# Poolburn Gorge Willow Removal Plan – Freshwater Ecology Review & Mitigation Guidance

**EOS Ecology Report No.** BEC01-24006-01 | March 2024

**Prepared for** Ida Valley Catchment Group under the Access 2 Experts programme

**Prepared by** EOS Ecology – Shelley McMurtrie, Alex James

**Reviewed by** Zoe Dewson

www.eosecology.co.nz
info@eosecology.co.nz

PO Box 4262, Christchurch 8140
P 03 389 0538

SCIENCE + ENGAGEMENT

RECOMMENDED CITATION: McMurtrie, S. & James, A. 2024. Poolburn Gorge Willow Removal Plan – Freshwater Ecology Review & Mitigation Guidance. EOS Ecology Report No. BEC01-24006-01. 21 p.

1 INTRODUCTION & SCOPE ..... 1

2 THE ISSUE WITH WILLOWS ..... 3

3 CURRENT FISH VALUES ..... 6

4 REVIEW OF WILLOW REMOVAL PROPOSAL ..... 8

4.1 Proposal Summary ..... 8
4.2 Potential Water Quality Effects ..... 8
4.3 Potential Ecological Effects ..... 11
4.4 Other Considerations ..... 15

5 GUIDANCE & RECOMMENDATIONS ..... 17

5.1 Staging of the Works ..... 17
5.2 Timing of the Willow Removal Works ..... 17
5.3 Recommended Measures to Reduce Effects/Risks ..... 18
5.4 Long-term Management ..... 19
5.5 Knowledge Gaps ..... 20

6 ACKNOWLEDGEMENTS ..... 21

7 REFERENCES ..... 21

# 1 INTRODUCTION & SCOPE

The Ida Valley Catchment Group is proposing to engage a contractor (East Coast Excavations Ltd) to remove riparian willows from an approximately 4 km length of the Ida Burn, where it flows through the Poolburn Gorge in Central Otago (Figure 1). East Coast Excavations Ltd have written a willow removal proposal/plan that details the methodology to be used. EOS Ecology was engaged by the Ida Valley Catchment Group via the 'Access 2 Experts' programme, to provide expert review of the willow removal proposal from a freshwater ecology and water quality perspective and provide mitigation recommendations and guidance.

The overall scope of this review and guidance includes the following:

» A kick off meeting to identify objectives and project purpose (completed 30 January and 5 February 2024).

» A site visit to gain an appreciation of the area and the influence the willows are having on freshwater ecology and water quality (completed 27 February 2024).

» Review the willow removal proposal/plan to identify whether potential impacts on ecology (including but not limited to on tuna/eel habitat) and water quality could arise through its implementation (this report).

» Based on the outcomes of the plan review, advice will be provided on whether mitigation measures are required to manage identified impacts, providing recommendations of what mitigation measures would be appropriate, in a short draft guidance document. Provide a gaps analysis of information that may be needed to fill knowledge gaps (this report).

» Facilitate a meeting following delivery of the draft guidance document to discuss outcomes and obtain feedback with the Ida Valley Catchment Group.

» Finalise the guidance document for issue.

As this work was funded through the 'Access 2 Experts' programme, which does not provide funding for field sampling and analysis, our report is necessarily based on existing available information and observations made during the site visit.

