



Newstead Flood Intelligence Documentation

Newstead Flood Study and Mitigation Strategy (M1751-2023)

Mount Alexander Shire Council

5 December 2025



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ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work. In particular, we recognise the Dja Dja Wurrung People as the Traditional Custodians of the waters and lands on which this project is based.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.



Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- Seven circles representing each of the States and Territories in Australia where we do our work
- Blue dots between each circle representing the waterways that connect us
- The animals that rely on healthy waterways for their home
- Black and white dots representing all the different communities that we visit in our work
- Hands that are for the people we help on our journey



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GLOSSARY

Annual Exceedance Probability (AEP)	Refers to the probability or risk of a flood of a given size occurring or being exceeded in any given year. A 90% AEP flood has a high probability of occurring or being exceeded; it would occur quite often and would likely be relatively small magnitude. A 1% AEP flood has a low probability of occurrence or being exceeded; it would be fairly rare but it would likely be of extreme magnitude.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average Recurrence Interval (ARI)	Refers to the average time interval between a given flood magnitude occurring or being exceeded. A 10 year ARI flood is expected to be exceeded on average once every 10 years. A 100 year ARI flood is expected to be exceeded on average once every 100 years. The AEP is the ARI expressed as a percentage.
Cadastre, cadastral base	Information in map or digital form showing the extent and usage of land, including streets, lot boundaries, water courses etc.
Catchment	The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Design flood	A design flood is a probabilistic or statistical estimate, being generally based on some form of probability analysis of flood or rainfall data. An average recurrence interval or exceedance probability is attributed to the estimate.
Discharge	The rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow, which is a measure of how fast the water is moving rather than how much is moving.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from elevated sea levels and/or waves overtopping coastline defences.
Flood frequency analysis	A statistical analysis of observed flood magnitudes to determine the probability of a given flood magnitude.
Flood hazard	Potential risk to life caused by flooding. Flood hazard combines the flood depth and velocity.
Floodplain	Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.
Flood storages	Those parts of the floodplain that are important for the temporary storage, of floodwaters during the passage of a flood.



Geographical information systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
Hydraulics	The term given to the study of water flow in a river, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.
Hydrograph	A graph that shows how the discharge changes with time at any particular location.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Intensity frequency duration (IFD) analysis	Statistical analysis of rainfall, describing the rainfall intensity (mm/hr), frequency (probability measured by the AEP), duration (hrs). This analysis is used to generate design rainfall estimates.
LiDAR	Spot land surface heights collected via aerial light detection and ranging (LiDAR) survey. The spot heights are converted to a gridded digital elevation model dataset for use in modelling and mapping.
Peak flow	The maximum discharge occurring during a flood event.
Probability	A statistical measure of the expected frequency or occurrence of flooding. For a fuller explanation see Average Recurrence Interval.
Probable Maximum Flood	The flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.
RORB	A hydrological modelling tool used in this study to calculate the runoff generated from historic and design rainfall events.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.
Stage	Equivalent to 'water level'. Both are measured with reference to a specified datum.
Stage hydrograph	A graph that shows how the water level changes with time. It must be referenced to a particular location and datum.
Topography	A surface which defines the ground level of a chosen area.
TUFLOW	A hydraulic modelling software package used to undertake modelling using hydrological modelling inputs.



1 INTRODUCTION

1.1 Overview

Water Technology was commissioned by Mount Alexander Shire Council (MASC) to undertake the Newstead Flood Study and Mitigation Strategy. The project is funded by the Disaster Ready Fund and the Victorian Government. The investigation covers the study area presented in Figure 1-1.

Newstead is a small township in Victoria, located 15 km west of Castlemaine on the banks of the Loddon River. Located within MASC and the North Central Catchment Management Authority (NCCMA) management area, Newstead was established in the mid-19th century as a river crossing point and today hosts a population of approximately 800 people.

The Loddon River catchment upstream of Cairn Curran Reservoir was included in a RORB hydrology model prepared as part of the Cairn Curran Dam Hydrology report¹ prepared by SKM. This model was refined for the catchment upstream of Guildford during the NCCMA Rapid Flood Risk Assessment². The SKM model was calibrated to three events from 2010 and 2011. Given the age of the SKM model and that the Guildford model only covers part of the catchment upstream of Newstead, a new hydrology model was produced for the current study. However, parameters adopted for the previous models were considered for model validation. This study will produce flood intelligence information for use in emergency management, assess the current flood impact/exposure in terms of annual average damages caused by flooding in Newstead, investigate structural and non-structural mitigation options and make recommendations for establishing a flood warning system for the town.

This report is one of a series documenting the outcomes for the Newstead Flood Study. Each reporting stage is shown below:

R01 – Data Review and Validation Report – Final version published 20 August 2024

R02 – Hydrology Report – Final version published 31 October 2024

R03 - Draft Hydraulic Modelling Report – Final version published 13 December 2024

R04 – Final Hydraulic Modelling Report – Final version published 3 April 2025

R05 - Design Modelling and Mapping Outputs – Final version published 3 April 2025

R06 – Flood Intelligence Documentation – This report

R07 – Flood Damage and Structural Mitigation Options – Final version published 5 December 2025

R08 – Final Project Report – Final version published 5 December 2025

This report details the hydraulic model build and calibration process undertaken as part of the study.

1.2 Objectives and outputs

The Newstead Flood Study and Mitigation Strategy outputs are required to meet several floodplain management objectives as highlighted in the project brief prepared by MASC. The objectives of the investigation are described below:

¹ SKM, 2012 Cairn Curran Dam: Flood Hydrology Update

² HARC, 2020 Guildford Rapid Flood Risk Assessment - North Central CMA Region, prepared for North Central CMA



- Undertake hydrologic and hydraulic modelling to determine flood levels and flood extents for the full range of flood events up to and including the Probable Maximum Flood (PMF).
- Calibrate models to historic flood events including the October 2022 flood event.
- Investigate modelling of climate change scenarios.
- Assess the feasibility of a range of potential mitigation options including understanding of the level of protection provided by the existing levee and information to inform necessary upgrades to this levee.
- Analyse the feasibility of establishing effective flood warning, accounting for time available between rainfall and the township flooding, in the context of a total flood warning system.
- Update flood intelligence to be incorporated into the Municipal Flood Emergency Plan.
- Provide recommendations to update the Planning Scheme and ensure it is informed by the best available flood information.

1.3 Study area

The main flood risk in Newstead is posed by the Loddon River, a levee was constructed in the 1920's that is still protecting the eastern portion of the township from Loddon River flooding. However, a number of smaller catchments generate runoff towards Newstead directly or indirectly, resulting in complex hydrologic and hydraulic conditions to address in planning and emergency response. These catchments include Mia Mia Creek, Muckleford Creek, Larni Barramal Yaluk, Green Gully and Green Gully Creek as shown in Figure 1-1. Additionally, there are several tributaries joining the Loddon River near Newstead further impacting river levels.

Newstead most recently experienced flooding in October 2022, causing flooding to parts of the township located on the western side of the Loddon River. Flooding in Newstead has historically caused levee breaches which were mitigated by sandbagging during the flood event. Flooding of the Loddon River also leads to the town being isolated when major traffic routes are cut off. The Loddon River at Newstead has been subject to considerable physical and ecological modifications due to extensive historic mining activities and other anthropogenic influences since European settlement. In recent years, bank erosion has been an issue for landholders adjacent to the Loddon River.

1.4 Flood intelligence and MFEP deliverables

The tender document sets out the following flood intelligence and warning products to be delivered as part of the Flood Intelligence and Warning Report:

- Flood/No flood tool – rainfall intensity and flooding indicator.
- Flood peak calculator – river gauge level correlations.
- Flood peak travel time calculator/warning time available.
- Modelled/calibrated hydrographs at gauging stations.
- Prepare draft documentation for insertion into the Mount Alexander Flood and Storm Emergency Plan (MFSEP), this includes:
 - Flood intelligence card
 - Property and road inundation tables, mapping and data (inundation depth and time) for all properties and roads impacted by flooding.
 - Proposed updates to other outdated information in the MASC MFEP relating to Newstead (Appendix A, B and C)

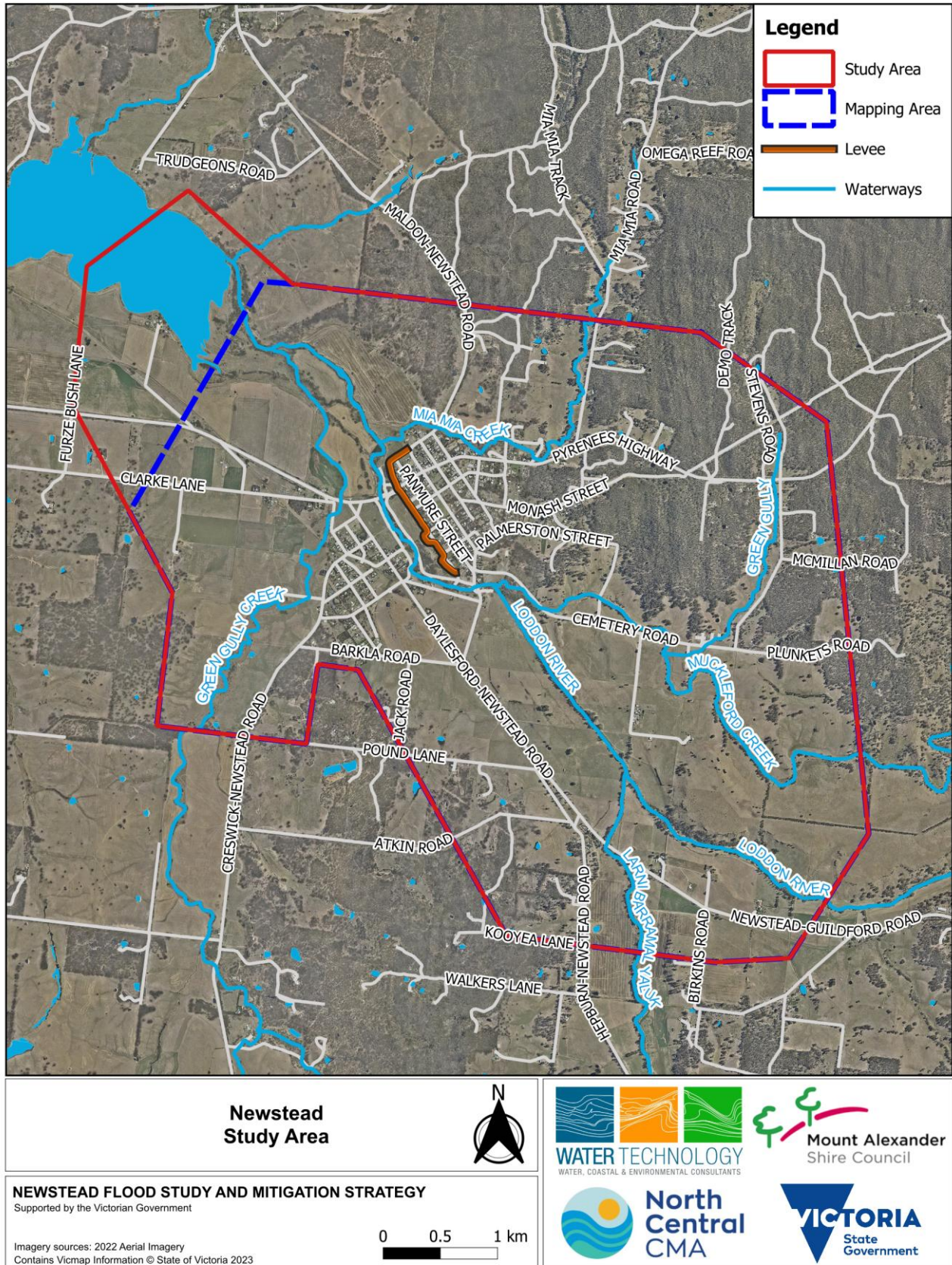


Figure 1-1 Newstead study area



2 CATCHMENT AND FLOOD BEHAVIOUR

2.1 Flood behaviour

The Loddon River originates in the Great Dividing Range within the Hepburn and Mount Alexander shires, flowing north until Vaughan where it turns in a westerly direction towards the township of Newstead. Upstream of Newstead, the Loddon River is joined by several tributaries including Campbells Creek, Larni Barramal Yaluk, Muckleford Creek, Green Gully, Green Gully Creek and Mia Mia Creek. Flooding in Newstead is primarily caused by the Loddon River, but localised flood events can cause flooding along any of the tributaries. The eastern portion of the Newstead township is located behind a levee bank.

When the Loddon River floods, widespread breakouts from the river channel and tributaries are observed in the 20% AEP event inundating farmland upstream and downstream of the township and the Pyrenees Highway is overtopped by Green Gully Creek. The flood behaviour is similar in the 10% AEP event.

The Newstead levee is overtopped in the 5% AEP event, with flood levels up to 0.5 m observed inside the levee. For the 2% AEP event, the flooding behind the levee causes flooding above floor at 80 properties and large areas of Newstead become isolated/inaccessible.

Note that all intelligence data presented in this report has been produced based on the near-term climate change considerations for the year 2030 (based on the Shared Social Pathway SSP5 scenario).

2.2 Rainfall and streamflow gauges

2.2.1 Streamflow gauge monitoring network

Four active streamflow gauges are located within the Upper Loddon Catchment with water level and streamflow data available to the present date. The four streamflow gauges information is displayed in Table 2-1 and shown in Figure 2-1. The streamflow gauges located upstream of Newstead may be useful in predicting flooding at Newstead, however it is noted that they are located relatively close to Newstead and that there are a number of ungauged catchments which contribute to flooding in Newstead, including Mia Mia Creek and Green Gully Creek. The Bureau of Meteorology (BoM) do not provide a quantitative level of service at the Newstead gauge. Any warning information is likely to be qualitative or general in nature and may reference the Flood Class Levels at the site.

