

# Warrnambool City Council

## FLOOD EMERGENCY PLAN

### A Sub-Plan of the Municipal Emergency Management Plan

For Warrnambool City Council  
and  
VICSES Warrnambool Unit

Version 1.1, July 2022



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## Distribution of MFEP

Once endorsed and signed the, MFEP should be distributed to all MFEP committee members, MEMPC Chair, council, MEMO, Deputy MEMO, Representatives from; BoM, CMA, DELWP, Parks Victoria, Ambulance Victoria, VicRoads, DFFH, relevant utilities, FRV, MERC, RERC, Police station, VICSES Units, VICSES Regional office, CFA Brigades, CFA Regional office.

## Document Transmittal Form / Amendment Certificate

This Municipal Flood Emergency Plan (MFEP) will be amended, maintained and distributed as required or every 3 years facilitated by VICSES in consultation with the Municipal Emergency Management Planning Committee (MEMPC)

Suggestions for amendments to this Plan should be forwarded to VICSES Regional Office via [SouthWest@ses.vic.gov.au](mailto:SouthWest@ses.vic.gov.au).

The VICSES MFEP template 6.0 was used to develop this Plan.

Amendments listed below have been included in this Plan and updated as a new version.

Amendment Number	Date of Amendment	Amendment Entered By	Summary of Amendment
<b>V0.5</b>	June 2018	Ken Smith	<b>Final Doc for presentation to MFPC.</b>
<b>V0.6</b>	July 2018	Clare Mintern	<b>Update mapping and flood intelligence data.</b>
<b>V0.8</b>	February 2021	Clare Mintern	<b>Update into new MFEP template version 6.0, with changes to maps, tables and section of the document.</b>
V0.9	April 2021	Clare Mintern	Include feedback from agencies.
V0.9.1	April 2021	Kaylene Sudholz	Amended references to new legislation
V1.0	October 2021	Ken Smith	MEMPC approved and signed document
V1.1	July 2022	Ken Smith	REMPC approved and signed document

This Plan will be maintained on the VICSES website at [www.ses.vic.gov.au/get-ready/your-local-flood-information](http://www.ses.vic.gov.au/get-ready/your-local-flood-information) and Warrnambool City Council website <https://www.warrnambool.vic.gov.au/page/HomePage.aspx>

# List of Abbreviations & Acronyms

The following abbreviations and acronyms are used in the Plan

<b>AAR</b>	After Action Review	<b>IMS</b>	Incident Management System
<b>AEP</b>	Annual Exceedance Probability	<b>IMT</b>	Incident Management Team
<b>AHD</b>	Australian Height Datum (the height of a location above mean sea level in metres)	<b>JSOP</b>	Joint Standard Operating Procedure
<b>AIDR</b>	Australian Institute of Disaster Resilience	<b>LSIO</b>	Land Subject to Inundation Overlay
<b>AIIMS</b>	Australasian Inter-service Incident Management System	<b>MEMP</b>	Municipal Emergency Management Plan
<b>AoOCC</b>	Area of Operations Control Centre / Command Centre	<b>MEMPC</b>	Municipal Emergency Management Planning Committee
<b>ARI</b>	Average Recurrence Interval	<b>MERC</b>	Municipal Emergency Response Coordinator
<b>ARMCANZ</b>	Agricultural & Resource Management Council of Australia & New Zealand	<b>MEMO</b>	Municipal Emergency Management Officer
<b>AV</b>	Ambulance Victoria	<b>MFEP</b>	Municipal Flood Emergency Plan
<b>BoM</b>	Bureau of Meteorology	<b>MFPC</b>	Municipal Flood Planning Committee
<b>CEO</b>	Chief Executive Officer	<b>MRM</b>	Municipal Recovery Manager
<b>CERA</b>	Community Emergency Risk Assessment	<b>PMF</b>	Probable Maximum Flood
<b>CFA</b>	Country Fire Authority	<b>RAC</b>	Regional Agency Commander
<b>CMA</b>	Catchment Management Authority	<b>RCC</b>	Regional Control Centre
<b>DELWP</b>	Department of Environment, Land, Water and Planning	<b>RDO</b>	Regional Duty Officer
<b>DFFH</b>	Department of Families, Fairness and Housing	<b>RERC</b>	Regional Emergency Response Coordinator
<b>DJPR</b>	Department of Jobs, Precincts and Regions	<b>REMP</b>	Region Emergency Management Plan
<b>EMLO</b>	Emergency Management Liaison Officer	<b>SAC</b>	State Agency Commander
<b>EMV</b>	Emergency Management Victoria	<b>SBO</b>	Special Building Overlay
<b>EMT</b>	Emergency Management Team	<b>SCC</b>	State Control Centre
<b>ERC</b>	Emergency Relief Centre	<b>SDO</b>	State Duty Officer
<b>EO</b>	Executive Officer	<b>SEMP</b>	State Emergency Management Plan
<b>FO</b>	Floodway Overlay	<b>SEWS</b>	Standard Emergency Warning Signal
<b>FRV</b>	Fire Rescue Victoria	<b>SOP</b>	Standard Operating Procedures
<b>IIA</b>	Initial Impact Assessment	<b>VICPOL</b>	Victoria Police
<b>EMT</b>	Emergency Management Team	<b>VICSES</b>	Victoria State Emergency Service

# Part 1. Introduction

## 1.1 Approval and Endorsement

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

VICSES staff have undertaken consultation with Warrnambool City Council staff, Glenelg Hopkins CMA staff, and Warrnambool VICSES Unit members regarding the arrangements contained within this plan.

This MFEP is a sub plan to the Warrnambool City Council Municipal Emergency Management Plan (MEMP), is consistent with the [Victorian State Emergency Management Plan](#) (SEMP) and the Victorian Floodplain Management Strategy (2016), and takes into account the outcomes of the Community Emergency Risk Assessment (CERA) process undertaken by the Warrnambool City Council MEMPC.

The MFEP is consistent with the South West Regional Flood Emergency Plan (RFEP), a sub-plan of the Regional Emergency Management Plan (REMP).

This MFEP is a result of the cooperative efforts of the Warrnambool City Council Municipal Flood Planning Committee (MFPC) and its member agencies.

This Plan is submitted by the VICSES Regional Manager as the preparer of the document.

This Plan is approved by the Warrnambool City Council MEMPC and endorsed by the Barwon South West Regional Emergency Management Planning Committee (REMPC) as a sub-plan to the MEMP.

<p><i>(For MEMP and MEMP sub-plans)</i></p> <p><b>On behalf of the Municipal Emergency Management Planning Committee:</b></p>  <p><b>Paul Turner</b> Chair, Municipal Emergency Management Planning Committee Date: 23/12/2021</p>	<p><i>(For sub-plans only, if prepared by an agency on behalf of the MEMPC)</i></p> <p><b>Nominated representative of preparer:</b></p>  <p><b>Nicholas Cowham</b> Regional Manager, VICSES Date: 17/12/2021</p>
<p><b>Approved on behalf of the Barwon South West Regional Emergency Management Planning Committee:</b></p>  <p><b>Mick McGuinness</b> Regional Emergency Management Planning Committee Chair, Fire Rescue Victoria Western District 3 ACFO Date: 28/06/2022</p>	

## 1.2 Purpose and Scope of this Flood Emergency Plan

The purpose of this MFEP is to detail arrangements agreed for managing a flood emergency before, during and after it occurs or potentially occurs within Warrnambool City Council.

As such, the scope of the Plan is to:

- Identify the local flood risk;
- Support the implementation of mitigation and planning measures to minimise the causes and impacts of flooding;
- Detail emergency management arrangements;
- Identify linkages with Local, Regional and State emergency and wider planning arrangements with a specific emphasis on those relevant to flood.

## 1.3 Responsibility for Planning, Review & Maintenance of this Plan

This MFEP must be maintained in order to remain effective.

VICSES through the MFPC has responsibility for facilitating the preparation, review, maintenance and distribution of this plan.

The MFPC will meet at least once per year. The plan should be reviewed following:

- A new flood study;
- A significant change in flood mitigation measures;
- After the occurrence of a significant flood event within the Municipality;
- Or if none of the above occur, every 3 years.

## Part 2. BEFORE: Prevention / preparedness arrangements

### 2.1 Community Engagement and Awareness

Details of this MFEP will be released to the community through; local media, any Flood Planning engagement initiatives and websites (VICSES and the Municipality) upon formal adoption by VICSES and the Municipality.

VICSES with the support of Warrnambool City Council and Glenelg Hopkins CMA will coordinate targeted community flood engagement programs within the council area.

Refer to **Appendix G**.

### 2.2 Structural Flood Mitigation Measures

The Warrnambool City Council have undertaken substantial flood mitigation works within the Russells Creek catchment, including the construction of levees along Russells Creek, construction of culverts at the Mortlake Road underpass, and drainage improvements at the Warrnambool Racecourse. Refer to **Appendix C1** for more details.

When the Merri River and the Hopkins River Estuaries close during flood events, this causes significant rises in flood levels on adjacent property. The Warrnambool City council MEMO can assist to artificially open these Estuaries to reduce flood impacts to buildings as needed. Refer to **Appendix C2** and **C3** for more details.

The Hopkins River mouth is opened manually by Warrnambool City Council staff using an excavator, accessed from the eastern side of the river. Ocean conditions are monitored to ensure the opening is effective. The water level trigger the Warrnambool City Council use to action opening the Hopkins River mouth is 1.5m.

### 2.3 Non-structural Flood Mitigation Measures

#### 2.3.1 Exercising the Plan

Arrangements for exercising this Plan will be at the discretion of the MEMPC. It is recommended that the MFEP is exercised on an annual basis, and reviewed in line with the SEMP Table 17 Section 1.6 Agency roles mapped to the VPF, by critical tasks within the Planning core capability.

#### 2.3.2 Flood Warning

Arrangements for Bureau issued Flood Watch and Flood Warning products are contained within the SEMP and on the Bureau of Meteorology (BoM) website [www.bom.gov.au](http://www.bom.gov.au).

Details on Warnings issued by VICSES through VicEmergency and VICSES channels are outlined in **Appendix D**.

#### 2.3.3 Local Knowledge

Community Observers provide local knowledge to VICSES and the Incident Control Centre regarding local insights and the potential impacts and consequences of an incident and may assist with the dissemination of information to community members.

Specific details of arrangements to capture local knowledge are provided in **Appendix F**.



# Part 3. DURING: Response arrangements

## 3.1 Introduction

### 3.1.1 Activation of Response

Flood response arrangements may be activated by the Regional Duty Officer (RDO) VICSES Barwon South West Region or Regional Agency Commander (RAC).

The VICSES Incident Controller (IC)/RDO will activate agencies as required as documented in the State Emergency Response Plan – Flood Sub-plan.

### 3.1.2 Responsibilities

There are several 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 Warrnambool City Council Local Government Area (LGA). These agencies will be engaged through the EMT (Emergency Management Team) when enacted or via the RAC when the EMT is not enacted.

The general roles and responsibilities of supporting agencies are as agreed within the MEMP and SEMP.

### 3.1.3 Emergency Coordination Centre or equivalent

If established, liaison with the emergency coordination centre will be through the established Division/Sector Command and through Municipal involvement in the EMT, in particular the Municipal Emergency Response Coordinator (MERC). The VICSES RDO / Incident Control Centre (ICC) will liaise with the centre directly if no Division/Sector Command is established.

The function, location, establishment and operation of an emergency coordination centre if relevant will be as detailed in the MEMP.

### 3.1.4 Escalation

Many flood incidents are of local concern and an appropriate response can usually be coordinated using local resources. However, when these resources are exhausted, the Regional arrangements provide for further resources to be made available, and then on a state-wide basis.

Resourcing and event escalation arrangements are described in the SEMP.

## 3.2 Incident Management

### 3.2.1 Control

Section 5(1)(b) of the *Victoria State Emergency Service Act 2013* detail the authority for VICSES to respond to flood.

The SEMP prepared under the *Emergency Management Act 2013*, identifies VICSES as the Control Agency for flood. It identifies DELWP as the Control Agency responsible for “dam safety”, reticulated water and wastewater (sewerage) services” and other emergencies. A more detailed explanation of roles and responsibilities is provided in the SEMP.

All flood response activities within the Warrnambool City Council including those arising from a dam failure or retarding basin / levee bank failure incident will therefore be under the control of the appointed IC, or delegated representative.

### 3.2.2 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 IC responsibilities are as defined in the SEMP.

### 3.2.3 Incident Control Centre (ICC)

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

Pre-determined ICC Footprints and Clusters are determined in **JSOP J02.03 Schedule 4**.

### 3.2.4 Divisions and Sectors

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

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

Division	Sector
Warrnambool	Warrnambool
	Allansford

### 3.2.5 Incident Management Team (IMT)

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

Refer to the SEMP for guidance on IMTs and Incident Management Systems (IMSs).

### 3.2.6 Emergency Management Team (EMT)

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

Organisations, including Warrnambool City 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 the SEMP for guidance on EMTs.

### 3.2.7 On Receipt of a Flood Watch / Severe Weather Warning

VICSES SOP008 and SOP009 outline in detail the actions to be undertaken upon receipt of a Flood Watch/Flood Warning or Severe Weather Warning. VICSES RDO (until an IC is appointed) or IC will undertake actions as defined within the flood intelligence cards (**Appendix C**). General considerations by the IC/VICSES RDO will be as follows:

- Review flood intelligence to assess likely flood consequences
- Monitor weather and flood information – [www.bom.gov.au](http://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 warnings and community information is prepared and issued to the community where required
  - Flood (Riverine and flash) Warnings are managed by the RDO/RAC
  - Severe Weather/Thunderstorm warnings are managed by SDO/SAC
- Develop media and public information management strategy
- Monitor watercourses and undertake reconnaissance of low-lying areas
- Ensure flood mitigation works are being checked by owners
- Develop and issue incident action plan, if required
- Develop and issue situation report, if required

### 3.2.8 On Receipt of the First and Subsequent Flood Warnings

VICSES RDO (until an incident controller is appointed) or IC will undertake actions as defined within the flood intelligence cards (**Appendix C**). General considerations by the IC/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 have buildings at risk of above floor inundation?
  - What areas may be at risk of isolation?
  - What areas may be at risk of indirect affects as a consequence of power, gas, water, telephone, sewerage, health, transport or emergency service infrastructure interruption?
  - 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, power, roads)
  - Implement response strategies as required based upon flood consequence assessment.
  - Continue to monitor the flood situation – [www.bom.gov.au/vic/flood/](http://www.bom.gov.au/vic/flood/)
  - Continue to conduct reconnaissance of low-lying areas
  - Liaise with relevant flood mitigation infrastructure managers

### 3.3 Initial Impact assessment

Initial impact assessments will be conducted in accordance with the SEMP 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 DFFH and recovery agencies.

### 3.4 Preliminary Deployments

When flooding is expected to be severe enough to cut access to towns, suburbs and/or communities the IC 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.

### 3.5 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 Emergency Response Plan - Flood.

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 and resources available;
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. Advice should be given to not attempt to flee by entering floodwater. If people become trapped, it may be safer to seek the highest point within the building and to telephone 000 if they require rescue.
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.
6. Contact the Warrnambool City Council MERC and MEMO at the earliest opportunity to allow for relief preparation to commence.

Due to the rapid development of flash flooding it will often be difficult, to establish relief centres ahead of actually triggering the evacuation. This is normal practice but this is insufficient justification for not adopting evacuation.

Refer to **Appendix C** for response arrangements for flash flood events.

### 3.6 Evacuation

The IC decides whether to warn people to evacuate or if it is recommended to evacuate immediately.

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 **Appendix D** of this Plan and the MEMP for additional local evacuation considerations for the municipality.

### 3.7 Flood Rescue

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

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

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

Victoria Police Rescue Coordination Centre should be notified of any rescues that occur: (03) 9399 7500

The following resources are available within Warrnambool City Council to assist with rescue operations:

- Flood Rescue boats are located at Cobden, Colac, Warrnambool and Hamilton
- Warrnambool has a land based Swift Water Rescue Team.
- HEMS 4 Rescue helicopter is located at Warrnambool Aerodrome.

### 3.8 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 IC

The IC may request aircraft support through the State Air Desk located at the SCC will establish priorities.

Suitable airbase facilities are located at:

- Hamilton (Southern Grampians Shire)
- Warrnambool (Warrnambool City Council)

### 3.9 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.

### 3.10 Essential Community Infrastructure and Property Protection

Essential Community Infrastructure and Property (e.g. residences, businesses, roads, power supply etc.) may be affected in the event of a flood.

Small stocks of sandbags are located in Warrnambool as outlined in the Warrnambool MEMP and back-up supplies are available through the Warrnambool Unit. The IC 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.

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.

The IC will ensure that owners of Essential Community Infrastructure are kept advised of the flood situation. Essential Community Infrastructure providers must keep the IC informed of their status and ongoing ability to provide services.

Contact your local VICSES representative for the most current [Sandbag Guidelines](#).

Refer to **Appendix C** for further specific details of essential infrastructure requiring protection and location of sandbag collection points.

### 3.11 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 Warrnambool City Council.

### 3.12 Road Closures

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

Regional Roads and the Warrnambool City Council will communicate community information regarding road closures. Information will be updated on the VIC Traffic website: <https://traffic.vicroads.vic.gov.au/>

Refer to **Appendix C** for specific details of potential road closures.

### 3.13 Dam Spilling / 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.

DELWP have developed Dam Safety Emergency Plans for municipalities where it is applicable.

There are no major dams with potential to cause structural and community damage within the municipality.

### **3.14 Waste Water related Public Health Issues and Critical Sewerage Assets**

Inundation of critical sewerage assets including septic tanks and sewerage pump stations may result in water quality problems within the municipality. Where this is likely to occur or has occurred the 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 Warrnambool City Council Environmental Health Officer to inspect and report to the MEMO and the ICC on any water quality issues relating to flooding.

### **3.15 Access to Technical Specialists**

VICSES Manages contracts with private technical specialists who can provide technical assistance in the event of flood operations or geotechnical expertise. Refer to VICSES SOP061 for the procedure to engage these specialists.

### **3.16 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. AFTER: Emergency relief and recovery arrangements**

### **4.1 General**

Arrangements for recovery from a flood and/or storm event within the Warrnambool City Council are detailed in the Warrnambool City Council MEMP.

### **4.2 Emergency Relief**

The decision to recommend the opening of an emergency relief centre sits with the IC. The IC is responsible for ensuring that relief arrangements have been considered and implemented where required under the SEMP.

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 the SEMP 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 Department of Jobs, Precincts and Regions (DJPR (Agriculture Victoria)).

Requests for emergency supply and/or delivery of fodder to stranded livestock or for livestock rescue are passed to DJPR (Agriculture Victoria).

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 the SEMP and the MEMP.

# Appendix A: Flood threats for the Warrnambool City Council

This Appendix is to provide a broad overview of flood risk within the Municipality. Detailed Flood Risk Information for Individual Communities is detailed in **Appendix C**.

## Coastal, Stormwater and Riverine Flooding

The Warrnambool City Council is known to be impacted by riverine, stormwater and storm surge flooding. Along the coast, two estuaries that are subject to coastal flooding include the Merri River Estuary and the Hopkins River Estuary. For more detail refer the Estuaries section below.

Towns impacted by stormwater flooding include Warrnambool and Allansford. Warrnambool is particularly susceptible to stormwater flooding. For more detail refer the Stormwater Flooding section and **Appendix C1** below.

The Warrnambool City Council has a history being impacted by riverine flood events during the last decade. Warrnambool has three main waterways that are prone to flooding these include Russells Creek, the Merri River and the Hopkins River. Refer to the map below. The most significant recent flood event was recorded in October 2020, refer to table 1 for significant flood events.

Table 1. Historic flood events.

Year	Description
October 2020	Significant flooding within the Merri River catchment, estimated to be a 1 in 40 year AEP event impacted Warrnambool, Dennington, Yangery, Woodford, Mailors Flat, Winslow, Grassmere and Bushfield. Warrnambool recorded 80mm on the 8th of October, 56mm falling in 3 hours. This event caused considerable damage to buildings, roads, bridges and other infrastructure. More than 10 buildings were impacted by flooding north of Warrnambool in Dennington, Yangery, Mailors Flat, Winslow, Woodford and Bushfield. More than 18 buildings were impacted by flooding in Warrnambool. Minor flooding also occurred in the Hopkins River.
September 2016	Minor flooding in the Hopkins River impacted Allansford and low lying farmland and minor road crossings along the lower Hopkins River.
January 2011	This was the largest flood event on record for the lower Hopkins River and Allansford. This flood caused considerable damage to buildings, roads, bridges and other infrastructure. Access to most minor roads was cut, including the Allansford Bridge on Ziegler Parade. Floodwater from the Hopkins River backed up the stormwater drainage network, impacting buildings and roads in Allansford.
2010	Minor flooding in the Hopkins River and Merri River at Warrnambool and Allansford impacted low lying farmland and minor road crossings.
2001	Minor flooding in the Merri River at Warrnambool impacted low lying farmland and minor road crossings.
1983	Minor flooding in the Hopkins River at Allansford impacted low lying farmland and minor road crossings along the lower Hopkins River.
1984	Minor flooding in the Merri River at Warrnambool impacted low lying farmland and minor road crossings.
1978	Minor flooding in Hopkins River at Allansford impacted low lying farmland and minor road crossings along the lower Hopkins River.
1946	The largest flood event recorded in the Merri River, Hopkins River and Russells Creek, estimated to be a 1 in 500 AEP year flood or larger. Warrnambool recorded 228 mm over two days. This flood caused seven deaths and caused thousands of people to be homeless. Farmers experienced extensive stock and crop losses. Seven bridges were damaged and three bridges were swept away including the Woodford Bridge and Cassidy's Bridge. A significant number of houses were flooded.

## Storm Surge Flooding

Within the Warrnambool City Council LGA storm surge flooding is known to occur along the Merri River Estuary and at the Breakwater adjacent to Viaduct Road. Low atmospheric depressions at sea can cause flooding due to storm surge, resulting in abnormally high sea levels along the coastline. While there are limited records of historic storm surge events, a significant storm surge event occurred in Warrnambool on the 24th of June 2014. During this event a number of buildings were impacted by flooding. Refer to **Appendix C2** for more detailed information.

Warrnambool's tidal Information is a good source of local information when there is storm surge potential. For BOM Marine Warnings web page: <http://www.bom.gov.au/marine/>

Also refer to MetEye for forecast wave height information:  
[http://www.bom.gov.au/australia/meteye/?loc=VIC\\_FA001](http://www.bom.gov.au/australia/meteye/?loc=VIC_FA001)

For further general information regarding storm surge, refer to the BOM web page:  
<http://www.bom.gov.au/cyclone/about/stormsurge.shtml>

## Estuaries

Many south west Victorian estuaries close intermittently following the formation of a sand bar at the estuary mouth. Estuaries that intermittently close typically reopen following high rainfall events when there is enough water flowing down the river to flush built-up sand from the estuary mouth. Estuaries that are closed during riverine flood events can significantly increase flood levels on adjacent property.

Most estuaries in the Glenelg Hopkins CMA region are naturally intermittently closed estuaries – the exceptions are the Moyne River Estuary and Fawthrop Lagoon, which are artificially kept open. The Estuary Entrance Management Support System (EEMSS) database was developed in 2006 by Glenelg Hopkins CMA in partnership with other agencies. The EEMSS considers the social, economic and environmental values of each estuary and the likely impact of opening and not opening at different times of the year and at different water levels. The EEMSS was recently modified to be web-based and is now available to all coastal CMAs:  
<https://www.ghcma.vic.gov.au/our-region/waterways/estuaries/>

Estuaries within the Warrnambool City Council include:

- Merri River Estuary
- Hopkins River Estuary



Figure 1. Estuaries within the Warrnambool City Council LGA.



Figure 2. Warrnambool City Council waterways and stream gauges.

