Flood Intelligence and Flood Warning Assessment Report

Lexton Flood Management Plan

Pyrenees Shire Council

6 August 2025

Document Status

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Project Details

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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 acknowledge the Jardwadjali and Djab Wurrung Peoples as the Traditional Custodians of the waters and lands on which this 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*

6 August 2025

Douglas Gowans
Director Assets and Development Services
Pyrenees Shire Council
5 Lawrence Street, Beaufort, Victoria 3373

Dear Douglas

Lexton Flood Management Plan

Please see the attached the flood intelligence and flood warning assessment report. This document also includes Municipal Flood Emergency Plan (MFEP) documentation. Flood intelligence and flood warning information is presented in a format consistent with the Pyrenees Shire Council MFEP. Information from this report should be used to update the MFEP and be used during future floods to inform emergency response actions.

If you have any questions regarding this report don't hesitate to contact me.

Yours sincerely

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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 be relatively small. A 1% AEP flood has a low probability of occurrence or being exceeded; it would be fairly rare but it would be of extreme magnitude.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level. Introduced in 1971 to eventually supersede all earlier datums.
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 and limb 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.

1 INTRODUCTION

1.1 Overview

Water Technology was commissioned by Pyrenees Shire Council (PSC) to undertake the Lexton Flood Investigation. The investigation produced detailed flood mapping and other outputs for the Lexton township and determined flows for the upstream catchment. The study area is presented in Figure 1-1.

The study produced reliable flood intelligence for use in emergency management, an assessment of the current flood impact/exposure in terms of annual average damages (AAD) caused by flooding in Lexton, investigation of structural and non-structural mitigation options and made recommendations for establishing a flood warning system for the town.

This report is one of a series documenting the outcomes of the Lexton Flood Management Plan. The report details the flood intelligence and warning outputs, providing inputs for the Municipal Flood Emergency Plan. Each reporting stage is shown below:

- R01 – Data Review and Validation
- R02 – Model Calibration Report
- R03 – Flood Damages and Mitigation Assessment Report
- **R04 – Flood Intelligence, Flood Warning and MFEP Documentation – This report**
- R05 – Final Summary Report

1.2 Study area

Lexton is a small township located in Victoria, Australia, with a population of approximately 285 (based on the 2021 census data). Lexton is located approximately 45 km northwest of Ballarat and 90 km southwest of Bendigo. Lexton Creek flows to the west of Lexton, into Burnbank Creek, the main waterway flowing through Lexton. The Burnbank Creek catchment is approximately 45 km^2, consisting of native bushland and agricultural areas, as shown in Figure 1-2. Burnbank Creek flows in a northerly direction towards Bet Bet Creek and then into the Loddon River north of Eddington.

Lexton most recently experienced flooding in October 2022, which caused widespread damage and disruption to the township. The flooding resulted in closed roads, isolating the town, preventing access in and out of the area. These flood events caused millions of dollars in damage and greatly affected the prosperity of the community, including impacting major events and deterring visitors.

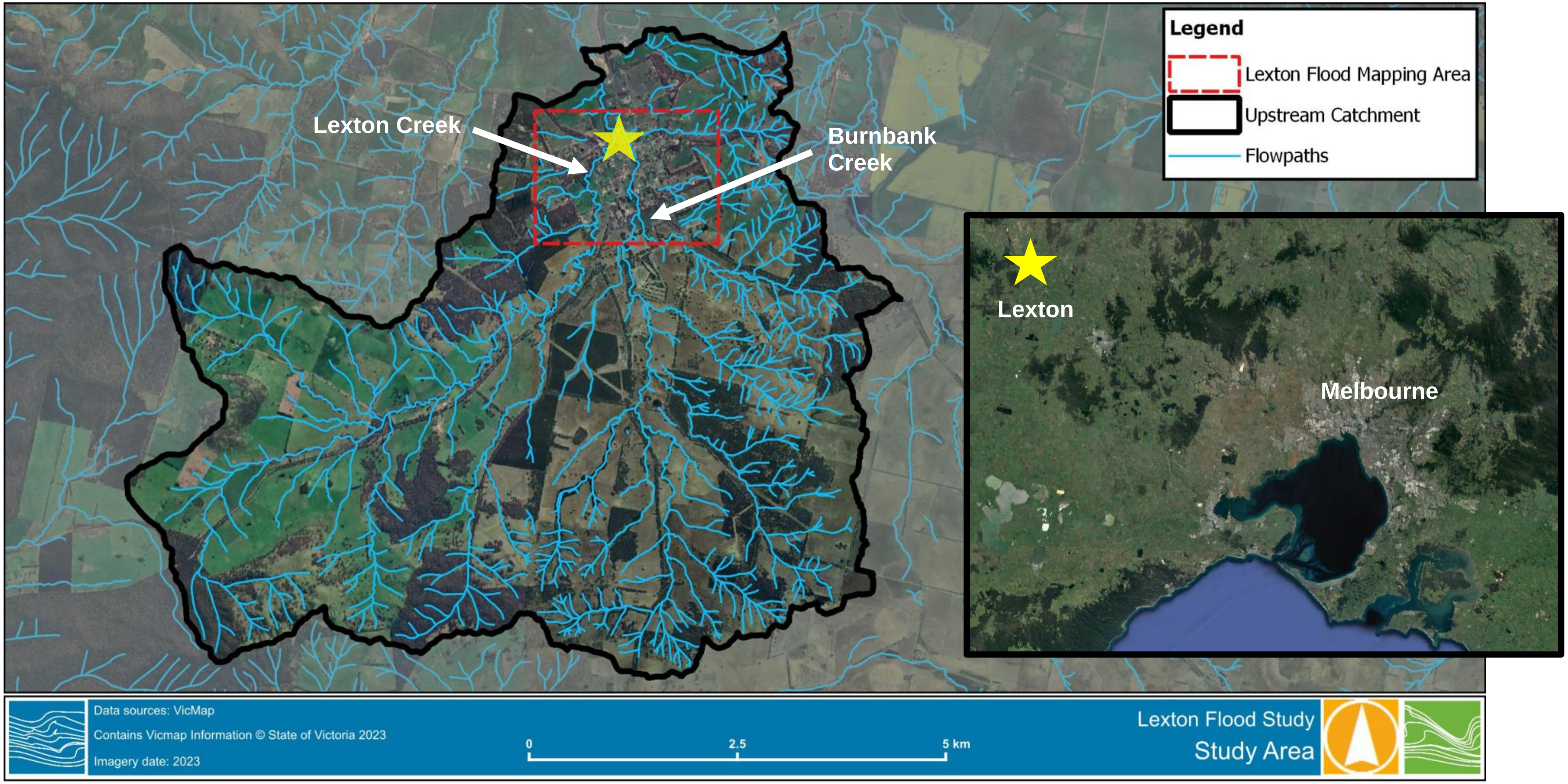

Figure 1-1 Lexton study area

1.3 General catchment and flood information

1.3.1 Rainfall gauge monitoring network

There are currently no streamflow gauges within the catchment upstream of Lexton. Predicting the likely magnitude of flooding in Lexton is reliant on the real time rainfall gauge network and rainfall forecasts, supplemented by downstream streamflow gauges. The nature of the flooding in Lexton is such that short duration storm events (e.g. 1 – 6 hours) are the likely duration to cause flooding and are considered to be “flash flooding” type events. Therefore, the warning time is too short for monitoring of streamflow to be of any use as a means of issuing early flood warning.

The rainfall gauges in proximity to the catchment upstream of Lexton are shown in Figure 1-2, these gauges are useful for predicting floods in Lexton and are summarised in Table 1-1.

