Australian National University

INSTITUTE FOR Water Futures

WATER ON THE HORIZON

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FORUM 2020 – THE MURRAY-DARLING BASIN

ANU INSTITUTE FOR WATER FUTURES

Water On The Horizon Forum 2020:
The Murray-Darling Basin

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ANU Institute for Water Futures acknowledges and celebrates the First Australians on whose traditional lands the University is situated, and pay our respect to their elders past and present.

Cover image: Aerial view of The Murray-Darling Junction with flood waters flowing near Lock 10. Location Wentworth. (Source: Hypervision Creative/Shutterstock.com)

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Foreword

The Institute for Water Futures (IWF) was founded on the understanding that "we" – academics, communities including Indigenous communities, policy makers, farmers and business people – are struggling to make sense of an increasingly different future. Can we disentangle the water challenges of the future from the significant challenges of today? What can we do differently today to enable us to adapt more effectively to external changes, and steer those change processes that we can exert some control over? The overarching aspiration of the IWF, "understanding change, enabling action", aims to answer these questions through the following goals:

- Empower decision-makers to anticipate the future in present-day actions
- Understand the science of uncertain futures
- Integrate social, cultural, economic and environmental values of water into actions
- Consider diverse innovations across technology, society, production and governance

IWF is dedicated to bringing different voices and experiences together, so we can tackle the complex challenges of achieving the future we want in a collaborative and exploratory way, while maintaining focus on what we can do "here and now" to work towards that future.

The Water on the Horizon Forum 2020 was a key step in starting this process. With a specific focus on the Murray-Darling Basin, we offered a number of sessions that explored key issues that are shaping the future of water and water-related communities. This document reports on the diverse and wide-ranging conversations that were started during the *WOTH Forum*, and that we plan to continue through 2021 and beyond.

– Professor Lorrae van Kerkhoff, Director of the Institute for Water Futures

Water on the Horizon Forum 2020: The Murray-Darling Basin

This synthesis report summarises the *'Water on The Horizon' Forum* convened by the Institute for Water Futures, online on the 1st – 2nd December 2020. The Institute for Water Futures annual *'Water on the Horizon' Forum (WOTH)* is a 'horizon scan' of the status and trends that will impact Australia's water futures. The *WOTH Forum* aims to stimulate public and academic dialogue and grow the collective capacity of the 'water community' of researchers, scholars, managers, practitioners and communities to envision and plan for the long-term future. Water on the Horizon is a major contribution to the IWF's intention to foster a national conversation around water that is based on dialogue, deliberation and future-oriented thinking. This document reports on the discussions and future-oriented thinking during the Forum.

In 2020, the *WOTH Forum* focused on the Murray-Darling Basin, with the two-day online event bringing people together across a range of innovative online formats. The event hosted four targeted workshops and two public seminar events:

- "Nation-Building Water Infrastructure: Back to Australia's Future"
- "Satellite Earth Observations"
- "Planning for ecological transformation of environmental assets in the Murray-Darling Basin"
- "Next generation groundwater management?"
- Two public forums 'in conversation' were also held online, *"First Nations knowledge and wisdom: Opportunities for recognition and sharing through academia"*and *"Imagining the Science-policy interface in 2050"*

The Murray-Darling Basin

The Murray-Darling Basin flows through south-eastern Australia, through a system of lakes and rivers including the River Murray and Darling River. Some 22 million people including 40 different First Nations live in the Basin. Around 40% of Australia's agricultural produce is grown in the Basin, and it also has 16 internationally significant wetlands. The Basin faces many issues, including contested and over-allocated water in a drying climate and degraded river systems and wetlands.

Wheat crop circle made by a centre-pivot irrigation system, in farm land, Australia. (Source: MountainAsh/Unsplash)

The Institute for Water Futures team (December, 2020): **Front row (left-right):** Hannah Feldman, Takuya Iwanaga, Carina Wyborn, Anthony Jakeman, Lorrae van Kerkhoff, Mahdiyeh Razeghi, Raktima Dey, Siyuan Tian. **Back row (left-right):** Luigi Renzullo, Susan Ward, Matthew Colloff, Paul Wyrwoll, Katherine Daniell, Paul Tregoning, Joseph Guillaume, Barry Croke, Wendy Merritt, Baihua Fu. (Source: Ian Skinner)

Workshop: Opening session and scene setting

Imagining our futures

In our opening session of the *WOTH Forum*, we warmed up with a conversation centred on two key ideas:

1. Why is thinking about the future so hard?
2. How can we begin thinking about the future in positive and productive ways, not just about current issues.

