Wimmera Catchment

Flood Warning Service Charter

Picture by Chris Guest, 1988

September 2009

Wimmera Catchment Management Authority

Australian Government
Attorney-General's Department
Emergency Management Australia

Wimmera Catchment

Flood Warning Service Charter

September 2009

It is the responsibility of the reader to verify the currency of revision of this report.

Water Technology
Water, Coastal & Environmental Consultants
15 Business Park Drive, Notting Hill, Victoria 3168
Tel: 03 9558 9366 Fax: 03 9558 9365 www.watech.com.au
ACN No. 093 377 283 ABN No. 60 093 377 283

Wimmera Catchment Management Authority
24 Darlot St, PO Box 479, Horsham Victoria 3402
Phone: (03) 5382 1544 Fax: (03) 5382 6076 Email: wca@wcma.vic.gov.au Website: www.wcma.vic.gov.au
ABN: 83 900 830 261

Wimmera Catchment Management Authority

Australian Government
Attorney-General's Department
Emergency Management Australia

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

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1 FLOOD WARNING SERVICE CHARTER

This Charter defines the roles and responsibilities of entities involved in the (total) flood warning system for the Wimmera catchment as well as the requirements of the flood forecast and warning service delivered for the catchment by the Bureau of Meteorology. It has been endorsed by the following entities and shall become effective on the last date shown below:

- Northern Grampians Shire Council (NGSC);
- Horsham Rural City Council (HRCC);
- Hindmarsh Shire Council (HSC);
- Yarriambiack Shire Council (YSC);
- Grampians Wimmera Mallee Water (GWMWater);
- Wimmera Catchment Management Authority (Wimmera CMA);
- Bureau of Meteorology (Bureau);
- Victoria State Emergency Service (VICSES); and
- Victoria Police (VicPol).

1. **Signed for and on behalf of**
   Northern Grampians Shire Council

…….....	……	……
CHIEF EXECUTIVE OFFICER	MERO	MAYOR
On this day ……	On this day ……	On this day ……

2. **Signed for and on behalf of**
   Horsham Rural City Council

…….....	……	……
CHIEF EXECUTIVE OFFICER	MERO	MAYOR
On this day ……	On this day ……	On this day ……

3. **Signed for and on behalf of**
   Hindmarsh Shire Council

…….....	……	……
CHIEF EXECUTIVE OFFICER	MERO	MAYOR
On this day ……	On this day ……	On this day ……

4. **Signed for and on behalf of**
   Yarriambiack Shire Council

…….....	……	……
CHIEF EXECUTIVE OFFICER	MERO	MAYOR
On this day ……	On this day ……	On this day ……

5. **Signed for and on behalf of**
   Grampians Wimmera Mallee Water

……
CHIEF EXECUTIVE OFFICER

On this day ……

6. **Signed for and on behalf of**
Wimmera Catchment Management Authority

……
CHIEF EXECUTIVE OFFICER

On this day ……

7. **Signed for and on behalf of**
Bureau of Meteorology

……
REGIONAL DIRECTOR, VICTORIA

On this day ……

8. **Signed for and on behalf of**
Victoria State Emergency Service

……
DIRECTOR OPERATIONS

On this day ……

9. **Signed for and on behalf of**
Victoria Police

…….....	……	……
SUPERINTENDENT, REGION 2 DIVISION 4 (DERC)	INSPECTOR, HORSHAM PSA	INSPECTOR, NORTHERN GRAMPIANS PSA
On this day ……	On this day ……	On this day ……

Base Charter for the Wimmera Catchment Flood Warning System	
Building Blocks of a Flood Warning System	**Entity Involvement coupled with Local Requirements and Arrangements**
DATA COLLECTION & COLLATION (and sharing)	Bureau provides real time data for flood forecasts and warnings from the national rain gauge network and provides technical assistance for improved data collection networks to support flood warning systems. Weather radar and satellite imagery along with rain and river data and all Bureau-issued forecasts and warnings are available from Bureau website or phone system. Rain and river data for the Wimmera catchment to be available from the Bureau's routinely updated web-based river height and rainfall bulletins. All stream and rainfall gauge data from the upgraded data collection network sites is available on the Bureau website (unless no data has been reported in the last 26 hours). GWMWater provides Bureau with information on operations, storage levels and releases as required. **Data sharing and real-time access arrangements to be established in relation to GWMWater data, particularly outside normal working hours. Bureau and GWMWater to resolve in the context of the Commonwealth Water Act 2007 and Water Regulations 2008.** Require clarity on roles and working arrangements between GWMWater and the Bureau. An MoU similar to the one developed between G-MW and the Bureau has been suggested. **Not yet available.** River and other rain data are available from the upgraded data collection network maintained through the DSE-managed North West Regional Surface Water Monitoring Partnership (a current membership list can be obtained from the Partnership). Only one of the repeaters (Mount Arapiles) is included in the Partnership: the others are maintained by the Bureau. All Partnership site data archived to the State water resources data warehouse. Ownership and responsibility for maintenance and replacement / upgrade of all elements of the data collection system base station located in Wimmera CMA's Darlot Street, Horsham office rests with Wimmera CMA. This includes the antenna, receiver, decoder, cabling, computer and all related equipment as well as the database and associated metadata. Wimmera CMA's Floodplain Management Officer and Manager, Planning and Assessment will monitor the condition of the base station and ensure that it is online and working without error. ➢ Any errors and / or failures of the base station will be reported immediately to the Bureau. ➢ Any errors and / or failures of field stations and / or repeaters will be reported immediately to Thiess Services for repair action as per Partnership arrangements and also to the Bureau and LG for information. Bureau has provided (and will maintain) ENVIROMON software for the upgraded data collection system base station located in Wimmera CMA's Darlot Street, Horsham office to facilitate the collation and display of data. The software can also allow initiation of alerts based on exceedance of criteria such as rainfall volumes or rates and / or river levels or rates of rise. Wimmera CMA will provide the Bureau with access to the base station as required to review and / or upgrade software. Access should be arranged through Wimmera CMA's Floodplain Management Officer or Manager,

Base Charter for the Wimmera Catchment Flood Warning System	
Building Blocks of a Flood Warning System	**Entity Involvement coupled with Local Requirements and Arrangements**
	Planning and Assessment during office hours (call ☎ 5382 1544) and through the Duty Officer (call ☎ 0407 840 514) outside normal office hours. Data access redundancy is required to be established and maintained for the Bureau and Wimmera CMA in case of a base station or repeater failure. The primary method of data transfer will be from the Wimmera CMA Enviromon base station to the Bureau via a UDP (User Datagram Protocol – an internet network connection) link. The redundant method of data transfer is to be either via an ERTS Gateway (device that receives ERTS data and transmits it via the mobile phone data network to the Bureau) located at either the Mt William or Ben Nevis repeater stations or via a new repeater network. See Box 1 at the end of this table. Data from the upgraded data collection network will be available to LG and VICSES via the Bureau's website. Data will also be available to LG and VICSES via physical access to the base station computer located in Wimmera CMA's Darlot Street office. Access should be arranged through Wimmera CMA's Floodplain Management Officer or Manager, Planning and Assessment during office hours (call ☎ 5382 1544) and through the Manager, Planning and Assessment (call ☎ 0407 840 514) outside normal office hours. Wimmera CMA will advise all organisations signing this charter of any changes to the above contact arrangements. On-going real-time access (as perhaps an SMS message initiated by ENVIROMON?) to data available from the upgraded data collection network (ie. from the base station located in Wimmera CMA's Darlot Street office) is important for HRCC and HSC to facilitate their operation of weirs at Horsham, Dimboola and Jeparit from quite low (less than minor flood) flows and also for YSC who are responsible for the operation of a number of weirs along Yarriambiack Creek. **Not yet available – Wimmera CMA and LG to investigate in the context of weir operation SOPs in terms of flow triggers and locations, lead times, contacts, etc.** Installation of another gauge upstream of Horsham to facilitate HRCC's management of the Horsham weir (perhaps at the Western Highway Bridge). **To be investigated by HRCC.** Installation of a rain gauge on Mt Difficult to assist flash flood warning for Halls Gap. **To be investigated by NGSC.**
FLOOD DETECTION & PREDICTION (ie. Forecasting)	After assessing catchment wetness and forecast rainfall totals, Bureau issues flood watches if flooding considered likely. Bureau prepares flood forecasts for key Wimmera River locations based on URBS rainfall-runoff model outputs and issues flood warnings for the Wimmera catchment. *Note that until a number of flood events have occurred and relevant data has been captured and used to calibrate the flood forecast model, forecasts for Jung and Upstream of Dimboola (Wail) are likely to be subject to substantial uncertainty and must therefore be considered as indicative only. Forecasts of the expected severity of flooding at Dimboola and Jeparit [derived from levels at Upstream of Dimboola (Wail)] and Warracknabeal (derived from levels at Jung) will be similarly indicative.* Flood forecast requirement is as follows: ➢ Forecast locations

Base Charter for the Wimmera Catchment Flood Warning System	
Building Blocks of a Flood Warning System	**Entity Involvement coupled with Local Requirements and Arrangements**
	○ Current: Glenorchy, Horsham (Walmer), Quantong Bridge. **Able to be provided.** ○ Expand to include: Drung Drung (Gross's Bridge), Upstream of Dimboola (Wail), and Jung. **Not yet available.** ➢ Forecast lead time. **Not yet specified by stakeholders.** ➢ The peak height and time of occurrence. **Provided.** ➢ Information on flood character – comparison against recent known and statistical events, rates of rise / fall, behaviour, etc. **Able to be provided.** ➢ Full forecast hydrograph from Bureau website. **Available to registered users.** ➢ The time that flood water will exceed critical levels at key locations (eg. overtopping of levees, key roads, level at which critical infrastructure and / or buildings are first surrounded by floodwaters and / or flooded over-floor, etc). Intelligence is contained in LG MEMP Flood Response Plans. Note that any requirement here may influence forecast lead time and other criteria requirements. **No requirement specified by LG or VICSES.** ➢ Time when floodwaters will begin to fall from peak. **Not provided routinely as can be difficult to predict due to local factors.** ➢ Forecast accuracy – in terms of height and time. **Not yet specified by stakeholders.** ➢ Communication of the uncertainty inherent in the forecast through provision of: ○ Confidence limits on forecast peak and timings. **Will not be available until a number of flood events have occurred and relevant data has been captured.** ○ Scenarios for a range of predicted rainfall and loss conditions so that VICSES, LG and community can better appreciate the likely impacts. **Not provided routinely.** ➢ Forecast issue times and frequency ○ Twice per day at 6am and 4pm and as required due to changed circumstances. **Not yet implemented.** Bureau provides predictions of weather conditions likely to lead to flash flooding. LG is primarily responsible for flash flood forecasting (if and as required).
MESSAGE CONSTRUCTION	Messages are prepared by: ➢ Bureau for weather conditions likely to lead to riverine and / or flash flooding; ➢ Bureau for flooding along the Wimmera River and some of the larger tributaries but not the distributaries such as Yarriambiack Creek; ➢ LG for flash flooding in municipal areas (if and as required). VICSES (in association with LG) adds value to flood warning messages through inclusion of local impacts and related information and reissues locally.
MESSAGE DISSEMINATION (ie. flood alerting and notification: communicating the warning message and	Bureau by fax to VICSES, LG (email too), VicPol, Wimmera CMA, DSE, VicRoads and media – see lists at Appendices E1 and E2. VICSES alerts LG when the Bureau issues flood warning(s). LG to disseminate flood warnings within the community. Forecasts, warnings, data and images available from Bureau website.

Base Charter for the Wimmera Catchment Flood Warning System	
Building Blocks of a Flood Warning System	**Entity Involvement coupled with Local Requirements and Arrangements**
information)	VICSES may enhance or add value to flood warning messages by issuing community safety information and action statements. All community information and media releases provided during a flood event, particularly as it relates to response actions, will be issued or authorised by the VICSES appointed Incident Controller. VICSES to conduct public meetings and issue media releases ahead of flooding where possible in order to deliver information and facilitate community response. Flood warnings and key messages available from VICSES website and VICSES Flood and Storm Information Line (when activated during incidents – 1300 842 737). ABC radio (3WV 594AM) promoted to the community as a reliable source of flood information consistent with national agreement with ABC on their role during emergencies.. Details of road closures and re-openings known to VicRoads are available from the VicRoad's website. This information is generally provided by the ICC based on intelligence available to VICSES, VicPol and LG. Current Bureau flood warning addressee and contact lists (agency name plus fax, email and phone numbers) to be reviewed and updated at least annually. **Bureau to propose and formalise process.** While the Bureau will verify flood warning dissemination address lists from time to time, it is the responsibility of individual entities to ensure that their details are provided to the Bureau so that warnings can be delivered.
INTERPRETATION (ie. converting the predicted flood height into areas and assets likely to be impacted so that the question "what does the forecast height mean for me or you" can be answered.)	Control Agency for flood response is VICSES. VICSES to use experience and technical expertise within LG and Wimmera CMA (and within GWMWater) to assist in interpreting Bureau-issued flood forecasts into areas and assets likely to be inundated. Rely heavily on flood intelligence contained in MEMP Flood Response Plans: ➢ Flood information tables; ➢ Inundation extent and hazard maps; ➢ Information contained in the VFD datasets; ➢ Historic flood events – impacts, etc; ➢ Intelligence gained from local knowledge and experience. Opportunity for Wimmera CMA to assist VICSES and LG through provision of flood related expertise and experience re impacts, etc during planning for flood response (ie. in strengthening Flood Response Plans, etc).
RESPONSE	Control Agency for flood response is VICSES while VicPol (MERC) undertakes coordination role. VICSES will establish an ICC and will expect Wimmera CMA, GWMWater and LG to provide Liaison Officers (technical specialists). Flood Response Plans are expected to be maintained by LGs. As Control Agency, VICSES relies on strong involvement from support agencies such as LG, VicPol, Wimmera CMA, GWMWater as well as community involvement. Response driven by LG Flood Response Plans that include local flood intelligence (complete with inundation and flood hazard maps) gained from experience and extracted from flood study deliverables as well as by individual personal and business flood response plans.