## Description of Major Waterways

Waterway	Description
<p><b>Russells Creek</b></p>	<p>The Russells Creek catchment contributes to frequent flooding in Warrnambool. The upper reach of Russells Creek begins north of Wangoom and flows south through the northern section of Warrnambool. During flood events Russells Creek receives inflows from the Warrnambool Racecourse Catchment and a tributary along Aberline Road (Water Technology, 2017). Russells Creek is a tributary of the Merri River, joining the Merri River north of Daltons Road. The catchment area of Russells Creek is small, approximately 37.5 km<sup>2</sup>.</p> <p>While Russells Creek is ungauged, a temporary stream gauge, Portable Automated Logging System (PALS) has been installed along Wares Road, south of Whites Road to monitor flood events. Due to the small size of the catchment, flooding in Russells Creek occurs quickly after rainfall and is subject to flash flooding. The estimated travel time between heavy rainfall in the upper Russells Creek catchment to steep rise in Warrnambool can vary between 1 to 6 hours. The flood peak travel time between heavy rainfall in the upper catchment and the flood peak arriving at Mortlake Road can vary between 2 to 6 hours.</p>
<p><b>Merri River</b></p>	<p>Riverine flooding within the Merri River catchment has caused extensive and frequent impacts to Warrnambool, Dennington, Yangery, Woodford, Woolsthorpe and Bushfield. The upper reaches of the Merri River catchment drains the eastern section of Mount Rouse and flows south through Woolsthorpe, Mailors Flat, Grassmere, Woodford, Bushfield, Dennington and Warrnambool before it discharges to the sea at Stingray Bay. The catchment area of Merri River is approximately 1,050 km<sup>2</sup>. The northern section of the Merri River catchment is named Spring Creek, it then becomes the Merri River south of Winslow. The main tributaries of the Merri River include Drysdale Creek, Yangery Creek, Gipsys Creek and Russells Creek. The Merri River receives inflows from Russells Creek and Yangery Creek downstream of Woodford. The Merri River floodplain is well defined up to the Dennington Bridge. From there the river breaks out to the east discharging to the sea at Stingray Bay, and the west inundating Kelly Swamp along with areas adjacent to the Merri River Cutting (Rutledges Cutting), the second opening to the sea.</p> <p>There is one stream gauge along the Merri River at Woodford that provides flood warning for Warrnambool. The estimated travel time between heavy rainfall in the upper Merri River catchment to the flood peak arriving at the Woodford gauge can vary between 20 to 30 hours. The flood peak travel time between heavy rainfall in the upper catchment to steep rise in streamflow in Warrnambool can vary between 25 to 35 hours.</p>
<p><b>Hopkins River</b></p>	<p>The lower section of the Hopkins River contributes to flooding in Allansford and Warrnambool. The upper reaches of the Hopkins River includes the Grampians National Park and the western upland areas around Ararat, and flows through Wickliffe, Hexham, Ellerslie, Hopkins Falls, Allansford and Warrnambool before it discharges to the ocean. The catchment area of Hopkins River is approximately 7,374km<sup>2</sup>. The main tributary of the Hopkins River is Mt Emu Creek, joining the Hopkins River immediately downstream of Hopkins Falls. Other minor tributaries of the Hopkins River include Blind Creek, Salt Creek, Mustons Creek and Stony Creek.</p> <p>There are eight stream gauges along the Hopkins River and Mt Emu Creek that provide flood warning for Allansford and the lower Hopkins River, these include Ararat, Wickliffe, Framlingham, Hopkins Falls, Mena Park, Guthries, Skipton and Taroon. While there are no stream gauges at Allansford, the Hopkins Falls (8 km upstream of Allansford) stream gauge was used to estimate the flood warning time for Allansford. The estimated travel time between heavy rainfall in the upper Hopkins River catchment to steep rise in streamflow at Allansford varied between 1.5 to 2.7 days during the January 2011 and October 2020 flood events.</p>

<p><b>Mount Emu Creek</b></p>	<p>Mt Emu Creek is a tributary of the Hopkins River that contributes to flooding in Allansford and Warrnambool. The upper reaches of the Mt. Emu Creek begins as a small waterway south of Lexton and flows through Langi Kal Kal, Trawalla, and Skipton. The catchment area of Mt. Emu Creek is approximately 3,150 km<sup>2</sup>. Mt. Emu Creek receives inflows from Baillie Creek and other minor waterways upstream of Skipton. The Baillie Creek catchment begins at Lake Burrumbeet and flows west where it joins Mt. Emu Creek 1.5 km north of the Guthries stream gauge.</p> <p>There are four stream gauges along Mt. Emu Creek that provide flood warning, these include Mena Park, Guthries, Skipton and Taroon. Two temporary stream PALS gauges can also be installed by DELWP (as needed) at Baillie Creek and along Mt. Emu Creek at Cameron Bridge. Rises in streamflow at the Taroon gauge can occur between 1.7 to 2.4 hours after rainfall in the upper catchment.</p>
<p><b>Yangery Creek</b></p>	<p>The Yangery Creek catchment contributes to flooding both within the Yangery catchment and to Warrnambool via the Merri River. Yangery Creek is a tributary of the Merri River, joins the Merri River downstream of Caramut Road. The catchment area of Yangery Creek is small, approximately 27 km<sup>2</sup>. During the October 2020 flood event flooding from the Yangery Creek impacted more than 5 houses (VICSES Request for Assistance Database).</p> <p>Yangery Creek is an ungauged catchment. Due to the small size of the catchment, flooding in Yangery Creek occurs quickly after rainfall and is subject to flash flooding. The estimated travel time between heavy rainfall in the upper Yangery Creek catchment to the flood peak entering the Merri River may vary between 2 to 6 hours.</p>

## Building Damages

Refer to the table below for property and building damages for flood events within the Warrnambool City Council. The table also provides an indication of when a Level 2 and 3 ICC will be required, based on the number of above floor damages.

Table 2. Warrnambool City Council building damages.

Annual Exceedance Probability (1 in year)	Total number of properties flooded (buildings flooded above floor)			Total damages for the Warrnambool City Council
	Warrnambool Russells Creek (Appendix C1)	Warrnambool Merri River (Appendix C2)	Allansford* (Appendix C3)	
5	36 (0)	17 (?)		53 (0)
10	57 (0)	51 (?)		108 (0)
20	69 (1)	93 (?)		162 (1)
50	99 (5)	112 (18)*		211 (23)
100	205 (14)	138 (20)*	51 (11)*	343 (34)
200	369 (18)	147 (25)*	87 (16)*	516 (43)

\*Estimated damages using anecdotal flood information provided by the VICSES Request for Assistance Database and the Warrnambool City Council.

- Level 2 ICC
- Level 3 ICC



## Dam Spill / Failure

There are no large dams within the Warrnambool City Council region that impact flooding.

Lake Pertobe levels are managed using a simple timber plank system in the channel outlet. Flooding is limited to standing water in low lying levels around the lake. The water level in Lake Pertobe would only become a problem if the Merri River is closed. While there is no protocol to open the Merri River mouth, there is a protocol to open the cutting at Killarney that usually leads to the Merri River opening up shortly after (Warrnambool City Council, Luke Coughlan, Infrastructure Services Manager).

## Appendix B: Typical flood peak travel times

Table 3. Flood peak travel times.

Location From	Location From	Typical Travel Time	Comments	Duration
<b>Warrnambool (Russells Creek)</b>				
Start of rainfall (upper catchment)	Warrnambool (Russells Creek)	1 – 6 hours	To steep rise	2 to 8 hours
Start of rainfall (upper catchment)	Warrnambool (Russells Creek)	2 - 6 hours	To peak	
<b>Warrnambool (Merri River)</b>				
Start of rainfall (upper catchment)	Woodford gauge (Merri River)	20 - 30 hours	To peak	1 to 2 days
Start of rainfall (upper catchment)	Warrnambool (Merri River)	25 – 35 hours	To steep rise	
<b>Allansford (Hopkins River)</b>				
Start of rainfall (upper Mt Emu Creek catchment)	Taroon gauge (Mt Emu Creek)	1.7 – 2.4 days	To peak	2 to 2.5 days
Start of rainfall (upper Hopkins River catchment)	Allansford (Hopkins River)	1.5 – 2.7 days	To steep rise	

# Appendix C1: Warrnambool (Russells Creek) Flood Emergency Plan

The Russells Creek catchment contributes to frequent flooding in Warrnambool. The upper reach of Russells Creek begins north of Wangoom and flows south through the northern section of Warrnambool, refer to the map below. During flood events Russells Creek receives inflows from the Warrnambool Racecourse catchment and a tributary along Aberline Road (Water Technology, 2017). Russells Creek is a tributary of the Merri River and joins the Merri River north of Daltons Road. The catchment area of Russells Creek is small, approximately 37.5 km<sup>2</sup>.

In addition to riverine flooding, Warrnambool is particularly susceptible to stormwater flooding. Given that Russells Creek flows through the northern section of Warrnambool, these impervious areas of the heavily urbanised part of the catchment increase runoff and exacerbate localised flooding. The Warrnambool City Council has undertaken a number of stormwater flood investigations that are used to target problem areas to undertake strategic infrastructure upgrades. For detail regarding stormwater ponding areas refer to the Stormwater Flooding section below.

Significant flood mitigation works costing in excess of \$3.9 million have been undertaken by the Warrnambool City Council to reduce flooding in the Russells Creek catchment. The construction of levees, culverts and other works have substantially reduced flood risk within the Russells Creek catchment, reducing flooding to more than 750 properties and in excess of 225 buildings.

The October 2020 flood event was the largest recent flood event recorded along Russells Creek in Warrnambool, estimated to be a 1 in 10 year AEP event (Glenelg Hopkins CMA). This event caused flood impacts to buildings, roads and other infrastructure. VICSES recorded three buildings were flooded above floor in Wangoom Road, Monterey Court and Ardlie Street. Minor and major roads were impacted by flooding within and surrounding Russells Creek, these include Gardens Street, Broomfield Street, Queens Road, Daltons Road and Ardlie Street. After the Russells Creek flooding receded, flooding from the Merri River back flowed along Russells Creek. Anecdotal information indicates that the second peak from the Merri River was larger. Refer to **Appendix C2** for these flood impacts.

While Russells Creek is ungauged, a temporary PALS stream gauge has been installed along Wares Road, south of Whites Road to monitor flood events. Refer to the map below for the gauge location.

Due to the small size of the catchment, flooding in Russells Creek occurs quickly after rainfall and is subject to flash flooding. The estimated travel time between heavy rainfall in the upper Russells Creek catchment to steep rise in flood levels in Warrnambool can vary between 1 to 6 hours. The flood peak travel time between heavy rainfall in the upper catchment and the flood peak arriving at Mortlake Road can vary between 2 to 6 hours.

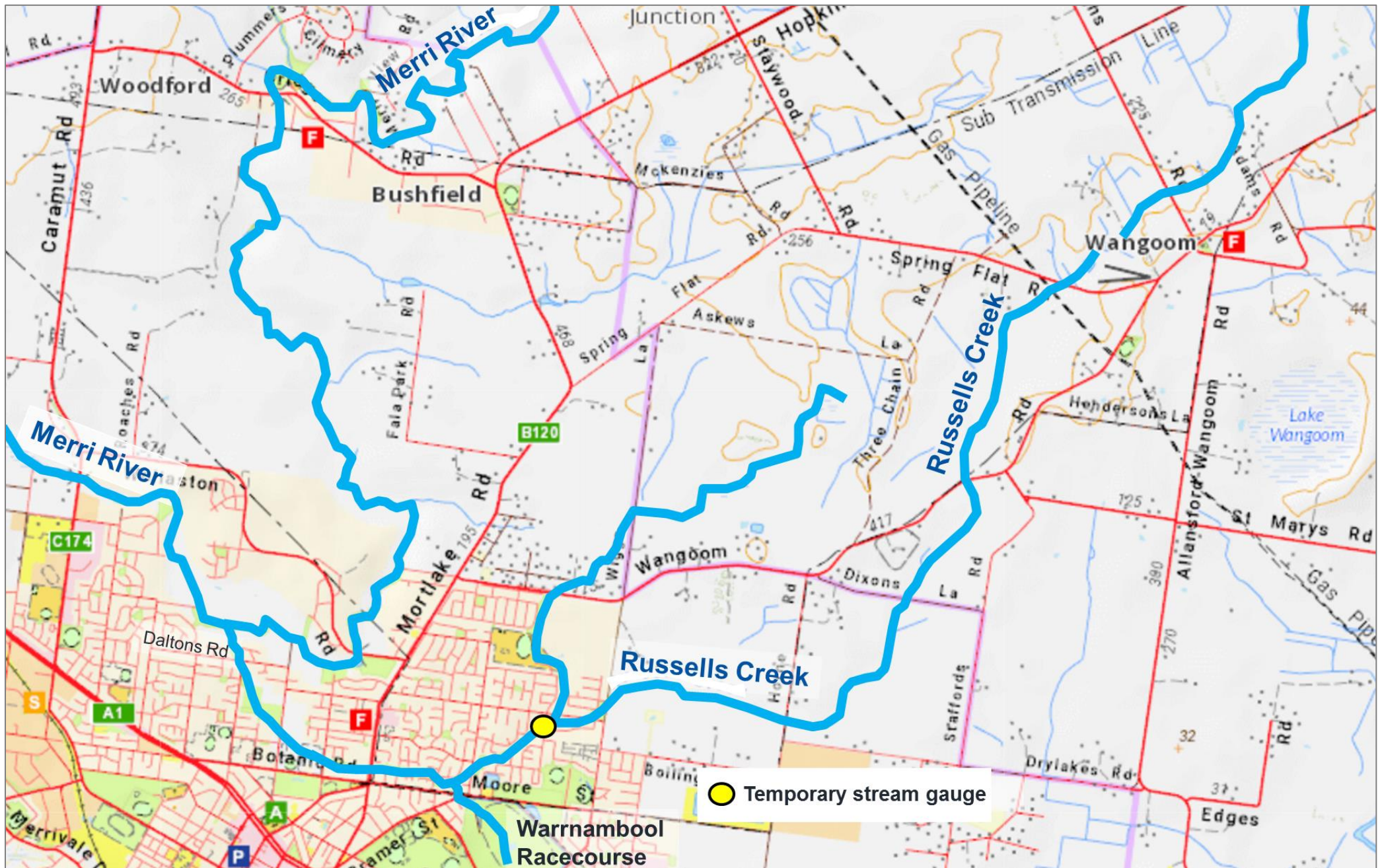


Figure 3. Russells Creek catchment waterways and stream gauge.

## Historic Riverine Floods

Rainfall records indicate that Russells Creek in Warrnambool has experienced frequent flood events since the early 2000's, refer to graph below. The largest flood event on record was in 2011. More recently Warrnambool has experienced flooding in October 2020, refer to flood photos below. Significant flood events have occurred in 2000, 2001, 2003, 2005, 2007, 2008, 2010, 2011, 2013, 2017 and 2020. The April 2011 rainfall event was the largest recent flood event on record, with 74.6 mm falling on the 11<sup>th</sup> of April.

The Warrnambool Airport rainfall gauge was used to indicate historic flood events that have occurred in Russells Creek, Warrnambool.

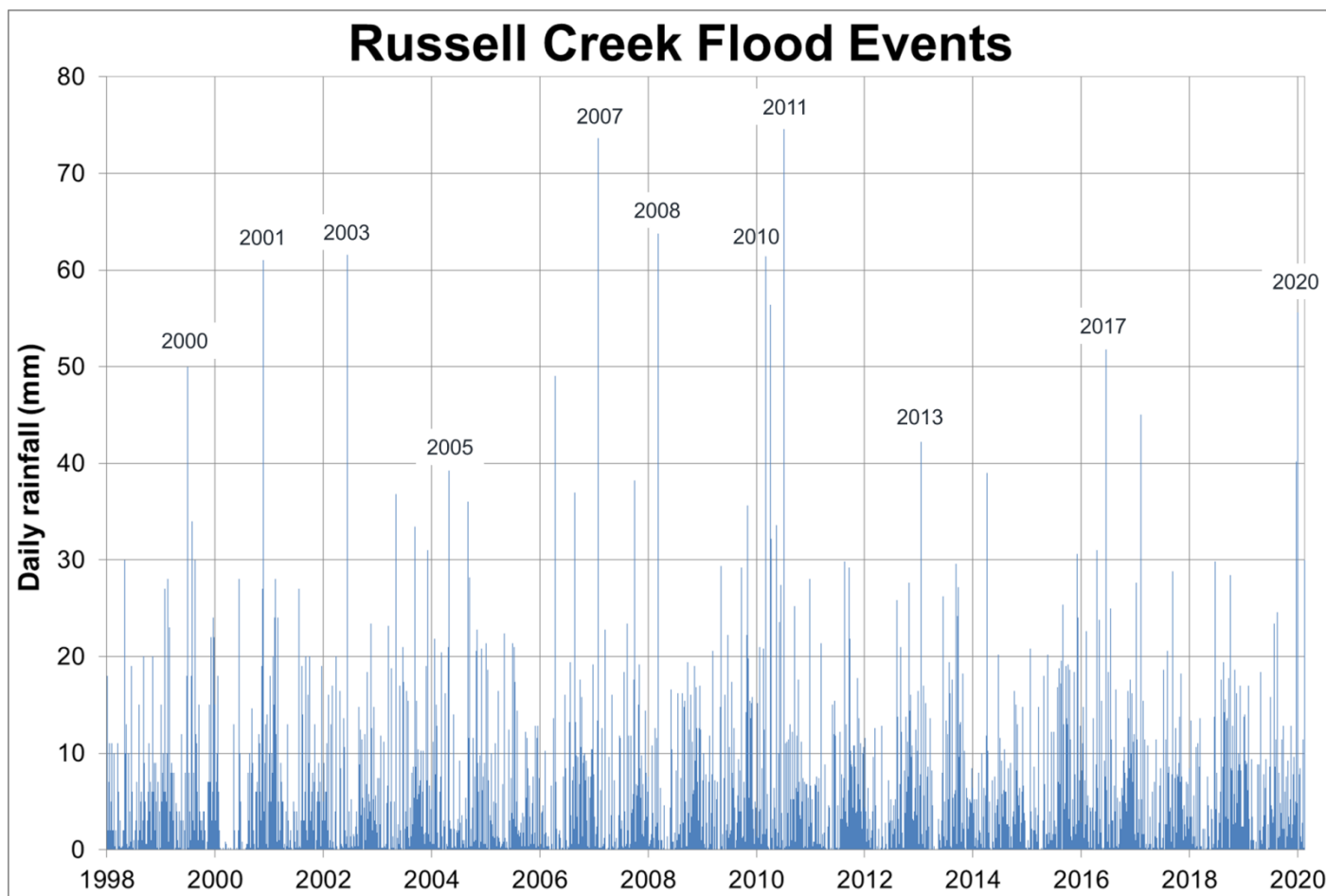


Figure 4. Warrnambool historic flood events.

## October 2020 flood event

The October 2020 flood was Warrnambool's largest recent flood event on record, estimated to be approximately a 1 in 10 year AEP event (Glenelg Hopkins CMA). This estimate is based on peak stream gauge board height measurements and a flood extent survey undertaken by the Glenelg Hopkins CMA. As the flood event occurred overnight, impacts were difficult to assess. Warrnambool recorded 80 mm of rainfall on the 8<sup>th</sup> of October. Significant flooding occurred along Russells Creek in Warrnambool at 2:30am on the 8<sup>th</sup> of October 2020.

Flood damages recorded in the VICSES Request for Assistance Database during the October 2020 flood event show there were several houses within the Russells Creek floodplain that were impacted by flooding in Monterey Court (1), Wangoom Road (135) and Ardlie Street (102), all of which were likely impacted by localised runoff.

Minor and major roads were impacted by flooding within and surrounding Russells Creek, these include Gardens Street, Broomfield Street, Queens Road, Daltons Road and Ardlie Street. Refer to the flood photos below. For more details regarding flood impacts refer to the Warrnambool (Russells Creek) Flood Intelligence Card below.



Figure 5. Flooding impacted the Russell Creek footbridge upstream of Mortlake Road during the October 2020 event.



Figure 6. Flooding impacting the St Joseph's Primary School Oval of Broomfield Street, Warrnambool during the 8<sup>th</sup> October 2020 flood event (VICSES Warrnambool Unit).

## Warning time

While Russells Creek is ungauged, a temporary stream gauge has been installed along Wares Road, south of Whites Road to monitor flood events. This PALS stream gauge has been temporarily installed during times of high flood risk, during October 2020 to January 2021. Refer to the map above for the gauge location.

Due to the small size of the catchment, flooding in Russells Creek occurs quickly after rainfall and is subject to flash flooding. The estimated travel time between heavy rainfall in the upper Russells Creek catchment to steep rise in flood levels in Warrnambool can vary between 1 to 6 hours. The flood peak travel time between heavy rainfall in the upper catchment and the flood peak arriving at Mortlake Road can vary between 2 to 6 hours.

During the October 2020 flood event, heavy rainfall late at night on the 7<sup>th</sup> caused flooding in Russells Creek at the Wares Road stream gauge, peak height of 17.73m at 2:30am on the 8<sup>th</sup> of October. The duration of the initial flood peak was only maintained in Warrnambool for 4 hours. Refer to the hydrograph below.

These estimates are based in informaiotn from the Russells Creek (Cardno, 2010) Flood Study and anecdotal informaiton collected during the October 2020 flood event.

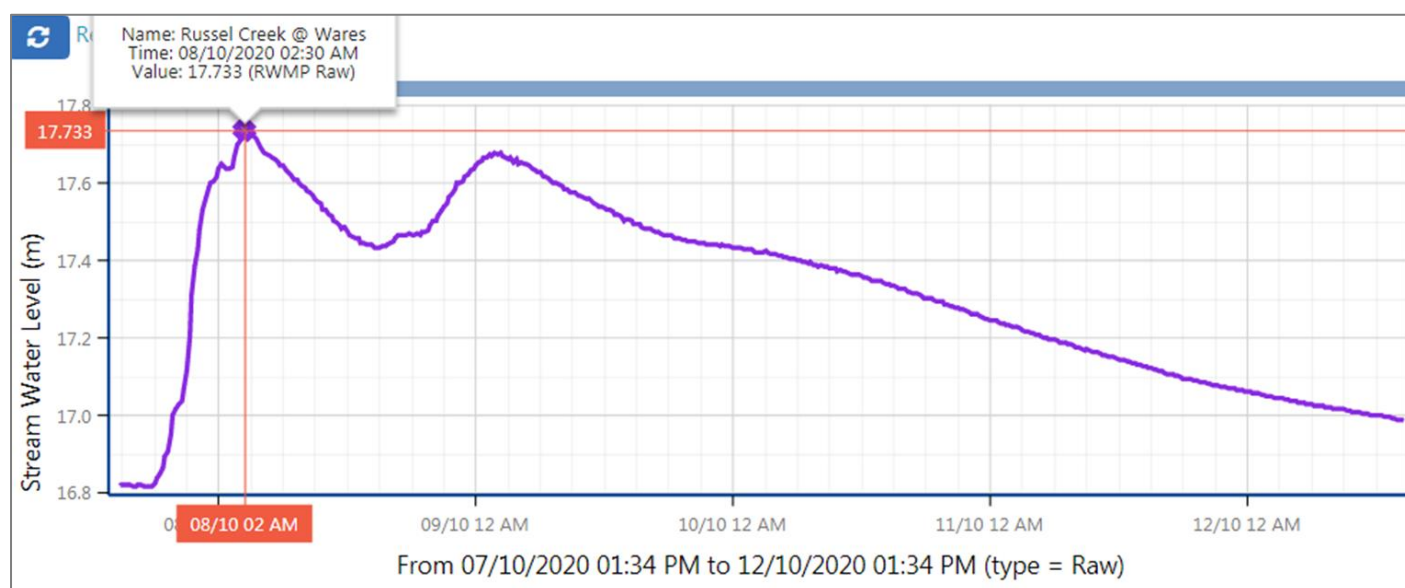


Figure 7. Russells Creek flood peak during the October 2020 flood event.