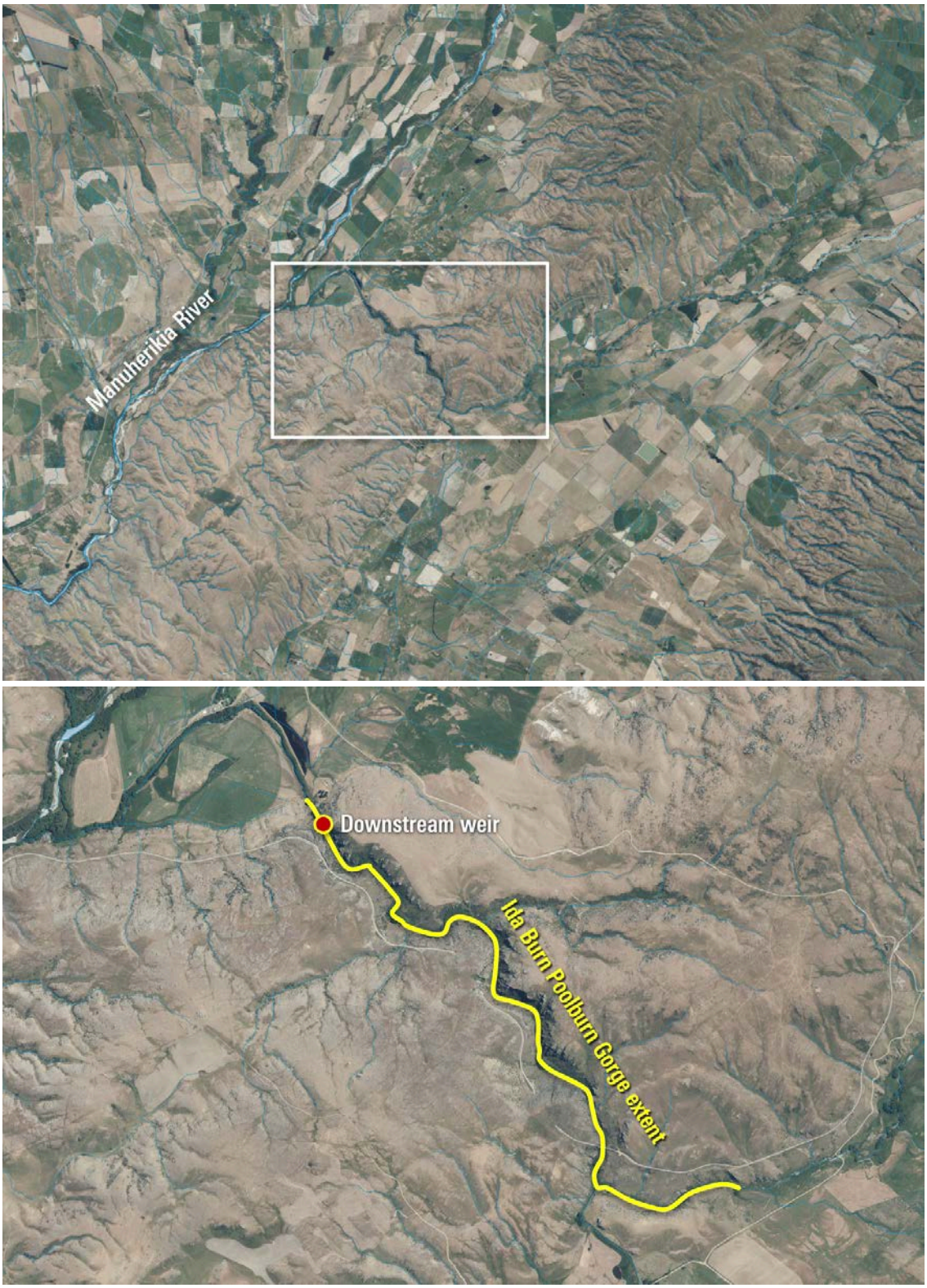
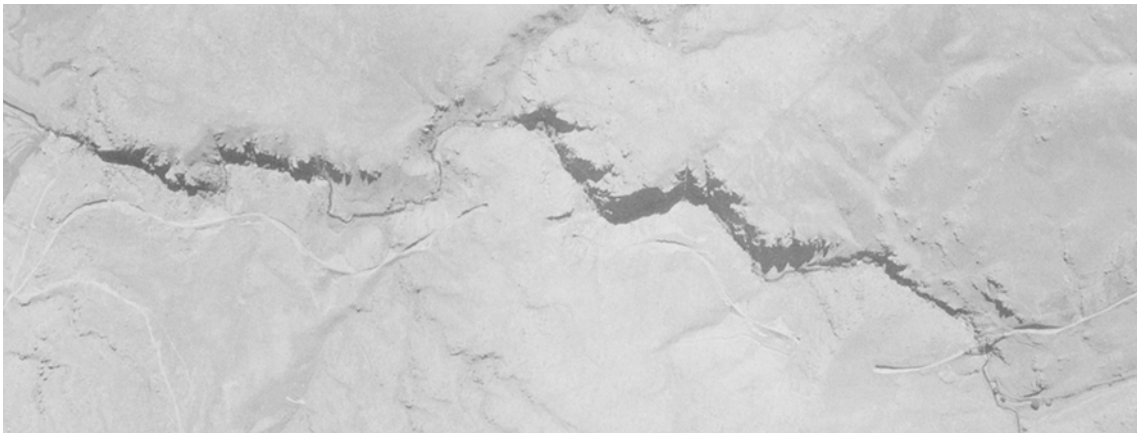



Figure 1 Ida Burn, Poolburn Gorge in Central Otago.

# 2 THE ISSUE WITH WILLOWS

Based on historic aerial imagery from Retrolens (https://retrolens.co.nz) in 1959 the Poolburn Gorge appeared to be largely free of willows. By 1976 willows were well established through the gorge (Figure 2). All subsequent aerial images show abundant riparian willows. It is understood that some willow removal efforts previously took place in the Poolburn Gorge 20+ years ago, but no follow up control was undertaken, and the gorge continues to have abundant riparian willows growing from end to end.



1959: No large willows evident in the gorge.

1976: Willows have become well established throughout the gorge.

2023: Willows form a complete canopy closure throughout the gorge.

**Figure 2** **Aerial views of Poolburn Gorge that track the spread of willows over time (photos have been rotated so are not showing north).**

These willows do provide some positive effects that need to be acknowledged:

» Provision of shade to the channel during the hot summer months, which may keep water temperatures cooler to the benefit of some freshwater species.

» Instream debris will provide habitat and cover for fish species.

» The large/deep pooled areas created by the plentiful debris jams may provide habitat for larger-bodied fish species (adult trout and large eels) and may provide low flow refuges for some species. However, these habitats may not be accessible to some fish due to the barriers formed by the large debris jams and leaking downstream weir.

However, despite these benefits, observations made during the site visit do indicate that there is a significant growth of willows within the entirety of the base of the gorge that is choking the channel and causing or contributing to a large number of significant issues:

» The sheer magnitude and size of the debris trapped against the willow trees and creating debris dams in the channel (some up to 2 m high) greatly increases the flood hazard, as they create debris dams that back up water flow during flood events, and could cause a flash flood if they failed (Figure 3A).

» Willows are altering the natural morphology and stream habitats of the Ida Burn by creating pooled areas behind debris dams, some of which appear to be stagnating (Figure 3B).

» Debris build ups/debris dams are impeding the movement of free swimming fish (such as trout) and limiting their upstream movement. In some cases this may also impede the dispersal of other fish species.

» Willow growth is impeding the natural movements of river gravels through the system, by trapping material behind debris dams and extensive willow root growth effectively trapping loose gravels in place (Figure 3A, C, D, E, F). This is having the effect of starving the downstream reaches of river gravels, which is most likely the cause of the old weir at the downstream end of the gorge no longer having an effective seal around its rock structure, resulting in a subsurface discharge and thus creating a barrier to downstream fish passage as well as upstream movement (Figure 3G).