Table 1-1 Maximum daily rainfall

Station Name	Station Type	Asset Operator
Lexton (88038)	Daily	Bureau of Meteorology
Avoca (Post Office) (81000)	Daily	Bureau of Meteorology
Talbot (Post Office) (88056)	Daily	Bureau of Meteorology
Raglan (89107)	Daily	Bureau of Meteorology
Trawalla (89030)	Daily	Bureau of Meteorology
Addington (89106)	Daily	Bureau of Meteorology
Beaufort (89005)	Daily	Bureau of Meteorology
Clunes (88015)	Daily	Bureau of Meteorology
Mount Lonarch (79033)	Daily	Bureau of Meteorology
Amphitheatre (79000)	Daily	Bureau of Meteorology
Colac West (90111)	Daily	Bureau of Meteorology
Mount Mitchell (88100)	Daily	Bureau of Meteorology
Waubra (89090)	Daily	Bureau of Meteorology
Lillicur (407288)	Sub-Daily	Department of Energy, Environment and Climate Action
Doctors Creek (407326)	Sub-Daily	Department of Energy, Environment and Climate Action
Pyrenees (Ben Nevis) (79101)	Sub-Daily	Bureau of Meteorology
Lookout Hill (89105)	Sub-Daily	Bureau of Meteorology
Ballarat Aerodrome (89002)	Sub-Daily	Bureau of Meteorology
Creswick (88019)	Sub-Daily	Bureau of Meteorology

There are two sub daily rainfall gauges in proximity to Lexton as shown in Figure 1-2. The Lillicur and Doctors Creek gauges are operated by the Department of Energy, Environment and Climate Action.

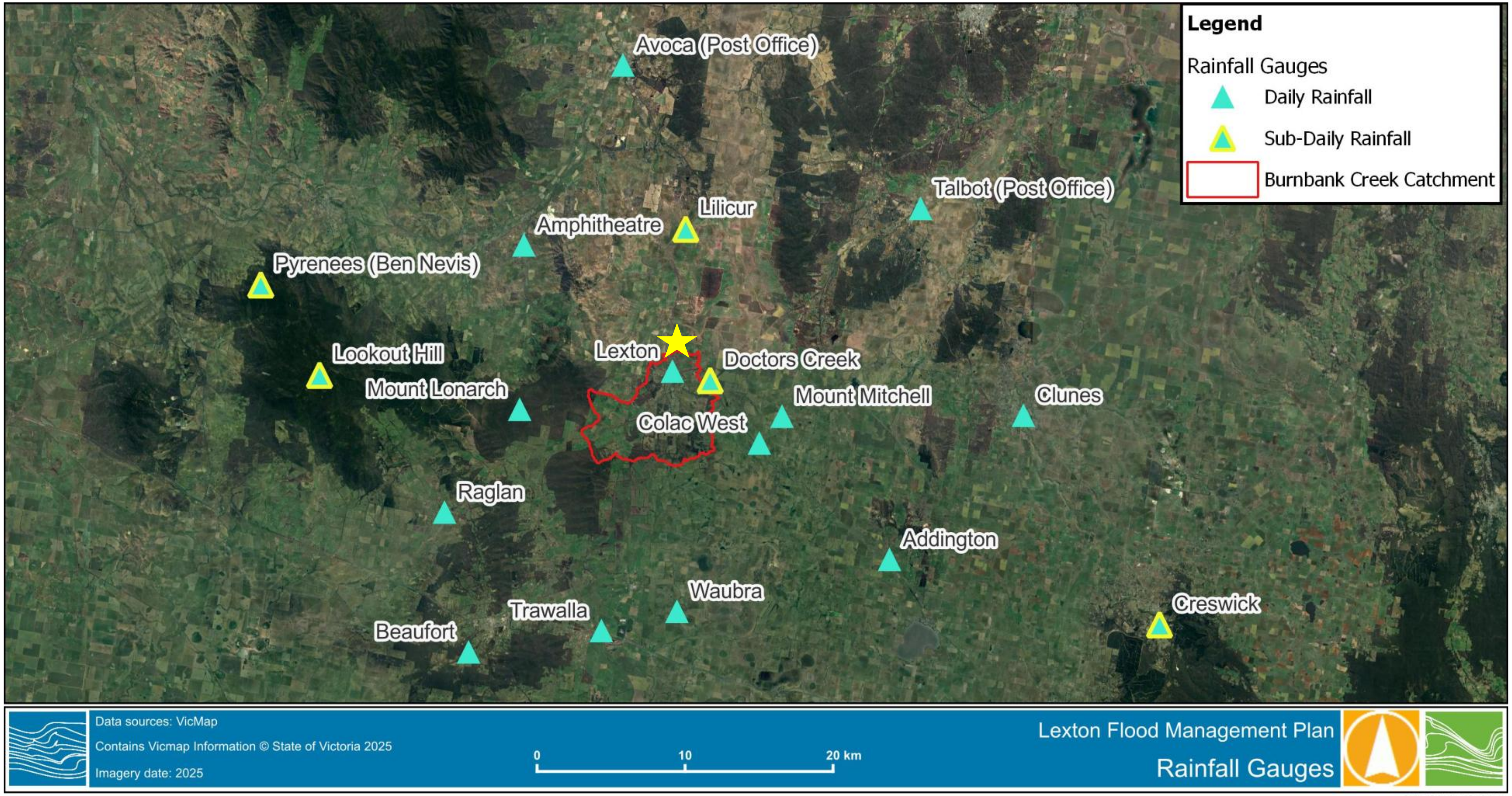

Figure 1-2 Rainfall gauge locations

1.3.2 Description of major waterways and overland flow paths

As discussed in Section 1.2, Lexton Creek and Burnbank Creek are the two major waterways contributing to Lexton. Lexton Creek originates to the south-west of Lexton. Lexton Creek flows in a northerly direction, along the west of Beaufort-Lexton Road, before crossing Lexton-Ararat Road and Anderson Street and converging with Burnbank Creek. The confluence of Lexton Creek and Burnbank Creek is approximately 500 m north-west of the Lexton township. The Lexton Creek catchment upstream of the confluence is approximately 20.7 km^2.

Burnbank Creek originates to the south of Lexton. It flows in a northerly direction, generally between the Beaufort-Lexton Road and the Sunraysia Highway. Burnbank Creek crosses Prince Street, Waldy Street and Clapperton Street before crossing Williamson Street and continuing north between Goldsmith Street and the Sunraysia Highway. There are four main tributaries to the east of Lexton which flow across the Sunraysia Highway and into Burnbank Creek. Burnbank Creek causes the most destruction in Lexton and can inundate several houses above floor level. The Burnbank Creek catchment upstream of Lexton is approximately 13.4 km^2. Burnbank Creek continues flowing north, into Bet Bet Creek and eventually into the Loddon River north of Eddington.

Intense rainfall generates runoff from the catchment located east of Lexton, and several tributaries of Burnbank Creek are formed. The largest of these tributaries begins north of School Road and flows westward toward Burnbank Creek. It flows under Lexton-Talbot Road through two large culverts and continues through a constructed channel. This channel passes beneath Skene Street, makes a sharp right-angle turn to the north, followed by another right-angle turn to the west along Anderson Street. Finally, it crosses under the Sunraysia Highway before reaching Burnbank Creek.

Figure 1-3 presents the areas impacted by Lexton Creek, Burnbank Creek and the eastern stormwater flow path.

1.3.3 Streamflow gauge monitoring network

There are no streamflow gauges in Lexton or within the Burnbank Creek catchment.

There is one active streamflow gauge approximately 10 km downstream of the study area located at Bet Bet Creek in Lillicur (Gauge Number 407288). This gauge records water level, stream flow and rainfall data available from September 1990 to present. The Burnbank Creek catchment, Bet Bet Creek catchment and the Bet Bet Creek at Lillicur gauge is presented in Figure 1-4.

