17th May 2016

An ecological fish survey of Reservoir creek to determine fish passage barriers, and recommendations for improved fish passage in these problem areas.

Overview

Fish and Wildlife Services were engaged by Tasman District Council as part of the State of Environment programme (Fish) to conduct an ecological survey in Reservoir Creek to determine if and where fish passage barriers are affecting fish movement through the catchment. Methods generally following Joy *et al* 2013, including a single pass electro fishing survey which took place on the 18th March, followed by a spotlight survey on the 25th March. Six stream reaches in Reservoir Creek were surveyed from Salisbury Bridge through Concordia Lane (*map 1*). The following report outlines the findings of a fish survey carried out by Fish and Wildlife Services, and highlights areas identified as fish passage barriers with recommendations on how to mitigate the effects. This report also takes the opportunity to suggest sections of Reservoir Creek where habitat for native fish could be enhanced.

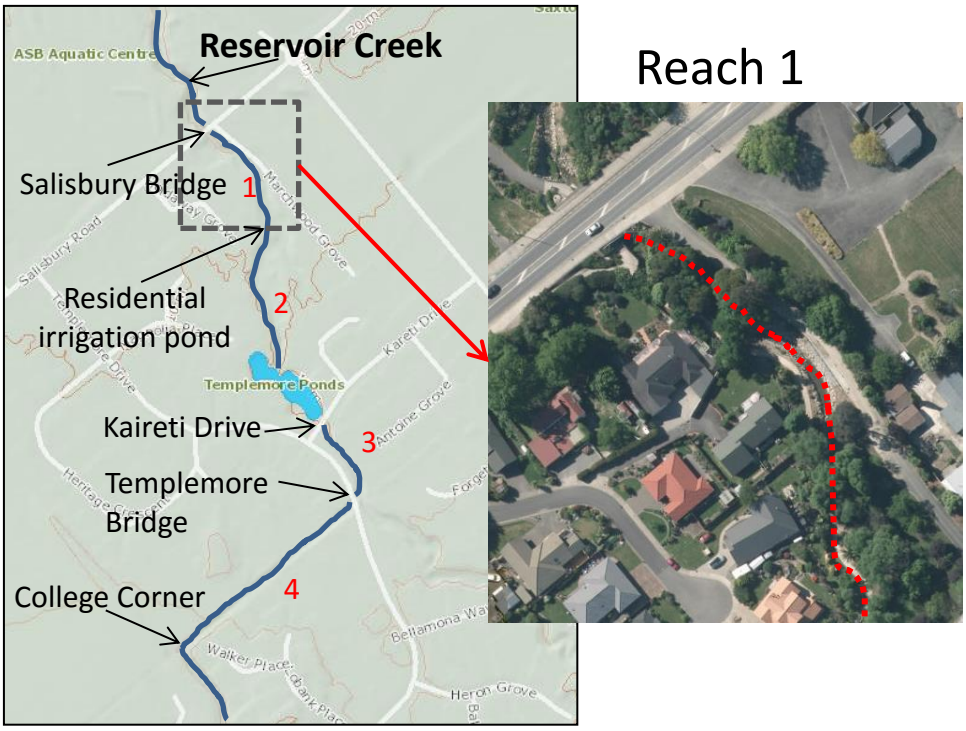
Table 1. Number range per 100m for the abundance classifications used in this report

Abundance classification	Number of individuals per 100m
Rare	1-5
Present	6-20
Common	21-50
Abundant	51-100
Very abundant	100+

Reach 1

Salisbury Bridge to Residential irrigation pond (*map 1*)

GPS (NZTM 2000): N 5424100 E 1616833 to N 5423984 E 1616893



Map 1. Reach 1 Salisbury Bridge to Residential irrigation pond

Creek habitat

Directly above Salisbury Bridge (*fig* 1) a series of large rocks lining the creek bed create a mixture of pools and riffles. Further upstream deeper pools develop with a fine sediment bed. A mixture of riparian planting creates cover for fish species and canopy cover shades large sections of the creek, and at times the grass verge from the footpath travels right to the creeks edge.

Figure 1. Large rocks upstream Salisbury Bridge

Results

Species	Numbers	Length range (mm)
Eel < 200mm	Very abundant	0-200
Longfin eel	Abundant	200-800
Shortfin eel	Abundant	200-400
Inanga	Abundant	50-90
Juvenile bully	Very abundant	10-20
Common bully	Abundant	50-90
Redfin bully	Abundant	40-80
Giant bully	Common	
Smelt	Rare	
Gambusia	Possible sighting	

Discussion

Reach 1 shows very fish friendly habitat with large shaded pools, cover for fish, and riffles throughout. The diversity of tolerant native fish species in this reach is high and almost all species observed were in abundance, with eels (less than 200mm) and bullies very abundant (*table 1*). Giant bullies were common (*table 1*) and smelt were rare (*table 1*). There was a possible sighting of the pest fish gambusia (spp. *Gambusia affinis*), however this was not confirmed. No obstacle to fish passage was found in this reach.

