BEFORE THE COMMISSIONERS ON BEHALF OF THE OTAGO REGIONAL COUNCIL

Consent No. RM20-039

BETWEEN	**Pig Burn water users group**
	Applicant
AND	**OTAGO REGIONAL COUNCIL**
	Consent Authority

EVIDENCE OF RICHARD MARK ALLIBONE

Introduction

1. My full name is Richard Mark Allibone.
2. I am the Director and Principal Ecologist of Water Ways Consulting Limited. I hold the following tertiary qualifications; a BSc (Zoology and Geology), an MSc (Zoology) and PhD (Zoology), all from the University of Otago. I am also a certified resource consent hearing commissioner.

3. I specialise in freshwater ecological research and management. I have been a freshwater fisheries specialist for the Department of Conservation in Otago, a Post-Doctoral Fellow and fisheries scientist at NIWA, and a Species Protection Officer in the Department of Conservation's Biodiversity Recovery Unit. Since 2004 I have worked as a consultant; firstly, at Kingett Mitchell Limited, then Golder Associates (NZ) Ltd. In November 2014 I formed the company Water Ways Consulting Limited where I am a director and the principal ecologist.

4. I am a recognised expert with regard to the conservation management of New Zealand's freshwater fish. My PhD conducted the first research into the ecology, distribution and conservation threats of four of non-migratory galaxiids in the Taieri River catchment, Taieri flathead (*G. depressiceps*), Central Otago roundhead galaxias (*G. anomalus*), Eldon's galaxias (*G. eldoni*) and Clutha flathead (*G. spD*) found in the Taieri River (Allibone 1997). Since completing my PhD, I have conducted further research on the effects of water abstraction and salmonid impacts on non-migratory galaxiids in Otago (e.g., Allibone 2000a, b).

5. My experience with irrigations schemes and deemed permit water takes began in 1992 during my PhD studies and has continued to the present day. I have assessed the potential impact of irrigation takes in Otago for the Department of Conservation (Allibone 2000a, b). As a consultant in the last 15 years, I have undertaken freshwater ecological assessments for a range of irrigation schemes, either working for the applicant, reviewing applications on behalf of Regional Councils or as an expert working for submitters including the Department of Conservation and Forest & Bird. These irrigation schemes include large schemes such as Central Plains and Hunter Downs irrigation schemes down to small individual farm-based irrigation schemes including application for deemed permits replacement resource consents

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:

    a. Freshwater fish and other aquatic values of the Pig Burn;

    b. Assessment of the effects of the proposed water takes from Pig Burn;

    c. Brown trout spawning;

    d. 7dMALF in the Pig Burn;

    e. Fish screen requirements;

    f. Fish passage requirements; and

    g. Residual flows.

8. I have read the amended application and S92 information provided by the applicant, hydrology information provided by Otago Regional Council (ORC) and the review provided by Prattle Delamore Partners (PDP) and also the submissions of Aukaha and Otago Fish & Game.

Application description

9. The consent application is for water abstraction at eight sites, and these are listed below from the most upstream to the most downstream (Figure 1):

    - The Shared take from a Pig Burn tributary;
    - Bradfield take;
    - Herlihy Gorge take;
    - Weir take;
    - Herlihy Ford take;
    - Concept South take;

- Molholland take; and
- Concept North take.

10. Each of the takes present different issues with regard to the ecological values present, the hydrological conditions at the take location and the proposed consent conditions. Therefore, below I refer to the individual takes when take specific issues are being discussed and when no take is referred to these are general issues for the assessment.

11. The consent application does apply to change the existing Mulholland, Herlihy Ford and Concept South takes. The Mulholland take will not continue at the existing site and will be moved to the Concept South site. The Herlihy Ford take will also operate from this take location when the flow at the Hamilton Road ford and Herlihy Ford take drops to and is less than 70 L/s. This new take is called the Combined take

Fisheries values of the Pig Burn

12. Fish surveys of Pig Creek reported in the New Zealand freshwater fish database (NZFFD) have reported brown trout and longfin eel present in the stream. The upper limits of the two species have not been identified and they may be able to penetrate upstream as far as the Bradfield take. Fish surveys at the Shared take in the Pig Burn tributary and two other fish survey sites in the upper Pig Burn (NZFFD) report no fish so it is expected that the upstream limit of the two fish species is upstream of Bradfield take but downstream of the Shared take, although it is possible longfin eel are limited to areas downstream of Bradfield take as high-altitude populations of longfin eel are rare.

13. The fish surveys report no threatened fish species in the Pig Burn. The two most likely threatened fish to be present are Central Otago roundhead galaxias and Taieri flathead. I would expect the Central Otago roundhead galaxias to be present downstream of the Gorge flow recorder. There have been sufficient fish surveys in the lower Pig Burn to detect this fish if it was present and its absence may be due to the presence of brown trout, or it was never present in the stream. If present, I would expect Taieri flatheads to occupy the upper reaches of the Pig Burn upstream of areas occupied by brown trout. The lack of Taieri flatheads in the fish surveys in the upper reaches of the Pig Burn indicates they have probably never been present in the upper reaches of the Pig Burn and any population in the lower reaches has been lost. Given these threatened fish are not present and no others are

reported there are no threatened species values to considered as would be required by the National Policy Statement-Freshwater Management (NPS-FM).

