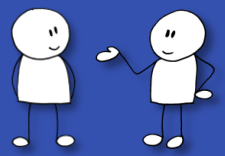
PULSE CHECK OF THE QUEENSLAND WATER MODELLING AND USE SECTOR:

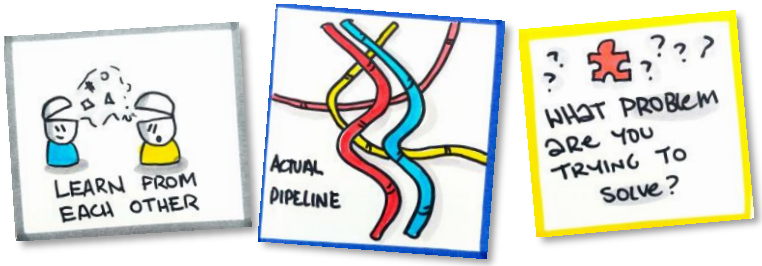
HIGHLIGHTS FROM THE QWMN FORUM 2020



1. Purpose of the Pulse Check

Following the recent Queensland Water Modelling Network (QWMN) 2020 Forum, we are keen to share various highlights or what could also be called a "Pulse Check" of what is a formative group of professionals working in an aspect of water modelling. The purpose of this report is to:

- Observe what does the QWMN look like in terms of participants and what roles do these colleagues undertake along the water modelling pipeline
- Update what was shared at 2020 Forum and how participants responded
- Describe the future focus desired by participants at this Forum – what would they like to see continue that either:
  - the QWMN Research Development and Innovation program could provide or
  - be included as an activity or focus in External Engagement Program or
  - is an activity that another self-leadership role may initiate.

