



Gannawarra Flood Emergency Plan

A Sub-Plan of the Municipal Emergency
Management Plan

For the Gannawarra Shire Council
And
VicSES Unit Kerang

Version 2.0 November 2015



Table of Contents

DISTRIBUTION LIST	IV
DISTRIBUTION LIST (CONTINUED)	V
DOCUMENT TRANSMITTAL FORM / AMENDMENT CERTIFICATE.....	VI
LIST OF ABBREVIATIONS & ACRONYMS	VII
PART 1. INTRODUCTION	9
PART 2. ENDORSEMENT	10
2.1 MUNICIPALITY.....	11
2.2 PURPOSE AND SCOPE OF THIS FLOOD EMERGENCY PLAN.....	11
2.3 MUNICIPAL FLOOD PLANNING COMMITTEE (MFPC)	11
2.4 RESPONSIBILITY FOR PLANNING, REVIEW & MAINTENANCE OF THIS PLAN	12
2.5 ENDORSEMENT OF THE PLAN	12
PART 3. PREVENTION / PREPAREDNESS ARRANGEMENTS	13
3.1 COMMUNITY AWARENESS FOR ALL TYPES OF FLOODING	13
3.2 STRUCTURAL FLOOD MITIGATION MEASURES	13
3.3 NON-STRUCTURAL FLOOD MITIGATION MEASURES	13
3.3.1 <i>Exercising the Plan</i>	13
3.3.2 <i>Flood Warning</i>	13
3.3.3 <i>Local Information Officers</i>	13
PART 4. RESPONSE ARRANGEMENTS	14
4.1 INTRODUCTION	14
4.1.1 <i>Activation of Response</i>	14
4.1.2 <i>Responsibilities</i>	14
4.1.3 <i>Municipal Emergency Coordination Centre (MECC)</i>	14
4.1.4 <i>Escalation</i>	14
4.2 STRATEGIC CONTROL PRIORITIES.....	14
4.3 CONTROL, COMMAND & COORDINATION	15
4.3.1 <i>Control</i>	15
4.3.2 <i>Incident Controller (IC)</i>	15
4.3.3 <i>Incident Control Centre (ICC)</i>	15
4.3.4 <i>Divisions and Sectors</i>	16
4.3.5 <i>Incident Management Team (IMT)</i>	16
4.3.6 <i>Incident Emergency Management Team (EMT)</i>	16
4.3.7 <i>On Receipt of a Flood Watch / Severe Weather Warning</i>	17
4.3.8 <i>On Receipt of the First and Subsequent Flood Warnings</i>	17
4.4 COMMUNITY INFORMATION AND WARNINGS	18
4.5 MEDIA COMMUNICATION	18
4.6 IMPACT ASSESSMENTS	19
4.7 PRELIMINARY DEPLOYMENTS	19

4.8	RESPONSE TO FLASH FLOODING	19
4.9	EVACUATION	20
4.10	FLOOD RESCUE	20
4.11	AIRCRAFT MANAGEMENT	20
4.12	RESUPPLY	21
4.13	ESSENTIAL COMMUNITY INFRASTRUCTURE AND PROPERTY PROTECTION	21
4.14	DISRUPTION TO SERVICES	21
4.15	ROAD/RAIL CLOSURES	21
4.16	DAM FAILURE	22
4.17	WASTE WATER RELATED PUBLIC HEALTH ISSUES AND CRITICAL SEWERAGE ASSETS.....	22
4.18	AFTER ACTION REVIEW	22
PART 5.	EMERGENCY RELIEF AND RECOVERY ARRANGEMENTS.....	23
5.1	GENERAL	23
5.2	EMERGENCY RELIEF.....	23
5.3	ANIMAL WELFARE	23
5.4	RESPONSE TO RECOVERY TRANSITION.....	23
APPENDIX A - FLOOD THREATS FOR GANNAWARRA SHIRE.....		24
APPENDIX B - TYPICAL FLOOD PEAK TRAVEL TIMES		42
APPENDIX C1 – KERANG COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN		43
APPENDIX C2 – APPIN SOUTH AREA COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN.....		49
APPENDIX C3 – LOWER AVOCA AND QUAMBATOOK COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN		54
APPENDIX C4 – MURRAY RIVER COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN		63
APPENDIX C5 – EASTERN BOUNDARY OF THE MUNICIPALITY COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN		66
APPENDIX D – FLOOD EVACUATION ARRANGEMENTS		67
APPENDIX E - FLOOD WARNING SYSTEMS		72
APPENDIX F - MAPS		84
APPENDIX G - SANDBAGS		93
APPENDIX H - SANDBAGGING OF CRITICAL INFRASTRUCTURE.....		97
APPENDIX I – RESPONSE COORDINATOR AIDE MEMOIR – RESOURCE CONSIDERATIONS.....		98
APPENDIX J - LOCAL FLOOD GUIDES.....		99
APPENDIX K - REFERENCES AND INTEL SOURCES.....		109

Distribution List

**NOT
AVAILABLE
FOR PUBLIC
VIEWING**

Distribution List (continued)

**NOT
AVAILABLE
FOR PUBLIC
VIEWING**

Document Transmittal Form / Amendment Certificate

This Municipal Flood Emergency Plan (MFEP) will be amended, maintained and distributed as required by VicSES in consultation with the Gannawarra Shire Council

Suggestions for amendments to this Plan should be forwarded to the Attention of the Regional Officer Emergency Management, VicSES Regional Office 17 Rutherford Street Swan Hill (PO Box 1700 Swan Hill Victoria 3585) or via email to northwest.office@ses.vic.gov.au

Amendments listed below have been included in this Plan and promulgated to all registered copyholders.

Number	Version	Date of Amendment	Amendment Entered By	Summary of Amendment
1	1.4	28/06/13		Municipal Emergency Management Planning Committee Signed off on the MFEP
2	2.0	Oct 2015		Full review due to a large number of changes in procedures and terminology

This Plan can be viewed on the both the VicSES and Gannawarra Shire Council websites www.ses.vic.gov.au / www.gannawarra.vic.gov.au.

List of Abbreviations & Acronyms

The following abbreviations and acronyms are used in the Plan:

AEP	Annual Exceedance Probability
AHD	Australian Height Datum (the height of a location above mean sea level in metres)
AIIMS	Australasian Inter-service Incident Management System
AoCC	Area of Operations Control Centre / Command Centre
ARI	Average Recurrence Interval
ARMCANZ	Agricultural & Resource Management Council of Australia & New Zealand
AV	Ambulance Victoria
BoM	Bureau of Meteorology
CEO	Chief Executive Officer
CERA	Community Emergency Risk Assessments
CFA	Country Fire Authority
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
DHHS	Department of Health and Human Services
DTPLI	Department of Transport, Planning and Local Infrastructure (amalgamated successor body to DPCD and DOT)
EMMV	Emergency Management Manual Victoria
EMT	Emergency Management Team
EO	Executive Officer
FO	Floodway Overlay
FWS	Flood Warning System
FZ	Floodway Zone
GFEP	Gannawarra Flood Emergency Plan
IC	Incident Controller
ICC	Incident Control Centre
IMT	Incident Management Team
IMS	Incident Management System
EMLO	Emergency Management Liaison Officer
LGA	Local Government Association
LIO	Local Information Officer
LSIO	Land Subject to Inundation Overlay
MECC	Municipal Emergency Coordination Centre
MEMP	Municipal Emergency Management Plan
MEMPC	Municipal Emergency Management Planning Committee
MERC	Municipal Emergency Response Coordinator

MERO	Municipal Emergency Resource Officer
MFEP	Municipal Flood Emergency Plan
MFPC	Municipal Flood Planning Committee
MFB	Metropolitan Fire and Emergency Services Board
MRM	Municipal Recovery Manager
PMF	Probable Maximum Flood
RCC	Regional Control Centre
RERC	Regional Emergency Response Coordinator
RERCC	Regional Emergency Response Coordination Centre
RDO	Regional Duty Officer
SBO	Special Building Overlay
SCC	State Control Centre
SEWS	Standard Emergency Warning System
SHERP	State Health Emergency Response Plan
SOP	Standard Operating Procedure
VicPol	Victoria Police
VICSES	Victoria State Emergency Service

Part 1. INTRODUCTION

This Municipal Flood Emergency Plan (MFEP) has been prepared by the Gannawarra Flood Planning Committee and with the authority of the Gannawarra MEMPC pursuant to Section 20 of the Emergency Management Act 1986 (as amended).

The Gannawarra Shire Council MFPC conducted consultations with the following community/communities about the arrangements contained within this plan:

- Kerang
- Murrabit
- Benjeroop
- Quambatook
- Lake Charm
- Mystic Park
- Koondrook
- Cohuna
- Leitchville

This MFEP is a sub plan to the Gannawarra Shire Council Municipal Emergency Management Plan (MEMP), is consistent with the Emergency Management Manual Victoria (EMMV) and the Victoria Flood Management Strategy (DNRE, 1998a), and takes into account the outcomes of the Community Emergency Risk Management (CERM) process undertaken by the Municipal Emergency Management Planning Committee (MEMPC).

The Municipal Flood Emergency Plan is consistent with the Regional Flood Emergency Plan and the State Flood Emergency Plan.

This Municipal Flood Emergency Plan is a result of the cooperative efforts of the Gannawarra Municipal Flood Planning Committee (MFPC) and its member agencies.

This Plan is endorsed by the Gannawarra Shire Council MEMPC as a sub-plan to the MEMP.

Endorsement

It was agreed by the Gannawarra Municipal Flood Planning Committee this plan be presented to the Gannawarra Municipal Emergency Management Planning Committee to be endorsed as a sub-plan of the Gannawarra Municipal Emergency Management Plan, as a living public document that is reviewed annually and as required, at their meeting on 12/11/2015.

Signed:  _____ Date: 6/4/16

Cr Brian Gibson
Chair

Gannawarra Shire Council Municipal Flood Emergency Management Planning Committee

This plan is endorsed by the Gannawarra Shire Council Management Emergency Management Planning Committee (MEMPC) at their meeting on 12/11/2015.

Signed:  _____ Date: 5/4/16

Eric Braslis
Chief Executive Officer
Gannawarra Shire Council

This Plan is supported by the Regional Manager State Emergency Service Victoria North West Region as suitable for community consultation.

Signed:  _____ Date: 23 MARCH 2016

Regional Manager
North West Region
Victoria State Emergency Service

2.1 The Municipality

An outline of Gannawarra Shire Council in terms of its location, demography and other general matters is provided in the MEMP. An outline of the flood threat is provided in Appendix A of this plan.

2.2 Purpose and Scope of this Flood Emergency Plan

The purpose of this MFEP is to detail arrangements agreed for the planning, preparedness/prevention, response and recovery from flood incidents within the Gannawarra Shire Council.

As such, the scope of the Plan is to:

- Identify the Flood Risk to Gannawarra Shire;
- Support the implementation of measures to minimise the causes and impacts of flood incidents within the Gannawarra Shire;
- Detail Response and Recovery arrangements including preparedness, Incident Management, Command and Control; and
- Identify linkages with Local, Regional and State emergency and wider planning arrangements with specific emphasis on those relevant to flood.

2.3 Municipal Flood Planning Committee (MFPC)

Membership of the Gannawarra Municipal Flood Planning Committee (MFPC) will comprise of the following representatives from the following agencies and organisations:

- Gannawarra Shire Council (Chair),
- VicSES Regional Officer – Emergency Management
- VicSES Unit Controller Kerang
- Victoria Police (i.e. Municipal Emergency Response Co-ordinator - MERC),
- North Central Catchment Management Authority (NCCMA),
- Department of Health & Human Services (DHHS) as required,
- Department of Environment, Land, Water and Planning (DELWP) as required,
- Lower Murray Water (LMW),
- Goulburn Murray Water (GMW)
- Bureau of Meteorology (BOM) as required,
- Local information officers
- Other agencies, as required

2.4 Responsibility for Planning, Review & Maintenance of this Plan

This Municipal Flood Emergency Plan must be maintained in order to remain effective.

VicSES through the Flood Planning Committee has responsibility for preparing, reviewing, maintaining and distributing this plan.

The MFPC will meet at least twice per year.

The plans should be reviewed:

- Following any new flood study;
- Change in non-structural and/or structural flood mitigation measures; and/or
- After the occurrence of a significant flood event within the Municipality to review and where necessary amend arrangements and information contained in this Plan.

2.5 Endorsement of the Plan

The MFEP will be circulated to MFPC members to seeking acceptance of the draft plan.

Upon acceptance, the plan is forwarded to the MEMPC for endorsement with the recommendation to include the MFEP as a sub-plan of the MEMPlan.

Part 3. PREVENTION / PREPAREDNESS ARRANGEMENTS

3.1 Community Awareness for all Types of Flooding

Details of this MFEP will be released to the community through the distribution of Local Flood Guides, media, and the FloodSafe Program once developed, VicSES and the Gannawarra Shire Council websites upon formal adoption.

VicSES with the support of Gannawarra Shire Council and North Central CMA will coordinate community education programs for flooding within the council area. .

3.2 Structural Flood Mitigation Measures

Refer to Appendix A and C for detailed information of structural flood mitigation measures.

3.3 Non-structural Flood Mitigation Measures

3.3.1 Exercising the Plan

Arrangements for exercising this Plan will be at the discretion of the MEMPC. This Plan should be regularly exercised, preferably on an annual basis.

Refer to Section 4.7 of the EMMV for guidance.

3.3.2 Flood Warning

Arrangements for flood warning are contained within the State Flood Emergency Plan and the EMMV (Part 3.7) and on the BoM website.

Refer to Appendix E for specific details of local flood warning system arrangements.

3.3.3 Local Information Officers

Local Information Officers provide a means of gathering information in real time on flood behaviour along a stream system, and a network for the distribution of community information and warnings to the community along the stream system based on current knowledge and previous flood behaviour. Local Information Officers are also represented on the Municipal Flood Planning Committee.

Refer to Appendix E for arrangements for Local Information Officers, including responsibilities and communications methods.

Part 4. RESPONSE ARRANGEMENTS

4.1 Introduction

4.1.1 Activation of Response

Flood response arrangements may be activated by the Regional Duty Officer (RDO) VicSES North West Region or Incident Controller.

The Incident Controller/RDO VicSES will activate agencies as required and documented in the State Flood Emergency Plan.

4.1.2 Responsibilities

There are a number of agencies with specific roles that will act in support of VicSES and provide support to the community in the event of a major flood within the Gannawarra municipality. These agencies will be engaged through the Emergency Management Team (EMT) *EMMV Page 3.23 section 3.7.4.3*

The general roles and responsibilities of supporting agencies are as agreed within the Gannawarra Shire Council MEMP, EMMV (Part 7 Emergency Management Agency Roles), State Flood Emergency Plan and Regional Flood Emergency Plan.

4.1.3 Municipal Emergency Coordination Centre (MECC)

Liaison with the MECC will be through the established Division/Sector Command and through Municipal involvement in the Incident EMT, in particular the Municipal Emergency Response Coordinator (MERC). The VicSES RDO / ICC will liaise with the MECC directly if no Division/Sector Command is established.

The function, location, establishment and operation of the MECC will be as detailed in the Gannawarra Shire Council MEMP.

4.1.4 Escalation

Most flood incidents are of local concern and an appropriate response can usually be coordinated using local resources. However, when these resources are exhausted, the State's arrangements provide for further resources to be made available, firstly from neighbouring Municipalities (on a regional basis) and then on a State-wide basis.

Refer to EMMV Page 3.34 section 3.12.2 for resourcing and event escalation arrangements.

4.2 Strategic Control Priorities

To provide guidance to the Incident Management Team (IMT), the following strategic control priorities shall form the basis of incident action planning processes:

- Protection and preservation of life is paramount - this includes:
 - Safety of emergency services personnel, and;
 - Safety of community members including vulnerable community members, visitors/tourists located within the incident area.
- Issuing of community information and community warnings detailing incident information that is timely, relevant and tailored to assist community members make informed decisions about their safety;
- Protection of critical infrastructure and community assets that support community resilience;

- Protection of residential property as a place of primary residence;
- Protection of assets supporting individual livelihoods and economic production that supports individual and community financial sustainability.
- Protection of environmental and conservation assets that considers the cultural, biodiversity, and social values of the environment;
- Circumstances may arise where the Incident Controller is required to vary these priorities, with the exception being that the protection of life should remain the highest. This shall be done in consultation with the State Controller and relevant stakeholders based on sound incident predictions and risk assessments.

4.3 Control, Command & Coordination

The Control, Command and Coordination arrangements in this Municipal Flood Emergency Plan must be consistent with those detailed in State and Regional Flood Emergency Plans.

Refer to Sections 3.4, 3.5 & 3.6 of the EMMV for further information.

4.3.1 Control

Functions 5(a) and 5(c) at Part 2 of *the Victoria State Emergency Service Act 1986 (as amended)* detail the authority for VicSES to plan for and respond to flood.

Part 7.1 of the EMMV prepared under the *Emergency Management Act 1986 (as amended)*, identifies VicSES as the Control Agency for flood. It identifies DELWP as the Control Agency responsible for “*dam safety, water and sewerage asset related incidents*” and other emergencies

All flood response activities within the Gannawarra Shire including those arising from a dam failure or retarding basin / levee bank failure incident will therefore be under the control of the appointed Incident Controller or his / her delegated representative.

4.3.2 Incident Controller (IC)

An Incident Controller (IC) will be appointed by the VICSES (as the Control Agency) to command and control available resources in response to a flood event on the advice of the Bureau of Meteorology (or other reliable source) that a flood event will occur or is occurring.

Refer to EMMV Page 3-11, Section 3.5.5.6 for the Incident Controller responsibilities.

4.3.3 Incident Control Centre (ICC)

As required, the Incident Controller will establish an Incident Control Centre (ICC) from which to initiate incident response command and control functions. The decision as to if and when the ICC should be activated, rests with the Control Agency (i.e. VicSES).

Pre-determined Incident Control Centre locations;

LEVEL 3

- Bendigo – DELWP Facility – Midland Highway Epsom
- Swan Hill – CFA District 18 HQ Curlewis St Swan Hill

LEVEL 2

- Bendigo – VicSES Regional Office- Rohs Road East Bendigo
- Swan Hill- VicSES Regional Office-Rutherford Street Swan Hill

4.3.4 Divisions and Sectors

To ensure that effective Command and Control are in place, the Incident Controller may establish Divisions and Sectors depending upon the complexity of the event and resource capacities.

The following Divisions and Sectors may be established to assist with the management of flooding within the Municipality:

Division	Sector
Kerang	Kerang, Boort, Pyramid Hill, Durham Ox, Cohuna, Serpentine, Koondrook, Lake Charm, Murrabit, Benjeroop, Quambatook.
Pyramid Hill	Pyramid Hill, Durham Ox, Boort, Serpentine,

Pre-determined Division Command locations are:

- Kerang CFA Fire Station, Cnr Fitzroy and Wyndham Streets Kerang

NOTE: Although the above sectors have been specified to work under the Kerang Divisional Command this may vary or change depending on the circumstances of the flooding event and will be determined by the appointed Incident Controller.

4.3.5 Incident Management Team (IMT)

The Incident Controller will form an Incident Management Team (IMT).

Refer to EMMV Page 3-11, section 3.5.5.6 for guidance on IMTs and Incident Management Systems (IMSS).

4.3.6 Incident Emergency Management Team (EMT)

The Incident Controller will establish a multi-agency Incident Emergency Management Team (IEMT) to assist the flood response. The IEMT will consist of key personnel (with appropriate authority) from stakeholder agencies and relevant organisations who need to be informed of strategic issues related to incident control and who are able to provide high level strategic guidance and policy advice to the Incident Controller for consideration in developing incident management strategies.

Note: Gannawarra Shire Council and other organisations may be requested to provide an Emergency Management Liaison Officer (EMLO) to an ICC or IEMT as required, the capacity of the organisations needs to be considered when requesting these resources.

Refer to the EMMV Page 3-23, Section 3.7.4.3 for guidance on EMTs.

4.3.7 On Receipt of a Flood Watch / Severe Weather Warning

Incident Controller or VicSES RDO (until an incident controller is appointed) will undertake actions as defined within the flood intelligence cards (Appendix C). General considerations by the Incident Controller/VicSES RDO will be as follows:

- Review flood intelligence to assess likely flood consequences
- Monitor weather and flood information – www.bom.gov.au
- Assess Control and Command requirements.
- Review local resources and consider needs for further resources regarding personnel, property protection, flood rescue and air support
- Notify and brief appropriate officers. This includes Regional Control Centre (RCC) (if established), State Control Centre (SCC) (if established), Council, other emergency services through the EMT.
- Assess ICC readiness (including staffing of IMT and EMT) and open if required
- Ensure flood bulletins and community information are prepared and issued to the community
- Monitor watercourses and undertake reconnaissance of low-lying areas
- Develop media and community information management strategy
- Ensure that contact is made to Local Information Officers to allow for two way communications and to notify Community Observers of conditions and warnings
- Ensure flood mitigation works are being checked by owners (once ownership has been established)
- Develop and issue incident action plan, if required
- Develop and issue situation report, if required

4.3.8 On Receipt of the First and Subsequent Flood Warnings

Incident Controller/VicSES RDO (until an incident controller is appointed) will undertake actions as defined within the flood intelligence cards (Appendix C). On receipt of flood warnings, general considerations by the Incident Controller/VicSES RDO will be as follows:

- Develop an appreciation of current flood levels and predicted levels. Are floodwaters, rising, peaking or falling?
 - Review flood intelligence to assess likely flood consequences. Consider:-
 - What areas may be at risk of inundation
 - What areas may be at risk of isolation
 - What areas may be at risk of indirect affects as a consequence of power, gas, water, telephone, sewerage, health, transport or emergency service infrastructure interruption
 - The characteristics of the populations at risk
 - Determine what the at-risk community need to know and do as the flood develops.
 - Warn the at-risk community including ensuring that an appropriate warning and community information strategy is implemented including details of:
 - The current flood situation
 - Flood predictions
 - What the consequences of predicted levels may be
 - Public safety advice

- Who to contact for further information
- Who to contact for emergency assistance
- Liaise with relevant asset owners as appropriate (i.e. water and power utilities)
- Implement response strategies as required based upon flood consequence assessment.
- Continue to monitor the flood situation – www.bom.gov.au/vic/flood/
- Continue to conduct reconnaissance of low-lying areas

4.4 Community Information and Warnings

Guidelines for the distribution of community information and warnings are contained in the State Flood Emergency Plan.

Community information and warnings communication methods available include:

- | | |
|--|---|
| ▪ Emergency Alert; | ▪ Phone messages (including SMS); |
| ▪ Radio and television; | ▪ Two-way radio; |
| ▪ Mobile and fixed public address systems; | ▪ Sirens; |
| ▪ Verbal messages (i.e. doorknocking); | ▪ Agency websites; |
| ▪ VicSES Flood Storm Information Line; | ▪ Variable message signs (i.e. road signs); |
| ▪ Community meetings; | ▪ Newspapers; |
| ▪ Email; | ▪ Telephone trees; |
| ▪ Local Information Officers | ▪ Community Observers; |
| ▪ Fax stream; | ▪ Newsletters; |
| ▪ Letter drops; | ▪ Social media and/or social networking sites (i.e. twitter and/or facebook). |

Refer to Appendix E for the specific details of how community information and warnings are to be provided.

The release of flood bulletins and information with regard to response activities at the time of a flood event is the responsibility of VicSES, as the Control Agency.

Council has the responsibility to assist VicSES to warn individuals within the community including activation of flood warning systems, where they exist. Responsibility for public information, including media briefings, rest with VicSES as the Control Agency.

Other agencies such as CFA, DELWP and VicPOL may be requested to assist VicSES with the communication of community flood warnings.

In cases where severe flash flooding is predicted, dam failure is likely or flooding necessitating evacuation of communities is predicted, the Incident Controller may consider the use of the Emergency Alert System and Standard Emergency Warning System (SEWS).

DHHS will coordinate information regarding public health and safety precautions.

4.5 Media Communication

The Incident Controller through the Information Unit established at the ICC will manage media communication. If the ICC is not established the RDO will manage all media communication.

4.6 Impact Assessments

There are three types of emergency impact assessments, each undertaken at a different stage – Initial, Secondary and Post emergency.

The Initial impact assessment sources information for the provision of early relief and recovery, whereas Secondary and Post assessments inform recovery and prevention activities.

Initial Impact Assessment

The intent of the Initial Impact Assessment process is to capture during the initial 48 hours of an emergency, the nature and scale of the impact on; people, community, infrastructure, economic, natural and built environments. The **Control Agency** has the overall responsibility for the instigation and management of the Initial Impact Assessment process.

Secondary Impact Assessment

This builds on the observational information gathered through the Initial Impact Assessment and provides an additional layer of analysis and evaluation. It is more detailed and the information supports understanding of the type and level of assistance needed by affected communities. Responsibility for the management of Secondary Impact Assessment rests with the **Recovery Coordinator**.

Post Impact (Loss) Assessment

This builds on the Initial and Secondary Impact Assessments and aims to estimate the cost of destroyed assets, the changes in the “flows” of an affected economy caused by the destruction of assets, and any changes in the performance of an affected economy. This process informs the medium to longer- term recovery process, and guides planning that focus on building structures and designing environments that enhance community resilience and assists in mitigating the impact of future emergencies. Accountability for the Post Impact assessment rests with the **State Recovery Coordinator**.

Refer to the EMMV Page 3-15 Section 3.5.9, and Appendix 10 page 8-50 for Initial impact Assessment Guidelines.

4.7 Preliminary Deployments

When flooding is expected to be severe enough to cut access to towns, suburbs and/or communities the Incident Controller will consult with relevant agencies to ensure that resources are in place if required to provide emergency response. These resources might include emergency service personnel, food items and non-food items such as medical supplies, shelter, assembly areas, relief centres etc.

4.8 Response to Flash Flooding

Emergency management response to flash flooding should be consistent with the guideline for the emergency management of flash flooding contained within the State Flood Emergency Plan.

When conducting pre-event planning for flash floods the following steps should be followed, and in the order as given:

1. Determine if there are barriers to evacuation by considering warning time, safe routes, resources available and etc.;
2. If evacuation is possible, then evacuation should be the adopted strategy and it must be supported by a public information capability and a rescue contingency plan;
3. Where it is likely people will become trapped by floodwaters due to limited evacuation options safety advice needs to be provided to people at risk advising them not to attempt to flee by entering floodwater if they become trapped, that it may be safer to seek the highest point within the building and to telephone 000 if they require rescue. This advice needs to be provided even when evacuation may be possible, due the likelihood that not all community members will evacuate.
4. For buildings known to be structurally un-suitable an earlier evacuation trigger will need to be established (return to step 1 of this cycle).

5. If an earlier evacuation is not possible then specific preparations must be made to rescue occupants trapped in structurally unsuitable buildings either pre-emptively or as those people call for help.

During a flash flood it will often be difficult, due the rapid development of flooding, to establish evacuation (relief) centres ahead of actually triggering the evacuation as is normal practice but this is insufficient justification for not adopting evacuation.

4.9 Evacuation

The decision to recommend or warn people to prepare to evacuate or to evacuate immediately rests with the Incident Controller.

Once the decision is made VicPol are responsible for the management of the evacuation process. Where possible and practical VicSES and other agencies will assist VicSES is responsible for the development and communication of evacuation warnings.

VicPol and/or Australian Red Cross may take on the responsibility of registering people affected by a flood emergency including those who have been evacuated.

Refer to the EMMV Part 8, Page 3.31 Appendix 9 and the Evacuation Guidelines for guidance of evacuations for flood emergencies.

Refer to Appendix D of this Plan for detailed evacuation arrangements for Gannawarra.

4.10 Flood Rescue

Victoria Police are the responsible agency for rescue from land or water within Victoria.

VicSES may conduct flood rescues. Appropriately trained and equipped VicSES units or other agencies that have appropriate training, equipment and support may carry out rescues.

