To: Tom Dyer, Pete Ravenscroft, Otago Regional Council

From: Richard Allibone, Water Ways Consulting Ltd

Date: 18 May 2023

Subject: Upper Taieri River SEFA issues

Dear Tom, Pete,

This memo reports my observations and assessment of the potential to conduct fieldwork in the upper Taieri River to produce physical habitat models.

I visited the upper Taieri River 13 January 2023 to assess the issues around:

- water depth and riparian vegetation that can compromise safe gauging while gauging;
- the river's visual character;
- the presence of macrophytes that can confound physical habitat models; and
- the location of irrigation infrastructure and flow modifications created by this infrastructure.

The state of the Taieri River was assessed for its suitability for developing physical habitat models along sections of the Serpentine Flats to Styx Creek confluence and downstream of the Paerau weir along the Maniototo Plains. In addition, the lower Taieri River downstream of Outram was also assessed for habitat modelling potential.

Background to physical habitat modelling

Physical habitat models require cross sections along a model reach to have the water depth, water velocity and riverbed substrate to be assessed at points across the cross section. The modelling also requires three measurements of flow and water level at each cross section to calibrate the rating curve so multiple site visits are required. Ideally each cross section requires at least twenty in water measurements spread across the river and additional bank side measurements to characterise the channel cross section. The suite of cross sections should also encompass the range of habitats in a model reach including the deepest and fastest water. It is possible for the SEFA modelling programme to insert modelled water velocity if it is not measured but this is likely to increase model error. However, for rivers where all the channel is deep the measurement of water depth, water velocity and riverbed substrates are difficult or impossible to conduct when personnel are relying on wadeable water depths to conduct the assessment. Measurement of water velocities can also be confounded by the presence of macrophytes as the plants can impede the measurement of water velocity and also as they grow during summer the increasing bulk of macrophytes in the channel alter the cross-section flow rating. Substrate composition is assessed using visual methods and require the ability to the see the stream bed. Turbid or low water clarity can restrict the depths the streambed can be seen in.

Serpentine Flats.

The key feature of the Serpentine Flats area is the Taieri River/Logan Burn confluence. The Maniototo Irrigation scheme stores water in the Logan Burn Reservoir on the Rock and Pillar Range and water conveyed to irrigation areas via the Logan Burn and the Taieri River. This creates an augmented flow section of the Taieri River downstream of the confluence and then via the Taieri River to the east and west side irrigation canals. Bywash water from the irrigation canal is discharged back into the Taieri River upstream of the Waipata flow monitoring site. Upstream of the Logan Burn confluence the Taieri River has XX water abstractions from the mainstem and its tributaries. Aside from the abstractions the flow upstream of the Logan Burn is unmodified.

Upstream of Logan Burn confluence

Upstream of the logan Burn confluence the Taieri River flow is only modified by the X water abstractions. There are inflowing tributaries such as Serpentine Creek and small tributaries flowing from the Rock and Pillar Range. However, it would be possible to locate a model reach in a section of the Taieri River between the inflowing tributaries. An assessment of the Taieri River channel downstream of the Linnburn Runs Road (Figure 1) found a wadable river, with a few isolated deep areas (Figure 2). Macrophytes were present in the channel (Figure 3) that would confound some cross sections. However, it would be possible to locate a habitat model either upstream or downstream from Linnburn Runs Road. However, as this area is subjected to rather limited water abstract flows will be close to natural and the need for a habitat model is also limited.