Kokopu and koaro were not observed in this reach even though habitat appears favourable with deep pools to regulate water temperature and plenty of canopy cover. Interestingly, no kokopu or koaro were found in any of the six reaches surveyed. Small populations of banded kokopu have been observed below Templemore pond before (December survey, 2006[1]), however more recent surveys have found no kokopu species. Areas around Reservoir Creek have undergone a number of changes over the last 10 years including the development of many subdivisions, instream works (e.g. reservoir spillway), and forestry practises in the upper catchment which have all impacted the streams health. This has changed large parts of the streams habitat and quality of the water. Kokopu and koaro are sensitive to poor water quality which may give a clue as to why they were not observed in this reach. Therefore even though habitat in reach 1 appears acceptable for fish species, other limiting factors such as poor water quality, competition from other fish species and predation might be restricting kokopu and koaro numbers.

Large rocks lining the stream bed just above Salisbury Bridge (*fig 1*) need to be monitored as there is a risk of debris building up causing a blockage under the bridge. Currently it is clear. The irrigation pond (*fig 2*) referenced as the upper boundary of this reach is believed to be put in by a nearby resident. Concrete has been placed in the stream to dam the water. Although it is a fairly minor structure and does not act as a barrier for fish movement it is recommended that it is pulled out. This is because it may lock up debris and as a result create fish passage issues.

Figure 2. Residential irrigation pond

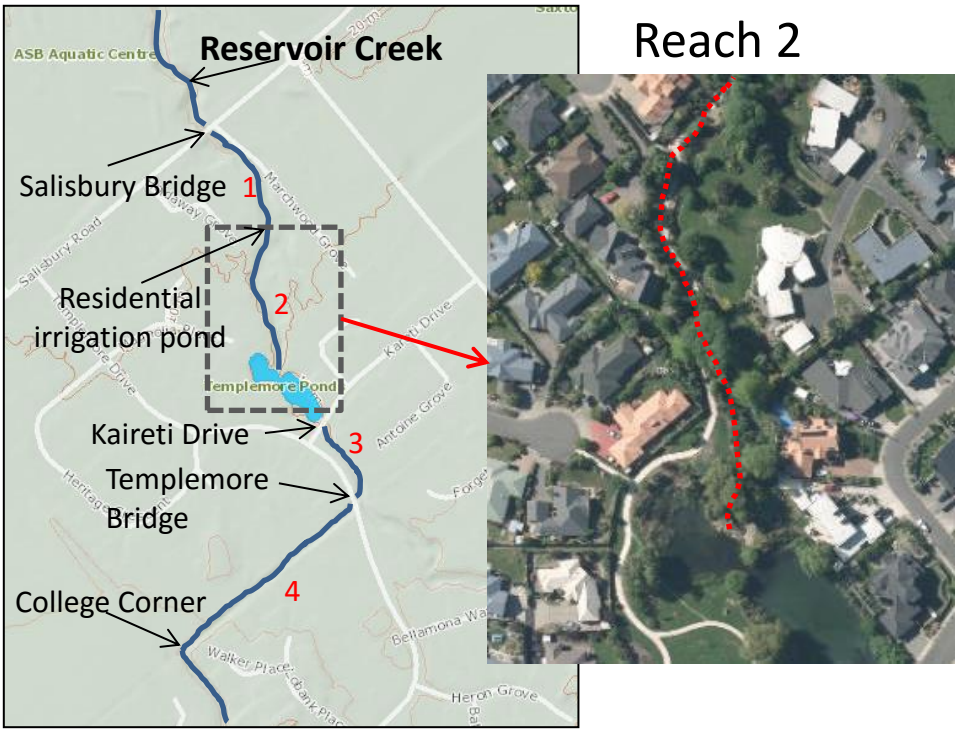
Further modifications by local residents have been carried out to the stream at the top end of this reach. Sticks and smaller debris had been placed as a small damming mechanism so that water could be taken from the site for irrigation on the true left. This structure was removed by Fish and Wildlife services because it had the potential to become a fish passage barrier.

