NT Environment Protection Authority
ntepa@nt.gov.au

PO Box 36019,
Winnellie NT, 0821
ABN: 47 665 738 318
P: 08 8945 6455
M 0415 471 600
ceo@afant.com.au
www.afant.com.au

To Whom It May Concern,

Re: AROWS EIS Referral

I write to you on behalf of the Amateur Fishermen's Association of the Northern Territory (AFANT). AFANT is the peak body for recreational fishing in the Northern Territory. It is our role to represent our members and to advocate for the interests of the 60,000 adult Territorians who go fishing each year, as well as the fishing clubs, associations, and diverse businesses that comprise the recreational fishing industry.

The most recent estimates available suggest that around one in three residents in the Northern Territory participate in recreational fishing each year. Recreational fishing also contributed $270 million dollars to Territory GDP in 2019 (the last time it was measured) and supported 2,500 full time jobs across a diversity of professions and enterprises[1].

AFANT supports a bright future for the Northern Territory, where growth and economic development are achieved alongside maintaining the productive natural values of our uniquely healthy ecosystems. The proposal to construct the AROWS dam in the Adelaide River catchment is understood to be the preferred option to secure the future water supply needs of the Darwin region. Critically, it seeks to do this without placing an instream dam on a major free-flowing river. We recognise that such an approach has potential to better balance future economic growth and social needs, with environmental protection and the maintenance of key existing social and economic benefits that are presently supported by the natural values of the Adelaide River catchment.

We recognise that the proponent (the NT Department of Logistics and Infrastructure) has been engaged with the community and industry, including AFANT in the preparation of the proposal to develop AROWS. Further, we recognise that several of the matters we have raised, or advised on the need to investigate, have been incorporated into the planning and are evident in the proponent-initiated EIS referral.

[1] Moore, A, Schirmer, J, Magnusson, A, Keller, K, Hinten, G, Galeano, D, Woodhams, J, Wright, (2022), National Social and Economic Survey of Recreational Fishers 2018-2021, FRDC Project No 2018-161

While on balance, the referral appears to be mostly comprehensive and explicitly recognises the need for further work to inform the EIS, this submission intends to draw attention to key areas relevant to the interests we represent, as well as to matters we suggest the EPA and the proponent should be required to consider at the next stage of assessment. These matters include the need to:

- Significantly refine the modelling of proposed water extraction to better mirror real world conditions; especially better accounting for the effect of high interannual variability in rainfall.

- Recognise and appropriately mitigate the potential impacts of the proposed water extraction on the productivity of riverine and coastal fauna populations, including fish and crustaceans.

- Reconsider the potential for significant impacts on coastal and marine environments, and detail proposed mitigations in the EIS.

- Recognise contemporary best practice by integrating fish screening on pumps into the base case for EPA assessment.

- Consider the potential socioeconomic impacts, as well as the opportunities for greater social and economic benefit by enhancing amenity related to recreational fishing.

Context: Recreational fishing interests in the Adelaide River catchment and the AROWS Project

Recreational fishing is a popular activity in the waters of the Adelaide River and the broader catchment. Barramundi is the most significant species for fishers in this area, with the free-flowing Adelaide River and its vast intact tributaries, wetlands and floodplains providing excellent fishery productivity and fishing experiences. Mud crab, jewfish and cherabin are other key species targeted by resident recreational fishers and fishing tourists. Recreational fishing occurs upstream, downstream and within the proposed AROWS development site (where the pump infrastructure is proposed to be built).

Most recreational fishing activity takes place within the Adelaide River, downstream of the proposed development. Most fishing is conducted from a boat, with key access points being the boat ramps at the Arnhem Highway bridge, Saltwater Arm and Leaders creek. Land-based fishing is common upstream of the proposed development, including at the crossings on the Marrakai Road, as well as downstream at the Arnhem Highway, and within the proposed development site. Recreational fishing within the proposed development site occurs with land-based fishers accessing the Adelaide River via informal tracks off the Marrakai Road, in accordance with rights established under Section 79 of the *Pastoral Land Act*[2]. The same Act also allows for camping within 50m of the river without specific permission.

It is anticipated that in the absence of active planning for alternative arrangements, the prevention of land-based recreational fishing access to the Adelaide River at the development site and changes to Marrakai Road, could result in most public access to the river being permanently lost. Unless the proponent updates the EIS with specific plans to facilitate access to these areas after the construction phase of the project additional specific investigation will be required to understand the social and economic impacts.

[2] *Pastoral Land Act* (1992): https://legislation.nt.gov.au/Legislation/PASTORAL-LAND-ACT-1992

Water extraction

The proponent has commenced significant baseline studies and has undertaken modelling of water extraction scenarios to support the proposed development. While it is noted that a "worst case" scenario has been modelled to stress test / expose key issues for the purpose of assessment, and that the proponent has been upfront about the limitations of the modelling presented so far, there are nonetheless several key matters that we wish to draw the attention of the proponent and EPA to, in preparation for the EIS.