## Stormwater Flooding

Warrnambool is particularly susceptible to stormwater flooding, refer to the photos below. The risk of stormwater flooding is greatest when the capacity of the stormwater drainage network is exceeded and the excess accumulates in the road network which often then drains to low lying land, as observed in the rain on grid stormwater modelling undertaken by Water Technology (2017). Refer to the stormwater mapping developed by Water Technology indicating the 1 in 100 year AEP flood depth map. Stormwater flooding is often compounded in urban areas that have experienced rapid growth, as has been observed in Warrnambool. Flooding is compounded due to increased runoff from hard surfaces along ageing and often undersized infrastructure.

This study highlighted two areas where flooding backs up against the Russells Creek levee:

- Land behind the Moore Street levee is low and given the orientation of the local drainage around the racecourse stormwater may pool behind the levee at this location.
- At La Bella Court stormwater pools in the court bowl.



Figure 8. Flooding impacted a house at 240 Moore Street, Warrnambool during the October 2017 event (Utilis 2018).



Figure 9. Flooding impacting properties along Wanstead Street during the October 2017 event (Utilis 2018).





Figure 10. Areas in Warrnambool impacted by stormwater flooding during a 1 in 10 year AEP event (Water Technology 2017).



Figure 11. Areas in Warrnambool impacted by stormwater flooding during a 1 in 100 year AEP event (Water Technology 2017).

In addition to the Russells Creek flood mapping, the Warrnambool City Council has undertaken extensive stormwater flood mapping for all urban areas in Warrnambool (Engeny 2016). Refer to the stormwater flood depth map below for a 1 in 100 year AEP event (Engeny 2016). This stormwater flood mapping has substantially improved knowledge of problem areas within Warrnambool. It provides valuable information that can be used to target problem areas to undertake strategic infrastructure upgrades. The assessment of stormwater flood risk shows that the majority of Warrnambool's streets experience nuisance flooding, although flows tend to drain back to the Warrnambool Racecourse. Stormwater modelling (Engeny 2016) indicates that considerable stormwater ponding occurs along:

- Corner of Japan Street and Koroit Street
- Flaxman Street
- Warrnambool Racecourse, Moore Street
- Harrington Road
- Stanley Street
- Morris Road
- Wanstead Street
- Glenrowe Avenue

Anecdotal information provided by the Warrnambool City Council (Rohan McKinnon) indicates that several houses that are frequently impacted stormwater flooding include:

- 120 and 128 Harrington Road
- 27 Morris Road, next to the sewerage pump station.

More recently during the October 2020 event, several buildings were documented in the VICSES Request for Assistance Database to be impacted by stormwater flooding, these included:

- Warrnambool Showgrounds, 331 Koroit Street
- 11 Minerva Drive
- 33 Gateway Road
- Wanstead Street
- Glenrowe Avenue



Figure 12. Flooding on the corner of Wanstead Street and Glenrowe Avenue during the October 2020 event.

## Racecourse Flooding

The Warrnambool Racecourse catchment, south of Russells Creek has been the source of a number of drainage issues in the past with frequent nuisance inundation of Moore Street following heavy rainfall events. Refer to flood photos of a house in Moore Street impacted by flooding. Following the expansion of the Warrnambool urban and industrial development areas to the east, additional drainage pressure has been placed on this and neighbouring catchment areas. In addition to the existing pressure on drainage infrastructure in this location are the issues around the functionality and capacity of the Simpson Street drain which discharges overland flows east of the racecourse to the Hopkins River. In consideration of future changes to natural drainage patterns in this area, assessment of retardation requirements from this catchment will be undertaken to ensure that flooding on Russells Creek is not adversely impacted.

Stormwater flooding can develop quickly as a result of heavy rainfall. Heavy rainfall can cause rapid rise of floodwater. The warning time available from rainfall to stormwater flood impacts occurring can range between 2 to 3 hours depending on the rainfall intensity.



Figure 13. Areas in Warrnambool impacted by stormwater flooding during a 1 in 100 year AEP event (Engeny, 2017).

## Russells Creek Mitigation Works

The Warrnambool City Council has undertaken substantial flood mitigation works within the Russells Creek Catchment since 2010. These works include:

- Construction of 1.2 km of levees along Russells Creek
- Construction of two culverts at the Mortlake Road underpass to improve flood flow capacity
- Drainage and flood storage improvements at the Warrnambool Racecourse

These mitigation works completed in 2016 by the Warrnambool City Council have substantially reduced flood risk within the Russells Creek catchment in Warrnambool. Refer to the map below showing the 1 in 100 year AEP flood extent before and after construction of these flood mitigation works. More detail regarding these mitigation works are provided below.



Figure 14. Flood risk in Warrnambool before and after undertaking flood mitigation works (Water Technology 2017).

## Mortlake Road Culverts

Along Russells Creek there are a significant number of waterway structures that affect the conveyance and storage of flows within the waterway during significant flood events. Of these structures the Mortlake Road culverts and the road embankment was the most significant hydraulic control within the Russells Creek floodplain. Before flood mitigation works were undertaken, floodwater at Mortlake Road would back up and break out to the east, flooding numerous adjacent properties. The original culvert also provided the pedestrian crossing for Mortlake Road which exacerbated the capacity issue and created a potential safety hazard, refer to photo below.

Flood mitigation works included the construction of two 2.4m x 3.6m box culverts at Mortlake Road, refer to the photo below. These new culverts significantly increase the culvert drainage capacity. Flood modelling showed that without the installation of the two new boxed culverts, flood levels upstream of the Mortlake Road would increase in excess of 0.5m and floodwater would outflank the levees upstream of Garden Street (Water Technology 2017). These mitigation works enable access along Mortlake Road during large flood events. The upgraded high bypass culverts also provide pedestrian access.



Figure 15. Mortlake Road culvert before the culvert upgrade, 12<sup>th</sup> August 2010 (Utilis, 2018).





Figure 16. Mortlake Road upgraded culvert capacity to reduce flood risk (Water Technology, 2017).

## Russells Creek Levees

The Warrnambool City Council has completed the construction of flood protection levees (concrete walls) along Russells Creek. Refer to photos and the map below for the levee location. The cost of the levee construction was \$3.9 million. These levees reduce flooding to more than 750 properties and in excess of 225 buildings. These levees have an average height of 1.1 m and are 1.2 km long.

There are six openings along the levee that require the installation of drop boards during flood events to provide flood protection. When there is risk of flooding the Warrnambool City Council staff will install these drop boards. Refer to the photos and map below for the locations of where the drop boards need to be installed.

The protection level of the levee is to a 1 in 100 year flood event. There is 300mm of additional freeboard when the drop boards are installed. Freeboard is a factor of safety above the design flood level, this tends to compensate for flood protection uncertainties. Refer to the Warrnambool (Russells Creek) Flood Intelligence Card and maps below for details regarding buildings and roads impacted by flooding.

Future recommendations for additional works include:

- Minor engineering works around the Garden Street areas where modelling shows minor outflanking of the levee.
- Minor raising of the surface level will improve the performance of the southern levee which will be outflanked in large flow events (Water Technology, 2017).



Figure 17. Russells Creek levee adjacent to Roslyn Close.



Figure 18. Russells Creek levee drop boards attached to the levee wall.



Figure 19. Russells Creek levee and board locations.

## Flood Impacts and Required Actions

Flood mapping from the Russells Creek Flood Study (Water Technology, 2017) was used to estimate assets, buildings and roads impacted by flooding.

For additional flood risk information refer to the Warrnambool Flood Intelligence Card (Russells Creek), table and maps below.

Key assets at risk of flooding in Warrnambool along Russells Creek are listed below.

Table 4. Key assets at risk of flooding.

<b>Asset register</b>				
<b>Asset Name and location</b>	<b>Annual Exceedance Probability (1 in year)</b>	<b>Consequence / Impact</b>	<b>Mitigation/ Action</b>	<b>Lead Agency</b>
<b>Queens Road and Garden Street, Warrnambool.</b>	10 year flood	Deep flooding, above 0.27m depth may cut access to Queens Road and Garden Street, during a 10 year flood event.	Deploy road closure signs as needed.	Council
<b>A house at 93 Wangoom Road, Warrnambool.</b>	20 year flood	A house at Wangoom Road may be flooded above floor during a 20 year flood event.	Sandbag buildings and undertake evacuations as needed	VICSES and Victoria Police
<b>Goodstart Early Learning Kindergarten, 121 Whites Road, Warrnambool.</b>	20 year flood	Flooding starts to impact the playground of the Warrnambool Goodstart Early Learning Kindergarten (121 Whites Road), depth 0.14 m.	Evacuate the Kindergarten as needed	Victoria Police
<b>Broomfield Street and Moonah Street, Warrnambool.</b>	20 year flood	Deep flooding, above 0.23m depth may cut access to Broomfield Street and Moonah Street, during a 20 year flood event.	Deploy road closure signs as needed.	Council
<b>Breton Street, Warrnambool.</b>	100 year flood	Deep flooding, above 0.27m depth may cut access to Breton Street during a 100 year flood event.	Deploy road closure signs as needed.	Council
<b>Shops at Northpoint, along Mortlake Road, Warrnambool.</b>	200 year flood	Flooding may start to impact properties surrounding Hayley Drive, including Gallo Bakery (84 Mortlake Road), Northpoint Coles (70 Mortlake Road), Northpoint Liquor Barn (82 Mortlake Road), Direct Chemist Outlet (72 Mortlake Road), and Brumby's Warrnambool (70 Mortlake Road).	Evacuate shops as needed.	Victoria Police
<b>Whites Road, Warrnambool.</b>	200 year flood	Deep flooding, above 0.23m depth may cut access to Whites Road, during a 200 year flood event.	Deploy road closure signs as needed.	Council

For more detailed information regarding buildings and roads impacted refer to the Warrnambool (Russells Creek) Flood Intelligence Card and flood impact maps below. Also refer to the Warrnambool (Russells Creek) flood depth maps in **Appendix E**, a list of flood observers in **Appendix F** and community sandbag collection point in **Appendix H**.



Figure 20. Warrnambool (Russells Creek) buildings impacted by over flood flooding for a range of design flood events (Water Technology 2017).

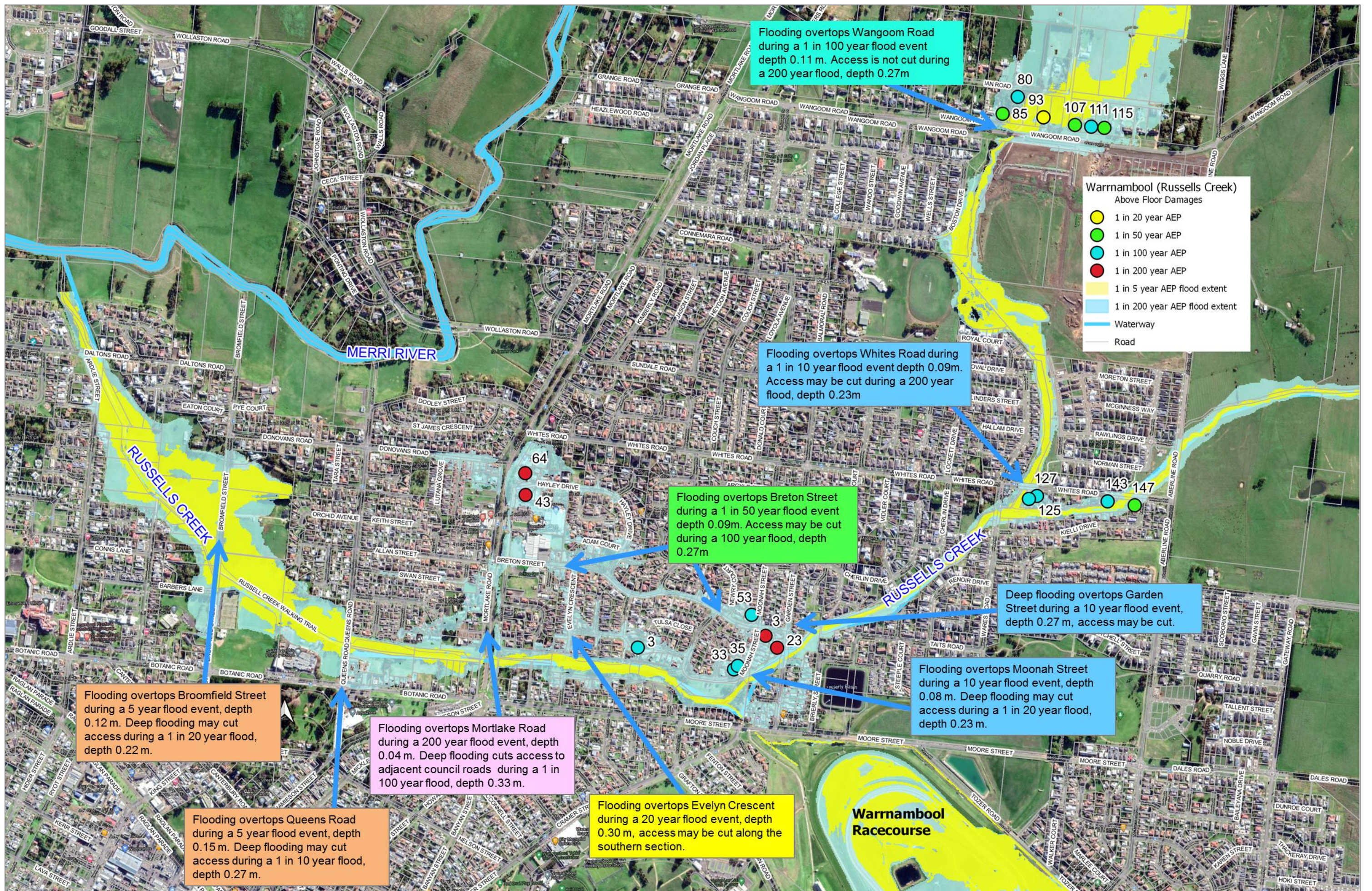


Figure 21. Warrnambool (Russells Creek) roads impacted by flooding for a range of design flood events (Water Technology 2017).

**Table 5. Warrnambool Flood Intelligence Card (Russells Creek)**

Flood travel time					Time from start of rain to steep rise in floodwater in Warrnambool 1 to 6 hours			
					Time from start of rain to peak at Mortlake Road gauge 2 to 6 hours			
					Riverine flooding duration: 2-8 hours			
Rainfall intensity (Water Technology 2017) (mm/hr)	Russells Creek at Wares Road PALS gauge height (m)	Annual Exceedance Probability (1 in year)	Russells Creek at Mortlake Road Design Flows (ML/d)	Warrnambool damages total number properties flooded (above floor)	Consequences/ Impacts	Buildings flooded / isolated	Roads impacted	Actions
		November 2017			Minor nuisance flooding.			
36.1 mm in 6 hours, 45.7 mm in 12 hours, 56.6 mm in 24 hours, 67.7 mm in 48 hours		5	2,134	36 (0)	Flooding starts to impact the walking paths and playgrounds of St Joseph's Primary School (70 Botanic Road), flood depth up to 0.28m.		Broomfield Street 0.12m Queens Road depth 0.15m Wangoom Road depth 0m Whites Road depth 0m Hayley Drive depth 0m Breton Street depth 0m Evelyn Crescent depth 0m Garden Street depth 0m	VICSES activate ground flood observers to take photos and record flood levels at key crossings along Russells Creek. Council monitor culverts and drains to check for debris build up, clear debris from waterway crossings, drains and culverts as needed.
44 mm in 6 hours, 55.7 mm in 12 hours, 69.2 mm in 24 hours, 82.8 mm in 48 hours		10 October 2020	2,817	57 (0)	Deep flooding may cut access to Queens Road and Garden Street. The October 2020 flood event caused over floor flooding at several houses in Monterey Court, Ardlie Street and Wangoom Road, likely to be from localised stormwater runoff. Minor and major roads were impacted by flooding within and sounding Russells Creek, these include Gardens Street, Broomfield Street, Queens Road, Daltons Road and Ardlie Street.	Buildings impacted by above floor <b>localised stormwater flooding</b> : 1 Monterey Court, 102 Ardlie Street, 135 Wangoom Road.	Broomfield Street 0.18m Queens Road depth 0.27m Wangoom Road depth 0m Whites Road depth 0.09m Hayley Drive depth 0m Breton Street depth 0m Evelyn Crescent depth 0m Garden Street depth 0.27m	In addition to actions listed above; Victoria Police, consider evacuating houses at risk of isolation in Queens Road and Garden Street as needed, access to houses may be cut by flooding. Council and Regional Roads Victoria deploy road closure signs and undertake traffic management as needed.
52 mm in 6 hours, 66.2 mm in 12 hours, 83 mm in 24 hours, 99.9 mm in 48 hours		20	3,655	69 (1)	One house is flooded above floor at 93 Wangoom Road. Flooding starts to impact the playground of the Warrnambool Goodstart Early Learning Kindergarten (121 Whites Road) starts to be impacted by flooding, depth 0.14 m. Deep flooding may cut access to Broomfield Street, Evelyn Crescent and Moonah Street.	One house may be flooded above floor at 93 Wangoom Road.	Broomfield Street 0.22m Queens Road depth 0.32m Wangoom Road depth 0m Whites Road depth 0.11m Hayley Drive depth 0m Breton Street depth 0m Evelyn Crescent depth 0.30m Garden Street depth 0.41m	In addition to actions listed above; Victoria Police, consider evacuating houses at risk of isolation in Broomfield Street, Evelyn Crescent and Moonah Street as needed, access to houses may be cut by flooding, they may be isolated. VICSES assist 93 Wangoom Road sandbag or raise furniture as needed.
63.8 mm in 6 hours, 82.1 mm in 12 hours, 103.8 mm in 24 hours, 124.1 mm in 48 hours		50	4,864	99 (5)	Four additional buildings are flooded above floor in Wangoom Road and Whites Road.	Four additional buildings may be flooded above floor: x3 Wangoom Road (85, 107, 115) and 147 Whites Road.	Broomfield Street 0.47m Queens Road depth 0.39m Wangoom Road depth 0m Whites Road depth 0.17m Hayley Drive depth 0m Breton Street depth 0.03m Evelyn Crescent depth 0.36m Garden Street depth 0.54m	In addition to actions listed above; VICSES assist sandbagging or raise furniture as needed.
73.5 mm in 6 hours, 95.7 mm in 12 hours, 122 mm in 24 hours, 145.2 mm in 48 hours		100	6,005	205 (14)	Nine additional houses are flooded above floor in Wangoom Road, Whites Road, Ian Road, Glenbane Court and Moonah Street. Flooding overtops Wangoom Road, flood depth 0.11m. Deep flooding may cut access to Breton Street. While access is not cut to Mortlake Road, access is cut to adjacent council roads, depth 0.33m	Nine additional houses may be flooded above floor: 111 Wangoom Road, x3 Whites Road (125, 127, 143), 80 Ian Road, 3 Glenbane Court, x3 Moonah Street (33, 35, 2/53).	Broomfield Street 0.76m Queens Road depth 0.48m Wangoom Road depth 0.11m Whites Road depth 0.19m Hayley Drive depth 0m Breton Street depth 0.27m Evelyn Crescent depth 0.59m Garden Street depth 0.64m	In addition to actions listed above; Council close Wangoom Road, access is not cut but high velocities may cause risk to motorists and pedestrians. Victoria Police, consider evacuating houses at risk of isolation in Breton Street as needed, access to houses may be cut by flooding, they may be isolated.
		200	8,110	369 (18)	Four additional buildings are flooded above floor in Garden Street, Breton Street and Hayley Drive. Flooding may impact properties surrounding Hayley Drive, including Gallo Bakery (84 Mortlake Road), Northpoint Coles (70 Mortlake Road), Northpoint Liquor Barn (82 Mortlake Road), Direct Chemist Outlet (72 Mortlake Road), and Brumby's Warrnambool (70 Mortlake Road). Flood depth up to 0.6m. Deep flooding may cut access to Whites Road.	Four additional buildings may be flooded above floor: Houses at 23 Garden Street and 3 Breton Street. Commercial buildings at: 43 – 45 Hayley Drive and 64 Hayley Drive.	Broomfield Street 0.94m Queens Road depth 0.54m Wangoom Road depth 0.17m Whites Road depth 0.23m Hayley Drive depth 0.62m Breton Street depth 0.59m Evelyn Crescent depth 0.72m Garden Street depth 0.75m	In addition to actions listed above; Victoria Police, consider evacuating houses at risk of isolation in Whites Road as needed, access to houses may be cut by flooding, they may be isolated.



### Table 6. Warrnambool Property Inundation Table (Water Technology 2017)

Colours used in the table below are the same used in the Warrnambool flood risk maps above. Yellow, buildings flooded above floor in a 1 in 10 year AEP. Blue, buildings flooded above floor in a 1 in 20 year AEP flood event, etc.

No	Address	Depth of building over floor flooding for each AEP (1 in year) event (m)				Type of building
		20	50	100	200	
1	93 WANGOOM ROAD, WARRNAMBOOL	0.115	0.376	0.108	0.175	House
2	85 WANGOOM ROAD, WARRNAMBOOL		0.184	0.081	0.27	House
3	115 WANGOOM ROAD, WARRNAMBOOL		0.061	0.05	0.148	House
4	107 WANGOOM ROAD, WARRNAMBOOL		0.03	0.046	0.186	House
5	147 WHITES ROAD, WARRNAMBOOL		0.068	0.026	0.14	House
6	127 WHITES ROAD, WARRNAMBOOL			0.012	0.06	House
7	111 WANGOOM ROAD, WARRNAMBOOL			0.001	0.156	House
8	80 IAN ROAD, WARRNAMBOOL			0.561	0.028	House
9	143 WHITES ROAD, WARRNAMBOOL			0.369	0.019	House
10	33 MOONAH STREET, WARRNAMBOOL			0.246	0.037	House
11	3 GLENBANE COURT, WARRNAMBOOL			0.215	0.008	House
12	35 MOONAH STREET, WARRNAMBOOL			0.19	0.628	House
13	2/53 MOONAH STREET, WARRNAMBOOL			0.151	0.435	Unit
14	125 WHITES ROAD, WARRNAMBOOL			0.108	0.314	House
15	23 GARDEN STREET, WARRNAMBOOL				0.281	House
16	3 BRETON STREET, WARRNAMBOOL				0.307	House
17	43-45 HAYLEY DRIVE, WARRNAMBOOL				0.357	Commercial buildings
18	64 HAYLEY DRIVE, WARRNAMBOOL				0.175	Commercial building

## Appendix C2: Warrnambool (Merri River) Flood Emergency Plan

Riverine flooding within the Merri River catchment has caused extensive and frequent impacts to Warrnambool, Dennington, Yangery, Woodford, Woolsthorpe and Bushfield. The upper reaches of the Merri River catchment drains the eastern section of Mount Rouse and flows south through Woolsthorpe, Mailors Flat, Grassmere, Woodford, Bushfield, Dennington and Warrnambool before it discharges to the sea at Stingray Bay. Refer to the waterway map below. The catchment area of Merri River is approximately 1,050 km<sup>2</sup>. The northern section of the Merri River catchment is named Spring Creek, it then becomes the Merri River south of Winslow. The main tributaries of the Merri River include Drysdale Creek, Yangery Creek, Gipsys Creek and Russells Creek. The Merri River receives inflows from Russells Creek and Yangery Creek downstream of Woodford. The Merri River floodplain is well defined up to the Dennington Bridge. From there the river breaks out to the east discharging to the sea at Stingray Bay, and the west inundating Kelly Swamp along with areas adjacent to the Merri River Cutting (Rutledges Cutting), the second opening to the sea.

The October 2020 flood event was the largest recent flood event recorded in Warrnambool and the surrounding Merri River catchment, a 1 in 40 year flood. This event caused considerable damages to buildings, roads, bridges and other infrastructure not only in Warrnambool, but also in Yangery, Woodford, Mailors Flat, Winslow, Grassmere, Woolsthorpe, Bushfield and Dennington. More than 10 buildings were impacted by flooding north of Warrnambool in Dennington, Yangery, Woodford, Mailors Flat, Winslow and Bushfield. More than 18 buildings were impacted by flooding in Warrnambool. The Woodford Primary School was closed due to flooding impacting the schools buildings and surrounding roads. Several sheds in the Mervue Estate were flooded above floor. Farmers north of Warrnambool along the Merri River catchment were significantly impacted by flooding, damaging infrastructure, washing fences away and impacting farmland.

