Instream Habitat Works Trial for Macquarie perch in the Hughes Creek Victoria, a Sand Slug Stream

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Key Points

- Field trials are demonstrating that instream structures assist development and maintenance of stream depth
- Sufficiently securing instream structures to withstand forces of high flow (flood) events is critical to maintaining developed scours
- Further monitoring will be critical in identifying which structure have been most successful in improving Macquarie perch and macroinvertebrate habitat

Abstract

The Hughes Creek is one of the few streams in Victoria to retain a population of threatened species, Macquarie perch (*Macquaria australasica).* The Hughes Creek has been affected by a large sand slug which formed in the early 1900s and was exacerbated by large flood events (Erskine, 2014). The catchment is no longer contributing significant volumes of sand, however high flow events continue to rework sand within the channel, impacting on important Macquarie perch habitat.

The Goulburn Broken CMA (GB CMA) has undertaken instream habitat trials at three locations within a 2 km reach. Structures composed of large wood and rock were created to instigate bed scour and reinstate depth, aiming to improve connectivity and condition of refuge pools. Strategic revegetation with emergent macrophytes to stabilise sand is also being trialled. Macroinvertebrates, fish and physical surveys are undertaken to evaluate the effectiveness of these structures. Pre work surveys occurred in autumn 2015, with comparable surveys repeated in autumn 2016. A minor flood was experienced early January 2016, which damaged many of these structures, requiring repair and reinforcement with additional anchoring rock. It was noted that where the structures remained in situ, the scour has been retained, though flow variations and further monitoring is required.

Keywords

Sand slug, instream habitat, Macquarie perch, Hughes Creek, scour, surveys, macroinvertebrate

Introduction

This paper details instream habitat works trials undertaken in the Hughes Creek to reinstate depth for fish passage and habitat, with a focus to benefit the threatened species, Macquarie perch (*Macquaria australasica).* Macquarie perch are listed as endangered under Federal and State legislation. Only eleven populations remain in Victoria, including one population in the Hughes Creek (Kearns and Tonkin, 2015).

Hughes Creek is an unregulated tributary of the Goulburn River, located in northern Victoria. The creek begins on the granite plateau of the Strathbogie Ranges before winding its way through farmland and a series of gorges and confined reaches. Erskine (2014) divided Hughes Creek into eleven reaches based upon their geomorphological characteristics (Figures 1 and 2). The lower reaches are currently impacted by a large sand slug, which formed in the early 20th century as a result of land clearing and channel incision in the region, amplified by large flood events.

With improved land management over time, the catchment is no longer a source of sand. Significant reworking of the sand occurs however in reaches 3, 4 and 5 where Macquarie perch predominate (Erskine, 2014). Fish surveys spanning the past ten years confirm reach 4 is the stronghold for the population where the best habitat remains (Kearns 2015). With a higher prevalence of adult Macquarie perch (>200mm) and young of year recruits than found anywhere else in the stream, this reach is a critical refuge and breeding zone. Burial of riffles, deep pools and large wood by sand within the stream channel poses a significant threat to the continuing survival of Macquarie perch in Hughes Creek (Kearns and Tonkin, 2015). This is a significant management issue for the GB CMA and a number of investigations have been undertaken around fish monitoring and geomorphological changes in Hughes Creek to improve knowledge and inform management actions.

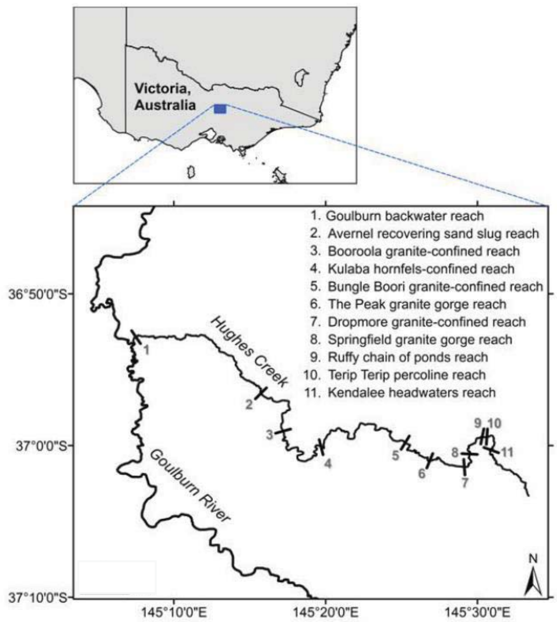


Figure 1. Location of river reaches (Erskine, 2014)