14. The lower Pig Burn is a significant brown trout spawning area and can provide recruits to the Taieri River and sports fishery in the river. The Otago Fish & Game submission reports spawning along much of the lower Pig Burn and potentially as far upstream as the Pig Burn gorge. The brown trout are either stream resident individuals or Taieri River residents that move into the Pig Burn in April through to June for spawning before returning to the Taieri River.

15. The stream resident brown trout in the Pig Burn have limited if any sports fishing value as the Pig Burn itself is not considered a sports fishing area. The Taieri River fishery is an important fishery and some of the adult fish use the Pig Burn as spawning habitat. The Otago Fish & Game submission notes that as well as the Pig Burn, Taieri River tributaries such as the Kye Burn and Sow Burn are also spawning tributaries in the Maniototo area. Water abstractions on these latter two streams have been through consent processes where residual flows have been set that improve the potential for spawning runs and out migration of juvenile fish to the Taieri River.

16. No assessment has been made of the importance of the Pig Burn spawning run for the Taieri River fishery and how many juvenile trout present enter the Taieri River from the Pig Burn or how many may enter the Taieri River under the new proposed conditions. As Otago Fish & Game has not or cannot state whether the Taieri River trout fishery is recruitment limited the need for additional juvenile recruitment in the river is unknown. Therefore, it is difficult to gauge the importance of the spawning run in the Pig Burn when considering its role in sustaining the Taieri River fishery.

17. Longfin eels have been reported in the lower Pig Burn but the abundance of this species is unknown and the limitation on its abundance/occurrence are also unknown. The NZFFD records report only two longfin eels have been caught. Potential limitations are recruitment and /or habitat and the drying reaches in the lower Pig Burn, will be unfavourable habitat. Furthermore, the natural state of any eel population that historically occupied the Pig Burn is unknown. This represents an information limitation that cannot be resolved with respect to the historic state.

18. A habitat model has been made for the Pig Burn in the reach from Hamilton Road downstream to the Patearoa Waipiata Road bridge (Golder 2008). This model indicates that

habitat for longfin eel and brown trout increases with increasing flow (Figure 2). It also shows large fish habitat is limited which may be reflected in the present-day low abundance of longfin eel reported in the NZFFD fish surveys.

Assessment of effects

19. The water takes will all reduce habitat downstream of the abstraction points. The impact of this is to reduce habitat for invertebrates and fish in Pig Burn. These effects can be cumulative in a downstream direction as the volume of water abstracted increases.

20. The assessment of effects has concentrated on demonstrating that the proposed water takes will improve the instream conditions from the present state, which is correct. However, an assessment of ecological effects has not been conducted. Such an assessment as noted above, is problematic as the baseline for assessment is unknown.

21. The application has assessed the stream hydrology including providing a longitudinal flow assessment to define gaining and loosing reaches and estimates of the flow losses and gains. The hydrology assessment includes an estimate of the 7dMALF of 53 L/s at the gorge flow recorder. PDP have reviewed this assessment and the hydrology assessment conducted by the ORC and concluded there will be some unavoidable error in the 7dMALF estimates due to the short flow record and the 7dMALF is, most likely slightly higher than the 53 L/s estimated. Hickey (2020) provides the longitudinal flow results and has estimated that the upper loosing reach (Figure 2) has a flow loss of approximately 90 L/s. I would consider that even with an increase in the 7dMALF at the gorge flow recorder the upper loosing reach will be present in all but the wettest of summers.

22. With respect to this upper loosing reach the upstream water abstraction will influence the duration of the dry period but the location of the drying reach is unlikely to extend, especially in an upstream direction as the underlying geology will control where the loosing reach starts. The consent application also notes that the Herlihy Gorge take and the Weir take are in the drying reach and abstraction halts in summer as flow is lost. This means during summer the upper loosing reach is subject to the water abstraction from the Bradfield take (7 L/s) and the shared take which is also often dry in summer. Therefore, aside from limiting the Bradfield take and gaining up to an extra 7 L/s there is little change in the volume of water available to keep flow present in the upper drying reach and the large residual flow already present at the Bradfield take means this is a natural drying reach that cannot be avoided by placing residuals flow requirements on the upstream water takes.

23. The lower loosing reach that has a flow loss of approximately 30 L/s is unlikely to dry naturally aside from during dry summers although this reach is likely to be a natural low flow reach in most summers. This reach is subject to all the water takes aside from the Concept North take. However, the Shared take, Herlihy Gorge take and Weir take are likely to be dry or taking little water when the lower drying reach is present. Therefore, the three takes that influence the lower drying reach are the Herlihy Ford take, the Concept South take and the Mulholland take, all of which are proposed to become the Combined take. Therefore, this Combined take and its residual flow are the major application related control on the drying reach flow, the flow in the lower drying reach and the ecological values that this reach supports.

