GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

Goulburn River Environmental Flows Hydraulics Study

Real time flow management Framework scoping

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1. INTRODUCTION

The Goulburn Broken Catchment Management Authority (Goulburn Broken CMA) has commissioned the Goulburn River Environmental Flow Hydraulics Study. The study is required to undertake hydraulic and hydrologic modelling of the Goulburn River from Lake Eildon to the River Murray.

This report documents the scoping of the framework required to provide real time management of environmental flow releases in the Goulburn River.

The study brief outlined the following project tasks:

- Data collation and review – Collation and review of the available topographic and streamflow data information.
- Topographic data gap identification – Identify the gaps in the available topographic data, and suggest potential mediation options.
- Asset mapping – Locate and map known public and private assets along the Goulburn River and adjacent surrounds.
- Hydrologic analysis – Investigate relative contribution from downstream tributaries, and assess design flood hydrographs for the Goulburn River catchment.
- Hydraulic analysis and flow behaviour – Assess flow behaviour of the Goulburn River over a range of potential environmental flows.
- Socioeconomic assessment – Evaluate the social and economic costs of potential Goulburn River environmental flows.
- Real time flow management – Review and scope real time flow management framework.
- Management option assessment – Scope feasibility of management options for environmental flow releases.

This document reports on aspects of the seventh project tasks.

This document draws on the discussions from a meeting held at the BoM Victorian Regional Office on Friday 5/6/09 with Elma Kazazic (BoM), Jim Elliot (BoM), Neil Plummer (BoM) and QJ Wang (CSIRO).

The structure of this report is as follows:

- Section 2: discusses the current framework for real time flow management (forecasting) over the short and medium terms.
- Section3: outlines the future directions in research into real time flow management (forecasting) over the short and medium terms.

2. CURRENT REAL TIME FLOW MANAGEMENT FRAMEWORK

2.1 Overview

The current real time flow management frameworks can be grouped as follows:

- Short term (Event based): Flow forecasting for short duration events (up to 7 days). Typically applied to flood forecasting
- Medium term (Seasonal based): Flow forecasting over a season (up to 3-6 months). Typically applied to water resource allocation planning.

This section outlines the current frameworks employed for the event and seasonal based forecasting.

2.2 Current short term (Event based) real time flow management

The following discussion draws on comments provided by Elma Kazazic and Jim Elliot (BoM) at a meeting on 5/6/09.

The Bureau of Meteorology, through the Victorian Regional Office, undertakes flood forecasting for the Goulburn and Broken River catchments. This forecasting service provides peak height/flow and time of peak for the following locations along the Goulburn River (downstream of Eildon) and major tributaries:

- Goulburn River: Downstream of Lake Eildon, Trawool, Seymour, Goulburn Weir, Murchison, Arcadia Downs, Shepparton and McCoy's Bridge.
- Tributaries: Acheron River at Taggerty, Yea River at Devlin's Bridge, Yea River at Yea, King Parrot Creek at Flowerdale, Hughes Creek at Tarcombe Road, Castle Creek at Telford Bridge, Seven Creeks at Kialla West, and Broken River at Orrvale.

The above forecasts utilises a URBS runoff routing model as the principal forecasting tool. The construction and calibration of these URBS models are discussed in BoM (2003). A data collection network provides real time streamflow, water level and rainfall data. At this stage, there is limited use of forecasted rainfall fields to provide flow forecasts.

This current event based forecasting service is targeted at flow events likely to approach and/or exceed the minor flood class levels along the Goulburn River and/or tributaries. The runoff component of the model includes initial and continuous loss estimates. The initial loss is poorly understood, and so model predictions are poor at the start of flow events. After any initial loss is met, model predictions improve. Actual river flows are used to refine the continuing loss in the model as the flow event develops, improving accuracy. There is currently no measurement of forecasting accuracy of the model's predictions at any of the forecast locations.

Table 2-1 displays the flood warning class levels for the Goulburn River catchment relevant to this project, as sourced from the BoM website (6/8/09).

Table 2-1 Goulburn River Catchment – Relevant flood class levels

Location	Gauge height (m) / Flow (ML/d)		
	Minor	Moderate	Major
Goulburn Catchment			
Goulburn R at Lake Eildon DS - Height	3.0	4.0	5.0
Goulburn R at Lake Eildon DS - Flow	15,000	26,000	40,000
Acheron R at Taggerty	2.0	2.6	3.0
Yea R at Devlin's Bridge	1.8	2.3	2.8
Yea R at Yea	3.0	3.9	4.9
King Parrot Ck at Flowerdale	2.0	n/a	n/a
Goulburn R at Trawool[1]	4.0 (21,700 ML/D)	5.65 (41,550 ML/d)	7.5 (83,000 ML/d)
Sunday Ck at Tallarook	3.0	3.5	4.0
Goulburn R at Seymour[1]	4.0 (22,800 ML/d)	5.2 (38,980 ML/d)	7.0 (81,200 ML/d)
Hughes Ck at Tarcombe Road	2.0	2.8	3.6
Goulburn R at Goulburn Weir DS - Flow	36,700	52,000	90,200
Goulburn R at Murchison[1]	9.0 (29,200 ML/d)	10.2 (59,015 ML/d)	10.7 (79,000 ML/d)
Goulburn R at Arcadia Downs	9.0	10.2	10.5
Goulburn R at Shepparton[1]	9.5 (27,916 ML/d)	10.7 (71,940 ML/d)	11.0 (87,000 ML/d)
Goulburn R at McCoys Bridge[1]	9.0 (29,200 ML/d)	10.0 (50,000 ML/d)	10.2 (62,600 ML/d)
Seven and Castle Creeks			
Castle Ck at Telford Bridge	1.2	1.8	2.4