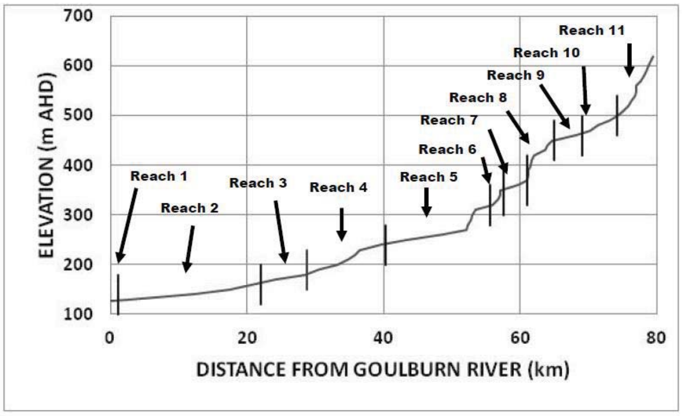


Figure 2. Long profile of Hughes Creek showing river reaches (Erskine, 2014)

Field Trials and Monitoring

Trial Sites

Three sites were selected to trial the effectiveness of several different instream structure designs to reinstate depth in former habitat pools degraded by sand. The trial sites are within Reach 3, as defined by Erskine (2014), and span two kilometres. Will Trueman identified these sites as priorities for enhancement in January 2015 (*pers. comms. 13 Jan 2015*), because of their reasonably intact fringing vegetation, past habitat value and for Site 3, the long-term fish monitoring data available. Because these trial sites occur downstream of the recognised refuge pools of Reach 4 (Figure 3), they provide an opportunity for the Macquarie perch population to extend their range and size. If successful, this would achieve a first step in the long term aim to reconnect the population to the Goulburn River, thus reducing the vulnerability of this isolated population to drought and fire.