» Willow growth has changed the substrate composition through increased deposition of fine sediments around debris jams, extensive willow roots effectively replacing the natural stony stream bed in places, and starving downstream habitats of gravels (Figure 3C, D, E, F).

» The trapping and binding of the river gravels limits the ability of the river to readily move and shift within a (small scale) braided river channel morphology.

» Extensive willows provide a large annual input of deciduous leaves into the stream, where their decay may adversely impact water quality (e.g., depress dissolved oxygen levels).

» Willows may increase the frequency and duration of low flow periods by the uptake of water directly from the Ida Burn through their extensive root systems.

» Willows likely are precluding various native riparian species through their shading and extensive root systems. This detracts from the natural biodiversity and high amenity values of the Poolburn Gorge.

A. Large debris dam with gravel deposit.

B. Large pooled area.

C. Extensive willow roots completely covering natural, stony stream substrates

D. Willow roots completely covering bottom of wetted channel

E. Extensive willow roots in the low flow channel.

F. Lower Gorge with deep pools starved of finer gravels due to upstream effects of willows.

G. The downstream (left) and upstream (right) side of the Lower Gorge weir. With no finer gravels/sediment to seal the structure, water is flowing through it.

**Figure 3 Representative images of the Ida Burn in Poolburn Gorge taken by EOS Ecology during 27 February 2024 site visit.**

# 3 CURRENT FISH VALUES

There is a lack of freshwater ecological data from the Ida Burn where it flows through the Poolburn Gorge. However, there is a relatively extensive data set of fish survey information from the greater Ida Burn catchment upstream and downstream of the gorge available on the New Zealand Freshwater Fish Database (Sotffels, 2022).

The greater Ida Burn and Pool Burn catchment upstream of the Poolburn Gorge provides habitat for three threatened indigenous fish species, the 'Nationally Critical' Clutha flathead galaxias, the 'Nationally Endangered' roundhead galaxias, and the 'Nationally Vulnerable' kanakana/lamprey (Table 1). The 'At Risk – Declining' longfin tuna/eel and kōura/freshwater crayfish are also present. Clutha flathead galaxias and roundhead galaxias are only found in Central Otago, whereas longfin tuna and kanakana are found nationwide. The species of kōura known from the catchment is found in the eastern and southern South Island and Rakiura/Stewart Island. Four introduced fish species are also recorded upstream of the Poolburn Gorge (brown trout, rainbow trout, brook char, and perch), although the slow flowing willow-trapped gorge section does not reflect ideal salmonid habitat. Based on the presence of the two nationally threatened galaxiids alone, the Ida Burn catchment is considered to be of very high ecological value.

In terms of fish migration, only two species are present upstream of the Poolburn Gorge that require access to the ocean to complete their life cycles (longfin tuna, kanakana; Table 1)Therefore, any willow removal works that disturb the bed of the stream may need to consider the upstream and downstream migrations of these species.

During the site visit on 27 February, a galaxiid was observed within a pool in the gorge (Figure 4). Given the known fish fauna of the area, it is most likely that this was a roundhead galaxias. Given the instream habitats observed in the gorge, which included some large pools, it is likely that longfin eel and possibly trout are also present. With respect to trout spawning, no suitable spawning habitat is likely to be present in the gorge based on the flow and substrate conditions observed during the site visit.

Figure 4 Small galaxiid fish observed in Poolburn Gorge on 27 February 2024.

**Table 1** Fish species and large macroinvertebrates found in the Ida Burn catchment upstream and downstream of the Poolburn Gorge based on New Zealand Freshwater Fish Database records. Also shown are the threat classification for each fish species of Dunn *et al.* (2018) and of Grainger *et al.* (2018) for macroinvertebrates.

| Location | Fish Species | Threat Classification | Requires ocean access for life cycle |
|---|---|---|---|
| Ida Burn & tributaries DOWNSTREAM of Poolburn Gorge | Longfin tuna/eel (*Anguilla dieffenbachii*) | At Risk – Declining | Yes |
| | Upland bully (*Gobiomorphus breviceps*) | Not Threatened | No |
| | Brown trout (*Salmo trutta*) | Introduced & Naturalised | No |
| | Rainbow trout (*Oncorhynchus mykiss*) | Introduced & Naturalised | No |
| Ida Burn & tributaries UPSTREAM of Poolburn Gorge | Roundhead galaxias (*Galaxias anomalus*) | Threatened – Nationally Endangered | No |
| | Clutha flathead galaxias (*Galaxias* species D) | Threatened – Nationally Critical | No |
| | Longfin tuna/eel *(Anguilla dieffenbachii*) | At Risk – Declining | Yes |
| | Upland bully (*Galaxias breviceps*) | Not Threatened | No |
| | Kanakana/Lamprey (*Geotria australis*) | Threatened – Nationally Vulnerable | Yes |
| | Kōura (*Paranephrops zealandicus*) | At Risk – Declining | No |
| | Brown trout (*Salmo trutta*) | Introduced & Naturalised | No |
| | Rainbow trout (*Oncorhynchus mykiss*) | Introduced & Naturalised | No |
| | Brook char (*Salvelinus fontinalis*) | Introduced & Naturalised | No |
| | Perch (*Perca fluviatilis*) | Introduced & Naturalised | No |

# 4 REVIEW OF WILLOW REMOVAL PROPOSAL

## 4.1 Proposal Summary

The removal of willows from the Poolburn Gorge is a challenging undertaking due to the steep valley sides and limited access points. The proposal to remove willow trees from the Poolburn Gorge was produced by East Coast Excavation Limited (East Coast Excavation Limited, 2023), who we understand is familiar with the landscape and is experienced in this type of work.

