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15 September 2025

Elinor Watson
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Dear Elinor

RESPONSE TO REQUEST FOR INFORMATION FROM GENESIS ENERGY LIMITED IN RELATION TO THE TEKAPO POWER SCHEME UNDER THE FAST-TRACK APPROVALS ACT 2024

1.0 Questions from the panel

At the direction of the Panel, the EPA is seeking the following information:

1) Regarding the potential implications, if any, of climate change (with reference to the Representation Concentration Pathways used in the PDP Hydrology Report) on the operation of the Tekapo Power Scheme (refer Canterbury Regional Council, Appendix 5: Technical Advice – Hydrology).

   For example, is it anticipated that there will be changes (increase or decrease) in terms of the timing, frequency, duration and/or volume of spill flows in the Tekapo River, either through Gate 15 or the Lake George Scott Weir?

2) Identify any potential environmental effects or impacts that are attributable to those potential changes to the operation of the Tekapo Power Scheme (if any), and an assessment of those effects by relevant experts as appropriate.

2.0 Response

2.1 Impact of Climate Change on Lake Tekapo Inflow

There are significant uncertainties associated with climate change. However, several studies are available which assess the potential climate change impact on lake inflow and hydro-electricity potential for Lake Takapō and these were addressed in section 4.1.3 of Appendix K to the AEE (the PDP Hydrology Report). These studies indicate the following climate change effects in terms of annual and seasonal changes:

- An increase in average annual inflow to Lake Tekapo for both the Mid-Century as well as for End - Century.

- The main change in inflow is likely to be an increase in flow in winter and potentially a small decrease in flow in summer. Most studies generally predict relatively small changes in flow for spring and autumn.

It is noted that although Lake Takapō inflows are projected to increase in winter under climate change the current general pattern of relatively low inflow in winter and high inflow in summer (refer to Table 4 in Appendix K to the application[1]) would be retained.

In terms of floods and low flows climate change is anticipated to result in:

- An overall increase in flood flows into Lake Takapō. Flood flows are anticipated to increase in winter and spring with no or limited change in summer and autumn.
- Low flows into Lake Takapō are anticipated to increase due to the increase in rain in winter (when flows are typically low) and increased snow melt. The total number of extreme low flow events is anticipated to decrease.

2.2 Potential Implications of Climate Change on the Operation of the Tekapo Power Scheme

2.2.1 Effects on lake levels

Genesis' management of lake Takapō levels are influenced by a range of factors including the lake level operating range defined in the consent conditions and generation demand. Genesis uses target lake levels to constantly manage the risk against breaching the minimum and maximum control levels (MinCl and MaxCl).

This management process includes a weekly meeting (at least) which includes the following:

- Use of historical flow records and calculated percentile inflows for every day of the year.
- The current lake level and projected levels (including the anticipated generation profile (which is commercially sensitive).
- A 10th and 90th percentile inflow risk is applied for droughts and floods respectively (this may include a 5th or 95th percentile for extreme forecasts).
- When the lake is very close to the MaxCL or likely to exceed MaxCL these weekly conversations turn into daily (or more frequent), and the High Flow Management Plan (HFMP) and communication with other parties apply.
- The same goes for low lake levels (barring the HFMP conversations).

[1] Pattle Delamore Partners Limited (2025), Tekapo Power Scheme - Hydrological and Hydrogeological Analysis.

The predicted changes in inflow under climate change are not anticipated to change the way in which the scheme is operated. Genesis will continue to manage **lake levels** using the process outlined above. The potential higher winter inflows under climate change can easily be accommodated within the existing generation capacity of up to 130 m^3/s. In other words, the increased lake inflows would likely result in increased generation in winter while still managing to target lake levels considering the risks of breaching the MinCL and MaxCL levels specified in the consent conditions. In that regard, the general pattern of the existing lake levels is unlikely to change.

