BEFORE THE COMMISSIONERS ON BEHALF OF THE OTAGO REGIONAL COUNCIL

Consent No. RM20.007

BETWEEN	SMALLBURN LIMITED
	Applicant
AND	OTAGO REGIONAL COUNCIL
	Consent Authority

EVIDENCE OF CIARAN SEWELL MERRICK CAMPBELL

Introduction

1. My full name is Ciaran Sewell Merrick Campbell.
2. I am a Freshwater Ecologist at Otago Regional Council. I hold the following tertiary qualifications; a Bachelor of Science (Ecology and Zoology double major) from Massey University and a Postgrad Diploma in Wildlife Management with Distinction from the University of Otago.
3. I specialise in freshwater ecological research and management of native freshwater fish. I was a freshwater fisheries specialist for the Department of Conservation from 2011 to 2019.
4. I am currently working my way towards a Master of Science (Zoology) through University of Otago, my project focusing on using genomic data to inform phylogenetics, and ultimately formal species descriptions, of threatened non-migratory galaxias fishes in Otago.
5. During the last ten years I have undertaken freshwater fish surveys throughout Otago catchments, and extending into the Waitaki catchment. I have considerable and contemporary understanding on the freshwater ecosystems and fish species of Otago from my employment and tertiary studies.
6. I confirm that I have read and agree to comply with the Environment Court Code of Conduct for Expert Witnesses (Consolidated Practice Note 2014). This evidence is within my area of expertise, except where I state that I am relying on the evidence or information provided by another parties. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Scope of Evidence

7. My evidence addresses:
    - An assessment of the nature and ecology of affected waterways
    - Considerations for residual flows at point-of-take
    - Consideration of residual flows for retakes
    - Consideration of fish screens

8. To inform my assessment, I have used
    - Freshwater fisheries data provided by the New Zealand Freshwater Fish Database (Crow 2017) - henceforth referred to as NZFFD.
    - Consent Application RM20.007.01

- An ecological assessment report (Allibone 2019)
- Technical comments provided by Landpro (2019a, 2019b) for this application
- Hydrological evidence prepared by Xiaofeng Lu – ORC Hydrologist.
- Observations I made during a site visit, 7 February 2020.
- Ecological advice from my colleague, Jason Augspurger.

Ecological values – freshwater fish and regionally significant wetlands

9. To consider the ecological values of the site, NZFFD records were combined with a recent survey report provided in the consent application.

10. The NZFFD provides presence/absence data for fish species at 16 sites in the Amisfield Burn, Park Burn and Five Mile Creek catchments. Records exist for fish surveys from 1996, 2001, and 2018 (Fig. 1, Table 1). There are three fish species recorded since 1996: brown trout (*Salmo trutta*), upland bully (*Gobiomorphus breviceps*) and kōaro (*Galaxias brevipinnis*).

11. Since 2018, a survey was completed in the Amisfield Burn and Park Burn catchments by Dr Richard Allibone of Waterways Consultants Ltd. Brown trout were detected at seven sites and a single rainbow trout (*Oncorhynchus mykiss*) was detected at one site (Allibone 2019).

12. Sampling across the catchments is not extensive, however in my opinion, there is sufficient data to determine fish values.

13. Brown trout and rainbow trout are introduced sports fishes that appear to have formed a self-supporting, stunted population in these catchments (Allibone 2019) which are highly unlikely to be acting as a nursery to the downstream Lake Dunstan fishery due to the ephemeral nature of the waterways.

14. Upland bullies prefer lower velocity areas and typically have life histories that do not include migration. There are scattered populations of upland bullies in the Lake Dunstan catchment. Upland bullies are classified as Not Threatened (Dunn et al. 2018). The limited distribution of upland bullies in the affected waterways, coupled with their preference for low water velocity reduces the need for residual flow considerations at the point of take.

15. Kōaro are classified as At Risk and Declining with a qualifier of partial decline (Dunn et al. 2018). This indicates that the threat classification panel consider kōaro are in decline only in

some regions of New Zealand. Landlocked populations of kōaro do not appear to be in decline, justifying the “partial decline” qualifier.

16. Two adult kōaro have been recorded since 1996 in the waterways affected by the consent application. It is not unusual to observe an individual kōaro in streams in this region. However, this does not necessarily indicate that whitebait runs coming from Lake Dunstan occur (Jason Augspurger, pers. comm.). An overview of the very few NZFFD kōaro records nearby highlights their scarcity with three or fewer kōaro observed at each site (Fig. 2).

17. There are conservation concerns associated with the expansion of kōaro upstream of inland lakes in Otago, particularly on their negative interactions with threatened non-migratory species such as Clutha flathead galaxias (*Galaxias* “species D”) – which is classified as Threatened – Nationally Critical (Dunn et al. 2018).