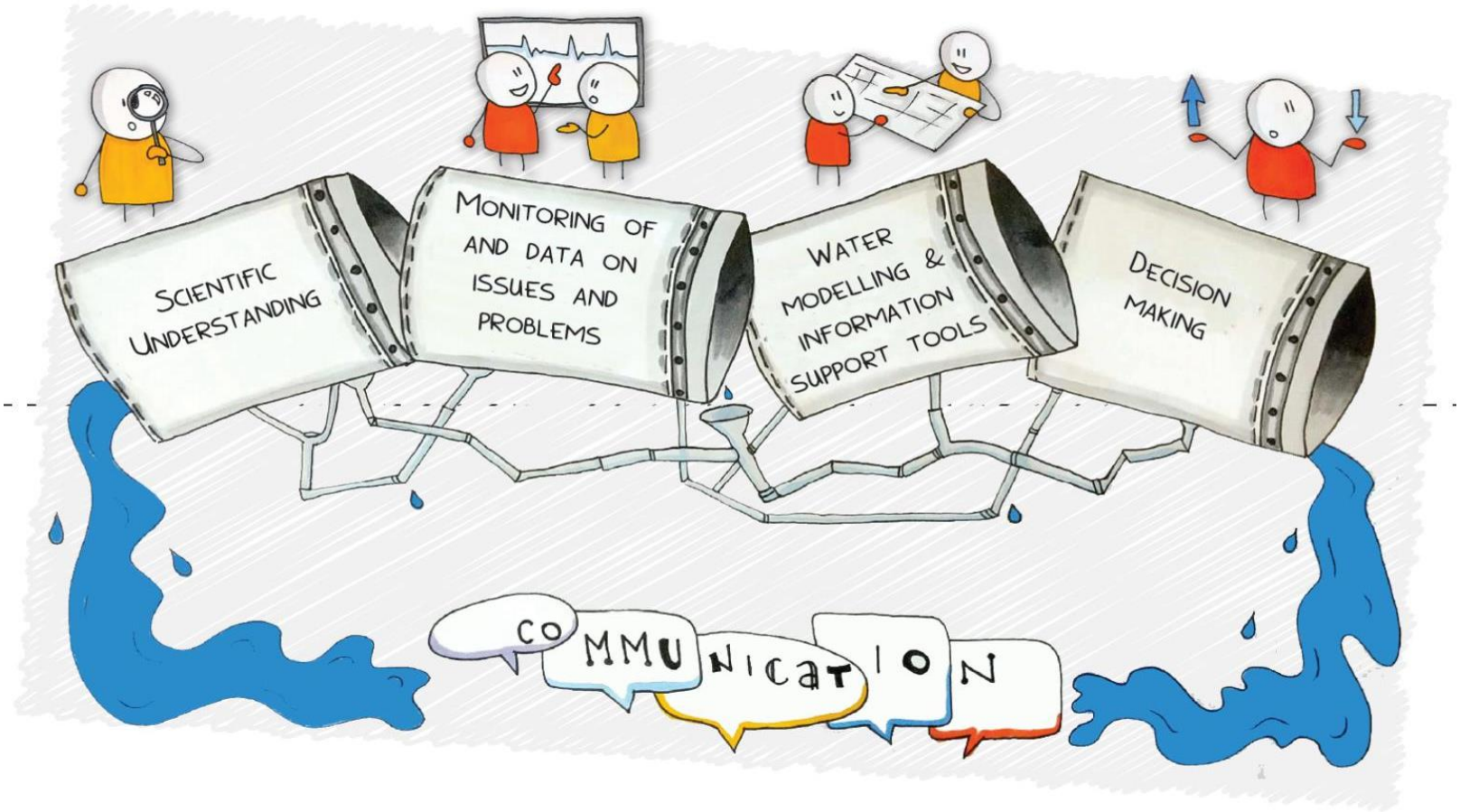


The information sources for the report arise from a range of activity, namely:

- ✓ **Plenary and breakout session material from all the presenters;**
- ✓ **Graphic summaries of the plenary talks and water modelling pipeline from Hayley Langsdorf;**
- ✓ **Event participant profile from the registration details;**
- ✓ **Day 1 workshop small group activity provided information of work areas and water modelling pipeline roles;**
- ✓ **Mentimeter responses were collected from interested participants in all sessions – with varying levels of response;**
- ✓ **Day 2 workshop activity provided a broad mix of future options for QWMN participants**

1.2 Theme

The theme of the Forum was based on a concept that water modelling as a tool to assist decision making, can also be pictured as a “Water Modelling Pipeline”. This Pipeline involves a range of other elements such as science, data and communication.



2. Profile of the colleagues who participate in the QWMN

2.1 At this years Forum, **the breakdown in participants** were:

Organisation type	Proportion of the 137 in attendance (%)	Name of organisation
Private Sector	16	Water Technology, Alluvium Consulting, DHI, Hydronumerics, FloodMapp, Hydrology and Risk Consulting, Calibre, Water Modelling Solutions, Volders Environmental Consulting, CDM Smith, Truii, Hydrobiology, BMT
Research	26	CSIRO, Griffith University, University of Southern QLD, CRC Water Sensitive Cities, Australian National University, University of Queensland, Nanjing University Yixing Environmental Research Institute, QUT
Local Government	5	Bundaberg Regional Council, City of Gold Coast, Sunshine Coast Council, Brisbane City Council
State Government	19	Manly Hydraulics Laboratory (NSW), DNRME, DES, Office of the Chief Scientist
Federal Government	3	Bureau of Meteorology
NRM	1	Healthy Land and Water, Southern Queensland Landscapes
Water Utility	10	Seqwater, Sunwater, Urban Utilities
Education	20	International Water Centre, James Cook University, University of Queensland, University of Southern QLD, QUT, Griffith University, Hohai University (China), Konstanz Universität (Germany)

2.2 Water Interest Areas

Some of the **water interest areas**, clustered under 3 theme areas used at the Forum, in which the participants were active with modelling pipeline related roles include:

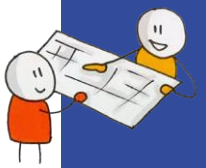
Forum themes	Water interest areas
Water Security	Water quality, Water supply reservoirs, Bulk water supply, Climate change impacts on bulk water, Dam - failure impact assessment, Groundwater, Reservoirs, Water availability, Water balance, Water balance for surface and groundwater, Water demand, Water resource planning, Water security infrastructure
Urban water and liveability	Performance or urban lakes, Demand protection, Drainage issues, Flooding, Heat and land surface temperature, Industry development, Integrate urban water systems with an overall urban system, Landfill gas remediation, Liveability and sustainability of cities, Reactor design, Reduce GHG emissions, Server networks, Stormwater capital works, Urban design options (water/energy efficiency/GHG performance/costs), Urban development, Urban impacts of change in hydrology, Urban water security, Wastewater, Water network
Landscape restoration	Catchment management, Catchment water quality, Catchments and rivers, Coastlines, Creeks in agricultural catchments, CSG impact assessment, Environmental impacts, Food security, Grazing land management, In-stream nitrogen processes under drought and floods, Lakes, Landholder change impacts on runoff and soil loss, Landscape rehabilitation, Pedotransfer functions, Reduce off site impacts on GBR, Reservoirs, River management scenarios, Save the reef, Smart water management in mining, Water quality

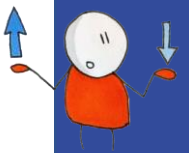
[1] A new term for some is that in soil science, pedotransfer functions (PTF) are predictive functions of certain soil properties using data from soil surveys.

