Te Arai River – Assessment of Ecological Impact of Proposed Managed Aquifer Recharge Trial

Lois Easton, MSc Environmental Science (First Hons)

October 2015

GDC Science Report 2/2015

GISBORNE DISTRICT COUNCIL

Contents

Figures

Tables

Summary

This report reviews the ecological and hydrological information about the Te Arai River and considers what the ecological impact of the proposed Managed Aquifer Recharge Trial might be on the river. It identifies that the Te Arai River is a very significant ecological asset for the East Coast but that, provided any water for the Managed Aquifer Recharge Trial is taken during winter, when the flow levels are greater than 220 l/s at Pykes Weir, the impact of the trial would be less than minor, and unlikely to be measurable.

In actuality during the trial the flows in the Te Arai River are likely to be in the order of 1000 l/s at Pykes Weir providing further confidence that there would be no impact on the ecological values of the Te Arai River.

1. Introduction

The Managed Aquifer Recharge Trial arose out of the freshwater planning process for Tairawhiti, when it was identified that the Makauri Aquifer was in decline – and that without action being taken to halt the decline the long term use of the aquifer as a water source was unsustainable.

As part of the trial, water is proposed to be sourced at the rate of 10-15 litres/second from the Waingake municipal water supply for a period of 77-90 days at a time when the Mangapoike Dams are overflowing.

Because water from the Mangapoike Dams flows down the pipeline to be merged with water sourced from the headwaters of the Te Arai River in Waterworks Bush, water from the Te Arai River will inevitably form part of the mix of water used in the proposed trial.

Generally across the year the municipal water supply sources 80% of its water from the Te Arai headwaters in Waterworks Bush. While it is the intention of the trial to maximise use of the Mangapoike Dams overflow water rather than use Te Arai water, because of the mixed nature of the water, this assessment assumes all of the water (equating to 100,000 m^3 over the trial period) will be sourced from the Te Arai River.

2. Te Arai River Catchment

The Te Arai River is a tributary of the Waipaoa River with its confluence near the coastal mouth of the Waipaoa. It is one of the few remaining East Coast rivers with unmodified headwaters and has been identified for some decades as a significant ecological asset in the Gisborne district.

The Te Arai River catchment has a land area of 18,900 hectares with the Waterworks Bush forming 1,050 hectares of this total area. Like other parts of the Poverty Bay area, the majority of the catchment has been highly modified, with pastoral farming and forestry pre-dominating in the upper catchment, and horticulture and arable cropping in the lower reaches and flood plain areas. The lower reaches in particular have been heavily modified with flood control structures, straightening of the stream and a number of water abstraction points for irrigation. Riparian vegetation in the lower reaches is predominantly mixed native – willow-agricultural weeds. Streambank erosion is common in the lower reaches due to the combination of riparian modification and stream straightening, loss of native riparian vegetation, willows growing into the channel diverting water and the underlying

loess geology in the lower reaches. Above Pykes Weir, the main monitoring point, the river becomes increasingly natural in its form and within Waterworks Bush, aside from the intake structure and a historic weir, the natural form and function of the stream is intact.

Aside from the main Waterworks Bush branch, the Te Arai River has three major tributaries:

- the Waimata Stream with its confluence just below Waugh Road
- the Kauwaewaka Stream with its confluence at Patemaru
- the Waingake Stream with its confluence at Waingake