Base Charter for the Wimmera Catchment Flood Warning System	
Building Blocks of a Flood Warning System	**Entity Involvement coupled with Local Requirements and Arrangements**
	VICSES liaise with LG on sandbagging and evacuation. Residents and business owners implement individual flood response plans as required. Is especially important at Halls Gap. Flood Response Plans contain SOPs and notification protocols for the operation of weirs (Wimmera River and Yarriambiack Creek) by individual Councils. LG, Wimmera CMA and VICSES have a role in collecting flood related information and intelligence and in: ➢ Feeding this back to the Bureau to further inform the forecasting process; ➢ Presenting it to LG for later inclusion in LG Flood Response Plans and Wimmera CMA FRAP.
REVIEW	For all forecast (and preferably at all river gauge) locations, there is need to establish flood class levels (and associated flows) that are representative of the reach of river associated with the gauge (particularly downstream). These are different from the trigger levels developed for the Upstream of Dimboola (Wail) site for expected flooding at Dimboola and Jeparit and would supersede them. ➢ LG (in conjunction with Wimmera CMA and VICSES) to determine representative flood class levels (and flows) for all forecast locations and advise the Bureau. **See Appendix B for levels established to date**. ➢ LG (in conjunction with Wimmera CMA and VICSES) to determine representative flood class levels (and flows) for all other river gauge locations and advise the Bureau. **See Appendix B for levels established to date**. LG in association with Wimmera CMA and VICSES: ➢ Identify locations in need of a flood forecast and warning service and advise the Bureau, through the VFWCC, accordingly; ➢ Periodically review flood class levels (in consultation with the affected communities) and advise Bureau of need for any changes and / or additions. LG, Wimmera CMA and VICSES have a role in collecting flood data other than real-time data such as provided through the river and rainfall gauge network (eg. hydrologic, flood extent, impacts, damages, photos, and other post-flood data). Must be converted to "intelligence" and included in LG Flood Response Plans and Wimmera CMA FRAP. Bureau, LG, Wimmera CMA, VICSES and VicPol along with all other stakeholders to review performance of all elements of the TFWS following a flood event individually and collectively. LG currently review and update MEMP Flood Response Plans annually. Ideally this will continue with review also occurring after a flood event or the completion of a flood related study. Should tap into Wimmera CMA expertise. Wimmera CMA to review and update the FRAP annually and following a flood event or completion of a flood related study.
AWARENESS	All community information provided during a flood event will be issued or authorised by the VICSES appointed Incident Controller. Property-specific flood charts (undated) were delivered to property owners in

Base Charter for the Wimmera Catchment Flood Warning System	
Building Blocks of a Flood Warning System	**Entity Involvement coupled with Local Requirements and Arrangements**
	Glenorchy in July 2006 and within Horsham, Dimboola, Jeparit and Warracknabeal in August 2009 while flood information brochures were produced for Horsham and Warracknabeal in October 2008 and for Dimboola and Jeparit in December 2008. ➢ Maintenance and periodic rework and re-issue of the property-specific flood charts developed by Wimmera CMA for Glenorchy, Horsham, Dimboola, Jeparit and Warracknabeal will be undertaken on an as-needed basis subject to the availability of funding. ➢ Maintenance and periodic rework and re-issue of flood information brochures developed for Horsham, Dimboola, Jeparit and Warracknabeal by Wimmera CMA in conjunction with LG and VICSES will be undertaken on an as-needed basis guided by VICSES, LGs and the Wimmera CMA subject to the availability of funding. VICSES to initiate and drive development and delivery of all new / future flood awareness programs (eg. FloodSafe) within the Wimmera catchment. Targeting based on information regarding vulnerable communities extracted from Flood Response Plans, property-specific flood charts, community flood information brochures, LG willingness to actively participate on an on-going basis and other intelligence provided by LGs and Wimmera CMA, etc. **VICSES will convene a bi-annual meeting of all organisations involved in this document aimed at reviewing actions and priorities.** NGSC in consultation with VICSES and Wimmera CMA will remind owners and / or operators of residential and business premises in Halls Gap that individual flood response plans should be maintained and that procedures described in them should remain valid and implementable. Note that responsibility for maintenance of Plans rests with individuals. NGSC in consultation with Wimmera CMA and VICSES will undertake annual review and routine maintenance / upgrade of flash flood related signage and displays at Halls Gap. At Halls Gap, NGSC in consultation with Wimmera CMA and VICSES propose to highlight flood risk and further improve the flood awareness of locals and tourists through the development of educational flood related signage and displays.

BOX 1

If one of the repeaters doesn't work, it is likely that data from some field stations will not be received at the Wimmera CMA base station or at the Bureau. While some field stations have multiple paths to the base station through alternative repeaters, path redundancy is not available for all field sites. In the event that all repeater stations fail, data will only be able to be accessed at field stations via a redundant telephone telemetry system. While 3 of the 4 rainfall stations and 9 of the 15 river stations in the Wimmera ERTS network have redundant telephone telemetry, the system is based around equipment that the Bureau will be unable to access after mid 2010.

2 INTRODUCTION

2.1 Overview

This report presents the initial version of the Wimmera catchment Flood Warning Service Charter ("the Charter" – see Section 1) together with relevant background on flood warning matters.

The Charter is a statement of requirements for the delivery of flood forecast and warning services to at-risk communities within the Wimmera catchment (refer to Figure 2-1). It documents the parameters and working arrangements for delivery of services for each location within the catchment identified as in need of a specific flood forecast. It therefore has due regard for communities and assets at risk as well as viable response actions and capacities. It also includes relevant supporting information such as details of the roles and responsibilities of each stakeholder entity with respect to each element of the Total Flood Warning System (TFWS). These have their genesis in the legislation, policies, procedures and other arrangements that comprise the framework for flood warning service delivery within Victoria but are stated in terms specific to the Wimmera catchment. As such the Charter provides a basis for the development and delivery of flood forecast and warning services aimed at meeting identified local needs.

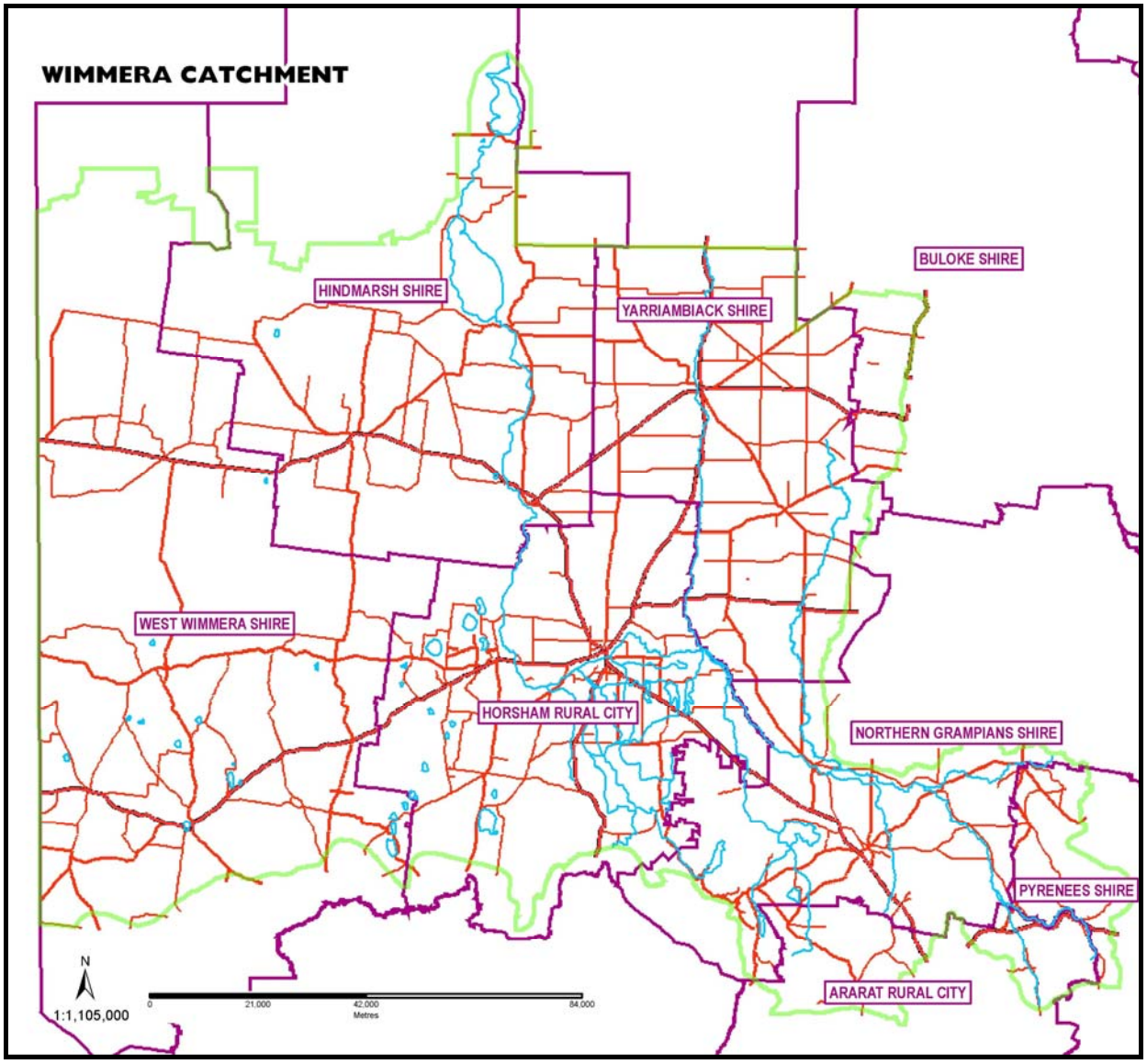

Figure 2-1: The Wimmera Catchment and Local Government Areas

The Charter is a "live" document and will be reviewed and updated annually via a bi-annual meeting convened by VICSES and involving all organisations involved in its development.

It is possible that (in time) the Charter will provide the basis for post-event evaluations of flood forecast and warning system performance on a location by location basis. Any gaps between what is required and service delivery on each of the total flood warning system components could be documented and form the basis for longer term upgrade plans.

The Charter was developed through a consultative process involving key stakeholder entities. It has been endorsed by the following entities:

- Northern Grampians Shire Council (NGSC);
- Horsham Rural City Council (HRCC);
- Hindmarsh Shire Council (HSC);
- Yarriambiack Shire Council (TSC);
- Grampians Wimmera Mallee Water (GWMWater);
- Wimmera Catchment Management Authority (Wimmera CMA);
- Bureau of Meteorology (Bureau);
- Victoria State Emergency Service (VICSES); and
- Victoria Police (VicPol).

2.2 Structure of this Report

The remainder of this report comprises four main sections supported by a number of appendices.

- Section 3 provides background to the development of a flood warning service charter. The place of flood warning systems in a risk based approach to floodplain management is explained and the concept of the TFWS introduced. Stakeholder entity roles and responsibilities are then outlined in the context of the TFWS model and current State arrangements.
- Section 4 presents an overview of the existing flood warning service for the Wimmera catchment.
- Section 5 contains a summary of recent local projects that support an improved TWFS for the Wimmera catchment.
- Section 6 discusses the review and update process for the Charter.

3 FLOODPLAIN MANAGEMENT AND FLOOD WARNING

3.1 Overview

A clear and precise definition of what is meant by 'floodplain management' is reasonably difficult to find. FIFMTF (1992) proposes a definition that sits comfortably within the context of the Victorian Flood Management Strategy (DNRE, 1998) as follows. "*Floodplain Management is a decision making process where the goal is to achieve 'wise use' of the nation's floodplains* and where 'wise use' is categorised as "*any (set of) activities that are compatible with the risk to natural resources (the natural and beneficial functions of the floodplain) and human resources (life and property*)".

There is no simple answer on how to achieve 'wise use' as floods, floodplains and the assets they support are highly variable within and between areas. Further, community perceptions of benefits and risk also vary within and between locations and communities. There is however, general agreement that the key to sound floodplain management is effective floodplain land use management and associated response (rather than physical / structural) modifications. This and the shift to a risk based approach to floodplain management are reflected in current Australian best practice guides (eg. EMA, 1999a; ARMCANZ, 2000) and in Victorian State policy (eg. DNRE, 1998; DoI, 2000a, b & c).

Consistent with the above, emphasis within floodplain management has moved from the implementation of structural solutions for flooding to a much greater reliance on non-structural solutions such as:

- Land use planning which seeks to discourage flood-vulnerable uses from flood prone areas;
- Provision of flood warning services together with measures to assist communities understand and utilise those warnings; and
- Implementation of emergency management measures such as flood response plans to guide property-protecting and life-preserving activities at the actual time of flooding.

Flood warning systems provide a means of gathering information about impending floods, communicating that information to those who need it (those at risk) and facilitating effective and timely responses from them (Mileti and Sorenson, 1990). Thus flood warning systems aim to enable and persuade people and organisations to take action to increase personal safety and reduce the damage caused by flooding[1].

While flood forecasting and warning are recognised as valuable floodplain management strategies (see for example EMA, 1999a; ARMCANZ, 2000; DNRE, 1998; DIPNR, 2005; ASFPM, 2006), it is essential that flood warning systems consider not only the production of accurate and timely forecasts but also the efficient dissemination of those forecasts to response agencies and threatened communities in a manner and in words that elicit appropriate responses based on well developed mechanisms that maintain flood awareness within communities (IDNDR, 1997). Thus, equally important to the development of flood warning mechanisms is the need for robust flood awareness (education) programs to ensure communities are capable of response. The 'flood warning coupled with flood awareness and preparedness' theme is reiterated in BTRE (2002).

3.2 Limitations of Flood Warning Systems

No single floodplain management measure is guaranteed to give complete protection against

[1] More generally, the objective of early warning is to empower individuals and communities, threatened by natural or similar hazards, to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life and damage to property, or nearby and fragile environments (IDNDR, 1997).

flooding. For example, levees can be overtopped when a flood exceeds design height or fail when construction standards are poor or maintenance is inadequate. Likewise, flood response plans can be poorly formulated or applied ineffectually by those responsible for putting their provisions into practice when flooding occurs.