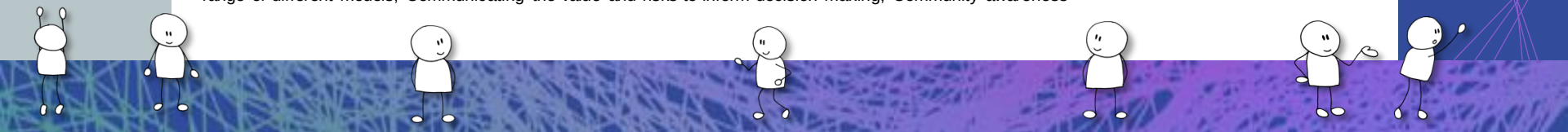
2.3 Roles and Responsibilities

The types of working **roles and responsibilities of participants**, expressed as an activity along the water modelling pipeline included:

Pipeline Focus	Various Role of QWMN participants
Science/research	Identify knowledge gaps, Research, Identify key factors to investigate, Scientific report writing, Test and challenge the science, Collect empirical data, Facilitate engagement of researchers in the pipeline, Quantitative literature review
Data collection and management	Understand trends, Data collection, Monitoring, Data management, Data manipulation, GIS analysis, Digital soil monitoring, Soil surveys, Aggregate real-time rainfall and river gauge data, Data visualization, Climate data and resources, Resourcing inputs to models, Affordable sensors and interfaces for interacting with them, Data utilizations, Decision for data collection and monitoring program
Modelling	Monitoring and evaluation, Open-source numerical platform development, Prediction, Forecasting, Risk assessment , Validation, Fine-scale process understanding, Improvement of quality and efficiency, Optimization, Key factors to influence, Optimize NRM investment, Use machine learning, Model improvement network, Options analysis, Coordinate modelling to support water planning, Pose policy water questions for modelers, Support design and outcomes, Construction of modelling software, Construction of modelling platforms, Optimization of water resource values, Risk identification, 3d models, Impact assessment, Isolating impacts, Predicting future hydrological changes, Consequence analysis, Resourcing inputs to models, Sensitivity and uncertainty analysis for water quality monitoring, Model setup, Model calibration and evaluation
Decision making	Strategic gaps, Medium term planning, long term planning, Collaborative solutions, Seek funding, Knowledge transfer of results into policy, planning, models, Decision support systems, Operations, Conceptual frameworks, Investment, Utility for end users, Allocate right resources for projects, Uncertainty-testing and risk appetite, Develop the vision for moving along the spectrum from conceptual to implementation of solutions, Policy direction, Priority actions, Capex decision making, Integrated planning, Setting up operational frameworks to facilitate "the pipeline", Economic modelling and understanding' Planning assumptions, Infrastructure plan, LGIP, Enhance data-driven decision-making
Communication	Communication of results, Inform decision makers, Interpretation of modelling outcome to influence strategic decision-making, Technical advice for regulatory decisions, Meeting needs of stakeholders, Engage community and stakeholders, Translating new science into applications, Communication and engagement with stakeholders, Needs analysis/identification, Trust and social license, Coordinate across stakeholders to ensure confidence in modelling, Helping clients and stakeholders to understand model results from a range of different models, Communicating the value and risks to inform decision-making, Community awareness







3. 2020 Forum

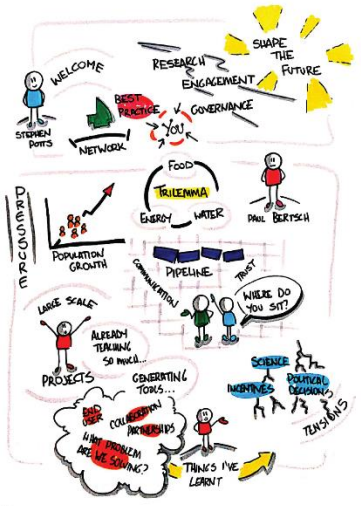
As mentioned earlier, the concept of a water modelling pipeline was used as a central theme for the Forum and that application of the concept is well embedded in the mix of presentations - https://watermodelling.org/resources/qwmn-forum-2020-presentations.

