Australian Hydraulic Modelling Association

AHMA Volunteers

We are seeking volunteers to assist with future newsletters and other AHMA activities. Please let us know at ahma@ahma.asn.au if you are interested in assisting us on this exciting modelling journey. Thank you.

fences and even thick vegetation, as these will all affect the flow paths. It is also important that there is linkage of

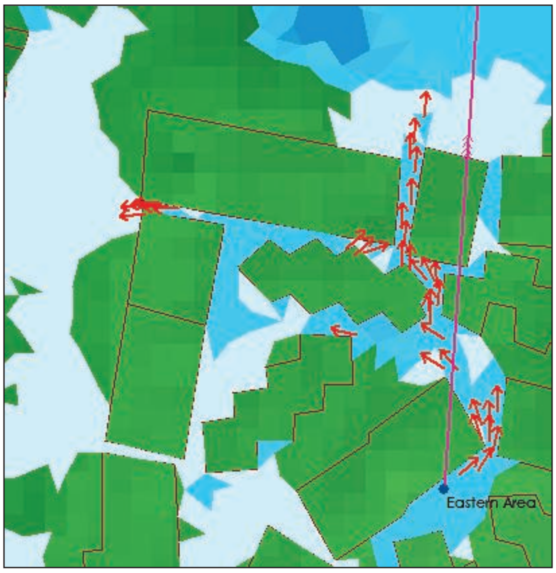

***Figure 15**: 2D Results Showing Velocity Arrows.*

the 1D model (pipes & manholes) to the 2D mesh, for stable and consistent results.

One of the main advantages of undertaking a 2D modelling study is that hydraulic results will be available for each mesh element – meaning that high flow areas can be readily identified – as shown in Figure 16.

Hydraulic Modelling of Energy Dissipation: Dynamic Similarity and Scale Effects

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At hydraulic structures, energy dissipation may take place in the form of localised dissipation (hydraulic jump, dropshaft, plunge pool), along the chute structure (stepped spillway, baffled chute), in a flip bucket and downstream pool, or a combination of the above (Figure 17). The magnitude of turbulent energy that must be dissipated in hydraulic structures is enormous even in small rural and urban structures. Let us consider a small storm waterway discharging 4 m^3/s at a 3 m high drop: the turbulent kinetic energy flux per unit time is 120 kW! In Figure 17, the rate of energy dissipation per unit time was nearly 2,500 MW at the time! Many engineers have never been exposed to the complexity of energy dissipator designs, to the physical processes taking place and to the structural challenges. Several energy dissipators, spillways and storm waterways failed because of poor engineering design (NOVAK and CABELKA 1981). It is believed that a major issue was the lack of understanding of the basic turbulent dissipation processes and of the limitations of physical and numerical models. Physical studies are conducted traditionally using a Froude similitude which implies drastically smaller laboratory Reynolds numbers than in the corresponding prototype flows. Despite recent