Table 2-1 Streamflow gauges in the Upper Loddon catchment

Station Name	Distance From Newstead	Station No.	Period of Record
Loddon River at Newstead	0.0 km	407215	1973 - current
Loddon River at Vaughan DS Fryers Creek	14.4 km E	407217	1967 - current
Muckleford Creek at Muckleford	12.6 km N	407300	1993 - current
Larni Barramal Yaluk at Yandoit	11.4 km S	407221	1973 - current

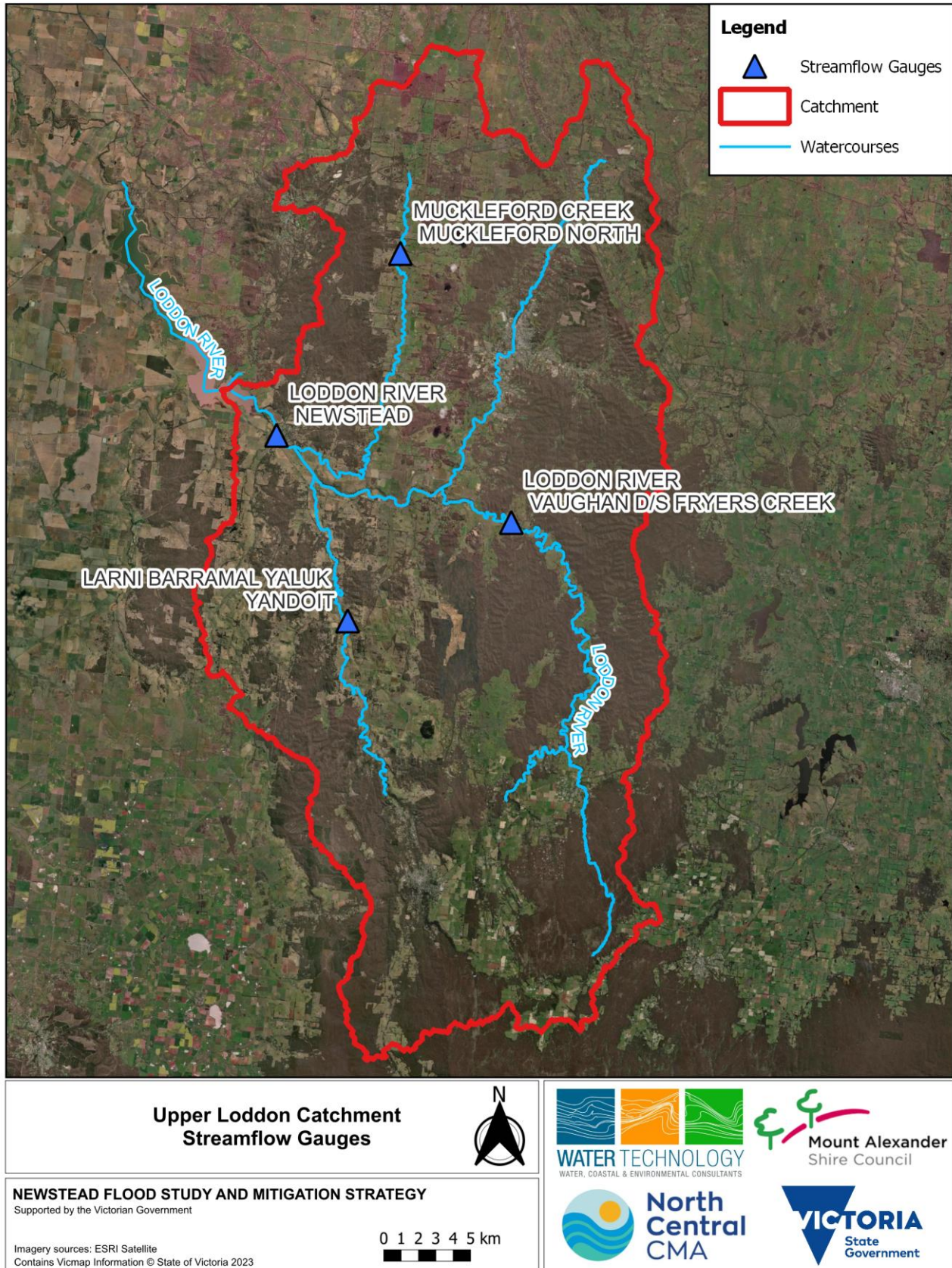


Figure 2-1 Streamflow gauges in the Upper Loddon catchment



2.2.2 Rainfall gauge monitoring network

Given the proximity of the streamflow gauges to Newstead and subsequently, the limited travel time from the upstream gauges, and the presence of ungauged catchments upstream of Newstead, predicting the likely magnitude of flooding in Newstead is reliant on the real time rainfall gauge network and rainfall forecasts. In some events, warning times may be too short for monitoring of streamflow to be of any use as a means of issuing early flood warning.

The currently active rainfall gauges within and in proximity to the Loddon River catchment upstream of Newstead are shown in Figure 2-2. These gauges are useful for predicting floods in Newstead and are summarised in Table 2-2. Three (3) of the available daily gauges, also record sub daily rainfall, typically every 6 minutes. These are the Bendigo Airport, Ballarat Aerodrome and Redesdale weather stations. These gauges are also highlighted in Figure 2-2.

Table 2-2 Active rainfall station information

Station Name	Dist. From Newstead	Station No.	Start
Newstead	0.6 km NE	088048	1897
Joyce Creek	6.1 km NW	088032	1907
Eberys	10.7 km SW	088021	1913
Maldon (Stump Rd)	13.6 N	088161	2005
Vaughan	14.0 km SE	088108	1958
Cairn Curran Reservoir	15.4 km NW	088009	1949
Castlemaine Prison	16.1 km E	088110	1966
Smeaton (Blampied (Bardia))	26.1 km SW	088113	1968
Daylesford	27.2 km SE	088020	1867
Malmsbury Reservoir	29.3 km SE	088042	1872
Creswick	37.6 km SW	088019	1949
Woodstock-On-Loddon	38.3 km N	081100	1970
Redesdale (sub-daily)	40.3 km NE	088051	1903
Glen Park (White Swan Reservoir)	46.9 km S	089048	1953
Bendigo Airport (sub-daily)	47.4 km NE	081123	1991
Ballarat Aerodrome (sub-daily)	50.6 km SE	089002	1960
Eppalock Reservoir	50.9 km NE	081083	1965

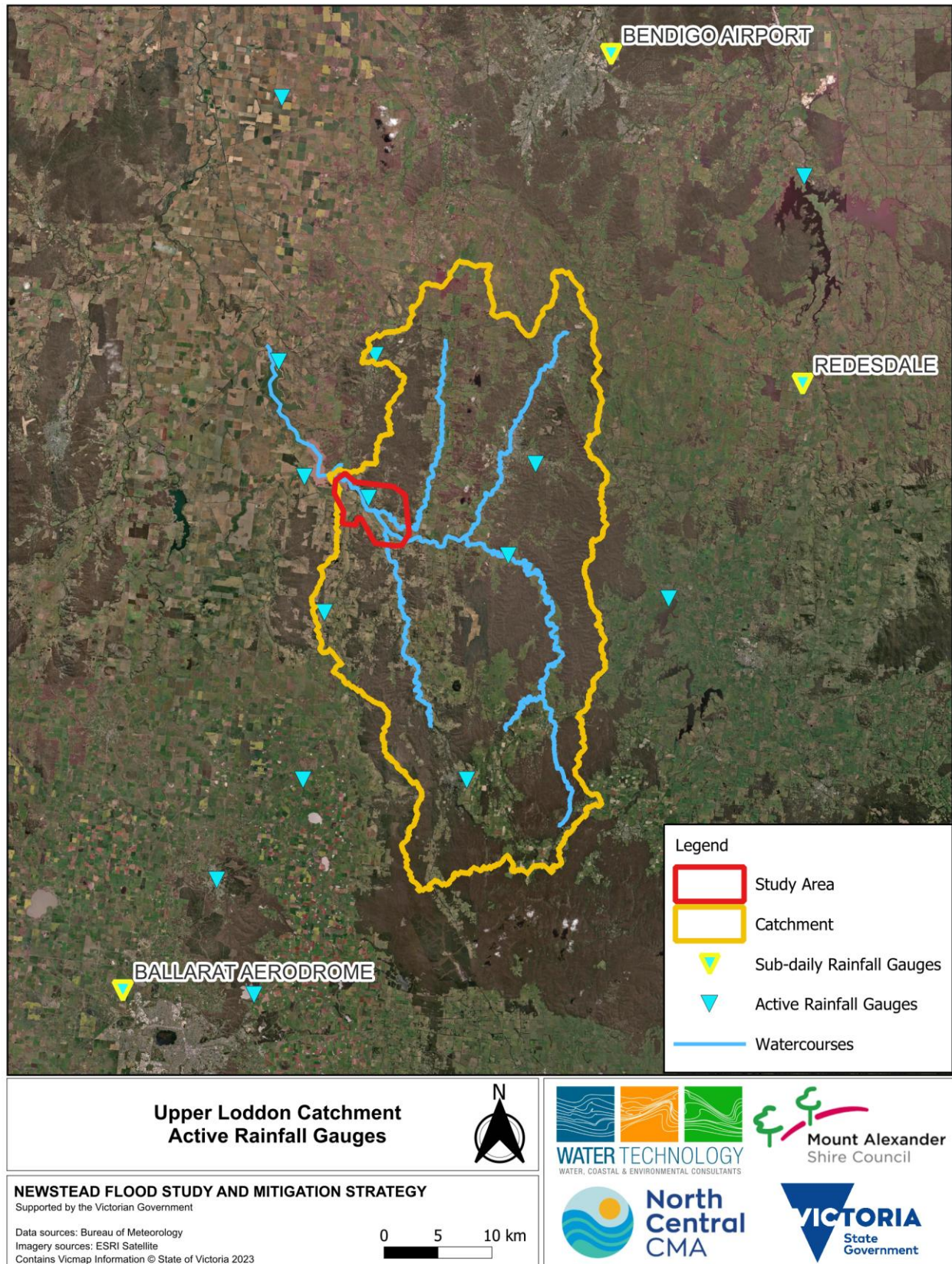


Figure 2-2 Daily and sub-daily rainfall stations near the study area



2.3 Historic floods

Newstead has a long history of flooding since European settlement in the 1850s. The current Newstead Local Flood Guide (developed by the SES) lists records of historic floods occurring in 1890, 1909 and 1934. Additionally, investigations of historic news articles identified significant flood events in Newstead in 1870, and 1916.

More recently, Newstead experienced significant flood events in 2000, 2010, 2011, 2016 and 2022. The recent flood event in 2022 is well documented and noted as the largest flood on record at the Loddon River at Newstead gauge. Table 2-3 details the total storm rainfall and duration at the Newstead rainfall gauge and the recorded flood level at the Loddon River gauge, together with an estimated flood magnitude.

Table 2-3 Total rainfall, peak flood level and associated flood event

Flood Event	Rainfall (Newstead)		Peak Flood Level (Loddon River at Newstead)	Approximate Flood AEP
	Rainfall (mm)	Duration (days)		
November 2010	123.6	4	5.60	20% - 10%
January 2011	180	6	5.90	10% - 5%
September 2016	124.2	10	5.70	20% - 10%
October 2022	68.8	3	6.12	5% - 2%

Several photographs taken during the 2010, 2011, 2016 and 2022 events collected by NCCMA, council and community members were used as of the calibration process, with a selection presented in Figure 2-3 to Figure 2-6 to highlight key roads and areas of the town which may be impacted in a flood event.



Figure 2-3 Pyrenees Highway west of the Loddon River, facing west, 1535 hours on 13 October 2022.



Figure 2-4 Brandt St/Hepburn-Newstead Rd intersection, captured at around 1400 hours on 14 September 2016.



Figure 2-5 Newstead residents sandbagging the Loddon River, January 2011



Figure 2-6 Intersection of Hepburn-Newstead Road and Pyrenees Highway, September 2010

2.4 Flood peak travel time

Definitive information on the time it takes for flooding to develop (i.e. to arrive at a location) following the onset of heavy rain and the time it takes for the flood peak to be reached is highly variable. The magnitude and timing of a flood is dependent on several factors including the attributes of the rainfall/storm event and antecedent conditions. Flood peak timing for all gauges within the Upper Loddon River catchment was assessed against existing gauge data to identify the time from the onset of heavy rainfall to develop an understanding of lag times from rainfall to gauge rise and catchment travel times.

Table 2-4 shows the typical travel time along the Loddon River and its tributaries, based on the flood events in 2022, 2016, 2011 and 2010. The rainfall temporal pattern and storm duration or the combination of both can impact the magnitude of flooding at Newstead. The table highlights that reliance on upstream gauges provides limited warning time, and that more warning time can be provided by monitoring rainfall gauges within the catchment.

Table 2-4 Timing of peak flow at Newstead

From	To	Typical travel time
Start of rainfall (catchment)	Start of Loddon River rising in Newstead	11 hours to 4 days
Start of Loddon River rising in Newstead	Peak Loddon River level at Newstead	11 to 54 hours
Peak Loddon River level at Vaughan	Peak Loddon River level at Newstead	0 to 5 hours
Peak Muckleford Creek level at Muckleford	Peak Loddon River level at Newstead	2 to 5 hours
Peak Larni Barramal Yaluk level at Yandoit	Peak Loddon River level at Newstead	0 to 6 hours

Additionally to analysing gauge data from historic events, the calibrated hydrology model developed as part of this study was utilised to estimate typical flood peak travel times. The modelled hydrographs at the Loddon River at Newstead gauge for the 1% AEP and 10% AEP rainfall events are shown in Figure 2-7 and Figure 2-8. The graphs show all modelled AEP events for durations between 12 hours and 168 hours for all ten temporal patterns. A total of 100 hydrographs were produced for each AEP. Also shown on the graphs is the critical duration and median temporal pattern peak flow at this location, selected in accordance with the recommendations of ARR.

The graphs show a significant range in peak flows and timing produced by rainfall depths of a specified AEP when that rain falls over different durations and temporal patterns within the duration. This illustrates the difficulty in accurately predicting flood peaks and timing from rainfall alone.

The graphs show that the modelled flood peaks can manifest around **10 to 20 hours** from the start of intense rainfall, with the majority of events peaking between 12 hours and 3 days from the start of the rainfall burst. Some events peak beyond 3 days from the start of rainfall, however these become rarer and may contain “embedded bursts” where rainfall intensity within an event increases for a short period of time.