To begin, our audience was asked "how well do you rate your ability to integrate thinking about the long-term future (more than 30 years out) into your work?" with participants rating themselves as middling (average 5.6/10). This is not surprising: Researchers in the USA have found that more than half of over 3000 survey participants reported that they 'rarely' or 'never' think about the future 30 years out[1]. Neuroscience investigating how our brains operate while thinking about 'the future' suggests that adults typically don't enjoy thinking about our future selves. When we think about ourselves in the present, an FMRI scan shows the medial pre-frontal cortex lights up; when we think about others, it powers down, especially if we are thinking about people we don't know. When we think about our future selves, the further out in time you go, the less activation shows in the medial pre-frontal cortex[2]. This suggests that when we think about our future selves, we are actually thinking about ourselves as people we don't know, and even more, as people we don't care about very much.

These insights have significant implications for why thinking about the future is hard and why people tend to prefer actions that meet short-term goals rather than long-term goals. The more we think of our future selves like a stranger, the less likely we are to choose to limit behaviour today for anticipated long-term benefit and the less likely we are to make pro-social choices. This research offers some further insight into why the controversies and challenges of water sharing decisions can often pivot around short-term interests versus long-term ecological or socio-cultural needs.

Becoming better acquainted with our future selves may seem a far cry from the bureaucratic offices, town halls, community spaces, paddocks or farm offices where we make decisions about water. But becoming more skilled in assessing the implications of various possible water futures will be all-the-more challenging if we cannot see ourselves as individuals, families and communities in that future. Getting to know your future self can be a significant component of enabling people to think in the long-term and gaining a different a different perspective on the decisions before us.

Word cloud showing key words, which participants used to describe "themselves in 2040".

(Source: Lorrae van Kerkhoff)

1 McGonigal, 2017. The American Future Gap. Institute for the Future. Online source. Available at: https://www.iftf.org/fileadmin/user_upload/downloads/IFTF_TheAmericanFutureGap_Survey_SR-1948.pdf

2 Hershfield, H. 2011. Future self-continuity: How conceptions of the future self transform intertemporal choice. Annals of the New York Academy of Sciences 1235(1):30-43.

Understanding Water Futures

Understanding uncertain water futures in Australia requires us to not only plan and adapt to climate change, but also face a myriad of other interconnected issues, including sustaining biodiversity and economic activity within our catchments, protecting and supporting the social and cultural values of water, and understanding and adjusting our legal, institutional, technological and political systems.

Making decisions now that prepare us for uncertain futures is the fundamental challenge confronting water users, traditional owners, practitioners, policymakers, and other custodians of water resources. Co-developing and co-producing deliberate strategies to adapt, transition and transform in anticipation of changing demands, climatic shifts and technological opportunities requires forward-looking, cooperative, and anticipatory solutions for water governance.

Diverse methods and terms are used to describe approaches that examine, anticipate and plan for the future: foresight, futures thinking, futuring, scenario analysis, horizon scanning, as well as many others. 'Horizon scanning' is one of many strategic foresight processes used to identify novel insights, persistent trends, risks and opportunities that may inform research agendas and policy. While some of these concepts have formalised procedures and methods, others infer an orientation towards understanding the future as a means to make better decisions in the present. The *WOTH Forum* brought together many of these approaches as a first step in enabling meaningful conversations and improving our collective capability to understand, imagine and prepare for Australia's water futures.

Murray River Wetlands, lagoon and back water along the River Murray near Mildura, Australia.
(Source: Hypervision Creative/Shutterstock.com)

Our climate future

Climate change is pervasive in water issues and must be addressed for us to explore Australia's water futures. Australia is the driest inhabited continent, experiencing extreme variability in rainfall across the continent, including in agricultural and highly populated areas. Australia's water security is already heavily impacted by climate change, with dramatic effects evident. Changes in rainfall, temperatures, stream flow, and drought are already experienced across the country, due to climate change. The devastating and challenging summer of 2019/2020, with bushfires, smoke, hail, heatwaves and drought, is projected to become the norm in the coming decades.

We need to be more prepared to pre-emptively adapt to changes, whilst strengthening mitigation efforts for a carbon-neutral society. The projected impacts of climate change on water systems in Australia suggest localised decreases in rainfall, longer and more severe droughts, increased storm and flood severity and impacts on water quality. These negative impacts will continue and amplify unless we transition rapidly to a carbon-free economy. The *WOTH Forum* provides much-needed space for participants to consider climate-changed futures and the steps we may take towards both mitigation and adaptation.