Flood warning systems are, by their very nature, complex. They are a combination of technical, organisational and social arrangements. To function effectively they must be able to:

- Forecast coming floods and their severity (using data inputs that may include rainfall and upstream river heights and / or flows along with modelling techniques);
- Transmit the forecast to those who will be affected (the at-risk communities) in ways that they understand; and
- Elicit appropriate behaviours from the at-risk communities (for example, to protect assets or to evacuate out of the path of the floodwaters).

It is not surprising, given the above, that flood warning systems often work imperfectly and have, on occasions, failed. Indeed, as Handmer (2000) points out, "*flood warnings often do not work well and too frequently fail completely – and this despite great effort by the responsible authorities*". While in some cases the problem is the result of a physical, mechanical or technical failure (for example of gauges or telemetry or of communications equipment during a flood event) or perhaps in defining what constitutes success (or failure), the more common reason is that the systems have not been properly conceptualised at the design stage and in terms of their operation despite the considerable and conscientious efforts of those involved. All too often, too little attention has been paid to issues of risk communication. In particular to:

- Building a local awareness and better understanding of flood risk along with knowledge of what can be done to minimise that risk;
- Determining what information is required by the at-risk community and with what lead times;
- How warnings and required information will be distributed to and within the target communities;
- Ensuring that recipients of warning messages understand what the message is telling them and what it means for their property and individual circumstances in terms of the damage reducing actions they need to take; and so on.

In many cases where flood warning systems have been developed, the bulk of the effort has been devoted to creating and strengthening data collection networks, devising and upgrading forecasting tools and facilities and utilising new dissemination technologies to distribute the forecast to at-risk communities. While all these things are important, they are never sufficient by themselves to ensure that flood warnings are heeded by those who receive them. Other equally vital elements of the system such as risk communication and the comprehension that people have of the flood problems they may face (and the value that warnings can offer) need at least as much attention at the design stage and in system operation. The lesson from many studies of flood warning systems (e.g. Smith and Handmer, 1986; Phillips, 1998; Handmer, 1997; 2000; 2001; 2002) is that the status of all elements of the system must be given appropriate resourcing if the system is to be made capable of functioning effectively.

Studies of flood warning system failures (e.g. Brisbane in 1974, Charleville and Nyngan in 1990, Benalla in 1993, Canada in 1997, England in 1998 and again in 2007, Kempsey and Grafton in 2001, New Zealand in 2005) suggest that the most common reasons for poor system performance are that those in the path of floods have either not understood the significance of the warnings they have received, or have not known that there were things they could do to mitigate the effects of flooding. The result has all too often been

unnecessary loss of private belongings and commercial and industrial plant, stock and records and/or unnecessary risk to life.

Flood warning systems (and investments in their implementation) that over-emphasise the collection of input data and / or the production of flood forecasts relative to the attention given to other elements (such as message construction, the information provided in the messages and the education of flood prone communities about floods and flood warnings) will fail to fully meet the needs of the at-risk communities they have been set up to serve.

3.3 The Total Flood Warning System

In 1995 the Australian Emergency Management Institute, following a national review of flood warning practices after severe flooding in the eastern states in 1990, published a best-practice manual entitled '*Flood Warning: an Australian Guide*' (AEMI, 1995). In describing practices for the design, implementation and operation of flood warning systems in Australia, the manual introduced the concept of the 'total flood warning system' (TFWS). It also re-focused attention on flood warning as an effective and credible flood mitigation measure but made it clear that successful system implementation required the development of some elements that hitherto had been given little attention as well as the striking of an appropriate balance between each of the elements. In particular, it was noted that more attention needed to be given to risk communication and the education of communities about the flood risk, the measures which people could take to alleviate the problems that flooding causes and the place of warnings in triggering appropriate actions and behaviours. It was made clear that implementing a flood warning system wasn't just a matter of installing a data collection network, developing a forecast tool and forwarding predicted flood levels and times to key agencies.

While the 1995 manual has been revised (and is currently undergoing further update) and is now known more formally as Guide 5 (Flood Warning: 2nd edition) of Volume 3 (Guidelines) of Part III, (Emergency Management Practice) of the Australian Emergency Manual Series, (EMA, 1999b) the concepts and terminology introduced in 1995 remain valid.

The TFWS concept is shown in diagrammatic form in Figure 3-1. It represents the many interests that must be brought together to deliver an effective flood warning service: no single agency is likely to be able to provide all the skills required. It therefore makes clear the need for several agencies to play a part, with clearly defined roles and with the various elements carefully integrated, and for the members of flood liable communities to be involved. Put another way, "*effective warning systems rely on the close cooperation and coordination of a range of agencies, organisations and the community*" (DoTARS, 2002).

The philosophy that underlies the TFWS concept coupled with the need for a coherent set of linked operational responsibilities and overlapping functions are documented and discussed in the context of guiding principles for effective early warning in IDNDR (1997). While this discussion paper is developed around the TFWS building blocks, direct parallels can be drawn between the guiding principles documented in IDNDR (1997) and the discussion herein.

Figure 3-1: The Total Flood Warning System (derived from EMA, 1999b)

3.4 Total Flood Warning System Building Blocks

An effective flood warning system requires all system components to be in place and for stakeholders, including members of the flood liable communities, to be working together. Effectiveness can be measured by considering whether people have:

- Received timely and accurate information;
- Understood that information and appreciated what it means for them; and
- Been prompted by the information to initiate relevant damage-reducing or safety-enhancing actions (for example, by avoiding flooded or closed roads, moving property and / or livestock, evacuating to a suitable location, etc) within timeframes appropriate to the circumstances.

Thus an effective flood warning system is made up of several building blocks. Each building block represents a component of the TFWS. The blocks (derived from EMA, 1999b) along with the basic tools to facilitate delivery against each of the TFWS elements, from a State-wide perspective, are represented in Appendix A.

These building blocks need to be appropriately developed and integrated to provide a successful and effective flood warning system. Such a system considers not only the production of an accurate and timely forecast but also the consequences of flooding and an efficient dissemination of that forecast to response agencies and the threatened community in a manner that elicits an appropriate response. An informed and flood aware community is more likely to understand any flood warnings and be motivated to act on them: in other words, to gain the full benefit of the warning system.

4 THE EXISTING WIMMERA FLOOD WARNING SYSTEM

4.1 Arrangements for Flood Warning Service Delivery

Arrangements for the provision of flood warning services in Victoria (and thus for the Wimmera catchment) were formalised in working arrangements approved by the Commonwealth Government in 1987 (Bureau of Meteorology, 1987) and agreed to in-principle by the Victorian Government through the State Disaster Council in early 1988. These arrangements were reiterated and aspects clarified in *Arrangements for Flood Warning Services in Victoria* (VFWCC, 2001) and then endorsed by the relevant Minister at both State and Federal level[2]. State and local entity responsibilities are addressed in the Emergency Management Manual Victoria (State of Victoria – OESC, 2008) as well as in applicable State legislation.

4.2 Who Does What in the Wimmera Catchment

Using the TFWS model and building blocks introduced at Sections 3.3 and 3.4 in the context of the arrangements outlined in Section 4.1, the roles of stakeholder entities in the Wimmera catchment coupled with local requirements and arrangements are summarised in Section 1 (the Charter).

4.3 Flood Forecasting Services Provided by the Bureau of Meteorology

4.3.1 Overview

Flood watches and warnings for the Wimmera River are disseminated through the Bureau of Meteorology's computer system by fax to the media, VICSES, Councils (some also receive the message by email) and other stakeholder agencies and organisations (see Figure 4-1). Watches and warnings, along with all available rain and river level / flow data, radar imagery and other related information, are also posted to the Bureau's website[3].

If the Bureau issues the warning outside normal business hours, the VICSES Regional Duty Officer will call appropriate MEROs or Deputy MEROs to alert them to the situation and the warning. While VICSES does not disseminate flood watches or warnings, it may enhance the warning by issuing community safety information and action statements and may refer relevant agencies and organisations to the Bureau's website or to its own website and the Flood and Storm Information Line (when activated) for key messages and action statements (VICSES, SOP009). Other stakeholder agencies and organisations, including Councils, are responsible for onward dissemination of the warning details.

As part of a State-wide emergency services agreement, ABC Radio has entered into a formal agreement with the Bureau to broadcast, in full, all weather related warnings including those for flood. The agreement provides for the interruption of normal programming at any time to allow the broadcast of warning messages. This agreement will ensure that flood (and other) warnings issued by the Bureau are broadcast in their entirety and as soon as possible after they are received in the ABC's studio.

[2] While this document is firm on 'who pays' with regard to data collection networks it is not so specific on roles and responsibilities for the delivery on other aspects of the TFWS. For example, on the development and delivery of flood awareness programs/activities, the interpretation of flood forecast information at the local level, etc.

[3] Available rainfall data is updated to the Bureau's website every hour while river data is updated every 15 minutes.

4.3.2 Flood Watches

Flood watches provide a 'heads up' of likely flooding. They are aimed specifically at raising flood preparedness within those areas likely to be affected in the period leading up to a flood event in order to reduce threat to life and property. Flood watches are based on an assessment of developing weather situations and indicators of current catchment wetness. They provide generalised statements about the developing weather situation including expected forecast rainfall totals, describe the current state (i.e. wetness) of the catchments within the target area and indicate the streams at risk from flooding. Instructions for obtaining rain and stream level observations and access to updated watches and warnings are also included.

Normally, the Bureau would issue a flood watch 24 to 36 hours in advance of any likely flooding and issue updates as required. If at any time during this period there was an imminent threat of flooding occurring, the flood watch would be upgraded to a flood warning.

4.3.3 Flood Warnings

Flood warnings are firm predictions of flooding based on actual and / or predicted rainfall measurements and current river levels and flows.

For the Wimmera River they are determined through application of the URBS rainfall-runoff model (see Section 5.9) which takes account of catchment characteristics and antecedent conditions (eg. the 'wetness' of the catchment, storage levels within dams, etc) together with current river levels / flows (including releases from dams) and actual as well as likely future rainfall at locations within and adjacent to the catchment[4]. Warnings are categorised as 'minor', 'moderate' or 'major' (see Appendix B for an explanation of these terms and current flood class levels) and indicate the peak height and expected severity of the flood for key locations along the river. Warnings usually include:

- A statement about recorded rainfall and forecast rainfall totals;
- The most recent available river heights, time of observations and trends (rising, steady, falling) at key locations within the Wimmera catchment [eg. Eversley, Crowlands, Navarre, Glynwylln, Stawell, Glenorchy, Lake Lonsdale, Fyans Creek, MacKenzie Creek, Burnt Creek at Wonwondah East, Drung Drung, Horsham (Walmer), Quantong Bridge, Yarriambiack Creek at Jung and Upstream of Dimboola (Wail)];
- The outflow (in ML/d or as a level at the downstream gauge) from Lake Lonsdale[5];
- Forecasts of the height and time of flood peaks at key locations [eg. Glenorchy, Jung, Horsham (Walmer), Quantong Bridge and Upstream of Dimboola (Wail)];
- Weather forecast and the likely impact of expected rainfall on flooding;
- A warning re-issue date and time;
- Contact information; and
- VICSES action statements

Note 1: The term "significant rises" may be used in the early stages of an event when it is clear that river levels will rise but it is too early to say whether they will reach flood level.

Note 2: The term "local flooding" or "flash flooding" may be used for localised flooding resulting from intense rainfall over a small area – for example at Halls Gap**.**

Note 3: The forecast may include additional information on river level behaviour.

[4] The Bureau also utilise satellite and radar imagery to further inform the forecast process. Radars of most relevance to the Wimmera catchment are located at Mount Gambier, Mildura and Melbourne.

[5] Outflow from other storages within the catchment (eg. Lake Fyans, Lake Wartook and Lake Bellfield) are not telemetered with the result that information can not always be provided within flood warnings.

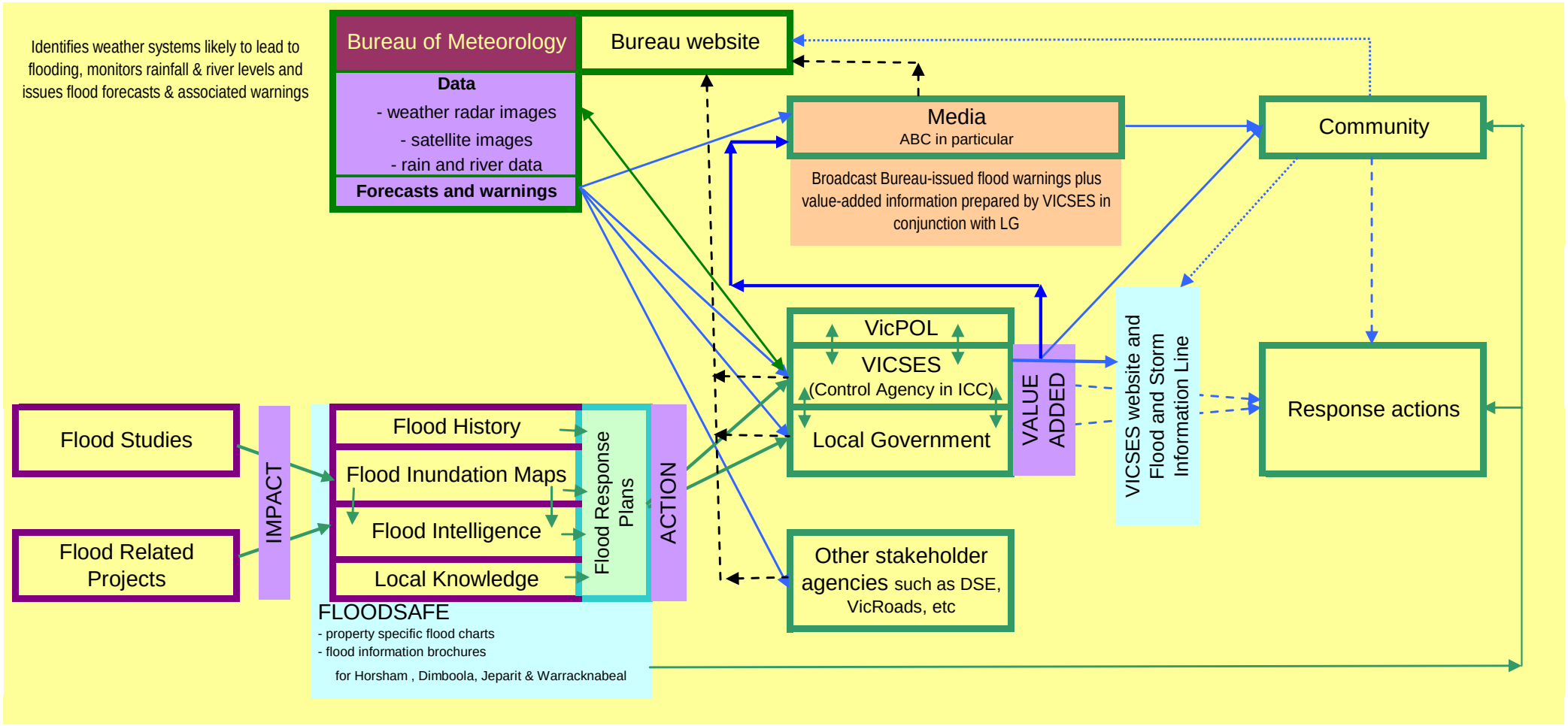

Figure 4-1: Wimmera Catchment Flood Warning & Data Dissemination Schematic

Note 4: In the event of a large flood or a flood following a long dry spell, the forecast may include reference to a recent similarly sized event so that recipients can gain a more personal appreciation of flood severity

Note 5: In the lower parts of the Wimmera River, there are river gauges at (a) the Horsham weir; (b) on the town (right hand) side of the Dimboola Weir structure; (c) on the right hand downstream side of the Wimmera Street Bridge in Dimboola around 1km upstream from the weir; (d) at the Lochiel Railway Bridge; (e) at Antwerp; (f) at Tarrenyurk; and (g) on the town (right hand) side of the Jeparit Weir structure. However, it is the river gauges at Walmer (ARWC No 415200) located approx 3.7km downstream of the Horsham Weir), Quantong Bridge (AWRC No 415261) and Upstream of Dimboola (AWRC No 415256) near Wail that are referred to in flood warnings for the lower Wimmera River

Note 6: Warnings of potential or actual dam failure and thus of potential flooding downstream, will be provided by GWMWater as per and consistent with specific dam safety emergency plans (DSEPs).