18. Although there is no evidence that suggests Clutha flathead galaxias are in the affected catchments, it makes little sense to provide residual flow considerations for kōaro given:
    - Limited records of kōaro nearby; and
    - Low abundances of kōaro where recorded nearby; and
    - The potential negative impacts of kōaro on threatened species in nearby catchments.

19. Regionally Significant Wetlands are listed in Schedule 9 of the Regional Plan: Water for Otago. There are no Regionally Significant Wetlands that will be affected, adversely or otherwise, by the proposed water takes and retakes.

Hydrology – Breakneck Creek, Amisfield Burn, Park Burn, Five Mile Creek and tributaries

20. These waterways flow roughly parallel in an easterly direction from the upper Pisa Range, descending rapidly before flattening out as they reach the valley floor on their way towards Lake Dunstan. To understand the waterways, water races, water takes and water retakes with regard to this consent application I have provided a schematic (Fig. 3).

21. Based on the data provided in the application and MALF statistics (57L/s – Appendix 1) provided by ORC Hydrologist, waterways affected by this consent application are naturally ephemeral due to loss of surface water to ground in reaches on the valley floor (Landpro 2019a, Landpro 2019b, Allibone 2019).

22. In my opinion, residual flows below water takes should maintain flow connectivity through the point of take to allow invertebrates to drift downstream and move upstream. In my original assessment (Objective Id A1327635), I recommended that a residual flow should be suggested by the applicant to look after natural character of the Breakneck Creek and Amisfield Burn below the points of take. The applicant responded by suggesting that there was a 10L/s residual flow proposed for the Park Burn take and the open channel diversions at current takes in Breakneck Creek (96320) and Amisfield Burn (96321) allow for roughly 50% of the flow to pass the intake, even during low flows (Objective Id A1367094). This equates to a 50:50 flow sharing regime. This supports considerations raised by the Department of Conservation in their advisory letter (Objective ID 1365692, DOC-6361452, dated 13 July 2020).

23. Otago Regional Council does not have flow recorders in every waterway along the eastern side of the Pisa Range, however a flow recorder was installed in the Amisfield Burn in 2013. The flow data provided from this recorder was used by ORC Hydrologist Xiaofeng Lu in developing modelled flow statistics with particular focus on a method for establishing residual flows on retakes – see *memo supplied by Xiaofeng Lu* (Appendix 1). Note that the Amisfield Burn flow recorder is not impacted by any water abstraction or augmentation, therefore the recorded flows can be considered natural.

24. In my opinion, any residual flow downstream of retakes should ensure only retake water is taken and natural flows remain. The Department of Conservation raised how best to ensure only retake water within Five Mile Creek and Park Burn Tributary is taken and any natural flow remains (Objective ID 1365692, DOC-6361452, dated 13 July 2020). To provide for that consideration, ORC hydrologist Xiaofeng Lu has calculated natural flows upstream of the retake points, which can be used to establish residual flows downstream of retakes. These values are summarised in Table 3, with more detail provided in the memo (Appendix 1).

25. During low flows, recharged waterways (Park Burn Tributary and Five Mile Creek) appear to be so small that retake is likely to be capturing only augmented water. In addition to this it is difficult to quantify flow statistics, due to the small flow dataset across a short time period. Based on this, there is difficulty quantifying numerical residual flows downstream of retakes.

26. Five Mile Creek appears to be almost entirely augmented water at low flows, no residual flow is proposed for this retake.

27. A residual flow established for the retake on Park Burn Tributary should maintain flow connectivity through the point of take to allow invertebrates to drift downstream and move upstream. Quantifying a numerical residual flow is difficult, therefore a visual residual flow immediately downstream of the Park Burn Tributary retake is recommended.

28. I have made further consideration to the potential for fish screens relevant to this application. In my original assessment (Objective Id A1327635) I made no comment on fish screens. The hydrological nature and connectivity of these catchments is complex and highly variable. To prevent unnecessary mortality, freshwater fishes should be able to move freely between natural waterways, water races, and storage ponds within the systems affected by this application. To further prevent unnecessary mortality, a fish screen should be installed on the outlet from the larger 120,000m^3 storage pond. A drum-shaped screen with 3mm mesh is recommended (Jamieson et al. 2007).

Recommendations

29. My recommendation is that further work is required to establish an agreed water take structure/design that provides the agreed 50:50 flow sharing regime and residual flow on Park Burn Tributary retake. Monitoring of residual flows should be in the form of photographs on regular fortnightly basis, photo points will need to be set up. These photographs then should be forwarded on to the Consenting Authority.
30. A 3mm fish screen is recommended to be attached to the outlet of the large storage pond.

