Consultancy report to DIPNR on the potential effects of the proposed salt interception scheme on the aquatic biota of Billabong Creek

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Extended summary

Background

A field survey of the general water quality, fish, macroinvertebrates, and aquatic/riparian plants was carried out at three sites on Billabong Creek near Walla Walla on the 13 December 2004. Sampling was completed before 1:00pm.

Site 1: The Walla Walla-Henty road bridge, approximately 1.5 km upstream of the proposed discharge.

Site 2: Billabong Creek, where the in-stream discharge is proposed to take place.

Site 3: Brooklyn Bridge, approximately 2.5 km downstream of discharge point

Site assessment

- The electrical conductivity (EC) of the river increased between site 1 (1053 µs/cm), site 2 (1175 µs/cm) and site 3 (1430 µs/cm), presumably as a consequence of the previously-described saline intrusion into the creek at site 2. Electrical conductivity above 1500 EC units have been predicted to have adverse impacts on freshwater aquatic biota. The in-stream temperature of the water was approximately 22ºC.
- Macroinvertebrates were collected using standard sweep net techniques from all sites and identified to Family taxonomic resolution. Twenty one taxa were collected from site1, 19 from site 2 and 15 from site 3. All taxa collected were typical of lowland rivers in the Murray region.
- Fish were sampled using a back-pack electrofisher. No fish were caught but European carp were observed. Site 2 is a known popular angling hole for Golden Perch and this species is apparently regularly caught from site 2.
- Riparian vegetation was dominated by mature red gums with little evidence of regeneration. Patches of *Phragmites* spp. occurred at all sites.

Based on our initial survey and reading of associated literature on Billabong Creek, there is little doubt that Billabong Creek is a degraded waterway.

Identifiable risks and potential Impacts

There are three immediately identifiable potential impacts of the discharge into Billabong Creek on the associated biota:

1. There is a risk that the discharged waters will raise the ambient temperatures, particularly over winter. This may have a negative impact on the biota immediately downstream of the discharge point. However, any impact would decrease as distance increases downstream and would be expected to be undetectable within a few hundreds of meters.
2. Billabong Creek is a naturally ephemeral system experiencing frequent periods of no or low flows.
    - There is a risk that providing increased and more permanent flows down Billabong Creek would result in the loss of wetting and drying cues that form an important part in triggering aspects of the life cycles of some biota.

- Ground water removal that is not ultimately returned to the Creek, ie, the proposed scheme continues no pumped water is returned to the creek, will result in the stream experiencing extended periods of lower base flow (extended dry periods). The latter will have negative impacts on biota.

3. A reduction in salinity will potentially be beneficial to the aquatic biota of Billabong Creek, many of which may currently be near their salt threshold, particularly at site 3. The decrease in salinity is likely to have some, albeit small, benefit to the aquatic biota in Billabong Creek.

Concluding remarks

The effects of pumping groundwater will depend on the mechanism used for disposal of the pumped water:

1) If all the pumped water is returned to the creek then organisms requiring wetting/drying cycles will be affected as the dry (or low flow) periods will be diminished. The extent of this effect would be determined by the extent and timing of the flow.
2) If no water is returned to the creek then biota will be subjected to extended periods of low flow or longer periods of dry conditions.
3) Given that Billabong Creek already is currently in a degraded state, in our opinion, the best operation would be to return pumped water to the creek in such a fashion as to promote periods of increased flow, but also to retain periods of low flow. We **strongly** advise introducing a monitoring programme for stream biota and water quality. Determining the impacts of changes to flow requires compiling a comprehensive data set on the ecology of the system prior to changes as well as continuing sampling after the introduction of flow changes. These monitoring programmes should be designed within an adaptive management framework.

Introduction

A field survey of the Billabong Creek at three sites near Walla Walla was carried out on 13 December 2004. The river was sampled for fish, macroinvertebrates and aquatic/riparian plants plus general water quality (NSW Fisheries permit No: PO4/0007)

Site Description

Three sites were survey on Billabong Creek. The upper and lower sites consisted of flowing sections. The middle site comprised deeper pools and flow was minimal (Table 1)

Table 1. Location and description of the surveyed sites on Billabong Creek.

Site	Location	Description	
1	The Walla Walla-Henty road bridge, approximately 1.5 km upstream of the proposed discharge	Shallow flowing section of the creek consisting of a series of pools and riffles fringed by *Phragmites australis*.	
2	"Lonerenong" at the base of Morgan's look out.	Long deep slow flowing pool fringed by *Phragmites australis.* Proposed section where discharge will occur	
3	Brooklyn Bridge, approximately 2.5 km downstream of discharge point	Shallow flowing section of the creek consisting of a series of pools and riffles fringed by *Phragmites australis*.	