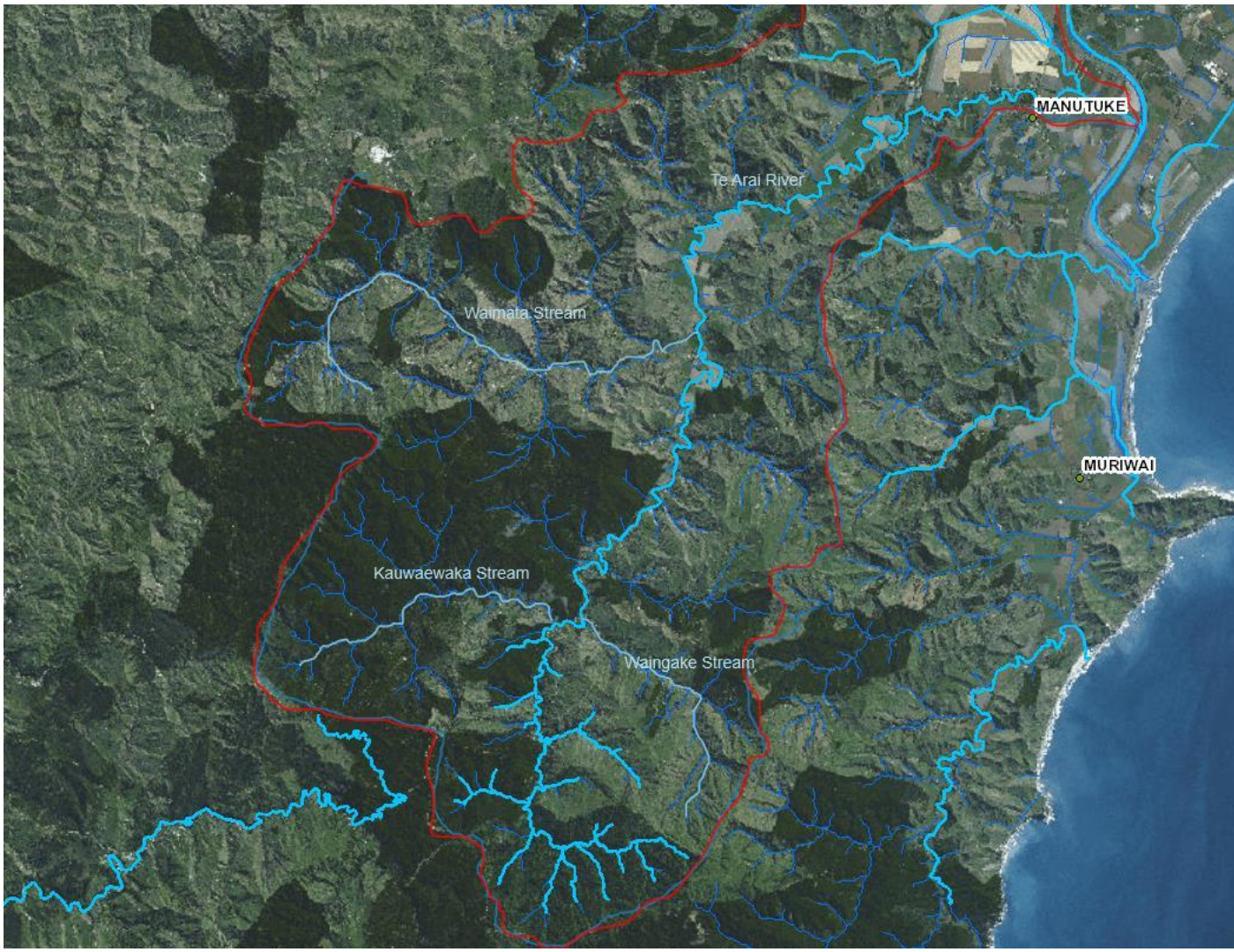

Figure 1 Te Arai River Catchment showing major tributaries

3. Take for the Municipal Water Supply at Waterworks Bush

The municipal water supply sources its water at an intake structure in the lower part of Waterworks Bush at Waingake.

The design of this structure is such that it is able to take all the water from the Te Arai headwaters that flows over it with an average flow of 600 m^3/hour (166 l/s). As a result of this, for many months

of the year, the municipal supply takes all the water from the stream at the intake point. Figure 3 shows the intake structure.

Figure 2 Municipal water supply intake structure at Waterworks Bush

During the winter period, and when heavy rain occurs there is substantial water which is not taken up by the intake structure and this forms a key part of the winter and peak flow for the Te Arai River. Additionally once the turbidity of the water becomes too high the Te Arai take is no longer used for municipal supply. In practice this only occurs following a rain event**.**

4. Water Quality in the Te Arai River

The main water quality monitoring point in the Te Arai River is located at Pykes Weir, 8.5 kilometres downstream of the water supply intake, which is also the main flow monitoring point. Because this location is relatively high in the catchment it does not give an accurate assessment of the water quality in the lower reaches of the river, where most of the landuse impacts are being felt.

