HOW SOURCE SUPPORTS THE MANAGEMENT OF THE MURRAY-DARLING BASIN

Source plays an important role in managing the waters resources of the Murray-Darling Basin

PARTNERING WITH THE MEKONG RIVER COMMISSION

> eWater has worked with the Mekong River Commission (MRC) since 2013.

Established in 1995 under the Mekong Agreement. The MRC is an inter-governmental agency working with the governments of Cambodia, Laos, Thailand and Vietnam with the goal of jointly managing the shared water resource and the sustainable development of the Mekong River.

Since 2013, eWater has partnered with the MRC on several projects.

The Mekong River Luang Prabang, Laos

Modelling in the Mekong River Basin

Beginning in 2013, eWater and the MRC worked together to trial the adoption of Source in the Mekong. This included developing a plugin to convert the MRC's existing IQQM (Integrated Quantity and Quality Model) models to Source. Initially, work focused on the 3C catchment, and was progressively expanded to the whole of the Mekong.

eWater Source models are now used to simulate flows, sediment loads, nutrient levels, hydropower production, and agricultural and industrial water use to assess the impacts of water resources developments and to assess national water resource development plans from a basin-wide perspective.

Over the years, eWater has provided capacity building and technology transfer focusing on hands-on training and technical support to the Mekong River Commission Secretariat (MRCS) and MRC Member Countries (Cambodia, Laos, Thailand and Vietnam).

Mekong River Council Study

The MRC Council Study is the first water resource study of this scale for the Mekong Basin. In 2018-19, eWater contributed to the MRC Council Study using Source to integrate information and existing SWAT basin models via plugins.

MRC Procedures for Water Use Monitoring (PWUM)

eWater implemented pilot projects to test the Procedures for Water Use Monitoring in Laos, Thailand and Cambodia. The MRC Water Use Monitoring procedures provide for the visualisation and analysis of trade-offs in different water management scenarios. The implementation of the pilot projects using water resource modelling is a major step towards a basin-wide water use monitoring in the Mekong Basin.

Data and information systems upgrade

In May 2019, eWater was invited by the MRC Secretariat to support a two-year initiative to reinvigorate its data, information, modelling, forecasting and communication systems to provide enhanced and timely information to the public and MRC Member Countries.

eWater's involvement was funded by the Australian Government, through the Department of Foreign Affairs and Trade.

The MRC's systems upgrade covers data collection and acquisition, data and information management, data analysis and assessment, and data and information reporting and communication. The initiative will support the Secretariat to:

- provide enhanced and timely information to the public and MRC Member Countries
- implement key responsibilities, such as assessing the state of the Basin and tracking development in the Basin

- respond to emerging issues, such as changes in flow regimes
- strengthen its role as a regional knowledge hub.

Working closely with the Secretariat and other Australian experts, we prepared a concept design for the systems upgrade, it will see a transformation in the way the Secretariat collects, analyses, uses and communicates water information. The design concept was approved by the MRC Joint Committee in November 2019.

Other important aspects of the support include training in the use of Source for water management planning and the integration of operations and flood forecasting. In partnership with water agencies and regional modelling groups, we are also helping establish a Community of Practice and Best Practice Guidelines. Relationships with key academic and research stakeholders in the region have also been strengthened.

The project has included close collaboration with the MRC Secretariat and experts from the Australian Bureau of

Meteorology, Geoscience Australia and the Murray-Darling Basin Authority, including review of existing systems, drafting of recommendations and presenting to members of the MRC and MRC Secretariat on the approaches used in Australia.

The project features as a success story in the MRC 2019 Annual Report.

INTEGRATED WATER RESOURCES MANAGEMENT IN LAO PDR

Water is essential to life and culture in the People's Democratic Republic of Lao. More than third of GDP and 75% of employment comes from subsistence

> agriculture, which is heavily dependent on rainfall and Lao’s rivers.

Traditionally, the People’s Democratic Republic of Lao (Lao PDR) was considered a water rich country, but increasing demand for water, especially in the dry season is putting pressure on water resources. Climate change is also affecting the region, with water quality impacted by rising temperatures and water infrastructure at risk from increased flash flooding.

In response, the Government of Lao PDR is implementing a series of water reforms, including developing a National Water Resources Strategy and Action Plan 2016-2020 and major amendments to the Water and Resources Law were approved in 2017. The new law focuses on better protection of water resources and sustainable use to support national economic development.

Supporting these reforms is the World Bank funded Mekong Integrated Water Resource Management (MIWRM) program, which seeks to establish good examples of integrated water resources management practice at the local, regional and river basin scales.

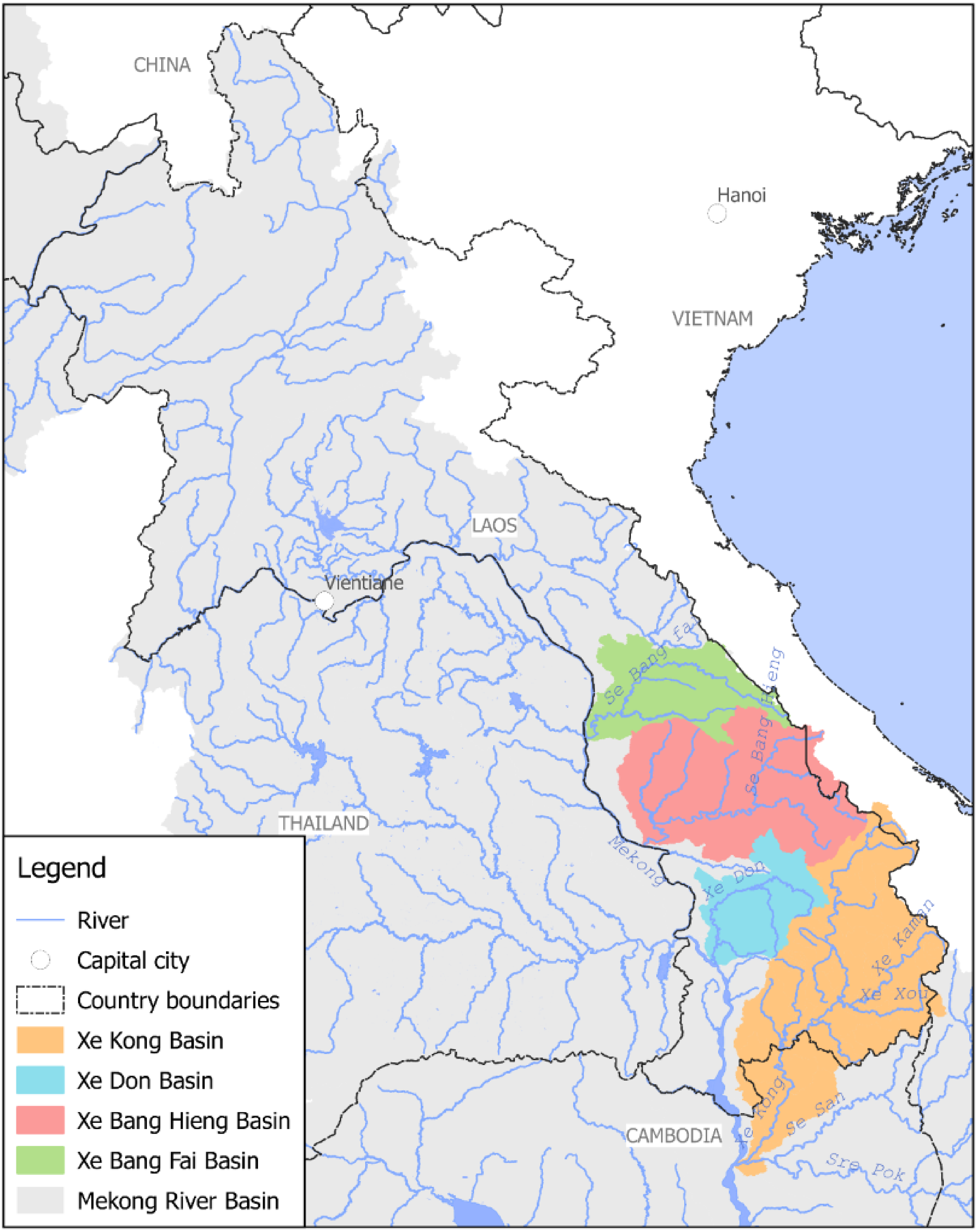
Landscape view over Xe Don river in Pakse, Laos (credit:

Marek/AdobeStock)

The project

eWater was engaged under the MIWRM program to support the Lao PDR Natural Resources and Environment Research Institute (NRERI) Hydrological Modelling Unit to build its capability to develop and apply water models for water resource assessment, sustainable water management and to support policy and investment decision making.

