MEET SUDEEP NAIR, HYDROLOGIST

We are continuing the *Meet Our People* series where we put the spotlight on the people that make up eWater Group. We are an organisation focused on delivering smart, sustainable water management solutions in Australia and internationally.

Sudeep Nair is one of our hydrological experts who has been working within our organisation and supporting our partners and clients nationally, and internationally, for nearly two years now, in addition to his 10 years of experience in the field of water resources management and modelling.

Sudeep’s interest in water resources began when he started his postgraduate studies at IIT Kharagpur leading him to pursue his doctoral studies in Environmental Hydrology and Water Resources, and eventually academia. But the urge to work on real-world water resource problems and water modelling was too great, and Sudeep made the leap from research to eWater Group.

As one of our hydrologists, Sudeep works on Australia’s National Hydrological Modelling Platform, eWater Source, and MUSIC, and supports this country’s most prominent government and non-government organisations to find solutions to support sustainable water management.

“I get the opportunity to involve in both the development of the tools and their application to solve real-world water

management problems. Moreover, I am part of the team which supports the adoption and use of our software products through various training programs."

Acting as a bridge between our customers, who include hydrologists and water modellers, and the software developer team, Sudeep identifies, tests, and reviews their models to ensure there are working at optimum levels to deliver high-quality water data and information in real time.

"I don't have a typical day *[at eWater Group]* which is why I like working at our organisation. The hydrology team is a small and cohesive team, and we get the opportunity to get involved in almost all activities such as the development of new functionalities in Source and MUSIC, software maintenance and support, modelling, supporting clients and partners, and training."

While our hydrology team may be small, it has a huge impact. "As a key member in a small team, my suggestions and feedback are heard and valued. It feels like a family here in eWater. I am also given the opportunity to undertake various training to regularly update my skills and

knowledge.”

Like any industry, we face many challenges in water management and delivering high-quality data and information to a growing audience in Australia and internationally. For eWater Group our focus is offering Australian governments, water experts and institutions here and abroad the highest of expertise, knowledge, and support.

For Sudeep, the challenge we face is the need for clarity amongst modellers regarding the selection of appropriate water modelling tool to address changing and emerging needs of water managers.

“eWater Source *[the National Hydrological Modelling Platform]* is different and is increasingly being adopted in Australia which enables uniformity and comparison, along with *[our other modelling platform]* MUSIC, which is already used widely in Australia for urban water modelling purposes.

eWater Source, and MUSIC, are constantly evolving tools, with more capabilities and functionalities added to our toolkit

based on customer feedback and requests. It is this continued drive to deliver better support and services which “make eWater tools ready for assessing new water-related challenges in the wake of climate change and other pressures.”

Who are we?

eWater Group is owned by the Australian Federal, State and Territory governments to further develop Australia’s world-class modelling tools and to provide support and training nationwide and internationally.

Our organisation is comprised of three divisions – eWater Solutions, the Australian Water Partnership and the Mekong Water Solutions to deliver water management solutions for communities in Australia and overseas.

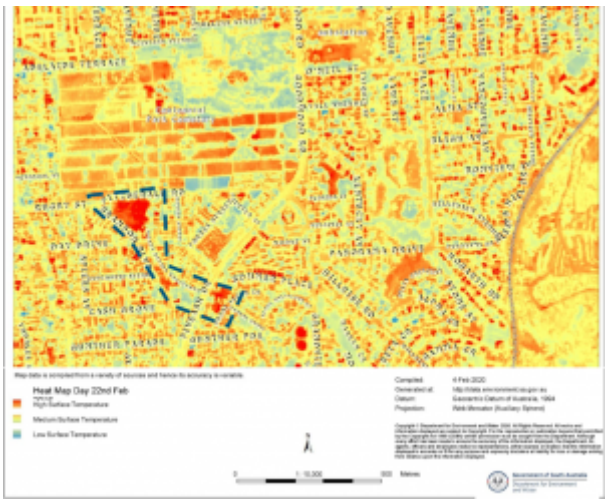
We also partner with the Australian Department of Foreign Affairs and Trade, and research groups and institutions to provide expertise and support for sustainable water management solutions in Australia and internationally, now and into the future.

REVITALISING ADELAIDE'S DRAINAGE RESERVES

REVITALISED RESERVES CONNECTING COMMUNITIES

Designing a Stormwater System for an Urban Biodiversity Corridor

The drainage reserves that run diagonally through Pasadena from the Adelaide Hills to the Plains are hot, dry and barren.