Generally the water quality in the river at Pykes Weir can be described as good – and within the context of the wider Waipaoa Catchment water quality, the water quality in the Te Arai River at Pykes Weir is excellent.

Table 1 outlines the 10 year median and 95th Percentile values for water quality for indicators monitored by the Gisborne District Council State of the Environment monitoring programme.

Indicator	10 year Median Value	10 year 95th Percentile	ANZECC Guideline trigger values for lowland rivers
Temperature ^{0} C	13.2	21.3	NA
pH	8.1	8.3	7.2-7.8 Note many Gisborne Rivers have natural pH levels of more than 8 due to high limestone in the catchment
Dissolved oxygen mg/L Higher values are better	9.9	7.2	95-105% (9-10mg/L at 21^{0}C)
Nitrate nitrogen mg/L	0.0115	0.436	0.444
Ammonia nitrogen mg/L	0.01 (limit of detection)	0.05	0.021
Dissolved reactive phosphate mg/L	0.0004	0.01675	0.01
Turbidity NTU	3.7	278	5.6
Suspended sediment mg/L	5.5	459.5	NA
Faecal coliforms cfu/100mL	520	2280	150 (Bathing Water Standard)

Table 1: 10 Year (2004-2014) Annual Median and 95th Percentile Water Quality Data for Te Arai River at Pykes Weir

As can be seen from Table 1, the Te Arai River at Pykes Weir has water quality well below the ANZECC guidelines trigger values for many key indicators –particularly nutrients. It does however have some very high 95th Percentile values – largely as a result of flood and heavy rain events which mobilise large quantities of contaminants and wash these into the river. Faecal bacteria are a particular problem in the river from a human use perspective, however in terms of aquatic ecosystem health the major contaminants which are affecting the river will be the high levels of suspended sediment.

A more detailed analysis of the 10 year median and 95th Percentile water quality values for the winter months of May-September in Table 2 shows the impact of the more frequent rainfall events that occur during this period with increased nitrogen and phosphorus alongside much higher levels of suspended sediment and reduced water clarity.

Indicator	Winter 10 year Median Value	Winter 10year 95th Percentile	ANZECC Guideline trigger values for lowland rivers
Temperature ^{0} C	9.4	13	NA
pH	8.1	8.23	7.2-7.8 Note many Gisborne Rivers have natural pH levels of more than 8 due to high limestone in the catchment
Dissolved oxygen mg/L Higher values are better	11	9.64	95-105% (9-10mg/L at 21^{0}C)
Nitrate nitrogen mg/L	0.196	0.469	0.444
Ammonia nitrogen mg/L	0.01	0.0441	0.021
Dissolved reactive phosphate mg/L	0.049	0.2335	0.01
Turbidity NTU	25	703	5.6
Suspended sediment mg/L	25	575	NA
Faecal coliforms cfu/100mL	330	3345	150 (Bathing Water Standard)

Table 2: 10 year Median and 95th Percentile values for water quality indicators in the Te Arai River at Pykes Weir during the months of May-September inclusive.

As discussed above, the Pykes Weir monitoring point is well above the majority of non point source contaminant discharges, so these water quality data do not tell the whole story of water quality in the river.

Some limited water quality monitoring has been undertaken in lower reaches of the river as part of other studies. This has generally been one off samples, however they do paint a picture consistent with other parts of the Poverty Bay flats where rivers have elevated nitrate and phosphate levels, high suspended sediment, elevated faecal bacterial levels and high summer temperatures. When the flow is very low in the Te Arai River it can also be expected that the dissolved oxygen levels in the river will also be low – somewhat improved at times as a result of oxygenated water coming into the tidal reaches from the sea.

5. Hydrology of the Te Arai River

The Te Arai river exhibits a transition from a steep, cobble/boulder stream in its upper reaches to a less steep, incised, pool-riffle-run type channel in its lower reaches (Booker et al, 2010).