Surface water resource models for four basins; Xe Bang Fai, Xe Bang Hieng, Xe Don and Xe Kong were built and calibrated using the eWater Source platform. The models were used to evaluate:


CHINA
Hanoi
VIETNAM
LAOS
Vientiane
THAILAND
CAMBODIA
Se Bang fai
Se Bang Hieng
Mekong
Xe Don
Xe Kaman
Xe Xou
Xe Kong
Se San
Sre Pok
Legend
River
Capital city
Country boundaries
Xe Kong Basin
Xe Don Basin
Xe Bang Hieng Basin
Xe Bang Fai Basin
Mekong River Basin

- total water availability from surface runoff
- inter-basin water transfers
- water demands and consumption for domestic, industrial and agriculture users
- hydropower operations and production.

Water supply and demand were summarised on a monthly basis and the impacts of water resource development on natural flow patterns were evaluated.

In addition, to understand the relative impacts of different water resources development options in the Xe Kong basin, four development scenarios were assessed:

1. current (2017) conditions
2. hydropower development
3. irrigation development
4. combined development.

Each scenario was evaluated under historical climate conditions and a climate change scenario. This initial assessment seeks to demonstrate the power modelling can bring to the decision-making process and inform the development of a later detailed scenario assessment.

Overcoming data constraints

Traditionally, good water modelling relies on high-quality, measured data. However, such data is often uncommon in countries such as Lao PDR. To address this, much of the data used in the modelling came from global, remotely sensed data sets, calibrated against the limited measured data.

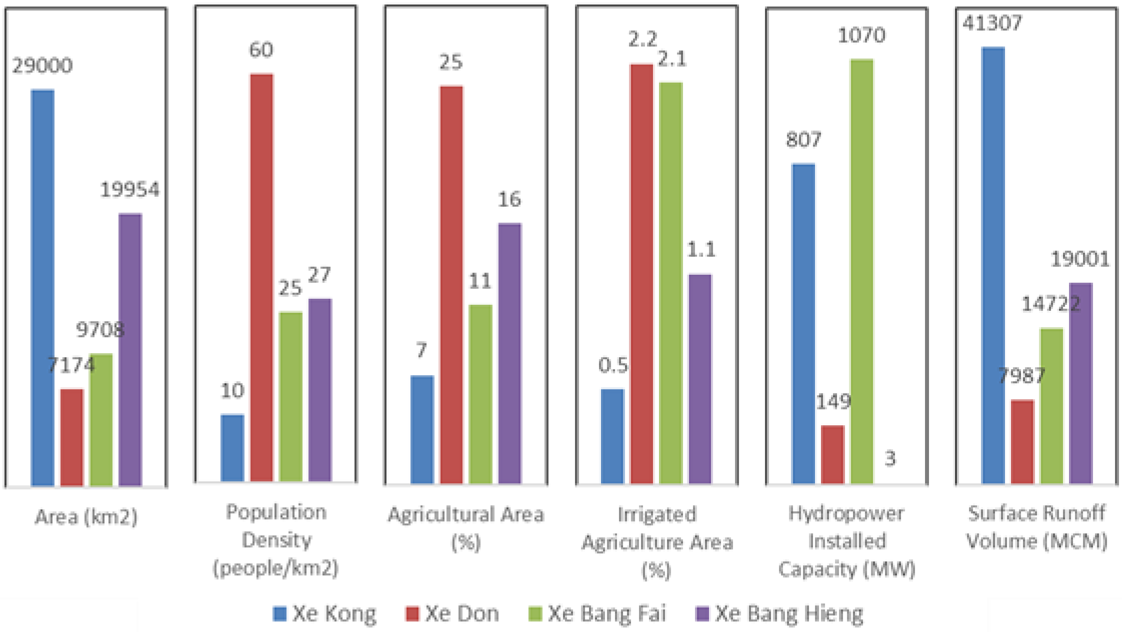
Despite the limited measured data, good calibration was achieved in all four basins, demonstrating that the Source model platform is an effective tool for low-data environments. Importantly, Source has the ability to incorporate additional data as it becomes available, progressively increasing reliability and accuracy over time.

Implementation

The project has helped to increase the capacity of water managers in Lao PDR to build and use water models. The four models build for the project give water managers vital information and new tools for responding to emerging water management challenges, such as:

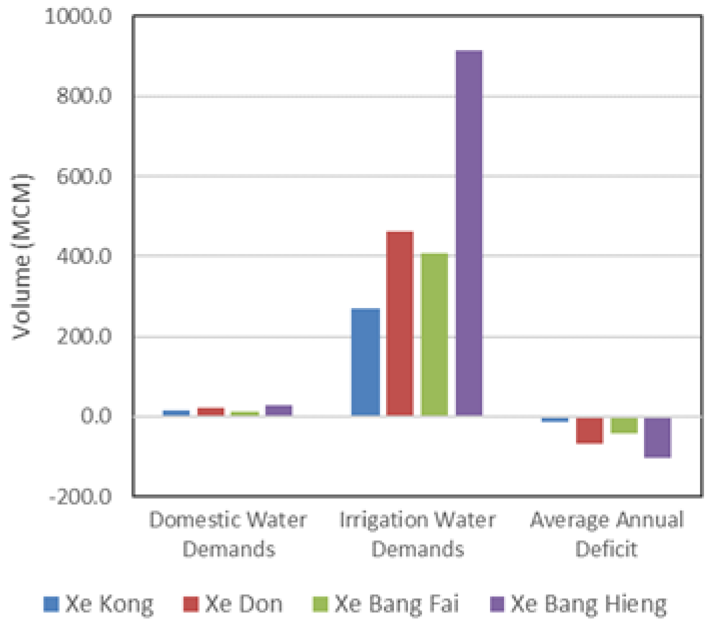
- annual and seasonal water availability
- annual and seasonal water flow patterns, and how these vary from natural conditions
- annual and seasonal water usage
- actual and potential water shortages
- hydropower demands and impacts on flow patterns and water balance

Example outputs from the model are shown in the figures below, they provide easy to understand, practical information to guide decision making.



Summary of basin characteristics.

NB: For Xe Bang Fai the installed capacity represents the NamTheun 2 hydropower project, which is located outside of the basin and diverts water into the basin.



Summary of average annual water demands and the deficit in supply (represented as negative values) for the four basins.

Capacity building

Building the capability of the NRERI Hydrological Modelling team was a core focus of the project. eWater provided tailored Source training and worked closely with the team in building the four models and developing the scenarios to be tested.

Back Row (L to R): Mr Daryl FIELDS (World Bank), Mr Chusit APIRUMANEKUL (World Bank), Mr. Somephone KHANPHANH (LNMC), Ms Phatthany KEOBOUNKHONG (DEPP), MR Khamphouay SIVONGXAY (Dept. of Water Resources), Ms Rachel BLAKERS (eWater), Mr Oulaphone ONGKEO (NRERI), Dr Thanapon PIMAN (Research Fellow), Dr Robert CARR (eWater), Mr Visanou METTHANY (Dept. of Meteorology & Hydrology), Mr Amphone CHOMXAITHONG (University of Laos), Mr Somphone KHONGSAP (Dept. of Planning & Cooperation), Mr Adnada BOULOM (Dept. of Transportation), Mr Phongsavath YINGYONG (NRERI)
Front Row (L to R): Mr Bounmy CHAYAVONG (NRERI), Mr Pankham SOUNDARA (NRERI), Mr Soulivanh LATHSAPHON (Dept. of Irrigation), Ms. Manysakhon CHITTHAPHONG (NRERI), Ms. Pakayphone YORDCHALEUN (NRERI), Ms. Nongnout PHANPHONGSA (NRERI), Ms. Souphada SENGVILAY (NRERI),

Participants at a workshop to develop scenarios for the Xe Kong basin. Attendees were from NRERI, other Lao PDR government agencies, the World Bank and eWater

CUSTOMISING SOURCE TO MANAGE BLACKWATER RISKS

Construction of dams, weirs and use of water for irrigation, industry and towns has meant

> that many aquatic and floodplain ecosystems don’t get the water they did naturally.