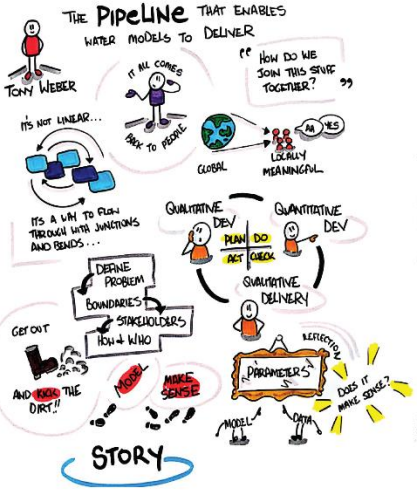
Presentations

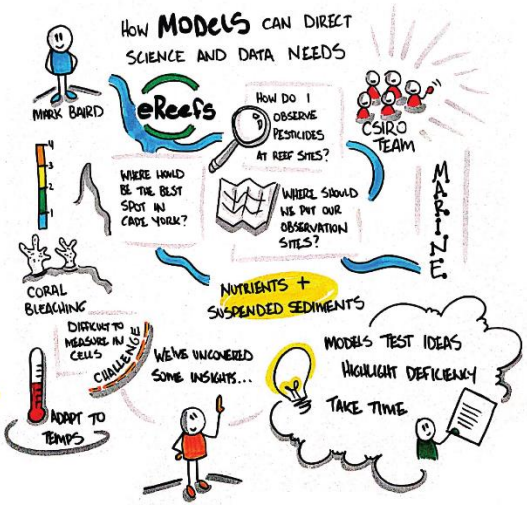
The plenary presentations all explored different aspects of the water modelling pipeline and the Panel session at the end of Day 1 looked at personal experiences and the importance with communication in this water modelling context. In addition, the last plenary presentation from the QWMN DES team highlighted the role of the QWMN program to continue to foster the application, innovation and capacity building needs of water modelling in Queensland.

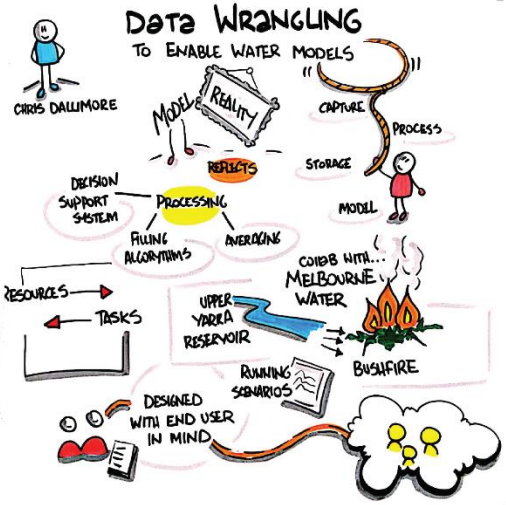
The merged drawing summaries of each of the plenary presentations – presented below - gives a snapshot of the highlights.