[1] Tasman District Council fish survey master sheet

Reach 2

Residential irrigation pond to Templemore pond (*map 2*)

GPS (NZTM2000): N 5423984 E 1616893 to N 5423871 E 1616902



Map 2. Reach 2 Residential irrigation pond to Templemore pond

Creek habitat

Majority of this reach comprised of a series of deep pools 500mm to 1500mm deep with a fine gravel bed. Riparian planting is in abundance creating shade over much of the stream.

Results – spotlight survey

Species	Numbers
Eel < 200mm	Abundant
Longfin eel	Abundant
Shortfin eel	Abundant
Inanga	Very abundant
Juvenile bully	Very abundant
Common bully	Abundant
Redfin bully	Abundant

Discussion

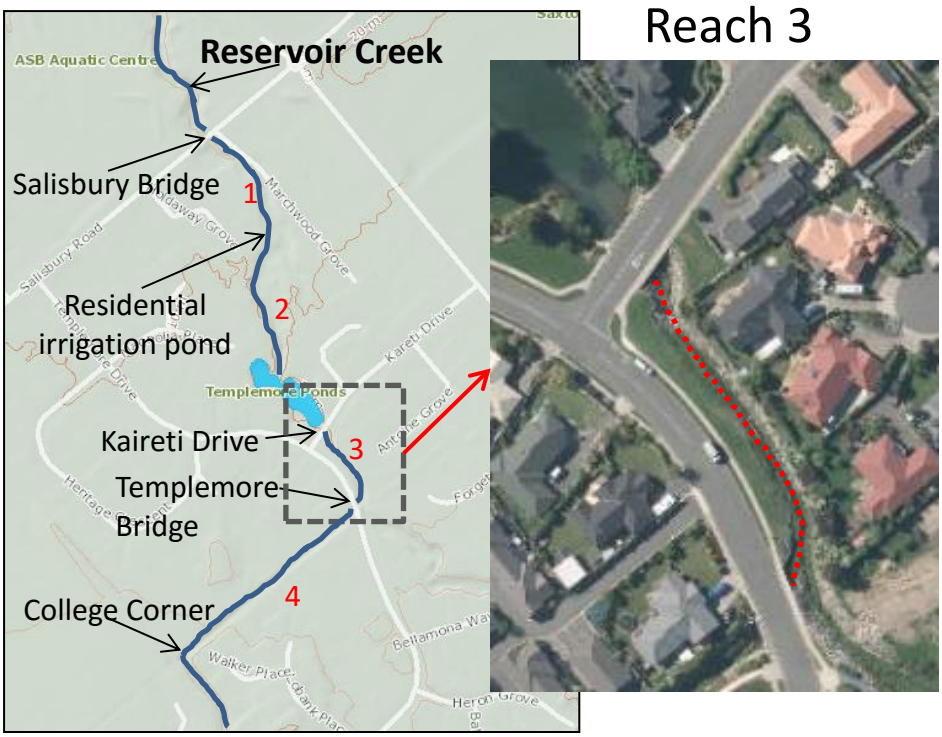
Due to the difficulty with electric fishing the deep pools in this reach, a spotlight survey was preferred. These deep pools are surrounded by significant riparian planting which provides good habitat for all seven species surveyed, as evidence by their abundance. Eels (less than 200mm) and inanga were present in large populations, with inanga numbers estimated above one thousand

individuals. Whilst you would expect high numbers of inanga in the lower river at this time of year due to their spawning cycles, for a small stream such as Reservoir Creek, these numbers are significant. Inanga were also found in the spillway leading into Templemore pond and Templemore pond itself. This shows the Templemore pond spillway is functional for fish passage. Fish are moving freely through this reach and there are no barriers to fish passage. One recommendation for reach 2 would be to remove a fallen tree in the stream directly downstream of the spillway. It is congesting the stream and poses a threat in the event of a flood.

Reach 3

Above Kareti Drive Bridge to Templemore Road Bridge (*map 3*)

GPS (NZTM2000): N 5423781 E 1616955 to N 5423702 E 1616990



Map 3. Reach 3 Above Kareti Drive Bridge to Templemore Road Bridge

Creek habitat

The habitat above the Kareti Drive Bridge differs from the downstream reaches in that large rocks line the channel and banks (*fig 3*). As a result, voids have been created with a low percentage of gravels and cobbles present within them. A large portion of this reach consists of slow moving water as a result of its passage through and beneath the large rocks. No obvious pools can be seen. Some well-established grasses cover the bank edges but the creek is void of any significant riparian planting and canopy cover.

