Otago Regional Council

MEMORANDUM

To: **Tom De Pelsemaeker (Policy Water & Land TL)**

From: **Marc Ettema, Sam Yeo, and Amir Levy (Groundwater Scientists)**

Date: **02 November 2023**

Re: **Trigger level wells – summary of information & recommendations for the LWRP**

1. Introduction

Groundwater quantity is addressed in Schedule 4 of the Regional Plan: Water (RPW). A common method for managing groundwater quantity is consent conditions that restrict takes when water levels in a specified monitoring bore (a "trigger well") fall below certain thresholds. The RPW (Schedule 4B.1) lists five trigger wells across Otago. This memorandum reviews the data from these existing trigger wells and provides recommendations about using this method in the proposed Land and Water Regional Plan (pLWRP).

The data shows that the trigger levels in most monitoring bores were never breached. In addition to that, this review also highlights substantial limitations associated with the trigger levels including ambiguity regarding their aims & the methodologies for setting them, site-specific issues, and challenges associated with compliance of the restrictions. Due to all these shortfalls, it is therefore recommended to stop using the existing trigger levels and not include any new ones in the pLWRP. However, this review also provides recommendations to improve this method if ORC wishes to adapt it in the future.

2. Groundwater level restrictions triggers in the RPW

Schedule 4B.1 of the RPW lists five bores with trigger levels, where consented groundwater takes that have level restriction conditions on their consent must reduce their rate of take when water levels in the trigger bores fall below the thresholds (Table 1). The restriction is gradual, with the rate reduced by 25% when levels fall below the first trigger, followed by further reductions if levels fall further below the threshold. There are 51 Groundwater Consents in Otago that are linked to a restriction level in these five bores alongside 35 consents with restrictions related to the levels in Lake Hawea.

Trigger Well	Aquifer	No. of consents linked to Trigger	Total GW Consents in area	Trigger water Level (m) & reduction in take
J41/0178 - Websters Well (Isbister's trigger well removed in 2014)	North Otago Volcanics	23	28	126.0 (25%) 125.5 (50%) 125.0 (100%)

G43/0209 Cemetery Bore	Ettrick Basin	12	23	170.29 (25%) 169.79 (50%) 169.29 (100%)	
I44/1141 "Piezo 2 Caledonia Drive" – replacement for Harleys Well P2	Lower Taieri -East	11	3 + 9 DCC Inactive	110.5 (25%) 110 (50%) 109.5 (100%)	
I44/0848 Taieri GW at Momona Bore	Lower Taieri - West	5	7	100 (25%) 99.5 (50%) 99 .0 (100%)	
G43/0072 White Hall Bore - Renamed from "Philips Bore"	Roxburgh Basin			188 (25%) 187.8 (50%) 187.5 (100%)	
Other levels					
	Lake Hawea at Dam	Lake level	35		338.2

Table 1: Trigger wells, restriction levels, and reduction in abstraction rate in the RPW

3. Summary of findings

This review highlights many limitations associated with the trigger level method, manifested by the low proportion of time when the triggers were actually breached in most bores. The issues include ambiguity regarding the aims and methodologies for setting the levels, site-specific issues, and challenges associated with compliance of the trigger levels. A summary of the data from each trigger bore is then provided in section 4.

<u>Ambiguity with the aims & methodologies of the trigger levels</u>

- There is no documented method on how the triggers and their values were determined in the RPW. This includes both the setting of the original values and subsequent changes to them, as highlighted by this current memo and previous work by Mourot (2015).
- The goals for setting the trigger levels are not clear, i.e. were they set to reduce bore interference, stream depletion, or protect water availability? It is also possible that some trigger levels were used as an allocation tool rather than protecting values, which is not the correct procedure for setting groundwater allocation.
- The triggers are not connected to reliability of supply for groundwater users, which may suggest that allocation can be increased if the trigger has not been breached. However, this is very difficult to assess when it is unknown how the levels were set, as an over permissive level (i.e. a trigger that is set too low will not be reached) can increase allocation (since the trigger was not breached) whilst this can adversely impact water levels.
- High uncertainty regarding the spatial variability and managing of groundwater levels in large aquifers by using only one trigger level bore.