One way of addressing this is to construct infrastructure, such as regulators and embankments that allow water managers to simulate natural watering regimes with lower flows.

While inundation brings a range of ecological benefits, it also has the potential to cause hypoxic blackwater (low dissolved oxygen) events. Blackwater events occur when inundation washes organic material from the floodplains into waterways leading to a rise in dissolved organic carbon in the water. This causes the water to turn a dark colour. The increased bacterial activity breaking down the carbon consumes oxygen, which causes a drop in levels of dissolved oxygen. In some circumstances, levels can drop so much that fish and other aquatic organisms do not have enough oxygen and die.

Blackwater can also create challenges for downstream water use, such as increasing treatment costs for drinking water supplies.

Blackwater events are a natural feature of many river systems. However, when natural flood patterns are changed and there are longer periods between overbank flows, the amount of organic material can be substantially increased, exacerbating the risk.

Changes to the natural inundation patterns of floodplains can increase the risk of blackwater events.

The project

As part of the South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP), the South Australian and Commonwealth governments have invested in major infrastructure upgrades to provide water to the Pike and Katarapko floodplains. The infrastructure allows the Department for the Environment and Water (DEW) to create higher water levels to inundate the wetlands, improving watering frequency and the ecological health of the floodplains.The project includes a number of initiatives to manage potential blackwater risks. This has included developing a model to help understand and predict dissolved oxygen responses to different inundation events, giving DEW important information to design watering events with reduced risk of blackwater events occurring.

Spreadsheet models were previously used to help understand blackwater risks (Howitt et al. 2007, Whitworth and Baldwin 2016, known as the Blackwater Risk Assessment

Tool – BRAT). While effective for non-complex situations, DEW was unable to represent realistic hydrology, such as events where water flowed into and out of different floodplains along the river. A more sophisticated approach was required. DEW determined the best approach to be to develop a Source plugin to model blackwater processes on the floodplains.

DEW and the Murray-Darling Basin Authority use the Source modelling framework to help manage the River Murray System. The Source framework uses “plugins” as a flexible way to build additional modelling capability into model. Combined with the South Australian Source Murray Model, the new Blackwater plugin allows DEW to model interactions between the river and floodplains and the different processes that contribute to the risk of blackwater events.

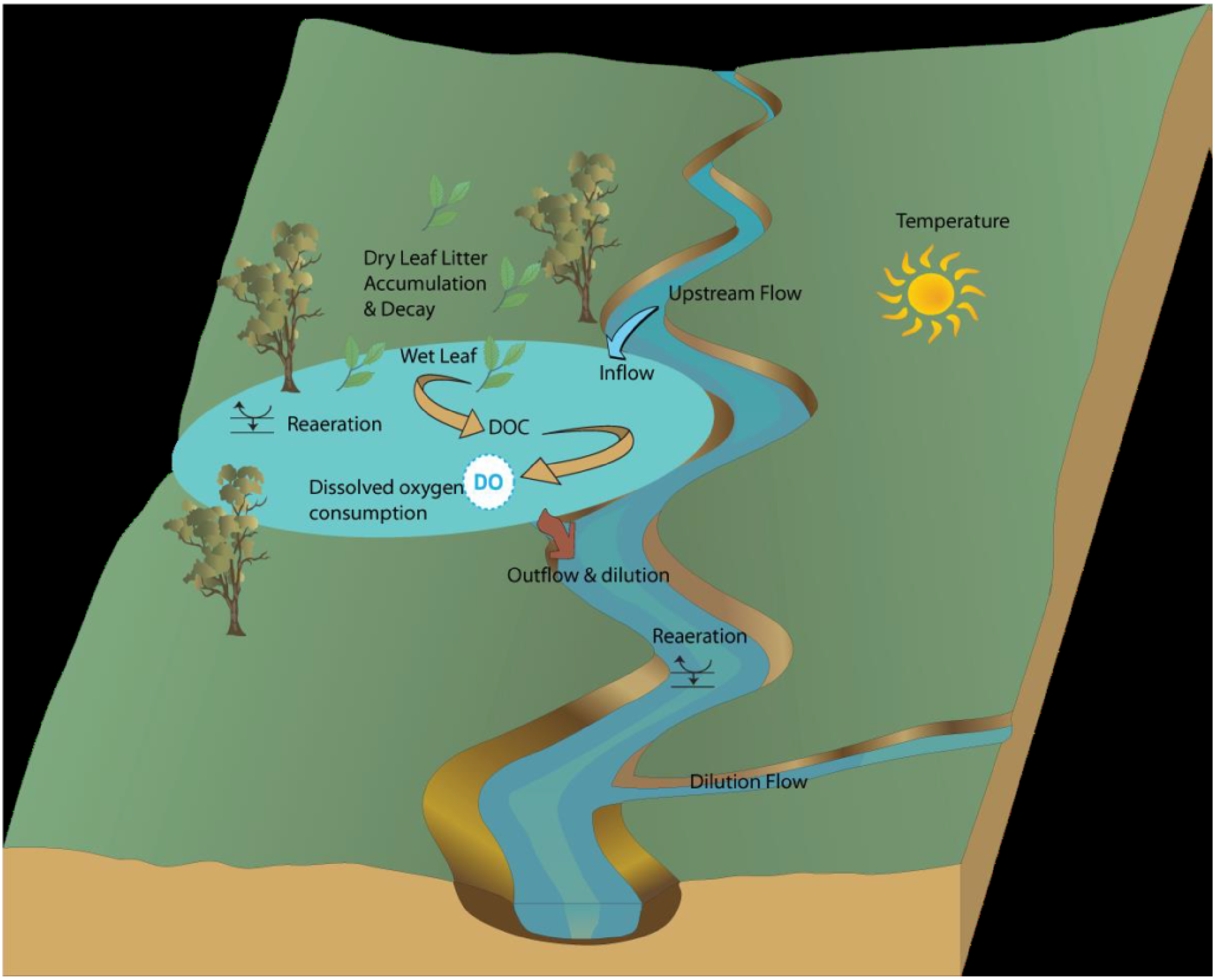
The approach

Conceptually, the model is based on the original spreadsheet models and represents the key influences on the generation of blackwater events (from SMEC 2015):

- time period since the last inundation
- the duration and rate of inundation
- water exchange during inundation
- temperature
- area of inundation
- litter loading
- depth of inundation
- influence of floodplain creeks on dilution
- river dilution flows and proximity to environmental values

In addition, the model includes location specific information such as elevation, floodplain area and litter accumulation (from vegetation type), to understand the extent of inundation and litter accumulation.

The blackwater plugin is set up to represent all of the River Murray in South Australia, to consider interactions between the river and floodplains, as well as cumulative effects from multiple operations being inundated at the same time.