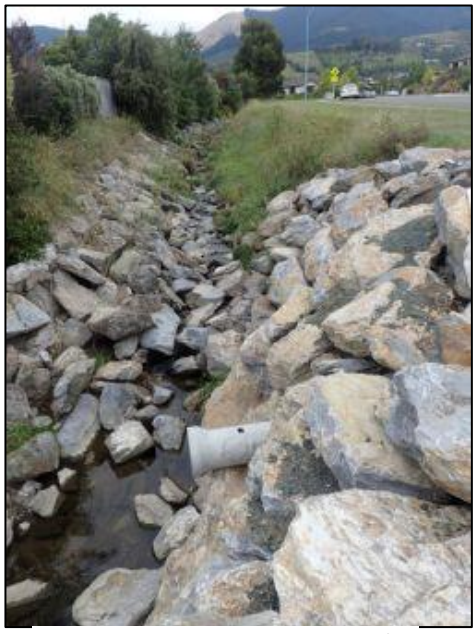


Figure 3. Upstream Kareti Drive Bridge

Results

Species	Numbers	Length range (mm)
Eel < 200mm	Abundant	0-200
Longfin eel	Abundant	200-1000
Shortfin eel	Common	200-350
Inanga	Common	50-90
Common bully	Very abundant	40-70
Redfin bully	Present	50-70

Discussion

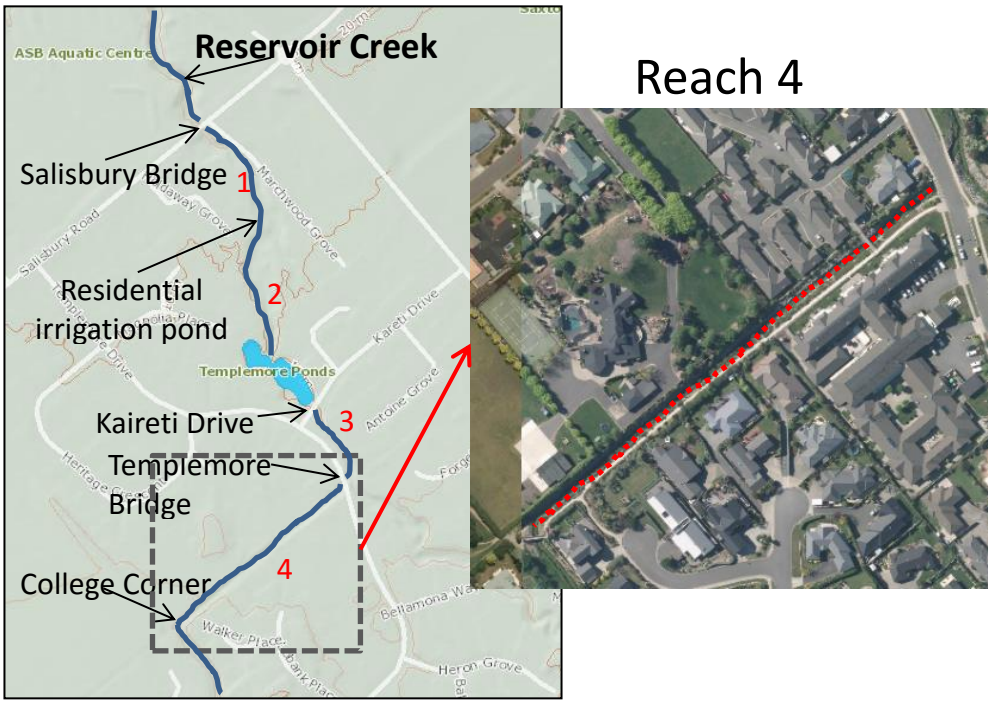
Before Fish and Wildlife Services had surveyed Reservoir Creek, an area directly above the Kareti Drive Bridge was pointed out as being a potential problem for fish passage by Trevor James (resource scientist at Tasman District Council). The problem lies with the large rocks armouring the creek bed, where at times the channel was not obvious and flowed beneath these rocks. A realignment of some rocks to create a more structured channel and fish passage was carried out by Mr James.

The fish data results indicate that fish passage through this reach is sufficient with longfin eels, common bullies and eels (less than 200mm) all either abundant *(table 1*) or very abundant right up to Templemore Bridge. A large number of the eels observed were between 50- 60mm which suggests they are migrating upstream. The low numbers of inanga, in comparison with surrounding reaches, is believed to be attributed to habitat factors, such as a lack of pool habitat and overhead planting, and not due to fish passage barriers. Whilst it appears fish passage is sufficient in reach 3, there is an opportunity to further improve fish passage by manoeuvring the larger problem rocks in the bed to create a meandering low flow channel. Fish habitat can also be enhanced by creating more pools in the stream and establishing some riparian planting for stream shading.

