



NSW Water Industry Innovation Workshop

2 October 2019



Welcome

Welcome to the NSW Water Industry Innovation Workshop.

As NSW contends with worsening drought conditions, there is a unique role for smart sensing to play as part of a wider response to the state's water challenges. This workshop brings the state's key water decisionmakers and stakeholders together with researchers from the leading universities across NSW & ACT to explore innovative solutions focussed around smart sensing.

Water is a critical resource that supports our communities and industries. 95% of the state is currently experiencing drought. Sydney is under Level 1 water restrictions, while other parts of the state, like Tamworth & Armidale, are in Level 4 restrictions, with Dubbo to follow next month. Industries like agriculture and mining depend on a stable water supply; while the biodiversity of our state and even the livelihood of our towns rely on a well-managed water ecosystem.

This is not a policy workshop. The objective of this event is to explore possible scientific and technological solutions to more effectively and efficiently measure and manage this finite resource. Hosted by the NSW Smart Sensing Network (NSSN), the workshop is particularly focussed on smart sensing solutions in two streams:

- New sensing technologies – how can recent and emerging developments in sensing science be applied to the water management cycle to deliver new insights and efficiencies to the water industry?
- Data – how can we better utilise, share and analyse data we are already collecting across the water management cycle to deliver innovative outcomes?

In the morning, we will hear from leading decisionmakers and stakeholders on the key challenges and 'pain points' they face in delivering better water outcomes for NSW. The workshop will be opened by the Minister for Water, Property & Housing, the Hon. Melinda Pavey MP.

In the afternoon, researchers and stakeholders are invited to split into concurrent streams focussed on new tech or data to workshop potential solutions. The objective of these sessions is to refine the key problem statements outlined in the morning sessions, identify 2-3 core projects (per stream) that can lead to innovative, impactful, practical and rapid solutions and identify the collaborative teams (both academic & practitioner) to drive them forward.

Following the NSW Water Industry Innovation Workshop, the NSSN will serve as a broker between universities, industry and government to further shape the proposals resulting from the day, negotiate funding and curate multi-disciplinary, multi-institutional project teams.

Thank you for the time and expertise you are lending to this important workshop. We look forward to developing impactful partnerships arising from today's conversations that will benefit the NSW economy, society & environment.

About the NSW Smart Sensing Network

The NSSN is a consortium of the nine leading universities across NSW & ACT. It exists to bring together expertise in academia, industry and government to develop innovative smart sensing solutions to economic, societal and environmental challenges. Discover more at nssn.org.au.

Join the conversation



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#NSSNWater2019 #SmartSensing #SmartWater #Drought

Program

8.30	Arrival Tea	
9:00	Welcome	
		Prof. Ben Eggleton, Co-Director, NSW Smart Sensing Network Prof. Justin Gooding, Co-Director, NSW Smart Sensing Network
9.10	Keynote Presentation	
		The Hon. Melinda Pavey MP, Minister for Water, Property and Housing
9.25	Overview	
		Prof. Hugh Durrant-Whyte, NSW Chief Scientist and Engineer
9.35	NSW Water Perspective	
		Dr. Jim Bentley, Chief Executive Officer - Water (Deputy Secretary) Department of Planning, Industry & Environment (DPIE)
9.55	The Value of Data	
		Dr. Ian Oppermann, CEO and Chief Data Scientist, NSW Data Analytics Centre
10.20	Morning Tea	
10.50	Panel Discussion 1 and Q&A – Data access, availability, sharing & outcomes	
		Moderated by Peter Runcie, New Industry & Platforms Leader, CSIRO Data61
		<ul style="list-style-type: none">• Helen Liassis, Head of Corporate Strategy and Business Planning, Sydney Water• Dr. Georgina Kelly, Executive Director Science, DPIE• Vanessa O’Keefe, A/Executive Director Policy Planning & Sciences, Water Group, DPIE• Kaia Hodge, Director Regulatory Innovation, Natural Resources Access Regulator (NRAR)
11.40	Panel Discussion 2 and Q&A – New Tech & Innovation in monitoring	
		Moderated by Matthew Coultou, Water Sector Engagement Lead, Bureau of Meteorology
		<ul style="list-style-type: none">• Dr. Anthony Clark, Leader, Climate Applications and Digital Ag, Dept. of Primary Industries• Ed Couriel, Director, Manly Hydraulics Laboratory• Nick Milton, Technology specialist, NRAR• Xavier Martin, Chair, NSW Farmers’ Water taskforce
12.30	Wrap up of morning session	
		Prof. Ben Eggleton and Prof. Justin Gooding
12.40	Lunch	
13.30	Breakout 1 - Data	Breakout 2 - New Tech
	Moderated by Prof. Ben Eggleton	Moderated by Prof. Justin Gooding
14.45	Afternoon tea	
15.15	Breakout 1 (Continued)	Breakout 2 (Continued)
16.30	Group Report-backs & next steps	
17.00	Concluding remarks	
17.10	Networking & refreshments	