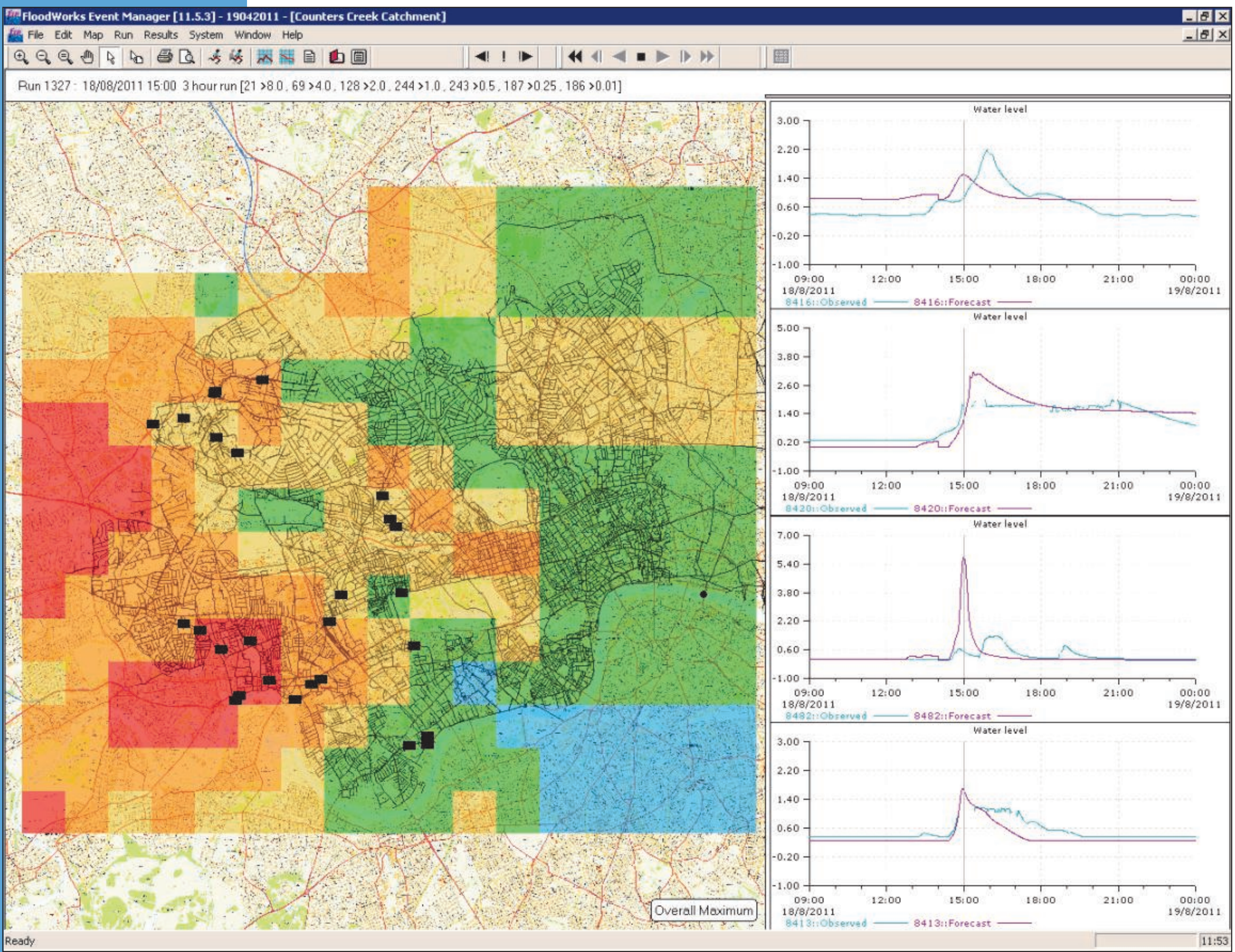

***Figure 16**: Floodworks User Interface.*

Australian Hydraulic Modelling Association

Young Water Professionals

'A World of Opportunities- Working in the International Water Sector'

This publication released by International Water Association (IWA) provides valuable information for young water professionals who make their early career decisions. It can be downloaded from www.iwapublishing.com.

Did You Know that... ?

'Rainy England' Imposes Tough Water Restrictions

London, April 12, 2012

Source: www.canberratimes.com.au

Refrain from washing cars - that is the message Londoners are getting from posters that have been put up in the British capital.

These days, water has to be saved in notoriously rainy England - and every opportunity to do so is being seized.

Figure 17*: Stepped Spillway and Downstream Stilling Basin at Paradise Dam (QLD) on 30 December 2011 Discharging Nearly 6,300 m^3/s, Re $\approx$1.9×10^7.*

advances, there are some basic concerns about the extrapolation of laboratory results to large size prototype structures, as well as the implications in terms of numerical model validation.

Theoretical and numerical studies of turbulent flows are complicated by the large number of relevant equations: i.e., three basic equations (continuity, momentum, energy) with a number of turbulence closure relationship, plus possibly a mass transfer equation. Many studies rely upon some physical experiments. Laboratory model studies are performed under controlled flow conditions with geometrically similar models (LIGGETT 1994). Considering the simplistic case of a horizontal hydraulic jump, a simplified dimensional analysis shows that the dimensionless flow properties may be expressed as:

$$\frac{V_x}{\sqrt{g\,d_1}}, \frac{V_y}{\sqrt{g\,d_1}}, \frac{V_z}{\sqrt{g\,d_1}}, \frac{v'_x}{V_1}, \frac{v'_y}{V_1}, \frac{v'_z}{V_1} ...$$

$$= F\left(\frac{x}{d_1}, \frac{y}{d_1}, \frac{z}{d_1}, Fr_1, Re, \rho\frac{V_1^2\, d_1}{\sigma}, ...\right) \quad (1)$$

where V is the velocity, v' is a characteristic turbulent velocity, x is the coordinate in the flow direction measured from the nozzle, y is the normal coordinate, z is the transverse coordinate measured from the channel centreline, and the subscript 1 refers to the inflow conditions. In Equation (1), the dimensionless flow properties (left hand side terms) at a dimensionless position (x/d_1, y/d_1, z/d_1) are expressed as functions of the dimensionless inflow properties and channel geometry. In the right hand side of Equation (1), the fourth, fifth and sixth terms are the inflow Froude, Reynolds and Morton numbers respectively. Note that any combination of these numbers is also dimensionless and, in Equation (1), the Weber number was replaced above by the Morton number $Mo = g\mu_w^4/(\rho_w s^3)$ which becomes an invariant if the same fluids, namely air and water, are used in model and prototype.

In the study of energy dissipation in free-surface flows, a Froude similitude is commonly used because the gravity effects are dominant (NOVAK and CABELKA 1981, CHANSON 2009). The model and prototype Froude numbers must be equal. However the turbulent dissipation processes are dominated by viscous forces (LIGGET 1994). Dynamic similarity becomes impossible because of too many relevant parameters.

