Central Goldfields Shire

Flood Emergency Plan

A Sub-Plan of the Municipal Emergency Management Plan

For Central Goldfields Shire Council

and

VICSES Units – Maryborough & Dunolly

Version 4 – June 2019

CENTRAL GOLDFIELDS SHIRE COUNCIL

VICTORIA State Government

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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 Central Goldfields Shire Council

Suggestions for amendments to this Plan should be forwarded to VICSES North West Region Headquarters, 7 Rohs Road East Bendigo or by email to **northwest@ses.vic.gov.au**.

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

Amendment Number	Date of Amendment	Section	Page No.	Amendment Entered By	Summary of Amendment
Draft				MCA/WT	Initial preparation of MFEP. Included all available intel.
V1				VicSES	Inclusion of community input to Carisbrook intel.
V2	Nov13			MCA/WT	Reformatted MFEP, various corrections including adjustment to flood / no flood tool for Carisbrook, addition of intel for Dunolly.
V3	August 17			MFEP Committee	Full Review
V4	June 19			MFEP Committee	Full Review (inc. Dunolly updates)

This Plan will be maintained on the Central Goldfields Shire website at www.centralgoldfields.com.au

List of Abbreviations & Acronyms

The following abbreviations and acronyms are used in the Plan			
AAR	After Action Review	**IMS**	Incident Management System
AEP	Annual Exceedance Probability	**IMT**	Incident Management System
AHD	Australian Height Datum (the height of a location above mean sea level in metres)	**JSOP**	Joint Standard Operations Procedure
AIDR	Australian Institute of Disaster Resilience	**LSIO**	Land Subject to Inundation Overlay
AIIMS	Australasian Inter-service Incident Management System	**MEMO**	Municipal Emergency Management Officer
AoOCC	Area of Operations Control Centre / Command Centre	**MEMP**	Municipal Emergency Management Plan
ARI	Average Recurrence Interval	**MEMPC**	Municipal Emergency Management Planning Committee
ARMCANZ	Agricultural & Resource Management Council of Australia & New Zealand	**MERC**	Municipal Emergency Response Coordinator
AV	Ambulance Victoria	**MERO**	Municipal Emergency Resource Officer
BoM	Bureau of Meteorology	**MFB**	Metropolitan Fire Brigade
CEO	Chief Executive Officer	**MFEP**	Municipal Flood Emergency Plan
CERA	Community Emergency Risk Assessment	**MFEPC**	Municipal Flood Emergency Planning Committee
CFA	Country Fire Authority	**MRM**	Municipal Recovery Manager
CMA	Catchment Management Authority	**PMF**	Probable Maximum Flood
DELWP	Department of Environment, Land, Water and Planning	**RAC**	Regional Agency Commander
DJPR	Department of Economic Development, Jobs, Transport and Regions	**RCC**	Regional Control Centre
DHHS	Department of Health and Human Services	**RDO**	Regional Duty Officer
EMLO	Emergency Management Liaison Officer	**RERC**	Regional Emergency Response Coordinator
EMV	Emergency Management Victoria	**RERCC**	Regional Emergency Response Coordination Centre
EMMV	Emergency Management Manual Victoria	**SAC**	State Agency Commander
EMT	Emergency Management Team	**SBO**	Special Building Overlay
ERC	Emergency Relief Centre	**SCC**	State Control Centre
EO	Executive Officer	**SDO**	State Duty Officer
FO	Floodway Overlay	**SERP**	State Emergency Response Plan
IIA	Initial Impact Assessment	**SEWS**	Standard Emergency Warning Signal
IEMT	Incident Emergency Management Team	**SOP**	Standard Operations Procedures

Part 1. INTRODUCTION

1.1 Municipal Endorsement

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

This MFEP is a sub plan to the Loddon Shire Emergency Management Plan (MEMP), is consistent with the Emergency Management Manual Victoria (EMMV) and the Victorian Floodplain Management Strategy (2016), and takes into account the outcomes of the Community Emergency Risk Assessment (CERA) process undertaken by the Municipal Emergency Management Planning Committee (MEMPC).

The MFEP is consistent with the Regional Flood Emergency Plan (RFEP) and the State Emergency Response Plan (SERP) – Flood sub-plan.

This MFEP is a result of the cooperative efforts of the MFPC and its member agencies.

This Plan is approved by the VICSES Regional Manager.

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

Approval

……

Mark Cattell Date

Loddon Mallee Region VICSES Regional Manager

Endorsement

……..

Lisa Knight (Mount Alexander) Date

Chair – (Integrated) Municipal Emergency Management Planning Committee

The Municipality

An outline of Central Goldfields Shire 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.

1.2 Purpose and Scope of this Flood Emergency Plan

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

As such, the scope of the Plan is to:

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

1.3 Municipal Flood Emergency Planning Committee (MFEPC)

Membership of the Central Goldfields Shire Flood Emergency Planning Committee (MFEPC) will comprise of the following representatives from the following agencies and organisations:

- VICSES – Regional Officer – Emergency Management (Chair)
- VICSES Maryborough Unit – Controller or Deputy Controllers
- VICSES Dunolly Unit – Controller or Deputy Controller
- Central Goldfields Shire – Manager Engineering Services (MERO)
- Central Goldfields Shire – Municipal Recovery Manager
- Central Goldfields Shire – Manager Operations,
- Central Goldfields Shire – Emergency Management Coordinator
- Victoria Police (MERC),
- Goulburn Murray Water Authority,
- CFA Goldfields Group Officer,
- North Central Catchment Management Authority (as required),

1.4 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.

This plan should be reviewed and where necessary, arrangements and information contained in it should be amended:

- Annually as per MEMPC Sub-Plan review schedule;
- Following any new flood study;
- Following a change in non-structural and/or structural flood mitigation measures; and
- After the occurrence of a significant flood event within the Municipality.

When a review is undertaken and minor amendments are made to the Plan, the amended Plan will be adopted by the MFEPC and the MEMPC and included into the website copy of the Plan. If significant amendments are made to the Plan at any time, the amended Plan must be passed to Council for adoption once the MFEPC and the MEMPC have endorsed the significant amendments.

1.5 Endorsement of the Plan

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

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

Part 2. PREVENTION / PREPAREDNESS ARRANGEMENTS

2.1 Community Awareness for all Types of Flooding

Details of this MFEP will be released to the community through local media, the FloodSafe program, websites (VICSES and the Municipality) upon formal adoption by Central Goldfields Shire Council.

VICSES with the support of Central Goldfields Shire Council and North Central Catchment Management Authority will coordinate community education programs for flooding within the MFEP area. For example, Flood Safe / Storm Safe and through the distribution of a local flood guide to the Community of Carisbrook

2.2 Structural Flood Mitigation Measures

There are currently no structural flood mitigation measures in place within the Shire apart from temporary Non-return valves in Victoria Street, Carisbrook.

2.3 Non-structural Flood Mitigation Measures

2.3.1 Exercising the Plan

This Plan will be exercised on an annual basis. Refer to section 4.7 of the EMMV for guidance.

2.3.2 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.

Specific details of local flood warning system arrangements are provided in Appendix E.

2.3.3 Flood Observers

There are currently no structured Flood Observers in the Central Goldfields Shire. However, further development of this will be considered.

Part 3. RESPONSE ARRANGEMENTS

3.1 Introduction

3.1.1 Activation of Response

The Regional Duty Officer (RDO) VICSES Loddon Mallee Region or Incident Controller (IC) may activate flood response arrangements.

The IC/RDO VICSES will activate agencies as required and documented in the State Flood Emergency Plan.

3.1.2 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 serious flood within the Central Goldfields Shire. These agencies will be engaged through the Incident EMT.

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

Agreed roles/actions of key agencies are listed in the Action Matrix in Appendix G to this plan.

3.1.3 Escalation

Most flood incidents are of local concern and an appropriate response can usually be managed 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 Statewide basis.

Resourcing and event escalation arrangements are described in the EMMV ('State Emergency Response Plan' – Section 3.6).

3.2 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:

1. Protection and preservation of life is paramount - this includes:
   a) Safety of emergency services personnel,
   b) Safety of the community which includes vulnerable community members and visitors/tourist located within the incident area; and
   c) Safety and welfare of displaced community members.
2. 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.
3. Protection of critical infrastructure and community assets that supports community resilience.
4. Protection of residential property as a place of primary residence.
5. Protection of assets supporting individual livelihoods and economic production that supports individual and community financial sustainability.
6. Protection of environmental and conservation values 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 priority. This shall be done in consultation with the State Controller and relevant stakeholders based on sound incident predictions and risk assessments.

3.3 Control, Command, & Coordination

The Command, Control and Coordination arrangements in this Municipal Flood Emergency Plan must be consistent with those detailed in State and Regional Flood Emergency Plans. For further information, refer to sections 3.3, 3.4, 3.5 & 3.6 of the EMMV.

The specific details of the Command, Control and Coordination arrangements for this plan are to be provided in Appendix C.

3.3.1 Control

Functions 5(a), 5(b) 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 as well as for water, sewerage and other emergencies / threats. A more detailed explanation of roles and responsibilities is provided in later sections of Part 7 of the EMMV.

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

3.3.2 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. The Incident Controller responsibilities are as defined in Part 3.5 of the EMMV

3.3.3 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 are

- Level 3 ICC – Epsom DELWP Complex (Bendigo)

3.3.4 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 (additional divisions/sectors may be identified by the Incident Controller if required):

Division (pre-determined Divisional Command locations)	**Sectors** (Pre-determined Sector Command locations)
Central Goldfields – CFA LCF/ DELWP Office 2/82 Alma St Maryborough)	**Maryborough** – 70 Burns St, Maryborough VICSES LHQ
	Dunolly – 51 Broadway, Dunolly VICSES LHQ
	Carisbrook – CFA 9 Urquhart St, Carisbrook
	Talbot – CFA 20 Scandinavian Crescent, Talbot
	Natte Yallock – CFA 21 School Rd, Natte Yallock
	Bealiba – CFA 8 Grant St, Bealiba

3.3.5 Incident Management Team (IMT)

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

Refer to Part 3.5 of the EMMV for guidance on IMTs and Incident Management Systems (IMSs).

3.3.6 Emergency Management Team (EMT)

The Incident Controller will establish a multi-agency Emergency Management Team (EMT) to assist the flood response. The EMT 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.

Organisations, including Central Goldfields Shire Council, required within the EMT will provide an Emergency Management Liaison Officer (EMLO) to the ICC if and as required as well as other staff and / or resources identified as being necessary, within the capacity of the organisation.

Refer to Section 3.5 of the EMMV for guidance on EMTs.

3.3.7 Coordination

The Municipal Emergency Response Coordinator (MERC) for the Central Goldfields Shire will ensure that the Coordination function is undertaken. The Incident Controller/RDO will ensure that communications are established with the MERC and that regular situational updates are provided. This may be undertaken through the Division/Sector Commander where appointed.

3.3.8 Municipal Operations Centre (MOC)

If a MOC is established, liaison with the MOC 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 MOC directly if no Division/Sector Command is established.

The function, location, establishment and operation of the MOC are detailed in the Central Goldfields Shire MEMP.

3.3.9 VICSES actions 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 Command and Control 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 flood mitigation works are being checked by owners
- Develop and issue incident action plan, if required
- Develop and issue situation report, if required

3.3.10 VICSES actions 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). 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 maybe at risk of isolation
  - What areas maybe 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

3.4 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 but not necessarily relevant in

Central Goldfields Shire 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;
- Community Flood Wardens;
- Fax Stream;
- Newsletters;
- Letter drops;
- Social media and/or social networking sites (i.e. twitter and/or facebook).

Refer to Appendices C and 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 however, the EMT, if activated, and the MERC will be advised of any warning issued when they occur.

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).

Dept. of Health will coordinate information regarding public health and safety precautions.

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

3.5 Media Communication

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

Support agencies should consult with the IC/ VICSES RDO prior to releasing information to the media, to ensure that consistent accurate information is being provided to the community.

3.6 Initial impact assessment

Initial impact assessment can be conducted in accordance with part 3 of the EMMV to assess and record the extent and nature of damage caused by flooding. This information may then be used to provide the basis for further needs assessment and recovery planning by DHHS and recovery agencies.

3.7 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.

3.8 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, and 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 emergency relief centres ahead of actually triggering the evacuation, as is normal practice. Evacuation must still be considered as an option for ensuring the safety of people in at risk areas.

3.9 Evacuation

The decision to recommend or warn people to prepare to evacuate or to evacuate immediately rests with the Incident Controller in consultation with the EMT, if activated.

Once the decision is made VicPol are responsible for the management of the evacuation process where possible. VICSES and other agencies will assist where practical. 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 Section 3.8 of the EMMV and the Evacuation Guidelines for guidance of evacuations for flood emergencies.

Refer to Appendix D of this Plan and / or the Central Goldfields Shire MEMP for detailed evacuation arrangements for communities within Central Goldfields Shire.

3.10 Flood Rescue

Under Victoria's emergency management arrangements, rescue is considered separately to the relocation of people who are stranded or isolated by floodwaters. Where the waters are either fast or swift flowing and/or the people being assisted are facing actual or threatened danger of physical harm the response escalates from relocation to rescue.

Victoria Police, as the designated control agency for water rescue, coordinates rescues undertaken during flood events.

To activate water rescue services VICSES, as control agency for overall flood response, will identify areas at risk of requiring rescue and notify the Officer in Charge of the Water Police Search and Rescue Squad to request pre-deployment of rescue resources to these areas.

In conducting rescues, Victoria Police will often require assistance of appropriately trained and equipped personnel from support agencies (including VICSES, AVCG, CFA and LSV) to undertake flood rescue.

VicPol coordinate with these agencies to ensure operational readiness for activation.

In significant flood events, Victoria Police will appoint a Flood Rescue Manager, who may be an officer from Victoria Police or one of the support agencies.

The primary responsibilities of the Flood Rescue Manager are to:

- Coordinate all rescue activities
- Identify and source required resources
- Deploy required police and support agency resources

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.

There are no Specialist rescue resources within the Central Goldfields Shire

There are no Agency owned/controlled aircraft or boats located with the Shire.

Aircraft may be available through Victoria Police for urgent rescue operations.

VicPol and VICSES can access rescue boats, but there is a lead-time required to get them onsite within the shire.

There are no known high-risk areas/communities where rescues might be required on a large scale, but experience has shown (January 2011) that property isolations can occur quickly in some rural areas, as well as stranded person(s) in vehicles trapped in floodwaters and both of these types of events may require specialist rescue.

3.11 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 who will establish priorities.

Suitable airbase facilities are located at:

- Maryborough Aerodrome, Leviathan Road, Maryborough;
- Maryborough Airport (24 hrs lighting)

3.12 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.

3.13 Essential Community Infrastructure and Property Protection

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.

Property may be protected by:

- Sandbagging to minimise entry of water into buildings
- Encouraging businesses and households to lift or move contents
- Construction of temporary levees in consultation with the CMA, LGA and VicPol and within appropriate approval frameworks.

Priorities for sandbags

Consistent with the Strategic Control Priorities within the State Emergency Flood Plan, sandbags will be issued in priority order of protecting:

1. Community Critical Infrastructure identified:
   a) in the MFEP and MEMP; 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

Any 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).

Quantities

As a guide, 25 sandbags are reasonable to supply to residents to allow for coverage of doorways, blocking vents, drains and toilets. Additional sandbags may be provided on a case-by-case basis having an understanding of individual issues and local priorities identified by the Incident Management Team.

The Central Goldfields Shire maintains a small stock of sandbags at the Maryborough Works Depot.. Maryborough and Dunolly VICSES Units will also maintain sandbag stocks. A small stock of bags is also

located at the Carisbrook CFA Fire station. Additional supplies are available through the VICSES Regional Headquarters to supplement local stocks.

The Incident Controller will determine the priorities related the use of sandbags, which will be consistent with the strategic priorities.

If VICSES sandbags are becoming 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.

Refer to Appendix C for further specific details of essential infrastructure requiring protection and location of sandbag collection point(s).

3.14 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 Central Goldfields Shire.

3.15 Road Closures

Central Goldfields Shire Council and VicRoads are responsible for road closures including observation and placement of warning signs, roadblocks etc. to the road network, walking and bike trails. Central Goldfields Shire Council staff may also liaise with and advise VicRoads as to the need for warning signs and / or of closing roads and bridges under VicRoads jurisdiction. VicRoads are responsible for designated main roads and highways and Council's are responsible for the designated local and regional road network.

VICROADS and Central Goldfields Shire will distribute community information regarding road closures.

Within the Central Goldfields Shire, there are a significant number of roads that are impacted by floodwater. A number of these roads have permanent flood warning signs in place that can be activated in emergencies to close the road. A list of these roads is provided in Appendix E. For details of the highways and arterial roads affected, see the Flood Intelligence Cards for each stream.

3.16 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.

Major dams with potential to cause structural and community damage within the Municipality are contained in Appendix A.

3.17 Waste Water related Public Health Issues and Critical Sewerage Assets

Inundation of critical sewerage assets including septic tanks and sewage pump stations may result in water quality problems within the Municipality. Where this is likely to occur or has occurred the responsibility 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 Central Goldfields Shire Council Environmental Health Officer to inspect and report to the ICC on any wastewater quality issues relating to flooding.

3.18 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 4. EMERGENCY RELIEF AND RECOVERY ARRANGEMENTS

4.1 General

Arrangements for recovery from a flood incident within the Central Goldfields Shire are detailed in the Central Goldfields Shire MEMP.

4.2 Emergency Relief

The decision to recommend the opening of an emergency relief centre rests with the Incident Controller in consultation with the MRM and EMT. 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.

Suitable relief facilities identified for use during floods are detailed in the MEMP.

Details of the relief arrangements are available in the MEMP.

4.3 Animal Welfare

Matters relating to the welfare of livestock and companion animals (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 passed to DELWP.

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

4.4 Transition from Response to Recovery

VICSES as the Control Agency is responsible for ensuring effective transition from response to recovery. This transition will be conducted in accordance with existing arrangements as detailed in Part 3 Section 3.10 of the EMMV and the Central Goldfields Shire MEMP.

ACCURACY & CONFIDENTIALITY

The information in the following Appendices provides a guide to the likelihood and possible effects of a flood. The information is based on estimates of rainfall rates and depths and on flood behaviours at particular heights or flows following actual flood events and / or hydrologic and hydraulic modelling. However, as all floods are different, those behaviours and effects may occur as a result of different rainfalls and / or heights and flows. They may also occur at different heights in different floods.

This document may contain sensitive information about the effects of flooding on private property. Specific reference to private addresses or businesses may be made directly to owners or other emergency services but should not be made public via broadcast or print media unless authorised specifically by the Incident Controller.

APPENDIX A –
FLOOD THREATS FOR CENTRAL GOLDFIELDS SHIRE

1. General

The Central Goldfields Shire is bounded by Northern Grampians Shire and Pyrenees Shire to the West, Loddon Shire to the North and North East, Mount Alexander Shire to the East and Hepburn Shire to the South East. The Avoca River forms part of the North West boundary of the Shire for a distance of about 25km, between Natte Yallock and downstream from Bealiba. Joyces Creek and Cairn Curran Reservoir form part of the boundary to the East.

The north western part of the Shire from Natte Yallock to Bealiba is part of the Avoca catchment. Tributaries of the Loddon River drain the remainder of the Shire.

The eastern and western edges of the Shire are basalt plain, while the central portion of the Shire is undulating to hilly country.

Maryborough is the largest town in the Shire. Towns in the northern part of the Shire include Dunolly, Bealiba and Moliagul. Carisbrook, Bowenvale and Majorca are in the central area of the Shire while Talbot is the main town in the southern part of the Shire. There is extensive rural residential development north of Dunolly, in the Bet Bet and Betley area, at Alma, around Bealiba, north of Carisbrook, in the Majorca-Red Lion-Dunach corridor, at Daisy Hill, between Amherst and Talbot, and south of Talbot.

There are a large number of creeks within the Shire that are subject to flooding. The flooding affects rural areas along the creeks, many local and larger roads and a number of the urban areas.

2. Major Waterways

Joyces Creek, Tullaroop Creek, McCallum Creek, Bet Bet Creek and the Avoca River between Natte Yallock and downstream from Bealiba are the major waterways within the Shire. A number of smaller tributaries are also important in respect to flooding, such as Burnt Creek at Dunolly.

Joyces Creek rises to the south of the Shire in the Shire of Hepburn and discharges into Cairn Curran Reservoir on the Loddon River. Joyces Creek forms the south eastern boundary of the Shire.

Tullaroop Creek rises south of Creswick within the Shire of Hepburn, on the northern slopes of the Great Dividing Range to the north of Ballarat. Along with McCallum Creek, which originates on the northern slopes of the Great Dividing Range to the east of Lexton and south of Talbot, it drains much of the central part of the Shire. McCallum Creek joins Tullaroop Creek immediately upstream of the Pyrenees Highway Bridge at Carisbrook, flowing downstream to the Loddon River at Laanecoorie Reservoir. Tullaroop Creek forms part of the eastern boundary of the Shire.

Bet Bet Creek rises to the west of the Shire in the Shire of Pyrenees around Lexton. The creek and its tributaries drain the central part of the Shire. It flows north/northeast through the localities of Bung Bong, Wareek, Timor West, Bet Bet and Betley and discharges into Laanecoorie Reservoir.

There are many other creeks within the Shire, many of which rise outside the Shire boundary, including:

- Cochranes Creek (a tributary to the Avoca River that flows through Bealiba);
- Dunria Creek (a Bet Bet Creek tributary that passes under the Old Maryborough – Avoca Road);
- Timor Creek (a Bet Bet Creek tributary that passes through Adelaide Lead);
- Emu and Green Hills creeks (Bet Bet Creek tributaries that passes through Dunluce);
- Carmanuel Creek (a Bet Bet Creek tributary that passes under the Dunolly – Stuart Mill Road);
- Burnt Creek (a Bet Bet Creek tributary that rises near Painswick on the southern slopes of Mt Moliagul and includes the eastern slopes of the Bealiba Ranges, passes through Dunolly and

joins Bet Bet Creek near Betley);

- Gypsy Creek (a tributary to Burnt Creek that rises near Moliagul);
- Old Lead Creek (a tributary to Burnt Creek that joins it at Dunolly);
- Four Mile Creek (a Bet Bet Creek tributary that passes through Maryborough);
- Splitters Creek (a tributary to Tullaroop Creek that passes under the Talbot – Mount Cameron Road);
- Sandy Creek (a tributary to Tullaroop Creek that passes under the Holmes Road);
- Back Creek (a tributary to McCallum Creek that passes through Talbot);
- Daisy Hills Creek (a tributary to Back Creek that rises near Lillicur);
- Middle Creek (a tributary to Joyces Creek that rises near Mount Duntrulm).

There are also a number of small catchments to the west and southwest of Carisbrook (between Maryborough and Carisbrook) that generate substantial overland flows that drain to Carisbrook during heavy rain events.

3. Flood Risks

Central Goldfields Shire experiences both riverine and flash flooding events.

There are a large number of creeks within the Shire that are subject to flooding. The flooding affects rural areas along the creeks, many local and larger roads and a number of the urban areas. Many of the roads affected result in isolation and transport disruption, details of which are listed later in this document.

The major flood risks within the Shire are associated with:

- Runoff from the local catchments to the south and south west of Carisbrook;
- Tullaroop Creek and McCallum Creek at Carisbrook and rural areas;
- Local drainage and flooding issues at Maryborough;
- Burnt Creek and runoff from the local catchment to the north and east of Dunolly;
- Bet Bet Creek and the low lying areas along its course (some risk of isolation and inundation of some rural residences and farm buildings) especially in the Bet Bet and Betley areas;
- That part of the Avoca River within the Shire between Natte Yallock and downstream from Bealiba; and
- Back Creek at Talbot

4. Riverine Flooding

Prolonged moderate to heavy rain often leads to flooding within the Shire. Generally, a wet catchment and a period of heavy rain are required to produce severe flooding along the Shire's waterways.

Historically this is normally summer related between September and February.

The more severe riverine floods within the Shire generally occur as a result of:

- Moist warm airflow from northern or north western Australia (perhaps from a decaying tropical cyclone) bringing moderate to heavy rainfall over a period of 12 hours or more following a period of general rainfall. The period of general rainfall "wets up" the catchments and (partially) fills both the on-stream dams and the natural floodplain storage. These combine to increase the runoff generated during the subsequent period of heavy rainfall.
- Successive cold fronts, often during winter and spring, that bring periods of rain that wet up the catchments and prime them for flooding from a further front or complex low-pressure system that is perhaps slow moving and brings moderate to heavy rainfall.

5. Flash Flooding, Overland Flows and Stormwater Flooding

Short duration, high intensity rainfall (usually associated with severe thunderstorms or small scale weather systems that are locally intense and slow moving) can cause flash flooding. 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.

High intensity rainfall such as associated with thunderstorms giving average rainfall rates of typically more than about 40 mm/hour for 30 minutes or so (i.e. 20mm or so in 30 minutes) is likely to lead to high flows in local creeks and / or along overland flow paths, even on a dry catchment. Flooding is also likely in urban areas as the capacity of the stormwater drainage system is likely to be exceeded.

Blocked or capacity impaired stormwater drains can also lead to overland flows and associated flooding: the drains surcharge and excess water flows above ground. Stormwater drains are generally only designed to cope with small frequent events.

This amount of rain on a wet catchment will result in higher flows within waterways but the depth, extent and duration of any flooding will be determined by the volume of rain and the period over which it falls.

6. Dam Failure Flood Risk

All dams have a risk of failure. All major dams (e.g. Centenial Reservoir in Maryborough – Central Highlands Water, Tullaroop Reservoir – GMW, Goldfields Reservoir ,Nuggety Gully Reservoir and Lake Victoria - Central Goldfields Shire Council) have dam safety management programs implemented by the managing entities. Centenial Reservoir and Tullaroop Reservoir are subject to individual Dam Safety Emergency Management Plans (DSEPs). DSEPs identify possible dam failure scenarios and provide direction on the order and detail of the necessary communications and incident management tasks to be initiated. They also refer to intelligence and maximum inundation extent mapping arising from detailed dam break analyses. Intelligence can include travel times to key locations, maximum depths and velocities and the time to reach those maxima at those key locations, as well as other information that would inform the response effort. Close communication with the dam manager is essential in the event of a dam safety incident.

Nuggetty Gully Reservoir, Goldfields Reservoir and Lake Victoria all have Dam Safety Emergency Management Plans.

Additionally there is the Old Lead Reservoir located due north of Dunolly. It is a former water supply reservoir now managed by Loddon Shire. A dam break from this reservoir is likely to have an impact on flooding in Dunolly. While it is understood that a Dam Safety Management Plan did not exist for the storage as at the date of this MFEP update, Loddon Shire are investigating options for the reservoir's future.

7. Health and Environmental Risks

There are many septic tanks and sewerage pump stations within the Shire that may be inundated by floodwaters. Further, chemicals and fuel may be stored in farm sheds and tanks on floodplains.

8. Properties at Risk

While information on property floor levels and the likelihood of over-floor flooding is available for Carisbrook (see Appendix C1 and Water Technology, 2013a) and Dunolly (see Appendix C2 and Water Technology, 2013b) similar information is not currently available for other locations within the Shire.

The table below is a breakdown of the number of buildings flooded over-floor in a 1% AEP flood event. These figures are **indicative only** and are based on information from Carisbrook and Dunolly only.

Waterway	Community	# buildings flooded in 1% AEP				
		Residential	Business	Industrial	Rural	Total
Tullaroop Creek	Carisbrook	37	14	0		51
Burnt Creek	Dunolly	11	4	0		15
Total		**48**	**18**	**0**		**66**

Due to the lack of flood information, other than at Dunolly, it has not been confirmed that any Caravan Parks within the Shire are at risk of being flooded during a 1% AEP event.

9. Infrastructure at Risk

9.1 Overview

Major infrastructure within Central Goldfields Shire includes major highways and rail lines.

9.2 Major Roads

Dependant on flood magnitude the following roads may be inundated.

- Pyrenees Highway at Carisbrook – overtopped in January 2011;
- Bucknall St, Carisbrook Eddington Rd and Landrigan Rd, Carisbrook
- Ballarat - Maryborough Road at Dunach and Talbot.
- Bendigo - Maryborough Road along Park Road at Maryborough.
- Maryborough - Dunolly Road south of Dunolly from reasonably small floods upwards.
- Dunolly - Moliagul Road (Dunolly- St Arnaud Road) immediately north of Dunolly from reasonably small floods upwards.
- .Dunolly - Avoca Road immediately west of Dunolly.
- Dunolly - Stuart Mill Road immediately west of Dunolly.
- Dunolly - Eddington Road west of Eddington.
- Lexton - Talbot Road at Talbot.
- Archdale - Avoca Road – significant sections of road inundated.

9.3 Other Infrastructure

Mobile network telephone towers – none known.

Wastewater treatment plant at Maryborough – unlikely to be flooded.

Sewer pump stations – at Carisbrook and Dunolly.

Water treatment plant at Maryborough – unlikely to be flooded

Electrical power kiosks / zone sub-stations (cabinets) – none known.

Community facilities

- **Carisbrook** – many facilities including the CFA building, Britannia Hotel, Churches, Carisbrook Sports ground and pavilions, Carisbrook indoor leisure centre at the Carisbrook School, etc (all affected by the January 2011 flood), elderly person residential units.

- **Maryborough** - elderly person residential units (Princes Park Lodge, High St).

10. Flooding Hotspots

Heavy rain often results in flooding in:

- South of Victoria Street (Pyrenees Hwy), Carisbrook (mitigation works in progress)
- Park Road (near Golf Course), Maryborough (drainage works in progress)
- Northern end of Broadway in Dunolly and particularly between the Inglewood - Dunolly railway line and Raglan Street.

Other flooding hotspots are identified on the maps in Appendix F.

11. Flood Inundation Mapping

Water Technology (2013a & 2013b) has produced a series of flood inundation maps for Carisbrook and for Dunolly. A subset of these maps is included in this MFEP at Appendices F1 and F2.

Coarse flood extent maps were developed for parts of the Municipality in 2000 as part of a statewide Flood Data Transfer Project (FDTP) (DNRE, 2000). Although some of this flood extent mapping has a low level of accuracy, the maps can be a useful guide to highlight areas subject to flooding where detailed mapping is not yet available. The associated reports provide guidance on likely accuracies and associated confidence in delineations.

12. Historic Floods

Records indicate that flooding within the Shire has occurred most often between the months of August and November, partially corresponding to the months of highest rainfall.

