QUEENSLAND WATER MODELLING NETWORK

Research, Development and Innovation Strategy
2021-2024

Queensland
Government

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Introduction

Water models help make informed decisions that reflect current understanding of the complicated natural and socio-economic systems driving water quality and availability for communities and the environment. They help build shared understanding of complex issues and develop joint solutions. Models need to be inclusive of the needs of communities, as well as ecosystems, from wetlands to offshore reefs, to be a valid representation of reality and help guide change. Ongoing research, development and extension efforts are needed to ensure models incorporate new knowledge and engage with those affected by decisions informed by models. The best model is one that captures the key elements of a complex system and provides a cross-section of stakeholders with quantitative information for robust decision-making.

The first Queensland Water Modelling (QWMN) Research, Development and Innovation (RDI) Strategy 2018-2020 (the 2018-2020 Strategy) identified priority research topics, regions and models. It delivered significant impact ranging from foundational reviews of climate change and wetland hydrology water models, to the effect of rising water temperatures on fish survival and streambank modelling. It also leveraged considerable co-investment from government, industry and research organisations.

This 2021-2024 Research, Development and Innovation (RDI) Strategy (2021-2024 RDI Strategy) reflects the results of stakeholder consultation undertaken throughout 2021. Consultation found good support for the work undertaken as part of the 2018-2020 RDI Strategy, and that many priorities remained relevant and should continue as priorities in the 2021-2024 RDI Strategy. The consultation also highlighted the need to specifically focus on ways to build trust and confidence in both water model outputs and the work modellers do (i.e. developing, running and validating models using real field data and making available model outputs for decision makers).

The 2021-2024 RDI Strategy focuses on research topics and regions as the critical lenses to concentrate effort and investment. Unlike the 2018-2020 RDI Strategy, it does not identify priority models, recognising that the choice of modelling platforms will be best decided by considering criteria such as the geographical location and research topic.

The 2021-2024 Strategy identifies four priority topics

Climate change and variability

Landscape rehabilitation and resilience

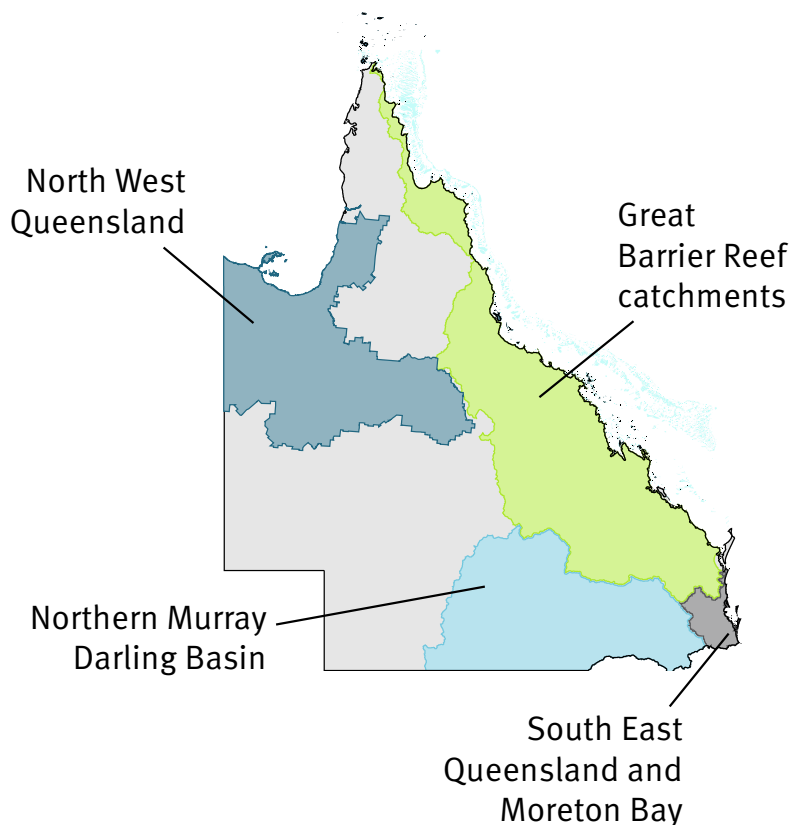**Building trust and confidence**

Model improvement and integration

Each topic is underpinned by priority actions, which will help frame, develop and implement projects. Examples given under the priority actions have been drawn from consultation and should not be seen as exhaustive, but rather indicative of the type of actions.

There are significant inter-relationships between the priority topics and supporting actions. For example, delivering a project focused primarily on climate change actions may also address aspects of the building trust and confidence and model improvement and integration topics, delivering outputs and outcomes across multiple priorities and for multiple stakeholders.

The 2021-2024 Strategy identifies four priority regions which encompass a diversity of landscapes and communities in Queensland

North West Queensland

Great Barrier Reef catchments

Northern Murray Darling Basin

South East Queensland and Moreton Bay

Climate change and variability

Water modelling plays an important role in supporting Queensland's response to the challenges and opportunities associated with a changing and variable climate. The opportunity identified in the 2018-2020 RDI Strategy was to consider the impact of likely climate change scenarios on Queensland's water quality and quantity to inform future policy, planning and management of our assets and environment. A key output of the 2018-2020 RDI Strategy was the Critical Review of Climate Change and Water Modelling in Queensland (Critical Review). The recommendations from the Critical Review remain relevant as a foundation for action.