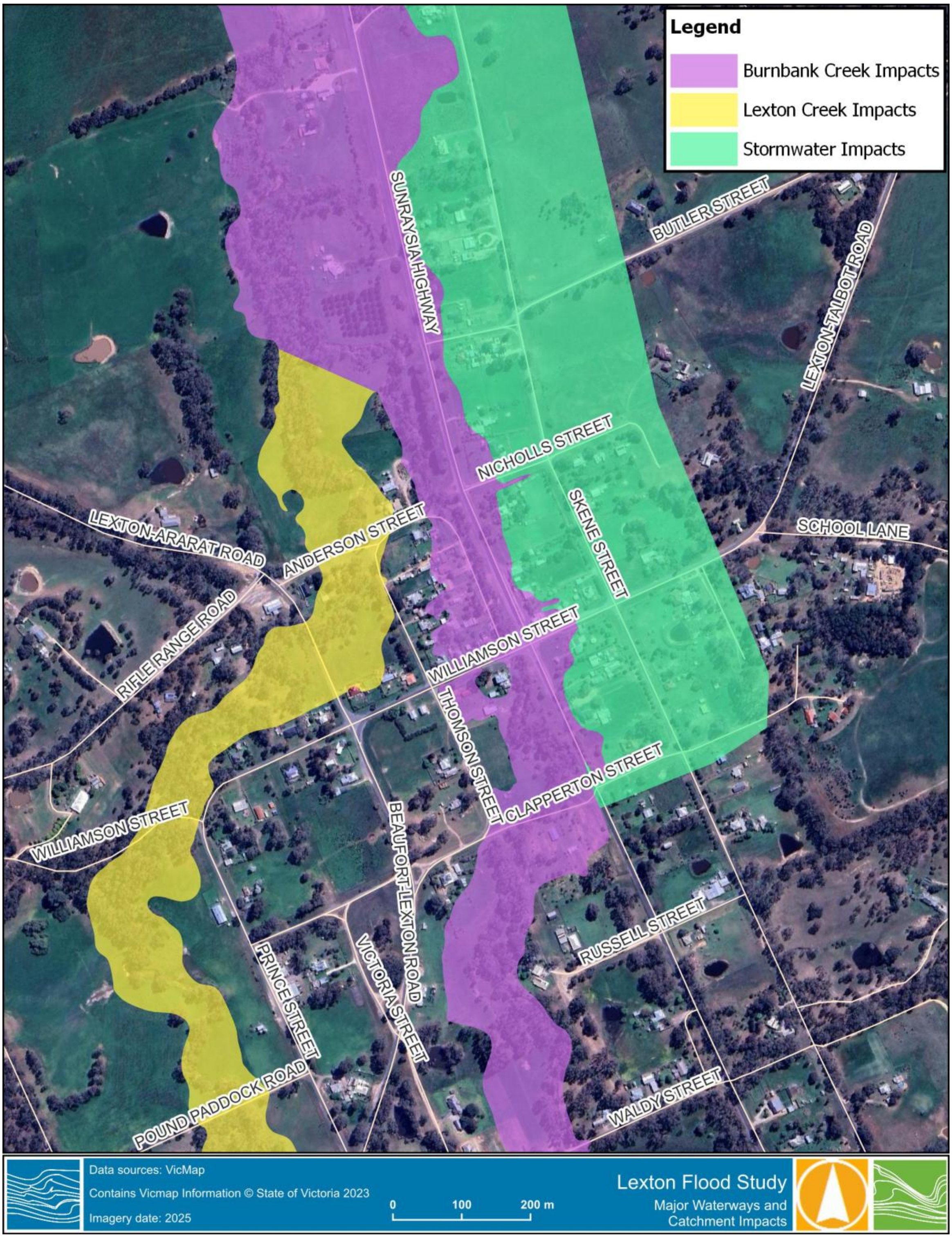

Figure 1-3 Major waterways and flow path impacts

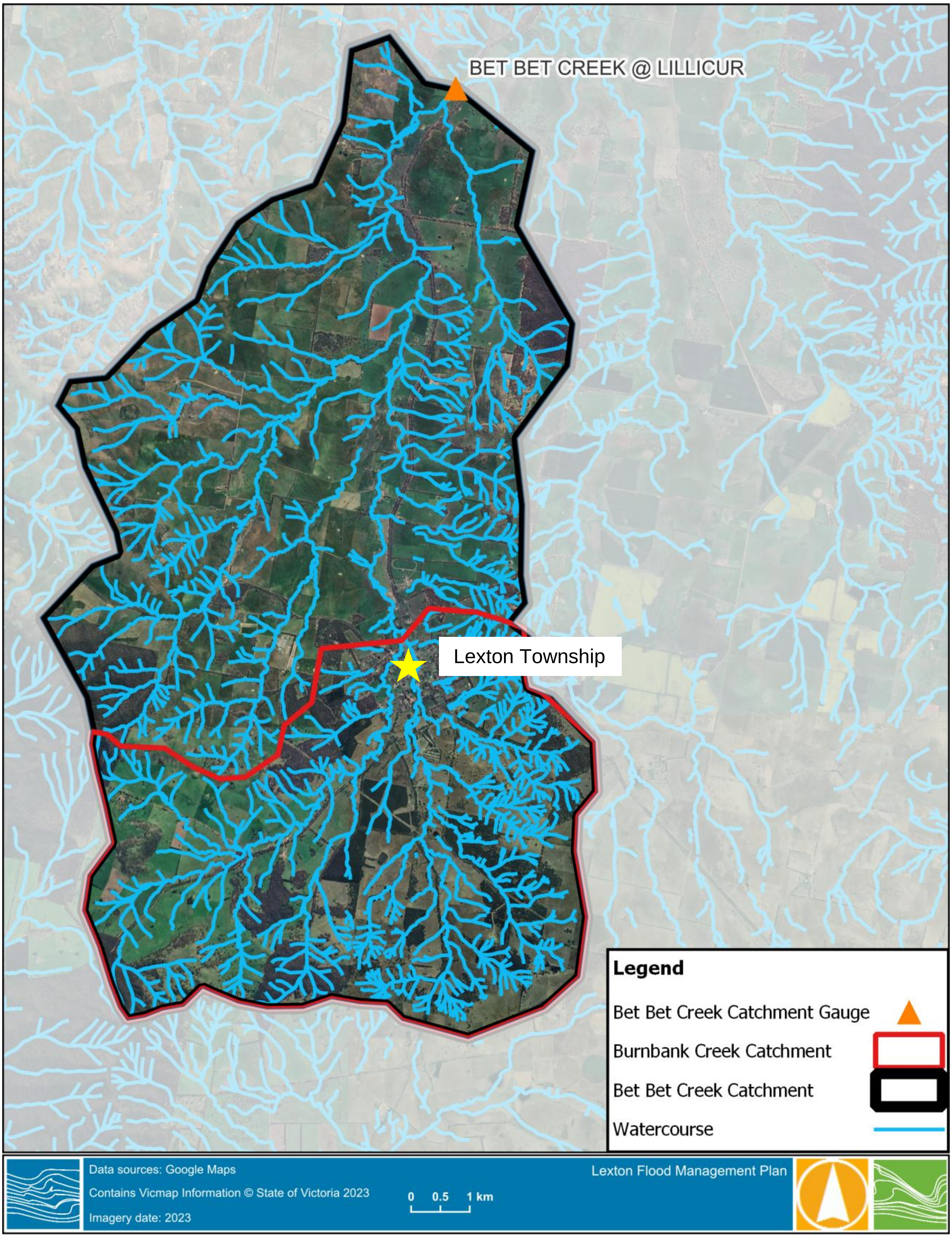

Figure 1-4 Burnbank Creek and Bet Bet Creek Catchments

1.3.4 Historic floods

Lexton experienced significant flood events in 1999, 2010, 2011, 2016 and two events in 2022. The recent flood events in 2022 are well documented and are noted as the largest floods on record at the downstream gauge (Bet Bet Creek at Lillicur). Table 1-2 details the total storm rainfall and duration at the Lexton Post Office rainfall gauge and the approximate flood magnitude at the downstream streamflow gauge (Bet Bet Creek at Lillicur). It should be noted that the flooding experienced around the Lexton township may not be accurately representative of the flooding experienced at the Lillicur gauge and should be used as a general guide only.

Table 1-2 Total rainfall and associated flood event

Flood Event	Rainfall (Lexton Post Office)		Flood Event AEP (Bet Bet Creek at Lillicur Gauge)
	Rainfall (mm)	Duration (days)	
December 27, 1999	127.8	4	Between 20% and 50%
September 4, 2010	62.0	1	Between 5% and 10%
January 14, 2011	79.0	3	Between 20% and 50%
September 14, 2016	81.4	2	Between 5% and 10%
October 6, 2022	94.3	4	Between 2% and 5%
October 13, 2022	85.7	3	Between 1% and 2%

Several photographs of historic events are presented below. A photograph of the corner of Williamson Street and Sunraysia Highway during the 2011 flood is presented in Figure 1-5. A photograph of the corner of Williamson Street and Thomson Street during the 2011 flood is presented in Figure 1-6.

Figure 1-7 shows Burnbank Creek along Goldsmith Street during the 2016 flood. It should be noted that the bridge shown in this photo has recently been removed to improve flood conveyance through the creek.

Figure 1-9 shows the community sand bagging efforts during the 2022 flood event. Figure 1-8 shows the 2022 flood event at Burnbank Creek along Goldsmith Street.

