

29 January 2019

Canterbury Regional Council
P.O. Box 345,
Christchurch 8140

**REVIEW OF CURRENT STATE OF SURFACE WATER HYDROLOGY IN THE SOUTH OF THE ORARI,
TEMUKA, OPIHI AND PAREORA ZONE.**

Dear Suz,

You have requested an independent review of the report produced by Michael Exner-Kittridge, and that notes on the review in a letter form were required.

Firstly this report has had considerable time spent summarising the available hydrology, climate, water allocation, and water use data. This analysis will be fundamental to future plan reviews.

Notes from the review follow below, these have been compiled into *major comments or corrections* and *minor comments or edits*.

Major comments or corrections

One recommended improvement would be for ECan to produce a mean annual rainfall isohyetal map using all the available data. The state of knowledge on rainfall is far superior to VCSN data used which unfortunately detracts from the object of the report.

I note there are no water resource maps of mean flow or 7day-MALF.

This is a report on the current state, the most recent flow data is to 30 June 2015, the report should be updated to 30 June 2018.

[Page 7](#) ET can be calculated from a water balance e.g. Aitchison-Earl et al. 2006 - Pareora at Huts runoff 298 mm rainfall 836 mm resulting in an estimate of ET of 538 mm. This 538 mm ET is consistent with the catchments location and other water balance estimates of nearby catchments. Further analysis can deduce monthly ET.

[Page 7](#) Using VCSN rainfall maps is risky and will produce unreliable values, as warned by Andrew Tait its developer. You have the skills and data to prepare a mean annual rainfall map that will be more credible. Remember even with ECan raingauges included in the VCSN there is still a vast number of historic raingauges omitted.

[Page 9](#) The catchment 585 mm annual rainfall is incorrect, if you are talking about a mean catchment precipitation?(clarify), and to where; Huts, SH1 or river mouth? If to the Huts then under estimated by 30 %, if to SH1 then by approximately 25%.

A water balance to SH1 (presumed) using VCSN catchment rainfall 585 mm and runoff 284 mm would result in an ET estimate of 301 mm, which is incorrect.

Page 10 Suggest you think about this PET. These numbers look incorrect. Suggest updating with real estimates for 3 variables, annual catchment precipitation, evapotranspiration and runoff in Figure 3-2 (at Huts or SH1? Must be naturalised?).

This is do able and will be more meaningful. Normally do 1 Jan to 31 Dec as water year here, but 1 July to 30 June is ok if that is what's important to you.

Page 11 Figure 3-3 may look ok but will be incorrect (see page 9 comments above). Still unsure if catchment refers to Huts , SH1 or mouth?

Page 12 Figure 3-4, once again you need to verify what you mean as catchment, Huts, SH1 or mouth?. This is a useful graph to include but again using real numbers, for catchment rainfall, catchment ET with an overlay of measured runoff in mm to show the seasonal flow regime.

Whilst PET is used as a substitute for ET, however the impression one is left with when looking at this graph is that the Pareora rarely flows in January, February, March, September, October, November and December, with a high chance of flowing in May, June and July with 50% chance of flow in April and August. This equates to a mean flow of approximately $0.34 \text{ m}^3/\text{s}$.

Minor comments or edits

Throughout the report 'South OTOP' but often 'south OTOP' suggest adopting South OTOP

Page i (Actually there are two page i) Summary, Background – difficult to understand, suggest a change to below.

The Pareora catchment is 540 km^2 of the 893 km^2 Orari, Temuka, Opihi, Pareora (OTOP) area. OTOP is 22% of the area of the Canterbury Water Management Strategy. Only 7% of the total allocated surface water in the OTOP zone is in South OTOP (Pareora catchment plus other minor coastal catchments) and supports the livelihood for many people residing in the area. The Pareora measured at SH1 has the lowest mean flow ($4.22 \text{ m}^3/\text{s}$) of the four major rivers in the OTOP zone.

Note $4.22 \text{ m}^3/\text{s}$ is recorded; suggest the use of naturalised and normalised value. Or state the Pareora residual flow if measured at SH1.