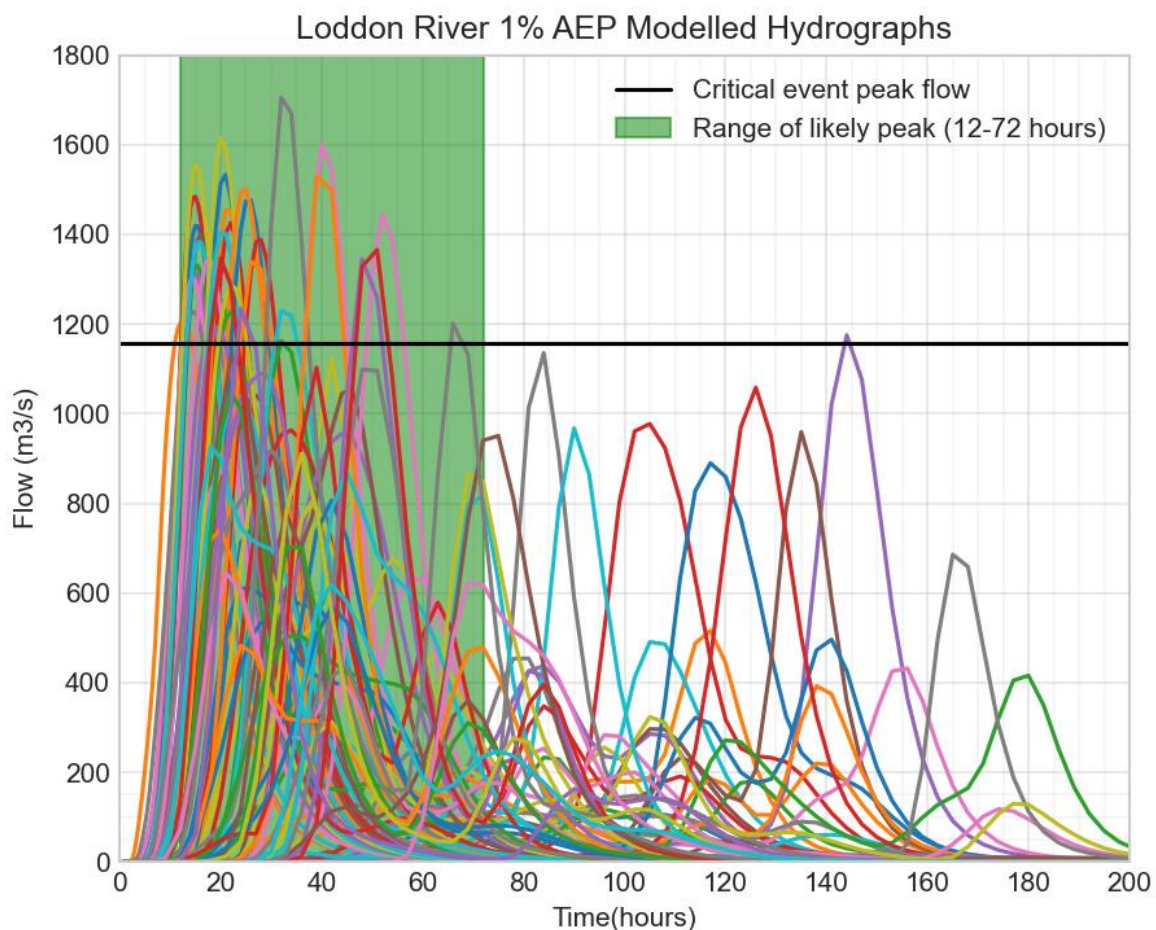


Figure 2-7 1% AEP hydrograph for all modelled rainfall events at Newstead

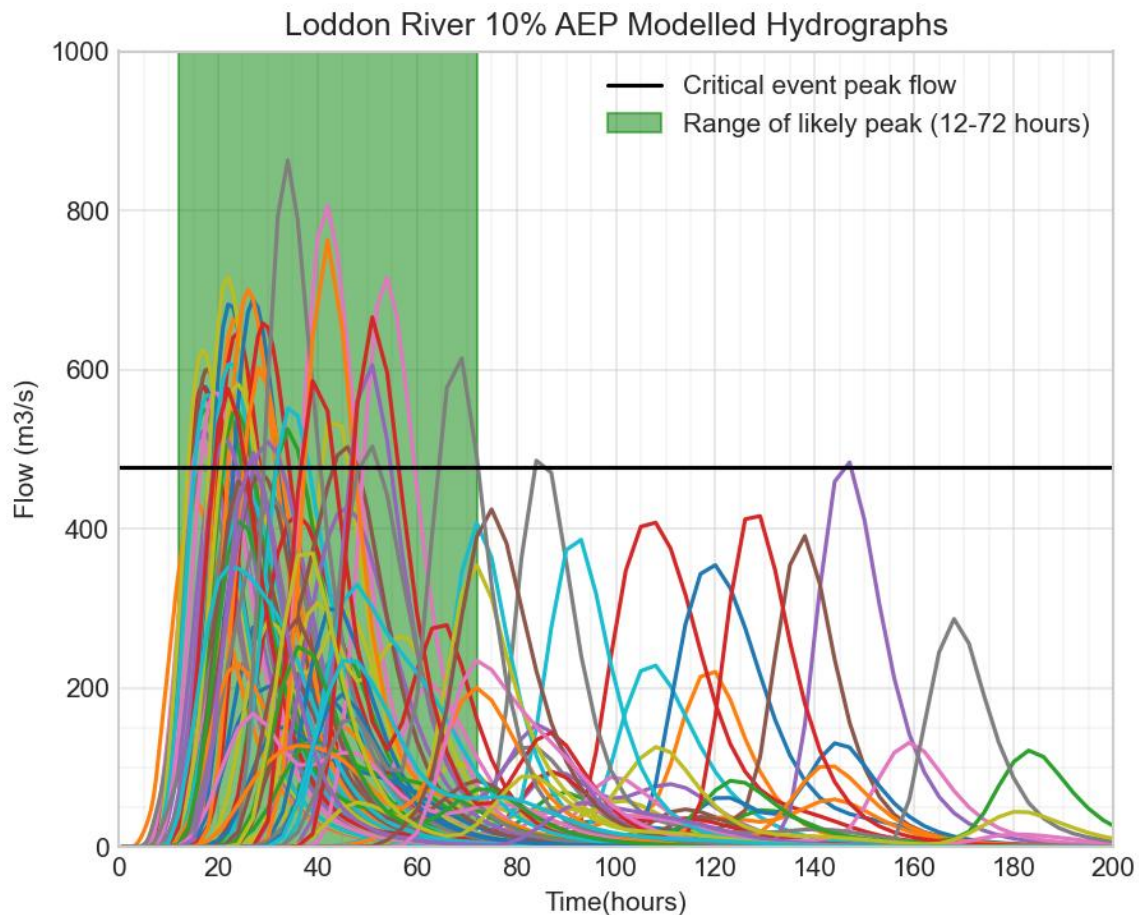


Figure 2-8 10% AEP hydrograph for all modelled rainfall events at Newstead

The lack of sub-daily rainfall gauges within the catchment increases the difficulty to estimate rainfall-runoff response times. However, the sub-daily rainfall stations located close to the catchment shown in Figure 2-2 can be monitored as an indicator to direct flood response activities.

The speed a flood travels along a waterway is largely dependent on antecedent conditions and the magnitude of the flood. A flood on a 'dry' watercourse will generally travel more slowly than a flood on a 'wet' watercourse (e.g. the first flood after a dry period will travel more slowly than the second flood in a series of floods).

In large floods, often water levels will rise reasonably quickly initially as flow predominately travels along the channel. The flood peak travels through the catchment a little slower as flow now spreads out on to the floodplain.

A range of factors including recent flood history, soil moisture and forecast weather conditions should be considered when using the following information to direct flood response activities.

The reality that a community at risk can be inundated before the peak of the flood should not be overlooked. In the past, efforts have concentrated on estimating and forecasting the time of the peak, however this can sometimes be detrimental. Messaging should focus on the expected extent and timing of inundation with respect to upstream areas and the broader floodplain. Flood warning messaging can focus on rainfall monitoring and forecasting ensuring predicting the likelihood of a flood, (i.e. a more general message).



2.5 Flood/No flood tool

The Intensity Frequency Duration (IFD) design rainfall data can be utilised along with forecast and observed rainfall data as an early flood warning tool. The data can be used to identify the likely magnitude of flooding and resulting consequences based on the predicted rainfall and rainfall which has occurred during an event. The Flood/No Flood tool in Figure 2-9 provides a graphical representation of the Intensity-Frequency-Duration relationships for various AEP events as presented in the Final Hydraulic Modelling Report (R04).

To use the table, plot the total rainfall depth against elapsed time since the start of the event. Exclude very light rain when determining the event start point. Plotting of rainfall data should occur periodically as the event progresses. The likelihood and potential severity of flooding can be estimated by checking the rainfall and adopting the nearest curve AEP event as being likely. The table displays intensity-frequency-duration data developed using statistical analysis of sub daily rainfall gauges, relevant gauges at Newstead being Bendigo Airport (81123), Ballarat Aerodrome (89002) and Redesdale (88051). The Flood/No Flood tool can be used in combination with these gauges and/or rainfall observed within the Loddon River catchment and at Newstead in particular.

It may be appropriate to step up or down a level depending on catchment antecedent conditions, for example if the rainfall for a 12 hour duration indicates a 5% AEP event will occur, but the catchment is dry with most farm dams empty, it may be appropriate to “step down” to a 10% AEP event or even lower. Similarly a very wet catchment will produce a greater response and may justify a “step up” in estimated AEP for response purposes.

The tool can provide a quick estimate as to whether there will be a flood and how severe that flood may be; however, it must be stressed that the tool cannot provide accurate flood predictions and should not be relied upon entirely. Should life or property be in danger a cautious approach should be taken.

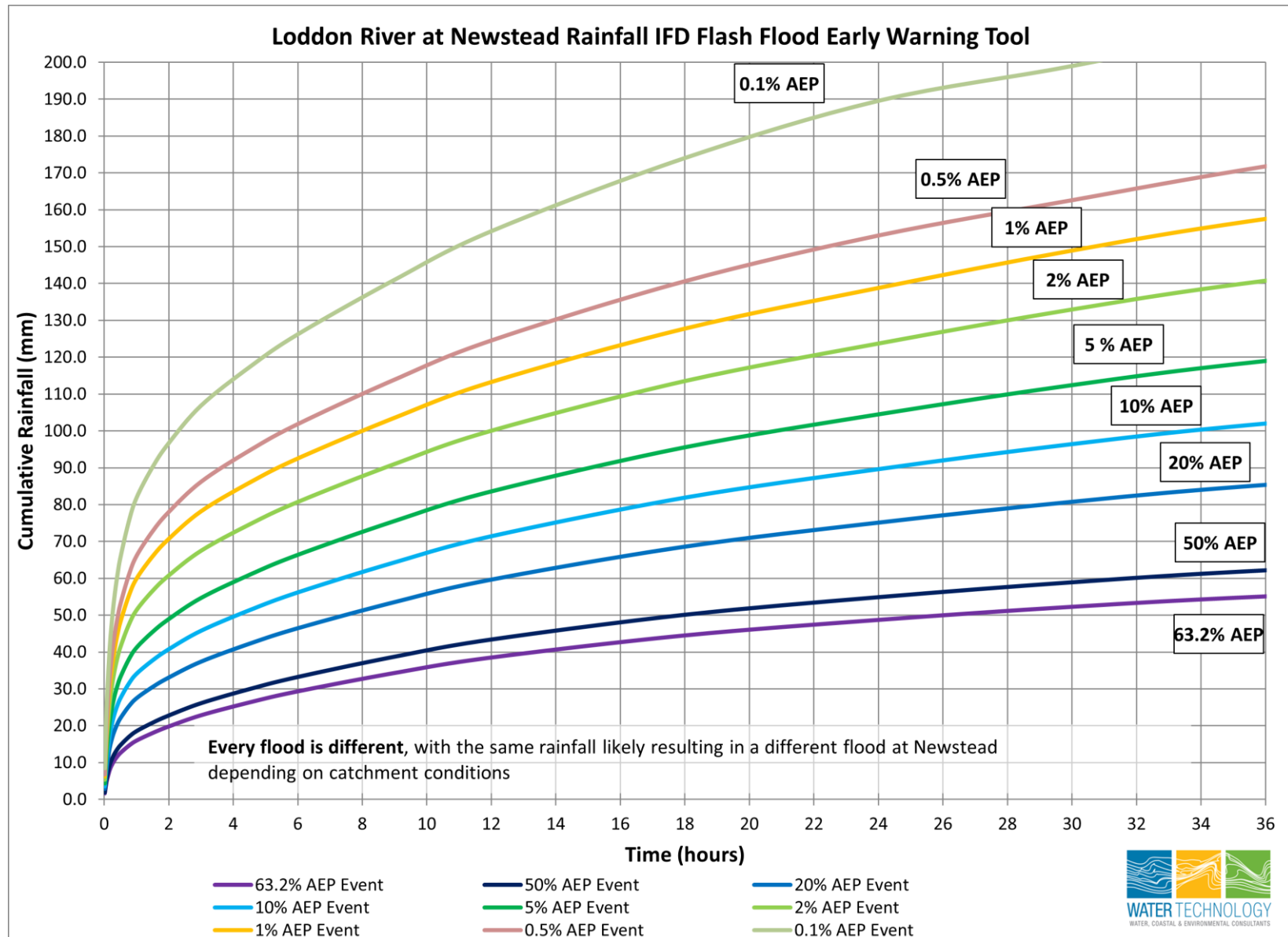


Figure 2-9 Loddon River at Newstead Flood/No flood tool



2.6 Flood class levels

Defined Flood Class Levels (FCLs) are available for the Loddon River at Newstead gauge and are detailed in Table 2-5. Flood mapping for the FLCs are presented in Appendix D. The Bureau of Meteorology's definitions of FCLs are presented below:³

Minor flooding

If the water level reaches the minor flood level, it causes inconvenience. Low-lying areas next to water courses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas flooding may affect some backyards and buildings below floor level as well as bicycle and pedestrian paths. In rural areas removal of livestock and equipment may be required.

Moderate flooding

If the water level reaches the moderate flood level, the area of inundation is larger. Main traffic routes may be affected. Some buildings may be affected above floor level. Evacuation may be required. In rural areas removal of livestock is necessary.

Major flooding

If the water level reaches the major flood level large areas are inundated. Many buildings may be affected above floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation may be required. Utility services may be affected.

Table 2-5 Current Flood Class Levels for Newstead

Flood Class	Level at Loddon River at Newstead gauge (m)	Level at Loddon River at Newstead gauge (mAHD)	Description
Minor	3	210.937	The minor flood level is well below the 20% AEP level at Newstead (5.49 m). Minor out of bank flooding from the Loddon River is observed upstream of Punt Road. Mia Mia Creek floods onto farmland north of Newstead and shallow outbreaks are observed along Green Gully Creek.
Moderate	4.5	212.437	The moderate flood level is also well below the 20% AEP level at Newstead (5.49 m). Out of bank flooding is observed along the Loddon River and Green Gully Creek in most of the study area, with the Pyrenees Highway overtopped by Green Gully Creek.
Major	5.6	213.537	The major flood level is in between the 20% and 10% AEP level at Newstead (5.49 m and 5.80 m respectively). Widespread out of bank flooding is expected along all waterways entering Newstead, with impacts to the Pyrenees Highway and Hepburn-Newstead Road as well as some residential streets. No properties are impacted above floor level.

