Harris Research

Freshwater ecology and fisheries

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Submission – Warragamba Dam Raising Project – SSI8441

Dr John H Harris, Bootawa NSW

I strongly object to this Warragamba Dam Raising project. In reaching this objection, I have carefully considered the EIS, Appendix F4: Aquatic Ecology. Reasons for my decision are detailed below, together with references to literature.

Following my assessment of the EIS, I conclude that it does not satisfy SEARs requirements, including numbers 3, 6, 13, 15, 16, 20 and 21, as key issue impacts are not assessed objectively and thoroughly. Particular impacts include:

1. effects on passage of 13 migratory fish species, including threatened species,
2. riparian zone impacts and consequences,
3. threatened species impacts,
4. changes in aquatic habitats upstream
5. changes in aquatic habitats downstream

Qualifications

I am a river ecologist and fisheries scientist of over 40 years' experience. Previously I led NSW DPI Fisheries' freshwater research group as a Principal Research Scientist; and was the Fish Program Leader for the CRC For Freshwater Ecology; was Independent Scientist for the MDBC and Auditor, MDB Sustainable Rivers Audit. Recently Independent Environmental Auditor for the Macquarie-Orange Pipeline project. I have published over 160 scientific papers on river ecology and freshwater fisheries.

EIS Section 1.4 – Riparian zone

Riparian zones are critically important component of riverine functional ecology (Erskine and Harris 2004; Humphries and Walker 2013). Riparian inundation, even for short periods, kills vegetation and destabilises stream banks, leading to erosion and increased sedimentation (Warner 1995), with smothering of habitats for macroinvertebrates and fish, sediment transport, disrupted fish-food production and habitat degradation and fish and macroinvertebrate decline (Bevitt et al. 2007; Harris 1983; Humphries and Walker 2013; Hynes 1970; Poff *et al*. 1997)

The shading effects of riparian vegetation are important in limiting stream temperatures (Hynes 1970; Williams 1980), especially in the context of climate change, threatening to exceed temperature tolerances of aquatic plants and animals, and stimulating algal blooms.

Inundation and sedimentation of many kilometres of Macquarie perch spawning habitat would directly conflict with the EPBC Act Species Recovery Plan for Macquarie perch strategy's requirements for protecting and restoring these habitats.

2.2.3 Fish Habitat and Conservation

Aspects of the Fisheries Management Act 1994 are inadequately or incorrectly discussed in the EIS, including those relating to migratory species of fish Gehrke et al, Harris PhD, Pollard?

Thirteen species of fish recorded from the region affected by Warragamba Dam are recorded as depending on upstream migration to sustain populations: Macquarie perch *Macquaria australasica* (plus the new taxon now provisionally identified as the separate 'Hawkesbury taxon') (Bruce et al. 2007), Australian grayling *Prototroctes maraena*, climbing galaxias *Galaxias brevipinnis*, common jollytail *G. maculata*, Australian bass *Percalates novemaculeata*, shortfin eel *Anguilla australis*, longfinned eel *A. reinhardtii*, striped gudgeon *Gobiomorphus australis*, Cox's gudgeon *G. coxii*, freshwater herring *Potamalosa richmondia*, freshwater mullet, *Trachystoma petardi*, striped mullet *Mugil cephalus*, Australian smelt *Retropinna semoni*

Fish migration, other than small numbers of two eel species, has been almost totally obstructed, since 1960 (personal communication, Warragamba staff, c. 1985). Lost connectivity through the building of hydraulic structures is a major factor in the severe declines of Australian freshwater fishes (Gehrke and Harris 1996; Harris et al. 2017; Humphries and Walker 2013; MDBC 2007).

1.4 Scope of assessment

I strongly dispute DPI advice that fish passage is not required at Warragamba Dam. This advice was based on inadequate assessment and lack of recent survey data.

I further strongly dispute DPI advice that elver passage would not be affected. The current dam creates a critical barrier to movement, this would be exacerbated by raising. Since 1960, elvers have been observed, by Sydney Water's site-operations staff and by me, occasionally moving upstream by climbing past the dam, both through subterranean routes and also wetted concrete surfaces. But these movements are in numbers that are far smaller than required to sustain population sizes. Consequent reduction in eel spawning biomass can be reliably predicted to adversely affect eel recruitment and abundance throughout south-eastern Australia (Jellyman et al. 2015)

I further strongly dispute DPI advice that adult eels passing over the dam wall in spills do so safely. Site-operation staff and personal experience on-site showed numerous large eels, both below the wall and in the draft tube, that were dead or dying, most with extensive lacerations, abrasions and other injuries. Such mortalities are well recorded in international literature (e.g. Jellyman et al. 2015). Furthermore, the long intervals (<14 years) between spills mean that adult eels are severely delayed in their spawning migrations. Together with the loss of recruitment, delays and mortalities further reduce natural population recruitment rates throughout the species' range.

2.2.1 Biodiversity offsets

The suggested offset arrangements are totally insufficient to compensate for migratory obstruction at Warragamba, where the size of the catchment and the extent of the fish community are far greater than the Nepean catchment, and where the scale of the fish-habitat impact of dam-raising would also be greater. The Warragamba catchment is classified by NSW DPI as Key Fish Habitat. Two EPBC Act endangered species have been recorded in both catchments.