Summary

31. The waterways affected by this consent application are small, ephemeral creeks situated in the Pisa Range, Lake Dunstan catchment.
32. They are connected via water races and contain a small, self-sustaining population of brown trout, occasional rainbow trout and very few native fish.
33. I recommend monitored 50:50 flow sharing regimes on takes in Breakneck Creek and Amisfield Burn as residual flow.
34. I recommend maintaining the 10L/s residual flow proposed for the Park Burn water take.
35. I recommend visual residual flow on Park Burn Tributary retake.

Ciaran Campbell

28 July 2020

Figure 1. NZFFD records from the catchments affected by RM20.007.

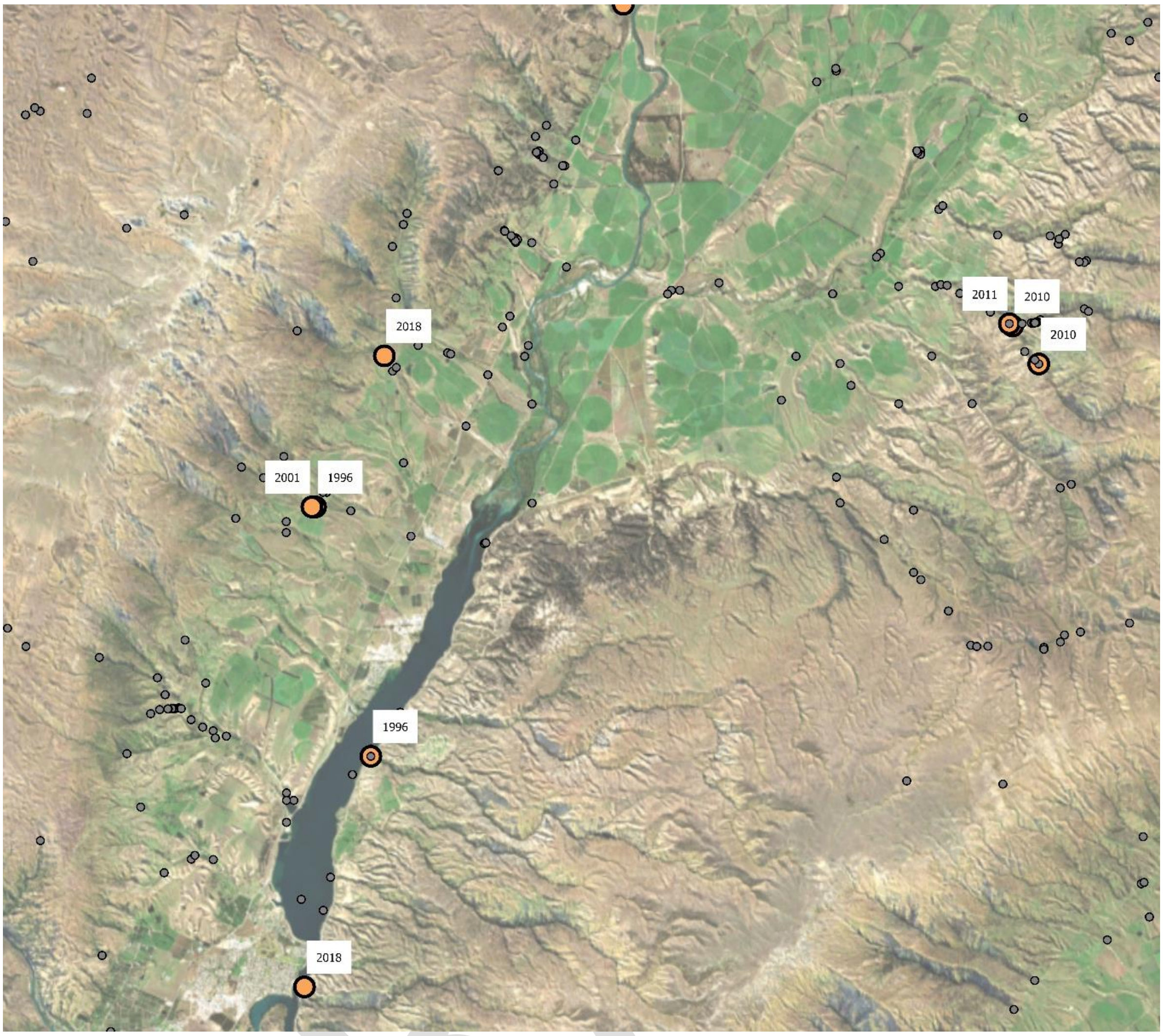


Figure 2. NZFFD records of kōaro (orange, labelled by year recorded) nearby to waterways affected by this consent application – no record in this area contains more than three kōaro. Also shown are all NZFFD records (grey).