24. The gaining reach in the lower Pig Burn has its flow controlled by the upstream Combined take and the Concept North take and residual flows at these takes will influence flow and habitat in the lowest gaining reach of the Pig Burn.

25. It should be noted that the Combined take and the Herlihy Ford take residual flow of 70 L/s provides some ecological benefits for the reach from the downstream end of the upper Drying reach to the Combined take location. This reach is appropriately 1 km long and will have near natural low flows when the upper drying reach has established, as the Herlihy Gorge take, the Weir take and the Herlihy Ford take will not be operating. With the upper two takes, the Shared take and Bradfield take being dry or also small (respectively) it also means near natural flows occur along the Pig Burn to the new Combined take.

Brown trout spawning

26. During the spawning season (late May and June) abstraction will have ceased at the Herlihy Gorge take, the Weir take and the Concept North take. Spawning in the reaches downstream of the Combined take can be affected by the 110 L/s take with the 200 L/s residual flow. However, much of the time the flow downstream of the Combined take will be greater than 200 L/s (Figure 3). There will be some variation to this as flow will be less in the lower loosing reach and greater in the lower gaining reach. Given Fish &Game report spawning occurs along the Pig Burn from O'Neil's Road to near the gorge this spawning is already occurring along varied flow and habitat conditions. I would expect that this will continue.

27. The Fish & Game submission notes several observations regarding brown trout spawning. Spawning surveys reported large redds, that are expected to be made by large brown trout,

most likely from the Taieri River, upstream of the Hamilton Road ford (submission paragraph 14). Hickey (2020) flow studies have identified this reach of the river as a natural drying reach. Therefore, if the juveniles spawned in this reach are to survive, they need to move downstream to perennial reaches of the Pig Burn. The 70 L/s residual flow at the Herlihy Ford take does provide perennial flow conditions immediately downstream and provides habitat for juvenile brown trout when their spawning reach dries. This appears to be a benefit of the new proposed abstraction regime.

28. Downstream of the Combined take the residual flow will be low during the juvenile rearing period and likely dry in the lower drying reach. However, this is not an effect on spawning, rather on the available summer habitat and fish passage.

7dMALF in the Pig Burn

29. The 7dMALF in the Pig Burn is subject to debate and estimates have been provided by the applicant and by ORC for flow at the gorge flow recorder. These have been reviewed by PDP and the applicant provided 7dMALF is expected to be lower than the actual naturalised 7dMALF.

30. However, the Pig Burn has gaining and loosing reaches downstream of the gorge flow recorder (Figure 4). This means the observed and natural 7dMALFs at sites downstream from the gorge flow recorder will be different and often less than the gorge flow recorder 7dMALF.

31. Submitters have requested that residual flows are set as a percentage of the 7dMALF. As none of the seven water take locations are at the gorge flow recorder site the 7dMALF at this site, whatever it may be, cannot be used as to set a residual flow at the water take sites as the natural (or observed) 7dMALFs elsewhere in the Pig Burn will be different. For the setting of residual flows by this method 7dMALFs would be required at all take points.

Residual flows

32. The consent application states the Shared take is in an area that naturally dries and operating and enforcing a residual at this remote location is difficult. However, the abstraction point should be constructed in such a way as to allow a visual flow of water through the abstraction to maintain a connecting flow when the abstraction is operating.

33. The Bradfield take is in a perennial flow section of the Pig Burn with most of the catchment inflows occurring upstream of the take. There are a few minor tributaries that are likely to

dry in summer between the Bradfield take and the Gorge flow recorder. The gorge flow recorder always records flow and this flow is essentially the flow remaining after the Bradfield take has abstracted 7 L/s. Therefore, no specific residual flow is recommended for the Bradfield take as the low abstraction rate limits the effect of the water take on stream flow.

34. The Herlihy Gorge take and the Weir take have no proposed residual flows as these takes are in the drying reach. The estimated water loss to ground water in this reach is 90 L/s and any residual flow less than this will not prevent drying and as drying will naturally occur on average and dry years. A key consideration is the speed at which drying occurs. Rapid drying means residual flows at these takes will have little effect on the duration of the dry period and limited value in protecting the freshwater fauna of this drying reach. If the consent conditions were to include a residual flow as a percentage of the 7dMALF at these two takes this is likely to be a 0 L/s residual as the 7dMALF is likely to be 0 L/s.

35. The Herlihy Ford take has a proposed residual flow of 70 L/s and this is at or above the estimated 7dMALFs for the gorge flow recorder. There is one tributary inflow between the gorge flow recorder and the Herlihy ford take. This tributary drains the Rock and Pillar Range front, and I would expect it to have little flow in the summer and therefore the gorge 7dMALF will be similar to the Herlihy Ford take location 7dMALF. Therefore, the proposed 70 L/s residual flow is most likely near to 90% of the 7dMALF for the ford location.