Keynote Speaker

The Hon. Melinda Pavey MP Minister for Water, Property and Housing



Melinda Pavey is the New South Wales Minister for Water, Property and Housing, appointed in April 2019 under the Berejiklian-Barilaro Government.

Minister Pavey has been a member of the New South Wales Legislative Assembly since 2015, representing the seat of Oxley for The Nationals.

Melinda previously served as the Minister for Roads, Maritime and Freight. (2017-2019) and was the first woman to hold this Ministerial position. She was a member of the New South Wales Legislative Council (2002-2015). She also served as the Shadow spokesperson for Emergency Services and the Parliamentary Secretary for Regional Health.

Melinda's career began in radio journalism at 2UW in Sydney. In 1988, she moved into politics as a media officer for Matt Singleton, the then NSW Minister for Administrative Services. Over the next decade, she worked for a number of MPs, including Deputy Premier Wal Murray (1990–1993), Minister for Consumer Affairs Wendy Machin (1993–1994) and National Party leader Ian Armstrong (1994–1997).

Melinda grew up on a dairy farm in regional Victoria. She has two children and enjoys surf lifesaving, netball and bike riding. As a country girl, Melinda is passionate about advocating for rural communities and issues that matter to families across the state.

Moderators

Professor Benjamin Eggleton is Director of The University of Sydney Nano Institute and Co-Director of the NSW Smart Sensing Network (NSSN). Eggleton was the founding Director of the Institute of Photonics and Optical Science (IPOS) at the University of Sydney and served as Director from 2009-2018. He was previously an ARC Laureate Fellow and an ARC Federation Fellow twice and was founding Director of the ARC Centre of Excellence for Ultrahigh bandwidth Devices for Optical Systems (CUDOS) from 2003-2017. Eggleton is the author or coauthor of more than 480 journal publications, including Nature Photonics, Nature Physics, Nature Communications, Physical Review Letters and Optica and over 200 invited presentations. His journal papers have been cited 22,000 times according to webofscience with an h-number of 70 (92 in google scholar). Eggleton is a Fellow of the Australian Academy of Science (AAS), the Australian Academy of Technology and Engineering (ATSE), the Optical Society of America and IEEE. He is Editor-in-Chief of APL Photonics.

Scientia Professor Justin Gooding is currently an ARC Australian Laureate Fellow, Co-Director of the Australian Centre for NanoMedicine and the Co-Director of the NSW Smart Sensing Network. He is a Fellow of the Australian Academy of Science, the International Society of Electrochemistry, the Royal Society of New South Wales, The Royal Australian Chemical Institute and the Royal Society of Chemistry. He is the inaugural editor-in-chief of the journal ACS Sensors. He has published over 370 research papers including Nature Nanotechnology, Nature Biotechnology, Nature Immunology, Nature Communications and Science Advances. He has also authored 14 patents and one text book. His papers have been cited more than 19000 times and his H-index (Scopus) is 68. He has won numerous awards including Eureka Prizes in Scientific Research and Mentoring of Young Researchers, the Faraday Medal of the Royal Society of Chemistry and the Elsevier Biosensors and Bioelectronics Award. He leads a research team of over 40 researchers interested in surface modification and nanotechnology for biosensors, biomaterials, electron transfer and medical applications. Aspects of his research have been commercialized through start-up companies.

