Submission to public consultation for the;

Draft AROWS EIS Terms of Reference

25 February 2025

Submitted by:

Colton Perna PhD (Candidate) Charles Darwin University

Postcode: 0810

Submitted to:

Northern Territory Environmental Protection Authority

I am writing to voice my concern for the limited scope of the proposed EIS for the Adelaide River Off-Channel Water Storage scheme (AROWS). I am currently completing my PhD at Charles Darwin University, investigating the relationship between river flow and fish community structure and energy flow through the food webs. Prior to this I worked extensively on habitat restoration and conservation in the Burdekin River region where there is extensive agricultural and water resource development.

Of great concern here is that the rivers of the top end maintain a natural flow regime. And research has clearly shown that river flow is highly correlated to fish species diversity and food quantity, quality and diversity (Poff 1997; Humphries et al. 2014; Jardine et al. 2012, Pettit et al. 2017). This project will remove freshwater flows from the Adelaide river to be stored off-channel which will have wide ranging downstream impacts.

Reviewing the Main report and Appendix D Hydrological Impact Assessment I have the following suggestions and concerns.

Key Summary Points

- The Adelaide river is a highly variable flow river as stated ranging in flow from 295 GL to 5,034 GL annual discharge. This poses issues with long-term supply as there will be years where the trigger for pumping most certainly will not be met suggesting the economic viability of the project is questionable.
- The trigger value for extraction is 60 m^3/s with a maximum pump rate at extraction point of 50 m^3/s. This would means that up to 83% of the freshwater flows at extraction point would be removed. This would have extreme effects to the physico-chemical make up of the downstream water which has not been address in the report, only water levels (section 4.3.3 Appendix D).
- There is an overall focus on water levels and the tidal nature of the river at extraction point. Suggesting that any variation in water level is "diluted" by tidal range more than 15 Km downstream of extraction (Section 6.2).
- Furthermore, the modelling suggests no impact to lower reaches, at the mouth and adjoining coastal waters. By removing freshwater, eg. lower density water, this will be replaced by higher density water (salt or brackish) therefore changing seasonal dynamics of the lateral floodplain ecology. Current work at CDU has shown that any increases in salt to these wetlands alters the quality and quantity of food sources available to be consumed by the fish community (Deadman unpublished data). My research suggests that this period of inundation by freshwater provides and large subsidy of energy to the fish community and would have impacts of fish diversity and biomass if reduced especially over the dry season periods (C. Perna unpublished data, Roberts et al. 2019).
- Of great concern in removing freshwater in a tidal reach of a river especially in light of climate change and increasing sea levels (Miloshis and Valentine 2013) it is likely that saltwater will reach the intake and impact supply to users.
- No assessment has been made or suggested for the supra-tidal wetlands in the lower reaches of the Adelaide River where removal of freshwater from the upstream reaches will change the physico-chemical makeup of these wetlands during wet season inundation. We now have clear evidence that salt will reduce quality and quantity of food sources and

therefore this should be considered especially as this is the food base of economically significant fish species of Barramundi and Threadfin Salmon.

- Freshwater flows from tropical rivers are an important contributor to the productivity of estuarine and coastal systems (Bucher and Saenger 1994; Chilton et al. 2021). Recent work has shown that the commercially important Banana Prawn relies on resources derived from these freshwater seasonal flows and may be impacted by flow reductions in the Adelaide River (Munroe et al. 2025)
- The groundwater-surface water interface is unclear and suggest losses of water to the underlaying aquifer through the two gap areas in the proposed storage basin. This leaves questions to the annual viability of the water supply if water is being lost to the ground as well as being a large shallow reservoir in an area with over 3 m of annual evaporation. And under current modelling our regional rainfall is likely to increase in variability, this all leads to questions of economic viability vs. environmental impact and lost of social and recreational access to the basin area.

