From:	Georgina Hamilton
To:	Plan Hearings
Cc:	Judy Blakemore; mwebb; "Andrew Mockford"; Julia Crossman; Greg Ryder; Richard Measures; Tim Kerr; Tim Ensor
Subject:	Plan Change 7: Adaptive Management Working Group (PC7-385) - Evidence in Chief
Date:	Friday, 17 July 2020 5:11:43 pm
Attachments:	Evidence in Chief of Judy Blakemore (AMWG) 17.7.20.pdf Evidence in Chief of Mark Webb (AMWG) 17.7.20.pdf Evidence in Chief of Andrew Mockford (AMWG) 17.7.20.pdf Evidence in Chief of Julia Crossman (AMWG) 17.7.20.pdf Evidence in Chief of Dr Gregory Ryder (AMWG & OWL) 17.7.20.pdf Evidence in Chief of Richard Measures (AMWG) 17.7.20.pdf Evidence in Chief of Tim Kerr (AMWG) 17.7.20.pdf Evidence in Chief of Tim Ensor (AMWG) 17.7.20.pdf

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Dear Tavisha

We act for the Adaptive Management Working Group (AMWG), submitter no. PC7-385.

We attach for filing, in relation to the above matter, statements of evidence in chief of the following witnesses on behalf of the AMWG:

1. Judy Blakemore (AMWG representative – Timaru District Council)
2. Mark Webb (AMWG representative – Fish and Game)
3. Andrew Mockford (AMWG representative - Opuha Water Limited)
4. Julia Crossman (AMWG representative - Opuha Water Limited)
5. Greg Ryder (ecology/freshwater quality) – please note that this statement of evidence also addresses matters pertaining to Opuha Water Limited's (OWL's) submission on PC7 and has been filed with the evidence of other OWL witnesses today).
6. Richard Measures (artificial freshes)
7. Tim Kerr (modelling)
8. Tim Ensor (planning)

Kind regards,

Georgina Hamilton
Partner

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BEFORE INDEPENDANT HEARING COMMISSIONERS
APPOINTED BY THE CANTERBURY REGIONAL COUNCIL

UNDER:	the Resource Management Act 1991
IN THE MATTER OF:	Proposed Plan Change 7 to the Canterbury Land and Water Regional Plan – Section 14: Orari-Temuka-Opihi-Pareora

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STATEMENT OF EVIDENCE OF ANDREW KEITH MOCKFORD ON BEHALF OF THE ADAPTIVE MANAGEMENT WORKING GROUP (SUBMITTER NO. PC7-385)

Dated: 17 July 2020

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1. INTRODUCTION

1.1 My full name is Andrew Keith Mockford. I am the Chief Executive of Opuha Water Ltd (**OWL**)

1.2 OWL is a member of the Adaptive Management Working Group (**AMWG**). This statement of evidence is provided in support of the AMWG's submission on Part B of Proposed Plan Change 7 to the Canterbury Land and Water Plan (**PC7**), and is endorsed by OWL.

Qualifications and experience

1.3 I have held my current role for two and a half years. Previously I held a role with Trustpower as their Southern Regional Production Manager, responsible for their hydro generation assets in Otago And Canterbury. In that role I also briefly held a role on the Environment Canterbury Regional Water Management Committee.

Background

1.4 Since joining OWL, I have been actively involved in the collaborative work of the AMWG in developing its adaptive management regime proposal, which was submitted to the OTOP Zone Committee in October 2018. This has included providing input to the groups discussions on matters relating to the operation of the Opuha Dam and Scheme infrastructure, presentations to the OTOP Zone Committee during the course of 2018 and discussions with Environment Canterbury (**ECan**) planning and technical staff in relation to elements of the AMWG's proposal.

1.5 I am familiar with the provisions of PC7 to which these proceedings relate. In preparing my evidence, I have reviewed the relevant parts of the section 32 Report and the section 42A Report. In preparing my evidence, I have also reviewed the evidence of other AMWG witnesses, including Ms Judy Blakemore, Mr Mark Webb, Dr Greg Ryder, Dr Tim Kerr, Mr Richard Measures and Ms Julia Crossman.

2. SCOPE OF EVIDENCE

2.1 My evidence primarily focuses on the operational aspects of the Opuha Dam that are relevant to PC7 and the AMWG's submission. I also address comments made in the Section 42A Report in relation to those matters.

2.2 My evidence is structured as follows:

(a) The various operational considerations for PC7 as relevant to the AMWG's submission, including:

(i) Saleyards Bridge minimum flow compliance;

(ii) Lake level thresholds;

(iii) PC7's proposed Opihi mainstem minimum flow regime;

(iv) Partial restrictions;

(v) Artificial freshes; and

(vi) Flood buffering.

(b) Responses to issues raised in the Section 42A Report.

(c) Conclusions.

3. EXECUTIVE SUMMARY

3.1 There are a number of operational considerations that must be understood and taken into account in developing a flow regime for an augmented river, such is the Opihi River.

3.2 The AMWG supports the intention of PC7 as notified, to specify the minimum flows for the Opihi mainstem at Saleyards Bridge being measured as average flows over a daily 24-hour period. Environment Canterbury's current approach to monitoring this site is to do so on an instantaneous basis, whereby flows are not to fall below the specified level at any time. There are a number of factors (the distance between dam and SYB; consideration of and fluctuations in additional inflows, and diurnal flow fluctuations) that mean that OWL always

runs the river higher than the minimum flow requirements in order to protect against the instantaneous minimum flow being breached. Any excess flow depletes lake storage faster and removes the ability to use this water in the future. Analysis has shown a significant saving in water use can be made by moving to a 24 hour daily average flow. The AMWG's agreement with ECan on a 24 hour daily average flow has informed the approach adopted by PC7.

3.3 The AMWG also supports the provision to progressively increase or decrease flows over a 48-hour period when the minimum flows increase or decrease between months. OWL understands that this is appropriate from an ecological perspective and matches the current operational procedures of OWL, and again reflects agreement reached between the AMWG and ECan.

3.4 The AMWG propose that the lake level thresholds, which trigger an alternative management regime, are based on an operational envelope which OWL utilise to make operational decisions throughout the year. My evidence explains this concept in further detail.

3.5 OWLs shares the significant concerns of the AMWG regarding the 'alternative management regime' proposed in PC7 for the Opihi mainstem at Saleyards Bridge. These concerns relate to:

a) The proposed 2025 minimum flows, and specifically, the limited ability to conserve water in water short years;

b) The proposed 2030 minimum flows, which are not hydrologically justified, and which will result in approximately 8% less stored water on average per year;

c) The limited ability of OWL to only undertake a threshold assessment at the start of the next calendar month, thereby failing to recognise that climatic conditions and water demand can vary significantly over the month;

d) The proposed 24 hour average compliance measure for affiliated permits and the inefficiencies this will invoke;

3.6 In response to comments made in the s42A Report, I wish to emphasise that with respect to Opuha Dam operations it is not a case of prioritising storage to

the detriment of environmental flows. Rather, to have reliable environmental flows throughout the year, maintaining water in the Lake is critical. The lake is not bottomless and there are no guarantees around how many times it will turn over a year.

3.7 Furthermore, the s42A Report's recommended deletion of any discretion about entering into a Level 1 or Level 2 flow regime, which has the effect of removing the ability to consider other relevant and often critical factors in addition to Lake level, Lake inflows and snow storage, is concerning for the AMWG, and will lead to the imposition of an alternative management regimes when they are not required.

3.8 The Section 42A Report's recommended wording of a revised artificial fresh policy would impose unrealistic expectations on OWL. The outcomes identified are unachievable with existing dam infrastructure, the peak flows and volumes that are physically able to be released and the considerable distances involved. To even try and achieve these outcomes would be a significant waste of stored water, with consequences for SYB minimum flow compliance. The implications for storage would be significantly worse without the ability to recoup artificial fresh volumes as is presently contemplated by the ORRP and OWL's consents.

4. OPERATIONAL CONSIDERATIONS FOR PC7

Minimum flow compliance - Saleyards Bridge flow measurement

4.1 The AMWG supports the intention of PC7 as notified (Policy 14.4.35(b)) to specify the minimum flows for the mainstem of the Opihi River at Saleyards Bridge (**SYB**) being measured as average flows over a daily 24-hour period. The AWMG's position in this regard has been informed by OWL advice, which has been based on its experience and advice received from its consultants in relation to dam operations. It has also been informed by discussions between OWL and ECan on issues relating to the instantaneous flow measurement. The 24-hour daily average was agreed with ECan technical staff before notification of PC7, following considerable discussion about other possible options.

4.2 In this regard, I note the PC7 Section 32 Report indicates an acceptance of the 24hr average flow measurement as follows:

a. At page 169, the Section 32 Report states that in response to OWL's submission on the draft PC7, '…*amendments have been made to allow averaging of minimum flows and restrictions over 24 hours to provide for better utilisation of existing infrastructure.'*

b. At page 258, the Section 32 Report states that '*The minimum flow at Saleyards Bridge is assessed as an average instantaneous flow over a 24 hour period provided that at any time the instantaneous flow is no less than 500 L/s below the applicable minimum flow to protect instream values and ensure the quantum of water being abstracted by shareholders is available at the time of abstractio*n'.

4.3 Condition 4 of OWL's discharge consent for the Opuha Dam, CRC155950 is couched in terms of the flows that must be achieved at SYB, that is, that SYB flows must not fall below the sum of the minimum flows as specified in the Opihi River Regional Plan (**ORRP**) PLUS *the total rate of the surface and stream depleting effects of abstractions which are currently authorised to be taken downstream of Saleyards Bridge pursuant to "AA", "BA" and "AN" permits (as defined in the Opihi River Regional Plan, operative 16 October 2000)*. While there is no stipulation in either the ORRP or the consent as to how this is to be monitored i.e. whether this is an instantaneous or 24hr rolling average, to date this has been monitored by ECan as an instantaneous measurement, whereby flows are not to fall below the specified level at any time.