Professor Mark Howden speaks at the Institute for Water Futures launch event.
(Source: Ian Skinner)

" Water resources in Australia and our region are under threat from a changing climate. The IWF research will help open new climate adaptation pathways to this vital resource." – Professor Mark Howden, Director, ANU Institute for Climate, Energy and Disaster Solutions, and IWF Leadership Team

Big Bend, Murray River, Australia.

(Source: Adrian Winther/Unsplash)

Dr Virginia Marshall, Institute for Water Futures Associate and First Nations Knowledge and Wisdom Panellist.

(Source: Leena Fraser)

IN CONVERSATION:

First Nations Knowledge and Wisdom: Opportunities for recognition and sharing through academia

Moderator: Professor Quentin Grafton
Panellists: Dr Virginia Marshall, Miss Hmalan Hunter-Xénié, Dr William Fogarty

In this public seminar, leading Indigenous academics and graduates discussed the role of universities in recognising, celebrating and connecting with Indigenous knowledge and wisdom in all its forms. While the challenges are significant, the opportunities are great, and panellists together with a live audience discussed *'How might we navigate these complex relationships together?'*

In this session we invited panellists to present their vision for how the future of Indigenous Peoples and universities, together, may become shared and mutually enriching. Here are some of the key discussions generated by our esteemed panel:

- **Indigenous knowledge, wisdom and resource management offer many opportunities for improved water management in Australia:** There are rich opportunities for land and water management if we can centre Indigenous knowledge and wisdom. Indigenous knowledge, identity, and connection to land and water offer an integrated and holistic approach to water management, which is vastly different to Western approaches. Engaging with Indigenous Peoples, who have been managing Australia's water and land for over 60,000 years, is to access deep reservoirs of knowledge.
- **Fairer structures for including Indigenous Peoples are needed:** We need equitable structures for including Indigenous Peoples, and to recognise Indigenous Peoples as landowners and landholders. Whilst there will always be contestation around resource use, particularly in a drying arid climate such as Australia, valuing water and valuing Indigenous People's water will be an important step towards improved management.
- **Within academia, creating culturally safe spaces for Indigenous students, researchers and knowledge is vital:** We need to consider how we are engaging Indigenous Peoples in research, including how we can undertake and maintain respectful knowledge transfer. This may result in better co-production of knowledge and management.
- **Engaging Indigenous Peoples:** New ways of thinking about Indigenous knowledge are needed in Australia, so that it can be supported systematically across all levels of education and research. Reform in education systems and curriculum represents one way in which Australians may engage in the knowledge and resource management of First Nations.

Indigenous Scholars Programme

The Institute for Water Futures is proud to be working closely with Aboriginal and Torres Strait Islander community members to develop our Indigenous Scholars Program. This Program will uphold the IWF's commitment to co-production of knowledge with Aboriginal and Torres Strait Islander communities, as well as strengthening engagement and capacity through research.

IN CONVERSATION:

Imagining the Science-Policy Interface in 2050

Moderator: Professor Anthony Jakeman

Panellists: Professor Katherine Daniell, Mr Phillip Glyde, Dr Deborah Peterson, Professor Paul Tregoning

We asked eminent water scientists and policymakers to share their ***creative thinking*** about how science and technology may re-connect with policy in 2050. *What will science and technology be like in 30 years? How might policy-making be different? When you bring the two together, will the interface between science and policy itself be different?*

The science-policy interface can be defined as: 'social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision making'[3].

Considering social, cultural, environmental, and economic values of water through the lens of the science-policy interface, we compiled the panel's optimistic responses to a possible 2050 future..."

- **Social data gaps are addressed:** By 2050, we have addressed major data gaps data on the social and economic conditions and values in the Murray-Darling Basin. We now examine the whole community in the Basin. *The large data gaps that existed in 2020 are now understood and covered, we have information on aspirations, challenges and Basin-wide social conditions.*
- **Real-time data are available for policy:** By 2050 we have an enormous amount of information from Earth observation, sensing technologies, modelling, and AI-powered systems which can tell/tells us on a daily basis what is in the landscape. Government agencies, communities and individuals can watch water and track allowances. *The real-time data are carefully curated to support policy decisions.*
- **Transparency and communication are established:** We have improved trust in governance, and all data are publicly available, transparent, open and coordinated. We have a range of policy analytics and policies are coordinated into overarching strategies. *This helps to develop fit-for-purpose tools across communities.*
- **Collaborative governance thrives:** All policy and science is connected, and information is getting out to people and communities so they can participate in decision making. Calls for collaborative governance and studies that look at the outcomes of these approaches in communities have been met. *Communities are at the centre of reform and at the heart of decisions deciding their futures.*