On an urban heat map (right), the reserves show up as the hottest areas in the locality, scarring the otherwise leafy suburb. Due to open unirrigated bare ground, the reserves contribute more urban heat island impacts than surrounding roads and structures.

The site is near a popular shopping centre, important recreation areas and in an area destined for further urban infill. A radically different passive recreation space is needed to serve the community both now and into the future, and climate change makes quality open spaces rarer.

Revitalising Reserves with a Biodiversity Corridor

Water Technology completed a conceptual design of a multi-function stormwater system for a new Biodiversity Corridor. The stormwater system diverts runoff into a number of underutilised reserves within the City of Mitcham in the Adelaide foothills.

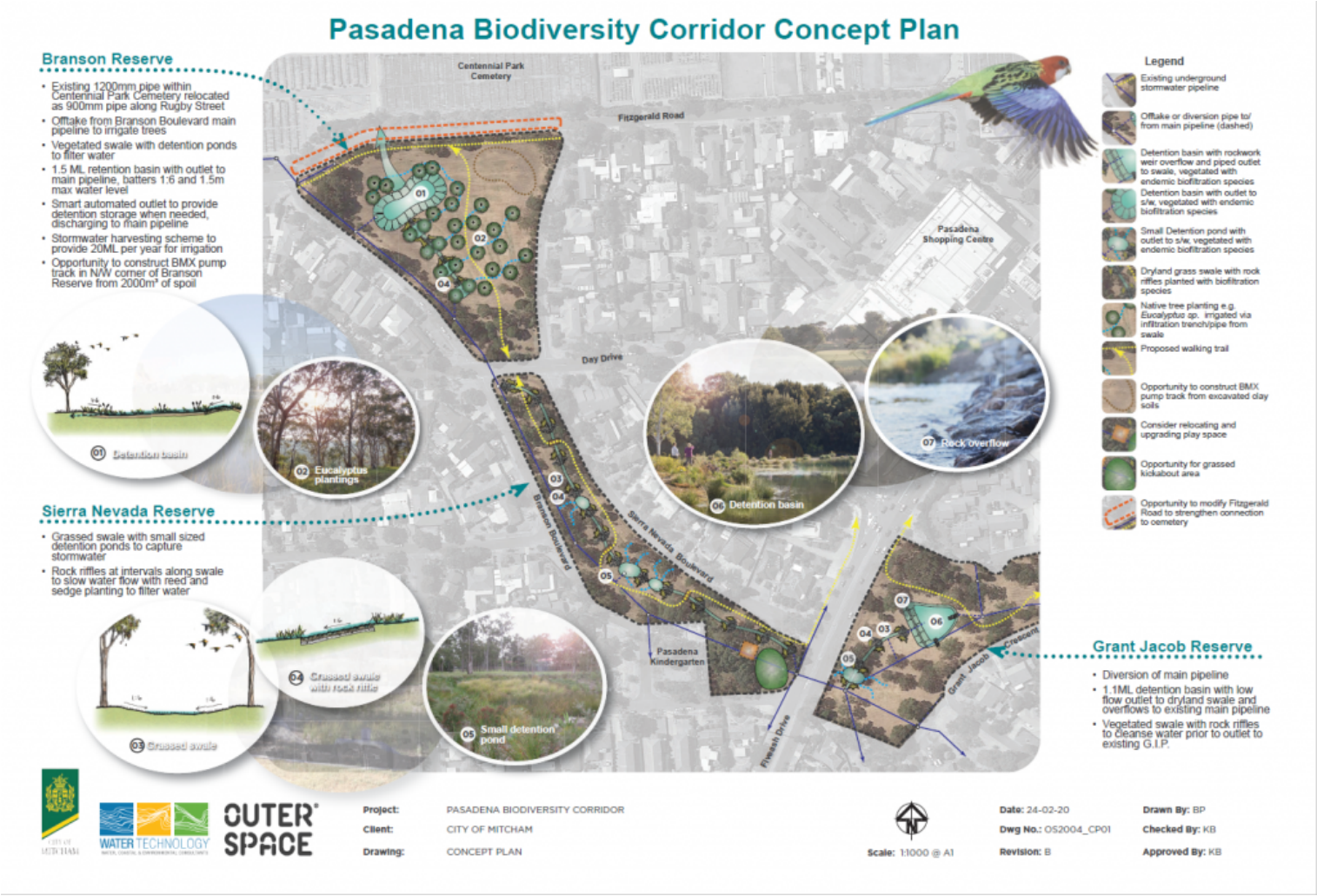
The project revitalises the reserves by providing much-needed water for irrigation and new native tree plantings. This is achieved by daylighting urban stormwater runoff from underground pipes into open channels within the reserves and diverting runoff to infiltration trenches for passive irrigation.