Rescue operations may be undertaken where voluntary evacuation is not possible, has failed or is considered too dangerous for an at-risk person or community. An assessment of available flood rescue resources (if not already done prior to the event) should be undertaken prior to the commencement of Rescue operations.

Rescue is considered a high-risk strategy to both rescuers and persons requiring rescue and should not be regarded as a preferred emergency management strategy. Rescuers should always undertake a dynamic risk assessment before attempting to undertake a flood rescue.

NOTE: There are no specialised Swift Water Rescue resources within the Gannawarra municipality Should these resources be required they will need to be accessed through the ICC/VicSES Regional Duty Officer.

4.11 Aircraft Management

Aircraft can be used for a variety of purposes during flood operations including evacuation, resupply, reconnaissance, intelligence gathering and emergency travel.

Air support operations will be conducted under the control of the Incident Controller.

The Incident Controller may request aircraft support through the State Air Desk located at the State Control Centre will establish priorities.

Suitable airbase facilities are located at:

- Kerang Aerodrome, Airport Rd Kerang.
- Cohuna Airstrip, Chuggs Road Cohuna
- Kerang Hospital Heliport

4.12 Resupply

Communities, neighbourhoods or households can become isolated during floods as a consequence of road closures or damage to roads, bridges and causeways. Under such circumstances, the need may arise to resupply isolated communities/properties with essential items.

When predictions/intelligence indicates that communities, neighbourhoods and/or households may become isolated, VicSES will advise businesses and/or households that they should stock up on essential items.

After the impact, VicSES can support isolated communities through assisting with the transport of essential items to isolated communities and assisting with logistics functions.

Resupply operations are to be included as part of the emergency relief arrangements with VicSES working with the relief agencies to service communities that are isolated.

4.13 Essential Community Infrastructure and Property Protection

Essential community infrastructure and property (e.g. residences, businesses, roads, etc...) may be affected in the event of a flood.

Note: The Gannawarra Shire Council maintains a small stock of sandbags, and back-up supplies are available through the VicSES Regional Headquarters. These resources will be distributed to the affected community in accordance with the VicSES Sandbag Guidelines (see Appendix G). The Incident Controller will determine the priorities related the use of sandbags, which will be consistent with the strategic priorities.

If VicSES sandbags are limited in supply, then priority will be given to protection of essential community infrastructure. Other high priorities may include for example the protection of historical buildings.

Property may be protected by:

- Sandbagging to minimise entry of water into buildings/assets
- Encouraging businesses and households to lift or move contents
- Construction of temporary levees in consultation with the NCCMA, LGA and VicPOL and VicSES in accordance with appropriate approval frameworks and the VicSES Local Knowledge Policy.

The Incident Controller will ensure that owners of essential community infrastructure are kept advised of the flood situation. Essential community infrastructure providers must keep the Incident Controller informed of their status and ongoing ability to provide services.

Refer to Appendix H for further specific details of essential community infrastructure requiring protection.

4.14 Disruption to Services

Disruption to services other than essential community infrastructure and property can occur in flood events.

Refer to Appendix C for specific details of likely disruption to services and proposed arrangements to respond to service disruptions in the Gannawarra municipality.

4.15 Road/Rail Closures

Gannawarra Shire Council and VicRoads will carry out their formal functions of road closures including observation and placement of warning signs, road blocks etc. to its designated local and regional roads, bridges, walking and bike trails. Gannawarra Shire Council staff may also liaise with and advise VicRoads as to the need or advisability of erecting warning signs and/or of closing roads and bridges under its jurisdiction. VicRoads are responsible for designated main roads and highways and Councils are responsible for the designated local and regional road network.

VicRoads and Gannawarra Shire Council will communicate community information regarding road closures.

Refer to Appendix A for roads under the responsibility of VicRoads and Gannawarra Shire Council.

Gannawarra Shire Council will liaise with VicTrack in relation to rail closures.

4.16 Dam Failure

DELWP is the Control Agency for dam safety incidents (e.g. breach, failure or potential breach / failure of a dam), however VicSES is the Control Agency for any flooding that may result.

There are no major dams located in the Gannawarra municipality. There is a large lake system within the municipality but most of these do not have significant banks or structures that would be affected by a flooding event. The structures and regulators such as Kow Swamp Box Creek outlet, on the lakes and waterways are the responsibility of Goulburn Murray Water.

4.17 Waste Water related Public Health Issues and Critical Sewerage Assets

Inundation of critical sewerage assets including septic tanks and sewerage pump stations may result in water quality problems within the municipality. Where this is likely to occur or has occurred the responsible agency for the critical sewerage asset should undertake the following:

- Advise VicSES of the security of critical sewerage assets to assist preparedness and response activities in the event of flood;
- Maintain or improve the security of critical sewerage assets;
- Check and correct where possible the operation of critical sewerage assets in times of flood;
- Advise the ICC in the event of inundation of critical sewerage assets.

It is the responsibility of the Gannawarra Shire Council Environmental Health Officer to arrange an inspection, and to report to the MERO and the ICC on any water quality issues relating to flooding.

4.18 After Action Review

VicSES will coordinate the after action review arrangements of flood operations as soon as practical following an event.

All agencies involved in the flood incident should be represented at the after action review.

Part 5. EMERGENCY RELIEF AND RECOVERY ARRANGEMENTS

5.1 General

Arrangements for recovery from a flood incident within the Gannawarra municipality is detailed in Part 7 of the Gannawarra Shire Council MEMPlan.

5.2 Emergency Relief

The decision to recommend the opening of an emergency relief centre rests with the Incident Controller. Incident Controllers are responsible for ensuring that relief arrangements have been considered and implemented where required under the State Emergency Relief and Recovery Plan (Part 4 of the EMMV).

The range and type of emergency relief services to be provided in response to a flood event will be dependent upon the size, impact, and scale of the flood. Refer to 4.4 of the EMMV for details of the range of emergency relief services that may be provided.

Refer to the Gannawarra MEMPlan for details of the relief arrangements.

5.3 Animal Welfare

Matters relating to the welfare of livestock, companion animals and wildlife (including feeding and rescue) are to be referred to DELWP.

Requests for emergency supply and/or delivery of fodder to stranded livestock or for livestock rescue are to be passed to DELWP.

Matters relating to the welfare of wildlife are to be referred to DELWP.

Refer to Appendix D for animal shelter compound locations.

5.4 Response to Recovery Transition

VicSES as the Control Agency is responsible for ensuring effective response to recovery transition. This transition will be conducted in accordance with existing arrangements as detailed in the EMMV Part 3 Page 3-36, Section 3.13.

APPENDIX A - Flood Threats for Gannawarra Shire

1. General

The Gannawarra municipality is located at the southern end of the Murray Darling Basin on the alluvial floodplains of three major rivers; the Murray, Loddon and Avoca. The Murray forms the north and part of the eastern boundary of the municipality while the Avoca and Loddon flow into the Murray near the northwest corner. The floodplains of the Avoca and Loddon are wide and complex with numerous tributaries, effluent streams, storages and levees. Superimposed on this is the Torrumbarry Irrigation System which comprises numerous channels, off-takes, flow control structures and salinity mitigation works.

The main watercourses and water bodies include the:

- ◆ Lower Loddon River;
- ◆ Lower Avoca River
- ◆ Little Murray River (short section only);
- ◆ Murray River;
- ◆ Pyramid Creek;
- ◆ Barr Creek;
- ◆ Bannacher Creek;
- ◆ Wandella Creek;
- ◆ Calivil, Nine Mile & Bullock Creeks;
- ◆ Sheepwash Creek and the Kerang Lakes;
- ◆ Lalbert Creek, Mosquito Creek and Back Creek;
- ◆ Kow Swamp; and
- ◆ Many irrigation and drainage channels.

2. Riverine Flooding

Riverine flooding is generated from rainfall outside the Municipality in the catchment areas of the Murray River and its north central Victorian tributaries and in the Avoca and Loddon catchments.

Large severe floods within the Municipality generally result from a moist warm airflow from northern Australia bringing moderate to heavy rainfall over a period of 12 hours or more following a prolonged period of general rainfall and / or a series of smaller floods. The rainfall and earlier floods “wet up” the catchments and (partially) fill both the on-stream dams and the natural floodplain storage. These combine to increase the runoff generated during the subsequent period of heavy rainfall.

Large but less severe floods result from sequences of cold fronts during winter and spring that progressively wet up the catchments and fill the on-stream dams and the natural floodplain storage. Prolonged moderate to heavy rain leads to major flooding.

A significant majority of large floods have occurred in the winter / spring period. However, large floods can also occur in the summer as evidenced in December 1933 and January 2011.

Water level rises through the Municipality usually occur sometime after the rain that caused the flooding has passed. Typically, initial rises occur 3 or more days after rain with the peak following a few days later. Rises in the Murray River tend to be more delayed and are driven by flows from the Campaspe and Goulburn Rivers.

Severe floods generally overtop many of the rural levees. Flood waters remain for extended periods. For example, parts of the lower Loddon floodplain remained flooded for several months following the January 2011 event.

3. Flash Flooding and Overland Flows

Short duration, high intensity rainfall (usually associated with thunderstorms) can also cause localised flooding within the urbanised areas, some rural areas of the Municipality and along overland flow paths when the local urban drainage system surcharges. Such events, which are mainly confined to the summer months, do not generally create widespread flooding since they only last for a short time and affect limited areas. Flooding from these storms occurs with little warning and localised damage can be severe.

High intensity rainfall, such as associated with thunderstorms giving average rainfall rates of typically more than 20 mm/hour for an hour or more is likely to lead to flash flooding and / or overland flows, particularly in the more urbanised parts of the Municipality.

Blocked or capacity impaired stormwater drains can also lead to overland flows and associated flooding: the drain surcharges and excess water flows above ground. The likely location of such flooding is hard to predict other than in cases where a drain has a past history of surcharging. Council maintenance records may provide some guidance in such cases.

4. Overview of Flooding

The town's most at risk of flooding within the Municipality are generally protected by rural levees and include Benjeroop, Murrabit, Cohuna, Koondrook, Leitchville and Quambatook. Kerang is also at risk but is protected by a township protection levee to 1% AEP (1 in 100 years ARI) flood standard. (See plan in Appendix F)

Large areas of rural land on either side of the Loddon River downstream from Laanecoorie Reservoir and particularly downstream from Kerang through Benjeroop to the Little Murray River and Pental Island are subject to flooding. Similarly, along the lower Avoca River and through the Avoca Marshes.

From a flooding perspective, the Loddon River dominates. Floodplain gradients are low, the drainage patterns are complex and water courses are poorly defined. Flood waters move slowly, are generally relatively shallow and extensive (i.e. widespread) with the main flow distributed between interconnected depressions. The peak flows at Laanecoorie Reservoir can be used as a guide to determine the potential impacts downstream of Serpentine, however caution must be applied as the relationship is not strong. Antecedent conditions as discussed below impact the timing, volume and peak flood level.

Flooding characteristics across the lower Avoca floodplain are similar.

Because of the very large storage capacity and effluent distribution characteristics within the Loddon floodplain, the impact of a flood must be considered both in terms of flood peak and flood volume. Flooding will be caused by large flood volumes occurring as one large single flood or a succession of moderate floods. The significance of a given flood is complicated by antecedent conditions (how wet the catchment is) and the density of crops and pasture on the floodplain and the level of vegetation and debris in the drainage levies prior to the flood¹. These factors are also a significant consideration for the Lower Avoca River floodplain.

Note that a large Murray flood upstream from Barmah is not indicative of future Murray flooding within the Shire.

This is because the Barmah Choke restricts Murray River flows past Barmah to around 35,000 ML/d with the balance being forced northwards into NSW along the Edwards River. Flooding through Torrumbarry Weir and downstream to Swan Hill is therefore very much dependent on the magnitude of flows coming from the Goulburn River and Campaspe Rivers and, to a much lesser extent, from the Broken Creek. On the Victorian side, the Murray River is confined by levees and G-MW irrigation supply channels. The levees are not formally maintained and have the potential to either breach or overtop during a large flood. Most of the levees are low as they are located on relatively high ground close to the Murray River. Further, downstream from Torrumbarry Weir, the myriad of effluent streams, swamps and

¹ This is demonstrated by the 1973, 1974 and 1975 floods which all had major impacts downstream from Kerang but which were not particularly large at Laanecoorie.

waterways on the New South Wales side of the river, provide a natural relief valve for high flows. Much of this water re-joins the Murray via the Edwards and Wakool River systems 120 or so river kilometres downstream from Swan Hill.

Refer to Appendix C for a history of notable flood events within the Municipality.

Drainage Hot Spots within the Shire – areas that have a high risk of flooding during heavy rain events

Map references are Spacial Visions Map Book North West Region (3rd edition)

Town & Street Name	Map Reference	Catchment
Corner Mitchell Street and Boundary Street	8424 E 10	KERANG
Corner Murray Street and Wyndham Street	8424 D 7	KERANG
Corner East Street and Murrabit Road	8424 E 4	KERANG
Corner Victoria Street and Ninth Street	8424 F 4	KERANG
Corner Cleeland Place and Ninth Street	8424 D 4	KERANG
Corner Lilac Avenue and Taverner Court	8424 F 5	KERANG
Mokana Street End	8424 F 9	KERANG
McCann Crescent	8424 G 5	KERANG
Forest Street	8245 F 10	KOONDROOK

Refer to Appendix F for a plan of the drainage hot spots listed above.

5. Overview of Catchments and Flood Behaviours

The **Loddon River** rises upstream of Laanecoorie Reservoir on the northern slopes of the Great Dividing Range, enters the municipality upstream of Appin South and joins the Murray River via the Little Murray River at the eastern end of Pental Island near Swan Hill. Around Serpentine, the Loddon floodplain widens and flattens to become a complex leveed and braided system of effluent watercourses. These watercourses include **Serpentine Creek**, **Bannacher Creek**, **Twelve Mile Creek** and **Nine Mile Creek** on the east side and **Kinypanial Creek**, **Venables / Johnsons Creek** and **Wandella Creek** on the west side. Downstream from (to the north of) Kerang, are the Kerang Lakes and the lower reaches of Barr Creek.

Effluent flows/watercourses are waterways that carry water that break away from the main river. Effluent flows to the western side of the Loddon generally do not return to the river and experience considerable attenuation in the natural lake systems of Boort, Lyndger, Yando, Leaghur and Meran and the adjacent State Forests. In contrast, the eastern effluent flows are into relatively steeper slopes (because they have been modified and deepened to provide drainage to the surrounding land) and enter an extensive and interconnected drainage system made up of Serpentine Creek, Bannacher Creek, Nine Mile Creek and other effluent watercourses that either drain directly back into the Loddon River or into Pyramid Creek.

Wandella Creek is the eventual recipient of all western effluent overflows and flows through to the Kerang Lakes.

Effluent flows along the Loddon River commence around 10km upstream of Serpentine and result in a peak flow reduction of at least 20%. This reduction increases downstream to Kerang although the effect is substantially reduced if a second flood arrives while the floodplain is still “wet” from the first flood, as occurred in August 1981 and in January 2011.

Note that flood flows that enter the Kerang Weir pool pass uncontrolled into the Loddon River and the Sheepwash Creek over low fixed crest weirs. Only flows into the Washpen Creek can be regulated at Washpen Creek.

The **Pyramid Creek / Bendigo Creek² / Bullock Creek** system drains the extensive eastern part of the Loddon basin. Bullock Creek, Bendigo Creek and tributary Myers Creek rise in the hills around Bendigo. The Bendigo Creek (*Mt Hope Creek*) enters Kow Swamp to the South at Normans Bridge before passing via the Box Creek Regulator to Box Creek. The Box Creek becomes the Pyramid Creek at the junction of Bullock and Box Creek immediately upstream of Flannery's Flume on the No2 channel and joins below Kow Swamp to become Pyramid Creek which enters the Loddon River just below (to the north of) Kerang.

Pyramid Creek has been remodelled to act as a water supply carrier and its capacity has been considerably enlarged. This enlargement together with the levees along much of its length (up to about the 5% AEP (1 in 20 year ARI) flood except near the confluences with Bullock and Calivil Creeks) has reduced the risk of breakaway flows into most of the natural overflow paths to the north and south. Breakaways to the south run into **Piccaninny Creek** which returns to Pyramid Creek while breakaways to the north enter **Barr Creek**. Pyramid Creek overflowed to the north during the 1973 and 1974 floods near the Calivil Drain depression, opposite the Nine Mile Creek confluence. The creek also overflowed in the January 2011 flood.

² *From just north of Dingee to Kow Swamp, Bendigo Creek is also been known as both Mt Hope Creek and Piccaninny Creek.*