36. The proposed Combined take and the Concept North takes have proposed residual flows of 10 L/s. These residual flows are the key residuals for the provision of habitat and fish passage in the lower Pig Burn. Downstream of the proposed Combined take the Pig Burn enters the downstream loosing reach. The 10 L/s residual flow will not provide a connecting flow given the estimated loss is approximately 30 L/s along this reach (Hickey 2020). The existing habitat model has been built to model this reach and the 10 L/s residual flow provides little habitat for any fish species. However, increasing the Combined take and the Concept North take residuals in increments from 10 L/s to 20 L/s and then to 30 L/s would provide a reasonable level of fish habitat and allow the Pig Burn to achieve the requirements of the NPS-FM.

37. The time steps and residual flow increases would reflect the duration of the consent granted. For a six year consent a 5 L/s increase could be appropriate for the start of the next consent. For a 15 year consent I would consider a residual of 20 L/s at the end of the

consent period to be appropriate, an increase of 10 L/s rise over the consent. For longer consent terms an increase up to 30 L/s should be required. These will lead to a reduction in the presence and duration of the lower drying reach and improve aquatic habitat in the lower Pig Burn.

38. An additional consideration with the residual flows and the provision of fish passage is the occurrence of rainfall events that reconnect all reaches of the Pig Burn. Hickey (2020) notes hydrological work was halted in two years due to high rainfall events. Since the applicants lodged their application this high rainfall situation occurred again in summer 2020-2021, with high flows across Central Otago for all of January. Therefore, the residual flows represent the low flows but not their duration nor the frequency at which these flows are reached. Rainfall and flow variation each year can provide periods where fish passage is readily available throughout the Pig Burn. The ORC gorge flow gauge record shows the variation in summer flows and that some summers will provide high flows and residual flows will not be required (Figure 5).

39. The applicant is also seeking to take 110 L/s from the Combined take location when a residual flow of 200 L/s can be maintained at this take point. A 200 L/s residual flow will provide a flow greater than 150 L/s through the lower drying reach and will provide fish passage in up and downstream directions. Using the Gorge flow recorder record (Figure 3) to demonstrate the effect of this higher flow take, this shows that this take will have limited effect on the lower Pig Burn flow with the flow frequently well above the 200 L/s residual flow. I do not expect this water take to effect fish passage nor given the natural variability in flow to impact on trout spawning in the lower Pig Burn.

Fish screens

40. In the absence of fish, I would not recommend fish screens for the Shared take in the upper Pig Burn. Without fish there is no need for screens. The fish survey information provided by the applicant demonstrates the lack of fish at this location.

41. The Bradfield take may have stream resident brown trout present in the vicinity of the take. The application includes a photograph of this take with a mesh screen and this would be an appropriate fish screen for this site.

42. The takes in the lower Pig Burn are all in areas occupied by brown trout and longfin eels. All these takes require fish screens. For the Herlihy Ford take, the Combined take and the Concept North take 3x3 mm mesh fish screens are required with appropriate sweeping

velocities to prevent small fish entrainment. These screens should be sufficient to withstand higher flow events and maintain their screening function as downstream fish passage often occurs during high flow events. The Herlihy Gorge take and the Weir take are within upper the drying reach and also towards the upper limits of the brown trout spawning. These takes will not operate for the full irrigation season and less substantial fish screens may be more appropriate at these locations. These screens should be capable of preventing the majority of juvenile salmonids entering the takes.

Fish passage requirements

43. Fish passage is required for longfin eel and brown trout at the water takes downstream of the gorge flow recorder. Upstream passage at these takes is required for juvenile longfin eel from 1 December to 30 April each year. This is when elver migrate upstream. As elvers are small fish and capable of using shallow wetted areas to progress upstream large volumes of water are not required to provide pathways through abstraction structures. The key feature to provide is a continuous flow path. The major limitation on elver passage will be the lower drying reach rather than the water abstraction structures. However, I do expect elvers to migrate through this reach during high flow period that are available in some summers.

44. Out migration of adult eel usually occurs in autumn during freshes. The gorge flow record (Figure 4) indicates frequent fresh events in autumn that will cue and aid downstream passage. As long as any water takes that are operating are screened the downstream migration of adult eels will be provided for.

45. Brown trout from the Taieri River will begin migration upstream from the Taieri River in April and need passage to spawning areas and back to the Taieri River between April and the start of July each. Large adult brown trout require water depths of 20-30 cm for easy upstream passage. Short shallow riffle areas may be negotiated but long shallow reaches are likely to be obstacles and prevent passage. Again, the major limitation for brown trout passage is likely to be the lower drying reach. For brown trout some behavioural mechanisms will aid their upstream passage as they will attempt to pass shallow reaches during freshes when the higher flows allow the fish to swim upstream in the shallower reaches. The gorge flow record does indicate autumn freshes occur that will aid upstream fish passage

46. The Bradfield take in its current state already provides fish passage and I expect any brown trout adults present near this take are stream resident with no specific fish passage requirements.

