Background and context - Andrew Balme

Date	8 April 2026
To	Trinity White, Environmental Manager – South Island Renewables, Genesis Energy
From	Andrew Balme, Engineering Manager – Civil and Dam Safety, Genesis Energy
Project advice provided for	Meridan Energy Limited – Lake Pūkaki Hydro Storage and Dam Resilience Works
Documents referred to	○ Tekapo Submerged Weir, Structural Condition Assessment, Rev 3, 25/03/2026, WSP. ○ Tekapo Submerged Weir, Bathymetric Survey and Hydraulic Assessment, Rev 3, 19/12/2025, WSP. ○ Tekapo B Power Station Submerged Weir – Damwatch Document Reviews, Rev 1, 26/03/2026, WSP. ○ Tekapo B Weir Assessment - Summary of Findings, Rev 2, 19/12/2025 ○ Design and construction records for the Tekapo Power Scheme held in Genesis records.
Qualifications and experience	Bachelor of Engineering (Honours) in Natural Resources, University of Canterbury. Consulting engineer (dam safety) for 8 years primarily involved in inspections and assessments of existing dams including dam safety reviews, forensic investigations, deficiency management, assessment of monitoring and surveillance data, dam break hazard modelling and mapping, Potential Impact Classification assessments, and supervision of physical site works. 7 years working for asset owners; last 5 years have been in current role as Engineering Manager – Civil & Dam Safety at Genesis, providing technical guidance and oversight for civil portfolio. Chair of New Zealand Society on Large Dams (2025 – current).
Code of Conduct	While I have relevant expertise, I am not providing this evidence as expert evidence but rather as lay evidence on behalf of Genesis Energy Limited.
Signature	

1. The purpose of my evidence is to briefly explain, in relation to the Tekapo B Power Station temporary tailrace and weir (Temporary Structure):
    a. the background and its context;
    b. its current role and function;
    c. its importance to the Tekapo Scheme;
    d. the risks associated with it in relation to Meridian's application;
    e. the operational response by Genesis to any damage to it;
    f. operational response to any failure;

g. current risks; and
h. mechanical / generating plant considerations.

Original role and function of the Temporary Structure

2. The Tekapo B Power Station was due to be commissioned in May 1977. The 1976 winter was the driest since 1931 and the decision was made to drop the level in Lake Pūkaki, which at the time was slowly being filled after the recent completion of the raised Pūkaki Dam, to ensure the downstream power stations on the Waitaki Scheme were able to operate. Because of this, it was unlikely that the Lake Pūkaki level would recover in time to allow for Tekapo B commissioning.

3. The tailrace level at the Tekapo B Power Station is a critical parameter as the turbine runners require a specific tailwater level (i.e. Lake Pūkaki) operating range. Whilst there was near continuous rain from mid December 1976 to mid January 1977, the risk of the lake not being full enough for commissioning was seen as too great, and in February 1977 the instruction was given to construct a temporary tailrace, consisting of a weir and discharge chute, to establish a suitable tailwater for commissioning and operation of Tekapo B Power Station until such time Lake Pūkaki was filled, expected to be around 12 months. Correspondence from the Ministry of Works and Development to the New Zealand Electricity Corporation at the time (see **Appendix A**) highlighted *"It should be stressed that the chute is a high risk structure and minimal use only can be recommended. Continued filling of the lake is the only certain solution to freedom of Tekapo in this respect"* (letter correspondence from MoWD to NZED, dated 7/3/77).

4. The Temporary Structure consisted of a concrete tailrace weir to provide the necessary minimum tailwater level at the station, and a rock lined tailrace chute to carry the station discharge down to the rising Lake Pūkaki; these elements are shown in Figure 1 below.