Use of "average" flows for the purpose of evaluating potential impacts

While the proponent has explicitly recognised and highlighted high levels of interannual variability in rainfall and wet season river flows,[3] at this stage there is still significant reference to "average" flows (for example when exploring predicted impacts on annual freshwater outflows in percentage terms). The referral provides that while average annual wet season flow at Dirty Lagoon is 1,679 GL, actual observed annual flows between 1970 and 2023 fluctuated significantly ranging from 295 GL to 5,034 GL. Given the extremely high variance in actual flows across individual wet seasons, considerations in the EIS, including the extraction base case for development, will need to place greater focus on the range (and predictability/reliability) of potential flows, as well as the annual (rather than average) pumping/extraction rules that are likely to be required to protect the environment. The EIS should also explicitly recognise that in some outlier years, no pumping is likely to be permitted at all, because in well below average years the limited water available will be essential to provide ecosystem services.

Reference to relevant NT policy governing surface water take

The development of the Adelaide River Water Allocation Plan (WAP) is referred to in the referral document, however, when it comes to underpinning policy, it appears the proponent has only referred to the NT Water Allocation Framework. The framework sets out a default extraction balance where 80% of dry season groundwater (and associated flow) is reserved for the environment, with 20% available for extraction. The referral does not appear to mention the NT Surface Water Take – Wet Season Flow Policy[4], which sets out a default extraction limit for surface water of 5% (based on the 25% percentile). While it understood that a water allocation plan can differ from the default limit (and provide for a higher or lower level of extraction), such a decision would have to be based on science and/or a use case to justify departure from the policy and must ensure that "agreed hydraulic conditions are maintained and protections to environmental and cultural values are met". This should be explicitly acknowledged by the proponent in the EIS (especially if the WAP is not finalised by that stage of assessment). This is of key importance as it is likely that in order to effectively licence the AROWS project, an extraction limit over 5% (and therefore, over the default rule) may be required.

[3] AROWS EIS Referral Main Report, p.119

[4] NT Surface water take – wet season flow policy : https://nt.gov.au/__data/assets/pdf_file/0008/1348190/surface-water-take-wet-season-flow-policy.pdf

Potential impacts of water extraction on important fisheries

Barramundi, mud crab, and cherabin (freshwater prawns) are key species endemic to the Adelaide River catchment that are of high value for recreational fishing and Traditional fishing, with Mud crab also being an important commercial fishing species. The abundance, quality and productivity of all three fisheries are understood to be susceptible to negative impacts from upstream water extraction[5,6,7].

Barramundi

Barramundi are an important species (socially, culturally and economically) for recreational, tourism and Traditional fishing. Owing to their catadromous nature, beginning life in saltwater before significant cohorts migrate upstream, including onto floodplains; barramundi are a significant fish species in the freshwater, estuarine and coastal waters of the Adelaide River catchment. Modelling focussed on other major rivers in the NT has indicated that wet season water extraction is predicted to have significant impacts on barramundi recruitment and year class size.

A recent study which modelled impacts on barramundi growth rates in the Gulf of Carpentaria, predicted 12%, 8% and 1% reductions in annual barramundi growth rates under scenarios of 18%, 8%, and 3% water extraction (reduction of freshwater outflows), respectively[8]. It has also been found that negative impacts from water extraction on barramundi recruitment and productivity can be significantly mitigated by allowing extraction only on the receding limb of flood events[9]. The proponent should recognise these potential impacts and actively consider the opportunity to significantly mitigate them as/if necessary. The EIS should be required to address to the potential for specific extraction rules (the amount of extraction and the specific timing of extraction) to impact on barramundi productivity, as well as to outline mitigating strategies that can be formalised in any approval, regardless of being contained in the planned WAP or licence conditions.

Mud crab

A saltwater/estuarine crustacean, mud crabs are common in the Adelaide River. While mud crabs do not make use of freshwater habitats (like freshwater floodplains or riverine headwaters), mud crab populations are significantly influenced by freshwater and are considered to be a flow-dependent species[10]. River flow is thought to benefit mud crabs in several ways, including by reducing competition for burrows, reducing juvenile cannibalism and improving downstream/coastal habitat condition[11]. While water extraction from temporally variable rivers like the Adelaide River is expected to negatively impact on crab populations, modelling suggests that negative impacts could be mitigated significantly if pumping is only allowed to commence once a certain amount of flow has been reached (i.e. using a high commencement threshold). This could mean that specific extraction management rules may be able to allow for the same volume of

