

Hydrology Science Plan – prioritization process and potential future directions

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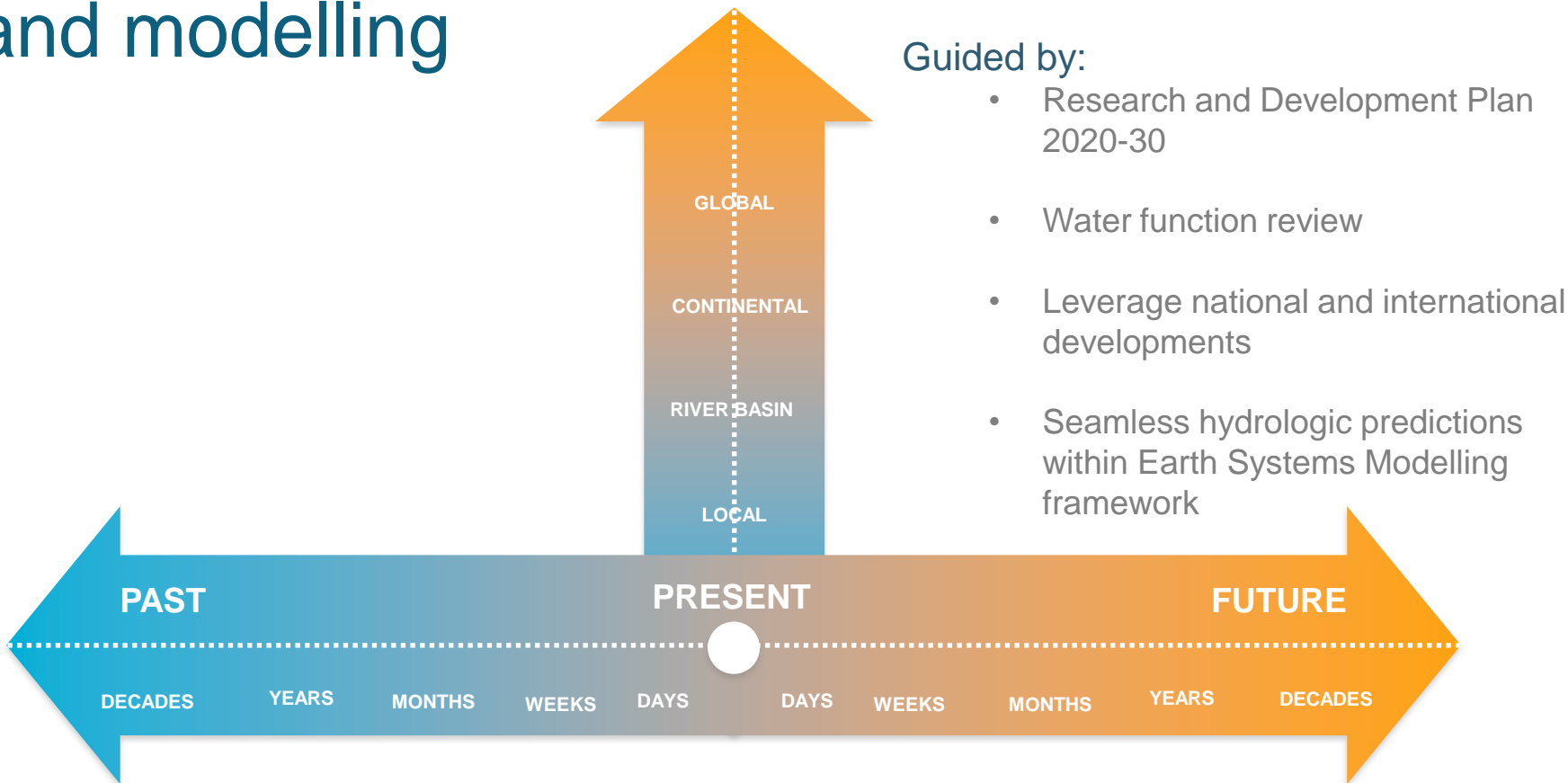