4.4 OWL holds a long-term contract with Environmental Consultancy Ltd (**ECS**) to monitor, manage and display the river flow, lake levels, sub-scheme race flows, and climate information required to operate the Opuha scheme. The SYB minimum flow requirements are displayed on the ECS website as follows in Figure 1. While the river minimum flow is set monthly, the actual minimum flow requirement (what OWL refers to as the 'green line') varies on a daily basis to reflect the water orders received for irrigators downstream of SYB.

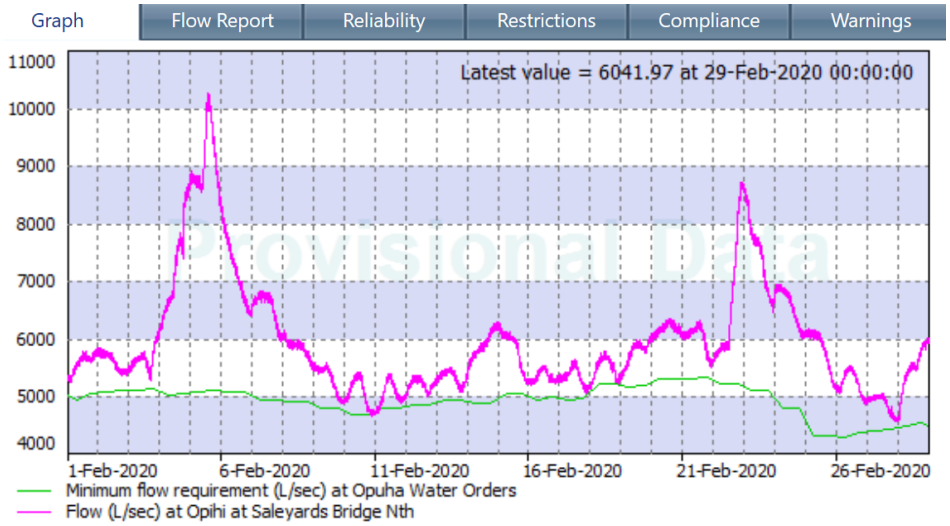

Figure 1. ECS website snip showing minimum flow requirements and recorded (instantaneous) flow.

4.5 The minimum flow monitoring point at SYB is approximately 38km below the downstream weir. Over this length, augmented water released from the Opuha Dam is further enhanced by flows from the Upper Opihi River and the Te Ana Wai River. For OWL to have confidence that the minimum flows requirements for SYB under its consent will be complied with, both these additional inflows and planned irrigation abstraction must be carefully monitored.

4.6 As already noted, all flows within the catchment are displayed on the ECS website. All water abstracted by affiliated water users[1] is 'ordered' via OWL's Customer Relationship Management (**CRM**) online portal or the 'water phone'. Because of the travel time for water released from the dam to reach the downstream users, OWL requires water orders with enough notice period to allow timely release to manage stored water efficiently. Notice periods for water ordering and cancellations vary around the scheme, dependant on the distance between the Dam and the abstraction point[2]. At any time, OWL's systems enable it to have a complete understanding of the anticipated water orders for

[1] I use the term "affiliated water users" in my evidence as a reference to holders of 'AA' or 'BA' water permits who are affiliated to the Opuha Scheme. As discussed in the evidence of OWL's Environmental Manager, Ms Crossman, in relation to OWL's submission on PC7, most permits that are categorised as 'AA' and 'BA' under the ORRP are those that hold an entitlement to be supplied water by OWL, where they have provided ECan with details of the shares, agreement or other entitlement held.

[2] Levels Plains irrigators are required to give 48 hours notice of placing orders and 24 hours notice of cancelling/editing orders while all other irrigators are required to give 24 hours notice of placing orders and 12 hours notice of cancelling/editing orders.

the next 5 - 7 days. This information is sent to Trustpower[3], ECS and Environment Canterbury on a daily basis.

4.7 The management of, and compliance with, these minimum flow requirements at SYB is made difficult due to the diurnal flow fluctuations that are evident in the river system, especially during the hotter summer months. During peak summer it is not uncommon for this diurnal flow fluctuation to alter the measured flow at SYB by 400-500l/s with all other river inputs remaining constant.

4.8 Cumulatively these factors (i.e. the distance between dam and SYB; consideration of and fluctuations in additional inflows, and diurnal flow fluctuations) make for a complex hydrological system and mean that OWL always runs the river higher than the minimum flow requirements (i.e. minimum flow plus sum of abstractions below SYB) in order to protect against the instantaneous minimum flow being breached. For this reason, the flow at SYB always tends to be between 300 – 500 l/s above the minimum flow requirement. While extra water may be considered 'good' for the river, any excess flow depletes lake storage faster and removes the ability to use this water in the future (e.g. for artificial freshes and to sustain environmental flows during water short periods).

4.9 Following the 2013/14 irrigation season, OWL commissioned Aqualinc to identify and assess options to reduce the amount of 'excess water' OWL was releasing. Their work concluded that the excess could be substantially reduced if minimum flows were monitored on a daily rather than instantaneous basis. Aqualinc's assessment was further confirmed by a subsequent assessment carried out by Mr Graeme Horrell for OWL, who calculated that the water savings during the period from 1 Feb -10 April 2019 that would have been made by measuring minimum flows on a daily basis rather than an instantaneous basis would be in the order of nearly 6,000,000 m^3. Mr Horrell's assessment is recorded in the Memorandum attached as **Annexure A**.

4.10 Mr Horrell's memorandum also demonstrates that the use of a daily average flow to measure compliance is not unique. The Rakaia Water Conservation Order specifies a daily average flow, meaning that the preceding day mean daily

[3] Trustpower operate and maintain the power station under contract with OWL. The station is monitored and operated from their Control Centre in Tauranga and the maintenance support is based at Lake Coleridge.

flow based upon 0 hour to 24 hour measured flows which are averaged, determine todays restrictions or non-restrictions.

4.11 The ability to operate according to a daily average flow is particularly important during the critically dry periods when there is high demand for water abstraction and low inflows into the system, and maintaining lake storage is therefore paramount. Outside these dry periods, there will continue to be times when the actual flow at SYB is in excess of the prescribed minimum flow. This will occur when the natural inflows into the catchment below the dam (i.e. Opihi River and Te Ana Wai River in particular) exceed the required minimum flow and/or OWL is releasing extra water from the dam to control the lake level. The AMWG also supports the approach taken in Policy 14.4.35(b) as notified in stipulating an operating window (500 l/s) to ensure that on an instantaneous basis the flows cannot drop so low as to compromise river health. The 500l/s flow variance is considered appropriate and operationally manageable by OWL.

4.12 Figures 2 and 3 below demonstrates how the 24hr daily average would be displayed on the ECS website, and demonstrates how the daily average flow 'smooths' the instantaneous flow, reducing the risk of compliance breaches. Figure 3 demonstrates how the flows against the 500l/s variance can be tracked on an instantaneous basis.

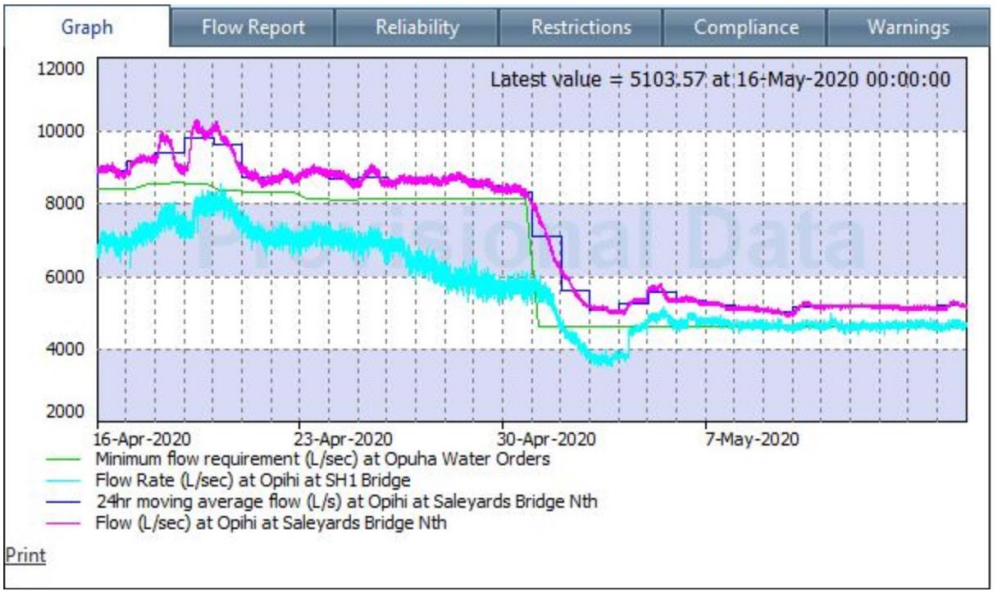

Figure 2 Example of how the 24hr daily average would be displayed on the ECS website.

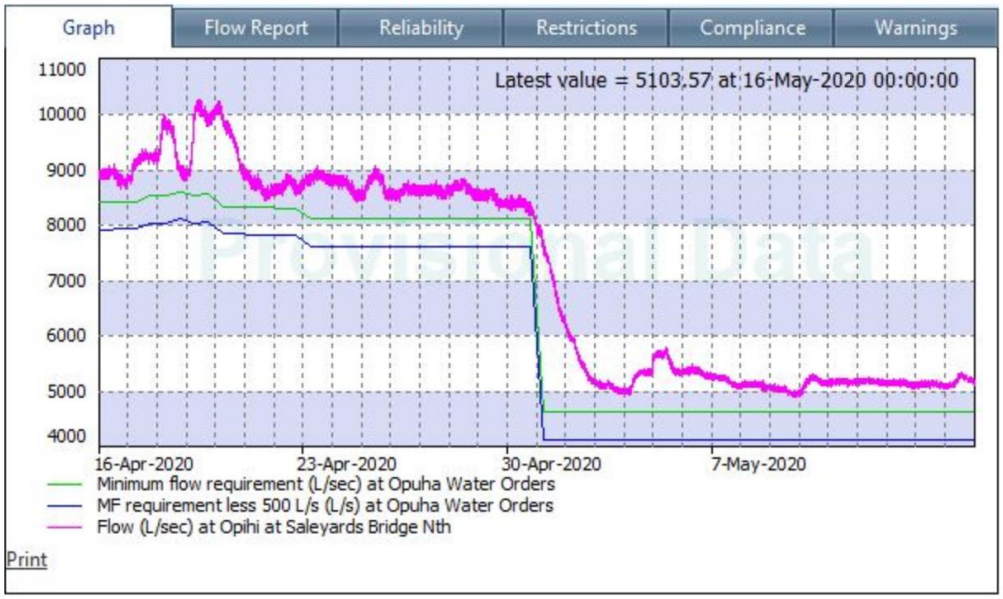

Figure 3 Example of how the 500l/s instantaneous flow variance would be displayed and monitored on the ECS website

Transitional flow requirement

4.13 The AMWG's submission on PC7 supports Policy 14.4.39, which provides for the progressive increase or decrease of flows over a 48-hour period when the minimum flows increase or decrease between months.