In this way, stormwater management will help deliver multiple benefits, including improving public health, local biodiversity, and providing a green and open space for the

local community to reconnect.

eWater MUSIC was a key Water Sensitive Urban Design conceptual design tool used for the project. eWater MUSIC allowed engineers to model multiple stormwater management functions and evaluate the resulting multiple benefits of the Biodiversity Corridor.

The Biodiversity Corridor concept design completed by Water Technology’s engineering consultants included design input from Outerspace Landscape Architects and was carried out in consultation with the City of Mitcham (below).



The design brings stormwater flows from the underground drainage pipes within the reserves to the surface to create a lush, green, passively irrigated recreation space that establishes a biodiversity corridor linking the Adelaide Hills to the Plains.

Developing green space is a focus, with hundreds of new trees and native vegetation understory plantings all sustained by soakage trenches filled by the above-ground

creek flows. Increased moisture availability supports healthier canopies with no supplementary watering even in the longest and hottest dry summer, and most of all, lots of shade to draw people to the space to recreate.

Not only will flora and fauna be drawn to the reserves, but also the community as the reserves will become a focal point for residents to visit, walk, run, explore, and engage with nature through the new trails, nature play water areas, benches and BBQ facilities, Kaurna edible garden, and BMX track.

In an area subject to high urban infill, small lot sizes, and minimal canopy cover, the Pasadena Biodiversity Corridor will become a place that brings the community in and allows them to enjoy a cool, vibrant, passive recreation space among native trees, birds, and animals.

Concept Design Features

The concept design provides for daylighting existing stormwater drains within and near several reserves in Pasadena. The design features extensive new native plantings that will be passively irrigated via daylighted stormwater flows conveyed and filtered through a series of raingardens, infiltration trenches and swales. Detention basins are required to attenuate the daylighted flows to offset a future reduction in pipe capacity proposed at a location downstream of the reserves.

As such, a key design requirement for the Biodiversity Corridor was that the stormwater system needed to perform multiple functions delivering multiple benefits.

The functions and benefits included stormwater harvesting for storage and irrigation of reserves and export off-site, low flow diversions for passive irrigation of new tree plantings, and biofiltration basins, ponds and swales to improve water

