Local Emergency Management Committee

MINUTES

Section 38 of the Emergency Management Act 2005

Wednesday 8 November 2017

Committee Brief:

To advise and assist the Local Government in ensuring that the Local Emergency Management arrangements are established for its district; to liaise with public authorities and other persons in the development, review and testing of Local Emergency Management arrangements; and to carry out other emergency management activities as directed by the SEMC or prescribed by the Regulations.

Members as per Council Resolution 172/10/17

- Councillor Chitty, Council Member
- Councillor Dow, Council Member
- Councillor Twine, Council Member
- Police Officer in Charge – Toodyay
- Chief Executive Officer – Shire of Toodyay
- Chief Bush Fire Control Officer (CBFCO)
- Department of Child Protection and Family Support representative
- Community Emergency Services Manager (CESM)
- Community Emergency Management Coordinator (CEMO)
- Local Recovery Coordinator
- Deputy Recovery Coordinator
- DFES District Manager Representative
- Main Roads Representative
- Toodyay Volunteer Fire & Rescue representative
- Silver Chain Service Coordinator Representative
- St John Ambulance representative
- Red Cross Representative
- Ranger Representatives
- Principal, Toodyay District High School
- Health/Medical Representative
- Main Roads Representative
- Councillor Bell, Council Deputy Member
- Councillor Welburn, Council Deputy Member

MINUTES OF THE LOCAL EMERGENCY MANAGEMENT COMMITTEE MEETING
HELD IN SHIRE OF TOODYAY COUNCIL CHAMBERS ON 8 NOVEMBER 2017

Preface

When the CEO approves these Minutes for distribution they are in essence "Unaccepted" until the following Local Emergency Management Committee Meeting, where the Minutes will be accepted as circulated subject to any amendments made by the members of the Committee.

The "Accepted" Minutes are then signed off by the Chairperson.

Attachments that formed part of the Agenda, in addition to those tabled at the Meeting are incorporated into a separate attachment to these Minutes.

Unaccepted Minutes

These minutes were approved for distribution on 27 November 2017.

Stan Scott
CHIEF EXECUTIVE OFFICER

Accepted Minutes

These minutes were accepted at a meeting held on 14.2.18.....

Signed: ..Therese Chitty.....

Note: The Chairperson at the meeting at which the minutes were accepted is the person who signs above.

CONTENTS

Local Emergency Management Committee

MINUTES

1. MEETING OPENING

N Rodger, Local Recovery Coordinator, declared the meeting open at 5.07pm.

Members

Cr T Chitty	Council Member
Cr E Twine	Council Member
Mrs N Rodger	Local Recovery Coordinator
Mrs K Stonham	Deputy Recovery Coordinator
Mr C Wroth	St John Ambulance representative
Mr T Bendtsen	DFES Representative
Mr C Stewart	Chief Bush Fire Control Officer
Mr D Ball	Principal, Toodyay District High School
Mr R Koch	Community Emergency Services Manager

Staff

Nil

Visitors

Mr J Hansen	Bushfire Risk Management Planning Coordinator
Mr T Dunlop	St John Community Paramedic

Apologies

Cr J Dow	Council Member
Cr R Welburn	Deputy Council Member
Mrs J Spadaccini	Department of Child Protection representative
Mr S Scott	Chief Executive Officer – Shire of Toodyay
Mr I McGregor	Toodyay Volunteer Fire & Rescue representative (VFRS)

2. ELECTION OF PRESIDING MEMBER

2.1 Election of Presiding Member - LEMC

Date of Report:	2 November 2017
File Reference:	LEG009/FIR27
Author:	S Scott – CEO
Responsible Officer:	S Scott – CEO
Attachments:	Nil

PURPOSE

To elect the position of Presiding Member of the Committee and if the Committee so chooses, a Deputy Presiding Member.

BACKGROUND

At a Special Council Meeting held on 23 October 2017, Council appointed the following members to the Local Emergency Management Advisory Committee:

- Councillor Chitty, Council Member
- Councillor Dow, Council Member
- Councillor Twine, Council Member
- Police Officer in Charge – Toodyay
- Chief Executive Officer – Shire of Toodyay
- Chief Bush Fire Control Officer (CBFCO)
- Department of Child Protection and Family Support representative
- Community Emergency Services Manager (CESM)
- Community Emergency Management Coordinator (CEMO)
- Local Recovery Coordinator
- Deputy Recovery Coordinator
- DFES District Manager Representative
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- St John Ambulance representative
- Red Cross Representative
- Ranger Representatives
- Principal, Toodyay District High School
- Health/Medical Representative
- Councillor Bell, Council Deputy Member
- Councillor Welburn, Council Deputy Member

OFFICER COMMENT

The CEO or his representative will preside over the meeting until the election of the Presiding Member has been completed.

OFFICERõS RECOMMENDATION

The Local Emergency Management Committee:

1. Elects …… as Presiding Member; and
2. Elects …… as Deputy Presiding Member.

Cr E Twine nominated Cr T Chitty as Presiding Member. Cr Chitty accepted the nomination.

OFFICERõS RECOMMENDATION/DECLARATION/LEMC RESOLUTION NO. 06/11/17

MOVED R Koch **SECONDED** C Stewart

1. Cr T Chitty is elected as unopposed Chairperson of the Local Emergency Management Committee; and
2. A Deputy Chairperson is to be nominated at a meeting where the elected Chairperson is an apology.

MOTION CARRIED

Cr Chitty assumed the Chair.

3. TABLING OF MINUTES FROM PREVIOUS MEETING

3.1 Local Emergency Management Committee Meeting held on 9 August 2017

OFFICER'S RECOMMENDATION/LEMC RESOLUTION NO. 07/11/17

MOVED C Stewart **SECONDED** T Chitty

That the Minutes of the Local Emergency Management Committee Meeting held on 9 August 2017 be accepted as circulated.

MOTION CARRIED

4. BUSINESS ARISING FROM MINUTES

Nil

4.1 Review of the LEMC Status Report (Action List)

Nil

5. CORRESPONDENCE

5.1 Inward Correspondence

Nil

5.2 Outward Correspondence

Nil

6. STANDING ITEMS TO BE CONSIDERED AT EACH MEETING

6.1 Update of Contacts (committee and emergency)

A request was made by T Bendtsen as follows:

"Due to changes with staffing within DFES the main Northam Regional DFES Office number and his own be the only contacts listed."

6.2 Any ISG Activations/ or incidents - debrief.

Nil

6.3 Any LEMC exercise held ï reports and/or debrief

6.3.1 Desktop Exercise (August 2017 meeting)

MOTION/LEMC RESOLUTION NO. 08/11/17

MOVED T Bendtsen **SECONDED** C Stewart

That the exercise report tabled be accepted.

MOTION CARRIED

6.4 Training ï future dates

WALGA provides Emergency Management training. Information is on their website at the following link: http://walga.asn.au/Training/Our-Courses/Emergency-Management-Courses.aspx

6.5 Funding ï NDRP or other (e.g. community safety grants)

Nil

7. DOCUMENTATION (to be considered at meetings where appropriate)

7.1 LEMC Meeting and Exercise Schedule

DFES will be conducting a level 2 bushfire exercise that will be "Recovery Committee based."

7.2 Exercise Report

Nil

7.3 Business Plan to be developed, reviewed, adopted?

Nil

7.4 Annual Report due?

The Annual Report has been completed.

8. PROJECT PROGRESS REPORT

8.1 Flood Level Classification

Assessment has been undertaken with DFES, Department of Water and the Bureau of Meteorology regarding the major flood levels and the impact on Toodyay.

Current flood service levels are:

- 2.5 m - Minor
- 3.5 m - Moderate

- 4.0 m - Major

The recent floods in February 2017 saw flood levels reach 4.08m.

The plan is to change flood levels to:

- 4.0 m - Minor
- 5.0 m - Moderate
- 6.0 m - Major

Mapping of flood zone areas has been done for the Shire of Beverley which, when utilised, was very accurate. Mapping will be done for the Shire of Toodyay within the next 12 months.

9. AGENCY UPDATES

9.1 Toodyay District High School

Principal D Ball and R Koch (CESM) had a meeting to discuss and provide an overview of the LEMC.

A copy of the school's evacuation plans and a copy of the bus routes has been supplied to the CESM.

9.2 DFES

There has been a change of staff at the DFES office in Northam. There is not a lot of local knowledge.

Currently looking for more volunteers.

There is training of volunteers and IMT's.

There is to be a Level 2 exercise in 2018.

Signed: J. Chitty
Presiding Member
Date: 14.2.18

9.3 St John Ambulance

An exercise was conducted with Fire and Rescue which was very successful.

The mobile tower in Julimar is going ahead with another possible tower in Coondle. This will help with coms.

We currently have roughly 60 jobs a month.

9.4 C Stewart

The rural ~~alert~~ urban interface exercise held at Wundowie was discussed.

9.5 R Koch

State Risk Program workshop in Northam on Wed 15 Nov 2017 between 10.00am and 4.00pm.

There will be four Local Governments in attendance and the workshop will cover storm, earthquake and flood.

Attendance by as many agencies as possible is required. If you are not able to attend, please send proxy.

10. PRESENTATIONS OR EXERCISES

J Hansen, Bushfire Risk Management Program Coordinator, provided an overview of his role and project objectives as follows:

- Objective to perform tenure blind bush fire risk assessments compliant with Westplan Fire.
- Working on four Local Government's (Beverly, York, Northam and Toodyay).
- Shire of Toodyay allocation – 2 days per fortnight.
- Supported by Tyron McMahon (Bushfire Risk Management Officer) – DFES Employee.
- No cost to Shire of Toodyay – Fully funded by DFES
- Assessments prioritised by Human Settlement and conducted with assistance of assessment software.

11. LEMA AND RECOVERY PLAN REVIEW

The LEMA was reviewed 12 months ago.

The desktop exercise in August 2017 did not bring up any issues with the LEMA.

12. GENERAL BUSINESS

Nil

13. CONFIRMATION OF NEXT MEETING

The next Local Emergency Management Committee Meeting is scheduled for Wednesday 14 February 2018, commencing at 5.00pm.

14. CLOSURE OF MEETING

The Chairperson declared the meeting closed at 5.55pm.

Attachments to Minutes

Local Emergency Management Committee **Wednesday 8 November 2017**

BUSINESS ARISING FROM MINUTES

4.2 Review of LEMC Status Report **1**

STANDING ITEMS TO BE CONSIDERED

6.1 Update of Contacts **SCA**
Note: Circulated as a confidential soft copy

6.3 Report on August Exercise **3**

PROJECT PROGRESS REPORT

8.1 Flood Level Classifications **12**

Attachments:

AGENCY UPDATES

9.1 District Emergency Services Officer – Wheatbelt **SCA**
Note: Circulated at the meeting as a confidential soft copy.

Administration Centre
15 Fiennes Street (PO Box 96)
TOODYAY WA 6566
T: 9574 9300
F: 9574 2158
E: records@toodyay.wa.gov.au

STATUS REPORT

Local Emergency Management Committee

Including Recommendations made to Council, Action List and Completed items

Recommendations to Council

Meeting Date	Item	Title/Description of Item	Resp. Officer	Proposed / Notes / Actions to be taken	Deadline

ACTION LIST (responses provided regarding other matters)

Meeting Date	Item	Title/Description of Item	Resp. Officer	Status / Action / Notes or Comment

COMPLETED RECOMMENDATIONS (to Council) and ACTIONS completed.

Meeting Date	Item	Title/Description of Item	Resp. Officer	Status / Action / Notes	RESOLUTION NO.
9/8/17	3.2.2	That Rangers become an occasional member of the LEMC, invited as required for particular agenda items.	CESM	This recommendation from LEMC will go to the Council for a decision with the report that will go to Council after the October election.	23 Oct 2017 Resolution No 172/10/17

STATUS REPORT

Local Emergency Management Committee

Including Recommendations made to Council, Action List and Completed items

COMPLETED RECOMMENDATIONS (to Council) and ACTIONS completed.					
Meeting Date	**Item**	**Title/Description of Item**	**Resp. Officer**	**Status / Action / Notes**	**RESOLUTION NO.**
8 Feb 2017 LEMC	5.4	Training – Future Dates	CESM	Need to look at exercises that can be done on the ISG. Needs to define roles when the person is not operational. Look to incorporate training regarding the ISG at the August 2017 LEMC meeting. OEM has organised training on the 21 June 2017 with York. Y Grigg will organise an invitation to observe once the training has been finalised. CESM Comment – Yvette is currently on leave, and as such I am unable to confirm. Have sought to confirm alternate exercise via Jo Spadaccini.	Advised this action is complete 20.11.2017 NFN13328
10 May 2017	7.1	Risk Workshop – York	CESM and Y Grigg	Action: CESM and Y Grigg to report back to next LEMC Meeting re: LEMC's five worst case scenarios as follows: Fire; Earthquake; Chemical Spill/ dams burst; Storm; & Train Derailment (dangerous goods). CESM Comment – Require further clarity as to the intended outcomes of this action. Will liaise with Yvette once back from leave (prior to the meeting).	Advised this action is complete 20.11.2017 NFN13328

ANNEX C

Post Exercise Report

1. **Agency / Region / District / Area**
   Shire of Toodyay

2. **Date of Exercise**
   09 August 2017

3. **Participating Agencies**
   Shire of Toodyay
   WA Police
   Department of Fire and Emergency Services
   Toodyay Volunteer Fire and Rescue
   Department of Communities

4. **Type of Exercise**
   Discussion (Workshops/Desktop)

5. **Aim of Exercise:**
   To test the effectiveness of the both Shire's Local Emergency Management Arrangements.

6. **Objectives of the Exercise:**
   1. To test the understanding of the LEMC in regard to the roles and responsibilities in the coordination of a local evacuation centre.
   2. To test how different situations or scenarios could be handled in the context of the scenario.
   3. To measure the effectiveness, accuracy and currency of the LEMA.

7. **Key Lessons Learnt:**
   Limitations of Toodyay evacuation facilities.
   Some Gaps in Contacts and Resource Register.

8. **Actions re Key Lessons Learnt:**
   1. Add CWA Contacts to Contact and Resources Register.
   2. Add Adding Op-Shop Contacts to Resources Register.

9. **Further comments.**
   Exercise Documentation Attached – Recorded responses listed in Red.

Exercise Brief

DISCUSSION EXERCISE "EVACUATION CENTRE"

Wednesday 9th August 2017

Prepared by Jo Spadaccini,
District Emergency Services Officer, Wheatbelt District,
Department of Communities – Child Protection and Family Support Division

Preparing Authority
District Emergency Services Officer, Wheatbelt District, CPFS

General Instructions:
References

- State Emergency Management Act 2005
- State Emergency Welfare Plan (Interim)
- State Emergency Welfare Plan Annex A - Registration and Reunification (Interim)
- State Emergency Welfare Plan Annex B - Reception
- State Emergency Welfare Plan Annex C - Disaster Information Support and Care Centre
- Shire's Local Emergency Management Arrangements
- CPFS Local Emergency Management Plan for the Provision of Welfare Support – Northam District – Dec 2015

Introduction

Exercise Style
Discussion Exercise

Location/Date/Timing
"Evacuation Toodyay" will be conducted on Wednesday 9/8/2016 on conclusion of the LEMC meeting at the Toodyay Shire Office

Reason for Exercise
To increase knowledge on the set up and running of an evacuation centre prior to CPFS arrival, including roles and responsibilities of Local Government and other support agencies.

"Evacuation Toodyay" has been designed for the Toodyay Local Government staff to organise and direct other assisting agencies to activate an evacuation centre after hours.

It is also an opportunity for participants to discuss scenarios and make decisions on actions to deal with the situation, including who would be the best person or agency to deal with the situation, practice delegation skills as required and making decisions within local protocols and guidelines while under pressure, within the safe environment of an exercise.

The theme of the exercise is to open a welfare centre in response to storm damage in the late afternoon.

Aim:
As part of testing the Local Emergency Management Arrangements and Local Standard Operating Procedures (SOP/LOP) the LEMC will respond to various scenario injects to organise the running of an evacuation centre to provide welfare services for individuals and families evacuated to a local welfare centre.

Objectives/Outcomes and Performance Measures:
Toodyay LEMC members will:

1. **Discuss and organise LGA staff to open a welfare centre using the LGA's LEMA and Standard Operating Procedures (SOPs)**

   1.1 Discuss call out procedures for staff after hours and how these will be implemented, whiteboard/document team members' roles and tasks, using LGA SOP's and other ES resources, as references.
   1.2 Length of shifts and rosters

2. **Discuss other requirements needed to provide welfare services.**
   2.1 List resources and equipment needed.
   2.2 Identify some of the welfare needs and the services that may be provided to address these.
   2.3 Explain how other agencies may provide their welfare services and work within the structure of the evacuation centre until CPFS are available.

3. **Familiarise themselves with the layout of one of the local welfare evacuation centres, explore the logistics of setting it up to provide welfare services and the closing procedures.**
   3.1 Study the floor plan for an identified local welfare centre and how it can be set up as a welfare evacuation centre.
   3.2 Identify the types of equipment that is available, what else may be needed and how it will be sourced.
   3.3 Identify some of the issues that may arise when setting up and utilising a local welfare centre and how they may be resolved
   3.4 Discuss the closing down procedures for a welfare centre.

Exercise Personnel:
The Exercise Director will be CPFS's DESO Wheatbelt District. Jo Spadaccini

Exercise Format:
1. A discussion exercise has been developed to consider the information presented in the General Idea and Special Ideas, which will be presented at intervals during the exercise and direct participants to respond.
2. Due to limited numbers and time, participants will be required to operate as one team, rather than in small teams.
3. Reasonable assumptions can be made in relation to human and other resources that would normally be available at the time, determined in the Special Ideas and the physical characteristics of the affected area.
4. Participants are asked to operate within the bounds of local and state emergency management arrangements.
5. Injects will be introduced in two ways:
   5.1. Directly to an agency or group:
   The inject may be as a direct responsibility or delegation prospect
   5.2. To the whole group as a discussion to find best practice

Exercise Pre-Brief

Safety
If there is a real emergency situation during the exercise participants will be informed using the words **"NO–DUFF"** and standard evacuation procedures will be followed.

Risk Assessment
No risks identified for this discussion exercise.

Communications
All communications will commence with Exercise "Evacuation Toodyay", but it is not anticipated there will be any external communications unless an emergency or urgent situation arises.

General Idea:
This scenario is based within the Toodyay Shire boundaries.

There is a Local Emergency Management Committee (LEMC) for the Shire of Toodyay

The Shire has developed its Local Emergency Management Arrangements.

CPFS has a mandated role to coordinate welfare services in the event of an emergency or disaster under:

- State Emergency Welfare Plan (Interim)
- State Emergency Welfare Plan Annex A - Registration and Reunification (Interim)
- State Emergency Welfare Plan Annex B - Reception
- State Emergency Welfare Plan Annex C - Disaster Information Support and Care Centre

CPFS has developed a Local Emergency Plan for the Provision of Welfare Support for the Northam District (Local Welfare Plan).

CPFS has consulted with the Shire and identified potential welfare (evacuation) centres which are listed in the Local Welfare Plan under Appendix 4.

Toodyay has Police, Ambulance, Volunteer Fire and Rescue Service and Local Bush Fire Brigade emergency services in the townsite and surrounding areas. State Emergency Services are loacated in Morangup.

The Event - Preliminary Information:

Saturday 29th July 2017
Severe Weather Warning for the Central West, Lower West and Central Wheatbelt Forecast Districts
Severe Weather Warning with the threat of strong damaging winds and possible tornadoes.
Special considerations (CPFS not available for 5 or more hours)
50 + Evacuees expected

It is mid-afternoon on Saturday 29th July 2017. It has been a cold and wet winter, with some severe storms in the last month. The Bureau of Meteorology issued a Severe Weather Warning for the Central Wheatbelt and Great Southern Forecast Districts of WA at 0800 hrs this morning, with the threat of strong damaging winds and possible tornadoes.

The storm impacted on many residential properties in the area, as well as the surrounding districts. There are reports of many fallen trees and branches, roofs blown off, damaged vehicles in

driveways, power lines down, debris strewn everywhere. There have been injuries but luckily no one has been badly injured.

Known Impacts:

- Town Hall – Lost significant portion of its roof.
- Significant debris on roads including main roads travel severely restricted.
- Western Power Yet to confirm isolation of damaged assets – could take serval hours
- Large parts of Toodyay without power (however showgrounds precinct in an area which still has power).
- Majority of damage reports are in the Majestic Height/Majestic Waters/Lozada Heights and Vernon Hills subdivision area
- Trees have fallen on at least 8 dwellings, both caravan parks have sustained substantial damage to caravans and cabins.

At 17:30 hrs the Police, on behalf of the Incident Manager, contact CPFS's Crisis Care, notifying them of the situation and request CPFS to activate the Local Welfare Plan as up to 50 people may need temporary accommodation.

CPFS Crisis Care has advised that due to notification from the HMA that road conditions in the areas are unsafe to travel on in the dark, their officers may not be in attendance till after first light. However the CPFS District Emergency Services Officer, Jo Spadaccini will be available by phone on 0429 102 614

After consultation with the HMA and Wheatbelt DESO JO Spadaccini, the Police inform Crisis Care that Goomalling Recreation Centre Pavilion on the corner of Quinlan and Hoddy Streets will be used as the evacuation centre as this has been identified by both the Shire's LEMC and CPFS's Local Emergency Management Plan for the Provision of Welfare Support – Northam District (LWP).

Setting the scene:
At 17:00 hrs the HMA has notified the LGA that an evacuation centre will be required for approximately 50 People.

Considerations:

1. If you answered the call from the HMA what will you do?
2. Do you have contacts and phone number for the Police/Agencies/ CPFS?
3. How will LGA staff be activated?
4. Who else needs to be contacted?
5. What other preparations and actions may need to be taken at this time?

When CPFS are contacted they may not be able to reach town till after first light on Sunday (due to road closures and other events)

Using the CPFS Local Welfare Centre Team Structure, discuss how you will provide the services listed from within the LGA and your community.

Registration:	Forms in Memorial Hall Kit – Possibly Need Second Kit
Catering:	CWA – Not in LEMA Contacts
First Aid:	St John or other known skilled community members.
Personal	Have after hours contacts for IGA which would service most need bar

Services/Requisites:	prescription medication – need to ensuring staffing levels at centre to support.
Clothing:	Op Shops – Not in LEMA Contacts
Bedding:	Limited bedding available – Some mats from Kinder Gym onsite. Emergency Messaging could request evacuees BYO.
Accommodation:	

Other considerations:

How long will the shifts be?	
Who else can help?	
Roster for next 48 hours	
Which hats are people wearing?	

ACTION PLAN

Given this was an exercise, has it identified any actions you may need to take to be prepared for a real event?

Issue / Problem	Strategy	Tasks	Action by who	Date to be completed

Summary - Debrief of Exercise

The aim for conducting this functional exercise was:

As part of testing the LEMA and LWP, the Toodyay Local Government staff to organise the afterhours activation and running of an evacuation centre until CPFS are able to gain access to town.

It was an opportunity for participants to discuss and organise the activation of one of the Local evacuation centres, discuss resources, equipment and other welfare organisations needed to provide welfare services. Efforts were made to make this exercise as realistic as possible.

Notes and actions to be followed up have been recorded.

Feedback is appreciated for future exercises and/or training opportunities.

Time	Scenario	Response/s
Stage 2	You have noticed a family arriving with two large dogs, one is on a leash and the other is just wandering loose. The family wishes to stay at the welfare evacuation centre, but it is a rule of welfare evacuation centres that animals are not allowed. The only exception is for guide dogs and "hearing" dogs. How will you address this situation? Who else could assist?	Utilise adjacent showground livestock pens.
Stage 2	You are running out of foam cups, paper plates, tea, coffee, milk and bread. How will you address this situation? Who else could assist?	IGA – After hour's contact.
Stage 2	A young boy has come into the welfare evacuation centre with some small cuts down his arm from playing outside and falling over. The cuts look superficial and not life-threatening. How will you address this situation? Who else could assist?	Advise parents to supervise children.
Stage 2	The Salvation Army have advised you that they are running out of bottled water and will require another 300 bottles approximately.	IGA – After hour's contact. Stocks at Shire Depot.
Stage 2	An evacuee has advised you that their handbag, which was sitting beside them, has gone missing. You notice that other evacuees have handbags that are not under close attention. How would you assist the evacuee who has lost her handbag? How might you eliminate the likelihood of further incidents such as this? How will you address this situation? Who else could assist?	Make an announcement to keep valuables on person. Ask for assistance of others in locating.
Stage 2	An evacuee needs to charge their mobile phone so they can ring their partner who is due to return to the affected area soon. but they don't have their charger. How will you address this situation? Who else could assist?	Provide a charger – Shire Evac Kit has a range of charges.
Stage 2	Several evacuees have told you the toilets aren't very clean and there is hardly any toilet paper, soap or paper towels. How will you address this situation? Who else could assist?	Ask for a volunteer to regularly check these facilities.
Stage 2	A family of five – 2 parents and 3 primary school aged children – have arrived at the welfare evacuation centre and need some assistance. The three children have gastro-enteritis which started yesterday evening. Mum is not feeling well either.	Separate to own space to prevent further infection.

Time	Scenario	Response/s
Stage 3	You have been advised by the Incident Controller or the Hazard Management Agency that up to 100 more people may be evacuated in the next two hours. How will you address this situation? Who else could assist?	Need for regional centre to be opened.
Stage 3	A family not affected by the emergency has come to the centre to get information about their friends who were in the evacuation area. They would like to know if their friends are in the welfare evacuation centre. How will you address this situation? Who else could assist?	Check registration forms – and provide/withhold information as per the individuals have indicated on the form.
Notes:	The final question was posed as to what issues would lack of or loss of power to the evacuation centre cause and how could they be overcome.	Utlise generators from local contractors. As the site is not wired for a generator plug in this would still be a makeshift solution. Communication to the IC for the need for a regional centre to be opened and access routes established.

Reviewing Flood Level Classifications

Avon River Stirling Terrace Gauge, Toodyay

Shire of Toodyay Local Emergency Management Committee

08 November 2017

Situation Background:

In February 2017 heavy widespread rainfall in the Avon River catchment resulted in increased flows in the Avon River with flooding occurring in various locations. During the flowing the Avon River was forecast to (and reached) trigger levels Minor, Moderate and Major flood level classifications for Toodyay – despite the actual impact to community, environment and infrastructure being minimal.

During and following the event, the relevance of the classifications in respect to observed levels and impacts were questioned. Concerns raised included 'the crying wolf effect' of issuing major flood warnings for a minimal impact event, and the ease at which the maximum warning was reached – leaving no scope for further warnings in the event of a lager flood event. Similar issues were experienced in other towns upstream.

Following the February 2017 events workshops/discussions with DFES, Bureau of Meteorology and Department of Water have assisted with a broader understanding of how flood information is issued and conveyed a willingness by relevant parties to make adjustment to flood level classifications to better reflect observed/predicted impacts.

About Flood Level Forecasting/Warnings

BOM predict and issue flood warnings based on a Service Level Specification for the catchment, these are either qualitative or quantitative. A qualitative service requires BOM to issue warning based on the expected flood level class (i.e. Minor, Moderate, and Major). A quantitate service provides both the flood level class and expected river heights and times (i.e. peaks). Naturally quantitative service requires greater resourcing around modelling, river gauges to ensure greater confidence in the predicted levels.

Service Level Specification for the Avon is currently qualitative.

The Flood Level Classes for Toodyay (Stirling Terrace, Upstream of Newcastle Bridge) are presently:

Minor	2.5m
Moderate	3.5m
Major	4.0m

Definition of Flood Level Classification

The National Arrangements for Flood Forecasting and Warning define the nature of impacts to be expected in each class.

Minor	Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.
Moderate	In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.
Major	In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.

About Flood Mapping

Major natural disasters are commonly referred to by a one in X year event (i.e. 1:10 year). This terminology is increasingly being replaced by the Annual Exceedance Probability (AEP). The AEP is the probability the event will occur in any given year. Analysis and mapping has been conducted along the Avon River on for different event probability intervals.

Assessed occurrence probabilities and related gauge height (Stirling Terrace, Upstream of Newcastle Bridge) are:

	AEP	**Gauge Height**
1:10	0.1	4.5m
1:25	0.025	5.3m
1:100	0.01	6.6m

Please note that in most cases contour lines on the attached flood mapping show the underlying land form and does not take into account modification of the land form to increase the finished floor level of buildings.

Observed Impacts February 2017 Event:

Peak Height: 4.08m (Stirling Terrace Gauge)

Impact	**Commencement Level**	**Comments**
Leeder Street Inundated (Toodyay West Road End)	2.4m	Access maintained to properties via Julimar Road at peak.
Pedestrian Walkway from School to	3.2m	Level of uncertainty as to riverine or flash flooding impact.

Impact	Commencement Level	Comments
Drummond Street (West)		
Toodyay Miniature Railway Track Inundation	3.5m	Buildings not Effected.
Northam – Toodyay Road Inundated (at Donkey Crossing)	3.7m	Commencement of inundation due to significant camber of road. Access maintained with traffic control.
Campbell Chase Inundated	3.7m	4WD Only at Peak.

It is worth noting that no buildings were at threat of inundation during the February 20017 event.

Low level impacts on low lying portions of Duidgee Park were experienced during the February 2017 event which included inundation of the walkway linking Duidgee Part to Stirling Park under the Newcastle Bridge.

Estimated Impacts based on observations February 2017 Event:

Impact	Commencement Height	Comments
Toodyay West Road	4.2m	
West Toodyay Bridge (Julimar Road)	4.3m	

Consideration for Revised Flood Classification Levels:

Given the flood level classification definition of the National Arrangements for Flood Forecasting, and the disparity with observed impacts of a 4.08m flood, the Shire of Toodyay proposes that the a recommendation to alter the flood level classification for the Stirling Terrace gauge is adopted.

Ultimately any proposal would need to be considered by the Flood Warning Consultative Committee, however, it is proposed initially that outcomes of this process are provided to DFES Goldfields Midlands Region to support a wider review of classifications along the Avon.

The process used to determine the below proposed flood level classifications included:

- Observations of impacts from February 2017 Floods
- Estimation of impacts based on observations of February 2017 Floods
- Predicted Impacts based on existing flood mapping
- Regional Level workshops with DFES, BOM, DOW and Local Government
- Visual inspection of potential low-lying sites identified by flood Mapping

Assessment Outcomes:

The recommendation below proposes that Minor, Moderate and Major flood levels commence at river levels of 4.0m, 5.0m and 6.0m respectively.

The recent experience of the February 2017 has provided good confidence in the impacts up to 4.1m and a little beyond. Assessment of impacts for river levels above 5m has less confidence as in most cases flood mapping is based on the underlying land form and not the finished level of a building or road. The flood mapping shows a number of possible road and building impacts. These areas have been subject to a visual inspection to assess extent of modification of the natural landform, and the asset excluded if significant land form modification has been observed. Measurement of finished levels has not be undertaken.

The following table lists the estimated impacts which would be experienced at each level.