Minor and major roads were impacted by flooding within and surrounding Warrnambool, these include Grassmere Road, Arlie Street, Broomfield Street, Wollaston Road, Tower Hill Road, Dooley Street, Younger Street, Morse Street, Denman Drive, Obrien Street, Mervue Court, Wellington Street, Northcote Drive, Landmann Street, Wilson Street, Braithwaite Street, and Farnham Road. Deep flooding cut access to Grassmere Road, Arlie Street, Broomfield Street, Queen Street and Wollaston Road.

There is one stream gauge along the Merri River at Woodford that provides flood warning for Warrnambool. The estimated travel time between heavy rainfall in the upper Merri River catchment to the flood peak arriving at the Woodford gauge can vary between 20 to 30 hours. The flood peak travel time between heavy rainfall in the upper catchment to steep rise in streamflow in Warrnambool can vary between 25 to 35 hours.

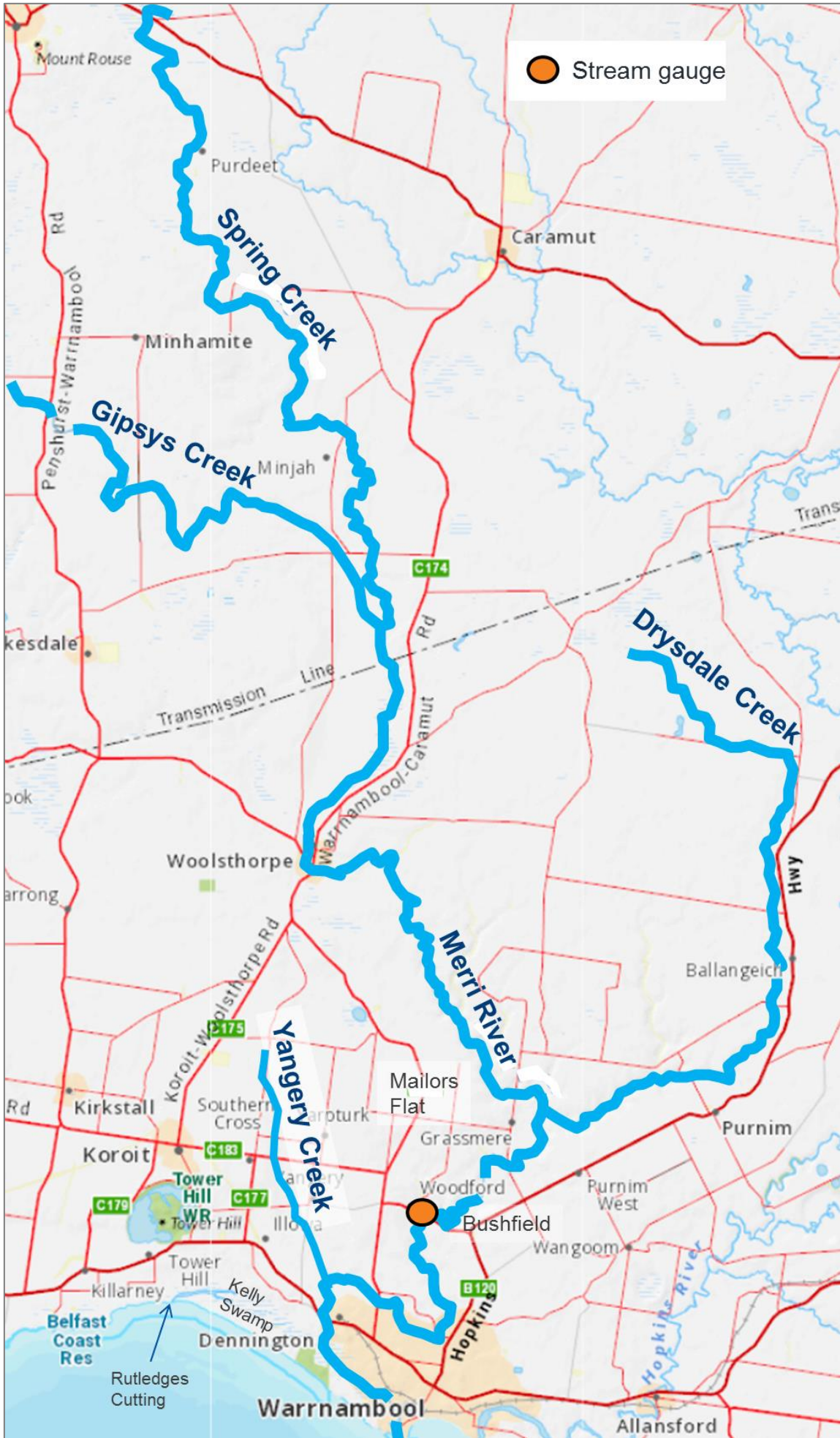


Figure 22. Warrnambool waterways and stream gauges.

## Historic Riverine Floods

Stream gauge records indicate that Warrnambool has experienced frequent flooding from the Merri River since the early 1960's, refer to graph below. The largest recent flood event on record was in 2020, refer to flood photos below. Warrnambool has experienced flooding from the Merri River in 1946, 1966, 1971, 1975, 1977, 1978, 1984, 1992, 1996, 1971, 1975, 1977, 1978, 1984, 1992, 1996, 2001, 2004, 2010, 2012, 2016 and 2020.

The Woodford stream gauge, 5 km north of Warrnambool was used to indicate historic flood events that have occurred along the Merri River, in Warrnambool.

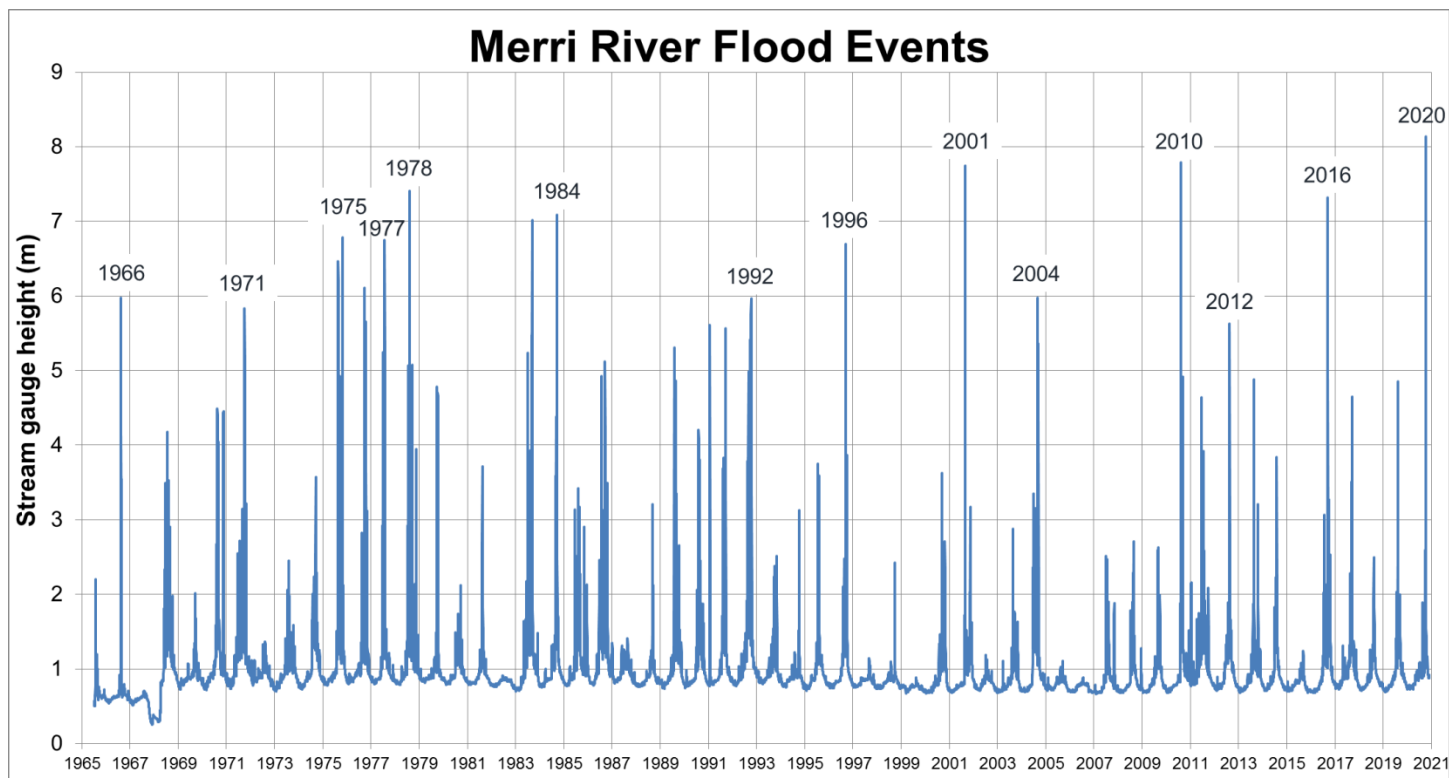


Figure 23. Merri River historic flood events in Warrnambool.

## 1946 flood event

This flood event was described as a catastrophic flood event, estimated to be in the order of 1 in 500 AEP or larger flood (Utilis, 2018). Warrnambool recorded 228 mm over two days. This flood caused seven deaths and caused thousands of people to be homeless. Farmers experienced extensive stock and crop losses. Seven bridges were damaged and three bridges were swept away including the Woodford Bridge and Cassidy's Bridge (Warrnambool Historical Society). A significant number of houses were flooded, refer to photos below.



Figure 24. Woodford Post Office impacted by flooding during the 1946 flood event.



Figure 25. Flooding impacting a house near the Botanical Gardens, Cox's House during the 1946 flood event.



Figure 26. Flooding impacting a house in Broomfield Street during the 1946 flood event.

## October 2020 flood event

The October 2020 flood was Warrnambool's largest recent flood event on record, estimated to be 40 year AEP event. This estimate is based on peak stream gauge board height measurements and a flood extent survey undertaken adjacent to Daltons Road by the Glenelg Hopkins CMA. Significant flooding in the Merri River back flowed along Russells Creek increasing the flood depth along roads and properties up to Mortlake Road.

Warrnambool recorded 80mm on the 8<sup>th</sup> of October, 56mm falling in 3 hours. A Woolsthorpe farmer recorded more than 140mm of rain over 5 days. Significant flooding occurred in Warrnambool and north of Warrnambool along the Merri River floodplain between the 8th and 11th of October 2020.

The October 2020 flood event was the largest recent flood event recorded in Warrnambool, refer to the flood photos below. This event caused considerable damages to buildings, roads, bridges and other infrastructure not only in Warrnambool, but also in Mailors Flat, Winslow, Yangery, Woodford, Woolsthorpe, Winslow, Grassmere, Bushfield and Dennington. More than 10 buildings were impacted by flooding north of Warrnambool in Dennington, Yangery, Woodford, Mailors Flat, Winslow and Bushfield. More than 18 buildings were impacted by flooding in Warrnambool. Refer to maps and photos below showing buildings impacted. Several sheds and pools (causing pools to pop out of the ground) in the Mervue Estate were flooded above floor, no houses were impacted.

Farmers north of Warrnambool along the Merri River floodplain were significantly impacted by flooding, damaging infrastructure, washing fences away and impacting farmland.

On Thursday the 8<sup>th</sup> of October flooding rose around the Woodford Primary School. The school was closed on Friday the 9<sup>th</sup> of October due to flooding impacting the schools buildings and surrounding roads. Deep flooding impacted the schools ovals, tennis courts, playgrounds, and fences. Floodwater damaged the schools storage pumps, shutting off their water supply.



Figure 27. Merri River flooding impacting the Woodford Primary School oval during the October 2020 flood event.

Minor and major roads were impacted by flooding within and surrounding Warrnambool, these include Grassmere Road, Arlie Street, Broomfield Street, Wollaston Road, Tower Hill Road, Dooley Street, Younger Street, Morse Street, Denman Drive, Obrien Street, Mervue Court, Wellington Street, Northcote Drive, Landmann Street, Wilson Street, Braithwaite Street, and Farnham Road. Deep flooding cut access to Grassmere Road, Arlie Street, Broomfield Street, Queen Street and Wollaston Road. For more details regarding flood impacts refer to the Warrnambool Flood Intelligence Card below.

Emergency mitigation works were undertaken at the Midfield Meat Rendering Plant at Levy's Point, Swinton Street. A section of the levee protecting the Midfield Meat Plant from flooding collapsed. A helicopter dropped large sandbags to reconstruct the collapsed section of the levee. Refer to the photos below of flood mitigation works undertaken and a map of the levee location. If the Midfield Meat Rendering Plant levee does not fail, the levee protection level may be up to a 1 in 100 year flood event.



Figure 28. Flooding impacting the Midfield Meat Rendering Plant during the October 2020 event.



Figure 29. A helicopter dropped large sandbags to reconstruct the collapsed section of the Midfield Meat Rendering Plant levee.

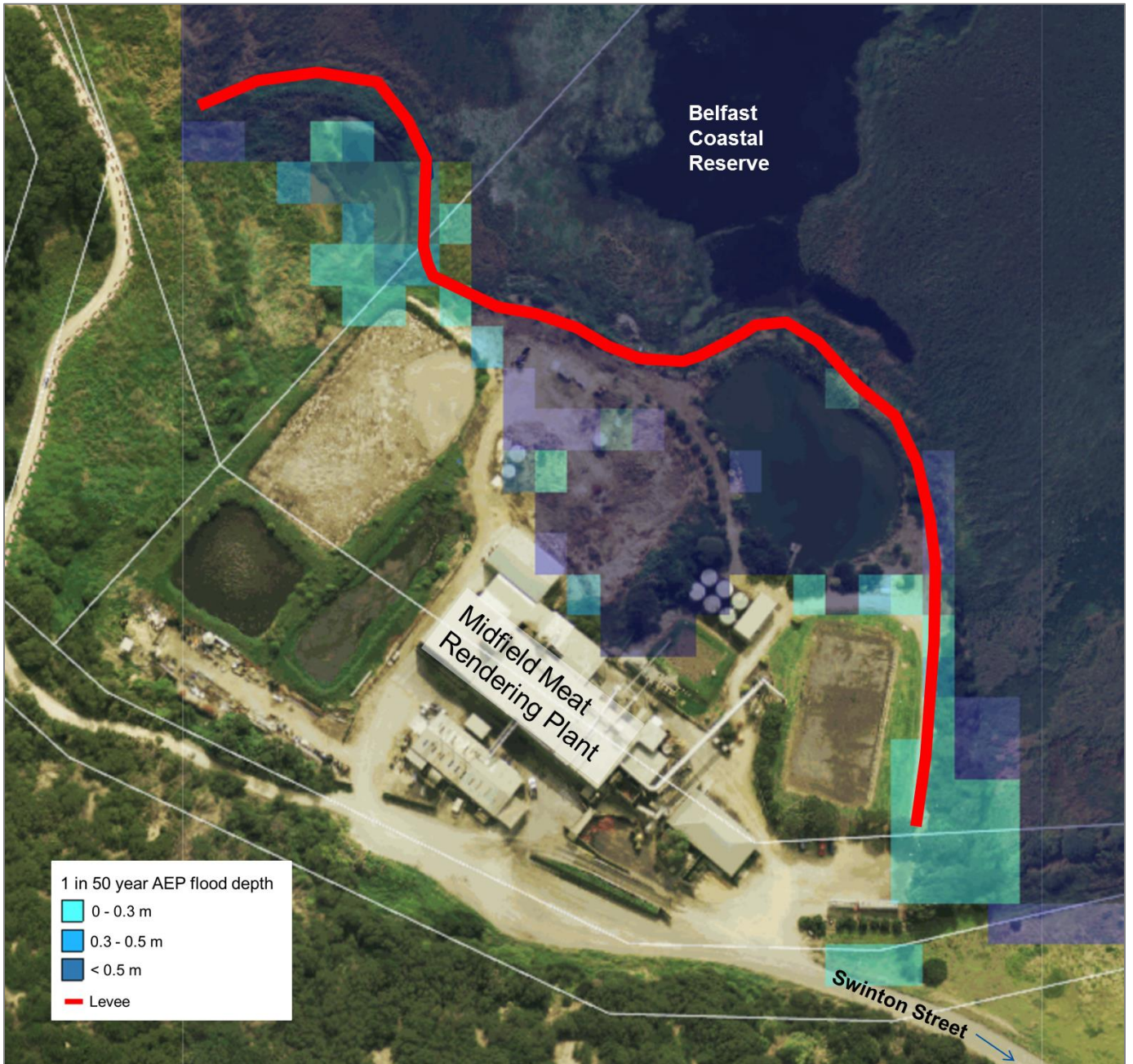


Figure 30. Midfield Meat Rendering Plant flood risk during a 1 in 50 year flood event (Water Technology 2007).



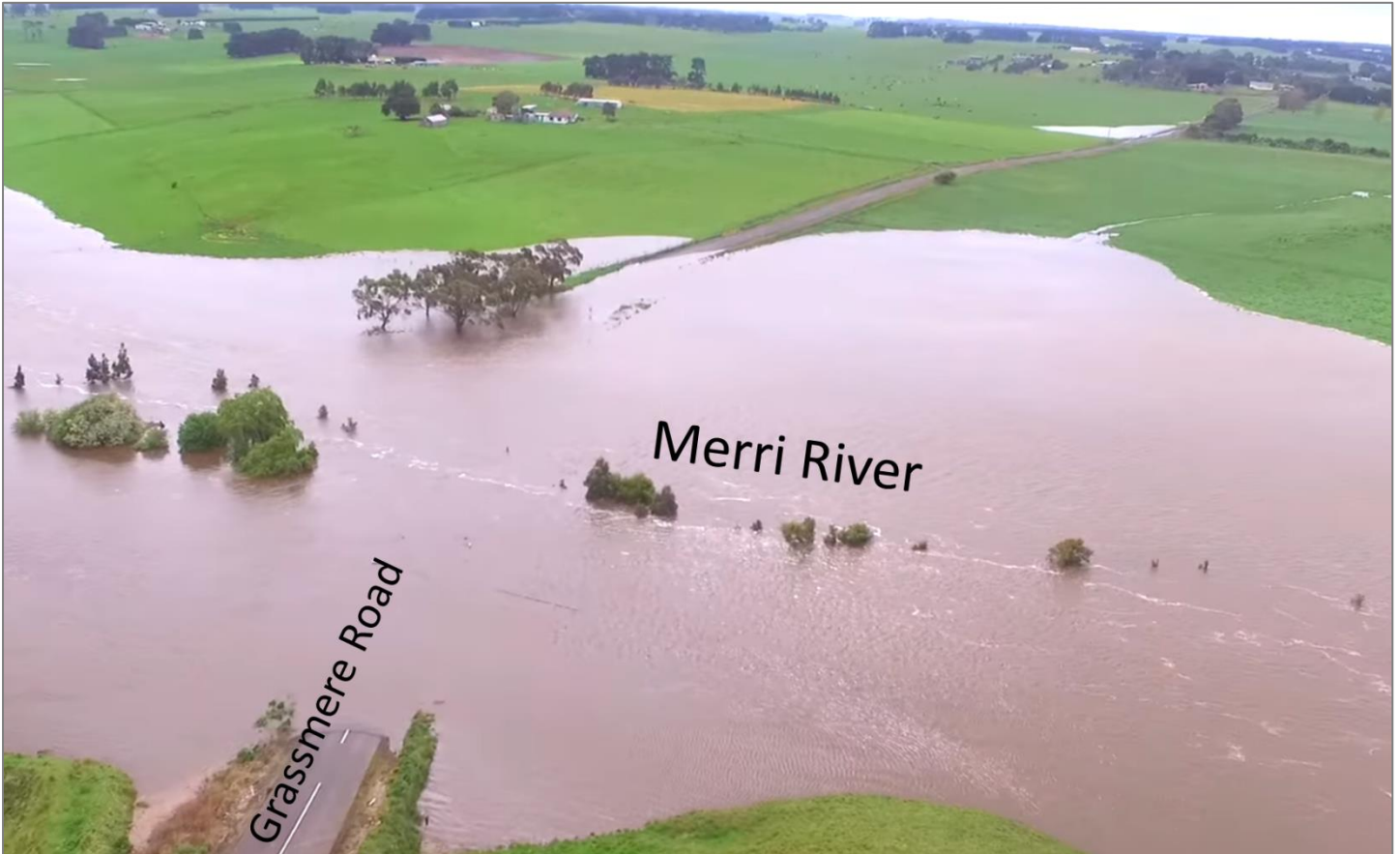


Figure 31. Merri River flooding cutting access along Grassmere Road, Grassmere during the October 2020 flood event.



Flooding impacted a house at 6 Morse Road during the October 2020 event.



Figure 32. Flooding impacting the St Joseph's Primary School in Bromfield Street, Warrnambool during the October 2020 flood event (VICSES Warrnambool Unit).



Figure 33. Russells Creek flooding impacting Ardlie Street, Warrnambool during the October 2020 flood event (FMP).



Figure 34. Flooding impacting the Ardlie Street, Warrnambool during the October 2020 flood event.



Figure 35. Flooding impacting Ardlie Street, Warrnambool during the October 2020 flood event.



Figure 36. Flooding impacting the Bromfield Street, Warrnambool during the October 2020 flood event.

Anecdotal information collected during historic flood events was also used to determine assets at risk of flooding. Flood damages recorded in the VICSES Request of Assistance Database during the October 2020 flood event show there were a significant number of buildings impacted by flooding in Warrnambool, Woodford, Woolstrophe, Winslow, within the Yangery Creek catchment, Grassmere, Bushfield and Mailors Flat.

There is no flood risk mapping for a large part of the Merri River catchment area, there is only flood risk mapping available for Merri River downstream of Woodend Road as part of the South Warrnambool and Dennington Flood Studies (Water Technology, 2007). Given this, anecdotal information collected during the October 2020 flood can be used as a guide to indicate buildings that may be at risk of flooding during future flood events. This anecdotal building damage information only indicates buildings that may be at risk of above floor flooding, some of these buildings may have been impacted by localised runoff (not riverine flooding). It's important to note this anecdotal information has a low level of accuracy and should be used as a guide only. For maps and tables that indicate buildings impacted by flooding during the October 2020 event, refer to table 9 and figures 44 to 46 below.

## Influence of the Merri River Estuary

The Merri River discharges to the ocean at two locations. Downstream of the Dennington Bridge the Merri River flows to the east via the Merri River cutting and discharges to the sea at Stingray Bay. The Merri River also flows to the west inundating Kelly Swamp along with areas adjacent to the western discharge point at Rutledges Cutting which is situated south of Tower Hill. The storage and flood attenuation function of this area is not well understood.

While the Merri River mouth at Stingray Bay does not regularly close, the river mouth at the Rutledges Cutting closes frequently due to the natural formation of a sandbar. This typically occurs during low river flow conditions and can result in “dry weather” inundation of some farmland neighbouring the estuarine wetlands. Parks Victoria is the responsible land manager for Rutledges Cutting and undertakes artificial openings of the estuary mouth at this location to alleviate this inundation. This is done according to strict conditions under an approval granted by Glenelg Hopkins CMA when artificial opening conditions are deemed safe, appropriate and effective. The approval conditions are designed to minimise environmental impact caused by the artificial opening, which includes the risk of mass death of aquatic organisms due to the rapid loss of oxygenated water from the wetlands to the ocean.