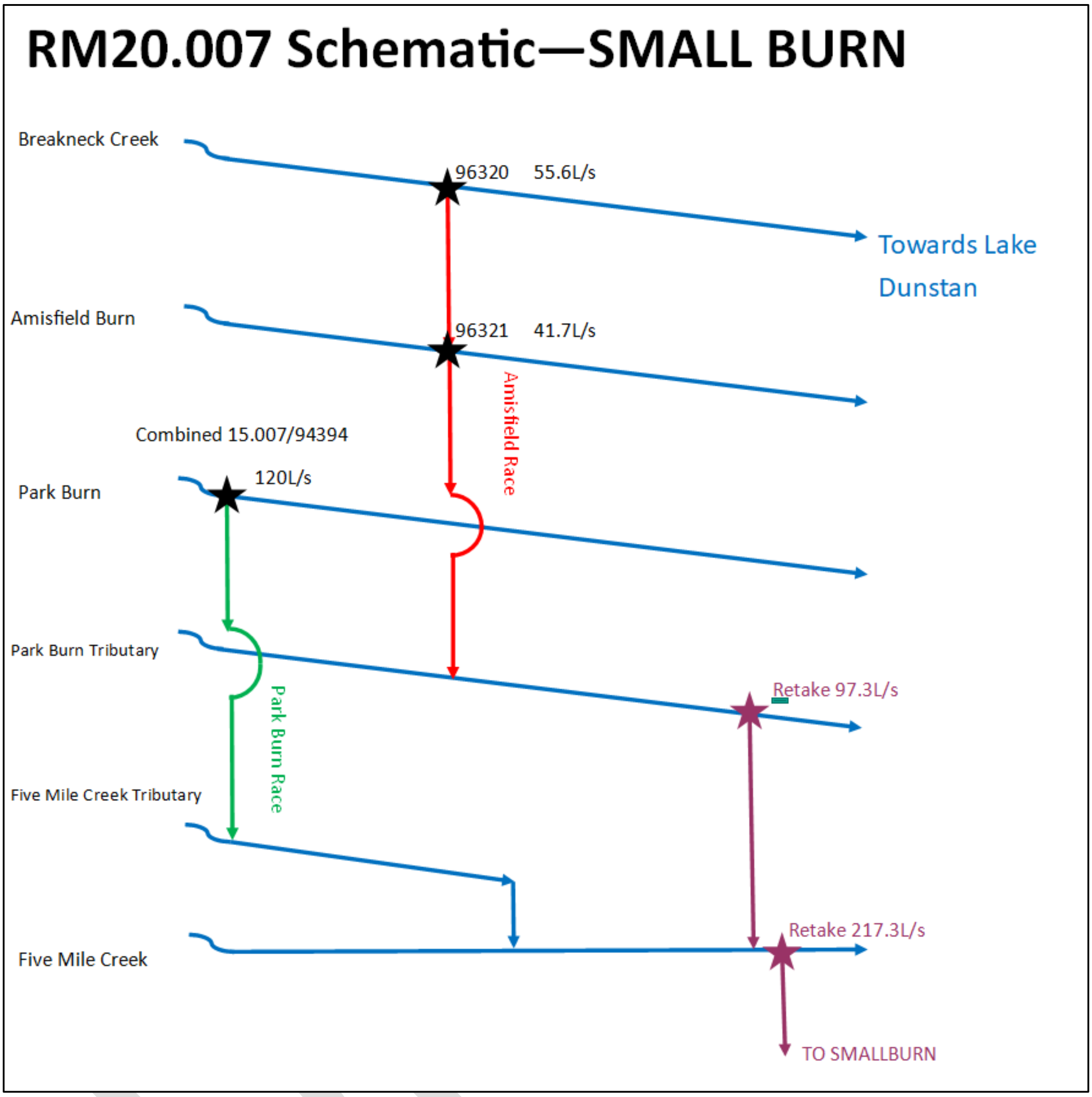


Figure 3. Schematic of the water takes and retakes within various watercourses relating to Consent Application RM20.007.01.