<u>Site specific issues</u>

- Unsuitable bores and levels (e.g. the trigger level in the Webster well was set below the bottom of the well).
- Trigger level bores located near large groundwater takes, hence their levels do not reflect groundwater levels in the wider aquifer (e.g. Caledonian Drive in Mosgiel).

- Trigger wells located in areas that experience substantial changes in hydrology from large surface water irrigation schemes (e.g. Websters well in the North Otago Irrigation Company [NOIC] area)

Compliance related issues

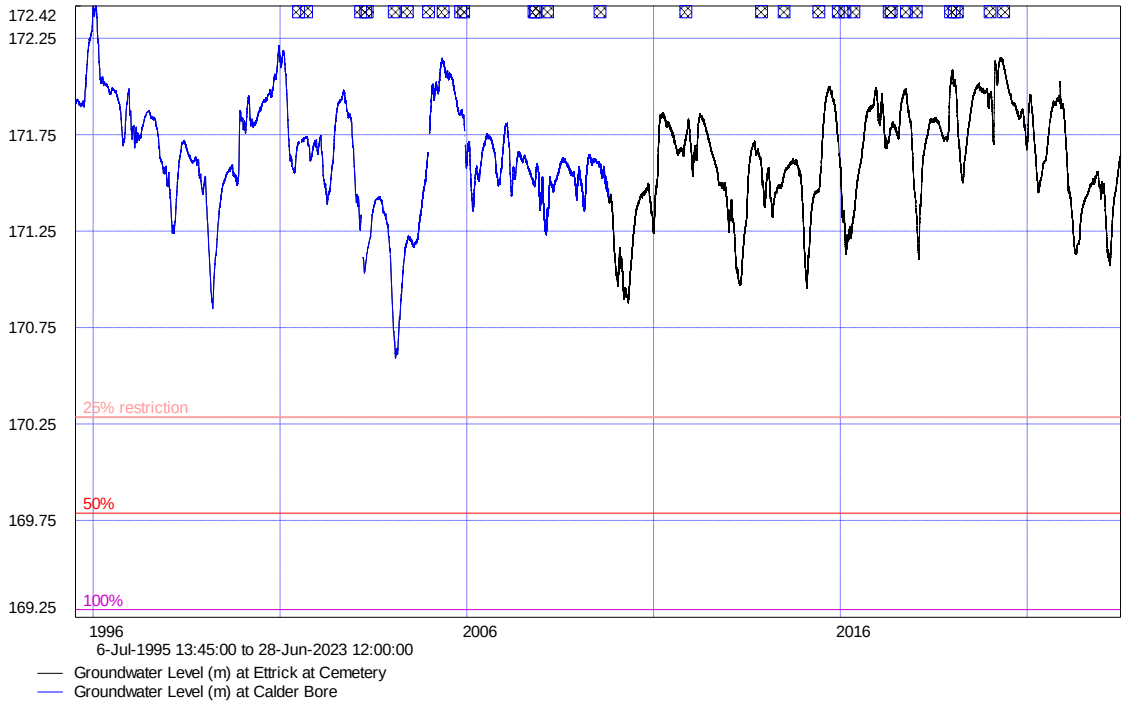
- There are too few consents linked to triggers to make any practical difference (Momona, Caledonian Drive Bores)
- Consents in some areas are mixed, where some consented groundwater takes contain restriction conditions and some lack them.
- It is not clear whether there is communication to consent holders regarding low levels (i.e., similar to takes restricted by minimum flows)
- Some consented takes (<5L/) are so small that a 25% reduction is not going to make any difference to water level in the aquifer.

4. Summary of trigger levels data

4.1 Trigger level well Ettrick Cemetery/Calder Bore

Water levels in this bore were monitored since 1996, although the Calder trigger level bore was replaced by the Cemetery bore around 2010. Water levels during these 27 years of monitoring never fell below the trigger level (Figure 1). The mean GWL is 1.34m above the 25% trigger level, and statistically it is unlikely to reach it, with the more restricted trigger levels even less likely to be breached. This is despite the likelihood of increases in the amount of consents and take volumes in the area. Another issue is that although there are 23 groundwater take consents in Ettrick, only 11 have restriction conditions. Therefore, the restrictions would not be as effective as they would be if all consents contained them.

