BEFORE A HEARING PANEL
CONSTITUTED BY OTAGO REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
IN THE MATTER	Resource Consent Application RM22.434 – Cold Gold Clutha Limited)

EVIDENCE OF ROGER YOUNG FOR MARILYN DUXON
9 NOVEMBER 2023

QUALIFICATIONS AND EXPERIENCE

1. My full name is Roger Graeme Young.

2. I hold a PhD (University of Otago, 1998) and BSc (Hons) (University of Otago 1992).

3. I am a freshwater ecologist and have been employed in this role at the Cawthron Institute for the last 25 years. My responsibilities include management of Cawthron's Freshwater Ecosystems Group.

4. My work involves a mix of government-funded research on river ecosystems and commercial projects assisting a range of clients with freshwater management issues. It has included studies on new tools for river health assessment, minimum flow and water allocation assessments, factors affecting fish abundance, relationships between human pressure indicators and river ecosystem integrity, water quality sampling and data analysis, integrated catchment management, synergies between Western scientific and cultural indicators of river health, and tools for rehabilitating river ecosystems.

5. I have written 71 scientific papers and more than 100 reports relating to this work.

6. I have been closely involved with the development of the Land, Air, Water Aotearoa (LAWA) website (www.lawa.org.nz), which displays water quality and ecological data for more than 1,500 river sites across Aotearoa New Zealand, including the upper Clutha River / Mata Au (hereafter Clutha River) at the Luggate Bridge.

7. The upper Clutha was one of the sites that I studied during my PhD.

EXPERT WITNESS CODE OF CONDUCT

8. I have read the Code of Conduct for Expert Witnesses set out in the Environment Court Practice Note 2014 and I agree to comply with it. I confirm that the opinions I express in this evidence are within my expertise and represent my true and complete professional opinions. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

SCOPE OF EVIDENCE

9. I have been asked by Marilyn Duxon to provide evidence on key water quality and aquatic ecology issues associated with the activities being applied for. For this, I have:

   a) reviewed the relevant documents submitted by the applicant

   b) reviewed the technical audit reports on ecological effects of the application prepared by Babbage Consulting

   c) provided a summary of the existing environment in the upper Clutha River / Mata Au where the application is sought

   d) summarised potential inadequacies and effects of the proposed application.

THE EXISTING ENVIRONMENT

10. The Clutha River is Aotearoa New Zealand's second-longest river and has the highest average discharge of any river in the country. Between its outlet at Lake Wānaka and the head of Lake Dunstan, the upper Clutha River is renowned for its outstanding water clarity, reflecting the lake-fed source of the river.

11. The lake-fed nature of the river is a critically important feature and contributes to many of the upper Clutha's special characteristics. Flow changes are buffered by the lake upstream, so the river does not experience the same level of extreme highs and lows that would be typical of a rain-fed river. Similarly, sediment washed into Lake Wānaka settles out within the lake, so there is a low supply of sediment to the upper Clutha River, further contributing to its stable environment and outstanding water clarity.

12. The median water clarity at the Luggate Bridge site over the last 5 years is 5.4 m, with a maximum water clarity of more than 10 m (Land, Air, Water Aotearoa (LAWA) – Clutha River/Mata-Au). This contrasts significantly with the Clutha River downstream of the Kawarau River confluence, where large inputs of fine sediment (mostly sourced from the Shotover River) reduce water clarity. For example, median water clarity

at Millers Flat over the last 5 years is only 1.94 m and at Balclutha it is only 1.62 m (Land, Air, Water Aotearoa (LAWA) - Clutha River/Mata-Au).

13. Regular monitoring at the Luggate Bridge site on the Clutha River has found 10–30 types of aquatic invertebrates in samples collected over the period from 2002 to 2022 (Land, Air, Water Aotearoa (LAWA) - Clutha River/Mata-Au at Luggate Bridge). Pollution-sensitive mayflies, stoneflies and caddis flies have made up 30–70% of the invertebrates recorded in these samples. Macroinvertebrate Community Index (MCI) scores have ranged between 85 and 110 over the 2002–22 period. These relatively low MCI scores would typically represent mild to moderate pollution (fair to good condition; Stark and Maxted 2007) in rain-fed rivers, but in the case of the upper Clutha River they are more likely to reflect the lake-fed nature and stable flows of the river, rather than any concerns with pollution or river health. A feature of lake-outlet rivers like the upper Clutha is the extremely high abundance of filter-feeding caddis flies, which feed on plankton sourced from the lake and contribute to an extremely productive ecosystem (Harding 1994).