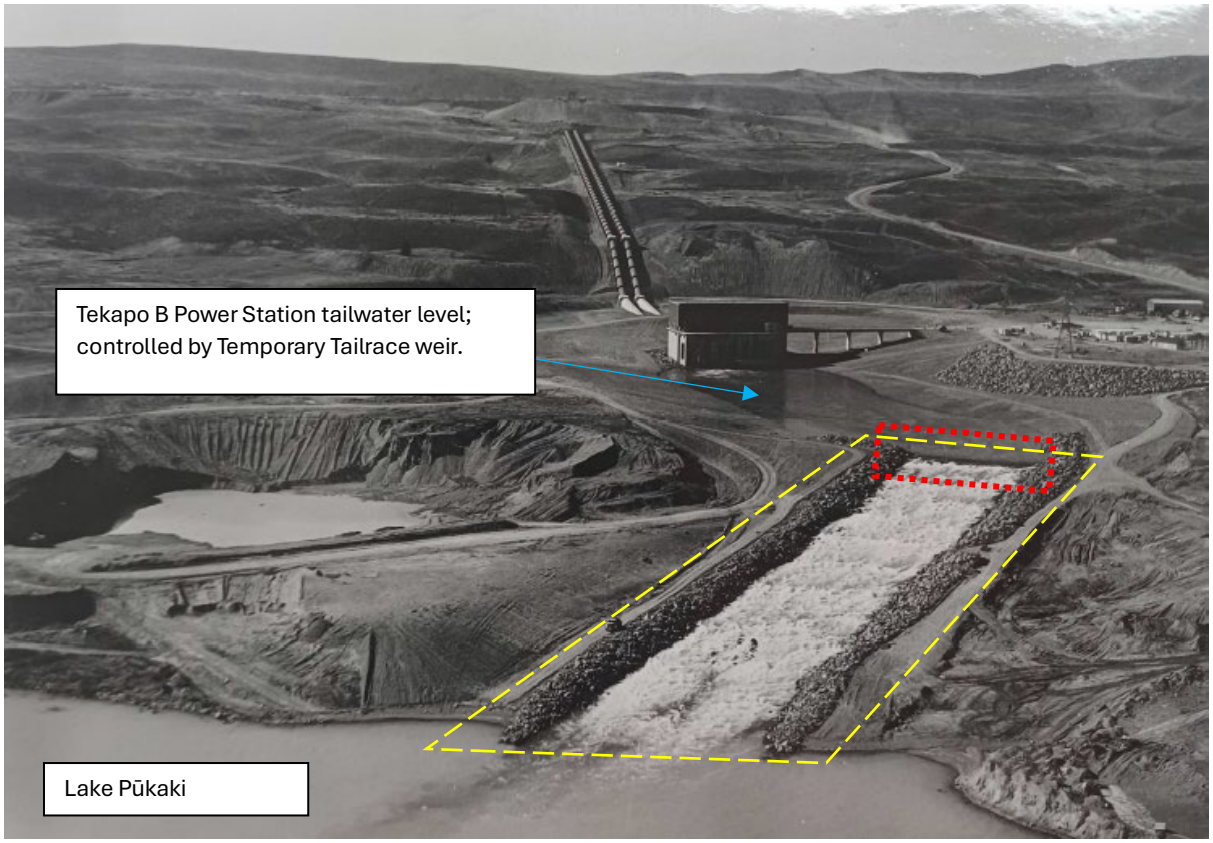

Figure 1 – Photo taken 1977 showing the Temporary Structure in operation. Weir is shown by red dotted outline and chute is shown by yellow dashed outline. Note - chute extends further below the water level in the photograph.

5. The function of the weir is to maintain a minimum tailwater level for the Tekapo B Power Station regardless of the level of Lake Pūkaki, which during operation of the weir was below the minimum required tailwater level. Without the weir, the Tekapo B Power Station cannot operate when the level of Lake Pūkaki is below 518 mRL, as it was between commissioning and eventual filling of the lake in late 1978. The function of the discharge chute is to safely pass the station discharge into Lake Pūkaki without damaging the weir and the bed of the lakeshore.
6. Since the initial filling of Lake Pūkaki to its intended operating regime, completed in 1978, the Temporary Structure has remained submerged and out of service.

<u>Current day role and function of Temporary Structure</u>

7. Under the current operating framework, operation of Lake Pūkaki below 518 mRL, i.e. the level at which the Temporary Structure would be required to return to service, is a prohibited activity, subject to two specific exemptions:

    a. at the time of a Security of Supply Alert the lake may be operated between the alert minimum control level of 515 mRL and 518 mRL

    b. during a time when an Official Conservation Campaign is commenced the lake can be operated between the minimum control level of 513 mRL and 518 mRL.

8. Neither of these scenarios have ever occurred, nor has Lake Pūkaki dropped below 518 mRL since 1978. Other than first filling in 1978, the lowest level recorded for Lake Pūkaki is 518.9 mRL in June 1992.

Importance of the Temporary Structure to the Tekapo Scheme

9. In the absence of the Temporary Structure, if Lake Pūkaki dropped below 518 mRL operation of Tekapo B Power Station would cease as the turbine runners and supporting generation equipment is not designed to operate with a tailwater level below this. Therefore, if Lake Pūkaki is below 518 mRL there is complete reliance on the Temporary Structure to operate Tekapo B Power Station (and, due to the design of the Tekapo Scheme and the Tekapo Canal connecting Tekapo A and Tekapo B Power Stations, requiring matched operation, the wider Tekapo Scheme).