Figure 1 Water levels (m) and restriction trigger levels for G43/0032 and G43/0209 (Calder and Cemetery Bore)



4.2 Websters Trigger Well

Groundwater levels in the bore were monitored since 1987, during which water levels have never fallen below the restriction threshold. The lowest water levels in the bore were slightly above 128.0m,

around 2.0m higher than the 25% reduction level (Figure 2). Scenarios for the North Otago Volcanic Aquifer (NOVA) were modelled in ORC (2008), which recommended removing the Isbister well from the trigger wells list and significantly lowering, rather than removing, the triggers at Websters well. However, after this lowering it is unlikely that the water levels in the bore will reach the trigger, reflecting the view that takes and the allocation in 2010 are not affecting the overall groundwater levels in the area.

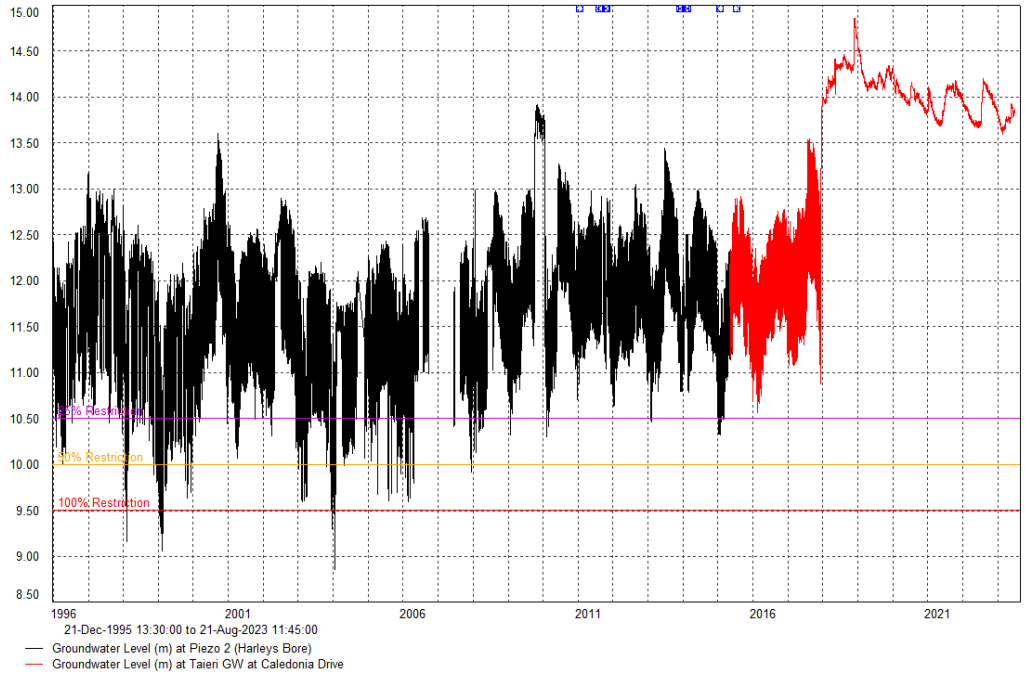
Other considerations for using this bore is the impact of NOIC's input of Waitaki surface water in the area, likely to increase water levels through recharge and decreasing the demand for groundwater. NOIC is also required to augment the flow in Waiareka Creek, hence there is less need for protecting its flow using groundwater level restrictions. It is also possible that there has been a mix up between bores, with water levels taken from the wrong bore. The ORC (2008) report also discusses setting trigger levels for reducing the risk of saline intrusion in the Kakanui estuary. This can now be considered using a new SoE bore in Kakanui township.

Figure 2: Water levels (m) and restriction trigger levels for the Websters well

4.3 Harley/Caledonian Drive Trigger Well

The monitoring of groundwater levels in Harleys bore began in 1996, and it was replaced by the Caledonia Drive bore around 2015. During this time, groundwater levels in the bores fell below the trigger levels several times, with levels falling below the 100% restriction levels of 9.50m in 1998, 1999, and 2004 (Figure 3). However, it seems that water levels have risen and stabilized above 13.50m following the shutdown of the Mosgiel municipal groundwater takes in December 2017.