4.14 This carries forward the approach under the ORRP in relation to transitioning of monthly minimum flows. The transition between minimum flow requirements provided for in the ORRP can occur for a period of up to 48hrs prior and up to 48hrs after the commencement of the month. This is reflected in OWL's discharge permit for the Opuha Dam, CRC155950 (condition 6(a)).

4.15 As Mr Webb has noted, this smoothing of flows between months reduces the risk of any fish strandings when minimum flows drop from one month to the next. Operationally, it has also been observed that it provides time for the gravels to fill and the flows to stabilise when the minimum flows increase between months, reducing the need to release excess water from the dam to ensure minimum flows are met at a single point in time.

4.16 The current practice is that on a minimum flow increase, OWL will make the change in the preceding 24 hour period, whereas in a decreasing minimum flow OWL will make the change in the 24 hour period following the 1st of the month.

4.17 Based on the ecological advice received from Mr Webb and/or Dr Ryder and operational experience, OWL is comfortable that the reduction in the proposed flow transition period to 48 hours (total) between months, as proposed by Policy 14.4.39, is practical and achievable.

Lake level thresholds

4.18 In developing the AMWG's dual level water restriction regime, the lake level threshold has been based upon a developed and refined operational envelope (also referred to in the AMWG's evidence as the "operational intent") which OWL utilise to make operational decisions on whether to be raising or lowering the lake level throughout the year. The goal is not to maintain the highest possible lake level all year round, but rather to target at keys times of the year to be at or around certain levels. These targets are primarily associated with maximising water stored in the lead up to the dry periods when water scarcity is common, and then operate the lake at a lower lake level during periods where flood buffering is advantageous to the downstream communities.

4.19 It should be noted that the 'operational envelope' has been developed by significant experience and learnings created over the dam's operational life. It continues to be refined presently and will require constant refinement as we attempt to combat the negative effects of climate change. I also note that the 'operational envelope' is aspirational in that the weather the catchment experiences and the instream environmental flow demands are beyond OWL's control. The underlying intent is not to waste water either in excessive storage or in excessive releases leading to storage shortages; it is fine balance to attempt to achieve and is daily considered by OWL management staff.

4.20 The lake level threshold used by the AMWG restriction regime is set at a consistent level below the OWL operational envelope. Setting the threshold appropriately below the bottom of the envelope provides sufficient protection that the restriction regimes is not entered into prematurely.

Opihi mainstem (SYB) flow regime

<u>Table 14(v): 2025 minimum flows</u>

4.21 Ms Blakemore has provided an overview of the AMWG's position on PC7's proposed 2025 "full availability", "Level 1" and "Level 2" minimum flow regimes

for SYB (Table 14(v)). As she has explained, the AMWG is genuinely concerned about the implications of those regimes during water short periods in light of the modelling Dr Kerr has undertaken and reported in his evidence.

4.22 The AMWG's approach to identifying an appropriate SYB minimum flow regime has been to balance environmental considerations across the year with the need to achieve water savings to ensure preservation of Lake storage to enable strategic use of stored water during water short periods.

4.23 The benefits of the AMWG's proposed change to PC7 in terms of water savings can be seen in the following table, which provides a comparison with the ORRP, PC7 as notified and incorporating the Section 42A Report recommendations.

Table 1. Summary of ORRP, AMWG, PC7 and s42A report monthly minimum flows at Saleyards Bridge.

	ORRP		PC7 (2025)			PC7 (2030)			AMWG			s42A (immediate)		S42A (2025)	
	Lake Level >RL375m	Lake level RL375-370m	Full availability	Level 1	Level 2	Full availability	Level 1	Level 2	Full availability	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2
	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec	m3/sec
Jan	3.5	3.35	3.5	3.4	3.4	3.8	3.4	3.4	4.5	4	3.5	3.5	3.4	3.8	3.4
Feb	3.5	3.35	3.5	3.4	3.4	3.8	3.4	3.4	4.5	4	3.5	3.5	3.4	3.8	3.4
Mar	7.5	5.35	7.5	6.4	5.4	7.8	6.4	5.4	7	6	3.5	7.5	6.4	7.8	6.4
April	8.0	5.6	8	8	5.6	9.0	8.0	5.6	7	6	3.5	8	8	9.0	8.0
May	4.5	3.85	4.5	4.5	3.9	5.3	4.5	3.9	4.5	4	3.5	4.5	4.5	5.3	4.5
June	4.0	3.6	4	4	3.6	4.8	4.0	3.6	4	3.5	3.5	4	4	4.8	4.0
July	4.0	3.6	4	4	3.6	4.8	4.0	3.6	4	3.5	3.5	4	4	4.8	4.0
Aug	4.5	3.85	4.5	4.5	3.9	5.2	4.5	3.9	4.5	4	3.5	4.5	4.5	5.2	4.5
Sept	6.0	4.6	6	5.3	4.6	6.6	5.3	4.6	6	5	3.5	6	5.3	6.6	5.3
Oct	8.5	5.85	8.5	7.2	5.9	9.4	7.2	5.9	8	6	3.5	8.5	7.2	9.4	7.2
Nov	7.0	5.1	7	6.1	5.1	7.3	6.1	5.1	7	6	3.5	7	6.1	7.3	6.1
Dec	6.0	4.6	6	5.3	4.6	6.3	5.3	4.6	6	5.5	3.5	6	5.3	6.3	5.3
Average min flow requirement)	**5.6**	**4.4**	**5.6**	**5.2**	**4.4**	**6.2**	**5.2**	**4.4**	**5.6**	**4.8**	**3.5**	**5.6**	**5.2**	**6.2**	**5.2**

4.24 This highlights the significant water savings that can be had in water short years under the AMWG's proposed changes, compared with both the PC7 and s42A report recommendations. Both the PC7 and s42A restriction regimes propose excessive minimum flows during water short periods, where water conservation is critical. The AMWG restrictions present a much more equitable restriction regime where the health of the river and the abstractors are balancing the finite resource with the key underlying intent to ensure that sufficient water is available for the river to remain fully connected throughout the year. The excessive minimum flows proposed by PC7 and s42A pose significant risk to draining the lake and disconnecting the river as a result. To highlight a specific example, I note the October minimum flows for Level 2 restrictions, comparing the AMWG and the s42A (2025) figures. The recommended s42A minimum flows are 3.7m^3/s higher, over the month, than the AMWG. Complying with the s42A October flow would lead to a significant loss of storage of 9.9Mm^3 (or 15% of lake volume), compared to the AMWG proposed flow.

4.25 As outlined in the evidence of Dr Tim Kerr, the AMWG's proposals reduce the risk of 'emptying' the lake and losing the augmented flow, and consequently reduce the risk of flows in the mainstem dropping below the "ecological minimum" (3,000 L/s) referred to in Mr Webb's evidence. As such, I believe the AMWGs proposals will reduce the future reliance for WSD's (which would have to be used to protect this ecological minimum) compared to the PC7 and s42A regimes, which is a view also shared by Ms Blakemore and Mr Webb.

Table 14(w): 2030 "full availability" minimum flows

4.26 In his evidence, Mr Webb has explained the AMWG's concerns about the "full availability" minimum flow increases proposed under Table 14(w). I agree with his analysis of the mathematical and hydrological flaws in ECan's rationale for those "full availability" flows. I also share his views about the inequity created by Table 14(w) in terms of increasing minimum flow requirements for affiliated permits tied to SYB minimum flows without any commensurate increases in minimum flows for non-affiliated permits tied to SH1 minimum flows (under Table 14(u)).

4.27 Mr Horrell, for the AMWG, has confirmed that approximately 5.2 million cubic metres (on average per year) of additional water would need to be released from the Opuha Dam to meet the increased minimum flows proposed under Table 14(w), which is equivalent to approximately 8% less stored water (on average per year). Mr Horrell's assessment is recorded in the Memorandum attached as **Annexure B.**

4.28 As Mr Horrell's modelling demonstrates, this "lost volume" of water could have significant consequences for OWL's ability to release water for environmental purposes (e.g. to maintain minimum flows during water short periods and provide artificial freshes) and meet the ongoing demands of community water supplies and irrigators in the Opihi catchment. To put this "lost volume" in context, the AMWG propose that the lake level threshold for a Level 1 is set at 15% below the operating envelope (as noted in Dr Tim Kerr's evidence). This 8% reduction in volume immediately brings the lake level trigger much closer to its threshold, therefore as Dr Kerr's modelling results indicates, the lake level trigger will be met more frequently.

4.29 In my opinion, this reinforces the AMWG's overall concerns as noted by Ms Blakemore about PC7 missing the mark in terms of addressing the significant shortcomings of the current ORRP framework and providing a regime that will ensure less reliance on WSDs in the future.

4.30 The increases in "full availability" minimum flows proposed in Table 14(w) appear to be a direct response to the recommendation of the OTOP ZIPA that minimum flow increases on the Upper Opihi and Te Ana Wai rivers should remain in the mainstem of the Opihi River, and not be available for abstraction, and should be reflected in the minimum flows measured at SYB. However, to address the difficulties identified by Mr Webb with translating the OTOP ZIPA recommendation into PC7, it is my opinion that ECan would need to develop a model to estimate the extent and timing of any flow gains from those tributaries realised at SYB.