The ultimate aim is to remove all willow material from the gorge, but to leave the stumps in place. The exception to this is where there are trees that are growing in the wetted low flow – where stumps will be removed as well to reduce future risk posed if the stumps become dislodged during a flood/fresh event. Prior to removal, willows will be sprayed via helicopter to reduce/minimise risk of spread via branches and regrowth of stumps. The proposal splits the gorge into four sections based on ease of access (Figure 5).

Sections 1 and 2 are inaccessible to tracked or wheeled machinery so chainsaws and manpower will be used to fell the willows, cut the timber into short lengths (1 m or less) and will use a rain event(s) to float the wood out. It will be removed from the channel with excavators on the Thurlow property downstream of the Poolburn Gorge before reaching the Manuherekia River. This work could be done all at once or staged over 2-3 seasons if necessary. Note that a conversation with the contractor during the 27 February site visit indicated that the procurement of a lighter winch rope would allow them to access more of the gorge length, thus reducing the length of inaccessible zone that would require removal of the logs via flood flows to the downstream reach.

Sections 3 and 4 are accessible by large machinery. Chainsaws will be used to fell the willows. Cut material will be stacked above the flood flow level to decompose or be burnt during winter. There is also the possibility of suitable wood being trucked out for use as an Ida Valley Catchment Group firewood fundraiser.

The works will be undertaken during summer low flows when the wetted channel is substantially reduced.

## 4.2 Potential Water Quality Effects

### 4.2.1 During Willow Removal

During the willow removal operations, the most likely adverse effect on water quality will result from the release of fine sediments. While much of the works will avoid the actual stream channel, there will be some unavoidable disturbance of the stream bed. The proposal document refers to a 300 m stretch of waterway somewhere in Sections 3 or 4 where excavators will need to cross the Ida Burn to extract wood. During the 27 February 2024 site visit, some large willows were observed growing within the wetted channel (Figure 6). There is the potential the stumps of these trees may need to be physically removed using machinery. This would certainly result in some fine sediment mobilisation. There may also be some bare earth exposed in the riparian zone due to machinery disturbance of existing vegetation in Section 3 and 4, and runoff from these areas may contribute fine sediments to the stream. It is expected that any access tracks/routes down into the gorge will need to be metalled or have some form of cover to reduce slippage, and this would also help with reducing rain event sediment runoff from the access tracks. While many stream biota are relatively tolerant of short-term increases in suspended sediments, the subsequent deposition of this sediment on the stream bed can have adverse effects. This is covered in the ecology effects section below.

The use of machinery also increases the risk of contaminants such as hydrocarbons from fuel, oil, grease, and hydraulic fluids adversely affecting water quality. Overall, the greatest risks of increased fine sediment and other contaminant inputs will be in Sections 3 and 4, where machinery is being used. This risk will be relatively minor in Sections 1 and 2.