Furthermore, if the Nepean fishways have proved to be inadequately provided with attraction flow, then there is a direct obligation on weir owners to remediate those structures accordingly.

2.2.5 Fish passage requirements

Comments in this section mention the importance of providing passage and relevant guidelines, as is necessary in the EIS. There is, however, a glaring absence of any serious attempt to examine this key issue in the context of Warragamba Dam. This deficiency alone totally negates any value of the EIS. Neglect of such a major environmental issue in this context is completely unacceptable.

Furthermore, only cursory mention was noted in the EIS of the effects of cold-water pollution on downstream ecology. Deep-water releases, if drawn from below the thermocline, generate this form of pollution, which impacts the ecology of downstream biota, including fish migrations (Astles et al. 2003). This issue is likely to be a significant component of the fish-passage problem at Warragamba (see below), and should be investigated and remediated, if necessary, as a key component of this general requirement.

3.2.2 Downstream environments

Large dams such as Warragamba often release cold hypolimnetic water downstream (Astles et al. 2003), which may also be hypoxic and contain toxic materials. Hydro-electric releases may also carry super-saturated levels of oxygen, leading to fish gas-bubble disease. Warragamba Dam is thermally stratified (records of Sydney Water). While the EIS states there will be no 'bottom water releases' this is imprecise, as thermoclines are likely to be far above the bottom, especially in deeply incised gorge storages. The environmental and hydro releases from Warragamba may therefore be subject to both problems, and they would risk exacerbation by dam-raising. The EIS neglects critical assessment of both these issues and fails to identify any necessary requirements for amelioration during the project, based on behaviour of the thermocline in relation to offtakes.

3.5.1 Fish – general

This section correctly notes the presence of 20 migratory fish species in the river below Warragamba Dam, obstructed from migrating to complete their life cycles. Duncan et al. (2016) also note this obstruction may have altered genetic diversity and viability of dozens of species in the Hawkesbury-Nepean River, with some local extinctions. This knowledge should have driven a meaningful assessment of fish-passage issues in relation to dam raising.

3.5.2 Upstream fish communities

Similarly, this section and Table 3-4 identify numerous regional fish species that are affected by obstructions to migration, emphasising the need to consider fish passage facilities in the project. Two of the species are endangered and the conservation status of many others is uncertain (Lintermans 2013).

4.1.2.2 Dewatering of dissipator pool

The dissipator pool is expected to contain large numbers of fish whose upstream migrations are blocked. Dewatering risks killing these fish unless effective prevention measures are used. These should be planned with NSW DPI Fisheries, with screening of pump intakes and relocation of fish from isolated habitat areas.

Runoff and discharges associated with new concrete works are highly alkaline and toxic to aquatic biota. Such materials need to be contained and removed from the downstream system.

4.2.1 Upstream operational impacts

The upstream operational impacts have been predicted in the EIS according to a 20-year timeframe. This grossly contradicts the purpose of the proposed project: to provide downstream safety from low-frequency large flood and PMF conditions. The area effects of inundation will obviously be much greater than those predicted in the EIS using the 20-year level. They should, at the very least, encompass 100-year prediction of inundation extents. The 'upstream impact areas' will be far larger than are suggested here. Similarly, the period of inundation would also be greater than is suggested. The EIS is seriously misleading in these issues.

These predictions also appear contradicted or trivialised in section 4.2.1.2. Probable geomorphic and ecological impacts of inundation are severe and have been identified above.

4.2.1.1 Obstructed fish passage

Again, the EIS is dismissive of the issue of obstructed passage, implying that only the potamodromous movements of Macquarie perch are affected. Contrary to this suggestion, the great majority (13) of the system's identified migratory species identified as naturally distributed upstream of the dam do have a tidally influenced period in their life-cycles (Harris 1983; 1984; Humphries and Walker 2013). They include Australian bass, freshwater herring, common jollytail, freshwater mullet, striped mullet, bullrout, striped gudgeon, Cox's gudgeon, Australian grayling, longfinned eels, shortfinned eels, Australian smelt, and climbing galaxias. The EIS is totally inadequate and misleading in this section and throughout.

4.2.2.1 Obstruction

As previously, this section wrongly suggests that obstruction by Warragamba Dam is somehow equivalent to the effects of downstream weirs. These weirs all have fishways that pass fish. Warragamba Dam is a total barrier to all except small numbers of elvers, and raising would further exacerbate this obstruction.

4.2.2 Ecosystem health

This section again provides misleading interpretation. While the Hawkesbury-Nepean hydrodynamic model may well provide a 'good spread of very low to flood flows' for most of the basin, it is well recognised that Warragamba Dam has, since construction, profoundly reduced such flows in the Warragamba River, as do large dams generally, by capturing and diverting low–moderate floods (Humphries and Walker 2013; Poff and Schmidt 2016; Swales and Harris 1994). Average river flow below Warragamba Dam declined by 5% every year from 1966–1980 (Harris 1988).

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