4.31 This would ultimately mean a variable (potentially on a daily basis) minimum flow for SYB, which would be operationally extremely impractical for OWL to manage and demonstrate compliance, and I expect, for ECan to monitor compliance. This is particularly due to the 8 hour travel time between the Opuha Dam and SYB, and having to match this with water orders (which OWL receive

with 24 - 48hrs notice). Furthermore, if the flows are set by ECan for the following day, based on the Te Ana Wai and Upper Opihi flows, by the time they are implemented it is highly likely that the contribution of the Te Ana Wai and Upper Opihi Rivers to the mainstem flows will have altered.

4.32 For all of these reasons, I support the AMWG's request that Table 14(w) be deleted.

Discretion to enter Level 1 or Level 2 flow regimes

4.33 The AMWG's preference is for a discretion around entry into Level 1 or Level 2 flow regimes to be retained as it allows for the consideration of various secondary factors, which have been shown in the past to influence whether or not minimum flow reductions may be necessary.

4.34 Ms Crossman has listed, in her evidence for the AMWG, the eight secondary assessment factors the AMWG have agreed should be considered in any decisions on the prudent use of water stored in Lake Opuha. Additional to the assessment factors explained by Ms Crossman and Mr Webb, climatic assessment factors are also important.

4.35 Long term climatic cycle projections, i.e. whether a La Nina or El Nino weather cycle is predicted, are well publicised and this information is an important assessment factor in adaptive management decisions. As the experience of 2014-16 demonstrated, however, there can be quite a range of local manifestations of these weather cycles (e.g. El Nino is traditionally dry on the east coast but can also be characterised by volatile, variable weather including rain).

4.36 Short and medium term weather forecast are also available from a variety of sources – both free and via subscription - and contribute to the assessment of likely conditions in the catchment and the urgency of decisions required.

Level 1 and Level 2 threshold assessment

4.37 Ms Blakemore has explained the AMWG's concerns about PC7's proposed monthly assessment of the Table 14(x) thresholds and the threshold values.

4.38 In my opinion, limiting OWL's ability to undertake the threshold assessment at beginning of the calendar month, and therefore precluding exit from the Level 1 or Level 2 minimum flow regime until the beginning of the next calendar month, fails to recognise that climatic conditions and water demand can change significantly over a month. As an example, two of the thresholds may not be met on the first day of the month, but may be met by day three. If the following three and a half weeks features a hot nor-west weather pattern, where evapotranspiration and water demands is high, a significant amount of storage can be used before any restrictions can be implemented.

In my view, this is an unnecessary oversimplification of the restrictive regime resulting from ECan's desire to simplify compliance monitoring. On the basis of Dr Kerr's modelling results, the AMWG is confident, however, that this drive for simplification will have negative consequences for OWL's ability to meet ecological flow requirements and therefore negative consequences for the health of the Opihi River. These requirements would result in delayed intervention, which in turn is more likely to lead to a fully drained Lake and associated loss of minimum flow control, as outlined in the evidence of Dr Tim Kerr.

4.39 This is the primary basis for the AMWG's request that Table 14(x) include daily assessment thresholds, and provision be made for entry into the Level 1 or Level 2 regime at any time.

4.40 I agree with the comments made in the Section 42A Report that the period of reduced minimum flows should be minimised and a return to "full availability" minimum flows occur as soon as possible.[4] In this regard, I note that the AMWG's original proposal to the OTOP Zone Committee provided the ability to exit from Level 1 and Level 2 minimum flow regimes at any time, but as Ms Crossman has noted in her evidence, the feedback that the AMWG received from ECan planners prior to PC7's notification was that this would create too much complexity in the PC7 planning framework.

4.41 The AMWG's revised position, which has been incorporated in the changes sought in its submission on PC7, was to align the period of reduced minimum flows with the maximum allowable period for WSDs under section 329 of the

[4] Section 42A Report, Part 4, para 9.62, page 316.

Resource Management Act 1991, i.e. two weeks, and to incorporate a separate exit strategy. Like all other elements of the AMWG's proposed changes to PC7's proposed regime for SYB, the exit strategy devised by the AMWG has been informed by prior WSD experience that the threshold test for entering into a regime with reduced minimum flows is not appropriate for exiting out of such a regime.

4.42 For example, if a small fresh occurred in the tributaries of Lake Opuha when the Lake level was at a minimum, the threshold test would not be met but it would be poor management to return to the "full availability" regime because the tributaries can be quite 'flashy' and in dry conditions will revert back to low flows quickly as the surrounding river gravels draw water in. If a regime is exited when lake levels are critically low, and it is not possible to go back into the regime until the following month, the risk of being unable to meet ecological flows significantly increases. It is entirely appropriate, in my view, therefore that the Lake level is the driver for exiting the regime.

4.43 The changes sought by the AMWG would allow OWL to exit from Level 1 and Level 2 minimum flow regimes when there is an exceedance of the respective Level 1 and Level 2 Lake level thresholds. The exit assessment would be undertaken at the end of the fortnight period, rather than at the start of the next calendar month as proposed under PC7.

Partial restrictions

4.44 Ms Crossman has addressed the various issues arising with PC7's proposed 24-hour average compliance measure for affiliated permits when subject to partial restrictions.

4.45 From a Dam infrastructure perspective, I note that attempting to meet a 24-hour average is impossible when considering on-farm pumping systems and the water travel time from release to abstraction points. The amount of excess water released to provide any certainty of meeting a 24-hour average target would lead to gross inefficiencies and create significant loss of stored water. In water scarce years, this would lead to additional restriction periods, heighten the risk of running the lake out of water, and disconnecting the river.

Artificial Freshes

4.46 As Mr Measures explains in his evidence, artificial freshes are utilised by OWL as a tool for managing nuisance periphyton growth, namely didymo and phormium, in the Opuha and Opihi Rivers. They have been trialled in the Opuha/Opihi system since an initial trial programme in 2004-06 and more recently since 2013, with varying degrees of success.

4.47 In 2016, OWL made modifications to the downstream weir to enable a fresh of greater peak flow to be released into the Opuha River. Prior to the 2016 modifications the maximum peak flow that could be released from the downstream weir for an artificial fresh[5] was 35 m^3s. With the new infrastructure, this peak flow has increased to 80 m^3/s. It should be noted, however, that the total volume able to be released from the downstream weir has not changed as a result of the modifications as this is constrained by the volume able to be stored in the regulating pond[6]. Despite this, monitoring undertaken since 2016 show that those modifications have been very successful from the perspective of periphyton removal in the Opuha and Opihi systems.

4.48 Mr Measures has gone into considerable detail in his evidence explaining the prior research and learnings that have been gained during artificial fresh trials and Dam operations since 2016. This knowledge about artificial freshes and their effectiveness at periphyton removal is continuing to build over time and OWL is committed to continuing research and trials in this space.

4.49 As Ms Blakemore and Ms Crossman have confirmed, the current planning and consenting framework requires OWL to consult with and obtain the written approval of OEFRAG members of any artificial fresh proposal and compensatory flows following an artificial fresh. The general approach adopted by OWL in conjunction with OEFRAG in preparation for an artificial fresh is as follows:

(a) Any member of OEFRAG will initiate the conversation about the need for an artificial fresh with the rest of OEFRAG. This may be driven by any number of factors including a forecasted rain event, nuisance

[5] Assuming there is no spilling over the Opuha Dam
[6] The regulating pond is the body of water between the Opuha dam and the downstream weir.

periphyton levels, operation issues (e.g. didymo clogging fish screens), general river health, flood buffering or recreational triggers.

(b) OEFRAG members discuss the merit of conducting an artificial fresh taking into account the weather forecast, the water availability/lake storage and any instream habitats that may be compromised by the release of a fresh (e.g. inanga spawning habitat, bird nesting habitat). OEFRAG also discuss whether the flow release should be compensated through reduced minimum flow requirements (until such time as the flow release is re-couped), as is required by the ORRP and OWL's consent CRC155950.

(c) If all OEFRAG members agree to an artificial fresh taking place:

(i) Expert advice is sought as to the most effective magnitude and duration of fresh, within operational constraints.

(ii) OWL contacts ECan to ensure compliance, river engineers, flood controllers, and water quality teams are comfortable with the proposed fresh. If the river mouth is shut, OWL liaises with ECan to mechanically open it.

(iii) Public notification of the proposed fresh occurs via OWL's Facebook page. If it is a 'sunny day' fresh, warning signage is placed at the main river access points along the river.

(iv) The fresh is released to coincide with low/rising tides at the river mouth taking into account travel time of the fresh.

(v) If nuisance periphyton has been the driver for the fresh, OWL undertakes a periphyton survey of the river to determine effectiveness of the fresh.

4.50 OWL sees considerable value in enabling this current approach to continue under PC7. I therefore support the AMWG's suggestion that artificial fresh protocols be developed through future augmentation consent conditions as part of an operational management plan.

4.51 I address the changes to PC7's artificial fresh policy recommended in the Section 42A Report separately, later in my evidence.

Flood Buffering

4.52 Lake Opuha is fed by Fox Peak and the Two-thumb Range and can experience very high inflows resulting in rapid lake level increases. In some circumstances, this requires proactive management to ensure the lake level does not rise at a rate and to a level that may compromise dam infrastructure, particularly the downstream weir, or risk flooding the Opuha and Opihi Rivers downstream of the dam.

4.53 In the past, downstream weir washouts associated with rain events have caused extreme flows, sediment release and costly repairs for OWL. When full, Lake Opuha at RL391.2 with spillway gates allowing a slightly higher level (RL392.2).

4.54 Under current consent conditions, OWL is not able to take the Lake below RL391.2 except to release of irrigation water and environmental flows. However, OWL consent CRC155950 (condition 8) states that if OWL forwards a 'Flood Buffering Proposal' and written approval of OEFRAG then releases of water from Opuha Dam storage may be made to provide buffering for anticipated flood inflows, provided that ECan is advised in writing before any such releases occur.

4.55 It is important that flexibility continues to be provided for adequate or responsive flood buffering based on knowledge of the presence of significant snowpack in the upper catchment or advance warning of rainfall in the catchment. I therefore support the AMWG's proposal that flood buffering protocols be developed through future augmentation consent conditions as part of an operational management plan.