Floods are reported to have occurred within the Shire in February 1873, November 1893, 1900, 1909, 1933 (Reference Darryl McLeish's book), December 1937, April 1959, 1964, 1975, 1981, September 1983, 1993, June 1995, 1996, December 1999, September 2010, January 2011 and September 2016.

Between late 2010 and early 2011, Central Victoria experienced a number of widespread heavy rainfall and flood events. The floods of 2011 were the most severe on record. Floods in September 2010, November 2010 and January 2011 caused in excess of $12 million in damages to public assets throughout the Shire. Many homes were flooded in Carisbrook, Dunolly and Talbot and major transport routes to each of these towns flooded for periods of up to four (4) days. The communities of Maryborough, Bet Bet, Betley and Bealiba as well as outlying properties were also affected.

From Monday 10th January to Friday 14th January, Maryborough received 215 mm of rain and Dunolly received 216 mm.

Avoca River

- 1893 (3.3% AEP) – Impact unknown
- 1909 (?? ARI) - Impact unknown
- September 1983 (4% AEP) - Impact unknown
- June 1995 (4% AEP) - Impact unknown
- October 1996 (5% AEP) - Impact unknown
- September 2010 (?? ARI) - Impact unknown
- January 2011 (?? ARI) - Houses with over floor flooding in the Natte Yallock, Archdale Junction and Archdale areas. Road and bridge infrastructure damage, arterial and local roads closed for several

days/weeks. Large areas of rural land flooded, with some kilometres of fencing destroyed. Stock losses unknown

- September 2016 – Flooding affecting roads and property.

Tullaroop Creek and McCallum Creek

- **Prior to 1999 major flood events were reported to have occurred in 1900, 1964, 1975, 1981 and 1993.**

- **27 December 1999**

The flash flood of 27 December 1999 resulted in significant inundation around Carisbrook. The southwest side of the town was impacted by overland flows coming off the hills to the southwest in the Mosquito Flat and Craigie catchment area (i.e. between Carisbrook and Maryborough) following heavy localised rain. A number of properties along the south side of Victoria Street were flooded over-floor and the Pyrenees Highway was closed. Neither McCallum Creek nor Tullaroop Creek flooded at Carisbrook.

- **September 2010**

Following a wet August, a major rain event affected the north of the State on the 4th and 5th September as a low-pressure system deepened over South Australia and moved into Bass Strait, with an associated trough extending north into NSW. Rain began falling on the 3rd and continued during the 4th.

Tullaroop Reservoir filled and spilled during the event after starting at around 60% capacity.

There was some rural fence damage.

At Carisbrook (see Appendix C1), significant overland flow from the local catchments to the west and southwest impacted the town on the 4th. Runoff accumulated to the south of town well before creek levels rose. The small sandbag levee along Belfast Road near the upstream end of the main bluestone drain was breached which led to the inundation of a number of properties upstream (to the south) of the Pyrenees Highway / Victoria Street, and along the alignment of the bluestone drains through town when it overtopped. Rural and residential areas to the west around the Trotting Track were also inundated. While raised levels in McCallum and Tullaroop creeks inundated low-lying areas along the creek, Bucknall Street was not overtopped. Only Victoria, Green and Powlett Streets were flooded. Approximately 25 buildings were flooded over-floor.

- **January 2011**

Significant widespread rainfall affected the majority of the State in January 2011. It was the wettest January on record. The event was significant enough for the Bureau of Meteorology to publish Special Climate Statement 26 to describe the synoptic conditions associated with the event. In summary, the extreme rainfall recorded was generated by the passing of complex and persistent low-pressure systems. A broad slow moving trough centred over western Victoria and a ridge of high pressure to the south of Tasmania were the main drivers for the rainfall that started to fall on 9th January. The two systems created exceptionally humid conditions and an unstable easterly flow across Victoria. The trough strengthened on the 12th and developed into a low-pressure system over eastern South Australia on the 14th as a high-pressure system moved into the Tasman Sea. The low-pressure system cleared the State on the 14th after adding an additional 50 to 100mm to the deluge already received.

Maryborough recorded 90.4mm in the 24 hours to 9am on Friday 14th January, the highest daily total recorded in 131 years.

Tullaroop Reservoir spilled during the event after starting from close to capacity.

Large area of rural land flooded with some kilometres of fencing destroyed. Stock losses are unknown

At Carisbrook (see Appendix C1), the flood on 14th January 2011 is considered to be the largest on record. It inundated most of the town. Damage was severe caused by a combination of overland flows from the local catchments to the west and south west of town and flows breaking out of McCallum and Tullaroop creeks. Runoff accumulated to the south of town before creek levels rose, and the small levee along Belfast Road near the upstream end of the main bluestone drain was breached. The drainage channels to the south and west of Carisbrook, designed to convey local runoff through the town to the creek, were overtopped. The Pyrenees Highway and Bucknall Street were both overtopped by the creeks some time after the local flows impacted the town. Around 250 residential and commercial buildings were flooded over-floor (Council listed 273 properties affected by flooding). A number of damaged houses had to be demolished and rebuilt.

September/October 2016

Carisbrook again came under threat as 25 houses were doorknocked as McCallums Creek peaked at a height of 4.12m and the Tullaroop Creek peaked at a height of 2.58m. Central Goldfields Shire opened a relief centre in Maryborough. Carisbrook Primary School and Highway College were both closed with highways affected by the floodwaters.

Bet Bet Creek

- December 1937 - Some houses with above-floor flooding in the Timor area. Isolated residences, road and bridge infrastructure damage, large areas of rural land flooded. Stock and fences lost. Result of severe storm event in the Bung Bong – Avoca area.
- September 2010 - Arterial and local roads closed for several days. Large areas of rural land flooded.
- November 2010 – Minor rural flooding
- January 2011 - Houses with above-floor flooding in the Bet Bet and Betley areas. Isolated residences, road and bridge infrastructure damage, arterial and local roads closed for several days/weeks. Large areas of rural land flooded, with some kilometres of fencing destroyed. Stock losses unknown

Burnt Creek

- 18th February 1873 – Heavy rain with thunderstorms resulted in severe flooding in Dunolly.
- 12th November 1893 – Overnight rain followed by a thunderstorm (a total of around 100mm in about 23 hours including 25mm in 25 minutes) led to severe flooding at Dunolly. Roads were impassable, the railway line was damaged (ballast washed away), houses were flooded, stock were drowned and crops were damaged.
- 1st April 1959 - 150mm of rain reportedly fell at Moliagul and 67mm at Dunolly within a sixty-five minute period. This led to significant flooding at Dunolly with some houses experiencing inundation to window height.
- 8th September 1983 - Flooding resulted from 94mm of rain across the Burnt Creek catchment over a 6-day period from the 25th to 30th September. Information on flood extents and impacts is not available.
- June 1995 - One person drowned in Dunolly.
- 4th September 2010 - Arterial and local roads were closed for several days. Large areas of rural land was flooded.
- 14th January 2011 - The flood of January 2011 was the largest flood in living memory at Dunolly and followed a 5-day period in which more than 200mm of rain was recorded in three separate bursts, The final burst of 84mm fell in a 12-hour period. Dunolly was isolated with only air or rail access. The town also lost power. Forty (40) homes were evacuated. Twenty (20) homes were flooded and areas along Burnt Creek and Broadway were seriously impacted. A relief centre was opened at the Dunolly Bowls Club during the event. . Large areas of rural land was flooded with some kilometres of fencing destroyed. Stock losses unknown.

Maryborough (Main Drain / Four Mile Creek)

December 1960 (New Years Day) Flash Flood event effecting Princes Park

- January 2011 - Many streets and lower areas in the vicinity of main drains flooded. Local roads flooded including Park Road (Bendigo-Maryborough Road), Gladstone Street, Nolan Street, Majorca Road, Gillies Street, Tullaroop Road, isolated arterial roads and local roads closed for several hours.
- September and November 2010 - Minor flooding only. Flash flooding occurred in isolated areas but cleared quickly.

Back Creek

- January 2011 - Lower areas of Talbot, to the west of the Ballarat-Maryborough Road, flooded. Isolated residences with road and bridge infrastructure damaged. Arterial roads and local roads closed for several days. Large areas of rural land flooded with some kilometres of fencing destroyed.
- November 2010 - Minor rural flooding.
- September 2010 - Arterial road closed for two days.

13. River Gauge Locations

The following stream gauges are of relevance to flooding within the Shire:

- Tullaroop Creek at Clunes (407222);
- Creswick Creek at Clunes (407214);
- McCallum Creek at Carisbrook (407213);
- The head gauge at Tullaroop Reservoir on Tullaroop Creek (407244); and
- The Tullaroop Reservoir outlet (407248).
- Bet Bet Creek at Bet Bet (407211)
- Bet Bet Creek at Norwood (407220)
- Bet Bet Creek At Lillicur (407288)
- Avoca River at Archdale (408206) – located approximately 3 km upstream of the Cherry Tree Creek junction.

14. Major Water Storages

Dam	Responsible Authority	Main Embankment Height (m)	FSL (mAHD)	Dam Capacity (ML)	Comments
Tullaroop Reservoir	G-MW	42.0	222.798	72,950	Fixed crest spillway.
Newlyn Reservoir		15.9	531.790	3,800	Fixed crest spillway.
Hepburn's Lagoon	G-MW	7.0	516.04	2,446	Fixed crest spillway.
Goldfields Reservoir	CGSC	4.7	262.07	150	Situated upstream of Maryborough.
Talbot Reservoir	CHW				South of Clunes – Evansford Road.
Evansford Reservoir	CHW			1,327	Top end of McCallum Creek east of the Waubra – Talbot Road.
Old Lead Reservoir	Loddon Shire	6.55	227.558	120	Located in the Old Lead Creek catchment above Dunolly (north) adjacent

					to Dunolly – Rheola Rd.
Lake Victoria	CGSC	2.6	230.99	67	Located in centre of Maryborough and discharged to Four Mile Creek.
Nuggety Gully	CGSC	5.3	212.10	75	Located south east upstream of Timor / Bowenvale.

15. Flood Mitigation

A small sandbag levee (temporarily constructed for the 2000 floods) of unknown ownership exists on the south (upstream) side of Carisbrook along Belfast Road near the upstream end of the main bluestone drain.

A contour drain in the forest area to the north-east of Dunolly that runs approximately north to south along the eastern side of the town, redirects overland flows from the higher ground to the north and east around the town and into Burnt Creek to the south. Mitigation measures proposed as part of the Dunolly Flood Study (Water Technology, 2013b), have been implemented. These works were incorporated in the flood modelling data and the flood maps have been updated.

16. Digital Flood Extent Datasets and Flood Photography

The Victorian Flood Data (VFD) datasets (available from NCCMA) contain a significant quantity of flood information in GIS format. For the waterways within the Central Goldfields Shire, this includes a number of surveyed flood levels from the September 2010 and January 2011 floods. These levels are also available from the NCCMA.

A number of ground level still photographs are also available from the NCCMA for the September 2010 and January 2011 events.

A significant amount of digital flood related information has been collated for Carisbrook and Dunolly. This data will be provided to North Central CMA and Central Goldfields Shire on completion of the two studies.

The NCCMA, CHW and Central Goldfields Shire hold a variety of other datasets that include:

- Contour and survey information, including LiDAR data.
- Drainage and road infrastructure data.
- Digital cadastral information.
- Flood and non-flood aerial photography.

APPENDIX B – TYPICAL FLOOD PEAK TRAVEL TIMES

Avoca River

Location From	Location To	Typical Travel Time	Comments
Start of rainfall (upper catchment)	Avoca		Begin to rise from normal levels
	Natte Yallock		Begin to rise from normal levels
	Archdale Junction		Begin to rise from normal levels
	Archdale		Begin to rise from normal levels
Avoca	Natte Yallock		Minor flooding
Natte Yallock	Archdale Junction		Minor flooding
Archdale Junction	Archdale		Minor flooding
Avoca	Natte Yallock		Moderate flooding
Natte Yallock	Archdale Junction		Moderate flooding
Archdale Junction	Archdale		Moderate flooding
Avoca	Natte Yallock		Major flooding
Natte Yallock	Archdale Junction		Major flooding
Archdale Junction	Archdale		Major flooding

Tullaroop Creek (also known as Deep Creek locally at Carisbrook)

Note: The BoM does not issue flood warnings for Tullaroop Creek (or for Carisbrook). The following information has been derived from the Carisbrook Flood and Drainage Management Plan (Water Technology, 2013a) and from observations of flood events by agency and community members.

Location From	Location To	Typical Travel Time	Comments
Start of rainfall (Creswick, Clunes areas)	Creswick		Begin to rise from normal levels
	Clunes		Begin to rise from normal levels
	Tullaroop Res HG		Begin to rise from normal levels
	Carisbrook	6 to 15 hours	Begin to rise from normal levels Tullaroop Creek peaks 6 to 24 hours after McCallum Creek at Carisbrook depending on levels in Tullaroop Reservoir
	Laanecoorie Res.		Begin to rise from normal levels
Start of rainfall over small local catchments to west and southwest of Carisbrook	Carisbrook	2 to 6 hours	Begin to experience overland flows, with water pooling upstream of Pyrenees Highway
Creswick	Clunes		Minor flooding
Clunes	Tullaroop Res HG		Minor flooding
Tullaroop Res HG	Carisbrook		Minor flooding
Carisbrook	Laanecoorie Res.		Minor flooding

Creswick	Clunes		Moderate flooding
Clunes	Tullaroop Res HG		Moderate flooding
Tullaroop Res HG	Carisbrook		Moderate flooding
Carisbrook	Laanecoorie Res.		Moderate flooding
Creswick	Clunes		Major flooding
Clunes	Tullaroop Res HG	Around 6 hours	Major flooding (Jan 2011)
Tullaroop Res HG	Carisbrook		Major flooding
Carisbrook	Laanecoorie Res.		Major flooding

McCallum Creek

Note: The BoM does not issue flood warnings for McCallum Creek (or for Carisbrook). The following information has been derived from the Carisbrook Flood and Drainage Management Plan (Water Technology, 2013a) and from observations of flood events by agency and community members.

▪ Location From	▪ Location To	▪ Typical Travel Time	▪ Comments
Start of rainfall (Talbot, Evansford, Clunes areas)	Talbot		Begin to rise from normal levels
	Craigie		Begin to rise from normal levels
	Carisbrook	6 to 15 hours	Begin to rise from normal levels McCallum Creek peaks 6 to 24 hours before Tullaroop Creek at Carisbrook depending on levels in Tullaroop Reservoir
Talbot	Craigie		Minor flooding
Craigie	Carisbrook		Minor flooding
Talbot	Craigie		Moderate flooding
Craigie	Carisbrook		Moderate flooding
Talbot	Craigie		Major flooding
Craigie	Carisbrook		Major flooding

Burnt Creek

Note: The BoM does not issue flood warnings for Burnt Creek or for Dunolly and there are no stream gauges in the catchment. The following information has been derived from the Dunolly Flood Study (Water Technology, 2013b) and from observations of flood events by agency and community members.

▪ Location From	▪ Location To	▪ Typical Travel Time	▪ Comments
Start of rain	Moliagul		Begin to rise from normal levels
	Dunolly	3.5 hours	Begin to rise from normal levels
	Betley (junction of Bet Bet Crk.)		Begin to rise from normal levels
Start of rain	Moliagul		To peak

	Dunolly	~10 – ~12 hours	To peak
	Betley (junction of Bet Bet Crk.)		To peak
Start of rise	Moliagul		To peak
	Dunolly	6 – 8 hours	To peak
	Betley (junction of Bet Bet Crk.)		To peak

Bet Bet Creek

▪ Location From	▪ Location To	▪ Typical Travel Time	▪ Comments
Start of rainfall Lexton area	Bung Bong		Begin to rise from normal levels
	Wareek		Begin to rise from normal levels
	Timor West		Begin to rise from normal levels
	Betley (junction with Burnt Crk.)		Begin to rise from normal levels
Bung Bong	Wareek		Minor flooding
Wareek	Timor West		Minor flooding
Timor West	Betley (junction with Burnt Crk.)		Minor flooding
Bung Bong	Wareek		Moderate flooding
Wareek	Timor West		Moderate flooding
Timor West	Betley (junction with Burnt Crk.)		Moderate flooding
Bung Bong	Wareek		Major flooding
Wareek	Timor West		Major flooding
Timor West	Betley (junction with Burnt Crk.)		Major flooding

APPENDIX C1 – CARISBROOK COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

1. Overview

Carisbrook is a small rural township (1115 residents: 2016 Census) located approximately 66 km north of Ballarat at the confluence of McCallum Creek and Tullaroop Creek within the wider Loddon River catchment. The town is generally of low relief and surrounding land use mainly agriculture. It has a history of flooding.

Tullaroop Creek is referred to locally as Deep Creek, from the Pyrenees Highway Bridge to somewhere downstream of Carisbrook, where it is again called Tullaroop Creek. In order to avoid confusion in this document, the creek through the town will be referred to as Tullaroop Creek.

The combined catchment area of the two creeks to Carisbrook is approximately 1,235km^2. The area of the Tullaroop Creek catchment is ~760km^2 while the McCallum Creek catchment is smaller at ~475km^2.

There is a small sandbag temporary levee constructed for the 2000 floods to the south of the town along Belfast Road near the upstream end of the main bluestone drain. The levee is in disrepair, has no ownership and is not maintained. In addition, the Pyrenees Highway acts as a small levee as it is elevated slightly. The Castlemaine – Maryborough rail line also acts as a levee.

A number of open channels drain local runoff, from a number of small catchments to the west and south west, around and through Carisbrook and ultimately into Tullaroop Creek. The local catchments have a combined area of approximately 21 km^2. The main drains are as follows:

- Main bluestone drain from Belfast Road and flowing from south to north through town to outflow into Tullaroop Creek near Hood Street;
- Drain commencing near Wills Street and flowing to the east to outflow into the main bluestone drain adjacent to the railway line;
- Drain commencing at Belfast Road at the southern end of the main bluestone drain and flowing east along Belfast Road to outflow into McCallum Creek near Virginia Street;
- Bluestone drain near the cemetery flowing to the east from the corner of Landrigan Road and Williams Road to outflow into McCallum Creek;
- Bluestone drain near the Primary School flowing to the east from the corner of Landrigan Road and the Pyrenees Highway to outflow into McCallum Creek near Camp Street.

There are also a number of grassed swales within Carisbrook that act as the local drainage network and that receive water from the underground-piped network. These swales discharge into Tullaroop Creek.

The grass table drain on the north side of Victoria Street flowing into the Bluestone drain has two backflow prevention devices (installed in 2012 by council) – one off Smith Street and one at the drain to prevent backflow along Victoria Street when the Bluestone drain is full.

Grass swales and driveway pipes across Carisbrook have recently been re-graded and renewed to provide a more appropriately functioning low flow drainage system in Carisbrook

Upstream of Carisbrook, the catchment comprises mainly cleared agricultural land. There are however some pockets of forested areas which are located in the upper catchment in the vicinity of Creswick. The towns of Waubra, Talbot and Majorca are within the McCallum Creek catchment while Clunes, Creswick and Springmount are within the Tullaroop catchment to the south of Carisbrook. There are no towns to the north of Carisbrook along Tullaroop Creek but numerous rural residential properties are situated along the creek.

Tullaroop Creek discharges into Laanecoorie Reservoir some 20 km downstream from Carisbrook near Eddington.

Tullaroop Reservoir is situated on Tullaroop Creek, approximately 8 km upstream (south) of Carisbrook and downstream from Clunes. It has a catchment area of approximately 743 km², which comprises the upper Tullaroop Creek and its tributaries including the catchments of Newlyn Reservoir and Hepburns Lagoon. The reservoir was built in 1959, has a capacity of 72,950 ML and covers an area of 742 ha.

The nearest steam gauges to Carisbrook are located at McCallum Creek at Carisbrook (approximately 5 km upstream) and the Tullaroop Reservoir head gauge.

In very general terms, a wet catchment with the natural floodplain storage essentially filled and a period of heavy rain are required to produce flooding at Carisbrook.

General rain of around 40 - 60mm over a 12 hours period or so across a wet catchment will cause significant rises with some minor flooding at Carisbrook within 9 to 18 hours or so of rain starting. More substantial rainfall (of order 70 - 80mm in 12 hours or so or around 80 - 90mm in 24 hours or so), again on a wet catchment, will cause moderate flooding within 9 to 12 hours or so of rain starting. Heavier rainfall (of order 90mm in 12 hours or 110mm or more in 24 hours or less) will cause more severe flooding within 6 to 9 hours or so of rain starting with over-floor inundation of a number of buildings within the town.

Within about 2 to 6 hours of the start of heavy rain, runoff from catchments approximately 1000 hectares to the west and southwest will begin to accumulate to the south of town and against the small levee at Belfast Road. If runoff is sufficient, the sandbag levee will be breached and properties south (upstream) of the Pyrenees Highway / Victoria Street inundated. Properties along the alignment of the bluestone drains through town will also be inundated when the capacity of the bluestone drain is exceeded and it overtops. Rural and residential areas to the west and north around the Trotting Track may also be inundated. The creeks will then begin to rise, some 6 to 15 hours or so after the start of heavy rain across the catchment. McCallum Creek will rise first. During large floods, a significant breakout will flow to the northwest over the Pyrenees Highway and over the railway line. Properties along Bucknall Street will also be impacted. Tullaroop Creek will peak some 6 to 24 hours after McCallum Creek with timing determined by the level of Tullaroop Reservoir before and after the event.

Note:

- Mitigation measures have been proposed as part of the Carisbrook Flood and Drainage Management Plan (Water Technology 2013a).. North Central CMA have undertaken vegetation management works along Tullaroop and McCallums creeks to diminish flood risk to urban Carisbrook.. Central Goldfields Shire Council are currently in the process of constructing a levee bank (known as the western levee), also to increase flood protection to urban Carisbrook. Works once completed will be incorporated into the MFEP, including any updated flood modelling data.

2. Flood Behaviour

Carisbrook has a history of flooding. Flooding in Carisbrook can be caused by overland flows from the small local catchments to the west and south west, between Carisbrook and Maryborough, as well as by high flows within Tullaroop Creek and / or McCallum Creek or some combination. The local catchments tend to respond before the creeks with the result that initial flooding is caused by local water. More severe flooding occurs several hours later as the creeks rise to a peak with McCallum Creek water arriving before water from Tullaroop Creek. The exception to this may be in longer duration rain events that have embedded thunderstorms: in such circumstances, it is possible that the peak flows from the local catchments will coincide with peak flows in the creeks.

Tullaroop Reservoir does attenuate and delay flows in Tullaroop Creek:

- Even under 1% AEP flow conditions, the reservoir is unlikely to spill if it is less than about 70%

capacity at the beginning of the event.

- If the reservoir is above 70% (but not full) and does fill during the event, the peak flow in Tullaroop Creek upstream of Carisbrook can occur up to 24 hours after the peak flow in McCallum Creek (e.g. September 2010).
- Even if the reservoir is near or at full supply level at the start of a flood event, the peak flow in Tullaroop Creek will occur 6 hours or so after the peak flow in McCallum Creek (e.g. January 2011).

What the above demonstrate is that regardless of the initial water level in Tullaroop Reservoir, peak flows through Carisbrook can be dominated by flows in McCallum Creek.

The local overland flows currently drain along a number of wide shallow depressions until they reach the outskirts of town where they are then drained back to McCallum Creek and Tullaroop Creek via three small bluestone drains (one to the south of the town at the cemetery, located on Landrigan Road, another north-south through the town and the other along Virginia Street).

During the 20%, 10% and 5%- AEP events, the creek is well confined with local runoff through town largely confined to the bluestone drains. There is significant shallow flooding of agricultural land to the west and south west of town and the Trotting Track as well as a number of properties in the vicinity begin to be impacted as a result of runoff from the local catchments to the west. In addition, during the 5% AEP event water will bank up on the south (upstream) side of the Pyrenees Highway and the railway line and begin to accumulate from Williams Rd and Potts Lane into to Landrigan Road. It is at this stage that water very quickly begins to overtop the bluestone drains and impact adjacent properties – 25 properties are impacted with 1 flooded over-floor.

During the 2% AEP event:

- A number of small breakouts impact properties along Bucknall, Cambridge, and Hood Streets downstream of the railway bridge;
- A small breakout from McCallum Creek near Chapel Street also impacts properties;
- Local flows from the south west overtop the levee along Belfast Road resulting in shallow inundation of properties south of Victoria Street;
- The main south-north bluestone drain is overtopped and impacts several properties between Victoria and High Streets;
- The bluestone drain adjacent to the Primary School surcharges and inundates property at the corner of Victoria Street and Landrigan Road;
- 63 properties are impacted with 4 flooded over-floor.

Flooding increases significantly between the 2% and 1% AEP events. During the 1% AEP event:

- A significant breakout from McCallum Creek overtops the Pyrenees Highway, flows northwest inundating properties through the centre of town, overtops the railway line and re-enters the creek further downstream;
- Local catchment flows overtop the main south-north bluestone drain and impact properties along the southern side of Victoria Street as well as between Victoria and High Streets;
- The majority of the town is inundated;
- 258 properties are impacted with 51 flooded over-floor.

The depth and extent of flooding (extends further to the west and north) and the number of properties flooded over-floor (up from 51 to 263) all increase substantially between the 1% and 0.5% events. Properties to the west adjacent to the main south-north drain and along the south side of Victoria Street are impacted first by local catchment flows that overtop the drain and then later from the breakouts from McCallum and Tullaroop Creeks as they flow to the northwest across the town.

27 December 1999

The flash flood of 27 December 1999 impacted the southwest side of the town with most of the floodwater resulting from overland flows coming off the hills to the southwest in the Mosquito Flat and Craigie catchment area. A number of properties along the south side of Victoria Street were flooded over-floor and the Pyrenees Highway was closed. Neither McCallum Creek nor Tullaroop Creek flooded.

4 September 2010 – see inundation map at Appendix F1

The September 2010 flood event (~1.3% AEP event) produced significant overland flow from the local catchments to the west and southwest and swelled McCallum and Tullaroop creeks. The local catchments responded quicker than the creeks and runoff accumulated to the south of town well before creek levels rose. The small levee along Belfast Road near the upstream end of the main bluestone drain was breached which led to the inundation of a number of properties upstream (to the south) of the Pyrenees Highway / Victoria Street, and along the alignment of the bluestone drains through town when they overtopped.

Flooding started in the early hours of 4th September. Residents reported that by around 8:40am on the 4th the culvert under Landrigan Road that drains the Belfast Road drain had reached capacity and water was starting to break out of the drain and flow north adjacent to Landrigan Road. Significant breakouts occurred from around mid-morning at the confluence of the two major drains on Belfast Road. This breakout flowed down a natural drainage line to the northeast and inundated properties on the south side of Victoria Street. Breakouts also occurred from the main bluestone drain on the upstream, side of the Pyrenees Highway culvert and further downstream near High Street. Residents reported that by 12:50pm the Belfast Road drain had overtopped over Virginia Street and that within about 85 minutes (around 2:15pm) water was approximately 200-300mm deep along Virginia Street. Rural and residential areas to the west around the Trotting Track were also inundated.

McCallum and Tullaroop creeks continued to rise through this time and peaked downstream of the confluence between noon and 1pm. Tullaroop Creek inundated the rear of properties along Bucknall Street: Bucknall Street was not overtopped. By this time around 25 properties had been inundated, primarily along the south side of Victoria Street as a result of flows from the local catchments. Victoria, Green and Powlett Streets were flooded.

Levels in McCallum Creek receded over the next few hours. Tullaroop Creek continued to rise slowly through the afternoon and peaked during the evening. Flows were less than in McCallum Creek largely due to attenuation through Tullaroop Reservoir.

Tullaroop Reservoir filled and spilled during the event after starting at around 60% capacity.

14 January 2011 – see inundation map at Appendix F1

The flood of January 2011 (~0.75% AEP) was larger that the September 2010 event. It occurred on a wet catchment and was caused by a combination of overland flows from the local catchments to the west and south west of town and flows within the creeks. Runoff accumulated to the south of town, again before creek levels rose. Local runoff flowed into the south and west of the town more than 12 hours before the creeks broke out through the town. Significant local flows were reported around the Gun Club and Trotting Track from around 7-8pm on the 13th with drains overflowing and minor roads in the area being closed. The road between Carisbrook and Red Lion was reported as being impassable from about 8:30pm on the 13th. By 10pm, residents in Bucknall Street were advised to evacuate due to concerns about rising levels in Tullaroop Creek.

The small temporary sandbag levee along Belfast Road near the upstream end of the main bluestone drain was breached and the drainage channels to the south and west of Carisbrook, designed to convey moderate local runoff through the town to the creek, were overtopped.

The first buildings were impacted by local runoff at the confluence of the two major drains on Belfast Road. The breakout flowed down the natural drainage line to the northeast and inundated properties on the south side of Victoria Street during the night. By 4:30am a number of properties along Victoria Street had been inundated and Victoria Street was about to be overtopped. Additional breakouts were also occurring along the main bluestone drain between Victoria Street and High Street.

Flooding occurred in the drainage line that flows under the Carisbrook – Eddington Road to the north of town. Initially this was due to local catchment flows and then later as a result of high levels in Tullaroop Creek backing up the drainage line. At 8am, water was too deep to drive through – up to car windows.

Levels in both McCallum and Tullaroop Creek continued to rise through the night. The Pyrenees Highway was first overtopped between Chapel Street and the Highway Bridge at around 9:30am on the 14th following a large breakout from McCallum Creek. By 10:10am water was flowing into the Fire Station (the CFA building in Urquhart Street in central Carisbrook) and much of the town was inundated.

The breakout over the Pyrenees Highway flowed northwest across the town and overtopped the railway line in a number of places although the line did act as a levee and increase depths on the upstream side. It is apparent that flood levels in properties along the Pyrenees Highway rose significantly, as the breakout from McCallum Creek flooded the town. A smaller breakout occurred to the south of Camp Street and flowed westwards to merge with the larger breakout and flood the Primary School at the corner of Landrigan Road and Camp Street.

The flood peaked between 1pm and 2pm on the 14th. Floodwater had receded from much of the town by late afternoon.

Tullaroop Reservoir spilled during the event after starting from close to capacity.

The January 2011 event was larger than the 1% AEP design event with:

- Deeper inundation through the central part of town;
- Flooding around Smith, Powlett, Albert and McLachlan Streets;
- Additional inundation to the north and northwest of the town resulting from the large breakout from McCallum Creek flowing northwest over the railway line;
- Additional properties impacted along Pleasant and Rose Streets; and
- Inundation around the Primary School.