Page i, 'What we found': first word third line, suggest changing 'in' with 'from'.

Also last sentence of this paragraph, suggested edit 'Most of the total allocated consented abstractions have water meters installed and available water use data in the Pareora catchment (82% volume)', etc.

Page i 'What does it mean?'

First sentence; suggest replacing 'gauges' with 'flow recorders'

Third sentence needs rewording as difficult to understand.

Fourth sentence suggest change to 'Water abstractions can directly affect the surface water losses especially during the summer low flows.'

Page 1 third paragraph, first sentence suggested edit –‘intermittently flowing lowland streams.’

Page 3 **Error reference source not found** add Figure 1-2.

Page 5 First paragraph last sentence, suggest, ‘Most recorder sites are gauged to enable the estimate of flow, but some recorders only have water level recorded (stage only purposes) without an associated water level to flow relationship.’ Plus add ‘Flow recorder site at Seadown Drain at Aorangi Road (1698)’

Page 13 Is section 4.1.1 still relevant with the withdrawal of the scheme?

Page 17 Section 5.1 3rd last sentence, word ‘splits’ suggest ‘split’

Page 21 Section 7.2 204/2015 correct to 2014/2015

Page 22 Figure 7-1 caption suggest replacing ‘in’ with ‘into’ on 3rd last line.

Page 24 Section 8.1. second last paragraph, 0.72 and 0.21 are these in terms of ± 0.72 m³/s? Also you mention the irrigation and stockwater should follow the ET seasonal trend, but results in the largest error, is it possible these numbers are incorrectly stated?

Page 24 Section 8.1. Last paragraph, first sentence, is ambiguous or needs further clarification. Indicated hydraulically connected (to surface water) groundwater takes, but not all groundwater abstraction is connected to nearby surface waters.

Page 24 Section 8.2.1. SH1 short record of 6.5 years. Suggest you consider using your naturalised records of Huts and SH1 in your regression to provide estimates of 7DMALF and monthly seasonal flow at SH1. Figure 8-1 could be repeated for SH1.

Page 27 Section 8.2.2 add ‘Flow recorder site at Seadown Drain at Aorangi Road (1698)’ data could be added to Table 8-2.

Page 27 Section 9.1. 2nd paragraph you mention ‘uncertainty of the flow gaugings’ there is a need to explain the method used to determine this, and the colours used on Figure 9-1 for gaining and losing, (require a scale code for colours) .

Page 28 Section 9.2 1st paragraph, last sentence. ‘shortly’ recommend replacing with ‘in short reaches above the gorge’.

Page 28 2nd paragraph. Suggest edits to sentence ‘In the 2000/2001 water year, less surface water irrigation abstraction occurred in the Pareora River’. Also ‘The surface water abstraction for irrigation almost doubled from 2000/2001 to the 2002/2003 water year, then tripled from 2002/2003 to the 2008/2009 water years (Figure 4-3)’. There is a third key contributing factor, what was the flow in the Pareora at the time of the concurrent gauging run?

Page 30 1st paragraph last sentence, replace ‘had significant’ with ‘experienced significant’

Page 32 Suggest changing title to ‘Normalisation of Pareora at SH1 flow records’

1st paragraph, second sentence suggest changing start of sentence to ‘The concurrent mean monthly naturalised flows’. etc.

Page 32 2nd sentence add 'Huts period of record (3.866 m³/s)' etc.

Page 32 Table A1-1 caption add to end of 1st sentence '(period November 2008 – June 2015)'

Second sentence, suggest replacing 'overlapping' with 'concurrent'

Table A1-2, inconsistent with Table 8-1, Recorded SH1 4.22 naturalised 4.87 and Huts record period naturalised 3.86 m³/s?

Page 33 Suggest replacing 'overlapping' with 'concurrent'

Thanks for the opportunity to review this draft report, I hope you find my review constructive and useful.

If you have any further questions, please get in touch with me.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Graeme Horrell', written in a cursive style.

Graeme Horrell
Hydrologist