14. The upper Clutha River supports populations of longfin eel, upland bully, common bully, rainbow trout, brown trout and (landlocked) Chinook salmon. Kōaro and the Threatened Clutha flathead galaxias are found in some tributaries of the upper Clutha River and could be present in the river itself at times.

15. Like other lake-outlet rivers, the upper Clutha supports very high trout densities (201 large and medium trout per kilometre, ranking it 7th out of 158 reaches surveyed across Aotearoa New Zealand; Teirney and Jowett 1990) and thus a very popular trout fishery (Unwin 2016).

POTENTIAL EFFECTS ASSOCIATED WITH THE APPLICATION

Sediment disturbance and discharge of sediment downstream

16. My main concern related to the application is the disturbance of riverbed substrates and the subsequent discharge of fine sediment from the dredge. The mechanical disturbance of the substrate will directly affect life on the stream bed (such as macroinvertebrates and benthic fish), while fine sediment discharges will affect downstream areas by reducing

water clarity. When the fine sediments settle, they will smother the riverbed and reduce food and habitat quality for invertebrates (Ryan 1991; Waters 1995). Elevated suspended fine sediment can also affect fish directly by reducing feeding efficiency (due to reduced clarity), as well as irritating and clogging gills.

17. When water clarity is high, it takes only a small change in the amount of suspended sediment to have a substantial effect (Davies-Colley and Smith 2001). This means that the upper Clutha River will be considerably more sensitive to the effects of dredging than the lower Clutha River, where the applicant has been operating in the past. The upper Clutha River remains relatively clear during floods due to its lake-fed source. Therefore, I disagree with the suggestion in the application that sediment discharges caused by the dredge operation would be equivalent to those experienced after rainfall.

18. The sediment that would be disturbed by dredging within the riverbed has probably accumulated slowly over years to decades. The release of this material in a concentrated pulse would be something quite unusual for the upper Clutha River and is likely to affect ecological and aesthetic values downstream.

19. On page 19 of the application, the applicant states:

> the sediment discharged will be naturally occurring silts, sand and gravels that can be sucked through the nozzle of the suction dredge. This material is passed through the dredge with a considerable amount of water and as it re-joins the water in the river it mixes quickly so typically no discolouration will not be evident 50m beyond the point of discharge.

20. In my opinion, a substantial sediment plume will be much more evident in the upper Clutha than would occur in the middle reaches of the river, due to the high background clarity of the upper river. The applicant has sought conditions allowing operations to continue with a plume of up to 200 m in length, which I consider is excessive but probably still difficult to comply with given the high background water clarity.

21. The e3Scientific report that was appended to the application describes the results of a study conducted by the applicant on the discharge of sediment from the dredge in the middle reaches of the Clutha River. As

mentioned above, the background water clarity in the middle and lower reaches of the river is substantially lower (less than one-third) of that in the upper Clutha, meaning that conclusions from the study are not directly applicable to the upper Clutha River.

22. In addition, the study measured only changes in turbidity and suspended sediment concentrations downstream of the dredge. No water clarity measurements were taken. Turbidity and suspended sediment concentrations are very coarse surrogate measurements of water clarity, particularly in very clear water, where they offer poor resolution compared to direct clarity measurements (Davies-Colley and Smith 2001). In my opinion, turbidity and suspended sediment concentrations are not appropriate measures of water clarity in a high-clarity environment like the upper Clutha River.

23. I note the comment in the Section 42A Staff Recommending report that further details are needed from the applicant on how they propose to measure water clarity. In the response to the s92 request on this matter, the applicant suggested the use of a Secchi disc to measure water quality. However, as also noted in the Babbage audit document, the Secchi disc method is only appropriate in lakes where there is no flow. The horizontal black disc method is the preferred approach used to measure water clarity in rivers (Davies-Colley 1988; Davies-Colley and Smith 2001).