Most hydraulic studies of energy dissipators are designed using a Froude similitude which implies drastically smaller Reynolds numbers than in the corresponding prototype flows. There are therefore some critical issues with the validity of model result extrapolation to prototype flow conditions, as well as the validity of numerical results calibrated with small-size physical data. Relevant discussions include NOVAK and CABELKA (1981) and LIGGETT (1994). Some recent results demonstrated that the notion of scale effects is closely linked with the selection of some characteristic turbulent flow property(ies), while true dynamic similarity might not be achieved unless at full-scale in some cases (CHANSON 2009).

References

CHANSON, H. (2009) "Turbulent Air-water Flows in Hydraulic Structures: Dynamic Similarity and Scale Effects." *Environmental Fluid Mechanics*, Vol. 9, No. 2, pp. 125-142 (DOI: 10.1007/s10652-008-9078-3).

LIGGETT, J.A. (1994) "Fluid Mechanics." *McGraw-Hill*, New York, USA.

NOVAK, P., and CABELKA, J. (1981) "Models in Hydraulic Engineering. Physical Principles and Design Applications." *Pitman Publ.*, London, UK.

Spatial Water Modelling in Public Health

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We've come a long way since John Snow sketched diagrams of the water supply for Soho England in response to a cholera outbreak in 1854. In Snow's day the challenge was to convince people there was a connection between their hygiene and their health, something few people would even think to question today. However, linking sewage-contaminated water with disease in a small suburb is much more straightforward than the challenges facing public health workers today. Water today is increasingly exposed to a host of environmental, industrial, and human influences that not only affect its quantity but also its quality. How can anyone begin to assess the effect of all those influences without the aid of spatial modelling?

Since the 1980's much of public health has focused on risk assessment as a tool for preventing disease, but only recently have spatial modelling tools been readily available to inform this process. Pivotal publications like the US EPA's "Red Book" and the Australian enHealth's *"Environmental Health Risk Assessment"* outline a process of hazard identification, dose-response, exposure quantification and final risk characterisation. Each step in the process relies heavily on evidence to support the final conclusions. Often that evidence is based on laboratory studies, environmental samples, or population surveys. Very rarely are spatial models used in the overall assessment process, at least in every day practice.

Newsletter of the Australian Hydraulic Modelling Association (AHMA)

AHMA
Australian Hydraulic Modelling Association

MODELLING stream

April 2012
Volume 1
Number 1

Our Vision

To be recognised as a national professional leader in the area of hydraulic modelling which supports and promotes modelling to maximise its visibility and value for Australian society.

Our Mission

To provide a forum to facilitate the exchange of knowledge, experience and ideas within the hydraulic modelling community in Australia.

Our Goals

To fulfill our vision, we strive to achieve the following 10 goals:

- Facilitate information sharing, networking, exchange of knowledge and experience within the hydraulic modelling community.
- Encourage and facilitate development of best industry practice and standards.

Welcome

Welcome to the first issue of the Australian Hydraulic Modelling Association (AHMA) newsletter. It has been a very exciting journey from the previous popular Victorian Modelling Group newsletter in 2010 and 2011, to this inaugural AHMA newsletter in April 2012.

Helena Mala-Jetmarova, AHMA President

Both state committee members and AHMA Board (Figure 1) members worked as a team to prepare this newsletter, which is the first of a series across the AHMA future. These newsletters are designed to provide a large variety of information for the hydraulic modelling community with a focus on recent industry developments. We anticipate that these newsletters will provide you with significant benefits and also widen your professional horizons.

I would like to also thank all who contributed to this inaugural AHMA newsletter and would like to welcome all water professionals not only from Australia, but also overseas to contribute to the future issues.

Helena Mala-Jetmarova

AHMA President

About AHMA & News

AHMA is a 'not-for-profit,' national, independent and professionally recognised body for the hydraulic modelling community in Australia, fulfilling a perceived gap across the Australian water industry sector. AHMA is targeted for water professionals, who are involved with all fields of hydraulic and water quality modelling from water supply, through wastewater, storm-water, groundwater, lakes and reservoirs, rivers, catchments, estuaries, coasts and oceans, to water resources. AHMA's membership base currently includes 300 members mainly from Australia, but also overseas.

***Figure 1**: From Left Ian Burrows, Maria Naranjo, Helena Mala-Jetmarova, Dave Birkett, Chris O'Neill, Rianda Mills.*

The main goals of the AHMA are to facilitate exchange of information, promote the hydraulic modelling profession, encourage and develop best industry practice and standards, narrow the gap between industry and universities, and others. Moreover, AHMA acts as a national 'umbrella' organisation to support activities of the state hydraulic modelling groups. These are the Victorian Modelling Group (VMG), the Queensland Modelling Group (QMG) and the newly formed New South Wales and Australian Capital Territory Modelling Group (NAMG). AHMA's main

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