5. RESPONSE TO s42A REPORT

Environment verses storage

5.1 At para 9.7, under the heading “The Opuha Dam and its operation”, the Section 42A Report states:

> *The Opuha Dam, forming Lake Opuha, was commissioned in November 1998 and designed as a means to maintain environmental flows in the downstream catchment as a first priority, while also providing a supply of water for irrigation, urban and industrial purposes. Consequentially, the lake also provides amenity and recreational benefits to the local community, including fisheries and water sports. We acknowledge that the first priority of environmental flows may not have transpired in practice to the extent that was envisioned, with storage appearing to be prioritised over river flows.*

5.2 With respect to this statement, I note that to have reliable environmental flows throughout the year, maintaining water in the Lake is critical; without storage there are no options available in terms of how water can be used best for the River. This is a key principle that underpinned many aspects of the AMWG’s submission.

5.3 Lake Opuha is not bottomless, and in lake storage terms it is a small reservoir, turning over multiple times a year. In the five years between 1st July 2014 and 30th June 2019, on average the lake inflows have totalled an average of 4.3 effective volumes of Lake Opuha per year. This average however hides the significant variance between years from inflows equivalent to 1.4 lake volumes to 7.4 in different years. This demonstrates the inherent seasonal variability of the catchment and the need for adaptability to respond to different climatic cycles.

5.4 Furthermore, the statement does not reflect actualities around the amount of water that has been ordered and released from the Dam for irrigation, compared to the water that has been released for environmental flows. To use the same period as mentioned in 5.3 above, the average total OWL irrigation demand as a crude percentage of lake inflow volumes, the average over this period is 23.6%. Further detail is provided in the evidence of Mr Ryan O’Sullivan for OWL

in support of OWL's submission on PC7, which demonstrates that significantly more water has been released for environmental purposes rather than irrigation

5.5 This clearly shows that the ORRPs intent that environmental flows are the first priority, has been implemented. As has been noted elsewhere in the AMWG PC7 evidence, the intent of the AMWG's proposal and the decisions it seeks on PC7 is to retain this first priority being that of the environment, however it is impossible to divorce this from the requirement to maintain storage.

Artificial freshes

5.6 There are various aspects of the Section 42A Report's analysis of the AMWG's submission that I consider are simply incorrect and/or have been overstated. While I understand from the evidence of other AMWG witnesses that these aspects will largely be addressed if the Report's recommendation for an outcome focused policy is adopted, I consider that they warrant a response.

5.7 The first issue arises at para 9.56, where the Report states:

> *The type of small freshes proposed by submitters have been described as 'operational' and assist with clearing didymo in the Opuha Gorge that can cause blockages in the intake of the Kakahu Irrigation Scheme but have limited effectiveness for clearing periphyton in the Opuha River downstream of Skipton Bridge and almost no influence on the Opihi River (Measures, 2020). Modelling shows that the types of freshes sought by submitters would occur many times, including when changing between monthly requirements, irrigation demands requiring more water, or there are high flows in the Upper Opihi or Te Ana Wai.*

5.8 As outlined in the evidence of Mr Measures, the AMWG never considered that these types of flow releases would be 'artificial freshes'. It is for this very reason that the AMWG sought greater clarity around the artificial fresh regime through the inclusion of definitions in PC7 for "small" and "large" artificial freshes, and provision for the matters and consultation that would inform future decisions about artificial freshes to be addressed through an operational management plan prepared and submitted as part of any future augmentation consent application.

5.9 In my view, there is no risk of the situations referred to by the Report's authors would be considered artificial freshes; this was simply not the intention of the AMWG. The underlying rationale of the AMWG's submission points was to ensure that the prescription around artificial freshes in PC7 would unduly restrict OWL's ability to release freshes for ecological health reasons. This concern appears to be shared by the Report's authors, and the AMWG agrees with the recommendation that PC7 should adopt an outcome-focused approach to artificial freshes.

5.10 The concerns around "small" freshes may explain why the Report then goes on to question the justification for allowing volumes for artificial freshes to be recouped immediately after a fresh. As Ms Crossman has explained in her evidence, the recouping of fresh volumes is a key element of the current ORRP and OWL consenting framework, with OEFRAG members' written approval. Indeed, Dr Kerr's modelling demonstrates the importance of recouping flows, and the implications for Lake storage and SYB flows if the ability to recoup flows following an artificial fresh were not enabled.

5.11 The issue of whether or not recouping volumes after an artificial fresh is justified may be a matter better addressed during a future consenting process. However, the AMWG sees no reason why the current ORRP approach should change under PC7; in my view, including direction in PC7 as regards compensatory flows provides certainty for all parties.

5.12 The commentary at 9.57 of the Report seems to be a criticism of OWL's and OEFRAG's approach to artificial fresh releases in the past, and is absent any acknowledgment of the considerable investment OWL has made in seeking assistance, advice, research and trial work, related to artificial freshes. Over the last 8 years, this has included a modelling study in 2012, monitoring of 3 artificial fresh trials, as well as separate analysis of the periphyton monitoring data to identify flow thresholds correspond to effective removal, totalling approximately $120,000. OWL is committed to ongoing investment to ensure knowledge relating to the effectiveness of artificial freshes in the Opuha and Opihi River systems continues to improve.

5.13 Finally, I wish to echo the concerns expressed by Mr Measures and Ms Crossman that if prescription around the magnitude and frequency of artificial freshes is to be deleted from PC7, it is essential that any outcomes identified by PC7 for artificial freshes are achievable.

5.14 While an outcome-focused policy appropriately recognises that OWL's knowledge on artificial freshes and their effectiveness will continue to build over time with more experience, the AMWG have considerable concern that the types of freshes that would have to be released to achieve the recommended changes in the Section 42A Report (i.e. *being effective at periphyton removal so that it does not reach nuisance levels*, and *opening the river mouth to enable effective fish passage*), are impossible with existing dam infrastructure, the peak flows and volumes that are physically able to be released and the considerable distances involved (as outlined previously, and further detailed in the evidence of Dr Measures for the AMWG).

5.15 To even try and achieve these outcomes would be a significant waste of stored water. The implications of this on storage will be significantly worse without the ability to recoup artificial fresh volumes.

5.16 I also note that in terms of the suggestion that artificial freshes should be effective at "opening the river mouth", as Mr Webb has explained, the Opuha Dam has created significant benefits in terms of *maintaining* an open river mouth compared with the situation before the Dam was constructed. However, the Dam was never designed for the purpose of opening the mouth.

5.17 I therefore support the AMWG's position that modifications to the Section 42A Report recommendations are required to address these matters.

6. CONCLUSION

6.1 The AMWG agrees with the provisions of PC7 confirming operational aspects such as SYB flow compliance measure, transitioning flow periods. These aspects of PC7 reflect prior agreement between the AMWG and ECan and should be retained in PC7.

6.2 However, for the reasons outlined in my evidence and that of other AMWG witnesses, the AMWG remains of the view that changes are required to the broader PC7 plan provisions describing the SYB minimum flow regime and alternative management regimes.

6.3 While the Officer's recommendation for an outcome based policy for artificial freshes is supported, further refinement is required to ensure the outcomes are achievable; the present proposal would be impossible to achieve with existing dam infrastructure constraints, the peak flows and volumes that are physically able to be released from the Dam and the considerable distances involved. No consideration has been given to these issues, or the implications for stored water and related consequences for SYB minimum flow compliance. Dr Kerr's evidence indicates that those implications would be significantly worse without the ability to recoup artificial fresh volumes as is presently contemplated by the ORRP and OWL's consents.

Andrew Keith Mockford
17 July 2020

ANNEXURE A - USE OF DAILY AVERAGE FLOW (RATHER THAN AN INSTANTANEOUS FLOW) AND WATER SAVINGS IF IMPLEMEMENTED Feb-April 2019. MEMORANDUM FROM GRAEME HORRELL CONSULTANCY LTD

Graeme Horrell Consultancy Limited

Memorandum

To: Opuha Water Ltd

From: **Graeme Horrell** Date 3 May 2019

Subject: Use of a daily average flow (rather than an instantaneous flow) and how much water this could have saved it had been implemented Feb-April 2019

1/ Monthly flow plots (Figure 1, Figure 2 and Figure 3) for February, March and part of April below show the current minimum flow and the calculated flow downstream of the LPIS intake (Saleyards Bridge measured flow minus the LPIS measured take). These plots show the acheivement of the current minimum flows.

2/ If OWL had managed the acheivement of the minimum flow at Saleyards Bridge as a 24 hour mean flow, thus having the flow (as can be observed on plots) at the start and end of day below the minimum but middle of day well above the minimum (hence overall 24 hour period average is above the minimum flow), then the amount of volume saved from dam releases from 1 Febuary to 10 April 2019 would be 5,977,032 m^3, or 9.1 % of the 65.47 million m^3 operating storage range of Opuha Dam. There are 3 small natural freshes (24 Feb, 9 and 15 March) which may exagerate these estimates, better estimate maybe 8%.

3/ An example of the wording of a daily average flow is from the minimum flow managed on the Rakaia (WCO).

"**gorge flow** means the mean daily flow of the Rakaia River as estimated for the preceding calander day by Canterbury Regional Council from measurements at –"

In other words, the preceding day mean daily flow based upon 0 hour to 24 hour measured flows which are averaged, determine todays restrictions or non-restrictions. There are occasions on the rakaia when the river is dropping and during the current day the river drops below the restriction level, however they continue to irrigate until the

next day when the 24 hour means shows they are below the minimum (a gain to irrigators), however if the river is in restriction and the river rises above the minimum, irrigators cannot irrigate until the next day (a loss to irrigators). Overtime the losses and gains to the irrigators become negligible.

4/ Figure 4, Figure 5 and Figure 6 provide graphed examples of what the flow may look like at Salesyard Bridge when operating under a mean daily flow, for one day in February, March and April, when the PC7 2030 minimum flow (as a 24 hour mean) was achieved.

The daily mean would be calculated by subtracting LPIS and any other downstream abstraction from the Salesyard Bridge measured flow.