³ <http://www.bom.gov.au/australia/flood/knowledge-centre/about-warning-service.shtml>



3 MUNICIPAL FLOOD AND STORM EMERGENCY PLAN (APPENDIX C) DOCUMENTATION

3.1 Warning time

Flooding at Newstead is caused by overbank flows from Loddon River and its tributaries near Newstead. The critical storm duration for the Loddon River, Muckleford Creek and Larni Barramal Yaluk ranges from 12 to 18 hours (for example, for a 1% AEP flood over an 18 hour storm duration, approximately 128 mm of rainfall would be observed), with shorter critical duration expected for the smaller tributaries Green Gully Creek, Mia Mia Creek and Green Gully (1.5 to 9 hours). Timing of peak flooding in the Newstead township is however likely to be within 12 hours to 3 days.

3.2 Roads affected

The main access roads to and from the township of Newstead include the Pyrenees Highway, Hepburn - Newstead Road, Creswick-Newstead Road and Maldon-Newstead Road. Table 3-1 outlines the roads where maximum depths exceed 0.3 m and the flood hazard classification becomes 'unsafe' for vehicles. These roads are shown in Appendix B with the comparison to the 1% AEP flood extent.

It should be noted that all access roads into Newstead become inundated, with Creswick-Newstead Road providing access the longest, up until the 2% AEP event.

Table 3-1 Roads with 'unsafe' inundation depth for each AEP (m)

Roads inundated	Design flood AEP (%)								
	20	10	5	2	1	0.5	0.2	0.1	0.05
Adair Street			0.47	2.05	2.38	2.49	2.61	2.71	2.83
Barkla Road									0.48
Bodles Road					0.36	0.42	0.57	0.62	0.67
Brandt Street		0.44	1.02	1.63	2.02	2.23	2.56	2.79	2.99
Cameron Road	1.30	1.39	1.51	1.76	1.92	2.00	2.11	2.20	2.27
Canrobert Street				1.66	2.24	2.47	2.76	2.93	3.11
Cemetery Road	1.73	2.49	3.02	3.52	3.85	4.03	4.32	4.52	4.70
Church Street			0.31	0.73	1.11	1.33	1.68	1.91	2.12
Clarke Lane	0.87	1.19	1.47	1.73	1.91	2.03	2.29	2.51	2.72
Clyde Street	0.44	0.52	0.63	0.83	0.96	1.03	1.13	1.21	1.28
Codrington Street			0.16	0.36	0.41	0.43	0.46	0.48	0.49
Creek Road	1.58	1.93	2.23	2.52	2.71	2.84	3.10	3.31	3.51
Creswick - Newstead Road					0.41	0.51	0.75	0.94	1.12
Daylesford - Newstead Road		0.36	0.94	1.55	1.94	2.15	2.49	2.71	2.91
Dundas Street	0.79	1.13	1.47	1.77	1.93	2.04	2.25	2.41	2.57
Fitzroy Street				0.53	1.25	1.52	1.85	2.05	2.24
Hepburn - Newstead Road	0.71	1.17	1.74	2.33	2.72	2.94	3.28	3.50	3.71
Hilliers Street				0.66	1.22	1.45	1.72	1.89	2.06



Roads inundated	Design flood AEP (%)								
	20	10	5	2	1	0.5	0.2	0.1	0.05
Layard Street	2.61	3.14	3.55	3.94	4.20	4.35	4.62	4.82	5.01
Maclaren Road	0.72	0.83	0.97	1.22	1.39	1.47	1.58	1.66	1.74
Maldon - Newstead Road				0.81	1.06	1.15	1.35	1.51	1.67
Mcnabb Road		0.96	1.49	1.89	2.27	2.48	2.82	3.05	3.25
Mia Mia Road								0.33	0.38
Newstead - Guildford Road					0.38	0.47	0.71	5.98	6.10
Palmerston Street	2.77	3.49	4.02	4.52	4.86	5.04	5.34	5.55	5.73
Panmure Street			0.54	2.12	2.47	2.58	2.71	2.80	2.95
Petersens Road	0.48	0.63	1.00	1.47	1.80	1.97	2.26	2.46	2.65
Punt Road	3.54	4.19	4.65	5.07	5.35	5.51	5.78	5.96	6.14
Pyrenees Highway	0.57	0.49	0.89	1.40	1.90	2.10	2.33	2.49	2.65
Recreation Avenue				1.03	1.66	1.88	2.15	2.32	2.49
Ruskis Place			0.45	2.14	2.71	2.94	3.22	3.40	3.57
Simpson Street	0.70	1.06	1.38	1.66	1.85	1.97	2.22	2.42	2.62
Tivey Street	0.44	0.79	1.09	1.38	1.57	1.70	1.96	2.16	2.36
Wyndham Street				0.38	0.54	0.61	0.67	0.80	0.98

3.3 Isolated areas

A number of areas are at risk of isolation due to access roads being inundated. The following list outlines these areas and the associated AEP:

- From the 20% AEP event, properties along the northern end of Simpson Street become inaccessible due to road depths above 0.3 m.
- From the 10% AEP event, the Pyrenees Highway begins to become inundated to unsafe levels (above 0.3 m) with parts of Newstead now isolated, but other access roads remain open. Properties on Brandt Street, 35 Campbell Street and 56 Punt Road become inaccessible.
- From the 2% AEP event, floodwater becomes deeper around the Newstead township. Many areas of central Newstead including along Layard Street, Recreation Avenue, Panmure Street, Canrobert Street, Ruskis Place, Hillier Street, Lyons Street and Maldon-Newstead Road become isolated, as well as the properties on Wyndham Street north of Maldon-Newstead Road.
- From the 1% AEP event, almost all properties in central Newstead both east and west of the levee bank are inaccessible due to road depths.

Creswick-Newstead Road and Maldon-Newstead Road provide access to the edge of the township in events rarer than the 1% AEP, however all properties within Newstead are isolated from accessing the dry areas of these roads.

3.4 Property inundation

Floor level survey of 148 buildings was captured within the study area, including 24 commercial and 124 residential buildings. These buildings were selected for floor level survey based on the preliminary flood



modelling undertaken during this study. It should be noted that there were minor limitations within the floor level survey data captured, in that only the main residential dwelling or commercial building was captured for each property, outbuildings were not surveyed. The number of properties flooded below floor indicates a property with a residential dwelling or commercial building on it. This does not include parcels of land which are flooded but do not have an associated building i.e. vacant lots, farm paddocks etc.

To classify the flood risk at a property scale, two categories were used, these were:

- Property flooded below floor.
 - This indicates the property is within the flood extent, however the flood level is below the surveyed floor level.
- Property flooded above floor.
 - This indicates the property is within the flood extent and the flood level is above the surveyed floor level.

The existing conditions 1% AEP flood extent and the properties flooded above floor during the range of modelled design events are shown in Figure 3-1 and Figure 3-2. The table provided in Appendix C outlines the properties flooded above and below floor, a summary can be found in Table 3-2. The values in the tables were obtained using flood level minus surveyed floor level for each modelled event. Therefore, a positive value indicates the property is flooded above floor, while a negative value refers to property flooded below floor.

Table 3-2 Summary of property inundation

Design flood event AEP	No. of properties flooded below floor - <u>residential</u>	No. of properties flooded above floor - <u>residential</u>	No. of properties flooded below floor - <u>commercial</u>	No. of properties flooded above floor - <u>commercial</u>
20%	2	0	0	0
10%	6	0	0	0
5%	32	2	1	0
2%	24	67	1	17
1%	21	81	3	18
0.5%	27	86	3	18
0.2%	24	98	5	19
0.1%	20	103	5	19
0.05%	18	106	4	20
PMF	0	124	0	24

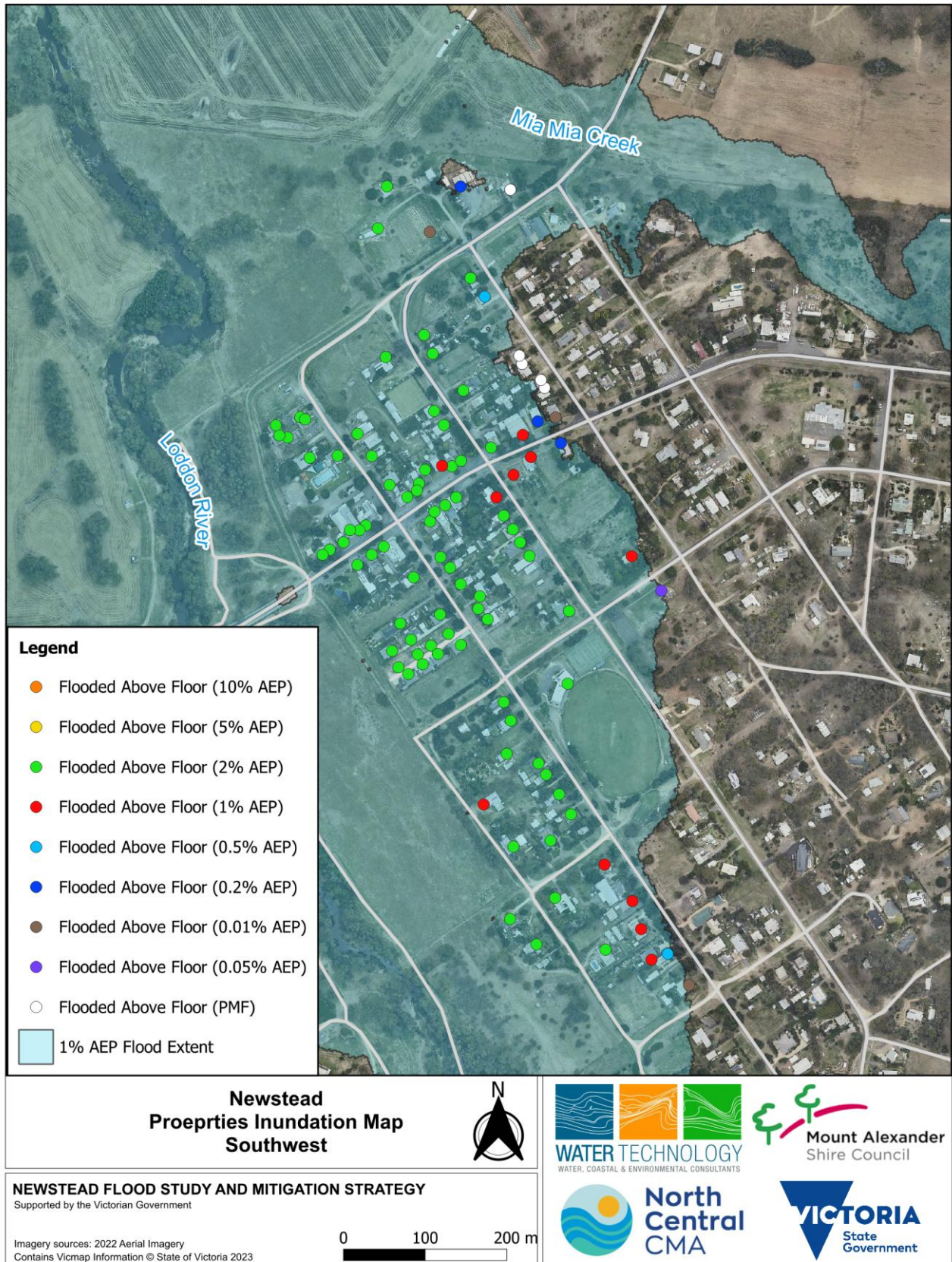


Figure 3-1 Properties flooded above floor – Northeast Newstead

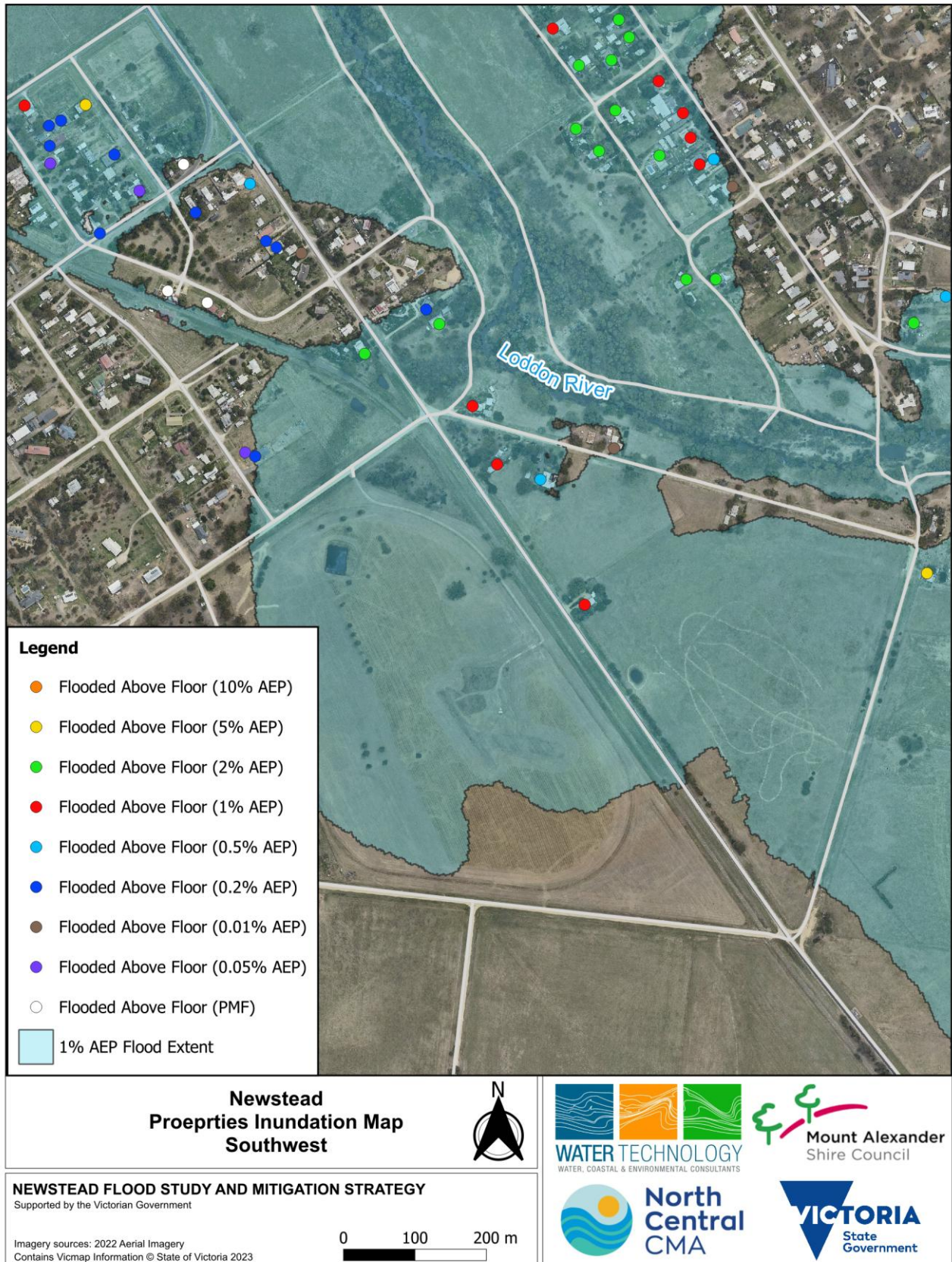


Figure 3-2 Properties flooded above floor – Southwest Newstead



3.5 Flood Intelligence Card

The flood mapping was produced to identify the consequences of flooding for various design events. Combined with the flood/no flood forecasting procedure described in Section 2.5, the flood consequence table allows emergency services and Council to quickly understand the likely impacts of flooding and plan accordingly. The Flood Intelligence Card below describes the key flooding consequences across the study area for each design event.