Peter Runcie is the New Industries and Platforms Leader for Data61 – CSIRO's data science unit. In this role he is exploring collaboration models that bring industry and innovation communities together to achieve significant national impact for society, the environment and the economy. Smart cities, sensing, data analytics and secure data have all been recent focus areas while at CSIRO. Peter came to CSIRO from National ICT Australia (NICTA) where he led R&D programs in structural health monitoring and cognitive load measurement. Previously Peter led a number of initiatives in product, service and channel partnership development for Avaya Inc in the US. Prior to that Peter consulted to Bell Laboratories and was the CIO of a technology based retail startup based in Sydney. Peter is also the director of a management consultancy firm specialising in corporate strategy and R&D processes for technology organisations. Peter is an inventor on over 25 granted patents in voice and video communications, data networking and biometrics with others pending in civil engineering and data analytics. Peter holds an MBA (Exec) from the Australian Graduate School of Management and is a graduate of the Australian Institute of Company Directors. Peter is also a director of the Australian Smart Communities Association and a Board member of the NSW Smart Sensing Network.

Matt Coulton is Manager of Water Sector Engagement in the Bureau of Meteorology's Water Program. Matt and his new team work to ensure decision-makers in the Australian water sector are supported by information, analysis, insight and data from the Bureau, and that the Bureau is focused on activities that deliver value and impact to the sector. Matt is a water scientist with expertise in water policy and resource management, and he has experience providing policy advice to water ministers at the state and federal level. Matt has a MSc in Water Science, Policy and Management from the University of Oxford and a BSc (Hydrology and Water Resources Science)/B Arts (Political Science and International Relations) from the Australian National University.

Speakers

Professor Hugh Durrant-Whyte is the New South Wales Chief Scientist & Engineer. From 2016-18, he was Chief Scientific Advisor to the UK Ministry of Defence. From 2014-16 and from 2002-2010, he was a Professor and ARC Federation Fellow at the University of Sydney. From 2010-2014, he was CEO of National ICT Australia (NICTA), and from 1995-2010 Director of the ARC Centre of Excellence for Autonomous Systems and of the Australian Centre for Field Robotics (ACFR).

Hugh is a world-leading authority on machine learning and robotics, and its application in areas including cargo handling, mining and defence. He has published over 300 research papers, graduated over 70 PhD students, and has won numerous awards and prizes for his work, including being named 2010 NSW Scientist of the Year.

In his career he has worked with many major companies, has co-founded three successful start-up companies, and has won many awards including being named 2008 Engineers Australia NSW Engineer of the Year. He is particularly well known for his work with Patrick in delivering the automated container terminals in Brisbane and Port Botany, and for his work with Rio Tinto in pioneering the automated “Mine of the Future”. He is an honorary Fellow of Engineers Australia (HonFIEAus), a Fellow of the IEEE (FIEEE), Fellow of the Australian Academy of Technological Sciences and Engineering (FTSE), Fellow of the Australian Academy of Science (FAA), and a Fellow of the Royal Society of London (FRS).