The Unregulated Billabong Creek Catchment is situated in the north-east extremity on the NSW side of the Mid Murray Valley. It comprises six separate subcatchment areas: Upper Billabong; Yarra Yarra; Ten Mile; Mountain Creek; Middle Billabong; and, the Lower Billabong; all of which drain into the Billabong Creek system above the Colombo Creek junction. Collectively these six subcatchments cover an area of approximately 3874 square kilometres. The Middle Billabong creek subcatchment in which the reach between Walla Walla and Walbundrie lies has a predominant winter/spring rainfall pattern (Alamgir 1999). Saline groundwater inflows, particularly into some sections of the middle subcatchment have an impact on the stream salinity along with runoff from saline affected soils. Water tables in the aquifer are between 2-10m from the ground surface. Groundwater is generally less than 2300 EC units.

Water Quality

Two replicate water quality measurements were taken at each site using a Horiba U10 water quality metre. The water quality within Billabong creek River at each site was within the parameters outlined in the ANZEEC Water Quality Guidelines for Recreational Water (http://www.deh.gov.au/water/quality/nwqms/pubs/wqg-ch5.pdf) (Table 2).

Table 2. Measured water quality parameters in Billabong Creek

Location	replicate	pH	Conductivity (µs/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature (^{o}C)
Site 1	1	7.53	1050	100	4.41	21.5
	2	7.54	1050	76	4.53	21.4
Site 2	1	7.58	1180	103	4.74	22.2
	2	7.46	1170	95	5.34	22.1
Site 3	1	7.6	1430	77	5.41	21.2
	2	7.62	1430	86	5.7	21.0

Aquatic and Riparian Vegetation

The riparian zone at the section of Billabong creek has undergone extensive modification by what is believed to be post European settlement land management practices. The current riparian zone at the three surveyed sites was dominated by a narrow band of River Redgums (*Eucalyptus camaldulensis*) with a scattering of other native and introduced trees. The age-class distribution of red gums at all sites was biased toward large mature trees, with little evidence of regeneration. While the riparian vegetation present would provide habitat for common species of birds, reptiles, amphibians, mammals and arthropods, it was not considered to be particularly sensitive or ecologically significant from an aquatic ecology perspective. No submerged aquatic macrophytes were observed in the river, however native rushes were abundant at all sites (Table 3).

Table 3 Aquatic and Riparian plants observed in the riparian zone of Billabong Creek

Common name	Scientific name	Site Number			Native	Aquatic (A) Terrestrial (T)
		1	2	3		
Common reed	*Phragmites australis* .	√	√	√	yes	A
Sedge	*Cyperus* sp.		√		yes	A
Rush	*Juncus* sp.		√	√	yes	A
River Redgum	*Eucalyptus camaldulensis*	√	√	√	yes	T
Silver wattle	*Acacia dealbata*	√	√	√	yes	T
River Bottlebrush	*Callistemon sieberi*	√	√	√	yes	T
Grass	*Phalaris* sp.	√	√	√	no	T
Scotch thistle	*Onopordum acanthium*	√	√	√	no	T
Willow	*Salix* sp.		√		no	T
Blackberries	*Rubus fruticosus*		√		no	T
Palms		√		√	no	T
Peppercorn		√			no	T
Total number taxa		**8**	**10**	**8**		

Macroinvertebrates

Aquatic invertebrates were collected at all sites using a standard sweep net sampling method. Samples were also collected by sweeping the net through fringing vegetation. Data collected represents the presence or absence of animals for the collections.

A total of 32 taxa were identified. With numbers of invertebrates collected highest at the upstream site and lowest at the downstream site. All of these are commonly found in rivers in south eastern Australia (Table 4). Most of the invertebrate families collected during this survey are similar to communities commonly collected from other lowland rivers in the lower Murray-Darling basin. None of the invertebrates collected are rare or could considered to be threatened. The presence of a diverse assembly of Ephemeroptera and Trichoptera indicate good water quality.

Table 4. Aquatic invertebrate taxa collected from Billabong Creek

Class	Order	Family	Genus	Site 1	Site 2	Site 3
Mollusca	Gastropoda (Class)	Ancylidae	Ferrissia	√		
	Gastropoda (Class)	Physidae			√	
Nematoda				√		
Oligochaeta				√	√	√
Crustacea	Cladocera	Dapnidae	Daphnia		√	
	Ostracoda (subclass)			√	√	√
	Copepoda (subclass)			√		