Priority action 1 – Undertake foundational planning and review to ensure recommendations of the Critical Review are implemented and ensure Queensland's models (current and future) are fit for purpose to inform understanding, planning and management around climate change

Examples include:

- ► Undertake a regular refresh of the science underpinning the Critical Review
- ► Review suitability of current models and datasets to inform future climate change scenarios and identify where new models are needed, especially with respect to mitigation
- ► Expand the Critical Review to evaluate existing water planning schemes' coverage of climate change in water models
- ► Address Critical Review recommendations in the context of particular sectors, and focus on recommendations relating to capability building; accessing and best using data; impacts on water security and quality

Priority action 2 – Develop resources, guidelines and standards to increase the robustness, consistency and confidence in water models used to inform understanding, planning and management around climate change

Examples include:

- ► Develop 'go-to' resource providing access to relevant climate data (data directory/library), methodology guides, guidelines for selecting scenarios/models, case studies
- ► Consider how extreme events can be incorporated across models
- ► Develop a conceptual design for inclusion of paleoclimate scenarios into water resource planning and extending water planning beyond a single 100-year time horizon
- ► Develop a conceptual framework for the application of climate change and/or paleoclimate data and scenarios to water models used in Queensland land-use planning (with case studies in priority regions)

Priority action 3 – Support model development, integration and improvement to ensure models are robust, and fit-for-purpose, in order to inform understanding, planning and management around climate change

Examples include:

- ► Develop models as required based on outcomes of foundational planning and review (above)
- ► Integrate water models with other models and datasets affected by climate change and with models that have elements which can be used to understand how to mitigate the impacts of climate change on water values
- ► Improve understanding of water security and the impacts on and implications for water plan models if stochastic rainfall/streamflow data replaced current datasets

Priority action 4 – Undertake communication and engagement with end users and other stakeholders to ensure models are understood, valued and used appropriately

Examples include:

- ► Develop relatable scenarios for policy makers on climate change impacts on water resources
- ► Carry out QWMN climate change stakeholder engagement e.g., to showcase what actions, understand end-user needs and concerns and increase capability to effectively model climate change and address climate change in models
- ► Increase consultation and collaboration with Bureau of Meteorology on climate change issues e.g., around standardisation, communication resources etc.

Landscape rehabilitation and resilience

Restoring landscapes and building resilience in Queensland is an important field that will benefit from more direct links with water modelling to help guide the design of targeted interventions and assess their effectiveness. There is an opportunity to consider this topic in its broadest context, to include catchments, coastal areas and 'green' infrastructure. Protection of existing landscapes also needs to be considered as a critical component of building landscape resilience under the goal of returning some landscapes to natural, sustainable states. Models should specifically build in a prevention and/or positive response element to ensure these considerations are not lost in understanding options and decision-making.

Priority action 1 – Undertake gap analysis and dependency mapping to understand where key knowledge gaps are and what work is required to underpin future requirements

Examples include:

► Document and benchmark existing tools and undertake gap analysis and capability and dependency mapping to identify critical gaps where the QWMN could engage. This may help broker linkages, including through the development of new models or application of existing models that align with policy and programs (e.g. blue carbon modelling in an estuaries/wetland environments)

► Develop conceptual frameworks that capture what is happening in each landscape at different scales, identify gaps in knowledge or action then develop a work program to address

► Develop models to reflect values and actions to address the gaps associated with missing links in the modelled landscape (e.g., wetlands, floodplains, green infrastructure)

Priority action 2 – Progress model development, integration and improvement to ensure models are robust, and fit-for-purpose, including helping address multi-disciplinary needs of restoration and rehabilitation planning and evaluation

Examples include:

► Facilitate cross-disciplinary collaboration to review and identify how to improve models and their underpinning science (including growing capacity in ecological & water economics)

► Incorporate hydrological, ecological, economic, cultural and social considerations into water models

► Develop a water quality model that reflects sources and transport of adsorbed and in-solution marine pollutants

► Review the impact of riverine vegetation on flooding outcomes and restoration response within models, including estuarine models

Priority action 3 – Develop decision-making tools, data and measurements to underpin robust models, test assumptions and inform end users

Examples include:

► Develop targeted guidelines that clearly articulate what water models can be used for, their applicable scale & locations and why their outputs can (or cannot) support certain decision-making pathways

► Develop baseline measurements informing model-based inputs and assumptions to guide investments in restoration and offsets activities.