	Impact	**Expected Impact Commencement Level**	**Notes**
Minor	Inundation of Leeder Street (Toodyay West Road End)	2.4m	
	Pedestrian Walkway from School to Drummond Street (West)	3.2m	
	Toodyay Miniature Railway Track Inundation	3.5m	
	Northam – Toodyay Road Partially Inundated (at Donkey Crossing)	3.7m	
	Campbell Chase Inundated	3.7m	Effected properties have secondary street frontage with Northam-Toodyay Road.
	Toodyay West Road (Between Leeder Street and Everett Street) Inundated	4.2m	Effected properties have secondary street frontage with North Street/Fitzgerald Terrace
	West Toodyay Bridge (Julimar Road) Inundated	4.3m	Access to properties to the west via Coondle West Road.
Moderate	*Impacts described above plus:*		
	Lower Playground and Shelters at Duidgee Park inundated.	5.0m	
	Northam – Toodyay Road Fully Inundated (at Donkey Crossing)	5.0m	Alternate Route to Northam Required.
	Possible Inundation of River Road (1.8km South of Julimar Road)	5.0m	

	Impact	Expected Impact Commencement Level	Notes
	Inundation on some private land some out buildings at risk.	5.0m	
Major	*Impacts described above plus:*		
	Toodyay Road (Between Northam-Toodyay Road and Racecourse Road Street) Inundated	6.0m	
	Potential for inundation of houses in Herbert Street and Henry Street.	Above 6.6m (1:100 Flood)	

While the assed impacts for Moderate and Major proposed levels do not appear extensive or fully fit the definitions to the National Arrangements for Flood Forecasting and Warnings a degree of caution has been applied due to the desktop centric nature of this assessment.

Recommendation:

The Shire of Toodyay is seeks feedback from and adoption by the LEMC of a proposal to adjust the river level classifications for Stirling Terrace, Toodyay as per the following table:

	Current	Proposed
Minor	2.5m	4.0m
Moderate	3.5m	5.0m
Major	4.0m	6.0m

Australian Government
Bureau of Meteorology

National Arrangements for Flood Forecasting and Warning

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Date	Version	Description	Author
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19 September 2013	V2.0	Amendments made as a result of Jim Elliot's review	Nicole Pana
29 January 2015	V3.0	Review of Jurisdictional chapters by RHMs	Nicole Pana

Release Signatories

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The Bureau would like to acknowledge the contributions and effort of the late Mr Nick Ronan and Mr Jim Elliott who provided the foundation for this document.

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1 Introduction

Flooding is a significant risk to the safety and amenity of all Australians. The provision of advance warning of the occurrence of flooding provides the opportunity for individuals living or travelling in the area at risk, their families, the communities in which they live and the agencies with responsibilities for ensuring their safety, to make appropriate preparations to mitigate the adverse impacts of the flooding. Advance flood warning benefits farmers and those operating businesses, critical utilities and infrastructure (power, water, roads etc) directly by providing time to protect their assets and operations. It assists insurance companies by reducing the level of compensation payment for flood damage and reduces costs to the general taxpayer of funding relief and recovery operations. Effective flood warning is just one of a range of measures that can be applied to reduce the impact of flooding.

1.1 Purpose of Document

Recent reviews following significant flood episodes in Victoria and Queensland have revealed that the current arrangements for providing flood warning services are not well understood nor have they been well communicated. The purpose of this document therefore is to provide the Australian public with a summary of how the provision of flood forecasting and warning services is arranged nationally and be a key resource for ongoing community education around Bureau flood services. These arrangements involve a collaborative approach involving all levels of government and, while the general role played by agencies at each level follow principles that are consistent nationally, the specific arrangements in terms of agency responsibilities and accountabilities that apply vary within each jurisdiction[1]. Accordingly the current national arrangements described in this document will be presented in terms of the general roles and responsibilities of each level of government in providing and supporting effective flood warning services, but include separate chapters that describe the specific arrangements and agency roles that apply in each jurisdiction.

This document has been prepared by the Bureau of Meteorology as lead national agency with responsibility for flood forecasting and warning, but (will be) circulated widely among key stakeholder agencies at the Commonwealth and other levels of government with a part to play in the current arrangements. The governance over agency roles in flood warning, while flowing directly from legislation directed toward flood warning in some cases, is indirect in many other cases and roles have evolved (or been adopted) as part of an agency's more wide ranging responsibilities in areas such as floodplain management.

This document needs to be read in conjunction with:

- the Australian Emergency Management Arrangements;
- relevant State/Territory disaster and emergency management legislation and arrangements; and
- arrangements for related activities in flood risk management.

It is one of a suite of documents aimed at improving the clarity and detail of flood warning policy and practice. The three tiers of documents published by the Bureau are:

- National Arrangements for Flood Forecasting and Warning (this document)
- Service Level Specifications (SLS) for each State/Territory that contain details of the services provided in each jurisdiction in terms of the areas served, forecast locations and service levels provided.
- Data Sharing Agreements (DSA) that describe the current arrangements for supplying (near) real-time data to support flood forecasting and warning operations.

[1] Jurisdiction: Refers to all States and the Northern Territory.

1.2 Type of Flooding

Floods in Australia are predominately caused by heavy rainfall, although extreme tides, storm tide, tsunami, snow melt or dam break can also cause flooding. More recently, coastal flooding as a result of sea level rise due to climate change is figuring in planning and land management strategies. This document only focuses on flooding as a result of heavy rainfall, which generally falls into the two broad categories, flash floods and riverine floods.

Flash floods can occur almost anywhere, and result from a relatively short, intense burst of rainfall, for example during a thunderstorm. During these events the drainage system may be unable to cope with the downpour and flow frequently occurs outside defined water channels. Areas with low-capacity drainage systems, whether natural or artificial, are particularly vulnerable to flash flooding. Although flash floods are generally localised, they pose a significant threat to human life, because of the high flow velocities and rapid onset. Flash floods are normally defined as those floods that occur within six hours of a rainfall event and effective warning is extremely difficult.

Riverine floods occur following heavy rainfall when watercourses do not have the capacity to convey the excess water. They occur in relatively low-lying areas adjacent to streams and rivers. In the flat inland regions of Australia, floods may spread thousands of square kilometres and last several weeks with warning lead times of the order of several days, sometimes weeks in advance for the longer rivers. In the mountain and coastal regions of Australia, flooding is often less extensive and of shorter duration, with higher flow velocities. Effective flood warnings can normally be provided in these flooding situations with lead times typically ranging from six to twelve hours or longer.

The Commonwealth Government released the final Regulations to the *Insurance Contracts Amendment Act 2012* (No. 41, June 2012) (the Act[2]) that gave effect to a standard definition of “flood” to make flood insurance simpler. This is defined as:

"the covering of normally dry land by water that has escaped or been released from the normal confines of:

- any lake or any river, creek or other natural watercourse, whether or not altered or modified; or
- any reservoir, canal or dam".

1.3 Scope of Arrangements

The arrangements described here focus in particular on riverine floods following heavy rainfall. Flood warning services provided for these types of floods can be grouped into:

- generalised services, which are those provided principally on the basis of meteorological considerations (predominantly the occurrence or likelihood of heavy rainfall); and
- qualitative and quantitative services that involve more detailed hydrological considerations to account for the role played by catchment soil moisture variations, the pattern of rainfall and catchment drainage characteristics.

At present, warnings of flash flooding are predominantly generalised in nature, apart from some locally based services in a few areas. National arrangements for this type of flooding are still under development and so are not addressed in this document. This document is principally concerned with the qualitative and quantitative services, for which specialised systems have been established and operate to support the service.

[2] Insurance Contracts Amendment Act 2012: http://www.comlaw.gov.au/Details/C2012A00041 .

The scope of activities covered in this document include the arrangements for the operation of the present system that prepares and delivers flood warning information to the community at risk, along with arrangements for establishing new and improved services including planning, coordination and review activities. For the system to operate with maximum effect, it is essential that the community be prepared to respond appropriately to the warning information being delivered. This involves those in the floodplain understanding their own personal risk, being aware of how the warning service has been designed to assist in making them safe, and knowing what to do when they become aware of the threat of flooding through a warning. Making arrangements for establishing and maintaining this level of preparedness is also a shared responsibility for the community and government agencies, but will only be covered peripherally in this document because the Bureau contributes to but does not lead such work.

1.4 Document Structure

The next section (Section 2) describes the activities that need to be performed for effective flood warning, both before and during flood episodes, along with the legislative and administrative arrangements that influence the activities of the various agencies involved. As discussed earlier, the detail of the flood warning arrangements in each jurisdiction do vary, however there is a general level of consistency in the approach to flood management of each level of government and the community. This will be discussed in Section 3 along with the principles that act to guide these roles and activities and the coordination arrangements that apply. The detailed arrangements for each jurisdiction will follow in separate sections (Sections 4 to 10). The arrangements for establishing and funding new and improved services are covered in Section 11 and the over-arching national coordination and policy arrangements in Section 12.

2 Flood Warning System Design

The goal of flood warning is to help flood management agencies and the members of flood-prone communities to understand the nature of developing floods so that they can take action to mitigate their effects. The purpose of a flood warning is to provide advice on impending flooding so people can take action to minimise its negative impacts. This will involve some people taking action on their own behalf and others doing so as part of agency responsibilities. A flood warning system is a set of connected activities (or elements) designed to achieve this purpose. Flood warning systems in Australia are designed using the concept of the Total Flood Warning System.

2.1 Total Flood Warning System

This concept (illustrated in Figure 1) has been developed to describe the full range of elements that must be developed if flood warning services are to be applied effectively.

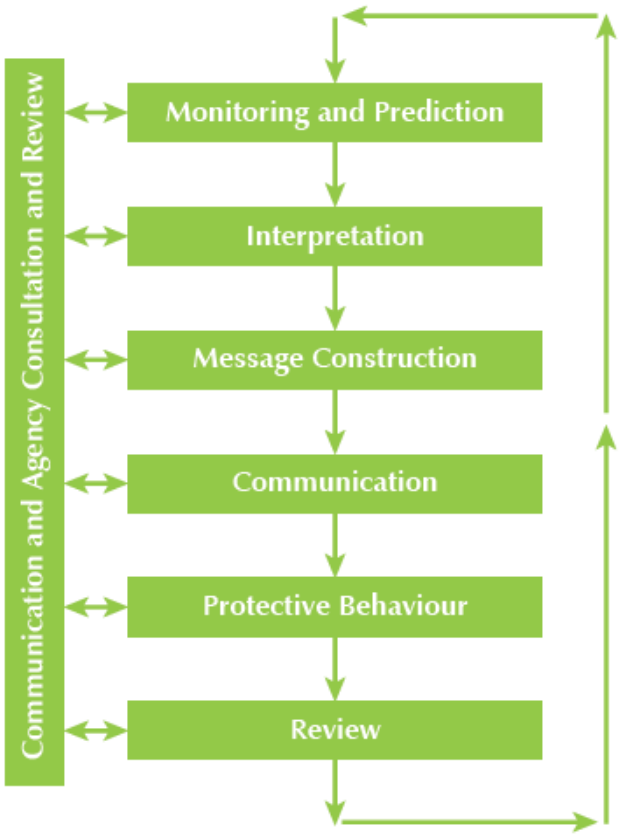

Figure 1. The components of the Total Flood Warning System (Australian Emergency Manual Series, Manual 21 Flood Warning, Australian Government 2009)

At its simplest, an effective flood warning system can be defined as having six components:

Monitoring and prediction: detecting environmental conditions that lead to flooding, and predicting river levels during the flood,

Interpretation: identifying in advance the impacts of the predicted flood levels on communities at risk,

Message construction: devising the content of the message which will warn people of impending flooding,

Communication: disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood,

Protective Response: generating appropriate and timely actions and behaviours from the agencies involved and from the threatened community, and

Review: examining the various aspects of the system with a view to improving its performance.

For a flood warning system to work effectively, these components must all be present and they must be integrated rather than operating in isolation from each other. The activities involved within each of these elements are shared among agencies at all levels of government. The integration of the activities such that the total system operates effectively and efficiently can present significant coordination issues. A more detailed coverage of the design of the Total Flood Warning System is found in *Manual 21 Flood Warning*[3] (Australian Government, 2009).

2.2 Flood Preparedness and Planning

Flood warning systems are designed to operate for the period immediately before and during flood events. To be fully effective in their operation, it is important that the target community is prepared to receive and act on the warnings provided. This requires that they be made aware of their own risk, how the warning system has been designed to provide the opportunity to mitigate the risk they face from the flood, and what to do when they learn of the imminent threat of flooding through a flood warning.

In addition to understanding arrangements for the establishment and operation of the Total Flood Warning System, an important part of the picture regarding flood warning arrangements is to ensure the community is aware of:

- Whether or not they are at risk from flooding.
- If there is a flood warning system covering their area.
- What they need to do to be prepared.
- How the flood warning system is maintained and kept in a state of readiness.
- How they will be alerted.
- What should they do when they learn of an imminent threat from flooding.

Putting the necessary arrangements in place for ensuring this understanding is also a shared responsibility for the community and relevant government agencies and is part of what is normally referred to as flood preparedness. While it is not intended to cover this activity in detail in this document, it is important that the arrangements for the above elements of flood preparedness are kept in view as part of any comprehensive picture of flood warning arrangements. The reader is referred to the *Manual 20 Flood Preparedness*[4] (Australian Government, 2009) for a more comprehensive coverage.

It is also important that flood warning systems be kept in a state of readiness so that they operate effectively with the little advance notice that is normally available, and that investments made in improving the existing system or implementing new systems between floods is planned effectively. Arrangements for the maintenance of flood warning systems are included in the various Service Level Specifications and Data Sharing Agreements as

[3] Manual 21 *Flood Warning* (Australian Government, 2009, http://www.em.gov.au/Documents/Manual%2021-Flood%20Warning%282%29.PDF) and
[4] Manual 20 *Flood Preparedness* (Australian Government, 2009, http://www.em.gov.au/Documents/Manual%2020%20-%20Flood%20Preparedness-Oct09.PDF

prepared for each State and the Northern Territory. System review and planning new investments in flood warning systems will be covered in later sections.

2.3 Legislative and Administrative Arrangements

The current authority for the Bureau of Meteorology role in flood warning comes from the *Meteorology Act (1955)* wherein the Bureau is required to issue "warnings of….weather conditions likely to give rise to floods….." and subsequent Commonwealth Government decisions which established the Commonwealth position that flood forecasting and warning be funded on a shared basis with other levels of government and coordinated through consultative committees.

The role of other agencies in the Total Flood Warning System is undertaken as part of their activities in the related fields of emergency management, flood risk management and water resources data collection; all of which are State and Territory responsibilities leading to some differences in arrangements between jurisdictions as already discussed.

2.3.1 Emergency Management Arrangements

Under Australia's constitutional arrangements, State and Territory governments have responsibility for emergency management within their jurisdictions, but work in partnership with the Commonwealth and Local Government, business and industry, and the community. The states and territories control most of the functions essential for effective emergency management, ensuring the relevant legislative and regulatory arrangements are in place that relate to the operation of the agencies that provide emergency services to the community. Under cooperative arrangements with the states and territories, the Commonwealth Government provides support and assistance to the states when requested, including financial assistance and support for capacity development and research.

The roles and responsibilities of different levels of government for emergency management, along with those for individuals, business and other parties, are set out in the *Australian Emergency Management Arrangements*[5] *(Australian Government, 2009)*. Each jurisdiction meets their requirements through legislation and related arrangements that have been established in particular for ensuring effective response to warnings.

2.3.2 Flood Risk Management

All levels of government have some responsibility for flood risk management. Although arrangements vary between jurisdictions, the responsibility is primarily with state and local flood management authorities, working within State/Territory and Local Government policies and legislation. The role of these authorities normally includes the design and implementation of flood mitigation strategies which can include the facilitation and support of flood warning systems. Local authorities in particular can be involved with detailed flood studies, flood inundation mapping and modelling, and flood awareness and education activities that are especially relevant to flood warning. Each jurisdiction has established independent arrangements for meeting their responsibilities for flood risk management and work within these arrangements to provide assistance with the development and operation of flood warning systems.

2.3.3 Water Data Collection and Flood Warning

State and territory governments are responsible for the assessment and management of water resources in their jurisdiction and undertake the majority of streamflow measurement

[5] Australian Emergency Management Arrangements (Australian Government, 2009, http://www.em.gov.au/Documents/Australian%20Emergency%20Management%20Arrangements.pdf)

and monitoring of the nation's rivers. As the national meteorological agency, the Bureau of Meteorology has responsibility under the *Meteorology Act (1955)* for climate monitoring and so operates and maintains the major portion of the nation's rainfall (and other climate/weather) monitoring networks. Although the Bureau has established some river monitoring networks for the purpose of flood warning, data from other agency streamflow measurement networks at State, Local and Regional level have always been a necessary input to the national flood forecasting and warning system operation, especially to assist the Bureau in its role in flood prediction. Figures 2 and 3 show the spatial coverage and ownership of rainfall and river level gauges across Australia.

There is no specific responsibility on agencies with a role in water data collection to establish special purpose flood warning networks. Despite this however, strong cooperative relationships have been developed among the agencies concerned and the Bureau of Meteorology and arrangements to provide data to the Bureau have developed on an informal cooperative basis, with different arrangements applying in each jurisdiction. These arrangements are described in separate Data Sharing Agreements established for each jurisdiction between the Bureau and agencies providing data.

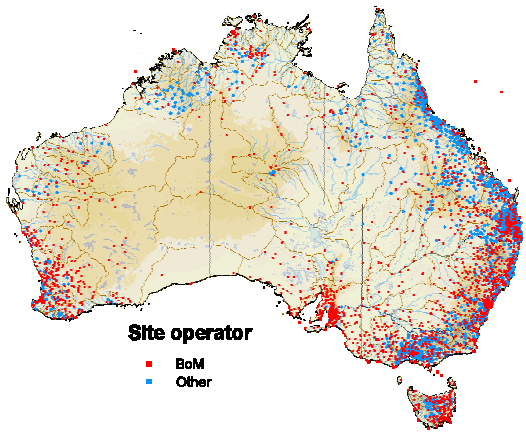

Figure 2 Rainfall stations available to the Bureau for flood warning services showing ownership (as at June 2013)

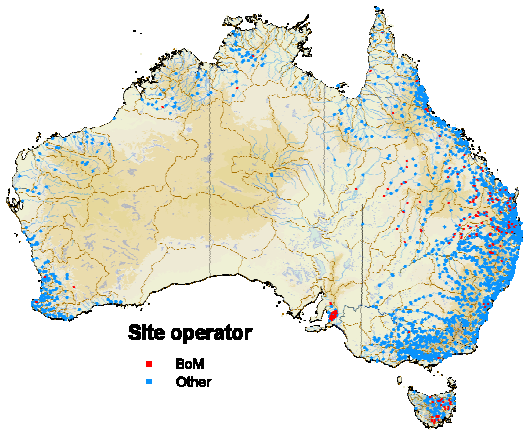

Figure 3 River height stations available to the Bureau for flood warning services showing ownership (as at June 2013)

3 Flood Warning Arrangements – National Summary

This section proposes a set of principles guiding the establishment of national arrangements and provides a broad national picture of flood warning arrangements, covering both the operation of the Total Flood Warning System and relevant flood preparedness activities undertaken outside of flood events. The requirements of each element of the Total Flood Warning System as identified earlier and the broad role of each level of government and the community will be described here in more detail, with the specific arrangements that apply in each jurisdiction following in separate sections of the document.

3.1 Principles to Guide National Arrangements

The set of national arrangements given here follow from earlier Commonwealth Government decisions and subsequent consultation processes around the position that flood forecasting and warning be funded on a shared basis with other levels of government and coordinated through consultative committees, along with recent development of national best practice around the establishment and operation of the Total Flood Warning System. The principles behind the arrangements are that:

- Flood warning in Australia involves agencies from Commonwealth, State and Local Government, regional authorities, and organisations that contribute to the data observing network.
- Flood warning services are best provided through a cooperative approach involving all these parties. It must also be recognised that all these parties make up the flood warning service whether they be an agency, private entity or individual and they all have some degree of service ownership.
- Flood warning arrangements need to recognise the whole-of-nation resilience based approach to disaster management adopted in the National Strategy for Disaster Resilience [6] as a shared responsibility between governments, communities, businesses and individuals.
- Effective flood warning services are provided where beneficiaries have a direct involvement in the provision of the service and contribute to its cost.
- Effective flood warning services rely on utilising the existing strengths of partner agencies, private entities and communities.
- Free real-time access to rainfall, stream level and stream flow data is to be provided to the Australian community especially agencies with a responsibility for flood prediction.
- National arrangements should be designed so as to move the current arrangements and practices that apply in each jurisdiction toward national best practice [7].
- National arrangements should recognise that flood preparedness activities (outside flood episodes) designed to ensure the target community is fully ready and able to respond are a crucial part of the overall set of arrangements.

[6] To view the National Strategy for Disaster Resilience http://www.em.gov.au/Documents/1National%20Strategy%20for%20Disaster%20Resilience%20-%20pdf.PDF

[7] For a guide on best practice refer to Manual 21 *Flood Warning* (Australian Government, 2009, http://www.em.gov.au/Documents/Manual%2021-Flood%20Warning%282%29.PDF) and Manual 19 *Managing the Floodplain* (Australian Government, 2009, http://www.em.gov.au/Documents/Manual19-ManagingtheFloodplain.pdf)

3.2 Roles of Each Level of Government

The role of each level of government in the Total Flood Warning System is generally consistent within each jurisdiction. A more detailed list of activities for each level of government in contributing to each element of the Total Flood Warning System is given later in this section, however the general role for each level of government can be summarised as follows.

Commonwealth Government Role:

- Undertakes (through the Bureau of Meteorology) generalised, qualitative and quantitative flood monitoring and prediction[8] activities, utilising data networks supplied under cooperative arrangements with State, Regional and Local Government agencies. Disseminates flood warnings to other agencies and the community through the media and the Bureau's website.
- Operates the Australian Government Crisis Coordination Centre (AGCCC)
  - to connect relevant Australian Government, State and Territory agencies and consolidate Australian Government actions during complex national crises, and
  - to develop a single, timely and consistent picture or understanding of a crisis, its implications and the national capacity to respond.
- Provides funding, policy and research and development support through the Attorney Generals Department and its components.
- The Bureau provides a component of the real time data collection network used for flood prediction.

State/Territory Government Role:

- Provide a component of the real time data collection network used for flood prediction.
- Interpret Bureau flood predictions into more localised impacts and prepare and disseminate locally tailored information based on these predictions to the community at risk.
- Lead responsibility for emergency management and response activities. This includes flood preparedness and the preparation and operation of flood response plans (including evacuation) in association with Regional and Local Government groups in accordance with jurisdictional emergency management and flood risk management arrangements.
- Support the planning, implementation and operation of flood warning systems as part of jurisdictional flood risk management plans and strategies.
- Develop and implement community and industry flood awareness programs down to the local level.

Regional Agency Level Role:

- Provide a component of the real-time data collection network used for flood prediction.
- Contribute expertise to assist with the interpretation of Bureau flood predictions into local impacts and with the preparation and dissemination of local warning information.
- Support the planning, implementation and operation of flood warning systems as part of jurisdictional flood risk management plans and strategies.

[8] There are isolated exceptions to the national role of the Bureau of Meteorology in flood prediction in Victoria and South Australia (see later Chapters).

Local Government Role:

- Contribute resources to the real-time flood warning data network through local cooperative programs with other agencies.
- Key role in emergency management and response, including flood preparedness activities and response planning.
- Lead and manage the preparation of flood studies and communicate their outcomes to at-risk communities and businesses.
- Assist with the interpretation of flood predictions into local impacts and with local warning dissemination in accordance with jurisdictional emergency management arrangements.
- Promote local flood awareness through locally developed programs and in coordination with programs of other levels of government.

A consolidated view of community and government flood warning related roles and responsibilities, covering both the operation of the Total Flood Warning System and the flood preparedness and planning activities outside of flood periods, is presented in Tables 1 and 2.

Before the Flood – Flood Preparedness and Planning				
	Am I at risk?	Is there a warning system for my area?	How can I be prepared?	How is the warning system kept current?
Community	Contact LG, SES to understand whether you are at risk and at what level floods become critical to you	Contact LG, SES. Refer to BoM website for specification of system. Build understanding of level of service available and how products relate to personal flood risk.	Refer to Emergency Management Australia Guide. Prepare a plan. Become familiar with local emergency response plan. Learn how to interpret warning products in personal context. Identify nearest (relevant) forecast location.	Regularly refresh knowledge of warning system and response arrangements. Adjust personal plan if situation changes.
Local Government	Understand risk profile for LGA. Utilise available flood mapping. Disseminate flood risk information to constituents.	Maintain awareness of local warning system and keep relevant information current within local community. Become familiar with relevant forecast locations and critical levels. Identify requirements for new/improved systems.	Develop and communicate local level emergency plan. Facilitate preparation of individual plans. Assist community to understand warning information such as flood class levels.	Review forecast needs including flood class levels. Synchronise with response plan. Assist in building flood intelligence for system effectiveness. Share maintenance of data collection assets
Catchment/ Regional/ District Authority	Assist LG with understanding risk profile.	Maintain awareness of local warning system. Assist in specification of forecast needs. Assist in building flood intelligence for system effectiveness. Facilitate requirement for new/improved systems.	Contribute to local emergency plan. Develop regional plan if appropriate.	Coordinate the implementation of flood risk management projects with flood warning system. Share maintenance of data collection assets. Assist in building flood intelligence.
State	Undertake state-wide (flood) risk analysis. Support flood mapping initiatives at local and regional (catchment) levels.	Publish information on warning systems operating in State. Assist in specification of forecast needs. Prioritise requirements for new/improved systems.	Develop and communicate State level response plan. Coordinate local and regional plans as appropriate.	Coordinate flood risk management projects with flood warning system. Share maintenance of data collection assets. Prepare flood intelligence to interpret flood predictions. Ensure flood class levels are current and understood.
Commonwealth	Funding support (AGD). Promote best practice (nationally consistent) risk analysis (NFRAG, AGD). Publish flood risk information (NFRIP, GA).	Publish details of all national warning systems (BoM). Coordinate/approve requirements for new/improved systems through FWCC.	Funding support (AGD). Promote best practice (NFRAG, AGD).	Maintain on-line flood forecasting system in state of readiness. Share maintenance of data collection assets. Adapt flood forecasting system to approved new requirements (BoM).

Table 1 Summary of Community and Government Roles in Flood Warning – Before the Flood

During the Flood - Total Flood Warning System						
	Monitoring and prediction	Interpretation	Message construction	Warning dissemination	Protective Response Behaviour	
Community	Participate in identifying needs.	Contribute personal requirements to flood intelligence gathering.	Utilise social media opportunities.	Share warning information with neighbours, relatives etc.	Who is responsible for alerting me?	What do I do when I receive/hear a warning?
					Personal responsibility to monitor media and maintain vigilance. Alerting arrangements as in local emergency plan. Emergency Alert system.	Activate personal plan. Cooperate with local response plan. Refer to Emergency Management Australia Guide.
Local Government	Specify prediction requirements. Contribute rain/river data from local networks.	Interpret river level prediction into local impacts.	Prepare message for local dissemination in accordance with jurisdictional arrangements.	Disseminate warning message in accordance with jurisdictional arrangements.	Develop and operate local alerting system (incl. SMS and other social media).	Activate local emergency response plan. Contribute to public education and awareness activities.
Catchment/ Regional/ District Authority	Specify prediction requirements. Contribute rain/river/storage data from local networks.	Interpret river level predictions into local and regional impacts. Provide information on impacts associated with their assets (e.g. water authorities managing storages	Regional water authorities have responsibility to prepare warnings/advices for dam brake or releases that will cause significant river rises	Regional water authorities have responsibility to disseminate warnings/advices related to dam brake or significant releases.	Develop and operate local alerting system	Participate in emergency response plan. Contribute to public education and awareness activities.
State	Specify prediction requirements. Contribute rain/river/storage data from State-owned networks.	Interpret river level predictions into local and regional impacts. Provide information on impacts associated with their assets (eg water authorities managing storages)	Prepare message from BoM flood warning for local dissemination in accordance with jurisdictional arrangements.	Disseminate warning message in accordance with jurisdictional arrangements.	Activate “emergency alert” system in accordance with established protocols.	Coordinate and control State emergency response plan. Design and sponsor State-wide public education and awareness activities.
Commonwealth	Monitor flood threat and predict flood levels (BoM).	Include flood class levels in warning products. Publish current flood class levels (BoM).	Prepare flood warnings and watches in accordance with Service Level Specification (BoM).	Disseminate warning products direct to media, emergency management agencies and publish on web site (BoM).	Provide briefing to National Crisis Coordination Centre.	Provide coordinated Commonwealth response through National Crisis Coordination Centre. Design and sponsor national public education and awareness activities in coordination with jurisdictional programs.

Table 2 Summary of Community and Government Roles in Flood Warning – During the Flood

Notes:
BoM: Bureau of Meteorology
LG: Local Government
SES: State Emergency Service
LGA: Local Government Association
AGD: Attorney General's Department
NFRAG: National Flood Risk Advisory Group
NFRIP: National Flood Risk Information Portal
GA: Geoscience Australia
FWCC: Flood Warning Consultative Committee

Apart from one or two isolated exceptions concerning flood monitoring and prediction activity, the Commonwealth role in the Total Flood Warning System is consistent nationally. However while the role for the other levels of government is broadly consistent between jurisdictions, there are no formal arrangements to ensure all of the inputs are provided in the same manner, to the same standard and purposefully connected as part of a system. To present a clear national picture of arrangements it is necessary to describe arrangements in each jurisdiction separately so that the unique differences can be understood. This applies in particular to the different mix of activities among State, Regional and Local Government agencies in how they share responsibilities for supplying rainfall and river level data to the Bureau for flood prediction, and how the Total Flood Warning System elements of interpretation, message construction and communication are arranged. The jurisdictional arrangements regarding the supply of data are explained in separate Data Sharing Agreements on data supply as mentioned earlier; however the specific roles of agencies across the remaining activities in each jurisdictional Total Flood Warning System will be presented separately in later chapters.

The remainder of this section will briefly discuss the requirements of each element and typical activities that might be undertaken by each level of government in order to present a (hypothetical) model set of national arrangements to provide a basis for comparison of the different jurisdictional arrangements and to assist in any future review and improvement activity.

3.3 Community Role

An important component of the National Strategy for Disaster Resilience is the recognition that the community (including individuals and businesses) carry a share of the responsibility for building a disaster resilient community. The effective operation of the Total Flood Warning System requires a target community to be aware of their flood risk and prepared and supported in responding effectively to the flood warning information being provided. While agencies have a role in providing the necessary support and information, the community equally has a role to inform themselves and contribute to the planning and implementation of flood response measures.

3.4 National Arrangements – Total Flood Warning System Operations

3.4.1 Monitoring and Prediction

This role is performed nationally by the Bureau of Meteorology operating through Flood Warning Centres in the Bureau Regional Office in each capital city and the Bureau National Operations Centre in Head Office in Melbourne. These Centres operate when required on a 24/7 basis and are staffed with specialist hydrologists involved in monitoring the state of rivers and their catchments and assessing the likely impact of any forecast rainfall in terms of whether or not flooding is likely in any particular part of the country. When flooding either becomes more certain or commences, specific predictions of future river levels at pre-

determined forecast locations are made in accordance with previously specified requirements in terms of critical threshold levels, forecast accuracy and lead time, for the duration of the flooding.

The Bureau prediction can be expressed in different ways dependant on the service level required and the quality (accuracy) of the hydrologic forecasting tool. Normally it is expressed either as:

- A value – e.g. 7.5m
- A range – e.g. between 7.5 and 7.8m
- Being above a particular value – e.g. greater than 7.5m, or
- A classification (or class) of flooding – e.g. minor, moderate or major.

