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# Improving low-flow simulation in the northern Murray–Darling Basin

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**Abstract:** The water resources in the Murray–Darling Basin (MDB) are the most intensively developed in Australia with over two thirds of Australia's irrigation occurring within the MDB. The MDB is known for facing many environmental issues including droughts, floods, bushfires, fish deaths, high salinity, algal blooms, blackwater events and acidic soils. To combat many of these issues, there has been increased emphasis placed on environmental flows and restrictions on extractions during low flows. This has highlighted the poor performance of basin scale river system models in predicting low flows, and therefore are unsuitable for studying ecological impacts during low flow conditions.

The crux of the problem is that river system models are designed for management and planning at basin scales, and, thus, they need to incorporate a wide range of physical processes and management activities which each operate at very different scales. Expectedly, most river system models used for management and planning are tuned to accurately predict cumulative flow volumes which is achieved by ensuring a close-to-zero bias when compared to observed streamflow. This, however, places more importance on medium and high flows at the cost of low flow fit performance. Another issue is that the standard approach for modelling transmission losses is to use very simplistic loss vs flow relationships. This is inadequate for modelling river losses particularly during low flow when the state of the alluvial aquifer may play a critical role in the loss process.

One of the objectives of the Murray–Darling Water and Environment Research Program (MD-WERP) is to develop methods that can be adopted by existing river system modelling tools to predict low flows more accurately. For this, the Alluvium As River Storage (AARS) model has been developed as a module to the Australian Water Resource Assessment River (AWRA-R) modelling system. The AARS model is a better physical representation of river water exchange processes than the loss vs flow relationships and allows explicit account of alluvium wetness which is crucial for estimating the efficiency and extent of environmental flow releases during dry conditions.

Within the AARS model, there are three potential constraints on leakage from a river reach to underlying sediments: (i) flow through a low permeability riverbed, (ii) flow to an adjacent aquifer, and (iii) available storage volume in underlying sediments (Doble et al., 2011). Thus, the losses are largely controlled by the saturated conductivities of the riverbed and alluvium, and the water holding capacity of the alluvial aquifer.

The model was trialled in the Border Rivers catchment while using a piecewise linear loss vs flow model as a benchmark. This was to test whether low flow fit metrics could be improved without degradation of medium and high flow fit metrics such as Nash-Sutcliffe Efficiency and percentage bias. Our study showed there is indeed a trade-off between the fit metrics but some improvements can be made to low flow prediction without severely degrading the higher flow fit metrics. Future work involves exploring potential improvements to the model structure and exploiting more observed water information such as groundwater bore data and river bed/bank soil characteristics to better inform the model.

## REFERENCES

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