47. The Shared take in the upper Pig Burn tributary is in a fishless area and no fish passage requirements are present.

Summary

48. The Pig Burn water users group is applying for new consents to take water from the Pig Burn at seven sites.

49. Brown trout spawning habitat will be provided in the Pig Burn.

50. Fish screens are recommended at six takes, with only the Shared take not requiring a screen.

51. Fish passage is required for longfin eel and brown trout at all water takes downstream of the gorge flow recorder.

52. Residual flows are required at all sites, with the applicants proposed residuals adopted for five sites. For the Combined take and the Concept North take the 10 L/s residual flow is adopted for the start of the consent period and it is recommended the residual is increased increments to 15 L/s, 20 L/s and 30 L/s depending on the duration of the consent granted.

53. The Combined take abstraction of 110 L/s with a residual flow of 200 L/s can be consented.

Richard Allibone

26 April 2021

Reference

Golder Associates Ltd (2008). Minimum flow assessment for six Otago rivers and streams. Client report prepared for the Otago Regional Council.

Hickey M. (2020). Assessment of Effects on Instream Ecology due to Water Takes from the Pig Burn. Report prepared for the Pig Burn Water Users Group.

Figures

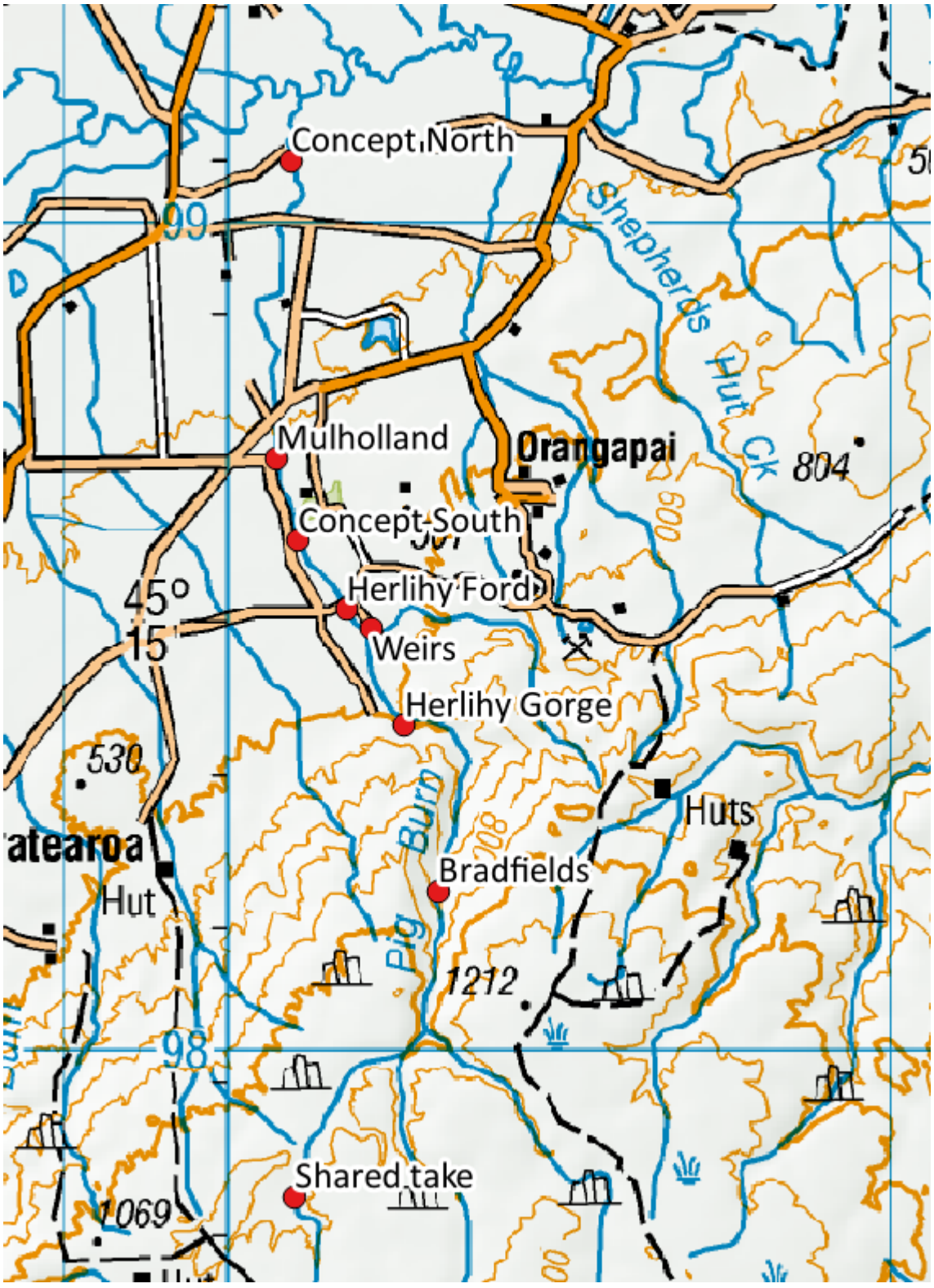

Figure 1: The Pig Burn catchment with present water take locations shown.