Table 1. NZFFD data from Amisfield Burn, Breakneck Creek and Park Burn catchments

card	m	y	location	org	east	north	fishmeth	species	abundance or number
15505	1	1996	Breakneck	doco	2212600	5580000	efp	brown trout	12
15506	1	1996	Amisfield	doco	2212300	5579600	efp	brown trout	a
15506	1	1996	Amisfield	doco	2212300	5579600	efp	kōaro	1
15509	1	1996	Amisfield	doco	2211300	5580100	efp	brown trout	a
25145	1	2001	Amisfield	doco	2214900	5578800	obs	nospec	
25259	5	2001	Breakneck	doco	2212500	5580000	efp	nospec	
25260	5	2001	Amisfield	doco	2212200	5579600	efp	brown trout	14
25260	5	2001	Amisfield	doco	2212200	5579600	efp	kōaro	1
114078	4	2018	Breakneck	rdcl	2211434	5580975	efp	nospec	
114080	4	2018	Amisfield	rdcl	2213258	5579491	efp	brown trout	18
114080	4	2018	Amisfield	rdcl	2213258	5579491	efp	upland bully	11
114083	4	2018	Amisfield	rdcl	2210278	5580687	efp	nospec	
114163	4	2018	Amisfield	rdcl	2210879	5580397	efp	brown trout	33
15507	1	1996	Park Burn	doco	2211500	5578900	efp	brown trout	1
15508	1	1996	Park Burn tributary	doco	2211500	5579200	efp	brown trout	1
114079	4	2018	Park Burn tributary	rdcl	2210123	5579288	efp	brown trout	4

Table 2. Water Ways Consulting Ltd Data from Allibone (2019)

Site	Area fished (m^2)	Species and size
Breakneck Ck 1	80	brown trout (length 76-194mm)
Breakneck Ck 2	80	brown trout (length 63-209mm)
Amisfield Burn 1	100	No species
Park Burn 1	100	brown trout (length 219mm)
Park Burn 2	Nil	Nil
Park Burn 3	10	Nil
Park Burn 4	80	brown trout (length 67-80mm)
Park Burn 5	20	Nil
Park Burn 6	80	brown trout (length 77-97mm)
Park Burn 7	Nil	Nil
Park Burn 8	Nil	Nil
Park Burn 9	30	brown trout (length 78-205mm)
Park Burn 10	50	Nil
Park Burn 11	100	brown trout (length 104-151mm), rainbow trout (length 127mm)
Park Burn 12	80	Nil

Table 3. Summary of 7dMALFs to advise setting residual flows on retakes in Park Burn Tributary and Five Mile Creek Tributary, calculated with two different methods at three points.

				Method 1		Method 2	
Point	Waterway	Location	Area (km^2)	Yield at MALF ($l/s/km^2$)	7dMALF (l/s)	Yield at MALF ($l/s/km^2$)	7dMALF (l/s)
L1	Park Burn Tributary	Upstream of retake	7.237	9.533	69	4.078	29.5
L2	Five Mile Creek Tributary	Upstream of confluence	1.36	9.533	13	1.604	2.2
L3	Five Mile Creek	Upstream of retake	2.414	9.533	23	1.541	3.7

References

Allibone, R.A. (2019). Park Burn and Amisfield Burn Ecological Considerations for Residual Flows. Water Ways Consulting Ltd, report 78-2019 for Landpro Ltd.

Crow, S. (2017). New Zealand Freshwater Fish Database. Version 1.2. The National Institute of Water and Atmospheric Research (NIWA). Occurrence Dataset https://doi.org/10.15468/ms5iqu.

Dunn, N. R., Allibone, R.M., Closs, G.P., Crow, S.K., David, D.O., Goodman, J.M., Griffiths, M., Jack, D.C., Ling, N., Waters, J.M., Rolfe, J.R. (2018). Conservation status of New Zealand freshwater fish. New Zealand threat classification series 24. Wellington, Department of Conservation.

Jamieson, D., Bonnett, M., Jellyman, D., and Unwin, M. (2007). Fish Screening: good practice guidelines for Canterbury. NIWA Client Report CHC2007.092. NIWA, Christchurch.

Landpro (2019a). Hydrological assessment prepared for water users of the Amisfield Burn: Small Burn Limited, Pisa Holdings Limited, and Lowburn Land Holdings Limited. Technical comment.

Landpro (2019b). Hydrological assessment prepared for water users of the Park Burn: Smallburn Limited and Parkburn Water Company. Technical comment.

