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IRRIGATION AUSTRALIA

# JOURNAL

## FOR IRRIGATION PROFESSIONALS

**RURAL**
New energy assessment tool for centre pivot and travelling irrigation systems

What's involved with designing and building a custom pump-set?

**BIG ISSUE**
The new One Basin CRC

**URBAN**
SIMPaCT: Australia's largest smart green infrastructure project

ISSN 1326-8180

**IN THIS ISSUE:**

POWERING IRRIGATION WITH RENEWABLES
NEW BOARD DIRECTORS FOR IRRIGATION AUSTRALIA
IMPRESSIVE TURNOUT FOR CONFERENCE

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# CONTENTS

## FEATURES



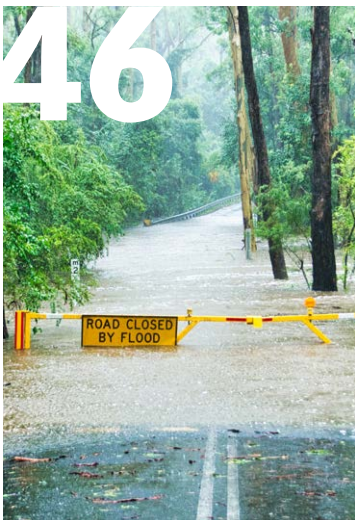
## REGULAR ITEMS



8


26


36



46


**ON THE FRONT COVER:** Agriculture Victoria has developed energy efficiency tools for centre pivot and travelling irrigation systems. Pictured: Irrigation Officer Joe Braden. Read the article on page 6.

# WELCOME

## CHAIR'S MESSAGE

It is great to be penning this first introduction as incoming Chair of Irrigation Australia after five years on the board, most recently as deputy chair.

The recent Irrigation Australia Conference and Exhibition and ICID Congress in Adelaide provided a great opportunity for members and stakeholders to connect. The success of the event and great feedback from delegates is a credit to the organisers, particularly former CEO Bryan Ward and Business Administration Manager Chris Delphin, who made a truly enormous effort to pull the event together. It was gratifying to see the positive response from so many key government representatives from Australia and elsewhere.

Clearly the industry is facing some significant and entrenched challenges. Events such as the conference are an effective way to advance Irrigation Australia's professionalism and influence within the industry and government. My hope is that Irrigation Australia can continue to effectively represent member interests in areas of domestic water policy.

Fittingly, the first article written by Andrew Ogden in his role as chair in early 2015 made reference to the abolition of the National Water Commission. Now we are enthusiastically looking towards the federal government's commitment to reinstating what should never have been abandoned – an opportunity for a holistic and balanced approach to water management based on good science and appropriate stakeholder consultation.

The new board will meet in the new year to further refine Irrigation Australia's strategic plan, building on the established pillars of advocacy and public relations, training and professional development, membership, certification and commercial activities. I look forward to sharing the results of this strategy day in future journal editions.

Being appointed as chair of an organisation like Irrigation Australia is an extraordinary privilege. I send my congratulations to the returning directors and the two new appointees, Valentina Tripp and Matthew Binder, who add their impressive abilities to what was already a knowledgeable and highly experienced board. Under the stewardship of our new CEO, Dave Cameron, assisted by the rest of the dedicated team, I am truly excited and optimistic about the coming 12 months.

Being a director of Irrigation Australia means leaving your day job at the door to focus on building the best possible association to support our industry. Together with the other directors I will continue to support the CEO and his team in his efforts to increase member benefits and value.

We have a diverse membership base with equally diverse interests. You can add your voice by getting involved in shaping the work program. The team is working hard on new ways for members to be more involved, so watch this space.

**Simon Treptow**
Chair

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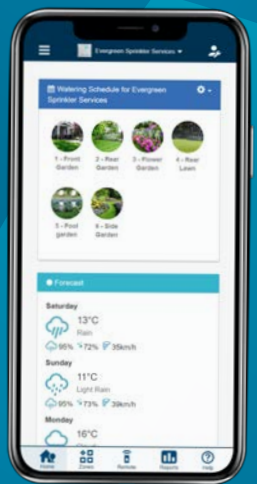

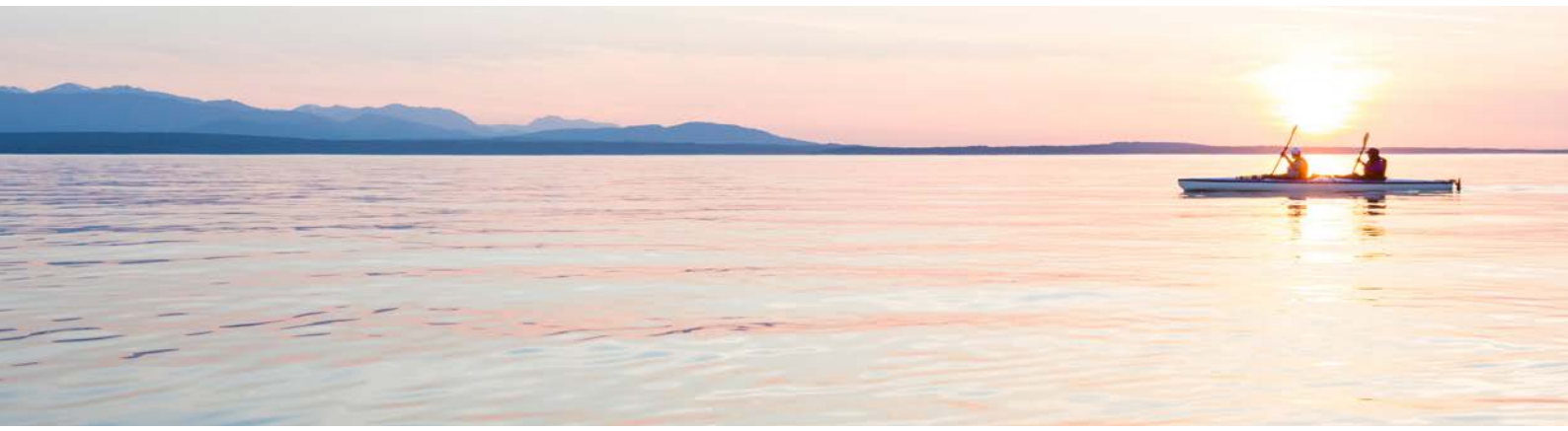

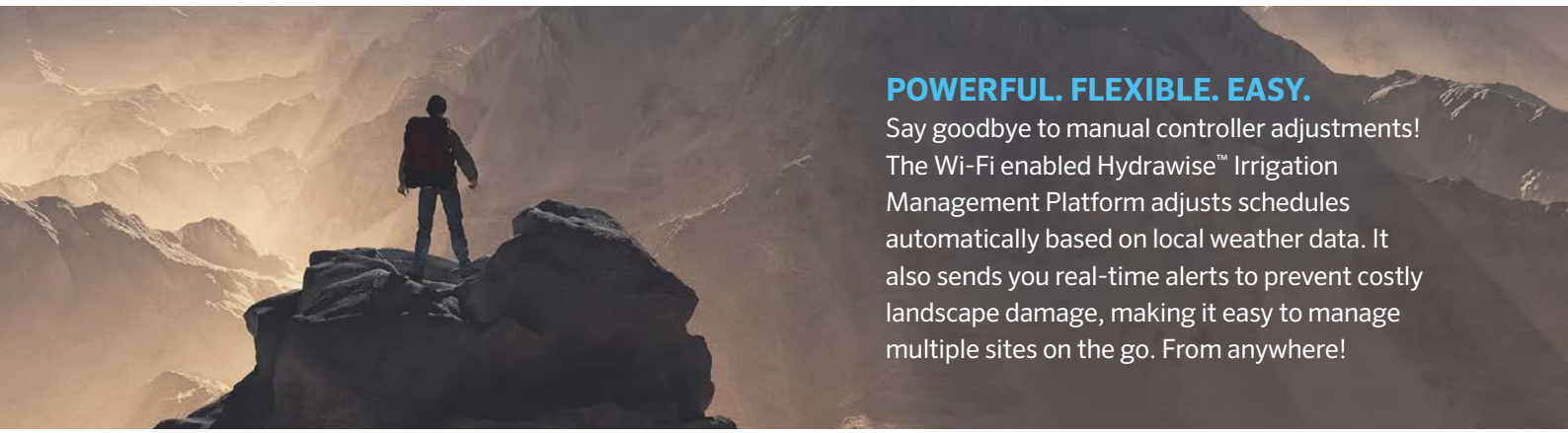

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# WELCOME

## FROM THE CEO

Welcome to the summer edition of the *Irrigation Australia Journal.*

This is my first opportunity since Bryan's retirement to take over the reins of page 4. At the time of writing we have the Adelaide conference and related activities under our belt, along with my first AGM and board election process.

### Changes to the board

Congratulations to our incoming Chair, Simon Treptow, and the other new directors. We've had some great chats already and I am genuinely excited about the future for both the organisation and its members.

It is appropriate to properly acknowledge the efforts of outgoing chair, Andrew Ogden. In the relatively short time I have known him, he's given me immense support in my role as incoming CEO, and was an amazing host during my recent visit to Perth, with a wealth of industry knowledge and respect among our stakeholders. The amount of time he's volunteered to the organisation is nothing short of amazing, and fortunately he's sticking around on the board for a bit longer. Tracy Martin reflects further on Andrew's achievements on page 35.

### Conference and AGM

Already, in my first months as CEO, I have visited each capital city except Darwin and Hobart. I returned home from Adelaide with many learnings as well as some disappointments – I've lost count of the number of positive comments I heard about the Women Working in Water Forum, for example, but unfortunately I couldn't make it to that event due to other duties.

I'd like to thank the members who found time to participate in the AGM at which, I gather, there was an unprecedented amount of discussion and questions. If anyone who was expecting a follow-up from me after the event hasn't heard from me yet, please drop me a line at dave.cameron@irrigation.org.au.

### Looking forward

Leading up to Christmas, the Irrigation Australia team will be busy. Some of our tasks include:

- planning an ambitious program of training and networking events for 2023
- pulling together ideas for our first face-to-face board strategy session in several years, to be held in early February
- finalising the implementation of our newish member management system. An enormous amount of hard work has gone into this, which will hopefully lead to a much-improved experience for members, students and stakeholders.

As a team we aim to keep things light and engaging, providing members with quality services and information and opportunities to network and share knowledge. Keep an eye out for our new trial e-news – a quick read with links to more information. Each edition will cover topics like Irrigation Australia news, including training and events, and key state, territory and national issues such as policy and regulatory movements. It will also include new resources contributed by members and others, and a bit of fun stuff as well. You'll gradually see plenty of new resources and opportunities at www.irrigation.org.au too.

On a different note, my thoughts go out to all members impacted by extreme weather events this year, and I hope there is some respite over the coming months. I know many people were just getting on top of business post-pandemic and now have additional kicks in the guts, including interest rates and broader economic challenges to deal with.

Finally, I'd like to acknowledge the efforts of Bryan Ward and Chris Delphin towards building the Irrigation Australia business over several years and holding the fort during some challenging times.

**Dave Cameron**
CEO

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# NEW ENERGY ASSESSMENT TOOL FOR CENTRE PIVOT AND TRAVELLING IRRIGATION SYSTEMS

## SNAPSHOT

- A new energy assessment tool is available to help irrigators determine whether their centre pivot and travelling irrigation systems are energy efficient, how much money can be saved by making improvements, and which parts of the system should be improved.
- The calculator, developed by Agriculture Victoria and NSW DPI, in collaboration with the Goulburn Broken Catchment Management Authority and Sapphire Irrigation Consulting, is the first freely available tool of its kind.
- The tool is a user-friendly Microsoft Excel workbook, which can be downloaded online. It requires some simple measurements and information about your irrigation system.

Energy assessments of irrigation systems across the Murray–Darling Basin have highlighted huge opportunities to improve irrigation energy efficiency. However, many growers still ask: How can I tell if my irrigation system is energy efficient? What are the likely costs and benefits of improving the energy efficiency of my system? What parts of my system can be improved to operate more efficiently?

Agriculture Victoria and NSW DPI, together with the Goulburn Broken Catchment Management Authority and Sapphire Irrigation Consulting, have developed a tool to help irrigators measure and benchmark the energy efficiency of their centre pivot and travelling irrigation systems. The tool allows farmers to estimate what cost savings may be possible and which parts of the irrigation system need attention.

### First of its kind

Nick O'Halloran, senior irrigation officer from Agriculture Victoria told *Irrigation Australia,* "This is the first freely available tool of its kind. The main advantages of this tool are the simplicity of data required to assess the energy efficiency of your irrigation system, combined with an intuitive diagram for entering this data".

"Crucially, the tool also identifies issues related to irrigation application uniformity that must also be considered when assessing an irrigation system to ensure changes will not compromise yield and productivity."

The tool indicates when irrigation pressure is too low, which often impacts irrigation uniformity. Low pressure must be addressed first, and could actually result in higher pumping costs, but will result in more uniform productivity. Any increase in pumping costs will be offset by production gains.

A new tool helps irrigators measure and benchmark the energy efficiency of their centre pivot and travelling irrigation systems.

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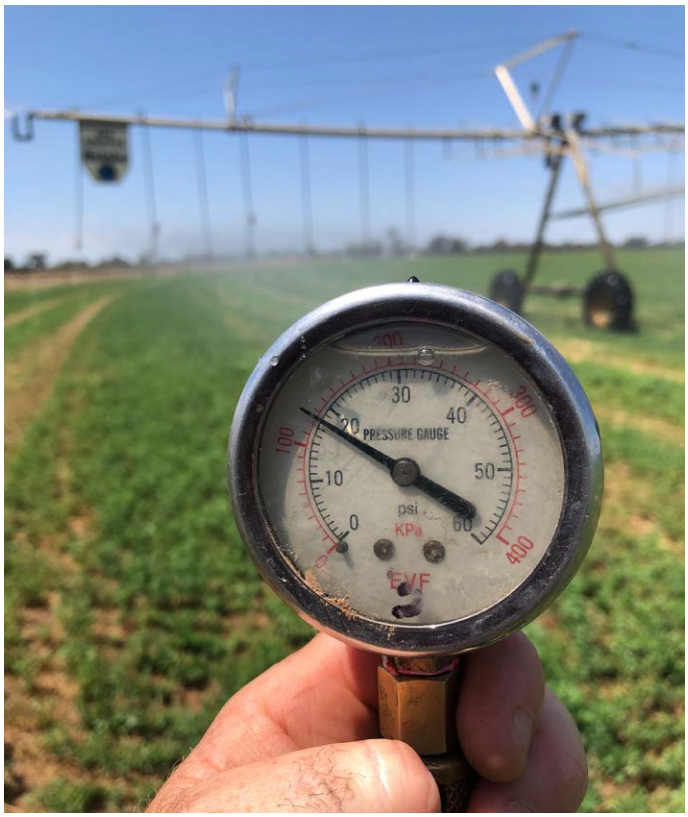



Low pressure must be addressed first, and could actually result in higher pumping costs, but will result in more uniform productivity.

## Using the tool

The tool can work with both electric and diesel-powered irrigation systems. It is designed to require minimal data inputs and is easy to use with the graphical display. Data you will need includes:

- water use (monthly, quarterly or annual)
- diesel or electricity usage (monthly, quarterly or annual)
- diesel or electricity costs (monthly, quarterly or annual)
- pump flow rates
- pressure at specific locations on the irrigation system
- vertical lift heights for water
- basic system specifications (e.g. system length, regulator rating, gun type and nozzle size)
- motor size and drive type.

The tool will give an indication of how efficiently the pump is operating. The minimum acceptable pump efficiency is 70 per cent. It will also indicate if the system pressure is within the desired operating range. Operating pressure may be too high, unnecessarily increasing costs and possibly upsetting the emitter pattern. Operating pressure also may be too low, which reduces operating costs but always diminishes irrigation performance and reduces crop productivity.

The tool calculates the pumping cost per megalitre and indicates where the costs occur in the system, as well as identifying components for upgrade consideration.

## Causes of excess energy use

Excess energy use can be caused by poor system design, typically in pipes being too small to carry the volume of water required at the necessary flow rate and pressure. Incorrect pump selection or impeller size causes a pump to operate outside of the optimal performance range, reducing energy efficiency and increasing costs. Running the system at a higher pressure than required reduces efficiency, although this determination should be based on the pressure at the furthest point of the system to ensure the emitter(s) are performing as required. System deterioration and blockages also increase pumping costs.

Two energy tools are currently available: Energy tool - centre pivot irrigation systems and Energy tool - travelling irrigation systems. Both are Microsoft Excel spreadsheets, which have been developed for Microsoft Excel 365 and above. They have not been tested on older versions of Excel.

**Information.** These tools were developed by Agriculture Victoria, the Goulburn Broken Catchment Management Authority, NSW DPI and Sapphire Irrigation Consulting. The centre pivot tool can be downloaded here and the travelling irrigation systems tool can be downloaded here.

**Acknowledgment.** Thanks to Agriculture Victoria and NSW DPI for granting permission to reprint this article, which was originally published on the ExtensionAUS Irrigating Agriculture website.

## THE TOOL IN ACTION

The user first enters the required data into a spreadsheet. The output is shown in an analysis report as shown below.

Based on the energy use, flow rate and pressure data inputted by the user, the tool estimates the current pump efficiency and potential cost savings available. In this example a pump efficiency of 63 per cent is costing $930 per year compared to the minimum standard pump efficiency of 70 per cent.

The tools also estimates where the friction loss is occurring along the system and what it should ideally be for a system of a given size and flow rate. In this example, more than 12 m of head loss is occurring in the delivery line between the pump and the pivot. We should only be seeing 4.3 m to this point, so clearly improvements could be made. The problem is likely a constriction such as a blocked filter or a small pipe in this part of the system.

Along the pivot itself, there is 8 m of head loss, which is acceptable considering we'd expect around 7.5 m of loss in this part of the system.

Pressure at the end of the system is 25 KPa higher than it should be. The tool also shows that the end gun is applying significantly less water than the rest of the pivot which will be impacting productivity.