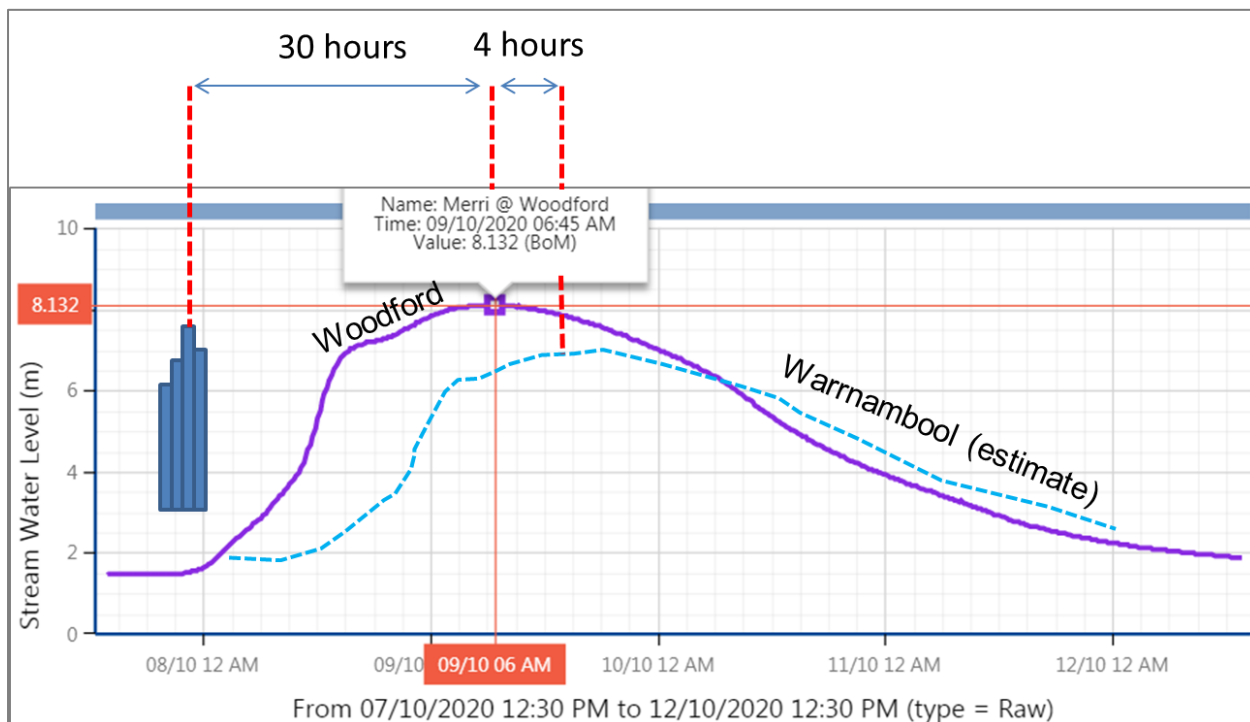
The Glenelg Hopkins CMAs records show that Rutledges Cutting generally opens naturally as a consequence of significant flood water flows from the Merri River.

In the event that Rutledge’s Cutting does not open naturally during a significant flood event and there is an impending risk of overfloor flooding of dwellings or damage to significant infrastructure, then Glenelg Hopkins CMA should be contacted for approval and advice with regard to conduct of emergency works to artificially open the river mouth at Rutledges Cutting.

## Flood Travel Time

There is one stream gauge along the Merri River at Woodford that provides flood warning for Warrnambool. The estimated travel time between heavy rainfall in the upper Merri River catchment to the flood peak arriving at the Woodford gauge can vary between 18 to 30 hours. The flood peak travel time between heavy rainfall in the upper catchment to steep rise in streamflow in Warrnambool can vary between 22 to 34 hours. Given there are no stream gauges in Warrnambool, the travel time between the Woodford gauge and Warrnambool was estimating using monitoring undertaken during the October 2020 flood event and results from flood investigations (Utilis, 2018).

Heavy rainfall occurred in the upper Merri River catchment approximately midnight on the 7<sup>th</sup> of October. The Woodford gauge recorded stream rises from early on the 8<sup>th</sup> of October until the stream gauge peaked at 8.13m at 6:45am on the 9<sup>th</sup> of October. A significant number of VICSES requests for assistance in Warrnambool occurred at the same time as the Woodford gauge peak indicating there were steep rises in the Merri River flood levels at the same time. The Warrnambool flood levels are estimated to have peaked by midday on the 9<sup>th</sup> of October. Refer to the graph below.



## Tide Influence

During flood events high tides reduce the rate that floodwater flows out of the Merri River into ocean. High tides may extend the duration of flooding in Warrnambool. However, low tides can increase the rate of floodwater flow into the ocean. It's important to monitor the tides during flood events to assess the likely influence on the duration of flooding in Warrnambool.

## Storm Tide Flooding

Flooding of an estuary is caused by high river flows not being able to flow into the sea due to high tides or storm tides. Estuarine flooding is known to occur in Warrnambool along the Merri River.

Storm tide flooding impacted the Merri River Estuary on the 24<sup>th</sup> of June 2014 event. Storm tide flood events occur when low atmospheric depressions (sea levels can rise significantly above high astronomical tide (HAT)) are combined with strong onshore winds. Storm tide flooding infrequently occurs in Warrnambool along the Merri River Estuary, the Breakwater Pier adjacent to Viaduct Road and the Pavilion Café. This flood event inundated more than 35 properties along the Merri River Estuary. One house at 8 Ferrier Drive was flooded above floor. Several buildings were flooded below floor, these include buildings in Stanley Street, Edina Street, MacDonald Street, Elliott Street and Ferrier Drive. Refer to the flood photos and map below.



Figure 37. Storm surge event impacting the Breakwater Pier during the October 2014 event (ABC website).



Figure 38. Storm tide flooding cut access to MacDonald Street during the 2014 event.



Figure 39. Storm tide flooding park land adjacent to Stanley Street during the 2014 flood event.



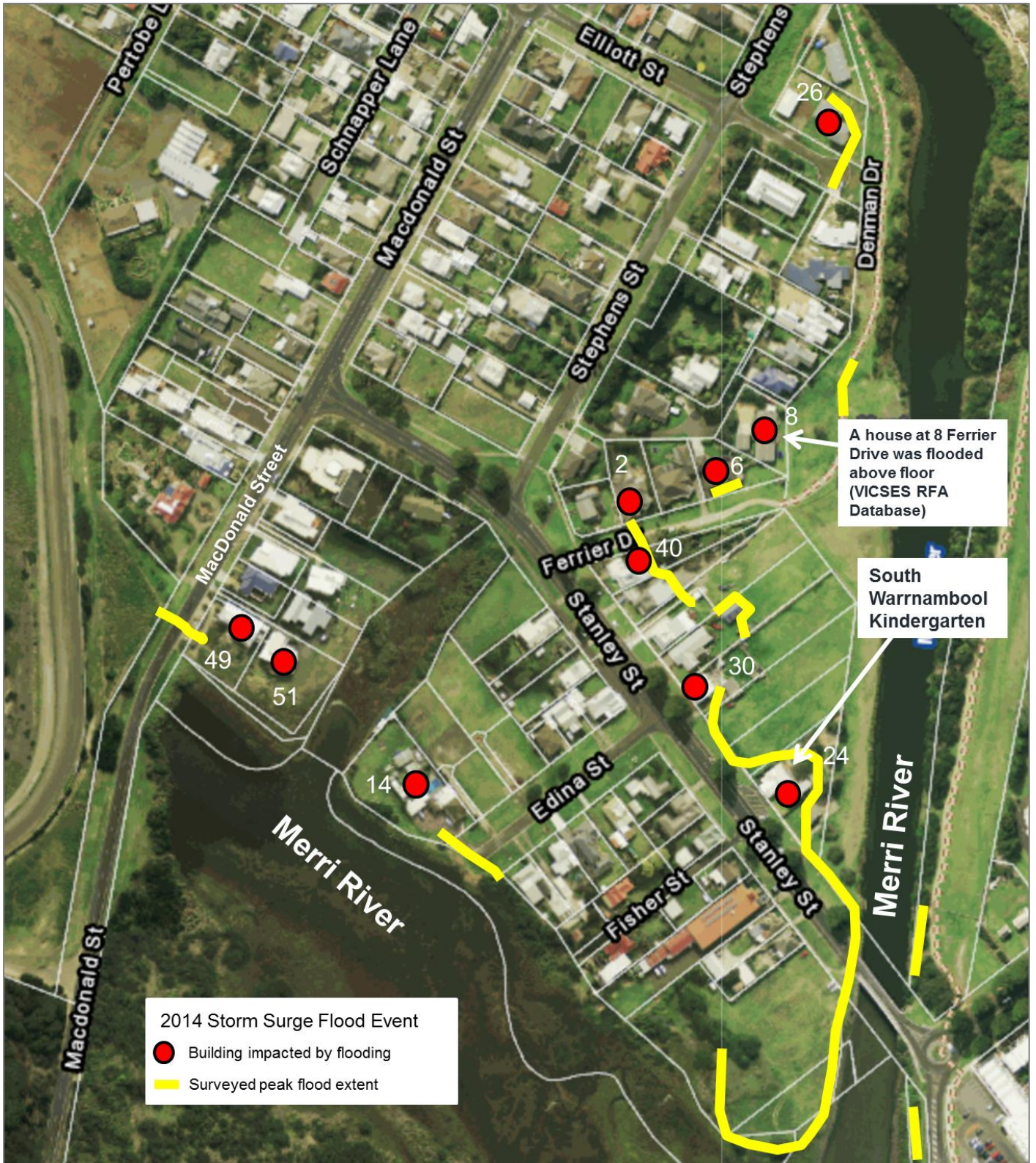


Figure 40. Area impacted by storm tide flooding along the Merri River Estuary during the June 2014 event (Glenelg Hopkins CMA).



Figure 41. Buildings along MacDonald Street impacted by storm tide flooding during the June 2014 event.



Figure 42. Buildings adjacent to the Merri River impacted by storm tide flooding during the June 2014 event.



Figure 43. Buildings along MacDonald Street impacted by storm tide flooding during the 2004 event.

## Flood Impacts and Required Actions

Flood mapping from the South Warrnambool and Dennington Flood Studies (Water Technology, 2007) was used to estimate roads impacted by flooding. A building floor level survey wasn't undertaken as part of these Flood Studies to indicate what buildings are at risk of flooding. There is limited flood risk mapping for a large part of the Merri River catchment area, flood risk mapping is only available for Merri River downstream of Woodend Road. Given this, anecdotal information was used to determine assets at risk of flooding. Flood damages recorded in the VICSES Request for Assistance Database and from other sources during the October 2020 flood event show there were a significant number of buildings impacted by flooding in Warrnambool, Woodford, Woolsthrope, within the Yangery Creek catchment, Winslow, Grassmere, Bushfield and Mailors Flat. This anecdotal building damage information only indicates buildings that may be at risk of above floor flooding, some of these buildings may have been impacted by localised runoff (not riverine flooding). It's important to note this anecdotal information has a low level of accuracy and should be used as a guide only. Refer to the maps and tables that indicate buildings impacted during the October 2020 flood event, table 9 and figures 44 to 46.

For additional flood risk information refer to the Warrnambool Flood Intelligence Card, table and maps below.

Key assets at risk of flooding in Warrnambool are listed below.

Table 7. Key assets at risk of flooding.

<b>Asset register</b>				
<b>Asset Name and location</b>	<b>Annual Exceedance Probability (1 in year)</b>	<b>Consequence / Impact</b>	<b>Mitigation/ Action</b>	<b>Lead Agency</b>
<b>Farnham Road, along Yangery Creek, north of Warrnambool.</b>	5 year flood	Deep flooding greater than 0.30m depth may cut access to Farnham Road, during a 5 year flood event.	Deploy road closure signs as needed.	Council
<b>Midfield Meat Rendering Plant, at Levy's Point, along Swinton Street, Warrnambool.</b>	10 year flood	The Midfield Meat Rendering Plant may be at risk of flooding if the levee to the east of the Plant fails. If the levee doesn't fail, it may provide flood protection up to a 100 year flood.	If the levee fails, reconstruct the collapsed section of the levee using a helicopter to drop large sandbags.	Midfield Meat Rendering Plant Owners
<b>South Warrnambool Kindergarten, 24 Stanley Street, Warrnambool.</b>	10 year flood	Property surrounding the Stanley Street Kindergarten may start to be impacted by flooding during a 10 year flood event.	Evacuate the Stanley Street Kindergarten as needed.	Victoria Police.
<b>Braithwaite Street, Warrnambool.</b>	10 year flood	Deep flooding above 0.34m depth may cut access to Braithwaite Street, during a 10 year flood event.	Deploy road closure signs as needed.	Council
<b>Northcote Drive and Younger Street, Warrnambool.</b>	20 year flood	Deep flooding greater than 0.35m depth may cut access to Northcote Drive and Younger Street, during a 20 year flood event.	Deploy road closure signs as needed.	Council
<b>Woodford Primary School, 8 Victoria Street, Woodford.</b>	40 year flood (estimate, no accurate flood mapping)	Flooding caused minor flooding Woodford Primary School to a few buildings, ovals, roads, footpaths.	Close the school to students until flooding subsides.	Woodford Primary School Principle
<b>Wollaston Road, adjacent to St James Park, northern side of Warrnambool.</b>	40 year flood (estimate, no accurate flood mapping)	Deep flooding greater than 0.30m depth may cut access to Wollaston Road, during a 20 year flood event.	Deploy road closure signs as needed.	Council
<b>Morse Street, Warrnambool.</b>	50 year flood	Deep flooding greater than 0.29m depth may cut access to Morse Street, during a 20 year flood event.	Deploy road closure signs as needed.	Council
<b>Denman Drive, Warrnambool.</b>	100 year flood	Deep flooding greater than 0.24m depth may cut access to Denman Drive, during a 100 year flood event.	Deploy road closure signs as needed.	Council

For more detailed information regarding buildings and roads impacted refer to the Warrnambool Flood Intelligence Card (Merri River) and flood impact maps below. Also refer to the Warrnambool flood depth maps in **Appendix E**, a list of flood observers in **Appendix F** and community sandbag collection points in **Appendix H**.



Figure 44. Buildings within the Merri River catchment impacted by flooding during October 2020 event (VICSES Request for Assistance Database).



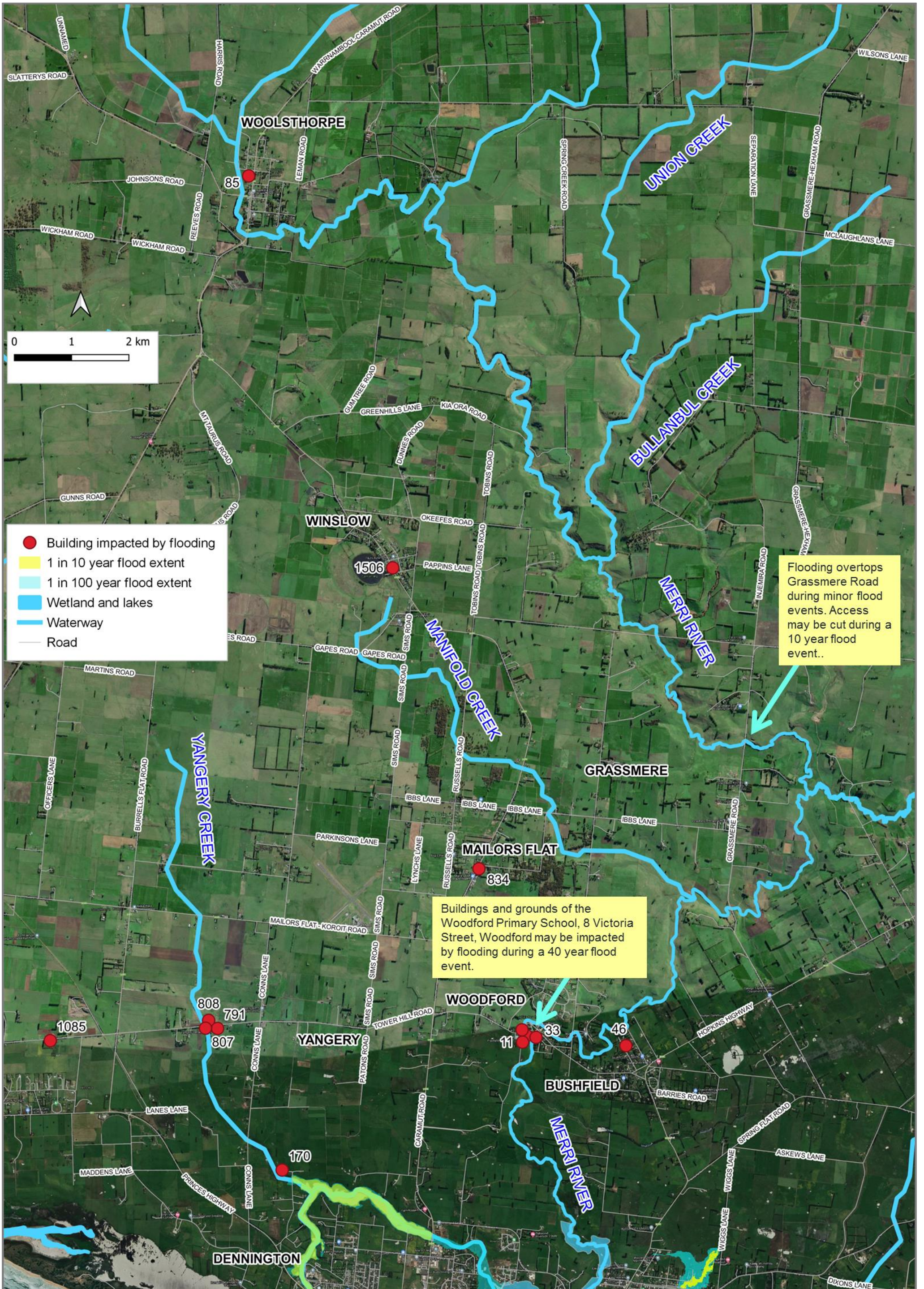


Figure 46. Buildings within the Merri River catchment impacted by flooding during October 2020 event (VICSES Request for Assistance Database).



Figure 47. Warrnambool and Merri River catchment roads impacted by flooding for a range of design and historic flood events (Water Technology 2007).



**Table 8. Warrnambool Flood Intelligence Card (Merri River)**

Flood travel time					Time from start of rain to flood peak at the Woodford gauge 20 - 30 hours	Time from start rainfall to steep rise in floodwater in Warrnambool 25 - 35 hours	Riverine flooding duration: 1 - 2 days
Merri River at Woodford gauge height 236205 (m)	Merri River at Dennington Design Flows (ML/d)	Annual Exceedance Probability (1 in year)	Merri River Catchment damages total number properties flooded (above floor)	Consequences/ Impacts	Buildings flooded / isolated	Roads Impacted	Action
4.13	4,740	2					
4.59		September 2017					
5.91		August 2004					
6.11	9,180	5	17 (?)	Floodwater is largely within the banks of the north Warrnambool and Dennington floodplain. Low lying crossings and farmland may be impacted by flooding. Flooding may cut access to Farnham Road and Grassmere Road (estimated no mapping available). Flooding from the Merri River may back up along Russells Creek up to Mortlake Road, raising flood levels along adjacent properties and roads.		Farnham Road depth 0.31m Braithwaite Street depth 0 Denman Drive depth 0m Younger Street depth 0m Morse Street depth 0m Northcote Drive depth 0m	VICSES advise agencies that flood warning may be issued for minor flooding. Council monitor culverts and drains to check for debris build up, clear debris from waterway crossings and culverts as needed. Council deploy road closure signs as needed.
7.19	14,500	10	51 (?)	Property sounding the Warrnambool Motorbike Club, Stanley Street Kindergarten and the Salt March Gallery/Café may be impacted by flooding. Flooding may cut access to Braithwaite Street. If the Midfield Meat Rendering Plant at Levy's Point (at the end of Swinton Street) levee fails, the Plant may be impacted by flooding.	Access is cut to a building at 64 Northcote Drive.	Farnham Road depth 0.49m Braithwaite Street depth 0.34m Denman Drive depth 0.08m Younger Street depth 0.19m Morse Street depth 0m Northcote Drive depth 0.23m	In addition to actions listed above: VICSES notify the South Warrnambool Kindergarten managers flooding may occur. VICSES let Midfield Meat Rendering Plant owners know flooding may occur.
7.26		September 2016					
7.55	18,400	20	93 (?)	Flooding may cut access to Younger Street and Northcote Drive.		Farnham Road depth 0.76m Braithwaite Street depth 0.50m Denman Drive depth 0.12m Younger Street depth 0.35m Morse Street depth 0.08m Northcote Drive depth 0.38m	Refer to actions listed above.
7.74		August 2010					
8.14	27,060	October 2020 40		This flood event caused considerable damage to buildings, roads, bridges, farmland and other infrastructure not only in Warrnambool, but also in Yangery, Woodford, Grassmere, Woolsthorpe, Winslow, Mailors Flat, Bushfield and Dennington. More than 10 buildings were impacted by flooding in towns north of Warrnambool. More than 18 buildings were impacted by flooding in Warrnambool. Buildings impacted by flooding include; 6 Moore Road, residents were evacuated. The grounds and buildings at the Woodford Primary School (8 Victoria Street) were impacted by flooding, the school was closed for a day. A section of the Midfield Meat Rendering Plant level (Levy's Point at the end of Swinton Street) levee failed, but a helicopter dropped large sandbags to reconstruct the collapsed section of the levee. A house at 170 Franham Road may be isolated due to access being cut along Farnham Road, flood depth greater than 0.76m. Flooding impacted more than 93 properties. Sheds were flooded above floor in Mervue Estate (corner of Younger Street and Mervue Court). Farmers north of Warrnambool, flooding impacted farmland and washed away fences and damaging other infrastructure.	Buildings impacted by flooding (VICSES Request for Assistance database) some of these houses may have been impacted by localised flooding; <b>Yangery Creek catchment:</b> 170 Franham Road, 808 Tower Hill Road, 807 Tower Hill Road, 791 Tower Hill Road, 1085 Tower Hill Road. <b>Woodford:</b> Woodford Primary School (8 Victoria Street), 224 Bridge Road, 233 Bridge Road, 11 Mill Street. <b>Mailors Flat:</b> 834 Warrnambool-Caramut Road. <b>Woolsthorpe:</b> 85 Manifold Street. <b>Winslow:</b> 1506 Warrnambool-Caramut Rd. <b>Bushfield:</b> 46 Bellmans Road <b>Warrnambool:</b> 19 Pointing Drive, 28 Dooley Street, 8 Dooley Street, 102 Ardlie Street, 8 Denman Drive, 4 Mcgennan Street, 26 Mcgennan Street, 64 Northcote Drive, 1 Fairway Crescent, 21 Wellington Street, 13 Henry Street, 17 Henry Street, sheds in Mervue Estate (address unknown), Midfield Meat Rendering Plant (end of Swinton Street).		In addition to actions listed above: VICSES and council ensure sand and sandbags are available when needed. Woodford Primary School Principal may need to close the school until flooding subsides. Council deploy road closure signs as needed.

8.27	29,300	50	112 (?)	A section of the Midfield Meat Rendering Plant at Levy's Point (at the end of Swinton Street) levee failed. The levee was quickly secured with large sandbags to protect the Plant from flooding. A building at 6 Morse Road was impacted by flooding, residents were evacuated. Properties along the Merri River side of Dooley Street begin to be threatened by floodwater. Flooding may cut access to Morse Street.		Farnham Road depth 1.19m Braithwaite Street depth 0.73m Denman Drive depth 0.17m Younger Street depth 0.55m Morse Street depth 0.29m Northcote Drive depth 0.59m	Refer to actions listed above.
> 8.6	> 35,600	100	138 (?)	Dooley Street and Mortlake Road near Wollaston Road is impacted by flooding. All properties in the lower south Warrnambool area including Stanley Street, Edina Court and Denman Drive are impacted by significant flood depth and velocities. Flooding may cut access to Denman Drive.		Farnham Road depth 1.5m Braithwaite Street depth 0.90m Denman Drive depth 0.24m Younger Street depth 0.70m Morse Street depth 0.43m Northcote Drive depth 0.74m	In addition to actions listed above: Council and Regional Roads Victoria deploy road closure signs and undertake traffic management as needed.
> 8.6	> 35,600	200 March 1946	147 (?)				
8.55		500 March 1946		This flood event was described as a catastrophic flood event, estimated to be in the order of 1 in 500 ARI or larger flood (Utilis, 2018). Warrnambool recorded 228 mm over two days. This flood caused seven deaths and caused thousands of people to be homeless. Farmers experienced extensive stock and crop losses. Seven bridges were damaged and three bridges were swept away including the Woodford Bridge and Cassidy's Bridge (Warrnambool Historical Society). A significant number of houses were flooded.			Refer to actions listed above.