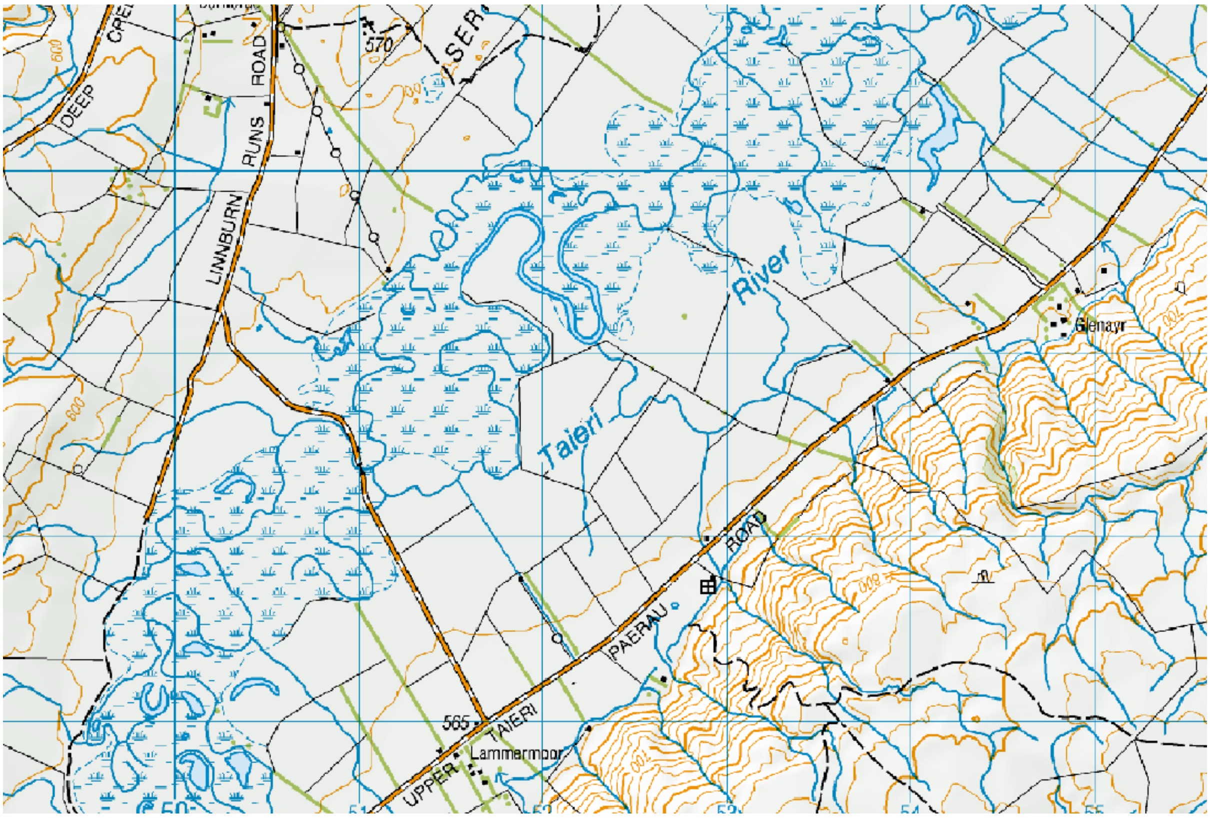

Figure 1: The Linnburn Runs Road reach of the upper Taieri River.

Figure 2: The Upper Taieri River downstream of Linnburn Runs Road.

Figure 3: Macrophyte beds and clear riverbed areas of the Taieri River near Linnburn Runs Road.

Downstream of Logan Burn Confluence.

The site visit viewed the Taieri River at the Logan Burn confluence at Logan Burn Ford Road and the Taieri River at the Upper Taieri Pateroa Road bridge (Figure 4).

At this location the Logan Burn appeared to have more flow than the Taieri River due to the release of stored water from the Logan Burn Reservoir (Figure 5). Both water courses had dark brown tannin-stained water that prevented seeing the riverbed in the deeper parts of the channel. This will restrict the assessment of the riverbed substrate as it is not visible from the surface. Macrophytes clusters were present along the river shallows and extended out into the deep water. The water depths also appear to prevent wading of the river channel to measure water depths and water velocity. The shallow areas could be measured, but even these areas have some confounding effects due to the macrophyte clusters.