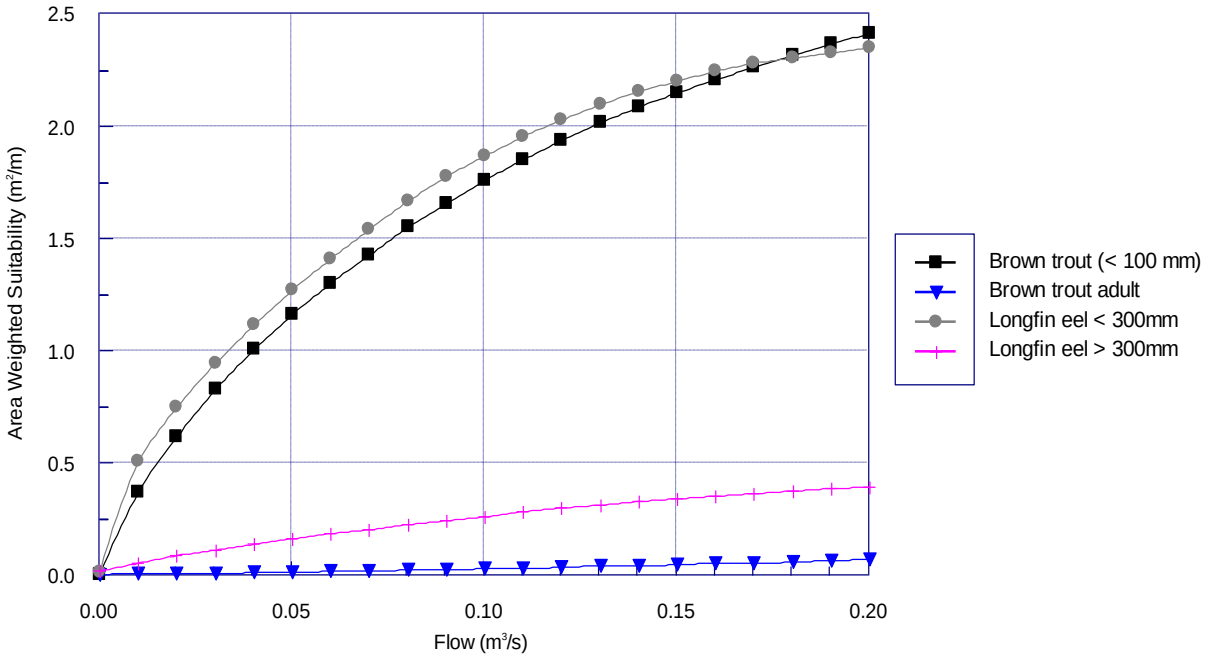

Figure 2: The SEFA habitat model outputs for longfin eel and brown trout for Pig Burn downstream of Hamilton Road.