24. I am also concerned with the data presented in this study on the sediment plume below the dredge as there appears to be a mismatch between the turbidity and suspended sediment concentrations reported from the same samples in the e3Scientific report (their table 7 water quality results). Based on the relationship between suspended sediment concentration and turbidity of samples collected from rivers throughout the country, a sample with a suspended sediment concentration of 9 g/m^3 (as reported 5 m downstream of the dredge) would be expected to have a turbidity of 4–6 NTU (Davies-Colley and Close 1990), not 1.62 NTU as reported. I cannot understand why there would be a such a large mismatch between the suspended sediment and turbidity data, and it puts the results into question.

Flow and habitat stability

25. In the application and associated e3Scientific report, the upper Clutha River is described as a 'highly unstable environment' (page 22), a 'highly variable and unstable environment' (page 22) and 'a highly dynamic and mobile river' (page 26) with an 'unstable benthic environment' (page 27). In fact, the opposite is true.

26. It is certainly a very large river, but owing to its lake-fed source, flows are much more hydraulically stable than those found in rain-fed rivers (Jowett and Duncan 1990). Due to the relatively low variability in flows in the upper Clutha River, there will be a relatively small amount of bed disturbance caused by high flows.

27. Similarly, the settling of sediment in Lake Wānaka means that sediment supply to the upper Clutha River is very low – and hence large amounts of mobile sediment are not continually moving down the river.

28. The relatively high level of flow and bed stability contribute to the unique characteristics and productivity of the upper Clutha River ecosystem. Artificial disturbance of the upper Clutha riverbed, as proposed in the application, is likely to have a detrimental effect on the ecosystem because there is very little natural streambed disturbance along this segment of the river.

Trout spawning and egg incubation

29. The application states that the applicant would focus their activities in a 1,500 m reach of the upper Clutha River during the trout spawning period. However, I am concerned that the period of egg incubation within the gravels has not been taken into account in this assessment.

30. Trout eggs (ova) remain within the gravels for about 4–6 weeks after spawning (McDowall 1990). After hatching, the young trout (alevins) remain within the gravels for several weeks, during which time they are susceptible to disturbance of the riverbed. Therefore, the disturbance exclusion period needs to incorporate not just the spawning period, but also the additional periods required for egg incubation and alevin sheltering. This would extend the disturbance exclusion period by 2–3 months.

31. In addition, fine sediment deposition resulting from repeated disturbance events may chronically reduce the quality of spawning habitats downstream of dredged areas over time. Trout require unembedded gravel substrate with less than 20% deposited fine sediment to spawn successfully (ideal spawning habitat has less than 10% deposited fines).

32. The application suggests that trout spawning will not be affected by activities because the dredge cannot access water shallower than 0.8 m. It assumes that trout spawning occurs only in shallow water. However, studies of brown trout spawning habitat preferences indicate that there is a minimum depth below which spawning rarely occurs (about 15 cm), and that spawning occurs over a wide range of depths greater than this and well beyond 0.8 m (Wollebaek et al. 2008).

Spread of aquatic plants

33. The e3Scientific report notes that the invasive aquatic plant *Lagarosiphon major* is found in some spots throughout reaches of the upper Clutha River. I expect that this plant is found in suitable habitats throughout the river, from the outlet of Lake Wānaka downstream. However, care should be taken to avoid transferring it to other waterways where it is not present.).

ADEQUACY OF ASSESSMENT OF EFFECTS

34. I share the concern raised in the Babbage audit report about the inadequacy of the sampling undertaken in the e3Scientific report appended to the application, given the potential ecological effects of the proposed dredging. However, I do not share the Babbage opinion that ‘the information provided is generally considered sufficient to assess ecological effects’.

35. Three small hand-net macroinvertebrate samples taken from the river margins provide a very poor representation of the macroinvertebrate community in the upper Clutha River from the Luggate Bridge to the head of Lake Dunstan (which equates to approximately a 30 km segment of Aotearoa New Zealand’s largest river).

36. Surprisingly, more than 20 years of data from regular Otago Regional Council water quality and macroinvertebrate monitoring within the

affected reach were not considered in the ecological assessment of effects.

37. As mentioned above, the lake-fed nature of the upper Clutha and the outstanding clarity and bed stability of this reach of the river were also overlooked in the assessment of effects, which I consider is a major omission.

Roger Graeme Young

9th November 2023

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