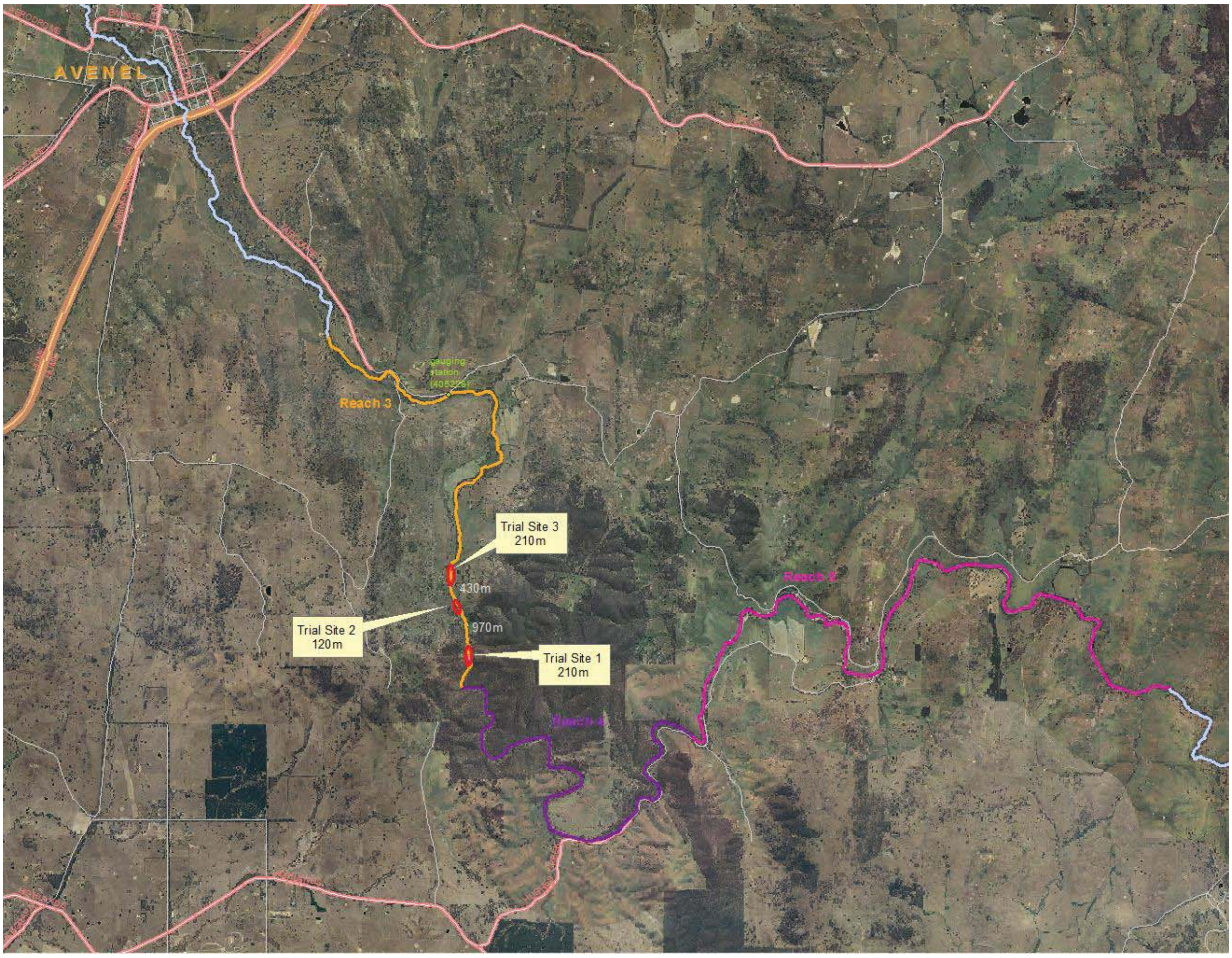


Figure 3. Location, size and distance between the three trial sites within Reach 3 (Erskine 2014)

Site 1 had a large sand slug (>400 m^3) along the right bank, with a shallow, narrow flow contained predominantly to the left bank (Figure 4). Site 2 retained a deep pool below which flow was restricted to the right bank by a sand island, before broadening out across a cobble bed and ford crossing (Figure 5). Site 3, a regular fish monitoring site, had been a lengthy deep pool that has become shallow with sand benches established along the left bank and mid-length, a sand slug island (Figure 6).

Figure 4. Site 1 view upstream from downstream extent taken 30 April 2015

Figure 5. Site 2 view upstream from downstream extent taken 13 January 2015

Figure 6. Site 3 view upstream from downstream extent taken 13 January 2015

Pre Monitoring

In autumn (Mar-Apr) 2015, prior to work commencing, fish, macroinvertebrate and physical surveys were undertaken. These results were to provide a benchmark for change to be evaluated against.

Arthur Rylah Institute (ARI) staff undertook fish surveys at 16 sites using fyke netting and backpack electrofishing techniques. Nine standard monitoring sites and seven new sites were surveyed within 24 kms, including the three works trial sites. In 2015 the highest number of Macquarie perch and river blackfish were recorded since surveys commenced in 2006, largely driven by the successful recruitment of both species during the past two years. Over 70% of Macquarie perch young of year were collected during the surveys within the gorge, highlighting Reach 4 as a vital breeding and nursery area. Downstream of the gorge, the next largest numbers of Macquarie perch and blackfish were found at each of the proposed trial sites.