Reach 4

Templemore Road Bridge to College Corner (*map 4*)

GPS (NZTM2000): N 5423702 E 1616990 to N 5423545 E 1616805



Map 4. Reach 4 Templemore Road Bridge to College Corner

Creek habitat

The true left side of the stream is rock armoured whilst the true right side consists of built up gravels and large cobbles. Native riparian planting creates some bank cover and canopy shading. The creek itself consists of mainly fine gravels and large cobbles which create a low flow channel and the larger rocks on the true left form a series of pools. Voids amongst the large rocks on the true left create a perfect habitat for eel species.

Figure 4. Downstream College Corner

Results

Species	Numbers	Length range (mm)
Eel < 200mm	Abundant	0-200
Longfin eel	Abundant	200-1200
Shortfin eel	Common	200-350
Inanga	Very abundant	40-90
Common bully	Abundant	40-70
Unidentified bully	Individual	120

Figure 5. Rock armouring creating pools

Figure 6. Low flow channel

Discussion

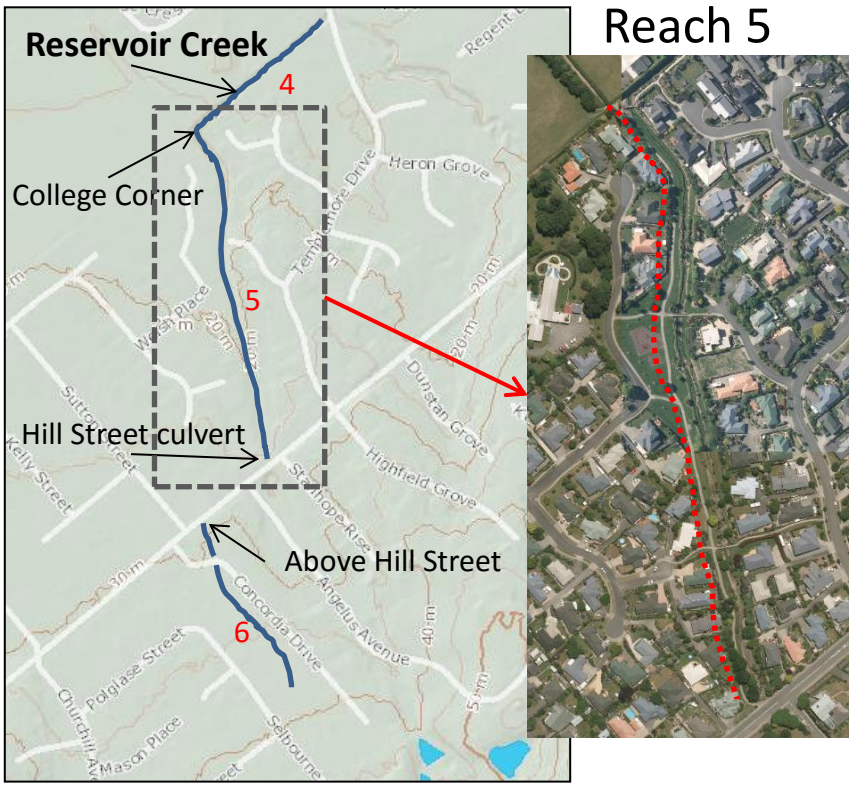
This reach showed a dominance of longfin eels, with shortfin eel numbers observed as common. Eels (less than 200mm) and common bullies were abundant and inanga were very abundant. Many of the longfin eels observed were greater than 500mm with the largest measuring 1200mm in length. This was a female longfin eel with enlarged eyes which suggests it is in spawning condition and therefore may be migrating to sea. The large rocks on the true left of the creek create great habitat for longfin eels to grow very large and in good numbers, whilst the pools they create allow large populations of inanga and common bullies to thrive. No fish passage barriers are present in this reach.

This reach is a good example of a successful compromise to provide both storm water capacity and fish habitat. The redevelopment of this reach was limited by only having a small area available to work with; therefore there was little opportunity to establish overhanging trees and a variety of bank shape in this stretch of Reservoir Creek. With this in mind, what has been developed is a riparian planted storm water drain which provides fish passage and fish habitat (see *fig 4, 5* and *6*), proven by the high numbers of fish present. Ideally, more canopy cover would be planted similar to the cover seen upstream of Salisbury Bridge (reach 1 and 2).