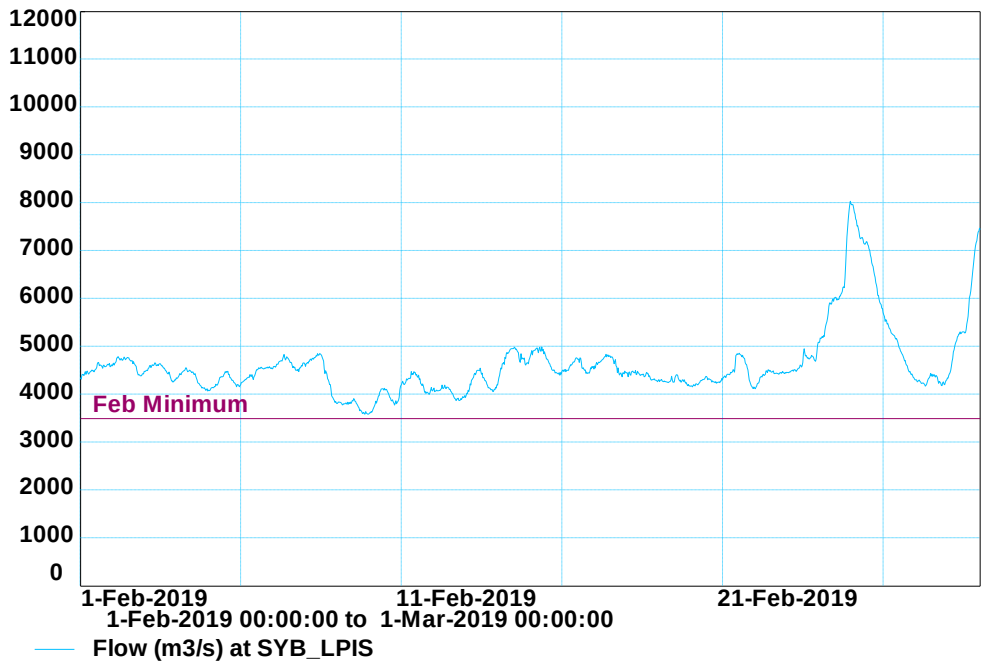

Figure 1: Achievement of the current minimum flow for February 2019

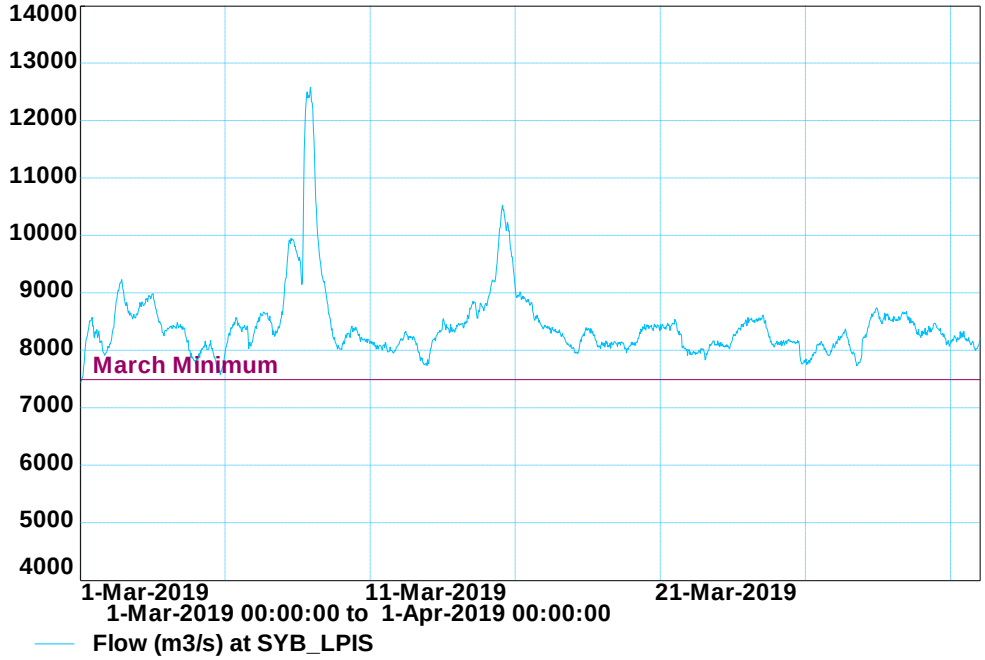

Figure 2: Achievement of the current minimum flow for March 2019

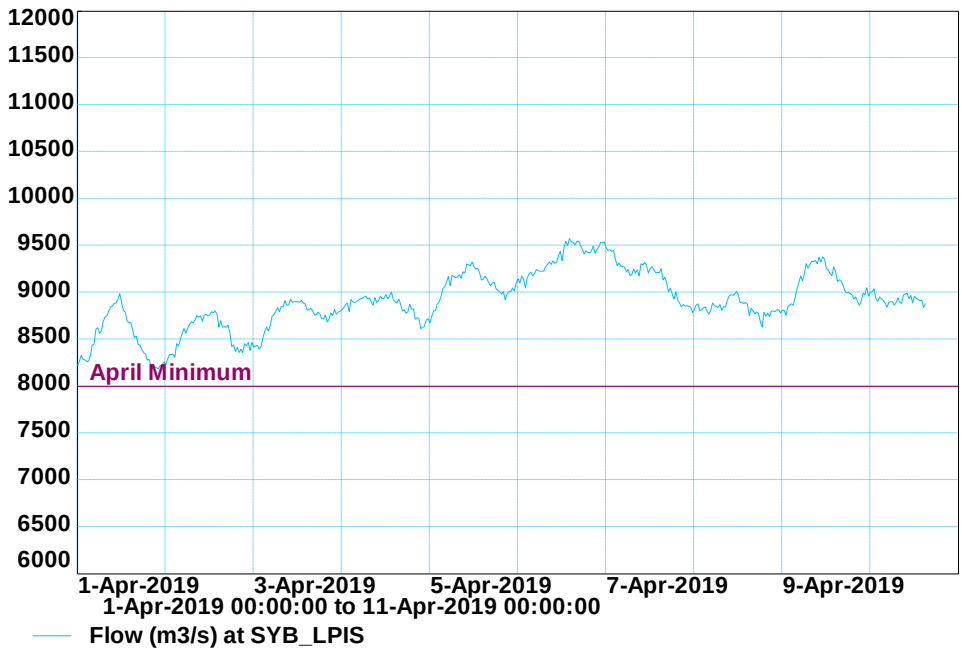

Figure 3: Achievement of the current minimum flow for April 2019

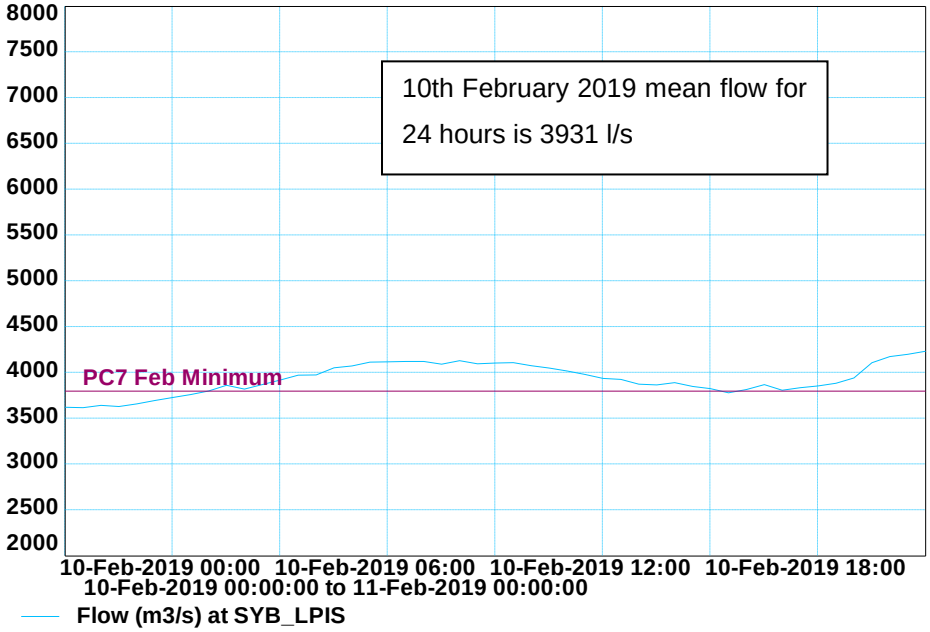

Figure 4: Achievement of February minimum flow of 3800 l/s on 10th February 2019

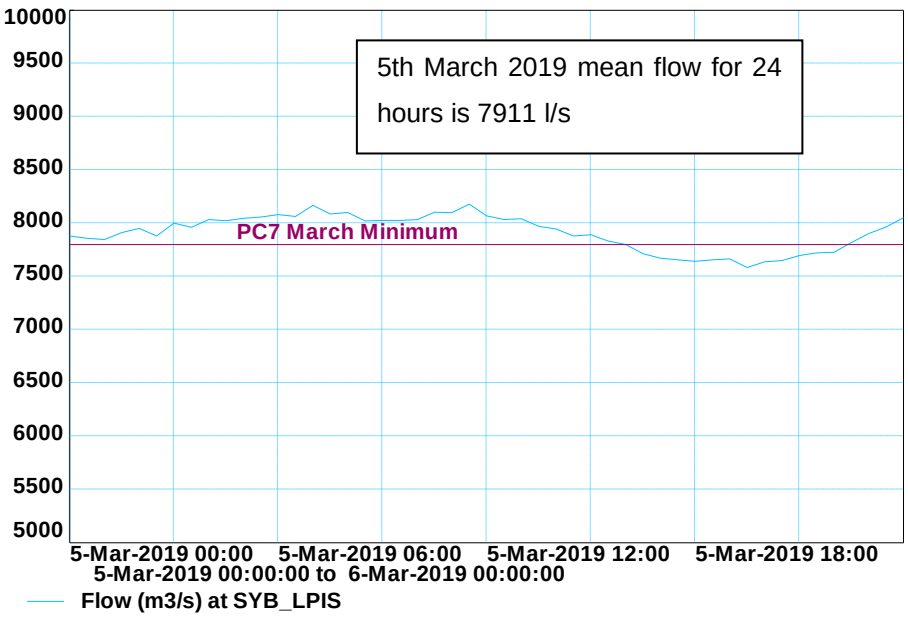

Figure 5: Achievement of March minimum flow of 7800 l/s on 5th March 2019

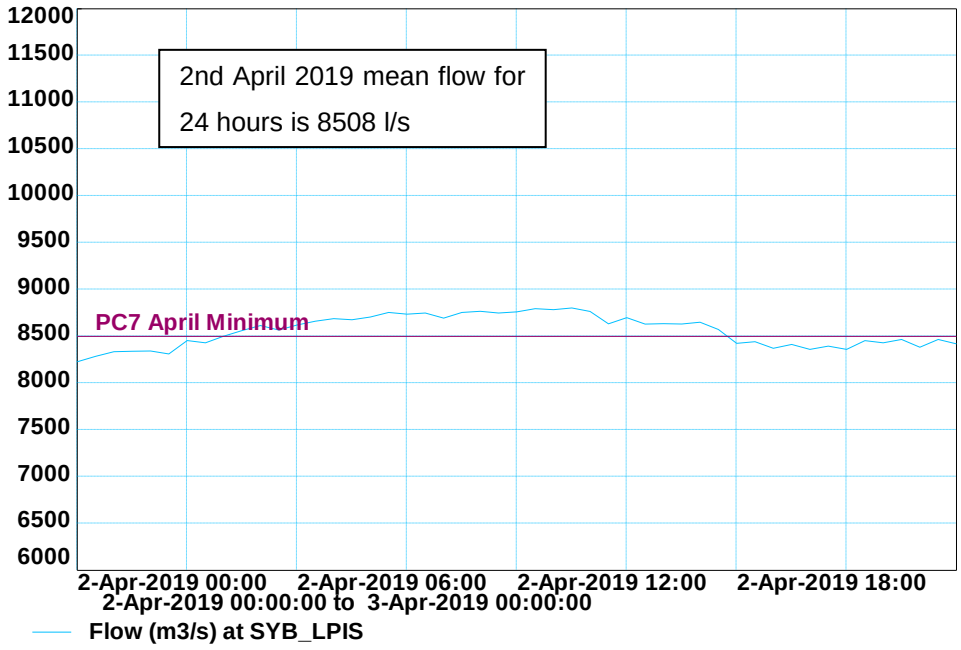

Figure 6: Achievement of April minimum flow of 8500 l/s on 2nd April 2019

ANNEXURE B – SEEKING REMOVAL OF TABLE 14(w) AND RETAINING CURRENT MINIMUM FLOWS AT SALEYARDS BRIDGE. MEMORANDUM FROM GRAEME HORRELL CONSULTANCY LTD

Memorandum

To: Adaptive Management Working Group

From: **Graeme Horrell** Date 30 August 2019

Subject: AMWG submission - Seeking removal of Table14(W) and retaining current minimum flows at Saleyards Bridge

The Adaptive Management Working Group (AMWG) have significant concerns relating to the Opihi main stem minimum flow increases displayed in PC7 Table 14 (W).

1 The issue with PC7 Table 14 (W)

It is proposed that the Opihi mainstem minimum flows at Saleyards Bridge (SYB) will have substantial increases to its monthly minimum flow as shown in Table 14 (w) e.g. 900 l/s in October. These increases are due to an interpretation error which will result in approximately 5.2 million cubic metres (on average per year) of additional water having to be released from Opuha Dam to meet these increased minimum flow.

This is due to a perceived additional contribution of flow from the Upper Opihi and Te An Wai tributaries. The release of 5.2 million cubic metres will reduce the availability of stored water volume for environmental and irrigation releases by approximately 8% per year on average, which will impact upon the frequency of water shortages into the future.

2 Background on how the miss interpretation occurred

2.1 The December 2018 'Orari-Temuka-Opihi-Pareora Zone Implementation Programme Addendum' states:

> *"5.3.1 Recommendation: Augmentation of the Opuha and Opihi Rivers*
> *I. The OTOP sub-region plan change includes an Adaptive Management Regime for the augmentation of the Opuha and Opihi rivers that provides for:*
> *e. All flow gains achieved by minimum flow increases on the Upper Opihi and Te Ana Wai Rivers remaining in the mainstem of the Opihi River, and not being available for abstraction, and should be reflected in the minimum flows measured at Saleyards Bridge."*

Interpretation of (e) above; is that all gains that might be achieved due to minimum flow increases on the Upper Opihi and Te Ana Wai Rivers will remain in the Opihi mainstem

are not available for abstraction and should be reflected at SYB. There is nothing here stating SYB minimum flow should increase. It indicates that when increased flows appear in the mainstem they should stay there. The AMWG understand and do not disagree with this.

Unfortunately it does not state, conversely, when there are no increases in flow to the mainstem (from these tributaries) that the current minimum flow at SYB is to be retained.

2.2 Unfortunately ECan's interpretation below follows the same miss-interpretation by not considering the situation when no gains are achieved.

Information from ECan report 'Hydrology technical summary report to support the Orari-Temuka-Opihi-Pareora limit-setting Process'. (Clark 2019 (a)) states