3 Van den Hove, 2007. A rationale for science policy interfaces. Futures 39(7):807-826.

– **Closer and deeper engagement with Indigenous communities is the norm:** We have learnt from Indigenous knowledge and science-policy interfaces. *Indigenous rights, perspectives, knowledge, and governance models are hardwired into Basin decision making allowing Indigenous leaders to contribute fully to Basin life and futures.*

– **Frameworks to track outcomes are funded:** By 2050 we have agreed on a framework to track outcomes in the Basin. It is well resourced, and a learning culture exists that supports question-asking and purposeful investigations. *The importance of up-to-date data and knowledge to support policy is reasserted, and we have strong research and innovation capabilities*

– **Rights and responsibilities are established:** We have distributed ownership and responsibility and have supportive legal and governance systems to assure these rights and responsibilities are effectively enacted. *Water sovereignty and data sovereignty are established.*

– **Robust decision-making processes exist:** Whilst we need to better understand dynamic change, better information doesn't avoid the need for robust decision making. Uncertainties will always exist, but they have been identified and prioritised for their criticality to decision making. There are still competing views and politics, but the way we organise them are different. *Autonomous decision-making systems are much more prevalent and now have the contested values built into them through effective co-design.*

Water feature at the public entrance to Australia's Parliament House, located in Canberra, Australian Capital Territory.

(Source: MEzairi/Shutterstock.com)

Workshop: "Nation-Building Water Infrastructure: Back to Australia's Future"

The Australian Government is investing $3.5 billion in a National Water Grid. New water storage and distribution infrastructure is expected to support regional economic growth, expand irrigated agriculture, increase water security and build resilience to climate change.

Large-scale dams, water diversions and irrigation projects are regularly planned the world over to be transformative, nation-building solutions. However, these projects are exposed to major risks: large cost overruns, expected benefits that do not materialise or are unevenly distributed, and environmental damages that were unexpected or undervalued prior to construction. Advances in water science, technology and governance could support management of these risks and the delivery of net social benefits from public funding of Australia's water infrastructure boom.

This workshop initiated a dialogue between water policy makers, practitioners and researchers regarding the challenges and opportunities associated with the National Water Grid and the National Water Infrastructure Investment Policy Framework. This coordinated national approach to water infrastructure development is delivering a portfolio of construction projects and feasibility studies, including large dams, infrastructure modernisation, treated wastewater and managed aquifer recharge. Major investments in the Murray-Darling Basin (MDB) include the Wyangala, Dungowan, and Mole River dam projects; the recently established National Water Grid Authority that oversees this program has also identified examination of the Bradfield Scheme – to divert coastal Queensland rivers inland and potentially into the northern catchments of the MDB – as an early priority.

The discussion of current developments was grounded in key lessons from historic public funding of water infrastructure and past policy reforms in Australia and the Murray-Darling Basin. These included:

- Regulating the Murray River system led to large benefits *and* large unintended costs
- Government generally made good decisions, but with governance issues impeding implementation
- Water infrastructure will not *always* add value
- National myths have persisted, including northern water dreaming, big solutions and "just add water"
- The interests and aspirations of all stakeholders need to be valued, not just irrigation communities
- Policy frameworks are often ignored by politicians and effective implementation is crucial
- Nation-building can instead benefit from small incremental steps and the steady enrichment of society.

IWF team members Takuya Iwanaga (left) and Paul Wyrwoll (right) work with remote colleagues in a WOTH workshop. (Source: Ian Skinner)

Aerial view of a wastewater treatment plant. (Source: Chekart/Shutterstock.com)

Participants separated into break-out groups to discuss challenges and opportunities across four objectives of the National Water Grid: regional economic growth, expand irrigated agriculture, increase water security, and build resilience to climate change.