Additional information (eg. weather radar and satellite images, updated rain and river level information, details of current watches and warnings) can be obtained from the Bureau's website (www.bom.gov.au/hydro/flood/vic) or for the cost of a local call on ☎ 1300 659 217.

4.3.4 Flash Flooding

Flash flooding[6] is often associated with severe thunderstorms or small scale weather systems that are locally intense and slow moving. The Bureau can forecast the environment in which these sorts of weather events may occur and provides a generalised service to that effect. As it is not yet scientifically possible to predict individual flash flooding events except on time scales of tens of minutes at the very best, the Bureau does not provide warnings for flash flooding for specific creeks and locations.

The Bureau's flash flood warning service is made up of four components that depend on the sophistication of available monitoring and forecast capabilities as follows.

- Generalised warnings (issued to the general public and VICSES, generally as a regional Severe Weather Warning) associated with the onset of heavy rainfall;
- Radar based warnings of rainfall (issued to the media and VICSES as a Severe Thunderstorm Warning) that could lead to flash flooding within specific areas, but only where those areas are covered by suitable weather watch radar and where a threshold intensity, chosen such that its exceedance will produce flash flooding irrespective of existing antecedent catchment conditions, is expected to be equalled or exceeded;
- Area specific predictions of rainfall intensities but only in areas covered by suitable weather watch radar (this service is not available for the Wimmera catchment), and
- Support and advice to local authorities regarding the establishment of automated flash flood warning systems (eg. ALERT systems) and related matters.

The Bureau is continuing to invest heavily in new technologies which include state of the art radars and a method of estimating rainfall accumulations using a combination of radar and electronically telemetered rain gauges. It is expected that these tools will assist in evaluating the likely onset of a possible flash flood event and should assist in the warning process.

[6] The Bureau's policy on the provision of flash flood warning services is enunciated in a document dated May 1996 (Bureau of Meteorology, 1996). Following a definition of flash flooding ("*flooding occurring within about 6 hours of rain, usually the result of intense local rain and characterised by rapid rises in water levels*"), the document describes the policy framework which underpins the flash flood warning service provided by the Bureau. The 1987 working arrangements (Bureau of Meteorology, 1987) also refer to the provision of flash flood warning services and make it clear that the Bureau does not have an exclusive role.

4.3.5 Severe Thunderstorm and Severe Weather Warnings

The Bureau issues severe thunderstorm warnings whenever severe thunderstorms are occurring in an area or are expected to develop or move into the area during the ensuing few hours. The warnings describe the area under threat and the particular hazards likely to be associated with the thunderstorms, including flash flooding. These warnings are distributed to the media, VICSES and a few selected LGs[7] and are available to the public via the internet and various telephone and fax based services. An image (map) is made available with the text of the warning on the Bureau's website to show the area at risk.

Severe weather warnings aim to provide advance (up to 24 hours) notice of very heavy rainfall that is considered likely to lead to flash flooding or storm surge. They are issued by the Bureau to the media, VICSES a few selected LGs[6] when such weather is expected but only when such weather is not the direct result of severe thunderstorms and is not covered by other warnings.

While VICSES does not disseminate severe thunderstorm or severe weather warnings, it may enhance the warnings by issuing community safety information and action statements and may refer relevant agencies and organisations to the Bureau's website or to its own website and the Flood and Storm Information Line (when activated) for key messages and action statements (VICSES, SOP008).

4.4 Water Act 2007 and Water Regulations 2008

In the Commonwealth Water Act 2007 (Part 7, Division 3 Section 126) it states that a person specified in the regulations, must give to the Bureau of Meteorology a copy of the water information specified in the Water Regulations 2008. While the regulations specify the time at which, the format in which and the type of data (including precipitation, river flow and river level) that is to be provided, they do not specify the locations (in terms of sites except in so far as there is a requirement to provide geo-referencing in metadata) for which data is to be provided.

The Water Regulations 2008 divides providers of water information into categories with Category H referring to providers of information for flood warning and forecasting. The agencies deemed to be providers of information are listed in Schedule 2 Part 8 of the regulation. Under this Schedule, Grampians Wimmera Mallee Water, Hindmarsh Shire, Northern Grampians Shire, Wimmera Catchment Management Authority and Yarriambiack Shire Council are listed as providers of water information for flood warning and forecasting.

Category H providers are requirement to transfer data to the Bureau of Meteorology on an hourly basis. For the purposes of complying with the Water Regulations, the transfer of data via the radio network established as part of the upgrade project meets this requirement.

[7] It is not clear how other LGs receive severe thunderstorm and severe weather warnings and related information other than via the media and through general situational awareness.

5 RECENT LOCAL PROJECTS THAT SUPPORT AN IMPROVED FLOOD WARNING SYSTEM

5.1 Flood Studies

Flood studies have been completed for Halls Gap, Glenorchy, Horsham, Dimboola, Jeparit and Warracknabeal over the past few years (Water Technology 2003a, 2003b, 2006a, 2006b, 2006c, 2007, 2008a, 2008b). These studies are supported by rigorous hydrologic and hydraulic investigations that, as a minimum, have necessitated data collation and review, frequency analyses and model calibrations. As a result, the studies provide valuable information about flood risk at these locations. The reports also include flood damage estimates, suites of flood inundation maps for a range of design flood events, and other tools aimed at assisting local interpretation of flood forecast and river height information.

5.2 Flood Response Plans

Municipal Emergency Management Plan (MEMP) Flood Response Plans (generally known as MEMP flood sub-plans previously) have been drafted for each of the Wimmera catchment Municipalities (ie. Northern Grampians, Horsham, Hindmarsh and Yarriambiack). The Flood Response Plans include intelligence derived from an interpretation of outputs from the flood studies mentioned above along with local knowledge of flood characteristics and impacts as well as flood extent and depth information contained in the VFD. Inundation maps delivered by the flood studies are also referred to and included with the Flood Response Plans.

5.3 Flood Response Action Plan

Following the preparation of draft MEMP Flood Response Plans, Wimmera CMA updated their Flood Response Action Plan (FRAP) to ensure that internal flood response arrangements are consistent with wider arrangements and that the "technical expertise" role Wimmera CMA may be asked to provide to VICSES during a flood event can be supplied. The updated FRAP also acknowledges and incorporates the flood intelligence contained in the Flood Response Plans.

5.4 GIS-Resident Flood Datasets

The Victorian Flood Database (VFD)[8] datasets provide an additional source of GIS-resident flood information for the whole Wimmera catchment: recent flood study areas as well as rural areas and locations not covered by flood studies. Available data includes areas delineated as likely to be inundated by 1% AEP flood flows, details of levees and other structures likely to influence flood flow paths and the extents of a number of previous flood events together with historic flood depths. The datasets therefore offer a further source of flood intelligence for emergency managers in times of flood and could be used to assist local response planning and activities. They also provide an indication of where hitherto unrecognised flooding problems / risks exist and where perhaps additional attention to service requirements and standards is warranted.

[8] The DNRE Flood Data Transfer Project (FDTP) was completed during 2001 (Gauntlett and Cawood, 2000). In addition to the collection, collation and upload to GIS of a range of flood related information, the project delivered a series of datasets and maps showing areas inundated by historic floods as well as areas likely to be inundated by 1% AEP flood flows. These are supported by a suite of reports that outline data availability and describe the underlying analyses and rationales. FDTP outputs (now known as the Victorian Flood Database [VFD] datasets) are routinely updated with the results of subsequent flood studies and provide a consolidated source of flood related information.

5.5 Planning Schemes Updated

An additional outcome from the recent flood studies has been the proposed amendment of relevant Planning Schemes to incorporate 1% AEP flood extents (as LSIO, FO and SBO) and associated flood levels (designated flood levels within the study areas).

5.6 Property-Specific Flood Charts

Using information from the recent flood studies, property-specific flood charts (see Figure 5-1)[9] have been developed by Wimmera CMA. They were distributed to all flood-prone properties in Glenorchy in July 2006 and within Horsham, Dimboola, Jeparit and Warracknabeal in August 2009.

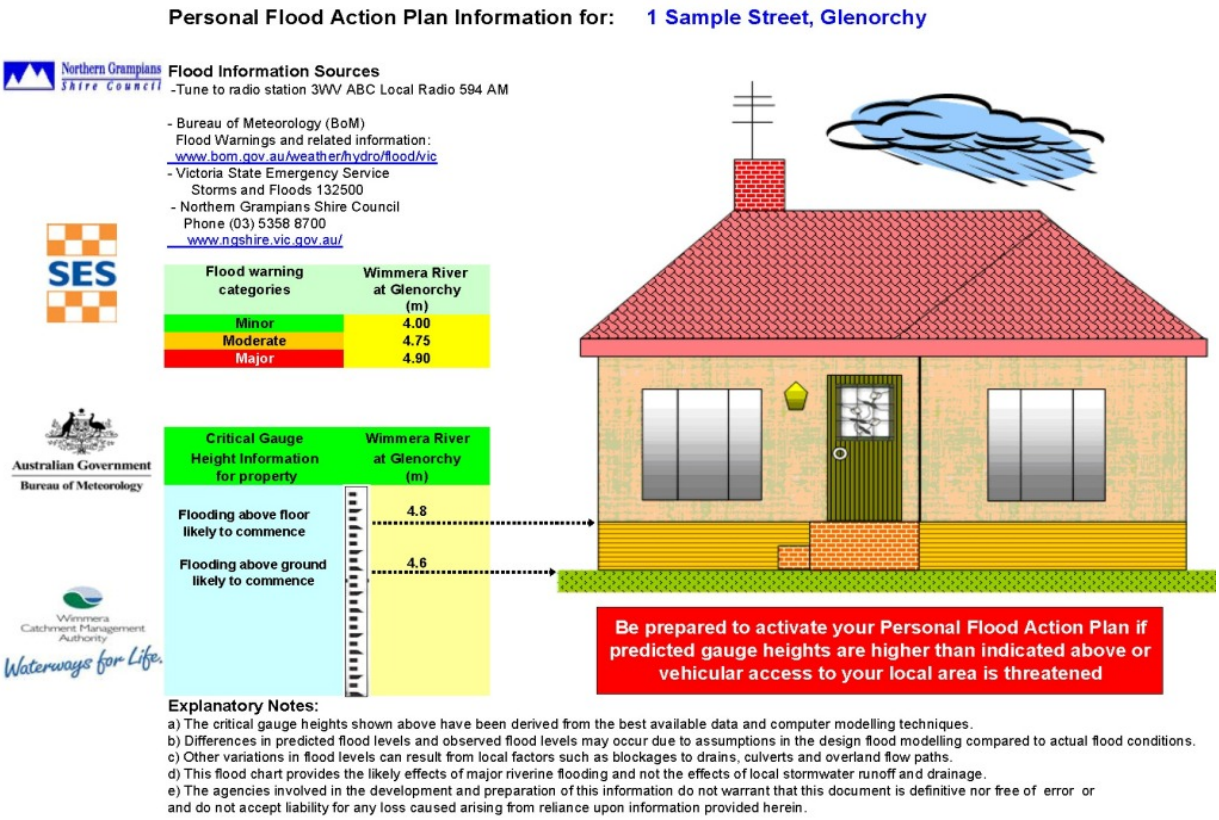

Figure 5-1: Example of a Property-Specific Flood Chart (Water Technology, 2006b)

5.7 Flood Information Brochures

Wimmera CMA in conjunction with VICSES and respective Councils (ie. the HRRC, HSC and YSC) has also overseen the development of flood information brochures for Horsham (dated October 2008), Dimboola (dated December 2008), Jeparit (dated December 2008) and Warracknabeal (dated October 2008). The brochures were distributed throughout the respective towns and are available from Wimmera CMA and councils (over the counter and from websites). The brochures:

- Contain information from the recent flood study reports;
- Provide general details about the stream gauge used to provide local flood information;
- List historic flood heights and dates;

[9] It is noted that the colour coding scheme used for these charts is not consistent with charts developed for other parts of the State, viz: first areas affected = yellow, 2nd areas = orange, last affected = red. The colour coding scheme used for the Wimmera charts aligns with the levels adopted for minor, moderate and major flooding. See Appendix B.