Figure A1 – Loddon River Lower Catchment

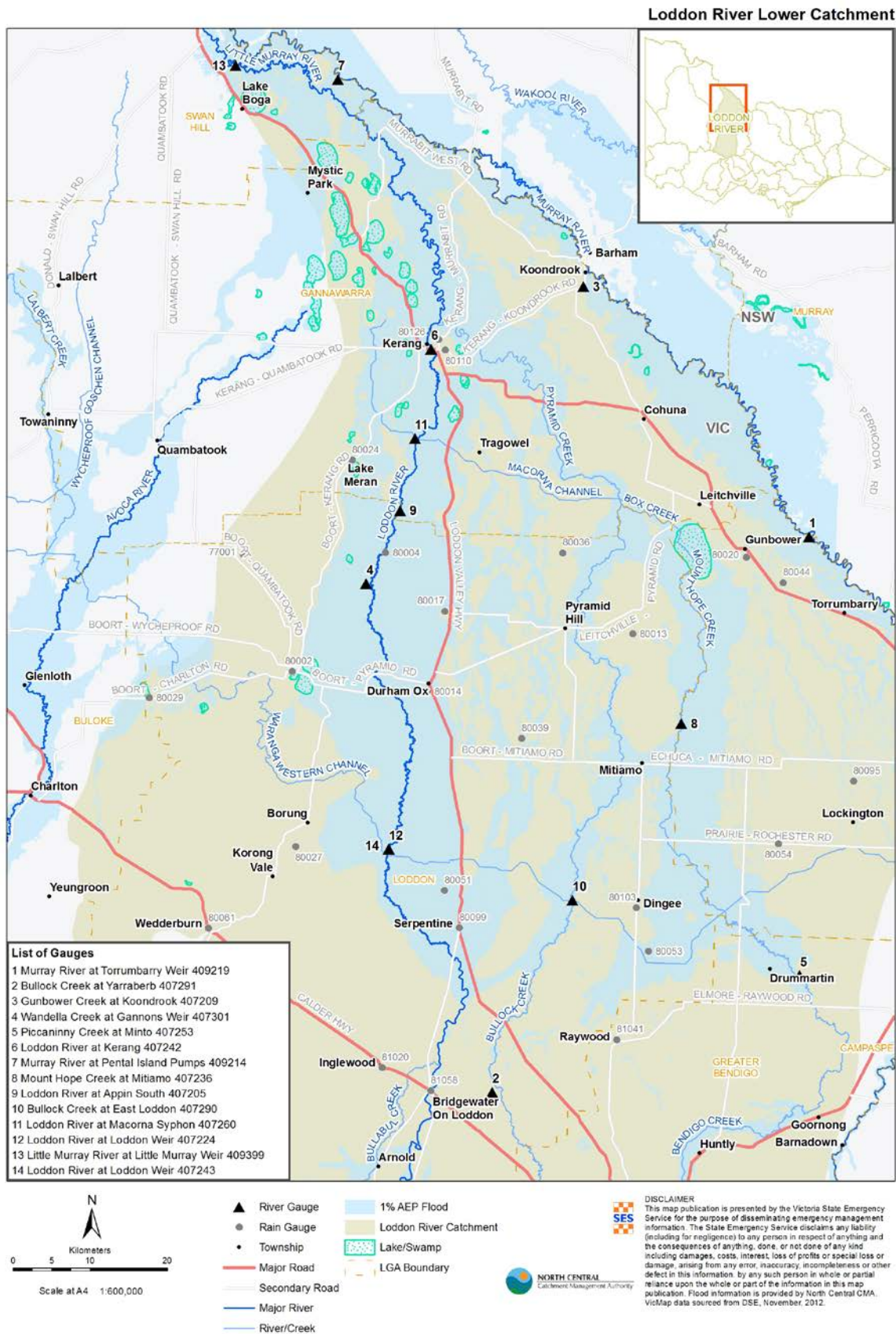


Figure A2 – Avoca River Basin

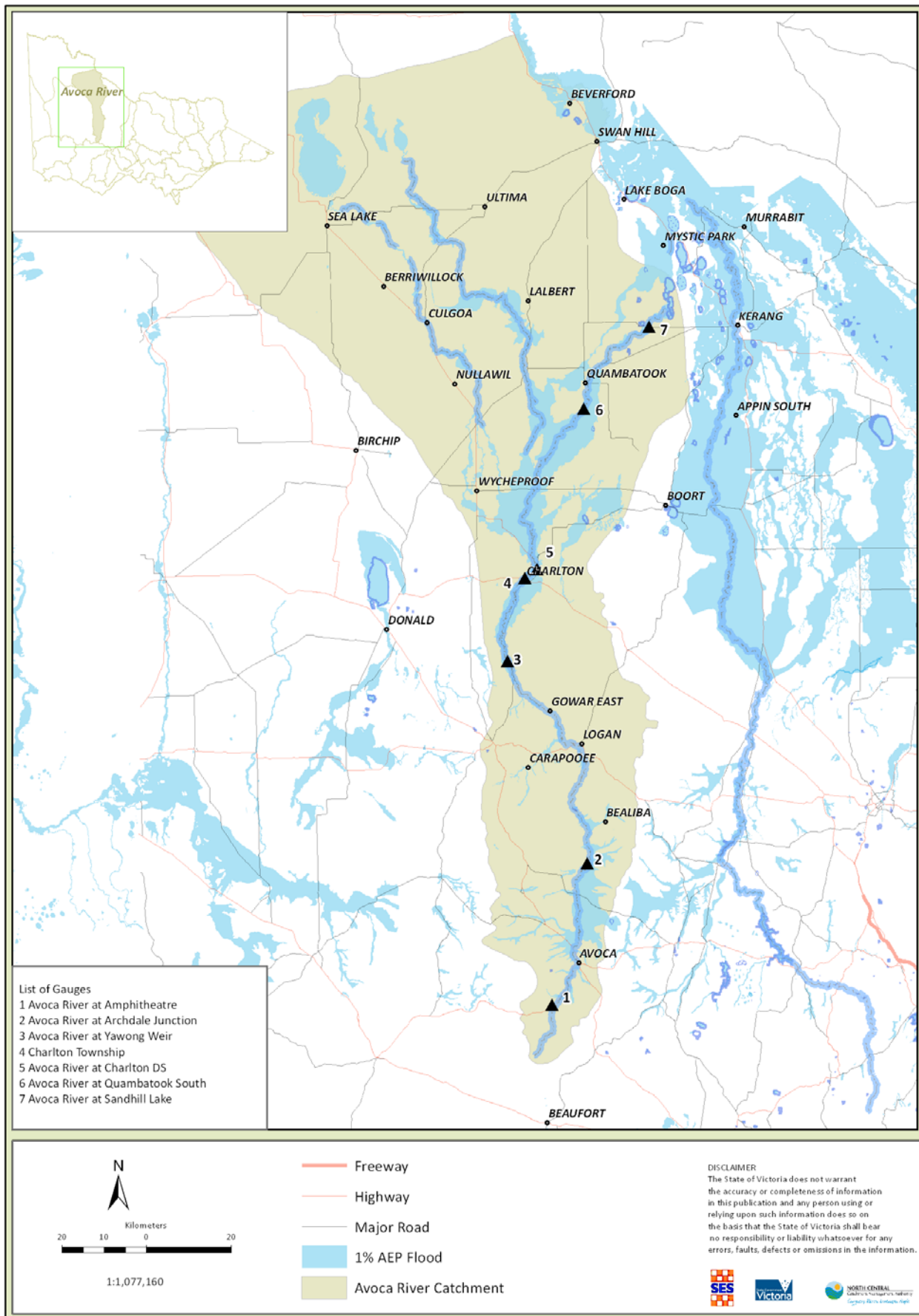


Figure A3 – Pyramid Creek Catchment

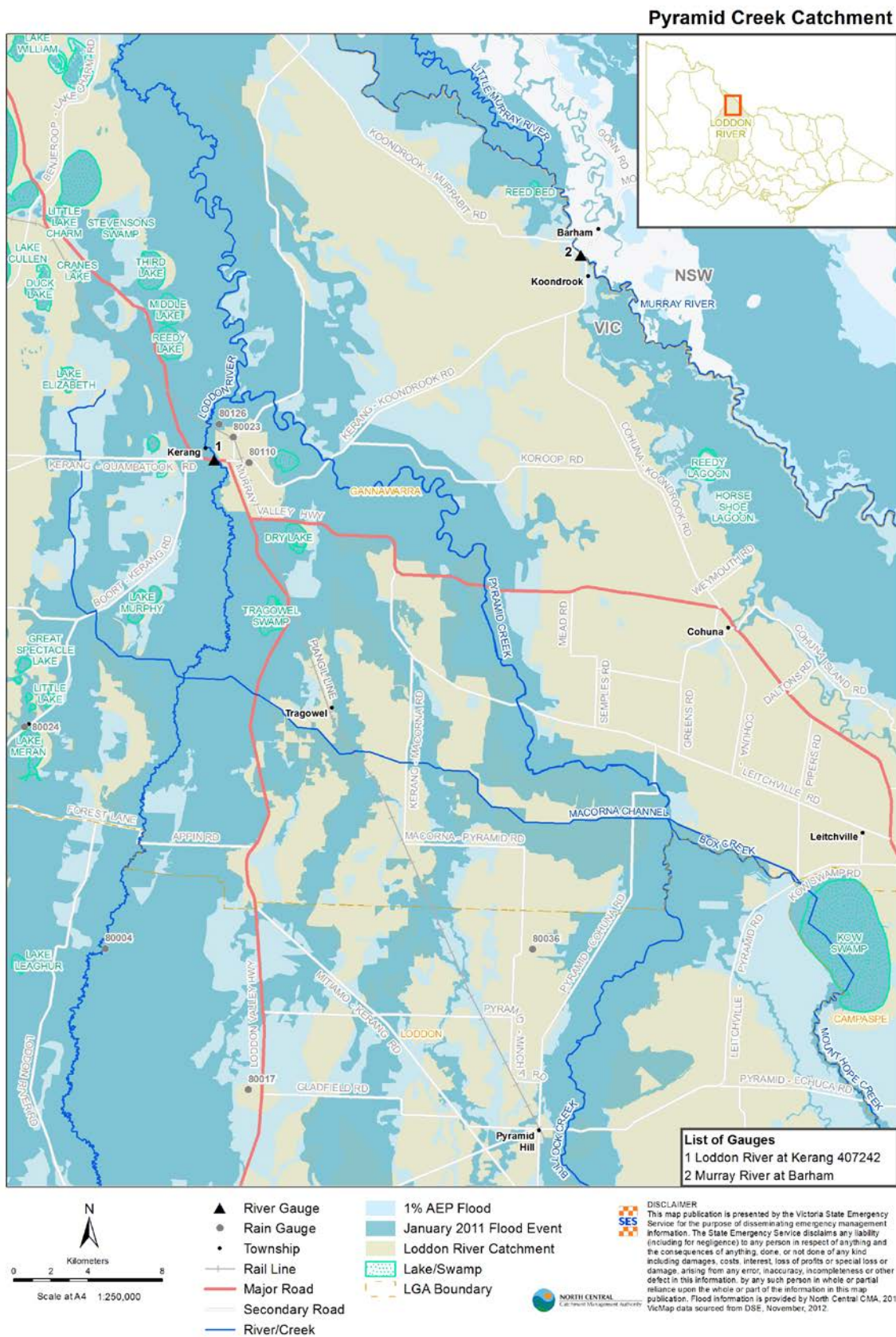


Figure A4 – Kerang Lakes

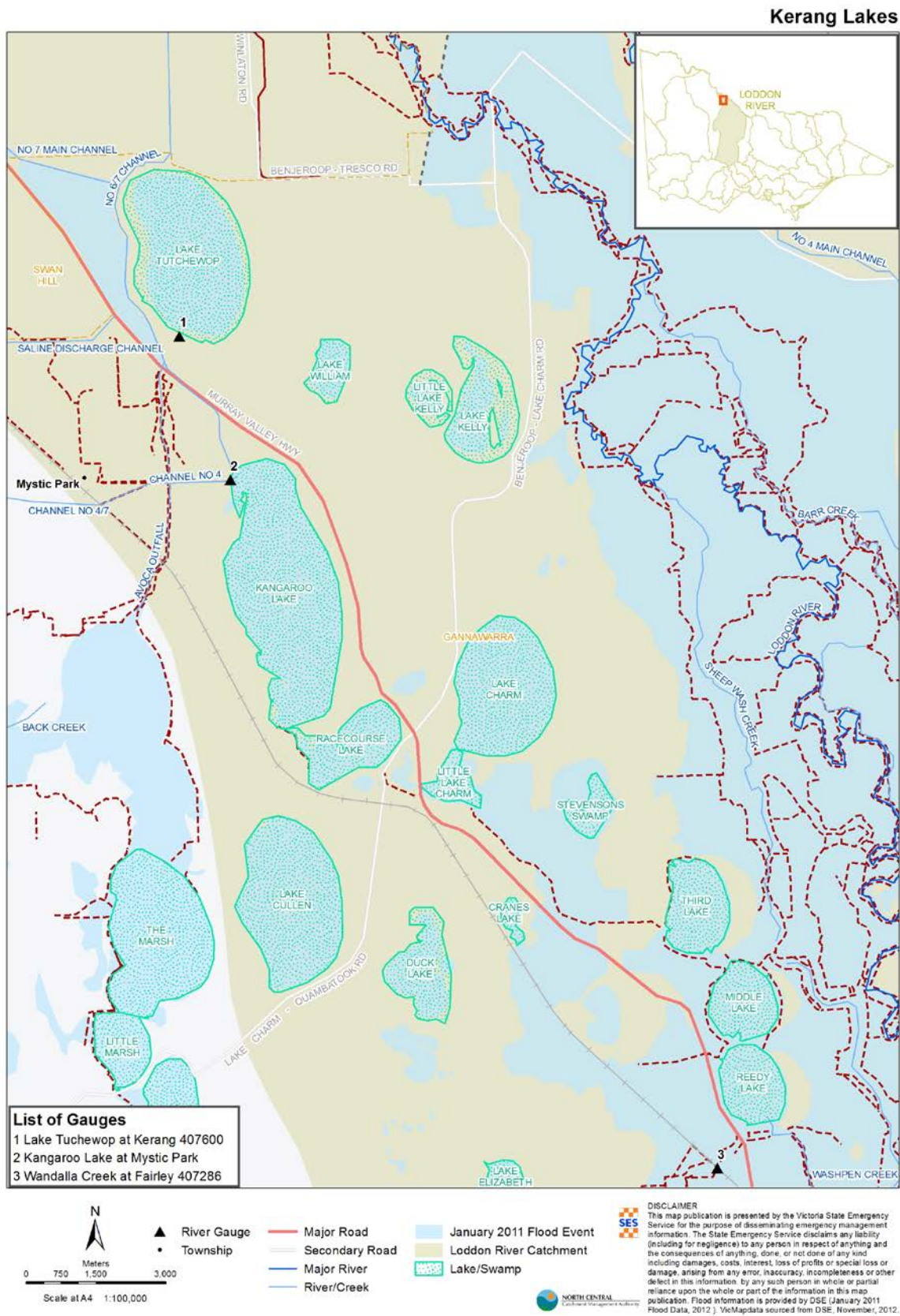


Figure A5 – Loddon River Catchment

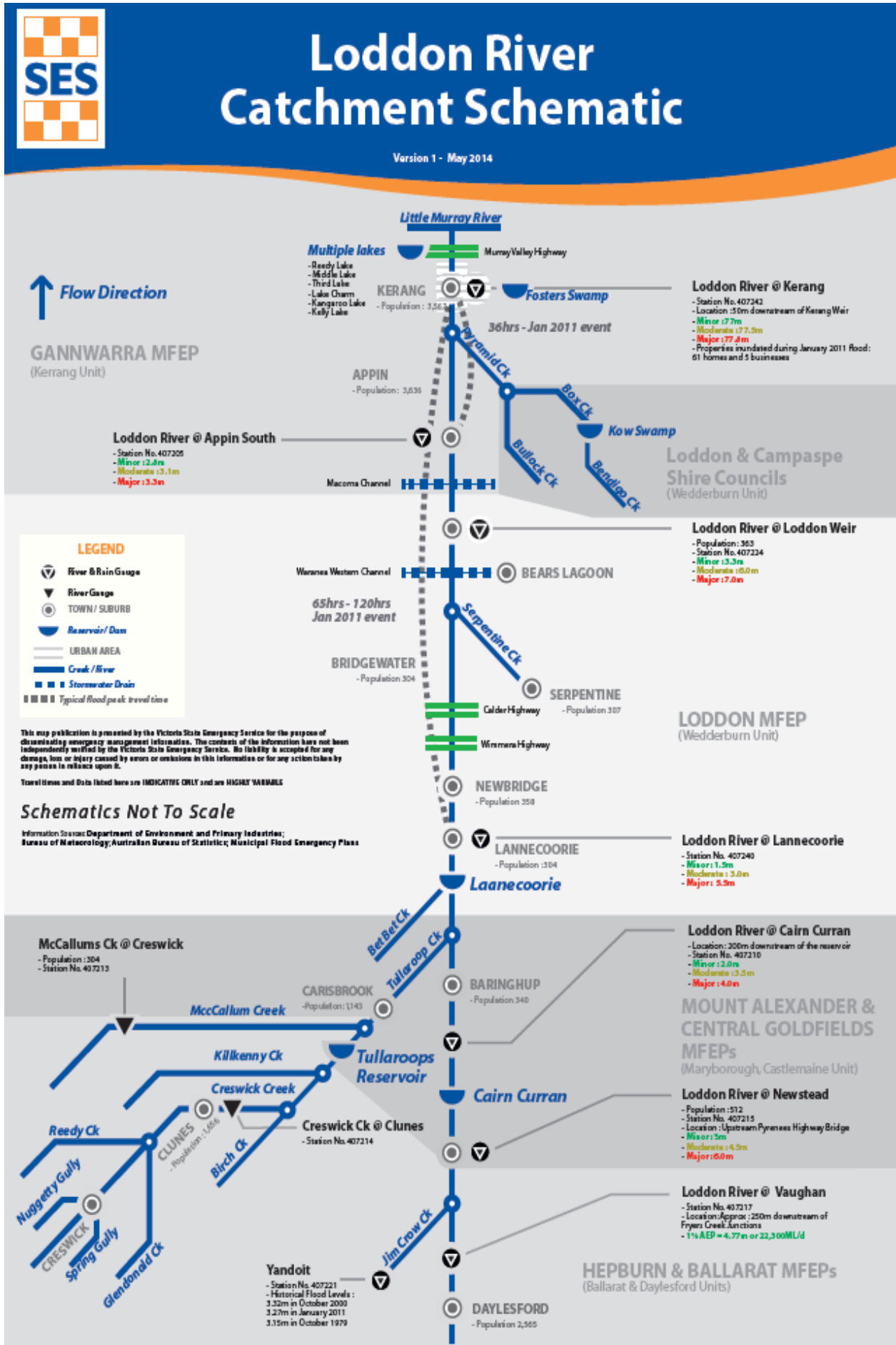
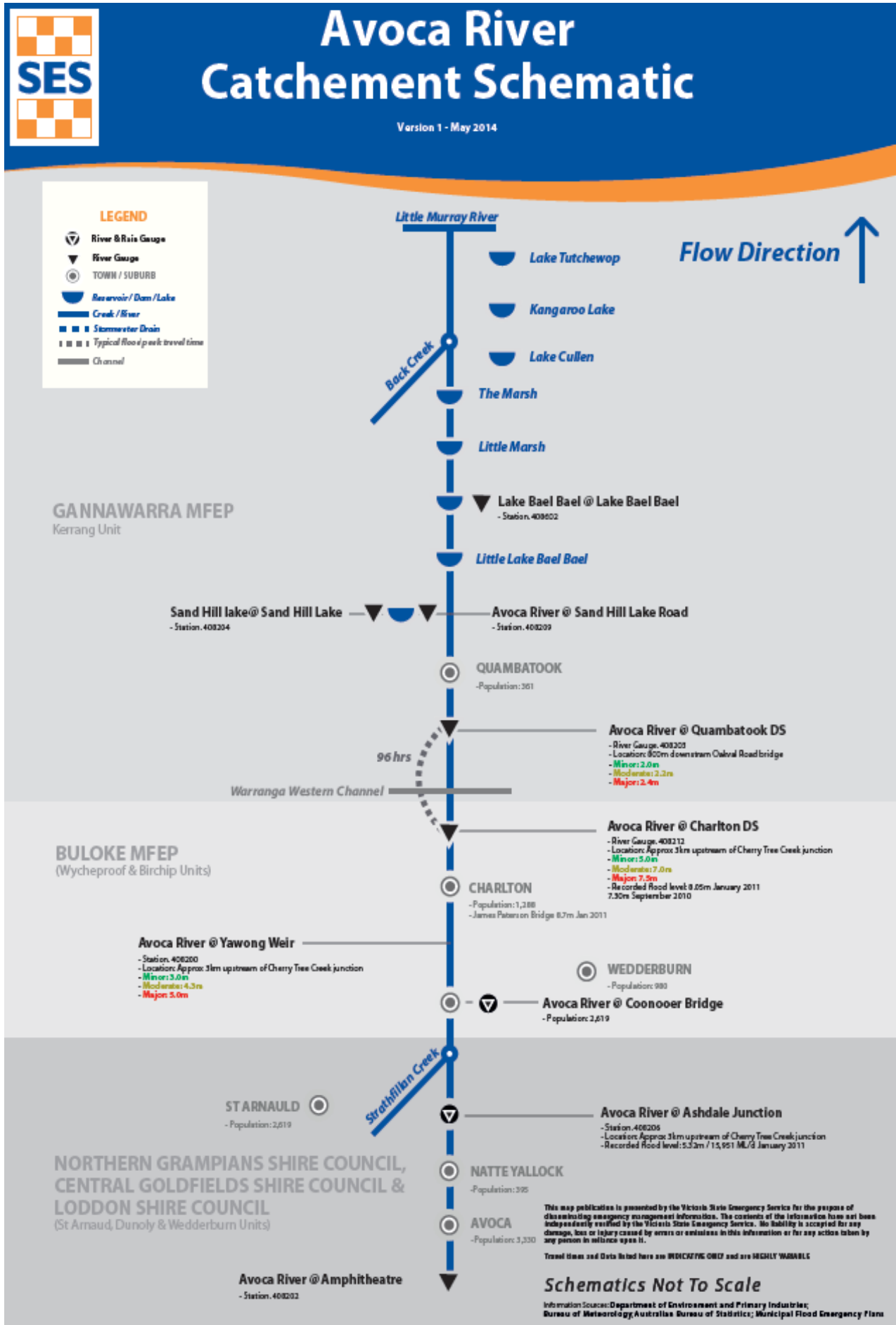


Figure A6 – Avoca River Catchment



Calivil Creek drains the Calivil Plains area between the Loddon floodplain and Bullock Creek and is joined by the Nine Mile Creek upstream of its confluence with Pyramid Creek.

Land gradients around the **Calivil, Nine Mile and Bullock Creeks** are low, the drainage patterns are complex and water courses poorly defined. Generally flooding is shallow and widespread with flood waters being distributed between a number of interconnected depressions.

Barr Creek drains the riverine plains between Pyramid Creek and the Murray River, joining with the Loddon River 35km downstream of the Pyramid Creek confluence.

The **Avoca River** has a long narrow catchment to the west of the Loddon and is subject to similar flood producing mechanisms. The Avoca flows into a series of retarding lakes and floodways to the south of Quambatook. The effluent stream systems of **Lalbert Creek** and **Tyrrell Creek** restrict the flow that reaches the Avoca Marshes.

Within the Shire, flooding is generally widespread and shallow along the **Avoca River** and **Lalbert and Back Creeks**. The Avoca River passes adjacent to Quambatook, which is protected by low level levees from small flood events, however requires extensive temporary works during large floods (eg. 1983 and 2011). Back Creek, a breakaway from the Avoca River, passes near the north-western outskirts of Quambatook but there is no record of it affecting the town.

During high flows and when the Avoca Marshes are full, the Avoca flows through the **Avoca Outfall** to Lake Boga via the Avoca Floodway. The major problems in this area relate to the difficulty of discharging flood waters from the Avoca Marshes and Kangaroo Lake through Lake Boga and the 6/7 Channel into the Little Murray River. If Loddon and Murray flows have elevated levels in the Little Murray River the latter becomes impossible.

Gunbower Creek, an anabranch of the Murray River, is used by G-MW as part of the Torrumbarry Irrigation System. **Gunbower Creek** is connected to **Kow Swamp** via **Taylors Creek**. **Gunbower Creek** flows from Gunbower and through Cohuna to Koondrook, with flows being returned to the **Murray River** at Koondrook or diverted for irrigation along the way. Due to G-MW regulatory works the risk of flooding is low. However, failure of levees on the Victorian side of the Murray River, particularly, particularly upstream of the **National Channel**, would cause widespread flooding and threaten the townships of Cohuna and Leitchville.

Taylors Creek flows from **Gunbower Creek / National Channel** at Gunbower to Kow Swamp. This is also part par the G-MW irrigation system and regulated, via National Channel and Taylors Creek Regulator.

On **Gunbower Island**, floodwaters are prevented from leaving the State Forest by levees constructed predominantly in the forest near the boundary of the freehold land. These levees are not formally maintained and have the potential to overtop during large floods. The levee banks play an important role in protecting alienated land on Gunbower Island.

6. Overview of Levees within the Shire

There are numerous levees within the municipality in close proximity to most of the watercourses and flow paths, aimed primarily at keeping floods off agricultural land and confined to flow paths and storage depressions. The Murray is also contained by levees. Most of the levees are privately owned and are generally neither well-constructed nor well maintained: their structural integrity, the date of construction, the extent of maintenance and the protection provided by many is unknown or dubious.

Most private levees appear to provide protection from around the 20% AEP (1 in 5 year ARI) event up to about the 4% AEP (1 in 30 year ARI) event. Few levees, if any other than for Kerang Township Protection Levee, provide a higher level of protection.

There are too many levees to discuss individually. Most watercourses are contained by levees, some larger than others. The main levees are discussed below along with the location of master plans detailing the features and locations of levees across the lower Avoca and Loddon floodplains.

South of Kerang roads, water supply channels and levee banks interfere with natural flooding patterns. A master plan of floodways and levees in this area is available in the *Lower Loddon Floodplain Management Study, Serpentine to Kerang*. The plan identifies the extent of recorded flooding, levee locations and land likely to be flooded in a 1%AEP (1 in 100 years ARI) event.

Large levees align with the Loddon River from Tragowel Swamp just upstream of Kerang to Kerang.

At **Kerang**, a formal Flood Mitigation Scheme project was undertaken between 1980 and 1987 comprising of construction of a township protection levee, installation of stormwater pumps, and key infrastructure from the Loddon River and Pyramid Creek. The levee construction works were primarily on the Loddon River frontage and eastern side of the Kerang township to protect the town from flows from the Pyramid Creek.

Between 1994 and 1996 there were further works on the northern section of the township protection levee.

In 2013 the Kerang Township Protection Levee Upgrade project was completed. The project saw the construction of permanent levee on three sections of roads (Murray Valley and Loddon Valley Highways; Kerang Murrabit Road; and Lower Loddon Road) surrounding the Kerang township. Works included:-

- Construction of a levee adjacent to the Murray Valley and Loddon Valley Highways to connect to existing levees on Sleepy Lane;
- Construction of a levee adjacent to the Ibis Caravan Park; and
- Raising of Lower Loddon and Murrabit Roads to fill in the gaps in the existing levee bank system.

The Kerang Township Protection Levee is a total length of 17km is routinely maintained by Gannawarra Shire Council.

Refer to Appendix C for greater detail on this levee. A plan of the works is detailed in Appendix F

North of Kerang a highly developed man-made system of floodways and levees is documented in the *Lower Loddon Floodplain Management Study, Kerang to Little Murray River*.

Through the Kerang Lakes area, the extent of flooding is limited by levees and water supply works along the western bank of the Loddon River at Kerang for floods up to around the 5% AEP (1 in 20 year ARI) level. Larger floods will overtop the levees and inundate large areas of land, as happened in January 2011.

More than 20,000ha of agricultural land incorporating some 237 properties on either side of Pyramid Creek are protected by around 140km of levees on both sides of the creek. These levees generally provide protection up to about the 5% AEP (20 year ARI) flood event except near its confluence with Bullock Creek and with Calivil Creek. As with other rural levees, they are poorly constructed with no proper provisions for maintenance and reconstruction, and are inadequate in large floods such as occurred in January 2011.

On the Victorian side, the Murray River is confined by levees and G-MW irrigation supply channels. The levees are not formally maintained and have the potential to either breach or overtop during a large flood. Most of the levees are low as they are located on relatively high ground close to the Murray River, therefore, making large breaches unlikely. Further, as there are a myriad of effluent streams, swamps and waterways on the New South Wales side of the river, there is a natural “relief valve” for high flows. Nevertheless, while the levees contained the 1993 and 2011 floods, they are generally in poor condition and are likely to be overtopped or breached by larger floods.

The structural integrity of the levee system in the Torrumbarry / Gunbower area is not known. Significant failure could cause problems for Gunbower, Cohuna, Kerang and other downstream townships.

The **Koondrook** township is protected by natural and man-made levees along Gunbower Creek and the Murray River. Flooding of the town from the Murray River has not occurred within living memory. Although some of these levees are poorly constructed and are not much higher than the flood level, the town is reasonably well protected from flooding due to:

- ◆ Floods tend to reach an upper limiting level at Barham gauge (due to the natural “relief valve” into New South Wales), irrespective of the magnitude of the flow further upstream. Future floods are therefore unlikely to significantly exceed this level unless flow distributions are altered in some way by works upstream.
- ◆ Existing levees are generally not higher than 300mm to 450mm and were successful in holding back the 1975 flood. In many cases, a roadway, which extends the full river frontage is higher than the levees. The roadway, together with the levees, offers an excellent line of defence.

Lalbert is protected from most floods by private levees along Lalbert Creek which confine flows to the main channel. The town may flood if the levees are overtopped or breached. The town has been flooded in the past but was not flooded by either the 1981, 1983 or 2011 floods.

The **Mystic Park** township is protected by an informal system of levees. Without the levees, the town would be subject to shallow flooding. If the levees failed under existing conditions, flooding may be more serious due to the effects of various nearby embankments (channels, levee banks, etc.).

Quambatook is adjacent to the Avoca River and protected by levees. However, a windrow is required on the Kerang - Quambatook Road at the north east end of the town during a large flood. During the 1995 flood, the windrow failed and caused partial flooding around houses to the north west of the Kerang - Quambatook Road.

Floods in excess of about the 5% AEP (1 in 20 year ARI) event will overtop many of the rural levees and spread across the natural floodplain. While this will cause some immediate damage, further damage is likely as once behind the levees, the water will have no way of re-entering the drainage system as flood levels recede.



Photo above: breach in the Lower Loddon Levee, Jan 2011 Flood (photo courtesy North Central CMA)

The following summary of the strategic levees that exist within the municipality:

Location	Owner	Responsibility if other than owner.	Protection Level
Kerang Township Protection Levee	Gannawarra Shire Council		1% AEP (1 in 100 year ARI)
Pyramid Creek north bank levees	TBC (To be confirmed)	No public agency or authority is currently responsible for undertaking maintenance	TBC
Loddon River/Back Swamp west bank between Murray Valley Hwy and Sheepwash Weir	TBC	As above	TBC
Loddon River west bank upstream Murray Valley Hwy	TBC	As above	TBC
Loddon River east bank between Kerang and the Glut	TBC	As above	TBC
Loddon River/Barr Creek/Benjeroop forest north east bank between Benjeroop and Capels Creek	TBC	As above	TBC
Loddon River west bank from Benjeroop to Bowdens Bridge	TBC	As above	TBC
Murray River upstream of Torrumbarry Headworks Channel	TBC	As above	TBC
Gunbower Forest Perimeter Levee	TBC	As above	TBC
Koondrook Township Bank	TBC	As above	TBC
Murray River from Murrabit to Little Murray River	TBC	As above	TBC
Little Murray River south bank from the Murray River to Fish Point	TBC	As above	TBC
Avoca Floodway Banks	TBC	As above	TBC

7. Infrastructure

7.1 Overview

The network of roads, irrigation channels and levees that cross the Loddon and Avoca floodplains intersect many of the natural flow paths and therefore have some impact on flood extents and the period of inundation.

The Murray Valley Highway passes generally from southeast to northwest while the Loddon Valley Highway passes from north to south. The Swan Hill-Bendigo railway line also crosses both floodplains, but contains mitigations including a bridge and culverts.

7.2 Roads

The following is a list of roads that may be inundated within the municipality depending on the magnitude of the flood. Note that many minor (gravel and earth) roads will also be inundated but are not listed.

Roads likely to be closed during a moderate flood		
Quambatook - Charlton Road (Ninyeunook)	Gravel Road (lot of traffic)	Council responsibility
Appin South Road	Sealed	Council responsibility
Quambatook South Road	Sealed	Council responsibility
Kerang - Quambatook Road at Budgerum Bridge	Sealed	VicRoads responsibility
Quambatook - Boort Road	Sealed	Council responsibility
Lalbert - Kerang Road	Sealed	Council responsibility
Flood Lane at Scotts Creek	Gravel Road	Council responsibility

In addition to the above, roads likely to be closed during a major flood		
Kerang Murrabit Road	Sealed	VicRoads responsibility
Murray Valley Highway	Sealed	VicRoads responsibility
Loddon Valley Highway	Sealed	VicRoads responsibility

8. Historic Floods

Significant flood events within the Municipality occurred in 1870, 1909, 1931, 1956, 1973, 1974, 1975, 1981, 1983, 1989, 1993, 1996 and January 2011.

The great flood of 1870 is the highest recorded event on the Murray River since European Settlement.

The 1974 and 1975 floods caused problems in the Kerang Lakes, Pyramid Creek, Lower Loddon, Appin South and upstream of Kerang. 1981 levels were the highest recorded at Kerang but did not cause the same problems as the floods of 1974 and 1975 due to levee upgrades.

The 2011 flood event caused the most significant problems. 75% of the municipality was inundated. The Loddon River, Avoca River and Pyramid Creek all experienced major flooding. The township of Benjeroop was severely flooded for an extended period. Kerang and Quambatook were isolated but not inundated. While the townships of Leitchville, Cohuna, Koondrook and Murrabit were not inundated, outlying areas were flooded for some considerable time.

Significant floods (greater than a major flood) have occurred within the Municipality as follows:

Murray River	Avoca River	Loddon River
1867		
1870		
	August 1909	August 1909
September 1916		
1917		
1931		
1956	1956	1956
1973	February 1973	February 1973
May & October 1974		May 1974

Murray River	Avoca River	Loddon River
November 1975		November 1975
July 1981		July 1981
	September 1983	September 1983
		1989
October 1993		October 1993
		1996
January 2011	January 2011	January 2011

August 1909 flood

The largest flood recorded at Laanecoorie Reservoir since it was constructed. Similar in magnitude to the January 2011 flood event but caused the failure of the Laanecoorie Reservoir dam wall.



Picture above: Laanecoorie Reservoir Dam Wall Failure, 1909

August 1956 flood

This event was the fourth largest along the Murray at Echuca since 1870 (4% AEP). It was also the largest flood (in terms of volume) along the Avoca River.

May 1974 floods

Widespread flooding occurred in May and October 1974. The May flood was more significant along the Murray (~6% AEP at Echuca) than the October event.

November 1975 flood

The 1975 flood was the third largest in the Murray at Echuca since 1870 (~3% AEP). It was also the third biggest (in terms of volume) along the Avoca River.

September 1983 flood

This event was the second largest flood along the Avoca (in terms of volume) and has a return period of around 50 years.

September and October 1993 floods

In September 1993 a major flood substantially reduced flood storage along the lower reaches of the Goulburn River floodplain. Consequently, a larger flood in October 1993 along the Goulburn (3% AEP at Shepparton) and Murray rivers (~4% AEP at Echuca) produced a peak a little higher than the 1916 event.

January 2011 flood

This flood followed an extended period of wet weather with major flooding through the lower Loddon and Avoca Rivers in September and December 2010. Heavy rain over the Avoca and Loddon Campaspe in January 2011 caused severe record flooding in both catchments and record outflows from the Loddon storages. Communities including Kerang were isolated for a considerable period. Many roads and levees were damaged but the Kerang electricity substation remained dry due to a temporary levee being erected. Flood water was trapped behind levees on the floodplain.

Refer Appendix C1 3.2

9. Dam Failure

A number of significant water storages are located within the Loddon basin, all outside the Gannawarra municipality. The most downstream dam is at Laanecoorie Reservoir. Torrumbarry Weir is also outside the Shire. However, flooding resulting from failure of either of these two dams is likely to cause significant structural and community damage within Gannawarra municipality.

Location	Owner and Operator	Primary Embankment Height (m)	Dam Capacity at FSL (ML)	FSL (m AHD)	Comments
Laanecoorie Reservoir	G-MW	22	7,980	160.21	Fixed crest thus at FSL inflow = outflow
Torrumbarry Weir	MDBA G-MW	5	36,810	86.05	At minor flood flow and above, the aim is to maintain outflow = inflow and for the weir to have minimal impact on flows.
Cairn Curran	G-MW		147,130	208.46	

10. Flood Inundation Mapping and Floor Levels

For areas of the municipality not covered by detailed flood maps, the Gannawarra Planning Scheme shows areas along the waterways within the municipality hire likely to be inundated by a 1% AEP (100-year ARI) flood event as Land Subject to Inundation Overlay (LSIO). While it is not practical to reproduce the overlay as an attachment to this Plan, hard copies are available from Gannawarra Shire Council offices. They are also available as PDF digital copies on the Gannawarra Shire Council website www.gannawarra.vic.gov.au or on the DTPLI website planningschemes.dpcd.vic.gov.au/gannawarra/map.html.

11. Aerial Flood Photography

Aerial flood photography is available as follows:

Murray River	Lower Loddon River	Kerang (Loddon River)	Avoca River	Kerang Lakes	Gannawarra Shire Council
May 1974					
November 1975					
July 1981					
October 1992					
October 1993					
		January 2011 *			January 2011 #

Note: * The 2011 datasets comprise geo-rectified aerial photography as well as NearMap imagery.

12. Flood Intelligence Cards

All flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Flood intelligence cards detail the relationship between flood magnitude and flood consequences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series.

Refer to Appendix C

APPENDIX B - Typical Flood Peak Travel Times

In using the information contained in this Appendix, consideration needs to be given to the time of travel of the flood peak. A flood on a 'dry' waterway will generally travel more slowly than a flood on a 'wet' waterway (eg. the first flood after a dry period will travel more slowly than the second flood in a series of floods). Hence, recent flood history, soil moisture and forecast weather conditions all need to be considered when using the following information to direct flood response activities. The amount of debris and vegetation and volume of water in the systems at the time will impact on travel times. This is more relevant to the Loddon and the Avoca Rivers – and impacts on roads and infrastructure.

Note that flooding will start some time ahead of the time indicated by the following travel times – these are the time between the flood peaks at respective sites.