Comparison of September 2010 and January 2011 floods

The January 2011 peak flood level was approximately 1.6m higher than the September 2010 event upstream of the Pyrenees Highway Bridge. The higher flood level in January led to the large breakout from McCallum Creek. Upstream of the railway bridge over Tullaroop Creek, the January level was approximately 1.3m higher than in September 2010. The difference in flood levels is reflected in the significantly greater flood extent, depths and damage that occurred in the January event.

Runoff from the local catchments had a significant role in both events with runoff accumulating to the south of the town well before creek levels rose. In both events, the small temporary sandbag levee along Belfast Road near the upstream end of the main bluestone drain was breached resulting in inundation of properties to the south of Victoria Street. The bluestone drain also overtopped at other locations leading to inundation of adjacent properties in the west of town.

3. Overview of Flooding Consequences

3.1 Warning Times

The flood warning time for Carisbrook is of order 9 to 18 hours - see Appendix B.

The approximate time between start of rain and flooding in Carisbrook is:

- 2 - 6 hours from the small local catchments to the west and southwest; and
- 6 - 15 hours from McCallum Creek and Tullaroop Creek although Tullaroop Creek will rise slower than McCallum Creek and peak somewhere between 6 and 24 hours later, depending on the level of Tullaroop Reservoir before and after the event.

3.2 Areas Affected

Maps at Appendix F1 provide guidance on where flooding is likely to occur within Carisbrook for flood events ranging form the 20% AEP event up to the 0.5% AEP event. Flooding to the extent and depths shown for each event may not occur simultaneously as the maps display the outer envelope of expected flooding from both the local catchments to the west as well as from McCallum Creek and Tullaroop Creek. As discussed above, the timing of peak flows from these sources differ: flows from the local catchments are likely to affect Carisbrook several hours before flows from the creeks.

3.3 Roads Affected

The main access roads for Carisbrook, the Pyrenees Highway (east and west), the Carisbrook – Eddington Road (north), Landrigan Road (Carisbrook-Talbot Road) (south) and Tullaroop Road (west to Maryborough) are all affected by flooding.

Water first flows over the Pyrenees Highway near the corner of Potts Lane in a 5% AEP event. It is shallow and during a 100-year event is still only 50 to 100mm deep. Water flows over the Pyrenees Highway on the western side of the bridge (between Chapel Street and the bridge) from a little above the 2% AEP event. The Highway becomes impassable from a little below the 1% AEP event and some 6 or more hours after the start of rise during a large flood. During a large flood, the Highway is likely to remain impassable for a day or more.

The Carisbrook – Eddington Road is affected from around the 5% AEP event. During a 1% AEP event, water is up to 800mm deep.

Landrigan Road (Carisbrook-Talbot Road)is overtopped by overland flows from the local catchments in two locations: next to the Primary School at the corner of the Pyrenees Highway and approximately 400m south of Belfast Road. At both locations, water depths are shallow at around 50mm during a 1% AEP event. Further south, Landrigan Road was inundated over a significant length between Craige and Commercial Road during the January 2011 event.

Other roads further up and down the catchment are likely to be impassable for a couple of days or more.

Most of the roads within Carisbrook will be affected in big floods, so it is important that residents are urged to evacuate early in a large flood event – see the flood inundation maps at Appendix F1.

3.4 Properties Affected

3.4.1 Summary

A summary of the number of properties likely to be flooded and the number likely to be inundated over-floor is provided in Section 8.3 of this Appendix.

Around 250 residential and commercial buildings were flooded over-floor (Council listed 273 properties affected by flooding) during the January 2011 event as a result of runoff from the local catchments initially and then later due to large breakouts from McCallum and Tullaroop Creeks (see Figure C1-1). A number of damaged houses had to be demolished and rebuilt.

The September 2010 event was not as severe and resulted in the inundation of approximately 25 buildings. These were located mainly along the southern side of Victoria Street and primarily a result of the runoff from the local catchments.

3.4.2 Detailed List

A list of properties likely to be flooded for a range of floods along with the expected depth of over-ground

flooding and the likely depth of over-floor inundation is provided in Section 8.5 of this Appendix**.** Properties within 100mm of over-floor flooding are also identified. **It is strongly recommended that the list is used in conjunction with the flood inundation maps (see Appendix F1) and the indicative flood guidance tool provided in Section 8.6.**

3.4.3 Update of List of Properties Likely to be Flooded

The list of properties likely to be flooded (with corresponding levels and indication of over-floor flood depth) should be updated within twelve (12) weeks of a flood. Update should occur with information collected as part of post-flood information recording activities and as may be collected as a consequence of the event debrief. Information on the collective experience of the IMT should also be gathered and utilised.

Figure C1-1: Carisbrook township on 14th January 2011 looking west into town along the Pyrenees Highway (source: North Central CMA)

3.5 Isolation

The main access roads for Carisbrook are the:

- Pyrenees Highway (east and west) – impassable from a little below 1% AEP event;
- Carisbrook-Talbot Road or Landrigan Road (south)- shallow flooding even at 1% AEP event, deeper flooding near Craige in a large event;
- Carisbrook - Eddington Road (north) – impassable from a little below the 2% AEP event;
- Maryborough – Bendigo road was inundated (near Shelbourne) during the January 2011 event and may prevent access to Bendigo in a large event; and
- Old Tullaroop Road (west to Maryborough).

The Castlemaine – Maryborough railway line is also overtopped at Carisbrook from between the 2% and 1% AEP flood event.

3.6 Essential Infrastructure

There is no known essential infrastructure affected by flooding at Carisbrook, other than the:

- Pyrenees Highway and Castlemaine – Maryborough railway line from a little above the 2% AEP event;
- Sewerage Pumping Stations located on the river side of Bucknall Street and at corner of Landrigan Road and Pyrenees Highway; and
- Telephone Exchange from a little below the 0.5% AEP event.

The CFA building, town hall and senior citizens centre in Urquhart Street are flooded over-floor from somewhere between the 2% and 1% AEP events. The Britannia Hotel, bakery, newsagency, supermarket, roadhouse shop and churches are also similarly impacted.

4. Flood Mitigation

4.1 General

Flood intelligence MUST have regard for changes within the catchment that modify likely flood behaviour (e.g. mitigation works that reduce the severity of flood risk).

4.2 Flood Protection Levees

There are no formal flood mitigation works in place at Carisbrook. A small levee does however exist along the northern side of Belfast Road at Carisbrook.

4.3 Drainage Works

The bluestone drains within and around Carisbrook provide some protection from and alleviation of flooding arising from local runoff from the small local catchment to the west and south west of town. They are all of modest proportions and not capable of discharging the large flows during flood events. The north south bluestone drain has a limited capacity of 229 ML/day, and probably makes flooding worse for properties that back onto it once it overtops in larger events.

5. Flood Impacts and Required Actions

Refer to the following Flood Intelligence Card.

Note that users of the flood intelligence card should consider rainfall depth and rates at locations in the vicinity of Carisbrook and across the upper catchment and use the indicative tool at Section 8.6 in order to better appreciate the likely severity of flooding and its impacts in the town. Local data and / or data from the BoM website (http://www.bom.gov.au/) should be used. It is suggested that the following sites, available from the BoM website, will provide useful indicative rainfall data:

- Creswick (407249A Gauge Location Number)
- Upper McCallums (Evansford) (GLN still to be issued)
- Clunes (407214A GLN & 407222A GLN)
- Lower McCallums (Carisbrook) (407213C GLN)
- Lillicur (407288A GLN)
- Norwood (407220A GLN)
- Bet Bet (407211B GLN)
- Avoca (408220A GLN)

6. Gauge Information

The tables below provide flows and levels for design flood events along with the September 2010 and January 2011 events for the McCallum Creek at Carisbrook gauge and the Tullaroop Reservoir head gauge. There is significant uncertainty in the data presented for the McCallum Creek gauge due to the rating curve used only extending up to 30,000 ML/d. The rating curve is currently under revision.

AEP	Flow (ML/d)	Gauge level (m)	Extrapolated level (m)	Estimated range (m)
20	10,700	3.67		
10	18,100	4.24		
5	26,800	4.74		
2	48,800	N/A*	5.60	5.4-5.8
1	69,600	N/A*	6.20	6.0-6.4
0.5	94,800	N/A*	6.78	6.6-7.0
January 2011 event	67,200	N/A*	6.14	5.9-6.3
September 2010 event	60,400	N/A*	6.00	5.8-6.2

AEP	Flow (ML/d)	Level (mAHD)
20	1,490	223.17
10	3,260	223.43
5	6,330	223.76
2	14,500	224.45
1	21,500	225.00
0.5	32,000	225.50
January 2011 event	31,400	225.20
September 2010 event	5,260	223.65

7. Command, Control and Coordination

The Command, Control and Coordination arrangements in this MFEP will be as detailed in the EMMV.

All flood response activities within the Central Goldfields Shire Council will be under the Control of the VICSES Regional Duty Officer /or an appointed Incident Controller.

An EMT may be established by the Incident Controller in accordance with the EMMV.

An ICC will be established by the Control (i.e. VICSES) for the command and control functions in response to flood events within the Municipality. It will be operated in accordance with VICSES arrangements.

The ICC for the Central Goldfields Shire and any Divisional or Sector Commands will be located as detailed in the VICSES North West Region Flood Emergency Plan.

8. Flood Intelligence Card, Property Inundation List and Flood / No Flood Guidance Tool

8.1 Introduction

The BoM does not currently provide flood forecasts for Carisbrook. All actions must therefore be driven by rainfall and / or river level observations.

Water level / flood gauges within the catchment upstream of Carisbrook are listed in Appendix E. Those of direct relevance to Carisbrook are

- Tullaroop Creek at Clunes (407222);
- McCallum Creek at Carisbrook (407213);
- The head gauge at Tullaroop Reservoir on Tullaroop Creek (407244); and
- The Tullaroop Reservoir outlet (407248).

The BoM collects and records rainfall at a number of locations within or close to the McCallum and Tullaroop creek catchments. Data from a number of these sites are available from the BoM website at intervals ranging from around 30 minutes to daily. Daily-read rainfall data is available from the BoM website for five sites near to Carisbrook: Bet Bet, Cairn Curran, Clunes, Dunolly and Maryborough. The BoM also operates a number of AWS' in the general vicinity for which rainfall data is available every half hour: at Ballarat on the southern side of the Divide in the upper Leigh River catchment and further to the west at Ben Nevis at the top end of the Wimmera catchment near Mt Cole. Synoptic stations are operated by the BoM at Castlemaine and Maryborough. An event reporting radio telemetry (ERTS) rainfall station is located at Mt Hope in the upper parts of the Werribee catchment. Central Highlands Water (CHW) also operates a number of rain gauges in the general vicinity. Rainfall data is also available from the BoM website at around 3-hourly intervals during heavy rain events from the rain gauge at the Tullaroop Creek at Clunes site and the Bet Bet Creek at Bet Bet site. Similar data is available from Avoca and Archdale to the west and north and from Daylesford, Vaughan and Yandoit to the east. Rainfall data will also become available from the Bet Bet Creek at Norwood site and from a site in the Upper McCallums Creek catchment (possibly from near Evansford).

Users of the flood intelligence card should consider rainfall depth and rates at locations in the vicinity of Carisbrook and across the upper catchment (Clunes in particular) and use the indicative Flood / No Flood guidance tool at Section 8.6 in order to better appreciate the likely severity of flooding and its impacts in the town. Instructions for use of the tool are also provided in Section 8.6.

Notes:

1. While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, 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. Further, the hydrologic and hydraulic modelling that underpins much of the intel detailed below is informed by a number of assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series at http://www.ema.gov.au and in particular in Manual 20 "Flood Preparedness".

2. All levels, impacts and actions listed in the following flood intelligence card and graph may need to be adjusted to better reflect experience.

8.2 Flood Intelligence Card

Observed Rainfall (see graph)	AEP of flood	Water level at Carisbrook (mAHD)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
The location for the water level at Carisbrook is immediately upstream of the Pyrenees Highway Bridge on the east bank – see **red dot** on map at Section 8.4.				
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
Note that flooding from the small local catchments to the west and southwest is likely to affect Carisbrook before flooding from McCallum and Tullaroop Creeks and that McCallum Creek dominates.				
Proposed minor flood level		190.700		◦ Monitor rainfall and water levels
~55mm in 12 hours to ~85mm in 48 hours	20% AEP (5-yr ARI)	190.769	Some shallow flooding to the west and southwest of town including parts of the Trotting Track. No buildings flooded over-floor but water around 13 buildings. Flows well confined along McCallum Creek and Tullaroop Creek and along the bluestone drains through town.	◦ Monitor rainfall and water levels. ◦ Use the indicative flood / no flood tool in order to develop an appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts. ◦ Implement appropriate response actions. This may include organising necessary resources, sandbagging at key locations (see maps), the removal of furniture etc from buildings likely to be flooded over-floor and / or sandbagging buildings.
~65mm in 12 hours to ~95mm in 48 hours	10% AEP (10-yr ARI)	191.357	Some shallow flooding to the west and southwest of town including parts of the Trotting Track. No buildings flooded over-floor but water around 16 buildings. Flows well confined along McCallum Creek and Tullaroop Creek and along the bluestone drains through town. The build up and overflow of local runoff at the confluence of the two major drains on Belfast Road is an indicator of serious flooding	◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts. ◦ Implement appropriate response actions and secure necessary resourcing. Actions may include assisting at 9 Belfast Road.

Observed Rainfall (see graph)	AEP of flood	Water level at Carisbrook (mAHD)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
The location for the water level at Carisbrook is immediately upstream of the Pyrenees Highway Bridge on the east bank – see **red dot** on map at Section 8.4.				
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
			Building at 9 Belfast Road likely to flood over-floor soon.	
Proposed moderate flood level		192.200		◦ SES to issue initial Warnings/Advice to community ◦ Ensure Communications established between Local Agencies
~75mm in 12 hours to ~110mm in 48 hours	5% AEP (20-yr ARI)	192.258	Bluestone drains begin to overflow. Shallow flooding to the west and south west of town including parts of the Trotting Track. Water beginning to bank up on the southern (upstream) side of the Pyrenees Highway and to the south of the railway line. Water beginning to accumulate adjacent to Landrigan Road. First building is flooded over-floor unless protected – High and Victoria St . Another 3 buildings to flood over-floor soon. Water around 34 other buildings. Flows still reasonably well confined along McCallum Creek and Tullaroop Creek and along the bluestone drains through town. The Carisbrook – Eddington Road begins to flood d/s of town. Pyrenees Highway west of town near Potts Lane overtops – water shallow.	◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts ◦ Monitor High St, Victoria St, Belfast Road, 44 Pleasant Street ◦ Implement appropriate response actions and secure necessary resourcing. Deploy “water over road” and other signs. ◦ If flood likely to be bigger than a 50-year ARI event, identify and plan to operationalise evacuation centres and plan to evacuate identified properties.

Observed Rainfall (see graph)	AEP of flood	Water level at Carisbrook (mAHD)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
The location for the water level at Carisbrook is immediately upstream of the Pyrenees Highway Bridge on the east bank – see **red dot** on map at Section 8.4.				
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
Proposed major flood level		193.000		◦
~90mm in 12 hours to ~135mm in 48 hours	2% AEP (50-yr ARI)	193.048	Small breakouts occurring along Tullaroop Creek and impacting properties downstream from the railway bridge. Small breakout from McCallum Creek near Chapel Street affecting properties. Local flows from the south west overtopping the levee along Belfast Road causing some shallow flooding of properties on the southern side of Victoria Street. Overtopping of the main south-north bluestone drain impacting several properties between Victoria Street and High Street. Water surcharging the bluestone drain adjacent to the Primary School causing some flooding of the property at the corner of Victoria Street and Landrigan Road. Unless protected, 3 more buildings flooded over-floor – in Bucknall Street (at Nos 6 & 30) and at 44 Pleasant Street. Water now around another 59 buildings – see table below. Another 51 buildings to flood over-floor soon including the CFA, Britannia Hotel, Bakehouse, Newsagency/Supermarket, Roadhouse shop and 4 churches – see table below. Most of these buildings are in Annesly,	◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts. ◦ Implement appropriate response actions and check resourcing. Actions may include protection of further properties from over-floor flooding and / or removal of household effects. ◦ Consider school situation and related transport. ◦ Deploy “water over road” and other signs. ◦ Close Carisbrook – Eddington Road. ◦ Discuss closure of the Pyrenees Highway with VicRoads. ◦ If flood is going to be bigger than a 50-year ARI event, continue to evacuate identified properties. ◦ Keep all but essential vehicles out of flooded areas. ◦ Record flood impacts and ensure this MFEP is updated.

Observed Rainfall (see graph)	AEP of flood	Water level at Carisbrook (mAHD)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
The location for the water level at Carisbrook is immediately upstream of the Pyrenees Highway Bridge on the east bank – see **red dot** on map at Section 8.4.				
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
			Bucknall, Green, McLachlan, McNeil, Powlett, Simson (Pyrenees Highway), Urquhart, and Victoria (Pyrenees Highway). The Pyrenees Highway is likely to be over-topped on the western side of the bridge soon (at 193.79mAHD) – initially between Chapel Street and the Bridge. The Highway will need to be closed if water continues to rise. The Castlemaine – Maryborough rail line will be overtopped soon.	
Flood peak 4 September 2010 70mm in 8 hours			Significant overland flow from the small local catchments to the west and southwest. Runoff accumulated to the south of town well before creek levels rose. The small levee along Belfast Road near the upstream end of the main bluestone drain was breached which led to the inundation of a number of properties upstream (to the south) of the Pyrenees Highway / Victoria Street, and along the alignment of the bluestone drains through town when they overtopped. Rural and residential areas to the west around the Trotting Track were also inundated. While raised levels in McCallum and Tullaroop creeks inundated low-lying areas along the creek, Bucknall Street was not overtopped. Approx 25 buildings flooded over-floor.	◦
~105mm in 12 hours ~155mm in 48 hours	1% AEP (100-yr ARI)	193.931	Overtopping of the main south-north bluestone drain from local catchment flows impacts a number of properties between Victoria Street and High Street as well as properties along the southern side of Victoria Street.	◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of

Observed Rainfall (see graph)	AEP of flood	Water level at Carisbrook (mAHD)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
The location for the water level at Carisbrook is immediately upstream of the Pyrenees Highway Bridge on the east bank – see **red dot** on map at Section 8.4.				
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
			Levels may drop a little and then rise again due to creek flows. There is significant inundation of properties through the central part of town (51 properties flooded over-floor and a further 207 with water around them) due to a large breakout from McCallum Creek that overtops the Pyrenees Highway and flows through town. Pyrenees Highway closed through town due to fast flowing water, 12 hours or so after start of heavy rain. Likely to remain closed for day or so. Unless protected the following buildings are flooded over-floor: - CFA and St Pauls Anglican Church in Urquhart Street; - Britannia Hotel, Bakehouse and Newsagency/Supermarket in Green Street; - Roadhouse shop in Victoria Street; - Scots Presbyterian Church in and Hall in McLachlan Street; - Uniting Church in Simson Street; - Old St Francis Church in McNeil Street. The number of buildings flooded over-floor will begin to increase rapidly as water levels continue to rise: a further 212 as water rises another ~600mm.	the flood event. ◦ Refer to indicated maps and impacts. ◦ Continue to deliver appropriate response actions and monitor implementation of plans – evacuation, removal of furniture etc from buildings, sandbagging, etc. ◦ Ensure the Pyrenees Highway is closed. ◦ Keep all but essential vehicles out of flooded areas. ◦ Record flood impacts and ensure this MFEP is updated.
Flood peak 14 January 2011 166mm in 72 hours on a wet catchment			A combination of overland flows from the small local catchments to the west and south west of town and flows within the creeks flooded the majority of the town. Approx 250 buildings were flooded over-floor. Runoff accumulated to the south of town before creek levels rose, and the	◦

Observed Rainfall (see graph)	AEP of flood	Water level at Carisbrook (mAHD)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
The location for the water level at Carisbrook is immediately upstream of the Pyrenees Highway Bridge on the east bank – see **red dot** on map at Section 8.4.				
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
			small levee along Belfast Road near the upstream end of the main bluestone drain was breached. The drainage channels to the south and west of Carisbrook, designed to convey local runoff through the town to the creek, were overtopped. There was inundation to the north and northwest of the town resulting from the large breakout from McCallum Creek flowing northwest over the railway line. The Pyrenees Highway was overtopped by the creeks. Smith, Powlett, Albert and McLachlan Streets were also flooded, properties were impacted along Pleasant and Rose Streets, and there was water around the Primary School.	
	0.5% AEP (200-yr ARI)	194.587	Properties to the west of the town adjacent to the main south-north bluestone drain and those on the southern side of Victoria Street will be impacted initially by local catchment flows overtopping the drain and later by creek water as it flows across the town. Flooding is more extensive and significantly deeper than the 100-year event through the majority of town due to the breakout from McCallum Creek upstream of the Pyrenees Highway. Flooding also extends further to the west and north of the central part of town. The Pyrenees Highway remains closed – water deep and fast. Expect 263 buildings to be flooded over-floor and a further 50 to have water around them.	◦ Continue to monitor rainfall and water levels and maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts. ◦ Continue to deliver appropriate response actions. ◦ Continue to monitor implementation of plans – evacuation (MERC), sandbagging, etc. ◦ Ensure the Pyrenees Highway remains closed. ◦ Keep all but essential vehicles out of town. ◦ Record flood impacts and ensure this MFEP is updated.

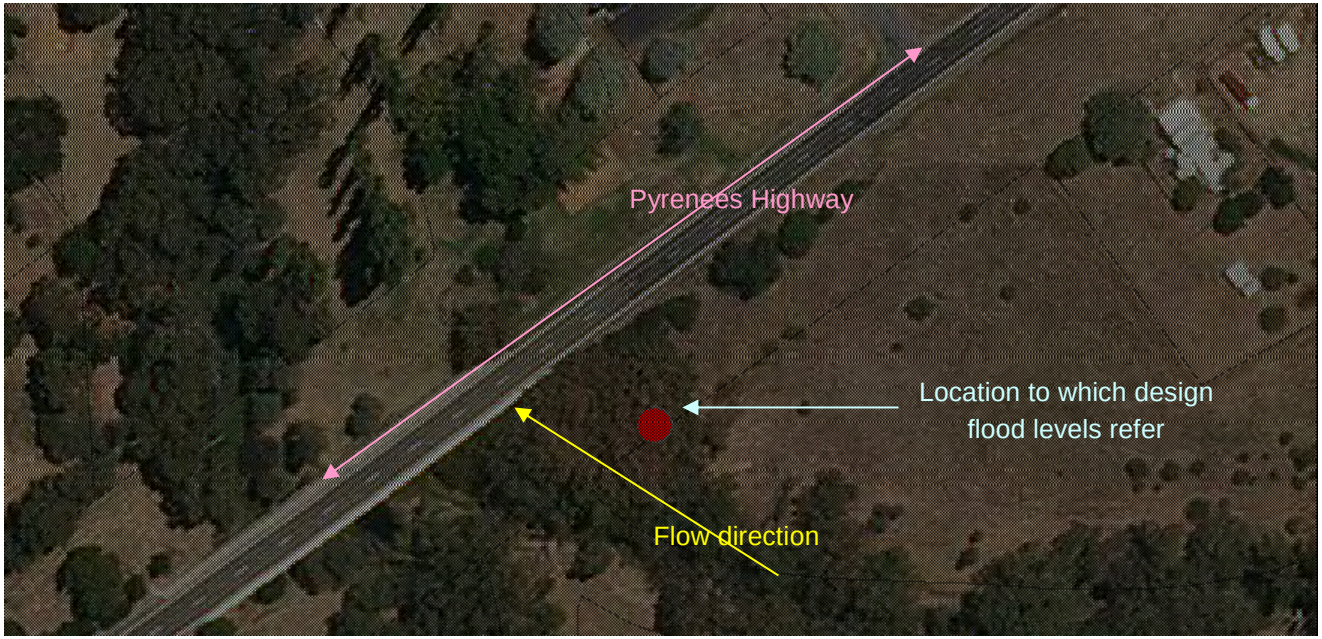
Observed Rainfall (see graph)	AEP of flood	Water level at Carisbrook (mAHD)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
The location for the water level at Carisbrook is immediately upstream of the Pyrenees Highway Bridge on the east bank – see **red dot** on map at Section 8.4.				
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				

8.3 Summary of Properties Flooded

Summary of number of flood affected properties in Carisbrook (ref WaterTech, 2013a) EXISTING CONDITIONS						
	Design Flood AEP (%)					
	20%	10%	5%	2%	1%	0.5%
Level upstream of Pyrenees Highway at Carisbrook (mAHD)	**190.769**	**191.357**	**192.258**	**193.048**	**193.931**	**194.587**
Number of properties flooded above floor	0	0	1	4	51	263
Number of properties flooded below floor only	13	16	34	59	207	50
Total number of flooded properties	13	16	35	63	258	313

8.4 Location for the above levels – at Carisbrook upstream of the Pyrenees Highway Bridge on the east (right hand) bank

Details of this location are provided so that if a flood event occurs before a gauge is installed at the Highway Bridge, a PALS (or similar) can be installed and maximum value can be extracted from the intelligence contained in this MFEP. The **red dot** on the map below indicates the location to which the above levels refer.



8.5 Detailed List of Properties Flooded (removed from public version)

8.6 Indicative Flood / No flood Guidance Tool for Carisbrook

8.6.1 Introduction

The BoM does not currently provide flood forecasts for Carisbrook. All flood response actions must therefore be driven by rainfall and / or river level observations. See Section 8.1.

8.6.2 Indicative Flood Behaviours

In very general terms, the approximate time between start of heavy rain and flooding at Carisbrook from the small local catchment to the west and southwest is 2 - 6 hours. For McCallum Creek and Tullaroop Creek it is around 6 – 15 hours although Tullaroop Creek will rise slower than McCallum Creek and peak somewhere between 6 and 24 hours later, depending on the level of Tullaroop Reservoir before and after the event. Levels fall around a half to a third the rate of rise – it takes 2 to 3 times as long to fall as it does to rise.

8.6.3 Using the Indicative Flood / No flood Guidance Tool

In the lead up to a flood event

An average of the rainfall data from the rain gauges at the Creswick and Clunes stream gauge sites and the rain gauge (Evansford?) in the upper McCallums Creek catchment (or if the catchments are wet and one gauge is consistently higher, the higher of the three) or an average of the rainfall recorded at Avoca, Norwood, Clunes and Upper McCallums Creek) should be used to determine an appropriate rainfall depth for use in the Indicative Flood / No Flood guidance tool provided below, unless data from alternative locations closer to areas considered likely to experience the heaviest rainfall is available. Care should be exercised however, as it must be remembered that runoff from headwater as well as low land areas contribute to flooding.

If the catchment is very wet, it would be appropriate to step up one level. For example, rainfall approaching the 5% AEP curve on a very wet catchment would likely result in flood extents and depths in and around Carisbrook similar to a 2% AEP event.

Two approaches can be used during a rainfall event to determine an indication of the likelihood and severity of flooding at Carisbrook. Both approaches can be used simultaneously using the same copy of the tool. **Unless there are unusual circumstances, actions as per the Flood Intelligence Card should be initiated as soon as the tool suggests flooding is likely.** Response can be escalated if the tool indicates an increase in the expected severity of flooding.

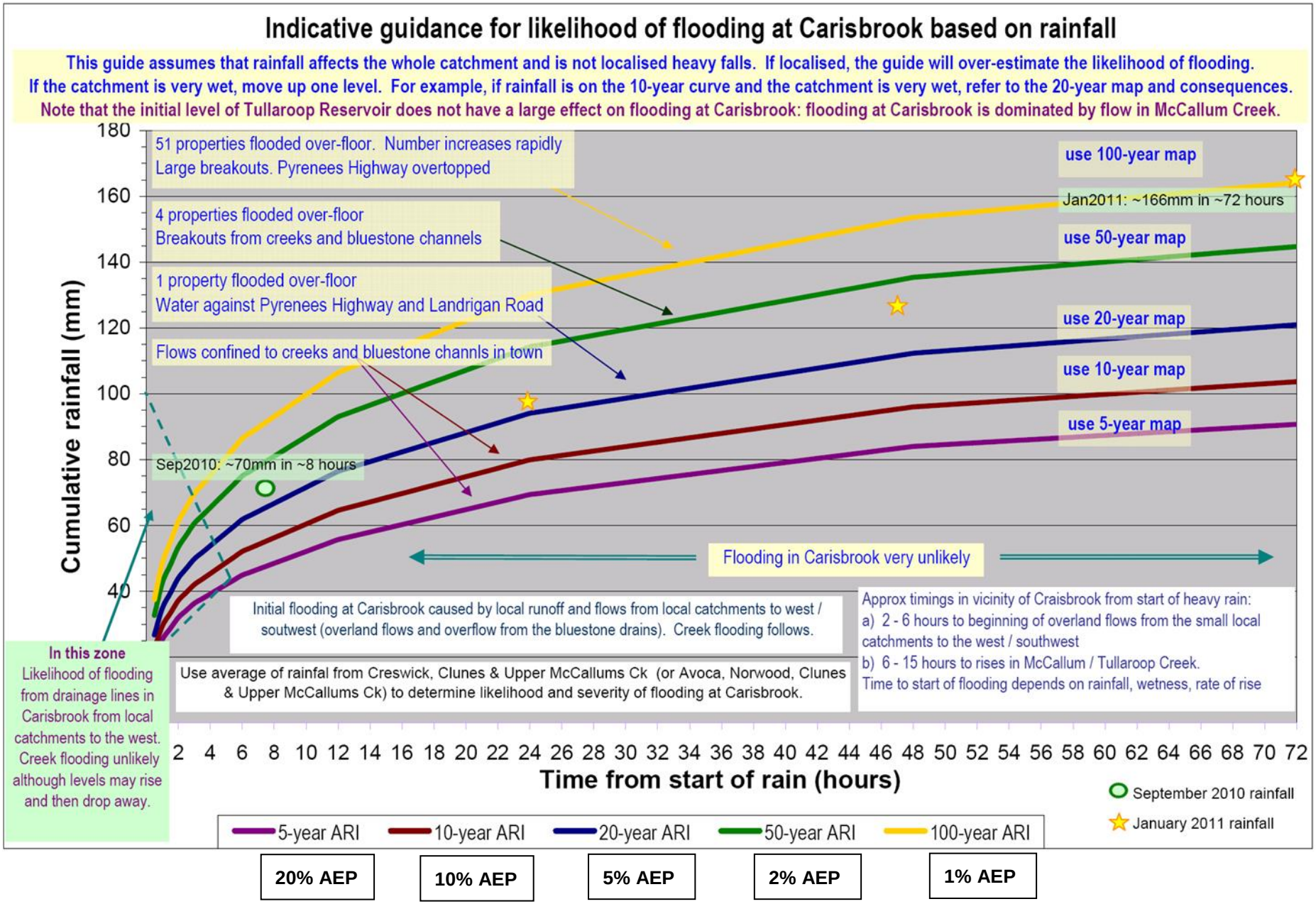
Approach 1: Using the total rainfall depth obtained from the start of the event (discount early drizzle or very light rain), plot the rainfall depth against elapsed time on a copy of the tool. A new plot should be started on receipt of data for each new time step and existing plots should be extended using the new data. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A crossing of the curves by any of the plots indicates that flooding of around that severity is likely.