Location	Gauge height (m) / Flow (ML/d)		
	Minor	Moderate	Major
Seven Cks at Kialla West	4.5	5.0	6.6
Broken Catchment			
Broken R at Orrvale	6.8	7.2	7.9

1. Flows assessed from current streamflow flow rating curves

The flow range of primary interest to this project is 20,000 to 60,000 ML/d. Comparison of this flow range to the flood level classes reveals the following points:

- Above Goulburn Weir:
    - The lower limit of the flow range (20,000 ML/d) exceeds the minor flood level immediately downstream of Eildon, and lies just below the minor flood level at Trawool and Seymour.
    - The mid point of the flow range (40,000 ML/d) equates to the major flood level immediately downstream of Eildon, and to approximately the moderate flood level at Trawool and Seymour
    - The upper limit (60,000 ML/d) exceeds the major flood level immediately downstream of Eildon, and exceeds the moderate flood level, but are under the major flood levels by about 0.7-0.8 m, at Trawool and Seymour.
- Below Goulburn Weir:
    - The lower limit of the flow range (20,000 ML/d) lies below the minor flood level at Murchison (by ~1.5 m), Shepparton (by ~0.9 m) and McCoy's Bridge (by ~ 1.3 m)
    - The mid point of the flow range (40,000 ML/d) exceed the minor flood level at Murchison (by ~0.6 m), Shepparton (by ~0.6 m), and at McCoy's Bridge (by ~ 0.7 m)
    - The upper limit (60,000 ML/d) equates to the moderate flood level at Murchison, lies just below the moderate flood level at Shepparton, and equates to the major flood level at McCoy's Bridge.

Above Goulburn Weir, the environmental release flow range lies in the operational range of the current flood forecasting service. Below Goulburn Weir, the lower limit of the flow range (20,000 ML/d) lies below the operational range of the current flood forecasting service. However, flow above about 30,000 ML/d lie within the operational range.

2.3 Current medium term (Seasonal based) flow management

The following discussion draws on comments provided by Neil Plummer (BoM) at a meeting on 5/6/09.

The Bureau of Meteorology currently provides a range of seasonal forecast services. Generally these current services are focused on seasonal rainfall and temperature. The current seasonal forecasts are predominantly based on statistical relationships to factors such as the Southern Oscillation Index and Indian Ocean Dipole.

Current services provide exceedance probabilities for various climatic variables such as temperature and rainfall. The transformation of seasonal rainfall and temperature into streamflow is of low accuracy and reliability.

3. FUTURE DIRECTIONS IN REAL TIME FLOW MANAGEMENT

3.1 Overview

In keeping with the review of current real time flow management frameworks, the future directions in real time flow management (forecasting) are grouped similarly as follows:

- Short term: Flow forecasting for a short duration events (up to 7 days).
- Medium term: Flow forecasting over a season (up to 3-6 months).

This section outlines the future directions in the short and medium term flow management frameworks.

3.2 Short term forecasting

The following discussion draws on comments provided by Jim Elliot (BoM) and Dr. QJ Wang (CSIRO) at a meeting on 5/6/09.

CSIRO, in conjunction with the BoM, are developing a short term streamflow forecasting framework, as part of the BoM's Water Division program. The aim of the framework is to provide continuous flow forecasts for the coming 7 to 10 days for water managers for irrigation demand and release planning.

The short term forecasting framework will be based on continuous simulation of soil moisture and catchment runoff volumes. The use of continuous simulation removes the need to assess catchment moisture prior to the commencement of a rainfall event. Numerical weather predictions of rainfall and evaporation (with their associated uncertainty of prediction) will be an input to the continuous simulation model to drive the flow forecasts. The temporal resolution of the flow forecasts is yet to be refined.

These directions are potentially very useful for environmental flow management. The use of numerical weather prediction will provide more lead-time to plan environmental flow management using tributary flows. The move to continuous forecasts will allow improve the understanding of the likely hydrograph of those flows over time, and improve prediction accuracy at the start of the event. A key issue will be to understand the likely accuracy of predictions from the start to the end of the forecast period, and as the flow events unfold.

Pilot studies of the framework are underway in the Ovens River (Victoria) and Mill Stream (Queensland) catchments. The current focus is on identifying the sources of uncertainty in the flow forecasts, and the structure and parameters of the continuous runoff models.

At the meeting on 5/6/09, both Jim Elliot (BoM) and QJ Wang (CSIRO) expressed a desire to pursue the Goulburn River catchment as a potential pilot catchment. The ready application to the real time management of environmental flow releases was seen as a favourable aspect.

Recommendation: To progress the desire expressed at the meeting, it is recommended that the GBCMA liaise closely with G-MW, BoM and CSIRO to develop a proposal (business case) for the consideration of the Goulburn River catchment as pilot study catchment, and to help develop the forecasting services of relevance to environmental flow management.

3.3 Medium term forecasting

The following discussion draws on comments provided by Neil Plummer (BoM) at a meeting on 5/6/09.

BoM is currently looking at using dynamic weather modelling to provide more dynamic forecasts. BoM is further looking to provide 3 month streamflow forecasts.

Seasonal flow forecasts would allow environmental managers to understand likely water availability (particularly in winter/spring)and so plan for major environmental releases.

Preliminary discussions exploring the scope of expanded seasonal forecast products have been undertaken with Goulburn –Murray Water and GBCMA.

Recommendation: To further progress the scoping of the potential seasonal forecast services, it is recommended that the GBCMA to liaise closely with G-MW, BoM and CSIRO to develop the indicative scope of services of relevance to management of environmental flows in the Goulburn River.