An additional factor that would need to be considered when attempting to calibrate the rating curves is the effect of changes to the flow caused by the release of water from the Logan Burn Reservoir. If the irrigation scheme operators wish to keep a steady water supply to the downstream irrigators there may be little flow variation in the reach between the Logan to Styx confluences with the Taieri River. The water release form the Logan Burn has a second effect with the Taieri River overflowing its low flow channel and extensive wetland areas adjacent to the river were flooded with ponded water (Figure 6) between Logan Burn and Styx Creek. If there is water flowing in these high flow /wetland areas these areas will need to be included in the model cross sections. This makes potential cross section lengths well over 100 m and the measurements confounded by wetland vegetation.

As such the reach from Logan Burn to Styx Creek is considered unsuitable for the development of a physical habitat model.

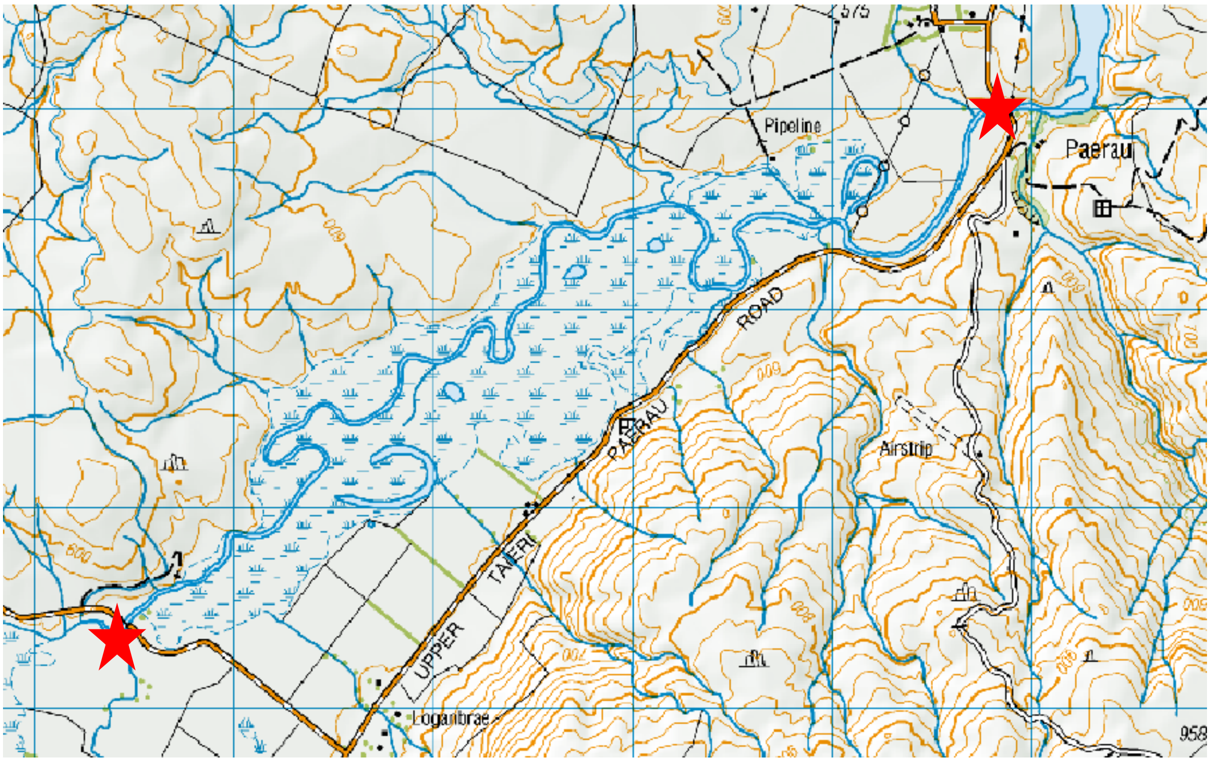

Figure 4: The Taieri River between the Logan Burn and Styx Creek confluences. Survey sites marked with red stars.

Figure 5: The confluence of the Logan Burn (left) and Taieri River (right).

Figure 6: The Taieri River between Logan Burn and Styx Creek confluences with wetland ponding areas.