Forecast locations and service level requirements are specified in Service Level Specifications (SLS) for each State and the Northern Territory.

To undertake this task, the Bureau gathers rainfall and river level data from an extensive network of observing sites in real-time which are then fed into hydrological forecasting models, along with weather forecast information and data from its national radar network, to prepare predictions of future river levels. This requires that the Bureau maintain a sophisticated communications and computing infrastructure with a capability of 24/7 operations. The Bureau continually improves its capability here with the development and implementation of new and improved hydrological forecasting models, and on-line operational computing and communications systems.

The rainfall and river level data comes from a network of stations owned and operated by the Bureau and by State and other local and regional agencies. The Bureau is responsible for the standard of data from its observing sites and this responsibility includes meeting replacement, maintenance and operating costs. Although the Bureau do own and operate a portion of the river level network, the majority of the river level data (incl. water levels in dams) is provided from observing sites owned and operated by other agencies. These agencies also provide a significant portion of the rainfall data. The arrangements whereby data from other agency sites is provided to the Bureau varies markedly around the country and follow protocols established for each jurisdiction as described in Data Sharing Agreements.

Typical activities for each level of government for flood monitoring and prediction are listed in Appendix 1.

3.4.2 Interpretation of Flood Predictions

A flood prediction is of little value unless people at risk are able to assess what it means in terms of the risk it presents to them in their individual situation. This requires that the prediction as prepared by the Bureau be given meaning. The interpretation of flood predictions is done at a number of different levels and depends on how the prediction is expressed.

Flood Classification Levels

For most forecast locations, standardised flood impacts (or flood classifications) have been determined. These flood classifications describe in general terms the degree and nature of flood impact at and around the forecast location. The classifications currently in use are:

Minor - Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.

Moderate - In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.

Major - In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.

These terms are assigned to a range of levels and the Bureau uses these levels to qualify/categorise the flood prediction by the particular classification so that the expected general impact of the flooding can be communicated with the prediction. Through this use of standard terms describing flood impacts, the Bureau prediction is given some meaning, however for this to be effective it requires that those hearing/receiving the warning understand what the classification level means to them. This requires that the levels be set to reasonably reflect the impact being described. This is best done as close to the impacted area around each particular forecast point by agencies which understand or are best placed to assess those impacts. These levels then need to be shared with the Bureau as the prediction agency so that the right terms can be attached to predictions, with relevant emergency response agencies so that they understand the on-ground impact around each forecast location in order to plan their response activities, and with the affected community so that they can understand how the levels relate to their particular exposure to flood risk.

More Specific Interpretation

When the flood prediction is expressed more precisely, either as a single value or a narrower range of values, more detailed interpretation is possible. This is normally undertaken either by the emergency management agency or local government, dependant on the availability of local flood intelligence. Such flood intelligence allows those agencies to interpret Bureau flood predictions into more detailed impacts on infrastructure (roads, critical life lines etc) and communities allowing them to better target local warning communications on particular areas at risk at the predicted level. Individuals (households, business owners, etc) with appropriate detailed knowledge, understanding and/or experience of the relationship between level at the nearest forecast point and impact at their location are able to use the Bureau prediction to plan their response.

Flood intelligence can be developed through the gradual collection and systematic recording of information gathered relating flood impacts to levels on the gauge at the forecast location during flood episodes as well as through flood studies, especially where these include flood inundation modelling and mapping exercises.

Typical activities for each level of government involved in interpretation are listed in Appendix 1.

3.4.3 Warning Message Construction and Dissemination

The warning message is the critical link between flood prediction and interpretation on the one hand, and taking appropriate protective action on the other. Current arrangements for providing that link can be multi-layered and include flood warning messages disseminated by the Bureau but can also include more localised and targeted communications from emergency management agencies and local government. Guidance on message construction and composition is provided in the Australian Government publication

"*Choosing your Words*" (Attorney Generals Department, 2008)[9], and *Manual 21 Flood Warning* (Australian Government, 2009)[10].

The Bureau Flood Watch and Flood Warning messages are disseminated primarily through the web and the media, but can also be sent directly (preferably email, sometimes by facsimile) to emergency management agencies. Emergency management operations centres are often telephoned on issue of a new or updated warning. The locations for which they are issued are included in the Service Level Specifications (published on the web). The Bureau has a *Memorandum of Understanding* with the ABC to ensure priority is given to the dissemination of warnings.

In some areas the Bureau message as received by the emergency management agency is further disseminated to local response groups and the community. This may be without any change or may include some local interpretation. In other cases the agency may separately generate and communicate more localised messages based on the Bureau predictions, but enhanced with more detailed local knowledge and interpretative information where available.

Typical activities for each level of government involved in warning message construction and dissemination are listed in Appendix 1.

3.4.4 Communicating with Individuals on their Specific Flood Risk

It is increasingly possible to advise people outside of flood time about their individual flood risk, and where this is done the warnings disseminated as floods are approaching will generally be better understood. In many circumstances, people can be provided with the actual gauge height at which their properties will experience over-ground or over-floor inundation or at which their evacuation route will be cut.

Arrangements for providing this sort of advice are generally established at the local level, either through Local Government or State/Territory emergency management agencies.

3.4.5 Generating Flood Response Behaviour – Community Alerting and Local Action

A critical part of any flood warning system is the prompt alerting of the community that flooding will occur. This alerting must be able to operate at any time and is usually through a variety of means. The arrangements for alerting communities when they are at risk from natural disasters are incorporated within the emergency management arrangements for each jurisdiction and normally rests with Local Government, the State emergency management agency and Police.

To assist in this alerting of local communities a decision may be taken within the agreed protocols to issue a flood warning with the Standard Emergency Warning Signal (SEWS) attached. The SEWS is used to communicate emerging situations of extreme danger or when there is a need to warn the public that they need to take some urgent and immediate action to reduce the potential for loss of life or property. This short signal should alert the community to take appropriate actions to protect life and property or to seek guidance from local authorities.

Community education and public awareness programs are another vital tool to achieve effective flood response by continually reminding of the threat of flooding and by informing and keeping fresh details of the flood warning system in place that operates to mitigate the hazard. Responsibility for programs in this area rests primarily with State and Local

[9] "*Choosing your Words" (Attorney Generals Department, 2008* http://www.em.gov.au/Emergency-warnings/Documents/EmergencyWarningsChoosingYourWordsEdition2.pdf
[10] Manual 21 *Flood Warning* (Australian Government, 2009, http://www.em.gov.au/Documents/Manual%2021-Flood%20Warning%282%29.PDF)

Government although the Commonwealth plays a role through the public education programs of Emergency Management Australia.

3.5 Coordination Arrangements – State/Territory Level

3.5.1 Incident Control Centres

The emergency or disaster management arrangements in each state and territory involve the establishment of coordination or control centres during flood events to coordinate the exchange of information, as well as the disposition of people and resources involved in the flood response operation. The Bureau contributes staff to work in these centres in some States/Territories. These centres, especially those at the local level, can act to provide the more detailed local interpretation of flood predictions and local dissemination of flood warning information. Such a centre can sometimes operate on a semi-permanent basis so that it can be activated quickly in times of emergency. Dependant on the arrangements, centres at a district level can be established as well as centres at the local level, either within a specific local government area or jointly across several local areas.

3.6 Coordination Arrangements – National Level

3.6.1 National Crisis Coordination Centre

The Australian Government Crisis Coordination Centre (AGCCC) has been designed to connect relevant Australian Government, State and Territory agencies to centralise Australian Government actions during complex national crises, to develop a single, timely and consistent picture or understanding of a crisis, its implications and the national capacity to respond. During major flood episodes it is anticipated that the Bureau will be liaising closely with this Centre, including posting liaison officers as appropriate to the circumstances. To ensure a whole-of-nation picture of flooding is available in order to maximise the effectiveness of the national response, the Bureau National Operations Centre in the Bureau Head Office in Melbourne will be the focus for this liaison activity.

3.6.2 Incident Management Protocol

A protocol exists for the communication of information between national agencies regarding significant severe weather and flood events. The Bureau prepares a Critical Event Brief (CEB) for key hazards such as severe weather, fire weather or heatwave, flood and tropical cyclone. These briefs are sent directly to an agreed email address at the Australian Government Crisis Coordination Centre on a once or twice daily basis. The Australia Government Crisis Coordination Centre is responsible for distributing this to key Commonwealth agencies and government.

3.7 Stakeholder Coordination – Flood Warning Consultative Committees

The primary vehicle for achieving coordination among key stakeholders in the national flood warning service is the Flood Warning Consultative Committee (FWCC) in each State and the Northern Territory. These State/Territory based consultative committees were established in the late 1980's as part of a set of new arrangements for flood warning proposed at that time by the Commonwealth Government. They are chaired by the Bureau Regional Director in each State and the Northern Territory.

The terms of reference for the Flood Warning Consultative Committees are to:

- Identify requirements for new and upgraded flood forecasting and warning systems.

- Establish the priorities of the requirements that have been identified.
- Review and accept the Service Level Specifications for the Bureau's Flood Forecasting and Warning Services on an annual basis.
- Coordinate the implementation of flood warning systems in accordance with an approved plan, using consistent and standard technologies and to promote effective means of communication of flood warning information to the affected communities.
- Monitor and review the performance of flood warning services.
- Build awareness and promote the Total Flood Warning System concept.

Membership of each Flood Warning Consultative Committee normally includes representation from:

- Bureau of Meteorology (Chair);
- State emergency management agency;
- Police
- State water agency(ies);
- Regional/catchment management agency(ies);
- Local government or representative association; and
- Transport and/or main roads authority.

In some jurisdictions the Flood Warning Consultative Committee provides reports to the State Disaster Mitigation Committee and/or State-based flood committees to assist with coordinating flood warning activities with wider activities in flood risk management and emergency management in the State.

An important role of the Flood Warning Consultative Committee is to regularly review the Service Level Specification in each State and the Northern Territory to ensure Bureau services and target performance levels are clear to all stakeholders. This includes reviewing performance against these target levels to identify areas where the systems may need improvement, as well as adjusting services and performance targets to meet changing needs. As part of its more general role to monitor and review the performance of flood warning services, the Flood Warning Consultative Committee acts to facilitate reviews of the performance of all elements of the Total Flood Warning System in coordination with all stakeholders, to examine the operation of each element as well their interaction in performing as an integrated system.

3.8 System Review

Each agency involved in the operation of the Total Flood Warning System for a particular flood event normally undertakes a review of its performance during the event as part of internal procedures. Perhaps more importantly however is the need for a multi-agency review of the operation of the total system, especially involving the interactions between the various agencies and elements of the total system. There is no consistent national model for these reviews but common practice includes post-flood debriefs, normally initiated by the state emergency management agency and involving key agency stakeholders. Following some events, public meetings are convened to allow people and businesses impacted by the flooding to provide feedback. Consultants are often used.

In addition to these routine reviews of the operation of the Total Flood Warning System, major reviews of the operation and performance of the flood warning service may be undertaken following significant and notable flood episodes. Such reviews may either be part of a wider review covering all aspects of flood risk management or focussed solely on flood warning. They are most commonly initiated at the State level and vary in form from reviews

by independent consultants to full scale public inquiries. Recent examples here are the Queensland Floods Commission of Inquiry (*Queensland Flood Commission Website*[11]) and the Review of 2010-11 Flood Warnings and Response in Victoria (*Victorian Flood Review*[12]).

[11] Queensland Flood Commission website: http://www.floodcommission.qld.gov.au
[12] Victorian Flood Review website: http://www.floodsreview.vic.gov.au

4 Flood Warning Arrangements in Victoria

4.1 Flood Risk Management and Emergency Management in Victoria

Arrangements for the emergency management of flooding in Victoria are set out in the State Flood Emergency Plan (February 2012). The plan is available at: *State Flood Emergency Plan*[13]. The plan sets out the roles and responsibilities of agencies and organisations that have role in planning for, responding to and recovering from a flood event. The roles of the Bureau of Meteorology are set out in the plan, with the Bureau's main role to act as the prediction agency for all Victorian catchments with the exception of Port Phillip and Westernport catchments for which Melbourne Water is the prediction agency, including formulating and issuing official forecasts and warnings and contributing to flood education.

Flood warning services in Victoria operate within the context of state and regional policies and strategies for flood risk and emergency management, as these strategies guide the actions of state, regional and local agency partners in the overall management of flood risk in the state. Flood management strategies at the state, regional and local level together with the roles and responsibilities for the various levels of government in the implementation of these strategies are summarised at: *Draft Floodplain Management Strategy*[14]. . The Victoria State Emergency Service (VicSES) is the control agency for floods in Victoria.

The Emergency Management Manual Victoria contains the policy and planning documents for emergency management in Victoria. It provides details about the roles and responsibilities of different organisations in the emergency management arrangements that apply in the state. An on-line version of the manual is available at: *Victorian Emergency Management Manual*[15].

The specific responsibilities of agencies at each level of government in providing flood forecasting and warning services in Victoria are summarised below.

4.2 Operating Arrangements

4.2.1 Flood Monitoring and Prediction

The Bureau of Meteorology (the Bureau) has responsibility for flood monitoring and prediction with the exception of Port Phillip and Westernport catchments for which Melbourne Water is responsible. The Bureau is responsible for the dissemination of flood forecasts and warnings throughout the period of flooding. These forecasts and warnings are disseminated to State agencies, Catchment Management Authorities, Local Government, Water Authorities and selected private entities and the media in accordance with the service levels as set out in the Service Level Specification for Victoria. Flood Watches and Flood Warnings are published on the Bureau web site along with rainfall and river level data for catchments covered by the service.

For Port Phillip and Westernport catchments Melbourne Water makes flood predictions and prepares flood warnings, which are disseminated by arrangement with the Bureau of Meteorology. The Bureau collects and provides real time rainfall and river level data for all

[13] Victorian State Emergency Services Flood Plan (2012) http://www.ses.vic.gov.au/prepare/em-planning/em-partners-resources/state-flood-emergency-plan)
[14] Victorian Department of Environment, Land, Water and Planning Draft Floodplain Management Strategy http://www.depi.vic.gov.au/water/Floods-and-floodplains/floodplain-management/draft-floodplain-management-strategy
[15] Victorian Justice Department, Office of the Emergency Services Commissioner – Emergency Management Manual (2012) http://www.justice.vic.gov.au/emanuals/emmv/default.htm

catchments including Port Phillip and Westernport catchments on the web and formulates and issues flood watches.

For locations downstream of major storages impacted by storage operations, the storage operators play a vital role in flood prediction. The arrangements relating to the management of flooding consequences downstream of dams are described in the attachment to the State Flood Emergency Plan titled Management of Flooding Downstream of Dams.

All agencies owning and operating rainfall and river level sites used for flood warning services in Victoria provide the data to the Bureau or allow direct access to sites in near real time in accordance with details included in data sharing agreements.

4.2.2 Interpretation

The VicSES as the control agency for flood provides a 24 hour flood warning dissemination service. VicSES interprets Bureau flood warnings and predictions into impacts at the local level in accordance with local flood intelligence. Incident Control Centres are established in the region of each flood and are staffed by personnel from Emergency Services, Catchment Management Authority's, water authorities, flood specialists and hydrologists and other relevant representatives as required. These centres are established to manage flood incidents and will interpret flood predictions using available flood mapping and other forms of flood intelligence as required, to support the provision of information and advice to communities.

4.2.3 Establishment of Flood Class Levels

The need to review or establish a new Flood Class Level (FCL) at a locality is identified by one (or more) of Department of Environment, Land, Water and Planning(DELWP), Catchment Management Authorities, VicSES, Local Government or the relevant water authority. The levels are established from local information informed by flood studies and flood emergency plans as available to best match impacts as per definitions of each classification. The levels are reviewed by the VicSES and other stakeholders including the Bureau DELWP, Catchment Management Authorities, Local Government and water authority as appropriate for feedback. DELWP is responsible for endorsing the new (or reviewed) Flood Class Level's, after which they are forwarded to the Bureau for inclusion in forecast and warning procedures.

4.2.4 Warning Dissemination

The responsibility for disseminating warnings and related information to the communities at risk, either at the onset or during periods of flooding, rests in the main with the Bureau, VicSES and Local Government. The Bureau disseminates flood warnings through its web pages, the media and direct to emergency agencies such as the Victoria State Emergency Services, relevant regional authorities (CMA's and regional water authorities) and councils (Local Government). Upon the receipt of a watch/warning the Victoria State Emergency Service disseminates notifications and advice to the emergency services, affected communities and key support organisations at State, Regional and/or Area of Operations and Local Levels. The VicSES value adds to Bureau's Flood Watches/Warnings through Flood Bulletins by providing a description of possible flood consequences and specific localised public safety advice actions. Flood Bulletins are distributed to the community through the media and the Victoria State Emergency Service website. Flood Bulletins are also distributed to other Emergency Services Organisations. The dissemination is in accordance with agency responsibilities and specific arrangements established.

For the Port Phillip and Westernport catchments the Bureau communicates flood warnings based on flood predictions prepared by Melbourne Water. Melbourne Water and other water authorities have an associated responsibility to provide support and advice in relation to

operations of the systems managed by them before and during periods of flooding. While the responsibility of warning communities downstream of storage operations rest with the VicSES, arrangements may be established between storage operators and VICSES to alter these arrangement particularly where response times may be limited.

4.2.5 Generating Flood Response Behaviour

A critical part of any flood warning system is the prompt alerting of the community that flooding will occur. This alerting must be able to operate at any time and is usually through a variety of means. The prime responsibility for implementing and operating flood alerting procedures for communities rests with the VicSES, Local Government and Police. Local Government has responsibility for actions at local level in order to respond to the flood. The alerting procedures and actions are contained in the Municipal Flood EPlan (MFEP). In the Greater Melbourne area Melbourne Water may be able to provide assistance to Local Government.

Emergency Alert (*Emergency Alert Website*[16]) is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area, about likely or actual emergencies including floods.

4.2.6 Community Information

Information and support to individuals and communities is available state-wide through the VicSES *Victorian SES - Floodsafe*[17] and *Flood Victoria Website*[18]. Information may also be on the relevant local government web sites. Advice to individuals on what to do before, during and after a flood is at: *Emergency Management Australia Guide*[19].

The provision of flood risk information to communities about flooding is vital for people in and surrounding flood affected areas. This information can be used to support community education and engagement activities. Flood education and engagement activities are primarily a VicSES and Local Government responsibility. The Victoria State Emergency Services prepare, coordinate and deliver awareness, educational materials and programs regarding flooding – i.e. FloodSafe. Information which is produced in flood warning system upgrades (e.g. response guidelines, flood level information guides, flood inundation maps etc.) can be used to improve community awareness.

4.2.7 Consultation and Coordination during Floods

Victoria establish a hierarchy of operational control arrangements during flood emergencies including a State level centre supported by Regional and more local Incident Control Centres. During significant severe weather events the Bureau will provide a meteorologist to the State Control Centre to provide weather-related briefings. Bureau hydrologists provide briefings on flood related issues to State and Regional emergency management teams. Bureau hydrologists also liaise on specific flooding issues with emergency management and other agencies through the regional and/or local incident control centres. There is a significant level of direct briefings to agency officials during floods.

4.3 Formal Service Levels and Data Provision

[16] Emergency Alert Website: http://www.emergencyalert.gov.au/
[17] Victorian State Emergency Service Floodsafe website: http://www.ses.vic.gov.au/prepare/floodsafe/
[18] Flood Victoria website: http://www.floodvictoria.vic.gov.au/
[19] Emergency Management Australia Guide for *"What to do before, during and after a flood?* (Attorney Generals Department, 2005, http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf

4.3.1 Service Level Specification

The Service Level Specification for Victoria describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in Victoria. This specification can be found here: *Victorian Service Level Specification*[20]

4.3.2 Data Sharing Agreements

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in Victoria are between the Bureau of Meteorology and:

1) Regional Water Monitoring Projects Participants
2) Gippsland Ports
3) Goulburn Murray Water
4) Southern Rural Water
5) Snowy Hydro
6) East Gippsland Water

4.4 System Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Victorian Water Monitoring Project Agreements and the Data Sharing Agreements for flood warning data collection. Each Data Sharing Agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

4.5 Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. The Victorian Government Response to the 2010-11 Victorian Floods Review appointed the Department of Environment, Land, Water and Planning to take the lead oversight and co-ordination role for the Total Flood Warning System Services in Victoria. The Victorian Flood Warning Consultative Committee provides a forum for agency co-operation. The membership includes:

7) Bureau of Meteorology (Chair and Secretariat)
8) Department of Environment, Land, Water and Planning
9) Victorian State Emergency Services
10) Municipal Association of Victoria
11) Melbourne Water
12) Catchment Management Authorities
13) Rural Water Authorities (currently represented by Goulburn Murray Water)

[20] Victorian Service Level Specification document:
http://www.bom.gov.au/water/floods/downloads.shtml#service-level-specification-documents

The Inspector-General for Emergency Management plays a role in providing assurance on the performance of flood warning systems in Victoria. The Victorian Emergency Management Reform was announced in December 2012 with a long term 10 year plan. The vision of the reform is for a sustainable and efficient emergency management system that minimises the likelihood and consequences of disasters and emergencies on the Victorian community.

The reform will be based on three principles:

14) Community – Emergency management founded on community participation, resilience and shared responsibility.

15) Collaboration – Efficient governance arrangements that clarify roles and responsibilities, embed cooperation across agencies, and ensure emergency management reform is coordinated across the sector; and

16) Capability – An all-hazard agencies approach built on networked arrangements, greater interoperability and a stronger emphasis on risk mitigation.

Strategic priorities include:

17) Building community resilience and community safety,

18) Streamlining governance arrangements,

19) Establishing clear and effective response and control arrangements,

20) Strengthening emergency management planning processes, and

21) Building capacity and capability of the emergency management sector.

5 Flood Warning Arrangements in New South Wales

5.1 Flood Risk Management and Emergency Management in New South Wales

Arrangements for the emergency management of flooding in New South Wales are set out in the New South Wales State Flood Sub Plan (June 2008)[21]. The plan sets out the emergency management aspects of prevention, preparation, response and initial recovery arrangements for flooding and the responsibilities of agencies and organisations with regards to these functions. The plan designates the New South Wales State Emergency Service (SES) as the designated Combat Agency for controlling flood operations. The functions of the Bureau of Meteorology are set out in the plan, with the Bureau's main role to act as the prediction agency, including the collection and provision of real time rainfall and river level data, formulate and issue official forecasts and warnings and contribute to flood education.

The arrangements for managing flood prone land in New South Wales are detailed in the State Government's Flood Prone Lands Policy and the Floodplain Development manual (2005) which covers floodplain management matters gazetted under the Local Government Act 1993. The management of flood prone land is, primarily, the responsibility of councils, with specialist technical assistance provided by the New South Wales Government through the New South Wales Office of Environment and Heritage and the State Emergency Service. This arrangement includes the establishment of local floodplain risk management committees through which local community groups and individuals can communicate on flood risk management issues.

5.2 Operating Arrangements

5.2.1 Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction throughout New South Wales and for the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding. These forecasts and warnings are disseminated primarily to the New South Wales State Emergency Service for further dissemination and response according to arrangements in the New South Wales State Flood Sub Plan and the service levels as set out in the Service Level Specification for New South Wales. Flood Watches and Flood Warnings are published on the Bureau web site along with rainfall and river level data for catchments covered by the service.

5.2.2 Interpretation

The New South Wales State Emergency Service as the control agency for flood emergencies in New South Wales provides a 24 hour flood warning dissemination service. As part of this, the New South Wales State Emergency Service interpret Bureau flood warnings and predictions into impacts at the local level in accordance with local flood intelligence, and prepares and disseminates local flood bulletins to those at risk.

5.2.3 Establishment of Flood Class Levels

The need to review or establish a new Flood Class Level at a locality is identified as a consultative process involving the Bureau of Meteorology, New South Wales State Emergency Service and local floodplain management committees. The levels are established

[21] New South Wales State Flood Sub Plan (June 2008)
http://www.emergency.nsw.gov.au/content.php/553.html

from local information informed by flood studies and flood emergency plans as available to best match the definitions of each classification. The levels are reviewed by the and other stakeholders. Once endorsed, the levels are forwarded to the Bureau for inclusion in forecast and warning procedures.

5.2.4 Warning Dissemination

The New South Wales South Emergency Service has primary responsibility for disseminating flood warnings in New South Wales. This involves generating and issuing flood bulletins based on Bureau flood predictions with advice on the local impact of these predictions, which are disseminated through appropriate coordination arrangements among regional and local control groups.

5.2.5 Generating Flood Response Behaviour

The prime responsibility for implementing and operating flood alerting procedures for communities rests with the New South Wales State Emergency Service working in close cooperation with local councils and other emergency management agencies. The alerting procedures and actions are contained in the New South Wales State Flood Sub Plan.

Community education about flooding is vital for people in and surrounding flood affected areas. This education is paramount to the community's effective response. Responsibility for education is primarily a responsibility of the New South Wales State Emergency Service and local floodplain management authorities. Information which is produced in flood warning system upgrades (e.g. response guidelines, flood level information guides, flood inundation maps etc.) should be used to improve community awareness.

Emergency Alert (*Emergency Alert Website*[22]) is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods.

5.2.6 Community Information

Information and support to individuals and communities is available state-wide through: *New South Wales Flood Safe Website*[23]. Advice to individuals on what to do before, during and after a flood is at: *Emergency Management Australia Guide*[24] .

5.2.7 Consultation and Coordination during Floods

The Bureau of Meteorology maintain close contact with the New South Wales State Emergency Service at all operational levels during floods to assist with interpreting flood predictions and related flood operational matters.

5.3 Formal Service Levels and Data Provision

[22] Emergency Alert Website: http://www.emergencyalert.gov.au/
[23] New South Wales State Emergency Service Floodsafe website: http://www.floodsafe.com.au/
[24] Emergency Management Australia Guide for *"What to do before, during and after a flood?* (Attorney Generals Department, 2005, http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf

5.3.1 Service Level Specification

The Service Level Specification for New South Wales describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in New South Wales. This specification can be found at: *New South Wales Service Level Specification*[25]

5.3.2 Data Sharing Agreements

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in New South Wales are between the Bureau of Meteorology and:

- Office of Environment and Heritage for Manly Hydraulics Laboratory data;
- NSW Office Of Water;
- Sydney Catchment Authority, now part of Water NSW as of 1 January 2015

5.4 System Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreements for flood warning data collection. Each Data Sharing Agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

5.5 Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in New South Wales is the Flood Warning Consultative Committee. Membership of the New South Wales Flood Warning Consultative Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- New South Wales State Emergency Service
- New South Wales Office of Environment and Heritage
- New South Wales Office of Water
- Sydney Catchment Authority, now part of Water NSW as of 1 January 2015
- Floodplain Management Association

[25] New South Wales Service Level Specification document: http://www.bom.gov.au/water/floods/downloads.shtml#service-level-specification-documents

6 Flood Warning Arrangements in Queensland

6.1 Flood Risk Management and Emergency Management in Queensland

Under the auspices of the *Disaster Management Act [2003]*[26] (the Act) Queensland Fire and Emergency Services (QFES) coordinates the emergency and disaster management arrangements and disaster mitigation programs for Queensland, including those for floods.

EMQ operates within the organisational structure of the Queensland Department of Community Safety (DCS) and provides the executive advice and support to the State Disaster Management Group (SDMG).

Aside from its operational responsibilities, the SDMG has the legislative responsibility to develop the State strategic policy framework to ensure that effective disaster management is developed and implemented for Queensland, and to prepare the State disaster management plan.

SDMG also has the responsibility to ensure the establishment of District Disaster and Local Disaster management groups (DDMG and LDMG) for each district and local government area across Queensland. Each group is required to develop their disaster management plans to ensure the coordination of disaster operations and activities.

State Emergency Service (SES) comprise operational units managed under the auspices of the Local Disaster Management Groups. The SES has the primary role to perform search and rescue operations during emergencies and to assist communities to prepare, respond and recover from an event or disaster.

Floodplain management in Queensland (including flood modification, land-use/property modification, response planning) is primarily a Local Government responsibility.

6.2 Operating Arrangements

6.2.1 Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction in Queensland and for the dissemination of flood forecasts and warnings. These forecasts and warnings are disseminated to State, District and Local Disaster Coordination Centres and the media in accordance with the service levels as set out in the Service Level Specification for Queensland.

Flood Watches[27] and Flood Warnings are published on the Bureau web site along with rainfall and river level data for catchments and river basins covered by the service.

6.2.2 Interpretation

The interpretation of Bureau flood warnings and predictions into local impacts is a function undertaken by the State Disaster Coordinate Centre (SDCC) and the Local Disaster Management Group. Under the Act, local disaster management plans must ensure the community is aware of ways of mitigating the adverse effects of a hazardous event, and preparing for, responding to and recovering from a disaster.

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[26] The Queensland State Government – Emergency Management Act 2003: http://www.disaster.qld.gov.au/About_Disaster_Management/DM_Act.html

[27] Flood Watches were not provided in Queensland prior to 2014.

6.2.3 Establishment of Flood Class Levels

The establishment of flood class levels primarily rests with local government, with an annual review coordinated by the Bureau.

QFES, Local Government Association of Queensland (LGAQ), Department of Natural Resources and Mines (DNRM) and the Bureau are working together to establish guidelines consistent with the State strategic policy framework to assist local government to appropriately review flood class levels. The guidelines will include a process to evaluate local government recommendations.

6.2.4 Warning Dissemination

Flood Warnings are disseminated *en* masse to the following agencies having emergency management responsibilities in Queensland;

- Australian Army
- Australian Red Cross QLD
- Emergency Management organisations (QFES, SES)
- Local Councils
- Local Government Association of Queensland
- Queensland Police Service
- Royal Australian Air Force
- State and Federal Government Departments (Department of Defence, Transport and Main Roads)

Flood Warnings are published on the Bureau web site along with rainfall and river level data for catchments covered by the service.

6.2.5 Generating Flood Response Behaviour

Under Section 30 of the Act, the Local Disaster Management Group and Queensland Police have the lead combat role for disaster operations within their jurisdiction consistent with their disaster management and operation plans.

Emergency Alert (Emergency Alert Website[28]) is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a definable polygon area about likely or actual emergencies, including floods. Queensland Fire and Emergency Services (QFES) have the operational responsibility for activating and disseminating Emergency Alert messages in Queensland, managed in association with Telstra.

6.2.6 Community Information

Information and support to individuals and communities is available state-wide through: *Emergency Management Queensland Publications*[29] Advice to individuals on what to do before, during and after a flood is at: *Emergency Management Australia Guide*[30] .

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[28] Emergency Alert Website: http://www.emergencyalert.gov.au/
[29] EMQ list of publications: http://www.emergency.qld.gov.au/emq/css/publications.asp
[30] Emergency Management Australia Guide for *"What to do before, during and after a flood?* (Attorney Generals Department, 2005, http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf

6.2.7 Coordination and Consultation during Floods

Coordination and consultation among agencies responsible for emergency management during flood operations in Queensland is achieved through a hierarchy of disaster coordination centres at the local, district and state levels which are activated as the need arises to coordinate resources, information and to provide support. The Bureau of Meteorology maintains close and regular contact with these centres during flood operations.

6.3 Formal Agreements for Service Levels and Data Provision

6.3.1 Service Level Specification

The Service Level Specification for Queensland describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in Queensland. This specification can be found at: *Queensland Service Level Specification*[31] .