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Acknowledgement

- Business Solutions Group:
 - (Water) Matthew Coulton, Vjekoslav Matic, Habibur Rahman, Sigrid Tijs, Daniel Burton + other sectors
- Research Program Leads
- CSG GMs and Team Leads
- R2O GM and experts
- UK Met Office and CEH
- Notable contributions to-date from:
 - CSIRO (WIRADA)
 - University of Adelaide/Newcastle
 - University of Melbourne
 - UNSW
 - ANU
- MDBA
- WMO – global hydrology initiatives

Establish priorities for hydrological science and modelling



Wide ranging operational water products (25)

Products in blue font require modelling effort

Water information standards: 3 products

- Australian water accounting standards, National industry guidelines for hydrometric modelling, and Water Transfer Data Format

Water data: 10 products

- National Groundwater Information System, Climate Resilient Water Sources, Design Rainfalls, Environmental Monitoring Sites, Groundwater Dependant Ecosystems, Groundwater Explorer, Water Data Online, Water Markets Information, Australian Hydrological Geospatial Fabric, and [Hydrologic Reference Stations](#)

Water Status: 9 products

- [National Water Account](#), Urban National Performance Report, Australian Groundwater Insight, [Regional Water Information](#), [Water in Australia](#), [Monthly water update](#), Water Restrictions, Water Storages, and [Landscape Water Balance](#)

Water Forecasts: 3 products

- [Flood Forecasting and Warning](#), [7-day Streamflow Forecasts](#), and [Seasonal Streamflow Forecasts](#)



Legacy parallel developments in water prediction systems

Water Resource Assessments

Water Resources Assessment Services (supports key modelling needs of the Water Accounting Services)					
Friday, 8 January, 2010					
	2010	2011	2012	2013	2014
Outcome	Best-practice water accounts delivered on schedule	Improved public awareness and knowledge of emerging water issues and opportunities	Improved currency, efficiency and accuracy of published water balances and water accounts	Improved design guidelines for practitioners	Greater public engagement with water balance data generated by the Bureau
Service	Provide estimates for terms to be used in the annual water accounts and assessments	On-line monthly water situation reports for selected catchments and publication of AWR 2010	Automated estimation of water balances for selected areas	Incorporation of revised IFD estimates showing spatial and temporal patterns into AR&R	User selected water balances available on-line
Modelling capability	Near-real-time climate raster data Prototype AWRA modelling system River Manager	Enhanced near-real-time climate raster data Better integration of satellite data into AWRA landscape hydro model Uncertainty estimates (BATEA)	Advanced near-real-time climate raster data Integration of river flow, diversion, interception and ET data into AWRA Workflow automation	Advanced AWRA modelling system e.g. groundwater interaction, regulated systems integration, unregulated use, and full data assimilation	Full AWRA modelling capability including scenario functionality, e.g. land use and burnfire impacts Advanced workflow automation

Page 1

Flood Forecasting

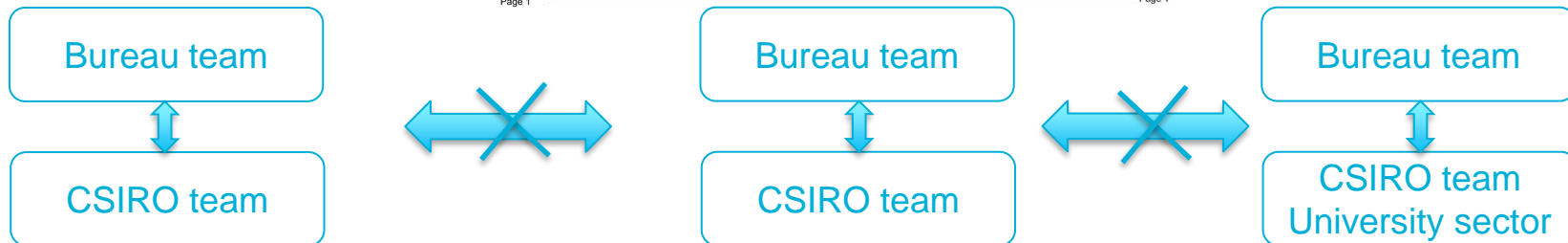
Flood & Short Term Flow Forecasting Services					
Thursday, December 24, 2009					
	2010	2011	2012	2013	2014
Outcomes	Continuous flow forecasting improving flood risk and water management decisions	Objective flood/flow forecast uncertainty information available to decision makers	Improved warnings for high flash flood risks	More flood impact information in high risk areas	Flood risk and water availability (hours to seasons) information available for most locations
Services	Flood forecasting service extended to include pilot short term flow forecasting service	Continuous flow forecasting service consolidated. Products extended using ensemble inputs from ACCESS	Continuous flow forecasting service extended to include flash flood thresholds (ungauged areas)	Real-time flood inundation modelling introduced for high risk areas	Integrated flow forecasting and flood modelling service through AWRS
Modelling capabilities	Semi-distributed catchment (continuous) model operational on FWS Remote sensing inputs (rainfall) Workflow automation, data visualisation, uncertainty estimation, optimisation & forecast verification tools	Ensemble modelling/forecasting FWS supporting continuous flow forecasting with uncertainty. Feeds to River Controller Supporting Management Information System Input data & extraction tool	Remote sensing inputs Model data assimilation (pilot measure) Spatially distributed grid catchment model AWRS integration Integrate with EBP systems	Floodplain hydraulic model AWRS integration Advanced workflow automation and data management	Dynamic modelling capability tested across space-time (hours to seasons) scales coupled to ACCESS Regionalisation methods for ungauged catchments