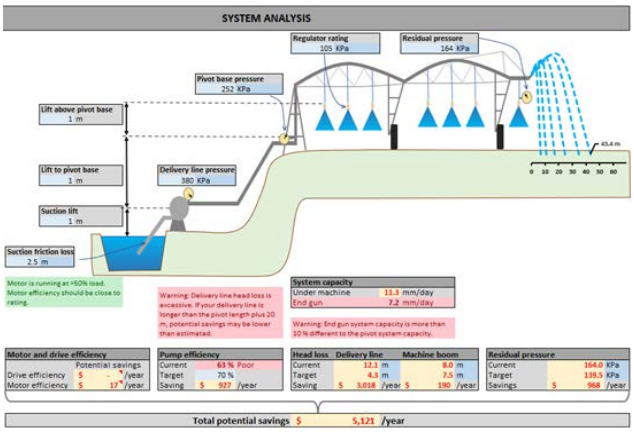
### Where improvements could be made

In this example:

- low pump efficiency is costing about $927 per year in pumping costs
- the delivery line is costing the grower $3018 per year
- restrictions in the pivot itself are costing about $190 per year
- the excess pressure at the end is costing over $968 per year
- the end gun should be adjusted or removed.

So, in this system there's potentially $5121 worth of excess pumping costs, which over a 15-year period equates to nearly $80,000.

Further explanation of the tool can be seen in the recorded webinar 'Irrigation Energy Efficiency' on the Energy Smart Farming website.




*Nick O'Halloran and John O'Connor.*

# SIMPACT - STRATEGIC IRRIGATION MANAGEMENT TO TACKLE URBAN OVERHEATING

## SNAPSHOT

- SIMPaCT is Australia's largest smart green infrastructure project.
- Based in Bicentennial Park, Sydney, it aims to reduce the urban heat island effect (UHIE) by maximising the transpiration cooling provided by plants.
- The project uses smart technology to optimise irrigation so plants can transpire freely during times when air temperatures are high.
- SIMPaCT uses artificial intelligence to 'learn' from the past and present to predict soil moisture conditions in the coming seven days and make irrigation decisions accordingly.
- SIMPaCT is expected to reduce air temperatures across the park by more than 3°C during hot days and the cooling effect is expected to extend at least half a kilometre into the surrounding urban land.
- The technology will apply to existing or new irrigation projects anywhere. The IP will be public domain and the technical solution follows open technology design principles, making it accessible for utility providers and local governments.

According to the United Nations, two out of three people will live in cities by 2050. This will create massive challenges across every aspect of city life. On top of this, urban populations will need to deal with the accelerating impacts of global warming: sea level rise and associated loss of land, flooding from increasingly intense rainstorms, rising summer temperatures and more intense heat waves.

### Warmer cities

The latest report from the Intergovernmental Panel on Climate Change (IPCC) highlighted that cities are hot spots for climate change. Cities currently only cover 0.03 per cent of the surface area of Earth, but cities and their support systems are huge emitters of greenhouse gases. At the same time, owing to the steady growth of urban populations, cities are highly vulnerable to the impacts of climate change.

Even without global warming, surface and air temperatures will always be warmer in cities compared with nearby green areas owing to the *Urban Heat Island Effect* (UHIE) – the fundamental difference in thermal properties between the two types of land surface cover (i.e., green and grey). Vegetated areas absorb rainwater, which can evaporate from the ground and be transpired by plants. Both processes lower air and surface temperatures.

The typical transformation of an area from green to grey involves the replacement of plants with unshaded impervious surfaces with low reflectivity. Because of the low reflectivity and lack of shade, grey areas like cities absorb large quantities of solar energy, which is emitted as sensible heat, warming the ambient air. Moreover, any human activity produces waste heat that leads to further warming of air. The lack of pervious surface reduces the amount of water held by the land and the low number of plants limit air cooling from evapotranspiration. And voila! You have an UHIE.

### Urban green infrastructure

Urban green infrastructure, especially mature trees with large crowns, is the most effective tool to cool our cities, reducing air temperature locally by more than 3°C. Our research has demonstrated that tree shade reduces surface temperature of unshaded asphalt from 70°C to 30°C. Green infrastructure improves human thermal comfort – how your body perceives a certain temperature environment. It also reduces cooling energy needs, which in turn lowers emissions generated by cities.

### Australia's largest smart green infrastructure research project

The goal of the SIMPaCT (Smart Irrigation Management for Cool Parks and Towns) project is to reduce the UHIE by maximising the transpiration cooling provided by plants. We use smart technology to optimise irrigation of an entire parkland so plants can transpire freely during times when air temperatures are high.

Public parks are the ideal location to implement our work. They are usually located where people live and work, can be enjoyed by everyone, have predominately pervious surfaces and large tree populations, are managed for safety and amenity, and are often irrigated. We have known for decades that during warm days, air temperature inside and around parks is lower than the adjacent built environment, a phenomenon known as *Park Cool Island Effect* (PCIE), which mitigates the UHIE at a local scale. We have designed SIMPaCT to bolster the PCIE.

Located in Bicentennial Park, a 40 ha, fully irrigated parkland in Sydney Olympic Park, SIMPaCT is Australia's largest smart green infrastructure research project. It is funded by the Digital Restart Fund of the NSW Government and Sydney Water and brings together universities, government agencies and industry. The project started in November 2021 and will finish at the end of July 2023. All project partners and companies involved in its realisation are listed at the end of this article.

## Bicentennial Park irrigation system

The park is built on landfill, capped by a clay layer. A relatively shallow layer of topsoil sits on the clay and is all that the plants in the park have available as a moisture reservoir. The reservoir holds little water and survival of the plants throughout the park heavily depends on irrigation. The water to keep the park green and lush comes from a nearby treatment plant. The park has an undulating surface, and plant cover is diverse, including pure lawn zones, garden beds, tree groves, native plantings, and mixtures of these elements (Figure 1).

Figure 1. Impressions of Bicentennial Park (Sydney Olympic Park). The vegetation across the parkland is highly variable, from ornamental gardens to native forests, intersected by lawns, wetlands and a large lake. Image © S. Pfautsch.

As a result, a complex sub-surface irrigation system replenishes soil moisture across 200 individual zones. Each zone is controlled by a solenoid valve that can have a single or multiple lateral heads. We use Hunter and Rainbird Rotors, Toro 570s, impact sprinklers and other hardware to distribute the irrigation water across the zones (Figure 2). Field Mouse software from Centratech Systems is used to operate the solenoids, watering the vegetation using a sequence of pumps. Irrigation management, operations and servicing in the park is provided by Total Water.

Figure 2. Irrigation operations at Bicentennial Park (Sydney Olympic Park). Sprinklers were only operated during the day for demonstration purposes. Any scheduled irrigation at the park takes place between 22:00 and 06:00. Image © S. Pfautsch

We installed wireless moisture sensors 10 cm below ground in each zone. In addition to the 200 soil moisture sensors, we also operate 54 ultra-compact wireless sensors that measure air temperature and relative humidity and seven weather stations that record a full suite of environmental information, including rainfall (Figure 3). All sensors take measurements every 15 minutes. SIMPaCT receives these measurements via 4G and three LoRaWAN gateways that we installed in the park and on top of a nearby 126 m tall building. SIMPaCT also ingests seven-day forecasts for the Sydney Olympic Park area from the Bureau of Meteorology (the Bureau). A digital twin of the park and artificial intelligence inside SIMPaCT use the data from forecasting (data from the Bureau) and nowcasting (current data from the park) to predict soil moisture in each zone. If soil moisture in any zone drops below set thresholds where plants do not transpire freely, irrigation commands are sent to Field Mouse and irrigation is provided.

Figure 3. Installation of wireless sensors, LoRaWAN gateways, power-autonomous weather stations and drone technology used to document environmental conditions across Bicentennial Park. Image © S. Pfautsch, B. Puncheon, A. Tovey.

## Artificial intelligence learns from data to predict the future

Over time, SIMPaCT records a lot of data, and the AI will learn how soil moisture changed under different environmental conditions and what affect that had on air temperature. This machine learning process is called hindcasting. SIMPaCT combines forecasting, nowcasting and hindcasting to 'learn' from the past and present in order to predict soil moisture conditions in the future. We defined 'future' as the coming seven days. Combining the digital twin for geospatial modelling and scenario analyses with artificial intelligence that can predict future scenarios makes SIMPaCT truly smart and a unique way to manage irrigation of an entire parkland.

SIMPaCT also generates dashboards for Sydney Olympic Park Authority and the public (Figure 4). These dashboards display information to support the operation of the irrigation system in the park, for example the water volumes used

in the past and those required for the coming seven days. Park visitors can use the dashboards to check where the coolest location for their picnic is or where they should not go for a run because it is very warm. We also operate six weather stations across the centre of Sydney Olympic Park and use their measurements to inform the public how much cooler it is in Bicentennial Park to encourage a visit. This information will become important during summer when people can come to the park to cool down and relax in the afternoon and evening, instead of being confined to indoors airconditioned environments.

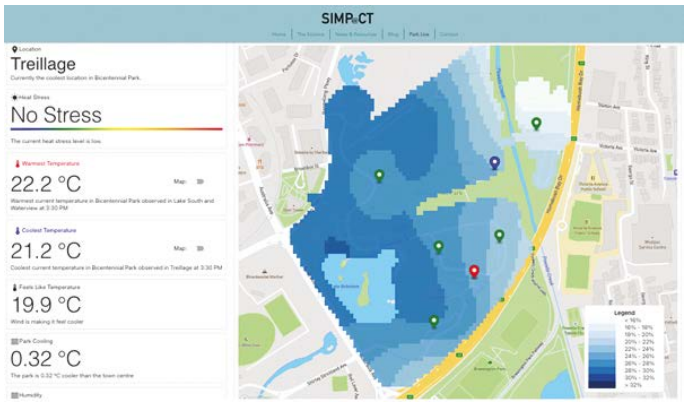



Figure 4. Example of the draft public dashboard (30 October 2022, 15:45), depicting live environmental conditions across the park. The projected map in scales of blue shows soil moisture, the pins indicate the locations for the seven weather stations with blue and red pins identifying the coolest and warmest air temperature, respectively. The dashboard is accessible at www.simpact-australia.com/live.

## Cooling within the park and beyond

Based on scientific models, we expect that SIMPaCT will reduce air temperatures across the park by more than 3°C during hot days. The reduction of air temperature is called Park Cooling Intensity. The same models predict that the PCIE of Bicentennial Park will extend at least half a kilometre into the surrounding urban land, reducing the cooling needs in residential and office buildings. The spatial extent of the PCIE is called Park Cooling Distance and will depend on wind speed and direction. SIMPaCT aims to maximise both the Park Cooling Intensity and Park Cooling Distance.

## A greener future

Given the expected increase in extremely hot summer conditions, including high air temperatures at night, and the race to net zero carbon, it is necessary to develop new solutions that help keep our cities cool without the need for electricity. Plants, especially trees with large, dense crowns do a wonderful job providing coolth. All they need are optimal soil moisture levels, and SIMPaCT is designed to maintain these levels in a complex parkland. We are developing SIMPaCT in a way that allows it to be applied to existing or new irrigation projects anywhere – it operates in digital space that has no physical boundaries. Importantly, the IP of SIMPaCT will be public domain and the technical solution follows open technology design principles, which makes this 'smart' irrigation solution accessible for utility providers and local governments.

In an increasingly urbanised and warming world, SIMPaCT demonstrates how science and industry can work together to deliver effective urban cooling solutions.

Organisations and companies involved in SIMPaCT:

- Western Sydney University (lead)
- Sydney Olympic Park Authority
- Sydney Water
- University of Technology Sydney
- Monash University
- NSW Department of Primary Industries (Water)
- SAPHI
- The ARCS Group
- Hydrology and Risk Consulting
- Eratos
- Centratech Systems
- Total Water
- Amazon Web Services
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**Information.** To find out more, visit the SIMPaCT webpage.

*Sebastian Pfautsch, Associate Professor in Urban Management and Planning, Western Sydney University*

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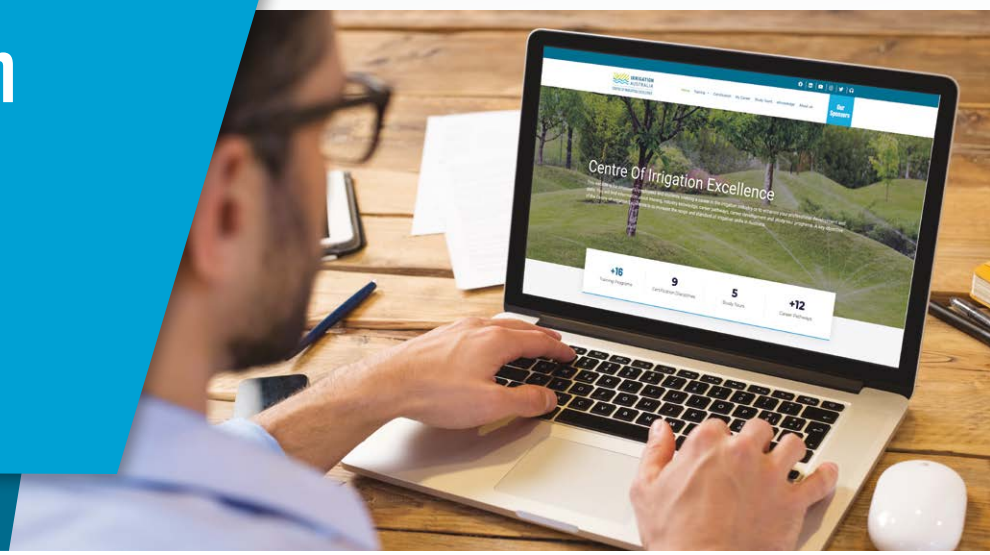


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# WHERE IS ALL THE WATER?
# FILLING THE GAPS IN WATER KNOWLEDGE IN NSW

## SNAPSHOT

- A report by the NSW Smart Sensing Network (NSSN) looks at how sensing technologies and data analysis techniques can increase certainty in our knowledge about water resources and fill in our knowledge gaps.
- This multidisciplinary collaborative project between four universities will help NSW government agencies and other stakeholders to make more informed water management decisions.
- The researchers looked at how advanced sensing methods, an understanding of groundwater and surface water interactions, and probabilistic modelling can be used in synergy to provide a better understanding of our water resources than any method in isolation could provide.

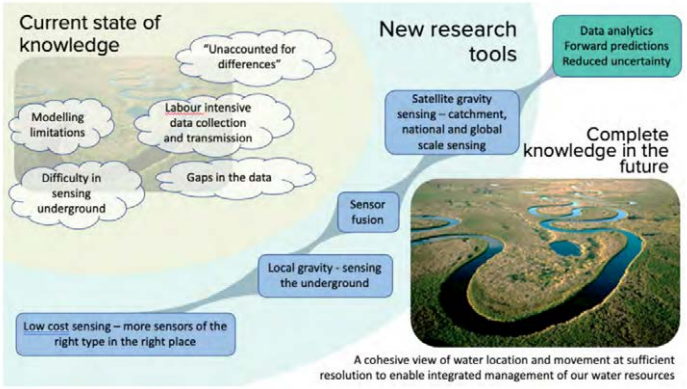
Agriculture, the environment and metropolitan water all compete for a share of surface and ground water resources in NSW. These demands are dynamic – growing populations, changing land use and climate change are placing increasing pressure on the state's water resources.

To manage water well, we need to understand where it is and how it moves, but there is a lack of simple, open, telemetered data across NSW, and 'unaccounted differences' in water measurements can be greater than 25 per cent. The *Where is all the water?* report looks at how new technologies and data modelling techniques can help us better measure this precious resource.

The project brought together the latest university research in different methods of advanced sensing and data analytics under a single umbrella. These new tools could help NSW government agencies and other stakeholders overcome challenges in water management and decision making, and develop a more complete knowledge of water in NSW.

The report includes research conducted by different universities, which focuses on:

- Low-cost sensors (Macquarie University)
- Gravity sensing using both traditional terrestrial gravity sensors and satellite data (the Australian National University (ANU))
- Recharge mechanisms of aquifers (University of NSW (UNSW))
- Probabilistic modelling (the University of Sydney's ARC Training Centre in Data Analytics for Resources and Environments (DARE)).

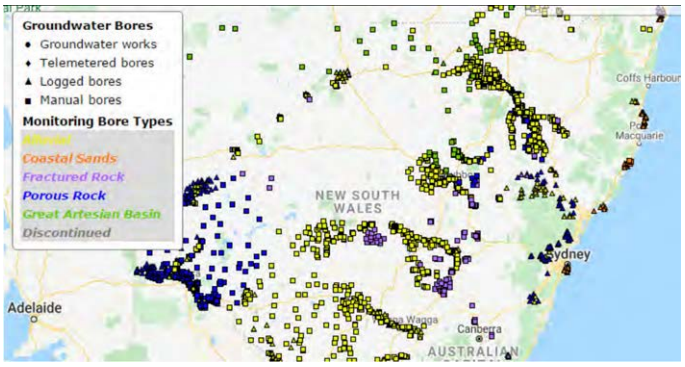



New research tools are intended to drive to a more complete state of knowledge.

Here we give an overview of these different research components and how they can contribute to helping with better understanding and managing water resources in NSW.

### Low-cost sensors

A quick look at the NSW state map of water sensor distribution shows large areas not currently sensed or telemetered. Infrastructure and methods such as weather stations, borehole drilling, wired communication, manual servicing and data collection are expensive to implement but there is potential to fill in the data gaps with low-cost sensors.




A quick look at the NSW state map of water sensor distribution shows large areas not currently covered by sensors or telemetered (WaterNSW data: https://realtimedata.waternsw.com.au/).

Low-cost sensors placed at strategic locations can provide data that can reduces uncertainties that arise from modelling assumptions. The sensors can also be deployed as reference points for large-scale sensing techniques such as emerging gravity sensing methods.

The project successfully deployed low-cost sensors in the Namoi catchment. The sensors provide telemetered data on soil moisture, rainfall and temperature, and other physical parameters can readily be added. The project demonstrated that deploying new sensors to provide additional data can be done as part of a relatively small and simple project.

## Gravity sensing

The concept of using gravity as a signal to detect water is simple. Changes in mass due to water movement will result in a change to the local gravitational field. By monitoring the local gravitational field, it is therefore possible to gain information about the general location and amount of water beneath the surface.