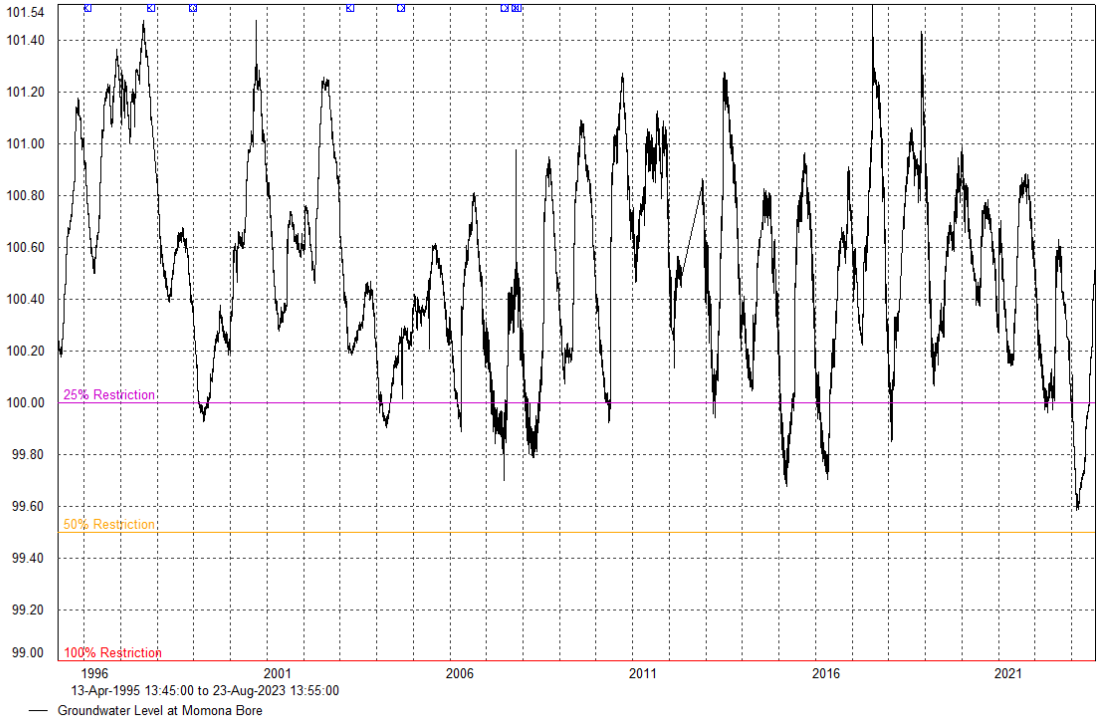
Figure 3: Water levels (m) and restriction trigger levels for the Harleys & Caledonia Drive bores



4.4 Momona Trigger Well

Groundwater levels in the bore were monitored since 1996. The data shows that water levels fell below the 25% restriction level of 100.0m several times. However, it never reached the 50% restriction level (Figure 4). A potential justification for the trigger level is that they are set at or below Sea Level datum to avoid saltwater intrusion. However, the aquifer does not have a direct seaward connection. It is also strange to think of restricting groundwater takes in an area with an extensive drainage scheme. Furthermore, some wells are artesian, which suggests a confining layer and an upward groundwater flow direction. These reduce further the potential for saline intrusion.

Figure 4: Water levels (m) and restriction trigger levels for the Momona bore (I44/0848)