- Give an overview of likely flood behaviour for the 5, 10, 20, 50 and 100 year ARI flood events;
- List emergency contact details along with an outline of the help available from these agencies; and
- Outline what to do before and during a flood event.

5.8 Data Collection Network Upgrade

The network of rain and river stations supporting the Bureau's flood forecast activities has been augmented and expanded through a joint project involving Wimmera CMA, GWMWater, VICSES, NGSC, HRCC, HSC and YSC (see Figure 5-2 and Figure 5-3). A number of the existing data sites were equipped with radio telemetry to enable rain and river data to be transmitted in near real-time to a base station in Wimmera CMA's Darlot Street office in Horsham as well as to the Bureau of Meteorology in Melbourne. At the same time, additional rain and river radio telemetered gauges were installed at key locations within the Wimmera catchment (see Box 2). Together, these stations assist in providing the Bureau with the data needed to support the provision of flood forecasting services for the Wimmera River. They also provide the data necessary to facilitate Council's operation of the weirs at Horsham, Dimboola and Jeparit.

Stage 1 of the project involved upgrading ten (10) existing stream and rainfall gauges from telephone telemetry to radio telemetry, installing three (3) new repeater stations and installing one (1) base station. The base station is installed at the Wimmera CMA's office in Darlot Street, Horsham. The upgraded stations (see Figure 5-2) are located at:

- Wimmera River at Eversley [rain and river]
- Wattle Creek at Navarre [rain and river]
- Concongella Creek at Stawell [rain and river]
- Mount Cole Ck at Crowlands [river]
- Wimmera River at Glynwylln [river]
- Fyans Creek at Fyans Creek [river]
- Mount William Ck at Lake Lonsdale tail gauge [river]
- Wimmera River at Glenorchy Weir [river]
- Burnt Ck at Wonwondah East [river]
- MacKenzie River at MacKenzie Creek [river].

The three new repeater stations are located at Mount Arapiles, Mount William and Ben Nevis.

Stage 2 of the project involved:

- Installation or upgrade of five (5) radio telemetered river stations in the lower catchment (see Figure 5-3) at:
  - Wimmera River at Upstream of Dimboola (Wail) (upgraded to radio telemetry) [rain and river]
  - Wimmera River at Quantong Bridge [river]
  - Wimmera River at Horsham (Walmer) (upgraded to radio telemetry) [river]
  - Wimmera River at Drung Drung (Gross's Bridge) [river]
  - Yarriambiack Creek at Jung [river]
- Development of property-specific flood charts (similar to the ones already completed for Glenorchy) for properties in Horsham, Dimboola, Jeparit and Warracknabeal expected to be flooding by an up to 1% event
- Development of flood awareness brochures for Horsham, Dimboola, Jeparit and Warracknabeal
- Development of a flood warning service charter (this document).

On-going maintenance, fault fix and long term management (including asset replacement) of all field sites in the upgraded data collection network[10] is achieved through the North West Regional Surface Water Monitoring Partnership[11]. and involves contributions from Wimmera CMA, YSC, HSC and HRCC[12]. The role of the Partnership is to provide a coordinated and cost effective approach to water monitoring across the region. Ultimately, all data collected under the Partnership contract is archived to and made available through the Victorian Water Resources Data Warehouse. The additional advantage of the Partnership is the ability to pool resources and share information to maximize benefits to the region.

All hardware associated with the base station together with the database and associated metadata will be maintained in good working order and replaced and / or upgraded as required by Wimmera CMA. Base station software will be maintained by the Bureau of Meteorology through Wimmera CMA.

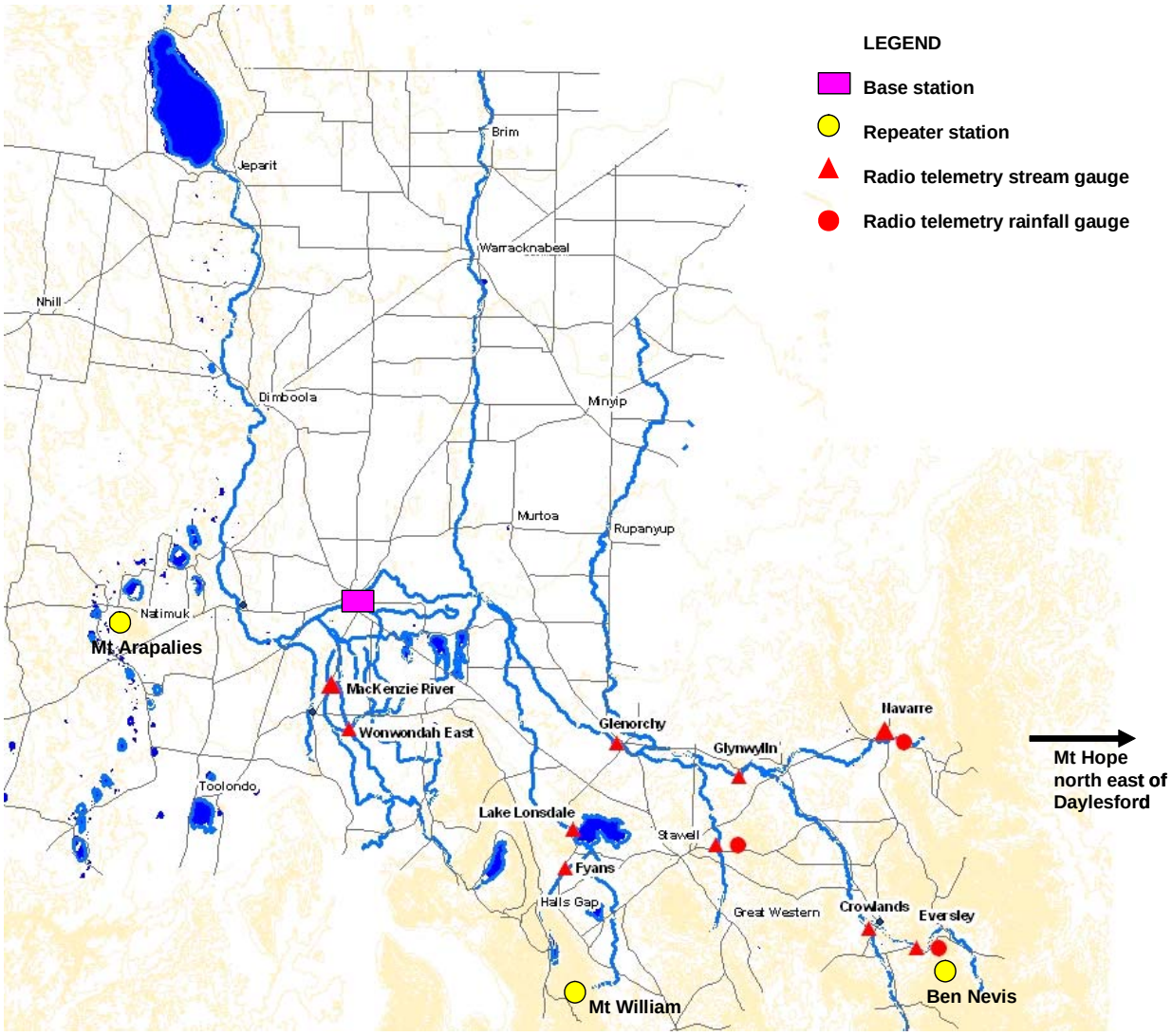

Figure 5-2: Stage 1 – Upgraded and Augmented Data Collection Network

[10] Only one of the repeater stations is included in the North West Regional Surface Water Monitoring Partnership: Mount Arapiles. The other two repeaters are maintained by the Bureau of Meteorology. The base station at Wimmera CMA's Darlot Street Office is also excluded from the Partnership. All base station hardware as well as the database will be maintained in good working order and will be replaced and / or upgraded as required by Wimmera CMA. Base station software will be maintained by the Bureau of Meteorology through Wimmera CMA.

[11] A current membership list can be obtained from the Partnership.

[12] NGSC had not joined the Partnership as at the date of this document.

5.9 Flood Forecast Model

The Bureau of Meteorology has developed an URBS rainfall-runoff model to forecast flood events within the Wimmera catchment (see Section 4.3.3). It provides river level forecasts for Glenorchy, Horsham (Walmer), Quantong Bridge and Upstream of Dimboola (Wail). In addition to being able to incorporate all available data, including forecast rainfall rates and volumes, the model provides a plot of the complete flood hydrograph which shows the characteristics of the (developing) flood in terms of the timing of exceedance of critical levels, the speed of rise, the peak level, duration of the peak as well as expected duration of inundation (or time the water remains above a critical level) and the time it will take for flood waters to recede. On the negative side however, initial forecasts as the river begins to rise can be in error due to difficulties associated with the determination of the rainfall loss rates that apply in the lead up to and during an event and in accounting for in-stream losses (ie. flow attenuation due to transmission losses) as the flood travels through the stream network, particularly after a prolonged dry period. The use of forecast rainfall can also have a negative impact on the accuracy of flood forecasts. The assured availability of actual rainfall and river level / flow information at key locations within the catchment however quickly allows these errors to be corrected.

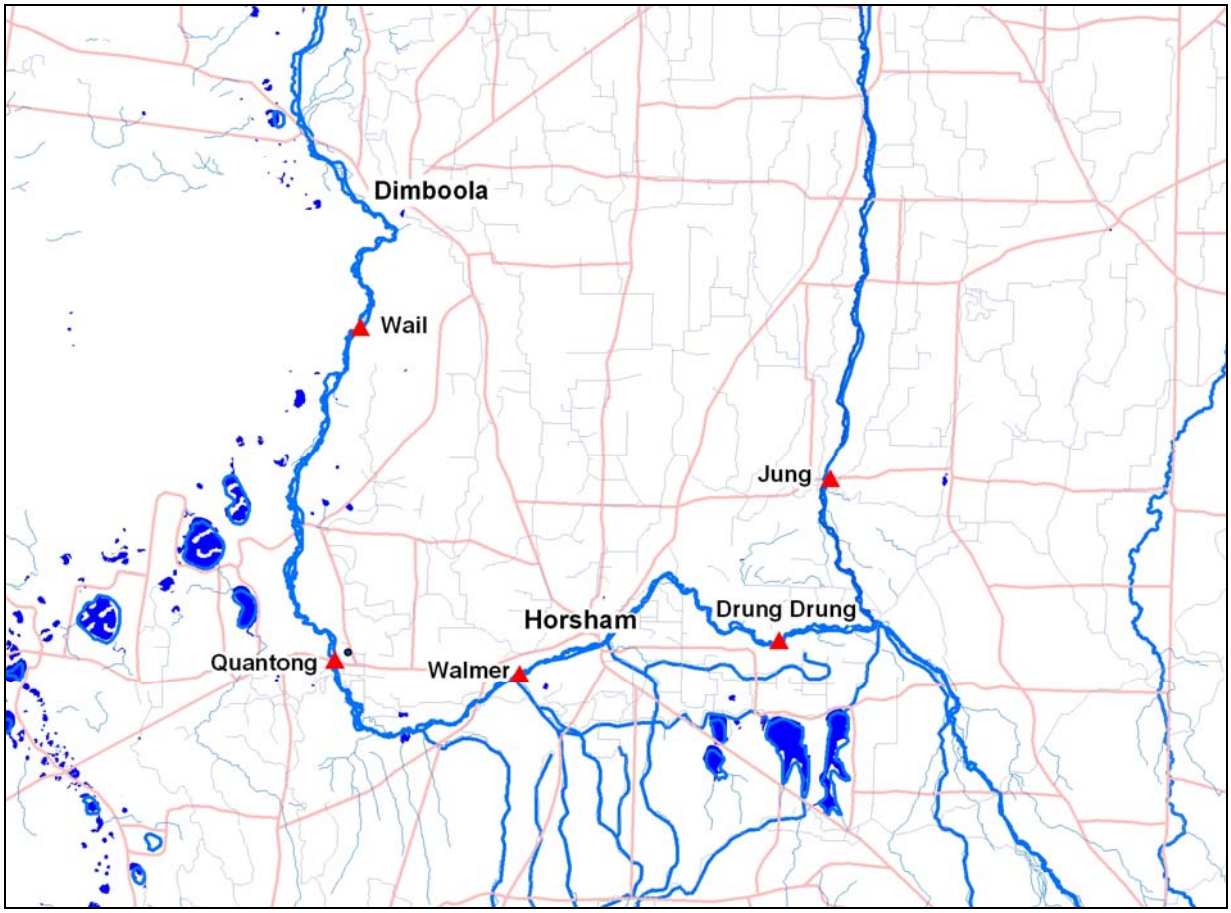

Figure 5-3: Stage 2 - Upgraded and Augmented Data Collection Network

5.10 Flood Warning Service Charter

Flood warning system stakeholder entities engaged in a series of workshops to develop this flood warning service charter. The charter is aimed at ensuring that local needs, considered in the context of local flood response plans and response capacities, drive flood warning service delivery and its further development. The charter is also aimed at making best use of the flood intelligence delivered through recent flood studies and associated work as well as a

result of actual flooding, so as to reduce risk to life and damage to property during future flood events.

6 REVIEW AND UPDATE OF THIS CHARTER

6.1 Overview

The review and update of this Charter is crucial to the continual improvement of the flood warning services for the Wimmera catchment. In particular, reviews and updates must be undertaken on a consultative basis and are needed to:

- Maintain a focus on warning system performance and reliability;
- Ensure that lessons learnt from operational experience are not lost;
- Ensure changes in the catchment, organisations and technology are considered and adopted as appropriate in a timely manner;
- Ensure that any new flood related intelligence is recognised and incorporated in warning system tools as soon as is practical;
- Ensure that any structural flood mitigation or other flood character altering works on the floodplain are also recognised and accounted for in warning system processes.

In turn, any review of the Charter should also trigger a review of the representativeness and adequacy of flood class levels at key locations with particular attention to those areas / locations where structural works have occurred on the floodplain over recent years and / or since the last major flood event.

It is likely that (in time) this Charter will provide the basis for post-event evaluations of flood forecast and warning system performance on a location by location basis. Any gaps between what is required and service delivery on each of the TFWS components could be documented and form the basis for longer term system upgrade plans.