Dr. Jim Bentley is Chief Executive Officer - Water (Deputy Secretary) at the Department of Planning, Industry and Environment (DPIE). Jim has 25 years’ leadership experience in the infrastructure sector. Having started his career with Thames Water in the UK, he progressed to be Regional Director for their Middle East business, based in Istanbul. During his time in Turkey he led the company’s response to a major earthquake which killed 15000 people in the city where he was responsible for the water supply system and oversaw business in Egypt, the UAE and Saudi Arabia. Having returned to the UK in 2002 Jim became Chairman and CEO of Thames Water’s 500 employee Spanish business trading in a number of European countries. After 12 years Jim left the Thames Group and shortly afterwards spent 10 years in New Zealand, undertaking roles including CEO of Auckland City’s water utility, Director of the Centre for Infrastructure Research at the University of Auckland and CEO of infrastructure consultancy firm Synergine Group.

Jim moved to Australia in 2016 and spent three years as Managing Director of the State Owned Corporation, Hunter Water and has recently been appointed CEO – Water for the NSW Government. Jim holds a BSc (Hons) and PhD in Chemical Engineering from Loughborough University in the UK, is a Visiting Professor at University College London and is a conjoint Professor of Practice at Newcastle Business School in NSW.

Dr. Ian Oppermann is the NSW Government’s Chief Data Scientist and CEO of the NSW Data Analytics Centre. Ian has 25 years’ experience in the ICT sector and, has led organizations with more than 300 people, delivering products and outcomes that have impacted hundreds of millions of people globally. He has held senior management roles in Europe and Australia as Director for Radio Access Performance at Nokia, Global Head of Sales Partnering (network software) at Nokia Siemens Networks, and then Divisional Chief and Flagship Director at CSIRO.

Ian is considered a thought leader in the area of the Digital Economy and is a regular speaker on “Big Data”, broadband enabled services and the impact of technology on society. He has contributed to 6 books and co-authored more than 120 papers which have been cited more than 3500 times.

Panel Speakers

Helen Liossis is the Head of Corporate Strategy and Business Planning at Sydney Water. Helen is an experienced senior executive with a background in strategy, investor relations, corporate communication and Corporate Services in both the public and private sectors. Helen's most recent roles have involved leading large government agencies as a Chief Operations Officer, managing strategy and policy, corporate services, customer services, the program management office, ICT and procurement functions. In her current role, Helen manages the Corporate Strategy, City Shaping, Policy, Strategic Analytics, Science, Research and Innovation and Business Planning functions. Data, insights and innovation forms a large part of her work at Sydney Water. Helen joined Sydney Water as Head of Corporate Strategy and Business Planning in 2017. Previous roles include, Director Customer and Corporate at Willoughby City Council, Deputy Chief Executive, Strategy, Performance and Services at the NSW Office of Environment and Heritage, First Assistant Secretary and Corporate services at the Department of Prime Minister and Cabinet and Group Strategy Manager at Telstra. Helen has also been involved in senior executive roles at Mirvac, Babcock & Brown Infrastructure and Coca-Cola Amatil. Helen has a Bachelor of Business, is a Certified Practising Accountant, has an MBA from the Macquarie Graduate School of Management and is a GAICD.

Problem Statement:

Sydney Water is combining our scientific expertise, operational knowledge and customer understanding, with data to deliver evidence-based decisions - from operations to policy to plans to strategy. We use data and analytical methods to generate foresight to support a growing, productive, liveable, sustainable and resilient city. Data and analytics enable the business to learn from the past, understand causes and effects, and generate foresights of the future. We strive to understand what drives change, and how they impact our business. Analytics ranges from standard reporting to predictive modelling and forecasting to optimisation. It relies on data, systems, and knowledge. The challenge is to collect the right data, in the right way and analyse it using the most appropriate analytical methodologies. We are working with the NSW government and key agencies such as the Greater Sydney Commission to advocate for the interests of our customers and inform future government services and infrastructure planning. Critical to this is the sharing of data, insights and projections to support interagency planning.

