

# **40th Hydrology & Water Resources Symposium 2022**

**The Past, The Present, The Future**

**Brisbane, Australia  
30 November - 2 December 2022**

**Volume 1 of 2**

**ISBN: 978-1-7138-6802-6**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2022) by Engineers Australia  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2023)

For permission requests, please contact Engineers Australia  
at the address below.

Engineers Australia  
Engineering House  
11 National Circuit  
Barton ACT 2600  
Australia

Phone: +61 2 6270 6555  
Fax: +61 2 6273 1488

[www.engineersaustralia.org.au](http://www.engineersaustralia.org.au)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

## TABLE OF CONTENTS

### VOLUME 1

Groundwater Management in Australia July 2022 .....	1
<i>Grahame Campbell</i>	
Energy Losses at Piers in 2D Hydraulic Models: An Adaption to the FHWA Loss Coefficients .....	8
<i>Richard Sharpe</i>	
Coastal Breakthrough Flooding Considerations, a Bribie Island Breakthrough Case Study .....	20
<i>N/A</i>	
Hydrodynamic Instabilities and Wave Motion in Fish-Friendly Box Culverts Equipped with Full-Height Sidewall Baffles.....	33
<i>Jiayue Hu, Youkai Li, Hubert Chanson</i>	
Hydraulics of a Broad-Crested Weir with Rounded Edges: Physical Modelling.....	43
<i>Sunhanut Chaokitka, Hubert Chanson</i>	
Optical Measurements in Dam Spillways During Major Flood Events: A Down-To-Earth Review of Pros and Cons.....	53
<i>Hubert Chanson, Rui Shi</i>	
Hydraulics of Minimum Energy Loss Weir: The Chinchilla MEL Weir During the Nov-Dec 2021 Flood Event .....	64
<i>Colin J. Apelt, Hubert Chanson</i>	
Urban Water Security in Queensland: There is No Substitute for Robust Analysis .....	76
<i>Richard Priman, Craig Gordon</i>	
Urban Water Security in Queensland: Understanding Supply Risks and Uncertainties .....	89
<i>Christopher Lane, Richard Priman, Julie Coysh</i>	
Making Weirs Safer .....	99
<i>A. R. Ladson, N. J. Lawson, R. J. Keller</i>	
A Model for Computing Flood Damage and Protective Measures from Individual Property Damage .....	109
<i>V. S. Bhavnagri</i>	
Changed Climate: Different Drainage – The Future of Urban Drainage .....	119
<i>Alan Rotsey, K. Fletcher, Steven Ly, M. Stovold</i>	
Urban Water Security in Queensland: Expectations of Managing Risk .....	131
<i>Emma Brewis</i>	
Developing an Artificial Intelligence Based Continuous Monthly Stream Flow Forecasting Model.....	138
<i>N/A</i>	
Guidelines for URBS Routing Parameters .....	145
<i>Terry Malone, Don Carroll</i>	
Mesh Modularization Enables Surrogate Modelling for 2D Hydrodynamic Solvers .....	156
<i>Matthew Garcia, Andrew Juan</i>	