Approach 2: Discount the early lighter rain from consideration (i.e. begin calculating rainfall depth from start of heavy rain) and plot rainfall depth against time on a copy of the tool. A new plot should be started on receipt of data for each new time step and existing plots should be extended using the new data. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A crossing of the curves by any of the plots indicates that flooding is likely.

CAUTION. While a strength of the tool is that it does provide a quick ball-park answer to questions such as “will we flood” and “how bad will it be”, it is based on a number of gross assumptions and generalisations. It is therefore indicative only. It is not property specific and does not enable accurate predictions of expected flooding, peak flood heights, the time of flood peak, the severity of expected flooding or specific likely consequences. Further, it will not always indicate the expected severity of flooding correctly although it will usually give a heads-up to severe flooding and thus of an indication of likely consequences.

After a flood event

After a flood event, plot the event rainfall depth (with date) on the tool and include an overview of the event, including antecedent conditions, in Appendix A of this MFEP. Relevant information should also be added to Appendix C1.


Indicative guidance for likelihood of flooding at Carisbrook based on rainfall
This guide assumes that rainfall affects the whole catchment and is not localised heavy falls. If localised, the guide will over-estimate the likelihood of flooding.
If the catchment is very wet, move up one level. For example, if rainfall is on the 10-year curve and the catchment is very wet, refer to the 20-year map and consequences.
Note that the initial level of Tullaroop Reservoir does not have a large effect on flooding at Carisbrook: flooding at Carisbrook is dominated by flow in McCallum Creek.
51 properties flooded over-floor. Number increases rapidly
Large breakouts. Pyrenees Highway overtopped
4 properties flooded over-floor
Breakouts from creeks and bluestone channels
1 property flooded over-floor
Water against Pyrenees Highway and Landrigan Road
Flows confined to creeks and bluestone channls in town
use 100-year map
use 50-year map
use 20-year map
use 10-year map
use 5-year map
Jan2011: ~166mm in ~72 hours
Sep2010: ~70mm in ~8 hours
Flooding in Carisbrook very unlikely
Initial flooding at Carisbrook caused by local runoff and flows from local catchments to west / soutwest (overland flows and overflow from the bluestone drains). Creek flooding follows.
Approx timings in vicinity of Craisbrook from start of heavy rain:
a) 2 - 6 hours to beginning of overland flows from the small local catchments to the west / southwest
b) 6 - 15 hours to rises in McCallum / Tullaroop Creek.
Time to start of flooding depends on rainfall, wetness, rate of rise
Use average of rainfal from Creswick, Clunes & Upper McCallums Ck (or Avoca, Norwood, Clunes & Upper McCallums Ck) to determine likelihood and severity of flooding at Carisbrook.
In this zone
Likelihood of flooding from drainage lines in Carisbrook from local catchments to the west. Creek flooding unlikely although levels may rise and then drop away.
Cumulative rainfall (mm)
180
160
140
120
100
80
60
40
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time from start of rain (hours)
September 2010 rainfall
January 2011 rainfall
5-year ARI
10-year ARI
20-year ARI
50-year ARI
100-year ARI
20% AEP
10% AEP
5% AEP
2% AEP
1% AEP

APPENDIX C2 – DUNOLLY
COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

1. Overview

Dunolly is a small rural township (around 700 residents) situated within Central Goldfields Shire approximately 178km north west of Melbourne, 20km north of Maryborough and less than 50km south west of Bendigo. It is within the Loddon River catchment.

Burnt Creek flows around the edge of Dunolly. It has a catchment area upstream of Dunolly of around 177km^2 and rises to the north west of town near Painswick on the southern slopes of Mt Moliagul and includes the eastern slopes of the Bealiba Ranges (see Figure C2-1). Burnt Creek flows into Bet Bet Creek near Betley approximately 10km to the south east. Bet Bet Creek flows into Laanecoorie Reservoir a further 8km downstream.

A small tributary (Old Lead Creek) with a catchment area of around 14km^2 flows from north east of Dunolly and joins Burnt Creek to the north west of town.

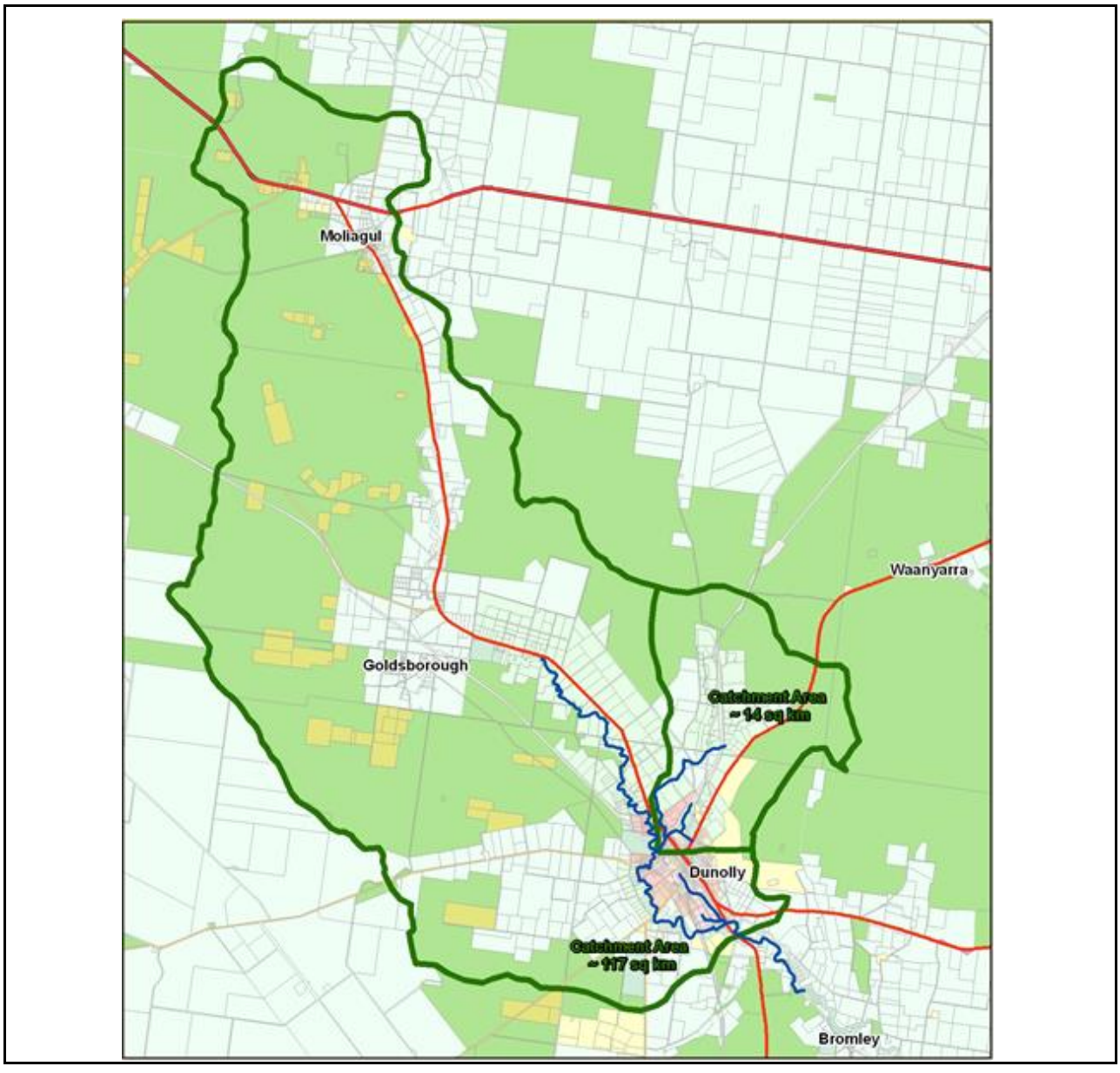


Figure C2-1: Burnt Creek catchment to Dunolly

The Old Lead Reservoir, a former water supply reservoir now managed by Loddon Shire, is located north of Dunolly near the intersection of Dunolly – Rheola Road and Dunolly – Orville Road. It is the only appreciable dam in the Burnt Creek catchment and is fed by contour channels (rather than a watercourse) that divert runoff from adjacent catchments. These contour channels are currently in poor condition. With a capacity of only 120ML, the Old Lead Reservoir has negligible impact on the extent and timing of flood peaks at Dunolly. For example, it would have filled 4.5 times during the January 2011 event and had filled before the first peak occurred at Dunolly on 12th January 2011. On the other hand, a dambreak from the reservoir is considered likely to have some impact on flooding in Dunolly but, as at the date of this MFEP, the extent of that impact has not been assessed. Further, it is understood that Loddon Shire are investigating options for the reservoir's future.

A contour drain runs approximately north to south along the eastern side of Dunolly (see Figure C2-2). The infrastructure has been upgraded with a levelled channel bank along the drain, as well as the addition of inflow and outflow structures to a reservoir basin. The drain captures the over-land flows from the higher ground to the north and east and channels it through a reservoir basin and into Burnt Creek to the south of town thereby providing flood protection for the town.

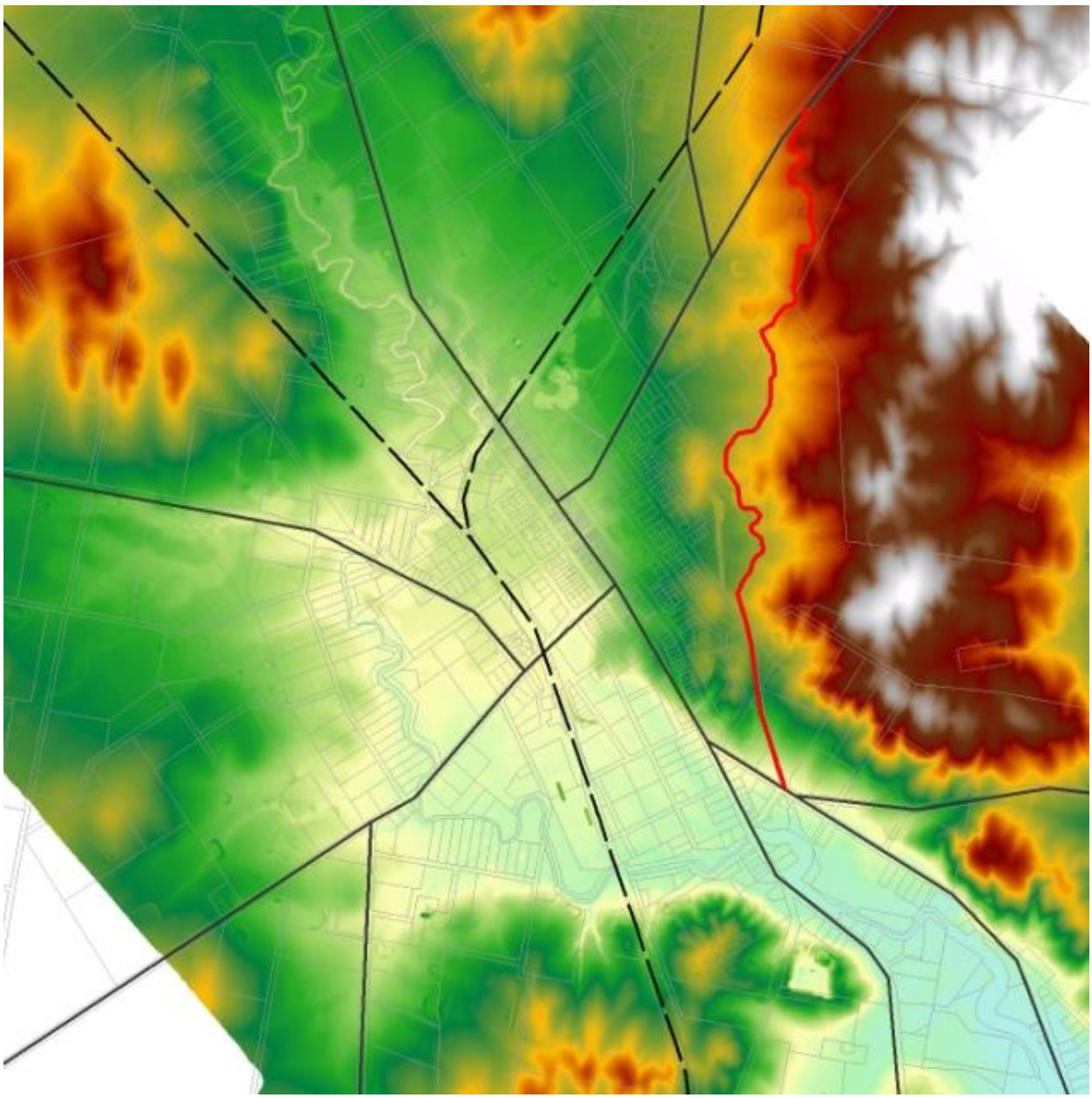


Figure C2-2: Contour drain (red line) to the east of Dunolly

There are no stream gauges in the Burnt Creek catchment.

The Burnt Creek catchment upstream of Dunolly is quite flat with high loss / infiltration rates. Floods therefore usually only occur following very heavy rainfall or after heavy rain on a wet catchment when the natural floodplain storage has been filled.

General rain of around 50mm or more over a 12 hour period or so across a wet catchment will cause significant rises with some flooding at Dunolly within 6 to 8 hours or so of rain starting. More substantial rainfall (of order 80mm or more in 12 hours or so or around 90mm in 24 hours or so), again on a wet catchment, will cause more severe flooding within 7 to 9 hours or so of rain.

2. Flood Behaviour

Dunolly has been flooded a number of times, most notably in February 1873, November 1893, April 1959, September 1983, September 2010 and January 2011.

Large flood events at Dunolly result from high flows in Burnt Creek and in the tributary creeks. Flows from the local creeks cause the initial rise at Dunolly. The recently upgraded drain redirects the overland flow from the east to the south towards Burnt Creek and protects the township. Flooding from Burnt Creek mainly affects the area upstream of the Inglewood – Dunolly railway line, areas to the west of town and the main access roads.

The Inglewood – Dunolly railway line acts as a flow barrier, which protects the town from more frequent and severe flooding. Water ponds upstream (to the north) of the railway line but does not overtop it. This results in an area of deep flooding to the north of the railway line and south of Raglan Street. A number of properties in this area are flooded to depth with a number of houses flooded over-floor.

Large floods have washed the ballast from under the line in the past but this did not happen in January 2011.

Water also ponds upstream of road crossings and many roads do get overtopped, creating access issues.

It is worth noting that:

- There are a number of shrinking islands immediately upstream of Dunolly and also to the west of town that are occupied by houses. A comparison between successive flood inundation maps at Appendix F2 and consideration of the list of properties flooded at Section 8.4 as well as the Evacuation Plan for Dunolly at Appendix D2 will provide guidance on appropriate response. Early evacuation will be essential during large floods.
- While Betley Road is first wetted at around the 5% AEP event and is impassable from around the 2% AEP event, the bridge is unlikely to be overtopped: it is the low section of the road on the town side of the bridge that is affected;
- The capacity of all rail structures (bridges and culverts) is sufficient for all floods up to and including the 0.5% AEP event;
- In very general terms, flood extents do not change dramatically between the 20% and 0.5% AEP events but depths do increase;
- Access and egress to the town is maintained for all design events through Bridgewater-Dunolly Road (protected from floodwaters by the railway line and the contour drain).;
- The Hospital is not affected by flooding but access for emergency cases, staff and visitors is maintained through Breakwater-Dunolly Road only during floods bigger than about the 5%AEP event; and
- Floodwaters outside the main creek channels flow relatively slowly at around 1m/s, even during very large floods.

During the 20% AEP event:

- The causeway at Burnt Creek is overtopped by around 400mm;
- Raglan Street is overtopped by around 20mm;
- The area between the Inglewood – Dunolly railway line and Raglan Street begins to flood as water backs up against the railway line;
- Some water (up to 50mm deep) is conveyed to the south along the Maryborough – Dunolly Road.
- No buildings are flooded over-floor, water is impacting the exterior or subfloor of buildings and water is flowing across further properties.

During the 10% AEP event:

- The causeway at Burnt Creek is overtopped by around 400mm;
- Raglan Street is overtopped by around 30mm;
- Short Street (to the north of town) and the Dunolly - Stuart Mill near the creek are wet;
- No buildings are flooded over-floor, water is impacting the exterior or subfloor of buildings and water is flowing across further properties.

During the 5% AEP event:

- Around 200m of Betley Road is inundated on the town side of the Betley Road Bridge to depths between 20mm and 70mm;
- Water (up to 150mm deep) is conveyed along the Maryborough – Dunolly Road;
- Floodwater, up to around 100mm deep, is breaking out across Dunolly Road at the low point north of Raglan Street;
- Short Street (to the north of town) and the Dunolly - Stuart Mill near the creek are flooded;
- The Dunolly – Avoca Road is not wetted by floodwater; and
- 1 building is flooded over-floor (at 1787 Dunolly-Maryborough Road), water is impacting the exterior or subfloor of 12 other buildings and water is flowing across a further 59 properties.

During the 2% AEP event:

- Around 500m of Betley Road is inundated on the town side of the Betley Road Bridge to depths between 100mm and 300mm;
- Water (up to 200mm deep) is conveyed along the Maryborough – Dunolly Road;
- Floodwater, up to around 250mm deep, is continuing to break out across Dunolly Road at the low point north of Raglan Street;
- The Dunolly – Avoca Road is wetted by floodwater in the vicinity of the creek crossing: all main access roads are flood affected except Bridgewater-Dunolly Rd (Elgin St)
- If flooding is regional rather than just local, properties to the west of the creek and between the Dunolly – Stuart Mill Road and the Dunolly Avoca Road are effectively isolated from town and from other centres; and
- 4 buildings are flooded over-floor (1 in Broadway, 1 in Bently, 1 in Dunolly Moliagul Road and 1 in Dunolly-Maryborough Road), water is impacting the exterior or subfloor of 15 other buildings and water is flowing across a further 56 properties.

During the 1% AEP event:

- Around 600m of Betley Road is inundated on the town side of the Betley Road Bridge to depths between 400mm and 1100mm;
- Water (up to 250mm deep) is conveyed along the Maryborough – Dunolly Road; and
- Floodwater, up to around 400mm deep, is continuing to break out across Dunolly Road at the low point north of Raglan Street; and

- 6 buildings are flooded over-floor (see property table), water is impacting the exterior or subfloor of 19 other buildings and water is flowing across a further 52 properties.

Historical Events

18th February 1873

Heavy rain with thunderstorms resulted in severe flooding in Dunolly.

12th November 1893

Overnight rain followed by a thunderstorm (a total of around 100mm in about 23 hours including 25mm in 25 minutes) led to severe flooding at Dunolly. Roads were impassable, the railway line was damaged (ballast washed away), houses were flooded, stock were drowned and crops were damaged.

1st April 1959

150mm of rain reportedly fell at Moliagul and 67mm at Dunolly within a sixty-five minute period. This led to significant flooding at Dunolly with some houses experiencing inundation to window height.

8th September 1983

Flooding in September 1983 resulted from 94mm of rain across the Burnt Creek catchment over a 6-day period from the 25th to 30th September. Information on flood extents and impacts is not available.

4th September 2010

The September 2010 flood event resulted from heavy rain falling over a 5-day period beginning on 4th September. Dunolly received 85mm of rain. The majority of this rain fell at the beginning of the period starting on the 4th. Maximum intensities (between 20% and 10% AEPI) were recorded in the early hours of the morning of the 4th. Arterial and local roads were closed for several days. Large areas of rural land was flooded.

14 January 2011 – see inundation map at Appendix F2

The flood of January 2011 was the largest flood in living memory at Dunolly and resulted from rainfall with a 12-hour duration AEP event of close to 2%. More than 200mm of rain fell over a 5-day period in three separate bursts. The first burst occurred on the morning of the 10th and only lasted a couple of hours. The second and third bursts, beginning on the 11th and 13th respectively, were more prolonged with rainfall occurring over periods of around 36 and 24 hours. The maximum daily total exceeded 90mm. Rainfall totals varied by up to 15mm across the catchment with the highest totals on the eastern side.

The Old Lead Reservoir would have filled 4.5 times during the event and had filled before the first peak occurred at Dunolly on 12th January.

Floodwaters began impacting the town during the early hours of Friday 14th January. The peak occurred around 9:30am, approximately 12 hours after the start of the third rainfall burst. Water receded quickly and residents returned to their homes during the afternoon.

Dunolly was isolated with only air or rail access. The town also lost power. Twenty (20) homes were inundated and areas along Burnt Creek and Broadway were seriously impacted. A relief centre was opened at the Dunolly Bowls Club during the event, with approx.. 40 residents attending

September/October 2016 – Road closures and some property affected.

3. Overview of Flooding Consequences

3.1 Warning Times

The Burnt Creek catchment responds very quickly to rain if the catchment is wet or rain is very heavy. Thus, the flood warning time for Dunolly is short: of order 4 hours or less for the creek to rise (to peak takes longer) - see Appendix B.

3.2 Areas Affected

The northern end of Broadway is a flooding hot spot, and particularly the area between the Inglewood – Dunolly railway line and Raglan Street.

Maps at Appendix F2 provide guidance on where flooding is likely to occur within Dunolly for flood events ranging from the 20% AEP event up to the 0.5% event. Flooding to the extent and depths shown for each event may not occur simultaneously as the maps display the outer envelope of expected flooding.

3.3 Roads Affected

The main access roads for Dunolly except Bridgewater-Dunolly Road (Dunolly – Moliagul Road, Maryborough – Dunolly Road, Dunolly – Eddington Road, Betley Road, Dunolly – Avoca Road and Dunolly – Stuart Mill Road) as well as a number of streets in the vicinity of the township are affected by flooding. Roads are not inundated for extended periods (generally less than 24 hours even in big floods).

3.4 Properties Affected

3.4.1 Summary

A summary of the number of properties likely to be flooded and the number likely to be inundated over-floor is provided in Section 8.3 of this Appendix.

Around 20 buildings in Dunolly were flooded over-floor during the January 2011 event.

3.4.2 Detailed List

A list of properties likely to be flooded for a range of floods along with the expected depth of over-ground flooding adjacent to the building and the likely depth of over-floor inundation is provided in Section 8.4 of this Appendix**.** Properties within 100mm of over-floor flooding are also identified. **It is strongly recommended that the list is used in conjunction with the flood inundation maps (see Appendix F2) and the indicative flood guidance tool provided in Section 8.5.**

3.4.3 Update of List of Properties Likely to be Flooded

The list of properties likely to be flooded (with corresponding levels and indication of over-floor flood depth) should be updated within twelve (12) weeks of a flood. Update should occur with information collected as part of post-flood information recording activities and may be collected as a consequence of the event debrief. Information on the collective experience of the IMT should also be gathered and utilised.

3.5 Isolation

The main access roads for Dunolly (Dunolly – Moliagul Road, Maryborough – Dunolly Road, Dunolly – Eddington Road, Betley Road, Dunolly – Avoca Road and Dunolly – Stuart Mill Road) are affected by flooding. The Bridgewater-Dunolly Road (Elgin St) is the only access road that remains free of floodwaters. The Dunolly – Avoca Road not wetted at the 5% AEP event. At the 2% AEP event, all roads west of the railway line and south of the township are wetted. Access & Egress to and from Dunolly is only possible through Bridgewater-Dunolly Road. While these roads do not remain inundated for an extended period (i.e. generally less than 24 hours even in big floods), road surfaces can be damaged which extends the period of isolation.

There are a number of shrinking islands immediately upstream of Dunolly and to the west of town that are occupied by houses. A comparison between successive flood inundation maps at Appendix F2 and consideration of the list of properties flooded at Section 8.4 will provide more accurate guidance on properties likely to be affected, isolated and / or require evacuation. See also the evacuation plan at Appendix D2.

The Castlemaine – Dunolly, Dunolly - St Arnaud and Inglewood – Dunolly railway lines are not overtopped by floods up to at least the 0.5% AEP event. However, floodwater does pond on their upstream sides and it is possible that ballast may be shifted or washed out. This did not happen during the January 2011 event but is reported to have happened during earlier floods.

3.6 Essential Infrastructure

There is no known essential infrastructure affected by flooding at Dunolly other than main access roads and the Pre-School. The Hospital, Police Station, CFA station, Telstra Exchange, School and Council offices all remain dry.

4. Flood Mitigation

4.1 General

Flood intelligence MUST have regard for changes within the catchment that modify likely flood behaviour (e.g. mitigation works that reduce the severity of flood risk).

4.2 Flood Protection Levees

There are no formal flood mitigation works in place at Dunolly although the railway line and roads do act to some extent as a barrier, as does the contour channel to the north-east of town.

4.3 Drainage Works

There are no specific drainage works planned or required in Dunolly, other than the contour drain that runs approximately north to south along the eastern side of the town and redirects over-land flows from the higher ground to the north and east around the town and into Burnt Creek to the south (see Figure C2-2), that impact on flooding or vice versa.

5. Flood Impacts and Required Actions

Refer to the following Flood Intelligence Card.

Note that users of the flood intelligence card should consider rainfall depth and rates at locations in the vicinity of Dunolly and across the upper catchment and use the indicative tool at Section 8.5 in order to better appreciate the likely severity of flooding and its impacts in the town. Local data and / or data from the BoM website (http://www.bom.gov.au/) should be used. It is suggested that the following sites, available from the BoM website, will provide useful indicative rainfall data:

- Archdale Junction (site number 408206)
- Bet Bet (site number 407211B)
- Norwood (site number 407220A)

6. Gauge Information

There is no stream gauge information for the Burnt Creek catchment.

7. Command, Control and Coordination

The Command, Control and Coordination arrangements in this MFEP will be as detailed in the EMMV.

All flood response activities within the Central Goldfields Shire will be under the Control of the VICSES Regional Duty Officer or an appointed Incident Controller.

An EMT may be established by the Incident Controller in accordance with the EMMV.

An ICC will be established by the Control agency VICSES for the command and control functions in response to flood events within the Municipality. It will be operated in accordance with VICSES arrangements.

The ICC for the Central Goldfields Shire and any Divisional or Sector Commands will be located as determined by VICSES.

8. Flood Intelligence Card, Property Inundation List and Flood / No Flood Guidance Tool

8.1 Introduction

The BoM does not currently provide flood forecasts for Burnt Creek or for Dunolly. All actions must therefore be driven by rainfall and / or river level observations.

There are no water level / flood gauges within the Burnt Creek catchment.

The BoM collects and records rainfall at a number of locations within or close to the Burnt Creek catchment. Data from a number of these sites are available from the BoM website at intervals ranging from around 3 hours to daily. Daily-read rainfall data is available for a number of sites in the general vicinity of the Burnt Creek catchment including at Dunolly. Rainfall data is also available at around 3-hourly intervals during heavy rain events from the rain gauge at the Bet Bet Creek at the Bet Bet site and from Laanecoorie Reservoir. Similar data is available from the Archdale site on the Avoca river. Rainfall data will also become available from the Bet Bet Creek at the Norwood site.

Users of the flood intelligence card should consider rainfall depth and rates at locations in the vicinity of Dunolly and across the upper catchment (if available) and use the indicative Flood / No Flood guidance tool at Section 8.5 in order to better appreciate the likely severity of flooding and its impacts in the town. Instructions for use of the tool are also provided in Section 8.5.

Notes:

1. While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, 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. Further, the hydrologic and hydraulic modelling that underpins much of the intel detailed below is informed by a number of assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series at http://www.ema.gov.au and in particular in Manual 20 “Flood Preparedness”.
2. All levels, impacts and actions listed in the following flood intelligence card and graph may need to be adjusted to better reflect experience.