Key potential challenges identified by the groups included:

- **Cost-benefit analyses for major public infrastructure projects in Australia often fail to meet best-practice standards:** All costs and benefits to society are rarely considered or assessed in their entirety. Broader economic benefits of water projects may be overstated and the external costs of water extraction, such as environmental damages, are typically under-represented. There is a drift away from cost recovery principles for public funding.
- **Alternative scenarios for water security and regional development are not being assessed:** A full options assessment and strategic plan for alternative projects is often lacking. Reliance on a single project, industry or crop can lead to a lack of regional diversity that decreases resilience. There is a lack of understanding of (assumed) market demand for expanded agricultural output.
- **Potential failure to incorporate Indigenous Peoples' rights and interests into planning and development:** There is a lack of formal recognition of Indigenous water rights in prevailing institutions. A focus on supporting the agricultural production and water security of incumbent water-holders may undermine the reallocation of water entitlements' ownership to Indigenous Peoples and their capacity to manage water to improve cultural, environmental, social and economic conditions.
- **Aspirations for new developments exceed the water that is actually available for irrigation under climate change:** The absence of baseline water accounting, lack of water monitoring and information, and understanding of suitable crops could lead to under-utilised infrastructure, unsustainable water extraction patterns, and/or failure to realise expected water security benefits.

Identified opportunities for realising the National Water Grid objectives include: systems-based approaches to project assessment that integrate risks and resilience in quantifiable ways; community-led and place-based planning approaches; encouraging diversity in regional economic activities; and focusing on profitability and sustainability rather than output-oriented goals for agricultural production.

The primary output from the workshop is an interdisciplinary research agenda on water infrastructure development in Australia that will be made publicly available.

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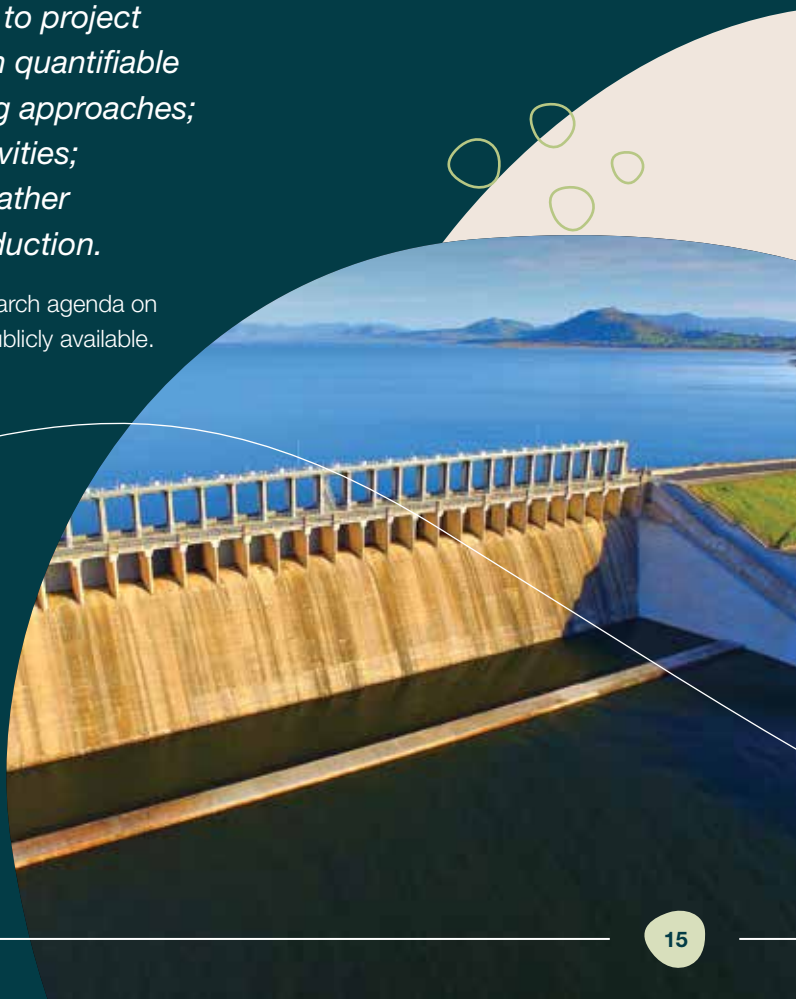

View of Hume Weir on Lake Hume at the start of the Murray River, Albury, Australia.
(Source: Hypervision Creative/Shutterstock.com)

Workshop: "Satellite Earth Observations"

High quality data underpin decision making on the use and distribution of our precious water resources. In a water scarce future, it is even more critical that our process understanding and hydrological modelling are guided by the best available water information products. However, the sparseness of ground-based metering, and disparities in the reporting of key water quantities across jurisdictions, mean that consistent and nationally comprehensive monitoring of water stores and fluxes at a useful management scale remains a challenge.

