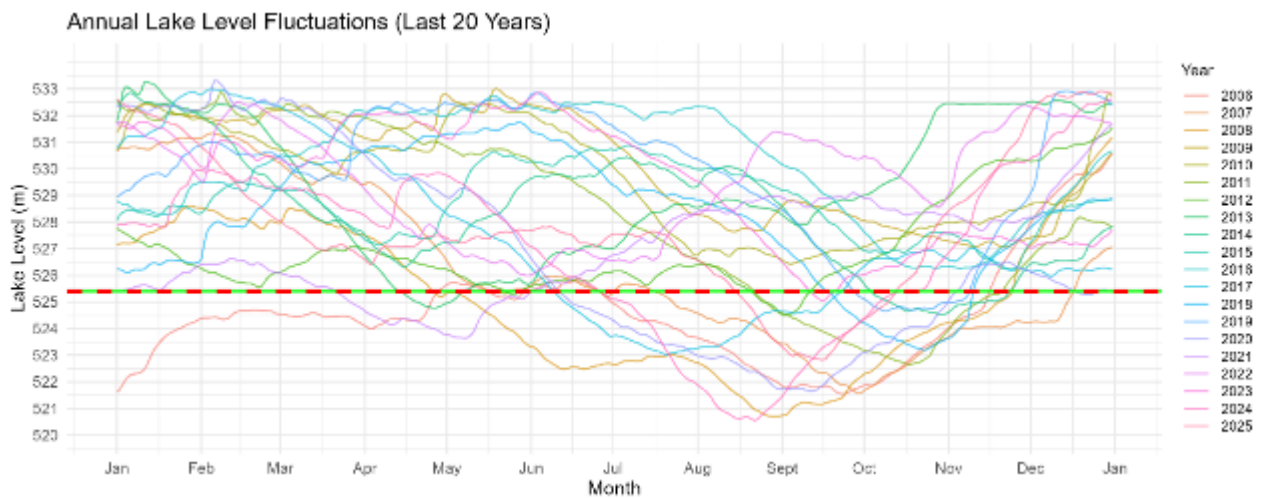


Figure A5.2. Graph of the daily levels of Lake Pūkaki in each of the last 20 years (2006 to 2025). The green and red dashed horizontal line shows the 20th percentile (525.4 m: lake levels have fallen below this level on 20% of days).

Table A5.1. Longest number of consecutive days starting in any calendar year between 1980 and 2025 that Lake Pūkaki spent below particular a particular level. Note that days in the following year are counted if they are consecutive with drawdown starting in the listed year. In any year not shown the lake spent all year above 525.4 m. Calendar years within the last two decades are in shaded cells.

	below 525.4 m	below 524.4 m	below 523.4 m	below 522.4 m	below 521.4 m	below 520.4 m	below 519.4 m
1981	120	105	92	63	25		
1982	143	111	82	54	37	20	
1984	109	93	81	68	38	14	
1985	134	101	86	72	46	22	
1986	76	28					
1987	9						
1989	145	134	120	104	65	22	2
1990	109	95	80	50	22		
1991	256	202	75	34	15		
1992	291	245	209	195	101	77	46
1993	142	133	125	115	105	53	
1994	71	55	42	32	4		
1995	43	3					
1996	64	45	25				
1997	157	123	103	77	58	8	
1999	91	71	47	35	18		
2001	150	134	89	65			
2003	62	32					
2004	23						
2005	263	131	86	67	23		
2006	142	120	77	50			
2007	153	129	54	29			
2008	213	176	137	59	36		
2011	91	61	31				
2012	22						
2013	23						
2014	51						
2017	105	62	29				
2018	53	41	9				
2019	42						
2020	146	119	76	33			
2021	71	38					
2023	9						
2024	111	81	60	44	25		
2025	59	39	21				
N years/20	15	10	9	5	2	0	0