The table was developed to be read from top to bottom, with each subsequent larger magnitude event reporting on the incremental changes in consequences. For example, if the reader wants to understand the consequences of a 1% AEP event, then the flood characteristics should be read for the 20%, 10%, 5%, 2% and 1% AEP events in succession. It is also recommended that the reader refer to the PDF maps provided with this study. There is a separate map for each modelled design event, providing peak flood depths, extents and water surface elevations for each flood event.

While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Further, the hydrologic and hydraulic modelling that underpins much of the intelligence detailed below is informed by several assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series at <https://knowledge.aidr.org.au/resources/manual-series/> and in particular in Manual 21 “Flood Warning”.

A guidance on sandbagging document published by VICSES is available in the SES sandbagging guide here detailed in Appendix A.



FLOOD INTELLIGENCE CARD – Loddon River at Newstead GAUGE, Newstead

Version 2 -December 2025

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

This Flood Intelligence Card publication is presented by the Victoria State Emergency Service for the purpose of disseminating emergency management information. The contents of the information have not been independently verified by the Victoria State Emergency Service. No liability is accepted for any damage, loss or injury caused by errors or omissions in this information or for any action taken by any person in reliance upon it. Scan the QR code for the current levels for this gauge.

Insert QR Code of
URL for current
level of gauge and
remove this box



LOCATION:	Newstead	MAP REFERENCE:	
CURRENT LEVEL:	http://www.bom.gov.au/fwo/IDV67207/IDV67207.588004.plt.shtml	MINOR FLOOD LEVEL:	3.0
STREAM:	Loddon River	MODERATE FLOOD LEVEL:	4.5
GAUGE NUMBER:	588004 (BoM) 407215 (VIC)	MAJOR FLOOD LEVEL:	5.6
GAUGE ZERO:	207.937 mAHD	LEVEE HEIGHT:	6.5
GAUGE TYPE:	Telemetered	HIGHEST RECORDED FLOOD:	6.12 (October 2022)
River Height (m)	Annual Exceedance Probability (% AEP)	Expected Inundation and Consequences	Actions
3.00	Minor Flood Level 	Properties likely Impacted - No property likely impacted above or below floor Community Infrastructure Likely Impacted - No community infrastructure likely impacted Essential Infrastructure Likely Impacted - No essential infrastructure likely impacted Tourism / Recreation Likely Impacted - No tourism/recreation likely impacted Roads Flooded - Clarke Lane, Clyde Street, Maclaren Road, Tivey Street Roads flooded above 0.3m - Cameron Road, Cemetery Road, Creek Road, Layard Street, Palmerston Street, Punt Road	Continue to monitor rainfall and water levels.
4.50	Moderate Flood Level 	Properties likely Impacted - No property likely impacted above or below floor Community Infrastructure Likely Impacted - No community infrastructure likely impacted Essential Infrastructure Likely Impacted - No essential infrastructure likely impacted Tourism / Recreation Likely Impacted - No tourism/recreation likely impacted Roads Flooded - Roads included in the events above and Bodles Road, Pyrenees Highway, Clarke Lane, Dundas Street, Hepburn - Newstead Road Roads flooded above 0.3m - Roads included in the events above. - Clyde Street, Maclaren Road	- Continue to monitor rainfall and water levels. - Consider early evacuation of vulnerable residents in areas likely to be inundated/isolated. - If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the Major event and / or sandbagging buildings. - Place 'water over road' signs on Pyrenees Highway and Hepburn - Newstead Road



5.49	20% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 2 Properties in Total 2 properties flooded below floor (2 Simpson Street and 2 Palmerston Street) and 0 commercial properties. - Properties along the northern end of Simpson Street become isolated due to road depths above 0.3 m. Community Infrastructure Likely Impacted - No community infrastructure likely impacted Essential Infrastructure Likely Impacted - No essential infrastructure likely impacted Tourism / Recreation Likely Impacted - No tourism/recreation likely impacted Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail) - Cameron Road, Cemetery Road, Clarke Lane, Clyde Street, Creek Road, Dundas Street, Hepburn - Newstead Road, Layard Street, Maclaren Road, Palmerston Street, Petersens Road, Punt Road, Pyrenees Highway (0.57m), Simpson Street, Tivey Street. Flood depth on these roads is above 0.3m	- Continue to monitor rainfall and water levels. - Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated. - If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the 10% AEP event and / or sandbagging buildings. - Close Pyrenees Highway and Hepburn - Newstead Road.
5.60	Major Flood Level 	Properties likely Impacted 4 residential properties flooded below floor (2 Simpson Street, 2 Palmerston Street, 2C Wyndham Street and 13 Campbell Street) and 0 commercial properties. - Properties along the northern end of Simpson Street become isolated due to road depths above 0.3 m. Community Infrastructure Likely Impacted - No community infrastructure likely impacted Essential Infrastructure Likely Impacted - No essential infrastructure likely impacted Tourism / Recreation Likely Impacted - No tourism/recreation likely impacted Roads Flooded - Roads included in the events above. - Daylesford - Newstead Road Roads flooded above 0.3m - Roads included in the events above. Brandt Street, Mcnabb Road, Petersens Road, Pyrenees Highway, Simpson Street, Tivey Street	- Continue to monitor rainfall and water levels. - Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated. - If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in larger events and / or sandbagging buildings. - Place 'water over road' signs on Daylesford - Newstead Road - Close Pyrenees Highway and Hepburn - Newstead Road.
5.70	September 2016 Flood Level Peak	2 residential dwellings located within flood extent	



5.80	10% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 6 Properties in Total • Properties included above • 2 additional properties are flooded below floor including 2 residential properties (35 Campbell Street, 1A Tivey Street) and 0 commercial properties • Properties on Brandt Street, 35 Campbell Street and 56 Punt Road become inaccessible. • Pyrenees Highway begins to become inundated to unsafe levels (above 0.3 m) with parts of Newstead now isolated Community Infrastructure Likely Impacted • No community infrastructure likely impacted Essential Infrastructure Likely Impacted • No essential infrastructure likely impacted Tourism / Recreation Likely Impacted • No tourism/recreation likely impacted Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail) • Roads included in the events above. • Roads are isolated and flood depth on the street is above 0.3m: Brandt Street, Daylesford - Newstead Road (0.36m), McNabb Road	• Continue to monitor rainfall and water levels. • Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated • If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the 5% AEP event and / or sandbagging buildings. • Close Daylesford-Newstead Road. Previously closed roads to remain closed.
6.10	5% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 35 Properties in Total • Properties included above • 2 properties flooded above floor: 2 Simpson Street and 56 Punt Road • 28 additional properties are flooded below floor including 27 residential properties: 1, 2A Brandt Street, 1,4 Layard Street, 1, 3 Tivey Street, 11, 13, 14, 15, 17, 18, 19, 28, 30, 32, 34, 40A Panmure Street, 18 Campbell Street, 1A, 2 Recreation Avenue, 2, 3, 4, 5 Ruskis Place, 2B Wyndham Street • and 1 additional commercial property (2 Panmure Street) Community Infrastructure Likely Impacted • No community infrastructure likely impacted Essential Infrastructure Likely Impacted • No essential infrastructure likely impacted Tourism / Recreation Likely Impacted • No tourism/recreation likely impacted Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail) • Roads included in the events above. • Roads are isolated and flood depth on the street is above 0.3m: Adair Street, Ruskis Place	• Continue to monitor rainfall and water levels. • Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated • If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the 2% AEP event and / or sandbagging buildings. • Plan for the event of the Newstead CFA Fire Station being isolated and/or inundated. • “Water over road” signs should be in place on Creswick-Newstead Road, and Newstead-Guildford Road.



6.12	October 2022 Flood Level Peak	- The Maldon Newstead Road bridge across Mia Mia Creek was the only road into Newstead not impacted by flood waters – this includes flooding outside the Newstead area - Sandbagging of the levee prevented levee from overtopping 11 residential dwellings located within flood extent	
6.38	2% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 109 Properties in Total - Properties included above 1 additional commercial property is flooded below floor (29 Lyons Street) 17 additional commercial properties are flooded above floor (14, 22 Hilliers Street and 27 Lyons Street, 4, 5, 6, 8, 9, 11, 12, 13, 14, 23-25 Lyons Street, 2, 21A Panmure Street) 17 additional residential properties are flooded below floor (1 Simpson Street, 13 Adair Street, 14 Hillier Street, 18, 18A, 21 Lyons Street, 2A Wyndham Street, 38, 38A, 42 Panmure Street, 5 Canrobert Street, 3, 5, 8 Tivey Street, 11A Campbell Street, 3 Codrington Street, 2A Palmerston Street, 4 Recreation Avenue) 65 additional residential properties are flooded above floor (13, 18 Campbell Street, 1 Canrobert Street, 1, 3, 4, 9, 10, 12, 16, 20, 20A Hilliers Street, 1, 3, 10, 15, 17, 19, 23-25 Lyons Street, 1, 2, 3, 4, 5, 6, 8 Ruskis Place, 2, 5, 7, 8, 9, 9A, 11, 12, 13, 14, 14A, 14B, 15, 17, 18, 19, 24, 24A, 26, 28, 30, 32, 34, 40A Panmure Street, 1, 2, 4, 6, 7 Layard Street, 1A, 2 Recreation Avenue, 2, 2B, 2C Wyndham Street, 2 Palmerston Street) - Many areas of central Newstead including along Layard Street, Recreation Avenue, Panmure Street, Canrobert Street, Ruskis Place, Hillier Street, Lyons Street and Maldon-Newstead Road become isolated, as well as the properties on Wyndham Street north of Maldon-Newstead Road. Community Infrastructure Likely Impacted - Newstead CFA Fire Station is flooded above floor, flood depth is 0.7m - Community Hall is flooded above floor, flood depth is 1.1m - Mechanics Institute is flooded above floor, flood depth is 1.0m Essential Infrastructure Likely Impacted - No essential infrastructure likely impacted Tourism / Recreation Likely Impacted - Newstead Cricket Club is flooded above floor, flood depth is 0.7m - Crown Hotel is flooded above floor; flood depth is 1.1m Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail) - Roads included in the events above. - Roads are isolated and flood depth on the street is above 0.3m: Canrobert Street, Codrington Street, Fitzroy Street, Maldon - Newstead Road (0.81m), Recreation Avenue, Wyndham Street	- Continue to monitor rainfall and water levels. - Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated - If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the 1% AEP event and / or sandbagging buildings. - Water over road” signs should be in place on Creswick-Newstead Road, and Newstead-Guildford Road - Close Maldon - Newstead Road.



6.54	1% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 123 Properties in Total • Properties included above • 3 additional commercial properties flooded below floor (2 Canrobert Street, 6 Tivey Street, 6 Creswick-Newstead Road) • 1 additional commercial property flooded above floor (29 Lyons Street) • 10 additional residential properties are flooded below floor (2 Brandt Street, 20-22, 31 Lyons Street, 4 Creswick-Newstead Road, 4 Wyndham Street, 40, 44 Panmure Street, 9 Church Street, 6A, 9, 11Tivey Street) • 14 additional residential properties are flooded above floor (1, 2A Brandt Street, 35 Campbell Street, 5 Canrobert Street, 14 Hillier Street, 18, 18A, 21 Lyons Street, 38, 38A, 40, 42 Panmure Street, 4 Recreation Avenue, 1 Tivey Street) Community Infrastructure Likely Impacted • Newstead CFA Fire Station is flooded above floor, flood depth is 1.23m • Community Hall is flooded above floor, flood depth is 1.57m • Mechanics Institute is flooded above floor, flood depth is 1.54m Essential Infrastructure Likely Impacted • No essential infrastructure likely impacted Tourism / Recreation Likely Impacted • Newstead Cricket Club is flooded above floor, flood depth is 1.31 m • Crown Hotel is flooded above floor; flood depth is 1.6m Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail) • Roads included in the events above. • Roads are isolated and flood depth on the street is above 0.3m: Bodles Road, Creswick - Newstead Road (0.41m), Newstead - Guildford Road (0.38m).	• Continue to monitor rainfall and water levels. • Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated • If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the 0.5% AEP event and / or sandbagging buildings. • Close Creswick - Newstead Road and Newstead-Guildford Road. Previously closed roads to remain closed.
6.65	0.5% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 134 Properties in Total • Properties included above • 10 additional residential properties are flooded below floor (10 Wyndham Street, 33 Lyons Street, 46 Panmure Street, 6, 8,10, 12, 14 Campbell Street, 1, 3 Creswick-Newstead Road) • 5 additional residential properties are flooded above floor (2 Brandt Street, 44 Panmure Street, 4 Wyndham street, 2A Palmerston Street, 2 Campbell Street) Community Infrastructure Likely Impacted • Newstead CFA Fire Station is flooded above floor, flood depth is 1.45m • Community Hall is flooded above floor, flood depth is 1.76m • Mechanics Institute is flooded above floor, flood depth is 1.74m Essential Infrastructure Likely Impacted • No essential infrastructure likely impacted Tourism / Recreation Likely Impacted • Newstead Cricket Club is flooded above floor, flood depth is 1.55 m • Crown Hotel is flooded above floor; flood depth is 1.8m Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail) • Roads included in the events above.	• Continue to monitor rainfall and water levels. • Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated • If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the 0.2% AEP event and / or sandbagging buildings. • Previously closed roads to remain closed.