In accordance with the Victorian EPA 'Guidelines for Environmental Management Rapid Bioassessment Methodology for Rivers and Streams' (VRBA), a 'sweep' or edge sample was collected and assessed at each of the three sites, along with comparable control sites. The Signal Index Scores for each site were 5.5-5.6 with similar species identified in each sample, including the Mayfly nymph (*Leptophlebiidae)* with a SIGNAL Grade of 10 and two additional Families representing SIGNAL Grade 8 (EPA 2002).

A physical survey was undertaken with surface levels recorded in cross sections at ~20 m intervals. The plans produced confirmed the low flow was only shallowly confined by sand in the wider channel, with very little bed drop across each of the trial sites.

Instream Works

Stockpiled wood was brought to site, along with some wood salvaged from the Creightons Creek fire in 2014. This material was large in size (>1 m diameter), but already docked to lengths of <2 m. Only a few of these retained habitat complexity with hollows or as stumps with roots intact. As the majority of wood available for use was structurally simple, rock was also carted to site for anchoring the wood in place and to add habitat diversity.

Prior to instream works commencing in May 2015, Prof Robert Keller, was consulted on structure designs to produce and maintain desired bed scours (*pers. comms. 30 Apr 2015*) and results from several similar projects (Saddlier, S.R. 2004, 2002, Lintermans, M. 2004, Tonkin *et al* 2015) were also considered, before deciding on the following five designs for application.

- Downstream angled groyne raised ~20 cm above the bed, to create scour as water passes beneath the obstruction
- Upstream angled groynes placed on the bed to encourage scour around the protruding end

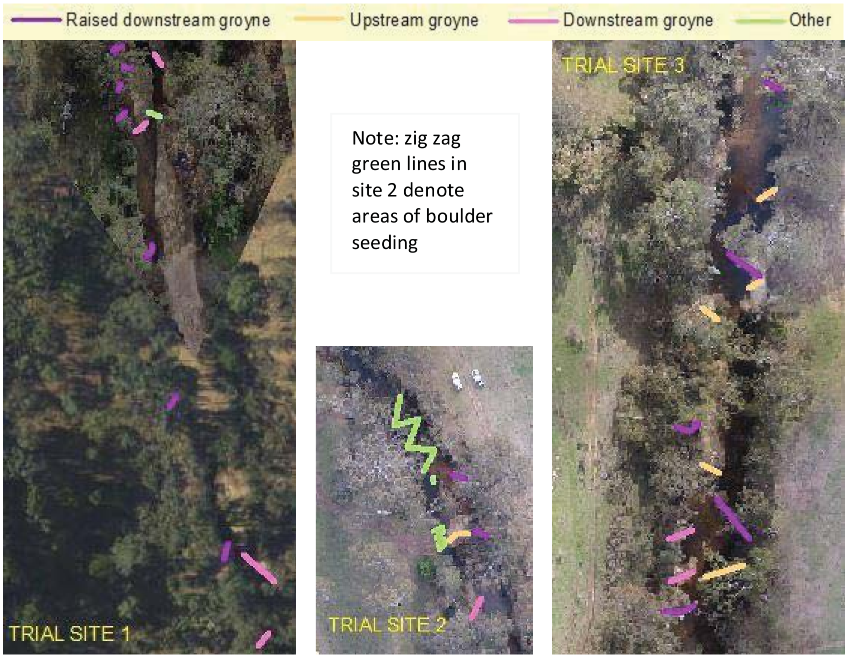
- Log jam extending into channel from both banks to constrict passing flows and cause bed scour
- Traditional downstream angled groynes placed on the bed to deflect flows and encourage deposition along the bank or island
- Boulder seeding to provide localised scours and shelter

As many of the lengths of wood were shorter than required, several pieces were often placed together to overlap and extend the structures length. In each instance, rock was placed either side and on top of the wood to anchor it in place. Where possible, existing rock and other embedded material was also utilised to shore up the structures (Figures 7 and 8).