This workshop explored the use of satellite observations in water monitoring, management and compliance. Satellite-derived variables can augment surface and groundwater measurements to quantify water use and provide a tool for regulatory authorities to target potential breaches of compliance across a large geographic extent. Furthermore, when satellite data are combined with hydrological modelling, through sophisticated methods of model-data fusion, they provide a spatially-explicit and temporally-dense source of water balance information products that enables nationally consistent water accounting. New and future satellite missions build on the legacy of Earth observation data to fill the gaps in our water monitoring and prediction capability and, through the integration with in-situ data and models, will deepen our understanding of drivers of change in our water resources.

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Luigi Renzullo (facing) facilitates the workshop on Earth Observations with colleagues both in-person and online. (Source: Ian Skinner)

Satellite imagery artwork.

(Source: Luigi Renzullo)

Workshop: "Planning for Ecological Transformation of Environmental Assets in the Murray-Darling Basin"

Future environmental watering in the Murray-Darling Basin (MDB) faces two critical challenges:

1. It is unlikely to be possible to provide water for all environmental assets
2. It is likely that many environmental assets will transform in character under projected climate scenarios.

Adequately anticipating and preparing for these challenges involves accepting future change, and identifying the rules and knowledge required to maintain asset values as they transform. This workshop was designed to create a safe space to discuss difficult issues concerning what shapes how decisions about environmental water are made, now and into the future. The workshop involved a mixture of short talks and small group discussions where participants considered the past, present and future trajectory of environmental assets. Participants discussed speculative futures in response to a selected set of cards from the *'Instant Archetypes card deck'*[2], an exercise that provoked creative thinking that critically questioned the underlying drivers, assumptions, and/or challenges of the current system.

Key past and present challenges to environmental watering identified by participants

Historical legacies shaping environmental watering emerged at colonisation through the dispossession of Indigenous Peoples, and a frontier mentality and myth of the 'real Australia'. This has resulted in a view that water is primarily an extractive resource, and something that can be separated from land management. Such a perspective runs counter to the reality that water is integral to a thriving society, culture and environment. Water reforms that have sought to redress this historical legacy have, however, largely focused on creating physical infrastructure, and a water market, with public debates and decision making dominated by certain voices: scientists, economists, (some) irrigators, politicians, bureaucrats, and powerful lobby groups. These legacies manifest in several contemporary challenges identified by workshop participants. First, a mistrust in Basin governance, governments, and increasingly-scientific expertise. This emerges from fragmented governance across Federal and State governments, and 'top-down' decision making that does not empower or engage Indigenous Peoples and Basin communities. Second, language and narratives around 'environmental water' and 'environmental assets' narrow the debate to values that can be monetised, alienating different ways of knowing and valuing water, and retaining the power of those who can engage with the technocratic or economic language. Finally, concerns were raised around: the definition of the 'environmentally sustainable level of take' (ESLT) as a single number; economic modelling that assumes a linear relationship between water use and economic outputs; the absence of a transparent framework to inform current and future decisions about environmental watering; and insufficient discussion about what is meant by 'environmental health' that takes into consideration a diverse suite of values and ways of knowing water.

Word cloud developed during the workshop, showing participants' vision for the future of environmental assets in the Basin. (Source: Carina Wyborn)

Characterising the future(s) of the Basin

Participants discussed speculative futures in response to a selected set of cards from the *'Instant Archetypes card deck'*[4]. Each breakout group received two cards that captured drivers of possible futures: the market & the consumer; growth & the academy; visionary & authority; assessment & collapse; the rogue state & innovation. Basin governance was a common thread across all futures, with various ways to elevate the voices of Basin communities imagined: e.g., 'bottom-up' citizen science assessments; populist politics; place-based co-production to facilitate connection and collective action; or deliberative processes (with authority to make decisions) facilitated by catchment management authorities and Indigenous Peoples' land and water management organisations. Most painted an optimistic future, emerging either through proactive actions to address future challenges, or as a result of dramatic reforms to break the perpetual state of crisis. Many addressed transparency issues around compliance and monitoring in some way, while one future explicitly revolved around reformulating the water market to prioritise food, shelter and belonging.

Basin governance was a common thread across all futures, with various ways to elevate the voices of Basin communities imagined ...

Most painted an optimistic future, emerging either through proactive actions to address future challenges, or as a result of dramatic reforms to break the perpetual state of crisis.

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Instant Archetypes card deck.

(Source: Copyright Superflux, 2018. Used with permission.)