Page 1

Extended Hydrological Predictions

Hydrological Prediction Services					
Friday, March 12, 2010					
	2010	2011	2012	2013	2014
Outcomes	Forming seasonal predictions for key agency stakeholders	Extending 'seasonal' decisions for many water managers and users	Seamless 'days to seasons' decisions for water managers and users	Improved 'seasonal' decisions for water managers and long-term guidance for key policymakers	Better long-term decisions for policy making and planning
Services	Operational seasonal rainfall predictions for catchments	Operational 'seasonal' water predictions extending from monthly to multi-seasons nationally	Operational water predictions from days to multi-seasons	Operational consensus 'seasonal' water predictions	Operational long-term (10 to 30 years) water availability predictions
Modelling capabilities	FAIR (BUP) generation 2-dimensional NMA outputs Dynamic Modelling System	Enhanced WAFRI Dynamic modelling system, e.g. improved downscaling, ensemble, uncertainty, data visualisation, spatial data, etc. Basic integration with water assessments and accounts	Enhanced dynamic modelling capability, e.g. semi-distributed, unregulated and regulated systems integration Complete AWRS integration	Advanced dynamic modelling capability, e.g. groundwater interaction, unregulated and regulated systems integration Advanced workflow automation ACCESS for 'seasonal'	Dynamic modelling capability coupled to ACCESS and other climate models. Includes climate, land use (e.g. plantations, forest harvesting and burnfire impacts) Integration with water assessments and accounts

Page 1





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The need for rationalising models and modelling systems

- Water status:
 - Australian Water Resource Assessment modelling system AWRA CMS (AWRA-L & -R)
- Flood Forecasting:
 - Hydrological Forecasting System HyFS (URBS)
- 7-day Streamflow Forecasting:
 - Development system PySWIFT, operational system HyFS (SWIFT, CHyPPS)
- Seasonal Streamflow Forecasting:
 - WAFARi modelling system (BJP, BATEA, FoGGS, GR4J)
- Hydrologic Reference Stations:
 - HRS Toolkit (lightweight modelling toolkit with trends)
- Bespoke modelling systems