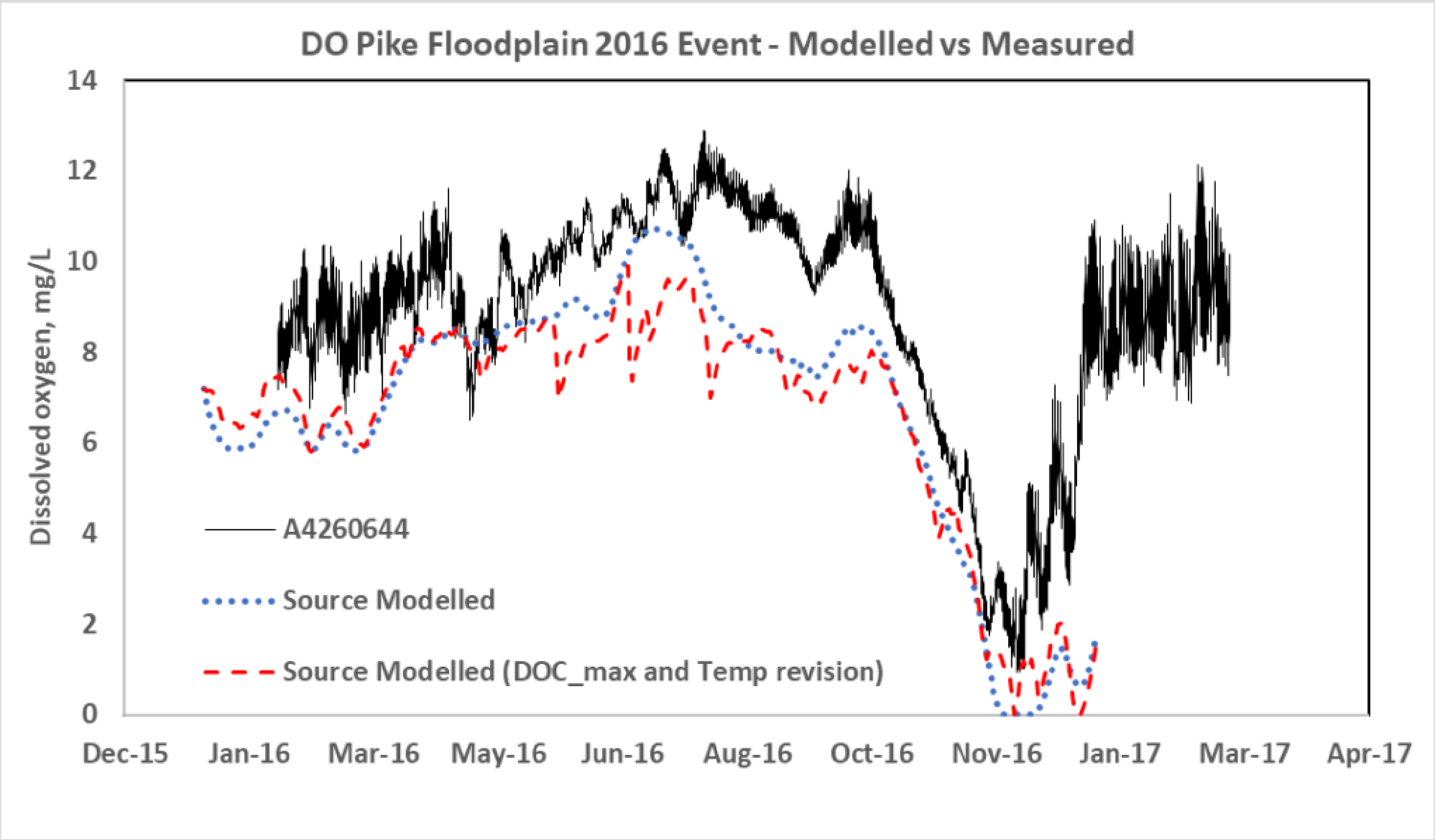


Conceptual model of the processes represented in the Source Blackwater plugin

Model performance

Model performance was tested in two ways. Firstly, simple floodplain scenarios were run through the Blackwater Risk Assessment Tool (BRAT) and the plugin. The results were comparable.

Secondly, a natural high flow event that inundated the Pike Floodplain in late 2016/early 2017 provided an opportunity to compare the model performance against observed DO data. The model compared well with the measured DO trends and magnitude but further testing under a wider range of scenarios is required to fully test the model. Notably, the event shows the importance of interactions with the river during blackwater events, as the majority of the DO decrease on the floodplain during Oct-Nov 2016 appears to relate to the low DO in the inflow water.



Modelled versus measures (Station A42602644, Pike River at Lettons downstream Rumpagunyah Creek) Dissolved Oxygen levels on the Pike Floodplain during the 2016-17 inundation event.

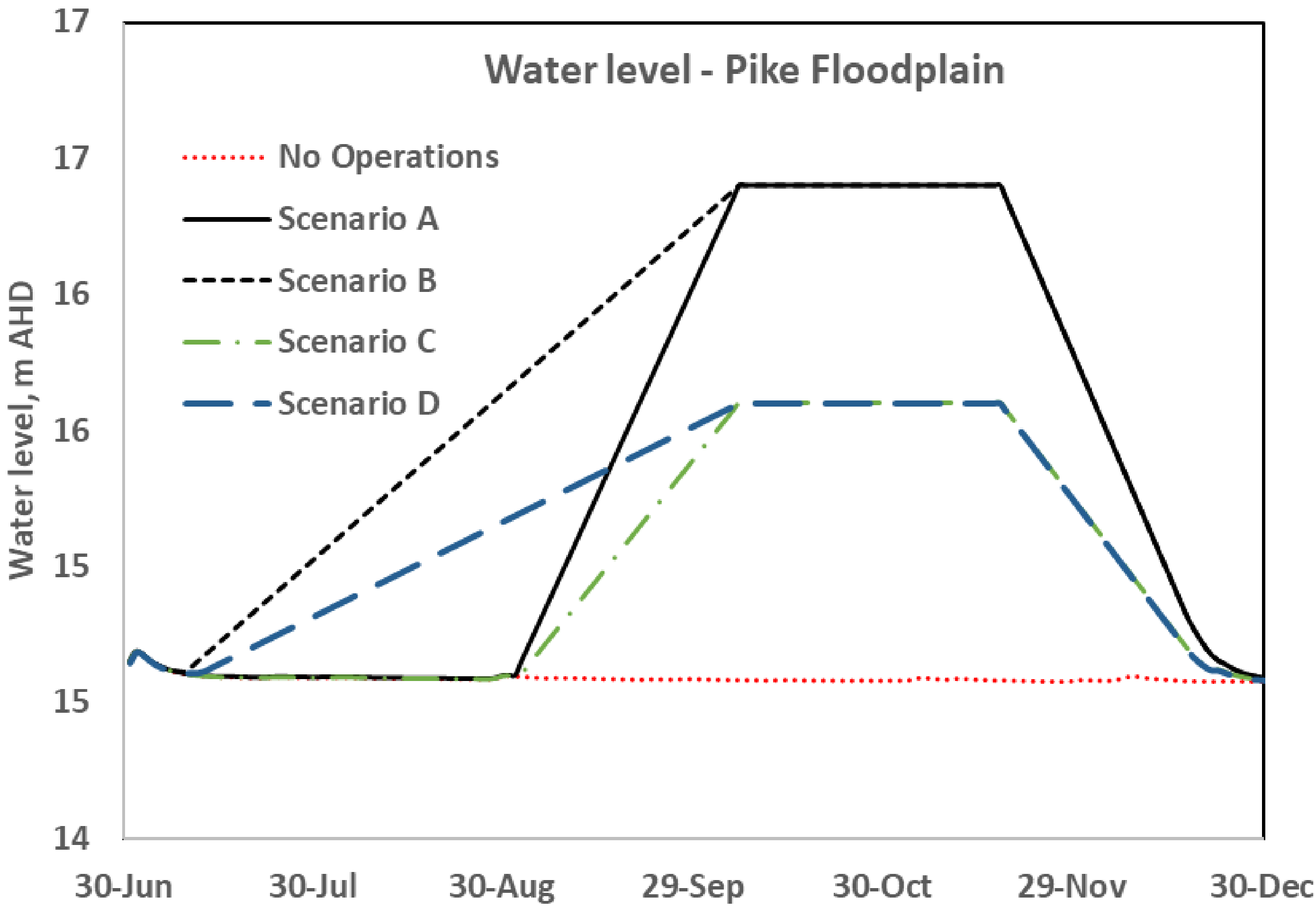
Implementation

The model supports DEW to:

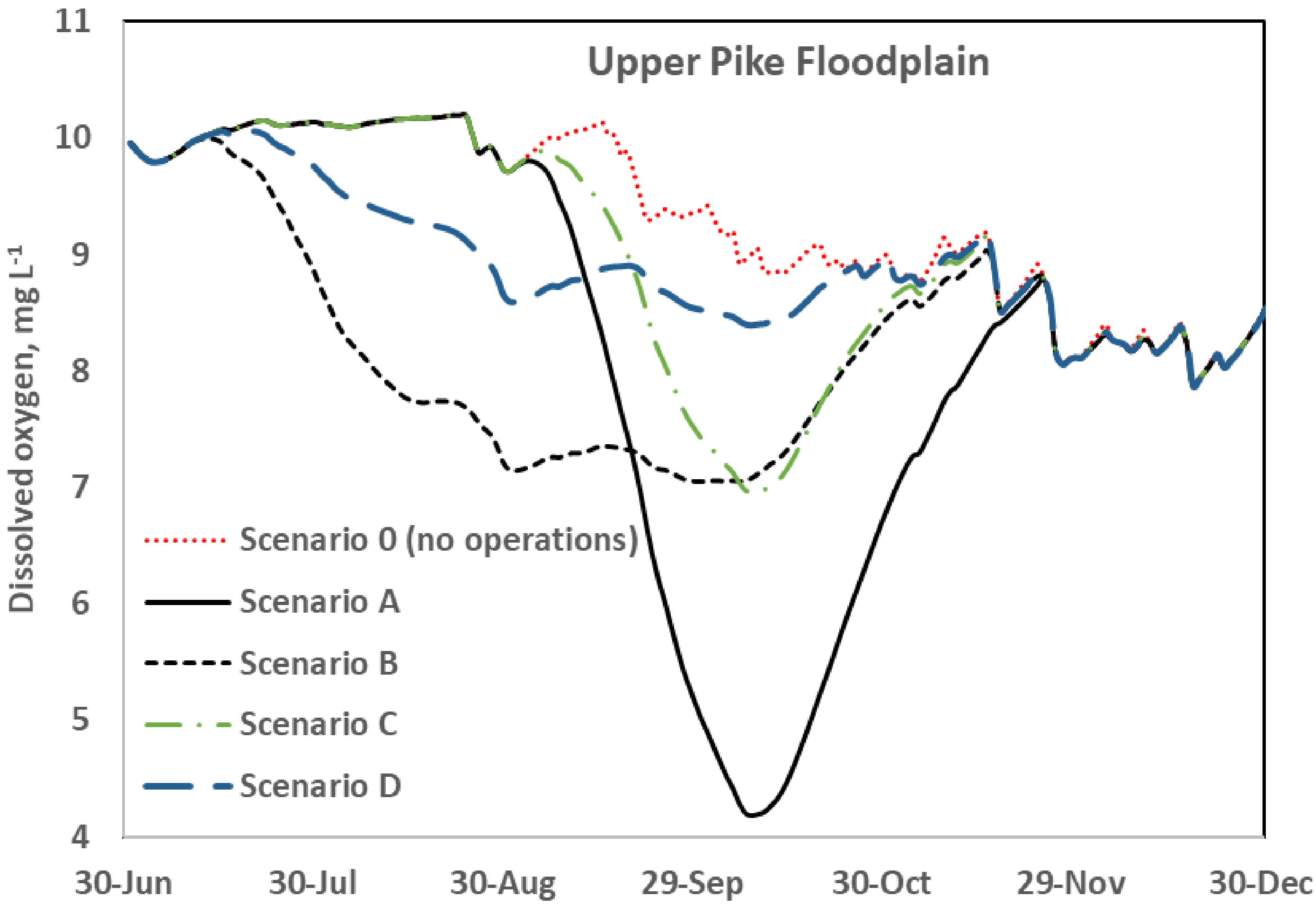
- understand the potential DO changes associated with different environmental watering actions on the floodplains

- adjust proposed watering actions to reduce the risk of blackwater events
- forecast potential DO changes and blackwater risks from floods, and to identify potential river operations to minimise forecast blackwater events.

The figures below are two examples of the blackwater plugins outputs. The first shows the range of floodplain inundation under five different scenarios. The second shows forecast dissolved oxygen levels for each of the scenarios.



Hypothetical scenarios of water level upstream of environmental regulators to create floodplain inundation



Scenario A represents a fast fill of the floodplain to full inundation extent, potentially resulting in DO concentrations that could be detrimental to aquatic biota. Through the use of the DODOC plugin, operations can be designed to reduce these impacts.

Project partners

This work forms part of the $155 million South Australian Riverland Floodplains Integrated Infrastructure Program (SARFIIP) to improve the health and resilience of Riverland floodplains. SARFIIP is funded by the Australian Government through the Murray–Darling Basin Authority and implemented by DEW in partnership with SA Water.

The Blackwater Plugin was developed for DEW by the University of Adelaide and Flow Matters Pty Ltd. eWater was engaged by DEW to further develop functionality and modify the plugin to better work with improvements made to the Source platform after the plugin was developed.

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Howitt JA, Baldwin DS, Rees GN and Williams JL (2007). Modelling blackwater: predicting water quality during flooding of lowland river forests. Ecological Modelling 203 (3–4):229–242. doi:10.1016/j.ecolmodel.20

SMEC (2015). SARFIIP Blackwater Risk Assessment: Stage 1. Report to the Department of Environment, Water and Natural Resources. SMEC, Adelaide in association with Natural Logic (Karla Billington) and University of Adelaide (Luke Mosley)

Whitworth KL, Baldwin DS (2016). Improving our capacity to manage hypoxic blackwater in lowland rivers: the Blackwater Risk Assessment Tool. Ecological Modelling 320, 292–298. 06.11.017

Acknowledgements

This case study was prepared in collaboration with the SA Department for Environment and Water and Murray-Darling Basin Authority.

Government of South Australia
Department for Environment and Water

Australian Government
MURRAY–DARLING BASIN AUTHORITY

ARGHANDAB INTEGRATED WATER RESOURCE MANAGEMENT PROJECT – AFGHANISTAN

Decades of war and political instability have decimated most of Afghanistan’s water infrastructure and reduced the technical capacity of the water resources sector.

In response, the Government of the Islamic Republic of Afghanistan is undertaking a range of initiatives to invest in new infrastructure, improve water resource management and increase capability. One such initiative is the Arghandab Integrated Water Resource Management Project.

The Asian Development Bank (ADB) is supporting the Afghanistan Government to scope the Arghandab Integrated Water Resource Management Project. The project will finance infrastructure to increase water resources for irrigated agriculture, urban water supply, and power generation for Afghanistan’s second largest city Kandahar and surrounding areas.

Farmland in Kandahar (credit Paul/AdobeStock)

Using Source to support infrastructure investment

eWater was invited to provide technical assistance to the project, through a rapid hydrologic study of the Arghandab River and capacity building through training in the use of the Source modelling platform. eWater's involvement was funded by the Australian Department of Foreign Affairs and Trade (DFAT).

eWater, in collaboration with modellers in Afghanistan built a baseline Source model for the Arghandab River Basin. The model is used to generate inflows to Dahla Dam for the period 2002 to 2016.

The model allows different multi-sector allocation scenarios for irrigation, urban water supply, hydropower and downstream flows to be compared against each other, providing key inputs to support the decision-making process. The potential impacts of climate change on the different options is considered by modelling different inflow scenarios.

Overcoming data constraints

Water models typically rely on observed measurements for flow, rainfall, evaporation etc. However, such data is very limited in Afghanistan. A combination of data from historic sources and remotely sensed sources were evaluated and used to develop the Source model. The hydrology is simulated using the GR4J and GR4JSG hydrological models which, respectively, represent direct rainfall-runoff and snow melt processes. The hydrology is calibrated to historic average monthly observed values.