> *"4.3.1 Opihi River mainstem (page 28)*
> *The ZIPA also recommends that any gains made in the tributaries are kept in the mainstem. If minimum flows in the mainstem are not increased by the same amount as the increase in the tributaries this means that any gains in the tributaries become increases in storage in Lake Opuha. This would occur if the tributaries provide higher flows to Saleyards Bridge and OWL would be required to release less water from the dam to maintain the minimum and therefore would be able to 'bank' the gains made by increasing the flows in the tributaries".*

This is correct when tributary increased flow resulting from minimum flow increases occur. Whilst we understand what ECan is attempting to achieve here, the flaw is those increases in flow in the mainstem will have a very short time component, therefore will not always be occurring. "Any gains made in the tributaries" signifies they may not be all the time. The proposal to raise the minimum flow at SYB for all the time for every month differs from our understanding of (e) in 1 above.

Further from Clark, ECan's report 'Setting trigger levels and evaluating a flow regime for the Opihi River' (Clark 2019b) Pages 3 and 4, states.

> *"The ZIPA recommends that the gains in flow made in the tributaries is retained in the main stem flow. To do this, the monthly full availability flows are increased by the sum of the increase in minimum flow from the Upper Opihi and Te Ana Wai Rivers. If the minimum flows are not increased by this amount, then the gains in the tributary flows are retained in the lake and would not provide the gain for the catchment as a whole. As the Opihi Catchment is managed as a whole system, where shareholders' abstractions on the tributaries are 'offset' by water released down the mainstem, then any gain in flow in the tributary must therefore result in a gain in the flow at Saleyards Bridge. If this gain does not occur, then the concept of 'offsetting' abstraction in the tributaries presents a conflict in the water balance."*

3 Impact upon Opuha Dam storage

ECan's technical advisors conclude that OWL would bank the additional water in the mainstem as unreleased storage from the dam. This will only occur for a very short period when the Upper Opihi and Te Ana Wai are at their minimum flows see Figures 1 and 2.

The core of the issue is that a paper increase of a minimum flow does not always change the flow in the river for all of the time. ECan believe the increased flow gained from current to proposed plan minimum flows will always be in the river, their interpretation is provided in Figures 3 and 4. These Figures were truncated to just a few days at lower flows, however ECan's logic would include higher flows including the full 31 days of January.

Taken further; for an extreme example, the Upper Opihi minimum flow was increased to 100,000 l/s (100 m3/s) will that raise all flows of the Upper Opihi by 100 m3/s all of the time? of course not. But as a consequence following ECan's interpretation, OWL would be required to add an additional release flow of 100 m3/s into the mainstem, unfortunately this would empty a full Dam in approximately 8 days. To a lesser degree, this is what will occur for OWL due to Table 14 (w).

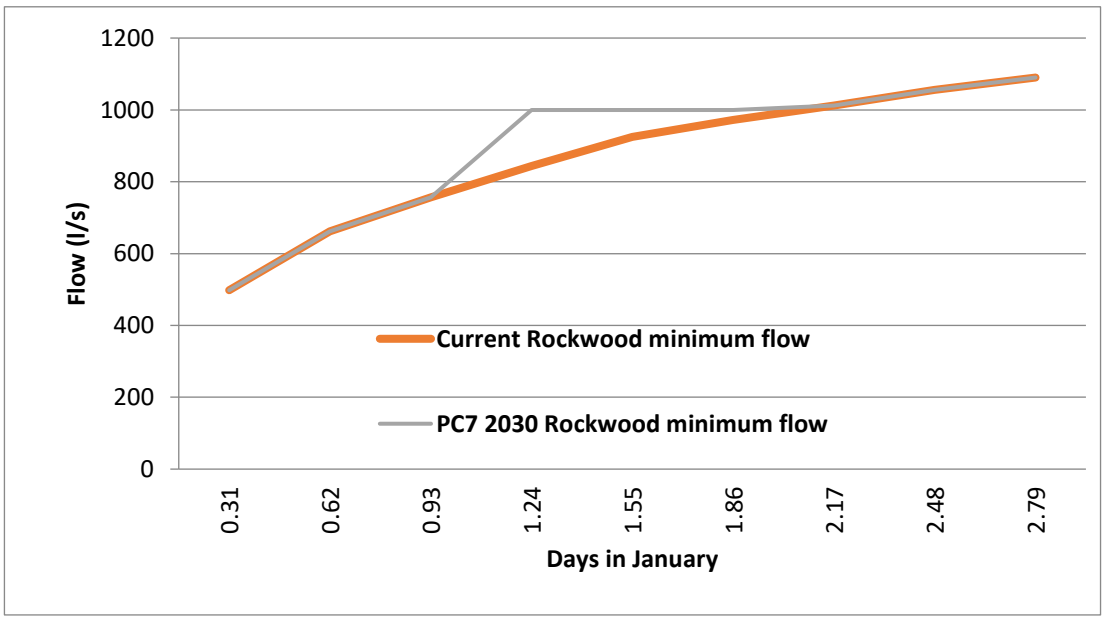

Figure 1: Distribution of Opihi at Rockwood January flows (1963 – 2019) showing an increase in flow for approximately 1 day on average.