? A building floor level survey wasn't undertaken as part of the Dennington and South Warrnambool Flood Studies (Water Technology, 2007), the number of buildings subject to above floor flooding is unknown.

**Table 9. Warrnambool and Merri River Floodplain Property Flood Impact Table (VICSES Request for Assistance Database)**

Anecdotal information collected during the October 2020 flood event was used to indicate buildings at risk of flooding given no floor level survey has been undertaken within the Merri River catchment to indicate buildings at risk of flooding. Below is a list of buildings impacted by flooding, recorded in the VICSES Request for Assistance Database and other anecdotal sources during the October 2020 flood event. It's important to note the building damage information below only indicates buildings that may be at risk of above flood flooding and should be used as a guide only. Refer to the table below.

No	Address	Date	Time	Comments
1	8 Victoria Street, Woodford Primary School	08/10/2020	-	Flooding caused minor impact to buildings, and school grounds, the school was closed for a day.
2	834 Warrnambool-Caramut Road, Mailors Flat.	07/10/2020	21:27	Flooding threatening the house, requested sandbags.
3	46 Bellmans Road, Bushfield	07/10/2020	21:23	Flooding threatening the house, requested sandbags.
4	233 Bridge Road, Woodford	08/10/2020	17:07	Flooding threatening the house, requested sandbags.
5	244 Bridge Road, Woodford	08/10/2020	14:00	Flooding threatening the house, requested sandbags.
6	11 Mill Street, Woodford	9/10/2020	1:02	Flooding entering the house.
7	33 River Road, Woodford	9/10/2020	1:37	Flooding entering the house.
8	170 Farnham Road, Yangery	09/10/2020	14:10	Flooding entering the house. Assistance to move belongings.
9	808 Tower Hill Rd, Yangery	08/10/2020	9:28	Flooding entering the house.
10	791 Tower Hill Rd, Yangery	08/10/2020	7:06	Flooding entering the house.
11	807 Tower Hill Rd, Yangery	08/10/2020	8:40	Flooding entering the house.
12	1085 Tower Hill Rd, Koroit	08/10/2020	8:30	Flooding entering the house.
13	85 Manifold Street, Woolsthorpe, near Carmichael Street.	08/10/2020	1:48	Flooding entering the house.
14	2 Hopkins Point, Warrnambool	08/10/2020	17:50	Flooding threatening the house, requested sandbags.
15	1506 Warrnambool-Caramut Road, Winslow	08/10/2020	19:13	Flooding threatening the house, requested sandbags.
16	1 Monterey Court, Warrnambool	08/10/2020	2:03	Flooding threatening the house, requested sandbags.
17	28 Dooley Street, Warrnambool	9/10/2020	6:27	Flooding entering the house. Requested sandbags.
18	102 Ardlie Street, Warrnambool	9/10/2020	6:35	Flooding threatening the house, requested sandbags. VICSES called back at 8:55 when flooding entering the house.
19	6 Morse Street, Warrnambool	9/10/2020	7:17	Flooding threatening the house, requested sandbags.
20	8 Dooley Street, Warrnambool	9/10/2020	7:17	Flooding entering the house, requested sandbags.
21	13 Henry Street, Warrnambool	9/10/2020	9:12	Flooding threatening the house, requested sandbags.
22	19 Ponting Drive, Warrnambool	9/10/2020	10:20	Flooding entering the house.
23	1 Fairway Court, Warrnambool	9/10/2020	11:39	Flooding caused minor impact to buildings, and school grounds, the school was closed for a day.
24	4 Fairway Court, Warrnambool	9/10/2020	14:12	Flooding threatening the house, requested sandbags.

No	Address	Date	Time	Comments
25	17 Henry Street, Warrnambool	9/10/2020	11:44	Flooding threatening the house, requested sandbags.
26	4 McGennan Street, Warrnambool	9/10/2020	11:44	Flooding the house, requested sandbags. VICSESSES requested.
27	64 Northcote Drive, Warrnambool	9/10/2020	13:13	Flooding threatening the house, requested sandbags.
28	8 Stephens Street, Warrnambool	9/10/2020	13:13	Flooding threatening the house, requested sandbags.
29	21 Wellington Street, Warrnambool	9/10/2020	15:38	Flooding threatening the house, requested sandbags.
30	26 Elliott Street, Warrnambool	9/10/2020	16:13	Flooding entering the house.
31	Buildings in Mervue Estate (addresses unknown)	9/10/2020	-	New report identified that sheds were flooded above floor and pools damaged by flooding.
32	End of Swinton Street, Midfield Meat Rendering Plant	9/10/2020	-	Due to a section of the levee failing during the flood, there were minor flood impacts to buildings and infrastructure.

## Appendix C3: Allansford and the Lower Hopkins River Flood Emergency Plan

Allansford and buildings along the lower Hopkins River are frequently impacted by riverine flooding. Allansford is also impacted by stormwater flooding when heavy rainfall events occur. Allansford has experienced minor riverine flooding from the Hopkins River. In Warrnambool buildings located along the lower Hopkins River Estuary have been impacted by flooding when the Estuary intermittently closes due to the formation of a sandbar.

The upper reaches of the Hopkins River includes the Grampians National Park and the western upland areas around Ararat, and flows through Wickliffe, Hexham, Ellerslie, Hopkins Falls, Allansford before it discharges to the ocean. Refer to the map below. The catchment area of Hopkins River is approximately 7,374km<sup>2</sup>. The main tributary of the Hopkins River is Mt Emu Creek, joining the Hopkins River immediately upstream of Hopkins Falls. Other minor tributaries of the Hopkins River include Blind Creek, Salt Creek, Mustons Creek and Stony Creek.

The January 2011 flood event was the largest recent flood event recorded in Allansford, causing both stormwater and riverine flooding. This flood event caused considerable damages to buildings, roads, bridges and other infrastructure. Stormwater and riverine flooding impacted a number of buildings in Allansford. Flooding along the Hopkins River caused shallow flooding along one side of the Princes Highway. It was close to needing to be closed. Refer to flood photo below. The Allansford Bridge along Ziegler Parade (off the Princes Highway), west of Allansford was closed due to floodwater overtopping the bridge. Minor and major roads are impacted by flooding within and surrounding Allansford, these include Garabaldi Lane, Ziegler Parade, Frank Street, Station Street and Tooram Road. Downstream of Allansford the Proudfoots Restaurant and the Warrnambool Rowing Club (2 Simpson Street) buildings were impacted by over floor flooding

There are eight stream gauges along the Hopkins River and Mt Emu Creek that provide flood warning for Allansford and the lower Hopkins River, these include Ararat, Wickliffe, Framlingham, Hopkins Falls, Mena Park, Guthries, Skipton and Taroon. Refer to map below for the gauge locations. The estimated travel time between heavy rainfall in the upper Hopkins River catchment to steep rise in streamflow at Allansford varied between 1.5 to 2.7 days during the January 2011 and October 2020 flood events.

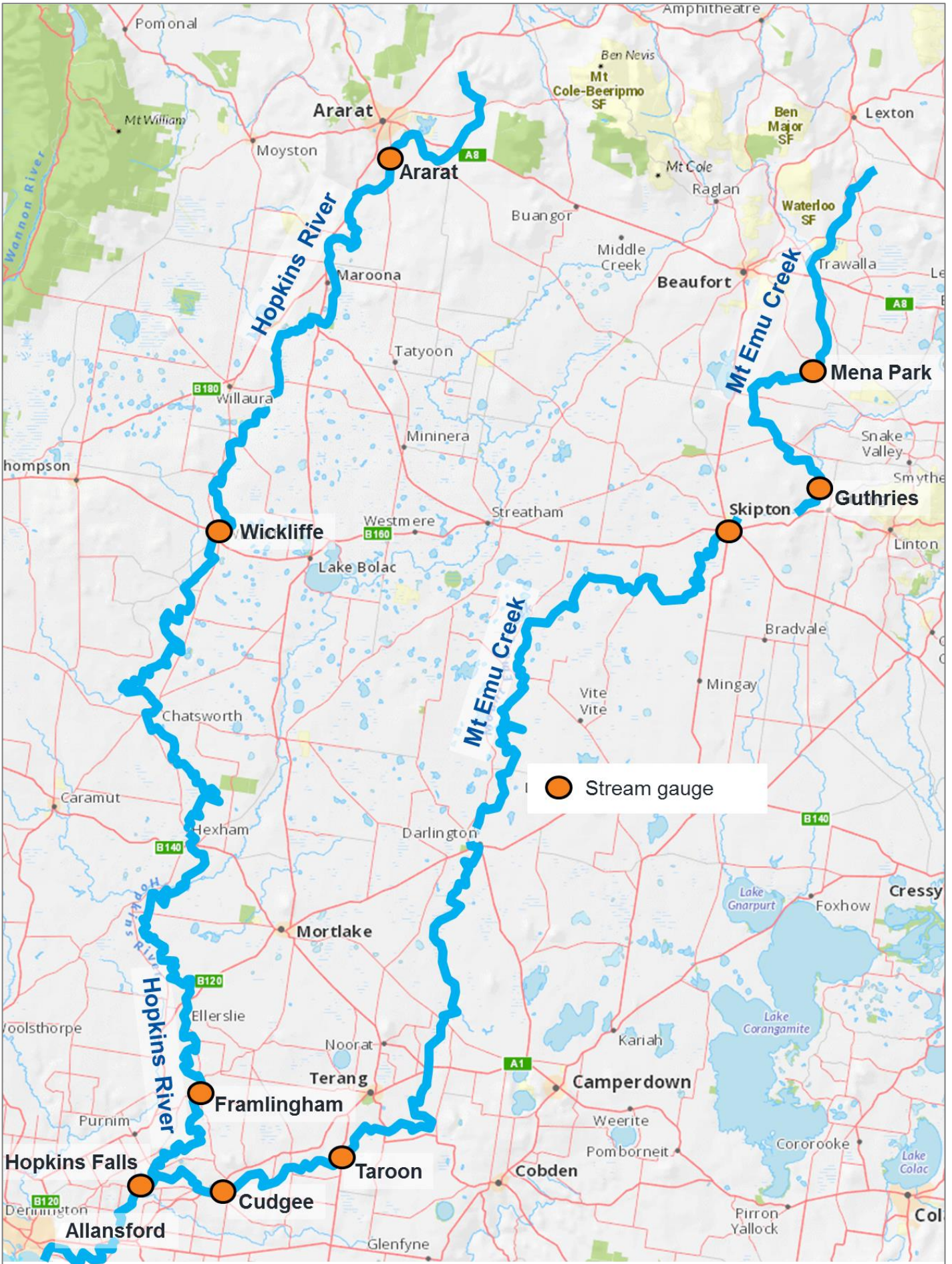


Figure 48. Allansford waterways and stream gauges.

## Historic flood events

Stream records show that Allansford has experienced frequent flood events since the early 1950's, refer to graph below. Significant flood events have occurred in 1956, 1960, 1964, 1971, 1975, 1978, 1983, 1984, 1986, 1992, 1996, 2010, 2011, 2016 and 2020. The January 2011 flood event was the largest recent flood event on record.

The Hopkins River stream gauge at Hopkins Falls (8.5 km upstream of Allansford) was used to indicate historic flood events that have occurred in Allansford.

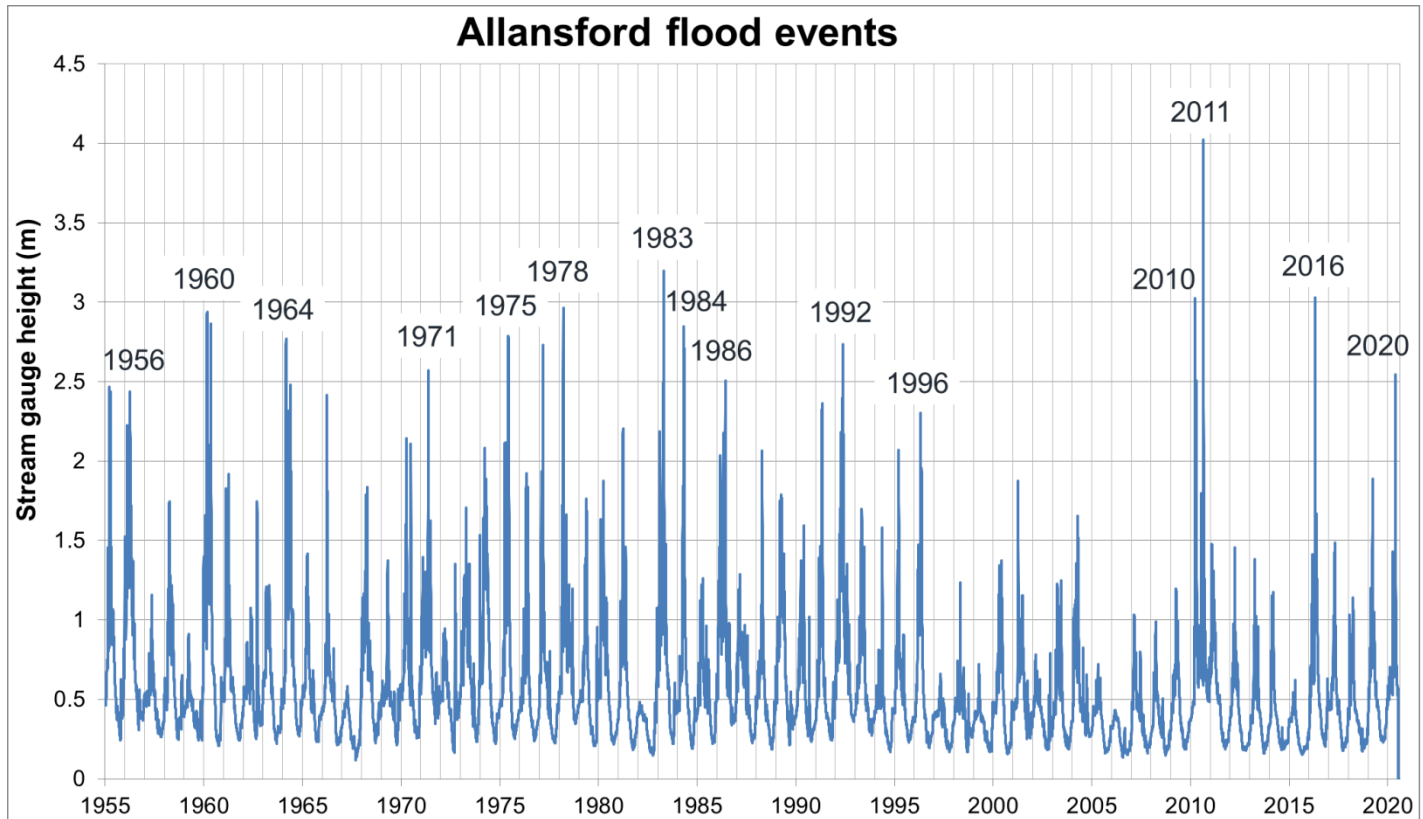


Figure 49. Allansford historic flood events.

## January 2011 flood event

The January 2011 flood was the largest recent flood event on record in the lower Hopkins River at Allansford, refer to the flood photos below. Prior to this flood event the catchment was already wet due to recent flood events in 2010. A flood peak of 4.02m (70,646 ML/d) reached the Hopkins Falls gauge on the 17<sup>th</sup> of January 2011. The January 2011 event occurred following unusual high intensity rainfall, large volumes of rainfall was recorded from the 10<sup>th</sup> to 14<sup>th</sup> of January 2011. Rainfalls were in the order of 112 mm and 172 mm over this period and were highest in the north of the catchment. Significant flooding occurred in Allansford between the 17<sup>th</sup> and 19<sup>th</sup> of January 2011.

The January 2011 flood event caused considerable damages to buildings, roads, bridges and other infrastructure. Stormwater and riverine flooding impacted a number of buildings in Allansford. Minor and major roads are impacted by flooding within and surrounding Allansford, these include Garabaldi Lane, Ziegler Parade, Frank Street, Station Street and Tooram Road.

Downstream of Allansford the Proudfoots Restaurant and the Warrnambool Rowing Club (2 Simpson Street) buildings were impacted by over floor flooding.

For more details regarding flood impacts refer to the Allansford and lower Hopkins River Flood Intelligence Card below.

Flooding along the Hopkins River caused shallow flooding along one side of the Princes Highway. It was close to needing to be closed. Refer to flood photo below. The Allansford Bridge along Ziegler Parade (off the Princes Highway), west of Allansford was closed due floodwater overtopping the bridge.

The Allansford Bridge was closed in 2011 as a precaution. During the January 2011 flood large debris flowed down the lower Hopkins River and when they came in contact with the Bridge they became wrapped around the Bridge piles, causing concern regarding the structural integrity of the Bridge. The Allansford Bridge was re-opened after a structural inspection was undertaken and once the flood water had receded.



Figure 50. Flooding starting to impact the Princes Highway, west of Allansford during the January 2011 flood event.



During the January 2011 flood event, high flood levels in the Hopkins River cause floodwater to back up the Allansford drainage network, flooding adjacent properties. Refer to the photos below showing emergency works undertaken to restrict floodwater backing up the Tooram Road main drain.



Figure 51. Tooram Road Drainage outlet at Allansford (Utilis, 2018)



Figure 52. Buildings impacted by flooding in Allansford during the January 2011 flood event.



Figure 53. Hopkins River Estuary mouth open during the January 2011 flood event.



House at 10215 Ziegler Parade

Figure 54. Flooding impacted a house at 10215 Ziegler Parade, Allansford during the January 2011 flood event.



Figure 55. Flooding along the lower Hopkins River impacted a shed in Allansford (1 Frank Street) during the January 2011 flood event.

## Riverine Flood Warning Time

There are eight stream gauges along the Hopkins River and Mt Emu Creek that provide flood warning for Allansford and the lower Hopkins River, these include Ararat, Wickliffe, Framlingham, Hopkins Falls, Mena Park, Guthries, Skipton and Taroona. Refer to map above (figure 47) for the gauge locations.

While there are no stream gauges at Allansford, the Hopkins Falls (8 km upstream of Allansford) stream gauge was used to estimate the flood warning time for Allansford.

The estimated travel time between heavy rainfall in the upper Hopkins River catchment to steep rise in streamflow at Allansford varied between 1.5 to 2.7 days during the January 2011 and October 2020 flood events.

During the October 2020 flood event there was approximately a 37 hour delay between the peak at Ararat and steep rise in stream flow at Allansford. Given the October 2020 flood event was significantly smaller and there were minimum inflows from the Mt Emu Creek, this cause the flood peak to travel faster.

The January 2011 flood event was significantly larger flood event. Significant inflows from the Mt Emu Creek entered the Hopkins River before the Hopkins River peak arrived and the confluence. This caused the Hopkins Falls gauge to peak 4 hours before the Framlingham gauge peaked. Refer to the graphs below.

For these flood events the flood peak was maintained at Allansford for a number of days.

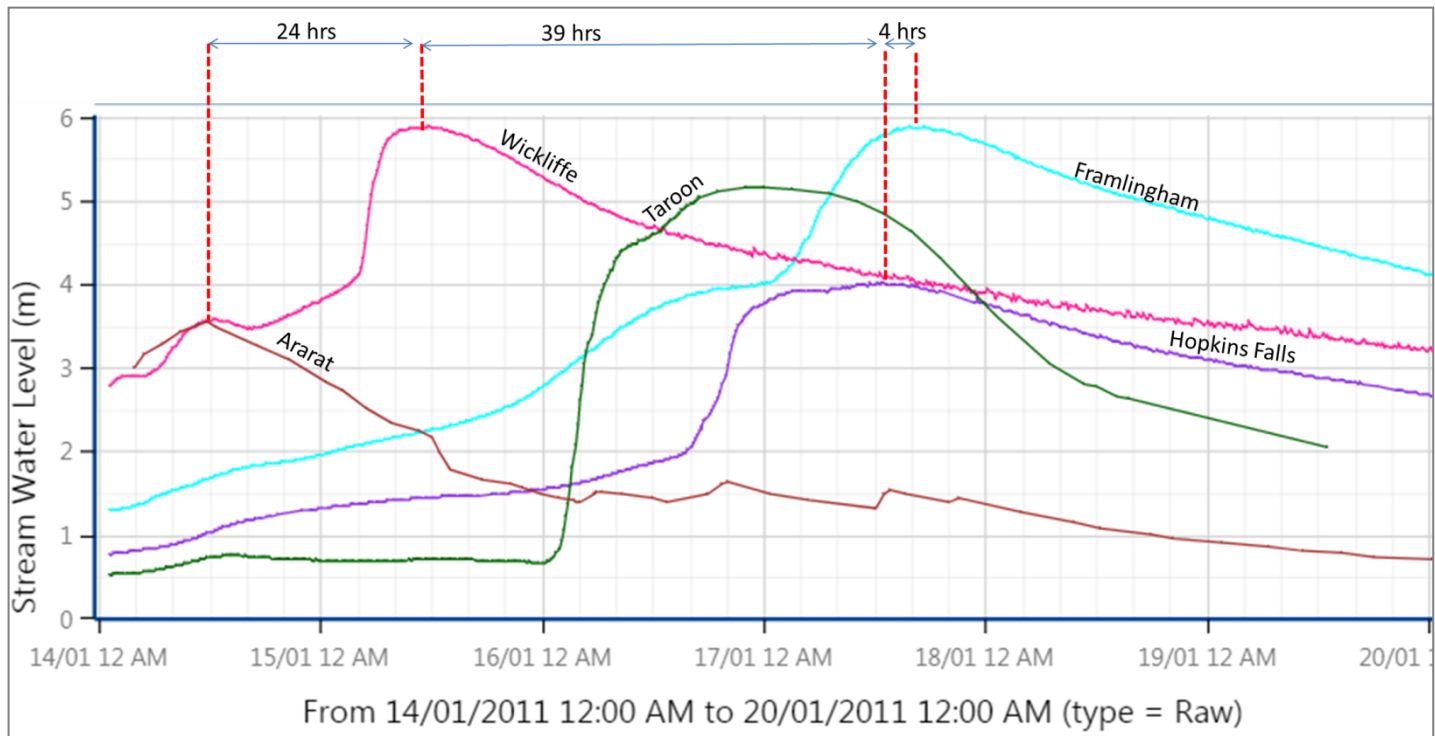


Figure 56. The travel time of flood peaks during the January 2011 flood event.