	Decapoda	Atyidae		√	√	√
	Decapoda	Palaemonidae		√		√
	Decapoda		Cherax	√	√	√
Collembolla						√
Insecta	Diptera	Ceratopogonidae		√		
	Diptera	Chironomidae – Chironomini		√	√	√
	Diptera	Chironomidae – Orthocladinae		√		√
	Diptera	Chironomidae - Tanypodinae				√
	Diptera	Coenagrionidae			√	
	Diptera	Empididae			√	
	Diptera	Isostictidae			√	√
	Diptera	Notonectidae			√	
	Diptera	Protoneuridae			√	
	Diptera	Psychodidae		√		
	Diptera	Scirtidae			√	
	Diptera	Simuliidae		√		
	Diptera	Statiomyidae		√	√	
	Diptera	Tipulidae		√		
	Diptera	Veliidae			√	
	Ephemeroptera	Baetidae		√	√	√
	Hemiptera	Corixidae		√	√	√
	Hemiptera	Notonectidae		√		√
	Trichoptera	Ecnomidae		√	√	√
	Trichoptera	Hydropsychidae		√		
	Trichoptera	Leptoceridae		√	√	√
Total				**21**	**19**	**15**

Fish

A Smith-Groot backpack electrofisher was used to sample for fish. No fish were caught during this survey but carp were observed at all sites within the creek.

Site 2, where the discharge is likely to occur, is known locally as a good area to Golden Perch (*Macquaria ambigua*). There are anecdotal descriptions of Murray Cod (*Maccullochella peelii peelii*) having been caught in the past 12 months within the vicinity of site 2. Historically, catfish (*Tandanus tandanus*) and Silver Perch (*Bidyanus bidyanus*) were potentially present in Billabong Creek but there is no antedotal evidence to indicate that they are currently within this section of Billabong Creek

Discussion

This study of Billabong Creek falls against the backdrop of NSW legislation. The aquatic community in the natural drainage system of the lower Murray River catchment is listed under NSW legislation as an “endangered aquatic community” (http://www.fisheries.nsw.gov.au/fsc/recommend/FR16-MR-EEC.pdf). Therefore before any modification to flows occur, a NSW Fisheries "8 Part Test" would need to be completed. As well, due to the potential presence of Murray Cod (*Maccullochella peelii peelii*), which is listed as endangered under federal legislation, the "Criteria for determining the need for and level of environmental impact assessment in Australia" (ANZECC Criteria) will need to be reviewed and addressed.

It is well documented that salinity increases lead to a loss of biodiversity (Nielsen et al 2003). The survey of Billabong Creek upstream and downstream of Morgan's lookout conformed to this pattern, with a loss of macroinvertebrate diversity as salinity increased from the upstream site to the downstream site. Consequently a reduction in the amount of saline ground water entering the system could offer some benefit to biodiversity. However there are some immediately identifiable effects that need to be considered.

1. Billabong Creek is a naturally ephemeral system. Pumping fresh ground water back into the system will potentially increase the permanency of flow. Such modification of flow has been shown to alter on invertebrate communities (Cook & Hawking 2000).

   However, current water extraction practices potentially have already impacted on the in-stream biota and the impact of controlled return of flows back to the river may be in fact be an advisable practice.

2. The pumped ground water will have a higher temperature than typically recorded in Billabong Creek during winter. Elevated water temperatures have been shown to have adverse impacts on in-stream communities (Cook & Hawking 2000). It would be expected that these impacts would only be in the immediate vicinity of the discharge point and probably undetectable within several hundreds of meters.

There are some potential benefits to returning less saline water to the creek and preventing saline water intrusions into the creek.

1. The macroinvertebrate survey indicates that some of the taxa may be near to their upper salt tolerance. The prevention of saline water intrusion and a subsequent decrease in the salinity within the creek will benefit these taxa.

2. Current water extraction practices potentially have already impacted on the in-stream biota. Retuning environmental flows back into the creek may improve the overall "health" of the creek. The improvements would be brought about by increasing in-stream complexity by inundation of benches and "slackwater" zones such as backwaters, low level flood runners and wetlands. This would potentially increase the number and variety of habitats available to be utilized by associated biota. The creation and inundation of these previously-dry in-stream areas may act as a trigger for biota requiring the wetting and drying to stimulate recruitment and enhance in-stream productivity.

References

Alamgir, M. (1999). *Scoping study on the saline groundwater inflows into Billabong Creek*. Resource assessment and planning. Murray Region DLWC.

Cook, R. & Hawking, J. (1999) *Monitoring of Flecter Challenge paper cooling water discharge to eight mile creek.* Annual report of monitoring of Fletcher Challenge paper cooling water discharge to eight mile creek.

Nielsen, D,L,, Brock, M.A., Rees, G.N. & Baldwin, D.S. (2003) The effect of increasing salinity on freshwater ecosystems in Australia. *Australian Journal of Botany* 51: 655-665