Figure 7. Completed structures at Site 3

Figure 8. Upstream angled groyne on left and raised downstream angled groyne on right

Overall, almost 50 structures were installed, with raised downstream groynes predominating (Figures 9a-c). In all instances, some scour was immediately apparent, however it was anticipated that high flow events moving large volumes of sand would be required to generate significant bed scours and test the capacity of the structure to maintain them.



Figures 9. Type of structure installed at each site. a) Trial Site 1, b) Trial Site 2, c) Trial Site 3

High Flow Impacts

On January 4 2015, up to 80 mm was recorded falling in a very intense summer storm overnight in the lower half of the Hughes Creek catchment. A maximum flow height of 2.84 m was recorded at the gauging station, 5 km downstream of the trial sites (Figure 10). Many steep gullies and minor tributaries carried large amounts of debris into Hughes Creek (pers. comms. 5 Jan 2016) along with the water that caused flash flooding. Erskine (2014) reported that a major flood event in early September 2010, also demonstrated a very rapid rising flow, during which time much sediment transport and geomorphic work was likely performed.

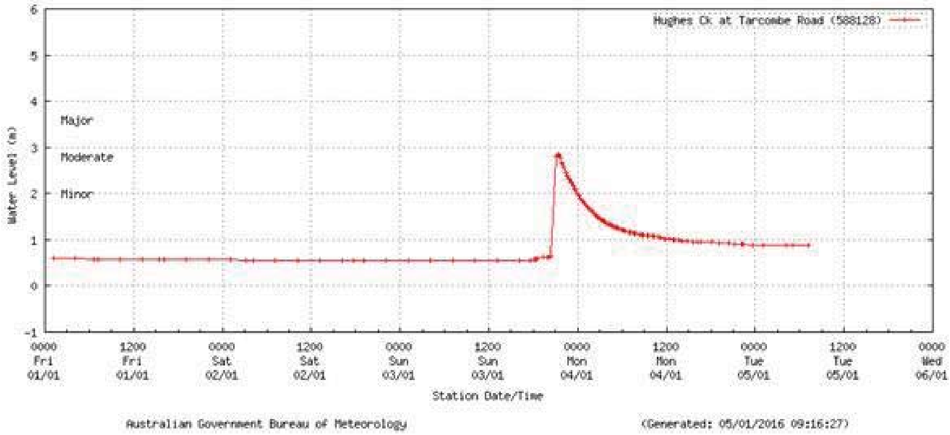


Figure 10. Stream Flow Records 1-6 January 2016 at Hughes Creek at Tarcombe Road (0405228) downloaded from the BOM website

Though the January 2016 flood event was only considered minor (<1 in 4 year), having already been expelled from the confined upstream gorge, the forces in the channel at the trial sites were not significantly less than would be applied in a larger flood event given that the additional water can spill over the adjoining floodplain.

On review of the trial sites on 6 January, many of the large log groynes constructed in channel had moved. Some wood had simply shifted out of designed alignment, while others had been transported downstream 20-30 m, with a further few not found anywhere in proximity. In all instances, rock used remained in situ.

Every length of wood that was keyed in to the bank (partly buried by being either pushed or dug in) remained as positioned. Despite dimensions of >1 m diameter and lengths of 1.5-2.5 m, unsecured wood was most often transported by flow. With almost 50 per cent of all design types failing, there seemed to be little correlation between structure design and its resistance to flow (Figure 11). Where the structures remained intact, the wood used was keyed into the bank and the intended scour has been maintained to some extent, despite the significant reworking of sand at each of the trial sites.