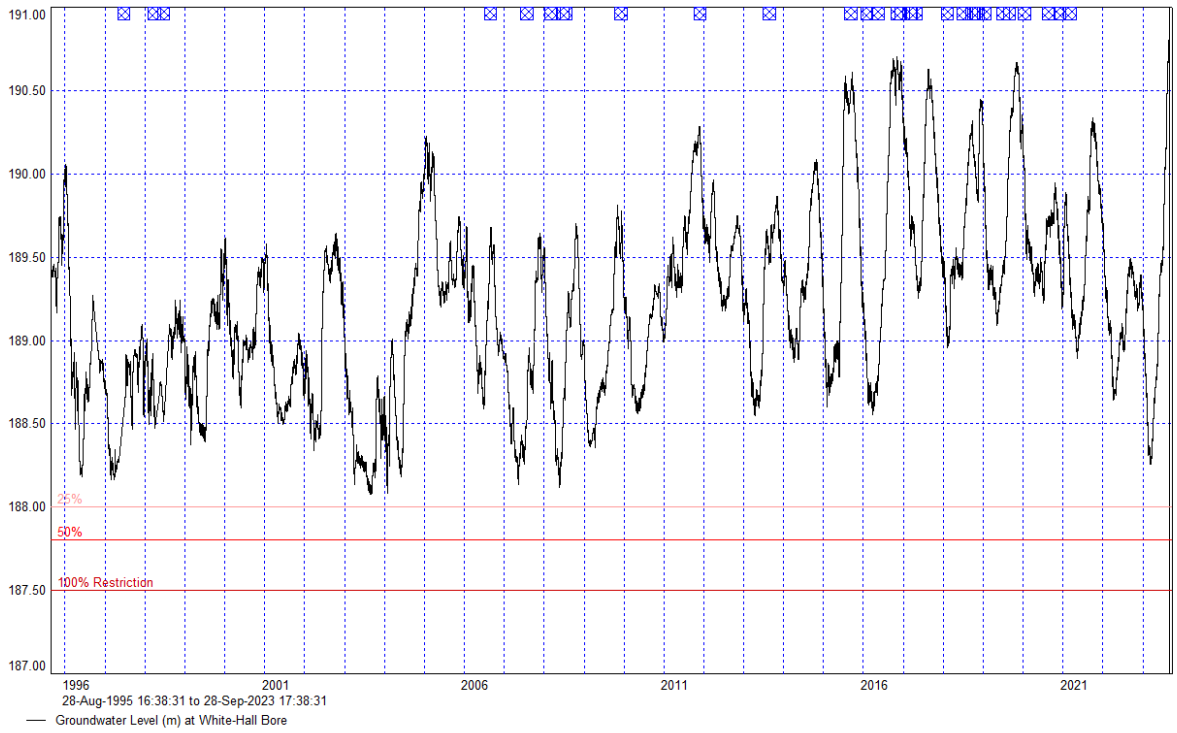


4.5 White Hall Bore (Roxburgh)

Groundwater levels in the White Hall bore were monitored since 1996. Similar to most of the other trigger level bores, water levels in this one also never fell below the first trigger level (25%) in 28 years (Figure 5). However, in contrast to the Ettrick and Websters bores, the lowest level in the White Hall bore (measured in 2003) is only less than 0.10m above the 25% restriction threshold.

Water levels in the White Hall bore show different patterns over the monitoring period, with a potential upward trend in groundwater levels since 2010 followed by an apparent downward shift since around 2020, although the highest water level in the bore was recorded in August 2023. However, further analysis including water usage and rainfall data, is needed to be taken to determine whether this recent downward shift is related to increased water usage or drought conditions.

Figure 5: Water levels (m) and restriction trigger levels for the Whitehall bore ()



5. Future recommendations

This review identified substantial shortfalls associated with the trigger water level restriction method. Due to these it was decided to stop using the existing trigger levels and not add any new ones to the pLWRP. However, if ORC does decide to use this method in the future, we recommend the following:

- Base the trigger levels on statistical values obtained from time series data in ORC's SoE bores. The recent upgrading and expansion of the SoE network will substantially increase the available data for this work.
- Remove the 25% restriction level, as this restriction does not make much difference. There should only be restrictions at 50% and 100%.
- Change the current approach of restricting the maximum flow rate to restricting the maximum daily volume and apply reductions to the annual (monthly) allocation as well (pro rata). However, this can be difficult as the annual volume may have already been used when restrictions are imposed.
- Assess water levels in September/October and, if needs to, declare a low water level year and reduce annual allocation for the coming season based on that. This will provide consent holders with higher certainty. However, we are aware this approach also has many limitations.

6. References

Mourot, F. 2015. Memorandum -*Monitoring Network & Groundwater Levels for Otago - October 2015*. Document ID A934176.

Otago Regional Council (2004). Regional Plan: Water. Accessed online August 2021. https://www.orc.govt.nz/media/10040/regional-plan_water-for-otago-updated-to-1-june-2021-final-17-june.pdf

Otago Regional Council. 2008. *North Otago Volcanic Aquifer study*. Prepared by J. Rekker, C. Holbrooke, and M. Gyopari. Objective ID A183969.