Levelling up: Modelling flood inundation changes in the South Australian River Murray

Daniel P McCullough

Department for Environment and Water, Adelaide, South Australia, Australia
Email: daniel.mccullough@sa.gov.au

Abstract: Hydrodynamic modelling of South Australian (SA) River Murray flood inundation was updated following the 2022–23 flood event. Detailed hydrodynamic outputs were generated that include modelled flood extents and water level profiles along the length of the River Murray between Wellington to Lock 7. The results were compared to previous modelling results to provide an indication of the hydraulic changes that have occurred along the river from historical flood events.

Keywords: *River Murray, flooding, inundation*

1. INTRODUCTION

The River Murray flood event of 2022–23 was the largest magnitude flood experienced in the SA River Murray since 1974, peaking at a calculated Flow to SA (QSA) of approximately 186 GL/d. Existing modelling outputs produced by Bloss et al. (2015) were used to inform SA's response to managing the impacts of the flood in 2022-23, providing the ability to translate forecast QSA into anticipated water levels along the length of the river. However, corrections to the data were required to improve the estimates of localised water levels against the anticipated flow peak given the earlier models were calibrated against historical (pre-2000) flood events.

The large amount of water-related data collected during the 2022–23 event provided an invaluable opportunity for updating the available hydrodynamic models of the River Murray in SA and producing new flood outputs, as presented in McCullough (2025). The following sections briefly summarise the findings emerging from this work relating to changes in the relationship of water level to flow between the 2022–23 flood and historical events.

2. METHODOLOGY AND RESULTS

The area of interest for revision of modelled flood extents is on the floodplain area spanning a distance of approximately 620 km from Lock 7 to Wellington, as indicated in Figure 1**Error! Reference source not found.**. Three sequential MIKE+ hydrodynamic models of the SA River Murray covering this reach were updated with best available data including on-ground survey and the latest Light Detection and Ranging (LiDAR) data commissioned by DEW in 2021. Calibration was conducted by iteratively comparing modelled outputs to monitored flow and water level data collected during the flood event, and Sentinel satellite imagery from the Copernicus Data Space Browser website (Copernicus Sentinel data 2024).

Steady state flow conditions were modelled to generate peak inundation extents throughout the modelled domain at QSA increments covering 80 to 341 GL/d, with the highest flow of this range representing the peak of the largest flood by flow on record, the 1956 flood event. Water level profiles along the river were extracted at every 1 km at each modelled flow. Water level profiles from the previous flood modelling were used as a surrogate indication of historical flood levels and compared with the latest modelling.

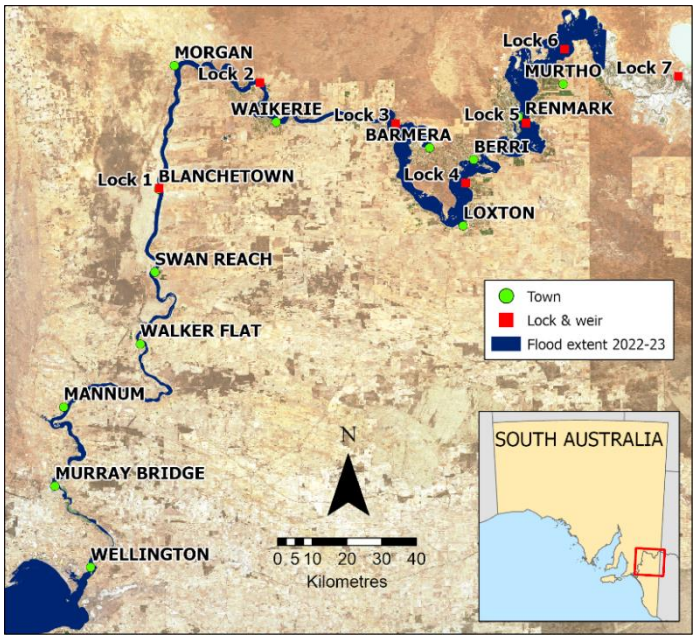

Figure 1 Modelled River Murray floodplain spanning from Wellington to Lock 7, including the 2022–23 flood extent