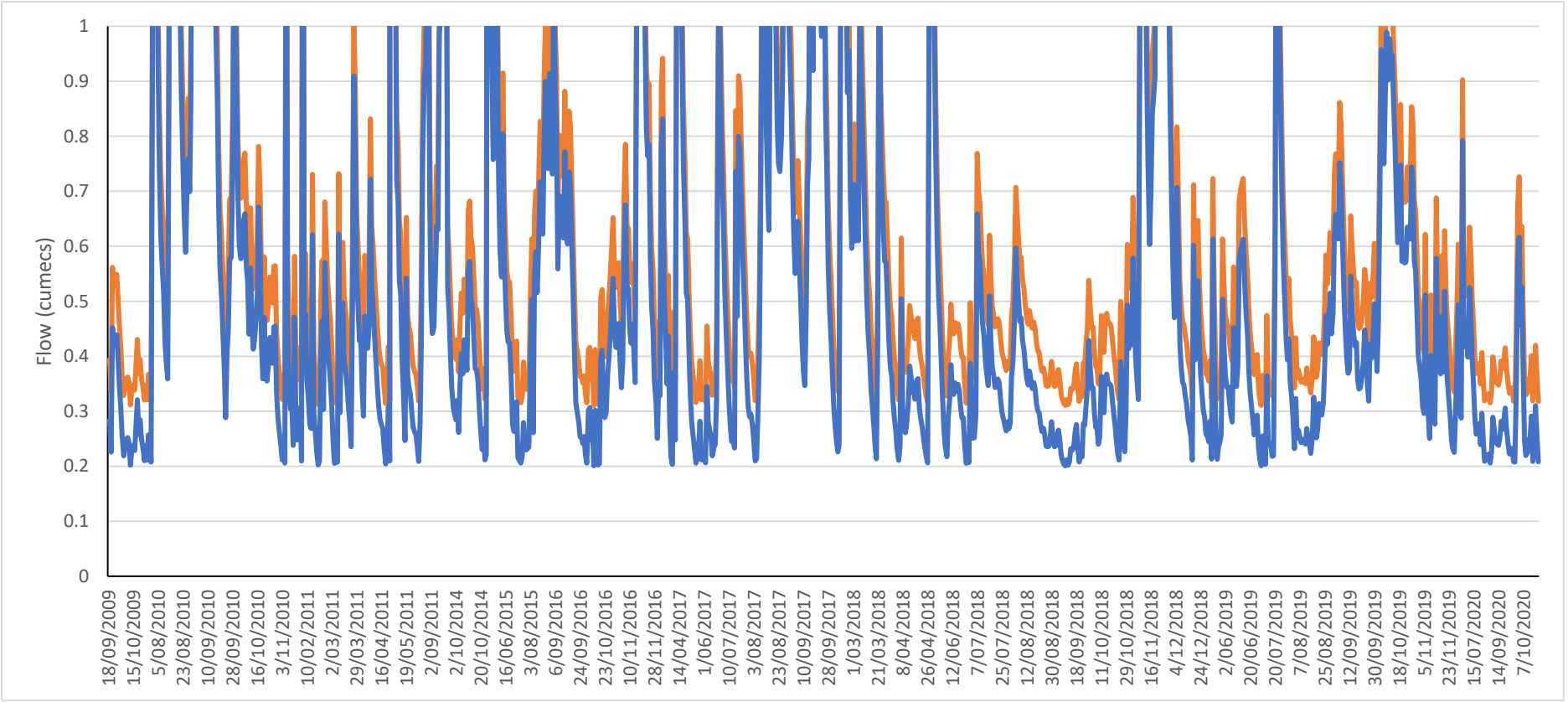

Figure 3: The Gorge flow when above 200 L/s (orange line) and the gorge flow minus 110 L/s (blue line).