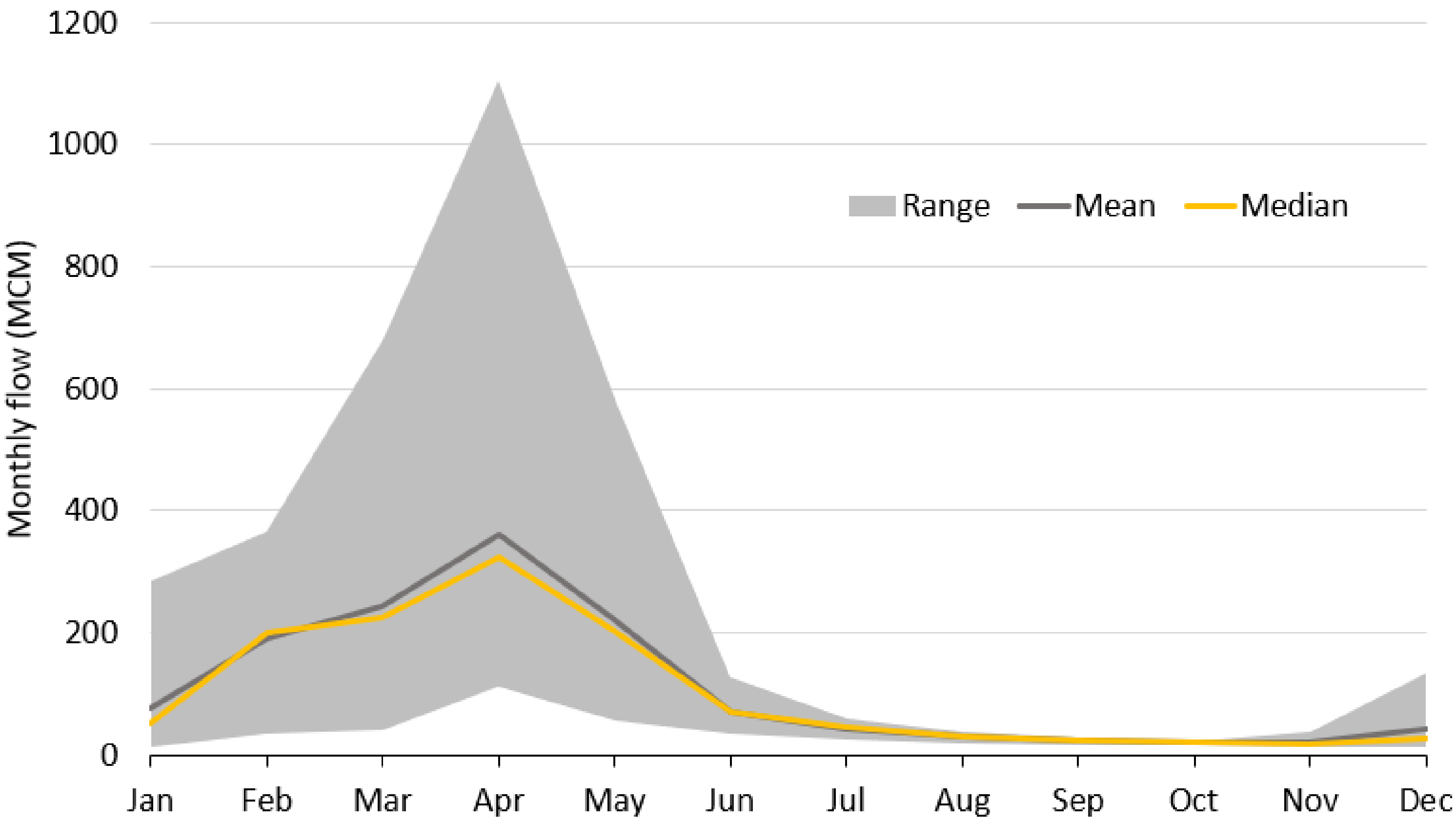
Given that this is a rapid study where limited time is available to explore alternate sources of data such as some of the globally generated flow sequences used for detailed climate change modelling, an expedient approach to calibrating the model was adopted. This was to assume stationarity in average monthly
flows and calibrate to observed monthly average discharge values despite differences in dates between rainfall and

discharge. This averaging impacts on the predictive ability of the model for extreme events such as flash flooding associated with sudden high rainfall since extreme peaks in flows can happen at a sub-monthly scale.

Nonetheless, the model significantly increases the information available to water managers to understand current flows and support initial investigations into the impact of changes in dam size and demand over time and with climate change. Examples of the model outputs are shown below.

Monthly flows

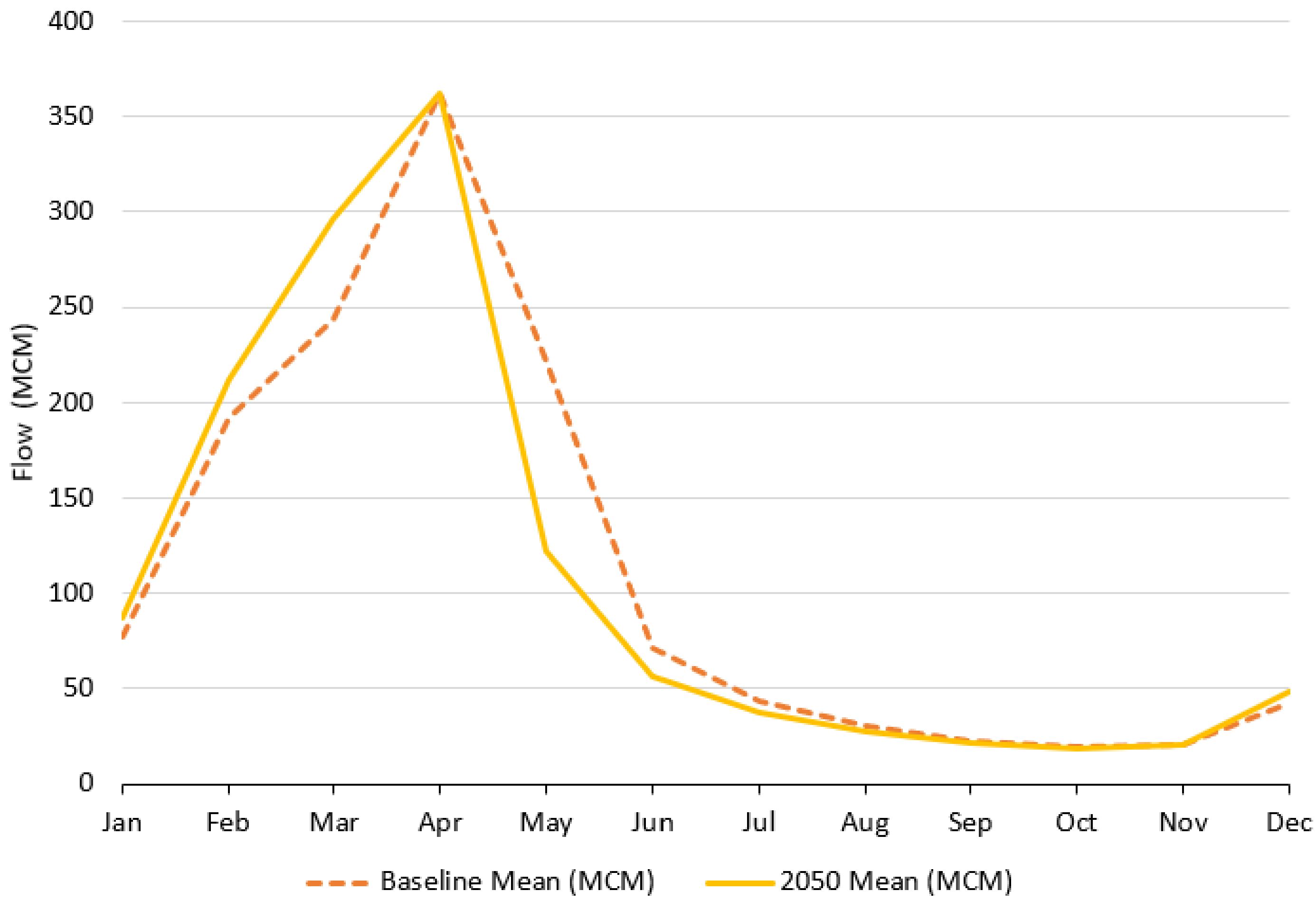
Flows are highly variable, particularly during the wet season. Monthly flows are lowest in October and November, and highest in April. The figure below shows the possible range in total monthly flows predicted by the Source model, with the grey area representing modelled minimum and maximum flows for each month. The modelled period 2002 – 2016 includes the drought years of 2010 2016 as well as extreme flows observed in 2007. Mean and median flows are also indicated.