[5] Plagányi, Éva, et al. "Integrated assessment of river development on downstream marine fisheries and ecosystems." Nature Sustainability 7.1 (2024): 31-44.
[6] Blamey, Laura K., et al. "Altering river flow impacts estuarine species and catches: lessons from giant mud crabs." ICES Journal of Marine Science 80.9 (2023): 2295-2312.
[7] Beesley, Leah S., et al. "Modelling the longitudinal distribution, abundance, and habitat use of the giant freshwater shrimp (Macrobrachium spinipes) in a large intermittent, tropical Australian river to inform water resource policy." Freshwater Biology 68.1 (2023): 61-76.
[8] Leahy, Susannah M., and Julie B. Robins. "River flows affect the growth of a tropical finfish in the wet-dry rivers of northern Australia, with implications for water resource development." *Hydrobiologia* 848.18 (2021): 4311-4333.
[9] Crook, David A., et al. "Environmental drivers of recruitment in a tropical fishery: Monsoonal effects and vulnerability to water abstraction." Ecological Applications 32.4 (2022): e2563.
[10] Blamey, et al., (2023)
[11] *ibid*

water extraction to have less impact on mud crab abundance[12]. In preparation for the EIS, the proponent should recognise the potential impacts to mud crabs and address the opportunity to significantly mitigate them as/if necessary.

Cherabin

Cherabin are a large freshwater prawn found in the Adelaide River catchment. While adult prawns typically reside in freshwater, juveniles require saltwater/estuarine water to survive. While in steep fast flowing rivers (or parts of rivers), adult cherabin may spawn in-situ and rely in strong currents to quickly transport juveniles to estuarine waters, in low gradient rivers like the Adelaide River, females often migrate downstream to (or just above) brackish water. While spawning occurs towards the early wet season, juveniles must migrate upriver in the late wet season. It is expected that decreases in velocity caused by water diversions could cause a significant reduction in population size of freshwater shrimps by slowing or stopping the drift of larvae downstream and by impeding the movement of juveniles back upstream[13]. Researchers have suggested that water extraction policy will be important for cherabin populations, and that it is important to protect wet season flows that promote larval drift to the estuary and protect recessional wet season flows to facilitate upstream migration of juveniles[14]. The proponent should directly address the potential impacts to cherabin from water extraction (volume, timing, and physical impediments) in the EIS, and address the opportunity to significantly mitigate them as/if necessary.

Reconsider the potential for significant impacts on coastal and marine environments

The proponent has provided that the project is not expected to significantly impact on "coastal processes", "marine environmental quality" or "marine ecosystems[15]". This is despite the fact that several key species in the Adelaide River catchment have life histories that necessitate accessing both riverine and coastal environments, and other species benefit from, or rely upon, freshwater outflows. The referral report states that "a 6% reduction in total monthly streamflow downstream towards the ocean outlet" is expected and Appendix D confirms that this refers to average monthly flows, and this is contrast with one year (in 1992) when an 18% reduction in flow at the mouth was simulated[16]. So, it is understood that with high levels of interannual variability, the impact on outflow in years with well-below average flows could be much larger than the 6% headline. It is worth revisiting here, that recent modelled impacts on barramundi growth rates in the Gulf of Carpentaria, predicted 12%, 8% and 1% reduction in annual barramundi growth rates under scenarios of 18%, 8%, and 3% water extraction (respectively).

Coastal species that spawn or spend their early life stages in estuarine or freshwater habitats are particularly vulnerable to changes in the timing and magnitude of freshwater flows[17]. Additionally, in the wet-dry tropics where river flow is typically driven by concentrated wet season rainfall followed by periods of low/no flow during the dry season (a model which describes the Adelaide River), water extraction has been modelled to significantly impact the productivity of some marine species such as banana prawn, especially in years of low flow/rainfall[18].

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[12] *ibid*

[13] Novak, Peter A., et al. "A life-history account of Macrobrachium spinipes (Schenkel, 1902)(Cherabin) in a large tropical Australian River." Freshwater Science 34.2 (2015): 620-633.

[14] Beesley, et al. (2023)

[15] Referral Main Report, at 5.1.3

[16] Referral – Appendix D, p.32

[17] Broadley, Andrew, et al. "Impact of water development on river flows and the catch of a commercial marine fishery." Ecosphere 11.7 (2020): e03194.

[18] Broadley, et al, (2020)

In reasoning that significant impacts to marine and coastal ecosystems are not likely (and therefore not included in the referral), the proponent stated, *within a highly variable tidal environment, minor changes in water levels from upstream river flows during the peak of wet season flows are unlikely to have a notable impact on the coastal environment, particularly because freshwater influx from the Adelaide River catchment is a very small portion of the overall coastal water volume*[19]. However, given the ecological value of wet season freshwater outflows into coastal waters, and the impacts that a reduction of outflow is known to have on the productivity of key coastal and marine fauna populations, the fact that freshwater influx makes up only a limited amount of overall coastal waters by volume, does not appear to reflect the known ecological importance of freshwater entering coastal ecosystems. This argument in of itself does not appear to be a sufficient mitigating factor against all potential significant impacts, especially in years at the lower end of expected rainfall variability.