Wivenhoe, January 2011: The Dam Truth.....	166
<i>Rob Ayre, Terry Malone, John Ruffini</i>	
Hydrologic Modelling as a Pre-Processor for ARR19 Design Flood Modelling.....	194
<i>Ted Rigby, Anthony Barthelmes</i>	
Assessment of Development Related Impacts on Design Flood Behaviour.....	204
<i>Anthony Barthelmes, Ted Rigby, Alex Kelly</i>	
An Immediate Need to Make Conversations About Disaster Impacts, Not the Probability of Occurrence -Application of Disaster Loss Estimation in Flood Risk Management .....	214
<i>Roozbeh Hasanzadeh Nafari, Luke Sheers</i>	
How Effectively Consider Data Uncertainties During a Hydraulic Model Calibration Process .....	229
<i>Jasmine Lee, Yucen Lu</i>	
An Approximate Method to Determine Climate Change Induced Increases in Flood Peaks .....	239
<i>A. R. Ladson, P. Pedruco</i>	
Long Term Seasonal Rainfall Forecasting Using Artificial Neural Network: Case Study of Northern Territory, Australia.....	247
<i>Rashid Farooq, Fatemeh Mekanik, Monzur Imteaz</i>	
A Case Study on the Interplay Between Numerical and Physical Hydraulic Modelling as Design Tools on Rookwood Weir .....	255
<i>James Apostolidis, Laura Beckingham</i>	
Regional Flood Estimation for Very Frequent Floods Based on Peaks-Over-Threshold Approach: A Case Study for South-East Australia .....	265
<i>Xiao Pan, Ataur Rahman, Khaled Haddad</i>	
Development of Long-Term Inflows for Historic Brisbane Dams .....	277
<i>Cia Musgrove, Maria Greer, John Vitkovsky</i>	
Refined Treatment of Noise and Negatives in Inflows Derived by a Water Balance on Storage .....	288
<i>Katherine Szabo, Michael Finger, Kate Austin</i>	
Catchment Response Times Decrease with Increased Rainfall Intensity .....	298
<i>Martin Jacobs</i>	
Overcoming the Challenges of Managing a Large Scale, Whole of Catchment Hydraulic Modelling Study for Environmental Flow Assessments .....	308
<i>Nick Streeton, Melissa Wells</i>	
What Can Australian Rainfall and Temperature Trends Tell Us About Climate Change (and What Can't They Tell Us)? .....	316
<i>N/A</i>	
Exploring Uncertainty in Predicting Annual Nutrient and Sediment Loads to Port Phillip Bay .....	326
<i>Lydia Cetin, Mark Alcorn, Alison Kemp, Vaughn Greg</i>	
An Integrated Water Resource Model for Townsville's Bulk Water Supply Management.....	337
<i>Tony Sheedy, Lydia Cetin, Joanna Szemis, Kiran Shrestha, Rahul Biswas</i>	
Changes in the Water Partitioning Behavior of Tasmanian Catchments.....	347
<i>P. Pokhrel, A. Rasheed</i>	

LGA Wide Investigation of Residential Inundation and Establishment of Decision-Making Framework in Redland City Council (HWRS 2022).....	353
<i>Rebecca Philipp, Lisa Holden</i>	
Assessing the Potential Impacts of Climate Change on Mining Operations - A Case Study.....	365
<i>Hamideh Kazemi, Leila Ang, Sheena Cheng, Greg Hookey</i>	
Practical Application of CFD for Fish Passage Design .....	376
<i>Kyle Thomson</i>	
Hydraulic Modelling 2D Cell Size Result Convergence – Comparing the Performance of Different Shallow Water Equation Solution Schemes.....	387
<i>Chris Huxley, Bill Syme, Phil Ryan, Greg Collecutt</i>	
Victorian Urban Drainage Manual – Introducing a Much-Needed State-Wide Strategy for Drainage Design.....	399
<i>N/A</i>	
The End of the 1D Open Channel Cross-Section? .....	409
<i>Shuang Gao, Phil Ryan, Bill Syme, Greg Collecutt</i>	
Direct Rainfall Hydraulic Model Validation.....	421
<i>Phil Ryan, Bill Syme, Shuang Gao, Greg Collecutt</i>	
Application of Decision Tree Algorithm for Predicting Monthly Pan Evaporation Rate .....	434
<i>Mustafa Abed, Monzur Imteaz, Ali Ahmed, Yuk Huang</i>	
Efficient Airspace Operations at Burrinjuck Dam, Murrumbidgee Valley to Lessen the Flood Impact at Downstream Townships.....	446
<i>M. Atiquzzaman, Nachi Nachiappan, Dan Berry, Vince Kelly</i>	
Quantifying Errors in Areal Rainfall Estimates Due to Interpolation in Poorly Gauged Regions.....	457
<i>Matthew Scorah, Simon Lang, Rory Nathan, Suwash Acharya</i>	
Investigation of Hydrological Non-Stationarity of the Greater Sydney Water Supply Catchments .....	467
<i>Ashok Raut, Richa Neupane, Golam Kibria</i>	
The Devil is in the Detail, a Comparison of TUFLOW Classic and Heavily Parallelised Compute Sub-Grid Sampling (HPC-SGS) Solvers .....	475
<i>Luke Sheers, Roozbeh Nafari</i>	
Case Studies of Coincident Flood Assessments with a Comparison to Recent Significant Flood Events Including a Correlation Comparison Between Sub Daily Rainfall and Streamflow Observations to Daily-Averaged Gridded Rainfall Data .....	486
<i>Adam Broit, Jina Lipman, Rachel Jensen, Dave Rowlings</i>	
Performance of Referable Dams in South East Queensland During the February 2022 Flood Event.....	494
<i>N/A</i>	
Determining the Probability Distribution of Downstream Peak Flows for Releases of Environmental Flows.....	503
<i>Markus Bauerle, Ian Burns</i>	
Enhancing Flood Model Accuracy Using TUFLOW Quadtree.....	509
<i>N/A</i>	