Downstream of Styx Creek the Taieri River is modified by the irrigation abstraction infrastructure with a ponding area and water abstraction area. The river then runs through a fourteen-kilometre-long gorge zone with little access. Downstream of the gorge the river pass through the Paerau Power Station and flows across the Maniototo Plain.

The Maniototo Plain

The Taieri River was visited at two reaches on the Maniototo Plain, at the Puketoi Road bridge and Maniototo Road bridge. The Maniototo reach in summer is a flow control reach as the Maniototo irrigation schemes maintain the river flow to meet the minimum flow requirement (1 cumec) at Waipata. This limits the flow variation in the river once irrigation demand requires all the water available over the minimum flow. A lack of flow variation restricts the ability to calibrate a flow model with as it requires different flows to be calibrated. This may be managed with short term flow releases to provide flows in excess of 1 cumec if irrigation companies can release water to raise the river flow.

Aside from the lack flow variation the river at both road crossing has macrophyte beds, very dark tannin-stained water that appeared too deep to wade (Figure 7, Figure 8). As noted above these features prevent the undertaking of habitat model field work.

Figure 7: The Taieri River looking upstream from Puketoi Road.

As such the reach from Paerau weir along the Maniototo reach is considered unsuitable for the development of a physical habitat model.

Lower Taieri River downstream of Outram

The physical habitat models require predictable relationships between river water levels and river flow. For this reason, tidal reaches of rivers are not suitable for habitat modelling as water levels fluctuate with not just with flow but also with the tide. The lower Taieri River is tidal to just upstream of the State Highway 86 bridge over the Taieri River at Allanton (Figure 9) and unsuitable for the development of physical habitat models.

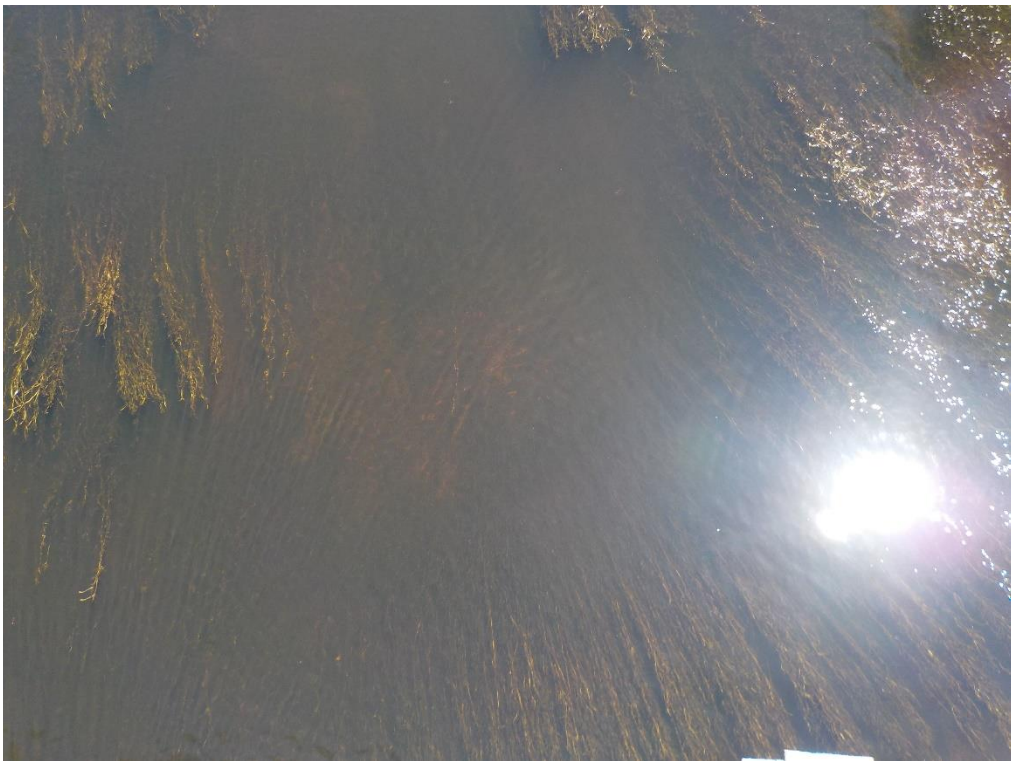

Figure 8: Macrophyte beds in the Taieri River at Maniototo Road bridge.