Figure 1-5 Photograph of Williamson St and Sunraysia Hwy (facing southwest) during October 2011 flood

Figure 1-6 Photograph of Williamson St and Thomson St (facing southeast) during October 2011 flood

Figure 1-7 Photograph along Goldsmith St (facing southeast) during October 2016 flood

Figure 1-8 Photograph of community sandbagging during October 2022 flood

Figure 1-9 Photograph of Goldsmith St (facing south) during October 2022 flood

2 FLOOD INTELLIGENCE

2.1 Typical Flood Peak Travel Times

Definitive information on the time it takes flooding (i.e. resulting from heavy rainfall associated with severe weather or thunderstorm activity) to develop (i.e. to arrive at a location) following the start of heavy rain and the time it takes for the maximum water depth/extent to be reached is highly variable dependent on the specific attributes of the rainfall. **Timing of flooding in the Lexton township is however likely to be within 2 – 10 hours.**

The time it takes rainfall associated with severe weather or thunderstorm activity to develop into runoff and streamflow is highly dependent on catchment antecedent conditions (dryness). The lack of pluviographs 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 1-2 should 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 it travels through the channel, with the peak coming later as the floodplain flow travels through the catchment a little slower. Hence a range of factors including recent flood history, soil moisture and forecast weather conditions all need to be considered when using the following information to direct flood response activities.

The 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, warning can focus on rainfall monitoring and forecasting ensuring predicting the likelihood of a flood.

Table 2-1 shows the typical travel time along Lexton Creek, Burnbank Creek and the eastern catchment overland flow paths. The rainfall temporal pattern and the storm duration or the combination of both can be the cause of flooding at Lexton driven by riverine flooding from Burnbank Creek.

Table 2-1 Timing of peak flow

From	To	Typical travel time	Comments	Duration of inundation
Burnbank Creek				
Start of rainfall (catchment)	Start of creek rising in Lexton	1 – 5 hours	Timing depends on rainfall pattern	Generally <15 hours
Start of creek rises in Lexton	Peak creek level	2 – 10 hours		
Lexton Creek				
Start of rainfall (catchment)	Start of creek rising in Lexton	1 – 5 hours	Timing depends on rainfall pattern	Generally <15 hours
Start of creek rises in Lexton	Peak creek level	2 – 10 hours		

From	To	Typical travel time	Comments	Duration of inundation
Eastern Catchment				
Start of rainfall (catchment)	Start of overland flow in Lexton	0 – 1 hours	Timing depends on rainfall pattern	Generally <10 hours
Start of overland flow in Lexton	Peak inundation level	0.5 – 2.5 hours		

With no active or historic gauges within the Lexton catchment, flood peak travel times have been extracted from the RORB model built for the Lexton Flood Investigation. Flood timing is also expected to be influenced by variations in temporal and spatial patterns, as well as antecedent catchment conditions. Given no gauge monitoring is possible, flood peak timing at Lexton has been estimated from the start of significant rainfall. The lag time from the beginning of rainfall to the beginning of flooding can be used as an approximate guide, but in general peak travel time between gauges is a more consistent approach.

The modelled hydrographs in Lexton for the 1% AEP and 10% AEP rainfall events are shown in Figure 2-1 and Figure 2-2. The graphs show all modelled AEP events for durations between 1 hours and 24 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 peak flow.

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.

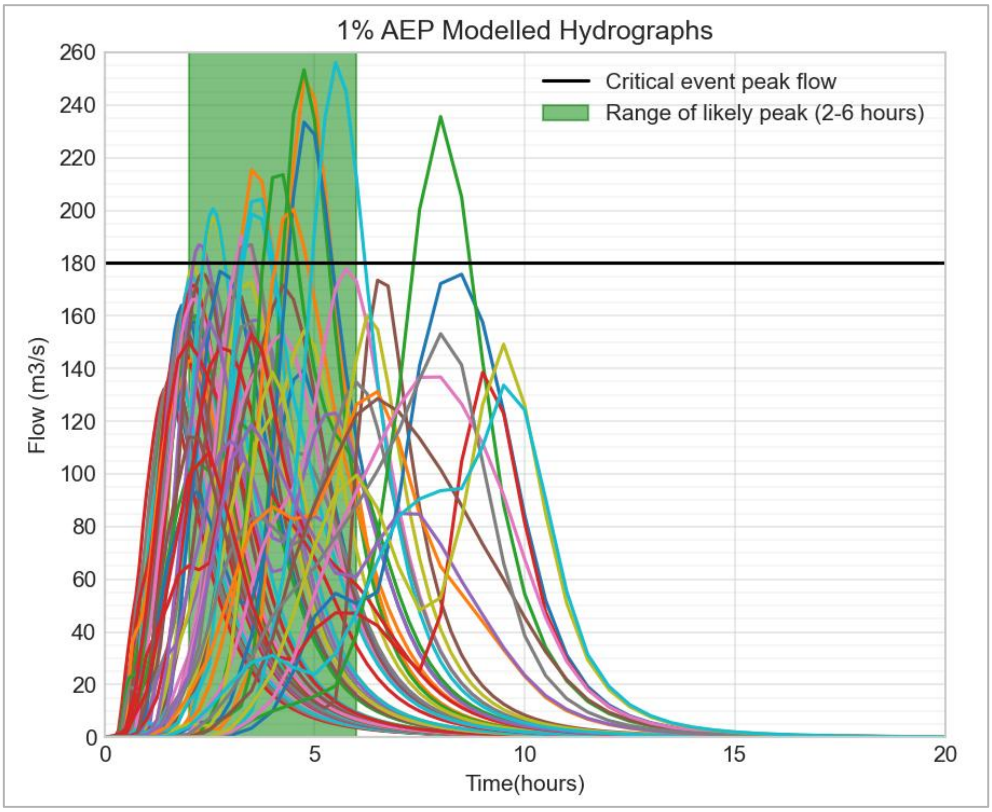

Figure 2-1 1% AEP hydrograph for all modelled rainfall events at Lexton

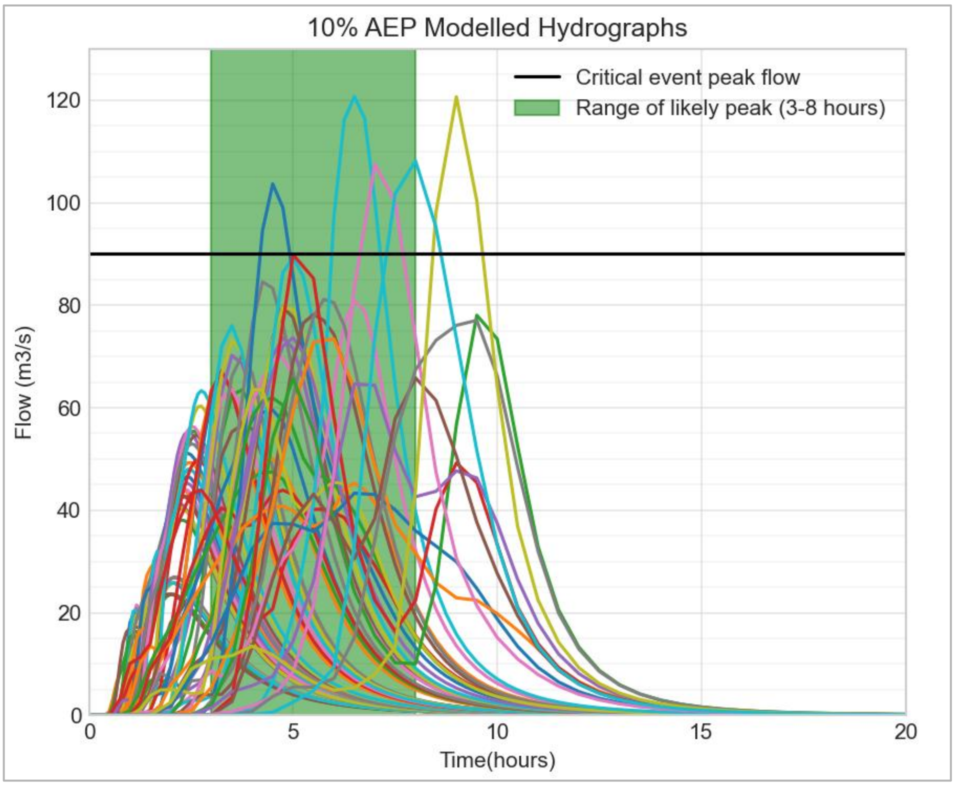

Figure 2-2 10% AEP hydrograph for all modelled rainfall events at Lexton

2.2 Monitoring Capability for Flooding

2.2.1 Existing capability

Currently, there is no formal flood warning system in place for Lexton. Additionally, there are no streamflow gauges within the catchment. Due to this, official flood warning capability for the catchment and township is limited to the issue of a Flood Watch. Note a Flood Watch is not necessarily guaranteed to be issued prior to flooding.