Key focus areas include the delivery of data and analytics to:

- inform decisions and policies to support the long-term water supply-demand balance and infrastructure planning for the Greater Sydney region eg Cross-agency cooperation on planning assumptions through the Common Planning Assumptions Group (CPAG) is a good example of a governed open data arrangement*
- improve our understanding of our customers to provide better services now and in the future*
- enable proactive, targeted management of our networks and operations through 'smarter' operating systems.*
- better understand weather and climate related impacts on our networks and inter-dependencies with others in our supply chain (eg XDI project with NSW Government is looking at climate change impacts across utility networks such as water, energy, transport and telecommunications to better inform a shared approach to climate change adaptation planning).*

Key challenges to achieve delivery include:

- The tension between open data and privacy considerations*
- The importance of data governance as a foundation for sustaining value from data insights (eg single view of truth and change management)*
- The challenges of IoT data in terms of speed and volume*

Georgina Kelly is the Executive Director of Science Division Department of Planning, Industry & Environment. Over the last three decades Georgina has practiced and led science for large, regionally dispersed divisions and programs with a focus on evidence-based decisions in natural resources, climate, agriculture, forestry and mining. Her career has focused on Government environmental management and research agencies, including National Parks and Wildlife Service, the Environment Protection Authority, Sydney Water, Forestry Corporation NSW, and the Department of Primary Industries (Agriculture). Georgina has both a passion for, and expertise in, natural resource research and science leadership. She has been appointed to more than 30 national committees and senior representative roles, and is acknowledged for her broad experience in environmental management, legislation, regulation and policy.

Problem statement:

Responsibilities for water management and regulation span various levels of government and a range of agencies and authorities, and the water industry is a major provider and user of water data. The challenge for both industry and government is to create an operating environment which supports transparent, evidence-based decision making, through appropriate regulation, incentives, guidance and systems that maximise the benefits of sharing data. Two-way exchange of data between government and industry is mutually beneficial. We spend large amounts of time inefficiently assembling data from multiple sources for major assessments. For example, Hunter River Catchment Salinity Assessment (2013) to support a review of Hunter Salinity Trading Scheme required direct access to over 20 industry sources, in addition to accessing data from Sydney Water Corporation, Hunter Water, universities, and various government agencies and authorities. Undoubtedly, relevant additional data remained undiscovered. Development of the Shared Resource for Environmental Data (SEED) has greatly improved data access, although the capturing of all relevant industry data remains a work in progress. However, relatively little of the industry data identified as important by the Chief Scientist and Engineer is yet available via SEED. Open data access and sharing is vital to win the trust of communities and maintain the social license for efficient operation of the water industry.

Better water data access, availability, and sharing would:

- *Assist evidence-based decision making;*
- *Help identify state and trends in water quality and ecosystem health;*
- *Support the development of scientifically justified water quality objectives for areas regions across NSW;*
- *Improve environmental impact detection and assessment;*
- *Assist in the calibration and validation of models used to understand/predict ecosystem response;*
- *Help test assumptions and conclusions made in the absence of scientific data or local area knowledge*

Our overall objective is for publicly funded data collection, and relevant environmental data collected by business, to be accessible for multiple uses. This requires accepted QA/QC protocols, widespread recognition that there are multiple users/uses across government, and discoverability.

Vanessa O’Keefe is the A/Executive Director Policy Planning & Sciences at Water Group in DPIE. Vanessa has been intimately involved in water policy and planning for 17 years, both in practice as a former senior manager in the (now) NSW Office of Water, and as an independent consultant for the past 7 years. Vanessa held positions as Groundwater Manager, and as Manager Water Planning and Management during the development of the initial 36 water sharing plans in NSW. She was closely involved in the development of the NSW State Groundwater policies, the NSW Water Management Act 2000, and the NSW contribution to the development of the NWI. Since leaving the public sector she has provided advice to Governments in Australia and the Asia-Pacific region on water legislation, governance, and entitlement and management frameworks, for both surface water and groundwater.

Problem Statement:

Our ability to effectively deliver and protect water rights for users and the environment relies on the use of many accurate data sets. These are used directly, or to develop support systems such as models to inform water resource management decisions.