► Explore opportunities to address key data gaps e.g., survey Queensland dams while storages are low to confirm if most coarse sediment is deposited before reaching the dam

Priority action 4 – Increase capacity building and investment to ensure access to the water modelling tools and capability needed to support restoration and rehabilitation projects into the future

Examples include:

► Commit upfront to supporting long-term assessment of the effectiveness of restoration interventions, including improving models and perceptions of models

► Explore opportunities to sponsor additional Queensland Government/university postdoctoral researchers following the QWMN Fellowship

► Explore opportunities to shift from empirical erosion models to more process-based models

Building trust and confidence

Water models are often seen as complex and opaque, resulting in misconceptions and a lack of confidence in the outputs and end uses of water models. Building an understanding of, and trust in, water models, needs to be prioritised to address these challenges. There is an opportunity to 'pop the bonnet of water models to provide a greater understanding of the mechanics of the models, their uses and limitations.

Priority action 1 – Develop guidance and communication materials to increase understanding and transparency of models, techniques, uses, and limitations.
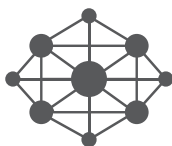
Examples include:

- ► Develop tailored communication products such as animations or videos using accessible language and formats
- ► Develop best practice guidelines (links to other priorities below)
- ► Collaborate with communications specialists including social scientists to design impactful communication resources

Priority action 2 – Foster collaboration between modellers and decision makers to increase mutual understanding of the strengths and constraints of models in addition to their application and use in decision making

Examples include:

- ► Develop, document and use information and guidance material including case studies
- ► Establish and foster broad-based communication platforms
- ► Promote and showcase model improvements via QWMN and beyond
- ► Investigate the establishment of targeted communities of practice e.g., communication of uncertainty, to share case studies and experiences

Model improvement and integration

As interest grows in the broader application of water planning and management data, there is increased need to ensure models are fit-for-purpose. There are opportunities to improve integration across model suites, domains and scales to improve system knowledge and design of management interventions. However, a more complex model may not be more accurate or effective than a less complex one and understanding the uses, benefits and constraints of our water models is very important.

Equally, water models (including input data, methods and techniques) must be robust and able to adapt over time to take full advantage of advances in technology and knowledge. A clear long-term plan is needed for ongoing model development and improvement, including guidelines and standards to underpin best practice and improve community confidence in model outputs and uses.

Priority action 1 – Undertake foundational planning and gap analysis, to develop a targeted and fit-for-purpose program for future model development and improvement

Examples include:

- ► Develop targeted projects that integrate specific scientific knowledge & modelling tools for dedicated purposes
- ► Map out and understand dependencies across areas/models to support appropriate integration
- ► Implement recommendations of QWMN critical reviews e.g. hydrology model review, etc.

Priority action 2 – Develop data and approaches to ensure water models are relevant, effective, and efficient and capitalise on technological developments and consider non-traditional information sources

Examples include:

- ► Identify and develop usage for alternative measurements/data approaches to parameterise and/or calibrate models, e.g., using autonomous data like Water Observations from Space
- ► Identify key data 'pain points' and possible solutions in strategic water models
- ► Explore options to create, populate, maintain and host a centralised data repository
- ► Incorporate Traditional Knowledge into models through co-design and co-development

Priority action 3 – Develop resources, guidelines and standards to ensure water modelling in Queensland is best practice

Examples include:

- ► Develop model integration standards & guidelines to guide future developments
- ► Develop case studies & learnings of where integration has worked well (and why)
- ► Develop best practice guidelines for models and data including management, provenance, governance and minimum data requirements

Priority action 4 – Engage with other strategic collaborators and stakeholders to increase multi-disciplinary outputs and build capacity

Examples include:

- ► Explore collaborations in developing improved decision-support for groundwater modelling and its application
- ► Continue building capacity for model improvement work by specifically engaging with early career researchers and students on model development principles and approaches
- ► Explore opportunities and utility associated with open modelling frameworks to further drive innovation, collaboration and model improvements

Priority action 5 – Explore specific areas for technical development / research to address key information gaps and needs

Examples include:

- ► Explore opportunities to dynamically link groundwater modelling to management, e.g. through a pilot project to appropriately link groundwater and surface water models
- ► Explore opportunities to extend the Queensland regional water supply security assessments
- ► Develop estuarine health models across Queensland with a pilot in a GBR catchment
- ► Develop robust approaches to appropriately integrate urban water models and outputs with other models to support holistic decision making

QWMN Investment Program 2021-2024

Investment approach

QWMN's investment approach is based on collaboration and co-investment to ensure existing and emerging expertise and resources are leveraged. These collaborations can occur in the course of day-to-day business between network partners, and through formal investment by the QWMN (such as the annual RDI tender).

The QWMN applies the Queensland Government's REDS decision rules to guide research and development investment and project selection. These can be found at www.chiefscientist.qld.gov.au/strategy-priorities/decision-rules-for-investment. Details of the criteria applied to decide RDI tenders are made available on the relevant tender webpages.

Ongoing Evaluation

An annual evaluation of progress against the priorities will be undertaken and published. Findings will help inform actions under the 2021-2024 RDI strategy.

Further Information

QWMN projects

Information relating to QWMN projects is available via the website.

QWMN contacts

The QWMN can be contacted via email: QWMN@des.qld.gov.au