8.2 Flood Intelligence Card

Observed Rainfall (see graph)	AEP of flood	Water level / flow at Dunolly (mAHD / m^3/s)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
Due to existing flow paths, water will flow across a number of properties but not up against the side of the building – these are indicated with blue shading in the following property table				
Heavy rain on wet catchment			Overflows from the contour drain to the east of town will cause initial shallow flooding in town streets and at the northern end of Broadway. The status of this drain is therefore an indicator of imminent flooding. Water also begins to back up against the Inglewood – Dunolly railway line downstream from Raglan Street.	◦ Check the contour drain for flow and capacity immediately to the south of the Bridgewater – Dunolly Road and in the section to the east of the Hospital. ◦ Monitor rainfall and water levels. ◦ Use the indicative flood / no flood tool to develop an appreciation of the likely scale of the flood event.
~50mm in 9 hours to ~60mm in 18 hours	20% AEP (5-yr ARI)	20 m^3/s	Burnt Creek causeway overtopped by around 400mm. Raglan Street overtopped by around 20mm. The area between the Inglewood – Dunolly railway line and Raglan Street begins to flood as water backs up against the railway line. Some water (up to 50mm deep) runs south along the Maryborough - Dunolly Road. No buildings are flooded over-floor, water is up against 6 buildings and water is flowing across a further 45 properties.	◦ Monitor rainfall and water levels. ◦ Use the indicative flood / no flood tool to develop an appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts. ◦ Implement appropriate response actions. This may include organising necessary resources and / or evacuations, sandbagging at key locations (see maps), the removal of furniture etc from buildings likely to be flooded over-floor and / or sandbagging buildings. ◦
~55mm in 9 hours to ~70mm in 18 hours	10% AEP (10-yr ARI)	42 m^3/s	Burnt Creek causeway overtopped by around 400mm. Raglan Street overtopped by around 30mm. Short Street (to the north of town) and the Dunolly – Stuart Mill in the vicinity of the creek crossing are wet. Some water (up to 100mm deep) running along the Maryborough –	◦ Continue to monitor rainfall and water levels. ◦ Maintain plot on indicative flood / no flood tool in order to further develop appreciation of likely scale of flood event. ◦ Refer to indicated maps and impacts. ◦ Implement appropriate response actions and secure necessary resourcing. Deploy "water over road" and

Observed Rainfall (see graph)	AEP of flood	Water level / flow at Dunolly (mAHD / m^3/s)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
Due to existing flow paths, water will flow across a number of properties but not up against the side of the building – these are indicated with blue shading in the following property table				
			Dunolly Road. No buildings are flooded over-floor, water is up against 8 other buildings and water is flowing across a further 56 properties.	other signs. ◦ If flood is likely to be bigger than the 5% AEP event, plan for access roads to the town, other than Bridgewater-Dunolly Rd, to be impassable for up to 24 hours. ◦ If flood likely to be bigger than a 2% AEP event, open the Relief Centre at the Bowls Club and start evacuation of identified properties..
	Sept 1983	45 m^3/s	Information on flood impacts not available.	◦
~65mm in 9 hours to ~80mm in 18 hours	5% AEP (20-yr ARI)	71 m^3/s	Around 200m of Betley Road is inundated on the town side of the Betley Road Bridge to depths between 20mm and 70mm. Water (up to 150mm deep) is running along the Maryborough – Dunolly Road. Floodwater (up to 100mm deep) breaking out across Dunolly Road at the low point north of Raglan Street. Short Street (to the north of town) and the Dunolly – Stuart Mill near the creek crossing are flooded. The Dunolly – Avoca Road and Bridgewater-Dunolly Road are the only main access roads not wetted by floodwater. 1 building is flooded over-floor (at 1787 Dunolly-Maryborough Road), water up against 12 other buildings and water is flowing across a further 59 properties.	◦ Continue to monitor rainfall and water levels. ◦ Maintain plot on indicative flood / no flood tool in order to further develop appreciation of likely scale of flood event. ◦ Refer to indicated maps and impacts. ◦ Implement appropriate response actions and secure necessary resourcing. Deploy “water over road”, “road closed” and other signs. ◦ If flood likely to be bigger than a 2% AEP event, activate the Relief Centre at the Bowls Club and continue evacuation of identified properties.

Observed Rainfall (see graph)	AEP of flood	Water level / flow at Dunolly (mAHD / m^3/s)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
Due to existing flow paths, water will flow across a number of properties but not up against the side of the building – these are indicated with blue shading in the following property table				
~80mm in 9 hours to ~95mm in 18 hours	2% AEP (50-yr ARI)	106 m^3/s	Around 500m of Betley Road is inundated on the town side of the Betley Road Bridge to depths between 100mm and 300mm. Water (up to 200mm deep) is running along the Maryborough – Dunolly Road. Floodwater (up to 250mm deep) is continuing to break out across Dunolly Road at the low point north of Raglan Street. The Dunolly – Avoca Road is wetted by floodwater in the vicinity of the creek crossing: all main access roads are flood affected; and If flooding is regional rather than just local, properties to the west of the creek and between the Dunolly – Stuart Mill Road and the Dunolly Avoca Road are effectively isolated from town and from other centres. 4 buildings are flooded over-floor (1 in Broadway, 1 in Betley, 1 in Dunolly Moliagul Rd and 1 in Dunolly-Maryborough Road), water is up against 15 other buildings and water is flowing across a further 56 properties.	◦ Continue to monitor rainfall and water levels. ◦ Maintain plot on indicative flood / no flood tool in order to further develop appreciation of likely scale of flood event. ◦ Refer to indicated maps and impacts. ◦ Implement appropriate response actions and as appropriate deploy “water over road”, “road closed” and other signs.
	Jan 2011	107 m^3/s	Dunolly isolated with only air or rail access and power was lost (contour drain was overtopped, flooding Bridgewater-Dunolly Road and all access roads to the town). 40 homes evacuated 20 homes flooded over-floor and areas along Burnt Creek and Broadway seriously impacted. A relief centre was opened at the Dunolly Bowls Club.	

Observed Rainfall (see graph)	AEP of flood	Water level / flow at Dunolly (mAHD / m^3/s)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
Due to existing flow paths, water will flow across a number of properties but not up against the side of the building – these are indicated with blue shading in the following property table				
			The peak occurred around 9:30am, approximately 12 hours after the start of the third rainfall burst. Water receded quickly and residents returned to their homes during the afternoon during the event.	
~90mm in 9 hours to ~110mm in 18 hours	1% AEP (100-yr ARI)	145 m^3/s	Around 600m of Betley Road is inundated on the town side of the Betley Road Bridge to depths between 400mm and 1100mm. Water (up to 250mm deep) is running along the Maryborough – Dunolly Road. Water is continuing to break out from the end of the contour drain across Dunolly Road with shallow flooding. Floodwater (up to 400mm deep) is continuing to break out across Dunolly Road at the low point north of Raglan Street. 15 buildings flooded over-floor (see property table), water up against 54 other buildings and water flowing across a further 114 properties.	◦ Continue to monitor rainfall and water levels. ◦ Maintain plot on indicative flood / no flood tool in order to further develop appreciation of likely scale of flood event. ◦ Refer to indicated maps and impacts. ◦ Continue to implement appropriate response actions.
	April 1959	160 m^3/s	Significant flooding at Dunolly. Some houses inundated to window height.	
A little above the 1% AEP line on the indicative flood / no flood tool	0.5% AEP (200yr ARI)	188 m^3/s	Around 600m of Betley Road is inundated on the town side of the Betley Road Bridge to depths between 600mm and 1300mm. Water (up to 300mm deep) is running along the Maryborough – Dunolly Road. Floodwater (up to 400mm deep) is continuing to break out across Dunolly Road at the low point north of Raglan Street.	◦ Continue to monitor rainfall and water levels. ◦ Maintain plot on indicative flood / no flood tool in order to further develop appreciation of likely scale of flood event. ◦ Refer to indicated maps and impacts. ◦ Continue to implement appropriate response actions.

Observed Rainfall (see graph)	AEP of flood	Water level / flow at Dunolly (mAHD / m^3/s)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at Central Goldfields Shire. Note time available – see below.				
It is important that the decision to Evacuate is made early based on available intelligence and local knowledge.				
Due to existing flow paths, water will flow across a number of properties but not up against the side of the building – these are indicated with blue shading in the following property table				
			15 buildings flooded over-floor (see property table), water up against 19 other buildings and water flowing across a further 52 properties.	

8.3 Summary of Properties Flooded

Summary of number of flood affected properties in Dunolly (ref WaterTech, 2013b) EXISTING CONDITIONS						
	Design Flood AEP (%)					
	20%	10%	5%	2%	1%	0.5%
Level at reference gauge						
Number of properties flooded above floor	0	0	1	4	15	23
Number of properties flooded below floor against building only	6	8	12	15	19	78
Number of properties flooded but water not against building	45	56	56	59	52	99
Total number of flooded properties	51	64	72	75		200

8.4 Detailed List of Properties Flooded (removed from public version)

8.5 Indicative Flood / No flood Guidance Tool for Dunolly

8.5.1 Introduction

The BoM does not currently provide flood forecasts for Burnt Creek or for the Dunolly area. All flood response actions must therefore be driven by rainfall and / or river level observations. See Section 8.1.

8.5.2 Indicative Flood Behaviours

In very general terms, the approximate time between start of heavy rain and flooding at Dunolly is around 9.5 to 10.5 hours. Levels fall at around half the rate of rise – it generally takes almost twice as long to fall as it does to rise.

8.5.3 Using the Indicative Flood / No flood Guidance Tool

In the lead up to a flood event

An average of the rainfall recorded at the rain gauges at Archdale Junction, Norwood, Bet Bet and Laanecoorie (or if the catchment is wet and one gauge is consistently higher, the average of that gauge and the next highest) should be used to determine an appropriate rainfall depth for use in the Indicative Flood / No Flood guidance tool provided below, unless data from alternative locations closer to areas considered likely to experience the heaviest rainfall is available. Care should be exercised however, as it must be remembered that runoff from headwater as well as low land areas contribute to flooding.

If the catchment is very wet, it would be appropriate to step up one level. For example, the 3rd burst of rainfall in January 2011 occurred over a 12 hour period and was around the 50-year ARI (2% AEP). However, the resulting flood extents and depths in and around Dunolly were similar to a 100 year ARI (1% AEP) event.

If the catchment is dry, this tool will tend to over-estimate the likelihood of flooding if the catchment is dry and / or rain extended over more than 24 hours

Two approaches can be used during a rainfall event to determine an indication of the likelihood and severity of flooding at Dunolly. Both approaches can be used simultaneously using the same copy of the tool. **Unless there are unusual circumstances, actions as per the Flood Intelligence Card should be initiated as soon as the tool suggests flooding is likely.** Response can be escalated if the tool indicates an increase in the expected severity of flooding.

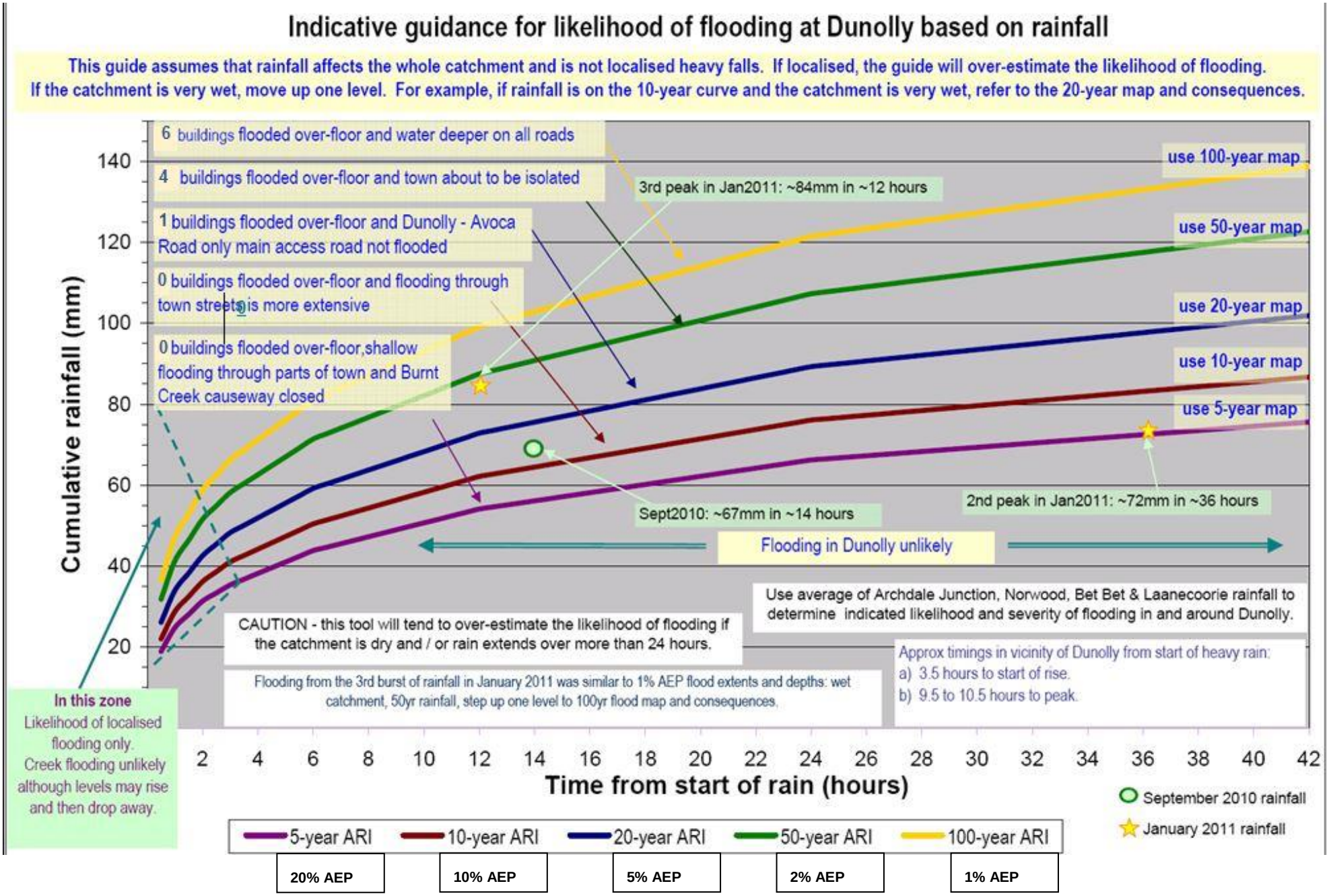
Approach 1: Using the total rainfall depth obtained from the start of the event (discount early drizzle or very light rain), plot the rainfall depth against elapsed time on a copy of the tool. A new plot should be started on receipt of data for each new time step and existing plots should be extended using the new data. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A crossing of the curves by any of the plots indicates that flooding of around that severity is likely.

Approach 2: Discount the early lighter rain from consideration (i.e. begin calculating rainfall depth from start of heavy rain) and plot rainfall depth against time on a copy of the tool. A new plot should be started on receipt of data for each new time step and existing plots should be extended using the new data. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A crossing of the curves by any of the plots indicates that flooding is likely.

CAUTION. While a strength of the tool is that it does provide a quick ball-park answer to questions such as “will we flood” and “how bad will it be”, it is based on a number of gross assumptions and generalisations. It is therefore indicative only. It is not property specific and does not enable accurate predictions of expected flooding, peak flood heights, the time of flood peak, the severity of expected flooding or specific likely consequences. Further, it will not always indicate the expected severity of flooding correctly although it will usually give a heads-up to severe flooding and thus of likely consequences. Note also that the tool will tend to over-estimate the likelihood of flooding if the catchment is dry and / or rain extends over more than 24 hours. On the other hand, it will tend to underestimate the likelihood of flooding if the catchment is wet. In such circumstances, it would be appropriate to step up one curve.

After a flood event

After a flood event, plot the event rainfall depth (with date) on the tool and include an overview of the event, including antecedent conditions, in Appendix A of this MFEP. Relevant information should also be added to Appendix C2.


Indicative guidance for likelihood of flooding at Dunolly based on rainfall
This guide assumes that rainfall affects the whole catchment and is not localised heavy falls. If localised, the guide will over-estimate the likelihood of flooding.
If the catchment is very wet, move up one level. For example, if rainfall is on the 10-year curve and the catchment is very wet, refer to the 20-year map and consequences.
6 buildings flooded over-floor and water deeper on all roads
4 buildings flooded over-floor and town about to be isolated
1 buildings flooded over-floor and Dunolly - Avoca Road only main access road not flooded
0 buildings flooded over-floor and flooding through town streets is more extensive
0 buildings flooded over-floor,shallow flooding through parts of town and Burnt Creek causeway closed
3rd peak in Jan2011: ~84mm in ~12 hours
use 100-year map
use 50-year map
use 20-year map
use 10-year map
use 5-year map
Sept2010: ~67mm in ~14 hours
2nd peak in Jan2011: ~72mm in ~36 hours
Flooding in Dunolly unlikely
Use average of Archdale Junction, Norwood, Bet Bet & Laanecoorie rainfall to determine indicated likelihood and severity of flooding in and around Dunolly.
CAUTION - this tool will tend to over-estimate the likelihood of flooding if the catchment is dry and / or rain extends over more than 24 hours.
Flooding from the 3rd burst of rainfall in January 2011 was similar to 1% AEP flood extents and depths: wet catchment, 50yr rainfall, step up one level to 100yr flood map and consequences.
Approx timings in vicinity of Dunolly from start of heavy rain:
a) 3.5 hours to start of rise.
b) 9.5 to 10.5 hours to peak.
In this zone
Likelihood of localised flooding only. Creek flooding unlikely although levels may rise and then drop away.
Cumulative rainfall (mm)
20
40
60
80
100
120
140
Time from start of rain (hours)
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
September 2010 rainfall
January 2011 rainfall
5-year ARI
10-year ARI
20-year ARI
50-year ARI
100-year ARI
20% AEP
10% AEP
5% AEP
2% AEP
1% AEP

APPENDIX D –
Flood Evacuation Arrangements

1 Phase 1 - Decision to Evacuate

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, MRM, DHHS, Health Commander and other key agencies and expert advice (CMA's 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
Carisbrook		Moderate Flood Warning issued by BOM

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, MRM, 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 VicPol.

Evacuation Routes to be utilised will be determined by the extent of flood waters

Landing zones for helicopters are located at:

Maryborough Aerodrome, Leviathan Road, Maryborough.

Vulnerable people/groups are identified in Council's Vulnerable People register. They can also be identified through community network organisations. Further information on Council's 'residents at risk' register can be obtained from vprmecccentral.com or via VicPol.

4 Phase 4 – Shelter

Relief Centres and/or assembly areas which cater for people's basic needs for floods may be established to meet the immediate needs of people affected by flooding. The venues that are suitable for flood events are detailed in the Central Goldfields Shire MEMP. The venue to be used in a particular flood event will be decided by the Central Goldfields Shire Municipal Recovery Manager in consultation with the Incident Controller and the MERC.

Animal Shelter

Animal shelter compounds will be established for domestic pets and companion animals of evacuees as required. These facilities will be coordinated under the arrangements in Part 6 of the Central Goldfields Shire MEMP.

Levee Environments

Not applicable in Carisbrook.

Isolated Properties

Not applicable in Carisbrook.

5 Phase 5 – Return

Return will be consistent with the Strategic Plan 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.

▪ Service	▪ Impact	▪ Trigger Point for action	▪ Strategy/Temporary Measures
▪ School Bus services	▪ Bus routes may be closed due to rising flood water.	▪ Road closures likely or actual.	▪ Council to advise Maryborough Education Centre Bus Coordinator of road status
▪ Waste Water Treatment	▪ Pump stations may stop due to rising water	▪ Pump stations inundated	▪ CGSC to advise community
▪	▪	▪	▪

7 Essential Community Infrastructure and Property Protection

Essential Community Infrastructure and properties (e.g. residences, businesses, roads, power supply etc.) that require protection are:

▪ Facility	▪ Impact	▪ Trigger Point for action	▪ Strategy/Temporary Measures
Telephone Exchange	Loss of local land lines	Predicted below 0.5%AEP event	Sand Bag
Sewage Pumping Station Bucknall St	Contaminated water in community	Moderate Flood Warning	Monitor and Sand Bag if predicted inundation
Castlemaine – Maryborough rail line	Rail stoppage	Little above 2% AEP Event	Contact State Rail Controller Melbourne

Central Goldfields Shire Council will establish a sandbag collection point at

Shire Depot 72 Burns St Maryborough

8 Rescue

Central Goldfields Shire Council is a signatory to the MAV Resource Sharing Protocol which includes neighbouring Shires to assist each other during an emergency incident. Currently CGSC does not have any formal resource sharing arrangements established with other Agencies. However, the Victorian incident management arrangements established for flood facilitate such sharing.

Known high-risk areas / communities (i.e. low-lying islands) where rescues might be required include:

Carisbrook: one recorded fatality

NatteYallock: one recorded fatality

APPENDIX E – FLOOD WARNING SYSTEMS

1 Flood Warning

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

2 Severe Thunderstorm and Severe Weather Warnings

The BoM can forecast the environment in which severe thunderstorms or small scale weather systems that are locally intense and slow moving may occur and provides a generalised service to that effect. However, it is not yet scientifically possible to predict individual flash flooding events except on time scales of tens of minutes at the very best.

The BoM issues warnings of flash flooding when it becomes apparent that an event has commenced which may lead to flash flooding or when flash flooding has commenced.

3 Flood Watches

Flood watches are issued by the 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.

4 Flood Warnings

4.1 Overview

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. Releases 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. More specifically, 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 any major dams within the catchment;
- Forecasts of the height and time of flood peaks at key locations;
- Weather forecast and the likely impact of expected rainfall on flooding; and
- A warning re-issue date and time.

Note 1: The term "local 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.

Additional information (e.g. weather radar and satellite images as well as updated rain and river level information) can also be obtained from the Bureau's website (www.bom.gov.au/hydro/flood/vic) or for the cost of a local call on ☎ 1300 659 217.

4.2 McCallum Creek and Tullaroop Creek

There are currently no specific flood warning systems or arrangements in place for McCallum Creek, Tullaroop Creek or the Carisbrook Township. The tool provided in Section 8.6 of Appendix C1 does however provide indicative guidance on the likelihood and expected severity of flooding at Carisbrook based on consideration of rainfall.

4.3 Burnt Creek and Dunolly

There are currently no flood warning systems or arrangements in place for Burnt Creek or for Dunolly. The tool provided in Section 8.5 of Appendix C2 does however provide indicative guidance on the likelihood and expected severity of flooding at Dunolly based on consideration of rainfall.

4.4 Other Watercourses

To be completed at a later date.

5 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 upon 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 (OSOM) system.

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

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.

6 Local Flood Warning System Arrangements

Carisbrook: The CFA fire siren may be used to inform residents of a community flood meeting or to warn if the town is in the direct path of flood water (this was utilised in 2016)

7 Flood Class Levels

The occurrence of a certain class of flooding at one point in a catchment will not necessarily lead to the same class of flooding at other points – for example along the main river and its tributary creeks or along a drainage network's overland flow paths. This is because the floodplain physiography and use (and thus flood impact) varies along the river or flow path and also because antecedent conditions combined with where and how rainfall occurs (both in time and space) will drive how a flood develops and progresses.

It is emphasised that the flood class levels quoted in the table below refer to that part of the watercourse where the flood effects can be related to the reading from the actual or proposed gauge.

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

Preliminary flood class levels have been proposed for the **Tullaroop Creek at Carisbrook** centred on a site on the right hand (east) bank of the creek immediately upstream of the Pyrenees Highway Bridge (see Section 8.4 – if gauge not installed the site is ideal for a PALS unit during a flood event) as follows:

- Minor flood level 190.700 m AHD
- Moderate flood level 192.200 m AHD
- Major flood level 193.000 m AHD

.

8 Details of relevant gauges

Station No	River / Creek	Station	Flood Class Levels (m)			Gauge Zero (m AHD)	Comments
			Minor	Moderate	Major		
407214A	Creswick Creek	Clunes					Telemetry with rain gauge by CGSC. 42 km upstream from Carisbrook
407222A	Tullaroop Creek	Clunes	---	---	---	253.076	Telemetry with rain gauge by CGSC. At road bridge 10 km downstream from Clunes.
407244	Tullaroop Creek	Tullaroop Reservoir HG	---	---	---		G-MW monitored site. Approx 7 km upstream of Carisbrook.
407248A	Tullaroop Creek	Tullaroop Res outlet	---	---	---		Of no relevance if reservoir is spilling. Telemetry with rain gauge by CGSC
407213C	McCallum Creek	Carisbrook	---	---	---	193.193	Approx 5 km upstream of Carisbrook. Telemetry with rain gauge by CGSC
407211B	Bet Bet Creek	Bet Bet	4.00	---	---		Telemetry with rain gauge by CGSC. 1 km upstream from Bet Bet
407220A	Bet Bet Creek	Norwood	---	---	---		Telemetry with rain gauge by CGSC. 22 km upstream from Bet Bet.
407288a	Bet Bet Creek	Lillicur					Telemetry with rain gauge by CGSC. 59 km upstream from Bet Bet
408206B	Avoca River	Archdale	---	---	---		Approx 3 km upstream from Cherry Tree Creek junction. Telemetry with rain gauge by CGSC
408220	Avoca River	Avoca					
TBA	Upper McCallums Creek	Evansford – exact location to be confirmed with consultation from CHW	---	---	---		Telemetry Rain Gauge. Telemetry with rain gauge by CGSC

APPENDIX F1 - MAPS for CARISBROOK

1 Overview

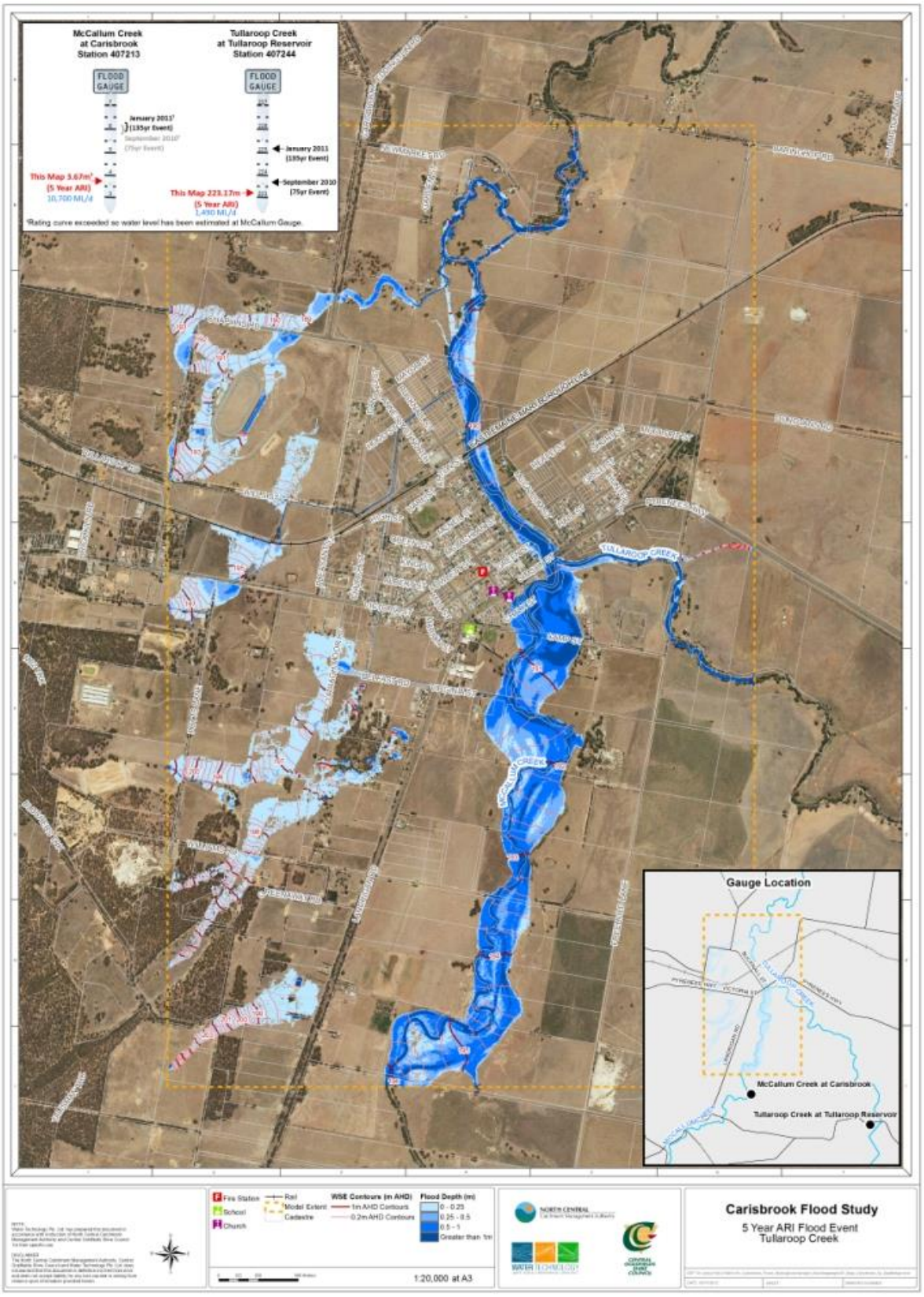
Maps considered useful to flood response at Carisbrook are included in this Appendix. They comprise:

- A set of maps showing flood extents, depths and hazard (based on consideration of depth and velocity) for the design flood events considered (i.e. 5, 10, 20, 50, 100 and 200 year ARI) by Water Technology when delivering the Carisbrook Flood and Drainage Management Plan (Water Technology, April 2013).
- Maps showing flood extent for the September 2010 and January 2011 flood events delivered by the Carisbrook Flood and Drainage Management Plan (Water Technology, April 2013).

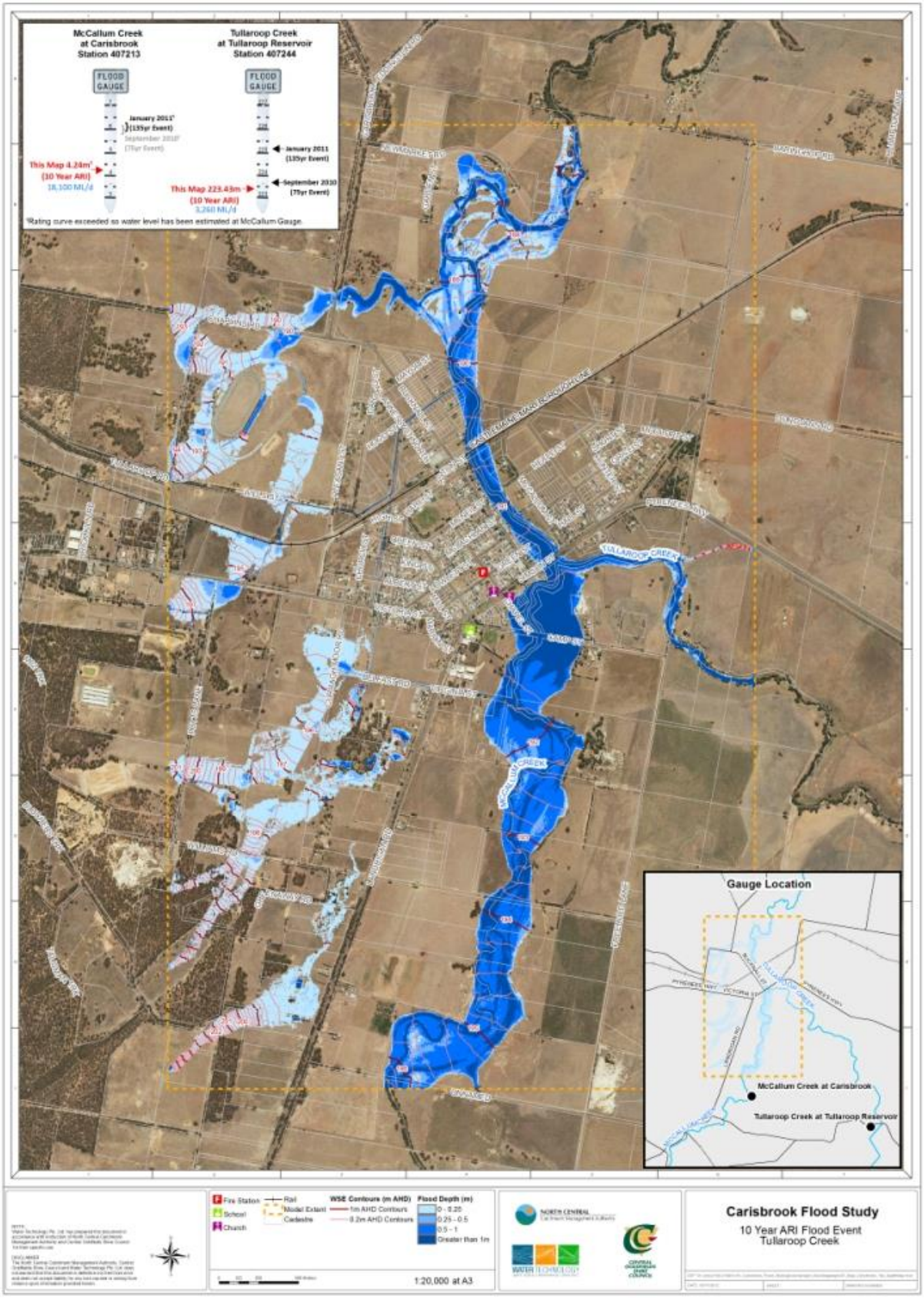
Note that:

- Maps showing 100-year ARI (1% AEP) flood extent and floodways (together with volume, height and water quality data) are shown at the Victorian Water Resources website (see the list of references in Appendix G).