The public and governments are reasonably demanding accountability for water management decisions. Robust auditing, monitoring, evaluation and reporting systems can provide this accountability and transparency, and inform improvements to our water resource management actions. They are critical to answering the questions – did we implement the actions, and did the actions deliver the intended outcomes. To do this, traditional data sets relating to surface water and groundwater dynamics and water use now, need to be supplemented with more complex data on water dependent environmental assets and functions, as well as economic, social, cultural and behavioural data.

In a world of budget constraint, efficiency is a must for data collection and analysis. Both technological solutions, and changes to the way we share data across agencies, across jurisdictions and between the public and private sectors should be a key focus. We should strive for open access, where the quality of data sets is well understood by end users. This sounds easy in theory, but making it happen will be a challenge. Let’s talk about how we do that.

Kaia Hodge is the Director Regulatory Innovation Natural Resources Access Regulator, Department of Planning, Industry and Environment. Kaia Hodge was appointed Director Regulatory Innovation, NSW Natural Resources Access Regulator (NRAR) in April 2018, two weeks before NRAR commenced operations. Kaia leads the development and implementation of the regulatory framework for NRAR, designing strategic compliance programs, and developing organisational capability in data analytics, technology and remote sensing.

Prior to joining NRAR, Kaia held executive and senior management roles in Sydney Water, leading long term strategy and organisational change programs, and business units responsible for urban planning and development, stormwater and waterway management, energy, sustainability, research, and environmental management.

Problem statement:

We are at a unique point in time for management of water resources across NSW, the MDB and Australia. Whilst information in the public domain is being used in sophisticated ways to help us plan, operate and regulate water use, there are also strong public expectations that the information we collect and create will be made available to water users, communities, and the public - fostering transparency and accountability for water management actions, decisions and outcomes.

Rapid technological advances and increased public availability of satellite, GIS and climate data have enabled independent monitoring and audit of metered water usage against satellite estimates of water take. This can now be done at an individual property scale, simultaneously for the whole of the Murray Darling Basin.

Similarly, the roll out of new metering requirements across NSW will enable collection of high quality daily telemetry data on metered water usage in near-real time. Such detail and availability is unprecedented.

The challenge facing water management in NSW and the MDB is not with the application of sophisticated sensor technologies to water management. Instead, the challenge lies with integrating this new information with legacy water licensing, accounting and modelling systems, databases and workflows for both surface water and groundwater resources.

In NSW, these key legacy databases and systems are split across three separate water management agencies (WaterNSW, DPIE Water and NRAR). This poses additional complexity for data access and integration, availability, and sharing. Issues with data integrity and completeness constrain the usefulness of critical legacy data, driving

the need for inefficient workarounds, manual re-entry and 'cobbled together' analytical tools. Much of this data is not effectively spatially enabled. Surface and ground water information is managed through separate systems, and indeed, surface water and groundwater are managed largely as separate resources despite acknowledged high levels of connectivity.

Dr Anthony Clark is leader of the Climate Applications and Digital Agriculture team, part of the Climate Branch in the NSW Department of Primary Industries. His team currently operates the state-wide drought monitoring system supporting DPI's response to the current drought event. They also have a portfolio of digital projects, Climate Smart Pilots, including in field telemetry innovations, sensor development and deployment, as well as cloud-based analytics. Anthony brings over 25 years of experience in climate, water and agricultural monitoring, analysis and forecasting, having worked in Australia, New Zealand and the United States on applied soil moisture, weather and production monitoring systems.