Location From	Location To	Typical Travel Time	Comments
MURRAY RIVER			
Echuca Wharf	Torrumbarry Weir	Around 12 hours	Travel times do not vary significantly
Torrumbarry Weir	Barham		
Barham	Swan Hill		
LODDON RIVER			
Laanecoorie	Appin South	65 – 120 hours	
Laanecoorie	Kerang	5 Days	January 2011 event
Laanecoorie	Fish Point	11 Days	January 2011 event
Appin South	Kerang	36 hours	January 2011 event – big flood on wet river
		145 hours	December 2010 – medium flood on dry river
		71 hours	September 1993
AVOCA RIVER			
Charlton	Quambatook	4 days	
Quambatook	The Marshes		

APPENDIX C1 – Kerang Community Flood Emergency Management Plan

1. Overview

Kerang is protected from flooding from the Loddon River and Pyramid Creek up to a 1% AEP (1 in 100 years ARI) Loddon River flood with freeboard allowance. The surrounding area including all access roads are however inundated for a considerable time during large floods (eg. January 2011).

2. Overview of Flooding Consequences

2.1 Warning times

Flood warning times for Kerang are in the order of 5 days or more. Bigger floods generally have less warning time.

2.2 Areas affected

The floodplain outside the Kerang Township Protection Levee is affected by floods. This includes many rural properties as well as roads and other infrastructure. During larger floods (eg. bigger than around 5% AEP (1 in 20 year ARI) event), rural levees are likely to be overtopped and / or breached resulting in the inundation of a large area.

During the January 2011 event the existing Kerang Township Protection Levee was not overtopped or compromised. Flood waters remained for an extended period – weeks rather than days.

2.3 Properties affected

Houses outside the Kerang Township Protection Levee are not protected from flooding. The number of houses inundated could be substantial as the floodplain does not offer many opportunities to build above flood level.

In the 2011 flood event, 144 houses in the municipality were reported as damaged due to the flooding. Of these, 103 houses were inundated. Houses were classified as inundated if they had water above floor board. Damaged houses were houses which had required repairs as a direct result of the flood water surrounding or being underneath the house. A number of commercial buildings such as dairies and piggeries were directly impacted by the flood as was a large area of farmland which was inundated.

2.4 Isolation

Properties start to become isolated to the north and south of Kerang for events equal to or greater than the 20% AEP (1 in 5 year ARI) event (ie. around 77.20m AHD on the gauge).

Significant isolation occurs when the Murray Valley Highway, Loddon Valley Highway, Koondrook Road and the Kerang Quambatook Road are all closed. This occurred in January 2011. The township of Kerang was totally isolated for a number of days and for the following weeks some access routes into Kerang were inaccessible. The landing strip at the Kerang Aerodrome remained serviceable as it is located within the township protection levee.

Refer to Appendix F for an aerial map.

2.5 Critical infrastructure

The Kerang electricity substation is located outside the township protection levee but was not flooded in January 2011 due to the extensive works undertaken by emergency services to construct a temporary levee around the site. In future this facility is unlikely to be inundated as significant structural mitigation work has been undertaken to provide protection to the 1% AEP.

3. Flood Mitigation

3.1 Kerang Township Protection Levee

The township protection levee at Kerang was constructed between 1980 and 1987 as part of a formal Flood Mitigation Scheme and is managed and routinely maintained by Council.

In 2013 the Kerang Township Protection Levee Upgrade project was completed. The project saw the construction of permanent levee on three sections of roads (Murray Valley and Loddon Valley Highways; Kerang Murrabit Road; and Lower Loddon Road) surrounding the Kerang township. Works included:-

- Construction of a levee adjacent to the Murray Valley and Loddon Valley Highways to connect to existing levees on Sleepy Lane;
- Construction of a levee adjacent to the Ibis Caravan Park; and
- Raising of Lower Loddon and Murrabit Roads to fill in the gaps in the existing levee bank system.

The Kerang Township Protection Levee now has a total length of approximate 18km. The remainder of the levee has a freeboard of between 530mm and 950mm.

The township protection levee is generally located on crown land, road reserve or freehold land, although there are some sections with no rights at all. Parts of the levee are up to 3m high. Other parts are public roadway including Hayman Lane.

The Kerang township protection levee is designed to provide protection from a 1% AEP (1 in 100 years ARI) Loddon River flood with between 600mm and 800mm freeboard. However, the following summary (extracted from the 1998 levee audit report) shows that some sections of the levee have less than the design freeboard, though generally there is at least 600mm of freeboard available. Note that there is a 300mm layer of rock ballast under the rail track which would be permeable giving an effective freeboard of 410mm.

As flood water rises, drains, channels and culverts need to be blocked by closing flap gates and in a major flood event sandbags or an earthen bund is required to be placed across the Kerang to Bendigo rail line on the southern levee

Operations and Maintenance Manual has been prepared for Council's Township Protection Levee. The manual outlines appropriate triggers for closing gate valves on stormwater drains and channels and blocking culverts including GMW drains. A copy of the manual is available from Council.

The following summary of the strategic levees that exist within the Council area:

Section No	Section Length (m)	Running Distance (m)	Section	Section Starts	Section Ends	Minimum freeboard (m)	Total design freeboard (m)
1	1885	00 to 1885	Back Swamp	Murray Valley Hwy (Twin Bridges)	148m past end of Ninth Street along railway line	0.70	0.95
2	1570	1885 to 3455	Ninth Street	148m past end of Ninth Street along railway line	Lower Loddon Road	0.71	0.95
3	1938	2455 to 5393	Northern Levee	Lower Loddon Road	Corner Kerang Murrabit Road and Haymans Lane	0.84	0.95
4	1098	5393 to 6491	Haymans Lane	Corner Kerang Murrabit Road and Haymans Lane	1.1kms down Haymans Lane	0.70	0.95
5	3332	6491 to 9823	Fosters Swamp	Haymans Lane	Kerang Koondrook Road	0.65	0.95
6	1880	9823 to 11703	Sleepy Lane	Corner Kerang Koondrook Road and Sleepy Lane	Corner Sleepy Lane and Murray Valley Highway	0.53	0.53
7	1830	11703 to 13533	Southern Levee	Corner Sleepy Lane and Murray Valley Highway	Loddon Valley Highway		
8	3884	13533 to 17417	Collins Road	Loddon Valley Highway	GMW outfall at end of access track opposite Leng St		
9	1155	17417 to 18572	Murphy Street	End of access track off Collins Road	Murray Valley Hwy (Twin Bridges)	0.30	0.70

3.2 Kerang Rural Levees

On the western side of the Loddon River, south west of Kerang a rural levee has been constructed on private property to contain flood flows within the Loddon River from events up to approximately the 30 year ARI. However, in larger flood events such as the January 2011, this levee overtops to provide a natural relief and ensure that the Kerang Township Protection Levee continues to provide a 100 year ARI level of protection. The rural levee extends from Taverners Road through to the Murray Valley Highway. In events greater than the 30 year ARI (marginally greater than the Nov 2011 flood event), a number of properties become isolated and floor levels may become inundated.

4. Flood Impacts and Required Actions

Refer to following action table. Note that users of the action table should be careful to use levels from the Murray Valley Highway Bridge gauge and not the Kerang Weir gauge. Failure to observe this difference will result in substantial underestimation of likely impacts.

5. Control, Command and Coordination

The Control, Command and Coordination arrangements in the Gannawarra Municipal Flood Emergency Plan are as detailed in the Emergency Management Manual Victoria (EMMV).

All flood response activities within the Shire of Gannawarra will be under the Control of the Incident Controller.

An incident Emergency Management Team (EMT) may be established by the Incident Controller in accordance with the Emergency Management Manual Victoria.

The local response in Kerang will initially be managed by the VicSES Kerang Unit while it is a manageable incident. Once the magnitude of the flood event is predicted to increase, local incident control shall be conducted from predetermined Incident Control Centres (ICCs) in Swan Hill and commanded by an Incident Controller. It will operate in accordance with VicSES arrangements. During significant events, VicSES will conduct incident management using multi-agency resources.

The Incident Controller will ensure that control is exercised at the lowest effective level. For the local response in Kerang, the Incident Commander may establish a Kerang Division Command Point functioning from the CFA Brigade facility with Sectors established in relevant locations for a targeted response. The Incident Controller in the ICC and the Division Commander in the Division Command Point will ensure that local knowledge is incorporated through the role of Local Information Officer embedded in the Division Command to ensure an effective and informed response.

Refer to the VicSES Local Knowledge Policy



Photo above: Kerang Power Sub-station, Jan 2011 (photo courtesy Gannawarra Shire Council)

Gauge Location: Loddon River at Kerang (Murray Valley Highway Bridge)

Flood impacts described in the following tables relate primarily to riverine flooding. It should be noted that local impacts, or impacts in excess of those indicated, may occur as a result of local stormwater runoff and drainage and / or be attributable to flooding emanating from tributary streams. Similarly, local increases in flood levels and impacts may result from local factors such as blockages at bridges and culverts and from obstructions to overland flows such as works, channels, fences, buildings and the like.

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
75.65m AHD		Sheepwash Creek commences to run	<ul style="list-style-type: none"> ➢ Landowners notified
77.00m AHD	Minor Flood Level 25% AEP (4 year ARI)		<ul style="list-style-type: none"> ➢ VicSES to activate email flood warning system and advise organisations that flood warnings have been issued – if not already done. ➢ VicSES to commence community information and warning program. ➢ Council staff to initiate routine inspections of the Kerang Township Protection Levee. Need to pay particular attention to the older sections of levee which weep. ➢ Council to prepare information for website, recorded telephone message and Customer Service Centres. ➢ Local Information Officers downstream from Kerang to initiate routine inspections of levees. ➢ GMW to close flood gate on GMW drain at Leng St (may require a temporary pump). ➢ GMW implement a plan for the management of the lakes in advance of the flood (storage within lakes, available outfall capacity at No.7 and 6/7 channels and inflow to lakes from other sources such as Wandella Creek and Sheepwash Creek).
77.20m AHD			<ul style="list-style-type: none"> ➢ Flood Emergency Management Team to liaise closely.
77.30m AHD			<ul style="list-style-type: none"> ➢ VicSES Incident Controller to consider convening an Emergency Management Team (EMT) if not already done. ➢ MERC, MERO and MRM to consider activating MECC.
77.40m AHD	10 December 2010 flood		<ul style="list-style-type: none"> ➢ Council to deploy signs and begin closing roads in the vicinity as appropriate. ➢ VicSES to notify people outside levee system.

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
77.50m AHD	Moderate Flood Level 5.9% AEP (17 year ARI)		<ul style="list-style-type: none"> ➢ Block the two culverts under the Murray Valley Highway in order to prevent backflow (located approx. 500m and 1480m north from Maxwell St). ➢ Block culvert under the rural levee approx. 1490m north from Maxwell St. ➢ If not fixed, close flap gates on channels and drains.
77.60m AHD	September 1993 flood		<ul style="list-style-type: none"> ➢
77.80m AHD	Major Flood Level x% AEP (xx year ARI)		<ul style="list-style-type: none"> ➢ Begin to pay close attention to the railway line and the potential for water to seep through the rock ballast under the rail line. This should not occur for a further 410mm rise in water level. ➢ Unless fixed, the low section of levee north of Koondrook Road where the earth levee merges into the road embankment should be sandbagged to provide sufficient freeboard.
77.84m AHD	1981 flood		
77.90m AHD	1% AEP (100 year ARI)		<ul style="list-style-type: none"> ➢ Closely monitor levees, especially the older weeping sections.
78.00m AHD	19 January 2011 flood		
78.10m AHD			<ul style="list-style-type: none"> ➢ VicPol to consider developing and implementing (evacuation) strategy for Kerang.

NOTES:

- 1 Flood intelligence records (ie. the above table) are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Flood intelligence cards detail the relationship between flood magnitude and flood consequences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series.

APPENDIX C2 – Appin South Area Community Flood Emergency Management Plan

Gauge Location: LAANECOORIE

Need to have regard for flood travel times - the faster the travel, the larger the volume of flood, hence higher expected levels. Recent flood events, soil moisture conditions and impending weather conditions, therefore, need to be considered.

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
1.50m (2,000 ML/day)	Minor Flood Level (1963)		> VicSES email warning system activated if not already done.
3.00m (9,400 ML/day)	Moderate Flood Level (1945)		
4.50m			<ul style="list-style-type: none"> > Local Information Officers advised to conduct levee checks at Appin South and Tragowel. > VicSES and Council review sandbag supplies. > Liaison to commence between Incident Emergency Management Team members.
5.00m			> Council in consultation with GMW consider removing the earth bund roadway on Flood Lane at Scotts Creek - 30,000 ML/day at Laanecoorie for larger volume flood.
5.28m (36,500 ML/day)	1996 Flood Peak		
5.50m (43,700 ML/d)	Major Flood Level (1988)		> Consider convening Incident Emergency Management Team.
5.67m (54,700 ML/d)	1981 flood peak		
5.82m (55,000 ML/d)	Sep 1993 flood peak		

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
5.93m (65,000 ML/d)	1956 flood peak		
6.35m (65,200 ML/d)	Nov 2010 flood peak		
6.34m (87,300 ML/d)	Sep1975 flood peak		
7.50m (194,700 ML/d)	14 January 2011 flood peak		
7.80m (195,140 ML/d)	Aug 1909 flood peak		

Gauge Location: LODDON WEIR (actual location)

Need to have regard for flood travel times - the faster the travel, the larger the volume of flood, hence higher expected levels. Recent flood events, soil moisture conditions and impending weather conditions, therefore, need to be considered

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
3.30 m	Minor Flood Level		➤ VicSES email warning system activated if not already done.
5.00 m			➤ CMA to advise Local Information Officers at Appin South based on earlier contact on Laanecoorie gauge.
6.00 m	Moderate Flood Level		➤ Council in consultation with GMW consider removing the earth bund roadway on Flood Lane at Scott's Creek.
6.78 (9,580 ML/day)	1992 Flood Event		
6.80 (9,660 ML/day)	1981 Flood Event		
6.83 m (9,780 ML/day)	1993 Flood Event 1996 Flood Event		
6.93 m (10,140 ML/day)	1983 Flood Event		
7.00 m	Major Flood Level		
7.18 m (36,000 ML/day)	Nov 2010 flood event		
7.29 m (45,200 ML/day)	Jan 2011 flood event		

Gauge Location: APPIN SOUTH

Need to have regard for flood travel times - the faster the travel, the larger the volume of flood, hence higher expected levels. Recent flood events, soil moisture conditions and impending weather conditions, therefore, need to be considered

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
2.80 m	Minor Flood Level (2.33 year ARI event)		<ul style="list-style-type: none"> ➢ VicSES email warning system activated if not already done. ➢ Local Information Officers to check levees if not already done based on Laanecoore gauge.
3.00 m			<ul style="list-style-type: none"> ➢ Council staff to monitor need for road closures/signage.
3.03 m	20% AEP (5 year ARI) event		
3.06 m (2,850 ML/day)	1975 flood peak		
3.07 m (2,880 ML/day)	Sep1983 flood peak		
3.10 m	Moderate Flood Level (8 year ARI event)		
3.11 m (3,000 ML/day)	Aug1981 flood peak		
3.13 m (3,200 ML/day)	Oct1992 flood peak		
3.14 m	10% AEP (10 year ARI) event		
3.15 m	Appin South Road crossed. Houses in Appin South Road under threat.		

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
3.18 m (3,550 ML/day)	Sep 1993 flood peak		
3.19 m (3,600 ML/day)	Oct 1996 flood peak		
3.21 m (11,300 ML/day)	Nov 2010 flood peak		
3.22 m	4% AEP (25 year ARI) event		
3.27 m	2% AEP (50 year ARI) event		
3.30 m	Major Flood Level		
3.58 m (50,500 ML/day)	Jan 2011 Flood Peak		

APPENDIX C3 – Lower Avoca and Quambatook Community Flood Emergency Management Plan

1. Overview

The Avoca River system downstream between Glenloth and Quambatook is a perched river system, ie. the natural banks of the river are higher than surrounding land. The physical size of the Avoca River reduces as it travels downstream towards Quambatook, therefore the capacity of the river is limited. It is estimated that on average once every one to two years, river flows will overtop the banks of the Avoca River and spread onto the surrounding floodplain. Significant work was undertaken in the late 1960s to limit the impact of this frequent flooding and to ensure the equitable distribution of flood flows across the floodplain. This included the construction of structures and floodways as well as regular maintenance of the waterways. These works were undertaken by the former Avoca River Improvement Trust (the Trust) utilising rates collected from landowners. Upon its formation North Central Catchment Management Authority took on the roles and responsibilities of the Trust, however as it does not currently have the legal ability to rate landowners, it has not had the necessary funds to undertake routine maintenance.

Downstream of Charlton, floodwaters are distributed away from the Avoca River via a number of flow paths / watercourses. It is estimated that in flood events approximately only 10 to 20% of the total flow rate in the Avoca River at Charlton reaches Quambatook. These flow paths include:

- Tyrell Creek (which flows towards Culgoa and terminates at Sea Lake);
- Lalbert Creek (which terminates at Lake Lalbert)
- Back Creek
- Mosquito Creek
- Eastern Floodway

Quambatook is only likely to experience flood inundation in severe flood events such as the January 2011 flood event. Quambatook was not inundated during the January 2011 flood event, however this was only due to the extensive works undertaken by the local council, emergency services and the local community to protect the town.



Picture above: temporary Works at River Street, Quambatook in January 2011 (photo courtesy Gannawarra Shire)

The Quambatook Flood Management Plan was completed in 2014. The plan details flood behaviours for a range of flood events and recommends a number of possible structural and non-structural mitigation measures to reduce future flood risk to the residents of Quambatook. At the time of this review Council is currently producing plans for the design of the flood mitigation measures detailed in the Flood Management Plan. A copy of the Quambatook Flood Management Plan can be obtained from Gannawarra Shire Council.

In 2013 the Quambatook Weir was replaced. The project saw the removal of the existing weir structure and the design and construction of a new weir with a permanent structure with a variable height. The sections of the manual flood gate boards were replaced with one full width air operated gate that will be controlled from the bank.



Photos above and to the left: Before and after shots of the Quambatook Weir (courtesy of Gannawarra Shire Council)

2. Overview of Flooding Consequences

2.1 Warning times

The Charlton DS (downstream) (the gauge has been switched off) river level gauge is used to provide predictions for Quambatook. Flood warning times for Quambatook are in the order of 4 days or more:

- River levels at Quambatook start to rise 3 days after river levels start to rise at the Charlton DS gauge;
- Flood levels peak at Quambatook approximately 4 days after flood levels peak at the Charlton DS gauge.

2.2 Areas affected

The floodplain between Charlton and the Avoca Marshes is affected by floods. This includes many rural properties as well as roads and other infrastructure. In events as little as the 1-2 year ARI event, river flows are likely to overtop the banks of the Avoca River and spread onto portions of the adjacent floodplain.

2.3 Properties affected

A number of properties and farming houses in the rural areas between Charlton and Quambatook are at risk becoming inundated or isolated in major flood events. It is only in severe flood events such as the January 2011 flood event that the township of Quambatook is at significant risk of flooding. Without temporary works, the entire township is at risk of inundation.

2.4 Isolation

In the 2011 event, properties at the end of Fenton Lane, Quambatook were isolated.

2.5 Critical infrastructure

In the 2011 event:-

Water supply – the water quality became a concern. Water was carted in for human consumption until such time as GWMW could guarantee safe potable water. The existing town water supply infrastructure is located outside of the limited town protection levee.

Sewerage – As Quambatook is currently unsewered the community rely on onsite effluent treatment (septic tanks). As these rely on function transporation beds, during the flood event these transporation beds became flooded resulting in little or no operating effluent disposal. During the September and December 2010 events, an ablution block was hired and located in Quambatook.

Electricity/Communication – The electricity substation at Charlton was directly impacted by flood waters resulting in Quambatook being without power for a considerable period of time. This caused the telecommunication repeater stations to fail resulting in no communication whatsoever for the area. The CFA radio system was the only form of communication.

3. Flood Mitigation

3.1 Structures

The Avoca River Improvement Trust constructed a number of assets in the late 1960s. Many of these structures have been decommissioned or are no longer required, however there are a few structures that remain and need to be monitored/operated during flood events.

Structure	Location	Purpose	Asset Owner	Action Required
Kops Orchard Outfall	Ninyeuook Road	To offset the levees constructed on the western side of the Avoca River and ensure the equitable distribution of flood flows.	North Central CMA / Grampians Wimmera Mallee Water	No operation required. Drop boards have been removed.
Mosquito Sills	Jeruk River Road	To maintain the distribution of flows between the Avoca River and Mosquito Creek in small flows.	North Central CMA / Grampians Wimmera Mallee Water	No operation required. Drop boards have been removed.
Quambatook Weir	Weir Road, Quambatook	To preserve weir pool in Quambatook for recreation purposes	Gannawarra Shire Council	Lower gates on structure during flood events.

4. Flood Impacts and Required Actions

Refer to the action tables below. The flood class levels for both the Charlton and Quambatook gauges were reviewed in October 2015 as the flood class levels for Charlton were set too high and were amended to reflect the recommendations of the Local Information Officers to the 2010-11 Victorian Floods Review.

5. Control, Command and Coordination

The Control, Command, and Coordination arrangements in the Gannawarra Municipal Flood Emergency Plan are as detailed in the Emergency Management Manual Victoria.

All flood response activities within the Gannawarra municipality will be under the Control of the Incident Controller.

An incident Emergency Management Team (EMT) may be established by the Incident Controller in accordance with the Emergency Management Manual Victoria.

The local response in Quambatook will initially be managed by the VicSES Kerang Unit while it is a manageable incident. Once the magnitude of the flood event is predicted to increase, local incident control shall be conducted from predetermined Incident Control Centres (ICCs) in Swan Hill and commanded by an Incident Controller. It will be operate in accordance with VicSES arrangements. During significant events, VICSES will conduct incident management using multi-agency resources.

The Incident Controller will ensure that control is exercised at the lowest effective level. For the local response in Quambatook, the Incident Commander may establish a Kerang Division Command Point functioning from the CFA Bridge facility with Sectors established in relevant locations for a targeted response. The Incident Controller in the ICC and the Division Commander in the Division Command Point will ensure that local knowledge is incorporated through the role of Senior Flood Observer embedded in the Division Command to ensure an effective and informed response.

Refer to the VicSES Local Knowledge Policy

Gauge Location: CHARLTON DS

Need to have regard for flood travel times - the faster the travel, the larger the volume of flood, hence higher expected levels. Recent flood events, soil moisture conditions and impending weather conditions, therefore, need to be considered

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
3.50m	Minor Flood Level		
4.77 m	August 2010	River flows overtop the Avoca River near Glenloth spreading onto surrounding farm land; some minor Council roads were affected.	
5.00 m	Moderate Flood Level	VicSES email warning system activated if not already done.	
6.50 m			<ul style="list-style-type: none"> ➢ Council to monitor need for road closures / signage in Quambatook South, Lalbert Creek and Back Creek areas. ➢ Local Information Officers at Quambatook South and Sandhill Lake to check levees.
7.00 m	Major Flood Level September 1993 Flood Peak		<ul style="list-style-type: none"> ➢ VicSES Region to liaise with G-MW and Council regarding the need to convene Flood Emergency Management Team. ➢ VicSES and Council review sandbag supplies. ➢ Council needs to prepare to possibly construct an earthen windrow along River Street, Quambatook.
7.10 m	30 November 2010 flood peak		
7.20 m	October 1992 flood peak		
7.30 m	6 September 2010 flood peak		<ul style="list-style-type: none"> ➢ Council construct an earthen windrow along River Street, Quambatook.
7.50 m	Major Flood Level		
8.05 m	15 January 2011 flood peak (150 year ARI flood Event)		

Gauge Location: QUAMBATOOK

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
2.00 m	Minor Flood Level		<ul style="list-style-type: none"> ➤ VicSES email warning system activated if not already done.
2.18 m	December 2010 flood peak		
2.20 m	Moderate Flood Level	Assess likely impact on Lalbert Creek.	<ul style="list-style-type: none"> ➤ Council staff to monitor need for road closures / signage. ➤ Seek advice from G-MW regarding gauge levels at The Marshes and also flood plain storage at Lake Boga. ➤ Operate the Quambatook South gauge.
2.23 m	September 2010 Flood Peak		
2.30 m	1993 flood peak	Water crosses Kerang - Quambatook Road. Water crosses Quambatook - Boort Road.	
2.32 m	1992 Flood Peak		
2.40 m	Major Flood Level	The Marshes likely to fill and overflow.	<ul style="list-style-type: none"> ➤ Council in consultation with NCCMA close Mystic Park Road and construct earthen bunds either side of the Avoca outfall.
2.42 m	June 1995 flood peak		
2.43 m	October 1996 flood peak		
2.50 m	September 1983 flood peak		
3.04 m	18 January 2011 flood peak		

Gauge Location: TOP MARSH

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
73.50m AHD			➤ Check levee at north end of The Marshes.
74.00m AHD		Flow enters Avoca Outfall Channel and flows to Lake Boga	➤ Flood Emergency Management Team to monitor relationship between flows in Avoca Outfall and Loddon River.