A gravity signal cannot be shielded or blocked by anything. This means information about the underground can be ascertained by a sensor above ground, without the need for digging, tunnelling, insertion of probes, chemical analysis or other contact.

Within the WIATW project, researchers at ANU investigated the use of both traditional gravity meters and satellite data.

**Traditional gravity meters.** The ANU simulated a real-world test case to investigate the gravitational signals from near surface groundwater. This feasibility study showed that the gravitational signals produced by recharge to the groundwater systems will be measurable by the next generation of portable quantum sensors.

Once developed, gravitational surveys could be used to monitor interesting or problem areas. For example, if a particular catchment consistently has less water in it than expected, a number of gravitational surveys could be done and the mass balances calculated and compared to existing models for that catchment. The extra data source can be used to identify where water is being lost to ground water recharge or to evapotranspiration.

**Satellite data.** While terrestrial-based gravity measurements provide a means of sensing very localised changes in water stores, this technique doesn't upscale easily to basin-scale or state-level studies. A combination of space gravity data, satellite-based measurements of shallow soil moisture and in situ terrestrial measurements can provide both broad-scale and fine-scale quantification of changes in water.

Satellites that measure changes in the gravitational pull of water on Earth can be used to quantify changes in total water storage at global, continental and basin scales. Combined with other data sources (e.g., soil moisture and ground-based gravity observations and models), the spatial resolution can be improved and estimates of groundwater changes can be made.

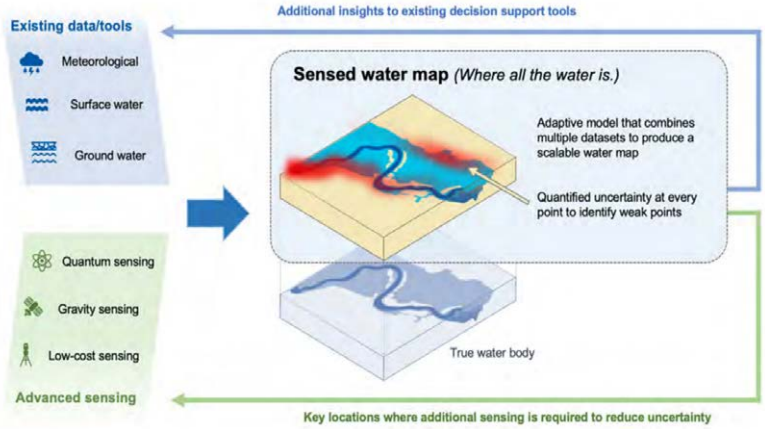
This research by ANU assessed what space gravity observations can contribute to our understanding of water resources. The study included assessments of the ability to resolve a simulated change in water volume from space gravity observations, including the broad-scale mapping of how the significant rain events in 2019 and 2020 propagated across NSW. In addition, an assessment was made of whether it is possible to track floodwaters from southern Queensland as they flowed into NSW after the March 2020 flooding events.

## Recharge mechanisms of aquifers

Understanding the groundwater and surface water interaction is important for sustainable management of water. Groundwater recharge is one of the components of the water balance that is notoriously hard to determine as it is difficult to measure directly (experimentally) because it is taking place in the subsurface. Its estimation is also associated with large spatio-temporal uncertainties due to variability in climate and heterogeneity of soils and hydrogeology.

There are three fundamental mechanisms of groundwater recharge:

- diffuse recharge where the groundwater table is directly recharged by rainfall through the general land-surface
- focussed recharge where the groundwater table is recharged by flow in stream/river channels
- floodplain recharge during large floods (overbank flows).




Sensing methods can help researchers develop models to address the question 'Where is the water?'. At the same time, models can be used to help refine sensing approaches – for example, determining where to put sensors to reduce uncertainty.

The project focused on the first two mechanisms.

The researchers found that focussed recharge is the main groundwater recharge mechanism in areas adjacent to intermittent streams, with on average one to two recharge events per year. In contrast, diffuse recharge of groundwater is more episodic, with only one to two significant events, depending on location, over a ten-year period.

This process of focussed groundwater recharge could explain surface water transmission losses of flow releases in dry streams. This process also potentially means that direct rainfall on fields may not be a determining factor for groundwater recharge, especially if flow is generated by rainfall further upstream.

## Probabilistic modelling

The sensing methods described above can help researchers develop models to address the question 'Where is the water?'. At the same time, models can be used to help refine sensing approaches – for example, determining where to put sensors to reduce uncertainty.

Previous NSW government reports have identified large-scale 'unaccounted differences' in the water balance across numerous NSW catchments. These volumes are typically around 20 per cent of inflows [1] but may occasionally reach 50 per cent of inflows in some catchments [2]. These numbers tend to be comparable to overall licensed extractions, as well as to surface water recovery volumes under the Murray-Darling Basin Plan, making uncertainty in the water balance a major source of risk for decision-making in water management.

Researchers at DARE developed a probabilistic modelling framework to explain and quantify unaccounted differences in the NSW General Purpose Water Accounting Reports (GPWARs) for major rivers up to catchments.

The model they developed was a pilot quantification of interactions between groundwater and surface water, evapotranspiration losses and rating curves. (Rating curves provide a way of predicting streamflow and uncertainties based on water levels.) The report points to how this method could be applied to future work looking at the overall water balance in a full river reach system to predict streamflow and quantify groundwater and surface water volumes.

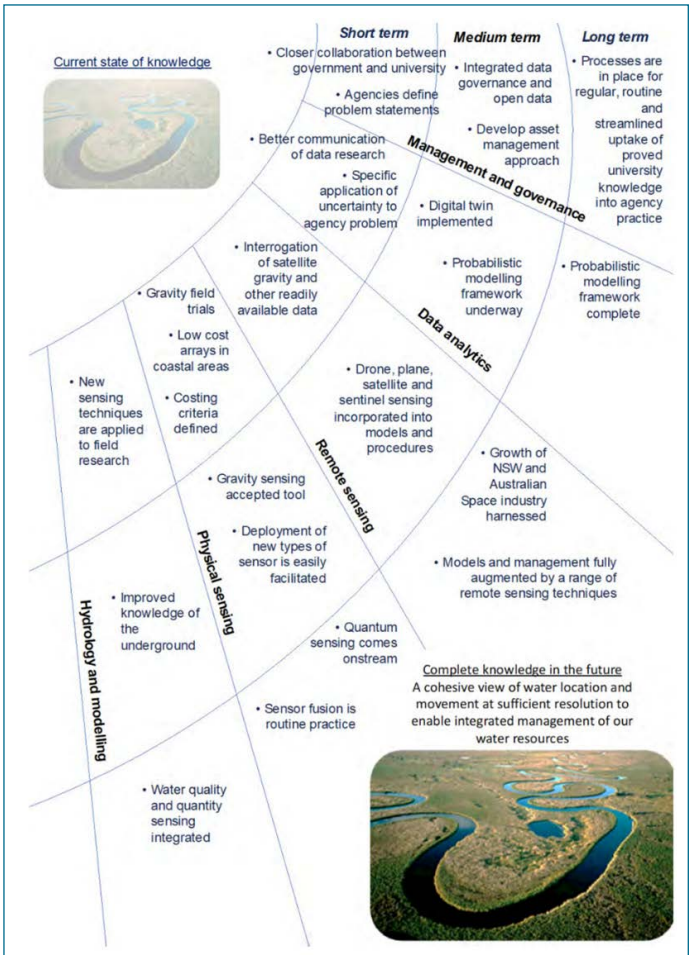
## The way forward

The research outcomes of this project are intended to provide tools that help with decision making in water management in NSW. The report has shown for the first time that low-cost sensor networks can respond to the Australian infrastructure problem of great distances and low population.

This project demonstrated that through multi-disciplinary collaboration, better understanding and information can be collected than each method alone could offer. The

synergy of physical sensing and the use of data provides a clear example of this; through data analysis we can provide stronger statistical understanding of what types of physical monitoring is required and where, how sensor fusion can be beneficial, and an understanding of where remote methods provide the most value.

The report includes detailed suggestions for the future work needed to fill in the knowledge gaps and provides a roadmap for how researchers and water managers might get there.




Project roadmap for the way forward to help answer the question: Where is all the water?

**Acknowledgment.** This is a summary of *Where is all the water?* (2021), a NSW Government report prepared by the NSW Smart Sensing Network (NSSN). It is included here with permission from the NSSN. The full report can be downloaded from the NSSN website.

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# Energy efficient pumping savings

## SNAPSHOT

- The Queensland Energy Savers programs have delivered more than 300 energy assessments and audits in most agricultural sectors, focusing on electric systems.
- If farms implemented all recommendations in the audits, they would reduce energy consumption by around 40 per cent in the areas monitored.
- Irrigation efficiency opportunities in energy audits have identified an average of 16 per cent reduction in energy consumption with cost savings of around 34 per cent on the systems audited.
- This article by Queensland Farmers' Federation outlines the recommendations and potential savings for some of the farms involved in the project.

Pumping and irrigation systems can account for a large proportion of farm energy use, so operating them efficiently is important. Moving water is energy-intensive so effective irrigation will require less energy per unit of production.

The key is to ensure that a system continues to deliver the right amount of water at the right time and then supply it through the most efficient system. This story illustrates how improvements can be made with the results of some on-farm energy audits conducted as part of the Queensland Energy Savers programs.

### QUEENSLAND ENERGY SAVERS PROGRAMS HELPING FARMERS

The Energy Savers programs have delivered more than 300 energy assessments and audits in most agricultural sectors throughout Queensland, focusing on electric systems.

In the most recent phase of the program, the Energy Savers Plus Program Extension (ESPPE) audits have identified annual savings of 7.5 million kWh, which would save an estimated $3 million and 6,000 t of carbon emissions.

If farms implemented all recommendations in the audits they would reduce energy consumption by around 40 per cent in the areas monitored.

The most recent 180 audits included 670 recommendations with 270 relating to pumps and irrigation systems. Irrigation efficiency opportunities in energy audits have identified an average of 16 per cent reduction in energy consumption with cost savings of around 34 per cent on the systems audited.

Pumping and irrigation systems can account for a large proportion of farm energy use. *Photo by Joel Dunn on Unsplash.*

The assessments considered the water requirements and system configuration as well as the pump and motor. They include pipe upgrades, pump upgrades, pressure reduction and the addition of variable speed drives.

Some measurement and verification has been done following implementation of changes by growers. As well as actual savings, farmers have reported other benefits from irrigation upgrades, such as improved crop consistency and time savings.

## ENERGY SAVERS PROGRAM IN ACTION

**Bore pump upgrades for a Burnett fodder farm.** In a Whole of Systems review (1) on a Burnett fodder farm, the auditor identified that 15 per cent of energy use was due to static head caused by narrow pipe and a number of elbow fittings.

The auditor recommended upgrading 130 m of 100 mm PVC pipeline to 150 mm PVC to reduce annual pumping energy by 17,429 kWh and cut annual costs by over $4,500. Three bore pump upgrades were also recommended. The farm is going ahead with the upgrade to three bore pumps.

One of the bore pumps will be replaced with a new pump and motor of approximately the same size, but as a new, high efficiency model, it will deliver an additional 5 L of water per second, reducing the pumping hours by 20 per cent and energy consumption by 30 per cent.

**Increasing motor efficiency for a Lockyer Valley fruit farm.** A Lockyer Valley fruit farm (2) implemented all of their energy audit recommendations, which included lighting, refrigeration and irrigation.

The 15 kW irrigation pump is used daily to irrigate several blocks of different sizes on an undulating farm. The energy auditor contacted the original pump installer who advised that there were different blocks and duty points on the farm when the pump was originally installed.

Although the pump has a variable speed drive (VSD), the assessment found the motor itself was worn and no longer suitable for the duty points.

The new motor will be the same capacity, but the new, efficient model is predicted to increase productivity by around 10-20 per cent because of the increased irrigation flow, with irrigation efficiency improving from 4.36 kWh/ML/m to 3 kWh/ML/m.

The farm has reduced annual costs by around $9,500 and will increase revenue due to the productivity improvement.

**Improving energy efficiency at an Atherton Tablelands farm.** An Atherton Tablelands farm (3) replaced a 55 kW pump with a 45 kW pump, adding a VSD and moving the pump closer to the creek to reduce suction head.

The farm has a centre pivot and lateral irrigator, which are both different sizes and operate on a sloping part of the farm so the VSD allows the pump to operate near its best efficiency point for both irrigators.

With the addition of solar, changing to daytime pumping can result in energy savings. *Photo by Jake Gard on Unsplash.*

A telemetry system has been installed so that the farmer can switch the pump remotely, saving many trips to the pump at all hours of the day.

The farmer has also installed a 39 kW solar PV system with a 30 kW inverter to power the pump. Measurement and Verification (M&V) has found that irrigation system efficiency improved from 400 kWh/ML to 251 kWh/ML with a resulting cost saving of $34.80 per ML pumped.

The lower electricity consumption, combined with the addition of a solar system, has reduced the farm's consumption from 130 MWh to 70 MWh per year, meaning it will be classified as a small customer.

In conducting the M&V, the auditor found that the farm was not yet operating the irrigation mostly during the day when it could be powered by the solar and was still mainly running at night.

A change to daytime pumping will result in savings. With these and some efficiency savings to the farm shed, the farm will reduce energy consumption by 46 per cent and annual carbon emissions by 48 t.

**Introducing VSDs to a Mackay cane farm.** A Mackay cane farmer (4) is replacing three Star Delta Starters with VSDs on centrifugal pumps ranging in size from 30 kW to 45 kW. Star Delta Starters have been commonly installed to reduce start up current.

The pumps are being throttled to manage pressure to the irrigator as the pumps are oversized. The VSDs will manage the pressure efficiently by slowing the motor speed as well as reducing pressure to the irrigators without using valves.

The auditor also recommended other initiatives including installing a 10 kW solar pump. These changes will save the farm over 52,000 kWh and $13,200 each year with an outlay of $22,100.

**Centrifugal pump and VSDs provide energy savings for horticulture grower.** A horticulture grower (5) has replaced a 30 kW centrifugal pump with a new efficient model and a VSD, as well as adding VSDs to an 11 kW submersible bore pump and a 22 kW centrifugal bore pump.

The grower is expected to reduce power consumption from 56 kWh/t to 49 kWh/t, saving 42,000 kWh and $21,600 per year as well as 34 t of carbon emissions.

The pumping requirements vary because the pump supplies water to multiple irrigation blocks with different irrigation systems including drippers and booms. The bore level varies as well.

On some blocks, the pressure is higher than required so it is managed by the grower by throttling with a valve at the discharge side of the pump. This significantly increases the friction losses, and therefore the amount of energy consumed per ML of water. The auditor has based the recommended pump on the most uphill position of the irrigation system and recommended a VSD so the pump speed can be reduced to provide the correct pressure to the lower blocks.

**Product and time savings realised for Brisbane nursery.** A Brisbane nursery (6) reported consistent product and time savings as two of the best outcomes of reducing the size of an irrigation pump as part of a group of efficiency projects that included hot water and lighting efficiency.

The pump was reduced from 7.5 kW to a variable speed 5.5 kW, giving the nursery consistent water and pressure over different sized blocks.

The nursery invested $12,000 to save $12,000 per year, reducing its power consumption from 130,000 kWh to 73,000 kWh per year, bringing them under the threshold for a large user and reducing carbon emissions by 28 t.

With some of their power provided by solar systems, farms have reduced the consumption of grid energy for pumping and also adjust their irrigation strategy to irrigate during the day using solar power rather than in the evenings on lower tariffs.

**VSDs reduce power consumption on Gatton horticulture farm.** A Gatton horticulture farm (7) is on track to reduce power consumption by 42 per cent by adding VSDs to nine submersible bore pumps under 7.5 kW to allow for variable aquifer levels; and replacing two 7.5 kW pumps with 5.5 kW models with VSDs.

The audit also recommended installing a soil moisture monitoring system to help manage irrigation scheduling as well as a 15 kW solar PV system.

The average payback on all these recommended projects is three years and the annual energy savings are estimated at 141,000 kWh per year, reducing power consumption from 30kWh/t to 17kWh/t and reducing carbon emissions by 114 t per year.

## SOLAR PV HELPS TO REDUCE PUMPING COSTS

Across all the energy audits, 140 solar systems were recommended, ranging in size from 5 kW to 100 kW, with 30 kW the most common size; this is the largest inverter size that can connect to the electricity distribution network as a micro-embedded generator in Queensland.

Across all the energy audits, 140 solar systems were recommended. *Photo by Mariana Proença on Unsplash*

## LOOKING TO THE FUTURE OF ENERGY SAVINGS

Queensland Farmers' Federation is working with industry partners on several other exciting energy transition projects including microgrids in agriculture and digital agriculture.

Information. See the agricultural energy efficiency case studies here and for more information, contact energysavers@qff.org.au.

**Acknowledgement.** This article was originally published on the Pump Industry website and is reprinted here with permission. The Energy Savers Plus Extension Program is delivered by the Queensland Farmers Federation with support and funding from the Queensland Department of Energy and Public Works.

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*Andrew Chamberlin, Project Manager (Energy) Queensland Farmers' Federation*

# Audit and redesign of pump setup helps improves vineyard irrigation efficiency

Pumping and irrigation systems can account for a large proportion of farm energy use, so operating them efficiently is important. Moving water is energy-intensive so effective irrigation will require less energy per unit of production.

## DRY AND EARTHY

Being able to control the water supply to the vine by designing and installing an efficient pumping system can contribute to a grape with the desired characteristics, which hopefully results in a good vintage.

With irrigation pumps operating for extended periods in vineyards, even marginal improvements to the efficiency of the system can provide sizeable long-term energy savings, maximising the cost-effectiveness of wine production.

## LAYING THE GROUNDWORK

In 2021, a vineyard owner near Griffith, NSW, approached irrigation company Yenda Prods Irrigation for help with improving the efficiency and reliability of the systems installed at its Cauduro & Poloni site.

To accomplish this, energy and system audits were required to find the optimal way to achieve the constant flow rate of approximately 256 L per second needed by the vineyards. The pumps, pump stations, pipes, filtration, mainlines and valves were all analysed, along with input from an irrigation consulting engineering firm to generate the required duty point.