Appendix 1

Hydrological assessment of Pisa Range catchments

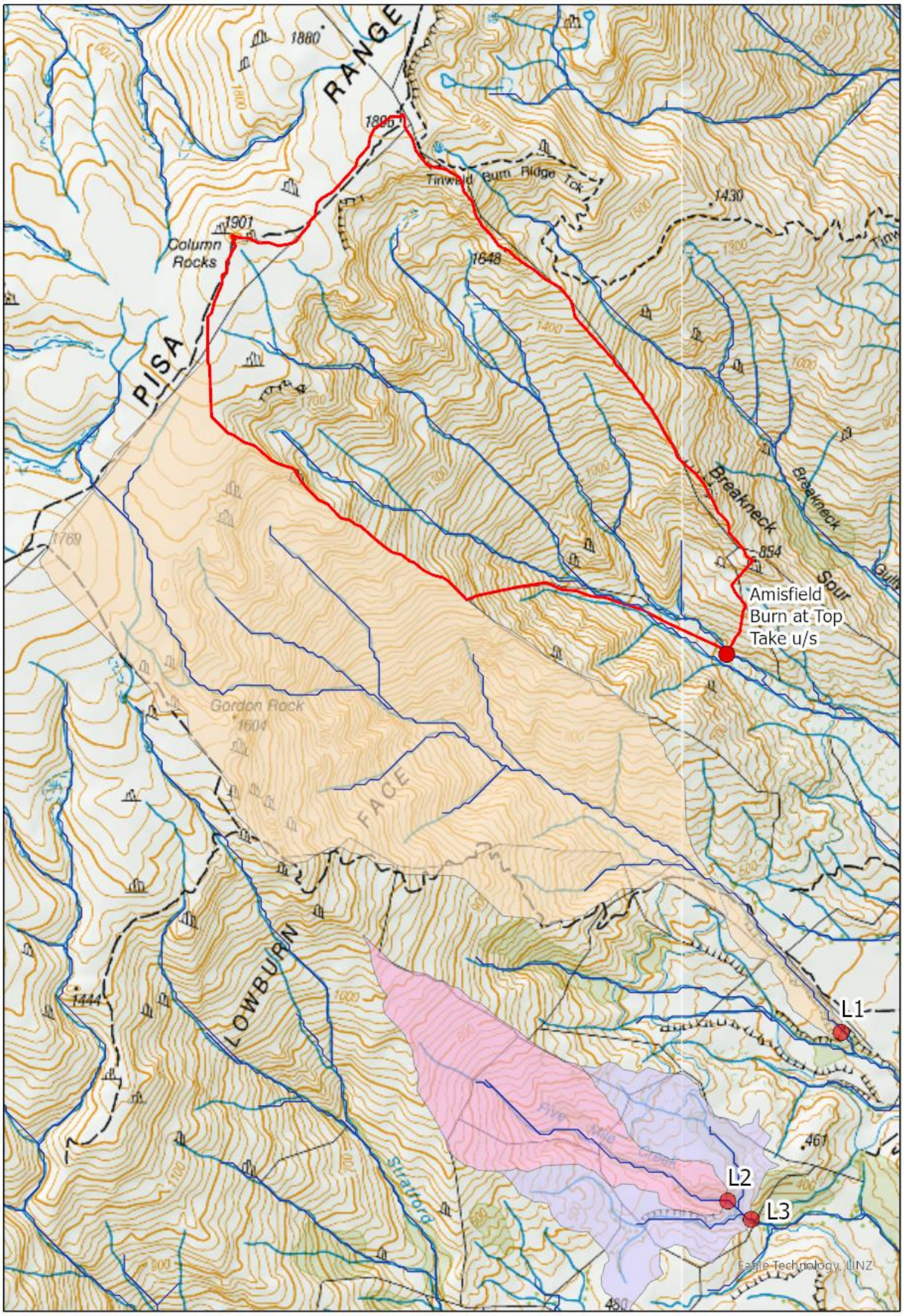
prepared by Xiaofeng Lu – ORC Hydrologist.

Target

Estimate the naturalised Seven-day Mean Annual Low Flow (7dMALF) values for the following locations L1 – L3 (see Map 1), and their locations are listed in Table 1:

Table 1. The key locations of interests

Point	*Waterway*	*Location*	*Easting*	*Northing*
L1	*Park Burn Tributary*	*Upstream of retake*	*1301008*	*5016581*
L2	*Five Mile Creek Tributary*	*Upstream of confluence*	*1300288*	*5015510*
L3	*Five Mile Creek*	*Upstream of retake*	*1300437*	*5015394*



Map 1. The locations of interests L1 – L3

Data

The data used for this task is the daily flow time series recorded at Amisfield Burn at Top Take upstream (31st Oct 2013 – 1st Jul 2020), which is natural and used as a reference for estimating the 7dMALF values for the key locations L1 – L3.

The average of the seven-day annual low flow (7dLF) each water year (Jul - Jun) calculated for this dataset is 54.7 (l/s), with six water years being involved in the calculations (Table 2).