		Roads are isolated and flood depth on the street is above 0.3m: Barkla Road	
6.87	0.2% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 146 Properties in Total - Properties included above 3 additional commercial property flooded below floor (2, 8A Tivey Street, 16 Simpson Street) 1 additional commercial property flooded above floor (6 Creswick-Newstead Road) 8 additional residential properties are flooded below floor (10 Tivey Street, 12,14, 16 Wyndham Street, 2 Creswick-Newstead Road, 3-7 Brandt Street, 3 Dundas Street, 1 Clyde Street) 10 additional residential properties flooded above floor (1 Simpson Street, 1 Creswick-Newstead Road, 8, 10, 11A Campbell Street, 11 Adair Street, 9 Church Street, 20-22, 31 Lyons Street, 1A Tivey Street) Community Infrastructure Likely Impacted - Newstead CFA Fire Station is flooded above floor, flood depth is 1.7m - Community Hall is flooded above floor, flood depth is 2.0m - Mechanics Institute is flooded above floor, flood depth is 2.0m Essential Infrastructure Likely Impacted - No essential infrastructure likely impacted Tourism / Recreation Likely Impacted - Newstead Cricket Club is flooded above floor, flood depth is 1.8 m - Crown Hotel is flooded above floor; flood depth is 2.0m - Newstead Railway Arts Hub is flooded below floor Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail) - Roads included in the events above.	- Continue to monitor rainfall and water levels. - Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated - If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the 0.1% AEP event and / or sandbagging buildings. - Previously closed roads to remain closed.
7.04	0.1% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 147 Properties in Total - Properties included above 1 additional residential property flooded below floor (48 Panmure Street) 5 additional residential properties are flooded above floor (12 Campbell Street, 3-7 Brandt Street, 33 Lyons Street, 46 Panmure Street, 2A Wyndham Street) Community Infrastructure Likely Impacted - Newstead CFA Fire Station is flooded above floor, flood depth is 1.9m - Community Hall is flooded above floor, flood depth is 2.2m - Mechanics Institute is flooded above floor, flood depth is 2.1m Essential Infrastructure Likely Impacted - No essential infrastructure likely impacted Tourism / Recreation Likely Impacted - Newstead Cricket Club is flooded above floor, flood depth is 1.9 m - Crown Hotel is flooded above floor; flood depth is 2.2m - Newstead Railway Arts Hub is flooded below floor Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail)	- Continue to monitor rainfall and water levels. - Consider early evacuation of vulnerable residents in areas likely to be inundates/isolated - If further inundation likely, implement evacuation plan and / or removal of furniture etc from buildings likely to be flooded over-floor in the 0.05% AEP event and / or sandbagging buildings. - Previously closed roads to remain closed.



		Roads included in the events above.	
7.22	0.05% AEP Flood Level	Properties likely Impacted (Refer to property table in this appendix for more detail) 148 Properties in Total - Properties included above 1 additional commercial property is flooded above floor (2 Canrobert Street) 3 additional residential properties are flooded above floor (4 Creswick-Newstead Road, 7 Church Street, 5 Tivey Street) Community Infrastructure Likely Impacted - Newstead CFA Fire Station is flooded above floor, flood depth is 2.1m - Community Hall is flooded above floor, flood depth is 2.3m - Mechanics Institute is flooded above floor, flood depth is 2.3m Essential Infrastructure Likely Impacted - No essential infrastructure likely impacted Tourism / Recreation Likely Impacted - Newstead Cricket Club is flooded above floor, flood depth is 2.1 m - Crown Hotel is flooded above floor; flood depth is 2.4m - Newstead Railway Arts Hub is flooded below floor Roads Flooded (Roads in red are DTP operated roads) (Refer to roads table in this appendix for more detail) Roads included in the events above.	



4 SUMMARY

Several flood intelligence products have been developed to improve flood response capability for Newstead and the Loddon River, including a flood impact summary table, flood peak timing estimates and the development of a quick “Flood/No Flood” tool designed to estimate the magnitude of flooding based on observed rainfall. The report should be used as a reference document during flood events to confirm flood response actions required.

Much of the flood intelligence information contained in this report will be included in a draft revision of the MASC MFSEP for SES and Council approval. It is recommended the flood intelligence information is incorporated into council and/or SES community education programs to improve flood awareness.



APPENDIX A VICSES SANDBAGGING GUIDE





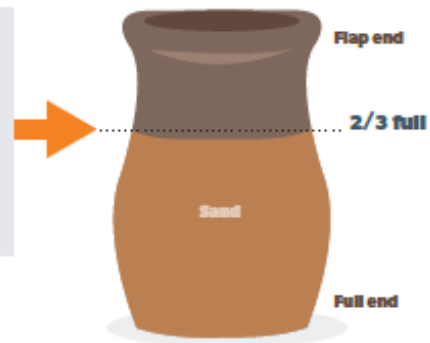
Sandbagging

Protecting your home

Sandbags won't stop the water completely, but can reduce the amount of water entering your home.

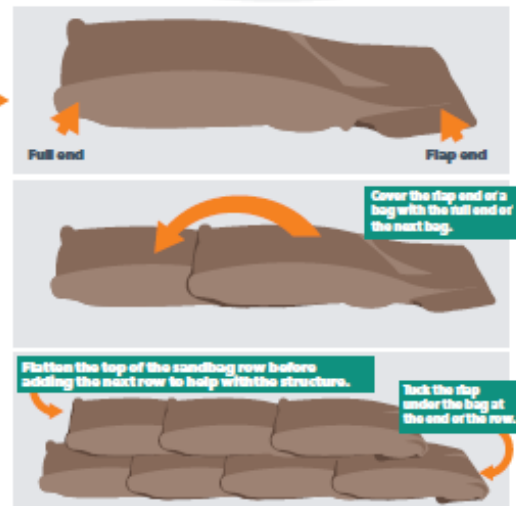
How do I fill a sandbag?

- Only use sand to fill hessian bags. Do not use dirt.
- Only fill sandbag two-thirds full.
- Do not over fill the sandbag as it will be too heavy to carry.
- Do not tie the top of the sandbag.
- Take care when filling and lifting the sandbag, to avoid injury.



How do I lay sandbags?

- Lay sandbags like brickwork. Stagger rows so that the joins do not line up.
- Start at one end and work to the other end.
- Ensure the unfilled part of the bag is covered by the next bag.
- Tuck flap under the bag at the end of the row.
- If the sandbag wall is going to be more than five (5) bags high, you will need to lay two (2) rows wide.



Where do I place the sandbags?

- Place sandbags in plastic bags to cover drainage holes in home (e.g. showers, toilets, sinks) to stop back flow of water.
- Place a small wall across doorways, at least the height of the expected water level. Be careful not to trap yourself inside.
- If available, plastic sheeting may be used under sandbags to reduce the seepage.



What do I do once I have finished with the sandbags?

- Sturdy gloves should be worn when handling wet sandbags as they can contain chemicals, waste and diseases.
- Sandbags that have been in contact with floodwater need to be thrown away.
- Contact your local council to find out how to dispose of your sandbags safely.



Sandbags and sand

Preparing your home

Having sandbag supplies ready can assist you before a flooding emergency occurs.



What supplies do I need to sandbag my home?

- Sandbags
- Sand
- Plastic sheeting
- Gloves and safety goggles
- Shovel or hand scoop

Where can I purchase these supplies?

- Many sandbag supplies can be purchased from hardware stores or garden centers.
- VICSES do not routinely supply sandbags to households.
- During floods, sandbag distribution points may be established in flood-affected areas.



How many sandbags will I need and how much sand?

- Most homes can be protected by less than 25 sandbags.
- The number of sandbags will depend on your local flood risk and availability.
- Sandbags are filled 2/3 full which requires around 15-20kgs of sand per bag.

How do I store my sand and sandbags?

- Filled sandbags only have a short shelf life.
- It is recommended to store sandbags empty.
- Sandbags should be stored in a cool dry area away from UV light.
- Sand should be kept dry and can be stored in water-resistant containers or under a tarp.
- Sand is heavy - ensure it is stored so it can be moved safely.



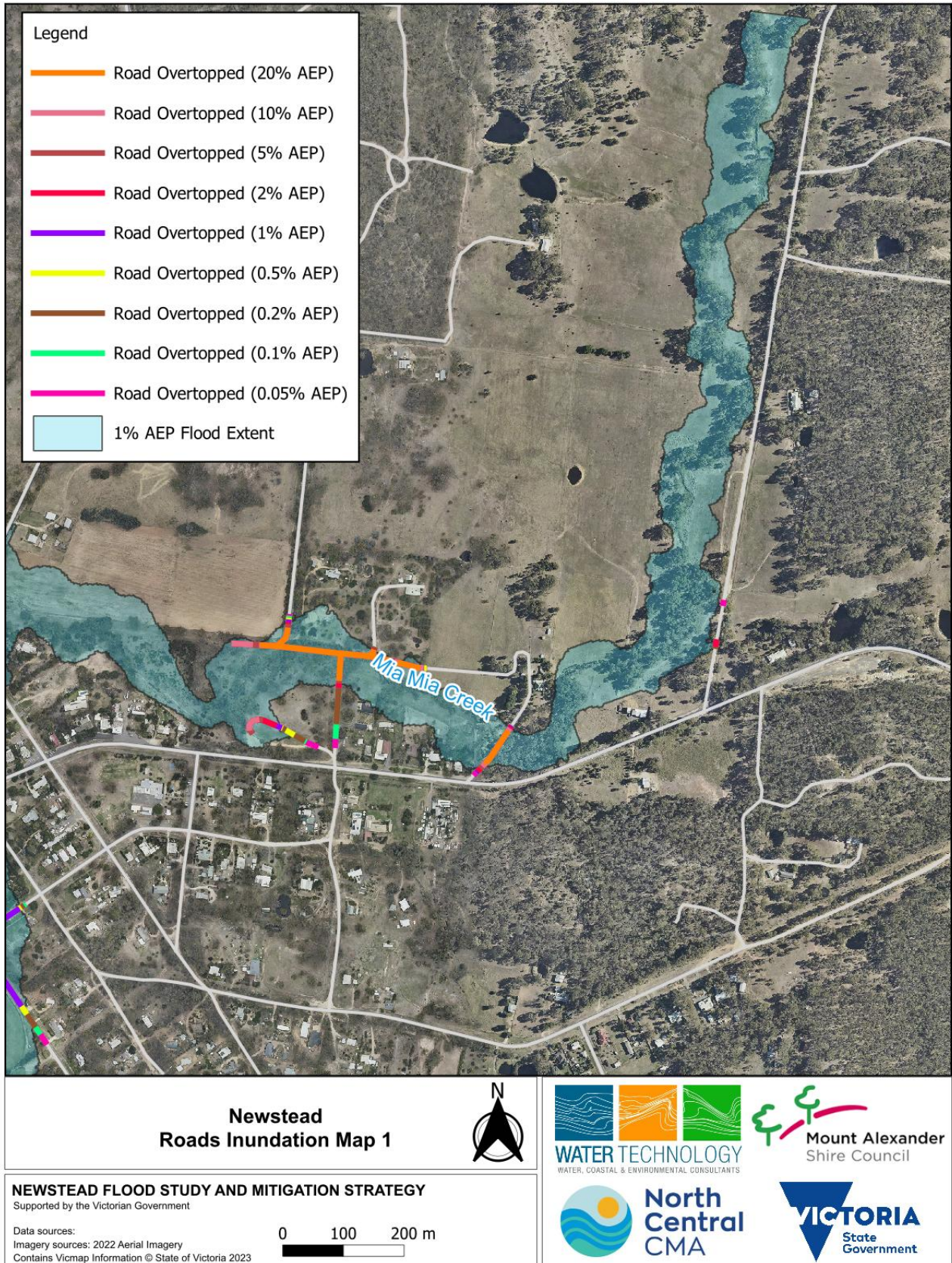
When should I sandbag my home?

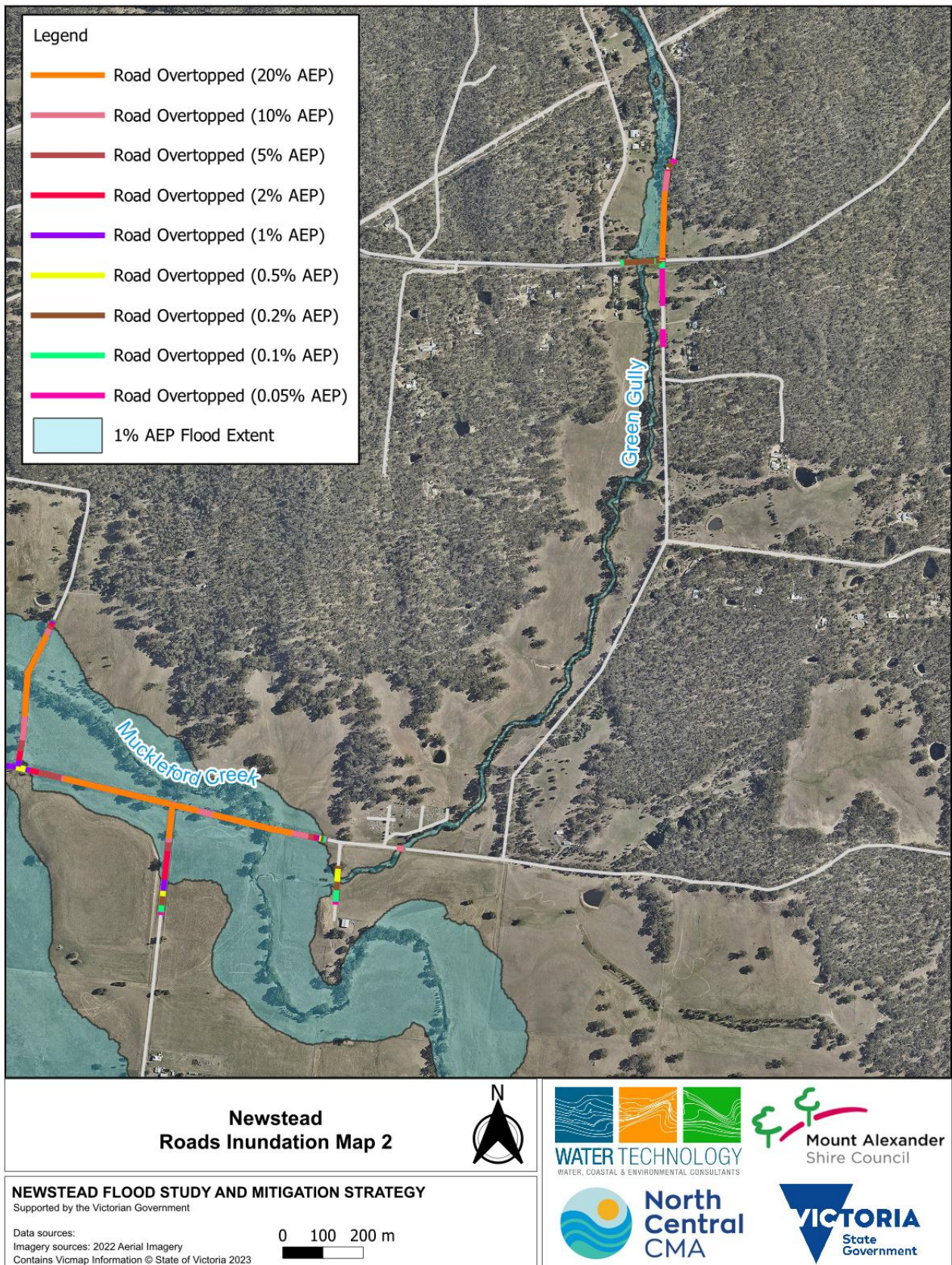
- **You** are best placed to decide if there is a need to sandbag your home, based on local knowledge and past flood events.
- Monitor your local conditions. Stay up-to-date with weather forecasts and warnings by downloading the **BOM Weather** and **VicEmergency** apps, or call the VicEmergency Hotline on 1800 226 226.
- If you think you are at risk, do not wait for an official warning to act.