Selecting and Processing High Resolution Climate Projections in Queensland Mine Water Planning and Hydrologic Assessment.....	518
<i>Weixi Zhan, Sarah Buckley, Paulina Genova, Jacobus Grobler, Mitchell Redenbach, Kane Eskola</i>	
Hydrological and Hydraulic Modelling of Design Floods for the Menindee Lakes.....	534
<i>Phillip Jordan, Suwash Acharya, Andrew Close, Yue Shen, Erin Hughes, David Stephens</i>	
Overcoming Flood Challenges on the Pakenham Level Crossing Removal Project .....	546
<i>Allan McManus, Alice Greco, Hayley Ta</i>	
Bridge Deck Afflux Modelling – Benchmarking of CFD and SWE Codes to Real-World Data.....	558
<i>Greg Collecutt, Urs Baeumer, Shuang Gao, Bill Syme</i>	
Stormwater Flood Forecasting and Decision Support System Using a Digital Twin – Bangkok Pilot Project.....	569
<i>Sean Ho, Peter Stephens, Sharla McGavock</i>	
Exploring the Effects of Future Climate on Lake and Reservoir Circulation in a Tropical Lake System: Lake Barrine .....	580
<i>Nathaniel Deering, Nicholas Hutley, Alistair Grinham, Simon Albert, Bertram Boehrer, Charles Lemckert, Badin Gibbes</i>	
South East Water Holistic Catchment Based Monitoring and Operational Modelling.....	590
<i>N/A</i>	
Innovations in Developing Multiple Regional Township Master Drainage Management.....	599
<i>N/A</i>	

## VOLUME 2

Flood Risk Evaluation for Rail Structures.....	609
<i>Taher Karimian, Rob Leslie, Kate Stephens</i>	
Application of Tube Fishways to Weirs.....	619
<i>Hiruni R. Kammanankada, William L. Peirson, John H. Harris, Stefan Felder</i>	
Impact of Catchment Homogeneity on the Accuracy of Design Flood Estimation: A Case Study for NSW .....	631
<i>Ali Ahmed, Xiao Pan, Khaled Haddad, Zaved Khan, Ataur Rahman</i>	
Yield Estimates for Water Resource Planning: Uncertainties, Challenges and Opportunities.....	641
<i>Bruce Rhodes, Udaya Kularathna, Heerbod Jahanbani, Stephanie Ashbolt</i>	
Urban Rail Corridor Flood Risk and Management – Updated Hydrology and Hydraulic Approach .....	651
<i>Himantha Mendis, Megan Holcomb</i>	
Observed Data, Synthetic Data and Regionalisation: Challenges of Predicting Streamflow in an Operational Context.....	663
<i>Jason Hunter, James Bennett, Kim Robinson, Mark Willis</i>	
Forecasting Irrigation Water Demands from Orders.....	672
<i>Tze Ng, David Robertson, Andrew Bishop, Jacki Thomson</i>	
A Review of Cascade Water Supply Systems.....	679
<i>Githmi Pathberiyage, Andrew Barton, Harpreet Kandra, Kithsiri Dassanayake</i>	