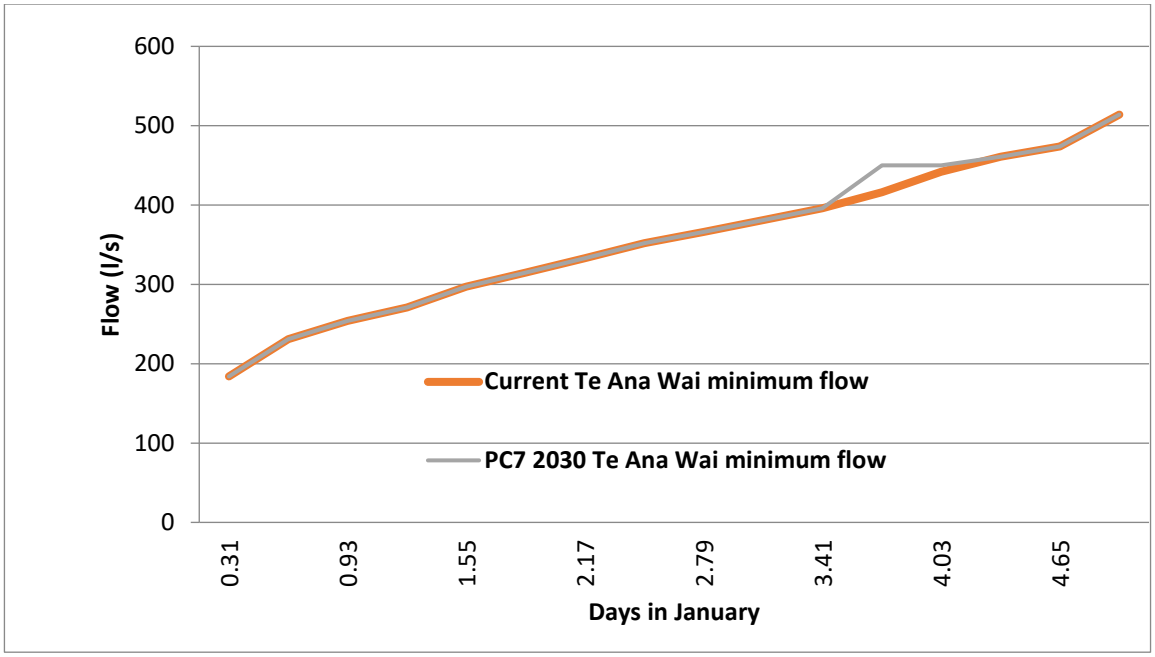

Figure 2: Distribution of Te Ana Wai January flows (1982 – 2019) showing an increase in flow for less than 1 day on average.

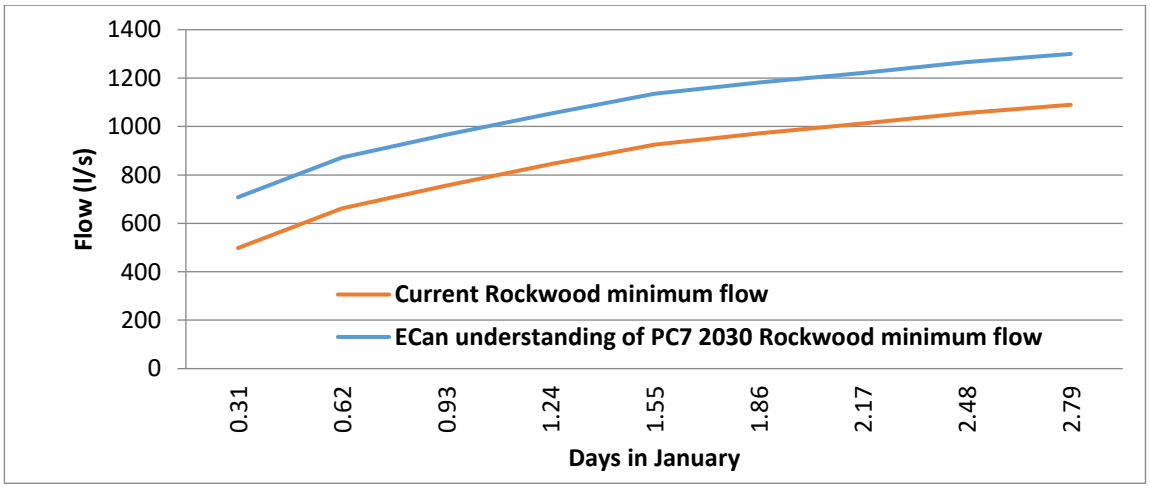

Figure 3: ECan's interpretation of the changes to Opihi at Rockwood flow for January.

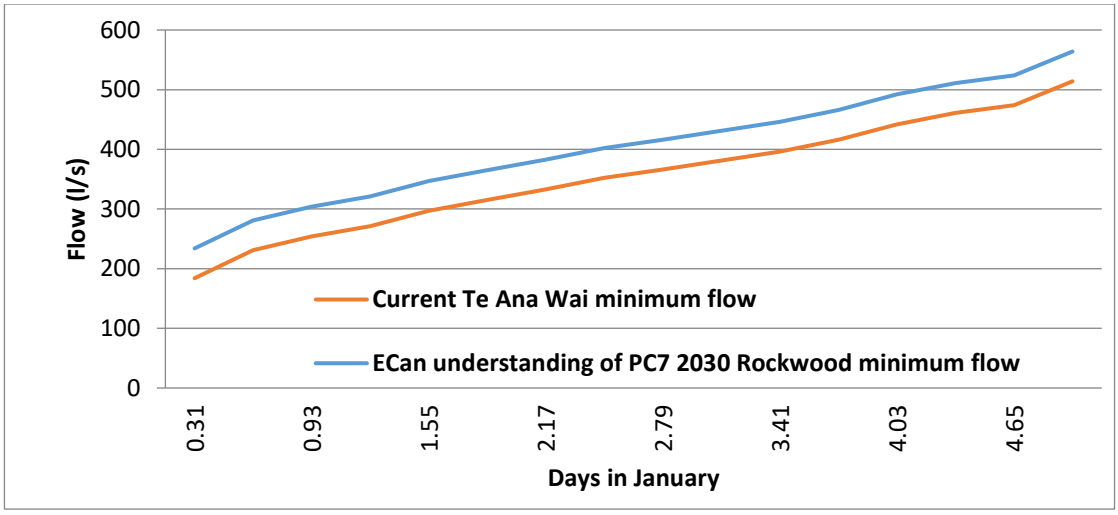

Figure 4: ECan's interpretation of the changes to Te Ana Wai flow for January.

An assessment of the impact of Opuha Dam additional releases can be observed in Figure 5 where the required additional releases appear in blue with the very small compensation from the Upper Opihi and Te Ana Wai included from Figures 1 and 2. The additional release volume calculated under the blue line for all of January is approximately 289,133 m3.

All of the above is for the month of January with a 300 l/s increase in Table 14 (W), far worse will occur in other months e.g. October 900 l/s increase. An assessment of additional releases for an average year is provided in Table 1.

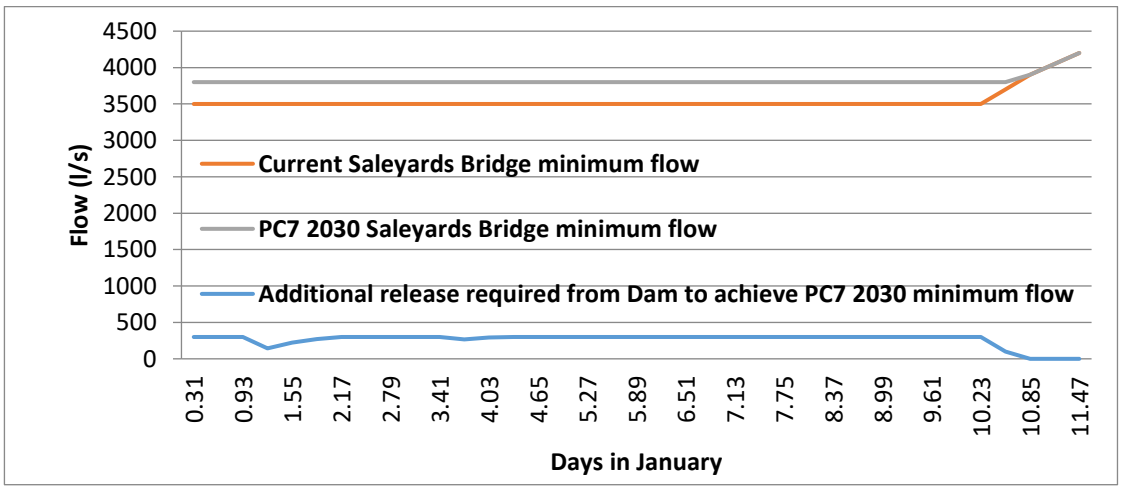

Figure 5: Saleyards Bridge minimum flows. The blue line signifies the impact of the Rockwood and Te Ana Wai minimum flows and the flows required for release from the Dam.

January	February	March	April	May	June	July	August	September	October	November	December
289,133	271,918	460,400	1,619,352	110,752	91,368	35,355	132,715	91,886	1,302,908	418,219	422,049

Total	5,246,055 m^3
Winter	370,189 m^3
Summer	4,875,865 m^3

Table 1: Monthly additional Opuha Dam releases (cubic metres) required for the increased minimum flows at Saleyards Bridge in Table 14 (W)

4 Relief Sought

There are essentially two options to address the situation outlined in this memo

(a) Remove Table 14 (w) and retain the current minimum flows at SYB, this is fairer for OWL and the most simplistic for ECan compliance monitoring staff.

or (b)when the flows in the Upper Opihi and Te An Wai are between the current and proposed minimum flow then the calculated additional water in the mainstem cannot be abstracted and OWL must release water for any downstream abstractors to protect these gains. When these additional tributary flows do not occur (most of the time when outside these flow ranges) then OWL release flows to achieve only the current minimum flows plus downstream abstractions as occurs currently. Calculating the additional water from the Upper Opihi and Te An Wai to inform OWL which gains are not available for abstraction, is not a simple task for compliance staff.