The closest rain gauges that record sub-daily rainfalls are detailed in Figure 2-2. The Doctors Creek gauge and Lillicur gauge report to the Department of Energy, Environment and Climate Action (DEECA) website and Pyrenees (Ben Nevis) and Lookout Hill report to the Bureau of Meteorology's website.

These sub-daily rainfall gauges should be used together with the Flood/No Flood tool presented in Section 3.1.1. It should be noted that the rain gauge may not provide warning times sufficient to enact response actions other than evacuation or shelter in place and a cautious approach should always be taken.

Table 2-2 Nearby hourly rain gauges (Bureau of Meteorology)

Site number	Name	Distance from Lexton
407326	Doctors Creek	2.6 km SW
407288	Lillicur	12.8 km N
79101	Pyrenees (Ben Nevis)	27.7 km W
89105	Lookout Hill	23.8 km W

3 MUNICIPAL FLOOD EMERGENCY PLAN APPENDIX INSERT

3.1 Flood Warning

A total flood warning system concept includes many elements, including: flood prediction, interpretation of the flood impact, messaging and communication of the flood risk, generating a timely response from the community and timely reviews of the system.

The Lexton catchment is small, and inundation of dwellings and infrastructure is mainly driven by riverine flooding with some stormwater. There are no streamflow gauges in the catchment, which means the flood prediction element of the total flood warning system relies on rainfall forecasts and rainfall observations.

The Bureau of Meteorology (BoM) will provide Severe Weather Warnings and Flood Watches, forecasting likely conditions. Rainfall gauges available in the Burnbank Creek area are shown in Figure 1-2. Rainfall gauges are available in daily or sub-daily intervals.

The forecast rainfall made available via the BoM, and the above mentioned sub-daily rainfall gauges along with gridded radar rainfall could be used in combination with an early flood prediction tool to predict possible flooding.

Please note that the 2030 climate change scenario SSP 3 – 7.0 has been used for this assessment.

3.1.1 Flood/No Flood tool

The Intensity Frequency Duration (IFD) design rainfall data used in the development of the Lexton Flood Management Plan can be utilised along with forecast and observed rainfall data as an early warning tool. The data can be used to identify the likely magnitude of flooding and resulting consequences based on the predicted rainfall depths of an event.

To use the table, plot the total rainfall depth obtained against elapsed time since the start of the event. Exclude very light rain or drizzle 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 a large number of sub daily rainfall gauges. The closest sub daily rainfall gauges to Lexton being Lillicur (407288) and Doctors Creek (407326). The Flood/No Flood tool can be used in combination with these gauges and/or rainfall observed within the Burnbank Creek catchment.

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 reference 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.

For example, in 2022, 72 mm of rainfall was observed over a 24 hour period. This is presented on Figure 3-1.