The hydrology of the Te Arai is also strongly affected by an intake in its upper reaches which supplies water for Gisborne, with some residual water being re-diverted back into the river (Booker

et al, 2010). Flow in the Te Arai River is measured at a telemetered site at Pykes Weir 8.5 kilometres downstream of this intake.

The seven day mean annual low flows at Pykes Weir are calculated at 68 l/s (Norton et al, 2010). The winter flows are however substantially higher. Figure 4 shows the median flows for the 23 year flow record as of 2010. In June the median flows are 1500 l/s (1.5 m3/s), 2500 l/s in July, 1600 l/s in August and 1400 l/s in September.

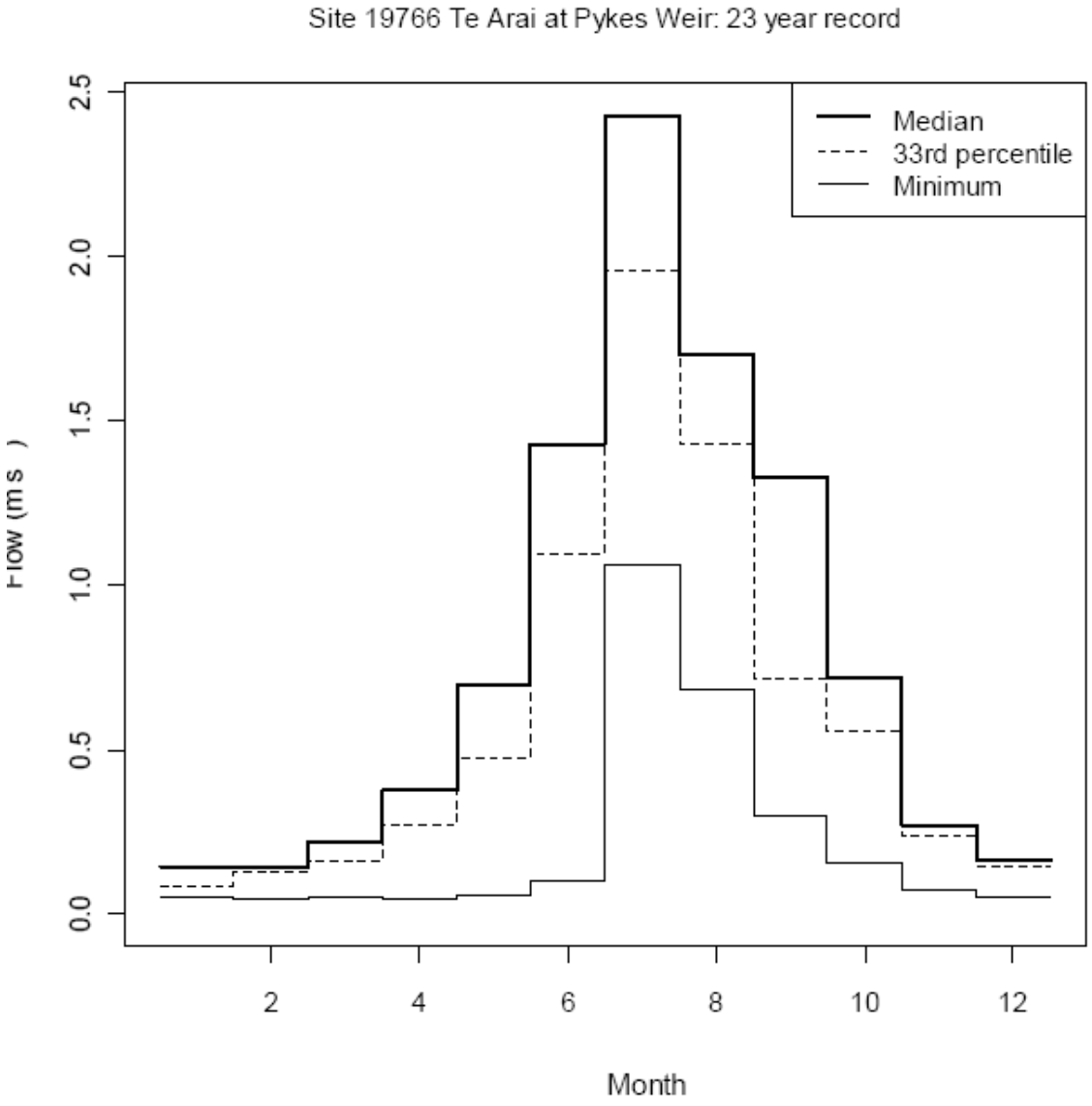

Figure 3: Summaries of annual median monthly flows at the Te Arai River Pykes Weir. (After Norton et al, 2010 page 23).

6.1 Environmental Flows in the Te Arai River

When considering management of surface water resources and maintaining good environmental flows in a river there are a number of key considerations:

- Ensuring adequate minimum flows (that could vary between months or seasons) to enable lifecycles of native species to be able to be maintained.

- Adequate flushing flows (small to medium sized freshes) and channel maintenance flows (large floods)
- Flow variation to ensure that the various streamflow characteristics (riffles, runs etc) to enable the maintenance and regeneration of river habitats and biological diversity
- Higher flows for sufficient periods of time to prevent the accumulation of periphyton and fine sediment in low velocity areas.

In the Te Arai with its large number of diadromous (migratory) fish this should consider minimum flows to enable migration and spawning as well as sufficient habitat for the species and their food sources. The longfin eel has been identified as a key species in this regard (Norton et al, 2010) and an ideal minimum flow to provide for all instream habitat value for the river was identified as 150 l/s at Pykes Weir.

Over the 1984 – 2013 period at Pykes Weir the median flow for the Te Arai River is 563 l/s but the mean flow is 2289 l/s reflecting the substantial winter flows. In addition 4.66 FRE3 events (events in size of 3 times the long term medium flow for a 7 day or greater period which act as flushing events) occur on average each year (Duncan, 2015).