Using this information, it was determined that combining two of the pumping stations, reducing the number of pumps from three to one and connecting the farms with new mainlines was the optimal approach. Key to this was a highly efficient pump that could meet the duty requirement.

## EFFICIENCY AND LESS DOWNTIME

After assessing available options, Yenda Prods Irrigation selected a Sulzer axial split case pump. This pump could meet the duty point of 256 L per second at a 57 m head with 87.1 per cent overall efficiency – a 3 to 5 per cent improvement over alternate options. Furthermore, it offered low net positive suction head required (NPSHr) of 3.2 m.

It was also important that the pump was robust as the irrigation water was likely to contain abrasive particles, which could cause premature wear to key components such as the impeller. A duplex steel impeller was specified to ensure long-term durability. Combined with additional filtration systems, this would reduce downtime so that the vineyards could properly capitalise on the energy savings.

## IMPROVEMENTS IN FIRST YEAR

During the first year of operation, the pump has boosted process reliability while delivering the high efficiency expected. This has resulted in reduced operating costs, allowing the sites to deliver essential water to the vines in the most cost-effective way possible.

**Acknowledgment.** This article was supplied by Sulzer.

The pumping stations were consolidated, the number of pumps reduced and the farms were connected with new mainlines.

# Four common causes of pump failure

Pump failure can result in damage and costly downtime. Understanding the causes of failure can help you select pumping equipment to reduce the chances of it occurring. This article by Franklin Electric looks at four common causes of pump failure and how to avoid them.

## CAVITATION

Cavitation is the result of insufficient pressure at the suction end of the pump or Net Positive Suction Head Available (NPSHa) causing the liquid in a pump to turn into vapour at low pressure.

At low pressures this creates air bubbles, which implode as the liquid moves from the suction side of the impeller to the delivery side. The resulting shockwave stresses the pumps' internal surfaces, creating vibration and mechanical damage, and can ultimately result in failure.

When this occurs repeatedly, cavitation can cause pitting and fractures in the impeller, volutes and casing, weakening the metal, increasing resistance to flow and reducing pumping efficiency. The shock loads from cavitation can also decrease the service life of the shaft and motor.

Cavitation and its related problems can greatly impact the life of a pump, reducing it by 10 to 15 years, or even more in extreme cases.

Cavitation is most easily avoided during the design stage, ensuring the chosen pump will have sufficient NPSHa so that the liquid remains above vapour pressure. The NPSH will need to be calculated for each application as vapour pressure is different for different liquids and varies with pressure and temperature. This can then be used when selecting a pump as manufacturers will be able to provide the Net Positive Suction Head Required (NPSHr) for any of their pumps to match it with the specifications.

## CORROSION

Corrosion in pumps is the result of a chemical reaction between the metal and the fluid being pumped.

This reaction can cause uniform corrosion of the wet surfaces – found mostly in pumps made from non-stainless-steel materials – or localised corrosion of a small portion of the components – occurring most commonly where metals that form oxide layers that adhere to and passivate the surface.

When corrosion occurs, pump performance and efficiency can be affected, increasing the need for frequent maintenance and downtime, and if left untreated it can lead to failure. The key to mitigating corrosion is by selecting a pump manufactured from the most appropriate materials for the application.

Cast iron is amongst the cheapest options and is often used for casings. It has good corrosion resistance to neutral and high pH liquids, making it a popular choice for general purpose, irrigation and mining pumps. However, it is not suitable for low pH applications where it is more prone to corrosion.

Stainless steel is commonly used as it has good corrosion resistance in a wide range of environments where other carbon and low alloy steels would corrode. Under some circumstances, such as exposure to aqueous environments where chloride is present, pitting corrosion may occur on lower grades of stainless steel. However, this is not an issue for higher grades of stainless steel, which have better corrosion resistance.

Therefore, corrosion is most easily avoided when selecting a pump. Material selection will determine corrosion resistance in a particular application as well as the pump's overall cost, including initial cost, maintenance, replacement, downtime, lifecycle and reliability.

*Photo by Merv Jesson*

## FOULING

Fouling occurs when particulate matter adheres to a pump's internal surfaces, most commonly in the distribution lines connected to the intake or outflow. When this occurs, pumping efficiency and flow capacity are decreased, and may eventually lead to failure.

This is unavoidable and is more prevalent when the fluid being pumped contains particles. However, various cleaning methods can be used to maintain the pump and improve efficiency and capacity.

## WEAR

Wear is inevitable when running a pump; however, there some factors cause excessive wear, speeding up deterioration of the pump.

Particulate matter in the fluid can lead not only to fouling but also increases the pace of wear on a pump. These particulates scour a pump's interior surfaces and roughen them, reducing pumping efficiency over time as it needs to work harder to move the fluid. Eventually, the pump will become so worn that it will be unable to produce enough lift and may cause excessive vibration.

Wear can also be the result of an improperly sized pump, which can cause an imbalance of pressure, putting undue stress on the bearings and seals; turbulence; fluid velocity; deterioration of wear rings; and erosion and corrosion.

Wear rate can be slowed down by ensuring the pump size and materials are suitable for the application, and regular maintenance is carried out to find and fix any problems before they result in unexpected downtime or pump failure.

**Acknowledgment.** Thank you to Franklin Electric for permission to reprint this article, which was originally published here.

# Custom-built pumps: what's involved?

In the irrigation industry, no two sites are identical. Many factors must be considered when designing and building long-lasting and efficient pumping systems. *Irrigation Australia Journal* spoke to Michael Garas from Brown Brothers Engineers about the benefits of custom-built pumps and the various components that can be customised.

Pumps are generally robust, but if they are not designed for the job at hand, we risk ending up with a short-term solution that requires routine maintenance. By considering the individual requirements of each site or project, we can ensure that the client ends up with a long-term set up for efficient trouble-free pumping. This is where custom-built pumps come in.

## LONG-TERM BENEFITS

It's important for pump manufacturers to be conscious not only of their own carbon footprint as a business, but the associated energy costs within all pump systems they send out in the marketplace. An optimised custom build may carry a higher initial cost, but it will ensure that the pump is operating at its best efficiency point. This means that within a couple of years the initial outlay can be offset by reduced running costs.

Michael Garas from Brown Brother Engineers, specialists in custom builds, explains, "While standard off-the-shelf jet pumps or submersibles might be the best option for domestic environments, in most cases our clients can benefit from custom-designed pump builds."

## THE DESIGN PROCESS

When designing a custom-built pump set, the first step is to find out what the customer needs. This is the discovery phase where the consultant will establish details from site specifics to the end game and set the wheels in motion on how to get there.

"The first question when approached about a custom build is: What infrastructure is already in place?" Michael says. "How water is moved around is often dependent on the current infrastructure and there are often existing constraints, such as pipe size. In other cases, it might be completely new build, in which case we'll advise on the pipework and the whole set up."

Michael Garas from Brown Brothers Engineers says most clients benefit from custom-designed pump builds.

"One of the first steps is to do friction calculations. Another major factor we consider is the power requirements – for example, in a remote area where there is not enough power available, we might need to look at a diesel-driven option. Sometimes we're limited in terms of what we can do by either power or flow rate. In this case, our job is to come up with the best possible design for the given constraints."

Along the way it's important to factor in elements like cost, lead time, availability of spare parts and servicing. Every pump should be designed so that it can be removed and isolated safely without causing too much disruption to the entirety of the build or supply. Dealing in water, we only really know how valuable it is when it's taken away from us, even for a few hours.

## WHAT CAN BE CUSTOMISED?

Many aspects of pumps can be customised, from designing a set-up for a tight space through to the control logic – a part of a software program that controls its operations, allowing functions to be added in and devices to communicate with one another. Most builds comprise both an electrical and mechanical component.

**Electrical component.** Any control logic can be customised and programmable logic controllers (PLC) can be made to communicate with each other. This is achieved through popular communication protocols such as PROFINET, Modbus or BACnet. These controllers will utilise gateways which essentially act as a translator between different controllers and devices in an automation setting when different protocols (languages) are being spoken within a control system.

The ability for different controllers and devices to communicate with each other facilitates all sorts of new automation scenarios. Michael notes, "Lately we've been seeing a huge increase in customised control panels. Data is key in many industries and the pump industry is no exception.

"It's amazing to see some of the tech-savvy farmers out there who have some of their control sets linked to the Bureau of Meteorology, enabling them to predict their water demands and initiate irrigation automatically based on the forecast.

"In a more unusual custom pump build, we have worked on a 'home defence' prototype with one of our dealers. The system accesses the local daily CFA fire danger rating and pre-emptively gives the surrounding property a soak in a bid to reduce the risk of encroaching fires. We hope this will become the norm in many rural areas."

**Mechanical component.** With highly versatile vertical multistage pumps, such as the Lowara e-SV pump range, it is possible to alter suction lift characteristics (lower NPSHR values). The initial stage diffuser has a special design that helps reduce losses toward the eye of the first impeller. This is often useful in scenarios when the water needs to be drawn water from a level lower than the pump.

One major design advantage in this pump range, Michael says, is their internal stack hydraulically balances under load, meaning the motor doesn't require any special thrust or inertia bearing. This provides the flexibility of easily swapping to a higher IP rating or higher efficiency class with minimum fuss.

Manifolds can be also manufactured to specified sizes or from different materials to enable them to deal with water of varying qualities or chemical additives, for example.

One of Brown Brothers Engineers' recent custom-built pump sets.

Michael provides the example of a nursery system: "We recently completed upgrades for a greenhouse at a large-scale nursery where there was a need to dose fertiliser into the irrigation supply. We were able to fabricate a full 316SS manifold to provide a longer lasting corrosion-resistant option."

## THE FUTURE: BIG ADVANCES IN CONTROL TECHNOLOGY

From a hydraulic design standpoint, pumps have barely changed for decades. Control technology is where the real changes are happening, and where we see great potential for customisation.

"The emergence of new control technology has made us more willing to continue pushing forward with bespoke pumping systems. What once seemed like expensive add-ons are seamlessly being integrated into most of our builds," Michael explains.

"We're about to undertake upgrades at a golf course in country Victoria, which we secured on the back of giving the turf managers and superintendents remote access to view and control the pump panel from their smart phones. These are huge steps forward.

"As we all know, something always happens on Good Friday or New Year's Eve! We are living in a digital age and the ability to be there without physically being there is where we are heading."

**Acknowledgment.** Thanks for Michael Garas from Brown Brother Engineers for providing information for this article.

# Monitoring matters: A vineyard water optimisation case study

## SNAPSHOT

- Using drip irrigation instead of furrow irrigation in vineyards improves water use efficiency, but regular maintenance of the system is required.
- The South Australian Research and Development Institute (SARDI) and the Australian Wine Research Institute (AWRI) recently ran a benchmarking project that looked at irrigation emitter uniformity.
- This case study from the Riverland region outlines one grower's intensive maintenance program, which varies depending on the quality of the water.
- The project found that despite regular maintenance, the system was performing below standard, with high pressure variation and high flow variation.
- The results highlight the need for both good irrigation system maintenance and system monitoring.

## BACKGROUND

Brian Caddy has been farming in South Australia's Riverland region for almost 60 years. In 1973, Brian established Limestone Ridge Vineyard on his Riverland property, first planting Cabernet Sauvignon and then four years later Chardonnay. This was one of the first Chardonnay plantings in the region. The Chardonnay has now been grafted over to Fiano – a Mediterranean variety well suited to the Riverland climate.

Growing wine grapes in a region where the average annual rainfall is less than 300 mm, Brian has a deep understanding of the importance of good water management. During his time as a wine-grape grower in the Riverland, he has experienced water restrictions as well as significant fluctuations in grape and water prices.

During the 2021/22 season, Brian participated in an irrigation emitter uniformity benchmarking project run by the South Australian Research and Development Institute (SARDI) and the Australian Wine Research Institute (AWRI) and funded by Landscapes SA, and the results were surprising. This case study explores Brian Caddy's current irrigation system monitoring and maintenance program, his vineyard's emitter uniformity results and changes he is planning to make to his monitoring and maintenance program as a result of the project outcomes.

Brian's irrigation water for wine-grape production is sourced from the River Murray. The water is generally high quality but brings with it suspended clay and organic material. Brian, like 85 per cent of the wine-grape growers in the Riverland region, converted from furrow irrigation to drip irrigation. This conversion, undertaken in 2004, significantly improved his water use efficiency but regular maintenance is required to keep the system working efficiently.

## BRIAN CADDY'S IRRIGATION INFRASTRUCTURE AND MAINTENANCE

Limestone Ridge has an 18-year-old irrigation system with pressure-compensating drippers, which is maintained with an extensive annual maintenance program. The quality of the water determines how often Brian needs to flush the system. In high-flow years, the amount of silt and organic matter in the river water increases and additional flushing is required. "If I don't flush enough, then my drippers will become blocked and inefficient" says Brian.

Brian's irrigation maintenance program involves flushing his irrigation sub-mains and laterals with hydrogen peroxide ten times during the season. He follows the flushing procedure outlined in the AWRI irrigation maintenance video, which is a three-stage process involving thoroughly flushing the mains, sub-mains, and laterals with water; injecting hydrogen peroxide into the system and leaving the solution in the lines for 1-2 days; and then flushing the system again with water.

The pre-and post-hydrogen peroxide water flushes take two hours and cost approximately $43.98 (Electricity cost: 8.9 kWh @ 26.576 cents per kWh = $23.65. Water cost: 81 kL @ $25.10 ML = $20.33). Brian reduces his irrigation maintenance costs by flushing his irrigation lines on the weekend when off-peak power is cheaper.

Limestone Ridge Vineyard had one of the first Chardonnay plantings in the region. *Photo by Manuel Venturini on Unsplash*

Like 85 per cent of growers in this region, Brian converted from furrow to drip irrigation.

With the increased inflows into the Murray River system due to La Niña weather conditions and full dams upstream, Brian is anticipating a drop in river water quality. To manage this, he is currently installing an automatic injector in the main line, just after his filters, to automatically inject hydrogen peroxide into his irrigation water during each irrigation application.

In addition to grafting to more heat-tolerant varieties and installing automatic hydrogen peroxide injectors to improve the water use efficiency of his vineyard, Brian is also refurbishing his pump house, installing a variable speed pump, additional filters, stainless steel piping and new electronics. "All this is to try to minimise our power use and have a more flexible and efficient irrigation system", says Brian.

## BENCHMARKING PROJECT RESULTS

Despite Brian's extensive irrigation maintenance program, results from the SARDI/AWRI irrigation emitter uniformity benchmarking project revealed that the system was performing below standard, with high pressure variation (90 per cent) and high flow variation (23 per cent). In a high-performing system, there will be less than 10 per cent variation in dripper discharge throughout the value unit (±5 per cent). In a system operating with 25 per cent variation, some vines may be receiving 11.5 per cent less water than they need, and others may be receiving 11.5 per cent more irrigation. Under-irrigation can cause yield reductions and over-irrigation can cause nutrient leaching and losses of water through deep drainage.

Pressure-compensating drippers are designed to provide the same discharge over a wide pressure range. They are effective at reducing and controlling dripper flow at high pressures but cannot increase the flow if pressures are too low. After some investigation, it was discovered that the pressures were very low (65 kPa), which increased the flow variation. When the pressures were adjusted to 174 kPa the irrigation system performance improved significantly.

**TABLE 1. LIMESTONE RIDGE IRRIGATION EMITTER UNIFORMITY BENCHMARKING PROJECT RESULTS**

| | PRESSURE VARIATION (%) | FLOW VARIATION (%) |
|---|---|---|
| Limestone Ridge pre-check | 90 | 23 |
| Limestone Ridge post-pressure adjustment | 34 | 6 |

## THE IMPORTANCE OF MONITORING

The results of this benchmarking project highlight the need for both good irrigation system maintenance and system monitoring. In response to these results, Brian has implemented an irrigation system monitoring procedure following the guidelines of Giddings (2004) outlined in the AWRI irrigation monitoring video. The monitoring procedure involves checking dripper pressures and flows at several points in each block at regular intervals throughout the season, and adjusting the pressures as required to maintain consistent flows.

**Information.** For more information and resources on irrigation monitoring and maintenance, including two 'how to' videos, visit the AWRI's water management webpage

**Acknowledgment.** This article was originally published on the AWRI website and reprinted here with permission. This work was funded by Landscapes SA. The AWRI and SARDI would like to thank Brian Caddy for taking part in the project and for generously sharing his knowledge and experience regarding irrigation monitoring and maintenance.

# The evolution of a smart irrigation system: Adelaide High School case study

## SNAPSHOT

- In 2017 SA Water initiated a project to improve water use efficiency at Adelaide High School, and to demonstrate to the community that conservative irrigation can conserve turf quality.
- This article explores how the irrigation scheduling software used in this project has evolved over the last five years.
- The project initially used a smart water meter, soil moisture probe and a link to SWAN Systems scheduling software. Manual intervention was still needed.
- Water use dropped by 15 per cent in the first year.
- By 2020 the system could formulate a seven-day irrigation plan based on a range of variables, and irrigation was automated.
- Satellite imagery has recently been incorporated into the dashboard to help turf managers make proactive management decisions and to save time.

Software for irrigation management evolves continually. Over time it is becoming increasingly automated, user friendly and better at helping growers and turf managers save water, time and make irrigation management decisions in a proactive way.

SWAN Systems is an irrigation and nutrient management solution that informs irrigation managers when to apply water and nutrients to their ovals, and how much to apply to maintain required turf quality. It is provided to users as a cloud-based Software as a Service (SaaS) solution.

In 2017, SA Water implemented SWAN Systems technology in a trial at Adelaide High School. Its aim was to improve water use efficiency on the school's ovals and demonstrate to the community that conservative irrigation can maintain turf quality. One oval at the school is classed as being of premium turf standard, one is classed as sub premium, where turf is of high quality, while turf on the other two is not managed to reach these higher standards.

Here we describe how the capabilities of the irrigation scheduling software used in the project have changed over the last five years, from requiring some manual intervention to being fully automated, and to incorporating satellite data to help turf managers make decisions.