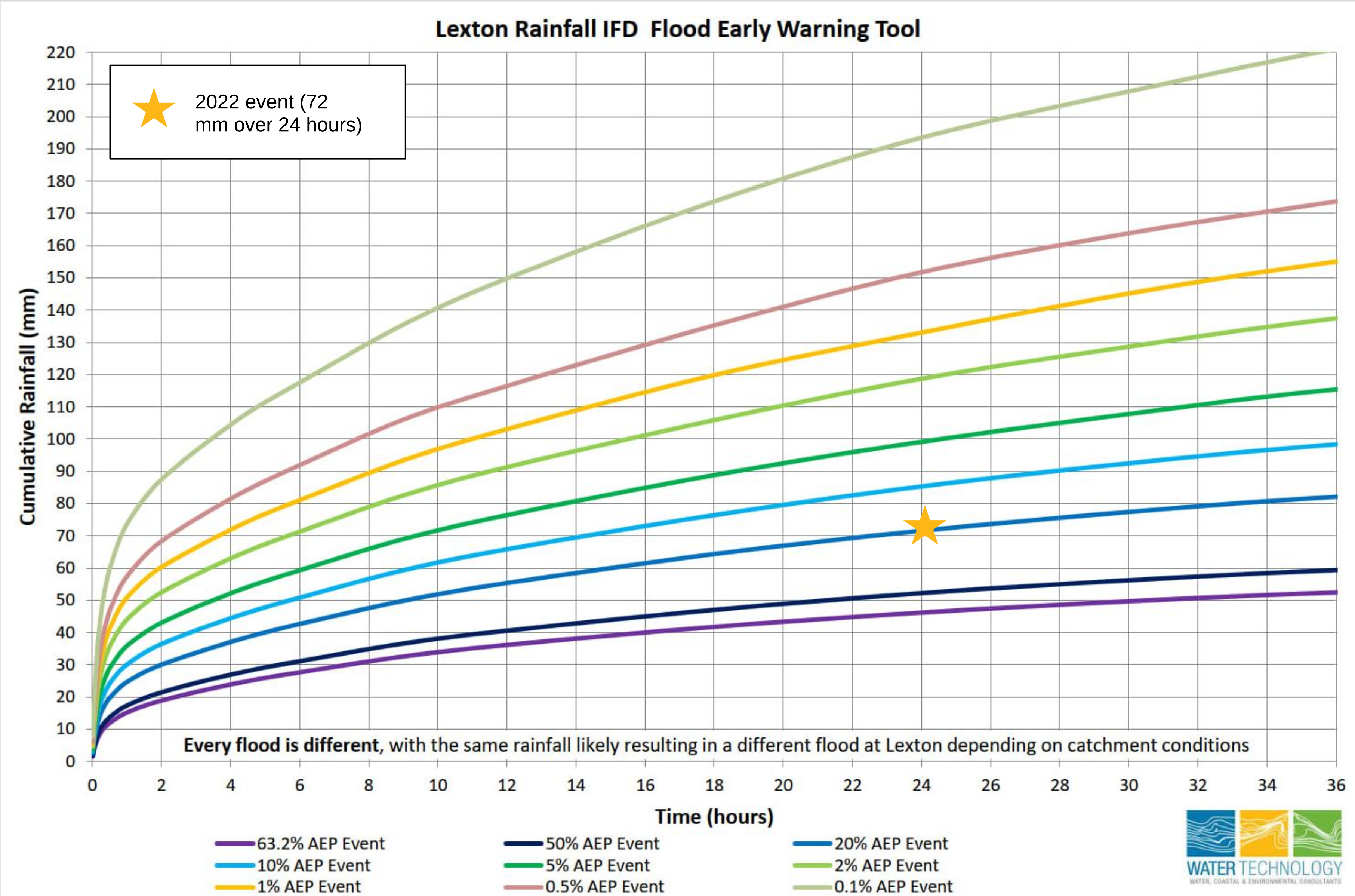

Figure 3-1 Lexton Flood/No flood tool

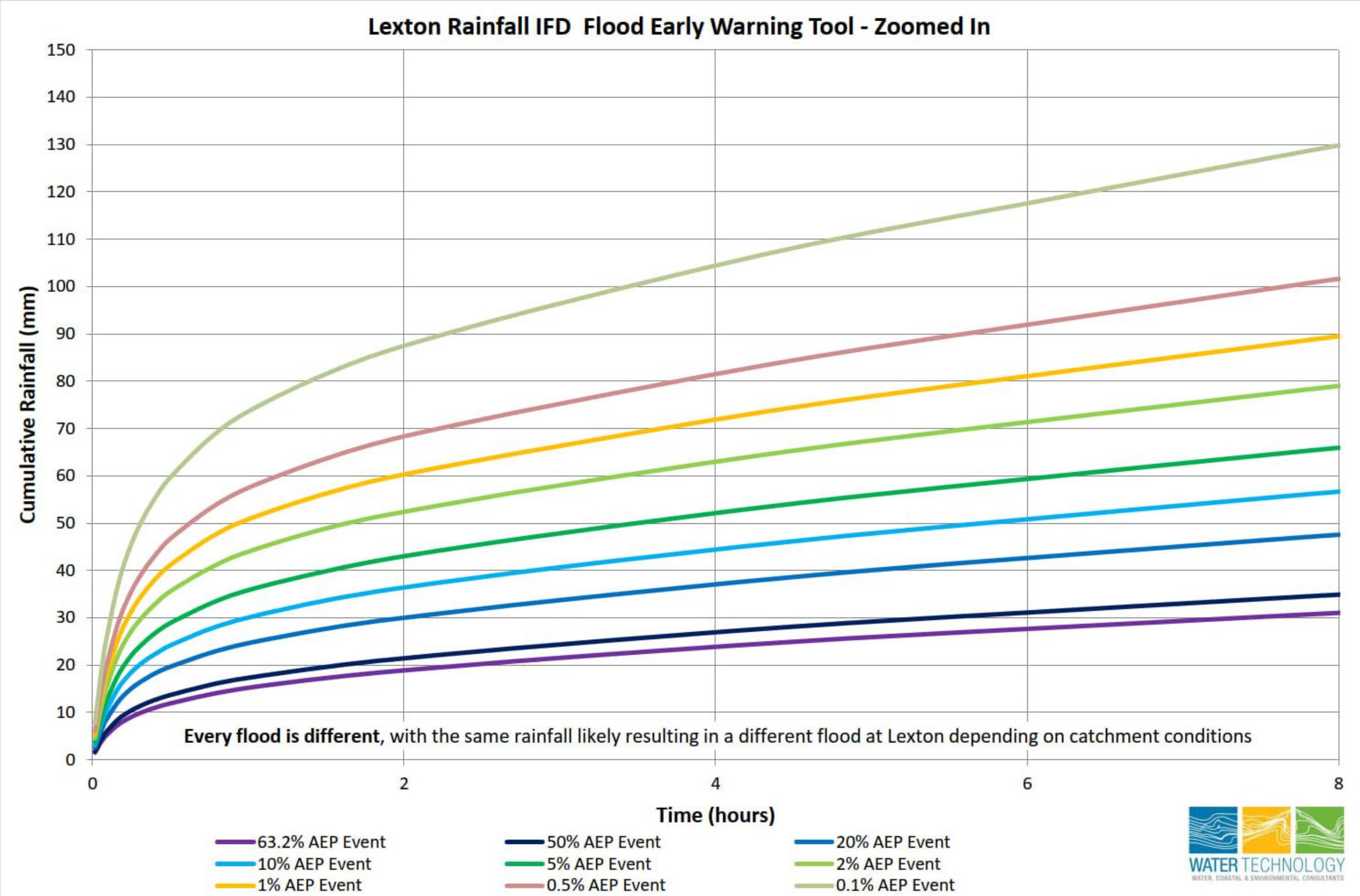

Figure 3-2 **Lexton Flood/No flood tool – Zoomed In**

3.2 Overview of flooding consequences

3.2.1 Warning time

The riverine flooding at Lexton is caused by overbank flows from Burnbank Creek and Lexton Creek through the town. The critical storm duration for Burnbank Creek and Lexton Creek ranges from 1 – 12 hours (for example, for a 1% AEP flood over a 9 hour storm duration approximately 93 mm of rainfall would be observed). **Timing of peak flooding in the Lexton township is however likely to be within 2 – 10 hours.**

Additional inundation impacting properties and infrastructure is caused by overland flow from the eastern catchment (which flows into Burnbank Creek). The critical storm duration within this catchment is 1 – 1.5 hours with peak flooding around Skene St and Anderson St likely to occur between 30 minutes and 2 hours.

Due to the nature of the critical storm durations within the catchments, the warning time of the flooding at Lexton can be **less than an hour.**

3.2.2 Roads affected

The main access roads to and from the township of Lexton include the Sunraysia Highway, Lexton-Ararat Road, Beaufort-Lexton Road and Lexton-Talbot Road. Table 3-1 outlines the impassable roads where maximum depths exceed 0.3 m and become unsafe for vehicles. These impassable roads (depths greater than 0.3 m) are shown in Figure 3-3 to Figure 3-5 with the comparison to the 1% AEP flood extent.

The Sunraysia Highway, Lexton-Ararat Road and Lexton-Talbot Road become inundated while the Beaufort-Lexton Road can provide access in and out of Lexton during flood events. It should be noted that during the 1% AEP event, the Sunraysia Highway can be inundated to unsafe levels for a period **between 2 – 12 hours.**

Storm durations in Lexton vary significantly. Due to the nature of the catchments, the inundation of roads to unsafe levels in Lexton can be **less than an hour** or longer depending on the critical storm duration. It should be noted that the eastern catchment typically responds quicker than the Burnbank Creek and Lexton Creek catchments. Therefore, roads will be inundated to unsafe levels faster on the eastern side of the town.

Table 3-1 Impassable roads inundation depth for each AEP (m)

Roads inundated	Design flood AEP (%)								
	20	10	5	2	1	0.5	0.2	0.1	0.05
Anderson Street	1.22	1.32	1.40	1.57	1.64	1.72	1.87	1.98	2.09
Butler Street	0.37	0.46	0.55	0.70	0.78	0.85	0.92	1.00	1.08
Clapperton Street	1.67	1.79	1.90	2.08	2.16	2.24	2.32	2.38	2.46
Gladstone Street	2.26	2.41	2.53	2.78	2.88	2.99	3.14	3.23	3.31
Goldsmith Street	0.64	0.73	0.82	1.00	1.09	1.18	1.25	1.31	1.39
Lexton - Ararat Road	1.78	1.87	1.94	2.05	2.11	2.18	2.27	2.34	2.42
Nicholls Street	0.43	0.54	0.62	0.75	0.82	0.88	0.93	0.98	1.03
Pound Paddock Road	1.50	1.63	1.74	1.96	2.06	2.17	2.36	2.47	2.58
Prince Street	2.28	2.47	2.61	2.78	2.85	2.91	2.98	3.02	3.08
Russell Street	0.33	0.34	0.36	0.43	0.45	0.46	0.48	0.48	0.48
Sunraysia Highway	1.03	1.13	1.20	1.33	1.41	1.48	1.55	1.63	1.72
Thomson Street	0.31	0.41	0.48	0.64	0.72	0.80	0.94	1.03	1.13

Roads inundated	Design flood AEP (%)								
	20	10	5	2	1	0.5	0.2	0.1	0.05
Waldy Street	1.39	1.75	2.03	2.32	2.44	2.53	2.63	2.70	2.79
West Street	0.50	0.60	0.68	0.83	0.91	0.98	1.07	1.16	1.25
Williamson Street	2.15	2.20	2.34	2.52	2.61	2.69	2.79	2.85	2.93
Lexton - Talbot Road				0.39	0.41	0.47	0.52	0.55	0.58
Lexton Recreation Reserve Access Road				0.32	0.39	0.45	0.51	0.54	0.60
Robertson Street						0.43	0.59	0.64	0.67
Skene Street						0.32	0.35	0.37	0.38

3.2.3 Isolated areas

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

- From the 20% AEP event, properties along Goldsmith Street directly opposite Burnbank Creek become inaccessible. This includes 5 – 19 Goldsmith Street and 36 Anderson Street. The property at 3521 Sunraysia Highway also becomes inaccessible.
- From the 10% AEP event, the Sunraysia Highway begins to become inundated to unsafe levels. Properties from 3550 – 3607 Sunraysia Highway become inaccessible, as well as properties along the west end of Russel St.
- From the 0.5% AEP event, floodwater becomes deeper around the Lexton township. The Lexton Post Office and several properties along Williamson St (39 – 48) start to become isolated.
- From the 0.2% AEP event, floodwater continues along Williamson St, isolating more houses along Williamson St and the south end of Thomson St (11 and 18 Thomson St) and north end of Thomson St become isolated (28 – 32 Thomson St).
- From the 0.1% AEP event, another property becomes isolated at 17 Robertson St on the east side of Sunraysia Highway.

Despite impassable inundation on the Sunraysia Highway and Williamson Street, remaining properties in Lexton have at least one route of access in events up to and including the 0.05% AEP event.

A set of maps showing the isolated areas for all modelled AEP events is presented in Appendix B.

3.2.4 Property inundation

Flood level survey of 35 residential and commercial buildings were captured as part of the Lexton Flood Management Plan. Only the main residential dwelling or commercial building was captured for each property, outbuildings were not surveyed. It should be noted that the number of properties flooded below floor indicates a property with a 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 flood level is below the surveyed floor level.
- Property flooded above floor.