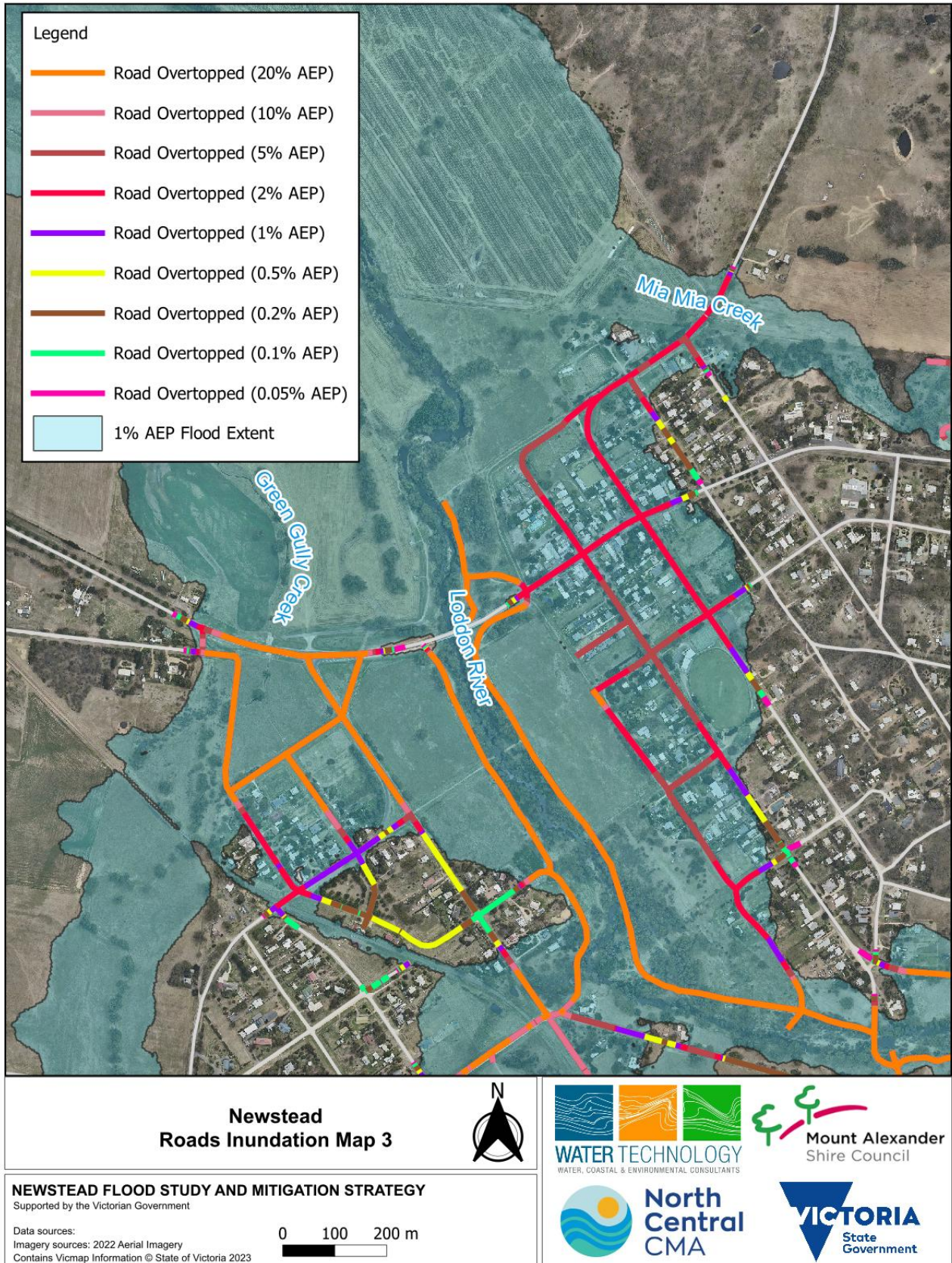


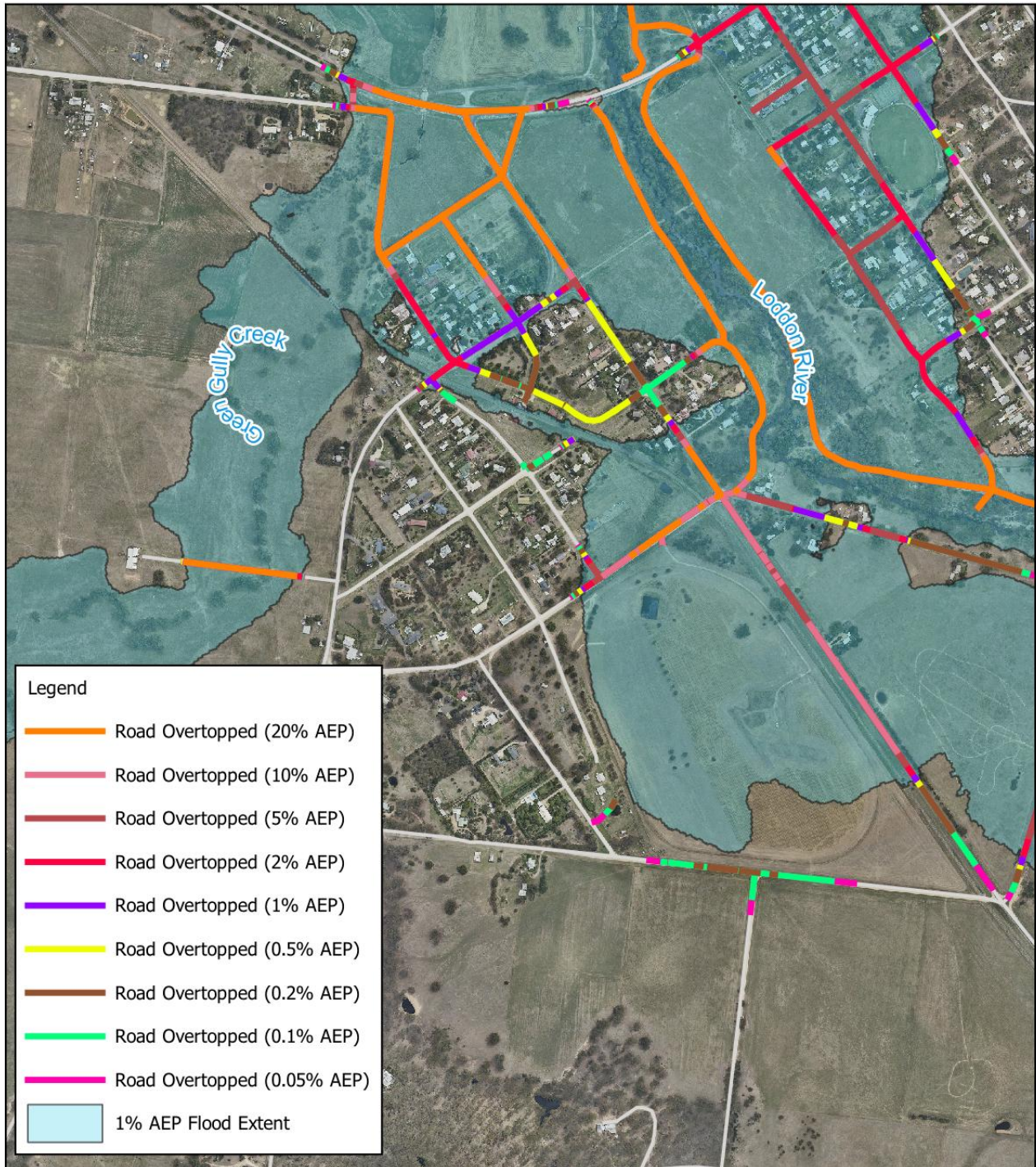
APPENDIX B ROAD INUNDATION MAPPING











**Newstead
Roads Inundation Map 4**

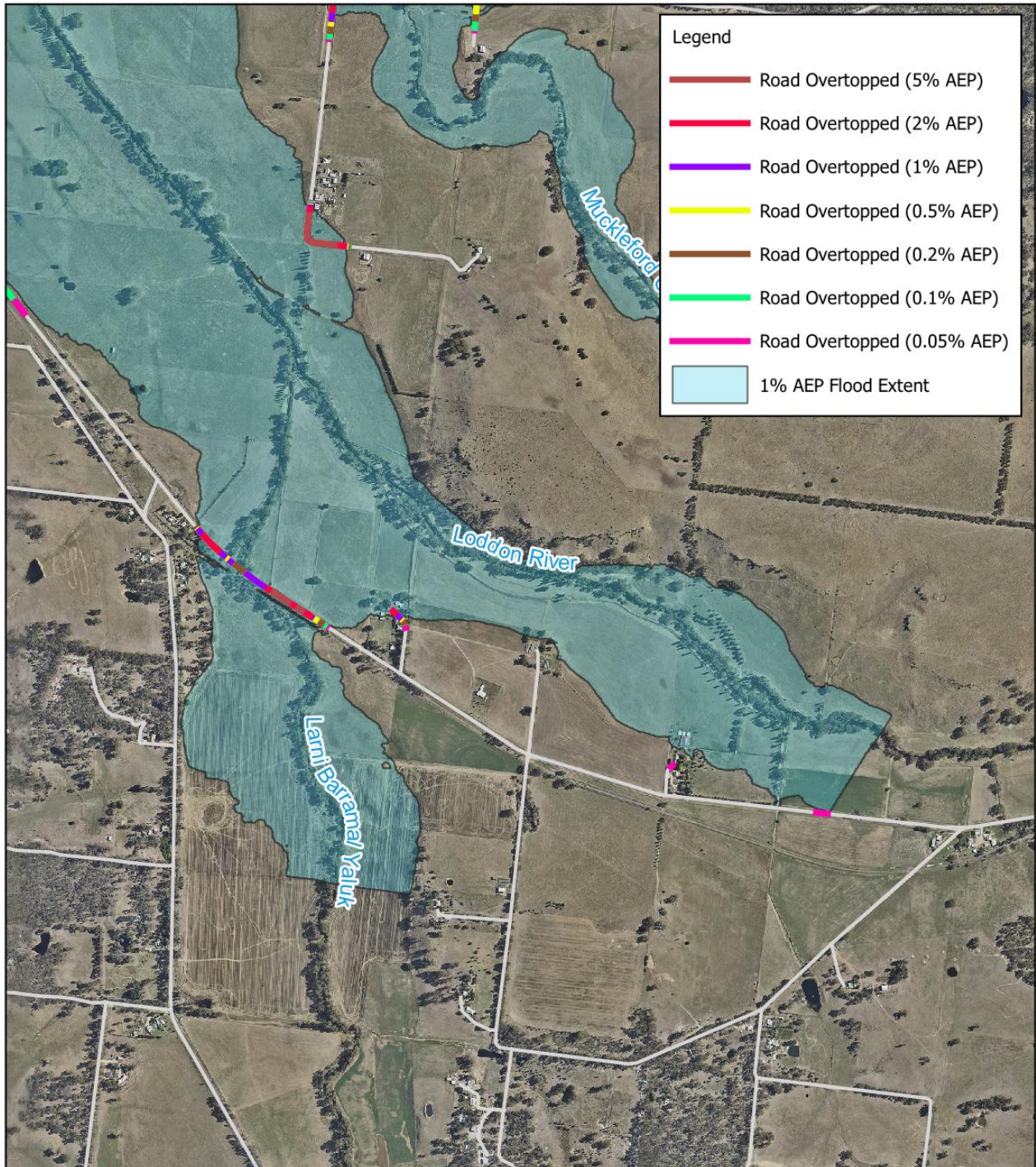


NEWSTEAD FLOOD STUDY AND MITIGATION STRATEGY
Supported by the Victorian Government

Data sources:
Imagery sources: 2022 Aerial Imagery
Contains Vicmap Information © State of Victoria 2023

0 100 200 m





**Newstead
Roads Inundation Map 5**

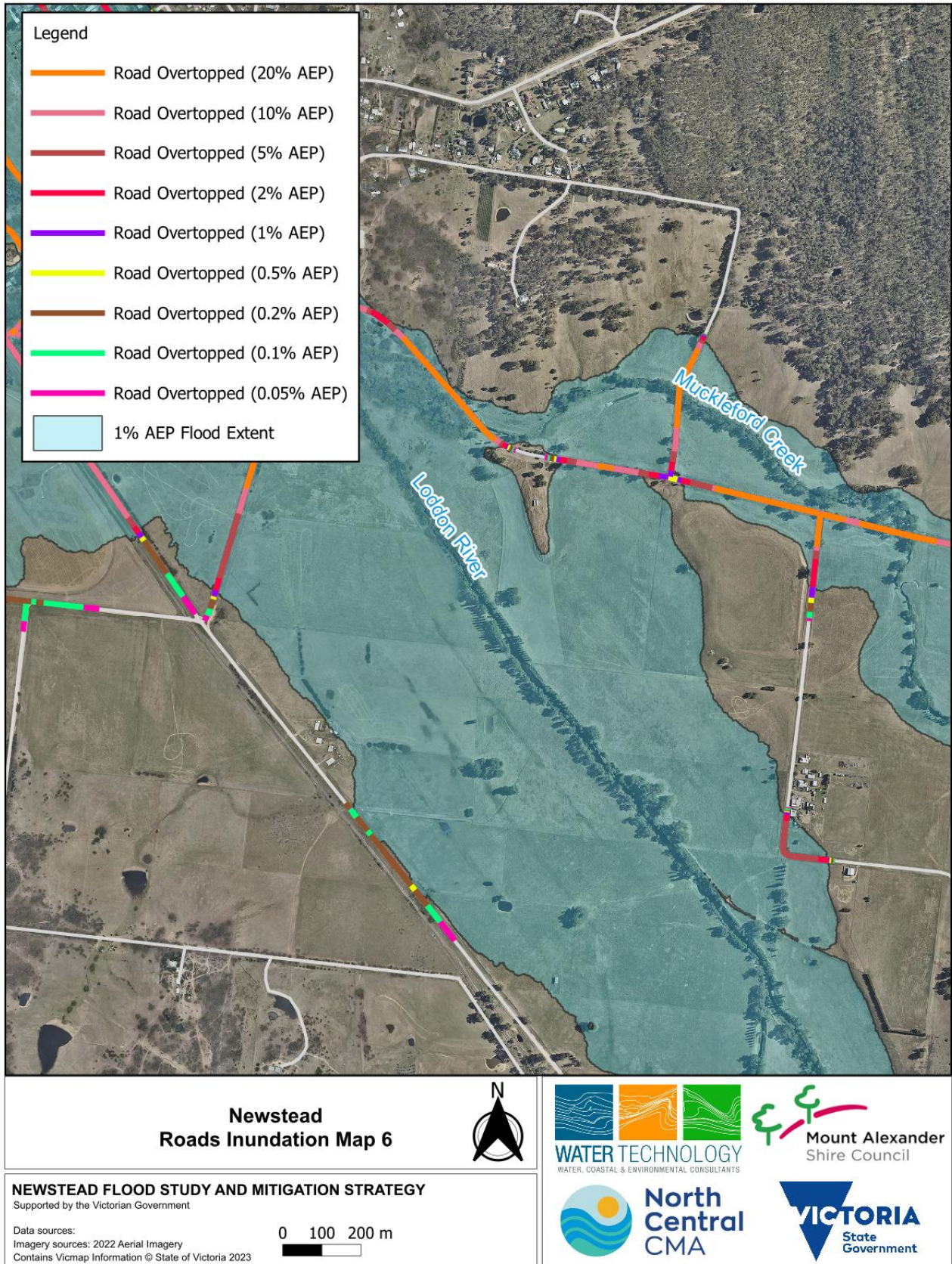


NEWSTEAD FLOOD STUDY AND MITIGATION STRATEGY
Supported by the Victorian Government