6.3.2 Data Sharing Agreements

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in Queensland are between the Bureau of Meteorology and:

- Sunwater;
- Department of Natural Resources and Mines (DNRM);
- Department of Science, Information Technology, Innovation and the Arts (DSITIA)
- Seqwater;
- Department of Transport and Main Roads (specifically Queensland Rail)

6.4 System Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreements for flood warning data collection. Each Data Sharing Agreement includes best endeavour arrangements for emergency callouts by the data provider for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

6.5 Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in Queensland is the Flood Warning Consultative Committee. Membership of the Queensland Flood Warning Consultative Committee is:

[31] Queensland Service Level Specification document:
http://www.bom.gov.au/water/floods/downloads.shtml#service-level-specification-documents

- Bureau of Meteorology (Chair and Secretariat)
- Department of Community Safety & Emergency Management Queensland
- Department of Natural Resources and Mines (DNRM)
- Department of Energy and Water Supply (DEWS)
- Department of Local Government, Community Recovery and Resilience (DLGCRR)
- Department of State Development, Infrastructure and Planning (DSDIP)
- Local Government Association of Queensland (LGAQ)
- Brisbane City Council (BCC)
- Queensland Reconstruction Authority (QRA)
- Queensland Bulk Water Supply Authority (Seqwater)
- Sunwater

7 Flood Warning Arrangements in the Northern Territory

7.1 Flood Risk Management and Emergency Management in the Northern Territory

Flood warning services in the Northern Territory operate within the context of Territory policies and strategies for flood risk and emergency management, as these strategies guide the actions of Territory agency partners in the overall management of flood risk in the Northern Territory. The Northern Territory Department of Land Resource Management (DLRM) is responsible for flood risk management related to land use planning in the Northern Territory. The Northern Territory Emergency Service is responsible for flood risk management related to flood response and emergency preparations.

The specific responsibilities of agencies in the Northern Territory in providing flood forecasting and warning services are summarised below.

7.2 Operating Arrangements

7.2.1 Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction for areas of the Northern Territory as outlined in the Service Level Specification for the Northern Territory. The Bureau is responsible for the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding for the specified forecast locations in the Service Level Specification for the Northern Territory. These forecasts and warnings are disseminated to the Northern Territory Emergency Service, the Police, the Department of Land Resource Management and the media in accordance with the service levels as set out in the Service Level Specification for the Northern Territory. Flood Watches and Warnings are published on the Bureau web site along with rainfall and river level data for catchments covered by the service.

7.2.2 Interpretation

The Northern Territory Emergency Service and the Northern Territory Police interpret Bureau flood warnings and predictions into impacts at the local level in accordance with local flood intelligence.

7.2.3 Establishment of Flood Class Levels

The need to review or establish a new Flood Class Level at a locality is identified by consultation between the Bureau of Meteorology, the Northern Territory Emergency Service, Police, the Department of Land Resource Management and local authorities. The levels are established from local information informed by flood studies and flood emergency plans as available to best match the definitions of each classification. The levels are reviewed by the Northern Territory Flood Warning Consultative Committee (FWCC) and then provided to the Bureau (and other agencies) for inclusion in forecast and warning procedures.

7.2.4 Warning Dissemination

The responsibility for disseminating warnings and related information to the communities at risk at the onset or during periods of flooding rests in the main with the Bureau of Meteorology, the Northern Territory Emergency Service and Police. The Bureau disseminate flood warnings through it's web pages, the media and direct to the Northern Territory

Emergency Service and Police. These agencies in turn disseminate warning information (Bureau and some local interpretation as available) further at the local community level. The dissemination is in accordance with agency responsibilities and specific local arrangements in emergency management plans.

7.2.5 Generating Flood Response Behaviour

The prime responsibility for implementing and operating flood response procedures for communities rests with the Northern Territory Emergency Service and, where appropriate, Police and local authorities.

Community education about flooding is vital for people in and surrounding flood affected areas and is primarily the responsibility of the Northern Territory Emergency Service.

Emergency Alert (*Emergency Alert Website*[32]) is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods.

7.2.6 Community Information

Information and support to individuals and communities is available at: *Northern Territory Emergency Service - Floods*[33] . Advice to individuals on what to do before, during and after a flood is at: *Emergency Management Australia Guide*[34] .

7.2.7 Coordination and Consultation during Floods

The Bureau of Meteorology maintains close contact with the Northern Territory Emergency Service and the Regional Controller in the lead up to and during flood events. Liaison with Police personnel responding to floods may also occur during flood events.

For larger or widespread events the Northern Territory Counter Disaster Council may organise meetings with the Northern Territory Government agencies responsible for relevant aspects of the local Flood Response Plans to coordinate community response to the flood. The Bureau of Meteorology will attend these meetings either in person or by telephone when requested by the Regional Controller (subject to operational availability).

7.3 Formal Service Levels and Data Provision

7.3.1 Service Level Specification

The Service Level Specification for the Northern Territory describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of

[32] Emergency Alert Website: http://www.emergencyalert.gov.au/
[33] Northern Territory Emergency Service Floods website: http://www.pfes.nt.gov.au/Emergency-Service/Public-safety-advice/Floods.aspx
[34] Emergency Management Australia Guide for *"What to do before, during and after a flood?* (Attorney Generals Department, 2005, http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf

Meteorology in the Northern Territory. This specification can be found at: *Northern Territory Service Level Specification*[35]

7.3.2 Data Sharing Agreements

A Data Sharing Agreement for supporting flood forecasting and warning services in the Northern Territory is under development between the Bureau of Meteorology and:

- Northern Territory Department of Land Resource Management

7.4 System Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreement for flood warning data collection. The Data Sharing Agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

7.5 Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in the Northern Territory is the Flood Warning Consultative Committee (NTFWCC). Membership of the Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- Northern Territory Emergency Service
- Northern Territory Department of Land Resource Management
- Local Government Association of Northern Territory
- Northern Territory Department of the Chief Minister (Security and Emergency Recovery)

[35] Northern Territory Service Level Specification document: http://www.bom.gov.au/water/floods/downloads.shtml#service-level-specification-documents

8 Flood Warning Arrangements in Western Australia

8.1 Flood Risk Management and Emergency Management in Western Australia

The Department of Water is responsible for the development of a floodplain management strategy for Western Australia and the Department of Fire and Emergency Services (DFES) is designated as Hazard Management Agency (HMA) for flood within Western Australia (Emergency Management Regulations 2006). Planning for flood emergencies is undertaken in compliance with the Emergency Management Act 2005. WESTPLAN-FLOOD (FESA - State Emergency Plan for Flood[36]) details the emergency management arrangements for potential or actual floods in Western Australia. This includes details of the roles and responsibilities of participating organisations in managing floods in Western Australia.

8.2 Operating Arrangements

8.2.1 Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction in Western Australia. This includes the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding. These forecasts and warnings are disseminated to State and Local agencies and the media in accordance with the service levels as set out in the Service Level Specification for Western Australia. Flood Watches and Flood Warnings are published on the Bureau web site along with rainfall and river level data for catchments covered by the service.

8.2.2 Interpretation

Bureau flood forecasts and warnings are issued to response agencies, in particular to the Department of Fire and Emergency Services and local councils. These agencies are responsible for further interpretation of Bureau flood predictions into local impacts. This interpretation is aided by local flood intelligence including available flood mapping where available. Main Roads Western Australia provides advice in particular on potential flooding impacts on the road system, including advice on alternate routes when major routes have been cut by flooding. The Department of Water assist with local interpretation of flood impacts and may undertake flood modelling for this purpose.

8.2.3 Establishment of Flood Class Levels

The Bureau of Meteorology collaborates with local councils, Department for Water and the Department of Fire and Emergency Services in the establishment of flood class levels.

8.2.4 Warning Dissemination

The Bureau of Meteorology prepares and disseminates Flood Watch and Flood Warning messages from the Flood Warning Centre. The Department of Fire and Emergency Services assists with the dissemination of Flood Watch and Flood Warning information and flood advice to the community; further assisted by Western Australia Police.

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[36] FESA State Emergency Management Plan for Floods (WESTPLAN) (2010): https://extranet.fesa.wa.gov.au/sites/emwa/Lists/StateEmergencyManagementDocumentLibrary/State%20EM%20Plans/Hazard%20Plans/Westplan%20Flood.pdf

8.2.5 Generating Flood Response Behaviour

The prime responsibility for implementing and operating flood alerting procedures for communities rests with the Department of Fire and Emergency Services and Western Australia Police. Police (and local authorities where appropriate) assist in facilitating appropriate response actions at the local level.

The Department of Fire and Emergency Services, in cooperation with other agencies, provide communities with flood risk awareness, information and education.

Emergency Alert (*Emergency Alert Website*[37]) is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods.

8.2.6 Community Information

Information and support to individuals and communities is available state-wide at: *DFES - Flood Website*[38]. Advice to individuals on what to do before, during and after a flood is at: *Emergency Management Australia Guide*[39] .

8.2.7 Coordination and Consultation during Floods

In order to assist flood forecasting, the Bureau of Meteorology Flood Warning Centre may consult with the Flood Warning Operational Group (FWOG) members or activate the FWOG as it deems appropriate. The roles and responsibilities of the FWOG is outlined in the WESTPLAN – FLOOD document and is comprised of the following representatives

- Bureau of Meteorology (Chair);
- Main Roads Western Australia;
- Department of Water
- Water Corporation; and
- Other agencies selected by the Chair.

The composition of the FWOG can be varied depending on the nature of the event, technical expertise requirements and resource needs. The duration of FWOG meetings will vary with the level and immediacy of the emergency and the requirements of DFES. Agencies may be requested to provide personnel to cover multiple shifts within the constraints of each agency's available resources and commitments.

8.3 Formal Service Levels and Data Provision

8.3.1 Service Level Specification

The Service Level Specification for Western Australia describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of

[37] Emergency Alert Website: http://www.emergencyalert.gov.au/
[38] DFES Flood Website: http://www.dfes.wa.gov.au/safetyinformation/flood/Pages/default.aspx
[39] Emergency Management Australia Guide for *"What to do before, during and after a flood?* (Attorney Generals Department, 2005, http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf

Meteorology in Western Australia. This specification can be found at: *Western Australia Service Level Specification*[40]

8.3.2 Data Sharing Agreements

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in Western Australia are between the Bureau of Meteorology and:

- Department of Water
- BHP Billiton
- Rio Tinto
- Department of Environment and Conservation (DEC)
- Department of Agriculture and Food

8.4 System Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreement's for flood warning data collection. Each Data Sharing Agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

8.5 Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in Western Australia is the Flood Warning Consultative Committee. Membership of the Western Australia Flood Warning Consultative Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- Department of Fire and Emergency Services
- Department of Water
- Western Australia Local Government Association
- Main Roads Western Australia
- Water Corporation of Western Australia
- Landgate (Remote Sensing Group)
- Department of Housing (Aboriginal Housing)

[40] Western Australia Service Level Specification document: http://www.bom.gov.au/water/floods/downloads.shtml#service-level-specification-documents

9 Flood Warning Arrangements in South Australia

9.1 Flood Risk Management and Emergency Management in South Australia

Flood warning services in South Australia operate within the context of state and regional policies and strategies for flood risk and emergency management. These strategies guide the actions of state, regional and local agency partners in the overall management of flood risk and flood events in the state. All emergency management arrangements in South Australia are governed by the *Emergency Management Act (2004)*. Relevant authorities, responsibilities and mechanisms are set out in the State Emergency Management Plan. This includes the appointment of a Hazard Leader as the agency to undertake a leadership role for the planning of emergency management activities pertaining to the prevention of, preparedness for, response to and recovery from the designated hazard. The Hazard Leader for flood is the Department of Environment, Water and Natural Resources (DEWNR).

The specific responsibilities of agencies at each level of government in providing flood forecasting and warning services in South Australia are summarised below.

9.2 Operating Arrangements

9.2.1 Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction in South Australia. This includes the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding. These forecasts and warnings are disseminated to State and Local agencies and the media in accordance with the service levels as set out in the Service Level Specification for South Australia. Flood Watches and Flood Warnings are published on the Bureau web site along with rainfall and river level data for catchments covered by the service.

9.2.2 Interpretation

Bureau flood forecasts and warnings are issued to South Australian State Emergency Service (SASES) as the control agency and to response agencies including South Australia Police (SAPOL), South Australian Country Fire Service (SACFS) and local councils. These agencies may provide further interpretation of Bureau flood predictions into local impacts. This interpretation is aided by local flood intelligence including available flood mapping.

9.2.3 Establishment of Flood Class Levels

The need to review or establish a new Flood Class Level at a locality may be identified by the Bureau of Meteorology, South Australian State Emergency Service, a local council or a State agency. The levels are established from local information informed by flood studies and flood emergency plans as available to best match the definitions of each classification. The levels are submitted to the South Australian Flood Warning Consultative Committee for final endorsement and then submitted to the Bureau (and other agencies) for inclusion in forecast and warning procedures.

9.2.4 Warning Dissemination

The Bureau is the responsible agency for the issuing of warnings and information, relating to the onset and progress of flood events, directly to South Australian State Emergency Service, South Australian Police, the Department of Environment, Water and Natural

Resources (DEWNR as Flood Hazard Leader), South Australian Water Corporation and local government authorities. It is the responsibility of the State Emergency Service and South Australia Police to immediately pass the information to their relevant Regional and Local Service Area commanders and officers and others as deemed appropriate.

The Bureau is also the issuing authority for Flood Watch and Flood Warning products to the general public and the media.

9.2.5 Generating Flood Response Behaviour

The prime responsibility for implementing and operating flood alerting procedures for the South Australian communities rests with the South Australian State Emergency Service and the South Australian Police. Emergency Alert (*Emergency Alert Website*[41]) is the national telephone warning system available to agencies with roles in emergency services. It is used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods.

Community education about flooding is vital for people in and surrounding flood affected areas. This education is paramount to the community's effective response. Responsibility for education is primarily a Local Government and South Australian State Emergency Service responsibility. In South Australia the South Australian State Emergency Service has established the Flood Safe program in concert with State and Local Government. The program is funded by the Department of Environment, Water and Natural Resources, the Adelaide & Mount Lofty Ranges Natural Resources Management Board and many local councils. The program utilises State Emergency Service volunteers to raise awareness of flood risk and management.

9.2.6 Community Information

Information and support to individuals and communities is available state-wide through the South Australian State Emergency Service - Flood Information[42]. Advice to individuals on what to do before, during and after a flood is at: *Emergency Management Australia Guide*[43] .

9.2.7 Coordination and Consultation during Floods

The Control Agency for floods in South Australia is the State Emergency Service. Their role is to take control of a flood incident and assume responsibility for tasking other organisations in accordance with the needs of the situation.

The South Australian State Emergency Service and South Australia Police maintain regular contact with the Bureau following the issuing of a Flood Watch or Flood Warning. Continuing liaison is aimed at ensuring that flood information is available for application by these organisations and other agencies (e.g. Country Fire Service, Department of Environment, Water and Natural Resources, Department of Planning, Transport and Infrastructure etc.).

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[41] Emergency Alert Website: http://www.emergencyalert.gov.au/
[42] South Australian State Emergency Service – Flood Information: http://www.ses.sa.gov.au/site/community_safety/floodsafe/flood_information.jsp
[43] Emergency Management Australia Guide for *"What to do before, during and after a flood?* (Attorney Generals Department, 2005, http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf

9.3 Formal Agreements for Service Levels and Data Provision

9.3.1 Service Level Specification

The Service Level Specification for South Australia describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in South Australia. This specification has been formally agreed between the Bureau and other stakeholders as represented by the Flood Warning Consultative Committee and can be found at: *South Australia Service Level Specification*[44]

9.3.2 Data Sharing Agreements

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in SA are between the Bureau of Meteorology and:

- South Australian Water Corporation
- Department of Environment, Water and Natural Resources (DEWNR)

9.4 System Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreement's for flood warning data collection. Each Data Sharing Agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

9.5 Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and a primary means of achieving such coordination among agencies involved in the Total Flood Warning System in South Australia is the Flood Warning Consultative Committee. Membership of the South Australian Flood Warning Consultative Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- South Australian State Emergency Service
- South Australia Police
- Department of Environment, Water and Natural Resources (DEWNR) including the Flood Hazard Leader
- South Australian Water Corporation
- Department of Planning, Transport and Infrastructure
- Adelaide and Mt Lofty Ranges Natural Resources Management Board
- Local Government Association

[44] South Australia Service Level Specification document: http://www.bom.gov.au/water/floods/downloads.shtml#service-level-specification-documents

- South Australian Fire and Emergency Services Commission (SAFECOM)

The Flood Hazard Leader has strategic responsibility for flood risk management in South Australia. The South Australian emergency management arrangements identify the Department of Environment, Water and Natural Resources (DEWNR) as the Flood Hazard Leader. The Flood Hazard Leader is responsible for the South Australian Flood Hazard Plan and reports to the Mitigation Advisory Group. The Flood Hazard Leader may establish subcommittees or working groups to advise on particular aspects of flood hazard planning.

10 Flood Warning Arrangements in Tasmania

10.1 Flood Risk Management and Emergency Management in Tasmania

Flood warning services in Tasmania operate within the context of state and regional policies and strategies for flood risk and emergency management, as these strategies guide the actions of State, regional and local agency partners in the overall management of flood risk in the State. The State Emergency Service Tasmania is currently working on producing the Tasmanian Flood Warning Plan. This document will outline the emergency management arrangements when dealing with a flood emergency.

The specific responsibilities of agencies at each level of government in providing flood forecasting and warning services in Tasmania are summarised below.

10.2 Operating Arrangements

10.2.1 Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction throughout Tasmania and for the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding. These forecasts and warnings are disseminated to State and local agencies and the media in accordance with the service levels as set out in the Service Level Specification for Tasmania. Flood Watches and Flood Warnings are published on the Bureau web site along with rainfall and river level data for catchments covered by the service. In Tasmania, the Bureau also issues River and Rain Alerts to selected local stakeholders when river and rainfall conditions exceed agreed threshold levels on behalf of State Emergency Services Tasmania.

The Bureau undertakes its prediction activities in close coordination with Hydro Tasmania in their role in operating the Tasmanian hydro-power system.

10.2.2 Interpretation

The State Emergency Service Tasmania as the control agency for flood emergencies interprets Bureau flood warnings and predicts impacts at the local level in accordance with local flood intelligence. State legislation requires local government to develop Emergency Management Plans. This includes the development of flood maps and plans and standard operating procedures during floods.

10.2.3 Establishment of Flood Class Levels

The need to review or establish a new Flood Class Level at a locality is identified by consultation between the Bureau of Meteorology, State Emergency Service Tasmania, Local Councils and the Department of Primary Industries, Parks, Water and Environment. The levels are established from local information informed by flood studies and flood emergency plans as available to best match the definitions of each classification. The levels are submitted to the Tasmania Flood Warning Consultative Committee for final endorsement and then submitted to the Bureau (and other agencies) for inclusion in forecast and warning procedures.

10.2.4 Warning Dissemination

The responsibility for disseminating warnings and related information to the communities at risk at the onset or during periods of flooding rests in the main with the Bureau of

Meteorology and State Emergency Service Tasmania. The Bureau disseminate flood warnings through its web site, the media and direct to emergency agencies. These agencies further disseminate Bureau warnings to Local Government and relevant regional authorities for more localised interpretation and dissemination in their community in accordance with agency responsibilities and specific local arrangements in the respective local flood plans.

10.2.5 Generating Flood Response Behaviour

A critical part of any flood warning system is the prompt alerting of the community that flooding will occur. This alerting must be able to operate at any time and is usually through a variety of means. The prime responsibility for implementing and operating flood alerting procedures for communities rests with Local Government and State Emergency Service Tasmania. Local Government has responsibility for actions at a local level in order to respond to the flood.

Community education about flooding is vital for people in and surrounding flood affected areas. This education is paramount to the community's effective response. Responsibility for education is primarily a Local Government and State Emergency Service Tasmania responsibility. The Tasmania Flood Warning Consultative Committee provides assistance where required.

Emergency Alert (*Emergency Alert Website*[45]) is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods.

10.2.6 Community Information

Information and support to individuals and communities is available state-wide through State Emergency Service Tasmania at: *Tasmanian State Emergency Service - Floodsafe*[46]. Advice to individuals on what to do before, during and after a flood is at: *Emergency Management Australia Guide*[47].

A summary of the history of flooding in Tasmania is available at *Tasmanian Flood History*[48]

10.2.7 Coordination and Consultation during Floods

The Bureau of Meteorology maintains close contact with the State Emergency Service Tasmania at all operational levels during floods to assist with interpreting flood predictions and related flood operational matters. The Bureau of Meteorology maintains regular contact with Launceston City Council, Northern Midlands Council and Huon Valley Council during flood operations. The Bureau of Meteorology also coordinates closely with Hydro Tasmania in their role in operating the Tasmanian hydro-power system during flood operations.

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[45] Emergency Alert Website: http://www.emergencyalert.gov.au/
[46] Tasmanian State Emergency Service Floodsafe website: http://www.ses.tas.gov.au/h/em/awareness/flood/
[47] Emergency Management Australia Guide for *"What to do before, during and after a flood?* (Attorney Generals Department, 2005, http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf
[48] Tasmanian Flood History website: http://www.bom.gov.au/tas/flood/flood_history/flood_history.shtml

10.3 Formal Service Levels and Data Provision

10.3.1 Service Level Specification

The Service Level Specification for Tasmania describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in Tasmania. This specification can be found at: *Tasmania Service Level Specification*[49]

10.3.2 Data Sharing Agreements (DSA's)

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in Tasmania are between the Bureau of Meteorology and:

- Hydro Tasmania;
- Department of Primary Industries, Parks, Water and Environment;
- CSIRO

10.4 System Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreements for flood warning data collection. Each Data Sharing Agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

10.5 Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in Tasmania is the Flood Warning Consultative Committee. Membership of the Tasmania Flood Warning Consultative Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- State Emergency Service Tasmania
- Tasmanian Farmers and Graziers Association (TFGA)
- Hydro Tasmania (Hydro Tas)
- Department of Primary Industries, Parks, Water and Environment (DPIPWE)
- Launceston City Council
- Northern Midlands Council
- Huon Valley Council
- Local Government Association of Tasmania (LGAT)

[49] Tasmanian Service Level Specification document
http://www.bom.gov.au/water/floods/downloads.shtml#service-level-specification-documents

11 Establishing New and Improved Systems

Initiatives for new or improved flood warning systems and services can come about in several ways including;

- routine reviews of the operation of the Total Flood Warning System;
- initiatives from the local level such as flood risk studies; or
- as an outcome of post-event reviews following a significant flooding episode.

The initiatives can be in the form of an improvement to an existing system in order to improve the quality of an existing service (e.g. enhancing the existing real-time data collection network); adding new forecast locations to an existing system; or establishing a completely new service.

Arrangements for establishing new and/or improved flood warning systems and services need to ensure that:

- The service requirement is clearly established and the solution proposed includes appropriate consideration of all elements of the Total Flood Warning System to ensure any investment will be effective.
- The requirement is fully costed including the initial investment costs and ongoing support and maintenance costs.
- The relative priority of the requirement is established.

11.1 Coordination of Requirements

In some jurisdictions there are now State government committees or agencies who have the lead role of prioritising investment in new networks or systems. Proponents of new or improved systems can also seek the advice of agencies represented on the relevant Flood Warning Consultative Committee, especially the Bureau of Meteorology, in order to ensure service requirements are properly specified, for advice on the elements of the Total Flood Warning System that need consideration, and for technical advice on potential solutions and costing.

11.2 Establishing Priorities

Priorities should ideally be established on the basis of the cost effectiveness of the proposed investment in reducing the overall flood risk exposure within the jurisdiction. Recent work through the Risk Assessment Management & Mitigation Subcommittee (RAMMS) group under the Australian-New Zealand Emergency Management Committee (ANZEMC) in developing national standards for risk analysis across all natural hazards is relevant here. This work is encouraging an all-hazards approach to this analysis such that jurisdictions are able to rank investments in mitigation measures across all hazards; not just flooding. The Australian Government provides funding to each jurisdiction under the Natural Disaster Resilience Program with jurisdictions able to establish their own priority for investment. The systematic availability of national flood risk information through the National Flood Risk Information Portal (NFRIP Section 12.4) will also assist with providing the nationally consistent data base of flood risk information to contribute to the assessment of priorities.

11.3 Funding Programs

11.3.1 Natural Disaster Resilience Program

The funding for new and improved flood warning services comes within the scope of the Australian Government National Partnership Agreement for Natural Disaster Resilience Program. The details of this program can be found at *National Partnership Agreement for NDRP*[50]. This program provides funding to the states and territories to enhance the resilience of communities against the impact of natural disasters. It aims to allow states and territories to effectively meet the requirements of threatened local communities to enhance their resilience to any natural disaster in the context of their overall risk priorities.

Funding for projects is prioritised by states and territories in the context of their natural disaster risk priorities. This recognises that different jurisdictions have different priorities and that these may change over time. Funding is provided on a shared arrangement and funds for flood mitigation (including flood warning) competes with funding for other natural hazards (bushfire, etc). Priorities are set by state and territory committees, which are encouraged to use risk measurement and assessment methodologies developed through the Risk Assessment Management & Mitigation Subcommittee (RAMMS) group as mentioned above in their evaluation of proposals.

The committees may seek input from the Flood Warning Consultative Committee (or the Bureau) for guidance on priorities in the case of flood warning proposals. Requests for funding need to include all costs associated with the new (or upgraded) service including the full costs to establish and to operate the service.

11.3.2 State and Territory Funding Programs

Each state and territory has some form of ongoing program for funding flood mitigation projects, which can include flood warning investments. Arrangements for these vary across the jurisdictions and can involve a shared contribution with local government. Establishing priorities for these investments is normally done within the context of the state flood risk management strategy and may involve consideration of more locally-based issues and political exigencies. Coordinating these flood warning projects through the Flood Warning Consultative Committee can help ensure the project is consistent with other related projects and that appropriate consideration is given to its implementation and operation within the Total Flood Warning System.

11.3.3 One-off Funding Through Major Initiatives

Significant injections of funding can be provided either after significant flooding or a major review exercise. These initiatives can come with their own arrangements. To ensure the sustainability and effectiveness of the initiative it is important that these arrangements include consideration of how the investment is made across all elements of the Total Flood Warning System to ensure effectiveness and that funding for the long term operation of any new capability is included. It is recommended that these opportunities be focussed through the Flood Warning Consultative Committee so that the necessary coordination across all stakeholders can be achieved such that resources are used most effectively and efficiently.

[50] National Partnership Agreement for the National Disaster Resilience Program: http://www.em.gov.au/npa

12 National Coordination and Policy

The peak coordinating body on emergency management issues is the Law, Crime and Community Safety Council (LCCSC). It has membership comprising the ministers from the Commonwealth, and each state and territory and New Zealand with portfolio responsibility for law and justice, police and emergency management. LCCSC's broad themes are law enforcement and crime reduction, law reform and emergency management.

A priority issue for the Council under the emergency management theme is increasing the resilience of individuals and communities to the impacts of disasters by undertaking and supporting initiatives that are designed to encourage all sectors of the Australian community to take responsibility for mitigating the effects of disasters, including implementation of the National Strategy for Disaster Resilience.

12.1 Australia-New Zealand Emergency Management Committee

The Australia-New Zealand Emergency Management Committee (ANZEMC) reports to the ministerial council LCCSC.

ANZEMC works to strengthen disaster resilience by providing strategic leadership on emergency management policy and supporting related capability and capacity development activities. The Australia-New Zealand Emergency Management Committee meets twice yearly, and holds additional meetings as required.

The Australia-New Zealand Emergency Management Committee is co-chaired by the Secretary of the Attorney-General's Department and the Deputy National Security Adviser, Department of the Prime Minister and Cabinet.

Australia-New Zealand Emergency Management Committee Members are:

- two senior representatives of the Commonwealth of Australia
- two senior representatives from each Australian state and territory government
- a representative from the Australian Local Government Association
- a senior official from the New Zealand Ministry of Civil Defence and Emergency Management

The Attorney-General's Department provides the secretariat for both the LCCSC and the ANZEMC.

12.2 Council of Australian Governments (COAG) Sub-committees

There are several sub-committees operating under ANZEMC that have some relevance to national flood forecasting and warning services. These include:

- Capability Development Sub-committee
- Community Engagement Sub-committee
- Recovery Sub-committee
- Risk Assessment Measurement and Mitigation Sub-committee (RAMMS)

12.3 National Flood Risk Advisory Group

The National Flood Risk Advisory Group (NFRAG) is a reference group operating as part of the COAG committee structure. The NFRAG works to strengthen the resilience to floods by providing strategic leadership and advice on best practice flood risk management. NFRAG works with RAMMS in most instances.

The functions of the NFRAG are to:

- Identify and promote nationally consistent best practice flood risk management.
- Advise on nationally consistent flood risk management policy.
- Provide specialist, expert advice on flood risk management to the work programme of the Australian-New Zealand Emergency Management Committee (ANZEMC) and its subcommittees.
- Promote community safety with respect to flooding and flood risk, in support of the Community Engagement Sub-committee of the Australian-New Zealand Emergency Management Committee.
- Identify and prioritise research needs for improving the quality of flood risk management.
- Facilitate and improve communication between flood emergency managers, flood risk managers, land use managers and other stakeholders.

Membership of the National Flood Risk Advisory Group includes a nominee from each state and territory government, Australian Government agencies, the Australian Local Government Association, the Insurance Council of Australia, the Australian Building Codes Board and research (currently through the RMIT University. Secretariat support is provided by the Australian Government and is currently shared by the Bureau of Meteorology and Geoscience Australia.

National Flood Risk Advisory Group (NFRAG)sponsors the development and publication of best practice guidelines in flood plain management and other aspects of flood risk management (including flood warning). It works to ensure that flood risk management requirements are appropriately coordinated within the development and implementation of national initiatives and policies, in particular the National Strategy for Disaster Resilience. The National Flood Risk Advisory Group provides a forum through which nationally consistent practices in the development and operation of the Total Flood Warning System can be identified and promoted.

12.4 Geoscience Australia

Geoscience Australia (GA) hosts the Australian Flood Studies Database (AFSD) (http://www.ga.gov.au/flood-study-search/ . This is part of the role Geoscience Australia plays in developing models, methods, information and tools to analyse natural hazard risk and impacts. The Flood Studies Database is a national repository of flood mapping studies and provides a starting point for seeking information on flood risks for a particular area.

Geoscience Australia is currently leading an extension of the Australian Flood Studies Database with the development of the National Flood Risk Information Portal (NFRIP) (Geosciences Australia - Flood Risk Information Portal). The main aim of this work is to make flood risk information accessible from a central location and to encourage best practice in the development of new flood risk information by producing standards and guidelines that can be used by stakeholders engaged in this task. During the initial phase of the project the Australian Flood Studies Database will be updated with digital flood study reports, some of which include flood maps, and enhanced through a more user-friendly interface.

Summary information on each flood study will also be provided, including information on how the study was done, what data was used, what flood maps were produced and for what scenarios, and the custodian and author (e.g. consultant) details. Where the study included

an assessment of damage, details such as estimates of annual average damage, or the number of properties affected during a flood of a particular likelihood will also be included.