Hydraulic Design Considerations for Floodways: Improving Public Safety with Best Practices .....	695
<i>Krey Price</i>	
Spatial Sensitivity of Generalised Equations for Rainwater Savings Based on Rainfall, Tank Volume, Roof Area and Water Demand.....	707
<i>N/A</i>	
Fluvial Modelling of the Fitzroy River for the Rookwood Weir Project .....	712
<i>Paul Muir</i>	
Field Verification of Tree Failure Thresholds in Flood in the Hawkesbury-Nepean .....	722
<i>D. Tetley, R. Thomson, I. Testoni, A. Sud, S. Yeo</i>	
Paper Template for the Hydrology and Water Resources Symposium (HWRS 2022) .....	735
<i>N/A</i>	
Dynamically Linked Stormwater and Traffic Models .....	743
<i>Faris Bin Faris, James Ball, Gnana Bharathy</i>	
Application of Spatial Rainfall in Hourly Rainfall-Runoff Modelling for Operational Systems .....	750
<i>Shengyang Chen, Cara van Megchelen, Donna Hughes, Marcia Abdollahian, Marlène van der Sterren</i>	
Deployment and Training for End-Users of a Decision Support System for Water Resources Planning and Operations for Greater Sydney .....	758
<i>Rizwana Rumman, Josie Cairns, Marlène van der Sterren</i>	
Application of a Novel Approach to Calculating Yield for Source Water Supply Planning .....	768
<i>Brendan Berghout, Natalie Lockart</i>	
Hydrologic and Hydraulic Analysis to Assess Potential for Fish Passage at Road Culverts .....	777
<i>Nazanin Khezri, Ross McMillan, Louise Dutton, Carlos Gonzalez</i>	
The Flow of Numbers Through the Lower Hunter Water Security Plan .....	788
<i>Natalie Lockart, Brendan Berghout</i>	
Regional Design Flood Modelling Over Tasmania .....	801
<i>Sarah Blundy, Fiona Ling, Daniel Wood, Mark Babister, Nathan Dunning</i>	
Detection of Sedimentation in Water Storages Using Distributed Temperature Sensing (DTS) .....	812
<i>Laureano Rodriguez, Adrian McCallum, Damon Kent, Charith Rathnayaka, Mark Robins, Helen Fairweather</i>	
Atmospheric Rivers in Australia? Implications for Flood Estimation and Emergency Management .....	824
<i>James Stuart</i>	
An Efficient Approach to Bookending Long-Term Continuous Hydraulic Simulation of Road Closure .....	833
<i>Gangfu Zhang, Anthony Gaffney, Chris Russell</i>	
Review of Available Techniques to Reflect Climate Change Signal in Generated Rainfall Datasets for Quantitative Water Security Assessment.....	844
<i>Sarah Kirsch, Lisa Holden</i>	
Developing a Real-Time Data and Modelling Framework for Operational Flood Inundation Forecasting in Australia .....	856
<i>Simone De Kleermaeker, Tim Leijnse, Yenory Morales, Cameron Druery, Shoni Maguire</i>	

Field Investigation of Iron Transformation in the Subterranean Estuary of a Coastal Bay .....	866
<i>Wenran Cao, Chenming Zhang, Zicheng Zhao, Harald Hofmann, Ling Li</i>	
Spatial Distribution of Atmospheric Chloride Deposition in a Small Island – The Case of South Pacific’s Norfolk Island .....	874
<i>Paula Teixeira, Carlos M. Ordens, Neil McIntyre, Liliana Pagliero, Russell Crosbie</i>	
Hydrological Modelling and Multicriteria Assessments in Reviewing Headworks Operations.....	882
<i>Patrick Quaine, Kym Wilson</i>	
Use of Australian Water Availability Project (AWAP) Rainfalls for Calibration of Flood Models .....	891
<i>Sarah Blundy, Fiona Ling, Mark Babister</i>	
Infrastructure Design in an Urbanised Corridor – The Flooding and Drainage Interface .....	901
<i>Peter Johnson, Anthony Gaffney</i>	
Designing a Monitoring Program and Conceptual Models to Protect Ecological and Cultural Values of Waterways Vulnerable to Coal Seam Gas Impacts.....	912
<i>Matthew Currell, Clint Hansen, Riley Nicholson, Monica Esmond, Katelyn Dooley</i>	
Regional Hydrodynamic Modelling and Calibration Over Tasmania.....	924
<i>N/A</i>	
Understanding Kangaroo Island Water Supply Reliability in Future Climates and the Path to Augmentation Solutions .....	934
<i>Jeffrey P. Newman, Sam A. Culley, Seth Westra, Leon van der Linden, Michelle Irvine, Bree Bennett, Holger R. Maier, Mark Thyer, Steve Kotz, Michael Leonard</i>	
Infrastructure Sustainability Ratings: Challenges in Establishing Criteria and Demonstrating Compliance for Water Quality.....	948
<i>Sonia Dong, Courtney Henderson</i>	
Sustainable Integration of Seawater into Regional Water Supply Networks.....	959
<i>Liliana Pagliero, Neil McIntyre, Douglas Aitken, Pascal Bolz, Carlos Ordens, Levi Campos, Giovana Garcia, Nathalie Jamett, Sebastian Leon, Luis Cisternas</i>	
The Headworks Optimisation Model for Adelaide, Guiding Us Through an Increasingly Uncertain World .....	966
<i>Leon van der Linden, Jeffrey Newman, Geoff Davis, Geoffrey Adams, Steve Kotz</i>	
Resetting Expectations of Brisbane’s Flood Protection.....	975
<i>Luke Toombes, Rob Ayre</i>	
Does Good-Modelled Rainfall Translate to Good-Modelled Streamflow? .....	988
<i>Thien Nguyen, Bree Bennett, Michael Leonard</i>	
Impact of Climate Change and Land Use on Groundwater Hydraulic Fluctuations .....	997
<i>Adnan Mohammad, Dawit N. Bekele, Sreenivasulu Chadalavada, Scott Warner, Ravi Naidu</i>	
The Impact of Spatial Variability on Flood Response in Small Catchments .....	1008
<i>Tim Craig, Andrew Northfield</i>	
Integrated Modelling Management – Can We Deliver Integrated Water Resources Management and Sustainable Outcomes Without It? .....	1017
<i>Stephanie Kermode, Frankie Coen, Paul Dunne</i>	