Figure 2 shows the modelled water level profiles of updated and previous modelling at selected flows, which includes observed levels from the 2022–23 event (solid dots) and historical observed peak levels from events with the nearest peak flow (hollow dots). The results indicate the water level profiles remain similar at 100 GL/d, and consistent with level observations from the 2022–23 event. As flow increases, the level profiles of the updated modelling shifts positively from the previous modelling outputs – and in line with comparisons between historical observations and those from the 2022–23 event. The largest differences are indicated in the narrowest floodplain areas along the SA River Murray, including weir pools 1 and 2, while the wider floodplain areas upstream of Lock 3 show a reduced difference. Differences between updated and previous modelling downstream of the River Murray distance marker at about 150 km are minimal at all flows, which may be attributed to this part of the reach being strongly influenced by conditions in the lower lakes, downstream of Wellington.

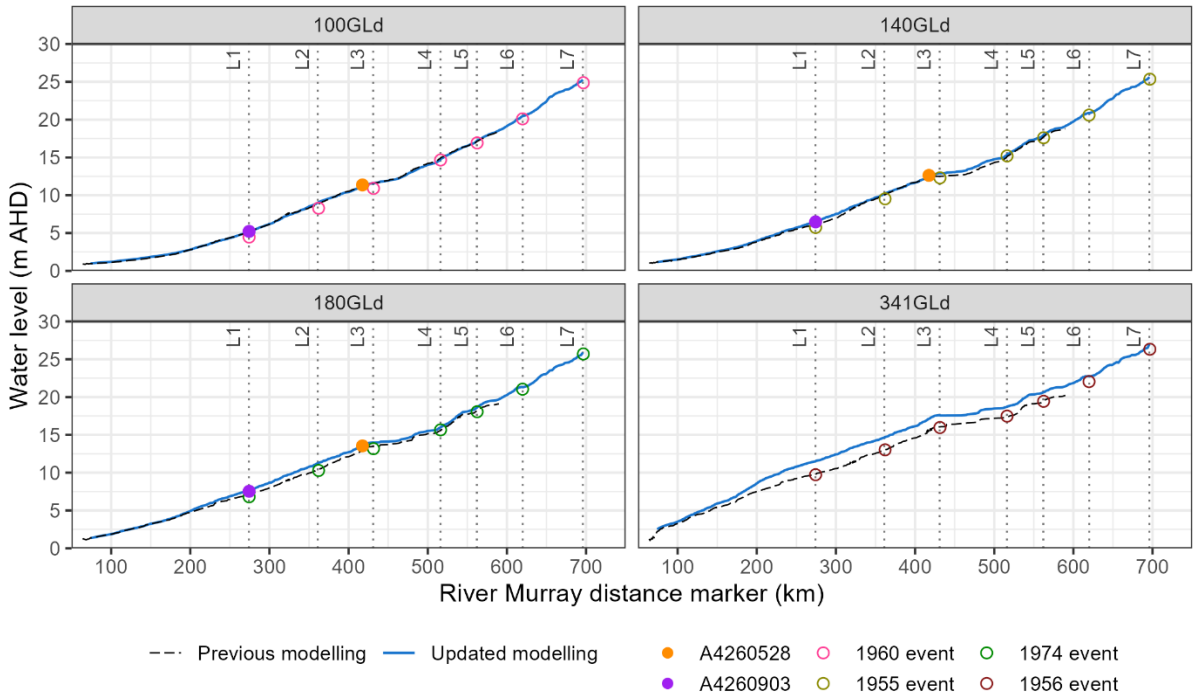

Figure 2 Differences in updated and previous modelled water level profiles by river flow, including observed levels from gauging stations during the 2022–23 flood event (solid dots) and peak levels from historical events (hollow dots)

3. CONCLUSIONS

The flood modelling conducted for the SA River Murray represents a significant body of work, resulting in new-generation models and an enhanced understanding of flood-related dynamics within the South Australian – Murray Darling Basin (SA–MDB). Notably the outputs, supported by observations, suggest a change to the water level-to-flow relationship since the last equivalent flood event in 1974. By updating and refining the modelling, this effort has strengthened the state's ability to predict water levels during future floods. Its applications extend from emergency flood response to floodplain planning and design. Moreover, the improvement in calibrated flow range and increase in modelled river floodplain area into weir pool 6 have significantly improved the hydrodynamic models available in the SA–MDB.

ACKNOWLEDGEMENTS

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