Data sources:
Imagery sources: 2022 Aerial Imagery
Contains Vicmap Information © State of Victoria 2023

0 100 200 m







APPENDIX C ROAD AND PROPERTY INUNDATION TABLES







APPENDIX D FLOOD CLASS LEVEL MAPPING



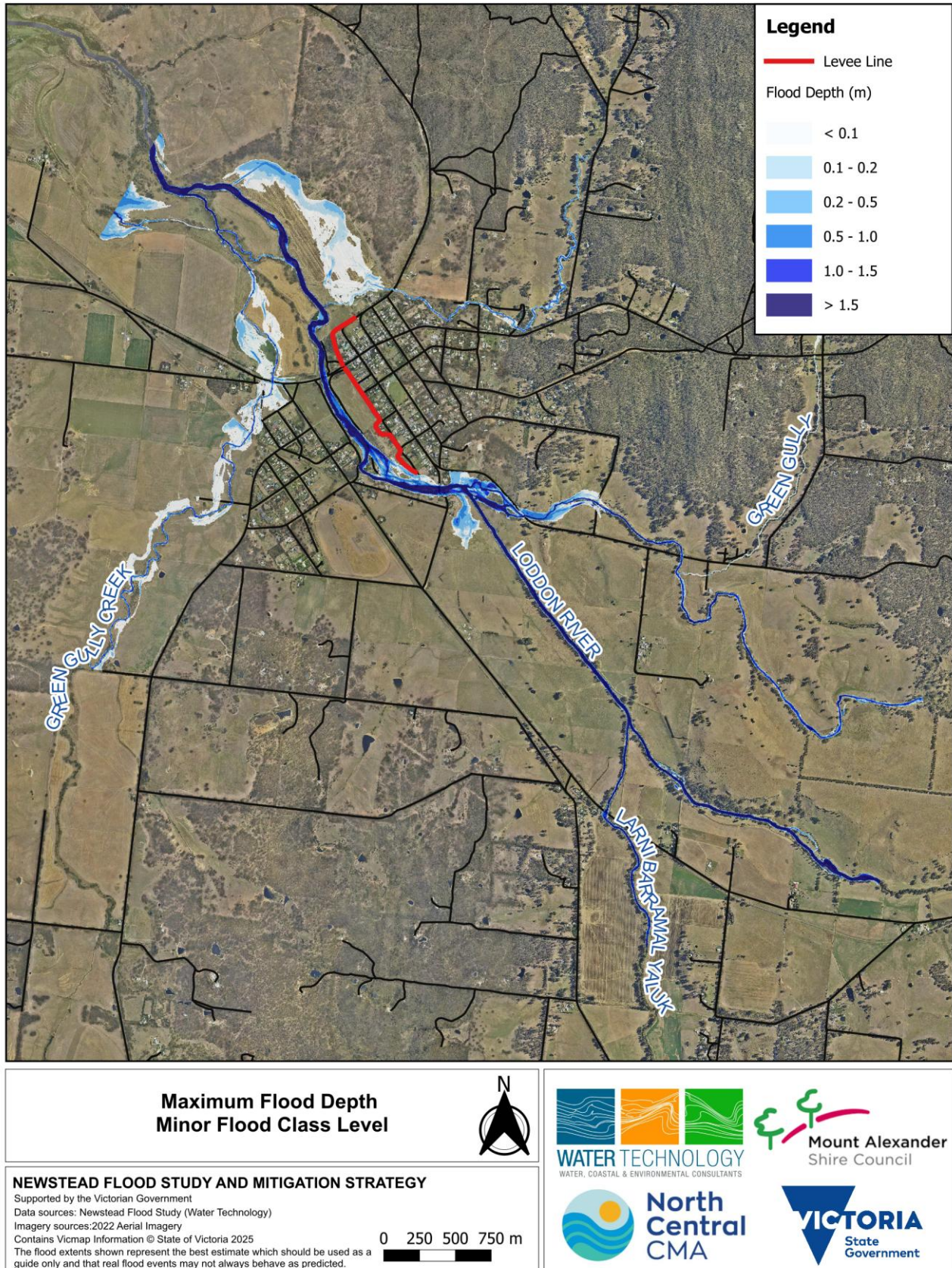


Figure 4-1 Minor Flood Maximum Depth

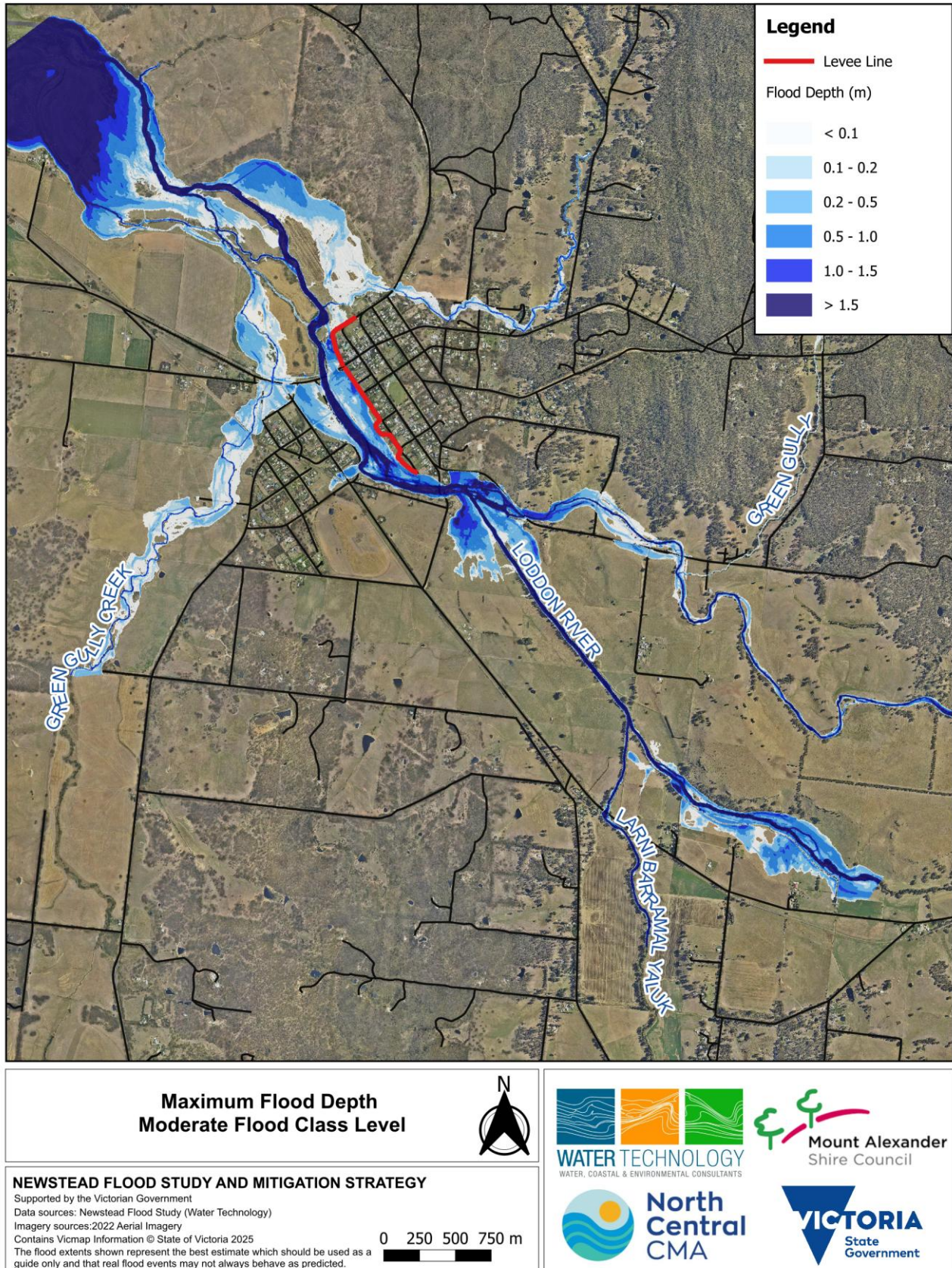


Figure 4-2 Moderate Flood Maximum Depth

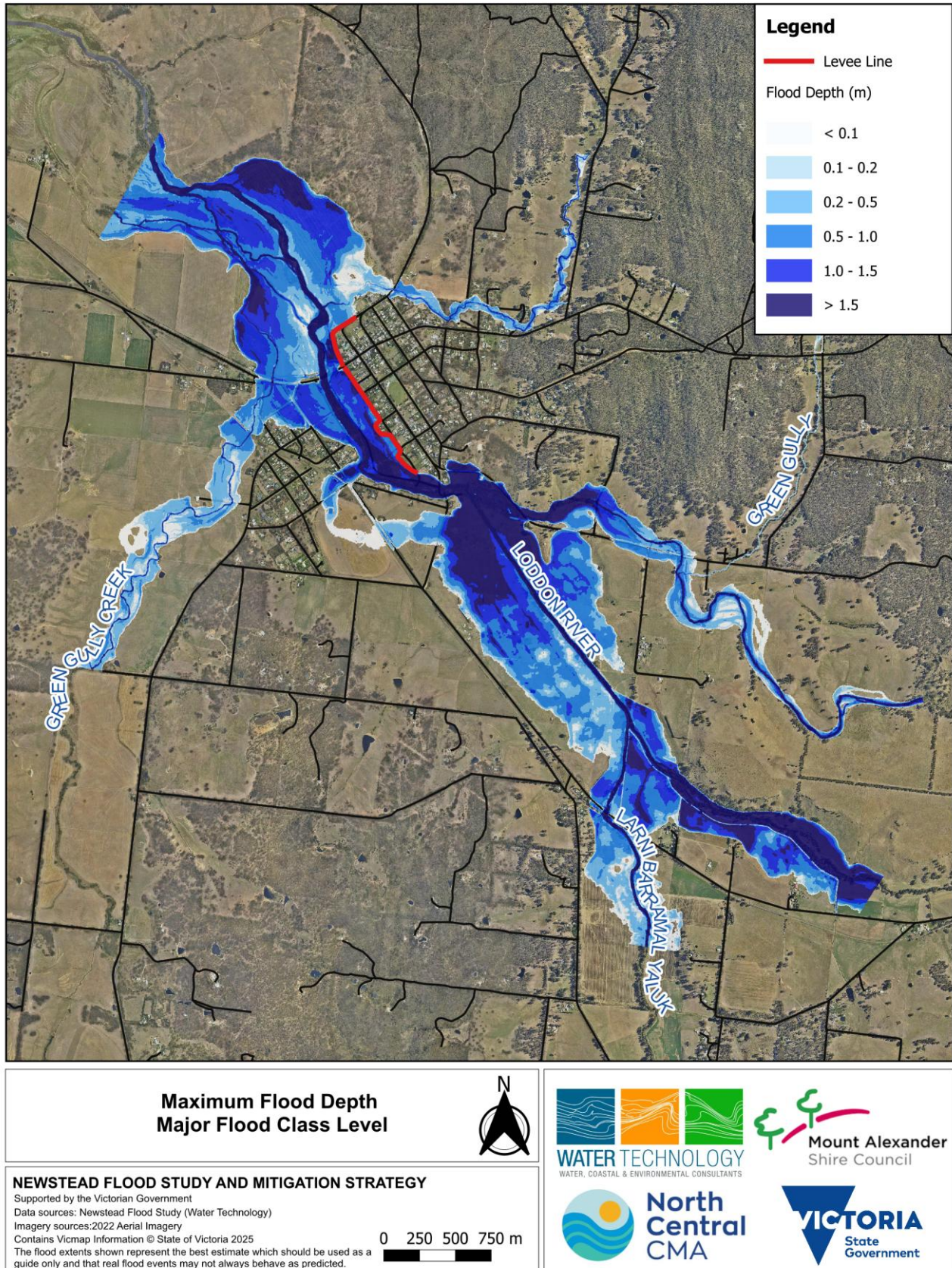


Figure 4-3 Major Flood Maximum Depth

Melbourne

15 Business Park Drive
Notting Hill VIC 3168

Brisbane

Level 5, 43 Peel Street
South Brisbane QLD 4101

Perth

Level 1, 21 Adelaide Street
Fremantle WA 6160

Wangaratta

First Floor, 40 Rowan Street
Wangaratta VIC 3677

Wimmera

597 Joel South Road
Stawell VIC 3380

Darwin

5/5 Goyder Road
Parap NT 0820

Sydney

Suite 3, Level 1, 20 Wentworth Street
Parramatta NSW 2150

Adelaide

1/198 Greenhill Road
Eastwood SA 5063

New Zealand

7/3 Empire Street
Cambridge New Zealand 3434

Geelong

51 Little Fyans Street
Geelong VIC 3220

Gold Coast

Suite 37, Level 4, 194 Varsity Parade
Varsity Lakes QLD 4227

Sunshine Coast

Office #4 of the Regatta 1 Business Centre
2 Innovation Parkway
Birtinya QLD 4575

1300 198 413



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