- This indicates the flood level is above the surveyed floor level.

The 1% AEP flood extent and the properties flooded above floor during the range of modelled design events are shown in Figure 3-7. Table 3-2 outlines the properties which are shown to be flooded above and below floor. The values in those tables were obtained using the difference between flood level and 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 Property flooded above or below floor (metres)

Property address	Design flood AEP (%)								
	20	10	5	2	1	0.5	0.2	0.1	0.05
11 Goldsmith St, Lexton VIC 3352			-0.47	-0.288	-0.197	-0.12	-0.049	**0.007**	**0.083**
11 Thomson St, Lexton VIC 3352									-0.253
128 Skene St, Lexton VIC 3352	-0.242	-0.237	-0.203	-0.156	-0.139	-0.107	-0.085	-0.075	-0.06
13 Goldsmith St, Lexton VIC 3352					-0.1	-0.015	**0.059**	**0.118**	**0.197**
134 Skene St, Lexton VIC 3352									**0.108**
15 Goldsmith St, Lexton VIC 3352	-0.473	-0.375	-0.285	-0.095	**0.007**	**0.091**	**0.162**	**0.221**	**0.297**
18 Thomson St, Lexton VIC 3352			-0.741	-0.545	-0.45	-0.369	-0.289	-0.231	-0.149
187 Skene St, Lexton VIC 3352			-0.1	-0.069	-0.046	-0.02	**0.008**	**0.023**	**0.037**
19 Goldsmith St, Lexton VIC 3352	**0.039**	**0.125**	**0.212**	**0.377**	**0.466**	**0.539**	**0.602**	**0.657**	**0.723**
20 Williamson St, Lexton VIC 3352				-0.363	-0.282	-0.211	-0.142	-0.091	-0.017
23 Thomson St, Lexton VIC 3352						**0.072**	**0.178**	**0.245**	**0.335**
24 Williamson St, Lexton VIC 3352						-0.377	-0.358	-0.352	-0.34
26 Waldy Street, Lexton VIC 3352	-0.404	-0.398	-0.394	-0.389	-0.381	-0.375	-0.363	-0.359	-0.355
28 Thomson St, Lexton VIC 3352				-0.237	-0.149	-0.071	**0.004**	**0.058**	**0.131**
30 Russell St, Lexton VIC 3352									-0.424
30 Thomson St, Lexton VIC 3352					-0.251	-0.184	-0.116	-0.066	**0.004**
32 Thomson St, Lexton VIC 3352				-0.238	-0.138	-0.056	**0.017**	**0.069**	**0.146**

Property address	Design flood AEP (%)								
	20	10	5	2	1	0.5	0.2	0.1	0.05
3521 Sunraysia Hwy, Lexton VIC 3352	-0.453	-0.364	-0.265	-0.095	-0.009	**0.067**	**0.144**	**0.202**	**0.284**
3550 Sunraysia Hwy, Lexton VIC 3352	**0.04**	**0.226**	**0.344**	**0.549**	**0.649**	**0.733**	**0.81**	**0.872**	**0.955**
3554 Sunraysia Hwy, Lexton VIC 3352		-0.012	**0.022**	**0.173**	**0.275**	**0.36**	**0.434**	**0.502**	**0.587**
3556 Sunraysia Hwy, Lexton VIC 3352			-0.077	-0.048	-0.032	**0.026**	**0.096**	**0.158**	**0.235**
3566 Sunraysia Hwy, Lexton VIC 3352		-0.665	-0.562	-0.407	-0.326	-0.261	-0.203	-0.154	-0.096
3582 Sunraysia Hwy, Lexton VIC 3352					-0.26	-0.185	-0.111	-0.056	**0.008**
36 Anderson St, Lexton VIC 3352					-0.065	**0.029**	**0.202**	**0.32**	**0.435**
3607 Sunraysia Hwy, Lexton VIC 3352									-0.625
39 Williamson St, Lexton VIC 3352					-0.081	-0.028	**0.025**	**0.066**	**0.127**
4 Lexton-Ararat Rd, Lexton VIC 3352				-0.041	**0.024**	**0.1**	**0.23**	**0.328**	**0.436**
44 Williamson St, Lexton VIC 3352				**0.086**	**0.169**	**0.243**	**0.322**	**0.38**	**0.462**
48 Williamson St, Lexton VIC 3352				**0.043**	**0.126**	**0.198**	**0.273**	**0.33**	**0.412**
5 Goldsmith St, Lexton VIC 3352	-0.091	**0.044**	**0.161**	**0.368**	**0.474**	**0.562**	**0.646**	**0.71**	**0.796**
5 Thomson St, Lexton VIC 3352									
53 Williamson St, Lexton VIC 3352							**0.029**	**0.078**	**0.145**
54 Russell St, Lexton VIC 3352						-0.012	-0.006	-0.002	**0.002**
7 Nicholls St, Lexton VIC 3352				-0.285	-0.188	-0.102	-0.024	**0.039**	**0.112**
Lexton PO, 1 Goldsmith St, Lexton VIC 3352			-0.383	-0.129	-0.044	**0.037**	**0.126**	**0.188**	**0.272**

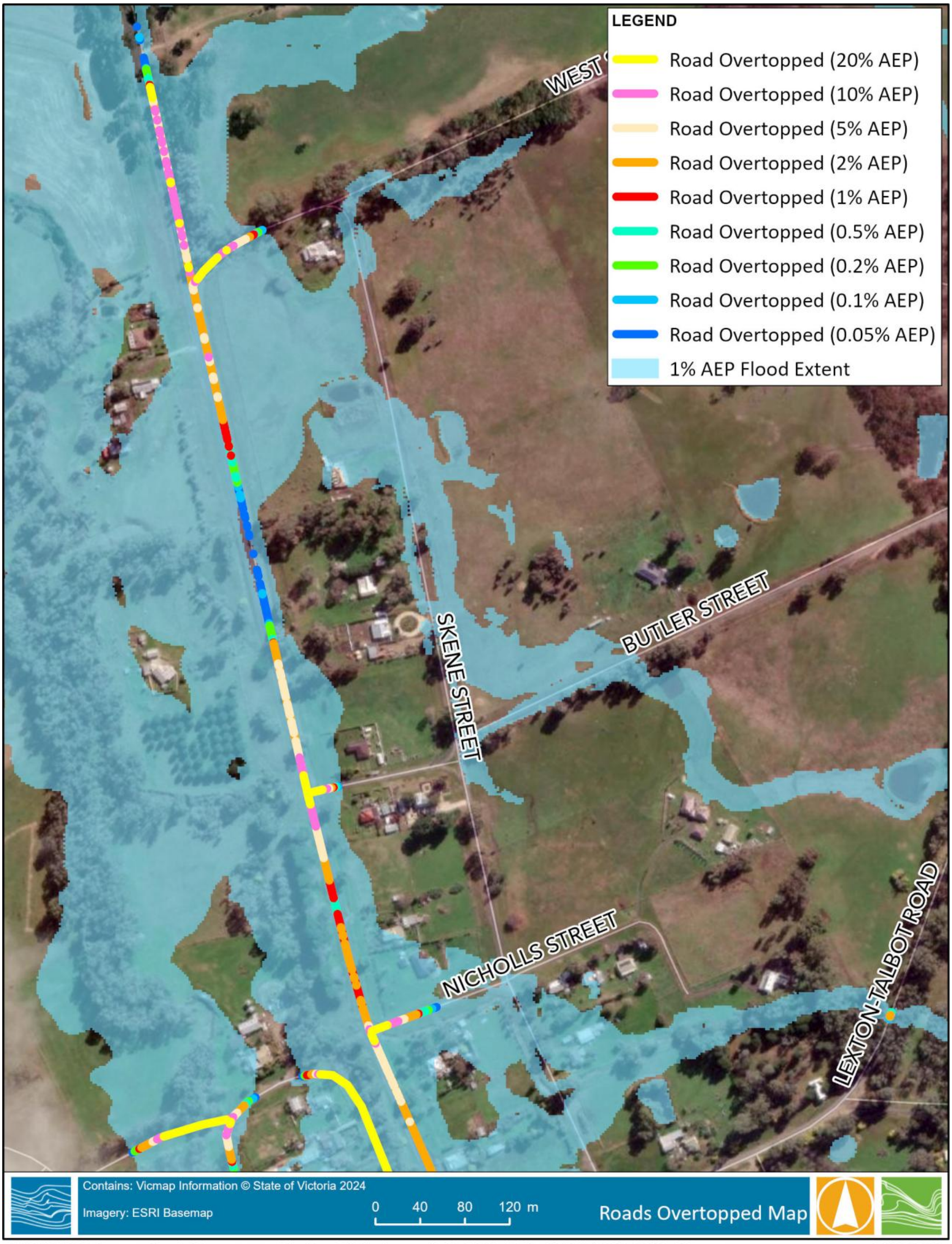

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Figure 3-3 Impassable roads in Lexton – North