6.2 Review process

6.2.1 Strategic level

A strategic level review should be conducted after each major flood event to examine and assess the following aspects:

- Effectiveness of the Charter to deliver reliable flood warning services to communities within the Wimmera catchment;
- Gaps and uncertainties in the provision of the service arrangements as outlined in this Charter.

The specific scope of the strategic review will be determined before commencement of the review by agreement between all parties involved in this Charter. VICSES shall chair the review. Any unresolved issues shall be referred to the VFWCC.

The VFWCC will be looked to for the coordination of resolution of any unresolved outcomes from the strategic level review as well as for feedback following its review of the outcomes from the strategic level review.

6.2.2 Operational level

Operational reviews should examine and assess the performance of individual entities with respect to roles and responsibilities as identified within this Charter.

Table 6-1 outlines the operational review process.

Operational reviews, as outlined in Table 6-1, will be conducted by the agencies listed. Review outcomes will be provided to all parties to this Charter for comment.

Table 6-1: Operational Review Process

TWFS Component	Timing of review	Aspects under review	Responsible entities
Data Collection and Collation	After a flood event which exceeded moderate flood level at any stream gauge within the catchment.	All required data available when needed. Effective transfer of information regarding GWMWater operations to the Bureau.	Bureau, LG, SES GWMWater
Flood Detection and Prediction	After a flood event which exceeded moderate flood level at any stream gauge within the catchment.	Reliability of flood prediction (peak and timing) for nominated key locations. Effective inclusion of information regarding GWMWater operations into the Bureau's flood prediction	Bureau
Message Construction	After a flood event which exceeded moderate flood level at any stream gauge within the catchment.	Description of current and future flood impacts. Warning messages received and understood by all, including communities. Appropriateness of response actions included in warning messages.	Bureau VICSES LG
Message Dissemination	After a flood event which exceeded moderate flood level at any stream gauge within the catchment.	Warning messages, value added information and supporting data received on time and widely available through easy to access channels. Success in communicating warning messages to communities.	Bureau VICSES LG
Interpretation	After a flood event which exceeded moderate flood level at any stream gauge within the catchment.	Success in determining the impacts of the flood and used to drive response activity. Availability of required flood intelligence (plans, maps, etc) and technical specialists / expertise.	VICSES LG Wimmera CMA
Response	After a flood event which exceeded moderate flood level at any stream gauge within the catchment.	Flood Response Plans up-to-date. Available flood intelligence sufficiently detailed and complete to support the task. Flood intelligence used to inform and pro-actively drive operational response.	LG, VICSES VICSES
Review	After a flood event which exceeded major flood level at any stream gauge within the catchment.	Matters raised in relation to any element of the TFWS considered and actioned in the context of this Charter.	VICSES
Awareness	After a flood event which exceeded major flood level at any stream gauge within the catchment.	Material available within the community is relevant and up-to-date. Communities demonstrated an awareness of flood risk and what to do.	VICSES LG, VICSES

Special Note:
If an MoU is established between the Bureau of Meteorology and GWMWater and as a result of that MoU or its later variation there is need to change the description of TWFS stakeholder entity roles and responsibilities, this Charter must be updated to reflect any such changes.

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8 GLOSSARY OF TERMS

AEMI	Australian Emergency Management Institute
AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
ARMCANZ	Agricultural & Resource Management Council of Australia & New Zealand
ASFPM	Association of State Floodplain Managers, Inc. *(US based)*
AWRC	Australian Water Resources Council
BTRE	Bureau of Transport and Regional Economics *(successor body to BTE)*
CIWS	Community Information and Warning System
CMA	Catchment Management Authority
DIPNR	Department of Infrastructure, Planning and Natural Resources *(NSW)*
DNRE	Department of Natural Resources and Environment *(now DSE)*
DoI	Department of Infrastructure
DoTARS	Department of Transport and Regional Services
DSE	Department of Sustainability and Environment *(successor body to DNRE)*
EMA	Emergency Management Australia
ERTS	Event Reporting Radio Telemetry System
FDTP	Flood Data Transfer Project *(created the datasets that were consolidated to form the VFD)*
FIFMTF	Federal Interagency Floodplain Management Task Force
FRAP	Flood Response Action Plan *(Wimmera CMA document)*
FO	Floodway Overlay *(Planning Scheme)*
GUI	Graphical User Interface
G-MW	Goulburn-Murray Water
GWMWater	Grampians Wimmera Mallee Water
ICC	Incident Control Centre
IDNDR	International Decade for Natural Disaster Reduction
LG	Local Government
LSIO	Land Subject to Inundation Overlay *(Planning Scheme)*
MEMP	Municipal Emergency Management Plan
MERC	Municipal Emergency Response Coordinator
MERO	Municipal Emergency Resource Officer
MoU	Memorandum of Understanding
MW	Melbourne Water
O&M	Operations and Maintenance
OESC	Office of the Emergency Services Commissioner
PMF	Probable Maximum Flood
RWA	Rural Water Authority
SBO	Special Building Overlay *(Planning Scheme)*
SOP	Standard Operating Procedure
TFWS	Total Flood Warning System
UDP	User Datagram Protocol
VFD	Victorian Flood Database *(see FDTP)*
VFWCC	Victorian Flood Warning Consultative Committee

VicPol	Victoria Police
VFWCC	Victorian Flood Warning Consultative Committee
VICSES	Victoria State Emergency Service
VPPs	Victorian Planning Provisions

APPENDIX A – FLOOD WARNING SYSTEM BUILDING BLOCKS AND ENTITY INVOLVEMENT

Building Blocks of a Flood Warning System	Entities Involved in Victoria	Basic Tools
DATA COLLECTION & COLLATION	Bureau provides real time data for flood warning from the national rain gauge network and provides technical assistance for improved data collection networks to support flood warning systems. MW provides real time river and additional rain data for flood warning for the Port Phillip and Westernport region. River and other rain data availability assured through the DSE-managed Regional Surface Water Monitoring Partnerships (involve Bureau, DSE, RWAs, CMAs, LG, etc). LG (as the prime beneficiary) has O&M funding responsibilities for upgraded (flash) flood warning networks not managed by MW.	Data collection network (eg. rain & stream gauges, weather radar, satellite images). System to convey data from field to forecast centre (eg. radio or phone telemetry). Data management system to check, correct, store, display data. Information on water storage levels, inflows and operations. Arrangements and facilities for system / equipment maintenance and calibration. For example, the Regional Surface Water Monitoring Partnerships, data warehousing, etc. Internet enabled GUIs to allow external users to access data in near real-time (eg. Bureau and MW websites).
FLOOD DETECTION & PREDICTION (ie. Forecasting)	Bureau prepares flood forecasts for rural areas and provincial centres. Murray River forecasts determined in conjunction with River Murray Water. MW prepares flood forecasts for the main streams in the Port Phillip and Westernport region. Bureau provides predictions of weather conditions likely to lead to flash flooding for the whole State. LG is primarily responsible for flash flood forecasting but likely to be assisted by MW in the Port Phillip and Westernport region.	Information on critical levels / effects at key and other locations. Appropriately representative flood class levels at key locations. Meteorological analyses and data. Flood forecast techniques (ie. hydrologic and rainfall-runoff models, stream flow and height correlations, simple nomograms based on rainfall). URBS models developed for most of the larger Victorian catchments, including the Wimmera.
MESSAGE CONSTRUCTION	Warning messages are prepared by: ➢ Bureau for weather conditions likely to lead to flash flooding for the whole State; ➢ Bureau for flooding in rural areas and provincial centres; ➢ MW for flooding in the Port Phillip and Westernport region but disseminated through Bureau system; ➢ LG for flash flooding in municipal areas. Opportunity exists for enhancement of messages by VICSES (in association with LG) through inclusion of	Warning messages / products and message dissemination system.

Building Blocks of a Flood Warning System	Entities Involved in Victoria	Basic Tools
	local impacts and related information.	
MESSAGE DISSEMINATION (ie. flood alerting and notification: communicating the warning message and information)	Bureau to VICSES, LG, VicPol, CMAs and media. VICSES alerts relevant agencies and organisations when the Bureau issues flood warning(s) and may enhance flood warning(s) by issuing community safety information and action statements. VICSES may refer relevant agencies and organisations to Bureau website or to VICSES website and Flood and Storm Information Line (when activated) for key messages and action statements. VICSES is not required to disseminate flood watches or warnings. LG disseminate information further. Not clear that messages are disseminated sufficiently to at-risk communities. Bureau provides ALERT system co-operators with ENVIROMON software to collate and display data and initiate flood alerts that are based on exceedance of criteria such as rainfall volumes or rates and / or river levels or rates of rise.	Formal media channels[13] – TV, radio and print. Internet (eg. email, websites – Bureau, VICSES, MW and VicRoads, the latter for road closures, etc). Tape message services (eg. VICSES' Flood and Storm Information Line for key messages and action statements). Other channels such as: ➢ fax / faxstream; ➢ phone / pager (eg. SMS such as offered by StreetData, voice, local communication 'trees'); ➢ voice messaging systems (eg. Xpedite is in use for Maribyrnong, Shepparton-Mooroopna, Euroa, Benalla and Traralgon and being considered for other communities, Telstra's CIWS has potential but while successfully trialled is not yet available); ➢ community radio (eg. FM-88); ➢ road-side signs. Local volunteers acting as wardens (eg. downstream of some reservoirs). Doorknocking. Other opportunities for at-risk communities to confirm warning details.
INTERPRETATION (ie. what does the forecast height mean for me or you)	LG and community but is spread across LG, VICSES and CMAs, none of whom consider it core business. Opportunity for MW and CMAs to assist LG through provision of flood related expertise and experience re impacts, etc – both during planning for and responding to flood.	Interpretative tools (ie. flood inundation maps from experience, studies, VFD and related databases, flood information cards, flood histories, local knowledge, flood response plans that have tapped community knowledge and experience as well as flood related studies and other sources, etc).

[13] As part of a State-wide emergency services agreement, ABC Radio has entered into a formal agreement with the Bureau of Meteorology to broadcast, in full, all weather related warnings including those for flood. The agreement provides for the interruption of normal programming at any time to allow the broadcast of warning messages. This agreement will ensure that flood (and other) warnings issued by the Bureau of Meteorology are broadcast in their entirety and as soon as possible after they are received in the ABC's studio.

Building Blocks of a Flood Warning System	Entities Involved in Victoria	Basic Tools
RESPONSE	VICSES with strong LG, VicPol and community involvement. Should be driven by Flood Response Plans that include local flood intelligence gained from experience and extracted from flood study deliverables as well as personal and business flood response plans.	Flood management tools (eg. MEMP Flood Response Plan complete with inundation maps and past 'intelligence', effective public dissemination of flood information, local flood awareness, individual and business flood action plans, etc).
		Standard operating procedures.
		Community flood education and flood awareness raising, flood response guidelines and related information – all those tools that together work to build flood resilient communities (see the Awareness building block below).
		Personal and business flood action plans (see EMA website, VICSES tool kit).
		Comprehensive use of available experience, knowledge and information.
REVIEW	All stakeholder entities including the VFWCC and communities potentially have opportunity to provide review comments. LG, MW, CMAs and VICSES have a role in collecting post-flood data (hydrologic, flood extent, impacts, damages, etc).	Post-event debriefs (agency, community), etc
		Review and update of personal, business and other flood action plans.
		Collection of flood 'intelligence' and flood damage data during and after the event.
AWARENESS	No clear lead but has been involvement from VICSES, LG, MW and CMAs (and RWAs in some instances).	Identification of vulnerable communities and properties (ie. flood inundation maps, information on flood levels / depths and extents, property-specific flood depths and charts, etc).
		Activities and tools (eg. participative community flood education, flood awareness raising, flood risk communication) that aim to build flood resilient communities (ie. communities that can anticipate, prepare for, respond to and recover quickly from floods while also learning from and improving after flood events).
		VICSES' FloodSafe and StormSafe (flash / stormwater flooding) programs.
		Local flood education plans – developed, implemented and evaluated locally (eg Cities of Maroondah, Whitehorse, Maribyrnong, Benalla, Greater Geelong, Wodonga and Lakes Entrance).
		Flood response guidelines, residents' kits, flood level information, flood

		inundation maps, flood markers, property-specific flood charts (eg. Glenorchy), flood levels in meter boxes (eg. Benalla) and on rate notices, etc.

Flood Warning System Building Blocks

[Based on the Emergency Management Manual Victoria (State of Victoria – OESC, 2008, Commonwealth-State arrangements for flood warning service provision (Bureau of Meteorology, 1987) and VFWCC (2001)]

APPENDIX B – FLOOD CLASS & FLOOD CLASS TRIGGER LEVELS

Flood Class Levels

Minor Flooding: Causes inconvenience. Low lying areas next to watercourses are inundated which may require the removal of stock and equipment. Minor roads may be closed and low-level bridges submerged.

Moderate Flooding: In addition to the above, the evacuation of some houses may be required. Main traffic routes may be covered. The area of inundation is substantial in rural areas requiring the removal of stock.

Major Flooding: In addition to the above, extensive rural areas and / or urban areas are inundated. Properties and towns are likely to be isolated and major traffic routes likely to be closed. Evacuation of people from flood affected areas may be required.

FLOOD CLASS LEVELS for river gauges relevant to the Wimmera catchment				
River Station	**Minor**	**Moderate**	**Major**	**Gauge Zero**
Wimmera River at Glenorchy (see note 1)	**4.0m**	**4.75m**	**4.9m**	
Wimmera River at Horsham				
Wimmera River at Horsham (Walmer)	**2.8m**	**3.1m**	**3.6m**	
Wimmera River at Quantong Bridge (see note 1)	**2.7m**	**3.7m**	**4.8m**	
Wimmera River at Upstream Dimboola (Wail)				
Wimmera River at Dimboola				
Wimmera River at Jeparit				
Yarriambiack Creek at Jung				
Yarriambiack Creek at Warracknabeal				

NOTE 1: as extracted from the Bureau of Meteorology's website (www.bom.gov.au) on 1st June 2008.

It is emphasised that the flood class levels quoted in the table above refer to that part of the river where the flood effects can be related to the gauge reading.