Based on the analysis of flow and allocation Duncan (2015) looked at the effects on the frequency of FRE3 events. He concluded that with a B block (high flow) minimum flow of 220 l/s the number of FR3 events was unaffected by abstraction. Duncan also calculated the frequency of FRE3 flushing flow events, he found that if B block allocations (above 220l/s) were taken during summer this could lead to a small increase in the length of low flow events (those beyond 30 days).

6. Aquatic ecosystem health of the Te Arai River

There are a number of studies which have been undertaken with regard to the aquatic ecosystem health of the Te Arai River. These include:

Stephens (1989) . This study specifically focussed on the fish of the Te Arai River and the impacts of the water supply intake. 10 locations along the Te Arai River which represented the range of habitats available were fished for native fish species. Seven species of native fish were identified. The study in included fishing locations immediately above and below the intake structure as well within Waterworks bush and down the length of the Te Arai River.

Cran's bullies (*Gobimorphus basalis*), longfinned eels (*Anguilla dieffenbachii*) and shortfinned eel (*Anguilla australis*) were the most widely distributed. Whitebait of the inanga (*Galaxias maculatus*) were caught by a whitebait fisherman fishing near Manutuke, one smelt (*Retropinna retropinna*) and two torrent fish (*Cheimarrichthys fosteri*) were found below Pyke's weir, where species diversity was greatest. Common bullies (*Gobiomorphus cotidianus*) and shrimps (*Paratya curvirostris*) were found in the lower reaches of the river near Manutuke. The freshwater crayfish *Paranephrops planifrons* was found in the upper and middle sections of the river.

Cran's bullies were most numerous in runs and in the tails of pools, where water depth was 25 to 65 cm and current velocity was less than about 25 cm.s-1. Densities of eels and Cran's bully were lower

above and immediately below the water supply intake than at a third site one kilometre downstream, below the confluences of two small streams where flow is permanent.

Long fin eels, short fin eels and Cran's bullies were found above the intake structure, with increasing abundance in the river further below the intake structure.

The study noted that the Te Arai River was dominated by Cran's Bully –a non diadromous species able to complete its lifecycle without access to the sea. Long and short fin eels were also common species found – and being strong climbers they were also identified as being in a position to have full access to the habitat within the river.