Onsite Sewage System Modelling: Lot Scale Releases with Catchment Scale Impacts .....	1030
<i>Andrew Herron, Michael Barry, Elnaz Tavakol, Stephanie Kermode, Niloo Masuleh</i>	
Hydraulic Modelling 2D Cell Size Result Convergence – Comparing the Performance of Different Shallow Water Equation Solution Schemes.....	1041
<i>Chris Huxley, Bill Syme, Phil Ryan, Greg Collecutt</i>	
Understanding Languages and Perspectives: A First Step to a Cybernetic Approach to Water Governance? .....	1053
<i>Katherine A. Daniell, Hannah R. Feldman, Flynn Shaw</i>	
Understanding Cone Fishway Flow Regimes with CFD .....	1063
<i>Kyle Thomson, Mitchell Redenbach</i>	
A Case Study Using a 2D Hydraulic Model for River Rating Curve .....	1075
<i>Feifei Tong, Simon Rodgers, Andrew Watson</i>	
Making the Impossible Possible – Saving the Town of Maclean in the March of 2022 Flood.....	1085
<i>G. Mashiah</i>	
Assessing Underestimation Bias in the ARR2019 Design Rainfall Method in Queensland .....	1095
<i>Harrison Babister, Mark Babister</i>	
Urban Water Quality Management in Metropolitan Adelaide .....	1106
<i>Helen Braithwaite</i>	
Hysteresis, Non-Linearity and Instabilities on Circular Crested Weir.....	1116
<i>Hubert Chanson, Oscar Memory</i>	
COSMUS: A Complete Storm Multi-Duration Sampling Approach for Design Flood Estimation.....	1125
<i>Mark Babister, Behzad Jamali, Nathan Dunnig, Scott Podger</i>	
Modelling Fish-Friendly Culvert: An Academic Approach to a Practical Engineering Problem .....	1139
<i>Xinqian Leng, Hubert Chanson</i>	
Merging of Civil Engineering and Atmospheric Science: An Example from America's Northern Great Plains .....	1161
<i>Robert Ettema</i>	
Water Resources in Queensland 2022 .....	1174
<i>Barton Maher, Chris Nielsen, Ian White</i>	
The Past, Present and Future of Hydrologic Research and Practice .....	1192
<i>Bryson C. Bates</i>	
Is Zero Afflux the Question or Answer to Better Flooding Outcomes?.....	1207
<i>Peter J. Coombes, Andrew Allan</i>	
Hydraulic Modelling: The Past, the Present, the Future.....	1217
<i>Bill Syme</i>	

## **Author Index**