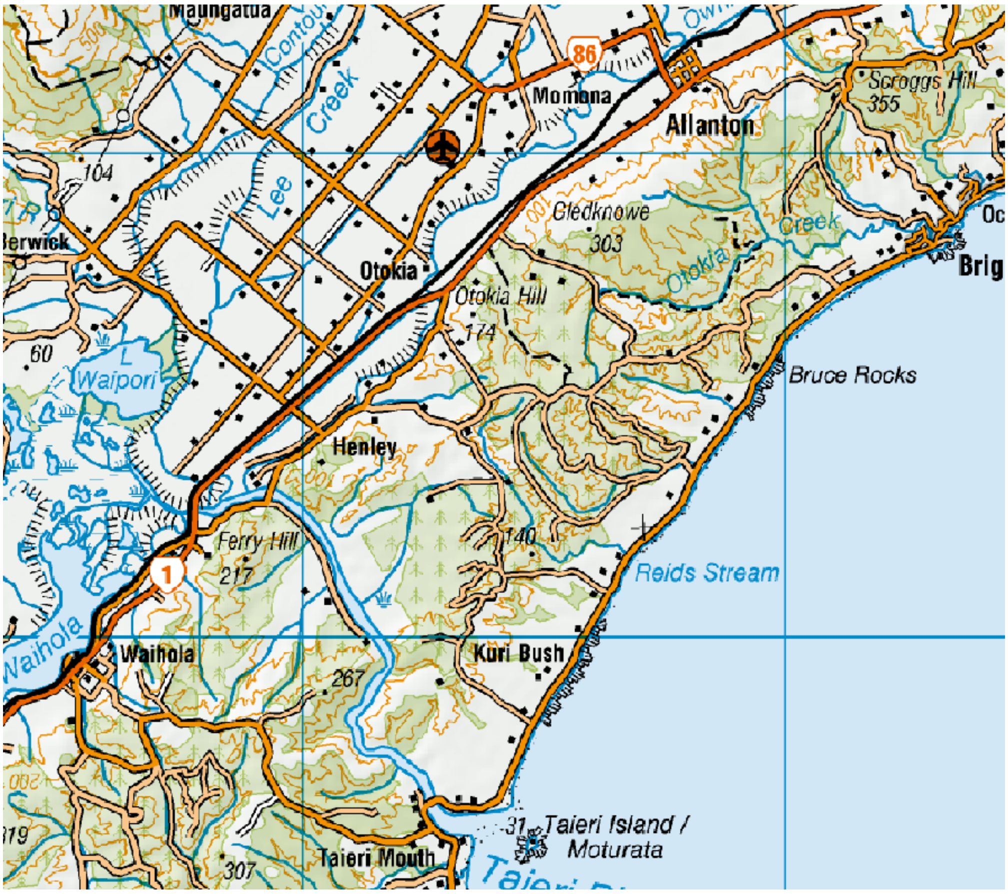

Figure 9: The tidal reach of the Taieri River.

Upstream of the tidal reach the Taieri River meanders across the Taieri Plain to Outram. This reach features shallow riffle areas and deep high-water velocity meander corners. These meander corners are also protected from erosion but willow tree planting that extend out into the river (Figure 10). The shallow riffle areas are suitable for habitat model cross-sections. However, the deep fast meander bend areas are suitable and with the willow trees extending into the river these areas are significant safety hazard. Therefore, habitat model is not recommended for the Taieri Plains reach of the Taieri River.

Figure 10: The meandering Taieri River on the Taieri Plains with willow lined meander bends.

Regards

Richard Allibone