Reach 5

College Corner to Hill street culvert (*map 5*)

GPS (NZTM2000): N 5423545 E 1616805 to N 5423102 E 1616902



Map 5. Reach 5 College Corner to Hill street culvert

Creek habitat

This reach shows a stark contrast between different fish habitats. The lower section of this reach is quite uniform and is almost one continuous pool. The grass bank, which has no riparian planting, creates a straight lined channel filled with moderately sized cobbles (*fig 7)*. The upper section is very similar with the only difference is there are a few more trees present (*fig 9*). The middle section however has had some obvious development shown by large rocks surrounding the bed forming a stable bank. Rocks within the bed have created a sequence of riffles and pools and the entire area has been planted out providing excellent shading and cover (*fig 8*).

Results

Species	Numbers	Length range (mm)
Eel < 200mm	Abundant	0-200
Longfin eel	Abundant	200-1000
Shortfin eel	Abundant	200-350
Inanga	Abundant	50-90
Common bully	Common	40-70

Figure 7. Reach 5 lower section

Figure 8. Reach 5 middle section

Figure 9. Reach 5 upper section

Discussion

Although in lower numbers than downstream, inanga were still abundant in reach 5 up to the Hill Street culvert. Eels of both species were also abundant, especially in the uniform sections of this reach. Common bully numbers were lower compared to downstream reaches which is likely due to habitat issues or predation. Cover in the stream is minimal in the lower and upper section of this reach (*fig 7 and 9*); therefore it does pose the question of how much predation of inanga and bullies is occurring by eels. There is also no canopy cover over these areas. This means over the warmer summer months, because there is little shading, the streams temperature can be unfavourable for fish which might explain the lower numbers in these sections.

The middle section of reach 5 (*fig 8*) showed higher numbers of inanga and bullies compared to the lower and upper sections. This is another example of an urban stream redevelopment providing good habitat for the more tolerant fish species. With this information in mind it is recommended some riparian and canopy planting takes place in the lower and upper section of reach 5 to provide more fish cover and stream shading. There might be an opportunity to get local schools involved with the planting.

Twenty meters below the Hill Street culvert at the head of a pool, three large rocks form a raised shelf (*fig* 10) which under low flow conditions could create a difficult passage for fish upstream. Currently it does not appear to be an issue for fish passage, however during the summer months when flows become low it will need to be assessed again. An option may be to install some mussel ropes to aid fish passage. A large pool at the base of these rocks contained several inanga therefore their placement is improving fish habitat.

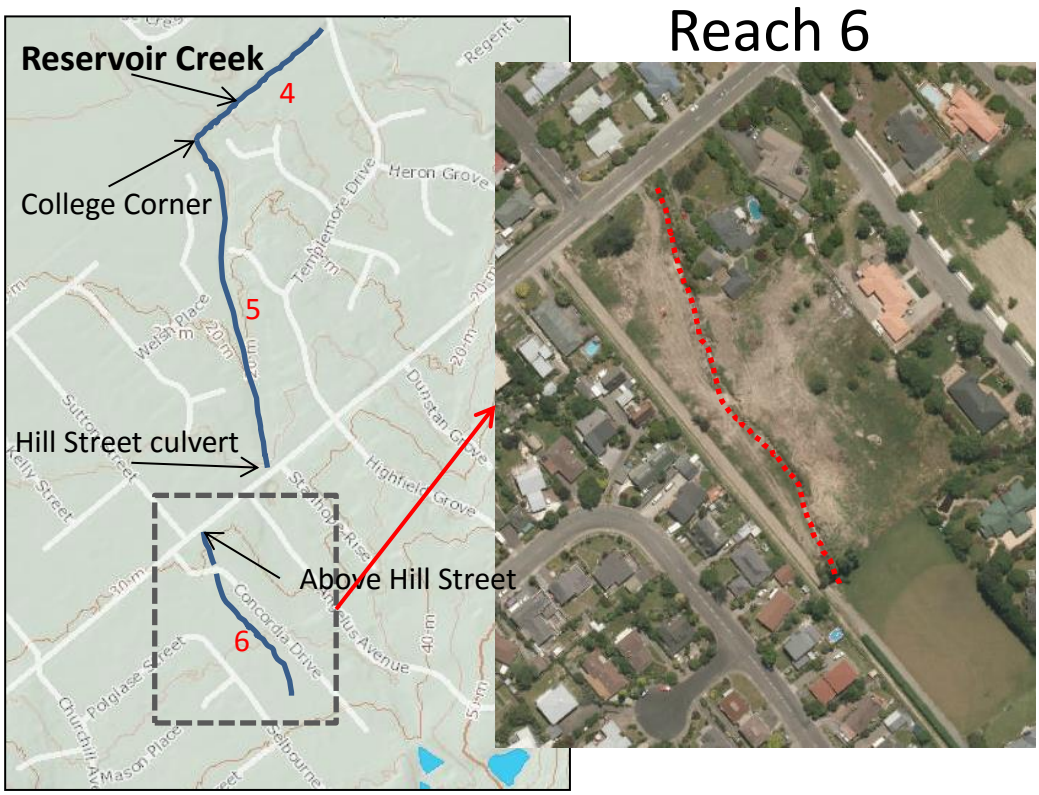
There are no fish passage barriers in reach 5.