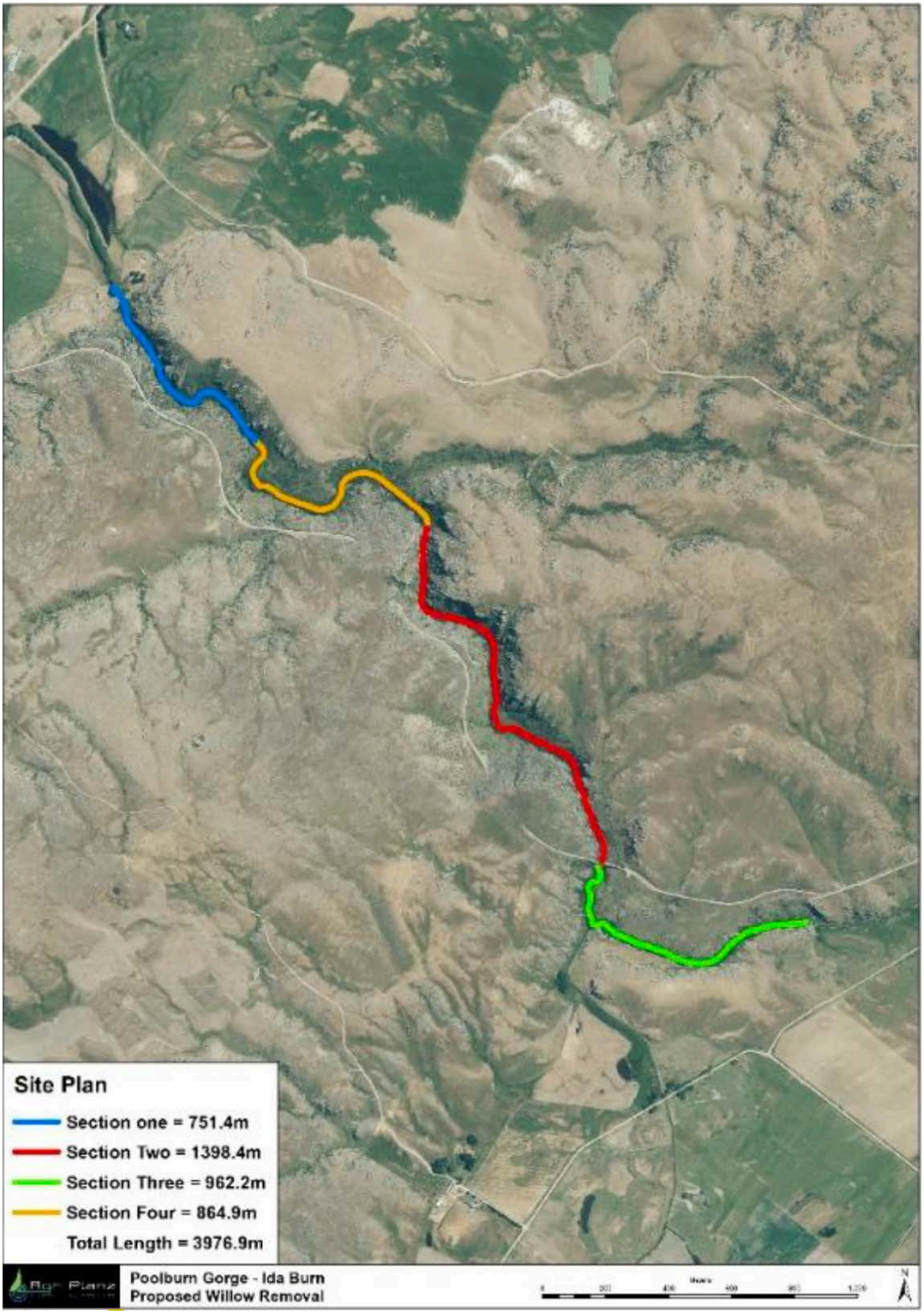



Figure 5 The willow removal reach split into four sections. Sections 1 and 2 are inaccessible to tracked or wheeled machinery, whilst Sections 3 and 4 are accessible by large machinery. Map from East Coast Excavation Limited's willow removal proposal.

Figure 6 Willows growing in the channel as observed on 27 February 2024.

### 4.2.2 After Willow Removal

With the removal of willows, the stream channel will be exposed to more sunlight. This could result in increased water temperatures, particularly during summer low flow periods, which may stress some stream biota. Without any existing information on water temperature, it is not possible to determine if any changes in water temperature will be ecologically significant. That said, the channel upstream of the gorge lacks tall riparian vegetation for the majority of its length and this part of the catchment supports ten fish species including two nationally threatened species.

Extra sunlight reaching the stream channel may also result in increased biomass of algae and potentially macrophytes (aquatic plants) where they are present. It is noted that even with the willows there are some extensive growths of algae in places (Figure 7), and upstream in the open river sections there are algal blooms and macrophytes present. This suggests that there are sufficient nutrients in the water to support high algae and macrophyte growth and that with increased sun this may become a seasonal event, with algae flushed from the system during high flow events.

With the removal of willows, there will no longer be the seasonal influx of leaves into the Ida Burn. This may have a positive effect on water quality, in particular dissolved oxygen levels.

Willows have traditionally been used as a means to control bank erosion in large river systems. As such there is the potential for there to be additional bank erosion (and thus sediment release) in the gorge following the removal of the willows. However, the observations during the site visit were that the presence of willow trees in the base of the gorge appear to be contributing to bank and channel scour, which may be a consequence of the natural recolonisation of the gorge by willows, rather than a planned planting programme. The downstream section near the weir also appears to have banks that are comprised of topsoil over large bedrock and boulder material, which would presumably be less prone to erosion and movement following the loss of any topsoil.

Figure 7 Extensive growth of filamentous green algae observed on 27 February 2024.

## 4.3 Potential Ecological Effects

### 4.3.1 During Willow Removal

Willow removal operations may cause the release and deposition of very fine sediments downstream, where they can have adverse effects on the stream biota that prefer a clean, clear stony stream bed. While many aquatic biota are relatively tolerant of at least short-term increases in fine suspended sediment, the deposition of this sediment on the streambed (at rates and with quantities of smaller particles greater than the natural state) is a major stressor on waterway ecosystems. Such deposition can alter physical habitat (clogging interstitial spaces in the stream bed used as refugia by fish and invertebrates), alter food resources (e.g., smothering algae), and degrade sites used for egg laying by many aquatic species. Hence, sediment can effect the diversity and composition of algae, macrophytes, fish, and aquatic invertebrate communities (Clapcott *et al.*, 2011), meaning that it will be advantageous to avoid and minimise inputs of fine sediment to the Ida Burn during willow removal operations.

Based on the site visit, the channel is primarily made up of gravel, cobbles and boulders, and thus it is not expected that there will be a large portion of fine sediment to be disturbed and redistributed within the bed of the Poolburn Gorge river plain. The significant number of debris jams and channel blockages, and lack of flow during the summer low flow period, will also help to reduce the downstream movement of suspended sediment, depending on the order that the works are done. That said, there will still be sediment release from the works; some of which will be unavoidable given the nature of the site. Sediment control measures can be most effective around the access tracks into the gorge, which we assume will need to be metalled or have some form of cover to reduce slippage, and this would also help with reducing rain event sediment runoff.

Where willow removal operations require direct disturbance of the stream bed (e.g., crossing of the stream with excavators to extract willow material, tracking of the timber along or across the channel via winch ropes) or where any stumps need to be removed from the channel, there is the potential that any fish in the way will be injured or killed. Given the likely presence of the 'Threatened – Nationally Endangered' roundhead galaxias in the gorge, the relocation of fish needs to be considered for parts of the channel that may be crossed by excavators or otherwise disturbed.

### 4.3.2 After Willow Removal

Willows have had a significant role in influencing the morphology of the Ida Burn through the gorge since the 1970s. Whilst we believe that their removal will ultimately benefit the ecology of the Ida Burn, there will be a change to the current (willow generated) river morphology and ecosystem functioning. The time that it takes for some of these changes will vary, depending on the periodicity and size of flood/fresh events that will help to mobilise the currently embedded and trapped channel substrates following willow removal.