PST: Water Function Review 2020

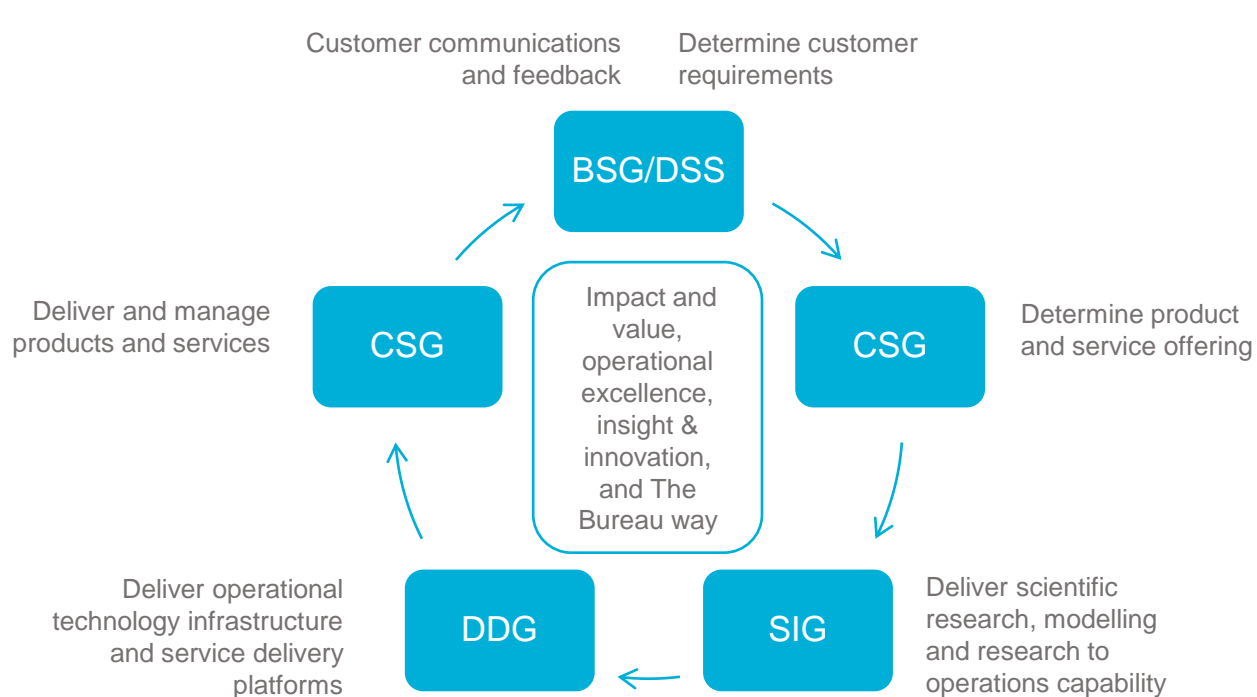
Recommendation 11: Consolidate Bureau hydrological models into two systems to address:

- i. distributed landscape water balance and hydrological modelling at a nationwide and river basin scale using a Numerical Weather Prediction with coupled river and land-surface modelling approach; and
- ii. semi-distributed catchment modelling for flood and short-term streamflow forecasting

Recommendation 12: Establish an independently-chaired, cross-disciplinary team (BSG Water, Research, Research to Operations and Environmental Prediction Services Programs) to:

- i. evaluate the potential for JULES to deliver the distributed landscape water balance and hydrological modelling at a nationwide and river basin scale and
- ii. for SWIFT to provide the capability for semi-distributed catchment modelling for flood and short-term streamflow forecasting.

Research and development, product management and customer engagement value chain



BSG: Business Solutions
(public, emergency services, water, agriculture, energy and resources, maritime and transport, and national security)

CSG: Community Services

SIG: Science and Innovation

DDG: Data and Digital

DSS: Decision Support
Services (Emergency sector)

Water research priorities

Riverine floods

Flood inundation & coastal hydrology

Water availability/demand (0-6 mth)

Bushfire and vegetation impacts

Water quality

Hydrologic projections

Surface water – groundwater links

Drivers

Research and Development Plan 2020-30
Public Services Transformation (Water Function Review)

