Fact sheet 13

Flood inundation modelling for Cooper Creek floodplain

The Cooper GBA region has a large floodplain that floods frequently. Flooding can be catastrophic to agricultural production in terms of loss of stock, fodder and topsoil, and to gas infrastructure. However, flooding is also critical to riparian and wetland ecosystems, with flood pulses providing an opportunity to replenish the instream waterholes and for off stream wetlands to connect to the main river channels.

Stakeholders in the Cooper GBA region identified a need for flood inundation modelling to better understand the movement of floods under current conditions and the impacts of future development infrastructure on overland flow pathways. The main objective of the hydrodynamic modelling was to set up a model, which can be used to investigate whether an increase in surface infrastructure (roads, pipelines, well pads etc) will change the flood regime, potentially affecting ecologically important waterholes and wetlands along Cooper Creek.

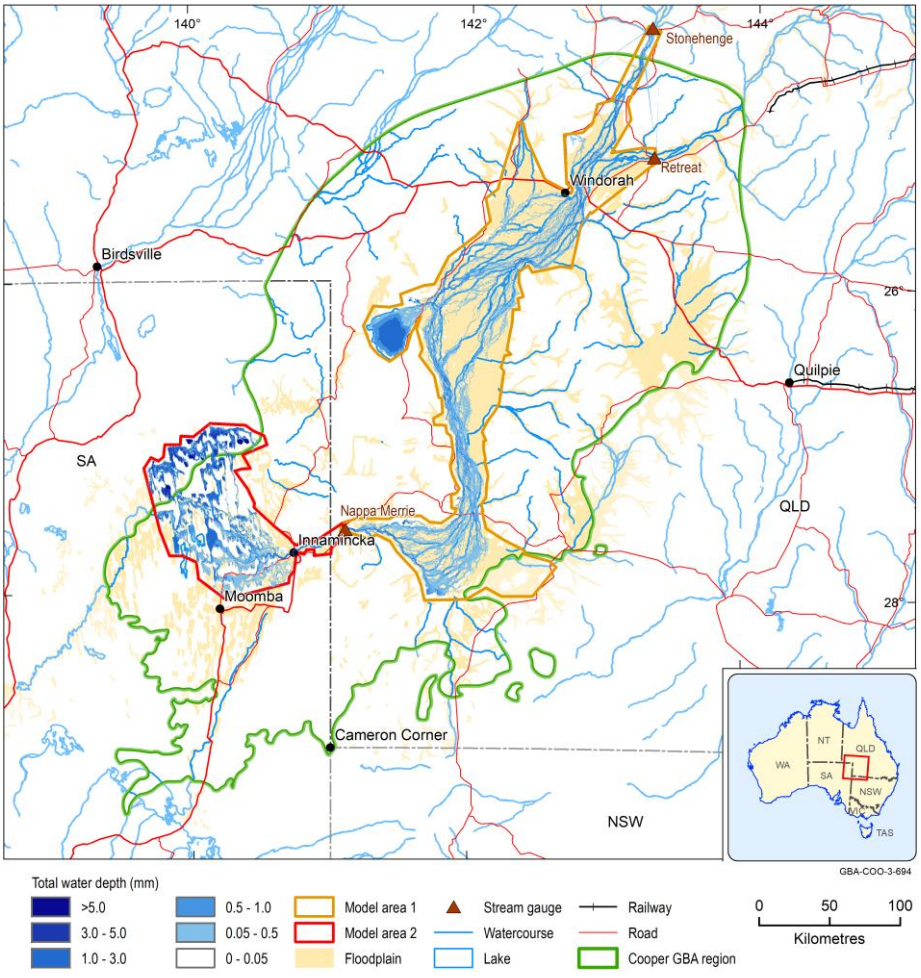
Model set-up

Detailed 2D hydrodynamic modelling was undertaken using MIKE21 FM to characterise flooding in the Cooper Creek floodplain for historical floods. Given the large size and complexity of the floodplain, separate models were setup in Queensland and South Australia (see Figure 1). The Queensland model covers an area of about 23,000 km^2 and includes 7,420,953 mesh elements. The South Australia model covers an area of about 9,000 km^2 and includes 4,754,440 mesh elements.

The Queensland flood model extends from the Stonehenge and Retreat stream gauges in Queensland to the Nappa Merrie stream gauge in South Australia. The South Australian flood model extends downstream from the Nappa Merrie stream gauge into Coongie Lakes wetland area.

Figure 1 State-of-the-art 2D hydrodynamic flood inundation models

Modelled extent of a 1-in-10-year flood showing modelled flood depth on 31/01/2004 for the Queensland flood model (model area 1) and on 03/04/2010 for the South Australian flood model (model area 2)



Minor floods with a recurrence interval of 2 to 5 years are important for maintaining the water supply to permanent waterholes. Flood frequency analysis was used to identify all of the available 1 in 2-, 3-, 5- and 10-year return period floods for the gauging stations. Based on availability of continuous daily streamflow data and reasonable quality Landsat images, the MIKE21 FM model was setup for 2 historical floods in each modelling domain (1 in 2-year return period – 2006 to 2007 for South Australia and 2018 for Queensland, 1 in 5-year return period – 2006 for South Australia and Queensland). After MIKE21 FM setup, calibration and validation for the 1 in 2-year and 1 in 5-year floods, the model was used to simulate the 1 in 10-year floods for both the Queensland and South Australia modelling domains to demonstrate applicability for a full range of flows under historical and future climates.

Key findings

The state-of-the-art 2D hydrodynamic flood inundation models (MIKE21 FM) cover extremely large areas (approximately 32,000 km^2), very complex terrain with very low gradients and sparse water level observations (Figure 1). There is good agreement between the calibrated models and satellite data for a range of historical floods. The calibrated models can evaluate how flooding may change under future development and climate change scenarios in one of the most complex floodplains in the world.

When further flow and stage heights data within the modelling domains becomes available in the future, the model setups can be further refined by finetuning to match these internal constraints. Also, if the area of interest is a much smaller area within the Queensland or South Australia modelling domains, a more detailed hydrodynamic model setup only covering that area will be needed to investigate the exact flow paths and flooding extents for that region.

The GBA Program

The $35.4 million Geological and Bioregional Assessment (GBA) Program is assessing the potential impacts of shale and tight gas development on water and the environment to inform regulatory frameworks and appropriate management approaches. The geological and environmental knowledge, data and tools produced by the GBA Program will assist governments, industry, land users and the community by informing decision-making and enabling the coordinated management of potential impacts.

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Find out more

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Datasets that support this work are available at data.gov.au:

- Geological and Bioregional Assessment Program (2021) Hydrodynamic model of the Cooper Creek floodplain [data].

More information is available at bioregionalassessments.gov.au/gba.