In the immediate period after willow removal (months to a few years), the stream will undergo a period of significant physical change. The willow roots that are covering parts of the stony stream bed will decay and disappear and there will no longer be debris dams to trap woody debris and gravel material. With time, high flow events will mobilise the gravels and the stream will develop a more natural morphology with less large, pooled areas. The downstream sections that are currently starved of gravel materials will, over the duration of a number of flood/fresh events, come to support a diversity of substrate sizes (including smaller gravel material that is currently entrenched upstream) that will better reflect a pre-willow morphology. The channel will also become more free-flowing with fewer debris dams causing stagnating water during summer low flows.

It is likely that the fish and macroinvertebrate community will adjust to the new morphology of the gorge, with those species that prefer still, pooled water and woody debris and willow roots as cover/habitat being in lower overall abundance. Conversely, those species that prefer flowing water and a clear stony stream bed may become more prevalent. There is no information on freshwater invertebrate or fish species composition or abundance within the gorge, so we can only speculate on potential effects. However, we know that roundhead galaxias are very likely to be present.

For tuna/longfin eel, there is the possibility that the removal of willows will reduce the habitat and cover used by larger individuals, however the more natural stream morphology that will form may be more suitable for juvenile and smaller tuna. The existing weir at the downstream end of the gorge is a current limitation to the upstream movement of migratory fish, so it is likely the abundance of migratory species such as tuna/longfin eel is relatively low. Therefore any reduction in large tuna/longfin eel habitat is unlikely to have much of an effect on their abundance as this habitat is not currently accessible. We note that the presence of this weir limiting upstream passage of migratory species is likely of benefit to the non-migratory threatened galaxiid species which would be susceptible to predation and competition from migratory fish. The more natural stream channel may also provide more suitable habitat for the threatened galaxiids known from the Ida Burn catchment (Table 1) that prefer flowing water over a relatively clean stony stream bed.

The most predictable effects of willow removal will be a reduction in summertime shading of the stream channel and the cessation of the annual autumnal input of willow leaves into the stream. A reduction in shading may increase water temperatures in summer and increased light may result in increased algae growth, should there be sufficient nutrient levels and stable flow. Based on algae and macrophyte growth in the upper, more open reach of the Ida Burn we would expect that there will be seasonal algal blooms through the gorge with increased sunlight. These will be flushed from the system during elevated flows where the narrow gorge will concentrate the flood flows.

Given the steep topography of the gorge, it is likely that some sections of the stream will remain shaded at times, even with the willows removed, potentially reducing any adverse effects of increased water temperature. In time, the revegetation of the gully sides with native species will add additional shading to the system. In addition, the channel upstream of the gorge is not shaded for much of its length and yet it supports ten fish species including two nationally threatened species.

The cessation of autumnal leaf fall into the stream will likely have positive effects on stream biota, as the decay of such leaf material can have adverse water quality effects. The removal of willows could also increase base flows to some extent, as willows will no longer be extracting water directly from the stream. Any such increase in baseflow would be advantageous to stream biota, particularly during the summer months.

The additional light that will reach the gorge floor will likely allow terrestrial plants currently growing in the understory and gorge sides to further flourish. A number of native species were observed in the understory during the site visit including prickly shield fern (*Polystichum vestitum*), porcupine shrub (*Melicytus alpinus*), matagouri (*Discaria toumatou*), Austral bracken (*Pteridium esculentum*), *Oleria odorata*, miki (*Coprosma propinqua*), and some *Carex* species (Figure 8) Those plants that are in areas not disturbed by the willow removal or subsequent redistribution of the valley floor gravels, may well continue to grow and indeed thrive with the removal of the willows. However, some specimens such as the miki seedlings on the riverbed gravels will become inevitable collateral damage during the willow removal or subsequent gravel redistribution/migration. The Ida Valley Catchment Group intends to collect many of these seedlings prior to the removal works and grow them on in their Poolburn School tunnel house. We feel that this is a worthwhile thing to do, and will help to ensure the survival of some of those seedlings.

There is a greater proportion of exotic species in the understory of the willows (including but not limited to dog rose, lesser burdock, and a wide range of grasses and perennial weeds), and it is very likely that these will grow in extent and stature following the removal of the willows. Other species such as ferns (including the exotic male fern; *Dryopteris filix-mas*) may be impacted by a higher light level and may struggle until other cover becomes established. However, we do note that our area of expertise is not in plant ecology, and these comments are based on our general knowledge of these native plants rather than any specialist knowledge. Regardless, a weed management plan to keep exotic weeds under control will be important to help control their spread.

Matagouri (*Discaria toumatou*)

Porcupine shrub (*Melicytus alpinus*)

Prickly shield fern (*Polystichum vestitum*)

Austral bracken (*Pteridium esculentum*)

*Olearia odorata*

Miki (*Coprosma propinqua*) seedlings

**Figure 8** Photos of some of the native plants that were observed in the Poolburn Gorge. Most of these were found along the sides of the gorge and thus likely be outside of the footprint of the willow removal. Some (including the miki seedlings) were seen along the riverbed and would likely be lost during the willow removal or subsequent gravel redistribution.