Figure C3-1 – Extent of Flood Inundation – Glenloth to Quambatook

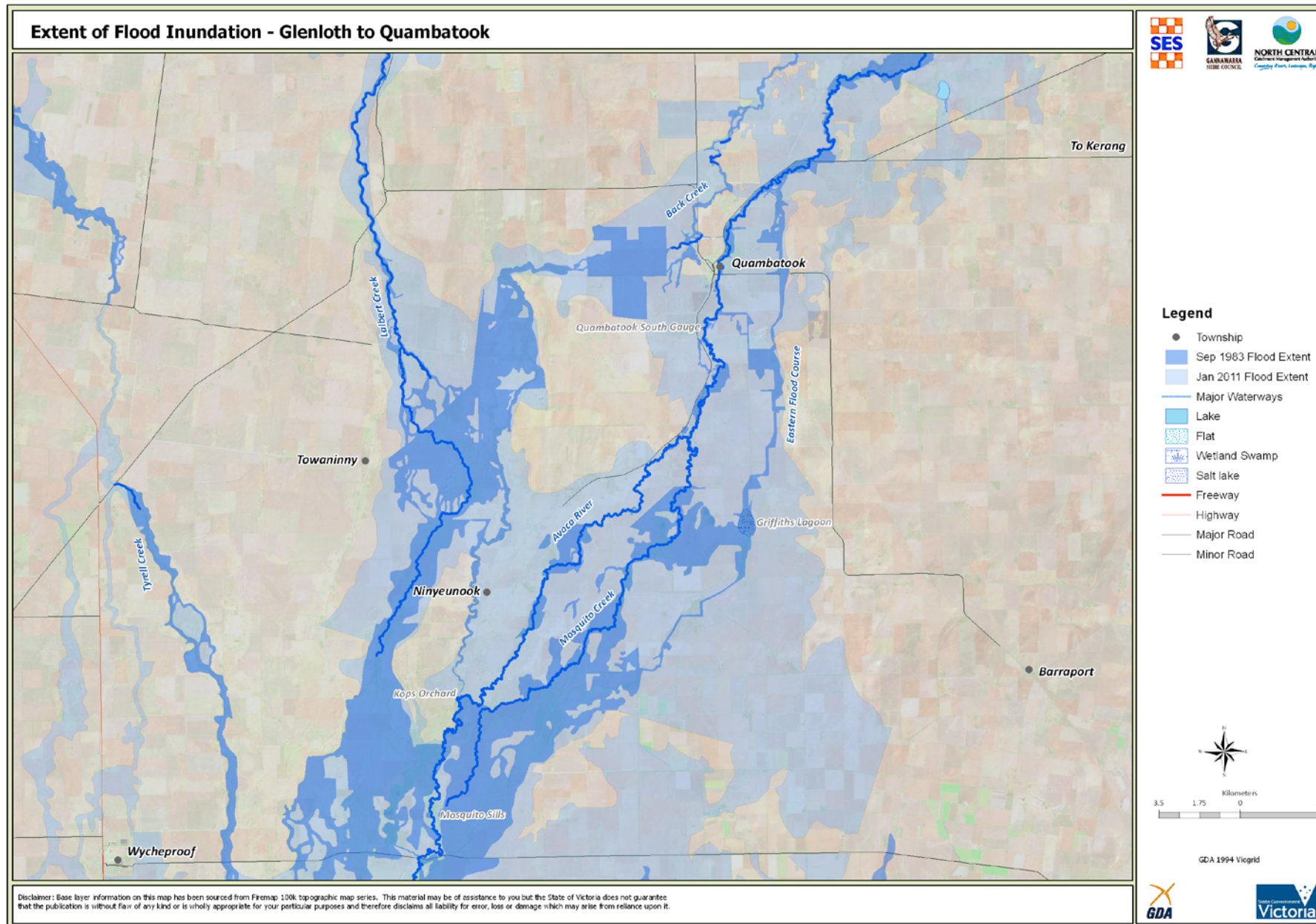
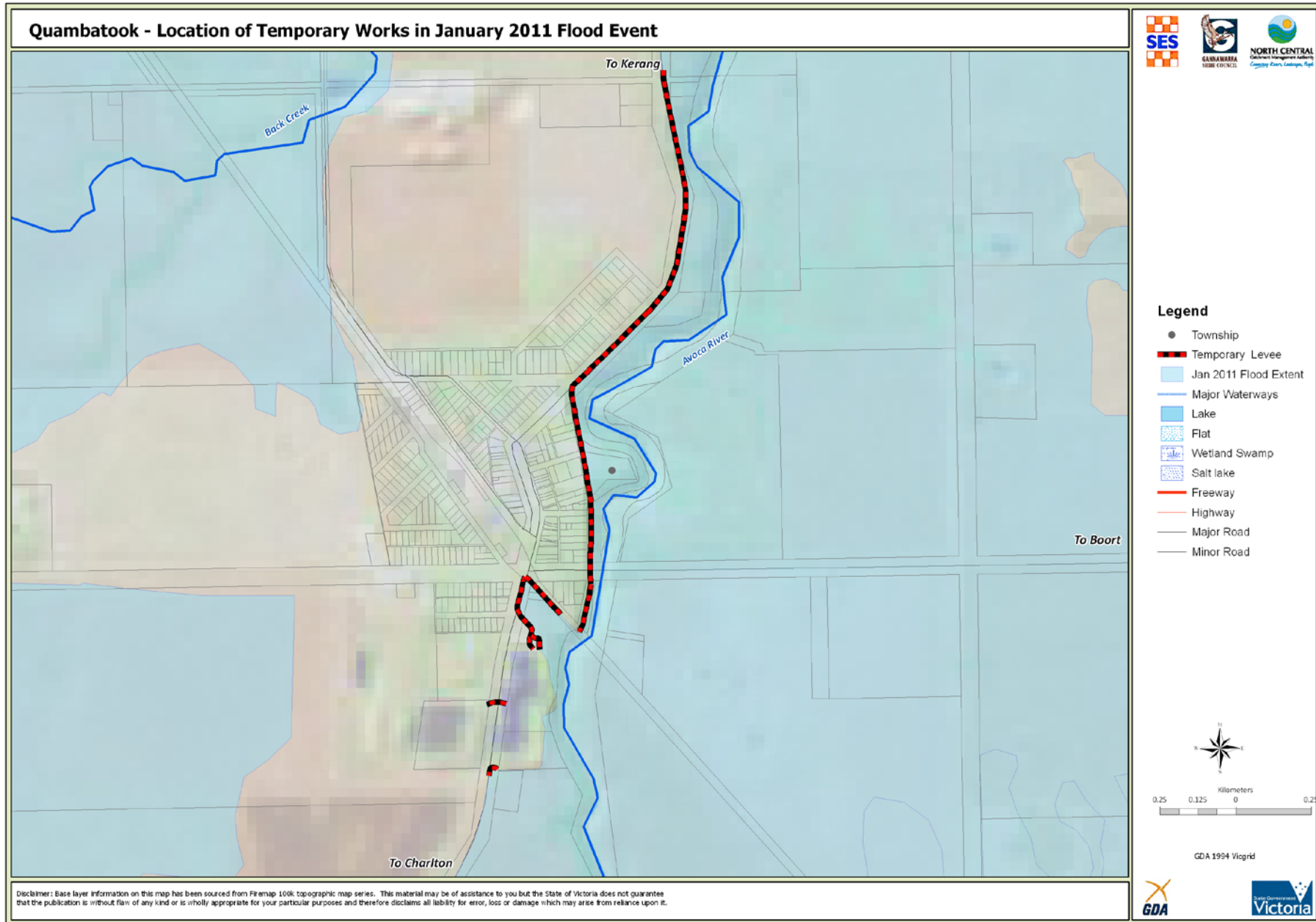


Figure C3-2 – Temporary works in January 2011 at Quambatook



APPENDIX C4 – Murray River Community Flood Emergency Management Plan

Significant failure of the levee system in the Torrumbarry / Gunbower area could cause problems for Gunbower, Cohuna, Kerang and other downstream townships. The structural integrity of these levees is not known.

The levee around the Torrumbarry Headworks weaves its way through private land and Crown land, over a distance of about 16kms. The depth of water held back by the levee can vary from very little to almost 2 metres where the bank crosses effluent creeks and depressions. Under natural conditions all these depressions would have fed into the Gunbower Creek, and the water would have followed the creek system to Gunbower and Cohuna and eventually back into the Murray River. Although the Gunbower Creek is cut off from the river by the Headworks Channel, any major flows through bank breaches find their way into the Gunbower Creek, and are then free to follow the irrigation system. Because of this, a major break in the bank system could have serious repercussions many kilometres away from Torrumbarry. Many sections of this levee are showing signs of deterioration.

The section of bank downstream from the Torrumbarry Headworks is different in that it is totally situated on Crown land under the control of either DELWP. This bank is almost all inside the Gunbower Forest and generally follows the river. It is mainly in better condition than the bank further upstream, having had more work done on it after floods in the 1980's. There is also potentially less water against this bank, which is also about 16km long, and it is also backed up by a secondary bank system which follows along inside the freehold boundary. This secondary bank being situated on much lower land would not control a major collapse, but would hold a certain amount of leakage and overtopping in the forest, and prevent water flooding onto farm land.

In September 2010, works to infill a number of low points in this levee were undertaken by the local Progress Association with the approval of the Incident Control Centre. These low points were caused by vehicles accessing the Murray River for recreational purposes.

Downstream of the Torrumbarry Headworks Channel, there have been historically two levee bank systems. A levee that follows the banks of the Murray River in addition to a perimeter levee that follows the boundary of the Gunbower State Forest. The banks of the Murray River have eroded over time and the levee bank that follows the Murray River within the Gunbower Forest cannot be relied upon. The perimeter levee prevents water flooding onto farm land, however this levee is not maintained and the condition is unknown.

Gauge Location: TORRUMBARRY WEIR

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
7.30m AHD	Minor Flood Level		<ul style="list-style-type: none"> > VicSES email warning system activated if not already done. > Local Information Officers at Koondrook, Murrabit and Benjeroop to check levees.
7.60m AHD	Moderate Flood Level		
7.80m AHD	Major Flood Level		
7.81m AHD	1981 flood peak		
7.86m AHD	1993 flood peak		
8.10m AHD	August 1909 peak 5% AEP (20 year ARI) event		
8.11m AHD	4% AEP (25 year ARI) event		
8.16m AHD	2% AEP (50 year ARI) event		
8.20m AHD	1% AEP (100 year ARI) event		

Gauge Location: BARHAM

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
5.50m AHD	Minor Flood Level		<ul style="list-style-type: none"> ➤ VicSES email warning system activated if not already done. ➤ Local Information Officers at Koondrook, Murrabit and Benjeroop to check levees.
5.80m AHD	Moderate Flood Level	Flows will be predominantly be downstream of Cohuna and should not cause any significant issues but need to be monitored if flood increases.	<ul style="list-style-type: none"> ➤ G-MW to monitor Gunbower Creek for any flows entering the Creek.
6.10m AHD	Major Flood Level		

APPENDIX C5 – Eastern Boundary of the Municipality Community Flood Emergency Management Plan

When Bendigo Creek floods, many of the east west roads crossing the creek can be cut. Generally flood waters take many days to travel along the creek and through Kow Swamp. Farm land situated in low lying areas some distance from the creek can be flooded. A few houses can also be affected. This includes the area around the Elmore - Mitiamo Road.

The Bullock Creek and Pyramid Creek, along with Bendigo Creek/Kow Swamp can add significant levels at Kerang. GMW would look to manage outfalls from Kow Swamp to work around peaks on the Bullock and Loddon rivers, where possible.

Gauge Location: MITIAMO

River Height (m) and / or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions in consultation with ICC
1.41m AHD	December 2010 flood level		> East west roads across the creek require signage due to water over the road.
2.08m AHD	January 2011 flood level	Kow Swamp regulator had limited ability to release sufficient flows which resulted in exceeding full supply level.	> GMW to monitor inflows and releases at Kow Swamp.
2.39m AHD	August 1981 flood level		> East west roads across the creek require signage due to water over the road.
2.86m AHD	May 1974 flood level – record		> East west roads across the creek require signage due to water over the road.

APPENDIX D – Flood Evacuation Arrangements

1 Phase 1 - Decision to Evacuate

Also see: Gannawarra Victoria Police Evacuation Plan.

The Incident Controller may make the decision to evacuate an at-risk community under the following circumstances:

- Properties are likely to become inundated;
- Properties are likely to become isolated and occupants are not suitable for isolated conditions;
- Public health is at threat as a consequence of flooding and evacuation is considered the most effective risk treatment. This is the role of the Health Commander of the incident to assess and manage. Refer to the State Health Emergency Response Plan (SHERP) for details);
- Essential services have been damaged and are not available to a community and evacuation is considered the most effective risk treatment.

The following should be considered when planning for evacuation:

- Anticipated flood consequences and their timing and reliability of predictions;
- Size and location of the community to be evacuated;
- Likely duration of evacuation;
- Forecast weather;
- Flood Models;
- Predicted timing of flood consequences;
- Time required to conduct the evacuation;
- Time available to conduct the evacuation;
- Evacuation priorities and evacuation planning arrangements;
- Access and egress routes available and their potential flood liability;
- Current and likely future status of essential infrastructure;
- Resources required to conduct the evacuation;
- Resources available to conduct the evacuation;
- Shelter including Emergency Relief Centres, Assembly Areas etc.;
- Vulnerable people and facilities;
- Transportation;
- Registration
- People of CALD background and transient populations;
- Safety of emergency service personnel;
- Different stages of an evacuation process.

The decision to evacuate is to be made in consultation with the MERO, MERC, DHHS, Health Commander and other key agencies and expert advice and in accordance to the Local Knowledge Policy (CMAs and Flood Intelligence specialists).

The table below details triggers for evacuation, if these heights are predicted or are likely to occur evacuation should be considered

Sector	Gauge	Trigger
Kerang	Murray Valley Hwy	77.90 m AHD
Quambatook	Quambatook South	2.8m

The table below details time required to evacuate established areas.

Sector	Likely time required for evacuation (including resource assumptions)
Kerang	2 days
Quambatook	2 days

2 Phase 2 – Warning

Warnings may include a warning to prepare to evacuate and a warning to evacuate immediately. Once the decision to evacuate has been made, the at-risk community will be warned to evacuate. Evacuation warnings can be disseminated via methods listed in part 3 of this plan.

Evacuation warning messages will be developed and issued by VicSES in consultation with the MERO, MERC, DHHS and other key agencies and expert advice (CMA's and Flood Intelligence specialists).

3 Phase 3 – Withdrawal

Withdrawal will be controlled by VicPol. VicSES will provide advice regarding most appropriate evacuation routes and locations for at-risk communities to evacuate to, etc.

VicSES, CFA, AV and Local Government will provide resources where available to support VicPol/VicRoads with route control and may assist VicPol in arranging evacuation transportation.

VicPol will control security of evacuated areas.

Evacuees will be encouraged to move using their own transport where possible. Transport for those without vehicles or other means will be arranged by the ICC.

Possible Evacuation Routes to be used:

Sector	Evacuation Route	Evacuation route closure point and gauge height of closure
Kerang	Murray Valley Highway	
Quambatook	Quambatook Swan Hill Road	

Landing zones for helicopters are located at:

- Kerang District Health, Burgoyne Street Kerang (no fuel available)
- Kerang Aerodrome (Avgas and JetA1 available)
- Cohuna Aerodrome (no fuel available)

People who may have special needs and require additional support during an emergency may be identified on the Vulnerable Persons Register (with their consent). VicPol have access to this register and will arrange for evacuation of these people, if required. Gannawarra Shire Council is the custodian of the Vulnerable Persons Register for the Gannawarra municipality. Funded agencies that provide personal care, support and/or case management services either in home or community settings, to clients living in the community are responsible for entering and maintaining information on Vulnerable Persons Register

Refer to the Gannawarra Shire Council's MEMPlan Appendix E for special needs groups.

4 Phase 4 – Shelter

Relief Centres and/or assembly areas which cater for people's basic needs following floods may be established. The flood relief centres and/or Assembly Areas are listed in Appendix C of Council's MEMP.

VicPol in consultation with VicSES will liaise with Local Government and DHHS (where regional coordination is required) via the relevant control centre to plan for the opening and operation of relief centres. This can best be achieved through the Emergency Management Team (EMT).

Animal Shelter

Animal shelter compounds will be established for domestic pets and companion animals of evacuees. These facilities may be located at locations detailed below and coordinated by Gannawarra Shire Council. .

Sector	Animal Shelter (include address)	Comments
Kerang Pound	Kerang Murrabit Road, Kerang	Dog and cat only
Cohuna Pound	Murray Valley Hwy, Cohuna	Dog only
Kerang Saleyards	Markets Road, Kerang	Livestock

Caravans

Caravans maybe evacuated to the following locations:

Sector	Caravan evacuation location (include address)	Comments
Cohuna	Cohuna Caravan Park	
Quambatook	Lake Boga Caravan Park	

5 Phase 5 – Return

Return will be consistent with the Gannawarra All Hazards Evacuation Plan 2012 for the return of community.

The Incident Controller in consultation with VicPol will determine when it is safe for evacuees to return to their properties and will arrange for the notification of the community.

VicPol will manage the return of evacuated people with the assistance of other agencies as required.

Considerations for deciding whether to evacuate include:

- Current flood situation;
- Status of flood mitigation systems;
- Size and location of the community;
- Access and egress routes available and their status;
- Resources required to coordinate the return;
- Special needs groups;
- Forecast weather;
- Transportation particularly for people without access to transport

6 Disruption to Services

Disruption to a range of services can occur in the event of a flood. This may include road closures affecting school bus routes, water treatment plant affecting potable water supplies, etc.

Kerang

Service	Strategy/Temporary Measures	Responsible agency
Water	Potable water tankers to be deployed	LMW
Communication	Temporary Mobile Station	Telstra
Sewage	Mobile ablution blocks	LMW
Waste	Skip bins	Council

Quambatook

Service	Strategy/Temporary Measures	Responsible agency
Water	Potable water tankers to be deployed	GMMW
Communication	Temporary Mobile Station	Telstra
Sewage	Mobile ablution blocks	GMMW
Waste	Skip bins	Council

7 Essential Community Infrastructure and Property Protection

Essential community infrastructure and properties (e.g. residences, businesses, roads, etc.) that require protection are:

Facility	Impact	Strategy/Temporary Measures
Halls	Community unable to attend hold social events for health & wellbeing	Consider alternative locations.
Schools	Children unable to attend school	
Supermarkets	Ability to buy food is reduced	

APPENDIX E - Flood Warning Systems

1 Flood Warning Products

Flood Warning products and Flood Class Levels can be found on the Bureau of Meteorology (BoM) website. Flood Warning products include Severe Thunderstorm Warnings, Severe Weather Warnings, Flood Watches and Flood Warnings.

2 Flood Watches

Flood watches are issued by the Bureau of Meteorology (BoM) to notify communities and other stakeholders within broad areas (rather than specific catchments) of the potential flood threat from a developing weather situation. They provide a 'heads up' of likely flooding.

Flood watches are based on an assessment of the developing weather situation and indicators of current catchment wetness. They provide generalised statements about expected forecast rainfall totals, the current state of the catchments within the target area and the streams at risk from flooding. Instructions for obtaining rain and stream level observations and access to updated Watches and Warnings are also included.

Normally, the BoM would issue a Flood Watch 24 to 36 hours in advance of any likely flooding and issue updates as required. If at any time during that period there was an imminent threat of floods occurring, the Flood Watch would be upgraded to a Flood Warning.

3 Flood Warnings

Flood Warnings are firm predictions of flooding based on actual rainfall and river height information as well as the results of stream flow based models of catchment behaviour that take account of antecedent conditions (i.e. the 'wetness' of the catchment, storage levels within dams, etc) and likely future rainfall. Outflows from dams are an essential input to such models.

Flood warnings are categorised as 'minor', 'moderate' or 'major' (see BoM website for an explanation of these terms and current flood class levels) and indicate the expected severity of the flood for agreed key locations along the river. Flood warnings usually include:

- ◆ Rainfall amounts for selected locations within and adjacent to the catchment;
- ◆ River heights and trends (rising, steady, falling) at key locations within the catchment;
- ◆ Outflows (in ML/d) from major storages within the catchment;
- ◆ Forecasts of the height and time of flood peaks at key locations;
- ◆ A weather outlook and the likely impact of expected rainfall on flooding; and
- ◆ A warning re-issue date and time.

Note 1: The term "local flooding" or "flash flooding" may be used for localised flooding resulting from intense rainfall over a small area.

Note 2: The term "significant rises" may be used in the early stages of an event when it is clear that river levels will rise but it is too early to say whether they will reach flood level.

BoM issues flood watches and warnings to the media, VicSES and a number of other organisations including Gannawarra Shire Council using a combination of email and fax. Flood watches and warnings are also forwarded to the Shire by the VicSES Flood Warning Distribution System. Onward distribution of these warnings to respective communities will be undertaken by the municipality.

On receipt on an Initial or Urgent Flood Warning, the VicSES Regional Office at Swan Hill (or the after hours Duty Officer) will telephone the nominated representative of affected organisations and pass on the information as supplied by the BoM. In the case of all subsequent warnings, copies of the information will be forwarded via email. Organisations to which flood watches and warnings for the Avoca, Loddon and Murray Rivers will be distributed are included at Attachment 1 to this Appendix.

All flood watches and warnings are available on the BoM website (www.bom.gov.au).

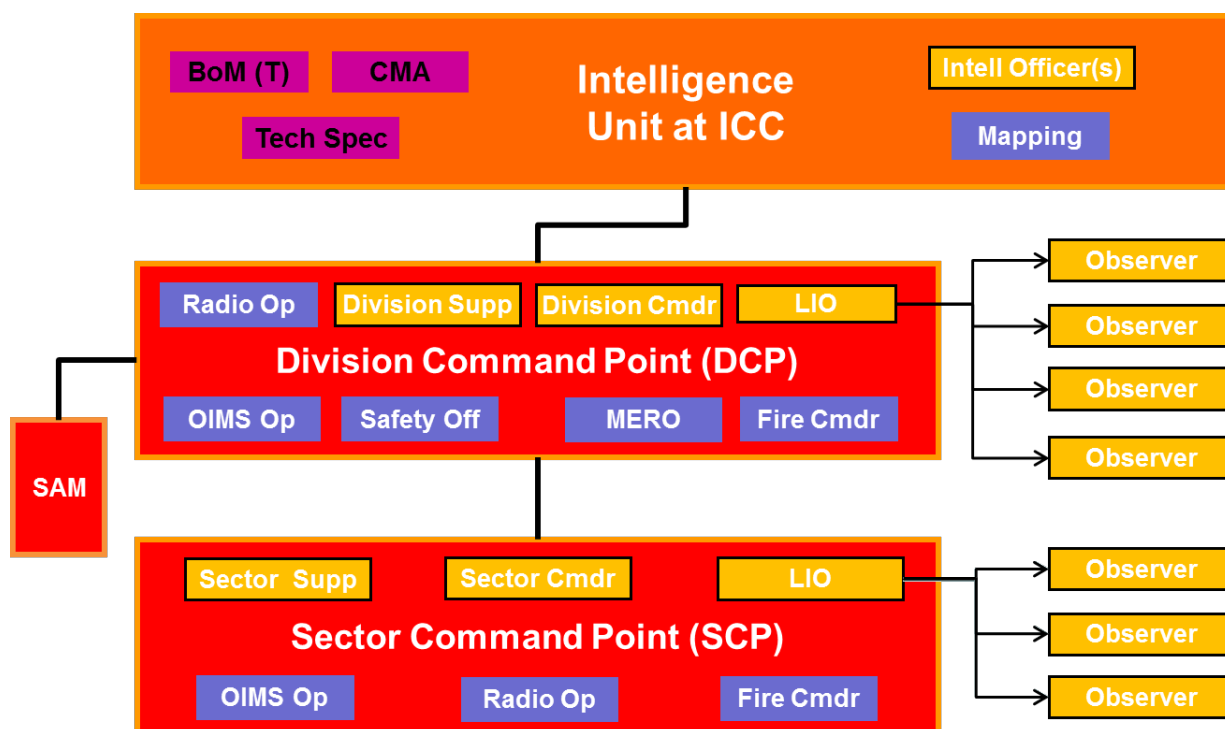


Figure 1: Intelligence Unit Information Flow

4 Flood Bulletins

VicSES distributes flood emergency information to the media through “Flood Bulletins”. Flood Bulletins provide BoM Flood Warning information as well as information regarding possible flood consequences and safety advice, not contained in BoM Flood Warning products. VicSES uses the title Flood Bulletin to ensure emphasis is placed on BoM Flood Warning product titles.

The relevant VicSES Region Headquarters or the established ICC will normally be responsible for drafting, authorizing and issuing Flood Bulletins, using the One Source, One Message system.

Flood Bulletins should refer to the warning title within the Bulletin header, for example Flood Bulletin for Major Flood Warning on Campaspe River.

Flood Bulletins should follow the following structure:

- What is the current flood situation;
- What is the predicted flood situation;
- What are the likely flood consequences;
- What should the community do in response to flood warnings;
- Where to seek further information;
- Who to call if emergency assistance is required.

It is important that the description of the predicted flood situation is consistent with and reflects the relevant BoM Flood Warning.

Flood Bulletins should be focused on specific gauge (or in the absence of gauges, catchment) reference areas, that is the area in which flood consequences specifically relate to the relevant flood gauge.

Flood Bulletins should be prepared and issued after receipt of each Flood Watch and Flood Warning from the BoM, or after Severe Weather or Thunderstorm Warnings indicating potential for severe flash flooding.

Flood Bulletins should also contain relevant local flood information, including that available from the NSW authorities for the use of those members of the public located adjacent to Gannawarra Shire but in NSW. The Bulletins may also include information on local trends based on best information available at the time of release.

To ensure Flood Bulletins are released in a timely manner, standardised Flood Bulletins may be drafted based on different scenarios, prior to events occurring. The standardised Flood Bulletins can then be adapted to the specifics of the event occurring or predicted to occur.

5 Local Flood Warning System Arrangements

5.1 Local Information Officers

The formal flood warning system is complemented by an effective network of Local Information Officers who reside in seven (7) of the more vulnerable areas of the municipality (see list below), and are capable of providing or disseminating information as the case may be:

- Avoca River (south) / Lalbert Creek (all) / Back Creek (south)
- Avoca River (north) / Sandhill Lake / Back Creek (north) / Lakes system Avoca Outfall / Marshes / Wandell Creek (north)
- Wandella Creek / Loddon River (south) / Bannacher Creek / Nine Mile Creek / Calivil Creek
- Kow Swamp / Pyramid Creek / Box Creek / Barr Creek (south) / Murray River (south) / Calivil Creek / Gunbower Creek / Piccininny Barr Creek (south)
- Murray River (mid) / Gunbower Creek (north) / Piccininny Barr Creek (north) / Barr Creek (mid) / Pyramid Creek (mid)
- Murray River (north) / Barr Creek (north) / Loddon River (north) / Sheepwash Creek / Reedy Lakes
- Loddon River (mid) / Kerang Township

The seven (7) x Attachments to this Appendix contain structures and contact information for each of the Local Information Officer Groups listed above.

Leading up to and during a flood event, the municipality will liaise directly with these Local Information Officer groups and establish a two way flow of information to facilitate:

- a) Issue of relevant warnings to the affected communities (landowners and occupants) where necessary;
- b) Provision to those communities of other appropriate flood related information; and
- c) Provision of local information from the Local Information groups to VicSES and other agencies regarding the progress of flood waters and of flood response activities intelligence and early advice to VicSES / Council of significant changes and/or developments in particular areas.

In each case, the first point of contact should be the nominated Local Information Officer

5.2 Websites

Council will include a 'Flood Information' tab on the homepage of their website www.gannawarra.vic.gov.au. Information available through this tab will include:

- BoM updates - river level predictions and weather forecasts;
- Road closures;
- Sandbag policy and availability (as provided in Appendix G); and
- Links to the websites of other relevant agencies.

More detailed river levels and rainfalls as well as all flood watches and warnings are available on the BoM website (www.bom.gov.au).