10. In addition to impacts on the Tekapo Scheme should the weir fail, there are impacts to the wider Waitaki Scheme due to the loss of inflows from the Tekapo Scheme into Lake Pūkaki. When the Tekapo Scheme is not generating, any water released from Lake Tekapo is directed through the Tekapo River into Lake Benmore, therefore bypassing Lake Pūkaki and the three Ōhau Power Stations.

Risks associated with the Temporary Structure in the context of Meridian's application

11. I engaged, on behalf of Genesis, WSP New Zealand (WSP) to carry out a range of technical assessments on the Temporary Structure. A bathymetric survey and dive inspection was conducted to support this work. The purpose of these assessments was to identify risks associated with the submerged structures and to determine if it is suitable for use in line with Meridian's proposed consent. WSP also reviewed the various Meridian commissioned technical assessments, which were completed by Damwatch Engineering (Damwatch).

12. Given the intent of the Temporary Structure was to offer short term control of the tailwater level at the Tekapo B Power Station, and that it has been submerged since, there are concerns around the ability of the structure to perform in the same manner almost 50 years later due to known and unknown degradation. I, and Genesis, consider the likelihood of failure of the Temporary Structure during operation is higher now than when it was constructed; this conclusion is also drawn by WSP in their assessments. The outcomes of the WSP assessments, and the vulnerability of the Temporary Structure raise significant issues for Genesis' operations considering the flexibility sought by Meridian through not conditioning key parameters including depth, duration, frequency of any drawdown.

13. The bathymetric survey and dive inspections confirm there has been movement of the riprap rock armouring along the chute, and in certain areas directly adjacent to the weir and concrete ribs where the rock armouring has separated from the concrete elements. Due to accumulation of silt since the Temporary Structure was last operated (1978) there is potential for masking of other underlying defects which would be exposed when flows operated and the accumulated silt flushed away. Areas of uneven armouring present potential for cascading flow through the chute that could increase shear forces on top of high-flow velocities and increase the risk of local scour and progressive chute failure. There are two documented failures of the chute rock armouring during operation between 1977 and 1978.

14. WSP is of the opinion that the method of assessment used by Damwatch for determining stability of rock chute environments tends to over-estimate long term stability, as it does not fully account for the turbulent high energy conditions and potential for hydraulic jumps to occur. Combined with the known movement of the rock armouring in the temporary tailrace chute, as well as potential for other masked areas, WSP has concerns that the chute would be expected to run at or close to its stability threshold. This may be appropriate for rare emergency use, but in my experience typically larger factors of safety are required for sustained and regular operation, especially given the direct impact failure would have on the Tekapo and Waitaki Schemes.

15. There are differences in the conclusions drawn in the WSP assessment work and the Damwatch assessment work. The Damwatch assessments have been completed in the context of short duration temporary operation of the Temporary Structure. However, due to the lack of conditions, WSP have considered discretionary operation as would be enabled by the consent. It is not clear if the conclusions drawn by Damwatch are applicable for discretionary operation.

16. Damwatch recommends enhanced monitoring and reactive controls to manage operation of the Temporary Structure, and that potential risk remains, even for short term temporary operation. This recognises that there are aspects of performance and stability that cannot be confirmed in advance. I am, and Genesis is, of the view that relying on such measures alone is unacceptable for the discretionary operation being sought by Meridian. WSP have recommended that repairs, which are specified in their works, are completed before such reliance can be considered.

<u>Operational response to damage or failure of the Temporary Structure</u>

17. There are two main scenarios resulting in a loss of the tailrace water level below 518 mRL that would require an operational response by Genesis:

    a. Progressive damage to any element of the Temporary Structure that warrants intervention to avoid partial or complete failure; and

    b. Failure of the temporary tailrace weir (partial or complete).

18. Progressive damage requiring intervention would require cessation (see paragraph 23 below) of Tekapo Scheme operation to undertake inspections and any necessary repair works. The duration of such an outage is difficult to predict, as it is a function of the nature and scale of the damage.

19. Failure of the Temporary Structure is expected to result in a longer duration outage compared to that described above. Outflows from Lake Tekapo would effectively cease, other than minor inflows into the Tekapo Canal to manage third party irrigation offtakes and to avoid undesirably low water levels in the canal due to evaporation losses, irrigation offtakes, and any leakage lost to ground. Discharge from Lake Tekapo into Lake Pūkaki is expected to be nil as the tailwater level at the Tekapo B Power Station would not accommodate operation. The antecedent level of Lake Tekapo at the time of

failure, and the magnitude of seasonal inflows into Lake Tekapo, would drive how quickly, and to what magnitude, spill from Lake Tekapo into the Tekapo River would be initiated. Spill into the Tekapo River bypasses Lake Pūkaki and the three Ōhau Power Stations.