Problem statement:

A future vision is that Australian water resource managers and markets are supported with transparent, accurate, comprehensive and integrated information about the current status, forecast situation and long-term risk of the water resource supply and demand. This should support not only better quality near real time decisions but also longer-term planning and investment decision making. The current drought event and the prospect of a changing climate only brings this challenge into sharper focus. Significant progress has and is being made in this area, but there is room for improvement by acceleration of viable solutions. Key barriers are diverse and complex, ranging from attitude to change, conflict fatigue, capability gaps, through to frameworks around data governance and security in the context of water markets. The fundamental technology platforms to significantly improve water resource monitoring, in terms of comprehensiveness and resolution, is pretty much here now and a functional technology mix should mature quickly in the short term. Making this count, in terms of following through to attaining potential management improvements, I see as a more profound challenge. How do we achieve this with minimal lead time, minimal cost impact for irrigators and risk to Government?

Ed Couriel is the Director of NSW Government's Manly Hydraulics Laboratory (MHL), which sits within the Water Division of the Department of Planning, Industry and Environment (DPIE). He has over thirty years' experience in water engineering, including physical and numerical modelling of water and wastewater systems, catchments, rivers, estuaries and oceans, including ocean outfalls and extensive involvement in coastal engineering, coastal zone management and master planning. Ed is a Fellow of Engineers Australia and has held senior positions responsible for large multi-disciplinary teams in both private and public enterprises, including RCI Industries, NSW Public Works Department, University of NSW Water Research Laboratory, Australian Water Technologies / Sydney Water, GHD and MHL. In 2012/13, Ed convened Engineers Australia's Coasts & Ports Conference in Sydney, and he is presently Chair of Engineers Australia's National Committee on Coastal and Ocean Engineering, a member of Engineers Australia's Civil College Board and co-convenor for the International Conference on Coastal Engineering to be held in Sydney, 2020. Ed has received several professional awards, including the Kevin Stark Award for Excellence in Coastal Engineering (1995), Engineers Australia Excellence Awards for the Environment and Ocean Outfall Studies and he was recently honoured by the Departmental Secretary's leadership award (2017). With the team at MHL, Ed is focused on developing coastal and water system solutions that maximise public value through planned adaptation to climate change to achieve significant cost savings by avoiding unnecessary overdesign inherent in many conventional design approaches.

Problem Statement:

Climate Change must be considered in design and operations, but how do we avoid unnecessary overdesign or catastrophic under-design of infrastructure and water systems management? Professional engineers and scientists have recognised the need to design for climate change since at least the early 1990's with release of National Guidelines that led Engineers Australia to adopt a Climate Change Policy since 2014 to avoid professional negligence claims. More recently, major financial institutions (the big multinational lending institutions led by their actuaries) and company Directors (led by the World Economic Forum Global Risks Report) cannot ignore Climate Change risks in their investment and management decisions. Given the remaining uncertainties in future climate projections, and given the need to act now, many conventional engineering and management approaches unwittingly can lead to misuse of limited public funds and valuable natural resources through potentially unnecessary overdesign or worse still, under-design by Climate Change ignorance.

A risk based and adaptive approach is now widely recognised as the way to go. But what does this actually mean, and how do we implement such a paradoxical approach. That is, what should we do now to ensure streamlined and affordable future actions?

This can be achieved if we design for current conditions and evaluate the consequences of future climate projections. Can these be tolerated / accommodated and at what cost, is there a clear future path to adapt (protect / renovate) or will we need to retreat (substitute / abandon). Each of these adaptation options has a decision tree associated with different benefits and costs that are activated by different future climate projections. A seawall designed to be over-topped by waves and future sea levels that leads to tolerable damage in it's leeward side need not be elevated now to a future sea level projection. Its design should include provision for future raising and should define clear serviceability and/or maintenance impacts that trigger future adaptation that is built into today's design. There are many examples but it is important to note that each will be situationally different based on triple bottom line considerations.

Impacts of over-design are not only financial (typically x2 to x4 the cost) but also social and ecological with reduced serviceability, access and aesthetic appeal via increased size and footprint... impacts of under-design often lead to failure with x10 to x30 cost and other major social and ecological impacts.