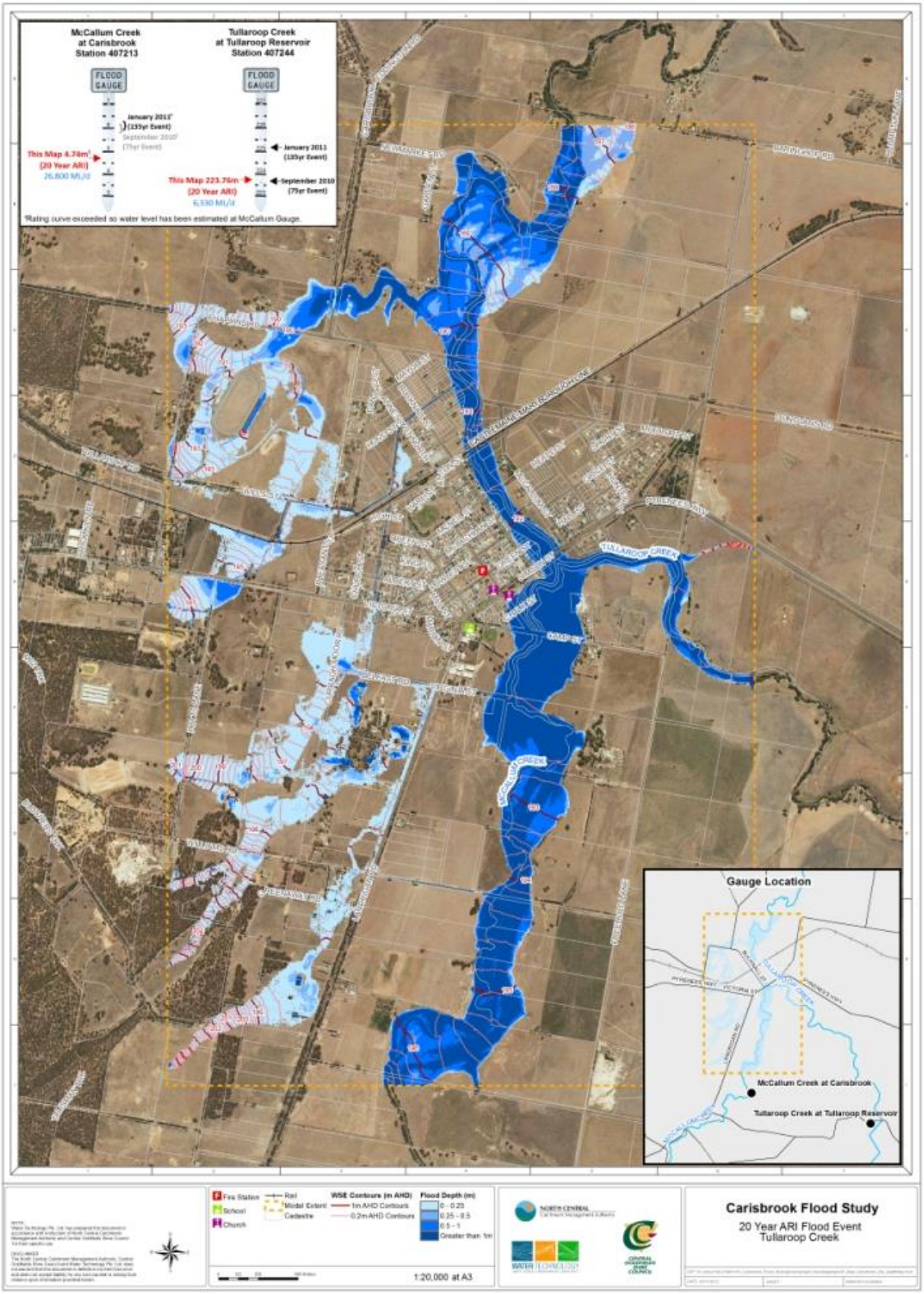
2 Maps showing flood extents and depths (sourced from Carisbrook Flood and Drainage Management Plan)



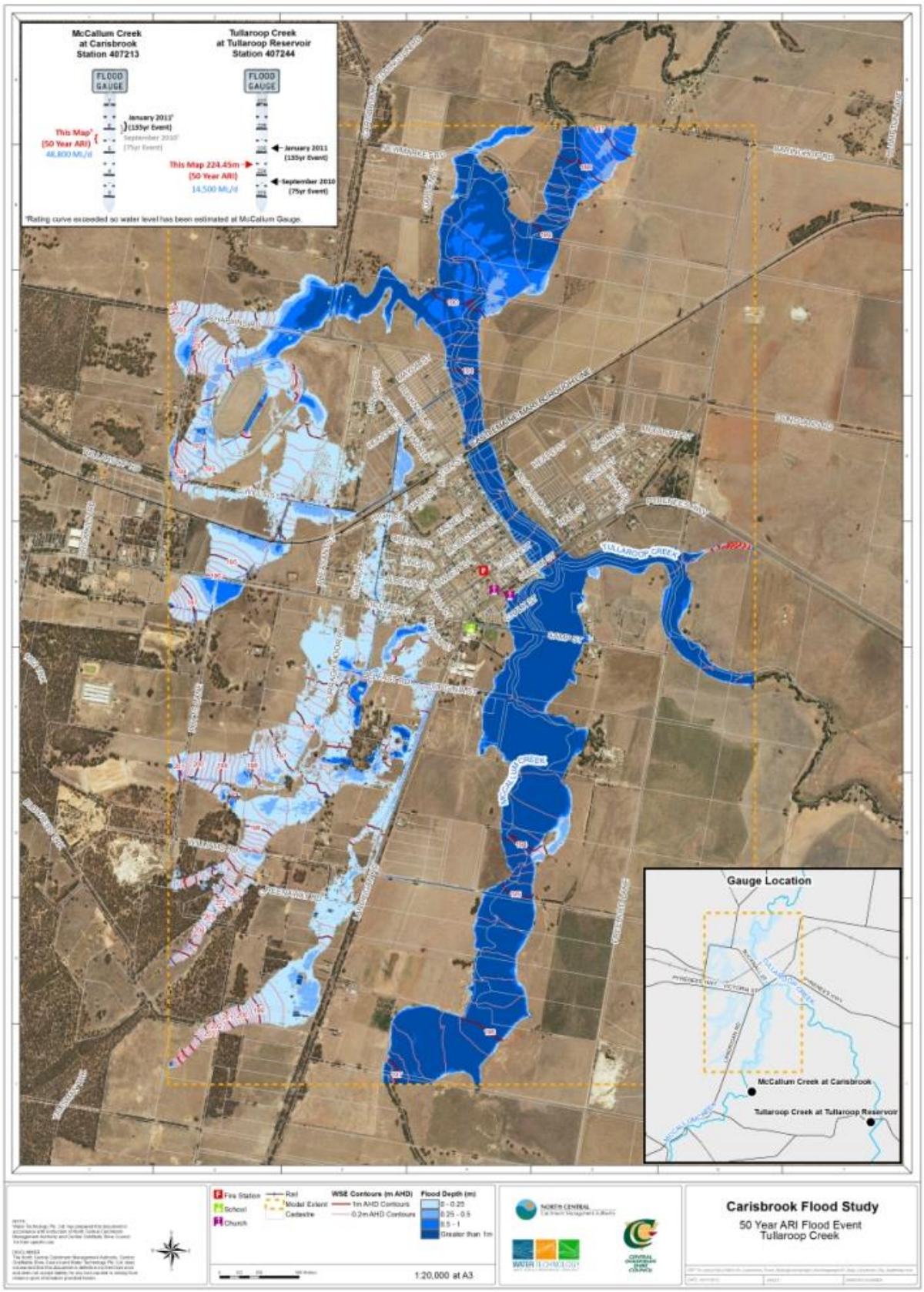
Flood extent and depths for the 20% AEP (5 year ARI) event



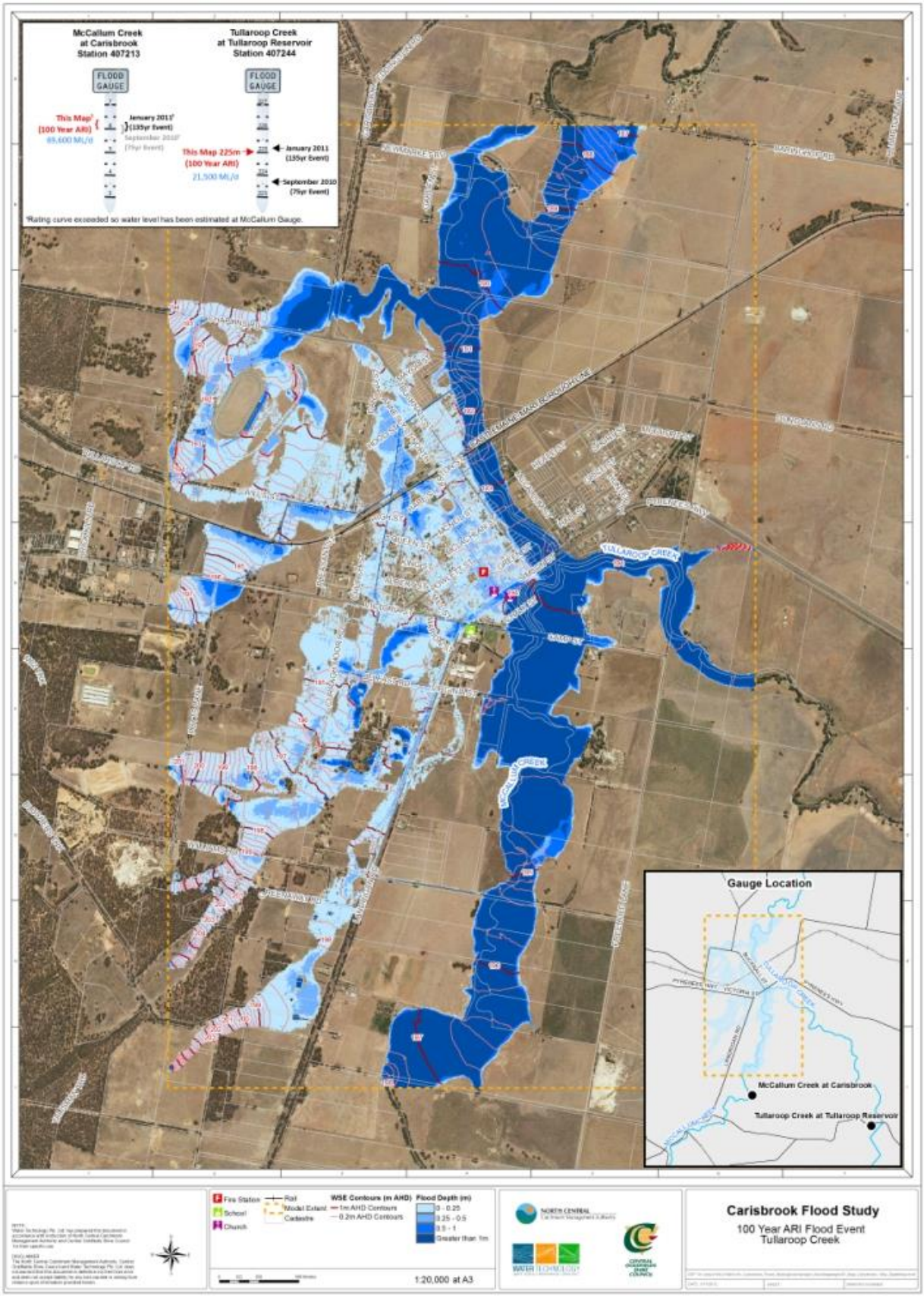
Flood extent and depths for the 10% AEP (10 year ARI) event



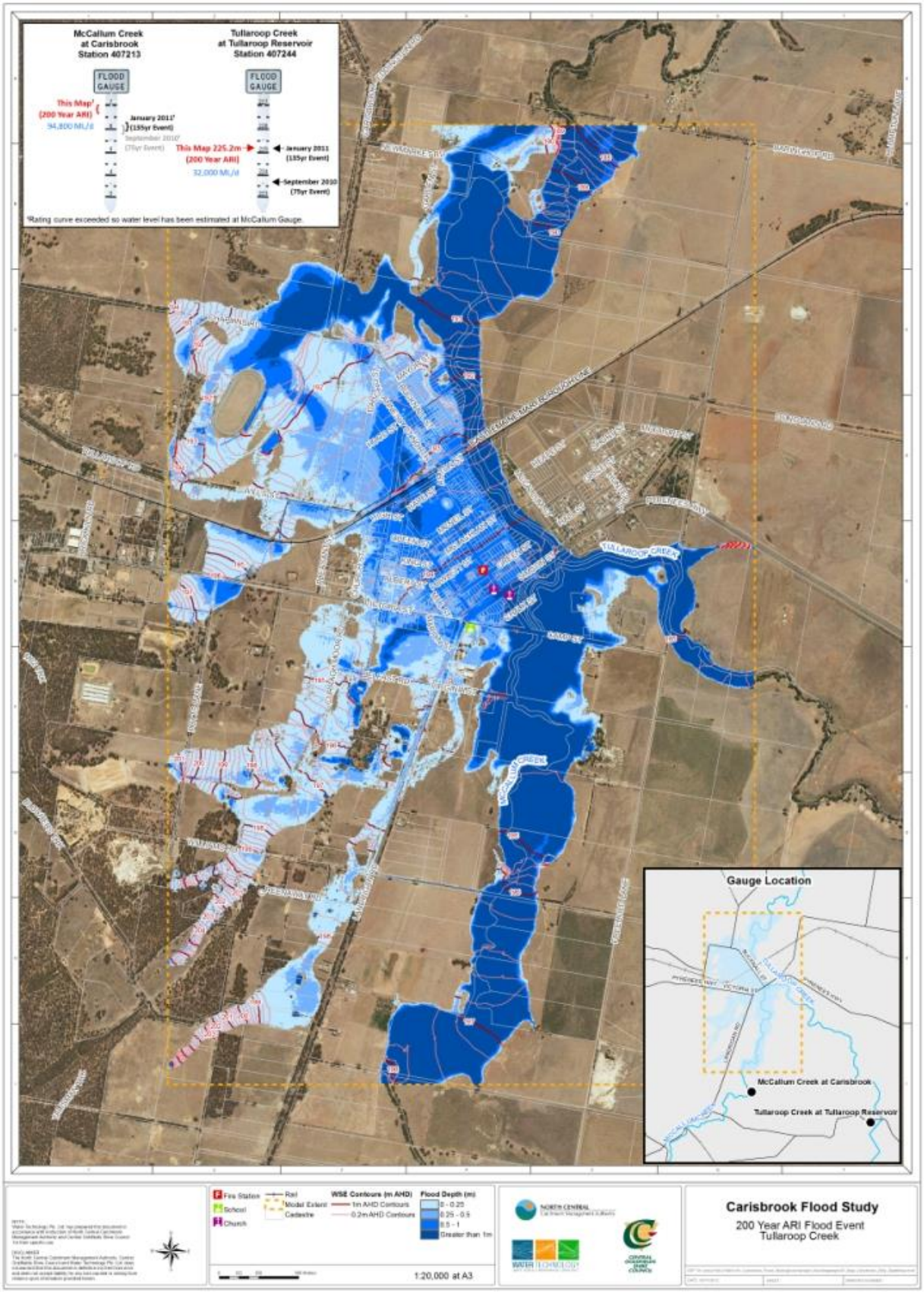
Flood extent and depths for the 5% AEP (20 year ARI) event



Flood extent and depths for the 2% AEP (50 year ARI) event

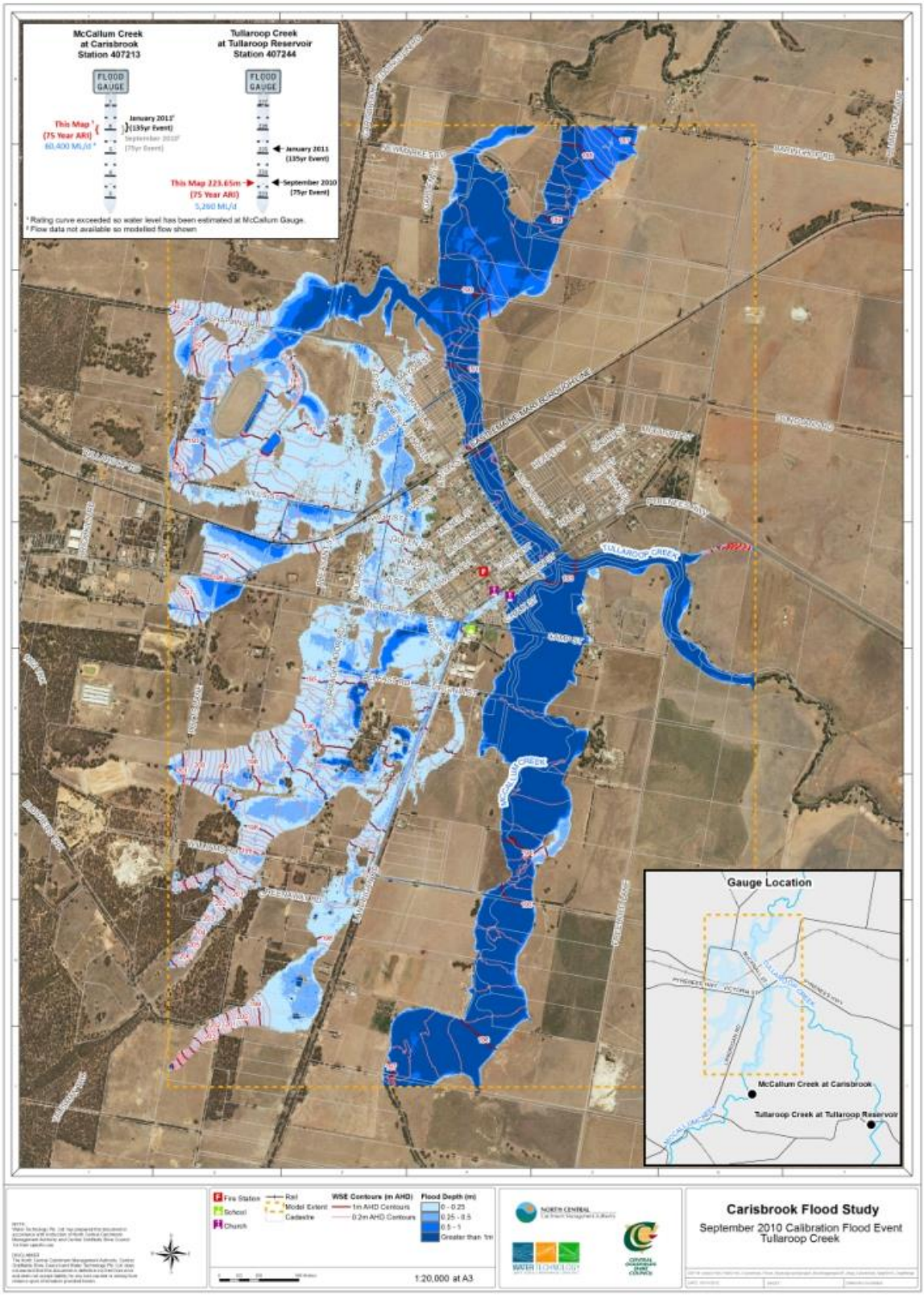


Flood extent and depths for the 1% AEP (100 year ARI) event

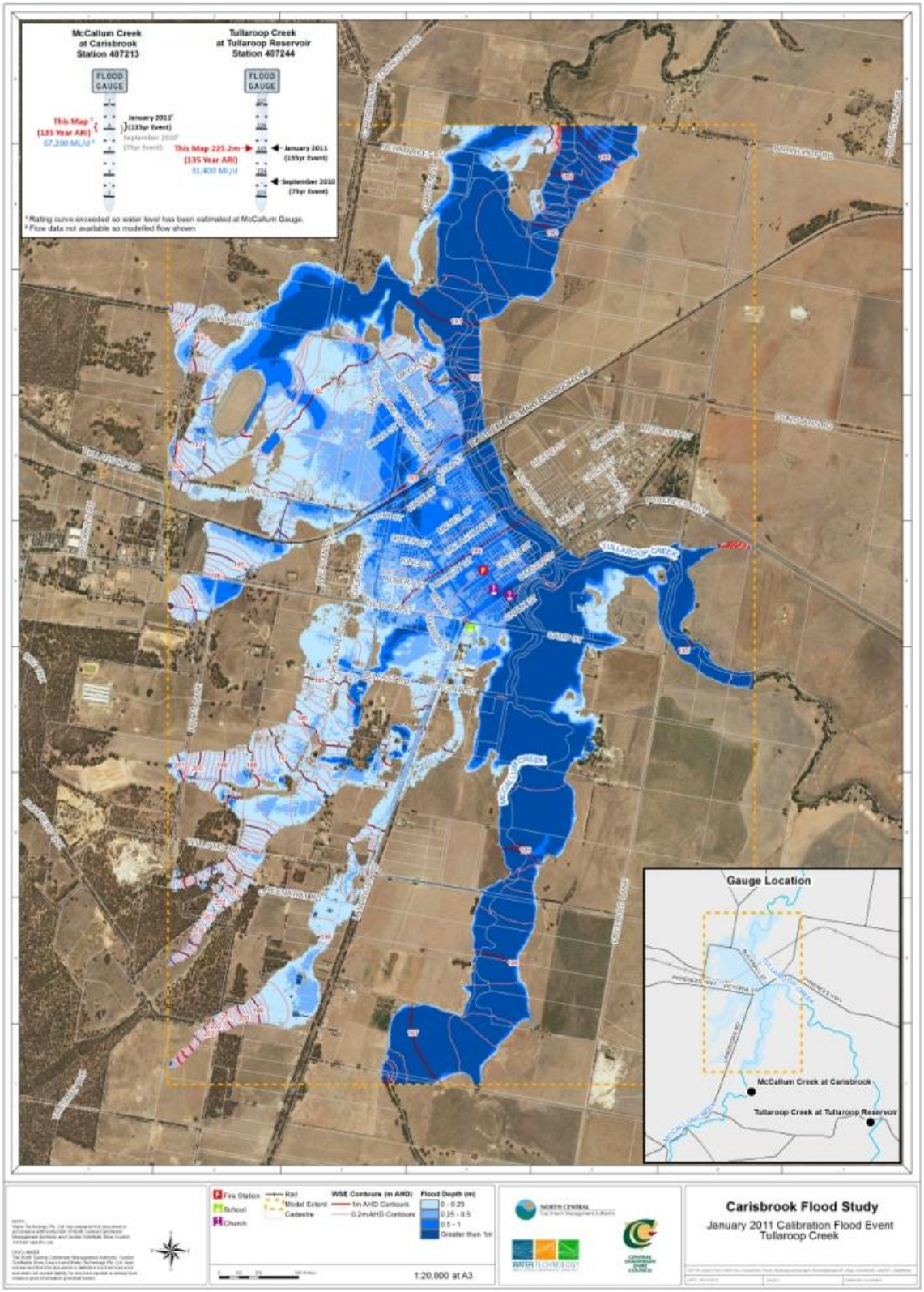


Flood extent and depths for the 0.5% AEP (200 year ARI) event

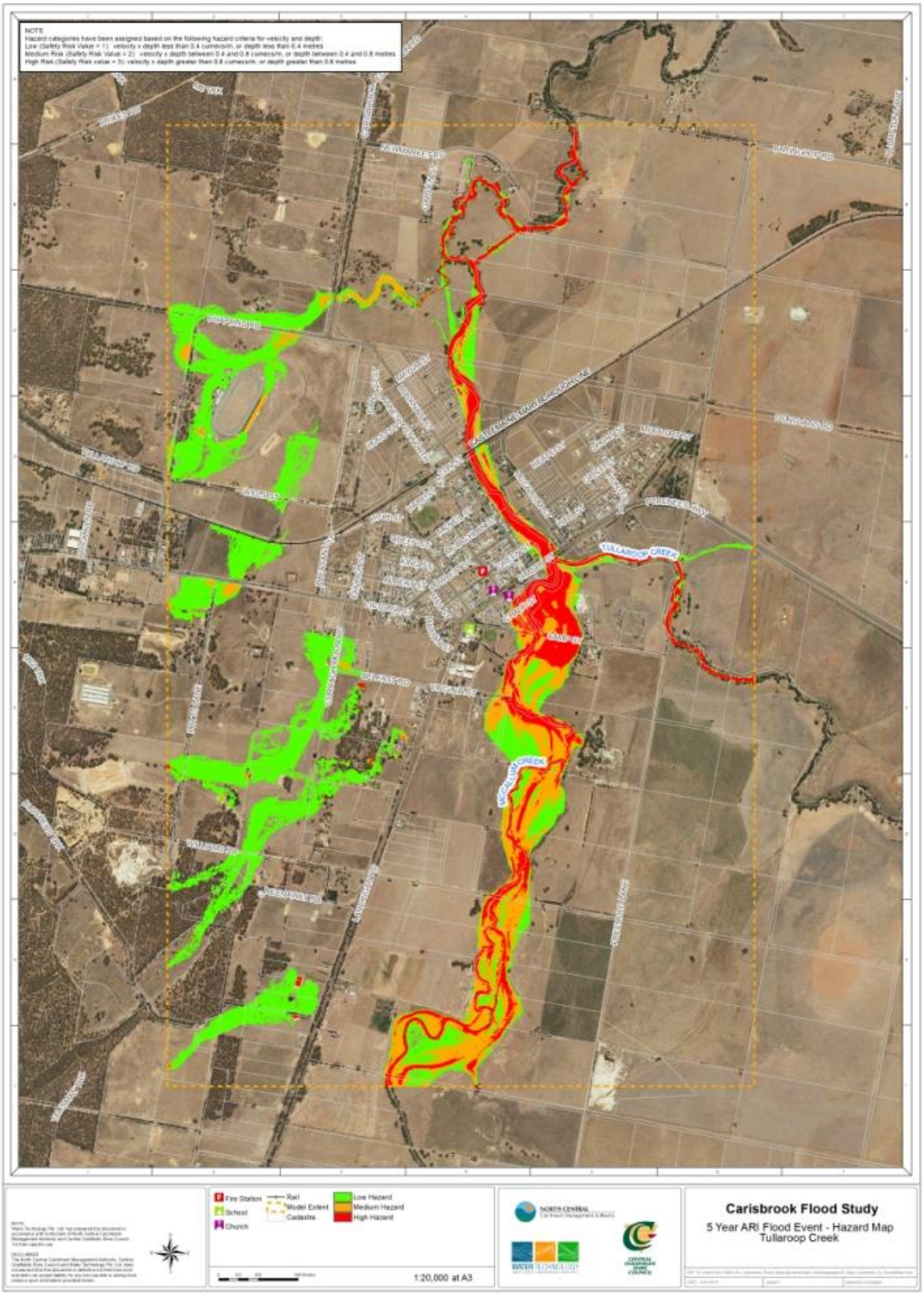
3 Map showing extents and depths for September 2010 event (sourced from Carisbrook Flood and Drainage Management Plan)



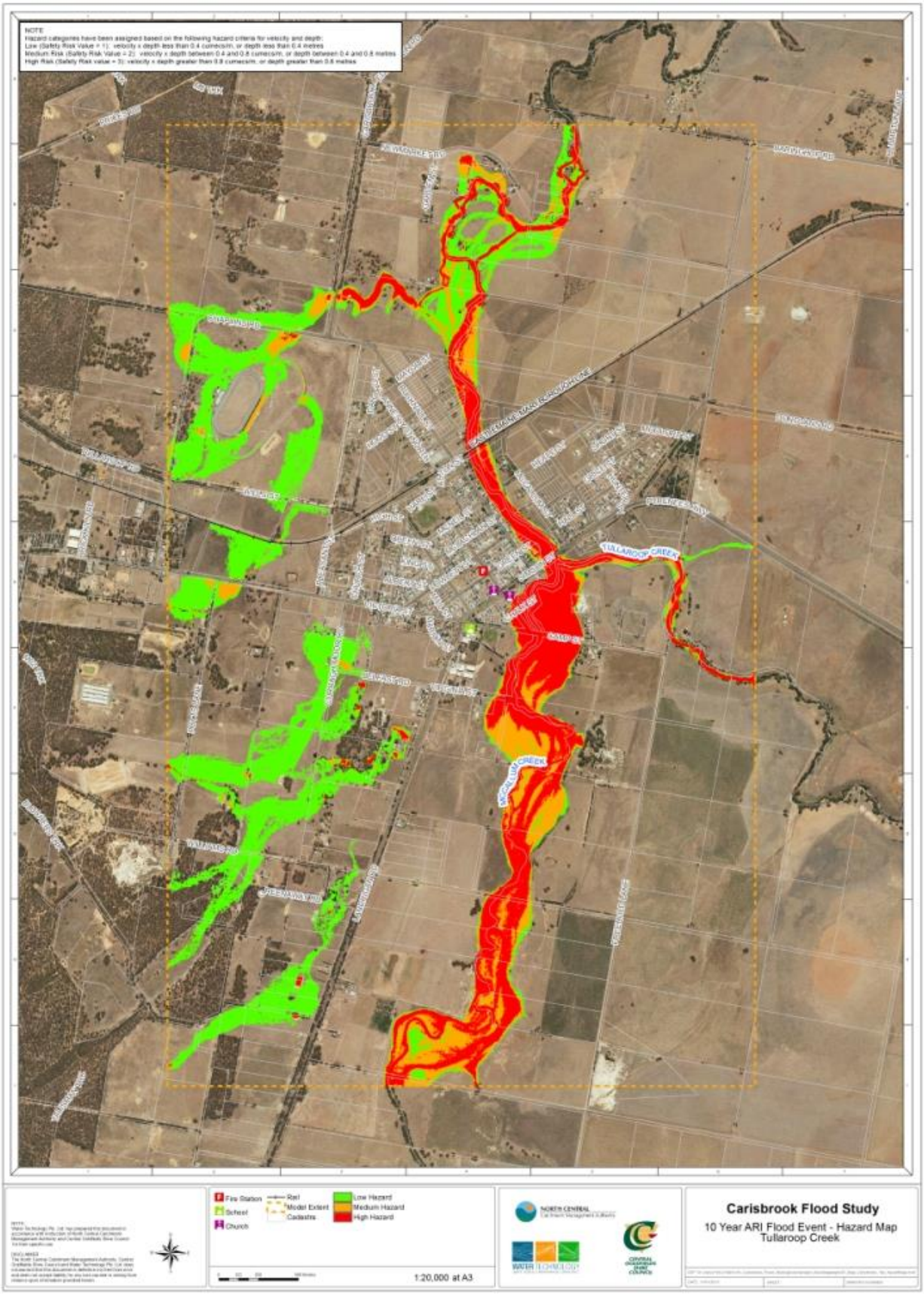
4 Map showing flood extents and depths for January 2011 event (sourced from Carisbrook Flood and Drainage Management Plan)