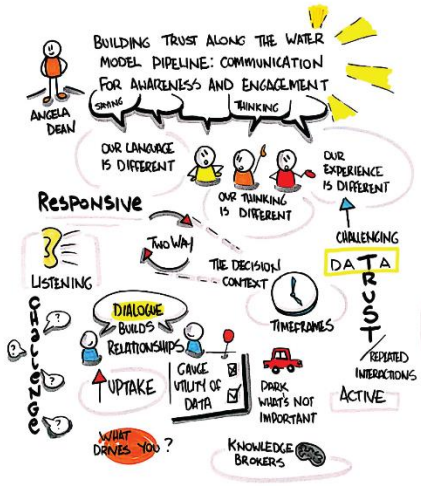
QWMN FORUM 2020

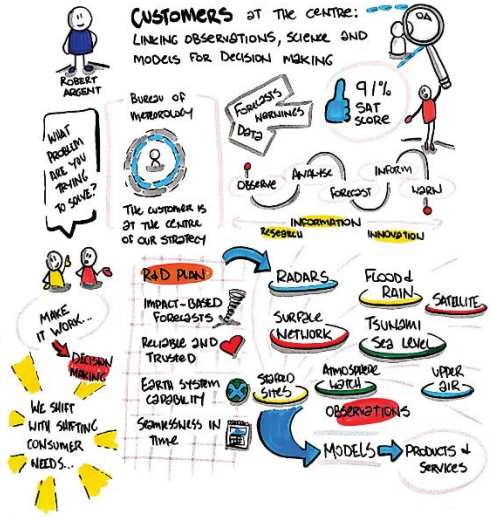












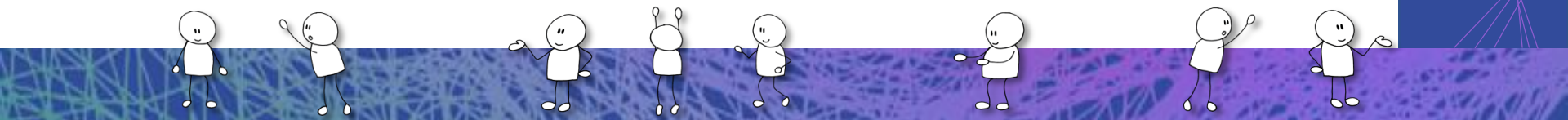
THOUGHTS DRAWN OUT

#qwmn2020

3.2 Mentimeter comments

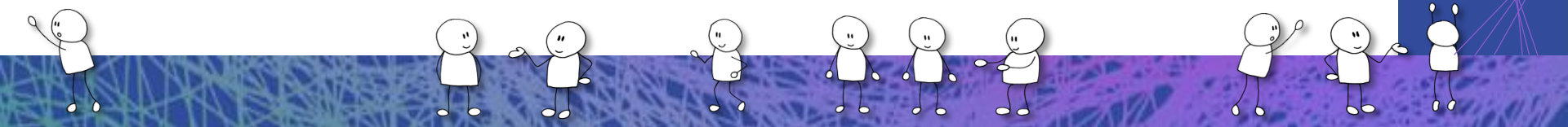
Responses from participants to various highlights and the implications for the various presentations – collected through the Mentimeter survey

Plenary Speaker or Joint Session	Mentimeter comments	Plenary Speaker or Joint Session	Mentimeter comments
Tony Weber The pipeline that enables water models to deliver		Mark Baird How models can direct science and data needs	
Water Security 1 Emma O'Neill and Sanjeev Pandey		Water Security 2 Dejan Subaric and David Putland	
Urban Water Liveability 1 Anna Hollingsworth and Steven Kenway		Urban Water Liveability 2 Juliette Murphy and Jacqui Willcocks	
Landscape Restoration 1 Lucy Richardson and Melanie Roberts		Panel discussion on communication	
Chris Dallimore Data wrangling to enable water models		Angela Dean Building trust along the water model pipeline	
Robert Argent Customers at the centre: Linking observations, science and models for decision making		Jean Erbacher & Stephen Potts Water Modelling Sector Advancements in Queensland	
Future Issues 1 Zhiguo Yuan and Time Malthus		Future issue 3 Rohan Eccles and Tony McAlister/Alister Daly	