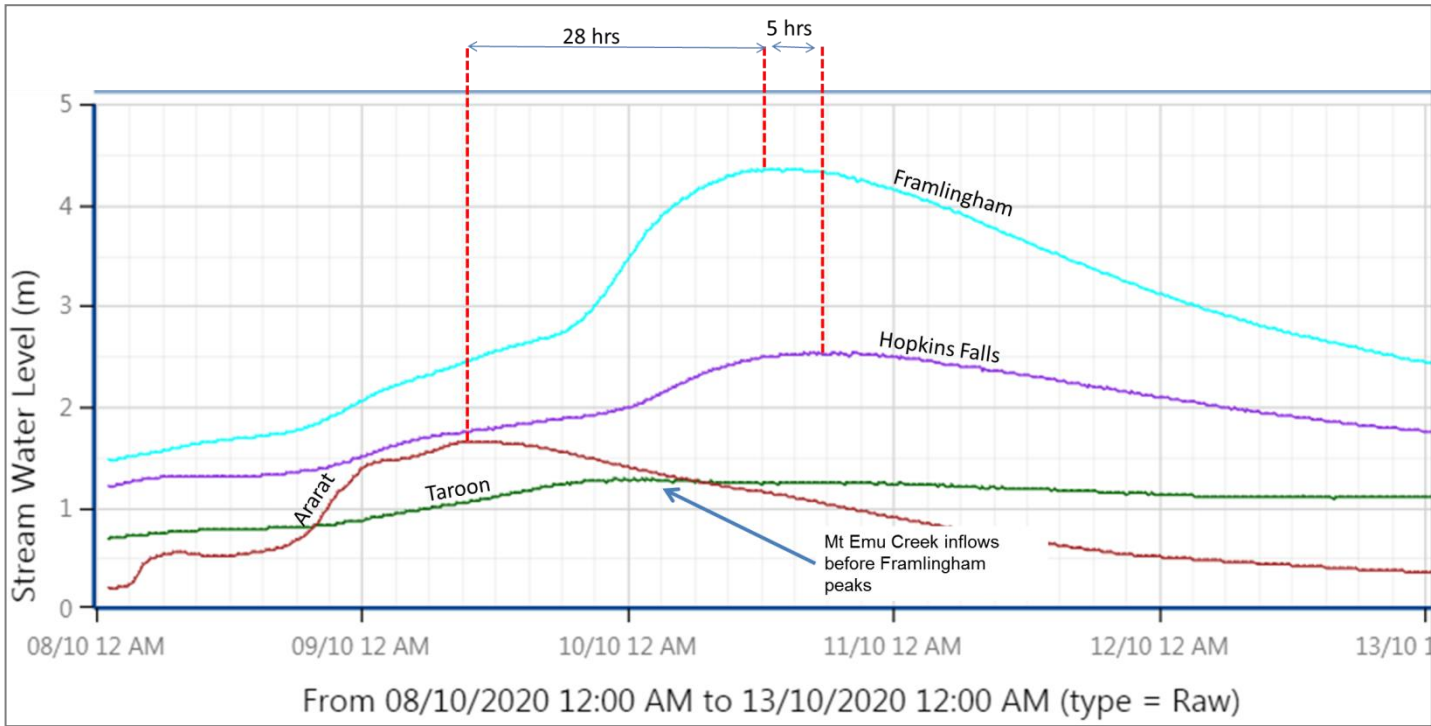


Figure 57. The travel time of flood peaks during the October 2020 flood event.

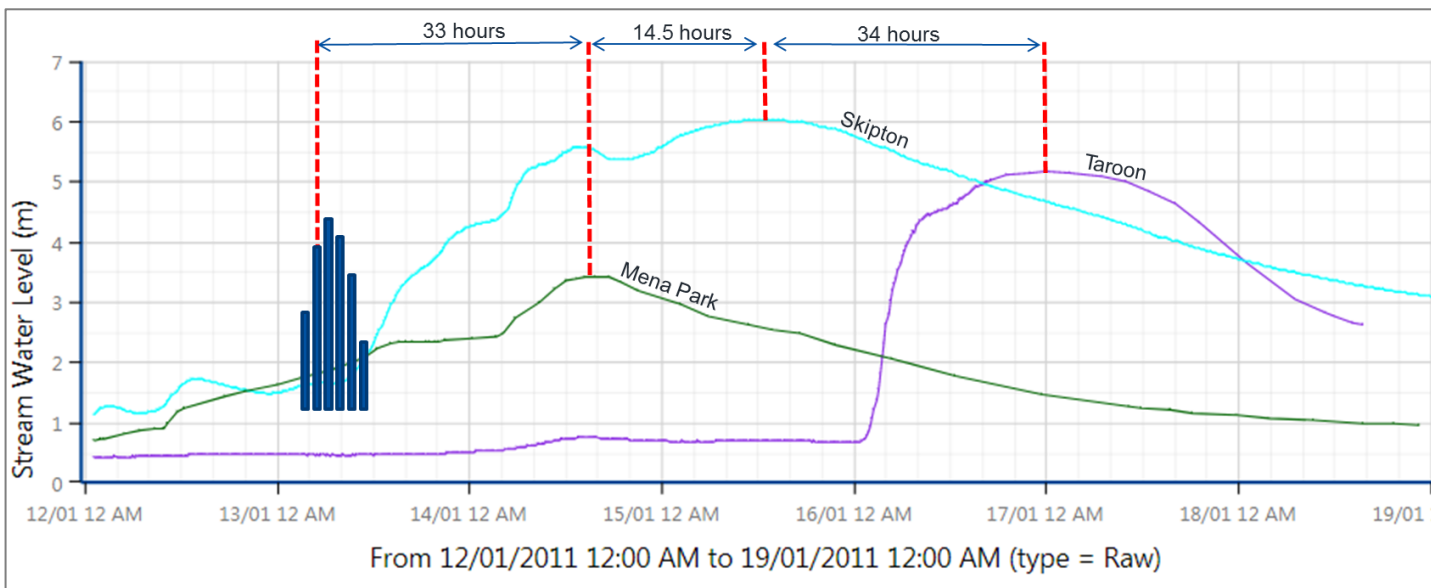


Figure 58. Mt Emu Creek travel time of flood peaks during the January 2011 flood event.

## Stormwater Flooding

VICSES Request for Assistance Database records indicate that Allansford has experienced frequent stormwater flood events. Building damages were recorded to have occurred during flood events in 2013, 2016, 2017, 2019, September 2020 and October 2020.

The October 2020 flood event was the largest recent flood event. A farmer's rainfall records at Woolsthorpe indicate 140mm fell over 5 days. Warrnambool recorded 80mm on the 8<sup>th</sup> of October, with 56mm falling in 3 hours on the 8<sup>th</sup> of October. This flood event caused considerable damages to buildings, roads and other infrastructure.

Records indicate that a significant stormwater flooding event occurred following a heavy rain in October 2013. Rainfall records indicate 70mm fell over 3 days, with 42mm falling in one day on the 23<sup>rd</sup> of October 2013.

Allansford is particularly susceptible to stormwater flooding. The risk of stormwater flooding is greatest when the capacity of the stormwater drainage network is exceeded and overflows onto adjacent property and roads. Buildings recorded in the VICSES Request for Assistance Database that have been impacted by stormwater flooding are located in Frank Street, Ziegler Parade, Station Street, Tooram Road and Garabaldi Lane. Refer to the map and table below for these building locations.



Figure 59. Pumping stormwater back into the Hopkins River during the October 2020 flood event.



Figure 60. Pumping stormwater back into the Hopkins River during the October 2020 flood event.



Figure 61. Stormwater flooding in Allansford along the main drain adjacent to Tooram Road during the October 2020 flood event.

## Stormwater Flood Warning Time

Stormwater flooding can develop quickly in Allansford from heavy localised rainfall. Rapid rises in stormwater flooding may occur in relatively short time after the onset of rain. Rapid rises in floodwater can occur within 1.5 to 6 hours after rainfall. It is important to note that all floods are different, and different rainfall patterns falling on dry or wet catchments may respond differently. This information should be used as a guide only. The time it takes rainfall associated with severe thunderstorm activity to develop into runoff is highly dependent on antecedent conditions, the saturation of the catchment. A flood on a dry catchment travels more slowly than a flood on a wet catchment. Hence, the size of the flood, recent flood history, soil moisture and forecast weather conditions all need to be considered when using the following information to direct flood response activities.



## Influence of the Hopkins River Estuary

When the Hopkins River Estuary intermittently closes due to the formation of a sandbar, this frequently causes buildings along the lower Hopkins River to be impacted by flooding. Refer to photo of the Hopkins River Estuary closed below. The Warrnambool Rowing Club building is regularly impacted by flooding when the Hopkins River Estuary closes, refer to the photo below. When this occurs the Warrnambool City Council are notified to assist with artificially opening the Hopkins River mouth to prevent buildings from being impacted by flooding.



Figure 62. Hopkins River Estuary closed, May 2017.



Figure 63. Flooding from the Hopkins River impacting the Warrnambool Rowing Club in Simpson Street during the 2014 flood event.

## Flood Impacts and Actions Required

Anecdotal information collected during historic flood events (VICSES Request for Assistance Database) was used to estimate assets, buildings and roads impacted by flooding. It's important to note the building damage information below only indicates buildings that may be at risk of above floor flooding and should be used as a guide only.

The 1 in 100 year flood extent developed as part of the Hopkins River flood mapping (DNRE, 2001) is provided below. This mapping is of low accuracy as it shows flooding breaks out through Allansford. This didn't happen during the January 2011 flood. Given the current lower Hopkins River flood risk mapping is of low accuracy, it is a high priority to revise the flood risk mapping for the whole Hopkins River Catchment.

The January 2011 flood event caused considerable damages to buildings, roads, bridges and other infrastructure. Stormwater and riverine flooding impacted a number of buildings in Allansford. Shallow flooding overtopped one side of the Princes Highway, west of Allansford. The Highway was close to being closed. The Allansford Bridge along Ziegler Parade (off the Princes Highway), west of Allansford was closed due to floodwater overtopping the bridge. Minor and major roads are impacted by flooding within and surrounding Allansford, these include Garabaldi Lane, Ziegler Parade, Frank Street, Station Street and Tooram Road. Downstream of Allansford the Proudfoots Restaurant and the Warrnambool Rowing Club (2 Simpson Street) buildings were also impacted by over floor flooding.

Key assets at risk of flooding in Allansford are listed below. For additional flood risk information refer to the Allansford Flood Intelligence Card, table and maps below.

Table 10. Key assets at risk of flooding.

<b>Asset register</b>				
<b>Asset Name and location</b>	<b>Annual Exceedance Probability (1 in year)</b>	<b>Consequence / Impact</b>	<b>Mitigation/ Action</b>	<b>Lead Agency</b>
<b>Buildings at risk of flooding within Allansford. Refer to the Allansford Flood Intelligence Card below for the locations of these buildings.</b>	Stormwater flood events	There are several buildings within Allansford along Garabaldi Lane, Ziegler Parade, Frank Street, Station Street and Tooram Road that may be impacted by stormwater flooding during heavy rainfall events.	Sandbag and evacuate buildings as needed.	Victoria Police VICSES
<b>Allansford Bridge, Ziegler Parade, west of Allansford.</b>	100 year flood January 2011	Flooding may overtop the Allansford Bridge, Ziegler Parade, west of Allansford during a 1 in 100 year flood event.	Deploy road closure signs and undertake traffic management as needed.	Council
<b>Allansford Princes Highway Bridge, west of Allansford.</b>	100 year flood January 2011	Flooding may cause debris to build up on the upstream side of the Allansford Princes Highway Bridge during a 1 in 100 year flood.	Deploy road closure signs and undertake traffic management as needed.	Regional Roads Victoria
<b>The Proudfoots Restaurant, 2 Simpson Street, Warrnambool.</b>	100 year flood January 2011	The Proudfoots Restaurant (reception office) at 2 Simpson Street, Warrnambool is at risk of flooding during large flood events similar to the January 2011 flood event.	Sandbag and evacuate buildings as needed.	Victoria Police VICSES
<b>Warrnambool Rowing Club, 2 Simpson Street Warrnambool.</b>	Hopkins River Estuary mouth closed	When the Hopkins River Estuary mouth is closed the Warrnambool Rowing Club building can be impacted by over floor flooding. Opening the River mouth will alleviate the flood risk to buildings.	Sandbag buildings as needed. Council MEMO will assist to artificially open the River mouth sandbar.	VICSES Council

For more detailed information regarding buildings and roads impacted refer to the Allansford and lower Hopkins River Flood Intelligence Card and flood impact maps below.

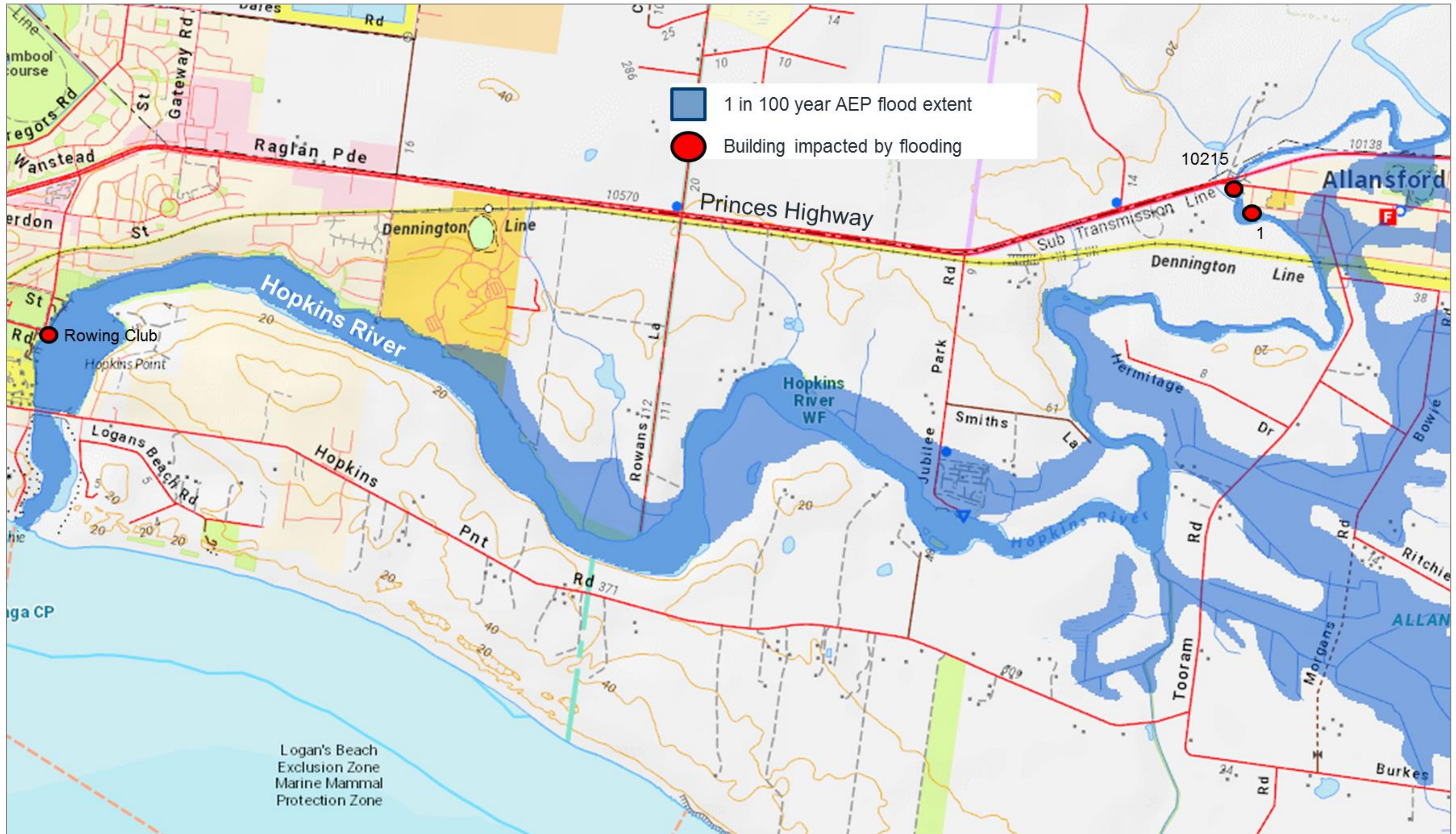


Figure 64. Buildings that have been impacted by flooding from the Hopkins River with the 1 in 100 year AEP flood event (DNRE 2001).



Figure 65. Buildings that have been impacted by stormwater and riverine flooding (VICSES Request for Assistance Database).

**Table 11. Allansford Flood Intelligence Card (Hopkins River)**

Flood travel time							Time from start of rain in the upper Hopkins River to steep rise in streamflow at Allansford can range between 1.5 to 2.7 days.			
							Time from start of rain in the upper Mt Emu Creek to flood peak at Taroona gauge can vary between 1.7 to 2.4 days.			
							Riverine flooding duration: 2 to 2.5 days			
Hopkins River at Wickliffe gauge height 23602 (m)	Hopkins River at Framlingham gauge height 236210 (m)	Hopkins River at Hopkins Falls gauge height 236209 (m)	Hopkins River at Hopkins Falls Design Flows (ML/d)	Mt Emu Creek at Taroona gauge height 236216 (m)	Wickliffe Annual Exceedance Probability (1 in year)	Allansford damages total number properties flooded (above floor)	Consequence / Impact	Houses/ buildings flooded / isolated	Road flood depth (m)	Action
							When the Hopkins River Estuary mouth is closed due to the formation of a sandbar, this causes flood levels in the lower Hopkins River to rise. When this occurs the Warrnambool Rowing Club building is regularly impacted by flooding.	Warrnambool Rowing Club, 2 Simpson Street Warrnambool.	Simpson Street.	Request the council MEMO to assist with artificially opening the Hopkins River Estuary mouth as needed.
	4.36	2.54	19,318	1.28	October 2020		Heavy rainfall caused localised stormwater flooding along Tooram Road, Garabaldi Lane and Ziegler Parade. During the September 2020 flood event the main drain along Tooram Road was blocked and caused localised flooding. Other flood events have also impacted buildings along Frank Street and Station Street.	Historic stormwater flooding (during 2020 and others): 7 Garabaldi Lane, 10 Tooram Road, 12 Station Street, 44 Station Street, 5 Frank Street, 4 Ziegler Parade, 122 Ziegler Parade and 149 Ziegler Parade.	Stormwater flooding: Garabaldi Lane, Ziegler Parade, Frank Street, Station Street and Tooram Road.	VICSES sandbag and use pumps as needed to protect buildings from flooding.
	5.73	2.95	28,264	2.9	September 2016					
4.13 (5,635 ML/d)	5.65	2.97	28,830	2.95	August 1992 September 2010		Localised minor flooding along Hopkins River of low lying rural land and minor road crossings.		Flooding may cut access to minor road crossings across Hopkins River.	
4.28 (5,788 ML/d)					5					VICSES activate ground observers to take photos and record flood levels at key crossings. Council clear debris from waterway crossings, drains, and culverts as needed.
4.39 (7,716 ML/d)	3.46	2.48	18,350		October 1986					
4.40 (7,800 ML/d)					Wickliffe Proposed minor flood level					
4.48 (7,369 ML/d)					10					Refer to actions listed above.
4.50 (8,621 ML/d)	5.05	3.12	33,133		September 1983		The extent and depth of rural land inundation has increased, roads are progressively becoming impacted by flooding. Flooding may cut access to major and minor roads.		The access/egress of a number of roads may be impacted by flooding; Church Lane, Harris.	
4.68 (10,105 ML/d)					20					Refer to actions listed above.
5.00 (12,500 ML/d)					Wickliffe Proposed moderate flood level					
5.18 (13,140 ML/d)					50					Refer to actions listed above.
5.30 (14,494 ML/d)					Wickliffe Proposed major flood level					
5.58 (16,932 ML/d)					100					Refer to actions listed above.
5.88 (21,519 ML/d)					200					Refer to actions listed above.

5.89 (21,650 ML/d)	5.88 (23,041 ML)	4.01	70,464	5.87 (23,020 ML)	January 2011	45 (8)	<p>Significant flooding in the lower Hopkins River impacted a number of buildings, roads, bridges, farmland and other infrastructure. During the flood peak, shallow floodwater overtopped one side of the Princes Highway, west of Allansford. The Highway was very close to being closed. The Allansford Bridge on Ziegler Parade was overtopped by floodwater and closed. A house at 10215 Ziegler Parade was impacted above floor by flooding. A shed at 1 Frank Street was flooded above floor. Floodwater from the Hopkins River backed up the stormwater drainage network (particularly the main drain along Tooram Road), impacting buildings and roads in Allansford.</p> <p>Along the lower Hopkins River (downstream of Allansford) the Proudfoots Restaurant (reception office) and Warrnambool Rowing Club (2 Simpson Street) were impacted by flooding.</p>	<p><b>Allansford:</b> House at 10215 Ziegler Parade, shed at 1 Frank Street</p> <p><b>Warrnambool:</b> Proudfoots Restaurant (reception office), Warrnambool Rowing Club at 2 Simpson Street.</p>	<p>Princess Highway close to being closed. Allansford Bridge on Ziegler Parade was overtopped by floodwater and closed.</p>	<p>Council and Regional Roads Victoria deploy road closure signs and undertake traffic management for the Princes Highway and other roads as needed. VICSES sandbag the buildings as needed. VICSES sandbag and use pumps as needed to protect buildings from flooding. Victoria Police evacuate buildings as needed.</p>
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# Appendix D: Flood evacuation arrangements

## Phase 1 - Decision to Evacuate

The decision to evacuate is to be made in consultation with the MEMO, MERC, DFFH, Health Commander and other key agencies and expert advice (CMA's and Flood Intelligence specialists).

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 and 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;
- Is cross border assistance required or evacuation to another municipality relief centre?;
- Resources required and 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.

## Phase 2 – Warning

Warnings may include a warning to ‘prepare to evacuate’ and a warning to ‘evacuate now’. Once the decision to evacuate has been made, the at-risk community will be warned to evacuate. Evacuation warnings should be disseminated via methods listed in section 3.6 of this plan.

## Phase 3 – Withdrawal

VICPOL is the responsible agency for evacuation. VICSES will provide advice regarding most appropriate evacuation routes and locations for at-risk communities to evacuate to.

VICSES, CFA, AV and Local Government will provide resources where available to support VICPOL/ REGIONAL ROADS 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.

Landing zones for helicopters are located at:

- Warrnambool Airport
- Port Fairy Airport

Special needs groups will be/are identified in Council’s ‘vulnerable persons register’. This can be done through community network organisations.

## 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

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



## Animal Shelter

Animal shelter compounds will be established for domestic pets and companion animals of evacuees.

## Phase 5 – Return

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

## 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, truck routes, water treatment plant affecting potable water supplies etc.

## Public Information and Warnings

VICSES uses EM-COP Public Publishing to distribute riverine and flash flood warnings in Victoria. The platform enables automatic publishing to the VicEmergency app, website and hotline (1800 226 226). Communities can also access this information through VICSES social media channels (Victoria State Emergency Service on Facebook and VICSES News on Twitter) and emergency broadcasters, such as Sky News TV and various radio stations (current list available via the [EMV website](#)).

VICSES Regions (or ICCs where established) lead the issuing of warnings for riverine flood events when pre-determined triggers are met (issuing of a BOM Flood Watch or Warning), and share locally tailored information via the standard VICSES communication channels (social media, traditional media, web and face to face). These activities are coordinated by the VICSES RDO and approved by the VICSES RAC, or the PIO and IC respectively (when an ICC is active).

If verified reports are received of flash flooding posing, or resulting in, a significant threat to life or property, VICSES Regions (or ICCs) will issue a flash flood warning product via EM-COP.

VICSES at the state tier (or SCC Public Information Section) plays an important role in sharing riverine and flash flood information via state-based standard communication channels.

During some emergencies, VICSES may alert communities by sounding a local siren, or by using the Emergency Alert (EA) platform to send an SMS to mobile phones or a voice message to landlines. The use of sirens for higher-end warnings has been pre-determined, and mapped to relevant warning templates in EM-COP.