Current risk associated with the Temporary Structure irrespective of Meridian's application

20. As described above, the Temporary Structure is required for Tekapo B Power Station to operate any time Lake Pūkaki drops below 518m RL. Under the current operating regime, this is only permitted during a Security of Supply Alert or an Official Conservation Campaign. Both are considered as rare, system-triggered, and time limited events.
21. There is an inherent risk in the current state associated with operation of the Temporary Structure during such an event. However, the likelihood and duration of these events is significantly lower and shorter than the unconditioned discretionary operation being sought by Meridian. Furthermore, the current scenarios would be foreseeable with notice given, allowing for a planned and targeted operational response in the context of the specific emergency situation. This is significantly different to the proposed provisions by Meridian which would allow it to, under the conditions it seeks (or lack thereof), operate Lake Pūkaki below 518 mRL at any time, for any duration.

Mechanical / generating plant considerations in relation to the Temporary Structure

22. The current Tekapo B Power Station turbine runners are not original; replacement was completed in 2022. Whilst design enhancements and operational improvements were made at the time to optimise the performance of the units, the current turbine runners and supporting generation equipment are not designed to be operated at a tailwater level lower than the original minimum design tailwater level for the Tekapo B Station of 518 mRL.

23. Operation outside the acceptable design envelope, which would be required if the tailwater level dropped below 518 mRL, has consequences for the turbine runner; primarily accelerated cavitation damage (high head and flow operational region), with reduced component life, and potentially hydraulic instability and transient operational safety aspects. The turbine runner design and operational limitations are informed by detailed runner design modelling, Computation Fluid Dynamics, and physical scale model testing completed during the design stage. In addition to the turbine runners, there are other limitations which may limit or prevent operations e.g. guide vane stroke range, system pressures, depending on actual tailwater levels.

24. If the tailwater level at Tekapo B Power Station was to drop below 518 mRL, Genesis would cease operation of the station and hence operation of the Tekapo Scheme until such time that safe operation could resume. Notwithstanding that operation may not be possible given inherent constraints of the system outside of its design envelope, to continue operation would significantly increase risks to asset and physical safety due to operation of generation equipment outside safe parameters.

Andrew Balme

Appendix A: Correspondence from the Ministry of Works and Development to the New Zealand Electricity Corporation

Ministry of Works and Development

Head Office, Vogel Bldg., Aitken Street
Box 12 041, Wellington North
Telephone 729 929
Telex NZ 3844

Inquiries to

Ref 92/12/71/39

Date 7 March 1977

General Manager
NZ Electricity Department
Private Bag
WELLINGTON

N.Z.E.D. 21.
81/39

ATTENTION Mr W Strauss

UPPER WAITAKI POWER DEVELOPMENT
TEKAPO B - TAILRACE CHUTE

Reference your memo of 27 January 1977.

Because of the subsoil condition towards the lower end of the initial chute, combined with rain during January and a higher lake level than envisaged, it has not been possible to work plant much beyond the concrete rib at elevation 1645. This rib has now been installed and riprap protection carried on 100 ft towards the lake. It was not practicable to construct the next lower concrete rib.

No difficulty is envisaged in completing the remainder of the work between 1645 and the powerhouse. Surplus rock for maintenance of the chute will be stockpiled adjacent.

It is unlikely that effective work could be carried out below lake level or adjacent to a receding lake level. It is not possible to operate plant on the in situ material and the riprap itself is difficult to handle and place.

Therefore protection is adequate to lake level 1650 ft, marginal to 1645 ft and not available below 1645 ft.

Should the lake fall below 1645 ft before Tekapo B is commissioned, there will be opportunity to extend the protection to levels of the order of 5 ft to 10 ft above lake level.

Should the lake fall below 1645 ft after Tekapo B is commissioned and continue to fall, operation of the station will suffer major interruption. Circumstances where the station could not run and yet chute extension could not be prosecuted, might arise.

1640' = 501.17 m
1645 = 502.69 m
1650 = 504.22

Sealevel feet ± 4.27' ≡ Sealevel metres.
Invert of Pukaki Canal inlet ≡ 1675.75

Mr W Strauss 14/3
McCullagh 15/3
Lowest Rib in place is at 502.69 (per monthly report attached 7/3/77)
Lake level on 7/3/77 approx 500.2, rising at 0.1m/day.
Mr M Gibbs 18/3

It should be stressed that the chute is a high risk structure and minimal use only can be recommended. Continued filling of the lake is the only certain solution to freedom of operation of Tekapo B in this respect.

N C McLeod
Commissioner of Works

per

(M J Williams)