While not found in this study, the author identified that redfin bullies (*Gobiomorphus huttoni)* and grey mullet (*Mugil cephalus)* were likely inhabitants of the lower reaches of the river.

While Pykes Weir and the water intake structure were identified as significant barriers to fish passage, the author also considered that the habitat was suitable for banded kokopu (*Galaxias fasciatus)* and koaro (*Gobiomorphus brevipinnis).*

The study recommended a minimum flow below the water intake structure of 25 l/s at all times.

Booker et al (2010). This study assessed in stream habitat and the implications for flow regimes in the Te Arai and Waipaoa Rivers. In relation to the Te Arai River two sites were assessed in detail in order to provide an understanding of the habitat types available for fish, macroinvertebrates and periphyton in the river. The sites assessed were at Waterworks Bush, some distance below the intake structure and at Reay's Bridge at Waugh Road. The study included undertaking electric fishing surveys at three different locations around Waterworks Bush. Key native fish species identified in this study were upland bullies, longfin eels, shortfin eels and torrent fish. They concluded that longfin eels, their food supplies and native fish biodiversity were all key attributes that could be considered as priority instream values for the Te Arai River in the vicinity of the water works. The focus of their work was minimum flows during the summer period and they recommended that a flow of 150l/s would provide for all the instream values of the Te Arai River.

Palmer (2014) and Palmer (2015)

These two studies investigated macroinvertebrate, periphyton and macrophyte taxa and abundances in the Waipaoa and Te Arai catchments over winter 2014 and summer 2015.

Three sites on the Te Arai River –directly below the Waterworks Bush intake, Pykes Weir, and the tributary Whatatuna Stream were looked at during these studies. Some studies were also undertaken at the Te Arai River at the footbridge by SH2, but due to the estuarine nature of the environment, comparisons with freshwater indicators were not able to be made.

Winter Results

During the winter survey the Waterworks Bush site scored Excellent for Physical Habitat Assessment and PES and Excellent (clean water) for QMCI, MCI and EPT taxa sensitive to pollution.

At Pykes Weir the MCI score was Good (upper quartile), and the QMCI score was excellent. At Whatatuna both the MCI and QMCI were Poor. These results confirm the ecological degradation of the river as it moves into more modified environments.

The periphyton enrichment scores and macrophyte clogginess scores reflect the macroinvertebrate data. At both Pykes Weir and in the Waterworks Bush, the periphyton enrichment and Chlorophyll A scores were excellent. At the Te Arai Footbridge Chlorophyll A was sampled and this was within the "A band" under the National Objectives Framework .

Physical habitat assessment of the Te Arai sites found that Waterworks Bush, Pykes Weir were very good – Waterworks Bush scored 86.82 and Pykes Weir scored 7. Physical habitat was also good in the lower Te Arai River at the footbridge with a score of 81.79 - particularly due to the presence of riparian vegetation, shading and bank integrity whereas the Whatatuna site scored a poor 22.

Summer Results

During the summer survey the Waterworks Bush site again scored Excellent for QMCI, MCI and EPT taxa sensitive to pollution.

At Pykes Weir the QMCI score and the EPT taxa sensitive to pollution dropped to Fair. At Whatatuna and the Lower Te Arai at the Footbridge by Manutuke the QMCI, MCI and EPT taxa sensitive to pollution were Poor.

The decline in the QMCI/MCI scores at the Pykes Weir site was due to the build up of periphyton over what was a dry summer. Water temperature was also a significant consideration with the temperature of 20.7 ^{0}C well above the optimal temperatures for sensitive taxa.

Periphyton was at in the Fair range at both Pykes Weir and at Whatatuna Stream - in both sites a deterioration from the winter time scores.

Hancock and Lander 2015 – unpublished data

As part of the assessment of the impacts of installing fish passage over Pykes Weir and the waterworks bush intake, a fishing study was undertaken by the Gisborne District Council and Department of Conservation over summer 2015. This study found a number of fish species present which had been found in other studies. In addition the rare short jawed kokopu was also found in a pool above the water supply intake.