### 2017 – MANUAL INTERVENTION NEEDED

The original project focused on the use of a smart water meter, soil moisture probe and a link to the SWAN Systems irrigation scheduling software. This was an effective irrigation solution, but still required manual intervention to set the irrigation control system to deliver the scheduling outputs from the software.

SWAN Systems technology is used for irrigation scheduling at Adelaide High School. Photo from Adelaide High School website, licensed under a Creative Commons Attribution 4.0 Licence.

In the first two years of the high school trial, the system was a manual one where the school's outdoor manager had to enter days to water using SWAN Systems' recommendations. These were based on field-tested algorithms which used data from site specific characteristics, a seven-day weather forecast, and flow meters. Soil moisture probes were used to ground-truth the recommendations.

The IPOS (Irrigated Public Open Space) code of practice and guidelines, which were developed by SA Water in conjunction with the turf management sector and adopted by a number of local councils in South Australia, were used to develop an irrigation target based on maintaining a particular standard of turf quality.

This system proved its value in the first year, when the school saw water use drop by 15 per cent.

## 2020 – FULLY AUTOMATED

In early 2020 an Aquamonix automated irrigation control panel was installed to enable the SWAN Systems software outputs to be automatically programmed into the irrigation control system and turn the irrigation equipment on and off according to the schedule.

Once the account was created, soil and agronomic characteristics were defined, virtual ovals mapped, and data feeds from the soil moisture probe, smart water meter, weather stations and satellite data established. This data, combined with local weather forecasts (obtained from Bureau of Meteorology forecast points) and predicted turf water needs, was processed using proprietary smart irrigation algorithms which determined how much water the turf required for the coming week.

The System Suggested Irrigation Module in SWAN Systems formulates an optimum seven-day irrigation plan which takes into account a range of variables including the amount of water available each day, capacity of local infrastructure, soil moisture target for each park, and one-off special irrigation requirements.

## 2022 – INCORPORATING SATELLITE DATA

The big change over the last two years has been in the amount of information provided on the dashboard thanks to rapid advances in satellite imagery. This information can save time and labour as well as helping turf managers identify and fix problems like leaks or turf health sooner.

John Pargeter, SA business manager for SWAN Systems, explains, "Affordable high-resolution satellite imagery is now easily available and is updated more frequently than it was in the past."

"The resolution has improved from 10 m to 3.7 m. This provides a much finer level of detail to help the turf manager monitor grass health. The frequency has also improved. Earlier satellite imagery was produced every four or five days, assuming there was no cloud cover. But with cloud cover, we could go for weeks without imagery. Now we have near-daily updates, depending on cloud cover."

"This is a very useful tool for the turf manager to track turf wear, including impacts by students and equipment. It's good for tracking overall health, broken sprinklers or faulty irrigation or to identify where irrigation practices could be improved. The school has used it to detect leaks that wouldn't have been picked up as early without this technology."

In addition to satellite imagery, the dashboard now provides seven different vegetation monitoring indexes. The most commonly used index for turf grass health and condition is NDVI (Normalised Difference Vegetation Index). This is a number on a scale of zero to one that describes 'greenness' and it allows turf managers to detect stress earlier than they could do using visual monitoring.

This information not only allows early detection and intervention, it also saves turf managers time. "Walking or driving to assess where things might need improvements takes a considerable amount of time," John says. "Now the turf manager can check the dashboard via computer or phone and make irrigation decisions any time and from anywhere."


Satellite imagery showing NDVI, which can help turf managers identify problems. Yellow areas show turf in poor condition, which can occur if the area is under-irrigated or where turf is experiencing greater wear in high-traffic areas. Dark green areas are indicative of healthy turf. Darker blue and purple areas can indicate leaks, overwatering or over-fertilising.

**Acknowledgment.** This is an updated version of an article published in the winter 2020 issue of the *Irrigation Australia Journal.* Thanks to John Pargeter from SWAN Systems for providing additional information.

# GREAT TURNOUT FOR IRRIGATION AUSTRALIA CONFERENCE AND EXHIBITION

In October more than 2,000 people attended the Irrigation Australia Conference and Exhibition, which was held together with the 24th ICID International Congress in Adelaide.

With COVID still around in our community, we were uncertain about how willing people would be to travel and attend large events, but thankfully, it did not impact attendance.

It was remarkable to see so many people back together for an irrigation event. The last time industry held an event of this type was in 2018 and much has changed since then. The delays and postponements meant that the planning extended to six years, which is quite extraordinary and is a credit to all involved in the process.

A key highlight for me was the Women Working in Water Forum, which provided a long overdue recognition of the important and often unrecognised role that females have in the irrigation industry. If just one young woman became inspired to believe that they can become a leader in our industry, then the forum was worthwhile. Another highlight was the ND Gulhati Memorial Lecture delivered by Hon Karlene Maywald, which perfectly summed up the challenges ahead for our industry.

Certainly, the challenges ahead are significant, not only for the industry but for the world. The World Bank has indicated that food production will need to increase by some 70 per cent by 2050 to feed the world's growing population. The efficient use of water is one of the keys to meeting this target.

Although we don't hear much about this in the media, malnutrition-related deaths were double those of COVID over the last few years, and many of these were children. To turn this around, we must find sustainable ways to increase food production. The conference attendees who travelled to Adelaide from 46 countries have the knowledge and skills to help address this problem. It was pleasing to see information and knowledge being shared in such an open and positive way for the betterment of the planet.

On a separate note, the exhibition was an important part of the event, and it was fantastic to see leading irrigation supply companies showcasing their products and technology. Each company should be congratulated for making the investment to attend.

The new Adelaide Conference and Exhibition Centre proved to be a world-class facility and staff went out of their way to make the event a success. I would also like to recognise the outstanding work undertaken by the team at Encanta Event Management, Irrigation Australia staff and our ICID Australian National Committee. Such a large event is a real challenge to organise – an achievement that is only possible through a massive team effort, so I extend my thanks to everyone involved.

I look forward to attending the next irrigation event in Sydney in 2024 as a very interested spectator.

*Bryan Ward, conference organiser.*

# ‘LEADING LIGHT’ WINS INDUSTRY AWARD

Erik Schmidt, described by colleagues as ‘a leading light for the irrigation industry’, has received the MacLean-Iedema Award for 2022. Presented biennially, the MacLean-Iedema Award recognises individuals who have made outstanding contributions to the industry.

Erik, who has recently retired, held director and deputy director roles in the Centre for Agricultural Engineering (CAE) at the University of Southern Queensland (UniSQ) since 2004. For more than three decades, Erik has contributed to research both in Australia and overseas into improving water management, developing supporting tools, and extension of this information to irrigation advisers and irrigators.

Erik Schmidt (left) was presented with his award by Irrigation Australia CEO Dave Cameron at the conference dinner

Michael Scobie, senior research engineer at UniSQ, describes Erik as having energy, vision and passion for the industry and an intuitive ability to understand the needs in the irrigation industry and bring people together, building on their strengths to solve problems. “He has impacted the lives and careers of many farmers and researchers in Australia and in developing countries in Asia,” Michael said.

Above all, Erik made significant contributions to water use efficiency. Among his many notable achievements, some highlights include:

- providing exceptional leadership at the CAE
- providing expert oversight in the Smarter Irrigation for Profit programs
- a leading role in the Cooperative Research Centre (CRC) for Irrigation Futures
- involvement with the commercialisation of the award-winning Irrimate technology for measurement and assessment of surface irrigation systems
- improving livelihoods of smallholder farmers in India, Nepal and Bangladesh
- authoring more than 65 journal and conference papers and presenting at many Irrigation Australia and ICID conferences
- significant contributions to Irrigation Australia and the Australian National Committee for Irrigation and Drainage.

Irrigation Australia CEO Dave Cameron presented Erik with his award at the Irrigation Australia Conference in October.

## ABOUT THE MACLEAN-IEDEMA AWARD

The Award includes a cash prize and commemorative plaque. It is named in honour of Scott MacLean and Don Iedema who were strong supporters of the Irrigation Association of Australia (IAA) during its early years.

Scott and Don were partners and principals of the large retail irrigation supply chain Aquafield McCracken. The two men together with Roger Bell, a well-respected irrigation designer, tragically lost their lives in a light aircraft accident in 1995.

The Award recognises an outstanding individual who has made a significant contribution to the advancement of the irrigation industry, or a sector of the industry.

## SNAPSHOT

- Outgoing CEO Bryan Ward and Business Administration Manager Chris Delphin reflect on their time with Irrigation Australia.
- Tracy Martin provides an update from the regions.
- The outcome of the board election was announced in October. We introduce two new directors.

# FAREWELL TO BRYAN WARD

For six years, Irrigation Australia has benefited from Bryan Ward's work ethic, financial acumen, and spirit of determination. He leaves his role as CEO on a high note following the successful Irrigation Australia Conference and Exhibition. Bryan spoke to *Irrigation Australia Journal* about his time with Irrigation Australia and the changes he's seen in Australia's irrigation industry.

### Progress over six years

Bryan has observed significant progress during his time as CEO. "The industry has matured in the past few years," he says. "Some of the notable changes I've seen include the establishment of a long-overdue irrigation trade qualification – the Certificate III in Irrigation Technology; the adoption of new metering standards in several states (particularly NSW), and consequently an increase in Certified Meter Installers and Validators; and three new certifications – Certified Storage Meter Installer and Validator, Certified Butt Welder, Certified Electrofusion Welder."

Bryan also commends the organisation and its members on their adaptability during the pandemic, "In a short timeframe, Irrigation Australia moved training to online and converted our two publications to digital," he notes.

On the future of the industry in Australia, Bryan says, "While the industry has matured, further consolidation should occur to ensure that the industry is truly speaking with one voice.

"This will be important when the Murray–Darling Basin Plan is reviewed again in 2025. Irrigation is critical to Australia's gross domestic product and to our long-suffering farmers who have been through bushfires, drought, COVID and floods in past two years."

### Financial acumen, work ethic and determination

Andrew Ogden, outgoing chair of the Irrigation Australia Board, says that Bryan's financial skills and his spirit of determination will be missed. "Bryan has an extraordinary work ethic – his thick skin and willingness to take on any challenge with complete determination, focus and commitment have been great assets for the organisation.

"We've benefited from his innate ability to lead delivery of marketing, training and industry representation, particularly during the transition to online training during COVID – and especially his financial acumen. It's been a fantastic six years."

Bryan says he will stay actively engaged with the industry. "I intend to wind back but not stop completely. I'll be open to any part-time work, including perhaps the irrigation aisle at Bunnings or some consulting work. My wife Christine Delphin, who also works for Irrigation Australia, and I will be returning to Tasmania and we are looking forward our life in our seaside cottage in Penguin."


Bryan Ward and Chris Delphin reflect on their time with Irrigation Australia

# CONFERENCES, COLLEAGUES AND COVID: CHRIS DELPHIN REFLECTS ON HER TIME WITH IRRIGATION AUSTRALIA

For the last six years, Chris Delphin has been an integral part of Irrigation Australia in the role as business administration manager/company secretary. Here, Chris reflects on her time with the organisation and changes she's seen in the industry.

**IA. What are some highlights from your time with Irrigation Australia?**

**Chris.** Being part of the organising committee for the 2022 International Conference and Exhibition, partnering with ICID, was spectacular. To be part of a team that brought the irrigation sector back together again after the last few difficult years was a fitting end to my tenure here.

The way our team rallied during COVID-19 to continue delivering training by converting as much as we could to virtual training was a mission and one that I was proud to be a small part of. It still makes me emotional to think of our members during this time, who dug deep and continued to service the irrigation sector and still supported professional development for their people.

Since I started in 2017, the organisation has developed a significant voice in the industry, widening the scope of training, securing a further international event in Sydney in 2024 and connecting with and supporting our members in any way possible, all with the assistance of a diverse and talented strong board of directors at the helm.

**IA. What will you miss most about Irrigation Australia?**

**Chris.** I will miss my colleagues – a small close-knit team that is like a family. I have enjoyed supporting the board of directors and I will miss this, especially with new directors on board, which bring a further level of expertise to the table. The IAICID committee members have also been a great bunch to work with, who voluntarily assist us without complaint (well not much anyway)! I've also connected with many members over the years – all will be remembered and missed.

**IA. What changes do you see happening for women in the industry?**

**Chris.** This is an issue that is close to my heart. The Women Working in Water forum was a huge success at the conference and the feedback by both men and women since puts this segment into a no-brainer for our international event in 2024.

Events like this put women at the forefront of what is currently a male-dominated industry – there's lots more to do but it is a great start to have such strong, talented and interesting women at the forefront. I am sure this session has provoked thought at an international level too and we hope this is the beginning of bringing more women into the industry.

**IA. What are your plans for your move to Tasmania?**

**Chris.** I'm looking forward to the clean, brisk air, walks along the beach, connecting with my family and some downtime (maybe a dog!). I am not thinking of full retirement yet – I plan to do some contract work in between doing some further renovations on our 100 year-old house. We are calling it SeaChange, which sums it up really.

## REGIONAL ROUNDUP

What's going on in the regions and with membership by Tracy Martin, Irrigation Australia's National Membership and Regions Manager.

**Melbourne.** A recent highlight for the Melbourne committee was the annual Irrigation Professionals Christmas Breakfast. The event was held on 21 November at Setto Bello Restaurant in Glen Waverley. We thank the following sponsors for their generous support of this popular event.

| | |
|---|---|
| Advanced Irrigation & Sprinklers | Brown Brothers Engineers Australia |
| Davey Water Products | Grundfos Pumps Pty Ltd |
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**South Australia.** The committee will be delivering a workshop for local government staff in 2023. This workshop will highlight the Certification Irrigation Framework and associated certified professionals, with a focus on local government adopting the use of certified disciplines into their irrigation-related tenders.

Look out for new events in 2023, including a facility tour, as well as the ever-popular field excursions. Once finalised, we will promote these to local members.

**Western Australia.** The region hosted its Annual Regional Meeting on 27 August at the South Perth Bowling Club. We received 24 nominations from members eager to volunteer their time to assist with our many activities and subcommittees. It is fabulous to see such enthusiastic support – without it we could not carry out the range of activities that we do.

Waterwise activities remain an important focus for the WA committee, as does the suite of activities that underpin the funding agreements with Department of Water and Environmental Regulation and Water Corporation.

One of these is the Waterwise Council Training Program, which entered its second year in July. This program delivers competency-based irrigation efficiency training for approved Waterwise council parks and gardens staff. A limited number of subsidised places are available for nominated and approved staff. Classes will be run from 16 to 19 May and 22 to 26 May 2023.

If you work within a WA-based local government and would like to learn more, contact DWER at waterwise@dwer.wa.gov.au.

## WATERWISE GARDEN WORKSHOPS A SUCCESS

The WA region won a bid to host three Waterwise Garden Workshops on behalf of Water Corporation at the Perth Garden Festival in October. The workshops were well attended by festival patrons, some of whom registered in advance, eager to secure their seats early, while others wandered in on the day to take a seat in the shady Waterwise marquee.

Paul Willmott delivered a presentation about how gardeners can adapt their gardens to climate change, covering topics such as: two-day rostered watering, lawn alternatives, soil amendments, mulching and more.

All participants received a show bag with resources to help them identify the emitters they have in their garden and learn their correct run time for a 10 mm drink, along with sample products kindly donated by Baileys Fertilisers, Mineral Magic, Netafim, Antelco and HR Products.

**Northern Territory.** NT Farmers Federation has approached Irrigation Australia to assist with hosting and delivering a field day in Darwin in March 2023, with a focus on soil moisture. The event will feature a field component, a workshop and a trade show.

## WATERWISE IRRIGATION PROGRAMS ON FACEBOOK

Have you checked out Irrigation Australia's Waterwise irrigation programs on Facebook?

There are two categories:

- **Waterwise Garden Irrigator** - for professional installation and maintenance services
- **Waterwise Irrigation Design Shop** - for expert advice and quality parts

The Facebook page aims to provide the wider community with #waterwise tips and advice and promote members.

Use the QR code and jump on Facebook to find out more and keep up to date.

## CHANGES TO THE BOARD

New directors Valentina Tripp and Matthew Binder.

Following the recent board election, Irrigation Australia welcomes two faces to the board – Valentina Tripp, CEO of Davey Water, who was appointed deputy chair, and new director Matthew Binder, director and principal design consultant of MJ Binder Consulting.

Valentina said, "I am honoured to be elected to the IAL Board and appointed deputy chair. I am looking forward to working with my fellow directors, new CEO Dave Cameron, and the amazing Irrigation Australia team on tackling the key industry issues for our members, continuing to lead in the delivery of technical training, certification and skills development, and working towards strengthening and growing our irrigation industry for a sustainable and water secure future."

Matthew Binder said, "I am looking forward to this new challenge ahead and helping the industry and organisation to continue to professionalise and grow."

All renominating directors were re-appointed, and Simon Treptow has been elected as chair, taking over from Andrew Ogden. Andrew will continue for a further year as director and member of the Governance Committee.

This year saw an impressive 19 nominations. Irrigation Australia would like to thank all who those who nominated for positions and a special thanks must also go to retiring directors Peter Durand and John Pivac for their years of service to Irrigation Australia and its members.

## IAL BOARD DIRECTORS

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## A NOTE OF THANKS TO OUTGOING CHAIR ANDREW OGDEN

Andrew began work in the irrigation industry in 1987 after graduating UWA as a civil engineer, and in 1993 he became managing director of Western Irrigation, a position he still holds.

He has been involved with Irrigation Australia in WA throughout his career, and in 2014 was appointed national chair of the board. I remember the day he rang me to discuss whether he should nominate for a position, which he did, and found himself the vice chair on his first year of recruitment (something I don't think he was expecting!).

Andrew is known for his quick wit and is always ready to stir the pot, ending his sentences with a characteristic chuckle. He's a rare breed of man, someone who can juggle multiple things at once.

He is greatly respected by his staff - you only need to visit his office at either end of the working day to see the staff vying to say good morning or goodbye to him. This says a lot about who he is; he is not only committed to the industry but is quick with a smile and always has time for people.

On behalf of Irrigation Australia, I would like to thank Andrew for his years of dedication to the industry and to our members.

*Tracy Martin, National membership and regions manager*

## CHANGES FOR 2023

A training update by Geoff Harvey, Irrigation Australia's National Training, Certification and Marketing Manager.