Nick Milton is a technology specialist with the Natural Resource Access Regulator. He collaborates with partner agencies across NSW and QLD, and with technology partners to implement metering reforms, influence IT strategy, and to plug into emerging technologies to assist metering monitoring and enforcement. Nick has expertise in hydrometrics, metering, telemetry, process control, water systems data management and remote piloted aircraft systems. Nick started with the Department of Water Resources as an instrument hydrographer, designing instrumentation systems for water quality monitoring, streamflow & storage monitoring, weather stations, dam failure early warning alert systems, and the challenging area of dam and weir automation. He pioneered the use of mobile data telemetry networks for hydrometrics in NSW and introduced the first accredited AS/ANZ ISO9001 business quality system for Department of Land and Water Conservation. Nick delivered and ran a five year strategic business plan for State Water Corporation before moving to private industry as a services manager, project manager and systems integration consultant. In his spare time Nick is a general aviation pilot.

Problem statement:

We have seen unprecedented innovation in field instrumentation and remote sensing technologies in recent decades. Yesterday's stand-alone handcrafted instrument designs have given way to low cost, reliable, adaptable integrated solutions.

There have also been impressive advances in the range of business intelligence tools, which turn data into information into the knowledge businesses needs to make the right decisions at the right time.

The weak link is access to reliable, secure, proven and affordable telemetry to connect field assets spread across NSW to these business intelligence solutions.

- *Satellite telemetry is available but costly and power hungry*
- *Mobile networks are more affordable but lack universal coverage*
- *Low earth orbit satellite solutions are cheap but tend to be 'one-way' communication*
- *Emerging Internet of Things (IoT) low power radio networks work well in urban areas*
- *Licensed terrestrial data radios work well for high value assets including dams and weirs*

Problem – the NSW Government has a mandate to monitor water extraction compliance across NSW. To be effective we need awareness of extraction behaviours as they occur, not after the fact. This can only be achieved by access to reliable, secure, proven and affordable telemetry to connect field assets spread across NSW.

Xavier Martin has a comprehensive and successful involvement in agri-business management and investment, with a track record over more than two decades in leadership, problem solving and strategic planning across economic, environmental and social issues. Having spent most of his work career involved in community awareness, communication, consultation and leadership. Xavier's areas of interest are and demonstrably have been in land management and environmental capability, service and infrastructure requirements, economic development, marketing structures, R&D, business and risk management. Whilst being actively involved as a family farmer and grain grower, he has, among other roles, also been employed as a project engineer in the Middle East and Asia, served as a Director of public [AWB Ltd, PHA Ltd] and private companies and led change across the Australian biosecurity continuum. Xavier has been a participant and leader in important and complex change processes for particular organisations and their interested community's. Additionally, he has actively sought a close involvement in ensuring both good stewardship within these organisations and ensuring that substantive change decisions were well consulted through their broader stakeholder group.

Problem statement:

Surface and underground water monitoring that is accurate and consistent, coupled with real-time data recording/telemetry is important for managing water in both the regulated and unregulated system and on farm. NSW Farmers is supportive of the Water Reform Action Plan and the principle of 'no meter, no pump' to ensure that all water take is measured accurately. However, we are uncertain of the supply and availability of pattern approved meters and data logger/telemetry equipment given the impending implementation timeframes. Additionally, the requirement to have these meters calibrated in-field without many irrigators having a water allocation means that it is unlikely that many water users will be compliant by the implementation timeframe. Further work need to be conducted to ensure that meters that irrigators currently have installed meet the metering standards; we would also like to see the Government cover the cost of the cost of calibrating water meters. NSW Farmers is also calling for increased investment by the NSW Government into automated quality and quantity monitoring of surface water and ground water. Accurate data is essential to the functional implementation of the MDBP, and most importantly, crucial to the development of adaptive responses to drought. We would also like NSW to commit to funding for water quality and water quantity monitoring to inform adaptive management strategies to drought.



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