## 4.4 Other Considerations

To remove willow trunks and branches from Sections 1 and 2, which are inaccessible to large machinery, it is intended to cut the timber into pieces of 1 metre or less and float the timber out during rain events. It would then be removed from the channel with excavators on the Thurlow property downstream of the gorge before reaching the Manuherekia River. Based on our observations and discussions during the site visit we think that this could be risky for the following reasons:

1. There is an irrigation weir near the downstream end of the gorge which supplies irrigation water through an elevated pipe to the Thurlow's property. There is the potential that this infrastructure could be damaged by floating timber during high flow events.
2. The deep channel upstream of the downstream weir would most likely be a natural deposition area for material to accumulate – it would be critical to have this regularly monitored to clear debris away as soon as possible, to avoid it building up and damaging the weir or downstream irrigation infrastructure. During the site visit the Thurlow's did feel that it might be possible to get machinery access to the pool above the weir from the true-left side.
3. If the intent is to leave the cut logs in the flood plain for a flood event to refloat them without any further intervention, then there is uncertainty around what size event would be needed based on how the timber is stacked on the banks. Alternatively, it would not be safe to have people working near the river in flood events to guide the timber into the flood flows.
4. The floating material may form debris dams where there are natural constrictions in the Ida Burn channel, which would then need to be cleared. This could cause some logistical issues.

There is a significant amount of debris trapped against willows throughout the Poolburn Gorge (Figure 9). This woody material would need to be removed along with the willow logs, to avoid this material being redistributed downstream and causing damage during flood/fresh events.

The Ida Valley Catchment Group have rightly recognised that monitoring the gorge for willow regrowth and undertaking additional spot spraying where necessary is a critical component of the longterm success of the project, to ensure that willows do not come back to recolonise the area in force. The valley floor area will also return to a more transient/naturally disturbed system following the removal of the willow trees, with the gravels being redistributed around the valley floor during flood events. This will also mean that it will become an area more suitable for the invasion of weed species that flourish in disturbed systems. As such there is a need for a weed control plan that covers not only the moitoring and spot spray plan for the willows, but also for other adventive weed species. Such a plan would ideally include detail of who will do the monitoring and weed control, timing and frequency, and how this will be funded.

The Ida Valley Catchment Group are proposing to undertake some revegetation with plants to be propagated in collaboration with the Poolburn School Tunnel House Project from locally sourced seeds. The aim is to begin planting in spring 2025. To be ready to source and grow plants ready for planting in 2025 we would recommend that a planting plan and species list is developed as soon as possible. We understand that the group is working with a local specialist to develop a plant list that would be suitable for the area. It is probable that plants may also need to be sourced from elsewhere, if the Poolburn School Tunnel House Project cannot supply all the plants needed. However, provided that there is an ongoing monitoring and weed management programme to control weed species, then planting could be spread over many years (and indeed would be beneficial as it would provide for the ability to adapt the planting plan based on plant survival in the initial planting phases). We would also recommend not doing too much planting in the gravels of the riverbed valley floor, as this area will become a naturally disturbed system with the gravels being redistributed around the valley floor during flood events.

Figure 9 Photos of debris caught against willows within Poolburn Gorge taken on the 27 February 2024. This material will need to be removed along with the willows.

# 5 GUIDANCE & RECOMMENDATIONS

## 5.1 Staging of the Works

We would recommend that the two sections accessible by machinery be undertaken first (Section 3 then Section 4), followed by Section 2, and Section 1 left until last (see Figure 5 for where these sections are located within the gorge). This will provide a number of benefits:

» It will provide the ability to finesse the removal approach in the most accessible and open section first (Section 3).

» It will reduce the standing stock of material that could create additional flood flow debris that could otherwise put the downstream weir and irrigation infrastructure at risk.

» By clearing Section 4 before Section 2, it will allow for the flood-floated logs from Section 2 to be trapped in Section 3 where they can be removed by machinery. Based on the site visit there was a wide flood plain in Section 3 that would allow logs to settle for later removal.

» By removing the trees in Section 1 last, it will retain additional trapping material to prevent too much woody material from entering Section 1 and making it to the downstream weir.

## 5.2 Timing of the Willow Removal Works

A multi-year approach to removal:

» Willows have played a major role in determining the physical characteristics of the channel for 50 years, so their removal is going to result in some major changes to the channel form. In addition, the environment is challenging to access in places, which provides some additional complexity to the willow removal approach.

» For these reasons, it is recommended that removal operations are staggered over at least three years, so the whole 4 km of stream length is not subject to drastic change all at once. Staggering willow removal over time will also provide the opportunity for adaptive management to occur as necessary. We understand from the willow removal plan that this is the intent anyway from a practicality perspective.

Fish migration considerations:

» The spawning period for trout is often a period where in channel works are avoided unless there has been a trout spawning assessment done and mitigation measures implemented. On the basis of our site visit it was very clear that the current habitat within the gorge is not suitable trout spawning habitat. The ability for trout to navigate through the gorge is greatly restricted with the debris dams blocking flow, and the slow flowing and sometimes stagnating pools do not provide good trout habitat. In addition, trout spawning is in the winter months when willow removal works would not be undertaken.

» It is typical to minimise any instream works during peak migratory periods for those fish species that migrate to/from the sea. For the Poolborn Gorge this would be limited to tuna/longfin eel and kanakana/lamprey, which have peak migration periods as shown in Table 2. In the case of this location however, the more critical consideration is to be able to undertake the willow removal works during the low flow summer period, as this will help to limit the area of wetted channel that is tracked through and will help to lower the risk of sediment release. Given that the Poolburn Gorge is 200+ km from the ocean, and there is a weir at the downstream end of the gorge that is impassable for fish, the abundance of longfin tuna and kanakana migrating to/from the ocean may be particularly low.

» Thus, on balance we believe that there are far more significant ecological benefits to be made by undertaking the willow removal during the summer low flow period.