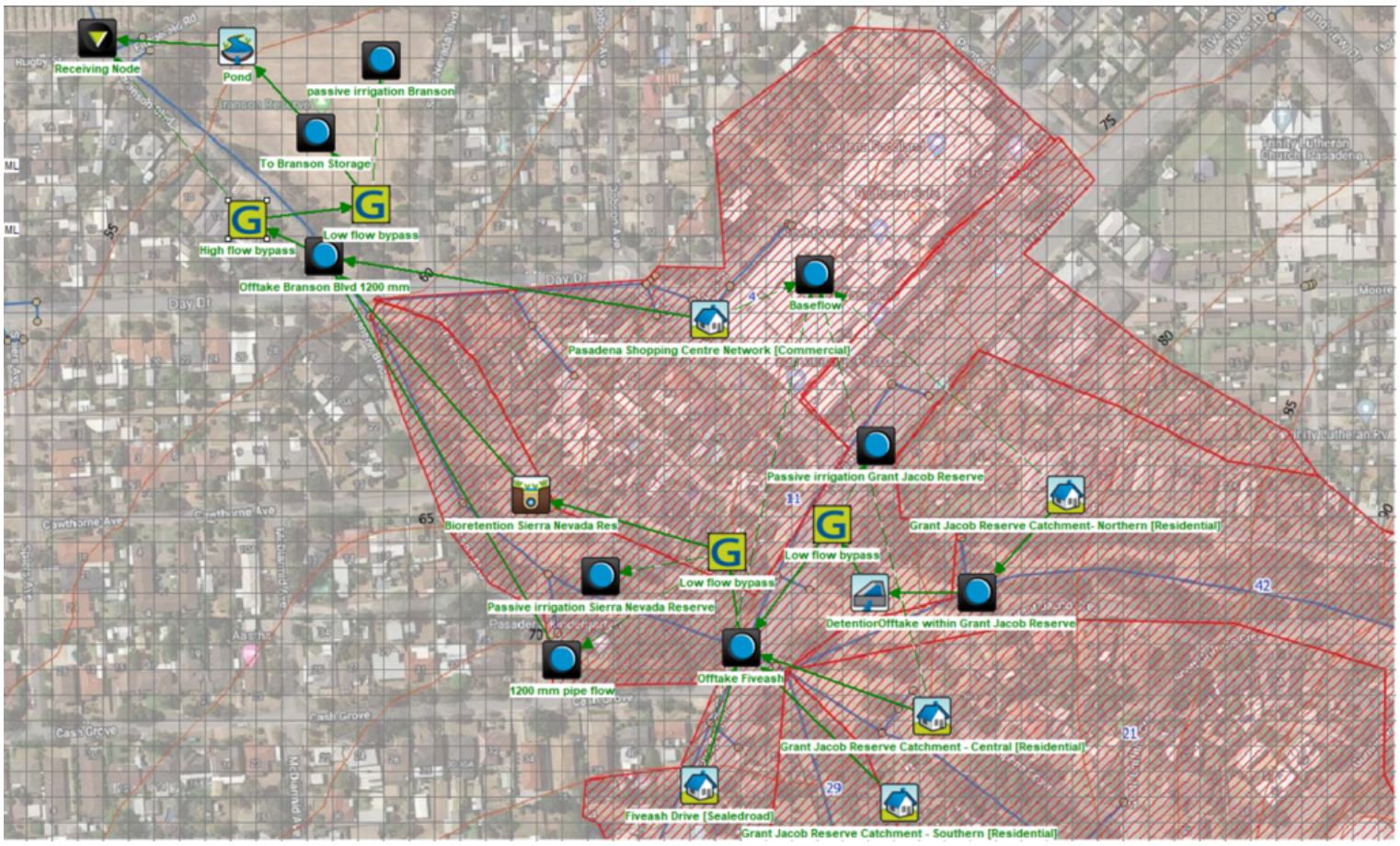
quality.

In addition, the system must distribute low flows equally to the various reserves to keep the new plantings watered consistently.

eWater MUSIC

Including multiple functions and delivering multiple benefits increased the complexity of the stormwater system for the Biodiversity Corridor. Designing and evaluating the system’s performance was a key challenge.

eWater MUSIC was an essential Water Sensitive Urban Design tool for navigating the complexity of the conceptual design of the Biodiversity Corridor (below).



In particular, eWater MUSIC software was used to:

- estimate stormwater runoff volumes from developed areas
- estimate and analyse the sensitivity of stormwater harvesting yield
- estimate low flow volumes available for diversion as passive irrigation
- design biofiltration basins
- assess pond storage inundation frequency
- estimate water quality improvement required for a

stormwater harvesting scheme
- estimate the water available for passive irrigation to promote urban cooling.

eWater MUSIC has several unique features that assisted with designing and evaluating Water Sensitive Urban Design approaches in the Biodiversity Corridor. These included:

- Secondary links from nodes allowed low flow diversions to be modelled and optimised.
- Biofiltration, swale and pond treatment nodes allowed treatment of stormwater to a quality fit for harvesting to be modelled.
- Advanced charting within MUSIC allowed rapid assessment of flow frequency at different locations to ensure the system provides equitable distribution of low flows.
- Stormwater harvesting demand patterns and custom demands allowed sensitivity analysis and the viability of a harvesting scheme to be assessed.

eWater MUSIC made a complex stormwater model simple to

modify and evaluate. Using eWater MUSIC for conceptual design, ensured that the Biodiversity Corridor has the best opportunity to remain robust, sustainable and functional, and will provide multiple ongoing benefits to the local community.

Next Steps

Following construction, the Biodiversity Corridor will become the ‘jewel in the crown’ for the local suburbs, giving the community access to a lush, cool, green space to walk, explore, recreate, and relax.

The upgrade will improve accessibility for the community by connecting the reserves to the adjacent streets, linking footpaths and trails, and providing all-weather walking surfaces, as well as solar bollard lighting for night safety along the path. Rather than dividing the suburb like a peace wall, the reserves will become a location that integrates the community.