Later phases will see the development of the Australian Flood Information System (AFIS) which will host mapped flood data as well as providing access to the information already available in the Australian Flood Studies Database . Mapped flood data likely to be accessible through the Australian Flood Information System will include flood extents and to a lesser degree information on water depths. The aim is for the Australian Flood Information System to display all available data for a range of scenarios from small to extreme events as well as historical flood data obtained from a thirty year record of Landsat imagery. This data will show whether a particular location was 'wet' at some point during the thirty year period which is expected to be useful particularly in rural areas where there is little or no flood information.

Appendix 1 – Typical Activities to Support TFWS Elements

Level of Government	Typical Activities
Commonwealth	**Flood Monitoring and Prediction** Establishing, maintaining and staffing a National Water Operations Centre in the Melbourne Head Office and Flood Warning Centres in each capital city Regional Office. Establishing and maintaining a real-time data collection, processing and storage system. Establish, operate and maintain a portion of the real-time rainfall and river level data collection network. The Bureau responsibility will include meeting all operation and maintenance costs of the equipment used to collect and communicate the data, however this responsibility may be varied by agreement as documented in the Data Sharing Agreements. Establish and maintain good working relationships with partner agencies contributing data. Establish new and improved flood warning systems, including data collection network design and installation, hydrological forecasting model calibration and design of warning products. Operating and supporting a state of the art hydrological forecasting system capable of supporting and generating flood predictions to match requirements documented in the Service Level Specification. Publish rainfall and river level data (maps and bulletins) showing current flood conditions on the Bureau web site. Prepare, disseminate and publish flood warnings to match requirements expressed in the Service Level Specification. **Interpretation** • Assist local and emergency response agencies to develop flood classification levels at each flood forecast location and maintain a data base of these levels for use with flood warning products. • Include appropriate flood classification level with all flood predictions. • Publish current flood classification levels on web site. **Warning Message Construction and Dissemination** • Compose and disseminate flood warning messages in accordance with the requirements regarding content and target distribution as set out in each Service Level Specification. **National Coordination and Response** • The AGCCC has the role of centralising Australian Government actions during complex national crises and to develop a single, timely and consistent picture or understanding of a crisis, its implications and the national

	capacity to respond.
State	**Flood Monitoring and Prediction** • Contributing real-time river level and rainfall data from data networks run by State agencies as defined and to the standards and protocols expressed in the Data Sharing Agreement's. In general, the State is responsible for funding the establishment, operation and maintenance of the equipment used to collect and communicate the data to the Bureau; however this responsibility may be varied by agreement as documented in the Data Sharing Agreement's. • In close cooperation with relevant local and regional agencies and affected communities, landowners and business enterprises, ensure the flood prediction requirements as specified in the Service Level Specification reflect current requirements for effective flood response and that these requirements are communicated to the Bureau. • Share with the Bureau any new information gained from flood studies and related analyses that could impact on flood behaviour for incorporation in flood prediction models. • If involved in flood prediction for agency-specific operational reasons, ensure this is coordinated and shared with the Bureau where the two activities are inter-dependant, and that predictions are communicated so as not to introduce confusion. **Interpretation** • Ensure flood classification levels are current and have been selected so as to reasonably reflect the impacts associated with each of the minor, moderate and major classifications. • Ensure flood prediction is linked with available information (flood intelligence) regarding expected impacts at the predicted level. • Progressively building flood intelligence data bases (including during flood events) and developing capability for relating flood predictions to impacts (GIS etc). • Include consideration of the needs for improving (or developing new) flood intelligence when planning and undertaking flood risk management studies and strategies. **Warning Message Construction and Dissemination** • Arrange (including through their local units) for effective communication of the content of Bureau flood warning messages to those at risk as effectively and efficiently as possible (in accordance with best practice). • Ensure all available flood intelligence is used effectively in composing and communicating warning messages. • Follow emergency warning communication protocols applicable in particular jurisdiction.

Regional	**Flood Monitoring and Prediction** • Contributing real-time river level and rainfall data from their data networks as defined and to the standards and protocols expressed in data the Data Sharing Agreement's. This will include data pertaining to the operation of water storages and other water management infrastructure that impacts on flood behaviour. In general, the authority is responsible for funding the establishment, operation and maintenance of the equipment used to collect and communicate the data to the Bureau; however this responsibility may be varied by agreement as documented in the Data Sharing Agreement's. • Provide input according to capability and knowledge to ensure the flood prediction requirements as specified in the Service Level Specification reflect current requirements for effective flood response and that these requirements are communicated to the Bureau. This will include information generated though flood studies and floodplain mapping activities. • Share with the Bureau any new information gained from flood studies and related analyses that could impact on flood behaviour for incorporation in flood prediction models. • If involved in flood prediction for agency-specific operational reasons, ensure this is coordinated and shared with the Bureau where the two activities are inter-dependant and communicated so as not to introduce confusion. **Interpretation** • Contribute to the establishment and review of flood classification levels. • Contribute to the improvement of flood intelligence. • Include consideration of the needs for improving (or developing new) flood intelligence when planning and undertaking flood risk management studies and strategies.
Local	**Flood Monitoring and Prediction** • Contributing real-time river level and rainfall data from locally operated data networks as agreed and to the standards and protocols expressed in the Data Sharing Agreement's. • If involved in flood prediction for agency-specific operational reasons, ensure this is coordinated and shared with the Bureau where the two activities are inter-dependant and communicated so as not to introduce confusion. • Ensure the needs for effective local flood response are reflected in the flood prediction requirements as defined in the Service Level Specification. • Foster community input to the identification of prediction

	requirements and maintain their awareness as to the particular flood prediction locations most relevant to the local community. **Interpretation** • Contribute to the establishment and review of flood classification levels. • Contribute to the improvement of flood intelligence. • Include consideration of the needs for improving (or developing new) flood intelligence when planning and undertaking flood risk management studies and strategies. • Communicate changes/revisions to flood classification levels to local community in affected area. **Warning Message Construction and Dissemination** • Arrange for further dissemination locally as required under prevailing emergency management arrangements.
Community	**Flood Monitoring and Prediction** • Proactively seek information about level of warning system available and build understanding about flood prediction locations and the flood levels most relevant to managing their personal flood risk. • Ensure personal needs are appropriately reflected in local flood prediction requirements. • Participate in endorsed volunteer flood observation programs. **Interpretation** • Identify forecast location most relevant to individual flood risk and build understanding of appropriate response to predicted flood levels (classifications) for gauge at that location. **Warning Message Construction and Dissemination** • Become familiar with source and likely content of warning messages and provide constructive feedback. • Proactively monitor appropriate media for warning information.

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- FESA State Emergency Management Plan for Floods (WESTPLAN) (2010): https://extranet.fesa.wa.gov.au/sites/emwa/Lists/StateEmergencyManagementDocumentLibrary/State%20EM%20Plans/Hazard%20Plans/Westplan%20Flood.pdf
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- Manual 20 *Flood Preparedness,* Emergency Management Australia (2009) http://www.em.gov.au/Documents/Manual%2020%20-%20Flood%20Preparedness-Oct09.PDF
- Manual 21 *Flood Warning,* Emergency Management Australia (2009) http://www.em.gov.au/Documents/Manual%2021-Flood%20Warning%282%29.PDF
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- Victorian Department of Environment and Primary Industries – Roles and Responsibilities (2012) http://www.water.vic.gov.au/environment/floodplains/responsibilities
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- Victorian Justice Department, Office of the Emergency Services Commissioner – Emergency Management Manual (2012) http://www.justice.vic.gov.au/emanuals/emmv/default.htm
- Victorian State Emergency Services Flood Plan (2012) http://www.ses.vic.gov.au/prepare/em-planning/em-partners-resources/state-flood-emergency-plan
- *"What to do before, during and after a flood?"* Attorney Generals Department *(*2005) http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf

Websites

- Western Australia Department of Fire and Emergency Services (DFES) Flood Website: http://www.dfes.wa.gov.au/safetyinformation/flood/Pages/default.aspx
- Emergency Alert Website: http://www.emergencyalert.gov.au/
- Flood Victoria website: http://www.floodvictoria.vic.gov.au/
- Geosciences Australia – National Flood Risk Information Portal website: http://www.ga.gov.au/hazards/flood/national-flood-risk-information-project/national-flood-risk-information-portal.html
- National Partnership Agreement for the National Disaster Resilience Program: http://www.em.gov.au/npa
- Northern Territory Emergency Service Floods website: http://www.pfes.nt.gov.au/Emergency-Service/Public-safety-advice/Floods.aspx
- Queensland Flood Commission website: http://www.floodcommission.qld.gov.au
- South Australian State Emergency Service – Flood Information website: http://www.ses.sa.gov.au/site/community_safety/floodsafe/flood_information.jsp
- Tasmanian Flood History website (Bureau of Meteorology): http://www.bom.gov.au/tas/flood/flood_history/flood_history.shtml
- Tasmanian State Emergency Service Floodsafe website: http://www.ses.tas.gov.au/public_safety-advice/floodsafe.htm
- Victorian Flood Review website: http://www.floodsreview.vic.gov.au
- Victorian State Emergency Service Floodsafe website: http://www.ses.vic.gov.au/prepare/floodsafe/

Service Level Specification for Flood Forecasting and Warning Services for Western Australia – Version 2.0

This document outlines the Service Level Specification for Flood Forecasting and Warning Services provided by the Commonwealth of Australia through the Bureau of Meteorology for the State of Western Australia in consultation with the Western Australian Flood Warning Consultative Committee

Service Level Specification for Flood Forecasting and Warning Services for Western Australia

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Cover image: Flooding in Kununurra, Western Australia.
Photo courtesy of WA Department of Fire and Emergency Services.

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1 Introduction

1.1 The purpose of this Service Level Specification is to document and describe the flood forecasting and warning services provided by the Bureau of Meteorology (the Bureau) in Western Australia.

1.2 The Bureau's flood forecasting and warning services are provided within the context of the Total Flood Warning System as defined in the Australian Emergency Manuals Series, Manual 21 Flood Warning (Australian Government, 2009 and illustrated in Figure 1).

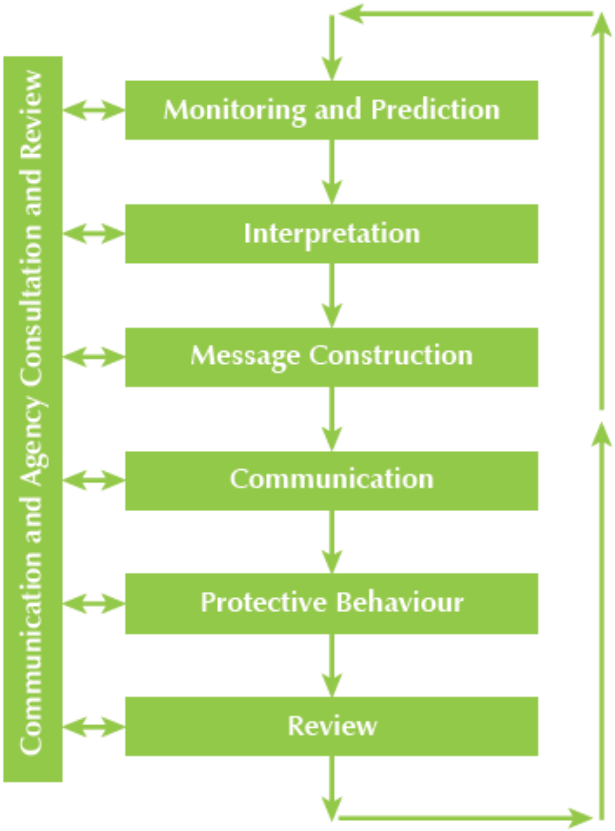

Figure 1: The components of the Total Flood Warning System (Australian Emergency Manual Series, Manual 21 Flood Warning, Australian Government 2009)

1.3 The Total Flood Warning System recognises that a fully effective flood warning service is multi-faceted in nature and its development and operation involves input from a number of agencies each with specialised roles to play. It is vital that the agencies involved work in close cooperation through all stages of developing and operating the system. The services described here are the Bureau's contribution to the Total Flood Warning System.

1.4 The Bureau's main role in the Total Flood Warning System is focussed on monitoring and prediction, and to a lesser extent interpretation, message construction, and communication components (see Appendix A for descriptions). The Bureau also contributes to review activities and takes a role in the planning and coordination activities associated with ensuring that the activities of all agencies and appropriate linkages are well coordinated. The roles and responsibilities of all key stakeholders involved in the provision of a flood warning

service in Western Australia are described in the National Arrangements for Flood Forecasting and Warning (Bureau of Meteorology, 2015)[1] as well as Appendix D of the Government of Western Australia – State Emergency Management Plan for Flood (WESTPLAN- FLOOD).

1.5 This Service Level Specification is concerned with describing the Bureau's role in the Total Flood Warning System and its interaction with other stakeholders as described in the National Arrangements. This is to ensure that the service the Bureau is providing in support of each of the relevant components of the Total Flood Warning System is understood by the Bureau and other stakeholders.

1.6 A description of the activities that make up the Bureau's flood forecasting and warning services for Western Australia is given in Section 3. This set of activities, associated products and target levels of service constitute the current standard services provided freely by the Bureau. The Bureau also provides supplementary services on a commercial or cost recovery basis but they are not covered in this document.

[1] The National Arrangements for Flood Forecasting and Warning (2015) is available on the Bureau's website: http://www.bom.gov.au/water/floods/index.shtml

2 Flood Warning Consultative Committee

2.1 The Western Australian Flood Warning Consultative Committee provides the Bureau's key stakeholder's with a consultation mechanism for its flood forecasting and warning services. As such, the committee is responsible for reviewing this Service Level Specification on an annual basis or as required. The role of the committee is also covered in Section 1.6.1.1 of WESTPLAN-FLOOD.

2.2 The overall role of the Western Australian Flood Warning Consultative Committee is to coordinate the development and operation of flood forecasting and warning services in Western Australia, acting as an advisory body to the Bureau and participating State and local government agencies. Membership and terms of reference for this committee in Western Australia are detailed in Schedule 1.

2.3 The Bureau chairs and provides the secretariat support to the Western Australian Flood Warning Consultative Committee, which meets six monthly depending on need and activity.

3 Bureau flood forecasting and warning services

3.1 The scope of services covered by this Service Level Specification is confined to those dealing with riverine flooding caused by rainfall where typical rain-to-flood times are six hours or more. Flash flooding (rain-to-flood times less than six hours) and flooding caused purely by elevated sea levels are not covered, nor are the weather forecasting and other services the Bureau provides that contribute to the flood forecasting and warning service, including Severe Weather and Severe Thunderstorm Warnings, Tropical Cyclone Warnings, provision of radar data and rainfall forecasts.

3.2 The nature of the services covered by this Service Level Specification include undertaking the routine catchment monitoring and river height prediction activities necessary for the Total Flood Warning System, as well as issuing and publishing specific warning and data products. These activities are listed below with further detail and associated performance measures provided in subsequent sections.

- Collect and publish rainfall and river level data
- Routine monitoring of flood potential
- Flood modelling and prediction
- Automated information and alerting
- Issue flood watches
- Issue flood warnings
- Communication of flood warnings and flood watches
- Data networks, communications and storage
- Operations
- Publishing of data and flood information
- Planning and liaison
- Support for emergency management training and training exercises

3.3 Collect and publish rainfall and river level data

3.3.1 The collection and publishing of rainfall and river level data is an important component of the overall service. Apart from use by the Bureau for data analysis and its hydrological modelling for flood predictions, the data is also used by the emergency service agencies, numerous operational agencies, businesses and the public to monitor rainfall and river conditions. To assist in describing the service, the locations where river height; dam, weir or lake level; and tidal observations are made are categorised into three types; namely forecast location (Schedule 2), information location (Schedule 3) and data location (Schedule 4).

- **Forecast location** is a location for which the Bureau provides a forecast of future water level either as the class of flood that is predicted (minor, moderate or major) or as a level and class – refer to Appendix A for definitions. At these locations observed data, flood classifications and additional qualifying information will also be available (Schedule 2).

- **Information location** is a location at which flood classifications are defined and observations of water level data are provided. At these locations forecasts of future water level are not produced. Other key thresholds may be defined and reported against (Schedule 3).

- **Data location** is a location for which just the observed water level data is provided. Flood classifications are not available for these locations and forecasts of future water level are not produced (Schedule 4).

3.3.2 An indicative level of priority has been assigned to each observing site and key communication infrastructure such as radio repeaters (Schedules 2-4 and 7-9) based on a three tiered scheme (Table 1). The priority level is based on the expected impact to the Bureau's services. The impacts identified are the expected outcome of a service outage at that site during a flood emergency. Impact is described in terms of forecast performance and the Bureau's ability to provide a flood warning service. Note that the scope of this priority scheme is limited to consideration of the requirements of forecasting and prediction only and should not be confused with any other priority assigned to that site by third party owners or other users.

Table 1. Site priority

Priority Level	Impact on performance	Impact on service delivery	Description
High	Very difficult to meet target	Direct and significant high level impact for the site and/or downstream locations	Degradation of service highly likely.
Medium	Difficult to meet target	Some impact for the site and/or downstream locations.	Possible degradation of service.
Low	Not likely to affect meeting targets	Little impact on the site and/or downstream location	No change in service. Lower possibility of degradation of service.

Note*:* Multiple outages within a given network will lead to higher impact levels and greater service degradation. Table 1 indicates the effect of a single site failure within an otherwise functional network.

3.4 Routine monitoring of flood potential

3.4.1 The Bureau will maintain an awareness of catchment conditions and monitor the potential for riverine flooding. This monitoring activity will be supported by the Bureau's weather services as required and is an activity undertaken to plan future flood operations.

3.5 Flood modelling and prediction

3.5.1 The Bureau will develop and maintain prediction systems for the forecast locations listed in Schedule 2.

3.5.2 The Bureau prediction systems can include real-time hydrologic models, simple peak to peak correlations and other hydrologic techniques as appropriate.

3.5.3 The Bureau prediction systems will be maintained and updated following significant events or when new data becomes available.

3.5.4 The target level of performance for the prediction at each forecasting location is given in Schedule 2.

3.6 Automated information and alerting

3.6.1 Automated information and alerting is not applicable in Western Australia.

3.7 Issue flood watches

3.7.1 The Bureau will issue flood watches when the combination of forecast rainfall and catchment conditions indicates flooding is likely. The catchments and basins covered by flood watches include all those listed in Schedule 10. Note that flood watches may cover catchments that do not have established flood warning services.

3.7.2 The primary purpose of a flood watch is to provide early advice to communities and the relevant emergency service organisations of the potential flood threat from a developing weather situation. Typically, a flood watch is issued 1 to 4 days before an anticipated flood event depending on the confidence in rainfall forecasts.

3.7.3 Flood watches will be communicated by the Bureau using the dissemination methods detailed in Section 3.9.

3.8 Issue flood warnings

3.8.1 In general flood warnings are issued based on the following criteria:

- The river level of at least one forecast location (listed in Schedule 2) is expected to reach and or exceed or has exceeded the minor flood level;
- The flood class levels or trigger heights defined at forecast locations are expected to be exceeded (refer to Schedule 2);
- The flood class levels defined at information locations are exceeded (refer to Schedule 3).

The specific initiating criteria, if any, for each flood warning product is listed in Schedule 10

3.8.2 Flood warnings may include either **qualitative** or **quantitative** predictions at forecast locations or a statement about future flooding in more **generalised** terms as outlined in Table 2. The type of prediction included is commensurate with user requirements, the availability of real time rainfall and river level data, and the capability of available flood prediction systems. A flood warning may contain **generalised, quantitative** and **qualitative** predictions and typically start with more **generalised** information and become more specific as data becomes available as the event develops and progresses.

3.8.3 **Quantitative** predictions include expected flood class (minor, moderate or major) with more specific information on the height and time of water levels at the forecast locations identified in Schedule 2. A **quantitative** prediction can be a specific level, or a range of levels, and has detailed timing down to blocks of a minimum of 3-6 hours. **Quantitative** predictions are based on all available information at the time of warning issue. The target lead time of the river height prediction for each forecast location where **quantitative** predictions are provided is given in Schedule 2. For an example of a **quantitative** prediction refer to Table 2.

3.8.3.1 For the Bureau to be able to provide a **quantitative** prediction at a location, it is essential to have a suitable network of rainfall and river level sites upstream with data coming in real time, sufficient historical data to calibrate the flood forecasting model, a reliable rating table and documented flood impacts and flood classifications.

3.8.4 **Qualitative** predictions include expected flood class (minor, moderate or major) and timing of flooding at the forecast locations identified in Schedule 2. The timing is

indicated in blocks of six, 12 or 24 hours, using the terms such as early morning, afternoon or overnight. Such predictions are based on all available information at that time and may include advice on the peak classification that is expected or has occurred at that location. The target lead time for each forecast location where only **qualitative** predictions are provided are given in Schedule 2. For an example of a **qualitative** prediction refer to Table 2

3.8.4.1 For the Bureau to be able to provide a **qualitative** prediction at a location, it is essential to have at least some rainfall and river level sites upstream of the location with data coming in real time, at least some historical flood data to calibrate the flood forecasting model, a reasonable rating table and documented flood impacts and flood classifications.

3.8.5 The Bureau may also issue flood warnings with more **generalised** predictions and information when there are not enough data to make specific predictions or in the developing stages of a flood. These warnings contain generalised statements advising that flooding is expected and may include forecast trend (rising or falling) (for examples refer to Table 2).

3.8.6 The typical target accuracy of a **quantitative** water level prediction is that 70% are within 0.3 or 0.6 metres of the observed water level. Specific accuracy targets by location are defined in Schedule 2. Achievement of these targets is not possible in all floods or at all locations. In general predictions of a flood peak are more accurate than “reach” or “exceed” predictions that are issued during the developing stages of a flood. This is due to uncertainty of future rainfall rates and/or upstream floodplain behaviour that are used when making those predictions.

3.8.7 A list of the flood warnings issued in Western Australia, along with the basin/river to which they apply is included in Schedule 10. Details about forecast locations in each basin/river are included in Schedule 2.

3.8.8 Flood warning summaries – A summary of flood watches and warnings that are current is provided to help media and other users readily access information.

Table 2. Prediction type description

Prediction Type	Height prediction	Time of prediction	Example
Quantitative	Numerical prediction - Any Height - Peak Height Can refer to flood class	More specific, typically in blocks of 3 to 6 hours	The Gascoyne River at Nine Mile Bridge is likely to exceed 6.5 metres with moderate flooding by 3pm Saturday before peaking late Saturday night. The Gascoyne River at Nine Mile Bridge is expected to peak near 7.7 metres (major flooding) about 6pm Sunday.
Qualitative	Refers to flood class (minor, moderate or major)	Range of times (6, 12 or 24 hour blocks)	Minor to moderate flooding is expected to continue in the Murray River at Pinjarra during Saturday afternoon and the river level is expected to peak early Sunday morning.
Generalised	No height prediction - forecast trend (rising or falling)	Range of times (24 hour blocks)	Widespread local flooding is expected to continue during Saturday in the Ludlow and Capel River catchments with further rises likely as the second peak moves through the area.

3.9 Communication of flood warnings and flood watches

3.9.1 Flood watches and warnings will be issued directly to a list of stakeholders with emergency management responsibilities. The list is maintained by the Bureau but is not detailed in this document. The direct dissemination methods supported include email, fax and internet protocols such as File Transfer Protocol (FTP).

3.9.2 The format of messaging in flood related products will conform to a nationally consistent standard determined by the Bureau, in consultation with the Flood Warning Consultative Committee.

3.9.3 Flood watches and warnings are also communicated via:

3.9.3.1 **Radio:** Radio stations, particularly the ABC, broadcast flood warning information as part of their news bulletins, or whenever practicable. This form of broadcast may be covered in separate agreements between the Bureau and broadcasters.

3.9.3.2 **Weather warning service:** Flood warning information is recorded on a contracted telephone information service. Calls to this service incur a fee-for-service charge.

3.9.3.3 **Internet:** Flood watches and warnings are published on the Bureau's public web site and available by File Transfer Protocol (FTP) and Rich Site Summary (RSS) along with related rainfall and river level information (see 3.12).

3.9.4 Emergency management partners[2] and media can also access flood level and warning information directly from the Bureau Flood Warning Centre and Bureau National Operations Centre, subject to operational constraints. The Bureau does not publish to the public the contact details for the Flood Warning Centres and Bureau National Operations Centre.

3.10 Data networks, communications and storage

3.10.1 The services to be provided by the Bureau under this Service Level Specification depend on provision of data from networks of stations owned and operated by the Bureau and partner agencies. Permanent or temporary loss of real time data may necessitate a downgrading of the flood warning service from **quantitative** predictions to **qualitative** or then **generalised**.

3.10.2 The Bureau contribution to this network of stations includes:

- The operation and maintenance of equipment at the sites which are fully owned and maintained by the Bureau as listed in Schedule 7.
- Assisting with maintenance of equipment for other agencies at the sites listed in Schedule 8.
- Operating and maintaining Bureau-owned equipment at sites where this equipment is co-located at a site owned by another agency Schedule 9.

3.10.3 Where the site is owned or operated by other parties, installation, maintenance and repairs of Bureau equipment will depend on adequate access being provided to the

[2] Emergency management partners include those organisations that have an emergency management responsibility for the wider community (e.g. State Emergency Services)

Bureau and any of its contractors. The Bureau will confirm access arrangements with relevant land owners before entering the premises. The Bureau also requires that the site operators provide timely advice regarding any possible faults or other issues affecting the performance of the data network.

3.10.4 The flood forecasting and warning service for Western Australia also depends on the provision of data from partner agency data networks. The provision of these data for each of the agencies concerned is detailed in a Data Sharing Agreement between the Bureau and each partner (Schedule 6).

3.10.5 The Bureau will maintain the essential set of metadata describing the network of stations and related infrastructure regarding the Bureau's component of the data network, along with metadata required to inform the data ingest process for partner agency related networks and sites.

3.10.6 The Data Sharing Agreements are intended to reflect operational arrangements and are not legally binding and allow multiple agreements between individual and/or multiple agencies.

3.10.7 The parties agree to the provision of data as set out in the Data Sharing Agreements during periods of routine site operation and increased frequency during flood periods.

3.10.8 Data transfer protocols and conditions regarding fitness for purpose as provided by each stakeholder will be adhered to as set out in the Data Service Agreements for data provision.

3.10.9 The sharing of data as set out in the Data Sharing Agreements can be amended by following the process described in the agreement.

3.10.10 The Bureau has developed special purpose software (Enviromon) for collecting, alarming, storing, on-forwarding and display of data from Event-Reporting Radio Telemetry Systems (ERRTS) (field equipment) based on Automated Local Evaluation in Real Time (ALERT) data protocol.

3.10.11 The Bureau provides a range of supplementary services associated with Enviromon, including: installation of Enviromon software; the commissioning of an Enviromon base station or maintenance and support; and onsite Enviromon training. However, software licensing and limited support for Enviromon base stations listed in Schedule 5 is currently a standard service (free of charge).

3.11 Operations

3.11.1 The Bureau will use reasonable endeavours to provide a 24 hours a day, seven days a week operational systems capability necessary to support flood warning operations. This will include on-line computer and data ingestion systems, along with appropriate communications infrastructure.

3.11.2 The Bureau operates a regional Flood Warning Centre in each capital city and a Bureau National Operations Centre in Melbourne on an as-required basis.

3.11.3 Through the regional Flood Warning Centre and Bureau National Operations Centre, the Bureau will provide operational coverage for up to 24 hours per day during flood

events, subject to event requirements and operational constraints. The Bureau will advise its key emergency management clients of any impact in services if it is unable to provide sufficient staff coverage to meet the service levels set out in this Service Level Specification (see also 4.2).

3.11.4 Staff in the Bureau National Operations Centre will support regional operations either remotely or by providing additional capacity to a regional Flood Warning Centre where reasonably possible during significant and long duration events. When necessary, staff from regional offices in areas not impacted by current flooding will endeavour to assist.

3.11.5 The Bureau will maintain an internal catchment directive for each catchment where a warning service is provided. The catchment directive documents and describes the forecast process for the particular catchment and includes flood intelligence information, flood history, contact details for partners with local knowledge and warning issue criteria.

3.11.6 The operation of the Flood Warning Centres will endeavour to be compliant with the fatigue management guidelines developed under the Bureau's Work Health and Safety procedures. Particular attention to fatigue management will be provided during the management of extreme events. The requirement to comply with these guidelines applies to all personnel present at these centres.

3.11.7 The Bureau will assist in meeting the needs of the Australian Government's National Crisis Coordination Centre. The Bureau will use reasonable endeavours to support and participate in relevant critical event briefings as resources permit.

3.12 Publishing of data and flood information

3.12.1 The Bureau will maintain the systems to ingest all data being gathered through the special purpose flood warning data network.

3.12.2 The river height and rainfall data received by the Bureau will be published as soon as practicable (the data are supplied at different frequencies and by various methods) upon receipt into Bureau operational systems. This data will be published in the form of data tables, maps and plots and will also be included in warnings and alerting messages and used in modelling systems.

3.12.3 Data collected in Bureau systems will be available for use by the Bureau as it requires and for distribution to the public on suitable open source licence terms[3].

3.12.4 The Bureau will continue to collect and update the flood background information on floods contained on its website. These include survey information, flood history and flood event reports, catchment maps and brochures.

3.13 Planning and liaison

3.13.1 The Bureau undertakes a range of routine planning, maintenance and liaison activities that support the Total Flood Warning System. This includes contributing to related flood risk management activities within the State or Territory impacting on, or

[3] Please refer to the Creative Commons License:
http://www.bom.gov.au/water/regulations/dataLicensing/ccLicense.shtml

related to flood warning along with the ongoing coordination and liaison activities essential to the smooth operation of the Total Flood Warning System.

3.14 Support for emergency management training and exercises

3.14.1 The Bureau will, within operational constraints, endeavour to support and participate in relevant disaster management activities outside of flood operational periods, including training exercises and flood response planning.

4 Level of service and performance reporting

4.1 Achievable levels of service provided by the Bureau are dependent on many factors including adequate access to Bureau equipment where located on sites owned by other agencies, data availability in near real time from Bureau and partner agencies, modelling and prediction capability, geomorphology of the catchment and meteorological considerations such as rainfall patterns.

4.2 If during a flood event the achievable service level is expected to be reduced, for any reason below the target level as stated in this Service Level Specification, the Bureau will inform the key emergency management clients in Western Australia of the reduced service level via email and phone.

4.3 The Bureau's performance during significant events will be reviewed and reported on using a standard performance structure developed in conjunction with key stakeholders and within the context of the Total Flood Warning System based on key performance indicators and the service levels defined in Schedule 2.

4.4 An annual performance report will be tabled at a Flood Warning Consultative Committee meeting if significant flooding has occurred in the previous year. This report may be published on the Bureau website.

4.5 Event based performance reports with more detailed technical information may also be produced for significant and high profile events.

5 Limitations of service

5.1 Performance of services provided under this document are subject to:

(a) The availability of funds and human resources of the Bureau and its partner agencies and changes to organisational policies that may affect the terms and conditions of the Service Level Specification.

(b) Circumstances beyond the control of the Bureau including where the performance is the responsibility of another entity.

(c) The existence of a reliable and ongoing supply of quality real time rainfall, water level and flow data.

(d) The reliable and ongoing availability of the computing and communication infrastructure required for the performance of the services.

(e) Adequate communication between the Bureau and all relevant partners under this Service Level Specification and related Data Sharing Agreements and any other agreement relevant to it including on any faults or issues.