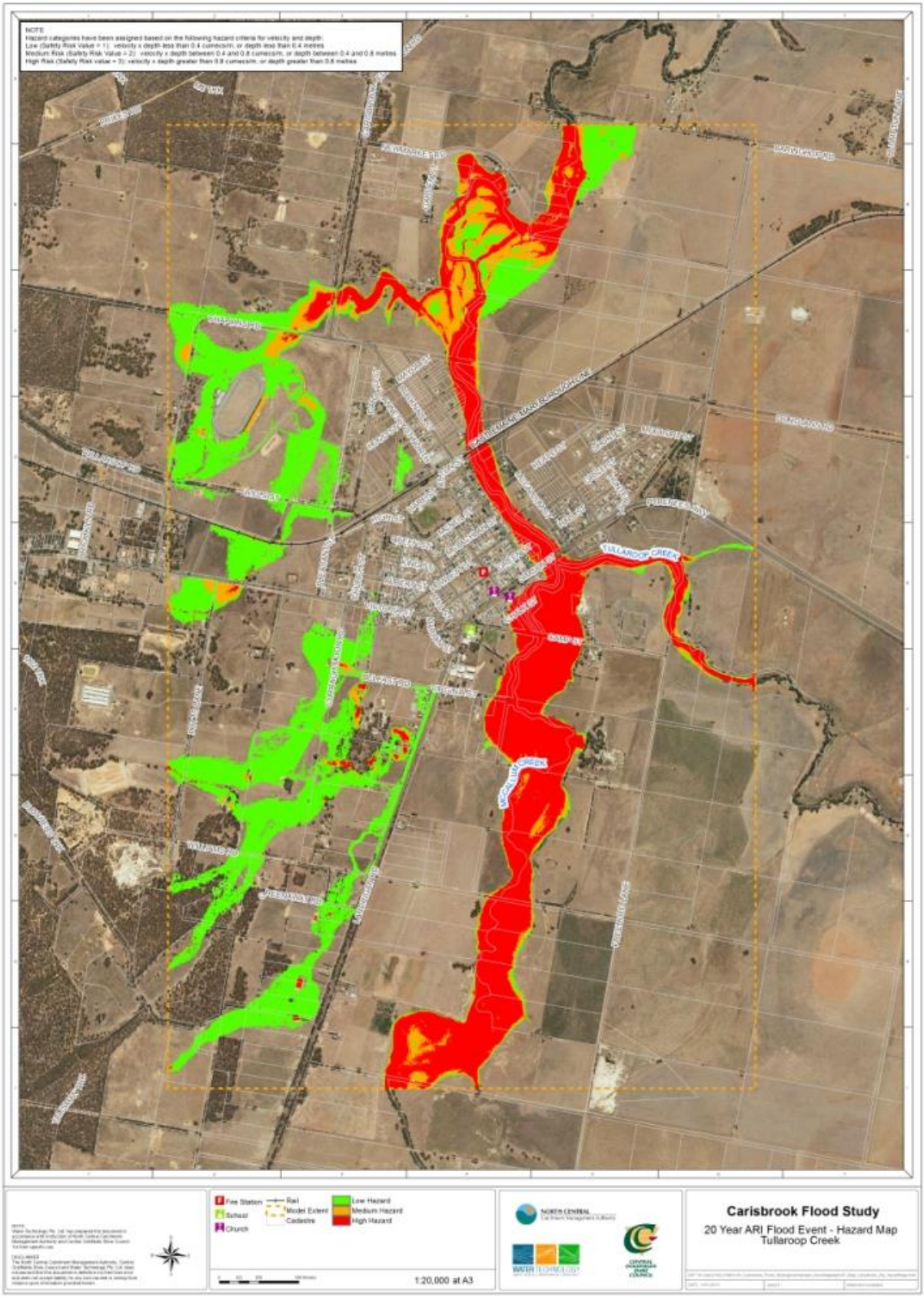
5 Maps showing flood hazard (sourced from Carisbrook Flood and Drainage Management Plan)



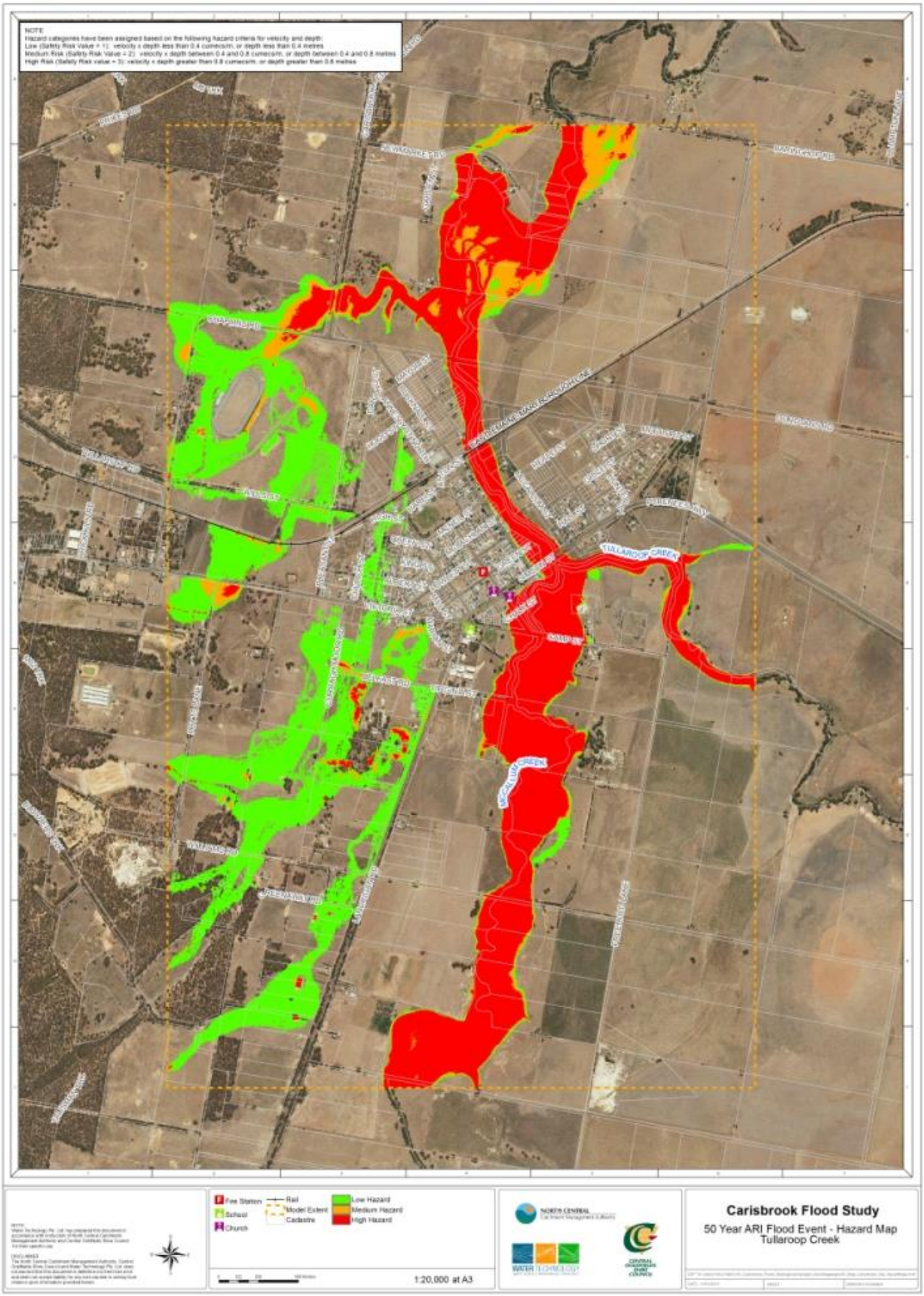
Flood hazard for the 20% AEP (5 year ARI) event



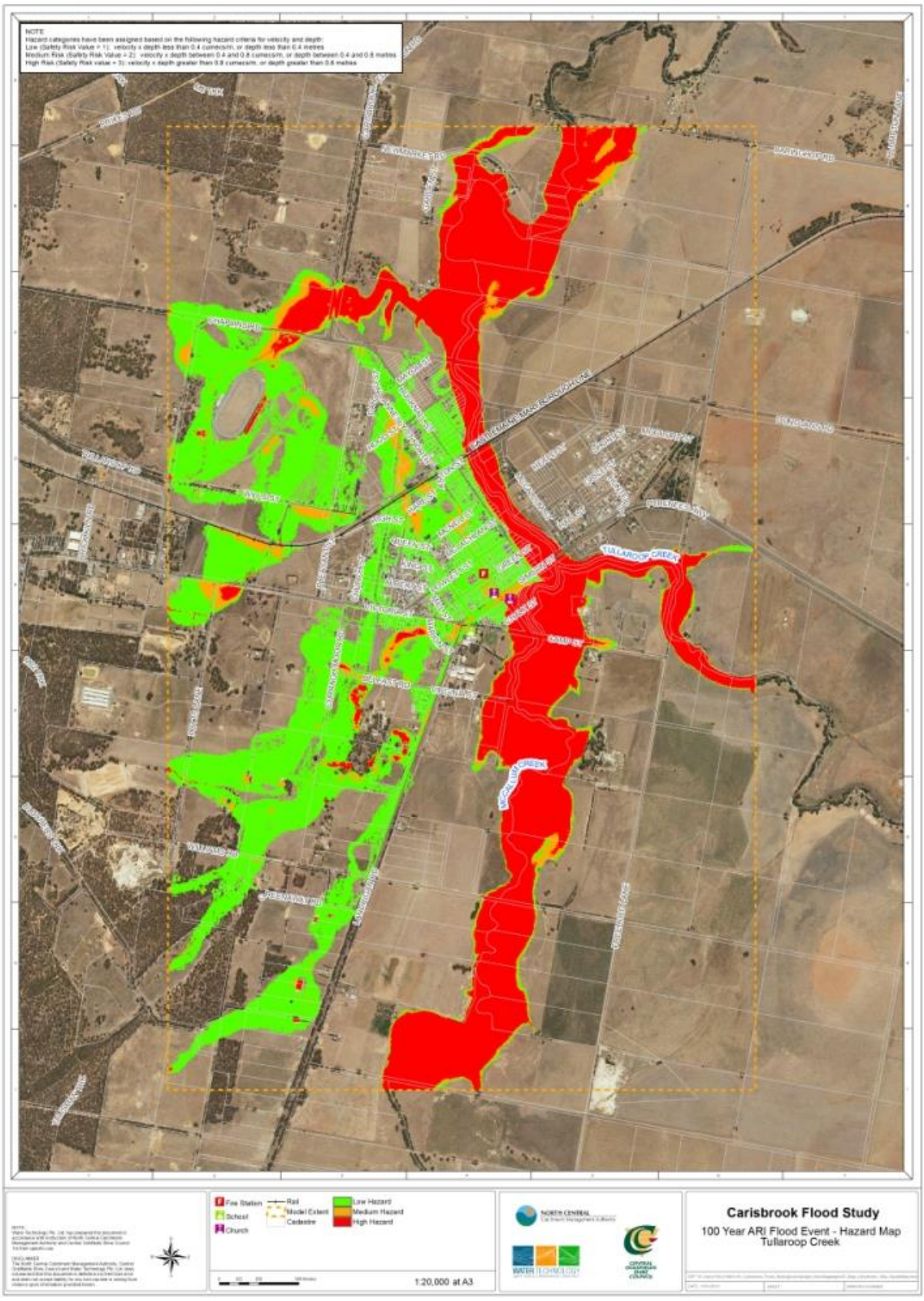
Flood hazard for the 10% AEP (10 year ARI) event



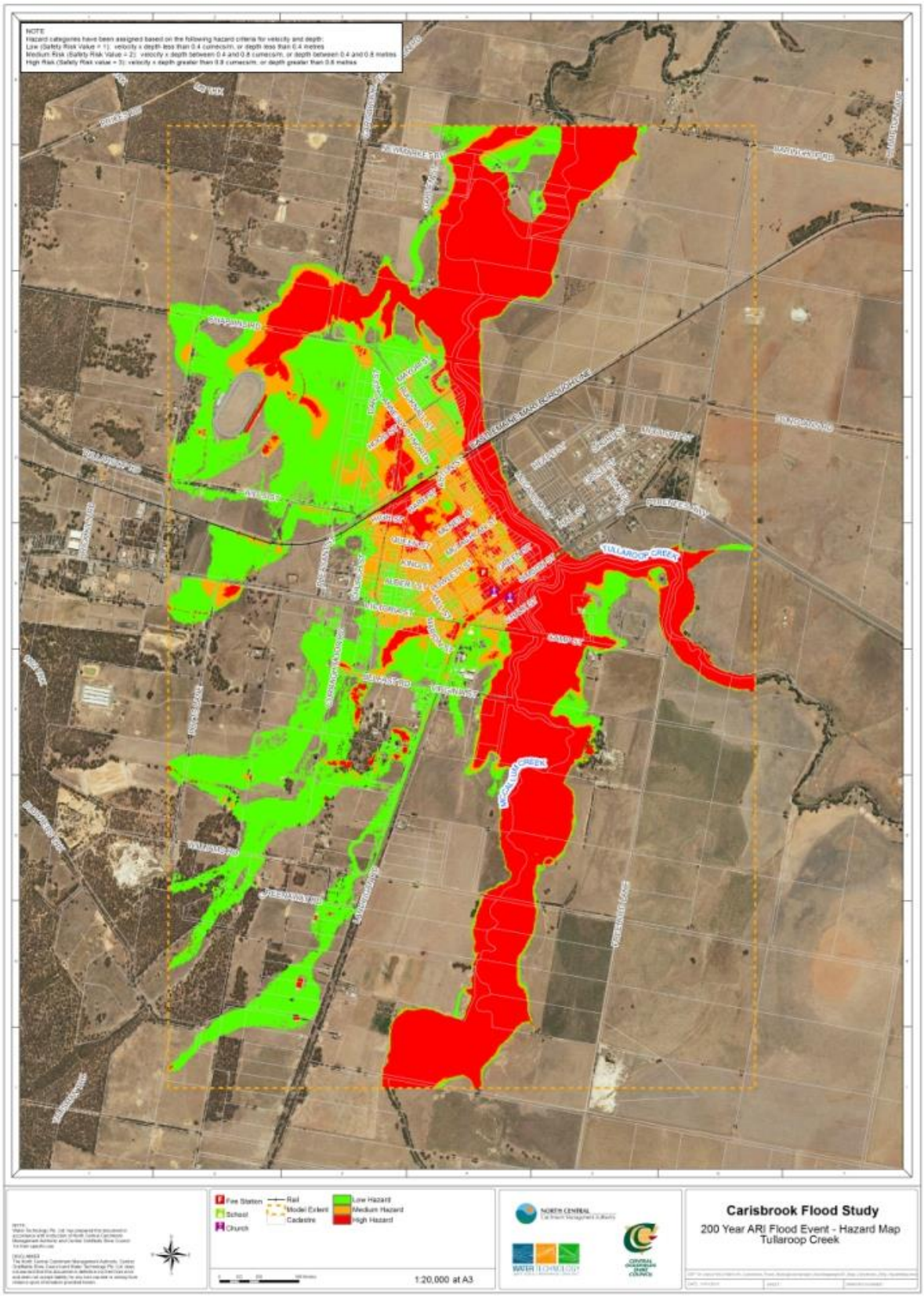
Flood hazard for the 5% AEP (20 year ARI) event



Flood hazard for the 2% AEP (50 year ARI) event



Flood hazard for the 1% AEP (100 year ARI) event



Flood hazard for the 0.5% AEP (200 year ARI) event

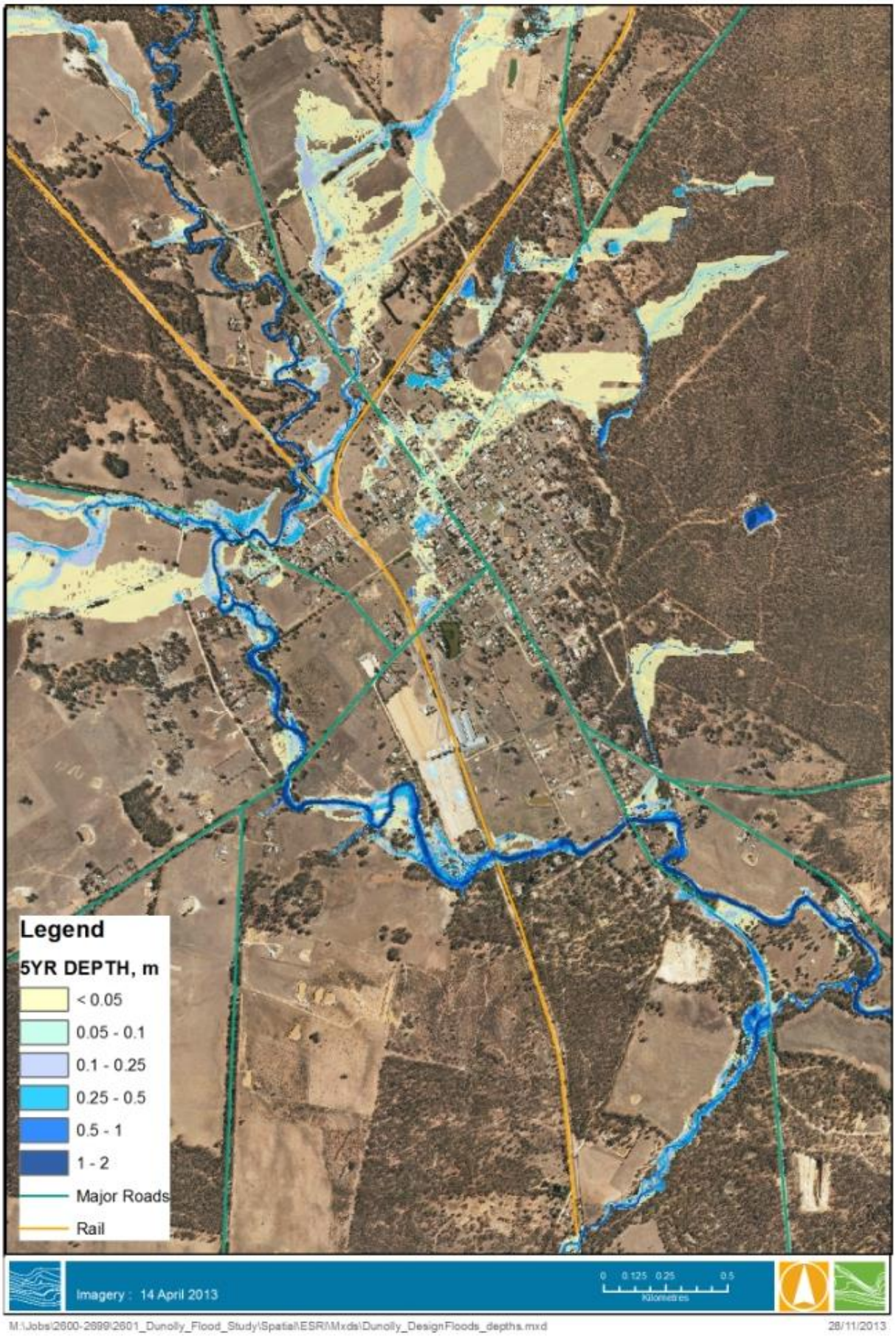
APPENDIX F2 – MAPS for DUNOLLY

1 Overview

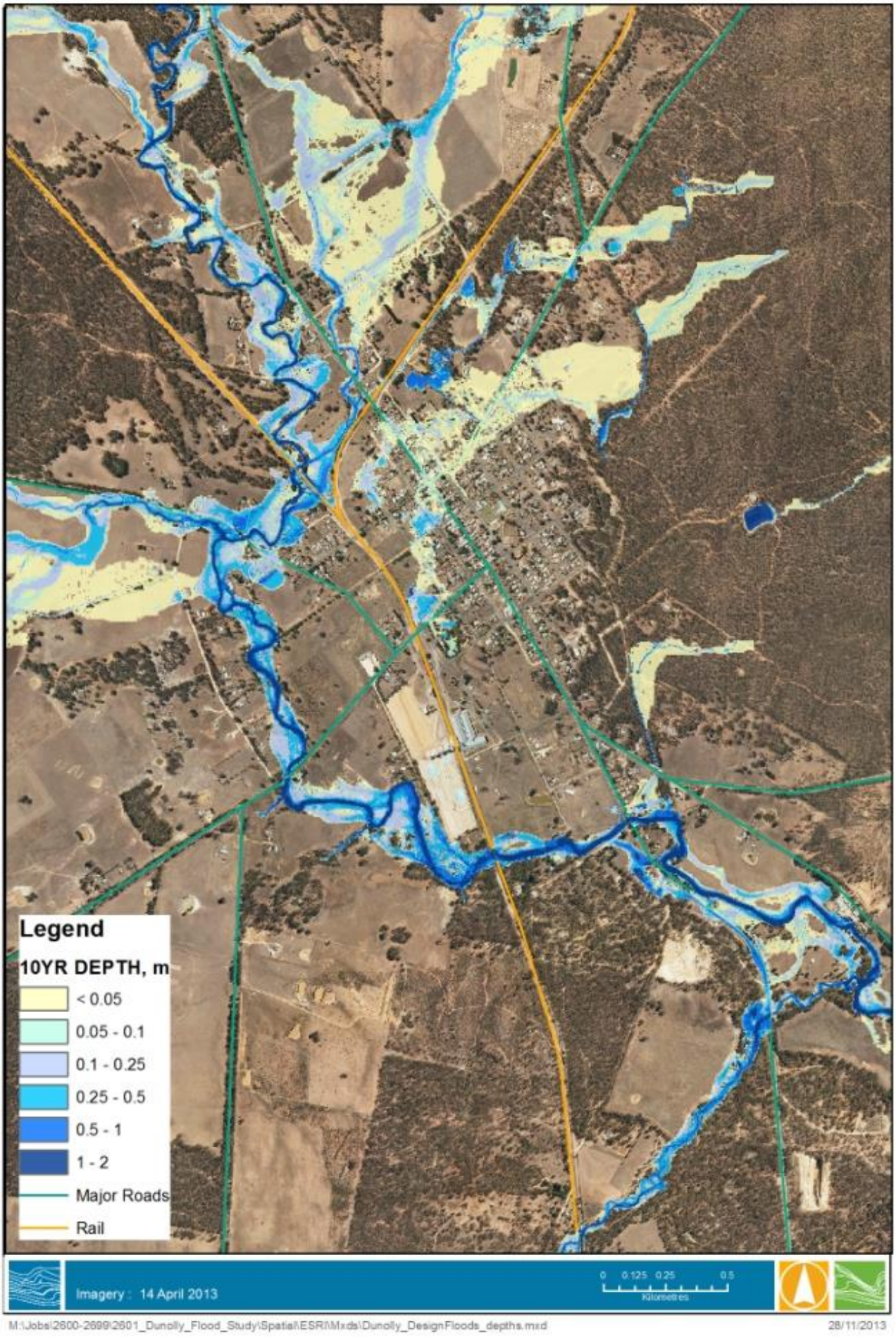
Maps prepared in the development of the Dunolly Flood Study that are considered useful to flood response at Dunolly are included in this Appendix. They comprise:

- A set of maps showing flood extents, depths and hazard (based on consideration of depth and velocity) for the design flood events considered (i.e. 5, 10, 20, 50, 100 and 200 year ARI) by Water Technology when delivering the Dunolly Flood Study (Water Technology, 2013b).
- A map showing the approximate extent of the January 2013 flood event as delivered by the Dunolly Flood Study (Water Technology, 2013b).
- A map showing the approximate extent of the January 2013 flood against the LSIO extent as at January 2013 (sourced from VICSES and NCCMA).

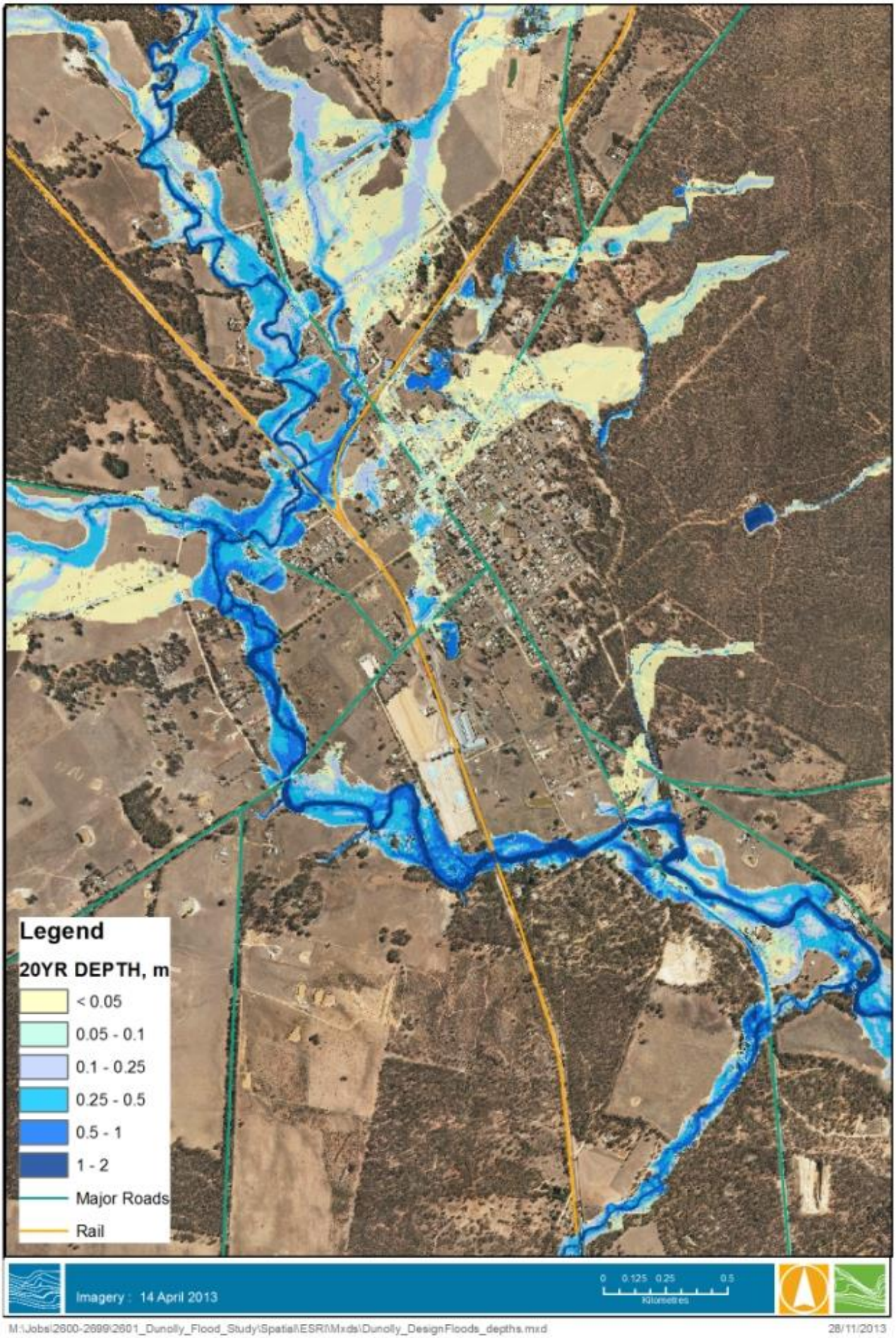
2 Maps showing flood extents and depths (sourced from Dunolly Flood Study)