The occurrence of a certain class of flooding at one point in a catchment will not necessarily lead to the same class of flooding at other points. This is because the floodplain physiography and use (and thus flood impact) varies along the river and also because antecedent conditions combined with where and how rainfall occurs (both in time and space) will drive how a flood develops and progresses along the river. For example, major flooding at Glenorchy will not always lead to major flooding at Horsham and similarly, minor flooding at Glenorchy will not preclude major flooding at Horsham.

It is important to remember that flood impact is dependent on more than the peak height or flow. The rate of rise, duration, extent and season of flooding are also important. For this reason, flood class levels can only be considered as a guide to flood severity.

Flood class levels are revised from time to time as experience accumulates and conditions

change in affected areas. It is up to Municipalities to drive this process and to ensure that flood class levels reflect community needs. Flood class levels are a key input to the flood warning service charter.

Flood Class Trigger Levels

There are three townships within the basin (Dimboola, Jeparit and Warracknabeal) which rely on levels at upstream river gauges to indicate the severity of expected flooding. The property specific flood charts for these towns as well as flood response are linked to actual / forecast levels at these river gauges. Levels are listed in the table below.

Note that until a number of flood events have occurred and relevant data has been captured and used to calibrate the flood forecast model used by the Bureau of Meteorology, forecasts for Jung and Upstream of Dimboola (Wail) are likely to be subject to substantial uncertainty and must therefore be considered as indicative only. Forecasts of the expected severity of flooding at Dimboola and Jeparit (derived from levels at Upstream of Dimboola (Wail) and Warracknabeal (derived from levels at Jung) will be similarly indicative only.

FLOOD CLASS TRIGGER LEVELS at river gauges within the Wimmera catchment		
Downstream location	**Expected flood severity at downstream location**	**Upstream river gauge**
		Upstream of Dimboola (Wail)
Wimmera River at Dimboola	Minor	5.3m
	Moderate	5.7m
	Major	6.0m
		Upstream of Dimboola (Wail)
Wimmera River at Jeparit	Minor	5.8m
	Moderate	6.0m
	Major	6.2m
		Jung
Yarriambiack Creek at Warracknabeal	Minor	1.8m
	Moderate	2.0m
	Major	2.1m

NOTE 1: as extracted from property specific flood charts for Dimboola, Jeparit and Warracknabeal.

APPENDIX C – DETAILS OF WORKSHOPS AND ATTENDANCE

Organisation	Workshop No 1 Held 19 March 2008 at GWMWater's Darlot Street office in Horsham	Workshop No 2 Held 31 July 2008 at Yarriambiack Shire offices in Warracknabeal	
Ararat Rural City Council	*Unable to attend*	*Unable to attend*	
Bureau of Meteorology	Elma Kazazic	Elma Kazazic	
Bureau of Meteorology		Peter Zimmermann	
DSE	Mike Edwards	Mike Edwards	
GWMWater	Andrew Barton	*Unable to attend*	
GWMWater	Steve Briggs	*Unable to attend*	
GWMWater	John Martin	*Unable to attend*	
GWMWater	Darcy Prior	*Unable to attend*	
Hindmarsh Shire Council	Janette Fritsch	Gary Salt	
Horsham Rural City Council	David Eltringham	David Eltringham	
Horsham Rural City Council	Kevin Johnson	*Unable to attend*	
Northern Grampians Shire Council	Martin Duke	*Unable to attend*	
Pyrenees Shire Council	*Unable to attend*	*Unable to attend*	
West Wimmera Shire Council	Colin Mibus	*Unable to attend*	
Thiess Services	*Unable to attend*	*Unable to attend*	
VICSES – Regional Officer	Tony Grimme	Tony Grimme	
VICSES – Regional Manager	*Unable to attend*	*Unable to attend*	
VICSES – Director of Operations	*Unable to attend*	*Unable to attend*	
VicPol Ararat	*Unable to attend*	*Unable to attend*	
VicPol Edenhope	*Unable to attend*	*Unable to attend*	

Organisation	Workshop No 1 Held 19 March 2008 at GWMWater's Darlot Street office in Horsham	Workshop No 2 Held 31 July 2008 at Yarriambiack Shire offices in Warracknabeal	
VicPol Horsham	John McTaggart	Mick Salter	
VicPol Nhill	*Unable to attend*	*Unable to attend*	
VicPol Stawell	*Unable to attend*	*Unable to attend*	
VicPol Warracknabeal	Bill Alford	*Unable to attend*	
Wimmera CMA	Hugh Christie	*Unable to attend*	
Wimmera CMA	Paul Fennell	Paul Fennell	
Wimmera CMA	Kate Moller	Kate Moller	
Wimmera CMA	Jacqui Noris	*Unable to attend*	
Yarriambiack Shire Council	Bernie Naylor	Bernie Naylor	
Yarriambiack Shire Council		James Magee	
Yarriambiack Shire Council		Michael Evans	
Consultant – Water Technology	Steve Muncaster	*Unable to attend*	
Consultant – Michael Cawood & Associates	Michael Cawood	Michael Cawood	
TOTAL NUMBER OF ATTENDEES	**21**	**13**	

A G E N D A

W O R K S H O P No 1

10.30am to 3.00pm on Wednesday 19th March 2008
in the large meeting room at GWMWater's Darlot Street office in Horsham

AIM: To identify what stakeholders require from the Wimmera catchment flood warning system as a step towards the development of a flood warning service charter and clarification of roles and responsibilities.

10:30	Tea/coffee on arrival	
10:40	Welcome and introduction Reason for the Workshop and outcomes sought	Steve Muncaster
10:50	Bureau of Meteorology Flood forecasting capabilities and related matters	Elma Kazazic
11:10	Grampians Wimmera Mallee Water Future role in the Wimmera flood warning system	Andrew Barton
11:30	Victoria State Emergency Service What is needed for an effective response	Tony Gimme
11:50	Facilitated discussion – key considerations	Michael Cawood
12:30	Lunch (a light lunch will be provided)	
13:00	Facilitated discussion – bare bones of a charter	Michael Cawood
15:00	Close with tea/coffee	

Note: A discussion paper that provides necessary background to the Workshop along with a number of prompts on matters that perhaps will need to be considered, during both the Workshop and development of the charter, has been circulated with this Agenda. Matters covered in the paper will not be presented at the Workshop: it will be assumed that all participants have read it. As part of your preparation for the Workshop would you also please give some thought to what you think should be included in the charter (see for example 2nd para of the paper).

A G E N D A

W O R K S H O P No 2

10.30am to 3.00pm on Thursday 31 July 2008
at Yarriambiack Shire offices 34 Lyle Street Warracknabeal

AIM: To receive feedback on the draft Wimmera catchment flood warning service charter and to conduct a tabletop walk-through of a flood event in order to verify that the charter adequately and accurately captures existing arrangements and requirements.

Note: The walk-through will not be conducted as an exercise and will not extend into wider emergency management and flood response arrangements. It will focus on the charter, particularly in relation to requirements and service delivery against each element of the total flood warning system.

10:30 Tea/coffee on arrival

10:40 Welcome and introduction
Reason for the Workshop and outcomes sought..... Steve Muncaster

10:50 Facilitated review and feedback session ..... Michael Cawood

12:30 Lunch (a light lunch will be provided)

13:00 Tabletop walk-through of a flood event – verification of the charter..... Michael Cawood

14:40 Discussion - process to finalise and sign-off on the charter..... Michael Cawood

15:00 Wrap-up and close with tea/coffee

APPENDIX D
– SUMMARY OF KEY CONCERNS RAISED AT WORKSHOP NO 1

Confidence limits on forecasts – lead time, level

- Related to flood impacts and conditions at key locations
- Standard limit at gauges (eg. +/- 20 % ?)
- Provide accuracy achieved for historical events (model calibration)
- Provide range of forecast accuracy during the course of the flood event
- Communicate uncertainty in forecast
- What information regarding the uncertainty is communicated to the public?
- Two levels of information required : public and agency
- Need scenarios so get an idea of the likely range of impacts - vary rainfall forecast, prior stream conditions, etc
- Accuracy is more important for major events

Availability of upstream and tributary data

- Locally
- For input to flood forecasts
- To manage weirs (at Horsham, Dimboola and Jeparit)

Access to data

- The Bureau has real time access to all data from the upgraded data collection network
- Bureau access to GWMWater data is not available in real time and after hours access is difficult. Bureau requires access to GWMWater operational and storage data – can have big impact on flood forecast accuracy and timing
- LG is looking for access to any and all data
  - Difficult to give access to base station at GWMWater
  - An SMS message system to LG would work OK.
  - GWMWater to investigate opportunities to achieve LG access data within the Horsham base station – but resourcing not available
- New data (from upgraded data collection network) will be added to Bureau river height bulletins – Bureau to follow up
- Bureau and GWMWater have a clear role to provide available data to the public
- Public interface role needs to be worked through - the "how" of this task
- The base station contains raw data only – GWMWater does not undertake any interpretation.
- Who interprets the data – from flood height to flood extent / impacts? LG in conjunction with VICSES using technical expertise available from Wimmera CMA and GWMWater and intelligence contained in MEMP Flood Response Plans

Data needed to manage weirs

- In the past, information needed for weir operations was passed from upstream to downstream through GWMWater's predecessor organisations
- HRCC and HSC require river flow data to enable decisions on removal of weir boards (not all are automated)
- HRCC require another gauge upstream of Horsham to facilitate management of the Horsham weir – would like a gauge at the Western Highway Bridge
- Need a process for passing information / data between stakeholders
- Travel time difference between Horsham and Walmer

Data sharing

- Liaison required between the Bureau and GWMWater
- Can be achieved through FTP two-way data exchange – Bureau is experienced

Data backup and redundancy arrangements,

- Data collection if breakdown during events – what happens? Not such an issue as sites are independent and data is transferred to two base stations (GWMWater in Horsham and Bureau in Melbourne)
- Is gauge breakdown covered by monitoring partnership? Yes as all gauges are included in the Partnership Agreement.

Ongoing maintenance and ownership of all elements of the upgraded data network

- Monitoring partnership – does it cover flood warning upgrade? Stage 1? Stage 2? Yes
- Flood warning upgrade to be included in monitoring partnership.
- Base station maintenance – who is responsible? Wimmera CMA to check regarding ownership of and responsibilities for warning upgrade base station
- Any need for gauge / station repairs (say during a flood) is covered by the Partnership performance agreement

Who is responsible for what data

- Wimmera catchment – gauges locations and type – Stage 1 and 2 - existing and proposed

Who is collecting what data

Flood warning delivery method: public and agency

- To agency: Bureau fax and email
- To public: ABC Radio provide full text, Bureau can access ABC radio
- Bureau to provide list of forecast address in the Wimmera – to be included in the charter

Level of service

- Flood class levels
  - Are they right?
  - HRCC use flows not levels
  - Table showing thresholds, critical levels
  - Appendix A discussion paper :
  - Drung Drung (Gross's Bridge), Burnt Creek, Jung, Walmer, Wail
- Forecast update frequency
  - How often? Depends on resourcing within Bureau
  - 4 am & 4 pm: updates
  - Same times / frequency for minor, moderate and major…
  - Reissue if there is a significant change in forecast - spot predictions similar to fire weather update

Community understanding / preparedness / awareness

- Current role re interpretation of Bureau-issued flood forecasts rests with LGA in conjunction with VICSES. May change with SES role review
- Interpreted flood information needs to be communicated to local residents
  - VICSES will hold public meeting ahead of flooding in the early stages of an event similar to CFA / DSE fire approach (done in Gippsland in November 2007)
  - How will this work for people in rural areas?
- Wimmera CMA is currently rolling out community information
  - Property-specific flood charts

        - Who is responsible for maintenance / update?
        - Who has the data?
        - How should it be managed?
        - Link into MEMP Flood Response Plan?
        - Three colours used on charts are different to what has been used at Benalla – what is the standard? Need to be consistent across the State
    - Flood information brochures
        - Must be accurate
        - Wimmera CMA to verify all data with VICSES – for example, promote ABC radio as a credible source of flood information rather than local commercial stations
- Historical information provided by GMW Water

What information is required

- Thresholds
- Flood class levels
- Exceedance of critical / key levels
    - Peak level and timing currently provided
    - Flood duration discussed in warning text…..
    - Multiple peaks??
    - Likelihood of further flooding, secondary peaks

Possible direct contact to Bureau - VICSES only…

Forecast locations

- Current locations: Glenorchy, Walmer, Quantong Bridge
- Potential locations: Drung Drung (Gross's Bridge), Horsham, Wail, Jung, Dimboola, Jeparit and Warracknabeal

Availability of data in real time

- Relationship between ICC and MECC
- Lessons learnt
- Forecast time
- Update frequency
    - Of forecast
    - Of rain and river data

Management of headworks channels

- Effect of harvesting on floods
- Effect of decommissioning of channels (due to Wimmera Mallee pipeline) on flooding
- Bureau and GWMWater need to talk

Flash flooding (Halls Gap)

- The Bellfield rain gauge does not provide a good indication of rainfall at Halls Gap
- Need a new rain gauge on Mt Difficult – thought this was part of the data collection network upgrade
- A rain gauge (part of Bureau automatic weather station) exists on Mt William. Data is available from Bureau's website. Not immediately available to Halls Gap.