Range in total modelled monthly inflows to the Dahla Reservoir (2002 – 2016)

Impact of climate change on flows

The projected impact of changes in temperature and rainfall on average total monthly inflows to Dahla Dam, between the baseline period (2002 – 2016) and future 2050 are illustrated in Figure X. Expected higher temperatures will cause snow to melt sooner in the season with an increase in flow in March and less water available from May resulting in a longer low flow season.



Average total monthly flow volumes (Baseline 2002 – 2016 and 2050)

USING SOURCE FOR WATER AND CATCHMENT MANAGEMENT IN THE AUSTRALIAN CAPITAL TERRITORY

Source models support strategic planning, policy development, catchment and water resource management in the Australian Capital Territory

The models underpin the Australian Capital Territory (ACT) Water Strategy 2014-44 – Striking the Balance and support the ACT Government to meet its obligations under the Murray-Darling Basin Plan 2012.

Together with eWater, the ACT Environment, Planning and Sustainable Development Directorate (the Directorate) have embarked on a series of initiatives to upgrade the ACT's

Source models.

Improving water quality through wetlands like this is one in the Canberra suburb of Bonner is a central part of the ACT Water Strategy
(credit: Danswell Starrs, ACT Environment, Planning and Sustainable Development Directorate)

Audit of water models

The Directorate use several different Source models to inform strategic planning and decision-making regarding land use planning, urban development and climate change on water quantity and quality and the operation and maintenance of water infrastructure.

eWater was engaged to audit the Directorate’s existing Source models to ensure they were fit-for-purpose and could address emerging needs, including the ability to:

- explore different policy, planning and management actions and assess potential impacts on the natural environment and water resources
- predict impacts of land development decisions on water resources and assess mitigate measures
- test new ways of operating water infrastructure
- predict future environmental states to inform policy and management decisions, such as environmental condition and future water supply/catchment yields.

The audit identified several issues with the existing models that limited their ability to meet the current and future needs of the ACT Government. eWater recommended a substantial rebuild of the models, including:

- Consolidating the existing nine models.
- Utilising human-readable input sets and data sets to run scenarios, rather than individual models.
- Reconfiguring storages and lakes in the catchment model to better represent how they operate.
- Reconceptualising and recalibrating the rainfall-runoff models.
- Incorporating the ACT water supply system.
- Establishing a current conditions baseline case for scenario assessment.
- Preparing and justifying a baseline scenario for the comparison of land use change scenarios.

Model rebuild

Following on from the audit, eWater was engaged to rebuild the ACT’s catchment and planning models.

eWater built two new Source models for the ACT, a catchment and a planning model. Model performance has been improved by reducing the number of sub-catchments outside of the ACT. The new models use LASCAM (Large-Scale Catchment Model) rainfall-runoff models, allowing for physically based assessments of hydrological impacts of land use change. The catchment model now incorporates Canberra’s water supply system, including storages. The consolidation of the models allows for different policy and management options to be implemented by Scenario Input Sets.

In addition to the model re-build, the project also included collaborating with the ACT Office of the Chief Digital Officer to the integrate Source models with the ACT Government Water Data Management System. This brings two main benefits, it streamlines the transfer of data and model outputs and adds dashboarding capabilities to improve the presentation of model outputs. Integrations was achieved through a customised plug-in, developed by the eWater

Software Development Team.

eWater also provided customised training to Directorate staff, to ensure they understood the Source model and were able to support its future development and application.

The updated models will support the ACT Government to better manage urban stormwater and flooding risks (credit: Danswell Starrs, ACT Environment, Planning and Sustainable Development Directorate)

Implementation

The Directorate is using the models to inform a wide range of water and catchment management activities, including to:

- support investment in catchment remediation and investment, by helping identify which areas will lead to the greatest improvements in water quality and/or water yield
- investigate Integrated Catchment Management options across the ACT and the greater region
- understand stormwater and flooding risks in urban areas
- forecast future water supply and demand scenarios
- compare likely outcomes from different water efficiency initiatives
- investigate alternative water supply options, such as treated effluent, grey water and stormwater for consumptive and non-consumptive uses
- test different options to improve the management

of rivers and lakes, to promote recreational use and reduce risks to public
health.

Acknowledgements

This case study was prepared in collaboration with the ACT Environment, Planning and Sustainable Development Directorate.

INTRODUCING MUSIC X

> MUSICX is the most significant upgrade to the industry standard MUSIC in a decade.

MUSICX has been re-designed and re-written into modern software coding platform, maintaining all the capability of MUSIC V6.3 but giving users additional functionality and the benefits of modern software architecture.

The real strength of MUSICX is the ability to link your urban water quality models with your eWater Source catchment and river system models and urban demand models (Urban Developer plugin). Allowing the whole water system to be modeled with the one tool providing a platform for exploring possible interactions and new ways of managing water.

For those who are focused on the urban context alone, MUSICX can be run separate to Source, allowing you to continue to use it the way you always have, with the benefit of modern software architecture.

Watch the MUSICX launch video to learn more

Transitioning to MUSICX

MUSICX is a major change to the software. We know that some of our community need time to learn the new features and transition to MUSICX. To ease the transition, MUSIC 6.3.0 remains available and eWater will continue to provide support services.

RIVER BASIN MODELS AND WATER SHARING POLICY IN THE UPPER GODAVARI SUB-BASIN, MAHARASHTRA, INDIA

eWater assisted the Maharashtra Department of Water Resources to develop a modelling framework to test water management options and to support the development of an integrated water resources management (IWRM) plan for the Upper Godavari sub-basin.

MELBOURNE WATER – IMPROVING WATER SECURITY WITH INTEGRATED WATER RESOURCE MANAGEMENT

For 130 years Melbourne’s catchments and water infrastructure have provided for the water needs of Melbourne’s growing population and industry.

Population growth and climate change are putting increasing pressure on Melbourne’s traditional water supplies.

Melbourne Water is working with retail water company customers to adopt a more integrated approach to delivering water services, with the aim of a city that is water sensitive, sustainable and liveable.

By adopting an Integrated Water Resource Management (IWRM) approach, Melbourne’s water companies are investing in a range of present or future innovative water management options, at the household, street, and suburb development scale, including:

- recycling and reusing wastewater for things like agriculture, firefighting and dual-pipe systems that provide recycled water to homes and businesses for non-potable use like toilet flushing and watering gardens
- recycling wastewater on site
- capturing more stormwater for watering parks and sporting fields
- refilling groundwater aquifers with stormwater or recycled water, for later extraction and use or to support natural environments

The IWRM approach requires a complete rethinking of the analysis of water system management. Traditional water system models are limited in their ability to analyse IWRM. Recognising this, Melbourne Water, with the support of eWater, has undertaken significant work to modernise their water resource models and to develop new tools to assess the benefits of IWRM.

Melbourne Water is increasing its use of recycled water

A new approach to water resource modelling

Work has focused on three key areas:

- upgrading the bulk water supply infrastructure (headworks) model
- integration with local water supply and demand models
- new tools for improving model performance.

Source Headworks Model

For the past 25 years, Melbourne Water has used the REALM (REsource ALlocation Model) Headworks System Simulation Model. The REALM model runs on a monthly time step and is used mostly for long-term water planning. Traditional monthly timestep water resource models like REALM focus on the behaviour of the centralized bulk water supply system and have limited ability to address emerging modelling needs, such as:

Maroondah Reservoir

Melbourne Water is reducing its reliance on traditional water supplies.

- To what extent can small scale alternative water sources, such as greywater, recycled water or stormwater, be utilized?
- What is the best mix of centralized and decentralized supply options?
- How will water use change with different policy options or new approaches?
- Where are the best locations for, or uses of decentralized systems?

- How to leave more water for healthy river flows and reduce stormwater pollution ?

Working with eWater, Melbourne Water is in the process of replacing the REALM model with a Source model. The new model can run on both a monthly and a daily time step and includes headworks infrastructure and water supply catchments. Catchments have been added to give a better assessment of both the amount of water flowing into the reservoirs and the quality of that water. This will be important for understanding the impacts of changes in the catchment, for example after bushfires or how climate change might impact runoff and streamflows.