6 Details of relevant gauges

Station No	River / Creek	Station	Flood Class Levels (m)			Gauge Zero* AHD (m)	Comments
			Minor	Moderate	Major		
	Avoca	Yawong Weir	3.00	4.30	5.00	142.719	
		Charlton (town)	5.00	7.00	7.50		
		Charlton D/S	5.00 (3.50)*	7.00 (5.00)*	7.50 (7.00)*		*Please note that these flood class levels are currently under reviewed, the recommended flood class levels are shown in brackets.
		Quambatook	2.00.	2.20	2.40	91.408	
	Loddon	Laanecoorie Res	1.50 2,000 ML/d	3.00 8,500 ML/d	5.50 43,000 ML/d	149.518	
		Loddon Weir D/S	3.30 2,030 ML/d	6.00 7,120 ML/d	7.00 10,380 ML/d	100.635	
		Appin South	2.80	3.10	3.30	80.116	
		Kerang (MVH Bridge)	77.00	77.50	77.80	0.000	
	Edwards	Deniliquin	4.60	7.20	9.40	83,174	
	Murray	Barmah	6.00	6.50	7.00	89,287	
		Echuca (Vic)	93.50	93.90	94.40	0.000	
		Torrumbarry D/S	7.30 39,000 ML/d	7.60 48,300 ML/d	7.80 56,800 ML/d	78.545	
		Barham	4.50	5.80	6.10	71.434	
		Swan Hill	4.50	4.60	4.70	62.921	

*Gauge Zero – Refers to normal gauge flow level

AVOCA RIVER (SOUTH) GROUP

Avoca River (south) ■ Lalbert Creek (all) ■ Back Creek (south)

**NOT AVAILABLE
FOR PUBLIC
VIEWING**

AVOCA RIVER (NORTH) / LAKES GROUP

**Avoca River (north) ■ Sandhill Lake ■ Back Creek (north) ■ Lakes System ■ Avoca Outfall ■
Marshes ■ Wandella Creek (north)**

**NOT AVAILABLE
FOR PUBLIC
VIEWING**

LODDON RIVER (SOUTH) GROUP

Wandella Creek ■ Loddon River (south) ■ Bannacher Creek ■ Nine Mile Creek ■ Calivil Creek

**NOT AVAILABLE
FOR PUBLIC
VIEWING**

LODDON RIVER (NORTH) / MURRAY RIVER (NORTH) GROUP

Murray River (north) ■ Barr Creek (north) ■ Loddon River (north) ■ Sheepwash Creek ■ Reedy Lakes

**NOT AVAILABLE
FOR PUBLIC
VIEWING**

MURRAY RIVER (SOUTH) / PYRAMID CREEK (SOUTH) GROUP

**Kow Swamp ■ Pyramid Creek ■ Box Creek ■ Barr Creek (south) ■ Murray River (south) ■ Calivil Creek ■ Gunbower Creek ■
Piccininny Barr Creek (south)**

**NOT AVAILABLE
FOR PUBLIC
VIEWING**

MURRAY RIVER (MID) / PYRAMID CREEK (MID) GROUP

**Murray River (mid) ■ Gunbower Creek (north) ■ Piccininny Barr Creek (north) ■
Barr Creek (mid) ■ Pyramid Creek (mid)**

**NOT AVAILABLE
FOR PUBLIC
VIEWING**

LODDON RIVER (MID) / KERANG TOWNSHIP GROUP
Loddon River (mid) ■ Kerang Township

**NOT AVAILABLE
FOR PUBLIC
VIEWING**

APPENDIX F - Maps

1 Overview

Maps considered useful to flood response are included in this Appendix. They include:

- Catchment maps showing the location of flood warning gauges (sourced from the Bureau of Meteorology – see Section 2).
- A 1% AEP flood extent map for Kerang which also shows the location of the town levees (note that the electricity substation is not shown). *Refer to Section 3.*
- Maps showing the location of the Kerang town levees. *Refer to Section 4.*

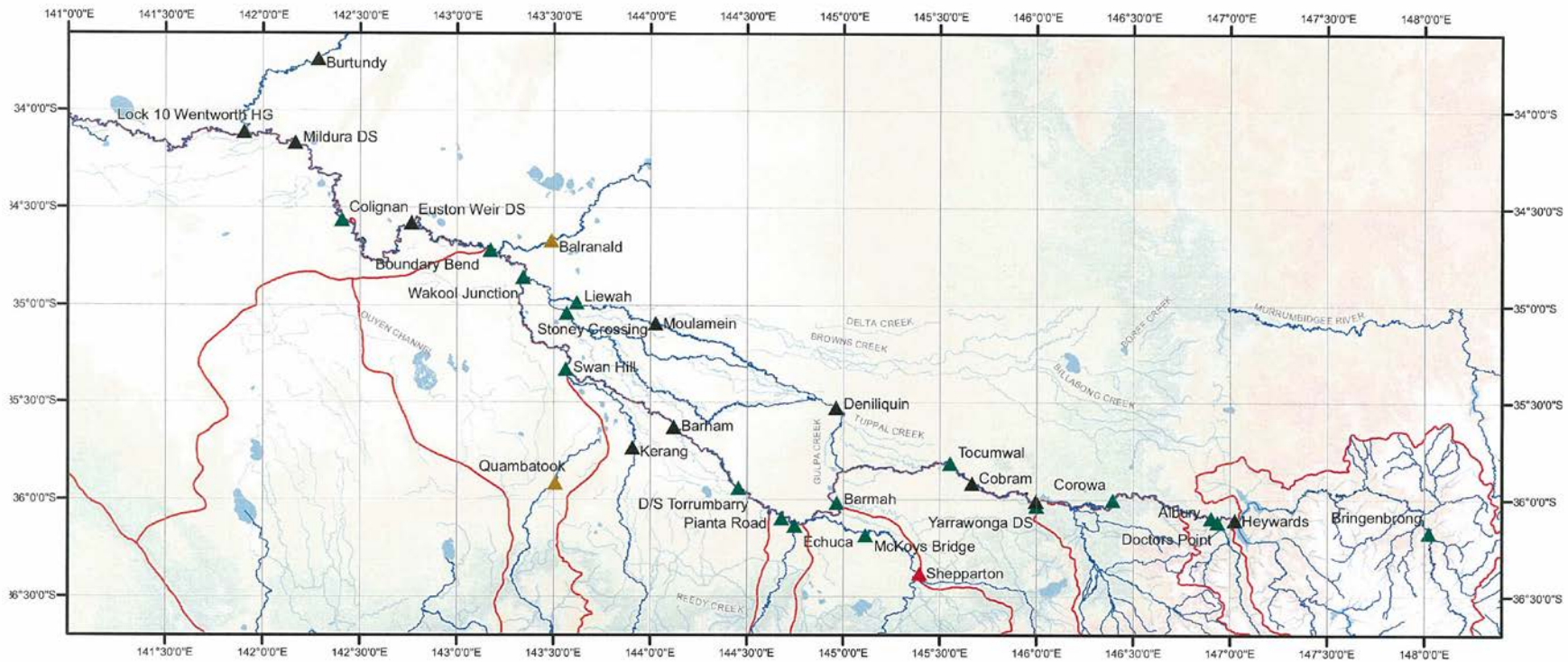
Note that:

- ◆ Maps that show the 1 in 100 year ARI (1% AEP) flood extent across the Shire are available from the North Central Catchment Management Authority website (*refer to the Appendix J for a list of references*).
- ◆ Maps showing the Urban Flood Zone, Floodway Overlay and Land Subject to Inundation Overlay are included in the Gannawarra Planning Scheme. These maps can be used as a guide to areas that may flood during an event. The maps can be found in hard copy in the Planning and Building Office at the Council's Kerang office or online at the Department of Planning and Community Development website (*refer to the Appendix J for a list of references*).
- ◆ Maps showing 100 year ARI (1% AEP) flood extents and floodways (together with volume, height and water quality data) are shown at the Victorian Water Resources website (*refer to the Appendix J for a list of references*).
- ◆ Maps showing the location of levees and flow paths are available from various study reports but particularly from
 - The Lower Loddon Floodplain Management Study, Serpentine to Kerang, and
 - The Lower Loddon Floodplain Management Study, Kerang to Little Murray River.

2 Catchment Maps (sourced from Bureau of Meteorology)

Murray River

Stream Gauge Flood Warning Data Collection Network



- Legend**
- | | | |
|--------------------------|-------------------------|-----------------------|
| Water Level Sites | Rain Gauge Sites | Repeater Sites |
| ▲ ERTS | ● ERTS | ■ ERTS |
| ▲ Mindata/Campbell | ● Mindata/Campbell/ES | |
| ▲ Vocamark/Telemark | ● AWS | |
| ▲ FTP | ● FTP | |
| ▲ Staff gauge | ● Manual Gauge | |



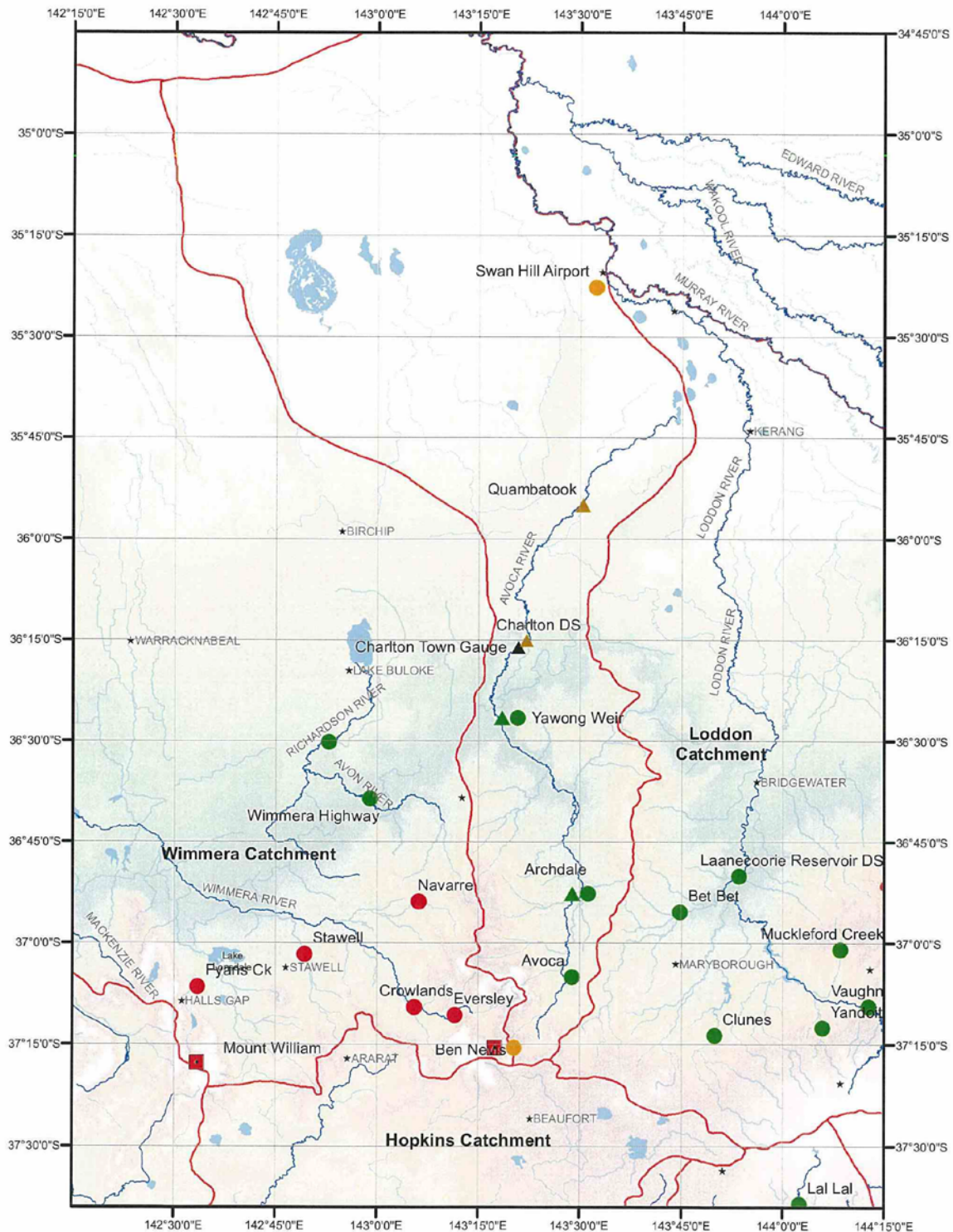
Hydrology and Flood Warning Section
Victorian Region
August 2007

Avoca River Basin

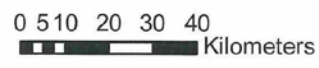
Flood Warning Data Collection Network



Australian Government
Bureau of Meteorology



- Legend**
- | | | |
|--------------------------|-------------------------|-----------------------|
| Water Level Sites | Rain Gauge Sites | Repeater Sites |
| ▲ ERTS | ● ERTS | ■ ERTS |
| ▲ Mindata/Campbell | ● Mindata/Campbell/ES | |
| ▲ Vocamark/Telemark | ● AWS | |
| ▲ FTP | ● FTP | |
| ▲ Staff gauge | ● Manual Gauge | |

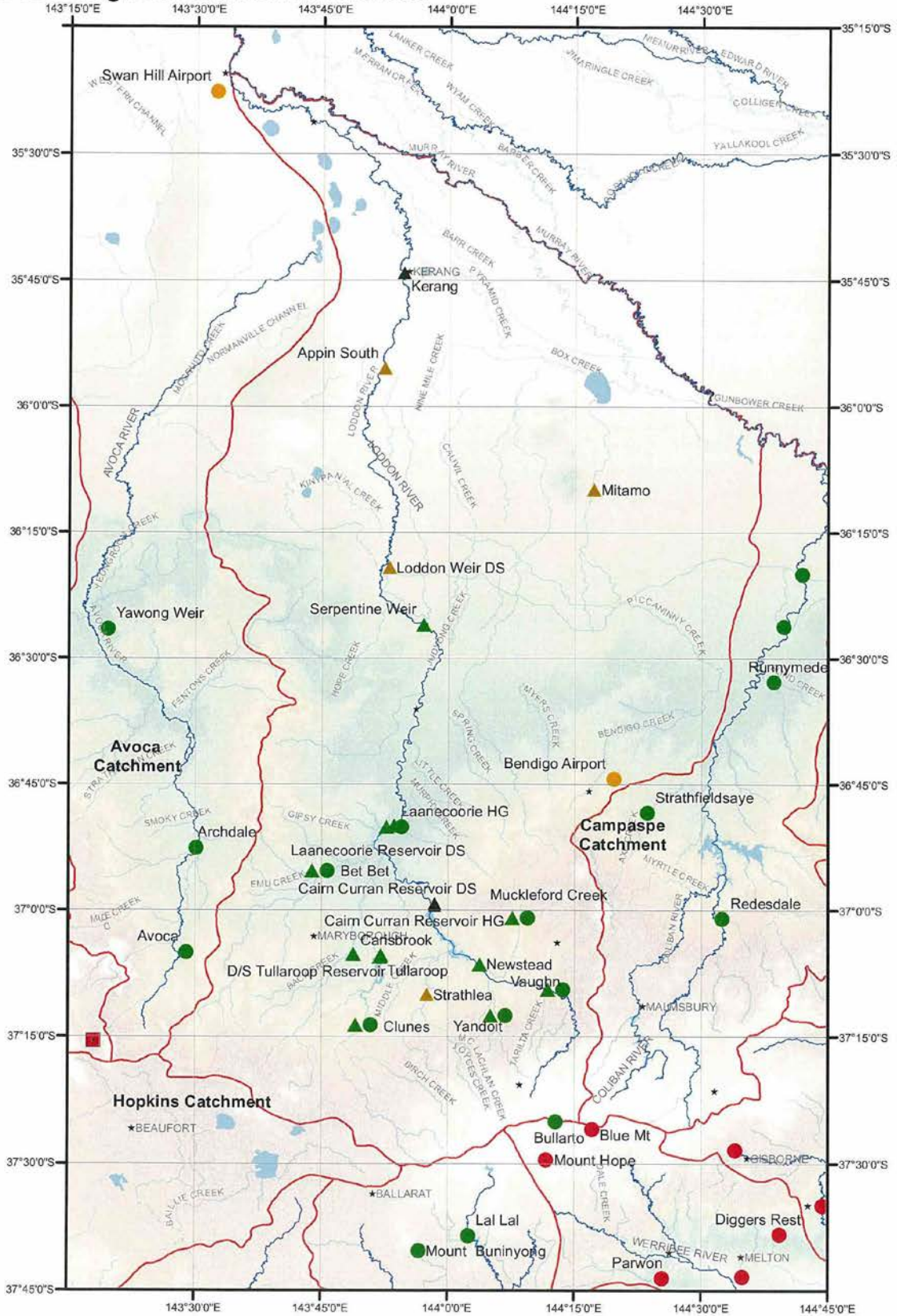


Hydrology and Flood Warning Section
Victorian Region
August 2007

Loddon River Basin Flood Warning Data Collection Network



Australian Government
Bureau of Meteorology



Legend

Water Level Sites

- ▲ ERTS
- ▲ Mindata/Campbell
- ▲ Vocamark/Telemark
- ▲ FTP
- ▲ Staff gauge

Rain Gauge Sites

- ERTS
- Mindata/Campbell/ES
- AWS
- FTP
- Manual Gauge

Repeater Sites

- ERTS

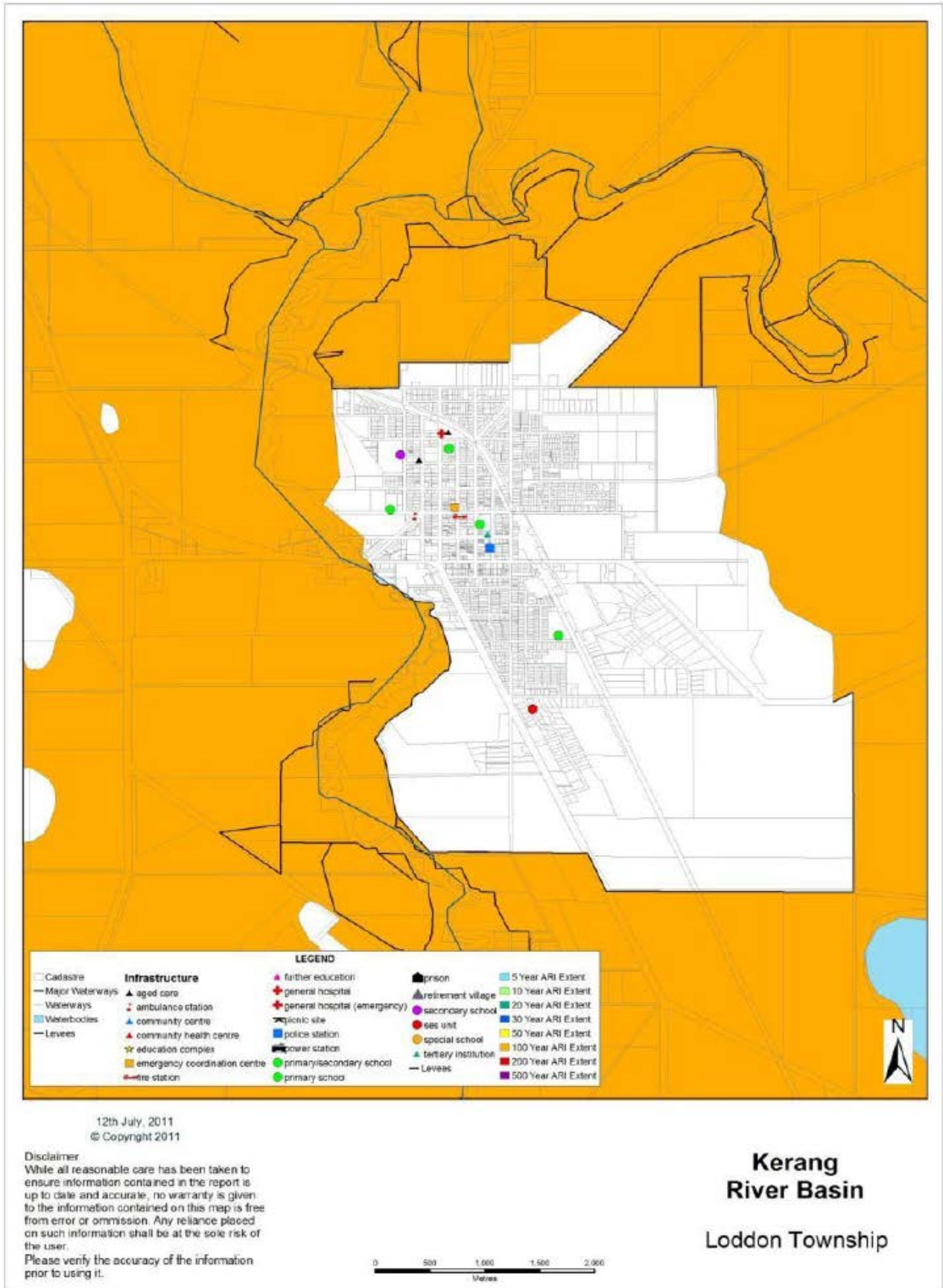
0 5 10 20 30 40

Kilometers

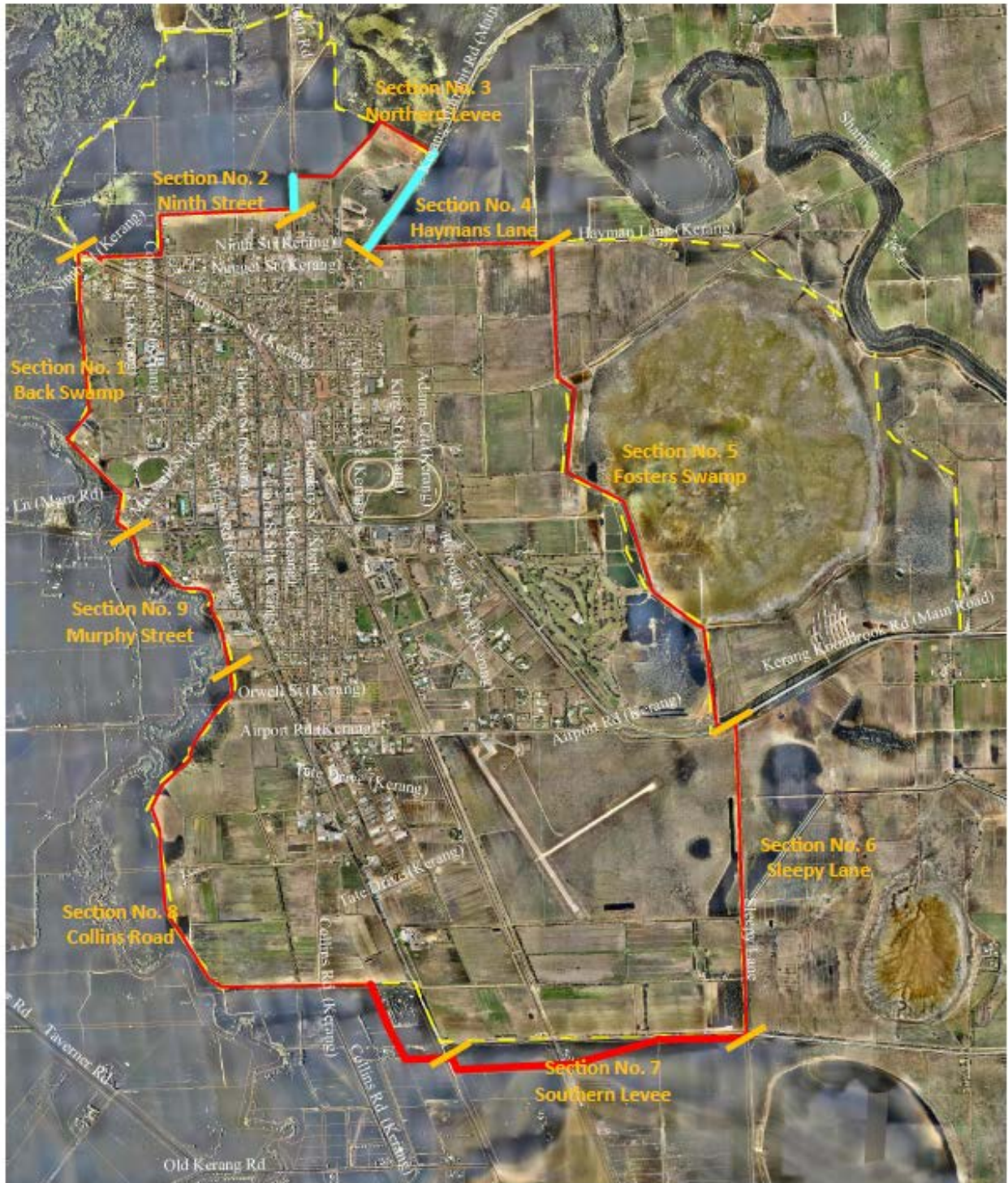
Hydrology and Flood Warning Section
Victorian Region
August 2007

3 1% AEP flood extent map for Kerang

The Kerang electricity terminal station is not shown on the following map. While threatened in January 2011, it did remain dry albeit isolated.



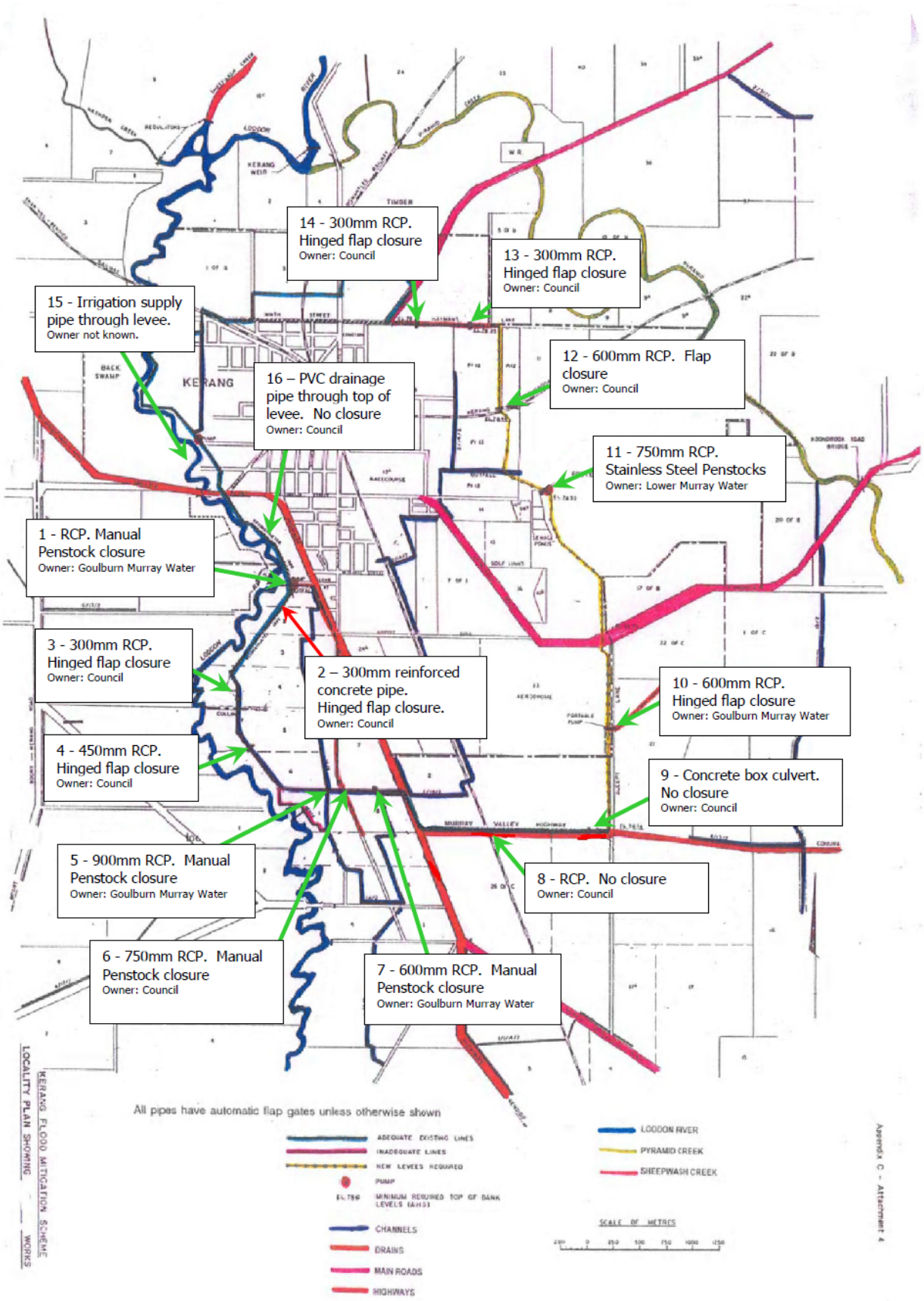
4 Kerang Township Protection Levee



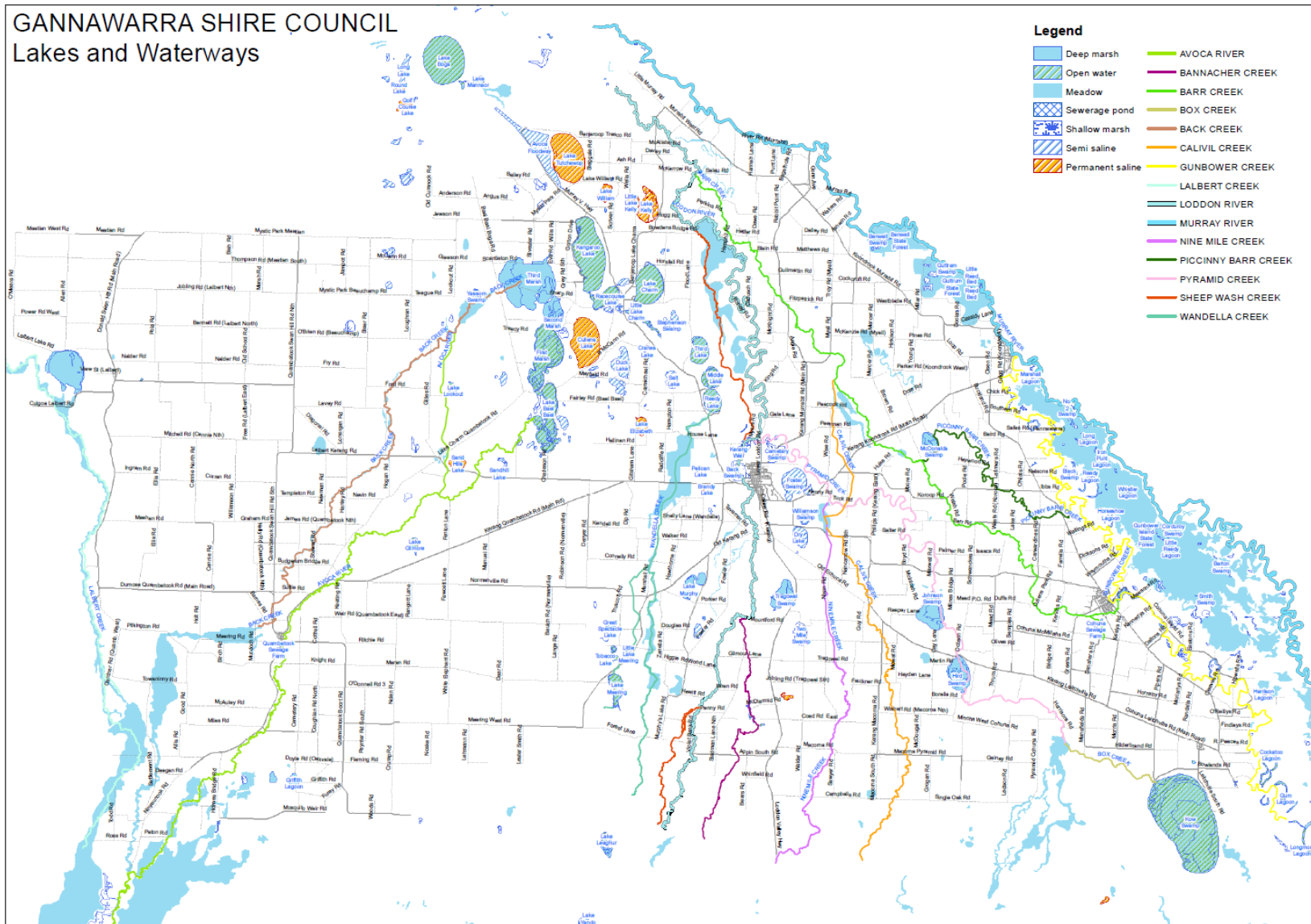
Legend

- Township protection levee
- Roads forming part of the levee
- Levee section break
- Existing levee

5 Kerang Drainage Systems



7 Gannawarra Lakes and Waterways



APPENDIX G - Sandbags

This applies to the procurement, storage, distribution, use and disposal of sandbags during flood emergencies, primarily Riverine flood events. Flash Flood events, due to their quick nature, will be directed by the local VicSES Unit.