### Certificate III in Irrigation Technology will be upgraded to meet new Australian Skills Quality Authority (ASQA) requirements.

Irrigation Australia is proud to introduce the upgraded qualification AHC32422 Certificate III in in Irrigation Technology, which supersedes the previous AHC34219 Certificate III in Irrigation Technology.

**What does this mean for you?**

- We have made only minor changes to course content
- The transition to the '22 New Package' will occur on 1 March 2023
- If you are currently enrolled in the '19 Package' the transition will be seamless. You will not need to undertake any additional training
- If you already have AHC32419, your qualification remains valid. However, you can apply to have your qualification upgraded to AHC32422 for a nominal fee – just contact us.

As per the '19 package, the new '22 package describes the skills and knowledge for trade-level roles in the irrigation industry. Individuals with this qualification perform tasks under supervision involving a broad range of skills that are applied in varying contexts, which will involve discretion and judgement in selecting and operating equipment, coordinating resources and applying contingency measures during work.

For more information about the upgraded qualification, please contact our Training & Certification team on training@irrigation.org.au or (07) 3517 4000.

## COLLABORATION WITH IRRIGATION NEW ZEALAND

Irrigation Australia trainers recently travelled to Ashburton in the South Island of New Zealand to deliver the inaugural Certificate III in Irrigation Technology training course to Irrigation New Zealand members.

Ten eager students attended this week-long training course, and the feedback was positive. Block 2 will be delivered in early February and a second training course is planned for New Zealand members in the North Island.

Irrigation Australia trainers recently travelled to the South Island of New Zealand to deliver the inaugural Cert III course to Irrigation New Zealand members.

Irrigation Australia would like to thank our Australian COIE sponsors who provided the materials required for the course, and to the New Zealand businesses that helped with locations for our practical activities. We look forward to further collaboration with Irrigation New Zealand.

## NEW IRRIGATION SYSTEMS AUDITOR CERTIFICATION

Are you an experienced irrigation professional with a passion for helping clients improve their systems? If you would like to refine your skills in this area and obtain official recognition of your expertise, Irrigation Australia's new Irrigation Systems Auditor Certification might be the perfect fit for you.

Nine people attended the pilot Irrigation Systems Auditor training course in Brisbane.

A Certified Irrigation Systems Auditor is an industry professional who can assess and audit irrigation systems and operations, provide advice and offer solutions for best practice irrigation.

Geoff Harvey, Irrigation Australia's national training, certification and marketing manager, says there are a number of benefits to obtaining certification: "People often walk away with a new level of confidence in their skills. Participants gain new skills by completing a certification, and they also consolidate the knowledge they already have."

The pilot Irrigation Systems Auditor training course was held in Brisbane from 12th to 16th September 2022 and nine people attended.

"This new certification sets the benchmark for best-practice irrigation auditing and satisfies the industry requirements that have been missing in this irrigation discipline," Geoff said.

"The participants got hands-on experience at Clem Jones Sports Complex at Carina, Kengoon Farming at Kalbar and Suncorp Stadium. Interestingly, we had 188 years of combined irrigation experience among all participants, and everyone said they learned new things and that this new certification will certainly set the necessary benchmark required for auditing irrigation systems."

This practical experience enabled the participants to satisfy the requirements of all the competencies in order to be competent in auditing irrigation systems in all facets of irrigation including urban, sports fields, turf, pivots, and commercial irrigation systems.

### Our New Certification - Certified Irrigation Systems Auditor is for you if you are:

- A practising irrigation professional with a particular interest in auditing and exposure to irrigation system performance
- Currently providing advice, designing, or consulting to end-users on irrigation system types, purchasing, operation, troubleshooting or evaluating irrigation systems.

This new certification is aligned to the new nationally recognised Irrigation Systems Auditor skill set (AHCSS00099). To attain this skill set and become a Certified Irrigation Systems Auditor, you must complete the following seven competencies:

- AHCIRG435 Determine hydraulic parameters for an irrigation system
- AHCIRG437 Schedule irrigation
- AHCIRG438 Select and manage pumping systems for irrigation
- AHCIRG507 Audit irrigation systems
- AHCWRK502 Collect and manage data health and safety processes
- AHCWRK510 Audit site operations
- AHCWRK513 Write and present reports

The course is designed to meet the above competencies and provide hands-on field experience. It is delivered face-to-face over five days. On successful completion, you will become a Certified Irrigation Systems Auditor and receive a nationally recognised Statement of Attainment.

## DOES YOUR NEW YEAR'S RESOLUTION INCLUDE PROFESSIONAL DEVELOPMENT?

If you've been thinking about signing up for some further professional development, why not make it your New Year's resolution?

The world is rapidly changing and many job opportunities are available across the irrigation industry. Irrigation Australia provides training on a number of qualifications and short courses, including:

### Qualifications:

- Certificate III in Irrigation Technology AHC32419
- Certificate IV in Irrigation Management AHC41119

### Short courses:

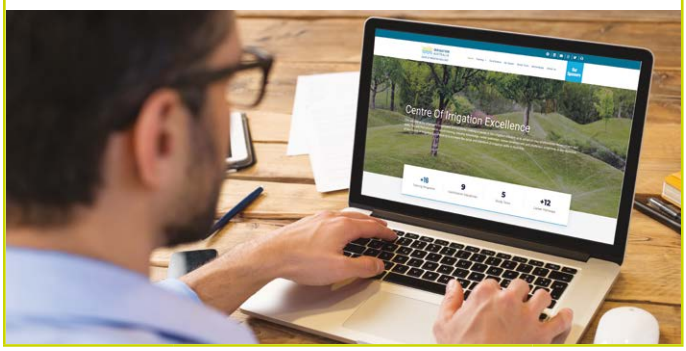
- Irrigation Pumps and Systems
- Meter Validation and Installation
- Irrigation Efficiency
- Centre Pivot & Lateral Move (CPLM)
- Urban, Commercial & IRRICAD design
- Electrofusion & butt welding of polyethylene pipelines
- Irrigation Systems Auditor

So don't delay. Lock in your plans for 2023 by visiting our website or phone (07) 3517 4000 and speak to our staff.

## TRAINING DIARY

| DATE | COURSE | LOCATION |
|---|---|---|
| 17 to 19 January | Storage meter installer & validator | Goondiwindi, QLD |
| 24 to 26 January | Meter installation and validation | Bowen, Qld |

More to come! Keep an eye on the COIE website.



# PROFESSIONAL DEVELOPMENT

## IRRIGATION TRAINING INFORMATION AT YOUR FINGERTIPS

Check out Irrigation Australia's new training course booklet. This comprehensive publication provides essential details on training courses offered by Irrigation Australia.

- Certificate III in Irrigation Technology
- Certificate IV in Irrigation Management
- Centre Pivot and Lateral Move
- Meter Installation and Validation
- Introduction to Irrigation | Agriculture
- Introduction to Irrigation | Urban
- Irrigation Pumps and Systems
- Irrigation Efficiency
- Urban Irrigation Design
- Commercial Irrigation Design
- IRRICAD Design
- Irrigation Installer
- Storage Meter Installation and Validation


## INTRODUCING NEW CENTRE OF IRRIGATION EXCELLENCE SPONSORS

The Centre of Irrigation Excellence (COIE) exists to increase the range and standard of irrigation skills in Australia, and it relies on sponsors to keep its work going. We are pleased to announce that two new sponsors have recently joined us – Davey and Bermad Water Technologies. Find out more below.

**DAVEY**

Davey has been a leader in pump and water solutions for over 88 years - both in Australia and across the world. Customers depend on Davey every single day to provide perfect pressure, healthy drinking water, protection from fire and flood, clean, relaxing pool or spas, or water to run farms or businesses. Davey's products are used in some of the world's toughest conditions, which is why they are built with dependability and reliability at their core. Traditionally servicing the domestic water pumping, water treatment and swimming pool and spa markets, Davey has in recent years expanded its focus and product portfolio to include the commercial pumping, irrigation and commercial pool markets.

As Australia's leading brand, Davey is committed to keeping our communities safe and protected – especially those who rely on our products, day in day out.

You can depend on Davey.

**BERMAD Water Technologies**

Bermad Water Technologies is a wholly owned subsidiary of Bermad Valves in Israel. For more than 33 years Bermad has distributed the highest level of automatic control valves and air valves to this irrigation market. Bermad now has the most comprehensive irrigation metering range and electronic solutions to integrate with most irrigation systems.

### Thanks also to our long-term sponsors listed below

AIP HOSE | VALVES | FITTINGS

Brown Brothers Engineers Australia Pty Ltd

Hunter®

iplex We Know Water

ISUZU POWER SOLUTIONS NEVER STOP

NELSON AUSTRALIA INNOVATION IN IRRIGATION

NETAFIM GROW MORE WITH LESS

Philmac The connection you can trust.

TORO.

VALLEY The Leader in Precision Irrigation

Vinidex Systems & Solutions

# WHY TALK ABOUT WATER CONSERVATION WHEN ITS FLOODING?

Only two years ago we were in drought, followed by bushfires and COVID, and now we are in a third La Niña that has brought floods that have left many Australians bereft of homes, businesses and more. History suggests drought will occur again just as soon.

Water is a finite resource, and we need it to combat all the above – that's why we need to talk water whatever the weather.

We believe we should be 'proactive' about water in our country - to be 'active' alone suggests being engaged in action but to be 'proactive' says we are actively creating or controlling a situation rather than just responding to it after it has happened.

## A short history of Smart Approved WaterMark

In 2004, the National Water Initiative identified the need to develop and implement a certification scheme to help consumers identify and choose water-saving products for garden use.

To address this need, Smart Approved WaterMark (SAWM) was established by four founding partners: Water Services Association Australia (WSAA), Irrigation Australia Limited (IAL), the Nursery and Garden Industry of Australia (NGIA) and the Australian Water Association (AWA).

SAWM was created to address the challenge of reducing residential outdoor water through the identification and certification of water efficient technologies and services.

Today SAWM provides:

- a simple and identifiable label for shoppers, so that they can make informed choices at point-of-sale outlets
- an identifiable label for innovative businesses that provides a market advantage over competitors.

## The irrigation sector

Many of our current licensees are from the irrigation sector with licensed products that include irrigation systems, Wi-Fi modules, trigger nozzles, sprinklers, moisture and weather sensors and dripper lines.

## Importance of awareness

A sustainable future depends on bringing water into everyday conversation and changing people's water-use habits. If more people were aware of their reliance on water in their homes and gardens, and were aware of the Mark, we could make a substantial difference to the amount of water used each year.

For more information, email: info@thewaterconservancy.org

Apply for the Smart Approved WaterMark at smartwatermark.org and help Australians use water wisely with your innovations

Help us to increase awareness of the Smart Approved WaterMark in your community by linking to smartwatermark.org on your website and in your marketing materials or by distributing flyers you can download from our website


Pictured (from top): Some Smart Approved WaterMark products: Hunter Flow-Clik, , Holman moisture sensor, Hoselink trigger nozzles.

# TAKING A REGIONAL APPROACH TO THE BIGGER PICTURE – THE ONE BASIN CRC

A new consortium, the One Basin CRC, is working to develop and commercialise opportunities within Australia's irrigated agriculture and rural water industries. The One Basin CRC, which aims to break down old silos, has been established to help these industries become more productive, resilient and sustainable in a changing world.

Australia's irrigation regions within the Murray-Darling Basin are the powerhouse of Australia's agricultural sector, producing 50 per cent of Australia's agricultural profits from less than 1 per cent of the agricultural land. As well as this, they support many of the large commercial centres across inland Australia. But these regions have encountered headwinds with changing climate, markets and national policy.

The One Basin CRC, announced in May, aims to address these challenges. Led by the University of Melbourne, the partnership brings together 85 partners from industry and academia. The Commonwealth CRC Program is contributing $50 million in cash over 10 years, combined with more than $106.5 million total commitment from its partners.

Some of the partners include the Australian National University, Charles Sturt University, the Goyder Institute, Hort Innovation, the Murray-Darling Basin Authority, Sensand Technologies, the University of Sydney and Irrigation Australia.

Through collaborative programs, the CRC will take an innovative approach to tackling the challenges facing the Basin regions.


The operations will be delivered through four regional hubs

## New approach needed

The future of these regions rests on innovation to drive the transition to new business models and technologies that are responsive to climate change, include First Nations and meet national and market expectations for environmental stewardship. Emerging technologies have the potential to transform agriculture, water and energy systems but they are not being effectively developed, commercialised and adopted.

Australia needs a new regional innovation system that breaks down old silos to bridge across water, agriculture and energy sectors and address the known barriers to adoption and commercialisation of new solutions.

## Inclusive partnership

One Basin partners include end-user organisations, commercialisation partners and knowledge agencies. This is the largest collaboration of its kind in the Murray-Darling Basin, demonstrating the widespread desire to get ahead of the challenges of a drier future and to work together collaboratively to meet those challenges.

The One Basin CRC partnership, across water, agriculture, First Nations, government, technology and environment responds to three shared opportunities to enable our regions to:

- diversify economic opportunities to build resilience in the face of increasing water scarcity
- transition irrigated agriculture for a drier and more variable future, and
- design smart connected water infrastructure to maximise efficiency and capacity for meeting multiple demands.

Meaningful inclusion, recognition and respect of First Nations is a core element of the One Basin CRC and the CRC will progress the national effort to recognise First Nations values in water management. The One Basin CRC board includes two First Nations peoples, and two First Nations conveners will be part of the One Basin team. In addition, First Nations input will be provided through the Regional Hubs and through involvement in research projects.

## Regional hubs

The CRC's operations will be delivered through regional hubs over its ten-year term. The One Basin CRC partners will work together in four hubs, located across Murray-Darling Basin's major irrigation regions, based in Loxton, Mildura, Griffith and Goondiwindi.

The CRC is committed to delivering 75 per cent of its work program through these hubs. A Regional Advisory Committee for each hub will advise on regional priorities and provide a check that project scope is inclusive of regional interests.

The CRC's operations will be delivered through regional hubs over its tenyear term.

Research in the regions enables meaningful collaboration and engagement with all partners. This ensures research is fit for purpose and directly relevant to the region – that will drive greater uptake and adoption, which is essential to achieve the innovation required for growth in both productivity and sustainability.

## Benefits beyond agriculture

Benefits will extend beyond agriculture to include growth in the Basin's water, environmental, tourism and technology sectors. And along with economic growth, the CRC will deliver other benefits for regional communities, the environment and First Nations people.

Members of the One Basin CRC leadership team: Back row (L to R): Andrew Hall, Alex Rolston, Kym Walton, Okke Batelaan, Alex Sas, Mike Stewardson. Front row (L to R): Sharon Davis, Seth Westra, Emma Payne, Rebecca Wells.

Regionally based research and development will support innovation and adaptation by farmers and communities, resulting in more resilient farms and diversified income streams. Regions will benefit from job growth and socio-economic improvements.

The One Basin CRC will fast-track emerging opportunities for irrigation regions, including for Indigenous enterprises and ecotourism. These opportunities can leverage growing interest in stable long-term returns from investing in sustainable agriculture.

The partnership will also work closely with the recreational fishers to advance their efforts to restore waterways and report on waterway health.

By 2037, an estimated $4.3 billion of economic impact is expected to be generated by innovation in water, agriculture and energy technology, enhanced forecasting and decision-making capacity, with a focus on sustainability and resilience in the face of climate change.

## Integrating research and industry knowledge

Building the current and future generation's decision-making and leadership capability and capacity will be critical to future success. By integrating research and industry knowledge, and working collaboratively, the One Basin CRC will educate and develop future leaders and workers who are innovative, holistic, collaborative, inclusive and resilient.

Over the life of the CRC, approximately 180 undergraduate students will join summer school activities and participate in industry-led, regionally based projects. Indigenous participation and engagement in the program is a key priority, working with local groups to identify projects for students within their own communities.

## Three programs

The One Basin CRC will focus on three programs to achieve a technology and business transformation in Australia's irrigation regions. The projects target technology-led productivity and sustainability improvements, and the need to mitigate effects of climate change:

- The Technology and Opportunity Program: Through a design-led approach, this program will move solutions through early-stage assessment and validation trials to commercialisation. Technological solutions will be co-designed and applied with industry to improve the capacity of water supply systems and profitability of irrigated agriculture.
- Foresight and Decisions Program: Decision processes and analytical tools will be co-developed with industry to enable lower risk and higher reward investment decisions regarding new opportunities, responding to changes in markets, technology and climate. Including First Nations knowledge, these tools will integrate diverse values and perspectives.
- Capability and Commercialisation Program: Research will target barriers to adoption of new technologies and management practices and develop methods to include diverse voices from relevant management and investor groups. Commercial partners will co-develop models to attract external investment and scale-up initiatives. Several Quickstart projects within each program are already underway.

**SAMPLE OF QUICKSTART PROJECTS ALREADY UNDERWAY**

| TECHNOLOGY AND OPPORTUNITY | FORESIGHT AND DECISIONS | CAPABILITY AND COMMERCIALISATION |
|---|---|---|
| Integrating irrigation technologies for horticulture | Shifting water availability and demand with climate change | Using brackish groundwater in inland Australia |
| Forecasting water demands to optimise storage control for rural water supply | Our Changing Water Future – "Adapting to change together" | Integrating community groups into basin-scale fish tagging and recovery programs |
| Rapid detection of equipment failure in water supply systems | Equity and vulnerability in a drying basin: water sharing policy and quality of life in towns | Using organic waste to increase agricultural production and reduce environmental impacts |

## Current progress and opportunities

Following a highly successful round of Regional Hub Partner forums in Loxton, Griffith, Mildura and Goondiwindi the One Basin CRC partners are currently in the process of identifying key challenge focus areas for our next tranche of projects to following on from our QuickStart work. Challenge focus areas will be used to frame the next round of detailed project co-design to be undertaken in the first half of 2023. The projects developed through this process will commence in mid 2023.

The CRC is open to considering new industry partners.

**Information.** To find out more, visit the One Basin CRC website.

*Mike Stewardson, CEO of the One Basin CRC.*

## ICID STUDENT AWARDS

The ICID student awards encourage students to present their research to peers and professionals and to acknowledge the contributions of students to the 24th ICID International Congress.