The monthly time step mode has been kept to support long-term water management decisions, with important improvements, including customised water allocation rules to determine allocations for primary entitlement holders, such as the water retailers and new optimization tools help assess operating strategies, to find the optimal trade-offs for different management objectives, such as cost and security of supply.

The daily time step mode supports Melbourne Water to manage environmental water in the regulated streams and to meet streamflow requirements in unregulated streams. It also facilitates smaller scale IWRM modelling and helps to better understand the potential risks to water quality. Importantly, the model has been designed to easily switch from a monthly and daily time step, allowing for better integration between short, medium and long-term operating plans.

Headworks models are designed to find the best way to meet water demands and inform the reliability of water supply. As such the representation of demands in the model is equally as important as the representation of water supplies. An innovative feature of the new model is the incorporation of spatial geographic data to better understand demand. Spatial data includes population data, dwelling types and land-use. Ultimately, it will help estimate changing water demand and the potential impact of alternate water supplies at the suburb scale.

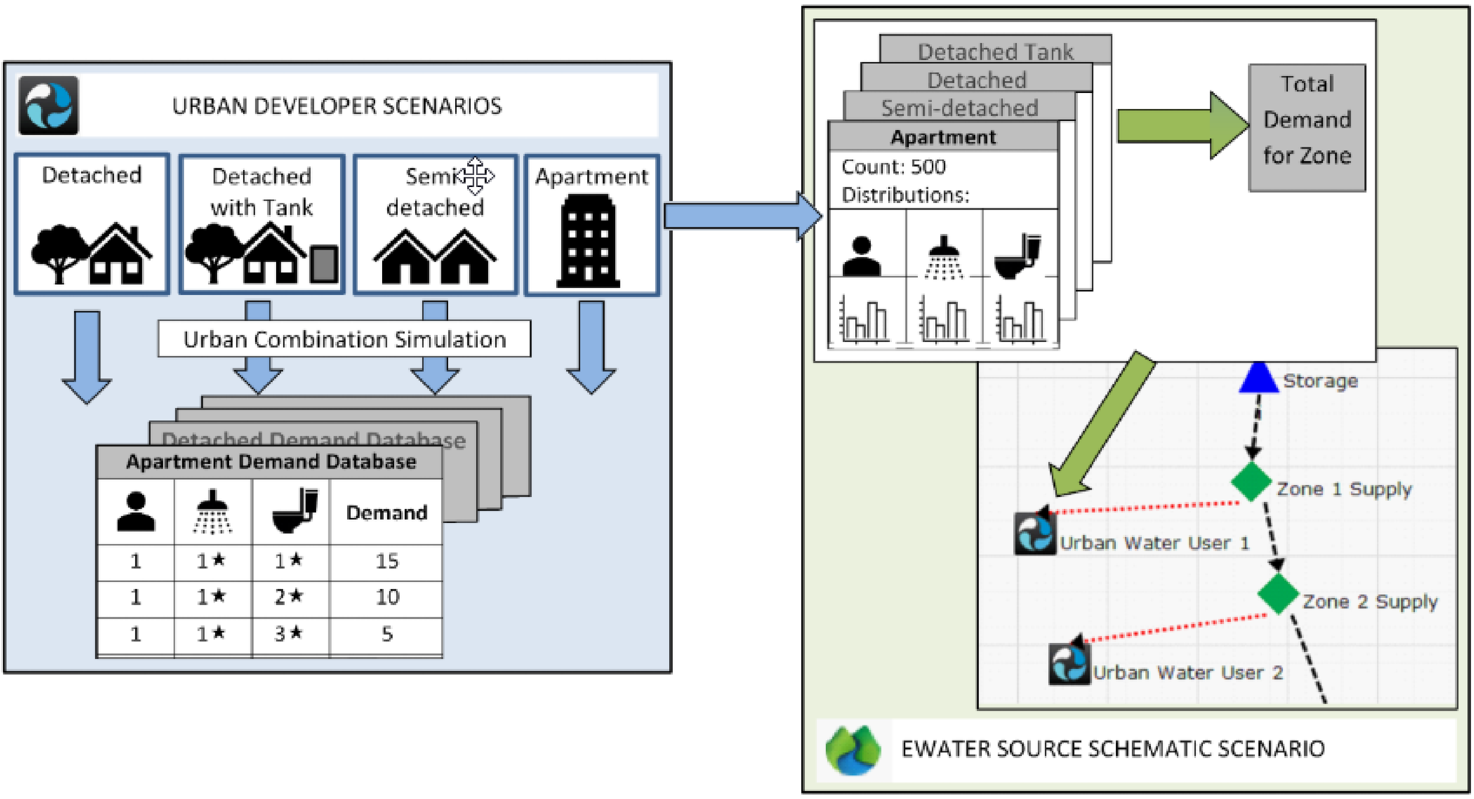
Urban Developer in Source

The upgrades to the headworks model bring a wealth of new features to support IWRM but they do not fully take into account potential alternative water supplies, such as rainwater, stormwater and wastewater, or localized demands. A second component of the project has been to incorporate eWater's Urban Developer tools into the Source platform. This allows local small scale water sources and demands to be considered in the context of overall large scale supply options.

Urban Developer can now estimate urban water demands based on a suburb's characteristics and how they might change, for example with population growth, dwelling type, the adoption of Water Sensitive Urban Design approaches or alternative water supplies like rainwater tanks. The approach was tested across four catchments and the model calibrated for the Melbourne region. The Urban Developer plugin to Source was developed to feed the outputs of the Urban

Developer demand model into the Source Headworks Model.

An important aspect of the work was looking for more sophisticated ways to estimate demand and to differentiate between indoor/outdoor water use, and commercial and industrial water use. For example, we can now test if including information on household income or lot size provides more accurate water use estimates.



The Source Urban Developer plugin allows detailed analysis of urban water use

Improving model performance

Running large, complex models for different scenarios takes a lot of computing power and time. Melbourne Water uses optimization tools to inform water resource decisions by assessing how to maximise the reliability of supply and reduce delivery costs. With the enhanced model functionality, it would take a month to process Melbourne Water's optmisation runs on a standard computer, even longer if new requirements, such as environmental flow delivery and integrated demand management options were included.

Working with eWater, a cloud-based run manager was set up to enable large numbers of simulations to be run across hundreds of virtual machines. A common web browser interface gives access to different run locations, including a local (single PC) and the Cloud (hundreds of virtual machines). Run times have been reduced to a number of hours.

In addition to saving time, the system is easy to install and use, does not require specialist knowledge and reduces the costs associated with owning and maintaining significant amounts of hardware. A particular advantage is that jobs can be tested locally before launching on the cloud, reducing the risk of minor errors negating the final results and the modellers can continue working on other projects while the simulation is being run.

Following the initial success, work is underway to expand the type of jobs that can be run on the cloud and to make Source and the optimisation tool, Insight, more cloud friendly.

Conclusions

The project has delivered significant improvements to Melbourne Water’s modelling tools. Innovative projects like these require flexibility, new ways of thinking and a high degree of collaboration. eWater and Melbourne Water have worked closely together throughout the process, proposing and testing different methods, refining and adapting along the way. A key aspect was including Melbourne Water in the software development process and allowing them to work directly with eWater to scope and prioritise software improvements.

USING AUSTRALIAN WATER TOOLS TO DEVELOP NEW DROUGHT METRICS FOR CAMBODIA

eWater, in partnership with UN Economic and Social Commission for Asia and the Pacific (UNESCAP), Geoscience Australia (GA) and the Australian Bureau of Meteorology

(BOM) implemented a pilot using space-based data to help water users in drought prone countries to better understand and manage droughts.

BUILDING WATER MODELLING CAPACITY IN EGYPT

Upcoming training – 31st May 2020

SOURCE PROFICIENCY & CERTIFICATION

As part of our eWater Academy, we are enhancing our Source training packages to provide a structured pathway to certification in Source Modelling for Industry, Governments and Development Partners.

WATERTOOLS: A GUIDE TO THREE

NATIONAL LEVEL PLATFORMS TO SUPPORT THE MANAGEMENT OF AUSTRALIA’S SCARCE WATER RESOURCES.