To put it another way, it would be wrong to say that impacting freshwater inundation of the Adelaide River flood plains is likely to have minimal impact on associated aquatic ecosystems by simple virtue of the fact that the floodplains are large and don't have any standing water for the majority of the year anyway. Instead, we understand that that the short period of freshwater availability is an exceptionally important annual process for a range of species and ecosystem processes.

There appears to be potential for the large-scale water extraction that is proposed for the AROWS project in the Adelaide River to have significant impacts on coastal and marine ecosystems, as well as on individual species. We acknowledge that it may turn out that the Water Allocation Plan or extraction rules proposed in the EIS, (including total limits that are responsive to annual water availability, as well as rules governing flow rates and timing of pumping activities) could ameliorate impacts to below "significant" levels. However, it would seem reasonable for the proponent to directly acknowledge these significant potential impacts to coastal and marine ecosystems and processes in the EIA, and to explain the proposed actions to mitigate these to below significant levels.

Integrate fish screening on pumps into the base case for EPA assessment.

The use of fish screens on pumping infrastructure is listed by the proponent as an "alternative component"[20], however, this seems to be a departure from the statement of precautionary approach on p.45 of the referral main report. Given the scale of the proposed pumping and the fact that migrations of juvenile barramundi and cherabin (to say nothing of all the other species) are known to occur at the same time as water extraction, the reference project at the EIS stage should assume that best practice fish exclusion infrastructure on pumps is a requirement, rather than an alternative option.

Research in Australia suggests that millions of fish are lost due to water pumping each year. Yet, modern fish screens are highly effective and can reduce injury and mortality to fish by around 90%[21]. Fish screens also reduce damage to water infrastructure, lower energy use, and can improve regional economies (that would otherwise be impacted by the loss of fish)[22]. It is acknowledged that in the main referral report, the proponent has referenced ongoing consideration about the need for fauna management (e.g., fish screens) with respect to the pump infrastructure on the Adelaide River[23]. The EPA should regard to this as insufficient,

[19] Referral Main Report, p.73.
[20] Referral Main Report, p.41
[21] Boys, Craig A., et al. "Native fish losses due to water extraction in Australian rivers: Evidence, impacts and a solution in modern fish-and farm-friendly screens." *Ecological Management & Restoration* 22.2 (2021): 134-144.
[22] Rayner, Thomas S., et al. "Protecting fish and farms: incentivising adoption of modern fish-protection screens for water pumps and gravity-fed diversions in Australia." PLoS Water 2.8 (2023): e0000107.
[23] Referral Main Report, p.32

and the proponent must be required to effectively demonstrate mitigation of significant impacts (diversion and mortality) to vast numbers of fish and crustaceans by incorporating suitable fish screens into the AROWS baseline project proposal and EIS stage of assessment.

Potential socioeconomic impacts; opportunities for greater benefit through the design of the project

The proponent has indicated that an Economic Impact Assessment and Social Impact Assessment will be prepared as part of the EIS. The proponent has also acknowledged uncertainty about impacts on presently legal access for recreational fishing on the development (nearby the pumping) site, the Marrakai Road, and in the waters of the proposed new impoundment. It is also possible that the extraction of water could impact on the quality, and by extension, the social and economic value of recreational fishing in the Adelaide River. AFANT has been engaged by the proponent and our organisation is expecting to provide significantly more input at the next stage of planning and approvals.

It will be important for the Social Impact Assessment to consider the following potential negative impacts:

- Potential loss of access to the unique land-based fishing opportunities presently enjoyed nearby the proposed pumping site (including the lack of alternative access).

- Potential for loss of access to the Adelaide River crossings on the Marrakai Road, as well as access between the Stuart Highway and the Arnhem Highway, due to changes/interruption to the road.

- Potential for recreational fishing quality in the catchment to be reduced due to negative impacts on fish populations.

The Social Impact Assessment should also consider the following potential positive impacts:

- Improved access to the Adelaide River for recreational fishing through the formalisation of access nearby (but separate from) the proposed pumping location.

- Ongoing or enhanced amenity and access through a realignment or upgrade of Marrakai Road.

- Improved social and economic benefits due to the creation of a unique and productive fishery inside the proposed AROWS dam site, through the stocking of fish and the development of basic infrastructure to facilitate fishing access.

I thank you for the opportunity to provide comment on the AROWS EIS Referral. Please do not hesitate to contact me with any questions or to clarify any matters raised.

Yours sincerely,

David Ciaravolo
Chief Executive Officer
25/02/2025