The awards, presented at the combined Irrigation Australia Conference–24th ICID Congress dinner in Adelaide, included prizes for:

- the best paper and oral presentation: 1st $1000, 2nd $500 and third $250
- the best paper and poster presentation: 1st $500, 2nd $250

The ICID Student Awards were presented at the conference dinner. Left to right: Dong-Hyun Yoon, Hee-jin Lee, Mara Zenebe, Matt Champness, Manita Raut

Irrigation Australia's Committee on Irrigation and Drainage (IACID) representative Michael Scobie noted, "There was strong competition from students across the world. It is encouraging to see the calibre and variety of the work being undertaken by students in our industry".

Congratulations to the award recipients listed below and to all students who travelled from around the world to participate!

| Best student paper and poster presentations | | |
|---|---|---|
| 1st | Dong-Hyun Yoon | Spatio-temporal trend analysis of drought occurrence using multi-satellite images in South Korea |
| 2nd | Hee-jin Lee | Water storage estimation in reservoirs using multiple satellite observations |

| Best student paper and oral presentations | | |
|---|---|---|
| 1st | Zitian Gao | Using remote sensing information for irrigation benchmarking |
| 2nd | Manita Raut | Gender relations and agricultural water and land management in Saptari farming collectives, Nepal |
| Equal 3rd | Matt Champness | Automated gravity surface irrigation as an enabling technology for aerobic rice production in Southern Australia |
| Equal 3rd | Mara Zenebe | System-wide nexus analyses: water management, agricultural productivity and livelihoods in flood-dependent drylands |

## EVENT SCHEDULE

| DATE | EVENT | LOCATION | CONTACT/ INFORMATION |
|---|---|---|---|
| 25 to 27 January 2023 | 10th International Micro Irrigation Conference (10MIC) | Dakhla, Morocco | contact@10imic.ma |
| 16 to 22 April 2023 | 74th IEC Meeting and 4th World Irrigation Forum (WIF4) | Beijing, China | gaolh@iwhr.com, cncid_office@sina.com, lihui.gao@qq.com |
| 1 to 8 November 2023 | 25th International Congress on Irrigation and Drainage & 75th IEC Meeting | Andhra Pradesh, India | rsdte@nic.in, ceenvtmgmt@nic.in, yellark@gmail.com |

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# POWERING IRRIGATION WITH RENEWABLES

## SNAPSHOT

- With rising energy prices, irrigation companies are looking at ways to reduce costs, including renewable energy sources.
- The best way for an organisation to incorporate renewables will vary depending on a range of factors, including the location, existing infrastructure and customer demand profile
- This article by Enel X showcases the actions that two irrigation companies and a water utility are taking to adopt renewables.

Anyone in the business of water – its transportation, processing and consumption – is inextricably linked to the business of energy. As energy prices rise, irrigation companies and irrigation operators are being faced with increasing costs of moving water from supply infrastructure to on farm.

This is leading to companies and individuals investigating cheaper options for energy and moving away from traditional sources such as electricity and diesel to renewable sources such as solar power and batteries. Underpinning these changes is an awareness of climate change and the need to develop mitigation strategies that involve fewer emissions.

Anyone in the business of water is inextricably linked to the business of energy.

The best approach to integrating renewables will vary between organisations and even between sites. In this article, Enel X will showcase some of the measures that two irrigation companies and a water utility are taking to improve energy efficiency and reduce energy costs for themselves and their customers.

Central Irrigation Trust recently partnered with Enel X to develop a network of 15 MWh of batteries across their pumping stations.

## A big battery system

Central Irrigation Trust (CIT), an irrigation cooperative in South Australia, recently partnered with Enel X to develop a network of 15 MWh of batteries across their pumping stations in Loxton, Chaffey, Cobdogla, Waikerie and Berri. This capacity is equivalent to around 1,500 home battery systems, and to our knowledge will be the largest installed single-customer battery in Australia when fully commissioned in May 2023.

For CIT, the best solution was to install batteries but not solar. This is because most of CIT's pump sites, which are some of the largest energy consumers in the area, are in the middle of towns where there is no adjacent land to co-locate solar. Having a battery reduces network costs while earning revenue from the energy and ancillary markets.

The communities in the Riverland region have very high solar penetration both from rooftop and nearby solar farms. Having large onsite batteries could improve the site's resilience and have the potential to provide a platform to improve community resilience.

This project involved Enel X developing, funding and operating the batteries on CIT pumping sites, using their electrical infrastructure to access energy markets and reduce their electricity bills. This arrangement is a very low-risk way of CIT hedging their exposure to a volatile commodity, while supporting the broader community.

Renmark Irrigation Trust has plans to adopt a similar approach, adding an additional 2 MWh of batteries at their pumping site only 15 km away from the Chaffey site under the same business model.

## Solar plants and floating solar

For organisations with available land or water bodies, installing land-based or floating solar systems can be the best option.

Gippsland Water is a water utility in South West Victoria that serves more than 69,000 properties with a substantial water treatment and wastewater treatment plant. Gippsland Water has a net zero carbon goal by 2030, and a 100 per cent renewable energy goal by 2025. Several solar plants have already been installed across the organisation, including a large 1,280 kW ground-based solar system at its largest site.

The organisation has recently installed a 350 kW floating solar system on one of its reservoirs. This system will not only produce clean energy, but will also reduce evaporation. This technology could be an important addition for the industry with three benefits: generating renewable energy, effective for space-constrained users, and improve water conservation.

## Microgrids

Where you live within Australia, and which network provides your power, has a big impact on your options to reduce costs. This is because networks have different tariff designs, which either make them more or less avoidable for different technologies.

One of our recent project proposals involves the construction of a large microgrid with a new HV network for a NSW irrigation customer under a hybrid purchase-power agreement (hPPA).

In this instance, the customer has ample land to develop solar, and the customer's network has both high demand charges and high costs. Installing solar without batteries wouldn't substantially reduce network costs, while having batteries without solar increases the risk of higher network costs when charging batteries. The best solution here is to have both solar and batteries, which in combination will reduce network costs substantially.

We are also proposing to combine a number of low voltage connections into one high voltage connection to both reduce costs and to maximise the scale of solar and battery plant. This new configuration will also make it easier for the microgrid to cover the reliability needs of the site in the case of a grid outage.

When completed, we expect customer electricity costs to reduce by over 30 per cent and energy-related emissions by around 80 per cent.

## The devil is in the detail

Most of us are familiar with the concepts of solar and batteries, which are in the news every other day, but renewable technology is very different to an irrigation company's core business.

For solar, substantial differences can exist between product quality and the value of performance or product warranties by supplier. For batteries, the scope of uncertainty is much greater. The value of these assets is largely determined by three factors: the value of the energy markets they can access, the effectiveness of the 'brains' operating the battery, and the impact this operation has on the battery's usable life.

By adopting renewables, irrigation companies can save money, improve the reliability of their power supply and reduce emissions. But given the industry's complex demands, fluctuating energy market prices and evolving technology, the devil is in the detail: the best solution will vary depending on a company's needs, assets, location, and customer demand profile.

*Matt Schultz, Enel X Australia*

# FLOODING AND LEGAL LIABILITY IN TIMES OF CRISIS

The recent and ongoing extreme flood events raise legal issues including managing flood risk and development in areas subject to inundation, the liability of public authorities for decisions that expose residents and businesses to greater risk from flooding events, and remedial steps to address past decision-making.

## Managing flood risk

Increased incidence and severity of floods as a result of factors such as changing land use patterns and climate change will cause damage to residences, agriculture, businesses and public and private infrastructure.

One avenue to address this is to manage development in at-risk areas and direct development toward safer places.

Planning schemes determine permissible land use and development

The mapping for the application of these planning controls to land will have been typically based on predictive flood modelling and data from previous flood events. Because data from previous flood events does not necessarily accurately predict future events, this raises the prospect that areas at actual flood risk are not identified in the planning scheme.

What liability do public authorities have for historical statutory and strategic planning decisions that have the effect of allowing use and development in areas that are now no longer safe?

## Case studies

Salient examples include the 2011 flooding of Grantham in South East Queensland. Almost every house in the floodplain area of the town sustained structural damage in what was described as an 'inland tsunami'. Seventeen lives were lost.

In partnership with the Queensland Reconstruction Authority, Lockyer Valley Regional Council responded by organising the relocation of the existing town. Only months after the flooding, it was announced that a 378-hectare site was purchased to facilitate a voluntary land-swap program. This gave residents the option of relocating to higher ground, with some eligible for state government assistance to rebuild in the new area. The new area was zoned for community purposes, residential living, rural residential, sport and recreation, and open space to encourage residents and businesses to move.

As of 2020, 80 families were living in the relocated area. In February 2022, the area was again inundated with flood waters but those in the new development managed to avoid damage.


The recent and ongoing extreme flood events raise many legal issues. *Photo by Phillip Flores on Unsplash.*

Another example is Grand Forks, Canada. After flooding in 2018 that damaged 500 buildings, the local council obtained funding from the federal and provincial governments to bolster flood mitigation efforts, including funding to acquire 80 homes in flood-prone areas. These acquired homes were to be demolished. Reportedly, the houses were acquired at their post-flood value, meaning that many residents received substantially less money than they were expecting.

Are decisions made during emergencies protected?

Another issue in regard to flooding and the liability of public authorities concerns decisions made in emergencies. Is there some kind of protection for decision-makers in such difficult circumstances?

In Victoria, the Emergency Management Act 1986 (Vic) defines an emergency as "the actual or imminent occurrence of an event which in any way endangers or threatens to endanger the safety or health of any person … destroys or damages … any property or threatens to endanger the environment." This explicitly includes flood.

The Victorian Water Act 1989 contains provisions that address liability for the flow of water that causes damage. One of the matters to be taken into account in determining liability is whether a flow of water was caused by the construction, removal or alteration of a levee in accordance with the Victoria State Emergency Service Act 2005, and if it was in response to an emergency under the Emergency Management Act 2013 (Vic).

Caselaw also establishes that if the flood event were of such severity that the flooding would have occurred anyway, liability will not arise. Does liability arise in regard to decisions made by the operators of Murray Basin storages to release limited water heading into a wet spring, resulting in the need to release water from those storages during flood events? Or would the flooding have occurred anyway, regardless?

## Conclusion

Planning controls seek to address flood risk and development in areas subject to inundation. Outdated or inaccurate mapping increases safety risk. Public authorities face potential liability for decisions that expose residents and businesses to greater risk. As to whether liability arises, central factors can include whether or not the decisions were made in an emergency situation and whether damage from water flows has been worsened by the relevant decision or whether the event was of such magnitude that damage would have occurred anyway.

Dr Joseph Monaghan, partner at Holding Redlich, Christopher Watt, lawyer at Holding Redlich and Jacob Atkinson, graduate at Holding Redlich. Joseph practices in water law, having completed his doctorate on the Murray–Darling Basin Plan. Christopher and Jacob have degrees in law and environmental science. Joseph has experience in water theft law having acted on behalf of Victorian water corporations. Email: joseph.monaghan@holdingredlich.com.

# GREAT MAN-MADE RIVER – THE WORLD'S LARGEST IRRIGATION PROJECT?

Beneath the Sahara Desert lies a vast network of underground pipelines and aqueducts that deliver fresh water from ancient underground aquifers deep in the Sahara to the coast of Libya for domestic use, agriculture, and industry.

The Great Man-Made River (GMR) has been described as the largest irrigation project in the world. Since 1991 the project has supplied much-needed irrigation and drinking water to cities and farms in Libya's north, which previously were dependent on desalination plants and on declining rain-fed aquifers.

This vast reservoir of 'fossil water' is anywhere from 10,000 to 1,000,000 years old, the water having percolated into the sandstone before the end of the last ice age, when the Saharan region enjoyed a temperate climate.

Libyan officials have claimed that the reservoirs could provide water for thousands of years. But critics say that the GMR might not last through the 21st century. The ancient Nubian Sandstone Aquifer System is not rechargeable, and its water supplies are finite.

## Facts

- Three phases of the project have been completed between 1983 and 2009 and an additional two phases are planned.
- The 250,000 sections of pipe laid in Phase I were said at the time to be the largest in the world, each having a diameter of 4 m and a length of 7 m.
- GMR 1's design capacity is 2000 ML of water per day through some 1,600 km of double pipeline between the well fields in the south and the destination cities in the north.
- GMR 2's design capacity is 2500 ML of water a day.
- GMR 3 added a total of 1,200 km of pipelines.

**Source.** Britannica website, accessed 3 October 2022.

*Photo by Wolfgang Hasselmann on Unsplash*

# IMPROVING SPORTS TURF IRRIGATION OUTCOMES

## SNAPSHOT

- Over the last 16 months, Richard Dilena and Geoff Connellan have assessed 66 irrigation systems for efficiency, capacity and effectiveness in maintaining sports turf surfaces, and water use.
- More than 30 per cent of sprinklers assessed had one or more faults that affected their performance.
- Flow sensors can be a cost-effective way of improving system and water use performance but less than 12 per cent of systems were fitted with one.
- Four key areas were identified where organisations could make improvements: understanding irrigation requirements, improving irrigation scheduling, regular sprinkler maintenance, and monitoring of irrigation and water use.
- Irrigation data collected over 20 years from the City of Greater Geelong demonstrates how improvements to irrigation practices can reduce water use.

How can organisations improve their turf irrigation practices? This is an issue that Irrigation Australia member Richard Dilena of R. Dilena Consultancy is passionate about. Based in Geelong, he assists organisations such as councils and schools assess the performance of their irrigation systems and their water use.

Over the last 16 months, Richard, in partnership with Geoff Connellan, G & M Connellan Consultants, has assessed 66 irrigation systems managed by municipal, regional and rural councils for efficiency, capacity and effectiveness in maintaining sports turf surfaces, and water use. This included checking 48 pump stations and 4,181 sprinklers for correct installation and operation.

Richard and Geoff have identified some common areas where improvements can be made. Broadly speaking, these can be categorised as: irrigation requirements, irrigation scheduling, sprinkler maintenance, and monitoring of irrigation and water use.

### Irrigation requirements

An important service that they provide is advising clients on the irrigation requirements for the range of assets they have. "Factors such as weather conditions, turf types and growth characteristics, levels of utilisation and required standard of maintenance are among the important factors in determining irrigation requirements, which can vary by more than 35 per cent between sites," Richard says.

### Irrigation scheduling

Opportunities to improve scheduling of irrigation can almost always be found. Ideally, the frequency and duration of irrigation should consider a range of factors to ensure the correct amount of water is applied to maintain turf in the desired condition. These include turf type and root depth, soil type and condition, irrigation system capacity, and weather conditions.

Richard often recommends that clients consider the use of scheduling techniques that respond to changing turf water requirements, such as evapotranspiration-based scheduling.

Excess irrigation leading to water loss through runoff and evaporation

### Sprinkler maintenance

The operating environment for a turf sprinkler is harsh, as it is exposed to foot and machinery loadings, multiple operating cycles, and loose soil, which can cause wear and sticking issues. Because of the harsh operating conditions, sprinklers need significant regular maintenance.

Richard says around 30 per cent of sprinklers that were assessed had one or more faults that affected performance. Of these, more than 68 per cent were too low or tilted. Leaking sprinklers or riser assemblies accounted for around six per cent of all faults, and one per cent of sprinklers exhibited critical faults that meant water was not delivered to the target area.

These observations highlight the importance not only of regular maintenance but also of checking the system before the start of the irrigation season, including the operation and installation condition of each sprinkler.

A critical sprinkler fault.

## Monitoring irrigation and water use

The flow sensor is a powerful tool to aid irrigation performance. It can be used to monitor the functioning of the system for faults, to optimise system flow rates, and assist in scheduling and the overall site water management in terms of volume of water applied and meeting water budget targets.

Flow sensors can be one of the most cost-effective ways to improve irrigation performance, "A flow sensor can generally be retrofitted for between $3000 to $5000. A five to ten per cent improvement in water use through better irrigation management can quickly recoup this cost," Richard notes.

Despite these benefits, however, Richard has found that flow sensors are not widely used. Less than 12 per cent of systems he assessed had a functional flow sensor, and of these only a handful were providing active monitoring.

## Obstacles to improvements

Richard says that clients highly value the independent assessment of irrigation asset condition and advice about maintenance and strategies to achieve water performance and sustainability targets.

Clients value the independent assessment of irrigation asset condition and advice about strategies to improve system performance.

He notes that an organisation's ability to improve irrigation outcomes is often limited by available labour, funding, and other resourcing requirements, skills shortages, and competing needs and workloads.

By helping clients understand the benefits of improved irrigation performance, well-informed business cases and project applications can be prepared to help organisations improve their irrigation practices.

## CASE STUDY – CITY OF GREATER GEELONG REDUCES WATER USE

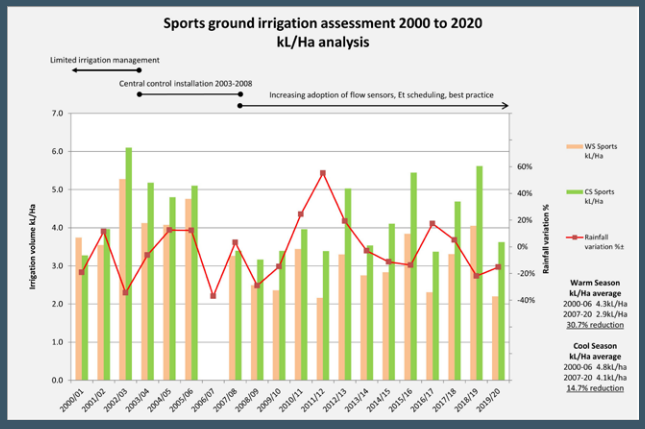
Before starting his consultancy business, Richard worked as irrigation officer for City of Greater Geelong. Richard collated council water use data over 20 years and was able to assess the effects of irrigation improvement processes (which occurred over 15 years) on irrigation application rates.

Richard found that through understanding and managing irrigation requirements and by improving the irrigation systems and equipment, irrigation application rates could be gradually reduced while maintaining turf quality and performance.