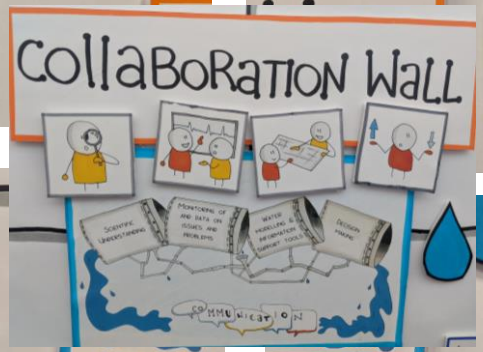
Mentimeter comments continued

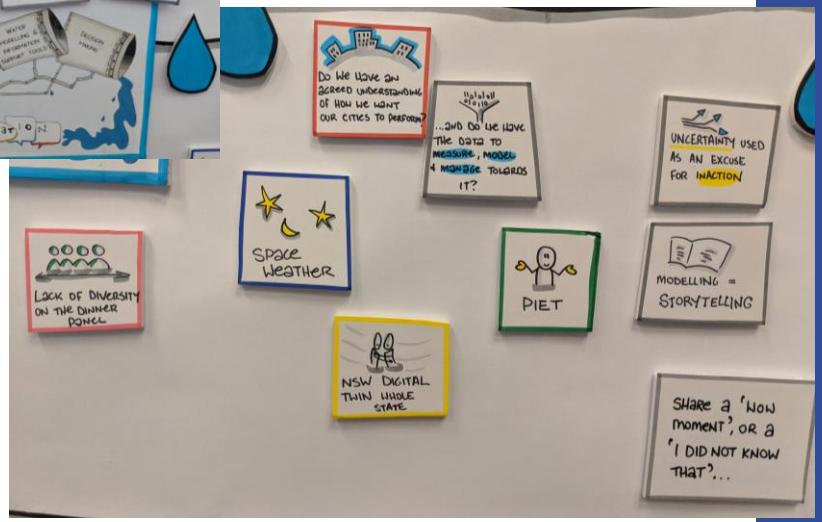
Enabling Models 1 Steve Skull and David Wiskar		Enabling Models 2 Ed Couriel and Chantal Donnelly	
Enabling Models 3 Paul Maxwell and Graham Webb		Demonstration on data wrangling Nick Marsh	



3.3 Collaboration Wall

Throughout the two days participants contributed to the collaboration wall, with responses invited to four key questions.





4. Themes of future activity for the QWMN

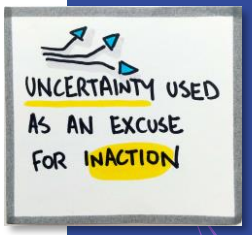
Sixty plus participants at the end of day 2 shared their ideas and views on where the QWMN can focus in the next 10 years. The material they developed are presented as (i) specific themes for focus and (ii) enabling actions that can underpin the first set of suggestions.

Specific themes for focus were:

1) An expanded focus on the application of **climate change and variability**
2) A focus on management of **groundwater**
3) Initiate a mix of that support to enhance the **ongoing use** of Queensland water models
4) Build a collective effort of **model development** based on:
   a. *Process issues along the water modelling pipeline*
   b. *Topic issues along the water modelling pipeline*
5) **Enhance the water modelling pipeline** – this is a broad mix of issues some of which will compliment both the ongoing and development of models' opportunities
6) Consider aspects of **uncertainty**
7) Consider aspects of **social sciences**
8) Look at ways that **decision making** is implemented in relation to water modelling outputs
9) Consider how indigenous knowledge and information can be linked with a water modelling pipeline

Enabling actions to underpin implementation of the specific themes:

1) Have a targeted **engagement with students and young water professionals**
2) Enhance **collaboration among professionals and organisations** through current and future QWMN activities
3) Consider **communication** needs of water modelling
4) Develop or promote **guidelines**
5) Develop or promote **standards for data management**
6) Promote **knowledge sharing** topics
7) **RDI program** development
8) **Governance** of QWMN programs



The 17 themes are developed from 170 specific suggestions. Not all suggestions are complete, nor are all the participants fully familiar with what may or may nor already be in place. As a result, developing any activity of QWMN activity around these themes, should simply use the specific suggestions as inputs into a further step of refinement and prioritisation on what is most important and feasible.

Specific Suggestions

The expanded list of specific suggestions on the future directions, clustered under the specific topics arising from the QWMN 2020 Forum follow.

An expanded focus on the application of **climate change and variability** including issues such as:

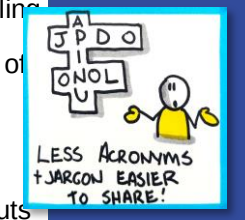
- Continuing focus on climate change & models
- Discuss bottom up meets top down climate change methods
- System response to climate change
- Ecological modelling (aquatic) utility to evaluate impact that climate change scenarios have on species distribution & abundance
- Downscaled climate predictions for water planning
- Linking climate change modelling across the water cycle - breaking down silos
- Climate planning - explore how we can log and track the emerging models & innovation
- Have tools workshops on climate change modelling, scenarios, socio- economic assessments

A focus on management of ***groundwater*** including issues such as:

- Groundwater R&D program up and running through OGA and need to share the learnings and experience so far
- Integration of models for surface water and ground water
- Bring ground water & surface water together in collaborative model development
- More completed regulations and policies for groundwater management

Initiate a mix of that support to enhance the **ongoing use** of Queensland water models by considering:

- Improvements in sharing resources, data, models
- Building a data commons - FAIR (Finable, Accessible, Interoperable, Reusable)
- Make all models and data discoverable
- Multi Criteria Analysis for Catchment Management for Decision Making - setting the criteria & factors
- Water data availability and discoverability
- More emphasis on supporting SEQ catchments modelling
- strategic focus on the known knowledge gaps in some of our models (ie source)
- Getting FAIR data from the community
- Model toolbox - tools available & publicly available inputs
- Metadata base for data sets & who is responsible for them
- Support and encourage documentation of work



Specific Suggestion Continued

Build a collective effort of **model development** based on the consideration of:

a. Process issues along the water modelling pipeline

- Sponsorship of model development
- QWMN could help put together an ARC Transformative hub for modelling practices
- Instagram style platform where QWMN members can # the models/data/skills they have & willing to share
- How do we “communify” model space - eg Hype
- Explore spatial data needs to improve catchment models
- Rapid proto-typing of best available science into models
- Seed funding for collaborative modelling projects
- Open source model collaboration
- A lot of scope for bringing remotely sensed data into water modelling (Cal, Val, Benchmarking)
- Facilitate interoperability opportunities
- Integrated impact modelling
- Model development for robustness together
- new/updated outputs sharing from different projects
- model improvement for robustness
- Look at emerging technologies
- Be more familiar with software - source, music, R, python

a. Topic issues along the water modelling pipeline

- Modelling the Anthropocene - getting human interventions & natural process modelling into single modelling system
- Model scaling from paddock to river basin
- Blue carbon modelling for Moreton Bay
- Linking urban & landscape design with planning outcomes in models
- Frameworks/platforms for connecting and assessing broad WSC concepts/scenarios using detail model output from other models
- Integrated urban/environmental systems/outcomes ie best practice way forward
- Better integration with SEQ models in QWMN - there are reefs in this catchment too
- Positioning water models in broad context - link with economic and social
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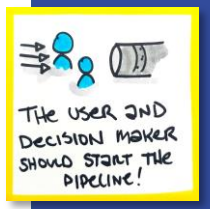
- more sessions on social and economic modelling



Specific Suggestion Continued

Enhance the water modelling pipeline – this is a broad mix of issues some of which will overlap into both the ongoing and development of models opportunities listed above:

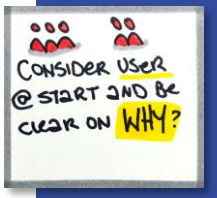
- Futures modelling - how do we bring models together for planning industry & economic development
- General community engagement - partner with local govts to link to on ground work
- Linking to environmental impacts models & planning framework
- Get more professionals to talk about their thought & ideas of the pipeline
- Continued focus on model development & improvement
- Site tour case studies area eg RainBank - who was involved, models used, lessons learnt
- Integration of social science into the model pipeline
- applied research outcomes leading to policy change
- Catchment restoration from drought & flood perspectives and catchment resistance and resilience building
- Expand the research input from just model researchers to researchers who study the key processes
- Sharing data & knowledge between companies and government on issues that effect everyone eg climate change
- Integrating across platforms for holistic understanding
- a big water research practice hub leading to a CRC in 10 years
- Better informed and educated purchaser of modelling output
- linkage of models and improving the science
- more transparency in modelling process
- deliver capacity to meet govt NRM priorities
- What is the best value for investing in modelling pipeline?? Chicken vs Egg
- Community building around research planning & data acquisition planning using models
- Using models in context & Decision Making - eg we used to integrate modelling into planning
- Stronger links between modelling & monitoring

Consider aspects of **uncertainty**, including:

- Capacity building for uncertainty quantification and sensitivity analysis, model & decision stress testing
- Better deal with uncertainty

Consider aspects of social sciences, including:

- Bring in social science dimension - mapping networks of influence and using them for ???????
- Linking the science with social and political outcomes



Specific Suggestion Continued

Look at ways that **decision making** is implemented in relation to water modelling outputs, namely:

- Implementing decision frameworks for dealing with model outputs
- Capacity building for robust & adaptive decision making - eg under climate change
- Linking the state water policies to models - SPP, WQ objectives, Nutrient offsets

Consider how indigenous knowledge and information can be linked with a water modeling pipeline including:

- I would like the QWMN to collaborate more with indigenous communities
- Working out how to facilitate incorporating cultural matters into modelling
- Collaborative projects with First Nations Australians to model cultural significance/knowledge
- Integration of traditional knowledge into models
- Inclusion & linkage of indigenous knowledge in water modelling

Have a targeted **engagement with students and young water professionals** that considers:

- The network looks to increase the number of students involved in model development
- Enhance visibility of water modelling as a profession with undergraduates
- Workshop for students
- Foster capability & engagement of early water professionals
- Network for undergraduate thesis students working on modelling projects
- Greater engagement of younger professionals
- Mentoring scheme
- Resources for technical upskilling for existing & upcoming water professionals
- Involving young people/earlier career people
- A national masters in hydrology
- Increased coding & computation

Enhance **collaboration among professionals and organisations** through current and future QWMN activities, such as:

- Expand, connect, promote communities of practice digitally/online - build on existing networks - share program of events
- Alignment of community of practices across the state
- Online platform for collaboration between researchers - university students
- Building formal interstate or national modelling networks
- Knowledge sharing & collaboration to meet NRM needs
- QWMN could hold specialist workshops in discrete areas

Specific Suggestion Continued

- Strengthen support for model management in other organisations, plus lead by example interstate
- Regional forums/conferences that address issues for regional Qld
- Regional forum outside SEQ
- Additional engagement with regional Qld & issues faced by regional Councils/areas
- Getting more USERS in the Network, Forum & CoP events
- Reports from local governments of collaboration with researchers
- Increased engagement with utilities to understand opportunities
- Workshop sessions with Flood CoP, StormWater Qld & QWMN
- Connect model community & BoM to optimise data availability and quality for modeler needs
- In regional Queensland, start improving water quality at a City level by managing the competing priorities

Consider **communication** needs of water modelling such as

- RDI projects need to build in succinct communications tools about project outcomes/impact at the project scope stage
- A clearer narrative about the co-benefits of modelled interventions
- Workshops on the applications of models and improvements
- improved visualisation for communication
- Advocacy for advancements in science underpinning the models
- Visualisation tools & communication tools to get a shared understanding
- Link modelling & communication expertise to help influence stakeholders - especially climate change impacts
- Presenting and communicating model outputs and visualization techniques (infographics)
- Focus on support for collaboration across sectors & disciplines

Develop or promote **guidelines** relating to:

- Guidance principles around simple vs complex modelling
- Water quality tools (in estuaries) for impact assessment (eg aquaculture)
- Water quality model have an Advisory-Review Panel to look at broader utility - eg Nutrient offsets
- Best practice modelling guidelines
- New technologies - described with data suitability guidelines
- a set of standards - best practice guidelines

Specific Suggestion Continued

- check on the mis-application of models - issue addressed through guideline or standard or endorsement

Develop or promote **standards for data management**

- Guidance principles around simple vs complex modelling
- Water quality tools (in estuaries) for impact assessment (eg aquaculture)
- Water quality model have an Advisory-Review Panel to look at broader utility - eg Nutrient offsets
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- a set of standards - best practice guidelines

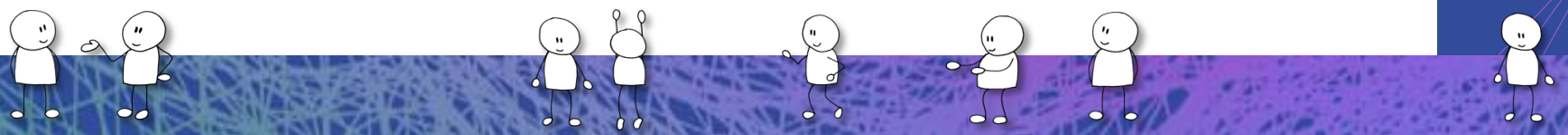
Promote **knowledge sharing** topics suggested include:

- Understanding the role of runoff on better prediction of soil loss
- Understanding of the change in grazing cover in space at different scale
- Understand the effect of cover variation on runoff
- Share the forum presentations

- Bring in the MDBA, connect with other states, to show how they use Qld models in their plans
- Nutrient offset science
- Greater utility of climate change scenarios

RDI program development

- Facilitate modelling gaps identification
- Identify innovation opportunities

Governance of QWMN programs

- Review & expand membership on governance groups - eg Steering QWMN panel to include industry, young water professionals and University