5.2 In Western Australia there is one key document that describes the State's arrangements for flood warning and flood risk management. This Service Level Specification does not replace or reduce the value of this document. The document is:

(a) WESTPLAN Flood State Emergency Management Plan, September 2010 (Western Australia FESA)

6 Service Level Specification consultation, review and updating

6.1 The initial and annual process for acceptance of this Service Level Specification will be:

6.1.1 The Flood Warning Consultative Committee members will be provided with the draft or amended Service Level Specification in advance of a special or scheduled committee meeting.

6.1.2 The members of the Flood Warning Consultative Committee will distribute the draft or amended Service Level Specification within their organisations and provide feedback from their organisation at the committee meeting.

6.1.3 After consultation and discussion at the Flood Warning Consultative Committee meeting, the Bureau will update the Service Level Specification.

6.1.4 The Chair of the Flood Warning Consultative Committee (Bureau's Regional Director) will accept and sign the document on behalf of the committee.

6.1.5 The Assistant Director Water Forecasting Services will sign the Service Level Specification on behalf of the Director of Meteorology.

6.1.6 The Bureau will then distribute the Service Level Specification to all members of the Flood Warning Consultative Committee and publish a copy on the Bureau website.

6.2 The schedules of this Service Level Specification will be reviewed annually and either updated following review, or when a significant change is made that impacts on the level of services described in this document. Updates to this document will be recorded in Schedule 11.

6.3 Any changes to the categorisation of a location into data, information or forecast location or to the level of services described in this document will be through a consultative process using agreed arrangements in Western Australia coordinated by the Flood Warning Consultative Committee.

7 Signature of parties

7.1 This Service Level Specification has been prepared by the Bureau of Meteorology in consultation with the Western Australia Flood Warning Consultative Committee.

3.3.16

Mike Bergin
Chair of Western Australia Flood Warning Consultative Committee, and
Regional Director – Western Australia
Bureau of Meteorology

Date

04 March 2016

Dr Dasarath (Jaya) Jayasuriya
Assistant Director
Water Forecasting Services
Bureau of Meteorology

Date

Schedule 1: Flood Warning Consultative Committee

The Western Australia Flood Warning Consultative Committee was formed in 1989. The Committee's role is to coordinate the development and operations of the State's flood forecasting and warning services. It is an advisory body and reports to the Bureau of Meteorology and participating state and local government agencies twice each year. The membership includes:

- Bureau of Meteorology (Chair/Secretariat)
- representative(s) of Department of Fire and Emergency Services (Hazard Management Agency for flood);
- representative(s) of Department of Water;
- representative(s) of Water Corporation;
- representative(s) of Main Roads Western Australia;
- representative(s) of Department of Agriculture and Food;
- representative(s) of Department of Housing – Planning and Programs Aboriginal Housing
- representative(s) of Landgate (Satellite Remote Sensing Service)
- representative(s) of Department of Planning
- representative(s) of Western Australian Local Government Association; and
- other agencies as seconded by the Chair

Representative(s) from other government agencies may include (e.g. Department of Planning and Infrastructure – Marine Information, Department of Environment and Conservation, etc.), academic institutions, industry or specific communities may be invited to work with the Committee to work on particular issues, problems and solutions.

The nationally consistent Terms of Reference for Flood Warning Consultative Committees are:

1. Identify requirements and review requests for new and upgraded forecasting and warning services
2. Establish the priorities for the requirements that have been identified using risk based analyses of the Total Flood Warning System.
3. Review and provide feedback on the Service Level Specification for the Bureau's Flood Forecasting and Warning services on an annual basis
4. Coordinate the implementation of flood warning systems in accordance with appropriate standards.
5. Promote effective means of communication of flood warning information to the affected communities
6. Monitor and review the performance of flood forecasting and warning services.
7. Build awareness and promote the Total Flood Warning System concept.

Schedule 2: Forecast locations and levels of service

Column definitions:

Bureau number: Refers to the unique number assigned to a particular station by the Bureau

Forecast location: Is the specific location that will be referred to in flood warnings (refer 3.3.1)

Station owner: Refers to the owning and operating agency of the station. The Bureau may co-own stations. (refer Schedules 7 and 8)

Gauge type: Either manual (read by human) or automatic (ERTS, IP (Next G and satellite and dial-up telemetry))

Flood classification: For definitions please refer to Appendix A.2.

Prediction type: The type of warning service that particular location can expect. (refer 3.8)

Target warning lead time: The minimum lead time that will be provided before the height or the flood class level given is exceeded (refer 3.8)

Target peak accuracy: The error within which peak river level height is predicted (refer 3.8.7)

Priority: The impact a temporary or permanent loss of site will have on service delivery and in meeting performance targets (refer 3.3.2)

Bureau number	Forecast location	Station owner	Gauge type	Flood classification (m)			Prediction type	Target warning lead time		70% of peak forecasts within	Priority
				Minor	Moderate	Major		Time (hours)	Trigger height (m)		
802 – Fitzroy River (WA)											
503014	Fitzroy Crossing	Department of Water	Automatic	9.5	11.0	12.5	Quantitative	15	Minor	n/a	High
503007	Noonkanbah	Department of Water	Automatic	9.5	12.0	13.0	Quantitative	15	Minor	n/a	High
503013	Willare Crossing	Department of Water	Automatic	8.0	8.8	9.2	Quantitative	48	Minor	n/a	High
710 – De Grey River											
504000	Coolenar Pool (Great Northern Highway)	Department of Water	Automatic	5.5	6.0	8.0	Qualitative	48	Minor	n/a	High
706 – Ashburton River											
505000	Nanutarra	Department of Water	Automatic	6.0	7.5	8.0	Qualitative	24	Minor	n/a	High

Bureau number	Forecast location	Station owner	Gauge type	Flood classification (m)			Prediction type	Target warning lead time		70% of peak forecasts within	Priority
				Minor	Moderate	Major		Time (hours)	Trigger height (m)		
704 – Gascoyne River											
506012	Jimba	Department of Water	Automatic	4.0	7.0	8.0	Qualitative	12	Minor	n/a	High
506011	Fishy Pool	Department of Water	Automatic	4.5	9.0	11.0	Quantitative	12	Minor	n/a	High
506000	Nine Mile Bridge	Department of Water	Automatic	5.5	6.5	7.6	Quantitative	24	Minor	n/a	High
701 – Greenough River											
508036	Eradu	Department of Water	Automatic	3.5	4.2	5.0	Qualitative	24	Minor	n/a	High
508020	Karlanew	Department of Water	Automatic	2.5	3.5	4.5	Qualitative	24	Minor	n/a	High
508042	Dongara	Department of Water	Automatic	5.0	7.0	8.0	Qualitative	12	Minor	n/a	High
616 – Swan Coast											
509438	Walyunga	Department of Water	Automatic	3.5	7.0	7.5	Qualitative	24	Minor	n/a	High
509440	Barrack Street Jetty	Department of Transport	Automatic	1.6	2.0	2.5	Qualitative	24	Minor	n/a	High
615 – Avon River											
510507	Beverley	Department of Water	Automatic	1.5	2.0	2.5	Qualitative	12	Minor	n/a	High
510059	York	Department of Water	Automatic	2.5	3.0	4.0	Qualitative	12	Minor	n/a	High
510061	Northam	Department of Water	Automatic	1.5	1.8	2.0	Qualitative	12	Minor	n/a	High
510060	Toodyay	Department of Water	Automatic	2.5	3.5	4.0	Qualitative	12	Minor	n/a	High
714 – Murray River											
509542	Pinjarra	Department of Water	Automatic	6.5	7.0	8.0	Qualitative	12	Minor	n/a	High
509543	Ravenswood	Department of Water	Automatic	2.0	2.5	3.0	Qualitative	18	Minor	n/a	High
611 – Preston River											
509525	Donnybrook	Department of Water	Automatic	3.5	4.5	5.0	Qualitative	6	Minor	n/a	High
509524	Boyanup Bridge	Department of Water	Automatic	3.0	3.5	4.0	Qualitative	12	Minor	n/a	High
609 – Blackwood River											
509517	Bridgetown	Department of Water	Automatic	3.5	4.2	6.0	Qualitative	12	Minor	n/a	High
509518	Nannup	Department of Water	Automatic	5.5	7.0	8.0	Qualitative	12	Minor	n/a	High

Notes:

- All levels are in metres to local gauge datums unless indicated otherwise.
- AHD - Australian Height Datum. See Geoscience Australia for further information.
- Certainty – Low (+/- 1 - 2 metres); Moderate (+/- 1.0 metres); High (+/- 0.5 metres)

Schedule 3: Information locations with flood class levels defined

Bureau number	Station name	Station owner	Gauge type	Flood classification (m)			Priority
				Minor	Moderate	Major	
809 – Ord River							
502015	Ord River at Bedford Downs	Department of Water	Automatic	6.5	7.5	8.0	Medium
502014	Fletcher Ck Trib at Frog Hollow	Department of Water	Automatic	2.0	2.8	3.5	Medium
502028	Ord River at Old Ord Homestead	Department of Water	Automatic	6.5	10.0	15.0	Medium
514825	Negri River at Mistake Ck Homestead	Department of Water	Automatic	6.8	10.0	15.0	Medium
502010	Wilson River at Odonnell Range	Department of Water	Automatic	5.0	6.5	8.2	Medium
502031	Dunham River at Dunham Gorge	Department of Water	Automatic	8.0	10.0	12.0	Medium
502029	Dunham River at Flying Fox Hole	Department of Water	Automatic	6.5	10.0	12.0	Medium
502000	Ord River at Tarrara Bar	Department of Water	Automatic	6.0	10.0	12.0	Medium
501000	King River at Cockburn North	Department of Water	Automatic	2.0	2.5	3.0	Medium
501029	Moochalabra Ck at Moochalabra Dam	Department of Water	Automatic	2.0	2.5	3.0	Medium
802 – Fitzroy River							
502024	Hann River at Phillips Range	Department of Water	Automatic	6.5	9.0	12.0	Medium
502027	Fitzroy River at Dimond Gorge	Department of Water	Automatic	6.5	9.0	12.0	High
502006	Margaret River at Me No Savvy	Department of Water	Automatic	7.0	9.0	12.0	Medium
502059	Margaret River at Margaret Gorge	Department of Water	Automatic	6.5	8.0	9.5	Medium
502001	Leopold River at Mount Winifred	Department of Water	Automatic	7.5	9.0	10.0	Medium
502005	Margaret River at Mount Krauss	Department of Water	Automatic	6.5	8.0	11.0	High
503000	Christmas Creek at Homestead	Department of Water	Automatic	4.0	6.0	7.5	Medium
503017	Fitzroy River at Fitzroy Barrage	Department of Water	Automatic	7.0	9.0	10.0	Medium
503012	Fitzroy River at Looma	Department of Water	Automatic	7.5	9.0	10.0	Medium
710 – De Grey River							
504039	Oakover River at Ripon Hills Rd	Department of Water	Automatic	1.5	5.0	8.0	Medium
504016	Nullagine River at Nullagine	Department of Water	Automatic	0.8	3.0	4.0	Medium
504036	Nullagine River at Tumbinna Pool	Department of Water	Automatic	1.5	3.5	4.0	Medium
504037	Coongan River at Marble Bar	Department of Water	Automatic	0.8	2.5	3.5	Medium
504041	Coongan River at Marble Bar Rd	Department of Water	Automatic	1.8	2.8	3.8	Medium
504035	Shaw River at North Pole Mine	Department of Water	Automatic	1.0	3.0	5.0	Medium
504040	Shaw River at Marble Bar Rd	Department of Water	Automatic	0.5	2.0	3.0	Medium
709 – Port Hedland Coast							
504017	Yule River at Jelliabidina	Department of Water	Automatic	1.5	5.0	6.0	Medium
504044	Sherlock River at Sherlock Rd Br	Department of Water	Automatic	4.0	5.0	7.0	Medium
505042	Maitland River at Miaree Pool	Department of Water	Automatic	2.0	5.0	7.0	Low

Bureau number	Station name	Station owner	Gauge type	Flood classification (m)			Priority
				Minor	Moderate	Major	
708 – Fortescue River							
507011	Fortescue River at Newman	Department of Water	Automatic	4.0	6.0	7.5	Medium
505010	Fortescue River at Gregory Gorge	Department of Water	Automatic	4.5	6.0	7.0	Medium
505039	Fortescue River at Bilanoo	Department of Water	Automatic	4.0	7.0	8.0	Medium
707 – Onslow Coast							
505055	Cane River at Toolungu	Department of Water	Automatic	3.0	5.0	6.0	Medium
706 – Ashburton River							
507002	Ashburton River at Capricorn Range	Department of Water	Automatic	4.5	8.0	10.0	High
705 – Lyndon-Minilya River							
506004	Minilya River at Minilya Bridge	Department of Water	Automatic	3.0	4.0	4.5	Medium
704 – Gascoyne River							
507000	Gascoyne River at Yinnetharra Xing	Department of Water	Automatic	3.0	4.5	5.5	Medium
506016	Gascoyne River at Pells Island	Department of Water	Automatic	2.5	3.8	4.5	Medium
506013	Lyons River at Lyons River Xing	Department of Water	Automatic	1.5	5.0	6.0	High
702 – Murchison River							
508021	Murchison River at Emu Springs	Department of Water	Automatic	5.0	6.0	7.0	Medium
701 – Greenough River							
508017	Greenough River at Pindarring Rocks	Department of Water	Automatic	2.0	2.5	3.0	Medium
508037	Greenough River at Mitthutharra	Department of Water	Automatic	2.5	6.5	7.5	High
508038	Irwin River at Yatharagga	Department of Water	Automatic	4.0	6.0	7.0	Medium
508039	Lockier River at Mingenew	Department of Water	Automatic	2.5	4.0	4.5	Medium
508303	Irwin River at Strawberry Bridge	Department of Water	Automatic	4.0	6.0	7.0	High
508032	Irwin River at Mountain Bridge	Department of Water	Automatic	4.5	6.5	7.0	High
617 – Moore-Hill River							
509168	Hill River at Hill River Springs	Department of Water	Automatic	1.5	2.0	2.5	Medium
509418	Hill River at Ardross	Department of Water	Automatic	2.5	2.8	3.5	Medium
508035	Moore River Nth at Nardy Road	Department of Water	Automatic	1.0	1.2	1.6	Medium
508031	Dungaroo Ck at Round Hill Br	Department of Water	Automatic	0.8	1.2	2.2	Medium
508030	Moore River Nth at Long Pool Br	Department of Water	Automatic	1.2	2.0	3.0	Medium
508000	Moore River Nth at Moora Caravan Park	Department of Water	Automatic	3.0	3.5	4.0	High
509381	Moore River at Quinns Ford	Department of Water	Automatic	3.5	4.5	5.0	Medium
509421	Moore River at Waterville Road	Department of Water	Automatic	2.0	2.7	3.0	Medium
509427	Gingin Brook at Gingin	Department of Water	Automatic	1.0	1.5	2.0	Medium
509419	Gingin Brook at Bookine Bookine	Department of Water	Automatic	1.4	1.8	2.0	Medium
615 – Avon River							
510514	Avon River at Boyagarra Rd	Department of Water	Automatic	2.2	2.5	3.0	Medium

Bureau number	Station name	Station owner	Gauge type	Flood classification (m)			Priority
				Minor	Moderate	Major	
615 – Avon River (continued)							
510058	Salt River at Qualandary Crossing	Department of Water	Automatic	2.2	2.5	3.0	High
510512	Avon River at Yenyening Confluence	Department of Water	Automatic	1.5	2.5	3.0	Medium
510524	Avon River at Bells Farm	Department of Water	Automatic	1.5	2.5	3.0	Medium
510508	Dale River at Waterhatch Br	Department of Water	Automatic	2.0	2.5	3.0	High
510000	Mortlock River North at Frenches	Department of Water	Automatic	1.9	2.2	2.5	High
510035	Mortlock River at ODriscolls Farm	Department of Water	Automatic	1.8	2.2	2.5	High
616 – Swan Coast							
509376	Wooroloo Brook at Karls Ranch	Department of Water	Automatic	2.2	2.6	3.2	High
509447	Brockman River at Tanamerah	Department of Water	Automatic	2.5	3.5	4.5	Medium
510523	Brockman River at Yalliawirra	Department of Water	Automatic	3.5	7.0	7.5	High
509457	Ellen Brook at Railway Parade	Department of Water	Automatic	1.8	2.0	2.5	Medium
509380	Swan River at Great Northern Hwy	Department of Water	Automatic	5.5	8.0	8.5	Medium
510017	Helena River at Ngangaguringuring	Department of Water	Automatic	2.0	2.5	3.0	Medium
509458	Helena River at Poison Lease	Department of Water	Automatic	2.0	2.5	3.0	Medium
509459	Helena Brook at Trew Road	Department of Water	Automatic	1.0	1.2	1.4	Medium
509456	Jane Brook at National Park	Department of Water	Automatic	1.0	1.5	2.0	Medium
509471	Darkin River at Pine Plantation	Department of Water	Automatic	1.0	1.5	2.0	Medium
509378	Swan River at Meadow Street Br	Department of Water	Automatic	2.0	3.5	4.0	High
509379	Canning River at Seaforth	Department of Water	Automatic	3.0	4.0	5.0	High
509063	Southern River at Anaconda Drive	Department of Water	Automatic	3.0	3.5	4.0	Medium
614 – Murray River							
509295	Serpentine Drain at Dog Hill	Department of Water	Automatic	2.0	2.5	3.0	Medium
509428	Peel Main Drain at Karnup Road	Department of Water	Automatic	1.4	1.8	2.2	Medium
510506	Hotham River at Pumphreys Br	Department of Water	Automatic	2.5	3.0	3.5	Medium
510521	Crossman River at Rivendale	Department of Water	Automatic	2.0	3.0	4.0	Medium
510522	14 Mile Brook at Congelin	Department of Water	Automatic	1.5	2.5	3.5	Medium
509545	Hotham River at Marradong Road Br	Department of Water	Automatic	3.5	4.5	5.0	High
509544	Williams River at Saddleback Rd Br	Department of Water	Automatic	3.0	5.5	6.5	High
509541	Murray River at Baden Powell Spout	Department of Water	Automatic	4.5	6.0	7.0	High
509129	Marrinup Brook at Brookdale Siding	Department of Water	Automatic	1.6	1.8	2.2	Medium
613 – Harvey River							
509119	Harvey River at Dingo Road	Department of Water	Automatic	3.0	3.6	4.0	Medium
612 – Collie River							
509539	Collie River East at James Crossing	Department of Water	Automatic	2.0	2.5	3.0	Medium
509534	Collie River at Buckingham Mill	Department of Water	Automatic	3.5	4.0	4.5	Medium
509529	Collie River East at Coolangatta	Department of Water	Automatic	3.5	5.0	6.0	Medium

Bureau number	Station name	Station owner	Gauge type	Flood classification (m)			Priority
				Minor	Moderate	Major	
612 – Collie River (continued)							
509533	Collie River at Collie	Department of Water	Automatic	3.5	4.0	4.8	Medium
509532	Collie River South at Collie	Department of Water	Automatic	1.8	2.2	2.4	Medium
509530	Collie River at Mungalup Tower	Department of Water	Automatic	2.8	4.5	5.5	Medium
509536	Collie River at Rose Road	Department of Water	Automatic	3.0	4.5	5.0	Medium
611 – Preston River							
509528	Thomson River at Woodperry	Department of Water	Automatic	1.5	2.0	3.0	High
509526	Preston River at Lowden Road Br	Department of Water	Automatic	3.8	4.5	5.0	High
509565	Preston River at Moonlight Bridge	Department of Water	Automatic	2.0	2.6	3.5	Medium
509551	Ferguson River at South Western Hwy	Department of Water	Automatic	2.3	3.2	4.0	Medium
610 – Busselton Coast							
109509	Walsall Bk at Chapman Hill Rd CB2	Department of Water	Automatic	3.0	3.6	3.7	High
109508	Vasse River at Doyle Rd CB1	Bureau	Automatic	2.8	3.3	3.6	High
009984	Sabina Main Drain at Vasse Hwy CB3	Bureau	Automatic	2.8	3.3	3.6	High
509523	Vasse Diversion at Wonnerup East Rd	Department of Water	Automatic	1.5	1.8	2.4	Medium
509521	Vasse Diversion at D/S Hill Rd	Department of Water	Automatic	2.5	3.5	4.2	High
609 – Blackwood River							
510503	Coblinine River at Bibikin Road Br	Department of Water	Automatic	1.5	2.5	3.0	Medium
510500	North Arthur River at Lake Toolibin	Department of Water	Automatic	1.0	1.4	2.0	Medium
510502	Beaufort River at Manywaters	Department of Water	Automatic	2.0	2.5	2.8	Medium
509461	Blackwood River at Winnejup	Department of Water	Automatic	3.5	4.2	6.0	High
509519	Blackwood River at Boyup Flax Mill	Department of Water	Automatic	3.2	5.0	6.5	High

Notes:

- All levels are in metres.
- All flow rates in cumecs (m^3/sec) unless indicated otherwise
- n/a indicates flood class levels are not yet determined
- All levels indicate flooding in the local reaches of the stream
- AHD – Australian Height Datum. Geoscience Australia for further information.

Schedule 4: River data locations

Bureau number	Station name	Owner	Gauge type	Priority
802 – Fitzroy River				
503011	ELLENDALE	Department of Water	Automatic	Medium
803 – Lennard River				
503008	MOUNT JOSEPH	Department of Water	Automatic	Medium
804 – Isdell River				
503009	DALES YARD	Department of Water	Automatic	Medium
709 – Port Hedland Coast				
504032	PINCUNAH	Department of Water	Automatic	Medium
708 – Fortescue River				
505040	TARINA	Department of Water	Automatic	Medium
701 – Greenough River				
508040	YERINA	Department of Water	Automatic	Medium
508026	UTAKARRA	Department of Water	Automatic	Medium
508017	PINDARRING ROCKS	Department of Water	Automatic	Medium
508037	MITTHUTHARRA	Department of Water	Automatic	Medium
508038	YATHARAGGA	Department of Water	Automatic	Medium
508039	MINGENEW	Department of Water	Automatic	Medium
508303	STRAWBERRY BRIDGE	Department of Water	Automatic	Medium
508032	MOUNTAIN BRIDGE	Department of Water	Automatic	Medium
617 – Moore-Hill River				
509168	HILL RIVER SPRINGS	Department of Water	Automatic	Medium
508418	ARDROSS	Department of Water	Automatic	Medium
508035	NARDY ROAD	Department of Water	Automatic	Medium
508031	ROUND HILL BRIDGE	Department of Water	Automatic	Medium
508030	LONG POOL BRIDGE	Department of Water	Automatic	Medium
509381	QUINNS FORD	Department of Water	Automatic	Medium
509421	WATERVILLE ROAD	Department of Water	Automatic	Medium
509427	GINGIN	Department of Water	Automatic	Medium
509419	BOOKINE BOOKINE	Department of Water	Automatic	Medium
615 – Avon River				
510031	MOORANOPPIN ROCK	Department of Water	Automatic	Medium
510030	GAIRDNERS CROSSING	Department of Water	Automatic	Medium
510252	KWOLYN HILL	Department of Water	Automatic	Medium
616 – Swan Coast				
509457	RAILWAY PARADE	Department of Water	Automatic	Medium
509476	SLADE STREET	Department of Water	Automatic	Medium
509477	LIEGE STREET OUTFLOW	Department of Water	Automatic	Medium
509484	KENT STREET WEIR	Department of Water	Automatic	Medium
614 – Murray River				
509221	ONEIL ROAD	Department of Water	Automatic	Medium
509586	KIELMAN	Department of W ater	Automatic	Medium
509442	LOWLANDS	Department of Water	Automatic	Medium
613 – Harvey River				
509368	URQUAHARTS	Department of Water	Automatic	Medium
509540	CLIFTON PARK	Department of Water	Automatic	Medium
509589	OLD BUNBURY ROAD	Department of Water	Automatic	Medium
614 – Collie River				
509309	PALMER	Department of Water	Automatic	Medium
509594	WORSLEY	Department of Water	Automatic	Medium
509370	SANDLEWOOD	Department of Water	Automatic	Medium
509535	JUEGENUP	Department of Water	Automatic	Medium
509531	CROSS FARM	Department of Water	Automatic	Medium

Bureau number	Station name	Owner	Gauge type	Priority
611 – Preston River				
509450	DOWDELLS ROAD BRIDGE	Department of Water	Automatic	Medium
610 – Busselton Coast				
509462	YATES BRIDGE	Department of Water	Automatic	Medium
509591	CAPEL RAILWAY BRIDGE	Department of Water	Automatic	Medium
509522	LENNOX VINEYARD	Department of Water	Automatic	Medium
509190	WOODLANDS	Department of Water	Automatic	Medium
509065	WILLMOTS FARM	Department of Water	Automatic	Medium
509355	WHICHER RANGE	Department of Water	Automatic	Medium
609 – Blackwood River				
510501	MOUNT BROWN	Department of Water	Automatic	Medium
509516	MOODIARUP	Department of Water	Automatic	Medium
509473	DARRAUP	Department of Water	Automatic	Medium
509468	GINGILUP	Department of Water	Automatic	Medium
509475	ROSA CAMPSITE	Department of Water	Automatic	Medium
509470	FOREST GROVE	Department of Water	Automatic	Medium
509549	HUT POOL	Department of Water	Automatic	Medium
509199	BRENNANS FORD	Department of Water	Automatic	Medium
608 – Donnelly River				
509467	STRICKLAND	Department of Water	Automatic	Medium
607 – Warren River				
509482	QUINTARRUP	Department of Water	Automatic	Medium
509465	WHEATLEY FARM	Department of Water	Automatic	Medium
509572	RAINBOW TRAIL	Department of Water	Automatic	Medium
509464	CASCADES	Department of Water	Automatic	Medium
509463	BARKER RD CROSSING	Department of Water	Automatic	Medium
509566	TONE RIVER AT BULLIUP	Department of Water	Automatic	Low
606 – Shannon River				
509196	BALDANIA CREEK CONFLUENCE	Department of Water	Automatic	Medium
509412	WATTLE BLOCK	Department of Water	Automatic	Medium
509266	ORDINANCE ROAD CROSSING	Department of Water	Automatic	Medium
509300	TEDS POOL	Department of Water	Automatic	Medium
509578	DOG POOL	Department of Water	Automatic	Medium
605 – Frankland River				
509548	MOUNT FRANKLAND	Department of Water	Automatic	Medium
604 – Kent River				
509278	STYX JUNCTION	Department of Water	Automatic	Medium
509385	ROCK GLEN	Department of Water	Automatic	Medium
603 – Denmark River				
509022	WOONANUP	Department of Water	Automatic	Medium
509466	KOMPUP	Department of Water	Automatic	Medium
509017	MOUNT LINDESAY	Department of Water	Automatic	Medium
509587	OCEAN BEACH ROAD	Department of Water	Automatic	Medium
509514	DENMARK COLLEGE	Department of Water	Automatic	Medium
509451	TORBAY TOWNSHIP	Department of Water	Automatic	Medium
509590	EDEN ROAD	Department of Water	Automatic	Medium
509439	SLEEMAN ROAD BRIDGE	Department of Water	Automatic	Medium
509559	WILSON INLET AT OLD RAINLWAY BRIDGE	Department of Water	Automatic	Medium
602 – Albany Coast				
509011	BLACK CAT FLATS	Department of Water	Automatic	Medium
509320	STEVENS FARM	Department of Water	Automatic	Medium
509585	BILLA BOYA RESERVE	Department of Water	Automatic	Medium

Bureau number	Station name	Owner	Gauge type	Priority
602 – Albany Coast (continued)				
509448	LOWER KING ROAD	Department of Water	Automatic	Medium
510026	BULL CROSSING	Department of Water	Automatic	Medium
601 – Esperance Coast				
509561	PITCHIE RITCHIE	Department of Water	Automatic	Medium
512018	CASCADES	Department of Water	Automatic	Medium
509004	NEDS CORNER	Department of Water	Automatic	Medium
509195	FAIRFIELD	Department of Water	Automatic	Medium
509546	MYRUP ROAD	Department of Water	Automatic	Medium
509513	FISHERIES ROAD	Department of Water	Automatic	Medium

Notes:

- Data from manual stations are not available in (near) real time.

Schedule 5: Enviromon base stations installed in Western Australia

Owner	City/town	License number	Number of users	Date of registration	License version
Bureau	Perth	61090005	10	8/05/2007	3

Schedule 6: List of Data Sharing Agreements for data provision

A Data Sharing Agreement for data provision has been set up or is in development for the following agencies.