Table 2. The 7dLF each water year for the recorder at Amisfield Burn at Top Take upstream

Start	*End*	*7dLF (l/s)*	*Gap (days)*	*Involved in the calculation*
31/10/2013	*30/06/2014*	*75.0*	*0*	*No*
1/07/2014	*30/06/2015*	*51.0*	*0*	*Yes*
1/07/2015	*30/06/2016*	*41.6*	*0*	*Yes*
1/07/2016	*30/06/2017*	*67.6*	*7*	*Yes*
1/07/2017	*30/06/2018*	*49.5*	*0*	*Yes*
1/07/2018	*30/06/2019*	*74.1*	*0*	*Yes*
1/07/2019	*30/06/2020*	*44.6*	*0*	*Yes*

Method I – assumption of consistent yield at MALF

*There are only **six** water years (Jul - Jun) used for estimating the 7dMALF for the recorder at Amisfield Burn Top Take upstream, and this relatively shorter flow records are NOT enough to calculate the 7dMALF. In this case, daily flow recorded at Lindis at Lindis Peak (assumed to be natural) is investigated by a simple regression analysis in order to extend the simulated flows at Amisfield recorder. However, the relationship is not good (Figure 1).*

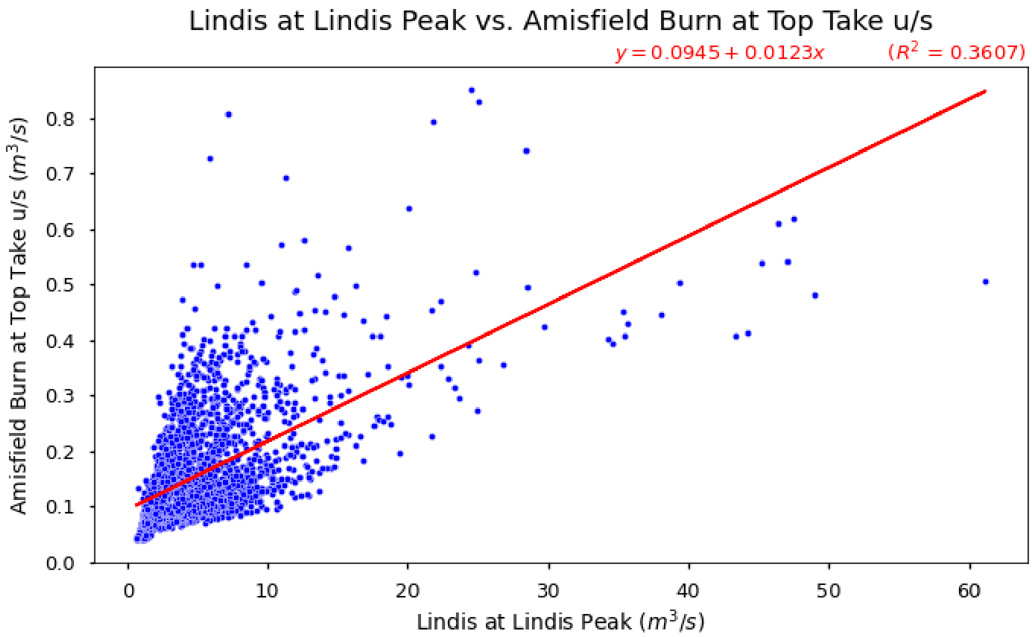


Figure 1. The simple regression analysis between Lindis at Lindis Peak and Amisfield flow recorders

The question is how representative the estimated 7dMALF of 57.2 l/s calculated from the ***six*** *water years of flow records? Check the nearby rainfall total each water year at Cromwell Electronic Weather Station ([Agent No. 26381]), presented by Standardised Precipitation Index (SPI) as shown in Figure 2:*