Table 2 Migration calendar for longfin tuna and kanakana. Dark blue represents peak periods and light blue the range. Calendar adapted from NIWA (2015).

| Species | Direction & life stage | Summer | | | Autumn | | | Winter | | | Spring | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D | J | F | M | A | M | J | J | A | S | O | N |
| Longfin tuna | Upstream – juveniles | | | | | | | | | | | | |
| | Downstream – adults | | | | | | | | | | | | |
| Kanakana | Upstream – adults | | | | | | | | | | | | |
| | Downstream – juveniles | | | | | | | | | | | | |

## 5.3 Recommended Measures to Reduce Effects/Risks

» We would recommend that all possible options are explored to reduce the length of gorge where the cutting and floating of logs downstream is required. We understand that the contractor has been able to secure a lighter winch rope that should help to increase the length of channel that is able to be accessed to remove the material by machinery.

» Where excavators are required to cross the wetted channel in areas of occluded channel (i.e., through isolated pools), then these locations may need to be be fished out to remove and relocate any fish trapped in them that will not be able to otherwise escape (moving them upstream of the works area). If the eDNA sampling that the group is planning on doing confirms the presence of the 'Threatened – Nationally Endangered' roundhead galaxias in the gorge, then this would become a priority.

» Ensure all refuelling and maintenance of machinery is undertaken away from the river channel and that an appropriate spill kit is onsite at all times.

» There is a significant amount of woody debris trapped against willows throughout the Poolburn Gorge (Figure 9). This material would need to be removed along with the willow logs, to avoid this material being redistributed downstream during flood/fresh events that could cause damage.

» Regular monitoring during the willow removal process to check for debris buildup after flood/fresh events and a programme to remove this material before such buildups become too substantial.

» Look at whether it would be possible to bring in a wood chipper to chip some of the wood material (Figure 10) that can then be used either as a fundraising option for the project or used as planting mulch (in areas outside of the flood inundation zone).

Figure 10 A wood chipper used by Mark Kruishoop to good effect in willow removal projects.

## 5.4 Long-term Management

» A weed control plan that covers not only the monitoring and spot spray plan for the willows, but also for other adventive weed species that will colonise the opened valley floor, will be needed. This should include the timing and frequency of such willow monitoring, the suppression methods to be used (e.g., spot spraying), who will be responsible for the work, and how it will be funded.

» Willows are present upstream of the proposed control area and will be the source of stem fragments that will be transported into the gorge, where they could take root and grow. It will be worthwhile investigating the control of willows upstream of the gorge to reduce this potential for reinvasion.

» The group propose to undertake some native planting once the riparian zone is cleared of willows. It is recommended that a planting plan and species list is developed for these areas as soon as possible. This will help with determining which plant species and the number required to be propagated or purchased, which in turn will inform how much effort and if necessary, extra funding is required to achieve the desired outcome.

» Native planting zones should consider high flow/flood levels to minimise the loss of plants during high flow events. This would include avoiding planting on the gravel beds of the valley floor which will become more transient following the removal of the willows.

» To allow native plantings to establish, pest plant and mammal control is likely to be required. It is probable that pest plant suppression will be required on the valley floor for many years.

## 5.5 Knowledge Gaps

» Apart from the sighting of a small galaxiid fish in the gorge during the 27 February 2024 site visit (Figure 4), there is no information on the freshwater fauna of the Ida Burn as it flows through the Poolburn Gorge. We have provided some guidance to the Ida Valley Catchment Group as to where it would be best to collect water samples for eDNA analysis to help to gain some information on the aquatic biota through the gorge. Unfortunately it was not possible for the group to collect this information prior to the due date for this report.

» There is no information on the current water quality in the gorge, in particular water temperatures during summer low flows, and dissolved oxygen level fluctuations during/after the autumnal input of willow leaves. In the context of what we have said in this report, we do not feel that such information would materially change our recommendations, which are based off observations made during the site visit both within and upstream of the gorge.

# 6 ACKNOWLEDGEMENTS

Thank you to Sam and Deb Stevens for your kind hospitality and accommodation for our site visit, to the Ida Valley Catchment Group and landowners for organising and taking us around the area during the site visit, and to the Access 2 Experts programme for the funding to cover this report.

# 7 REFERENCES

Clapcott, J.E., Young, R.G., Harding, J.S., Matthaei, C.D., Quinn, J.M. & Death, R.G. 2011. Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, Nelson, New Zealand.

Dunn, N.R., Allibone, R.M., Closs, G.P., Crow, S.K., David, B.O., Goodman, J.M., Griffiths, M. Jack, D.C., Ling, N., Waters, J.M. & Rolfe, J.R. 2018. Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation, Wellington. 11 p.

East Coast Excavation Limited. 2023. Ida Valley Catchment Group: Poolburn Gorge Willow Removal Proposal. 11 December 2023. 18 p.

Grainger, N., Harding, J., Drinan, T., Collier, K., Smith, B., Death, R., Makan, T. & Rolfe, J. 2018. Conservation Status of New Zealand Freshwater Invertebrates, 2018. Department of Conservation, Wellington, New Zealand. 25 p.

NIWA. 2015. Freshwater Fish Spawning and Migration Periods. NIWA, Hamilton. MPI Technical Paper No: 2015/17

Sotffels, R. 2022. New Zealand Freshwater Fish Database. Version 1.7. The National Institute of Water and Atmospheric Research (NIWA).

www.eosecology.co.nz
info@eosecology.co.nz

PO Box 4262, Christchurch 8140
P 03 389 0538

SCIENCE + ENGAGEMENT