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)

WRITTEN RESPONSES FROM ROGER YOUNG TO QUERIES FROM THE COMMISSIONERS
14 NOVEMBER 2023

TURBIDITY AND WATER CLARITY AND THEIR SENSITIVITY

1. As mentioned in my evidence (paragraph 22), turbidity and suspended sediment concentrations are coarse surrogate measures of water clarity.

2. Turbidity is particularly insensitive as a measure of water clarity in clear water where a relatively small change in turbidity is equivalent to a relatively large change in water clarity (Figure 1). The relationship between these two indicators is not linear. For example, an increase in turbidity from only 0.5 NTU to 1.0 NTU is equivalent to a reduction in water clarity from the median measured in the upper Clutha River at Luggate (i.e. 5.4 m) down to a water clarity of <3 m (Figure 1).

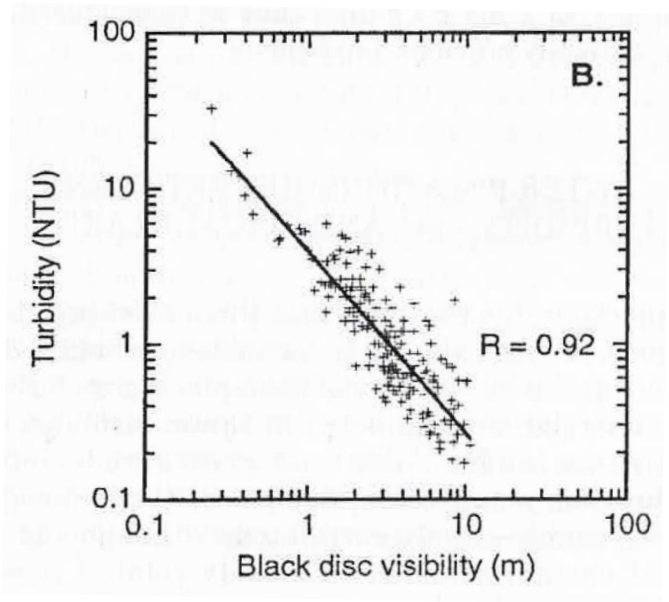

Figure 1. Relationship between water clarity (black disc visibility) and turbidity (from Davies-Colley & Smith 2001). Note the log-log scale on both axes, meaning that the relationship between these indicators is not linear.

3. Under more turbid conditions, turbidity is a more useful measure of clarity (e.g. a change from 5 NTU to 10 NTU only results in a change in water clarity from 0.9 m down to 0.5 m).

COULD A TURBIDITY STANDARD BE USED TO DETERMINE THE EFFECTS OF THE APPLICANT'S PROPOSED ACTIVITIES IN THE UPPER CLUTHA RIVER?

4. Conceivably, a turbidity standard could be set. For example, to avoid a 30% reduction in water clarity (from 6 m to 4 m), the increase in turbidity would have to be less than 0.2 NTU (from 0.5 NTU to less than 0.7 NTU). However, accurately measuring such a small change in turbidity is not achievable using the turbidity meters that I have used, given the typical measurement uncertainty involved.

5. In my opinion a standard based on turbidity measurements would not be workable and I do not recommend the use of turbidity as a standard for determining the effect of the applicant's activities on water clarity in the upper Clutha River.

TROUT SPAWNING AND EGG INCUBATION

6. Both brown trout and rainbow trout are found in the upper Clutha River. Spawning for brown trout typically occurs in May and June. Spawning for rainbow trout typically occurs in June, July and August.

7. Trout eggs (ova) remain within the gravels for about 4–6 weeks after spawning. After hatching, the young trout (alevins) remain within the gravels for several weeks, during which time they are susceptible to disturbance of the riverbed.

8. Therefore, to avoid the full extent of the spawning, egg incubation and alevin sheltering periods for both brown trout and rainbow trout, disturbance of the riverbed would need to be restricted from May to at least October.

References

Davies-Colley RJ, Smith DG. 2001. Turbidity, suspended sediment and water clarity: a review. Journal of the American Water Resources Association. 37:1085–1101.