The addition of thousands of new native trees and plants will

promote the connection of birds and animals from the Hills Face area to the urban plains, expanding their natural environment. By creating the use of passive stormwater as irrigation, it will create a location that is self-sustaining and climate resilient.

Further Information

For further information on the project please contact Water Technology at the details below.

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WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

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.

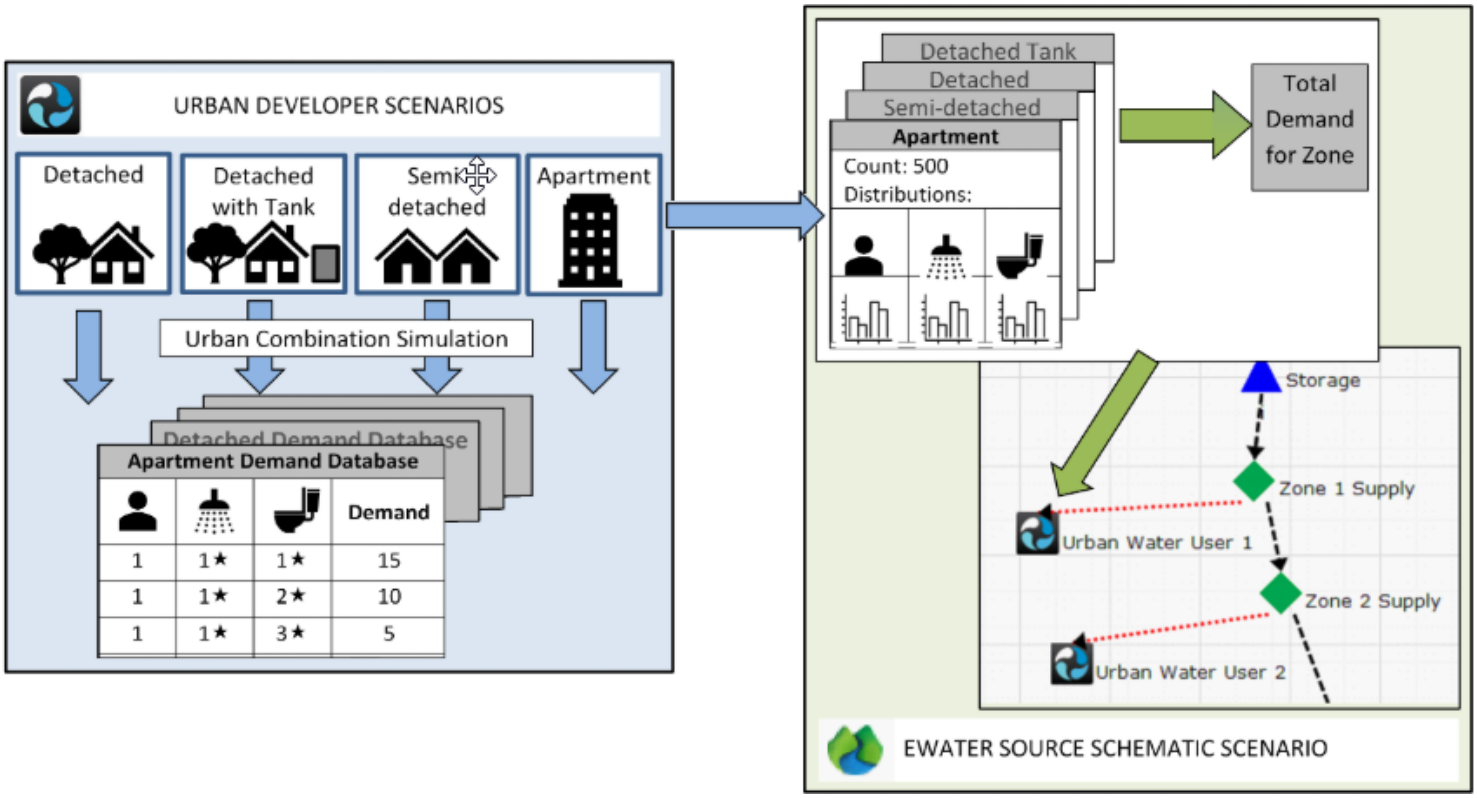
Urban Developer in Source

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.