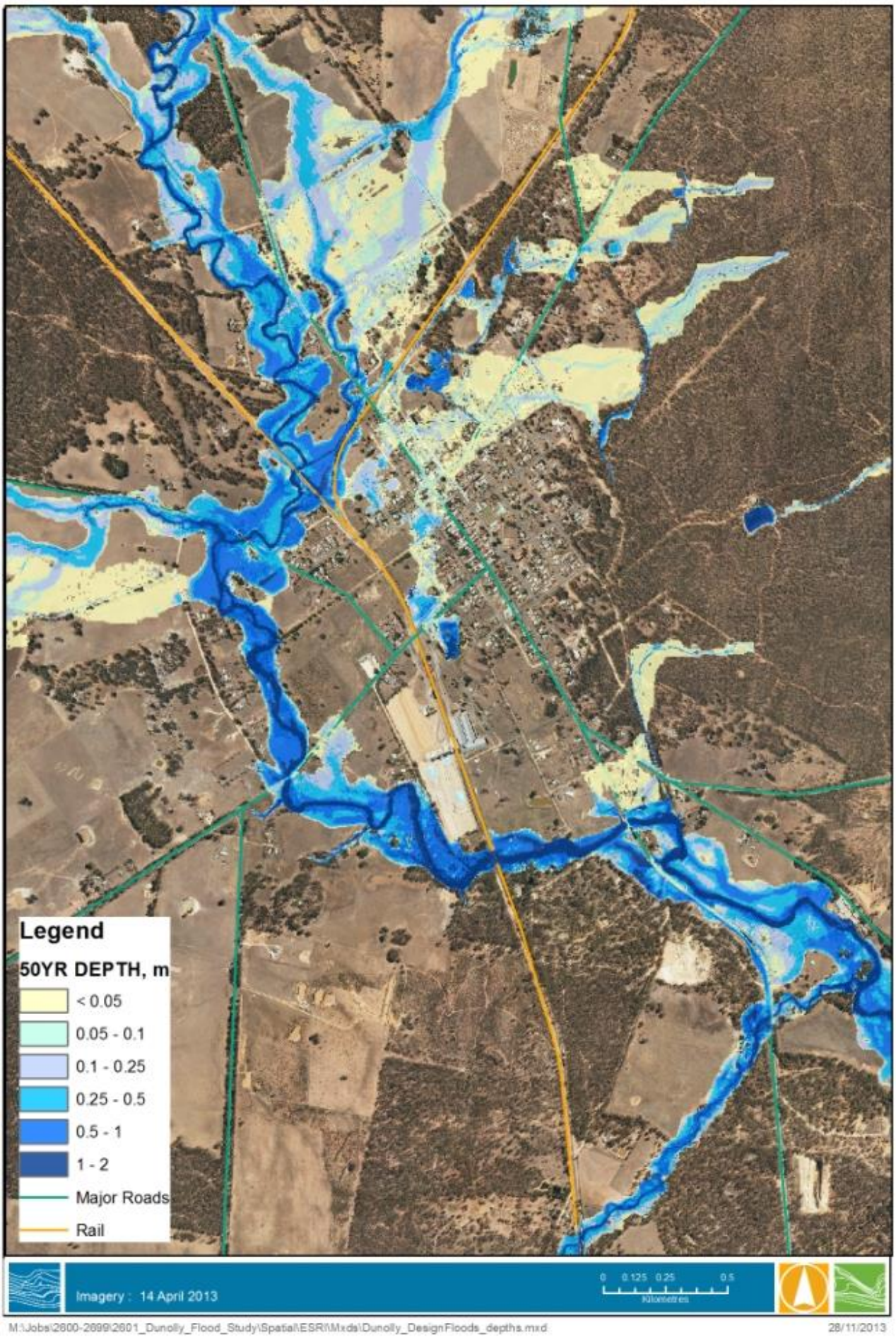
Flood extent and depths for the 20% AEP (5 year ARI) event



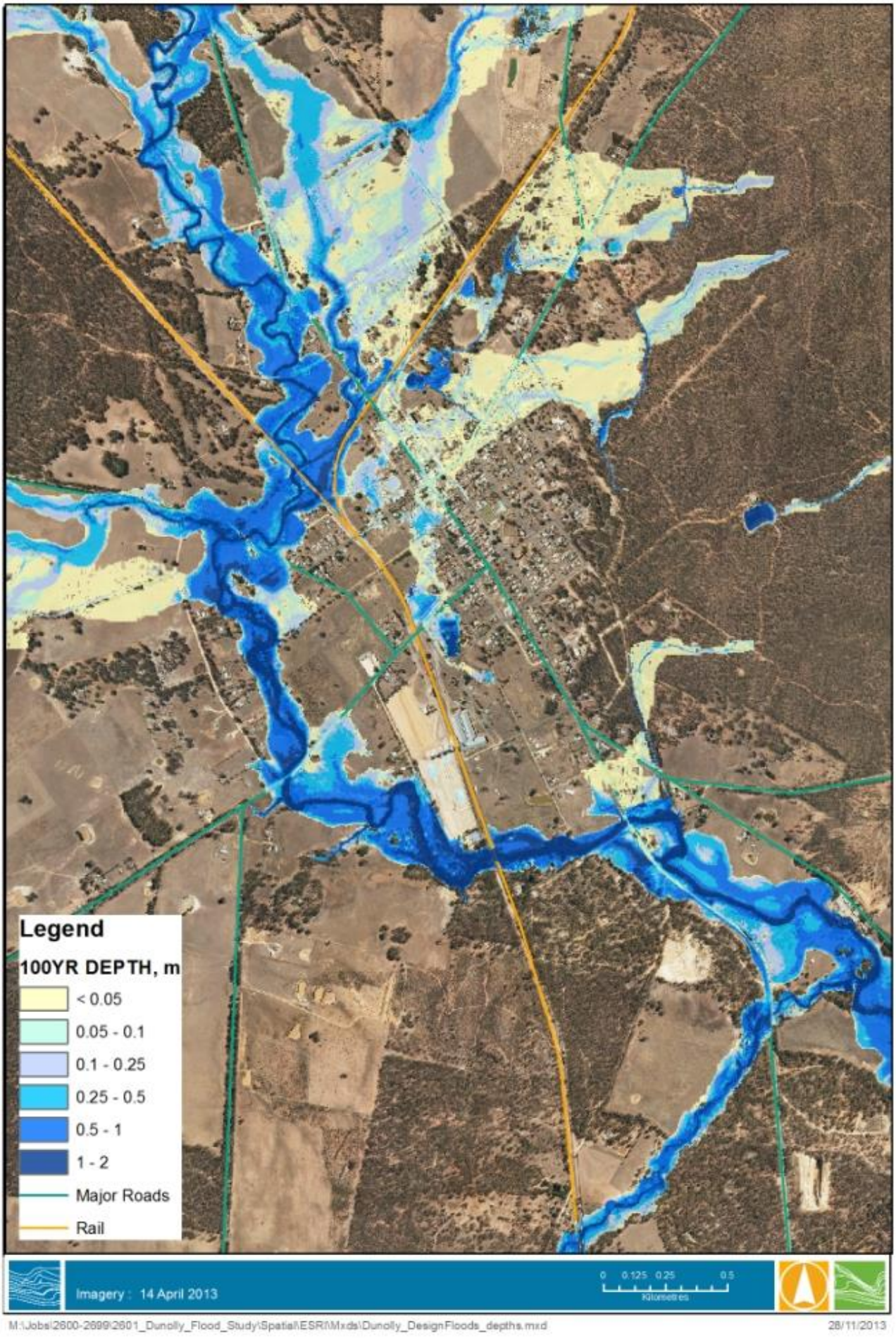
Flood extent and depths for the 10% AEP (10 year ARI) event



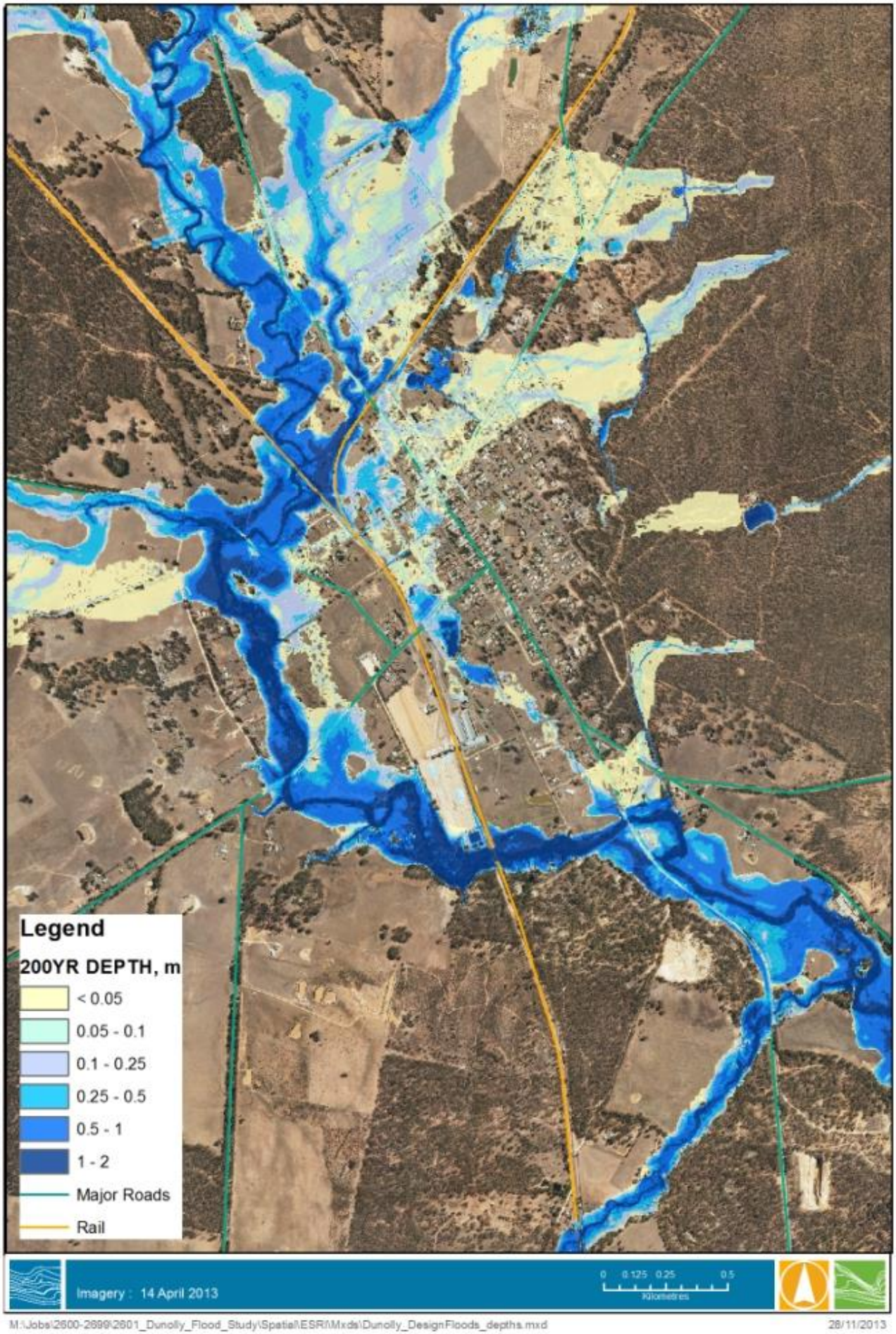
Flood extent and depths for the 5% AEP (20 year ARI) event



Flood extent and depths for the 2% AEP (50 year ARI) event

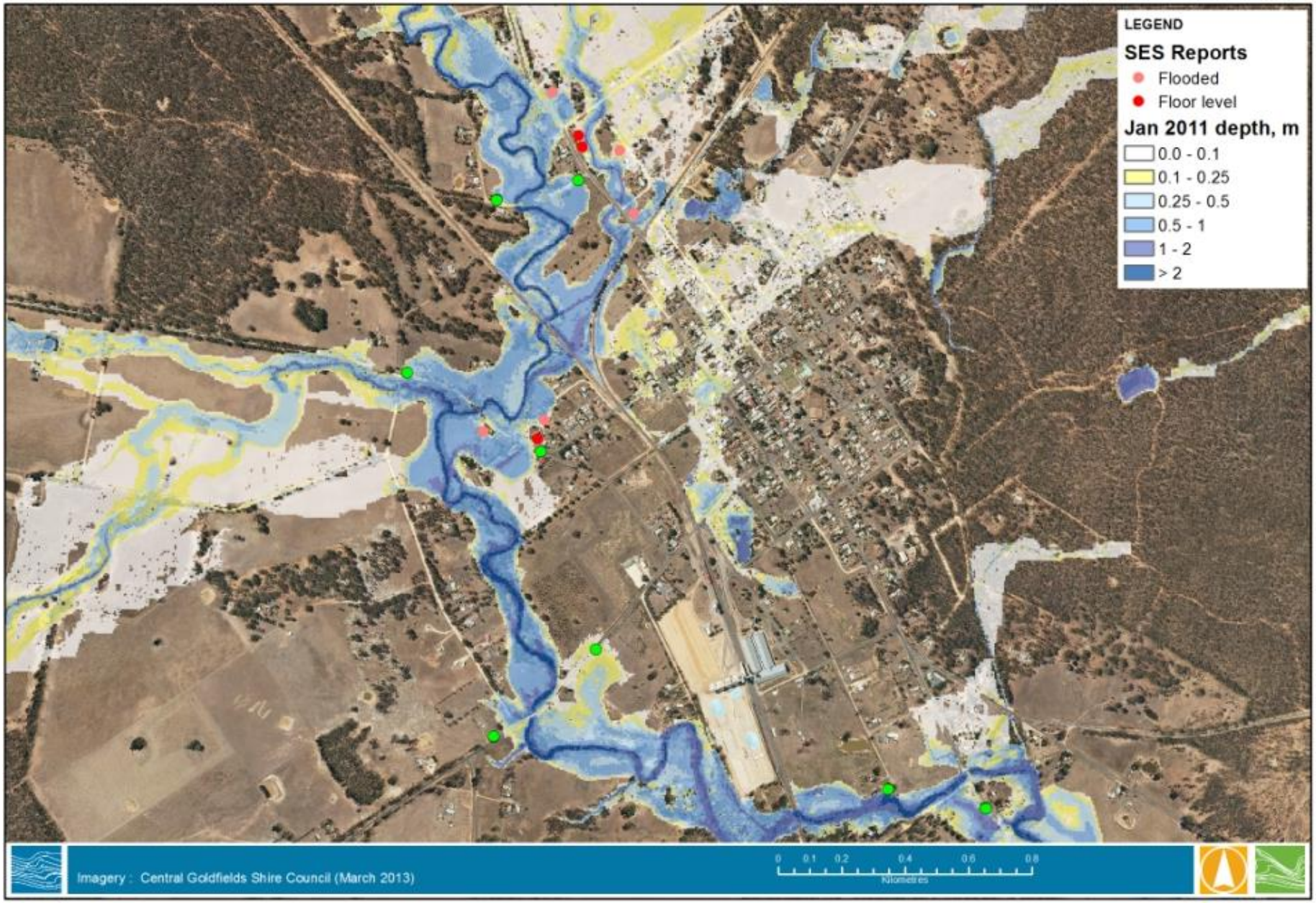


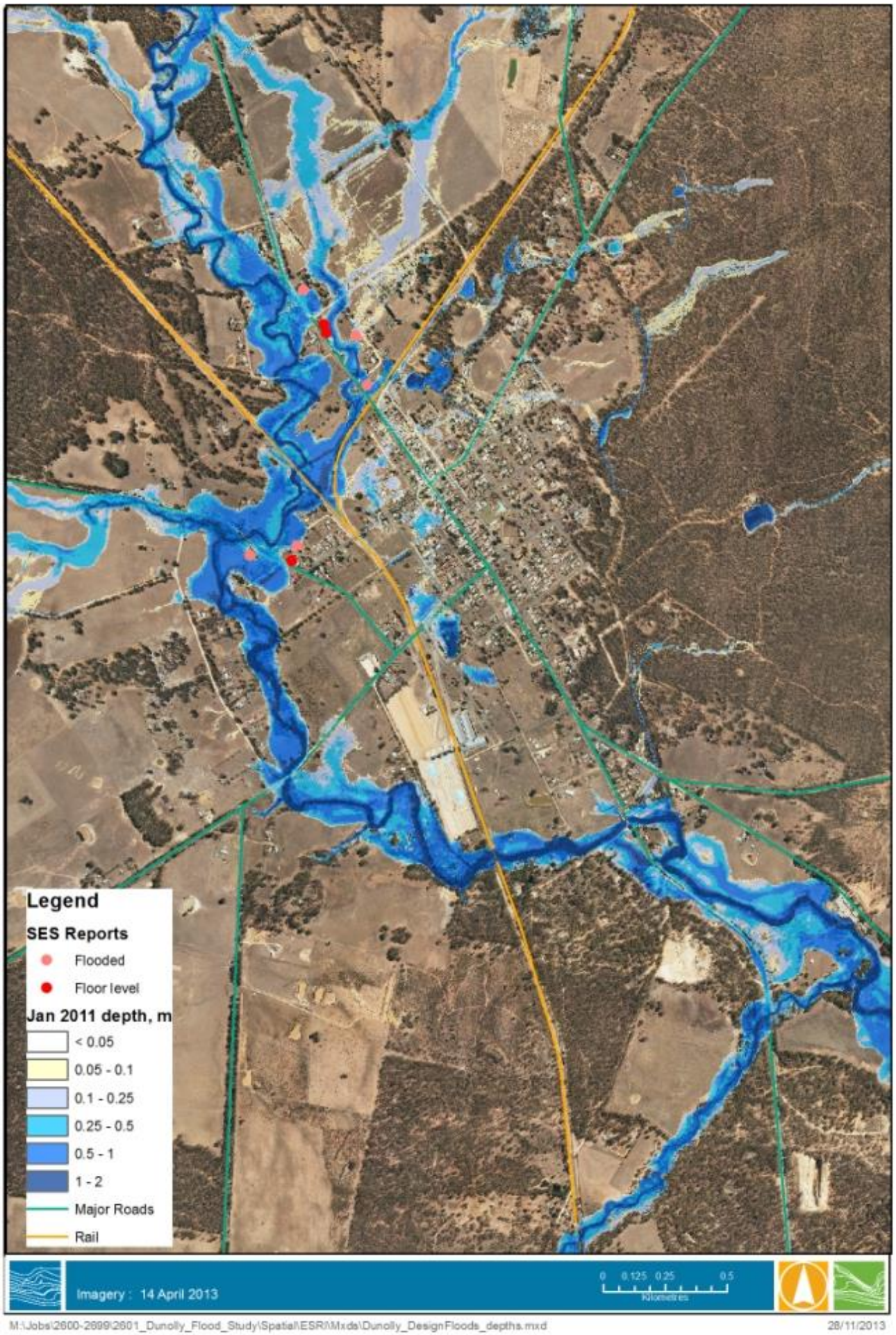
Flood extent and depths for the 1% AEP (100 year ARI) event



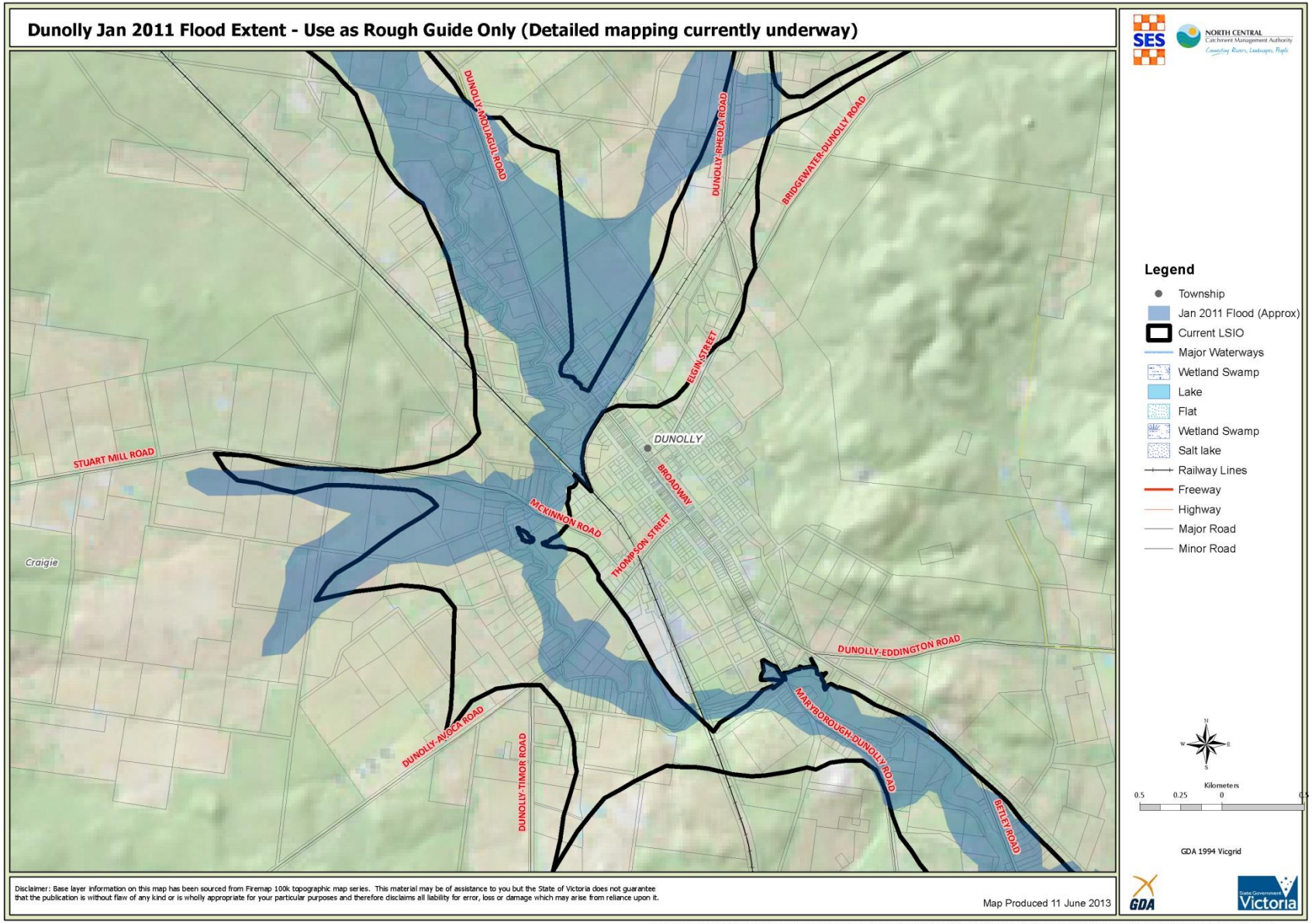
Flood extent and depths for the 0.5% AEP (200 year ARI) event

3 Map showing flood extents and depths for January 2011 event (sourced from Dunolly Flood Study)




Legend
SES Reports
Flooded
Floor level
Jan 2011 depth, m
< 0.05
0.05 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 1
1 - 2
Major Roads
Rail
Imagery : 14 April 2013
0 0.125 0.25 0.5
Kilometres
M:\Jobs\2600-2699\2601_Dunolly_Flood_Study\Spatial\ESRI\Mxds\Dunolly_DesignFloods_depths.mxd
28/11/2013

4 Map showing the approximate extent of the January 2013 flood against the LSIO extent as at January 2013 (sourced from VICSES and NCCMA)



APPENDIX G – Agency Action Matrix

The following Action Matrix shows the agreed actions by agencies leading up to and during a flood event within Central Goldfields Shire. The Matrix is a guide to ensure that there is an understanding of agency roles and expectations during flood events.

Common Actions	VICSES	COUNCIL	POLICE	CFA	Community
Situation triggers					
• Severe weather warning issued by BoM, with the risk of heavy rainfalls likely to cause flooding and/or a Flood Watch has been issued	• SES contacts Council MERO, VicPol, MERC & CFA Group Officer to provide "heads up". • Incident control/Div Comm. Point facility prepared and on standby • Alert and activate Flood Wardens.	• Check all reservoirs (Goldfields, Timor, Dunolly, Bealiba) overflows • Council checks sandbag supplies and sand supplies. • Ensure Dunolly has adequate sand and sandbags. • Ensure Council has adequate signs. • Check staff availability. • Free up trailers for support. • Contact Maryborough Hospital to advise.	• Receive notification text from water catchments/SES	• Receive notification by pager.	• Residents prepare for heavy rain and possible flooding. • Purchase sand and sandbags.
• Flood warning from BoM & SES for Avoca R, Loddon R, Tullaroop or Bet Bet Crks. • Flooding likely on key streams and creeks without warning levels.	• Consider local knowledge sources • SES maintains contact with Council, VicPol & CFA Grp.Officer. • SES contact Council for access to Depot. • L1 Incident control point initiated at LHQs • Monitor reservoir outflows for Tullaroop (G-MW), Cairn Curran (G-MW) available on BoM Website, Evansford, (CHW)	• Check all reservoirs (Goldfields, Timor, Dunolly, Bealiba) overflows • Council checks sandbag supplies and sand supplies. • Ensures Dunolly SES has signs trailer. • Ensure Dunolly has adequate sand and sandbags. • Ensure Council has adequate signs. • Put staff on standby. • Free up trailers for support.	• Receive notification text from water catchments/SES. • Liaise with Council. • Check rosters. • Check availability of members. • Send units out to gather intelligence & confirm reports of flooding and provide feedback to SES & Council.	• Receive notification by pager. • Provide ground observation info to SES	• Residents prepare for heavy rain and possible flooding. • Purchase sand and sandbags.
• Predicted heavy rainfall is occurring. • Lexton and Creswick area experiencing heavy flooding. • Burnt Creek, Mount Moliagul and Black Ranges receiving heavy rainfall. • Bet Bet Creek flooding at Bung Bong. • Info from Flood Wardens indicates high stream levels. • Avoca township flooding levels (including Avoca Football field)	• SES to consider escalating local incident control level. • Situation reports to RDO. • Regular contact with local knowledge on streams maintained. • VICSES distributing Community information/warnings. • Local EMT formed to discuss likely consequences and actions required.	• Council proactive in putting out water over roads signage and/or closing roads where appropriate. • MOC set up not staffed. • Participate in Local EMT • Prepare for sandbag filling	• Participate in Local EMT. • Set up IPOC • Monitoring/enforcing road closures & road diversions • Confirm staff availability • Considering evacuation/resources • Assess staff isolation risk. • Vulnerable communities • Advise communities to activate safety plans/Media	• Notify Brigades in risk areas to be on standby. • Participate in Local EMT • Provide ground observation info to SES	• Implement personal flood plan.
• Areas of flooding & significant numbers of Requests For Assistance (RFA) received by VICSES • Multiple connector road closures. • Flooding of properties likely	• Monitor access & egress routes for crews. • Incident Command Centre/Divisional Command Point established. • SES is responding to RFAs. • Seek support/relief crews. • Assess at risk areas for partial/full evacuation. • EMLO's from VicPol, CFA and Local Government into Divcom/ICC.	• MRM reviews Dunolly staffing on standby (ERC staff). • Council advises VicRoads, VicPol and VICSES ICC of road closures. • Low level MOC initiated • Depot begins filling sandbags for SES and Council use • Call in crews. • Consider availability of staff and facilities for relief centres. • ID buses for possible evacuations. • Provide EMLO to ICC/Div Comm. Point	• Monitor access & egress routes for crews. • MOC operating and staffed by police. • Police Operations Centre operating. • Identify personnel to support key locations. • Protracted staffing for the event. • Consider implementation of evacuation plans. • Provide EMLO to ICC/Div Comm. Point	• Monitor access & egress routes for crews • Provide info on road inundation and at risk properties to SES & Council • Provide EMLO to ICC/Div Comm Point • Provide crews to support SES as required	• Community to monitor websites, VicRoads. BoM, Emergency Services Broadcasts and ABC Radio • Be alert and monitor Emergency Broadcasters for Emergency Warnings and community information. • Monitor their immediate environment for flood risks

APPENDIX H – 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 he 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 council

Residential and commercial property owners'
Sandbags and sand may be obtained (purchased) from hardware suppliers (Bunnings/Mitre 10 etc.)

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:

Maryborough VICSES Local Headquarters (LHQ) 4000 bags (minimum)
Dunolly VICSES Local Headquarters (LHQ) 4000 bags (minimum)
Carisbrook CFA Brigade HQ 4000 bags (minimum)
Other locations to be determined

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 are currently stored at the Maryborough Works Depot

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.

Distribution Points
In preparation for a significant flood emergency, VICSES will work with local councils and other agencies to identify appropriate locations for sandbag collection points. Location considerations will include access, safety, human resources and machinery requirements.

Suggested sandbag collection points:
*additional/alternate points can be nominated by the Incident Controller

Maryborough
Jubilee Oval, Burns St.
Roscholler Park, Kennedy St.
JN Hedges Memorial Park, Rinaldi Dr.

Carisbrook
Recreation Reserve, Urquhart St
Bucknall Reserve, McCallum St

Dunolly
Recreation Reserve, Elgin St.
Dunolly Racecourse Reserve, Dunolly-Timor Rd

The Floodsafe Sandbag Quick Reference Guide (https://www.ses.vic.gov.au/documents/112015/136923/sandbag%20guide.pdf/8fb25a6f-dab1-2ef9-944b-9f5007c66b39) 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.

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 I – REFERENCES AND INTEL SOURCES

The following studies maybe useful in understanding the nature of flooding within Central Goldfields Shire.

- Water Technology (2013a): Carisbrook Flood and Drainage Management Plan, April 2013. Various reports.
- Water Technology (2013b): Dunolly Flood Study, December 2013. Various reports.

Add to list as MFEP built

Other sources of information of direct relevance to the Municipality include:

- 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

  BoM Special Climate Statement 26 (http://www.bom.gov.au/climate/current/statements/scs26b.pdf)
- http://www.floodvictoria.vic.gov.au
  for information on historic floods in Victoria – VERY USEFUL
- http://www.ses.vic.gov.au
  Victoria State Emergency Service
- http://www.dse.vic.gov.au/fire-and-other-emergencies
  Department of Sustainability and Environment emergency management.
- COUNCIL, NCCMA and VICSES Geographical Information System (GIS) – these contain layers showing drainage assets, flooding extents, flood related call-out locations, roads, title boundaries and other useful information.
- Water Technology (2012): Strategic Flood Intelligence Report – Loddon Basin and Avoca Basin, May 2012.

Relevant but more general references include:

- Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000), Standing Committee on Agriculture and Resource Management (SCARM) Report No 73: *Floodplain Management in Australia, Best Practice Principles and Guidelines*.
- Bureau of Meteorology (1996): *Bureau of Meteorology Policy on the Provision of the Flash Flood Warning Service.* May 1996.
- Department of Natural Resources and Environment (DNRE) (2000): *Flood Data Transfer Project* – – Flood Data and Flood Planning Maps as well as Flood Mapping and River Basin Reports.
- Department of Sustainability and Environment (DSE) (2008): *Victoria Caravan Parks Flood Emergency Management Plan Template and Guidelines*. (Two documents) March 2008.
- Victorian Flood Management Strategy 1997-2007
- Emergency Management Act 1986
- Emergency Management Manual Victoria, 1997 Edition
- http://www.ema.gov.au
  Emergency Management in Australia
  - Managing the Floodplain, Manual 19, EMA 2009
  - Flood Preparedness, Manual 20, EMA 2009
  - Flood Warning, Manual 21, EMA 2009
  - Flood Response, Manual 22, EMA 2009
  - Emergency Management Planning for Flood Affected by Dams, Manual 23, EMA 2009
- Central Goldfields Shire Municipal Emergency Management Plan
- Water Act 1989
- Flood Warning Station Information Manual - February 1999