1. Use of sandbags

Sandbags can be used to block doorways, drains and other openings into properties as well as to weigh-down manhole covers, garden furniture and to block sinks, toilets and bath drains to prevent water backing up. They have proven to be successful in keeping water out for short periods of time.

Sandbagging is not always the most effective option and should be considered in the context of this Flood Emergency Plan which includes alternatives for managing flood risk. Other alternatives include moving possessions to higher places, securing objects so they do not float away and placing valuables in water tight containers. During a flood event the Incident Controller and operational staff in the flood affected community will assess the overall risk to communities and allocate sandbag resources based on risk.

2. Responsibilities

VICSES responsibilities include:

- The management of the state-wide procurement and storage of sandbags for flood emergencies
- Providing sandbags to local areas for distribution based on requirements identified in the MFEP
- Identifying distribution arrangements in the MFEP
- Community education and awareness on sandbag management and safe use
- Identifying Critical Infrastructure and Community Critical Facilities in the MFEP
- Providing a support role in flood recovery.

Council responsibilities include:

- Supporting VicSES in developing the MFEP
- Providing a support role during flood response
- Identifying Community Critical Facilities at a municipal level
- Procuring sandbags to protect council owned facilities including Community Critical Facilities managed by council
- Providing locations, plant and equipment, where available and capable, to support sandbagging operations as agreed in the MFEP
- Coordinating the clean-up and community recovery arrangements

Community Critical Facility owners' responsibilities include:

- Working with VicSES to develop an effective flood mitigation plan for their property as part of the MFEP with a priority for permanent structures.

Other 'Response' agencies responsibilities include:

- Supporting VicSES in their response role.

Residential and commercial property owners' responsibilities include:

- Understanding their own flood risk
- Preparing an emergency plan for their home or business
- Procurement and storage of sandbags to protect their own property
- Filling and movement of sandbags to protect their property
- Seek advice from their local council regarding the removal of sandbags from their property, as part of the community recovery

3. Community and business education

VicSES has an established community education program to support community and business in responding to flood emergencies (see www.ses.vic.gov.au/prepare/floodsafe).

VicSES will use the existing community education tools and programs (such as the Local Flood Guides and the FloodSafe Program) to promote:

Practical information on:

- The purpose, use and disposal of sandbags (see www.ses.vic.gov.au/prepare/floodsafe/floodsafe-resources/sandbag-reference-guide)
- Obtaining sandbags
- Safety considerations e.g. OHS, manual handling, safe use and disposal
- Alternative flood mitigation strategies to sandbagging
- Where to get information – Phone 1300 842 737 for the VicSES Information Line
- The responsibilities of critical infrastructure owners, businesses and private individuals to understand their flood risk and develop a flood plan

Key messages:

- Emergency response agencies will not always have the capacity to provide sandbags due to other competing priorities
- Businesses and individuals need to understand the flood risk to their property and, where appropriate, develop a Flood Emergency Plan
- Sandbagging is only one way of protecting properties against floodwater and not always the most effective option. Sandbagging should be considered in the context of a Flood Emergency Plan which considers alternatives for managing flood risk.

4. Procurement of sandbags

VicSES

VicSES will maintain a supply of sandbags to support the effective readiness and response to flood emergencies as identified in this MFEP.

The number of sandbags required at a State and regional level will be determined from information provided through the MFEP planning process. There may be occasions where the supply of sandbags is limited and priorities for distribution will need to be determined through local emergency management arrangements.

VicSES will maintain the current cross-border and mutual aid arrangements for flood emergencies. VicSES will also work with local councils to access the resource sharing arrangements established between councils during emergencies.

Council

Council will procure sandbags to protect council owned facilities including community critical facilities managed by Gannawarra Shire Council.

Residential and commercial property owners'

Sandbags may be obtained (purchased) from a number of online shops. There are a number of local businesses who sell sand such as Mawsons (Cohuna), C Wandin (Kerang), Dahlsens (Kerang), Elliotts (Gunbower).

5. Storage of sandbags

VicSES

Sandbags will be stored by VICSES in appropriate locations across the municipality. VicSES will monitor the condition of all its sandbags for deterioration.

VicSES sandbags storage locations and initial quantities are as follows:

Kerang VicSES Local Headquarters (LHQ) 4000 bags (minimum)

Swan Hill VicSES Local Headquarters (LHQ) 4000 bags (minimum)

Additional sandbag supplies are held at the North West (Loddon Mallee) VicSES Regional Offices, located in Bendigo & Swan Hill. These can be accessed for replenishment or additional requirements. Additional sandbags will be supplied to these locations in the lead up to a flood event.

Council

Sandbags will be stored at appropriate Council locations across the municipality. Council will monitor the condition of all its sandbags for deterioration.

Council sandbags storage locations and quantities are as follows:

- Council Works Depot, Park Road, Kerang.

6. Distribution of sandbags

Priorities

The Incident Controller may make sandbags and sand available for flood mitigation activities during declared flood emergencies.

Sandbags will be issued consistent with the Strategic Control Priorities within the State Flood Emergency Plan, in the following order of priority to protect:

1. Critical Infrastructure and Community Critical facilities identified:
 - (a) in the MFEP; or
 - (b) by the Incident Management Team
2. Residential properties identified in the potential flood area
3. Commercial properties identified in the potential flood area
4. Environmental and conservation areas identified in the potential flood area.

Properties identified as being outside the potential flood area, will be referred to an alternative source of sandbags (e.g. local hardware store or sandbag supplier) by VicSES.

The Floodsafe Sandbag Quick Reference Guide provides details to community members about the indicative number of sandbags required for residential property protection and guidance on the safe use, for the filling and laying of sandbags.

Refer to www.ses.vic.gov.au/prepare/floodsafe/floodsaferesources/sandbag-reference-guide

As part of the response arrangements, the Incident Controller will track the distribution of sandbags through the Incident Management Team (IMT). This information will be provided to the recovery team as part of the transition from response to recovery.

Provision of sand

VicSES

VicSES will have plans in place to acquire sand through its own supply arrangements and where necessary through the emergency management arrangements. These arrangements will be identified in the MFEP. Sand suppliers may be identified in the MFEP.

Council

Council will have plans in place to acquire sand through its own supply arrangements.

During a localised non declared flood event, sand will be procured by the local responding VicSES Unit. During a declared flood event, sand will be procured via the Incident Control Centre.

7. Disposal and relocation of used sandbags

Sandbags may be contaminated after use and local councils should ensure that clean up and disposal is considered as part of recovery. Removal and disposal of sandbags used for flood mitigation shall be dealt with under the clean up and community recovery arrangements as outlined in the Emergency Management Manual Victoria. The disposal of sandbags is a shared responsibility between different agencies.

Incident Controllers will provide information on sandbag locations to councils, to assist with clean-up. VicSES will continue to work with relevant agencies to develop protocols for the safe and environmentally responsible disposal of sandbags.

APPENDIX H - Sandbagging of Critical Infrastructure

Gannawarra Shire Council has a stock of sandbags (approx. 10,000 sandbags) and sand for the protection of critical infrastructure during a flood. Strategic locations for sand and sandbags will be decided upon determined by the nature of the flood. VicSES is the responsible authority for providing sandbags for private properties as per the VicSES Sandbag Guidelines.

The following critical infrastructure will be sandbagged depending on the nature of the flood.

Water Supply

- Kerang Filtration Plant (Lower Murray Water)
- Cohuna Filtration Plant (Coliban Water)
- Koondrook Filtration Plant (Lower Murray Water)
- Quambatook Filtration Plant (Grampian Wimmera Mallee Water)
- Murrabit Sewerage Scheme - Effluent Reuse

Water Treatment

- Kerang Sewerage Lagoons and pump stations (LMW)

Electricity

- Kerang Substation (SPAusNet) – remained dry and protected during the January 2011 flood The owner of this facility is currently working on permanent structural mitigation measures that are expected to conform to 300mm above the 1% AEP
- Horefield Substation (SPAusNet)
- Charlton Substation (SPAusNet) – this substation affects Quambatook District

Telecommunications

- Kerang Exchange

Stormwater Pump Stations

- Kerang
- Quambatook
- Koondrook

Strategic Levees

- Murray Valley Highway Loddon River Bridge
- Bendigo Swan Hill rail line south of Kerang (when new levee constructed 2012 / 2013)

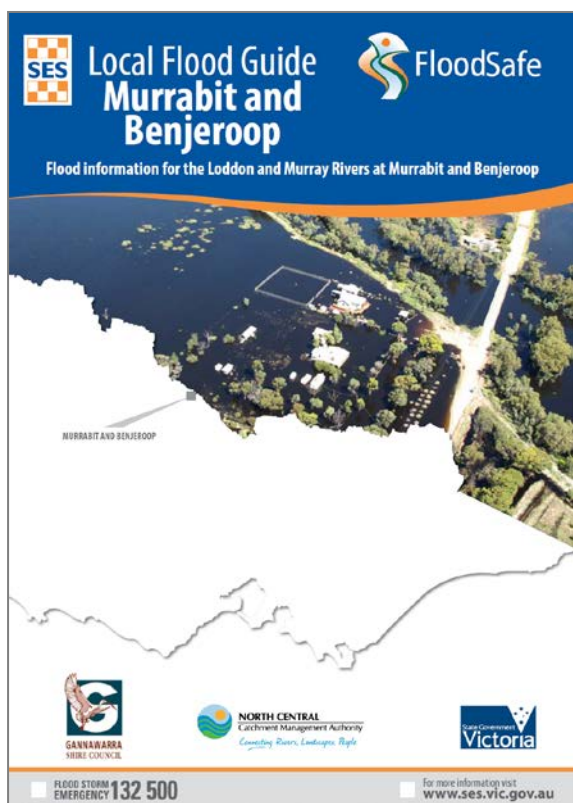
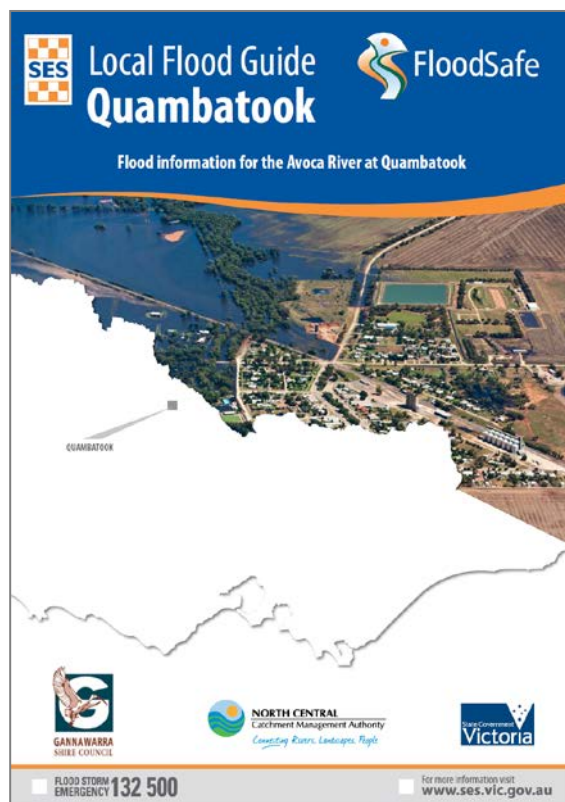
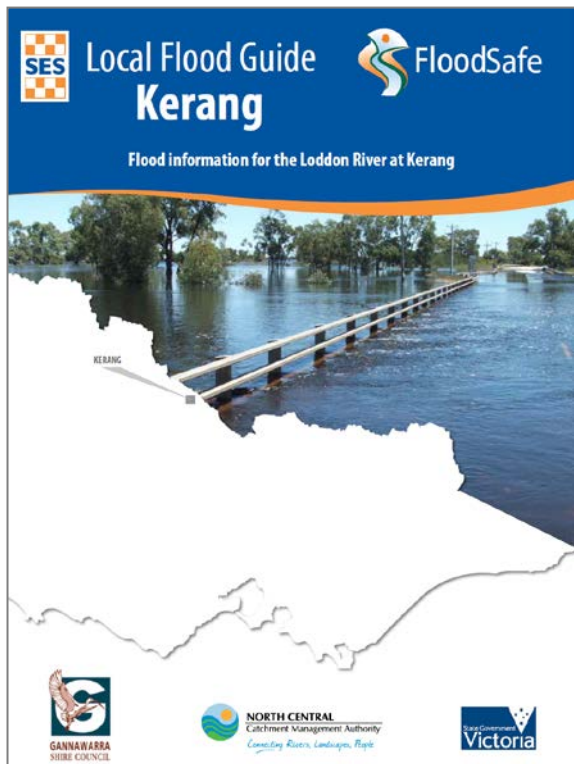
APPENDIX I – Response Coordinator Aide Memoir – Resource Considerations

The Response Coordinator, whether municipal or regional, is primarily responsible for ensuring resources are made available to support to the Control Agency, which in the case of flood is VicSES. In considering responsibilities, the following is a list of potential activities which, although not meant or intended to be exhaustive, may act as a prompt to assist in focusing on the type of activities that may be needed to provide resources to assist the Control Agency:-

- Establishment of a Municipal Emergency Co-ordination Centre (MECC)
- Protection of life, property and environment
- Ensuring medical treatment is provided and hospital(s) notified
- Adequate medical supplies and medications are available
- Evacuation of persons where necessary
- Registration of persons evacuated or otherwise affected
- Provision of material needs of evacuees, control and support agencies where necessary
- Prevention of unauthorised entry into emergency area
- Maintenance of order around emergency area
- Traffic diversions
- Access and egress for emergency vehicles
- Care of deceased on behalf of Coroner
- Investigation of crime (where appropriate)
- Fact gathering for inquests or Judicial inquiries
- Media relations
- Maintenance of proper records

APPENDIX J - Local Flood Guides

Under the Floodsafe Program, VicSES in consultation with Local Information Officers, Council and NCCMA produced Local Flood Guides for the townships of Kerang, Quambatook and Murrabit/Benjeroop. The Flood Guides explain local flood risks for each of the communities of Kerang, Quambatook and Murrabit/Benjeroop. The guides also advise how to prepare for and respond to flood events.



KERANG LOCAL FLOOD GUIDE

Local Flood Information

The Kerang Local Area

Kerang is located within the Shire of Gannawarra on the Loddon River, a few kilometres north of the intersection of the Murray Valley and Loddon Valley Highways. Kerang's main river is the Loddon River but it often receives overflows from other rivers and creeks such as Pyramid Creek. Properties in the town, surrounding rural areas and essential infrastructure including the nearby electricity sub-station are at risk of flooding.

The area around Kerang is prone to being cut-off by floodwater when any or all of the Murray Valley and Loddon Valley Highways, Koondrook Road and Kerang-Quambatook Road are closed.

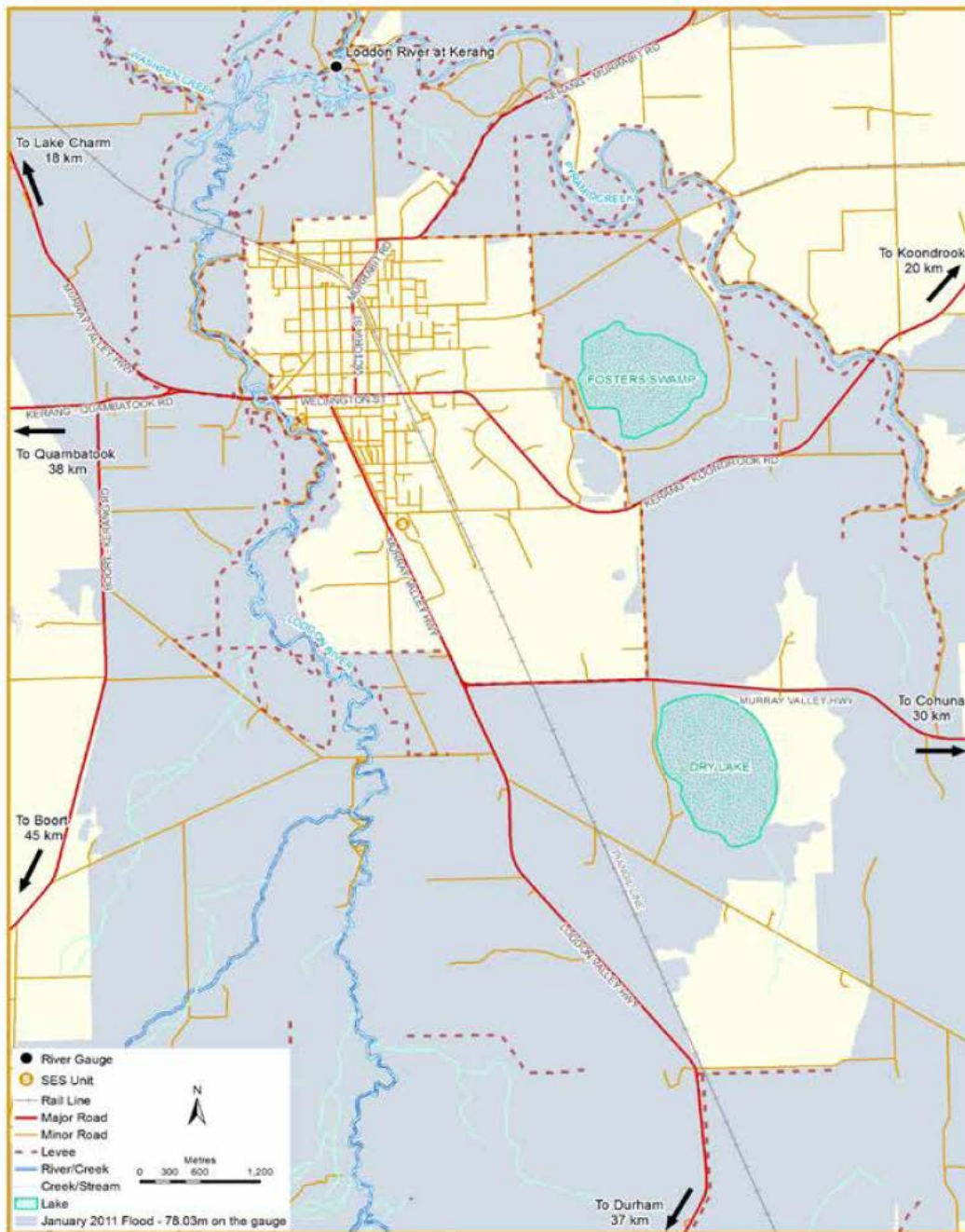
The town is surrounded by levees, most of which were built between 1980 and 1996 as part of a flood mitigation scheme. However, no levee is flood proof and parts of the town may still be prone to flooding. The map below shows the extent of the January 2011 flood which measured 78.03m on the Murray Valley Highway River Gauge:

Your local emergency broadcasters are:

- ABC Local 102.1 FM
- Mixx 98.7 FM
- SKY NEWS Television

Gannawarra Shire Council Contact:

Phone: (03) 5450 9333
 Email: council@gannawarra.vic.gov.au
 Web: www.gannawarra.vic.gov.au



Disclaimer
 This publication is presented by the Victoria State Emergency Service for the purpose of disseminating emergency management information. The State Emergency Service disclaims any liability (including for negligence) to any person in respect of anything and the consequences of anything done, or not done of any kind including damages, costs, interest, loss of profits or special loss or damage, arising from any error, inaccuracy, incompleteness or other defect in this information. By any such person in whole or partial reliance upon the whole or part of the information in this map publication. Flood information is provided by North Central Catchment Authority.

Your Local Flood Information

Know your risk

Are you at risk of flood?

Kerang is on the Loddon River floodplain, making it susceptible to flooding. The town and its surrounding areas are vulnerable to overland flows of water due to the flat nature of the landscape. Kerang is located close to the Loddon River and within the Loddon catchment there are a number of creeks and river run offs.

Significant floods have occurred in Kerang since records began including in 1909, 1916, 1933, 1975, 1981, 1993 and 2011. The 2011 flood followed an extensive period of wet weather with major flooding through the lower Loddon and Avoca Rivers in September and December 2010.

Properties start to become isolated to the north and south of Kerang when the Murray Valley Highway Bridge Gauge reads 77.20 metres, just about minor flood level.

Widespread flooding in Kerang led to a number of mitigation works in the area during 1980-1996 to help reduce the impact of floods. Kerang's levees run for 17 kilometres and includes part of the Murray Valley Highway to the south of the town.

During the 2011 flood, floodwater overtopped the Pyramid Creek levee. However, the township of Kerang was saved from the full extent of the flooding by a combination of the levee on the Loddon River and a temporary levee built on the southern side of Kerang. Kerang's levees have reduced the level of risk associated with flooding in some areas of the town, however no levee is flood proof and some houses and businesses inside and outside of the town were flooded.

Loddon River Flood Levels at the Murray Valley Highway Bridge Gauge

When the Bureau of Meteorology (BoM) issues flood warnings they include a prediction of the flood height at a particular gauge. While no two floods are the same, the following table can give you an indication of what you can expect at certain heights, including when your access may be cut off and when your property may be affected.

78.03 m	19 January 2011 flood During the January 2011 flood, Kerang was just protected by town levees but many properties, roads and levees damaged in the surrounding area including 20 houses in the immediate vicinity, 13 houses and one shop in East Kerang, 28 houses and four businesses in Kerang West, the Murray Valley and Loddon Valley Highways. Height shown on page 2.
77.90 m	Design level for Kerang flood levee*
77.84 m	1981 flood – before the town levees was completed
77.80 m	MAJOR FLOOD LEVEL
77.60 m	September 1993 flood
77.50 m	MODERATE FLOOD LEVEL
77.40 m	Properties start to become isolated to the north and south of Kerang
77.20 m	10 December 2010 flood
77.00 m	MINOR FLOOD LEVEL

*Note: The design level is the height that a levee was designed to provide protection. This is lower than the top of the levee which is why the Kerang levee did not overtop in the 2011 flood. This is called the freeboard of a levee. Freeboard should NEVER be relied on to provide protection in a flood.

Did you know?

Until January 2011, the largest flood occurred in 1909 where extensive parts of Kerang and its surrounding rural areas were flooded. In 2011, the flood reached the highest levels ever recorded causing significant damage to the township and its associated rural areas flooding:

- 13 houses and 1 shop in East Kerang, and 28 houses and 4 businesses in West Kerang.
- Rural properties surrounding the town isolating them for days.
- Main transport routes and other roads, disrupting traffic.
- Community facilities and other private properties.

During the 2011 flood, widespread power outages for Victorian communities were avoided by emergency sandbagging activities of the electricity substation, located south of the Kerang township.

If you live or work close to a creek, river or low-lying area you may be at risk from floods.

Even if you are not directly affected, you may still have to detour around flooded areas.

The Murray Valley Highway Bridge Gauge is measured based on the Australian Height Datum (AHD) which assumes sea level is 0 metres.



An example of a flood gauge.

About Flood Warnings

What warnings mean

Flood Watches and **Flood Warnings** are issued by the Bureau of Meteorology (BoM) to tell people about possible flooding.

A **Flood Watch** means there is a developing weather pattern that might cause floods in one or two days.

Flood Warnings mean flooding is about to happen or is already happening. There are Minor, Moderate and Major flood warnings.

Minor Flood Warning means floodwater can:

- Reach the top of the river banks
- Come up through drains in nearby streets
- Cover low-lying areas including riverside camping areas
- Affect some low-lying caravan parks
- Cover minor roads, tracks and low level bridges
- Spread across land or go into buildings on some properties and farms.

A Moderate Flood Warning means floodwater can:

- Spill over river banks and spread across low-lying areas
- Start to threaten buildings, roads, rail, power and other developments
- Require evacuation in some areas
- Cover main roads.

A Major Flood Warning means floodwater can:

- Cause widespread flooding
- Threaten more houses and businesses
- Cause properties and whole areas to be isolated by water
- Disrupt major roads and transport routes
- Require many evacuations.

The Victoria State Emergency Service (SES) will give information about how the floodwater might affect people and properties. This includes safety messages to remind you what to do.

Severe Thunderstorm Warnings

Thunderstorms are classified as severe, due to their potential to cause significant localised damage through: wind gusts, large hail, tornadoes or flash flooding. Severe thunderstorm warnings are issued to the community by the Bureau of Meteorology.

Severe Weather Warnings

These warnings are issued to the community by the Bureau of Meteorology when severe weather is expected that is not directly related to severe thunderstorms or bushfires. Examples of severe weather include damaging winds and flash flooding.

Flash Flooding happens quickly. There may be little or no warning. The arrival time or depth of a flash flood can usually not be predicted.

Remember, you may not receive any official warning.

Emergency assistance may not be immediately available. Be aware of what is happening around you to stay safe.

Never wait for a warning to act.

Emergency Alert

SES may provide alerts to the Kerang community through the Emergency Alert telephone warning system. All Emergency Services can use Emergency Alert to warn communities about dangerous situations by voice message to landline telephones or text message to mobile phones.

If you receive a warning, make sure that all family members, people at work and your neighbours are aware of the situation.

If you receive an Emergency Alert you should pay attention and act. It could mean life or death.