Agency	Status (Complete or In Progress)	Date of Completion	Number of sites
Department of Water	In progress	TBA	189
Department of Agriculture and Food	In Progress	TBA	99
Department of Conservation and Environment	In progress	TBA	13
BHP-Billion	In progress	TBA	6
Rio Tinto	In progress	TBA	4

Schedule 7: List of sites owned and maintained by the Bureau

Bureau number	Station name	Gauge type	Data type	Priority
809 – Ord River				
1006	WYNDHAM AERO *	Automatic	Rainfall	Medium
2012	HALLS CREEK AIRPORT *	Automatic	Rainfall	Medium
2056	KUNUNURRA AERO *	Automatic	Rainfall	Medium
2064	ARGYLE AERODROME *	Automatic	Rainfall	Medium
2072	BEDFORD DOWNS AIRSTRIP *	Automatic	Rainfall	Medium
806 – King Edward River				
1019	KALUMBURU	Automatic	Rainfall	Medium
802 – Fitzroy River				
2009	GIBB RIVER	Automatic	Rainfall	Medium
2019	MARGARET RIVER AIRFIELD *	Automatic	Rainfall	Medium
2020	MOOLA BULLA	Automatic	Rainfall	Medium
2021	MOUNT AMHURST	Automatic	Rainfall	Medium
2022	MOUNT WINIFRED	Automatic	Rainfall	Medium
2030	YULMBU	Automatic	Rainfall	Medium
2036	OLD MORNINGTON HOMESTEAD	Automatic	Rainfall	Medium
2043	MOUNT KRAUSS	Automatic	Rainfall	Medium
2053	LANSDOWNE	Automatic	Rainfall	Medium
2077	SIDDINS CREEK	Automatic	Rainfall	Medium
3011	LEOPOLD DOWNS	Automatic	Rainfall	High
3032	DERBY AERO *	Automatic	Rainfall	Low
3043	CHRISTMAS CREEK	Automatic	Rainfall	Medium
3051	MOUNT BARNETT	Automatic	Rainfall	Medium
3068	DAMPIER DOWNS AIRFIELD *	Automatic	Rainfall	High
3080	CURTIN AERO *	Automatic	Rainfall	Low
3088	LARRAWA AIRFIELD *	Automatic	Rainfall	Medium
3093	FITZROY CROSSING AERO *	Automatic	Rainfall	Medium
3098	MOUNT HOUSE AIRSTRIP *	Automatic	Rainfall	Medium
808 – Pentecost River				
2068	MARION DOWNS	Automatic	Rainfall	Medium
801 – Cape Leveque Coast				
3003	BROOME AIRPORT *	Automatic	Rainfall	Medium
3096	WEST ROEBUCK	Automatic	Rainfall	Medium
803 – Lennard River				
3094	WINDJANA GORGE	Automatic	Rainfall	Medium
125 – Sandy Desert				
4019	MANDORA	Automatic	Rainfall	Medium
13030	TELFER AERO *	Automatic	Rainfall	Medium
709 – Port Hedland Coast				
4032	PORT HEDLAND AIRPORT *	Automatic	Rainfall	Medium
4083	KARRATHA AERO *	Automatic	Rainfall	Medium
4090	ROEBOURNE AERO *	Automatic	Rainfall	Medium
710 – De Grey River				
4106	MARBLE BAR *	Automatic	Rainfall	Medium
705 – Lyndon-Minilya Rivers				
5007	LEARMONTH AIRPORT *	Automatic	Rainfall	Medium
6072	EMU CREEK STATION	Automatic	Rainfall	Medium
6108	CAPE CUVIER WHARF	Automatic	Rainfall	Medium
707 – Onslow Coast				
5008	MARDIE	Automatic	Rainfall	Medium
706 – Ashburton River				
5017	ONSLOW AIRPORT *	Automatic	Rainfall	Medium
7185	PARABURDOO AERO *	Automatic	Rainfall	Medium
704 – Gascoyne River				
6011	CARNARVON AIRPORT *	Automatic	Rainfall	Medium
6104	MINNIE CREEK AIRSTRIP *	Automatic	Rainfall	Medium
6111	WINDERIE AIRSTRIP *	Automatic	Rainfall	Medium

Bureau number	Station name	Gauge type	Data type	Priority
704 – Gascoyne River (continued)				
6112	LYONS RIVER AIRSTRIP *	Automatic	Rainfall	Medium
7207	LANDOR AIRSTRIP *	Automatic	Rainfall	Medium
7208	MOUNT AUGUSTUS AIRSTRIP *	Automatic	Rainfall	Medium
7209	COBRA AIRSTRIP *	Automatic	Rainfall	Medium
7210	BURRINGURRAH AIRSTRIP *	Automatic	Rainfall	Medium
7211	DALGETY DOWNS AIRSTRIP *	Automatic	Rainfall	Medium
703 – Wooramel River				
6105	SHARK BAY AIRPORT *	Automatic	Rainfall	Low
702 – Murchison River				
7045	MEEKATHARRA AIRPORT *	Automatic	Rainfall	Medium
708 – Fortescue River				
7176	NEWMAN AERO *	Automatic	Rainfall	Medium
618 – Yarra Yarra Lakes				
7600	MOUNT MAGNET AERO *	Automatic	Rainfall	Medium
8296	MORAWA AIRPORT *	Automatic	Rainfall	Medium
701 – Greenough River				
8051	GERALDTON AIRPORT *	Automatic	Rainfall	High
8237	TENINDEWA	Automatic	Rainfall	High
8298	TIBRADDEN	Automatic	Rainfall	High
8299	ARRADALE	Automatic	Rainfall	High
8300	TABLETOP	Automatic	Rainfall	High
8304	MOASCAR	Automatic	Rainfall	High
8307	COOLANGATTA ALERT	Automatic	Rainfall	Medium
8308	TARDUN HILL	Automatic	Rainfall	Medium
8309	BELLENDAINE	Automatic	Rainfall	Medium
8310	SOUTH HOLMWOOD	Automatic	Rainfall	High
615 – Avon River				
8297	DALWALLINU	Automatic	Rainfall	Medium
8302	WONGAN HILLS NORTH	Automatic	Rainfall	Medium
10000	AMERY ACRES	Automatic	Rainfall	Medium
10031	YORKRAKINE TM	Automatic	Rainfall	Medium
10064	BOLGART BIN	Automatic	Rainfall	Medium
10089	LONG FOREST	Automatic	Rainfall	High
10111	NORTHAM	Automatic	Rainfall	Medium
10129	MOUNT NODDY	Automatic	Rainfall	High
10132	MOUNT HARDEY	Automatic	Rainfall	High
10230	WAEEL	Automatic	Rainfall	Medium
10245	BERRING	Automatic	Rainfall	Medium
10286	CUNDERDIN AIRFIELD *	Automatic	Rainfall	Medium
10307	QUADNEY	Automatic	Rainfall	Medium
10308	TOODYAY EAST	Automatic	Rainfall	Medium
10311	YORK	Automatic	Rainfall	Medium
10511	WICKEPIN SOUTH	Automatic	Rainfall	Medium
10515	BEVERLEY	Automatic	Rainfall	Medium
10524	BROOKTON	Automatic	Rainfall	Medium
10527	BULYEE	Automatic	Rainfall	Medium
10536	CORRIGIN	Automatic	Rainfall	Medium
10556	COONDEE	Automatic	Rainfall	Medium
10614	NARROGIN	Automatic	Rainfall	Medium
10626	PINGELLY	Automatic	Rainfall	Medium
10628	QUAIRADING	Automatic	Rainfall	Medium
10908	YANGEDINE	Automatic	Rainfall	High
10692	NEWDEGATE RESEARCH STATION	Automatic	Rainfall	Medium
10911	LAKE GRACE	Automatic	Rainfall	Medium
10912	YEALERING EAST	Automatic	Rainfall	Medium
10920	MOUNT WESTDALE	Automatic	Rainfall	High
10923	WILLIAMS NORTH	Automatic	Rainfall	High
12320	SOUTHERN CROSS AIRFIELD *	Automatic	Rainfall	Medium

Bureau number	Station name	Gauge type	Data type	Priority
617 – Moore-Hill River				
8301	BARBERTON EAST	Automatic	Rainfall	High
9037	BADGINGARRA RESEARCH STN	Automatic	Rainfall	Medium
9279	CANTERBURY	Automatic	Rainfall	High
9178	GINGIN AERO *	Automatic	Rainfall	Medium
616 – Swan Coast				
9021	PERTH AIRPORT *	Automatic	Rainfall	Medium
9053	PEARCE RAAF	Automatic	Rainfall	High
9066	GIDGEGANNUP	Automatic	Rainfall	Medium
9147	MOOLIABEENEE	Automatic	Rainfall	Medium
9172	JANDAKOT AERO	Automatic	Rainfall	Medium
9204	GOOSEBERRY HILL	Automatic	Rainfall	Medium
9214	OCEAN REEF	Automatic	Rainfall	Medium
9215	SWANBOURNE	Automatic	Rainfall	Medium
9224	FREMANTLE PORT	Automatic	Rainfall	Medium
9225	PERTH METRO	Automatic	Rainfall	Medium
9240	BICKLEY	Automatic	Rainfall	High
9263	WHITEMAN PARK	Automatic	Rainfall	Medium
9268	JULIMAR FOREST	Automatic	Rainfall	High
9271	BUNGENDORE	Automatic	Rainfall	Medium
9274	MINSTON PARK	Automatic	Rainfall	High
9275	MUCHEAU	Automatic	Rainfall	Medium
9277	LAKE CHITTERING	Automatic	Rainfall	Medium
10310	WERRIBEE	Automatic	Rainfall	Medium
614 – Murray River (WA)				
9023	JARRAHDALE	Automatic	Rainfall	Medium
9039	SERPENTINE	Automatic	Rainfall	Medium
9260	MOUNT SOLUS	Automatic	Rainfall	High
9538	DWELLINGUP	Automatic	Rainfall	Medium
9769	CULFORD	Automatic	Rainfall	Medium
9977	MANDURAH	Automatic	Rainfall	Medium
10917	WANDERING	Automatic	Rainfall	Medium
10919	WILGARRA	Automatic	Rainfall	High
109516	BODDINGTON NORTH	Automatic	Rainfall	Medium
609 – Blackwood River				
9518	CAPE LEEUWIN	Automatic	Rainfall	Medium
9617	BRIDGETOWN	Automatic	Rainfall	High
10916	KATANNING	Automatic	Rainfall	High
610 – Busselton Coast				
9519	CAPE NATURALISTE	Automatic	Rainfall	Medium
9569	BUSSELTON	Automatic	Rainfall	Medium
9746	WITCHCLIFFE	Automatic	Rainfall	Medium
9603	BUSSELTON AERO *	Automatic	Rainfall	Medium
9771	YOONGARILLUP	Automatic	Rainfall	Medium
9776	ASTON DOWNS	Automatic	Rainfall	Medium
9877	LUDLOW	Automatic	Rainfall	Medium
9971	ACTON PARK	Automatic	Rainfall	Medium
9978	JINDONG	Automatic	Rainfall	Medium
9987	PAYNEDALE AL	Automatic	Rainfall	Medium
9988	HAPPY VALLEY	Automatic	Rainfall	Medium
9992	CAPEL NORTH	Automatic	Rainfall	Medium
9997	RAVENSCLIFFE AL	Automatic	Rainfall	Medium
109508	DOYLE ROAD CB1	Automatic	River	High
109509	CHAPMAN HILL ROAD CB2	Automatic	River	High
009984	VASSE HWY CB3	Automatic	River	High
611 – Preston River				
9527	DARDANUP EAST AL	Automatic	Rainfall	Medium
9965	BUNBURY	Automatic	Rainfall	Medium
9989	THOMSON BROOK	Automatic	Rainfall	Medium
9990	BOYANUP NORTH	Automatic	Rainfall	Medium

Bureau number	Station name	Gauge type	Data type	Priority
611 – Preston River (continued)				
9991	DONNYBROOK EAST	Automatic	Rainfall	Medium
109507	FERGUSON VALLEY AL	Automatic	Rainfall	Medium
601 – Esperance Coast				
9542	ESPERANCE AERO *	Automatic	Rainfall	Medium
9789	ESPERANCE	Automatic	Rainfall	Medium
9961	HOPETOUN NORTH	Automatic	Rainfall	Medium
12044	MUNGLINUP WEST	Automatic	Rainfall	Medium
607 – Warren River				
9573	MANJIMUP	Automatic	Rainfall	Medium
602 – Albany Coast				
9741	ALBANY AIRPORT *	Automatic	Rainfall	Medium
10905	JACUP	Automatic	Rainfall	Medium
604 – Kent River				
9964	ROCKY GULLY	Automatic	Rainfall	Medium
606 – Shannon River				
9968	SHANNON	Automatic	Rainfall	Medium
9998	NORTH WALPOLE	Automatic	Rainfall	Medium
612 – Collie River				
9982	HENTY BROOK	Automatic	Rainfall	High
9994	COLLIE EAST	Automatic	Rainfall	High
122 – Nullarbor				
11003	EUCLA	Automatic	Rainfall	Medium
11052	FORREST	Automatic	Rainfall	Medium
124 – Salt Lake				
12009	NORSEMAN AERO *	Automatic	Rainfall	Medium
12038	KALGOORLIE-BOULDER AIRPORT *	Automatic	Rainfall	Medium
12071	SALMON GUMS RES.STN.	Automatic	Rainfall	Medium
12241	LEONORA AERO *	Automatic	Rainfall	Medium
12305	LAVERTON AERO *	Automatic	Rainfall	Medium
12314	LEINSTER AERO *	Automatic	Rainfall	Medium
123 – Warburton River				
13011	WARBURTON AIRFIELD *	Automatic	Rainfall	Medium
613 – Harvey River				
109501	MOUNT WILLIAM	Automatic	Rainfall	High

Notes:

- Does not include daily rainfall and other Bureau synoptic stations.
- * Refers to an Automatic Weather Station which is owned and operated by the Bureau of Meteorology but its primary purpose is not for flood warning.

Schedule 7a: List of rainfall sites owned and maintained by external agencies

Bureau number	Station name	Gauge type	Data type	Priority
601 – Esperance Coast				
509579	CONDINGUP WEST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509011	BLACK CAT FLAT	Automatic	Department of Water	Medium
510026	BULL CROSSING	Automatic	Department of Water	Medium
509574	COOMALBIDGUP (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509556	ESPERANCE (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
511002	MT BURAMINYA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
512016	MT HOWICK (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
512021	CASCADE (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510517	RAVENSTHORPE (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
512015	SALMON GUMS (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
512014	SCADDAN (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509004	NEDS CORNER	Automatic	Department of Water	Medium
509195	FAIRFIELD	Automatic	Department of Water	Medium
509560	RAISED BED	Automatic	Department of Water	Medium
512018	CASCADES	Automatic	Department of Water	Medium
512017	MT BURDETT (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
602 – Albany Coast				
509571	MANY PEAKS (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509570	WELLSTEAD (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509581	GAIRDNER (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510511	JERRAMUNGUP (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509582	STIRLINGS SOUTH (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510532	MAGENTA DAM (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510540	STIRLINGS NORTH (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
603 – Denmark Coast				
509022	WOONANUP	Automatic	Department of Water	Medium
509439	SLEEMAN ROAD BRIDGE	Automatic	Department of Water	Medium
509453	BEIGPIEGUP	Automatic	Department of Water	Medium
509466	KOMPUP	Automatic	Department of Water	Medium
509474	SUNNY GLEN	Automatic	Department of Water	Medium
509555	MOUNT BARKER (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
605 – Frankland River				
510539	TUNNEY (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium

Bureau number	Station name	Gauge type	Data type	Priority
605 – Frankland River (continued)				
509573	FRANKLAND (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
606 – Shannon River				
509196	BALDANIA CK CONFLU	Automatic	Department of Water	Medium
509300	TEDS POOL	Automatic	Department of Water	Medium
509319	OSULLIVAN	Automatic	Department of Water	Medium
509394	LAKE MUIR	Automatic	Department of Water	Medium
509412	WATTLE BLOCK	Automatic	Department of Water	Medium
509413	MATTABAND	Automatic	Department of Water	Medium
509512	WALPOLE CALM	Automatic	Department of Parks and Wildlife	Medium
607 – Warren River				
509554	MANJIMUP (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509506	MANJIMUP CALM	Automatic	Department of Parks and Wildlife	Medium
509210	CORBALLUP ROAD	Automatic	Department of Water	Medium
509212	QUABICUP HILL	Automatic	Department of Water	Medium
509383	METTABINUP	Automatic	Department of Water	Medium
509566	BULLILUP	Automatic	Department of Water	Medium
509509	PEMBERTON CALM	Automatic	Department of Parks and Wildlife	Medium
608 – Donnelly River				
509564	PEMBERTON (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
609 – Blackwood River				
509580	QUAELUP (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
510536	DARKAN (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
510535	DUMBLEYUNG AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510510	KATANNING (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
509583	SCOTT RIVER (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
509508	NANNUP CALM	Automatic	Department of Parks and Wildlife	High
509184	LAWSON ROAD	Automatic	Department of Water	Medium
509199	BRENNANS FORD	Automatic	Department of Water	Medium
509516	MOODIARUP TM	Automatic	Department of Water	Medium
510500	LAKE TOOLIBIN INFLOW	Automatic	Department of Water	Medium
510502	MANYWATERS	Automatic	Department of Water	Medium
510503	BIBIKIN ROAD BRIDGE	Automatic	Department of Water	Medium
510504	WISHBONE	Automatic	Department of Water	Medium
510505	COOKS FARM	Automatic	Department of Water	Medium
510534	WAGIN AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510516	WICKEPIN (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium

Bureau number	Station name	Gauge type	Data type	Priority
610 – Busselton Coast				
509553	VASSE (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509505	KIRUP CALM	Automatic	Department of Parks and Wildlife	Medium
509062	GEORGE ROAD	Automatic	Department of Water	Medium
509584	WILYABRUP (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509065	WILLMOTS FARM	Automatic	Department of Water	Medium
509191	HARMAN SOUTH RD	Automatic	Department of Water	Medium
509355	WHICHER RANGE	Automatic	Department of Water	Medium
509520	CHAPMAN HILL TM	Automatic	Department of Water	Medium
509507	MARGARET RIVER CALM	Automatic	Department of Parks and Wildlife	Low
611 – Preston River				
509073	MANDALAY	Automatic	Department of Water	Medium
509310	HARRIS ROAD	Automatic	Department of Water	Medium
509528	WOODPERRY HOMESTEAD	Automatic	Department of Water	Medium
509563	DONNYBROOK (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
612 – Collie River				
509503	COLLIE CALM	Automatic	Department of Parks and Wildlife	High
509082	SANDY ROAD	Automatic	Department of Water	Medium
509220	WIGHTS CATCH	Automatic	Department of Water	Medium
509321	MAXON FARM	Automatic	Department of Water	Medium
509370	SANDALWOOD	Automatic	Department of Water	Medium
509539	JAMES CROSSING	Automatic	Department of Water	Medium
509577	DARDANUP (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509594	WORSLEY	Automatic	Department of Water	Medium
613 – Harvey River				
509360	ORION	Automatic	Rio Tinto	Medium
509576	HARVEY (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
509562	MYALUP (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
509504	HARVEY CALM	Automatic	Department of Parks and Wildlife	High
509575	WAROONA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509119	DINGO ROAD	Automatic	Department of Water	Medium
509307	SAMSON BROOK DAM	Automatic	Department of Water	Medium
509366	BRISTOL ROAD	Automatic	Department of Water	Medium
509368	URQUHARTS	Automatic	Department of Water	Medium
614 – Murray River				
509510	SADDLEBACK CALM	Automatic	Department of Parks and Wildlife	Medium
509500	BODDINGTON CALM	Automatic	Department of Parks and Wildlife	Medium
510530	POPANYINNING (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium

Bureau number	Station name	Gauge type	Data type	Priority
614 – Murray River (continued)				
509396	MEDINA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509129	BROOKDALE SIDING	Automatic	Department of Water	Medium
509221	O'NEIL ROAD	Automatic	Department of Water	Medium
509295	DOG HILL	Automatic	Department of Water	Medium
509329	YARRAGIL FORMATION	Automatic	Department of Water	Medium
509460	BOURNBROOK AVENUE	Automatic	Department of Water	Medium
509472	OLD MANDURAH ROAD	Automatic	Department of Water	Medium
509544	SADDLEBACK ROAD BRIDGE	Automatic	Department of Water	Medium
509545	MARRADONG ROAD BRIDGE	Automatic	Department of Water	Medium
510506	PUMPHREYS BRIDGE TM	Automatic	Department of Water	Medium
510531	NARROGIN AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
615 – Avon River				
510067	BEACON AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510520	EAST BEVERLEY (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510526	BROOKTON (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510527	CORRIGIN AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510074	EJANDING (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
510528	HYDEN (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510070	KELLERBERRIN AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
510533	KONDININ AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510073	KOORDA AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510519	HOLT ROCK (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510518	LAKE KING (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510064	MECKERING NORTH (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
512022	BURRACOPPIN SOUTH (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510062	MERREDIN (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
512010	BONNIE ROCK (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510068	MUKINBUDIN AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510525	NAREMBEEN AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510529	DRAGON ROCKS (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510509	NEWDEGATE (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510065	MURESK (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510063	NORTHAM (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510537	NYABING EAST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510538	ONGERUP NORTH (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510072	SHACKLETON (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
512013	YILGARN SOUTH (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium

Bureau number	Station name	Gauge type	Data type	Priority
615 – Avon River (continued)				
510069	TRAYNING WEST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
512020	WESTONIA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510515	WICKEPIN EAST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508041	WONGAN HILLS (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
510000	FRENCHES	Automatic	Department of Water	Medium
510018	JELCOBINE	Automatic	Department of Water	Medium
510031	MOORANOPPIN ROCK	Automatic	Department of Water	Medium
510035	ODRISCOLLS FARM	Automatic	Department of Water	Medium
510046	OTOOLE	Automatic	Department of Water	Medium
510252	KWOLYN HILL	Automatic	Department of Water	Medium
510508	WATERHATCH BRIDGE	Automatic	Department of Water	Medium
616 – Swan Coastal				
509446	FLOREAT PARK (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509391	SOUTH PERTH (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509281	WANNEROO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509141	CHITTERING ROAD	Automatic	Department of Water	Medium
509269	SELDOM SEEN CREEK GARDENS	Automatic	Department of Water	Medium
509270	CERIANI FARM	Automatic	Department of Water	Medium
509271	MOUNT CURTIS	Automatic	Department of Water	Medium
509359	WELSHPOOL DEPOT	Automatic	Department of Water	Medium
509376	KARLS RANCH	Automatic	Department of Water	Medium
509388	YALLIAWIRRA NORTH	Automatic	Department of Water	Medium
509611	CARLOTTA FARM	Automatic	Department of Water	Medium
510017	NGANGAGURINGURING	Automatic	Department of Water	Medium
509288	WANNEROO CALM	Automatic	Department of Parks and Wildlife	Medium
617 – Moore-Hill Rivers				
509479	NEW NORCIA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508063	WARRADARGE EAST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509445	BADGINGARRA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508055	ENEABBA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
509430	GIN GIN WEST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
509478	JURIEN BAY (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
509431	LANCELIN EAST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508057	BINDI BINDI (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508044	MOORA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508062	COOROW WEST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508054	LATHAM (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium

Bureau number	Station name	Gauge type	Data type	Priority
617 – Moore-Hill Rivers (continued)				
508035	NARDY ROAD	Automatic	Department of Water	High
508065	LONG POOL	Automatic	Department of Water	High
509168	HILL RIVER SPRINGS	Automatic	Department of Water	High
509381	QUINNS FORD	Automatic	Department of Water	High
509419	BOOKINE BOOKINE	Automatic	Department of Water	High
508056	WATHEROO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
618 – Yarra Yarra				
510066	KALANNIE (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508045	MORAWA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508060	CANNA EAST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508053	PERENJORI AERO (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508058	THREE SPRINGS (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
701 – Greenough River				
508061	ALLANOOKA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508049	ERADU (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508052	ERANGY SPRINGS (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508059	GUTHA WEST (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508048	MINGENEW (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508046	MULLEWA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	High
508050	CHAPMAN VALLEY (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508051	YUNA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508011	WICKA	Automatic	Department of Water	High
508017	PINDARRING ROCKS	Automatic	Department of Water	High
508020	KARLANEW PEAK	Automatic	Department of Water	High
508032	MOUNTAIN BRIDGE	Automatic	Department of Water	High
508034	NOLBA	Automatic	Department of Water	High
508037	MITTHUTHARRA	Automatic	Department of Water	High
508040	YERINA	Automatic	Department of Water	High
508064	KAPARI	Automatic	Department of Water	High
508066	CASLEYS	Automatic	Department of Water	High
702 – Murchison River				
508047	BINNU (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
508021	EMU SPRINGS	Automatic	Department of Water	High
704 – Gascoyne River				
506011	FISHY POOL	Automatic	Department of Water	High
506012	JIMBA	Automatic	Department of Water	High
506013	LYONS RIVER CROSSING	Automatic	Department of Water	High

Bureau number	Station name	Gauge type	Data type	Priority
704 – Gascoyne River (continued)				
506016	PELLS ISLAND	Automatic	Department of Water	High
507000	YINNETHARRA CROSSING	Automatic	Department of Water	High
506014	CARNARVON (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
706 – Ashburton River				
505019	AREA C	Automatic	BHP Billiton Limited	Medium
507002	CAPRICORN RANGE	Automatic	Department of Water	High
507020	WEST ANGELAS	Automatic	Rio Tinto	Medium
507018	CHANNAR	Automatic	Rio Tinto	High
507019	PARABURDOO	Automatic	Rio Tinto	High
505043	BROCKMAN 2	Automatic	Rio Tinto	Medium
505044	BROCKMAN 4	Automatic	Rio Tinto	Medium
505046	MARANDOO	Automatic	Rio Tinto	Medium
505047	TOM PRICE	Automatic	Rio Tinto	Medium
708 – Fortescue River				
507015	OPHTHALMIA	Automatic	BHP Billiton Limited	Medium
507014	WHALEBACK	Automatic	BHP Billiton Limited	Medium
507013	WHEELARRA	Automatic	BHP Billiton Limited	Medium
504043	YANDI	Automatic	BHP Billiton Limited	Medium
505045	HOPE DOWNS 1	Automatic	Rio Tinto	Medium
505004	MUNJINA	Automatic	Department of Water	High
505009	UPPER PORTLAND	Automatic	Department of Water	High
505010	GREGORY GORGE	Automatic	Department of Water	High
505011	FLAT ROCKS	Automatic	Department of Water	High
505039	BILANOO POOL	Automatic	Department of Water	High
505040	TARINA	Automatic	Department of Water	High
505041	WATERLOO BORE	Automatic	Department of Water	High
507012	WONMUNNA	Automatic	Department of Water	High
505048	YANDICOOGINA	Automatic	Rio Tinto	Medium
710 – De Grey River				
504042	YARRIE	Automatic	BHP Billiton Limited	Medium
504009	UPPER NORTH POLE	Automatic	Department of Water	High
504016	NULLAGINE TM	Automatic	Department of Water	High
504035	NORTH POLE MINE	Automatic	Department of Water	High
504036	TUMBINNA POOL	Automatic	Department of Water	High
504037	MARBLE BAR	Automatic	Department of Water	High
504039	RIPON HILLS ROAD	Automatic	Department of Water	High
504040	MARBLE BAR RD CROSSING	Automatic	Department of Water	High

Bureau number	Station name	Gauge type	Data type	Priority
809 – Ord River				
501008	MOOCHALABRA NO 1	Automatic	Department of Water	High
501029	MOOCHALABRA DAM	Automatic	Department of Water	High
502014	FROG HOLLOW	Automatic	Department of Water	High
502015	BEDFORD DOWNS TM	Automatic	Department of Water	High
502019	LIAMMA BORE	Automatic	Department of Water	High
502020	ELGEE CLIFFS	Automatic	Department of Water	High
502028	ORD RIVER HOMESTEAD	Automatic	Department of Water	High
502030	DURACK RANGE	Automatic	Department of Water	High
502031	DUNHAM GORGE	Automatic	Department of Water	High
502039	LAKE KUNUNURRA	Automatic	Department of Water	High
502046	MOUNT ROB	Automatic	Department of Water	High
502062	ABNEY HILL	Automatic	Department of Water	High
514825	MISTAKE CREEK HOMESTEAD	Automatic	Department of Water	High
502007	KUNUNURRA (DAFWA)	Automatic	Department of Agriculture and Food Western Australia	Medium
802 – Fitzroy River				
502001	MT WINIFRED	Automatic	Department of Water	High
502002	MUD SPRINGS	Automatic	Department of Water	High
502005	MOUNT KRAUSS	Automatic	Department of Water	High
502006	ME NO SAVVY	Automatic	Department of Water	High
502024	PHILLIPS RANGE	Automatic	Department of Water	High
502027	DIMOND GORGE	Automatic	Department of Water	High
502059	MARGARET GORGE	Automatic	Department of Water	High
503000	CHRISTMAS CK	Automatic	Department of Water	High
503007	NOONKANBAH	Automatic	Department of Water	High
503011	ELLENDALE	Automatic	Department of Water	High
503012	LOOMA	Automatic	Department of Water	High
804 – Isdell River				
503009	DALES YARD	Automatic	Department of Water	High
810 – Keep River				
502033	MICROWAVE TOWER	Automatic	Department of Water	High
502038	EIGHT MILE MILL	Automatic	Department of Water	High
604 – Kent River				
509278	STYX JUNCTION	Automatic	Department of Water	High
509385	ROCKY GLEN	Automatic	Department of Water	High
803 – Lenard River				
503008	MOUNT JOSEPH	Automatic	Department of Water	High

Bureau number	Station name	Gauge type	Data type	Priority
705 – Lyndon-Minilya Rivers				
506004	MINILYA BRIDGE	Automatic	Department of Water	High
709 – Port Hedland Coastal Rivers				
504001	COONANARRINA POOL	Automatic	Department of Water	High
504030	SOANSVILLE	Automatic	Department of Water	High
504031	ABYDOS NORTH	Automatic	Department of Water	High
504032	PINCUNAH	Automatic	Department of Water	High
504033	CARRABA	Automatic	Department of Water	High
504038	BOODARIE	Automatic	Department of Water	High
504046	LYRE CREEK WELL	Automatic	Department of Water	High
504047	BLACK HILLS	Automatic	Department of Water	High
505057	59 MILE PEG	Automatic	Department of Water	High
702 – Wooramel River				
506002	MEEDO POOL	Automatic	Department of Water	High
506015	STEADMANS	Automatic	Department of Water	High

Schedule 8: List of sites where the Bureau assists other agencies with maintenance

Bureau number	Station name	Owner	Gauge type	Data type	Priority
NIL	NIL	NIL	NIL	NIL	NIL

Notes:

- The Bureau does not currently assist any other agencies with maintenance in Western Australia

Schedule 9: List of sites owned by another agency where the Bureau co-locates equipment

Bureau number	Station name	Owner	Gauge type	Data type	Priority
610 – Busselton Coast					
509521	D/S HILL ROAD	Department of Water	Automatic	River	High
616 – Swan Coast					
509440	BARRACK STREET JETTY	Department of Transport (Marine Information)	Automatic	River	High
509438	WALYUNGA POOL	Department of Water	Automatic	River	High
615 – Avon River					
510060	STIRLING TCE TOODYAY	Department of Water	Automatic	River	High
510061	NORTHAM WEIR	Department of Water	Automatic	River	High

Notes:

- Does not include daily rainfall, automatic weather stations and other Bureau synoptic stations.

Schedule 10a: List of flood warning related products issued by the Bureau in Western Australia (warnings, watches, bulletins)

Flood warnings

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW39700	Eucla District	To be issued in potential or actual developing weather situations which could lead to flooding.	Minimum once a day, usually twice daily, more frequently depending on severity of event or if significant changes in the situation indicate the need to do so.	When no further significant rainfall expected and threat of further stream rises has passed.
IDW39710	Interior District	To be issued in potential or actual developing weather situations which could lead to flooding.	Minimum once a day, usually twice daily, more frequently depending on severity of event or if significant changes in the situation indicate the need to do so.	When no further significant rainfall expected and threat of further stream rises has passed
IDW39715	Goldfields District	To be issued in potential or actual developing weather systems which could lead to flood situations .	Minimum once a day, usually twice daily, more frequently depending on severity of event or if significant changes in the situation indicate the need to do so.	When no further significant rainfall expected and threat of further stream rises has passed
IDW39720	Southern Coastal District	To be issued in potential or actual developing weather situations which could lead to flooding.	Minimum once a day, usually twice daily, more frequently depending on severity of event or if significant changes in the situation indicate the need to do so.	When no further significant rainfall expected and threat of further stream rises has passed..
IDW39730	Blackwood River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a day, usually twice daily, more frequently depending on severity of event or if significant changes in the situation indicate the need to do so.	When all river levels are falling, approaching minor flood level and no further heavy rainfall is expected
IDW39740	South West District	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a day, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and no further heavy rainfall is expected.
IDW39760	Preston River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a day, usually twice a day. More frequently if required due to Three (3) or six (6) hourly intervals, depending on the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and no further rainfall is expected.
IDW39765	Collie River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a day, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and no further rainfall is expected.

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW39770	Lower West District	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and threat of renewed rises has passed.
IDW39775	Murray River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39780	Canning River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39785	Swan River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39790	Avon River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39798	Moore River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a day, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39800	Irwin River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a day, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39802	Greenough River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a day, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39805	Chapman River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once a day, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW39808	Wooramel River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39810	Murchison River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39820	Gascoyne River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39830	Pilbara Coastal Rivers	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39835	Ashburton River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39840	Fortescue River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39845	De Grey River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	Minimum once daily, usually twice a day. More frequently if required due to the severity of the event and/or a fast rate of rise.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39870	East Kimberley District	To be issued in potential or actual developing weather systems which could lead to flood situations.	For small or minor floods products should be renewed at least daily.	When the threat of flooding has passed.
IDW39875	North Kimberley District	To be issued in potential or actual developing weather systems which could lead to flood situations.	For small or minor floods products should be renewed at least daily.	When the threat of flooding has passed.
IDW39880	West Kimberley District	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	For small or minor floods products should be renewed at least daily.	When the threat of flooding has passed.