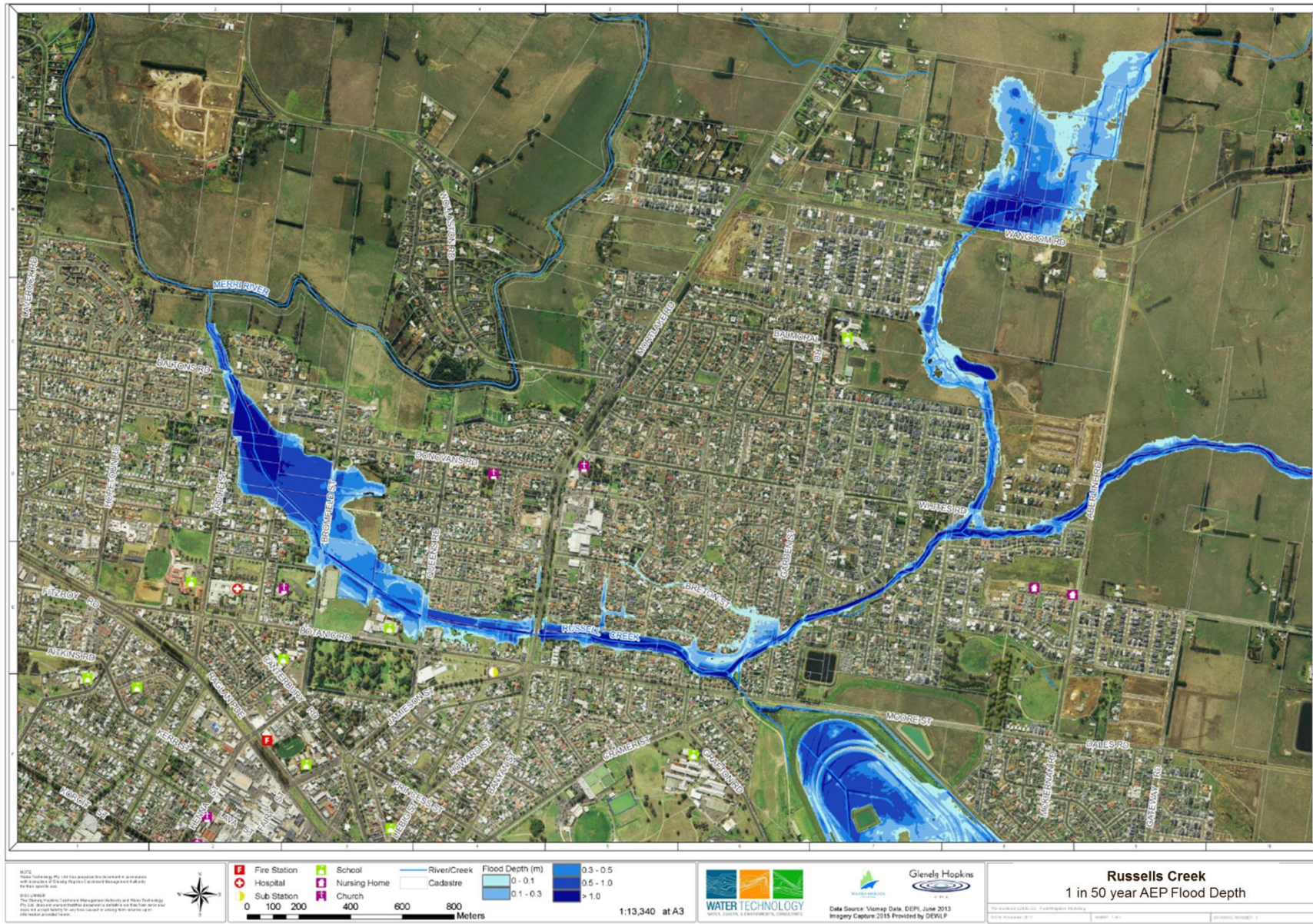
EM-COP Public Publishing Business Rules for Riverine and Flash Flood are available in the **Public Information tab of the IMT Toolbox**, providing further guidance on specific triggers, roles and responsibilities. VICSES SOP057 and JSOP 04.01 provide further guidance.

# Appendix E: Flood Maps

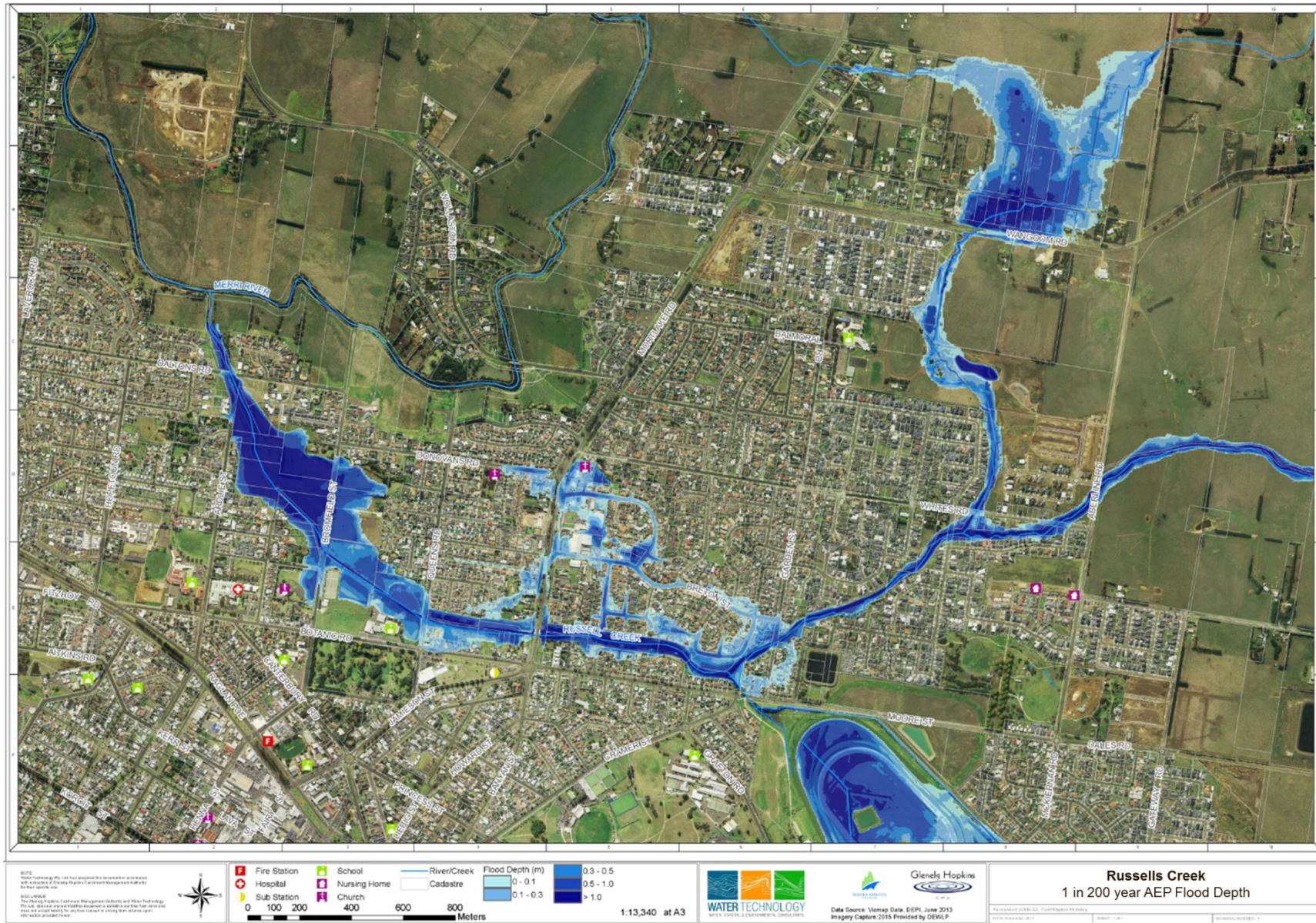
Russells Creek 1 in 10 year AEP flood depth map (Water Technology, 2017).



Russells Creek 1 in 50 year AEP flood depth map (Water Technology, 2017).



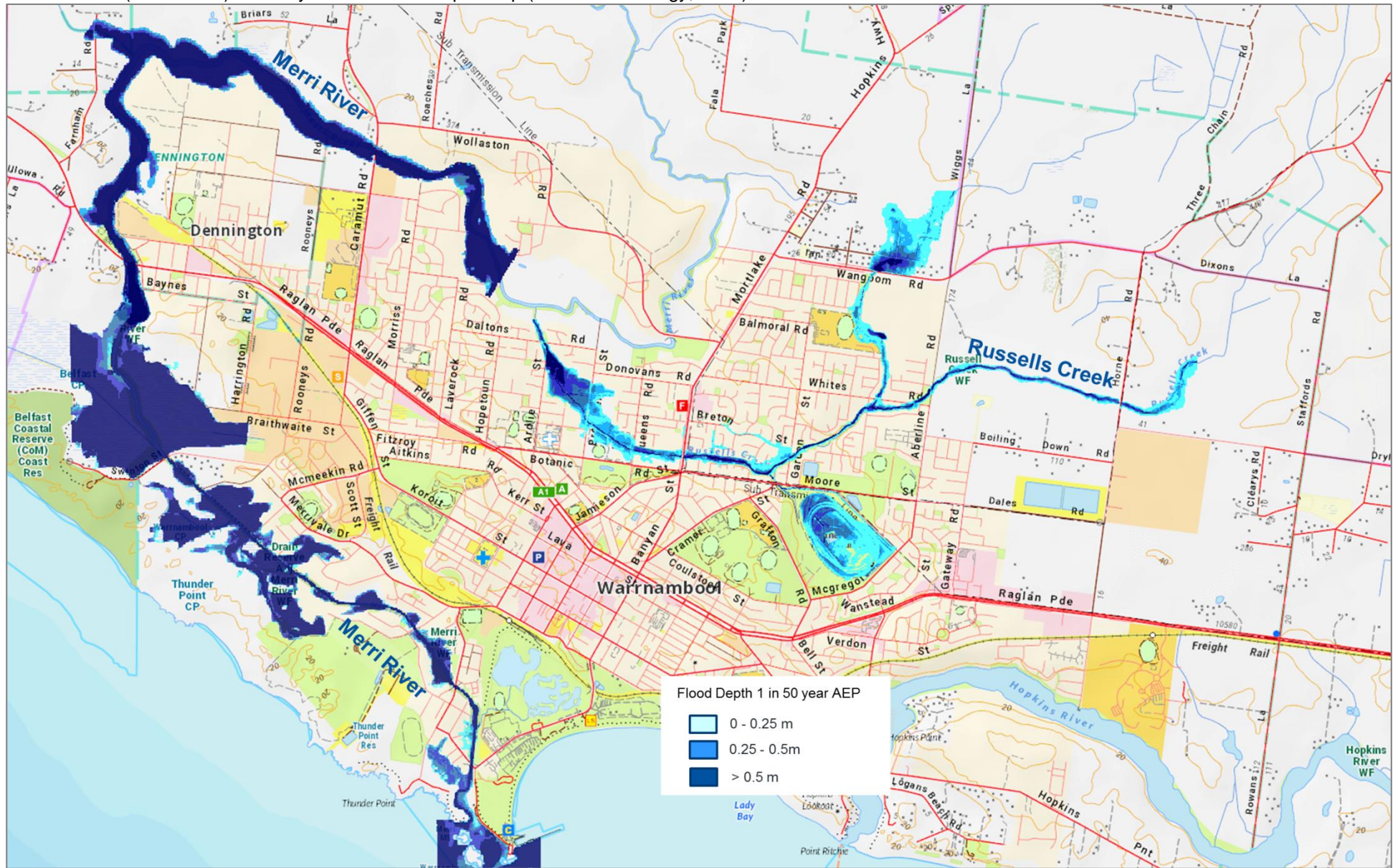
Russells Creek 1 in 200 year AEP flood depth map (Water Technology, 2017).



Warrnambool (Merri River) 1 in 20 year AEP flood depth map (Water Technology, 2007).



Warrnambool (Merri River) 1 in 50 year AEP flood depth map (Water Technology, 2007).





Warrnambool (Merri River) 1 in 100 year AEP flood depth map (Water Technology, 2007).



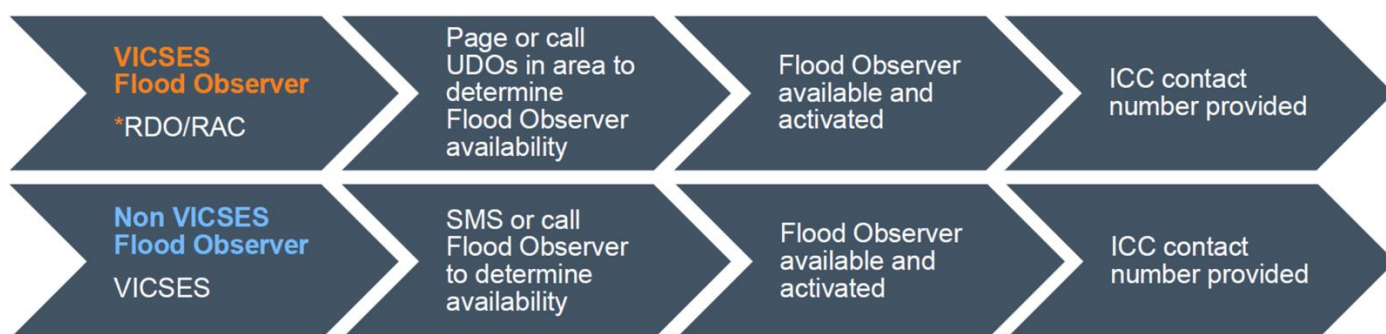
## Appendix F: Local knowledge arrangements

As control agency for flood in Victoria, VICSES is committed to ensuring the incorporation of local knowledge in decision making before, during and after incidents.

Information from community sources including but not limited to observations, historical information and information about current and possible consequences of an incident may be utilised to help inform the process of incorporating local knowledge into decision making during an incident. Community observers and agency staff will help support this process.

### Flood Observers

When a VICSES Incident Control Centre is activated with knowledge of a potential flooding event, Flood Observers should be contacted to determine their availability to assist. The process for activating flood observers is as flows:



\*VICSES Flood Observers – The Intelligence Cell in consultation with the RDO/RAC will contact the Unit Duty Officer (UDO) of Units with Flood Observers in the area where observations are required. The UDO will contact Flood Observers to determine their availability. Available Flood Observers names and contact details will be provided to the intelligence cell from the UDO so they can be contacted and activated under normal resourcing arrangements.

In no-notice flash flooding events, the full list of observers will be provided by the RDO or RAC to the Incident Controller, for use by the Intelligence Cell once activated.

If non VICSES Flood Observers witness an unexpected significant flood event, they will notify VICSES via the 132 500 phone number and share flood photos via the Snap Send Solve app.

Targeted Flood Observer training will be undertaken by VICSES on an as needs basis for high flood risk towns where limited stream gauge monitoring is available.

## Appendix G: Local flood information

A Local Flood Guide has been developed for the Warrnambool City Council Region;

- Refer to the link below for the Warrnambool Local Flood Guide  
<https://www.ses.vic.gov.au/documents/112015/135241/Warrnambool+Local+Flood+Guide-pdf/3e474d9b-9a23-468b-b397-dacbb37fe472>

**SES** Local Flood Guide **Warrnambool** **FloodSafe**

Flood information for Russell's Creek, Merri River and Hopkins River at Warrnambool

WARRNAMBOOL

WARRNAMBOOL CITY COUNCIL

Glenelg Hopkins  
CMA  
Protecting our future - Naturally

State Government  
**Victoria**

FLOOD STORM EMERGENCY **132 500**

For more information visit [www.ses.vic.gov.au](http://www.ses.vic.gov.au)

# Appendix H: Warrnambool City Council Community Sandbag Collection Points

Triggers to start prefilling sandbags and setting up community sandbag collection points;

- BOM flood watch has been issued for the town / catchment area
- Significant rainfall is predicted for the town/catchment area (greater than 50mm)
- BOM has high certainty the rainfall event will impact a town/catchment area listed below.
- Flooding is imminent

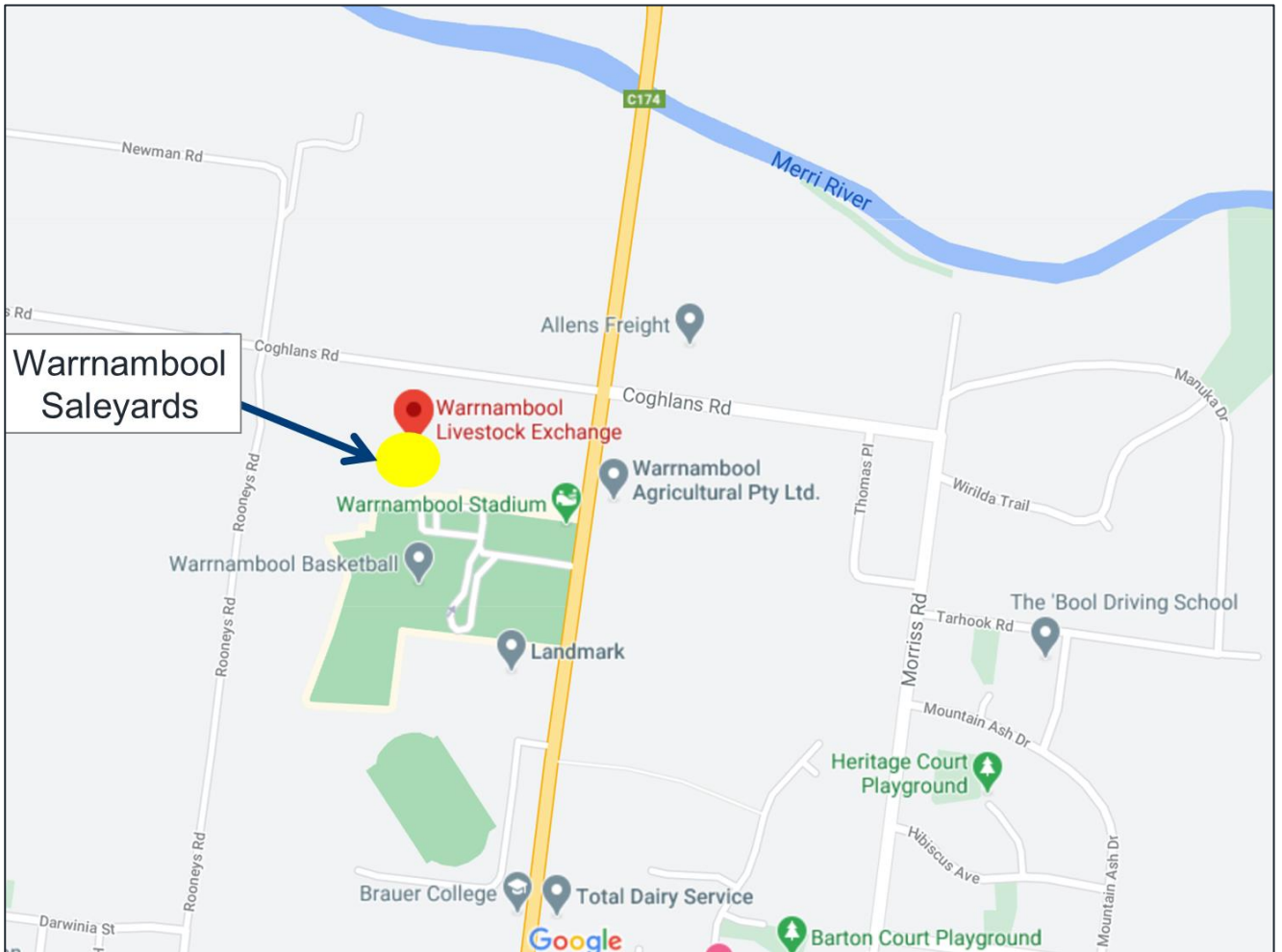
When needed community sandbag collection points will be set up at;

- Warrnambool: Saleyards, 81-Caramut Road, Warrnambool.
- Allansford: Recreational Reserve: 85 Ziegler Parade, Allansford.

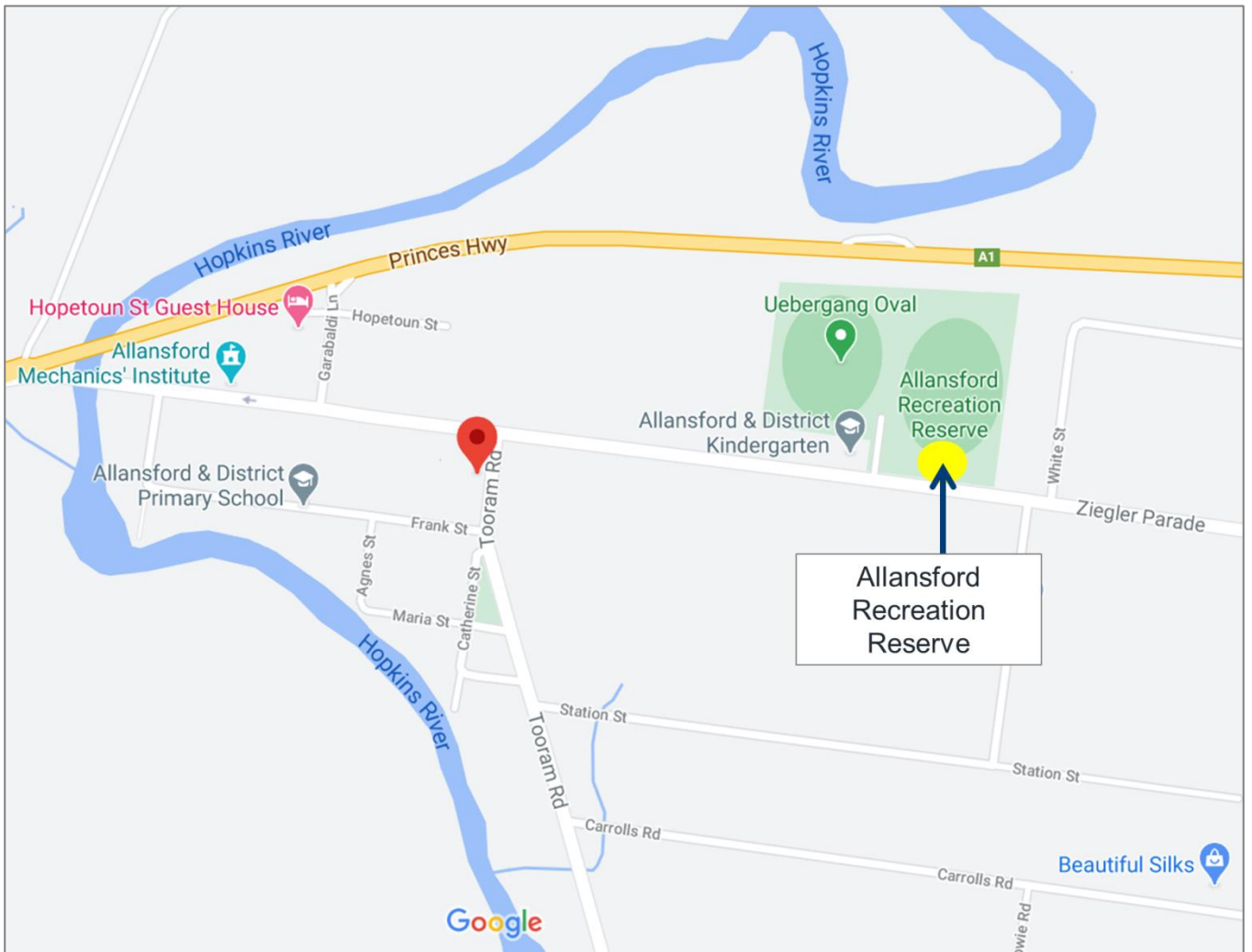
Refer to the list below of key tasks that may be undertaken to prepare sandbag filling and community sandbag collection points.

Agency	Task Description
VICSES	Deliver sandbags to the council depot or other nominated sandbag filling point to prefill the sandbags.
Warrnambool City Council	Deliver sand to sandbag filling points documented below.
Warrnambool City Council / VICSES / CFA	Deliver prefilled sandbags either directly to buildings that need to be sandbagged or to the nominated community Sandbag collection point. Provide staff/volunteers to set up the community sandbag point. Provide staff/volunteers to distribute prefilled sandbags to the community.
Warrnambool City Council / VICSES	Notify the community of the location of the community sandbag collection point via local radio and social media channels.

**Warrnambool:** Saleyards, adjacent to the Recreational Centre, 81-Caramut Road, Warrnambool (refer to the map below).



**Allansford:** Allansford Recreational Reserve: 85 Ziegler Parade, Allansford (refer to the map below).



## References

Cardno (2010), Design of North Warrnambool Floodplain Management Plan.

DNRE (2001), Flood Data Transfer Project – Hopkins Basin.

Engeny (2017), Warrnambool City Council Drainage Study.

Water Technology (2017), Russells Creek Flood Mitigation Report – As constructed modelling.

Water Technology (2015), North Warrnambool Design of Flood Mitigation Works.

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Utilis (2018), Warrnambool Floodplain Management Plan 2018-2023.