Figure 10. Large rocks downstream Hill street culvert

Reach 6

Above Hill Street culvert

GPS (NZTM2000): N 5422986 E 1616823



Map 6. Reach 6 Above Hill Street culvert

Creek habitat

This stretch of creek is narrow with shallow, fast water and a low number of pools (*fig 11*). Gravels and cobbles provide fish habitat with larger rocks creating some cover and a slight meander effect. Reach 6 shows a high percentage of fine sediment cover; at times reaching 80%. The sediment has likely flushed downstream from the Reservoir dam in the upper catchment. Some riparian planting is present overhanging the creek. Watercress is dominant at times near the household entrance culverts.

Figure 11. Upstream Hill street culvert

Results

Species	Number	Individual Lengths (mm)
Eel < 200mm	9	60, 80, 80, 100, 120, 130, 120, 50, 70
Longfin eel	7	220, 260, 250, 300, 500, 200, 250
Shortfin eel	2	240, 200
Common bully	1	50
Koura	1	50
Unidentified eels	14	(200-300mm size range)

Discussion

The Hill Street culvert (*fig* 16) between reach 5 and 6 appears to be acting as a true fish passage barrier. Furthermore, immediately above the Hill Street culvert two potential fish passage barrier are apparent. The first (*fig 12*) is a build-up of rocks behind a piece of uplifted filter cloth which had been placed during the redevelopment of this reach. It is unknown how long this barrier has been in place; therefore it is recommended a survey is undertaken next year to establish just how intrusive it has been on fish passage. The cloth was partially cleared by Fish and Wildlife Services, but a complete removal is recommended (*fig 13*).

Figure 12. Uplifted filter cloth backing up water

Figure 13. Uplifted filter cloth partially cleared

The second barrier (*fig 14*) is minor and a result of a drop in gradient within the stream caused by rock armouring from the bank to the bed. Adult fish would not have a problem passing this area; however juvenile fish might find it a partial barrier. Use of mussel ropes or a rock ramp might allow easier access upstream.

Figure 14. Rock armouring causing a gradient drop in the stream

Further upstream on Concordia Lane there are four culverts created for vehicle access to households. At least two of these culverts have a build-up of rocks and gravels which under low flows could impede fish passage *(fig 15*). This is due to the water percolating through the gravels and not as a surface flow. The gravels do however create a good habitat for fish when there is flow. Therefore no action needs to be taken in these culverts.

Figure 15. Rocks and gravel build up in Concordia Lane culvert

Surveys in February 2008, and January 2012 (TDC master sheet) found banded kokopu numbers above Hill Street as observed and rare respectively. These surveys were carried out before the Concordia subdivision was built when habitat (shaded pools etc.) was conducive for banded kokopu. The present survey found no banded kokopu in reach 6. The current creek habitat appears unsuitable for kokopu to inhabit largely due to little canopy cover, no deep pools and a potentially

low food supply due to the smothering of fine sediment which may be limiting invertebrate abundance. Kokopu have moved up into this reach previously, as evidence by the 2008 and 2012 surveys. Therefore the two potential fish barriers (filter cloth and gradient drop) and the Hill Street culvert may be an impediment for kokopu passage but is unlikely to be completely preventing their migration. Instead, it seems unsuitable habitat explains why banded kokopu and possibly koaro are currently not found in reach 6.

Despite the lack of pool habitat and fine sediment deposits, reach 6 has many riffles and runs for the more tolerant native fish species to inhabit. Therefore it would be expected similar species observed downstream of Hill Street would also be observed in reach 6. Whilst this is the case for longfin and shortfin eels, the lack of other species such as inanga and bullies is of concern. Only one adult common bully was observed and inanga were absent. Similar rock armoured habitat as seen in reach 6 was also seen in downstream reaches (particularly reach 3) and fish species were still represented abundantly. Therefore, habitat may be an issue for these particular fish, but it does not solely explain why less fish species were observed in reach 6. This suggests a fish passage barrier occurs between Hill Street and Concordia Lane.