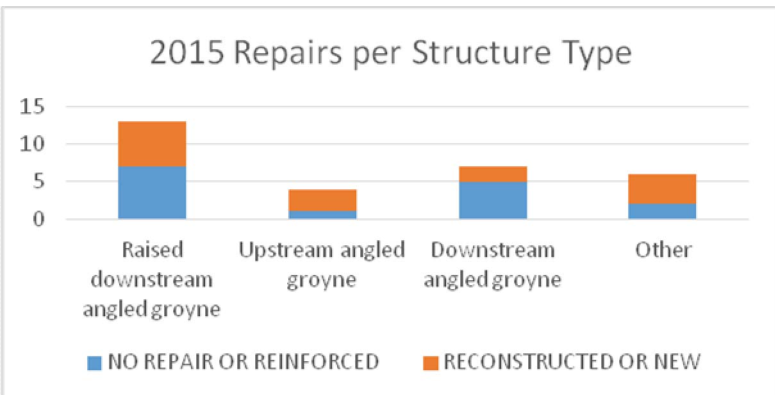


Figure 11. Extent of repairs undertaken post flood 2015 per structure design

In February 2016, works were undertaken to repair and reinforce the trial works to withstand future high flows and thereby enable more accurate assessment of scour depths and longevity per design. In total, twelve structures were reconstructed with longer and more complex lengths of wood. These were keyed into the bank and further secured with anchoring rock (Figures 12a-d).

Figure 12a. Trench dug into bank for desired alignment.

Figure 12b. Length/s of wood placed in trench at desired angle.

Figure 12c. Anchoring rock placed on and around wood.

Figure 12d. Trench filled in with soil and compacted.

Five structures were not reinstated at Sites 1 and 3 due to inability to secure wood in channel and in the case of Site 1, due to closure of a secondary channel. Three new structures composed predominantly of rock were installed at Site 3 to induce localised scour and address changes in deposition since the January event, along with one additional raised groyne. Of the thirteen intact structures, ten were reinforced with more anchoring rock.

With the post work autumn surveys anticipated within the month following the structure repairs, it is expected the high degree of disturbance at sites will influence these results. The fish and macroinvertebrate surveys will continue to be undertaken, with at least another year of monitoring planned to capture post work change when the sites are further established. The physical survey however has been postponed, as it was decided it was not able to provide sufficient comparative data for the expense with around half of the structures failing and site features reverting to much as they were prior to works. It is anticipated that future high flow events will once again rework the sand to develop scours at each of the now more robust instream structures, enabling the post work surveys to better measure the size, depth and maintenance of developing scours, along with the species that may utilise them in time.

Conclusions

The Hughes Creek is a very flashy stream with rapid rises in flow following catchment rain. With predominant flows low to moderate, any wood used in the structures will remain dry and buoyant in rising water, being prone to move unless securely anchored in place. Embedding the wood in the bank appears to be the most successful way of achieving this, reinforced further with pinning rocks. With a much greater density, large rock is less liable to move and appears to produce, scours of similar depth and size to other designed structures. Largest along its upstream edge, scours around these seeded boulders increases with relative size (D50) of rock used.

In retrospect, the stockpiled wood that was readily available and utilised in the initial structures, was not best suited for application in the Hughes Creek. The long, branching lengths of wood used in the repairs, was more successfully secured in place, and not unsurprisingly, also appeared to provide more niche habitats. The undamaged structures have maintained some depth post flood, however the scours are not as significant as they were observed to be before the January flood. It will be good to verify with further monitoring how the scours develop in size with consistent low to moderate flows.

Further monitoring is scheduled for repetition in twelve months, anticipating changes may be captured in the fish and macroinvertebrates populations utilising this habitat; pre-works, immediately following (repair) works and 12 months post works. With trial revegetation works to stabilise the sand where high flows pass being undertaken in autumn 2016, it is hoped that the site will have stabilised and commenced providing useful habitat to many creatures by the 2017 surveys.

Ideally the Hughes Creek experiences changes in flow before repeating the physical surveys that have been postponed until 2017. In particular, a high flow would test the resilience of the reinforced structures, predicted scour development and longevity. Early indications from scour measurements undertaken a month following repairs verify quite similar results per design, though a sequence of raised downstream angled groynes spaced equal distances to flow width (4 m) at Site 1, also demonstrate scour connectivity. Whether coincidence or reason, it will be worth monitoring further and, if possible, replicating elsewhere with further habitat trial works.

For further details visit: www.gbcma.vic.gov.au/projects/hughes_creek

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