4 UK design studio Superflux: Toolkit to imagine plural futures.

Workshop: "Next Generation Groundwater Management?"

Existing trends

Groundwater in the Murray-Darling Basin has long been trailing surface water in use and regulation and tends to be shoe-horned into existing water policy frameworks, often treating groundwater as a river rather than a reservoir. Taking a long-term view, there is potential to revisit fundamental assumptions to shape the next generation of management and plan for transition.

Changes in management will weave into current and emerging trends. Groundwater utilization is increasing, and also as a primary rather than backup water source, contrasting with calls for managed aquifer recharge and conjunctive water use to contribute to maintaining water security in drier periods. Experimentation with new rules tackles limitations of long-term diversion limits to allow flexibility in groundwater use within resource condition limits.

Improved data and high value of water driving more active resource management

High value of water is encouraging control of water flows and reduction of unproductive evaporation. New options are emerging to integrate precision agriculture and new monitoring and telemetry alternatives into digital twin models that may allow for active management of groundwater resources for multiple ecosystem benefits, including for Indigenous Peoples.

While recognising the opportunity for improvement and need for adaptive policy, providing confidence and certainty in the midst of change is a priority on the back of decades of radical reform. Some changes may emerge naturally, for example in areas with highly connected surface and groundwater systems, as occurred in the past in response to salinity issues.

In cases where business decisions connect surface and groundwater use, a common understanding and vision will become increasingly important. Active management of groundwater lends itself to stewardship of a resource, but what does sustainable use of groundwater involve? What water is needed to sustain groundwater-dependent ecosystems and communities in dry times? What role should groundwater and water security play in fitting within Australia's cyclical climate?

Potential for disruptive innovation reinforces need for dialogue to help manage transitions

Despite increased real-time data availability, gaps in understanding aquifers will likely remain, requiring policy to consider the cost of information it requires, the sharing of that cost, and mechanisms for public-private data sharing. Policies based on resource condition limits, pricing or agricultural policy (e.g. on permanent plantings) may allow sustainable diversion limits to be indirectly but more efficiently achieved.

Increased system understanding will likely allow new engineering solutions facilitated by impact assessments, such as the use of desalination, but also confident adoption of nature-based solutions with catchment rehydration and protection of recharge zones helping to manage groundwater at landscape scale.

Active management lends itself to greater local involvement, raising questions about roles and responsibilities for public and private sectors, and potential for empowerment of communities within a framework of subsidiarity. Avoiding monopoly control of groundwater resources will benefit from water literacy of smaller players, supported by harmonised guidelines and training. The next generation of groundwater management is one that all stakeholders have a role in shaping.

High value of water and emerging data sources and models mean that active management of surface and groundwater is increasingly within reach, with the potential for disruptive innovation that needs to be carefully managed.

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Groundwater bore feeding into irrigation canal in the southern Murray-Darling Basin.
(Source: Joseph Guillaume)

Aerial photo of irrigated agricultural land in the southern Murray-Darling Basin.
(Source: NSW Spatial Services 1997)

What's On The Horizon?

The futures that may unfold in the Murray-Darling Basin (MDB) involve common pressures with governance and data challenges across diverse fields, including within groundwater, environmental assets, infrastructure, and water allocations. By adopting a futures orientation, the Water on the Horizon Forum provided the space to discuss these challenges and opportunities in the context of research, policy, and practice. This section explores what is on the horizon for the Murray-Darling Basin, including the existing challenges and processes, as well as outlining future steps towards improved water governance.

Decision-making frameworks face increasing need to consider diverse water values and pressures

Across the Murray-Darling Basin and Australia-wide, water resources are under increasing pressure from climate change. Whilst uncertainty exists regarding the effects of climate change in the MDB, projections point to significant decreases in inflows, already observed in parts of the MDB. Full or over allocation of water in most river systems and degraded riverine ecosystems in the Basin are being exacerbated with climatic shifts. For example, key groundwater sources are already under increasing pressure, both in dry periods and as a primary water source. Similarly, environmental assets already under strain are likely to degrade further under projected future climate scenarios. How sites and rivers are prioritised for environmental watering across the Basin will come under increasing pressure as a result of climate change and increasing water demand.