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW39885	Fitzroy River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	For small or minor floods products should be renewed at least daily.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39890	Ord River Catchment	To be issued in potential or actual developing flood situations when minor flood levels are expected to be exceeded.	For small or minor floods products should be renewed at least daily.	When all river levels are falling, approaching minor flood level and the threat of renewed rises has passed.
IDW39600	Western Australia Flood Summary	Is issued once the first flood warning or watch product is issued.	When new warning and watch products are added and/or removed.	Once all warning and watch products are removed.

Flood watches

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW39610	Kimberley	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39620	Pilbara	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39625	Gascoyne District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW39630	Central West District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39640	Lower West District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39650	Central Wheatbelt District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39660	South West District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39670	Great Southern District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW39680	Goldfields District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39683	Interior District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39687	Eucla District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.
IDW39690	Southern Coastal District	When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region.	A flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so.	The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.

River height bulletins

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW60400	Latest River Heights for the Pentecost, Ord, Fitzroy, Lenard and Isdel Rivers	None	Hourly	Never
IDW60401	Latest River Heights for the De Grey, Pilbara coastal, Fortescue and Ashburton Rivers	None	Hourly	Never
IDW60402	Latest River Heights for the Lyndon-Minilya, Gascoyne, Wooramel and Murchison Rivers	None	Hourly	Never
IDW60403	Latest River Heights for the Hutt, Chapman, Greenough, Irwin and Hill-Moore Rivers	None	Hourly	Never
IDW60404	Latest River Heights for the Avon, Dale, Mortlock, Brockman, Swan and Canning Rivers	None	Hourly	Never

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW60405	Latest River Heights for the Serpentine, Murray, Harvey, Collie, Preston, Capel and Ludlow Rivers	None	Hourly	Never
IDW60406	Latest River Heights for the Vasse, Margaret, Blackwood, Donnelly, Warren, Shannon, Frankland, Kent and Denmark Rivers	None	Hourly	Never
IDW60407	Latest River Heights for the Albany and Esperance Coast Rivers	None	Hourly	Never

Rainfall bulletins – 1 Hourly

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW60200	Kimberley	None	Hourly	Never
IDW60202	Pilbara	None	Hourly	Never
IDW60203	Gascoyne – Murchison	None	Hourly	Never
IDW60204	Mid West	None	Hourly	Never
IDW60207	Avon – Swan	None	Hourly	Never
IDW60205	Mandurah – Ludlow	None	Hourly	Never
IDW60206	Bussleton – Albany	None	Hourly	Never
IDW60201	Albany to Esperance	None	Hourly	Never
IDW60208	Goldfields	None	Hourly	Never
IDW60227	Wheatbelt	None	Hourly	Never

Rainfall bulletins – 3 Hourly

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW60209	Kimberley	None	Every three hours	Never
IDW60211	Pilbara	None	Every three hours	Never
IDW60212	Gascoyne – Murchison	None	Every three hours	Never
IDW60213	Mid West	None	Every three hours	Never
IDW60216	Avon – Swan	None	Every three hours	Never
IDW60214	Mandurah – Ludlow	None	Every three hours	Never
IDW60215	Bussleton – Albany	None	Every three hours	Never
IDW60210	Albany to Esperance	None	Every three hours	Never
IDW60217	Goldfields	None	Every three hours	Never
IDW60228	Wheatbelt	None	Every three hours	Never

Rainfall bulletins – 24 Hourly

Product ID	Product name	Initiating criteria	Updated	Finalising
IDW60218	Kimberley	None	Hourly	Never
IDW60220	Pilbara	None	Hourly	Never
IDW60221	Gascoyne – Murchison	None	Hourly	Never
IDW60222	Mid West	None	Hourly	Never
IDW60225	Avon – Swan	None	Hourly	Never
IDW60223	Mandurah – Ludlow	None	Hourly	Never
IDW60224	Bussleton – Albany	None	Hourly	Never
IDW60219	Albany to Esperance	None	Hourly	Never
IDW60226	Goldfields	None	Hourly	Never
IDW60229	Wheatbelt	None	Hourly	Never

Schedule 10b: Flood warning products – Linkages to general Bureau products

Flood Watch issue times

When, as a result of a routine assessment, it is anticipated that flood producing rainfall may occur within 24 to 72 hours for a particular forecast district or region, a flood watch advice will be issued daily or more frequently if the changing weather situation indicates the need to do so. The flood watch advice is to remain in effect until either the potential flood threat passes and activity reverts to routine catchment monitoring, or the flood situation has developed to a point where flood warnings are warranted.

The emphasis must be on advising those authorities responsible for action at a state and local level of the likelihood of flooding. Rainfall and river level reports should be obtained from a sufficient number of indicator stations, where possible, to monitor developments and enable assessment of catchment rainfall.

Flood Watch will be mentioned in the District Forecast Products. GFE?

Flood Warning issue times

For streams in the ***South West Coast Drainage Division***, the flood warnings will be issued:

- immediately the need becomes apparent; then
- Minimum once a day, usually twice daily, more frequently depending on severity of event or if significant changes in the situation indicate the need to do so. three (3) or six (6) hourly intervals, depending on the severity of the event and/or a fast rate of rise. Towards the forecast peak level the warnings may be required to be issued hourly.

For other regions of the State, flood warnings are normally issued:

- immediately the need becomes apparent (eg. when a cyclone affects the area or extremely high rainfall is forecast or reported); then
- Minimum once a day, usually twice daily or up to six (6) hourly intervals, depending on the severity of the event and/or a fast rate of rise. For extreme events when rises moving towards the forecast peak level the warnings may be required to be issued more frequently.

When river systems in the Kimberley and Pilbara regions are in flood for a large part of the wet season, once the initial extent and severity of the flooding in the region are known to the different agencies involved in the services and the public, updates may be covered in the flood summary rather than issuing flood warning advices.

Intermediate issues will be made for any river system in the State if it is considered that, in light of new information, the previous issue was significantly in error.

In order to assist flood forecasting, the Flood Warning Centre may consult with Flood Warning Operational Group (FWOG) members or activate the FWOG as it deems appropriate.

Product ID	Product name	Forecast district			Towns covered by area of product
IDW39600	Flood Summary				
Flood watch advices					
IDW39610	Kimberley	Kimberley			Broome & Kununurra
IDW39620	Pilbara	Pilbara	North Interior		Port Hedland, Karratha, Exmouth & Newman
IDW39625	Gascoyne District	Gascoyne			Carnarvon, Newman & Meekatharra
IDW39630	Central West District	Central West			Geraldton
IDW39640	Lower West District	Lower West			Perth & Mandurah

Product ID	Product name	Forecast district			Towns covered by area of product
Flood watch advices (continued)					
IDW39650	Central Wheatbelt District	Central Wheat Belt			
IDW39660	South West District	South West			Bunbury & Busselton
IDW39670	Great Southern District	Great Southern			
IDW39680	Goldfields District	Goldfields			Kalgoorlie
IDW39683	North Interior District	North Interior			
IDW39687	Eucla District	Eucla			
IDW39690	South Coastal District	South Coast			
IDW39695	SouthEast Coastal District	Southeast Coastal			Esperance
Flood warnings					
IDW39700	Eucla District	Eucla			
IDW39710	Interior District	North Interior	Southern Interior		
IDW39715	Goldfields District	Goldfields			Kalgoorlie
IDW39720	South Coastal District	South Coastal			Albany
IDW39725	SouthEast Coastal District	Southeast Coastal			Esperance
IDW39730	Blackwood River Catchment	Southwest	Great Southern		
IDW39740	South West District	Southwest			Bunbury & Busselton
IDW39760	Preston River Catchment	Southwest			Bunbury
IDW39765	Collie River Catchment	Lower West	Great Southern	Southwest	Bunbury
IDW39770	Lower West District	Lower West			Perth & Mandurah
IDW39775	Murray River Catchment	Lower West	Great Southern		Mandurah
IDW39780	Canning River Catchment	Lower West			Perth
IDW39785	Swan River Catchment	Lower West			Perth
IDW39790	Avon River Catchment	Central Wheat Belt	Great Southern	Lower West	Perth
IDW39798	Moore River Catchment	Central West	Lower West		
IDW39800	Irwin River Catchment	Central West			
IDW39802	Greenough River Catchment	Central West			Geraldton
IDW39805	Chapman River Catchment	Central West			Geraldton
IDW39808	Wooramel River Catchment	Gascoyne			
IDW39810	Murchison River Catchment	Central West	Gascoyne		
IDW39820	Gascoyne River Catchment	Gascoyne			Carnarvon
IDW39822	Lyndon-Minilya Rivers	Pilbara	Gascoyne		Exmouth
IDW39825	Onlow Coastal Rivers	Pilbara			
IDW39830	Pilbara Coastal Rivers	Pilbara			Port Hedland & Karratha
IDW39835	Ashburton River Catchment	Pilbara	Gascoyne		
IDW39840	Fortescue River Catchment	Pilbara			Karratha & Port Hedland
IDW39845	De Grey River Catchment	Pilbara	North Interior		Port Hedland
IDW39870	East Kimberley District	Kimberley			Kununurra
IDW39750	North Kimberley District	Kimberley			
IDW39880	West Kimberley District	Kimberley			Broome

Product ID	Product name	Forecast district			Towns covered by area of product
Flood warnings (continued)					
IDW39885	Fitzroy River Catchment	Kimberley			
IDW39890	Ord River Catchment	Kimberley			Kununurra

Schedule 11: List of changes to this Service Level Specification

Version	Date	Name	Update
1.0	25th October 2013	Nicole Pana	Version 1.0 signed
2.0	April 2015	Nicole Pana	Additional sentence to clause 1.6 highlighting supplementary services
			Addition of priorities to stations in schedules 2-4 and 7-9. This is defined in clause 3.3.2 and Table 1 which are also new additions.
			Quantitative and Qualitative clauses better described (3.8.3 and 3.8.4)
2.0	March 2016	Steve Dugan	Editorial and table data changes in response to FWCC comments.

Appendix A: Glossary of terms

A.1. General

Bureau Flood Warning Centre: an operational area set aside in each capital city to fulfil the Bureau's role in the Total Flood Warning System specifically flood forecasting and warning.

Bureau National Operations Centre: The principal role of the National Operations Centre is to augment regional flood forecasting teams during major floods and to provide operational system support. The National Operations Centre is also responsible for leading new initiatives to enhance the quality of operations and services.

Catchment Directive: A catchment directive provides guidance specific to a catchment to help develop forecasting and warning products.

Flood warning: A written product to provide advice on impending flooding so people can take action to minimise its negative impact. This will involve some people taking action on their own behalf and others doing so as part of agency responsibilities.

Flood watch: A written product that alerts when the combination of forecast rainfall and catchment conditions indicates the flooding is likely.

National Crisis Coordination Centre: The Australian Government Crisis Coordination Centre has been designed to connect relevant Australian Government, State and Territory agencies to centralise Australian Government actions during complex national crises, to develop a single, timely and consistent picture or understanding of a crisis, its implications and the national capacity to respond.

National Flood Warning Arrangements: The National Arrangements outline the general roles and responsibilities of each level of Government in providing and supporting an effective flood warning service and includes separate chapters describing the specific arrangements and agency roles that apply in each jurisdiction.

Protective behaviour: generating appropriate and timely actions and behaviours from the agencies involved and from the threatened community.

Severe Thunderstorm: A thunderstorm is characterised by sudden electrical discharges, each manifested by a flash of light (lightning) and a sharp rumbling sound. Thunderstorms are associated with convective clouds (cumulonimbus) and are usually accompanied by precipitation. Thunderstorms are often short-lived and impact on only a small area. Severe thunderstorms may last for an hour or more and can have a more widespread impact.

A severe thunderstorm will also have one or more of the following phenomena:

- Tornado
- Wind gust of 90 km/h (49 knots) or more
- Hailstones with diameter of 2 cm or larger
- Very heavy rain sufficient to cause flash flooding

Weather warnings: Weather warnings are messages sent out by the Bureau to warn the community of potentially hazardous or dangerous weather conditions. Such warnings include but are not limited to: road weather alerts, severe thunderstorm warnings, severe weather warnings for heavy rain, strong or gale force winds, marine wind warnings, warnings for sheep graziers and frost warnings. More information on weather terms is given in the Bureau's glossary.

A.2. The components of the Total Flood Warning System

Based on the Manual 21 Australian Emergency Manual Series, Australian Government 2009 (see the Manual for more details).

Communication: disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood (see Chapter 6).

Interpretation: identifying in advance the impacts of the predicted flood levels on communities at risk (see Chapter 4).

Message construction: devising the content of the message which will warn people of impending flooding (see Chapter 5).

Monitoring and prediction: detecting environmental conditions that lead to flooding, and predicting river levels during the flood (see Chapter 3),

Review: examining the various aspects of the system with a view to improving its performance (see Chapter 7).

A.3 Flood classifications

The classification of minor, moderate and major flood levels at key river height stations is based upon the effect of flooding for some distance upstream and downstream of that station. These levels are determined using the following descriptive categories of flooding, historical data or relevant local information.

The process for establishing flood class levels involves determining local flood effects, review and endorsement by relevant stakeholders and passing recommendations to the Bureau for inclusion in forecast and warning procedures. The process for establishment of flood class levels specific to each State and Territory is documented in the National Arrangements.

- Minor flooding - Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.

- Moderate flooding - In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.

- Major flooding - In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.

Appendix B: References

1. Emergency Management Australia 2009, *Flood Warning Manual,* Series 21.
2. Bureau of Meteorology 2013, *National Flood Warning Arrangements*
3. Bureau of Meteorology 2013, *National Flood Directive* (unpublished - internal use)
4. Bureau of Meteorology 2013, *Catchment Flood Directives* (unpublished - internal use)

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Guidance on Flood Classification

Version 1.1, October 2016

Flood classifications are key reference levels used to provide effective flood warnings to the Australian community. They relate river levels to expected impacts. This brochure aims to provide nationally consistent guidelines to those who are responsible for reviewing and updating flood classifications in their jurisdictions.

What are flood classifications?

Flood classifications describe in general terms the severity and nature of flood impacts at river height stations. There are three flood classes: minor, moderate and major. The nationally-applied definition for flood classifications as outlined in the **National Arrangements for Flood Forecasting and Warning** (www.bom.gov.au/water/floods) are listed below. Note the subtle difference between rural and urban impacts.

- **Minor** - Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.
- **Moderate** - In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.
- **Major** - In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.

Who leads or owns flood classifications?

It is important that flood classifications accurately reflect the impacts at key river height stations. In this regard, **State/Territory Emergency Services** will lead the determination, review and update of flood classifications in consultation with the Bureau and relevant State and local agencies. Current flood classifications are listed in each regions Service Level Specification (SLS) document, and a national registry is held by the Bureau (in coordination with regional Flood Warning Consultative Committees (FWCC)).

Why flood classifications are important?

Flood classifications are central to the Flood Warning Service for the following two reasons:

1. Flood classifications allow the expected or observed impact and severity of flooding to be clearly communicated and understood;
2. The expected or observed exceedance of flood classifications is an integral part of the warning issue criteria, the frequency of issue and the severity that is attached to the warning.

Why review them?

Flood classifications require at least an annual review to ensure they continue to reflect the expected or known flood impacts. Local development and changes to infrastructure (e.g. bridges/levees) are two common reasons why flood classifications need to be updated.

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Who should review them?

Flood classifications should be reviewed by local authorities and state government agencies (e.g. emergency services and lead water agencies) with a good knowledge and understanding of flood risk and flood behaviour, and preferably supported by information from flood studies. Potentially, other stakeholders such as the Police and agencies responsible for utilities and public infrastructure (e.g. roads and bridges) and water authorities have a responsibility to ensure acceptable appropriate flood classifications are set. The Bureau will contribute by providing relevant data and advice on flood behaviour and implications in the SLS.

What factors should be considered when reviewing flood classifications?

- Whether flood classifications currently exist and when were they last reviewed / updated?
- How the existing flood classifications were set (e.g. based on past floods, survey details, etc.)?
- Are the flood classifications in line with the expected or known flood impacts, as per the national Flood Class Level definitions?
- Has there been any development or physical changes in the area (e.g. levee construction, bridge works, etc) since the flood classifications were last reviewed / updated?
- Has there been a recent flood study completed with the full review and identification of flood risks in the vicinity of a gauge?
- Are all three flood classifications defined / required at the river height station? The range of flood impacts at some river height stations may only warrant one or two of the flood classifications to be set. For example, there may be no further flood impacts once the river overtops its banks, in which case, only a minor flood classification is required.
- Is the level of accuracy of the flood classifications appropriate in line with the prediction capability? The Bureau needs to advise if the accuracy required is commensurate with the prediction capability available for that location. It is recommended that flood classifications are generally set to the nearest 0.1m. For locations where the impacts can change significantly for a small change in level 0.05m increments could be used.
- Has the river height station been relocated, rebuilt or modified in any way since the flood classifications were last reviewed / updated? Or has the gauge zero (point above which the water level is measured) been adjusted?
- Do the flood classifications fit with current local disaster management plans?

How should flood classifications be determined?

All flood classifications are impact-based. Assess all of the available information of relevance:

- **Historic water levels and known / documented flood impacts** (e.g. inundation of properties in the 2009 flood began at a water level of approximately 3.2m at river height station X)
- **Outputs from flood studies** may assist with relating flood levels to flood impacts. However, as flood classifications are impact-based, it is not appropriate to directly associate minor, moderate or major flood levels with flood levels based on exceedance probabilities (e.g. 5% AEP) as the impacts are not directly related to likelihood.
- **Survey information** (e.g. channel cross-section information or bridge survey) may assist with identifying the river level at which flood impacts occur and subsequently reference this back to a key river height station.
- **Local knowledge** is invaluable. Knowledge and experience of flooding mechanisms and impacts is often the best way to determine flood classifications. Local knowledge is likely to be held by council staff, disaster management agencies, landowners and residents, the Bureau, state water agencies, catchment management authorities and other interested parties.

Once all the available information has been collated, compare the information on flood impacts to the formal flood classifications definitions (minor, moderate and major) to determine the appropriate level for each flood class.

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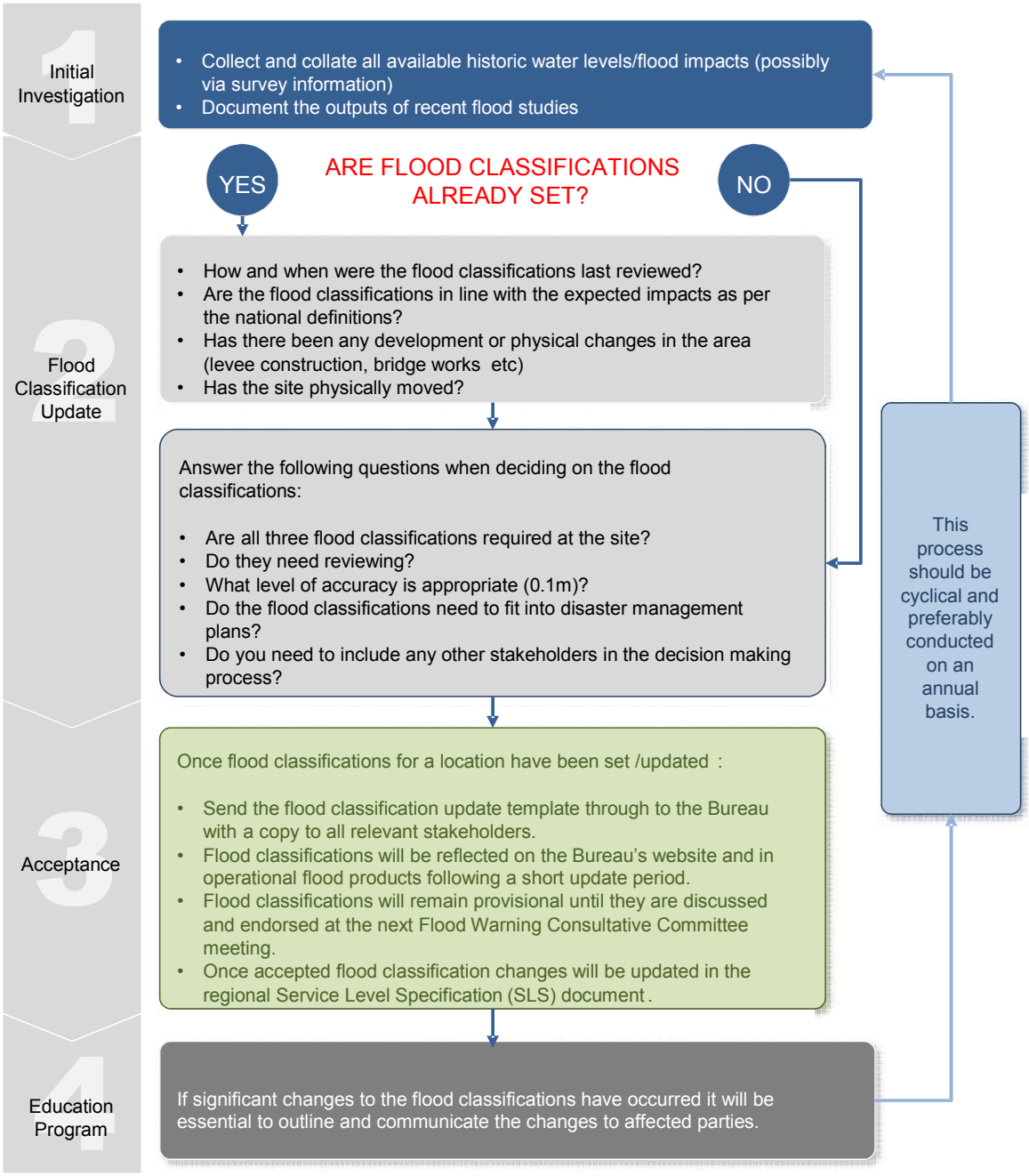
Use the following flow diagram as a guide to complete the process of updating flood classifications in your jurisdiction.



Upon completion of the review and update process (or for any other questions), email the Bureau's Flood Forecasting and Warning team in your region:

New South Wales	ffw_nsw@bom.gov.au
Northern Territory	ffw_nt@bom.gov.au
Queensland	ffw_qld@bom.gov.au
South Australia	ffw_sa@bom.gov.au
Tasmania	flood.tas@bom.gov.au
Victoria	flood.vic@bom.gov.au
Western Australia	ffw_wa@bom.gov.au

Australian Government
Bureau of Meteorology

Frequently Asked Questions (FAQ)

Can we define extra flood classifications (e.g. extreme major) in addition to minor, moderate and major?	No. Currently there are three official flood classes that are recognised and supported by the Bureau. Whilst there is nothing preventing emergency response agencies and local councils defining additional thresholds or trigger levels for their own internal use, they are not used in the warning products reaching the community.
Do flood classifications need to be defined at all river height stations?	No. The Bureau classifies river height stations as either *forecast, information* or *data* locations (see the SLS for further information). Flood classifications are required at *forecast* and *information* locations. By definition, *data* locations neither require nor have them.

Example Flood Classification Review sheet

Name of reviewer and role	*e.g. John Smith, Chief Engineer*		
Endorser	*e.g. A Person*		
Council	*e.g. Big Shire Council*		
Station name	*e.g. Long Creek TM*		
Station number	*e.g. 123456*		
Flood classifications	***Minor***	***Moderate***	***Major***
Current	*e.g. 5.0m*	*e.g. 7.0m*	*e.g. 8.0m*
New (revised)	*e.g. 4.6m*	*e.g. 6.5m*	*e.g. 7.4m*
Known / expected flood impacts at each flood classification (i.e. justification for flood classifications, including flood extent information if available)	*e.g. Water starts to affect the minor road to the north of the river and agricultural land alongside the river*	*e.g. Water begins to affect the main highway between Town A and Town B, and several houses are affected above floor level*	*e.g. Closure of the main highway required due to flood waters and multiple properties flooded internally*
Consultation	*Name organisations/persons consulted. Details of consultation. Any concerns raised?*		
BOM Review	*Reviewed by Bureau?*		*Yes/No*
	Required changes made to Bureau systems and documentation?		*Yes/No*
	Logged electronically on file?		*Yes/No*
	Notification of changes provided to council?		*Yes/No*

FOR DETAILED MAPPING OF THE 100 YEAR ARI FLOODPLAIN AND THE RECOMMENDED FLOODPLAIN MANAGEMENT STRATEGY FOR THIS AREA, REFER TO MAP 4-1

Department of Water
Government of Western Australia

AVON CATCHMENT COUNCIL

AVON RIVERCARE PROJECT

Australian Government

SURVEY FILES	DATUM	DES CALC	NORTH POINT
Too_to_Bev_digital.xls Structures.xls TDYAVON1.xls NORAVON1.xls YKAVON1.xls BEVAVON1.xls	Vert: AHD Hor: MGA Z50	RB DES CHD RB	N
	DES REF	DRN DM CH Apr 2008	
	.....	Q.C. CHD RB	

LEGEND

Floodplain

	Flood levels (m AHD)
100 year ARI	133.26
25 year ARI	131.93
10 year ARI	131.80

Cadastre
Extent of study
Surface contour (m AHD)

0 50 100 200 300 400
Metres

Map sheet index

Map 3-1

RECOMMENDED 11-06-08 M COPPOLINA ENGINEER	AVON RIVER FLOOD STUDY TOODYAY TOWNSITE 10, 25 AND 100 YEAR ARI FLOODPLAIN
APPROVED 11-06-08 R BRETNALL MANAGER, WATER RESOURCE ASSESSMENT	

ORIGINAL SHEET SIZE	FILE	PROJECT	PLAN	GIS	ISSUE	ORIGINAL SCALE
A1	WT0072	B1315	3-1		A	1:5000

FILE PATH: J:\gisprojects\Project\B_Series\B1315\0001_avon_river_fpm\mxd\HardPrint_3-1-Toodyay.mxd

FOR DETAILED MAPPING OF THE 100 YEAR ARI FLOODPLAIN AND THE RECOMMENDED FLOODPLAIN MANAGEMENT STRATEGY FOR THIS AREA, REFER TO MAP 4-2

WILKERSON RD
WEIR RD
KANE RD
HARDERS CHITTY RD
HUTCHINGS RD
FRANCIS ST
COTTAGE ST
NORTH ST
EVERETT ST
PICNIC HILL RD
FITZGERALD TCE
TOODYAY WEST RD
LEEDER ST
HOWICK ST
BARING ST
AVON TCE
JULIMAR RD
WELLINGTON ST
CLARKE ST
BEAUFORT ST
CLARKSON ST
RIVER RD
DEEPDALE RD
Avon River

West Toodyay Bridge
100yr ARI flood: overtopped
25yr ARI flood: overtopped
10yr ARI flood: not overtopped

125.92 124.85 123.64
126.43 124.97 124.05
125.79 124.41 123.48
125.68 124.33 123.42
125.53 124.20 123.31
125.56 124.22 123.33
125.24 123.98 123.13
125.02 123.89 122.95

Department of Water
Government of Western Australia
AVON CATCHMENT COUNCIL
AVON RIVERCARE PROJECT
Australian Government

SURVEY FILES	DATUM	DES CALC	NORTH POINT
Too_to_Bev_digital.xls Structures.xls TDYAVON1.xls NORAVON1.xls YKAVON1.xls BEVAVON1.xls	Vert: AHD Hor: MGA Z50	RB DES CHD RB	N
	DES REF	DRN DM CH Apr 2008	
	.....	Q.C. CHD RB	

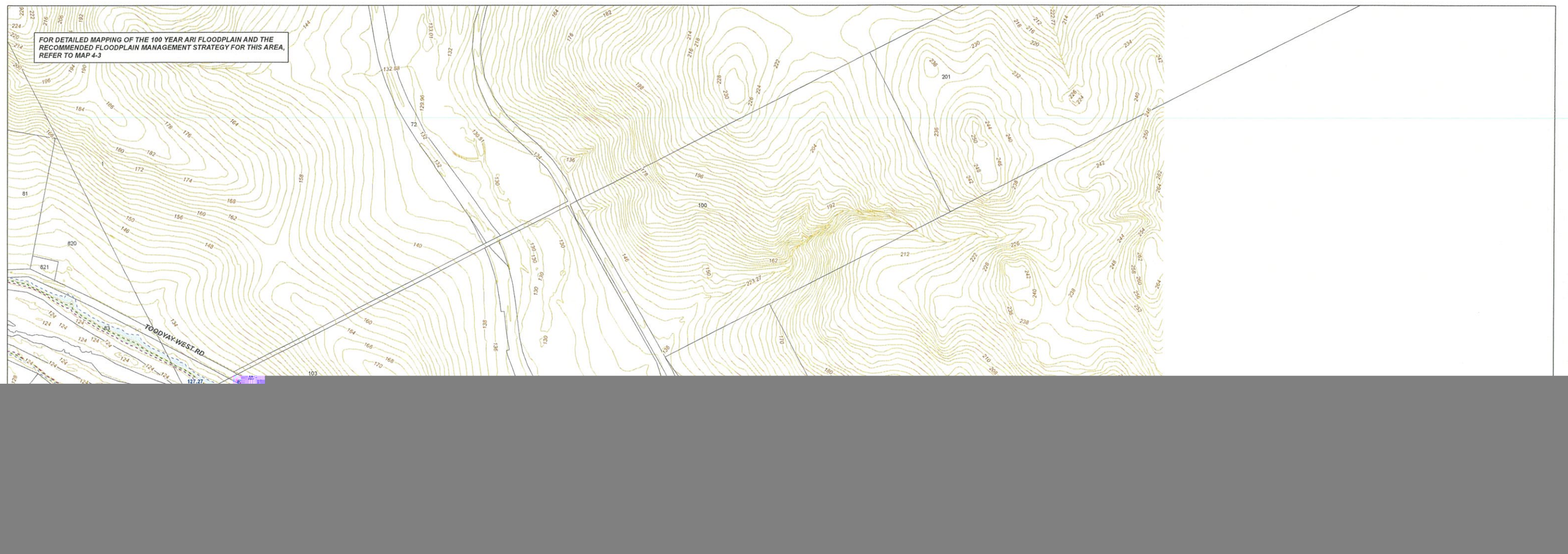
LEGEND
Floodplain
Flood levels (m AHD)
100 year ARI 133.26
25 year ARI 131.93
10 year ARI 131.80
Cadastre
Bridge
Surface contour (m AHD)
0 50 100 200 300 400
Metres

Map sheet index
Map 3-2

RECOMMENDED 11-06-08 M COPPOLINA ENGINEER	AVON RIVER FLOOD STUDY TOODYAY TOWNSITE 10, 25 AND 100 YEAR ARI FLOODPLAIN
APPROVED 11-06-08 R BRETNALL MANAGER, WATER RESOURCE ASSESSMENT	ORIGINAL SHEET SIZE A1

FILE	PROJECT	PLAN	GIS	ISSUE	ORIGINAL SCALE
WT0072	B1315	3-2		A	1:5000

FILE PATH: J:\gisprojects\Project\B_Series\B1315\0001_avon_river_fpm\mxd\HardPrint_3-2-Toodyay.mxd


FOR DETAILED MAPPING OF THE 100 YEAR ARI FLOODPLAIN AND THE RECOMMENDED FLOODPLAIN MANAGEMENT STRATEGY FOR THIS AREA, REFER TO MAP 4-3
TOODYAY-WEST-RD
127.27
223.27
81
820
821
103
72
100
201
212