Hydrologic modelling toolkit

JULES:
continental
scale land
surface model

Hydro-JULES:
next
generation
hydrological
prediction
system

SWIFT: River
basin scale
hydrological
model

Hydrologic
uncertainty,
data
assimilation
and verification

Observations, meteorology research and tech. advances

Satellite data,
meteorology and
hydrology data,
analysis and
post-processing

NWP, sub-
seasonal and
seasonal
forecasts, and
climate change
projections

Next generation
modelling
systems, data
science and
cloud computing

Benefits and impact

Seamless hydrological and land
surface prediction capability

Improved water services – accurate,
reliable and automated

Enhanced public safety from floods

Increased resilience from drought
and water scarcity

Better preparedness from bushfire
hazards

Practical solutions for environment
sustainability

Hydrologic research inputs to water
and climate policy

Valued outcomes for agriculture,
transport, energy and marine sectors



View



Products



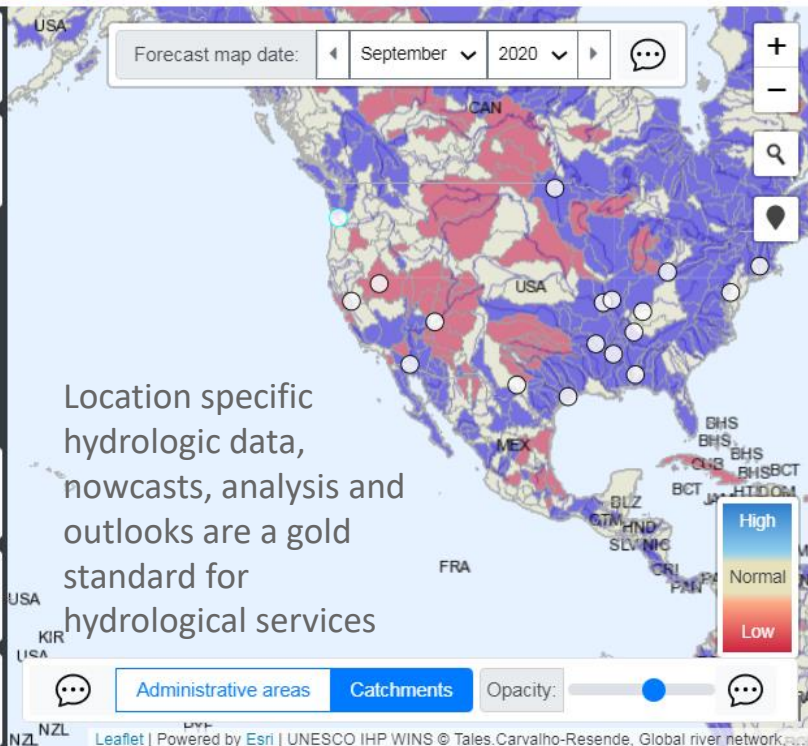
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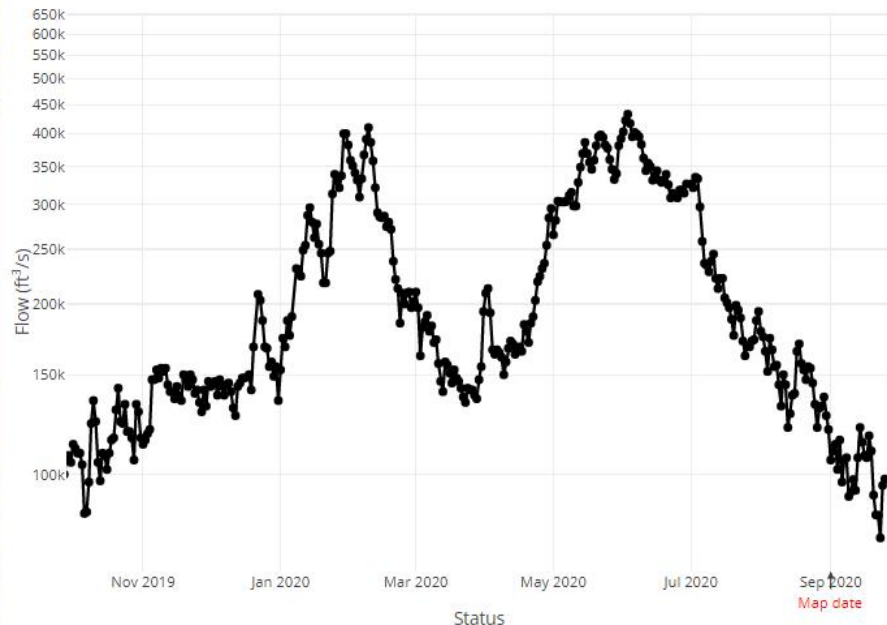
Feedback



Graph type: Values



River flow graph for 14246900 - COLUMBIA RIVER AT PORT WESTWARD, NEAR QUINCY, OR



Strategic partnerships

- UK agencies – Met Office, Centre for Ecology and Hydrology and Flood Forecasting Centre
- CSIRO leveraging developments from 10+ years of research in hydrology
- Australian university sector
- MDBA
- eWater Ltd. (SOURCE)
- WMO hydrology initiatives
- ECMWF hydrologic modelling group

Thank you

Questions?



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