IMPROVING RIVER EFFICIENCY

Modelling the Murrumbidgee to improve river management

The 1,600 km long Murrumbidgee River system in New South Wales, Australia, is an important source of water for irrigation, urban water supplies and river wetlands. As one of Australia's longest rivers, its daily operation is also very complex. Excess water is often released – and subsequently lost – to the river system due to this complexity. To help the State Water Corporation of New South Wales make better informed decisions, we worked with them to develop the Computer Aided River Management system (CARM). CARM is driven by MIKE OPERATIONS and integrates models that reproduce key catchment and river processes with real-time measurements for the entire Murrumbidgee River system. It gives river operators insight into the current and forecasted state of the river, allowing them to combine dam releases with natural tributary inflows. This enables them to deliver the right amount of water to the right location.

DIVERSE WATER DEMANDS ON A COMPLEX RIVER

The 1,600 km Murrumbidgee River system is one of Australia's longest. Located in New South Wales in the southern part of the Murray Darling basin, it runs inland from the eastern ranges through semi-arid country. People and businesses along the river depend on its water for irrigation, environmental and town water needs. Like many long rivers, the daily operation of the Murrumbidgee is very complex. This complexity often results in excess water being released and subsequently lost to the river system.

CARM will allow State Water to operate the Murrumbidgee River more efficiently and with a higher degree of precision. © DHI

CLIENT

State Water Corporation of New South Wales, Australia

CHALLENGE

- Difficulty meeting the water needs of irrigators located far away from upstream dams
- Dependence on aging technology that relies heavily on human judgement and does not fully utilise real-time data
- Suboptimal release strategies leading to inefficient river management

SOLUTION

- Customised Decision Support System based on MIKE OPERATIONS
- Advanced hydraulic and hydrological modelling
- Optimisation tools
- Integrated online data

VALUE

- Improvement in river management leading to a reduction in water lost to the river system
- Ability to time water releases based on real-time information
- Increase in reliability of water supply

LOCATION / COUNTRY

New South Wales, Australia

SOFTWARE USED

MIKE OPERATIONS / MIKE SHE / MIKE 11

This project was carried out by the client using MIKE Powered by DHI software.

The expert in **WATER ENVIRONMENTS**

In 2001, the nine-year long Millennium drought struck the country. One of the worst droughts in Australia's history, it highlighted the need to modernise river operations to make them more efficient.

To do this, the State Water Corporation of New South Wales embarked on the Computer Aided River Management (CARM) project. Part of the AUD 65 million Murrumbidgee Water Efficiency Project supported by Water for Rivers, CARM included updating river infrastructure and metering, combined with the integration of this information in a real-time operational system. This ensures the most efficient operational dam and weir release settings, enabling effective and frequent decision making by river operators.

We developed the operational models for the project and integrated these tools with additional optimisation in an online Decision Support System. The operational models accurately described catchment and river processes including:

- catchment rainfall runoff
- groundwater seepage and evaporation
- river hydraulics

THE RIGHT AMOUNT OF WATER AT THE RIGHT TIME

The real-time operational models assimilate measured flows and water levels during hindcast, ensuring an accurate description of the state of the river at the time of forecast. We forecast tributary inflows using the NAM Rainfall-Runoff model. We then compute groundwater exchange and bank-side evapotranspiration losses utilising our MIKE SHE software. Using a MIKE 11 hydrodynamic model, we compute flows and storages in the river, at weirs and in wetlands.

Berembed Weir diverts water into the Murrumbidgee Irrigation Area, one of the largest in Australia. © DHI

MIKE OPERATIONS integrates the models with the real-time data feeds. This ensures that the models always operate with the most recent catchment rainfall, irrigation demands and river flows. All demands, inflows and outflows from the model are aggregated from weir to weir to generate initial release hydrographs. We take into account river flow travel times, which depend on the flow itself.

The MIKE 11 model returns measures of how close the initial hydrographs are to satisfying the different targets, including:

- delivery of irrigation water on time
- delivery of environmental flows
- maintenance of user-specified water levels at weir ponds

With these measures, we identify corrections to the initial hydrographs. We then apply the optimiser AutoCal to fine-tune these to obtain optimum operation. Built-in descriptions of weir capacities and constraints ensure that the optimised set points can be implemented without contravening present river infrastructure status. This includes:

- capacity constraints in the river
- the rates of change of discharge at weirs
- information on the capacity of the gates if they are temporarily out of service

Based on information about the present state of the river, as well as optimisations conducted several times a day, it is possible for State Water Corporation to run a 'leaner' river. This means only water that is needed to meet demands is released, reducing flow transmission losses. It also leaves more room (air space) for water storage in the river channel and in the ponds upstream of the weirs. This additional air space allows weirs more flexibility in operating the river. In addition, it provides storage for unexpected inflows and water orders that have been rejected by irrigators.

THE BENEFITS OF CARM

The State Water Corporation used our work as part of the development of their Computer Aided River Management (CARM) system. CARM's backbone is our real-time, fully hydrodynamic model that gives river operators an accurate picture of the river's current state and future behaviour. The benefits of CARM include:

- a comprehensive overview of measured and forecasted data
- online optimisation of weirs and dam set points
- efficient river operation leading to savings in dam releases
- accurate description of the processes in the river

This information ensures irrigators, environmental and other customers receive the right amount of water at the right location at the right time.

CLIENT TESTIMONIAL

" *The CARM project will make control of water flows more and more precise and responsive.*

Official of State Water Corporation—New South Wales, Australia

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The expert in **WATER ENVIRONMENTS**

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