Foxley et al 2015 – unpublished data

A team of Gisborne District Council staff and local community volunteers assessed the inanga spawning habitat of a range of rivers in the Poverty Bay flats during February – June 2015. The largest whitebait/inanga spawning habitat was identified on the lower reaches of the Te Arai River – a length of 1.2km. Unfortunately the habitat and eggs were smothered during the May 2015 storm, however it is the largest known inanga spawning area in Poverty Bay and therefore is likely to be highly significant to the health of the inanga population.

7. Potential Impact of Managed Aquifer Recharge Trial

The Managed Aquifer Recharge Trial involves the use of 10-15 l/s of water for a period of 77-90 days with a total volume of 100,000 m^3 from the Waingake municipal water supply pipeline. The trial is proposed to be undertaken when the Mangapoike Dams are overflowing. The dams are located in the headwaters of adjacent catchment to the headwaters of the Te Arai River/Waterworks Bush and

are subject to the same weather patterns and rainfall attributes. As a consequence the overflowing of the Mangapoike Dams can be anticipated to occur when flows are also high in the Te Arai River. Data held by the water utilities section of the Gisborne District Council would indicate that in a "normal" year the dams would start overflowing in early June and continue to do so until early October. The flow records for the Te Arai River indicate that its highest flows are normally experienced during the June – September period, coinciding with the overflow period of the dams. Median winter flows in the Te Arai River are over 1,000 l/s at Pykes Weir – 8.5km below the water supply intake.

The ecological values of the Te Arai River are significant, and in relation to the waterworks bush intake there are undoubtedly impacts of abstraction to the upper reaches of the river during the summer months.

In relation to the Managed Aquifer Recharge trial however, the impacts of abstracting 10-15 l/s of water over a three month period on top of the normal water supply take of 166l/s during high flows would be ecologically insignificant. The median winter flows in the river are substantial and even the minimum winter flows experienced during very dry winters are sufficient to provide for ecological needs, sediment flushing and channel maintenance requirements within the river.

The Managed Aquifer Recharge trial is only proposed to go ahead when the Mangapoike Dams are overflowing, so in actuality abstraction from the Te Arai River is likely to be much less than 10-15 l/s, as the water is intended to be sourced from the dam overflow.

However because of the significance of the Te Arai River a conservative approach should be undertaken.

The Waipaoa Catchment Plan identifies that the A block for the Te Arai River is fully allocated in terms of use. The summer period places considerable pressure on the river from a range of uses, and no use of water from the Te Arai River for a Managed Aquifer Recharge trial should occur during the irrigation season of 1 October – 30 April.

When looking at B block allocations Duncan (2015) recommended that a B block (high flow allocation) be set at 220/litres per second. Currently there are no water consents issued for B blocks in the Te Arai River catchment.

Accordingly therefore it is suggested that if water from the Te Arai River forms any part of the Managed Aquifer Recharge trial; that it be taken outside of the irrigation season during the period 1 May – 30 September and only when the flow at Pykes Weir is greater than 220 l/s.

References

Armstrong, D. 2008 Barriers to Fish Passage in the Gisborne Region. Department of Conservation Technical Support Series No. 27 ISBN Hard copy: 978-0-478-14483-3 Web PDF: 978-0-478-14484-0

Booker, D., Norton, N. and Murphy, P. 2010 Instream habitat and flow requirements of the Waipaoa and Te Arai Rivers. NIWA Client Report CHC2010-067. For Gisborne District Council.

Duncan, M. 2015 Waipaoa and Te Arai River B block minimum flows and allocations. NIWA Client Report CH2015-42. For Gisborne District Council

Palmer, M. 2014 Winter biomonitoring survey for the Waipaoa River and associated catchments. Report for Gisborne District Council September 2014.

Palmer, M. 2015 Summer biomonitoring survey for the Waipaoa River and associated catchments. Report for Gisborne District Council, May 2015.

Stephens, R. T. T. 1989 Fishes of the Te Arai River. Department of Conservation Science and Research Series No 15. ISBN 0-478-01139-3