As an example, a recent study from Purdie[2] estimated the changes in lake inflow due to climate change over a 30-year period (current - 2020 and future – 2050). It is noted that this study states that due to the relatively short timeframe of 30 years between current (2020) and future (2050) the impact of different emission scenarios (i.e. low (RCP 2.6), mid-range (RCP 4.5) and high emissions (RCP 8.5) scenario) on inflows was found to be small. Although impacts on inflows are significant overall, the 30-year period examined was not long enough for clear distinctions between different emissions scenarios to emerge, distinct from that which is already 'locked in' by past emissions. Therefore, only the mid-range emissions scenario (RCP4.5) outcomes are discussed in the paper. With regard to Lake Takapō inflows the results indicate:

- A moderate increase in annual inflows of approximately 6%.
- A large seasonal change in inflows with an increase in winter flow of 26% and a decrease in summer flow of 10%. The modelled increase in flow in spring and autumn is more moderate at 2% and 6% respectively.

Using the climate change predictions above as an example (while recognising the uncertainty associated with quantifying the magnitude of the changes in lake inflows under climate change) the winter inflows may increase from an average flow of 55-65 m^3/s (refer to table 4 of Appendix K to the application[1]) to around 70 – 80 m^3/s. The maximum generation capacity of the scheme is 130 m^3/s. Therefore, this potential increase in winter flow can easily be accommodated within the existing scheme capacity resulting in increased generation in winter while still managing to the target lake levels outlined above.

For example, an increase in winter inflows of 26% in the months of June, July and August results in an increase in lake level of up to 0.7m at the 95th percentile inflow sequence.[3] This is small in comparison with the approximate 10 metre range in lake levels shown in Table 1 and Appendix B of the PDP Hydrology Report. This shows no extra risk of spill from Lake Takapō given the lake is drawn down over winter to meet demand during winter months and to be ready for the increase in spring inflows. The 95th percentile inflow sequence indicates that the lake level continues to fall in a controlled fashion through the winter period utilising normal generation patterns.

The risk of spill in the following months is not increased by this inflow increase, highlighted by the fact that high lake levels then occur at the same time of the year as a 'normal' historical inflow sequence. Further to this, a reduction in mean summer inflows further reduces risk of spill.

[2] Purdie, J. (2022), modelling climate change impacts on inflows, lake storage and spill in snow-fed hydroelectric power catchments, Southern Alps, New Zealand. Journal of Hydrology (NZ) 61(2): 151-178.

[3] The 95th percentile inflow is the threshold, based on historical records, below which inflows occur 95% of the time, with only the highest 5% of inflows exceeding it. 95th percentiles are commonly used to characterise *extreme high inflows or flood-like conditions.*

In addition, the lake level risk management process described above means that generation will be restricted when lake levels approach the minimum levels specified in the consent conditions.

2.2.2 Effects on spill flows

The effect of climate change on spill flows is discussed in section 4.1.3.3 of Appendix K to the application[1]. In summary, analysis of historical spill flow events indicates that spill events predominantly occur in spring/summer with no or very limited spills in winter. As outlined above (refer to section 2.1) climate change projections are for an increase in flood flows in winter and spring with no or limited change in summer or in autumn. Lake levels are typically low in winter and spring (and it is anticipated that this will continue to be the case under climate change) and therefore this projected increase in flood flows is likely to be mitigated by the lake storage ability to 'capture' these flood flows. Therefore, the projected increase in flood flows in winter and spring due to climate change is unlikely to result in increased spill flows, although as discussed above there is significant uncertainty in climate change projections.

It is noted that the frequency of spill flow over the Lake George Scott weir is closely related to lake levels and operational constraints during maintenance/upgrade projects when portions of the generation network are offline and additional spills are required to manage the lake level. Examples of this are the canal relining project during 2013-2014 and refurbishment of Tekapo B during 2020-2022. Further details on this are provided in section 4.2.1.1 of Appendix K to the application[1].

Although there are spills associated with flood flow management outside these maintenance/upgrade periods it can be expected that some of the longer duration spill flow events will continue to be associated with maintenance/upgrade projects. Genesis anticipates that this is unlikely to change under climate change

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