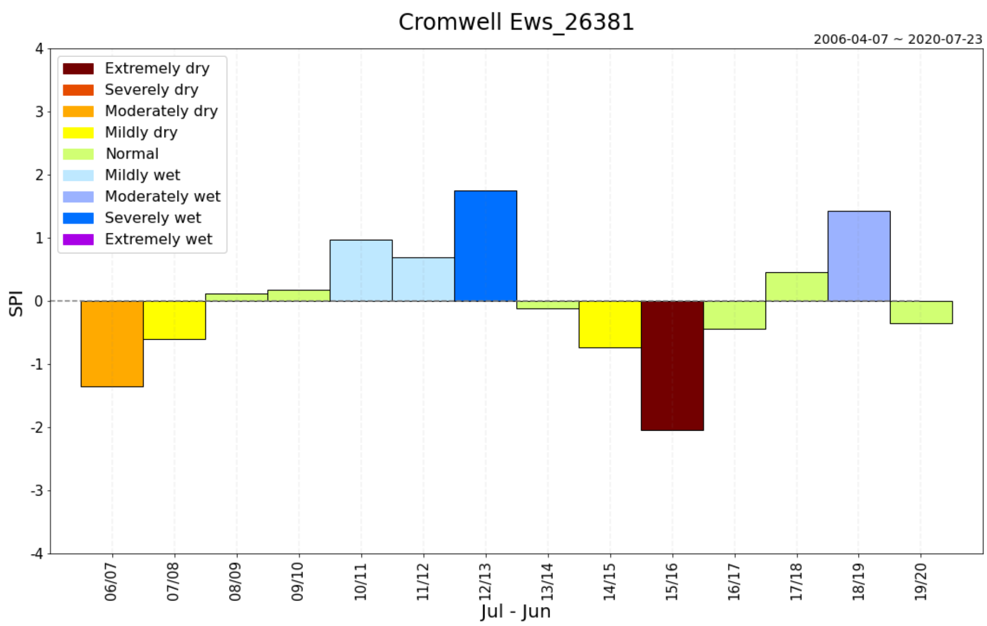


Figure 2. The SPI category each water year for the rain gauge at Cromwell EWS

The SPI category each water year at rain gauge at Cromwell Ews indicates that dry/normal/wet water years were captured from the water year 2013/14 to 2019/20, which has a similar trend for those 7dLF values for Amisfield Burn flow recorder (Table 1). This might indicate that 57.2 l/s as the estimated 7dMALF for Amisfield Burn recorder might be OK to some degree (more flow data need to be collected to verify this).

Use the derived 7dMALF of 57.2 l/s as a reference to estimate the 7dMALF values for the key locations of L1 – L3. Assume that the catchment yield for the three upstream catchment areas above locations L1 – L3 is the same as that of the upstream area above the Amisfield Burn flow recorder, which is 57.2 l/s divided by the area of 6 km^2, calculated as 9.533 l/s/km^2. Applying this catchment yield at 7dMALF to the three upstream areas above locations L1 – L3 derives the naturalised 7dMALF values shown in Table 3.

Table 3. The estimated 7dMALF values for the area above locations L1 – L3 (by applying a consistent catchment yield at MALF to the upstream areas)

Point	*Waterway*	*Location*	*Area (km^2)*	*Yield at MALF (l/s/km^2)*	*7dMALF (l/s)*
L1	*Park Burn Tributary*	*Upstream of retake*	*7.237*	*9.533*	*69.0*
L2	*Five Mile Creek Tributary*	*Upstream of confluence*	*1.360*	*9.533*	*13.0*
L3	*Five Mile Creek*	*Upstream of retake*	*2.414*	*9.533*	*23.0*

Method II – NIWA's NZ river

NIWA's NZ river (Booker, 2010, 2013, 2014) models the natural river flow statistics, and predicts for all river reaches for New Zealand. The specific catchment yield at MALF can be obtained and applied to the corresponding upstream areas above the locations L1 – L3, which derives the long-term naturalised 7dMALF values for locations L1 – L3. The results are listed in Table 4:

Table 4. Naturalised 7dMALF estimated from NIWA's model

Point	*Waterway*	*Location*	*Area (km^2)*	*Yield at MALF (l/s/km^2)*	*7dMALF (l/s)*
L1	*Park Burn Tributary*	*Upstream of retake*	*7.237*	*4.078*	*29.5*
L2	*Five Mile Creek Tributary*	*Upstream of confluence*	*1.360*	*1.604*	*2.2*
L3	*Five Mile Creek*	*Upstream of retake*	*2.414*	*1.541*	*3.7*

Discussion

Lack of longer flow data for the reference site is the main issue. To derive the long-term flow statistics, it is suggested that at least 30-year continuous time series is needed (WMO, 2008). The SPI category used for indicating dry/normal/wet water years is purely rainfall total based, and it has no consideration of how rainfall events were distributed over a water year – it is just an indicator.

As for method I, the assumption of the catchment yield at MALF for all three areas above locations L1 – L3 is the same as that of the upstream area above Amisfield Burn recorder might not be the case in the real world. To have better understanding on the general flow regime for both Amisfield Burn and Five Mile Creek more data are needed to be collected in the future.

NIWA's model is a good tool for having a quick idea of possible river flow statistics for those reaches without any observed flows. Given the lack of ground truth (flow measurements) for Five Mile Creek and highly uncertainties in nature for hydrology, it is hard to verify how good it is.

References

WMO- No. 1029 (2008); Operational hydrology report (OHR)- No. 50

Booker, D.J. (2010) Predicting width in any river at any discharge. Earth Surface Processes and Landforms. 35, 828-841.

Booker, D.J., Hicks, D.M. (2013) Estimating wetted width and fish habitat areas across New Zealand's rivers. Report to Department of Conservation, CHC2013-075, 33pp.

Booker, D.J.; Woods, R.A. (2014) Comparing and combining physically-based and empirically-based approaches for estimating the hydrology of ungauged catchments. Journal of Hydrology DOI: 10.1016/j.jhydrol.2013.11.007.