As shown in Figure 1, a central control system was installed between 2003 and 2008. The central control system comprised two professional grade weather stations, located according to local weather conditions, rain sensors at each site, and flow sensors on each irrigation system. Communication to all sites and weather sources was via cellular modems.

From 2008, evapotranspiration-based irrigation scheduling and flow management was initiated, along with irrigation system maintenance and upgrade plans, a site inspection regime, and assessments of irrigation efficiency – was the correct amount of water applied to meet turf and site requirements?

Significant water savings. As shown in the figure below, from 2007/08 onwards irrigation became increasingly responsive to weather conditions and site requirements with application rates reduced by approximately 15 per cent for cool season turf, and 31 per cent for warm season turf.




**Acknowledgment.** Thanks to Richard Dilena of R. Dilena Consultancy for providing information for this article.

# STATE ROUNDUP

## FEDERAL BUDGET

The 2022-2023 Federal Budget is investing more than $2 billion for the Water for Australia Plan.

The Australian Government has announced that its priorities are:

- Murray-Darling Basin water reform. The government says it will fulfil its election promise to deliver the Murray-Darling Basin Plan in full. Water buybacks will be used to achieve this.
- Restoring trust and confidence. The government has allocated $29.0 million to improve trust and transparency in Murray-Darling Basin water management, including metering and monitoring of water use.
- Updating the science. A total of $22.9 million will be invested in updating the science to ensure the impacts of climate change are accounted for in managing Murray-Darling Basin water resources.
- National water policy and reform. The government will scope the establishment of a National Water Commission to deliver national water reform, in collaboration with state and territory governments.
- National Water Grid Fund. The government will broaden the remit of the National Water Gird Investment Framework recognises that states, territories and local governments retain responsibility for water infrastructure, but allow for a broader range of projects to be funded.

**Source.** The Budget 2022-23 Water Fact Sheet, accessed 22 November 2022.

## WATERWISE INITIATIVES FOR WA SCHOOLS

A new cross-government program will help public schools in Western Australia save groundwater. The $1.5 million Water Efficient Public Schools Program aims to save around half a billion litres of drinking water over coming years - equivalent to 200 Olympic-sized swimming pools.

The program will involve water audits and irrigation checks at metropolitan schools that use groundwater bores to irrigate ovals and playing fields. Inefficient irrigation systems will be upgraded and school groundskeepers will receive waterwise training to help reduce water use.

The development of the new Waterwise School Grounds program will be informed by the outcomes of a water efficiency program that has been run in public schools over the past two years.

Other actions under the plan include work by the Department of Education to incorporate waterwise design principles into buildings, landscaping, and grassed sporting spaces of new public primary and secondary schools.

**Source.** Government of Western Australia website.

## NEW TOOLS HELP PARKS ADAPT TO CLIMATE CHANGE

The Climate Change Alliance of Botanic Gardens (CCABG) has launched two new tools, the Landscape Succession Toolkit and the Climate Assessment Tool, to help garden and landscape managers select plants that will thrive in future climates.

Both tools have evolved from the Landscape Succession Strategy released by Royal Botanic Gardens Victoria in 2016, the first of its kind for botanic gardens in Australia and a blueprint for other botanic gardens across the world. The strategy guides the selection of trees and plants at Royal Botanic Gardens Melbourne to those more suited to the projected climate of 2090, which is predicted to be more like present day Dubbo.

The Royal Botanic Gardens Melbourne
*Photo credit: Annette Epifanidis*

The Landscape Succession Toolkit provides a framework for botanic gardens to develop their own landscape succession strategies, while allowing botanic gardens the flexibility to discover creative solutions to their own unique challenges and opportunities.

The Climate Assessment Tool takes this a step further. It compares natural and cultivated records of over 60,000 trees and compares them to climate data projected in the Intergovernmental Panel on Climate Change (IPCC) emission scenarios. This gives botanic gardens guidance on which trees may struggle or thrive in their future climate, and a direction for research and experimentation.

This online assessment tool was developed by the Climate Change Alliance of Botanic Gardens, Botanic Gardens Conservation International, International Association of Botanic Gardens, Royal Botanic Gardens Victoria and University of Tasmania.

**Information.** The Landscape Succession toolkit can be downloaded from the Royal Botanic Gardens Victoria website.

**Source.** Scimex website.

## WORSE DROUGHTS AND FLOODS DECADES EARLIER THAN THOUGHT

Australians will experience noticeably more extreme weather events just eight years from now, decades earlier than previously thought, according to a new study published in *Nature Communications*.

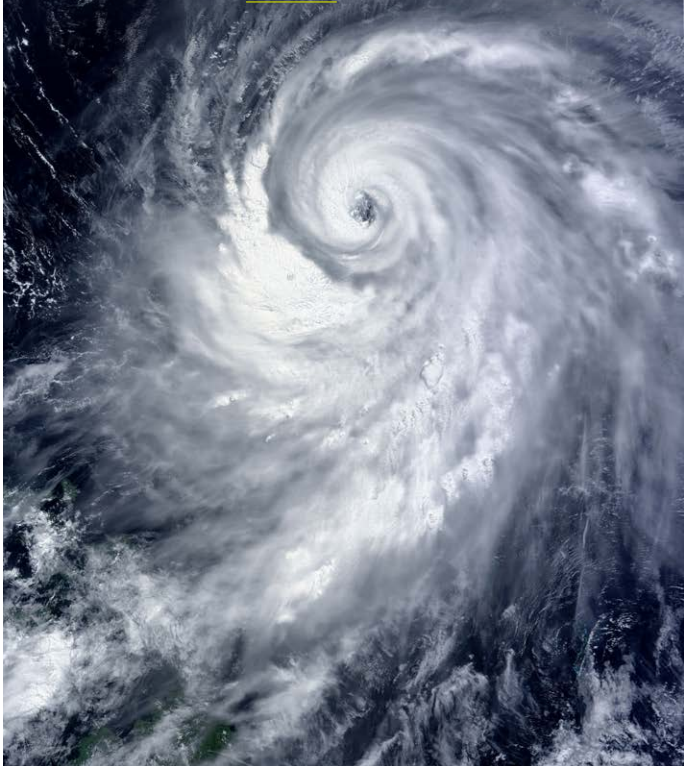
The El Niño-Southern Oscillation (ENSO) involves complex interactions between the atmosphere and the ocean. But until now it has been unclear how climate change will affect ocean temperatures and how this might affect El Niño and La Niña events.

The recent study, led by Dr Wenju Cai from CSIRO, looked at 70 years' worth of El Niño–Southern Oscillation data, and combined it with 58 of the most advanced climate models available.

The research showed that by 2030 ocean surface temperatures in the eastern Pacific will be significantly warmer than now. This will result in stronger El Niño events and stronger and more prolonged La Niña events. Previous research had indicated that we wouldn't see changes of this magnitude until 2070.

In other words, Australians need to prepare for more extreme floods and droughts much sooner than we had previously thought.

**Source.** The paper is available on the *Nature Communications* website.



## VALE SIMON COWLAND-COOPER

The industry sadly acknowledges the passing of one of its and the association's longest-serving members in September, at age 82. Simon's long career included 30 years as a member of Irrigation Australia. Simon retired from his consulting work last year but remained actively engaged with the industry in a voluntary capacity.

Simon was a greatly respected industry figure whose service to the industry was recently acknowledged with an Order of Australia Medal. Bryan Ward, former CEO of Irrigation Australia, said "Our industry and our association have lost a great man. Simon was an intellectual giant who made many friends and made a significant contribution to the irrigation industry".

You can read more about Simon Cowland-Cooper's life and achievements in the winter issue of the *Irrigation Australia Journal*.

## NEW COMMERCIAL BUSINESS MANAGER FOR TORO

Toro Australia recently consolidated its business into the three business units:

- Garden and trade irrigation
- Residential landscape contractor equipment and
- Commercial equipment and irrigation.

Anthony Lonergan was appointed as business manager commercial (equipment and irrigation) position. Anthony joins Toro from the First Five Group where he was chief operating officer. With a career that began in sales and marketing, he has worked across a range of industries and functional areas, including large and complex tender projects, mergers and acquisitions and strategic planning along with prior experience of large-scale grounds maintenance. He is looking forward to working collaboratively with Toro customers.

Anthony's team will look after all Toro golf, sports fields and grounds and agriculture customers as well as Toro service centres.

# REAL-TIME DATA COLLECTION VITAL FOR WATER MANAGEMENT

A new report by the Australian Academy of Technological Sciences and Engineering points to the importance of using real-time data in water management.

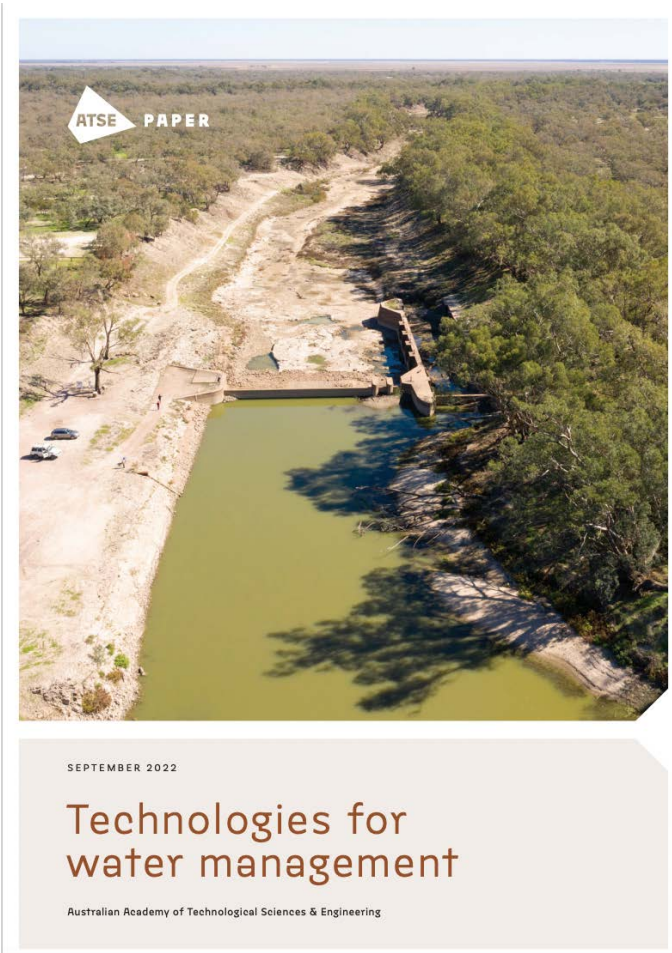
To make accurate predictions for future water management, catchments need to be closely monitored. Decision-makers need to know how much water is in the system, where it is, where it goes, and the value of this water.

This will become increasingly important as Australia's water needs change and as extreme events driven by climate change continue to impact the distribution of water across the country. But accurate monitoring is difficult in systems like the Murray–Darling Basin, which is ecologically complex and is managed by multiple water management bodies.

A recent ATSE report has found that emerging data collection technologies must harness contextual real-time data to ensure farmers, local councils, Traditional Custodians and other water resource managers to help them make evidence-based decisions.

## Report key messages

- Emerging technologies for data collection need to incorporate systems for gathering metadata, or contextual information, if they are to replace human-led in-field measurements.




- Developing and implementing technologies to streamline how data is managed, integrated and communicated in very short periods of time will allow water managers to use the information to make the best possible evidence-based decisions in the moment.
- Designing modelling technology that can handle imperfect data, in real time, to provide clear information in a usable format should be a priority for future technology development. Providing clear information from data analysis will increase the likelihood these are used in evidence-based decision making for a range of end users.

Engaging closely with people who use water information – like Traditional Owners, farmers, ecologists and utility water managers – will help scientists and policymakers better understand how technologies that gather, manage and analyse water data can inform better water management decisions.

**Information.** To download the report, visit the ATSE website.

# NEW TECHNOLOGY BRINGS REAL PRODUCTIVITY GAINS

The Australian irrigation industry is under pressure to adopt water-efficient practices to improve productivity. Modern irrigation technologies can go a long way towards helping irrigators decrease irrigation water use while increasing crop yield, as outlined in a recent report by Smarter Irrigation for Profit 2 (SIP2).

Building on the work of Smarter Irrigation for Profit 1, SIP2 was a two-year collaborative multi-state project. It was led by the Cotton Research and Development Corporation in partnership with fellow RDCs Dairy Australia, Grains Research and Development Corporation, Sugar Research Australia and AgriFutures Australia.

The objective was to improve the profit of over 4,000 cotton, dairy, rice, grains and sugar irrigators through the adoption of precision irrigation technologies and strategies.

## Technical advances

SIP2's final reports outline the project's key technical advances, which include:

- An average water productivity increase of 40 per cent across the cotton, sugar, rice and grains industries (with industry averages ranging from 5 per cent to 133 per cent, median 11 per cent). Additional productivity benefits included increased crop yields, labour savings, pumping energy savings and anecdotally, general improvement to farmer wellbeing through improved sleep.
- An average 47 per cent improvement in tonnes of dry matter produced per ML of water used across the dairy optimisation sites.
- The development of a satellite-based irrigation management approach for gravity surface irrigation of pasture.
- New strategies to reduce on-farm water storage evaporation by up to 39 per cent using a combination of chemical monolayers and wind-barriers.
- Two new precision irrigation sensing technologies able to be integrated into autonomous irrigation systems. One is available commercially, the other is under negotiation.
- The development of fully autonomous commercially viable irrigation systems for gravity and flood irrigation. Two systems are now available commercially: a smart sensing and automation system tailored to rice growers, and an economically viable smart sensing and automation system for bankless cotton irrigation.
- A commercial-grade system for real time optimisation of furrow irrigation events using advanced sensor data and water level information in SISCOweb that is close to commercialisation for cotton and sugar producers.

## Relevant to all agricultural industries

SIP2 outputs include a suite of legacy information resources including 64 videos, 71 fact sheets, 36 case studies and 16 scientific papers. These outputs are available and will continue to be available from the Smarter Irrigation for Profit and Improved Irrigation (sugar) websites.

The SIP2 research outputs and findings are applicable to all agricultural industries that use gravity, surface and pressurised irrigation systems. While each of the sites focused upon a particular irrigation and pasture or crop system, the key messages are transferable across all regions where similar systems are used.

**Information.** To read the full reports (Smarter Irrigation for Profit: Monitoring and Evaluation Economic Report and Smarter Irrigation for Profit Phase 2: Final Report), visit the Smarter Irrigation for Profit website.

# PREVENTING PSYCHOLOGICAL HARM IS AN ESSENTIAL PART OF CREATING A HEALTHY AND SAFE WORKPLACE

Preventing psychological harm is an essential part of creating a healthy and safe workplace. The model work health and safety (WHS) laws have recently been changed to include regulations on psychosocial hazards. This means people who run a business or undertaking, such as employers, must eliminate or minimise psychosocial risks so far as is reasonably practicable.

## What are psychosocial hazards?

A psychosocial hazard is anything that could cause psychological harm (e.g. harm someone's mental health). Common psychosocial hazards at work include:

- job demands
- low job control
- poor support
- lack of role clarity
- poor organisational change management
- inadequate reward and recognition
- poor organisational justice
- traumatic events or material
- remote or isolated work
- poor physical environment
- violence and aggression
- bullying
- harassment, including sexual harassment, and
- conflict or poor workplace relationships and interactions

## How psychosocial hazards cause harm

Psychosocial hazards can create stress. Stress itself is not an injury, but if workers are stressed often, over a long time, or the level of stress is high, it can cause psychological or physical harm. Psychological harm may include anxiety, depression, post-traumatic stress disorder, sleep disorders. Physical harm may include musculoskeletal injuries, chronic disease or fatigue related injuries.

Psychosocial hazards may interact or combine to create new, changed or higher risks. Some hazards may not create psychosocial risks on their own but may do so if combined with other hazards. For example, when workloads are high the risk may increase if workers cannot take breaks or there is no one around to help. Some hazards may only create risks on their own when severe.

It is important to consider all the psychosocial hazards workers may be exposed to when managing psychosocial risks.

## Managing psychosocial risks at work

A person conducting a business or undertaking must eliminate psychosocial risks, or if that is not reasonably practicable, minimise them so far as is reasonably practicable.

To manage psychosocial risks, apply the four-step risk management process:

1. identify the hazards
2. assess the associated risks
3. implement control measures to eliminate or minimise risks, and
4. regularly review control measures to ensure they remain effective.

Every step of the risk management process must be supported by consultation with workers and their representatives. Good consultation with workers can help you identify and control risks and lead to better outcomes.

**Information.** For more information, read the Model Code of Practice: Managing psychological hazards at work.

## HOW ONE IRRIGATION BUSINESS IS BRINGING HAPPINESS TO THE FORE AT WORK

The staff at irrigation design company CADsult IDS recently got together to brainstorm how they could improve happiness in the workplace. The outcome was their 'Happiness Initiative' (HI) – a set of tangible strategies to improve staff wellbeing and reduce stress.

Troy Fiscus, managing director of CADsult said, "Most of us have young families, so work and home balance is important. CADsult is also a male-dominated business and we want to do our part to bring mental health – or as I like to call it, mental fitness – to the fore.

"Through these initiatives, we aim to genuinely check in with each other and ensure everyone is getting the balance and time they need to be the best version of themselves at work and home."

The group came up with the following strategies:

- Fully flexible working arrangements, including:
  - The ability to work from either home or office (each employee has been equipped with the tools they need at each location).
  - Flexible start times, finish times and break times that work for the individual. Cadsult wants to ensure that its people can make it to school and day-care pick up/drop off and attend appointments when needed.
- One rostered day off per quarter, in addition to annual leave, to provide an additional refresher. This is recommended to be taken at the same time so staff can all switch off from work together.
- For each employee, the company will contribute up to $1,000 each year towards something that will improve employee mental/physical health, such as gym membership or personal and professional coaching.

Troy said, "We're still required to be accessible to our clients within their hours, along with any meeting or on-site requirements, but with the flexibility that CADsult gives to our clients, we also need to give that back to our people."

CADsult IDS will introduce further strategies as the HI program develops.

## IN THE NEXT ISSUE

The **Autumn 2023** issue of *Irrigation Australia Journal* will feature:

**EDITORIAL**

> Training and professional development

> Digital technology in irrigation

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