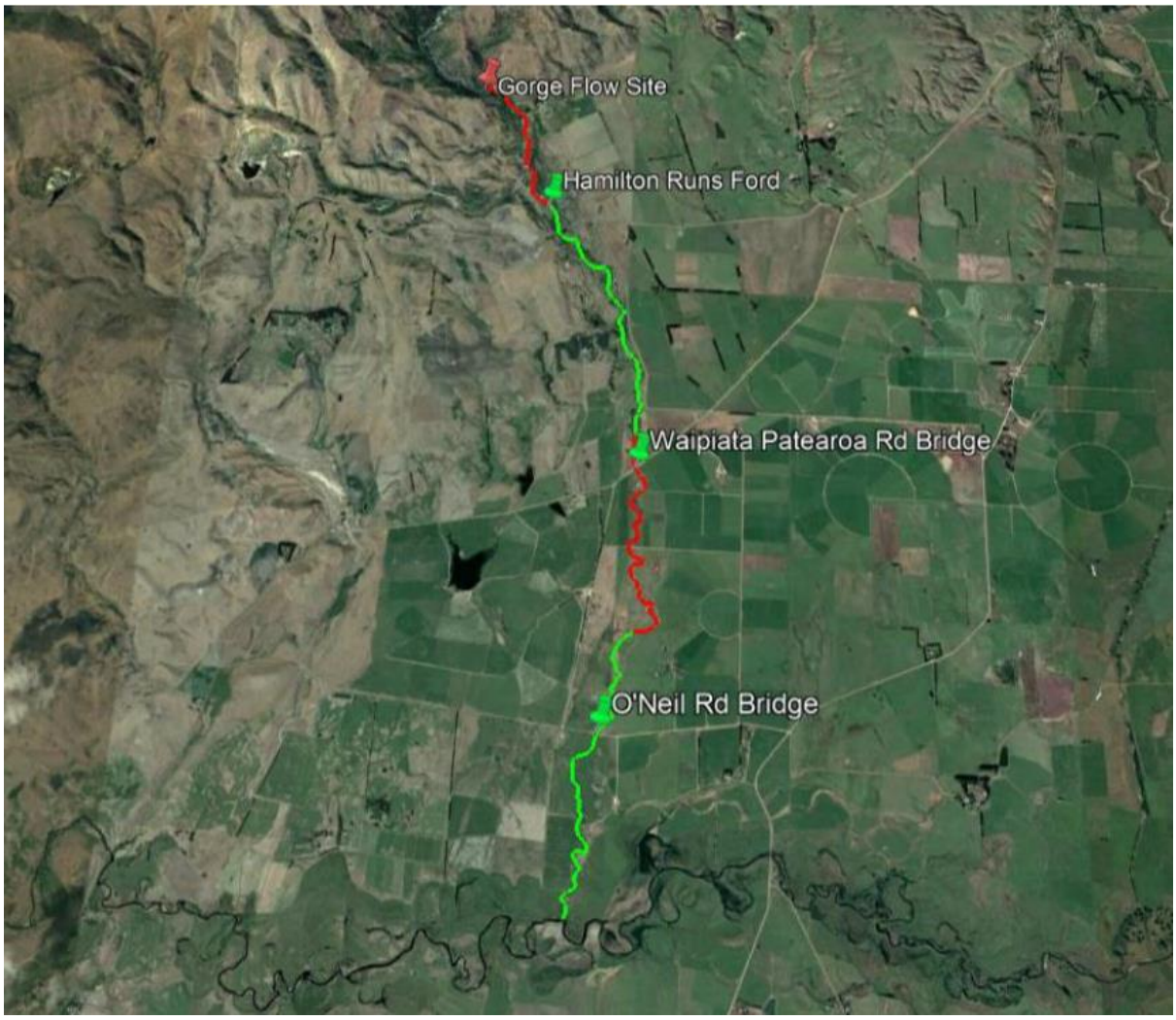

Figure 4: The gaining and loosing reaches of the lower Pig Burn, red lines indicating losing reaches, and green lines gaining reaches (copied from Hickey 2020).

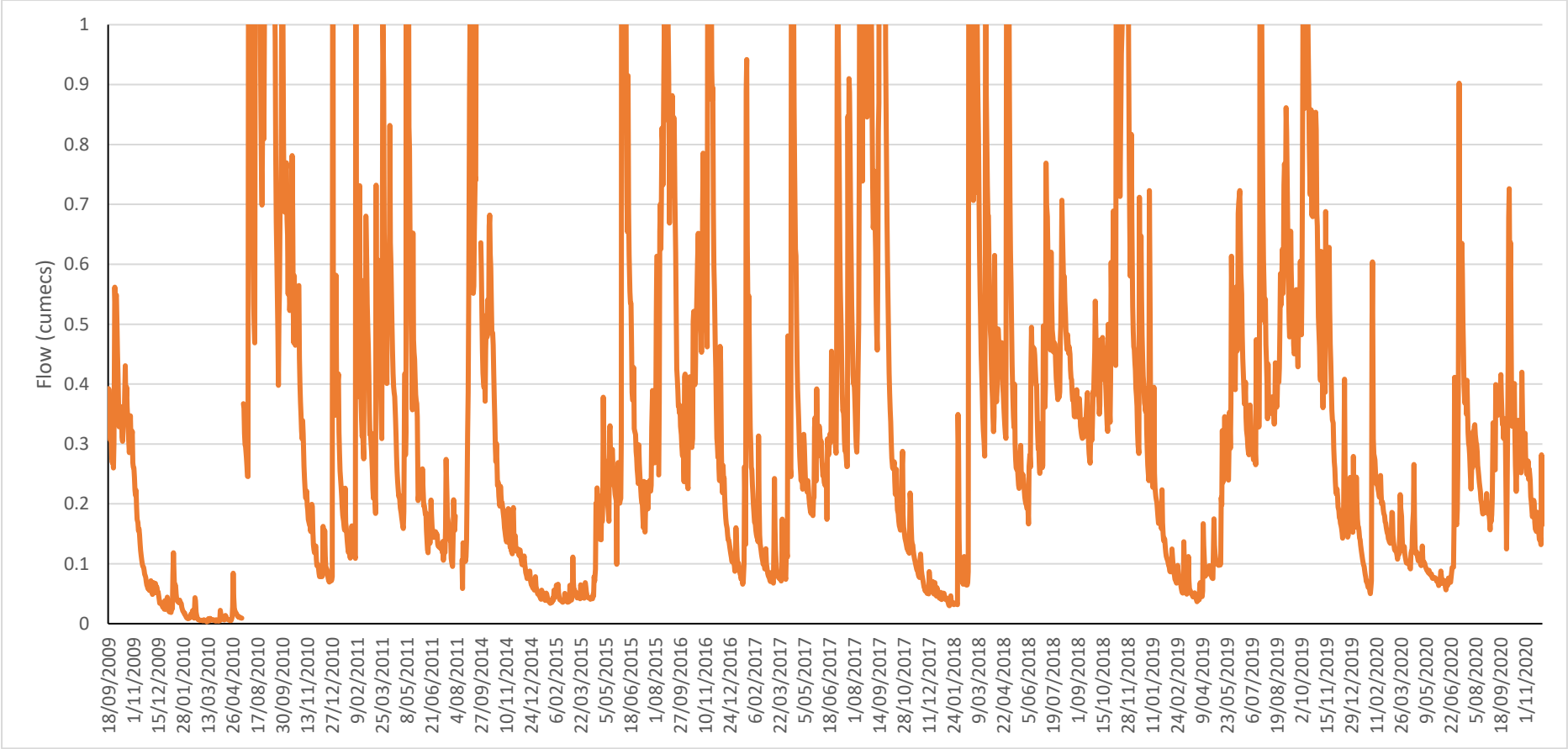

Figure 5: The Pig Burn flow record from the gorge site flow recorder (note the sequence is not continuous).