Flood Warnings for Kerang

For the Loddon River Flood Warnings are issued by the Bureau of Meteorology. Flood Warnings provide predictions of flood size (minor, moderate or major), time and possible peaks of the Loddon River.

It is important to know how the predicted flood levels are likely to impact you as you may be affected before the peak. *See page 3: Loddon River Flood Levels at the Murray Valley Highway Bridge.* While no two floods are the same, you can use this table to help you figure out when you need to start following your flood emergency plan.

Flood levees

A levee is an embankment usually along-side a river or creek designed to protect property from floodwater.

Levees can reduce the frequency of flooding but no levee is guaranteed to be flood proof. A levee is designed to control a certain amount of floodwater. If larger floods occur, water will flow over the levee into low-lying areas. Floodwater may also damage the levee, allowing floodwater to flow through an opening or break.

Flood levees are to protect property, not people. If the levee is in danger of failing, you will be advised to evacuate flood prone areas. It is important that you follow this advice.



QUAMBATOOK LOCAL FLOOD GUIDE

Local Flood Information

The Quambatook local area

Quambatook is located on the banks of the Avoca River, and is at risk of flooding from the Avoca River. Quambatook is also vulnerable to flash flooding caused by heavy rainfall over a short period of time.

Although Quambatook town is built on higher ground and has levees providing some protection, large floods can still cause damage within the township and no levee is guaranteed flood proof. During the January 2011 flood event approximately three kilometres of temporary earthen levees were constructed by Council with considerable local voluntary effort. If the temporary levees had not been constructed most of the 120 houses and shops in town would have been flooded.

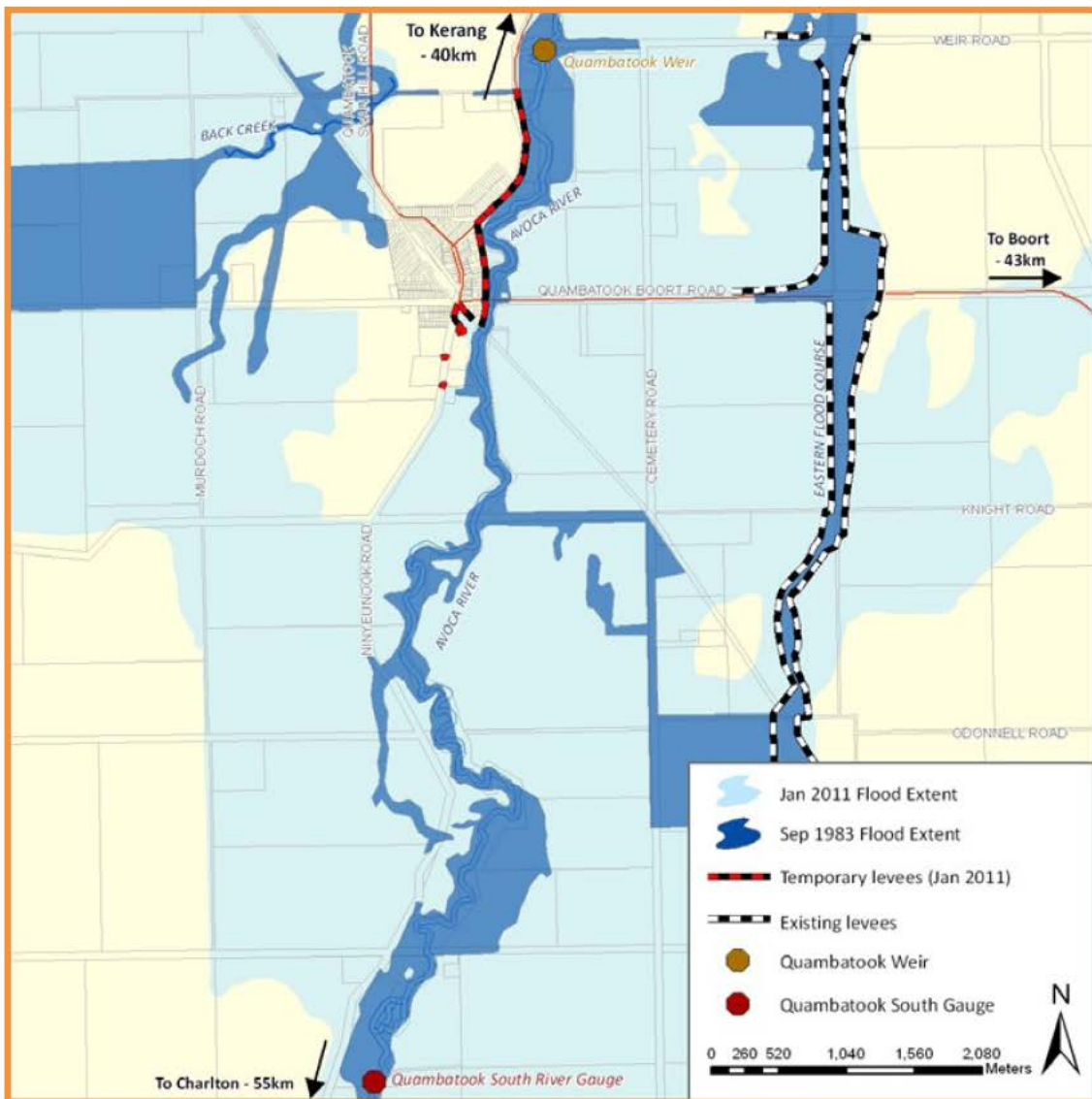
The map below shows the extent of flooding in the January 2011 and September 1983 floods as well as the location of the temporary levees built by Council and the local community:

Your local emergency broadcasters are:

- ABC Local Radio 102.1 FM
- Mixx 98.7 FM
- SKY NEWS Television

Shire of Gannawarra Contact details:

Phone: 03 5450 9333
 Email: council@gannawarra.vic.gov.au
 Web: www.gannawarra.vic.gov.au



Disclaimer

This publication is presented by the Victoria State Emergency Service for the purpose of disseminating emergency management information. The State Emergency Service disclaims any liability (including for negligence) to any person in respect of anything and the consequences of anything, done, or not done of any kind including damages, costs, interest, loss of profits or special loss or damage, arising from any error, inaccuracy, incompleteness or other defect in this information, by any such person in whole or partial reliance upon the whole or part of the information in this map publication. Flood information is provided by North Central Catchment Management Authority.

Your Local Flood Information

Know your risk

Are you at risk of flood?

Quambatook is situated on the banks of the Avoca River. This results in Quambatook being at risk of flooding from the Avoca River as well as being vulnerable to overland flooding from Back Creek.

Quambatook is also subject to flash flooding from heavy rainfall. On 9 January 2011 after 100mm of rain fell in a few hours, water overwhelmed the town's drainage which resulted in flash flooding in parts of the township.

Since the river gauge was installed at Quambatook South in 1963, there have been 17 recorded flood events above the minor flood level. Until the January 2011 flood, prior smaller flood events were generally limited to rural land and required the occasional closure of minor roads.

Although levees and floodways assist in protecting the Quambatook township, these levees are only designed to protect property and cope with a certain flood level. Floods in excess of the major flood level may result in water overflowing the levees and floodways, flooding of town. This was prevented in 2011 when temporary levees were constructed on the eastern side of town. No levee is guaranteed flood proof.

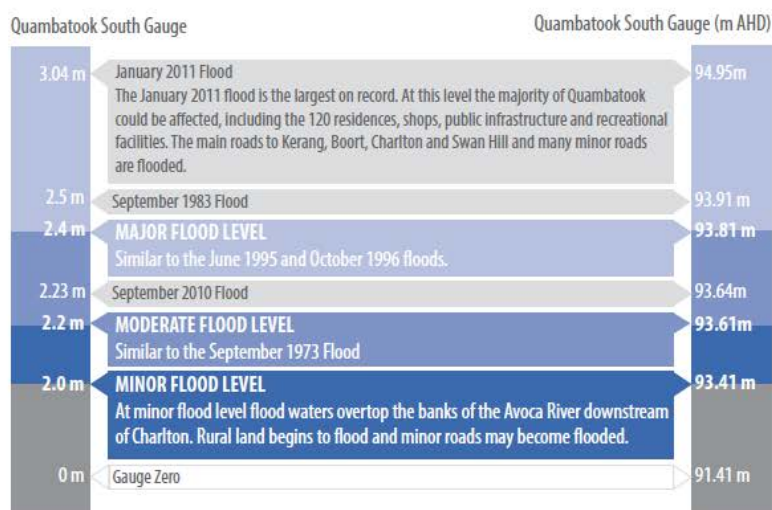
If flooding affects Charlton, then it typically affects Quambatook 40-80 hours later.

Avoca River flood levels at the Quambatook South Gauge

When the Bureau of Meteorology (BoM) issues a Flood Warning, they will include an expected height of the peak of the flood based on a flood gauge. There are three gauges along the Avoca river: Yawong Weir at Coonooer, Charlton (approx 3 km downstream of Charlton) and Quambatook South (approx 6.5 km upstream of Quambatook-see map page 2).

The table below provides an indication of what may happen when floodwater reaches a certain height on the gauge at Quambatook South. It is important to remember that no two floods are the same and this information is a guide only.

The Quambatook South gauge on the BoM website is measured based on the depth of water above the bed of the river. This information has also been displayed in Australian Height Datum (AHD) which assumes sea level is 0 metres.



Did you know?

The Quambatook area has a history of flooding, including between 1973 to 1983, when a period of unusually wet weather led to flooding of the Avoca River. More recently, the January 2011 flood was the worst in Quambatook's recorded history and caused:

- Surrounding rural areas to flood.
- Construction of temporary levees to protect the town.
- Significant flood damage to the community swimming pool, tennis courts, caravan park, football oval and golf club.
- Isolation of Quambatook with the only way out being towards Swan Hill.

The January 2011 flood has been classified as a '1 in 200 year' event on the Avoca River. This does not mean that it will not occur again for another 200 years, rather it indicates that there is a 0.5% chance of this level of flood occurring in any year.

While no two floods are the same, floods like this or worse could occur again. If you live or work close to a creek, river or low-lying area you may be at risk of flooding. Even if you are not directly affected, you may still have to detour around flooded areas.



Example of a river height gauge

About Flood Warnings

What warnings mean

Flood Watches and **Flood Warnings** are issued by the Bureau of Meteorology (BoM) to tell people about possible flooding.

A **Flood Watch** means there is a developing weather pattern that might cause floods in one or two days.

Flood Warnings mean flooding is about to happen or is already happening. There are Minor, Moderate and Major flood warnings.

A Minor Flood Warning means floodwater can:

- Reach the top of the river banks
- Come up through drains in nearby streets
- Cover low-lying areas including riverside camping areas
- Affect some low-lying caravan parks
- Cover minor roads, tracks and low level bridges
- Spread across land or go into buildings on some properties and farms.

A Moderate Flood Warning means floodwater can:

- Spill over river banks and spread across low-lying areas
- Start to threaten buildings, roads, rail, power and other developments
- Require evacuation in some areas
- Cover main roads.

A Major Flood Warning means floodwater can:

- Cause widespread flooding
- Threaten more houses and businesses
- Cause properties and whole areas to be isolated by water
- Disrupt major roads and transport routes
- Require many evacuations.

The Victoria State Emergency Service (SES) will give information about how the floodwater might affect people and properties. This includes safety messages to remind you what to do.

Severe Thunderstorm Warnings

Thunderstorms are classified as severe, due to their potential to cause significant localised damage through: wind gusts, large hail, tornadoes or flash flooding. Severe thunderstorm warnings are issued to the community by the Bureau of Meteorology.

Severe Weather Warnings

These warnings are issued to the community by the Bureau of Meteorology when severe weather is expected that is not directly related to severe thunderstorms or bushfires. Examples of severe weather include damaging winds and flash flooding.

Flash Flooding happens quickly. There may be little or no warning. The arrival time or depth of a flash flood can usually not be predicted.

Remember, you may not receive any official warning.

Emergency assistance may not be immediately available. Be aware of what is happening around you to stay safe.

Never wait for a warning to act.

Emergency Alert

SES may provide alerts to the Quambatook community through the Emergency Alert telephone warning system. All Emergency Services can use Emergency Alert to warn communities about dangerous situations by voice message to landline telephones or text message to mobile phones.

If you receive a warning, make sure that all family members, people at work and your neighbours are aware of the situation.

If you receive an Emergency Alert you should pay attention and act. It could mean life or death.

If you need help to understand a warning, ask a friend, neighbour or family member.

Flood Warnings for Quambatook

For the Avoca River Flood Warnings are issued by the Bureau of Meteorology. Flood Warnings provide predictions of flood size (minor, moderate or major), time and possible peaks of the Avoca River.

It is important to know how the predicted flood levels are likely to impact you as you may be affected before the peak. *See page 3: Avoca River Flood Levels at the Quambatook South Gauge.*

Use the table on page 3 to figure out when you need to start following your flood emergency plan.

Flood levees

A levee is an embankment usually along-side a river or creek designed to protect property from floodwater.

Levees can reduce the frequency of flooding but no levee is guaranteed to be flood proof. A levee is designed to control a certain amount of floodwater. If larger floods occur, water will flow over the levee into low-lying areas. Floodwater may also damage the levee, allowing floodwater to flow through an opening or break.

Flood levees are to protect property, not people. If the levee is in danger of failing, you will be advised to evacuate flood prone areas. It is important that you follow this advice.

MURRABIT AND BENJEROOP LOCAL FLOOD GUIDE

Local Flood Information

The Murrabit and Benjeroop local area

Murrabit, Benjeroop and the surrounding rural areas are located on the floodplain of the lower Loddon River and are prone to widespread flooding. Although the township of Murrabit is located on higher ground and has levees providing some protection, large floods can still cause damage within the township and no levee is guaranteed flood proof.

The land around Murrabit and Benjeroop is very flat, which means that if either the Loddon River or Murray River floods, extensive areas across the district can be inundated for an extended period of time. Levees are located throughout the floodplain, however levees are not guaranteed and parts of the region may still be prone to flooding.

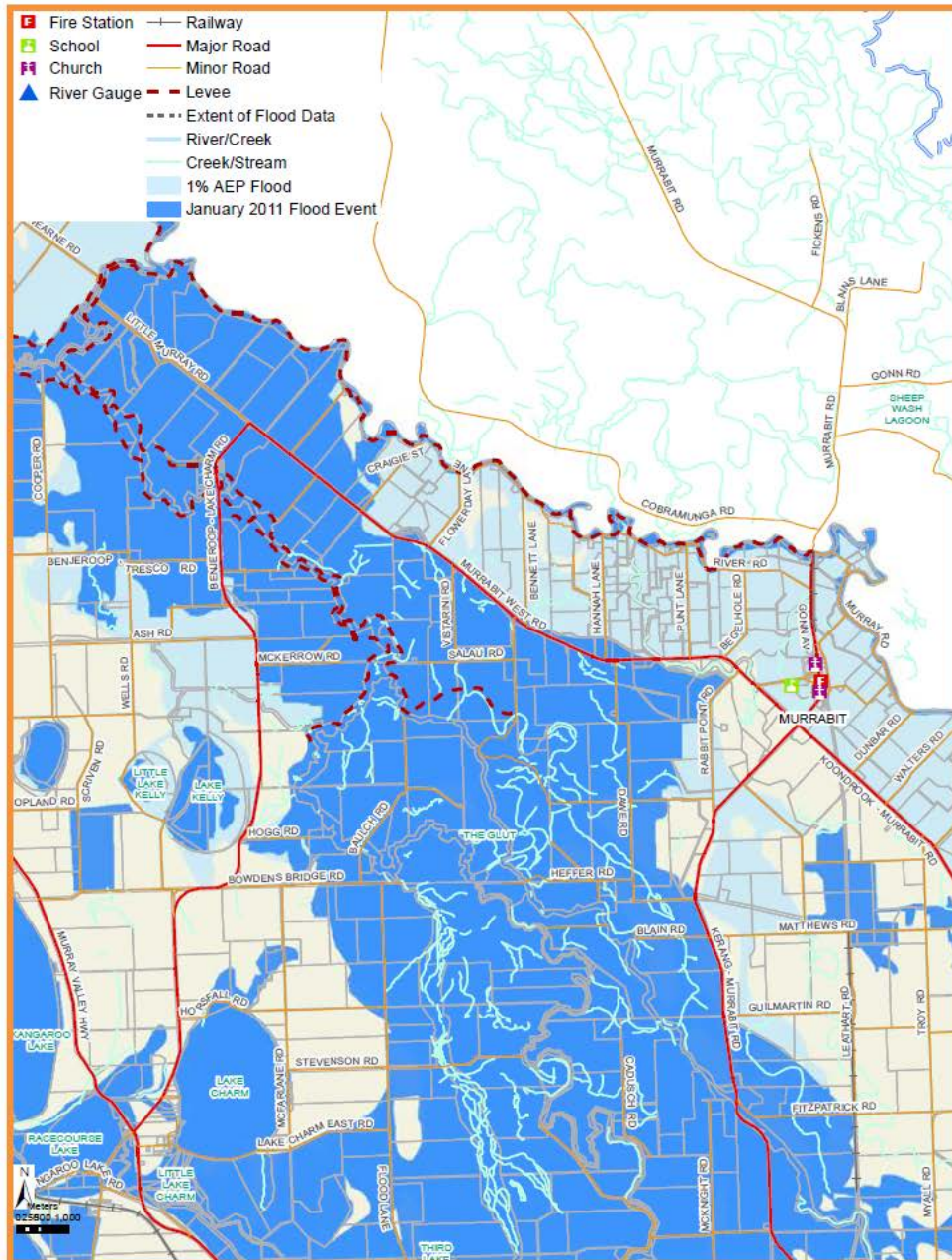
The map below shows the extent of flooding in the area during the 2011 flood event and the expected flooding from a 1% Annual Exceedence Probability (AEP) flood of the Murray River. A 1% AEP flood means in a given year there is a 1% chance of a flood of this size occurring in any year.

Your local emergency broadcasters are:

- ABC Local Radio 102.1 FM
- Mixx 98.7 FM
- SKY NEWS Television

Gannawarra Shire Contact details:

Phone: (03) 5450 9333
 Web: www.gannawarra.vic.gov.au
 Email: council@gannawarra.vic.gov.au



Disclaimer

This map publication is presented by the Victoria State Emergency Service for the purpose of disseminating emergency management information. The contents of the information have not been independently verified by the Victoria State Emergency Service. No liability is accepted for any damage, loss or injury caused by errors or omissions in this information or for any action taken by any person in reliance upon it. Flood information is provided by North Central Catchment Management Authority.

Your Local Flood Information

Know your risk

Are you at risk of flood?

Murrabit and Benjeroop are located on the lower Loddon River floodplain near the Murray River. The chance of flooding increases when both the Loddon and the Murray Rivers are in flood at the same time. Major flooding of the Avoca River can also contribute to flooding of the lower Loddon floodplain area.

Significant flooding has occurred throughout the region since settlement, and property owners have constructed a series of earthen and strategic levees throughout the floodplain over the last hundred years. Many of these levees are in poor condition, are located on private land and cannot be relied on to protect from riverine flooding.

Murrabit township is located on higher ground, and is protected by a series of levees; however extensive rural areas around the township including Benjeroop are at risk of extensive and long-term inundation. No levee is flood proof, including the many levees built on private land. It is likely that large parts of the district will be inundated in future flood events.

Murray River and Loddon River Gauges

When the Bureau of Meteorology (BoM) issues Flood Warnings they include a prediction of the flood height based on a river gauge. As Murrabit and Benjeroop can be impacted by flooding from both the Murray and Loddon Rivers, there are a number of gauges which can give residents an indication of what to expect at certain heights, including:

- Loddon River at Laanecoorie
- Loddon River at Kerang (Murray Valley Highway Gauge)
- Murray River at Torrumbarry
- Murray River at Barham

The following tables show historical flood events on each of these gauges. You can use this information to help you prepare.

Loddon River Gauges

Laanecoorie	Kerang*	
7.80 m		August 1909 flood level.
7.50 m	78.00 m	January 2011 flood level (height shown on map page 2).
6.35 m		November 2010 flood level.
6.34 m		September 1975 flood level.
5.93 m		1956 flood level.
5.82 m		September 1993 flood level.
5.67 m	77.84 m	1981 flood level.
5.50 m	77.80 m	MAJOR FLOOD LEVEL. 1988 flood level.
5.28 m		1996 flood level.
	77.60m	1993 flood level.
3.00 m	77.50 m	MODERATE FLOOD LEVEL. 1945 flood level.
	77.40 m	December 2010 flood level.
1.50 m	77.00 m	MINOR FLOOD LEVEL. 1963 flood level.

*The Murray Valley Highway Bridge Gauge at Kerang is measured based on the Australian Height Datum (AHD) which assumes sea level is Zero metres. The Gauge Zero is 73.46 metres.

Did you know?

The Murrabit and Benjeroop area has a history of flooding, including large floods in 1909, 1956, 1975 and from late 2010 to early 2011. The 2011 flood measured 7.50 metres on the Laanecoorie Gauge and peaked at 78.00m at the Kerang Gauge five days later, with floodwater slowly spreading across the landscape as it moved down the Loddon floodplain towards the Murray River.

Record flood levels in the Avoca River also contributed to the widespread inundation of the Murrabit and Benjeroop area. The fact that the Murray River did not exceed minor flood level at the time prevented more widespread inundation, however many rural properties were under water for weeks or even months. As a result:

- 15 houses experienced flooding.
- 10,000 hectares of farmland were under water for over three months.

While no two floods are the same, floods like this or worse could occur again. If you live close to a creek, river or in a low-lying area you may be at risk of flooding. Even if you are not directly affected, you may still need to detour around flooded areas.

Knowing what to do can save your life and help protect your livestock and property.

Murray River Gauges

Barham	Torrumbarry	
	8.20 m	1% flood (height shown on map page 2)
	8.16 m	2% flood
	8.11 m	4% flood
	8.10 m	August 1909 flood level (5% flood)
	7.86 m	September 1993 flood level.
	7.81 m	1981 flood level.
6.10 m	7.80 m	MAJOR FLOOD LEVEL. 1988 flood level.
5.80 m	7.60 m	MODERATE FLOOD LEVEL. 1945 flood level.
5.50 m	7.30 m	MINOR FLOOD LEVEL. 1963 flood level.



Temporary levee around property in Benjeroop, 2011 flood

About Flood Warnings

What warnings mean

Warnings are issued by the Bureau of Meteorology (BoM) to tell people about possible flooding.

A **Flood Watch** means there is a developing weather pattern that might cause floods in one or two days.

A **Flood Warning** means flooding is about to happen or is already happening. There are general, minor, moderate and major flood warnings.

A Minor Flood Warning means floodwater can:

- Reach the top of the river banks.
- Come up through drains in nearby streets.
- Cover low-lying areas including riverside camping areas.
- Affect some low-lying caravan parks.
- Cover minor roads, tracks and low level bridges.
- Spread across land or go into buildings on some properties and farms.

A Moderate Flood Warning means floodwater can:

- Spill over river banks and spread across low-lying areas.
- Start to threaten buildings, roads, rail, power and other developments.
- Require evacuation in some areas.
- Cover main roads.

A Major Flood Warning means floodwater can:

- Cause widespread flooding.
- Threaten more houses and businesses.
- Cause properties and whole areas to be isolated by water.
- Disrupt major roads and transport routes.
- Require many evacuations.

The Victoria State Emergency Service (SES) will give information about how the floodwater might affect people and properties. This includes safety messages to remind you what to do.

Severe Thunderstorm Warnings

Thunderstorms are classified as severe, due to their potential to cause significant localised damage through: wind gusts, large hail, tornadoes or flash flooding. Severe Thunderstorm Warnings are issued to the community by BoM.

Severe Weather Warnings

These warnings are issued to the community by BoM when severe weather is expected that is not directly related to severe thunderstorms or bushfires. Examples of severe weather include damaging winds and flash flooding.

Flash Flooding happens quickly. There may be little or no warning. The arrival time or depth of a flash flood cannot always be predicted.

Remember, you may not receive any official warning.

Emergency assistance may not be immediately available. Be aware of what is happening around you to stay safe.

Never wait for a warning to act.

Emergency Alert

SES may provide alerts to the Murrabit and Benjeroop community through the Emergency Alert telephone warning system. All emergency service providers can use Emergency Alert to warn communities about dangerous situations by voice message to landline telephones or text message to mobile phones.

If you receive a warning, make sure that all family members, people at work and your neighbours are aware of the situation.

If you receive an Emergency Alert you should pay attention and act. It could mean life or death.

If you need help to understand a warning, ask a friend, neighbour or family member.

Warnings for Murrabit and Benjeroop

For the Loddon River and Murray River, Flood Warnings are issued by the Bureau of Meteorology. Flood Warnings provide predictions of flood size (minor, moderate or major), time and possible peaks of the:

- Loddon River
- Murray River

It is important to know how the predicted flood levels are likely to impact you as you may be affected before the peak.

See page 3: *Murray River and Loddon River Gauges*. You can use this table to figure out when you need to start following your flood emergency plan.

Flood levees

A levee is an embankment usually alongside a river or creek designed to protect property from floodwater.

Levees can reduce the frequency of flooding but no levee is guaranteed to be flood-proof. A levee is designed to control a certain amount of floodwater. If larger floods occur, water will flow over the levee into low-lying areas. Floodwater may also damage the levee, flowing through an opening or break.

Flood levees are to protect property, not people. If the levee is in danger of overtopping, you will be advised to evacuate. It is important that you follow this advice.

APPENDIX K - References and Intel Sources

The following studies may be useful in understanding the nature of flooding within Gannawarra Shire.

- Avoca Floodplain Management Study, March 1985
- Avoca River Flood Mitigation Study, December 1987
- Recent Hydrologic Changes in the Avoca River Catchment, December 1992
- Lower Avoca Hydrologic Flood Study, December 2006
- Kerang Flood Mitigation Scheme Levee Audit Report, 1996
- Kerang Lakes Flood Study - Options Paper, 1989
- Kerang Lakes Flood Study – Pyramid Creek - Options Paper, 1989
- Kerang to Little Murray Floodplain Management Plan, June 2006
- Lower Loddon Floodplain Management Study, Kerang to Little Murray River, November 1986.
- Lower Loddon Floodplain Management Study (Serpentine to Kerang), 1992
- Lower Loddon and Avoca Rivers Floodplain Management Studies Integration Report, 1994
- Lower Loddon Hydrologic Study, October 2001
- Lower Loddon and Avoca Rivers Flood Scoping Studies, 2001
- Swan Hill Regional Flood Strategy - Overview of Reports

Other useful references include:

- Victorian Flood Management Strategy 1997-2007
- Emergency Management Act 1986/2013
- Emergency Management Manual Victoria, 1997 Edition
- The Gannawarra Shire Council Municipal Emergency Management Plan 1997 should this be the latest version
- Water Act 1989
- Flood Warning : An Australian Guide, Manual 21, Emergency Management Australia 2009
- VICSES Flood Warning Manual - North West Region
- Flood Warning Station Information Manual - February 1999
- Murray River Levee Audit Project – Final Report CMPS&F March 1997 for Building Services Agency
- <http://www.nccma.vic.gov.au> North Central Catchment Management Authority for various references
- <http://planningschemes.dpcd.vic.gov.au/index.html> Department of Planning and Community Development for planning scheme flood maps
- <http://www.vicwaterdata.net/vicwaterdata/home.aspx> for historical data on water quality, river heights and flows
- <http://www.bom.gov.au> Bureau of Meteorology for river gauge readings and flood warnings
- <http://www.floodvictoria.vic.gov.au> for information on historic floods in Victoria
- <http://www.ses.vic.gov.au> Victoria State Emergency Service
- <http://www.ema.gov.au> Emergency Management in Australia
- <http://www.dse.vic.gov.au/fire-and-other-emergencies> Department of Sustainability and Environment emergency management.
- COUNCIL and NCCMA Geographical Information System (GIS) – these contain layers showing aerial photographs, roads, title boundaries and levees (amongst other things).