

Attachment 3: Basis for Residual Flows in Cluden and Waiwera Streams

Waiwera Creek residual flow.

The residual flow condition proposed on Waiwera Creek of *“a visible surface flow is maintained below the take to the first tributary entering Waiwera Creek on the true right, approximately 100m below the take”* acknowledges that there is no fish either above or immediately (~500m) below the take most likely due to waterfalls preventing access. Maintaining a surface flow will provide for the macroinvertebrate community present.

Fish values in Waiwera Creek have been recorded upstream of the Ardgour Road culvert (small brown trout and bully). These values have been maintained under the existing flow regime with no residual flow condition.

The take from Waiwera Creek is from a steep gorge that is very difficult to access. measuring low flows in this environment is largely impractical without significant expense. Flows have always been observed to increase below the take due to the contribution from tributaries, springs and groundwater.

The applicant proposes a further condition of *“a visible surface flow is also maintained at the Ardgour Road culvert”* to ensure the fish values in the lower Waiwera are maintained.



Figure 1. Waiwera Creek between the take and Ardgour Rd culvert maintaining surface flows below the take.

Cluden Stream residual flow

Originally a residual flow of 5 l/s was proposed at the Cluden take to maintain surface connection. A site visit was carried out on the 31st of January 2018, this visit confirmed that a residual flow of 5 l/s at the take location maintains surface flow connection and aquatic habitat downstream with a mixture of riffles, runs and pools. Flows were also observed to increase below the take with contributions from springs seeps and groundwater. Figures 2 – 6 provide photos of Cluden stream from the intake to ~700m downstream.



Figure 2. Cluden Stream at the intake.



Figure 3. Cluden Stream immediately below the intake. Flow at ~5 l/s.



Figure 4. Cluden Stream below intake ~50m.



Figure 5. Cluden Stream below intake, ~100m.



Figure 6. Cluden Stream at Ford ~700m downstream of the take. Flow ~15 l/s.

While on site on the 31st of January 2018 it was noted that there were no young of the year (0+) trout observed below the take although the water was clear and visibility excellent. 0+ trout are prolific in the lower Cluden Stream at this time of year. Given the lack of 0+ trout F&G staff queried whether large adult trout from the Lindis River are able to access the upper reaches of Cluden Stream. In September both Daniel Jack (DoC) and myself observed what appears to be a significant waterfall in the upper Cluden, some 11 km's above the Lindis confluence (Figure 7 & Figure 8). Given the lack of 0+ trout below the intake and in considering the downstream waterfall it is unlikely that adult trout from the Clutha or Lindis are able to access the upper reaches of Cluden Stream to spawn.

In the reach below the waterfall where it is known that adult trout spawn flows historically are ~85 l/s or more in summer under the existing take regime with no residual flow. By maintaining surface flows below the take in future as depicted in Figure 3 to Figure 6 it is expected that the existing high value juvenile trout rearing reach of Cluden Stream will be maintained.

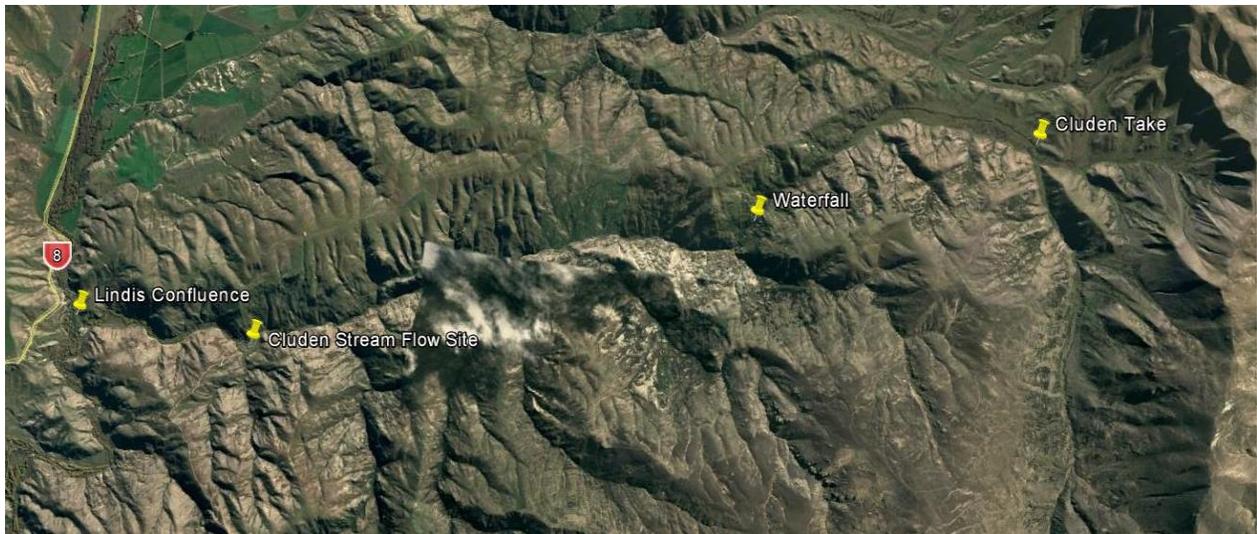


Figure 7. Location of a known waterfall in the Cluden Stream below the existing water take.