The barriers within reach 6 already described are minor, with only the build-up in front of the filter cloth a partial fish passage barrier. Whilst this filter cloth could be an explanation for the lack of native fish species past this point, because of its likely recent occurrence, it is not thought to have played a major role in preventing fish access. Instead the most restrictive barrier is believed to be the Culvert which lies beneath Hill Street (*fig 16*). It is a major culvert with a steep velocity gradient which inanga, smelt and bullies appear unable to swim through. Some eels appear unaffected by the culvert as evidence by both juvenile and adult eels observed in reach 6. However, in comparison to downstream reaches, both longfin and shortfin eel numbers are low therefore it is unknown how much eel passage through the Hill Street culvert is affected. The top end of the culvert (*fig* 16) was assessed by Fish and Wildlife Services and considered a velocity barrier to fish passage. Therefore it is recommended that baffles are installed inside the top of the culvert to minimalize water velocity. Another recommendation would be to have the entire culvert inspected for fish passage barriers.

Final Summary

No major fish barriers were observed from the sea to Hill Street (reaches 1 to 5). Native fish species were abundant throughout these reaches, with eels and inanga at times showing very large populations. Above Hill Street, even though some of the habitat was fish friendly, only one common bully was surveyed and inanga were absent. Two major fish barriers, the Hill Street culvert and the filter cloth, were identified as reasons for the low number of fish species in reach 6. Whilst the filter cloth was partially cleared to create fish passage the Hill Street culvert remains a barrier to inanga and bullies. Longfin and shortfin eels may be able to swim up the culvert, and through reach 6, as evident by the presence of both adult and juvenile eel's right to the top of the survey sight. However, because eel numbers were lower in comparison to downstream reaches it is possible the culvert is acting as a fish passage barrier for some eels. Two recommendations have been given to create native fish passage through the Hill Street culvert; this was to install baffles at the top end of the culvert which is deemed a velocity barrier, and to further investigate the culvert for barriers to fish passage. Finally, a further recommendation would be to conduct follow up fish surveys above

and below the Hill Street culvert when fish passage is restored to determine whether fish passage for native fish has been achieved.

Figure 16. Hill Street culvert

While in this report the Hill Street culvert is identified as the most restrictive fish passage barrier, others may still occur upstream of the last survey reach, above Concordia Lane. The most likely structure limiting fish passage would be the trash rack in between Concordia Lane and Easby Park. It is recommended that this structure is also investigated to remedy any fish passage issues.

In March 2016, Fish and Wildlife Services carried out a fish survey in upper Reservoir Creek for the engineering department of Tasman District Council. This survey took place as part of a condition of resource consent to advise the presence of native fish both below and above Reservoir creek spillway, and therefore whether the spillway is a barrier to native fish passage. Results from reach 1 in this survey show only one juvenile *Galaxia* observed, which was located in Easby Park and no inanga or bullies were observed. Poor habitat and water quality were some reasons suggested for this distribution; however fish passage barriers through the middle of Reservoir Creek were also seen as a factor. Results from the current survey, as already discussed, provide further evidence for these assumptions.

Habitat varies vastly between the six reaches surveyed. Reach 1 and 2 show areas of Reservoir Creek which have been relatively untouched compared with upstream reaches. Riparian planting has either been restored or left to naturally grow shading large deep pools. It is no surprise then that diversity is high in these reaches and some populations of fish are especially large. The remaining

upstream reaches have all undergone some form of redevelopment with varying impacts on habitat. Reach 3 and 4 have been rock armoured to create storm water capacity. Both of these reaches give prime examples of how fish habitat can either be restored (reach 4), or how habitat is lost (reach 3) after a redevelopment. Further evidence for a stream redevelopment which provides viable fish habitat is seen in the middle section of reach 5. Whilst habitat in some reaches is good, we did not observe other fish species such as kokopu and koaro in any reach. These species are more sensitive to changes within streams than the other fish found in this survey. There are likely a number of factors which might be limiting kokopu and koaro numbers in recent times. These factors may include changes in habitat, water quality and predation from other fish species. Recommendations have been given throughout this report to improve habitat for native fish in Reservoir Creek.

References

Joy, M., David, B., & Lake, M. New Zealand Freshwater Fish Sampling Protocols. 2013.

Tim Olley

For: Fish &Wildlife Services Ltd

Reviewed by: Tom Kroos

Director Fish & Wildlife Services Ltd