APPENDIX E1
– BUREAU OF METEOROLOGY DISSEMINATION ADDRESS LIST FOR FLOOD WATCH FOR CAMPASPE, LODDON, AVOCA AND WIMMERA BASINS (BoM product 35800)

Current as at 23rd June 2009

Client Name	Symbolic Address	Actual Address	Medium
ABC - Bendigo	XABCBEND	0354401799	FAX
ABC - Mildura	XABCMILD	0350224599	FAX
ABC - Radio – 3LO Program dir	X3LO	0396261774	FAX
ABC - Radio – 3WV	XABCHORS	0353815399	FAX
ABC - Radio CO-FM - Albury	XABCALBU	0260492099	FAX
Bureau of Meteorology SSU	CSSUW	SSUW	CMSS
CFA - HQ	ECFA	secc.records@cfa.vic.gov.au	EMAIL
CFA - HQ	XCFA	0392628744	FAX
Caxton Printer	PS_CAXTON	caxton	PRINTER
Dept Human Services2	EECC2	ecc@dhs.vic.gov.au	EMAIL
EMERGENCY COMMUNICATIONS VICT	EESTA	estaweather@esta.vic.gov.au	EMAIL
Emergency Services TA-Ballarat	XESTA3	0353373501	FAX
Emergency Services TA-Melbourne	XESTA1	0392063445	FAX
Emergency Services TA-Tally Ho	XESTA2	0392929898	FAX
GFCS	CGFCS	GFCS	CMSS
Hydro CMA Mallee	XMCMA	0350514379	FAX
Hydro CMA Mallee 1	EMCMA	Trent.Wallis@dpi.vic.gov.au	EMAIL
Hydro CMA Wimmera	XWCMA	0353826076	FAX
Hydro Coliban Water Bendigo	XCOLWATB	0354842378	FAX
Hydro Coliban Water Echuca	XCOLWATE	0354802245	FAX
Hydro Coliban Water Serpentine	XCOLWATS	0354378415	FAX
Hydro Council Buloke Shire Birchip	XBULBIRCH	0354922630	FAX
Hydro Council Buloke Shire Charlton	XBULCHARL	0354911723	FAX
Hydro Council Buloke Shire Wycheproof	XBULWYCHE	0354937395	FAX
Hydro Council Central Goldfields Shire	ECTGOLDSH	mero@cgoldshire.vic.gov.au	EMAIL
Hydro Council Gannawarra Shire Kerang	XGANSHKER	0350323023	FAX
Hydro Council Gannawarra Shire Cohuna	XGANSHIRC	0354562173	FAX
Hydro Council Hindmarsh Shire	XHINDSHIR	0353911376	FAX
Hydro Council Horsham Rural City 1	XHORCITY1	0353811007	FAX
Hydro Council Horsham Rural City 2	XHORCITY2	0353825358	FAX

Client Name	Symbolic Address	Actual Address	Medium
Hydro Council Horsham Rural City 3	XHORMECC	0353829791	FAX
Hydro Council Loddon Shire Serpentine	XLODDSHSE	0354378407	FAX
Hydro Council Loddon Shire Wedderburn	XLODDSHWE	0354943003	FAX
Hydro Council Loddon Shire Wedderburn 1	ELODDSHWE	loddon@loddon.vic.gov.au	EMAIL
Hydro Council Mt Alexander Shire Castle	XMTALEXSC	0354711749	FAX
Hydro Council Northern Grampians Shire 1	XNGRASHI1	0354951026	FAX
Hydro Council Northern Grampians Shire 2	XNGRASHI2	0353588798	FAX
Hydro Council Swan Hill Rural City	XCITYSWAN	0350362340	FAX
Hydro Council Yarriambiack Shire	XYARRSH	0353982502	FAX
Hydro Council Yarriambiack Shire 1	EYARRSH1	jmagee@yarriambiack.vic.gov.au	EMAIL
Hydro Council Yarriambiack Shire 2	EYARRSH2	bnaylor@yarriambiack.vic.gov.au	EMAIL
Hydro Council Yarriambiack Shire 3	EYARRSH3	mevans@yarriambiack.vic.gov.au	EMAIL
Hydro DSE Emergency Coordination Centre	XDSEECC	1300134488	FAX
Hydro DSE Emergency Coordinator Centre 1	EDSEECC	ecc.statedutyofficer@dse.vic.gov.au	EMAIL
Hydro DSE Floodplain Management Unit	XDSEFMU	0396378600	FAX
Hydro DSE Floodplain Management Unit 1	EDSEFMU1	Michael.B.Edwards@dse.vic.gov.au	EMAIL
Hydro DSE Floodplain Management Unit 2	EDSEFMU2	Viktor.Brenners@dse.vic.gov.au	EMAIL
Hydro DSE Floodplain Management Unit 3	EDSEFMU3	Ian.Gauntlett@dse.vic.gov.au	EMAIL
Hydro GMW - Axedale	XGMWEPPA	0354392600	FAX
Hydro GMW - Cairn C'n	XGMWCAIR	0354751040	FAX
Hydro GMW - Kerang	XGMWKER	0354522990	FAX
Hydro GMW - Pyramid Hill	XGMWPYRH	0354557102	FAX
Hydro GMW - Rochester	EGMWROCH	Rochy@g-mwater.com.au	EMAIL
Hydro GMW - Tatura 1	EGMWTAT1	PEOperationsSupport@g-mwater.com.au	EMAIL
Hydro GMW - Tatura 2	EGMWTAT2	PERegulatedSystems@g-mwater.com.au	EMAIL
Hydro GMW - Turrumb	XGMWKERA	0354522990	FAX
Hydro Grampians Wimmera Mallee Water	EGWMWAT	Andrew.Barton@gwmwater.org.au	EMAIL
Hydro Grampians Wimmera Mallee Water 1	XGWMWAT1	03 5381 9881	FAX
Hydro HOffice - Flood Warnings	EHOWOPS	flood_warnings_all@bom.gov.au	EMAIL
Hydro Lower Murray Water Kerang	XLMWKERAN	0354503967	FAX
Hydro Lower Murray Water Swan Hill	ELMWSWANH	Maurice.Tyers@lmw.vic.gov.au	EMAIL
Hydro NSW Flood Warning	EHYDNSW	hydronsw@bom.gov.au	EMAIL
Hydro Northern Grampians Flood Committee	XNGFCOMMI	0353584139	FAX
Hydro River Murray Water	XMDBC	0262307278	FAX
Hydro THIESS	XTHIESS	0359615741	FAX

Client Name	Symbolic Address	Actual Address	Medium
Hydro Vic Roads Flood	XVICROAD2	0353811000	FAX
JAAP	CJAAP	JAAP	CMSS
MEDIA – Radio Inter - 2QN	X2QN	0358814613	FAX
MEDIA – Radio Vic 3BO FM/3CV	X3BO	0354302858	FAX
MEDIA – Radio Vic 3MA Mildura	X3MA	0350213730	FAX
MEDIA – Radio Vic 3SH	X3SH	0350329635	FAX
MEDIA – Radio Vic 3WM	X3WM	0353811147	FAX
MEDIA – Radio Vic KLFM 1	EKLFM	klfm@klfm.com.au	EMAIL
MEDIA - TV Vic Win Balla2	EWINBALL2	weather@winvic.com.au	EMAIL
MEDIA - TV Vic ATV10	XATV10	0392751288	FAX
MEDIA - Weathernews Interntl	CWNIW	WNIW	CMSS
MEDIA- TV VIC WINTVBALL3	EKNIGHTM	knightm@winvic.com.au	EMAIL
Metra (NZ Met)	CMNZW	MNZW	CMSS
Newspaper - AGEPOL2	EAGEPOL2	ccleung@theage.com.au	EMAIL
PROD STORE	PROD	PROD	DUMMY
SES - Ballarat	XSESBALL	0353391344	FAX
SES - Bendigo Northwest Region	XSESBEND	0354448400	FAX
SES - SESHQ - State HQ	XSESHQ	0396846623	FAX
SES - Swan Hill	XSESSWAN	0350362200	FAX
The Weather Company	CBTWC	BTWC	CMSS
V-Line	XFREIGHT	0384148741	FAX
Vic Police D24 Ballarat	ED24BALL	d24.2ba@police.vic.gov.au	EMAIL
Vic Police D24 Bendigo	ED24BEND	BENDIGO.D24@police.vic.gov.au	EMAIL
Vic Police D24 Colac	ED24COLAC	COLAC.UNI@police.vic.gov.au	EMAIL
Vic Police D24 Melbourne	ED24MELB	poc@police.vic.gov.au	EMAIL
Vic Police D24 Mildura	ED24MILD	MILDURA-COMMS-OPS-R3D5@police.vic.gov.au	EMAIL
Vic Police D24 Morwell	ED24MORW	morwelld24@police.vic.gov.au	EMAIL
Vic Police D24 Wangaratta	ED24WANG	WANGARATTA.D24@police.vic.gov.au	EMAIL
Vic Police D24 Warrnambool	ED24WARN	WARRNAMBOOL.UNI@police.vic.gov.au	EMAIL
Vic Police Emergency Response	EVPOLEMER	sero@police.vic.gov.au	EMAIL
Vic Police Media Liaison Unit	EVPOLMED	policemedia@police.vic.gov.au	EMAIL
Vic Roads	XVICROAD	0398542381	FAX
WIN TV Ballarat - Gilbert Bani	EWINBALL3	banigj@winvic.com.au	EMAIL

APPENDIX E2
– BUREAU OF METEOROLOGY DISSEMINATION ADDRESS LIST FOR FLOOD WARNINGS FOR THE WIMMERA CATCHMENT (BoM product 36830)

Current as at 23rd June 2009

Client Name	Symbolic Address	Actual Address	Medium
ABC - Bendigo	XABCBEND	0354401799	FAX
ABC - Mildura	XABCMILD	0350224599	FAX
ABC - Radio - 3LO Program dir	X3LO	0396261774	FAX
ABC - Radio - 3WV	XABCHORS	0353815399	FAX
Bureau of Meteorology SSU	CSSUW	SSUW	CMSS
Caxton Printer	PS_CAXTON	caxton	PRINTER
EMERGENCY COMMUNICATIONS VICT	EESTA	estaweather@esta.vic.gov.au	EMAIL
Emergency Services TA-Ballarat	XESTA3	0353373501	FAX
Emergency Services TA-Melbourn	XESTA1	0392063445	FAX
Emergency Services TA-Tally Ho	XESTA2	0392929898	FAX
GFCS	CGFCS	GFCS	CMSS
Hydro CMA Wimmera	XWCMA	0353826076	FAX
Hydro Council Hindmarsh Shire	XHINDSHIR	0353911376	FAX
Hydro Council Horsham Rural City 1	XHORCITY1	0353811007	FAX
Hydro Council Horsham Rural City 2	XHORCITY2	0353825358	FAX
Hydro Council Horsham Rural City 3	XHORMECC	0353829791	FAX
Hydro Council Northern Grampians Shire 1	XNGRASHI1	0354951026	FAX
Hydro Council Northern Grampians Shire 2	XNGRASHI2	0353588798	FAX
Hydro Council Yarriambiack Shire	XYARRSH	0353982502	FAX
Hydro Council Yarriambiack Shire 1	EYARRSH1	jmagee@yarriambiack.vic.gov.au	EMAIL
Hydro Council Yarriambiack Shire 2	EYARRSH2	bnaylor@yarriambiack.vic.gov.au	EMAIL
Hydro Council Yarriambiack Shire 3	EYARRSH3	mevans@yarriambiack.vic.gov.au	EMAIL
Hydro DSE Emergency Coordination Centre	XDSEECC	1300134488	FAX
Hydro DSE Emergency Coordinator Centre 1	EDSEECC	ecc.statedutyofficer@dse.vic.gov.au	EMAIL
Hydro DSE Floodplain Management Unit	XDSEFMU	0396378600	FAX
Hydro DSE Floodplain Management Unit 1	EDSEFMU1	Michael.B.Edwards@dse.vic.gov.au	EMAIL
Hydro DSE Floodplain Management Unit 2	EDSEFMU2	Viktor.Brenners@dse.vic.gov.au	EMAIL
Hydro DSE Floodplain Management Unit 3	EDSEFMU3	Ian.Gauntlett@dse.vic.gov.au	EMAIL
Hydro Grampians Wimmera Mallee Water	EGWMWAT	Andrew.Barton@gwmwater.org.au	EMAIL
Hydro Grampians Wimmera Mallee Water 1	XGWMWAT1	03 5381 9881	FAX

Client Name	Symbolic Address	Actual Address	Medium
Hydro HOffice - Flood Warnings	EHOWOPS	flood_warnings_all@bom.gov.au	EMAIL
Hydro NSW Flood Warning	EHYDNSW	hydronsw@bom.gov.au	EMAIL
Hydro Northern Grampians Flood Committee	XNGFCOMMI	0353584139	FAX
Hydro River Murray Water	XMDBC	0262307278	FAX
Hydro THIESS	XTHIESS	0359615741	FAX
Hydro Vic Roads Flood	XVICROAD2	0353811000	FAX
JAAP	CJAAP	JAAP	CMSS
MEDIA - Radio Vic 3BO FM/3CV	X3BO	0354302858	FAX
MEDIA - Radio Vic 3MA Mildura	X3MA	0350213730	FAX
MEDIA - Radio Vic 3SH	X3SH	0350329635	FAX
MEDIA - TV Vic Win Balla2	EWINBALL2	weather@winvic.com.au	EMAIL
MEDIA - TV Vic ATV10	XATV10	0392751288	FAX
MEDIA - Weathernews Interntl	CWNIW	WNIW	CMSS
MEDIA- TV VIC WINTVBALL3	EKNIGHTM	knightm@winvic.com.au	EMAIL
Metra (NZ Met)	CMNZW	MNZW	CMSS
PROD STORE	PROD	PROD	DUMMY
SES - Ballarat	XSESBALL	0353391344	FAX
SES - SESHQ - State HQ	XSESHQ	0396846623	FAX
The Weather Company	CBTWC	BTWC	CMSS
V-Line	XFREIGHT	0384148741	FAX
Vic Police D24 Ballarat	ED24BALL	d24.2ba@police.vic.gov.au	EMAIL
Vic Police D24 Bendigo	ED24BEND	BENDIGO.D24@police.vic.gov.au	EMAIL
Vic Police D24 Colac	ED24COLAC	COLAC.UNI@police.vic.gov.au	EMAIL
Vic Police D24 Melbourne	ED24MELB	poc@police.vic.gov.au	EMAIL
Vic Police D24 Mildura	ED24MILD	MILDURA-COMMS-OPS-R3D5@police.vic.gov.au	EMAIL
Vic Police D24 Morwell	ED24MORW	morwelld24@police.vic.gov.au	EMAIL
Vic Police D24 Wangaratta	ED24WANG	WANGARATTA.D24@police.vic.gov.au	EMAIL
Vic Police D24 Warrnambool	ED24WARN	WARRNAMBOOL.UNI@police.vic.gov.au	EMAIL
Vic Police Emergency Response	EVPOLEMER	sero@police.vic.gov.au	EMAIL
Vic Police Media Liaison Unit	EVPOLMED	policemedia@police.vic.gov.au	EMAIL
Vic Roads	XVICROAD	0398542381	FAX
WIN TV Ballarat - Gilbert Bani	EWINBALL3	banigj@winvic.com.au	EMAIL