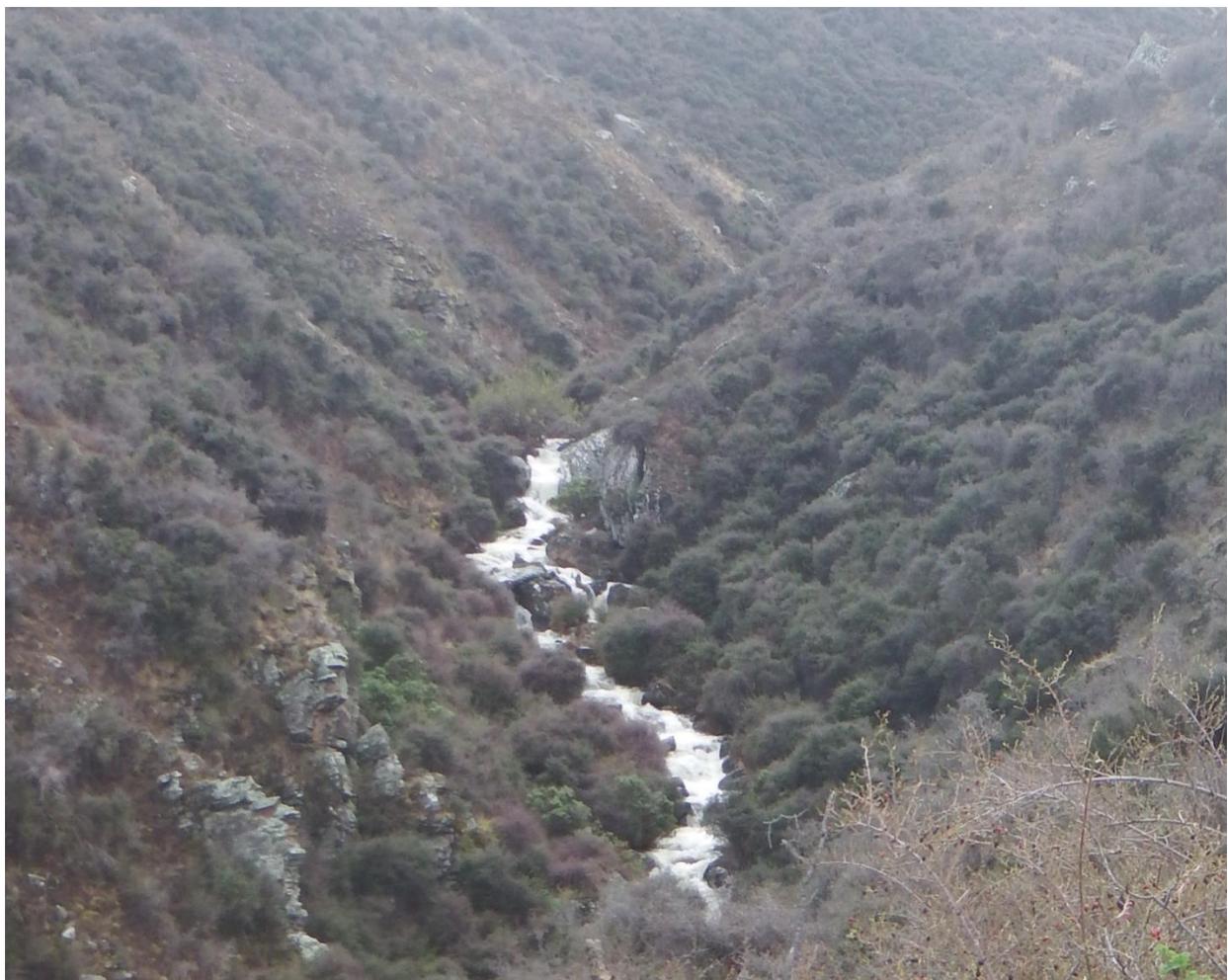


Figure 8. Waterfall in Cluden Stream 11 Km's upstream of the Lindis confluence. Photo taken in Sept 2017.