Suggestions for inclusion in EIS

- Expand area of influence in models to include water quality and reach to the mouth of the river system. Monitor over a series of years to include different magnitudes of wet season flows and how physico-chemical water quality changes. This can then be added to the model to predict changes in water quality (specifically salinity) to these downstream reaches.
- Include models of sediment content in the wet season flows and how removal of freshwater flows containing nutrient supply via sediments will be reduced in delivery to the inshore area. This supply of annual nutrient is likely linked to inshore fisheries production
- Collect baseline data on fish communities in lateral wetlands including those wetlands downstream of the Arnhem Highway. These wetlands are refuges for freshwater fish communities through the dry season when the river becomes tidally flow dominated. These wetlands are important in providing annual subsidies in food sources to fisheries within the region.
- Include modelling of sea-level rises to predict when salt water will reach the extraction point as it seems inevitable under current climate and sea-level predictions this is likely and will be accelerated with further extraction. Given that salt-water intrusion occurs due to various mechanisms including, storm surge, groundwater or surface water intrusion due to sea level rise, alterations in groundwater flow (this is occurring already with extraction bores located throughout the catchment), reductions in river freshwater flows such as those proposed here, increase inland incursion of saltwater and altered coastal geomorphology (happening to some degree by the movement of introduced Water Buffalo.
- **Of great concern to me having worked in developed floodplain rivers on the east coast, is the lack of mention of the impacts of tail water from increase agricultural development.** This project is being proposed as a source of water for industrial and agricultural expansion in the region. Our rivers in tropical Australia are largely nutrient limited and this in important as agriculture uses synthetic fertilizers to grow crops and it is well documented that much of this nutrient flows over the surface or through the ground back into the river (See Trop water reports and Davis et al. 2017). This causes a cascade of impacts to the instream ecology, changing basal food quality, increasing invasive weed cover, and decreasing water quality (Perna et al. 2005). Any modelling of the impacts of this

development should also include the impacts of the proposed agricultural development that is proposed also within the catchment as tail water will be an issue.

I am submitting this as a concerned wetland scientist and feel that many of the impacts have either not been addressed in the terms of reference or have been minimized by including easier variables to monitor such as water level, rather than water quality. And including a far more detailed model of the impacts of sea level rise and climate change is needed to determine the long-term viability of the project as saltwater is likely to reach the extraction location.

Regards,

Colton Perna PhD Candidate Charles Darwin University

References

Bucher, D., & Saenger, P. (1994). A classification of tropical and subtropical Australian estuaries. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *4*(1), 1-19.

Chilton, D., Hamilton, D. P., Nagelkerken, I., Cook, P., Hipsey, M. R., Reid, R., ... & Brookes, J. (2021). Environmental flow requirements of estuaries: providing resilience to current and future climate and direct anthropogenic changes. *Frontiers in Environmental Science*, *9*, 764218.

Davis, A. M., Pearson, R. G., Brodie, J. E., & Butler, B. (2016). Review and conceptual models of agricultural impacts and water quality in waterways of the Great Barrier Reef catchment area. *Marine and Freshwater Research*, *68*(1), 1-19.

Humphries, P., Keckeis, H., & Finlayson, B. (2014). The river wave concept: integrating river ecosystem models. *BioScience*, *64*(10), 870-882.

Jardine, T. D., Pettit, N. E., Warfe, D. M., Pusey, B. J., Ward, D. P., Douglas, M. M., ... & Bunn, S. E. (2012). Consumer–resource coupling in wet–dry tropical rivers. *Journal of Animal Ecology*, *81*(2), 310-322.

Miloshis, M., and E. M. Valentine. 2013. Sea Level rise and potential mitigation of saline intrusion in Northern Australia [Paper Presentation]. In 2013 *IAHR Congress* (pp. 9158-9167). Tsinghua University Press, Beijing.

Munroe, S., O'Mara, K., Kenyon, R., Coates_Marnane, J., Faggotter, S.J., Burford, M.A. Trace element and $\delta^{13}C$ values of the banana prawn *Penaeus merguiensis* reveal the importance of catchment-derived resources across both estuarine and nearshore habitats. Marine Environmental Research, https://doi.org/10.1016/j.marenvres.2025.107028.

Perna, C., & Burrows, D. (2005). Improved dissolved oxygen status following removal of exotic weed mats in important fish habitat lagoons of the tropical Burdekin River floodplain, Australia. *Marine Pollution Bulletin*, *51*(1-4), 138-148.

Pettit, N. E., Naiman, R. J., Warfe, D. M., Jardine, T. D., Douglas, M. M., Bunn, S. E., & Davies, P. M. (2017). Productivity and connectivity in tropical riverscapes of northern Australia: ecological insights for management. *Ecosystems*, *20*, 492-514.

Poff, N. L. (1997). Landscape filters and species traits: towards mechanistic understanding and prediction in stream ecology. *Journal of the north american Benthological society*, *16*(2), 391-409.

Roberts, B. H., Morrongiello, J. R., King, A. J., Morgan, D. L., Saunders, T. M., Woodhead, J., & Crook, D. A. (2019). Migration to freshwater increases growth rates in a facultatively catadromous tropical fish. *Oecologia*, *191*, 253-260.