Beyond protecting environmental assets, water is valued in the Basin for agricultural production and social and cultural values. Despite this, diverse values and perspectives are often not considered in frameworks for planning and decision making. This has impacts across multiple domains, including regarding distribution of costs and benefits from investments and water allocations and their management. For example, federal and state governments are currently investing in and committing to water infrastructure projects to support agricultural water security and regional economic development under climate change. "Fast-tracked" large dam projects have the potential to lock-in unsustainable and inequitable water management for decades to come. Whilst a national-level policy framework has been developed to guide public funding of large agricultural water infrastructure, historical experience suggests that all costs and benefits to society may not be fully incorporated into decision making and implementation.

Similarly, decision-making frameworks are also lagging for both active groundwater management and environmental watering in the Basin. Close management required by increasing pressures in turn needs clear common visions of management objectives at local, state, and national scales. There needs to be a more consistent, transparent and equitable framework to guide planning for environmental assets in the Basin that takes into consideration a diverse range of perspectives and values. Decision making in the Basin is inevitably contested, and the presence of diverse and potentially conflicting interests needs to be acknowledged when approaching discussions about where and how environmental water might be prioritised.

The high value of water and emerging data sources and models mean that active management is within reach

Despite governance challenges, the high value of water and emerging data sources and models mean that more participatory management models are within reach and increasingly attractive to help maximise the value of resources. For groundwater, such a shift would move toward treating groundwater as a large, low evaporation reservoir through careful conjunctive use as well as managed aquifer recharge, paired with precision agriculture.

Similarly, for water allocation and water use decisions, satellite Earth observations (EO) have the demonstrated potential to provide routine comprehensive assessments of water stores and fluxes in the landscape to enable water management authorities to make targeted decisions. Regulatory authorities use derived products from EO to map water use and identify possible unmonitored extractions across the Murray-Darling Basin. The Bureau of Meteorology integrates EO products, spanning the visible, thermal and microwave regions of the electromagnetic spectrum, in their continent-wide modelling to support mandated reporting of annual National Water Accounts. Furthermore, Geoscience Australia provide seamless access to the rich legacy of EO for government departments and researchers to facilitate the studies of multi-decadal change in water resources for the country.

On the horizon – enabling agreement on ways forward for sustainable water governance

Across the Basin, within domains of groundwater, water use allocations, environmental watering and water infrastructure, there is a clear need for more comprehensive, coherent, and transparent frameworks, policies, and data for more informed decision making.

For environmental watering, explicit discussion is needed about how environmental watering decisions will be made in the future, who should participate in them, and through what types of collective decision making processes. These discussions will need to confront potential trade-offs in allocations, and grapple with the fact that environmental assets in the Basin are likely to transform under projected future climate scenarios.

Similarly, rules and norms for active management of groundwater will play a crucial role in what objectives management will achieve, how groundwater information and its costs will be shared, and who will therefore benefit from this paradigm shift.

For water infrastructure investments, independent analyses of project business cases, transparent project development, and compliance with the National Water Initiative and best-practice guidelines are among the steps that could build public trust, mitigate negative outcomes, and ultimately ensure that taxpayers' money is spent wisely. A coordinated approach to funding water infrastructure needs beyond agriculture is urgently required, most notably for drinking and household water provision in regional and remote areas.

Whilst improved data sets may support decision making, future research is required to integrate this data into decision-making and governance frameworks. Current, new and planned satellite missions promise enhanced water monitoring capability that can complement surface sensor networks and improve landscape water model predictions and forecasts.

There is a need to integrate this rich variety of data (EO, ground-based and modelling) to provide consistent, accurate, and reliable products for decision makers, while anticipating and addressing possible controversies that can arise from use of that data.

The 2026 revision of the Basin Plan provides an opportunity to make substantial progress, if the groundwork is laid now. Supporting processes of change will involve research investments that ensure best available science is also fit for purpose alongside efforts to strengthen relationships among the diverse communities of interest in the Basin. Successfully anticipating and preparing for change will require: developing means to incorporate diverse perspectives; enabling opportunities for more active management; and fostering dialogue and deliberation. This will inevitably include transdisciplinary work with collaborations between government, industry, researchers, Indigenous Peoples, and communities, in a spirit of mutual learning and respect.

IWF members and workshop facilitators **(clockwise from top left):** Luigi Renzullo, Carina Wyborn, Joseph Guillaume, Paul Wyrwoll. (Source: Ian Skinner)

As the Institute for Water Futures (IWF) continues to grow its research themes and partnerships, we look forward to fostering and convening national conversations on water futures.

Future events will explore new and emerging themes from the Institute's growing range of multi-disciplinary research agendas.

Australian National University

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If you'd like to know more about the IWF, partner with us or contribute to events or research, please visit our website, subscribe to our newsletter or get in touch:

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