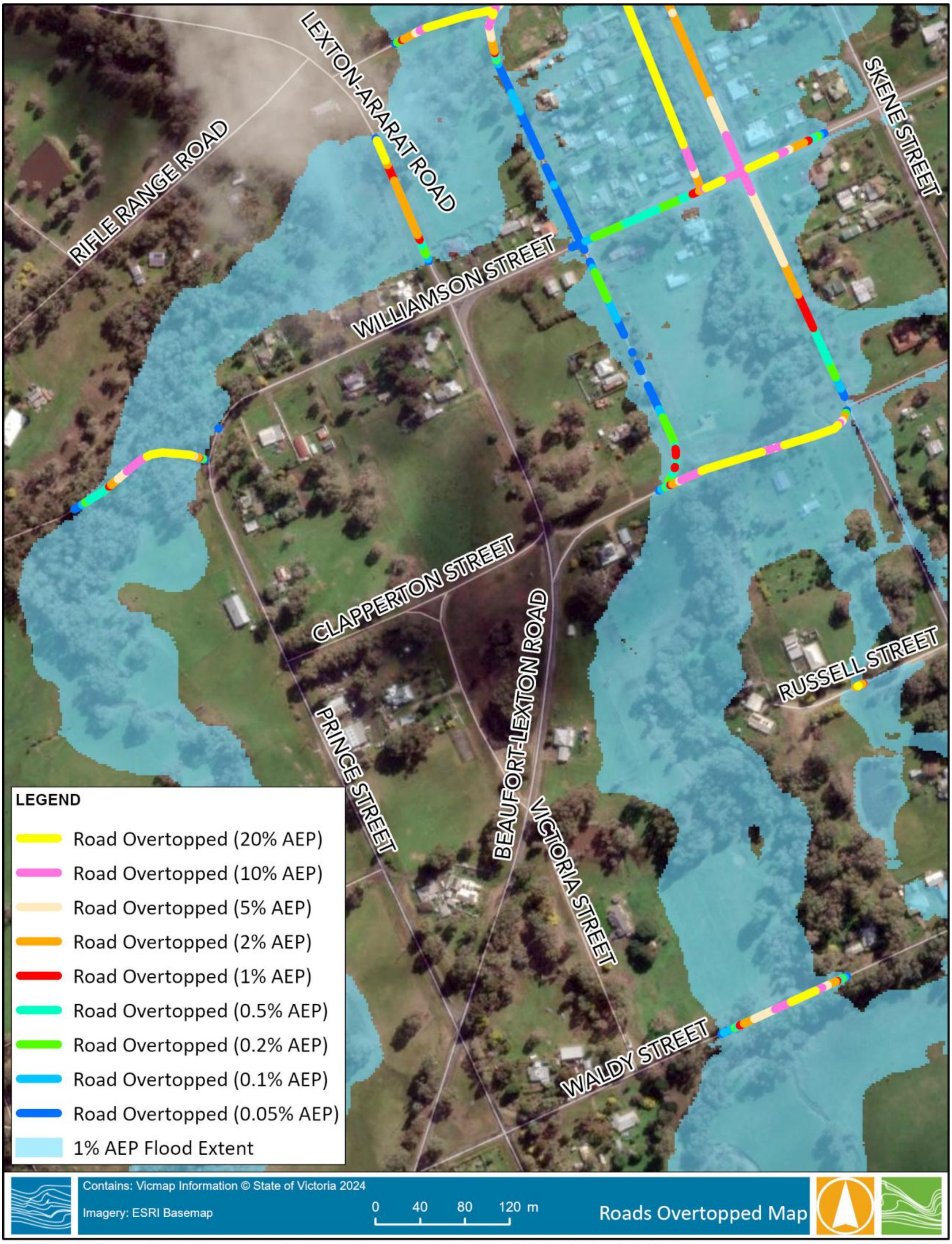


Figure 3-4 Impassable roads in Lexton – West

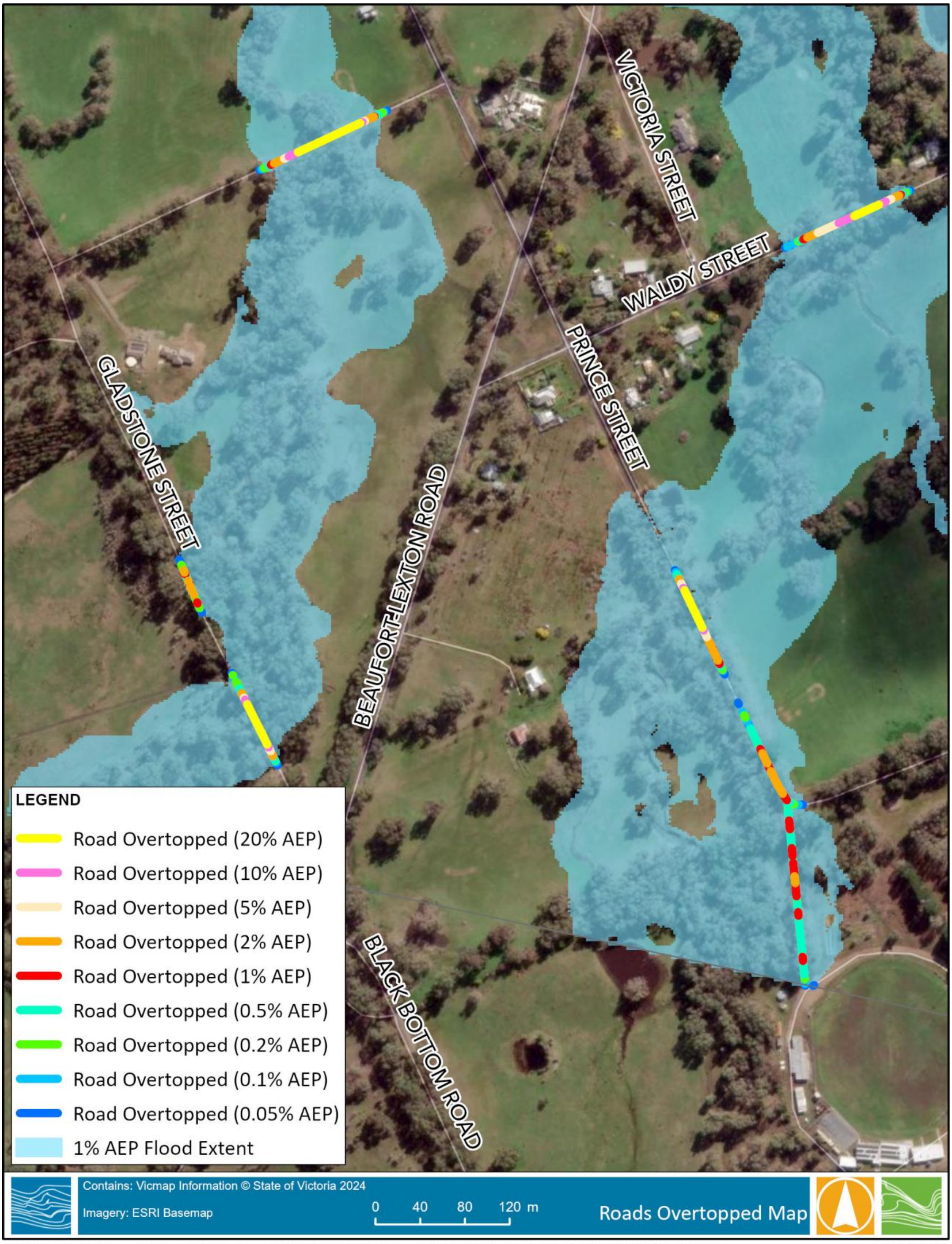


Figure 3-5 Impassable roads in Lexton – South

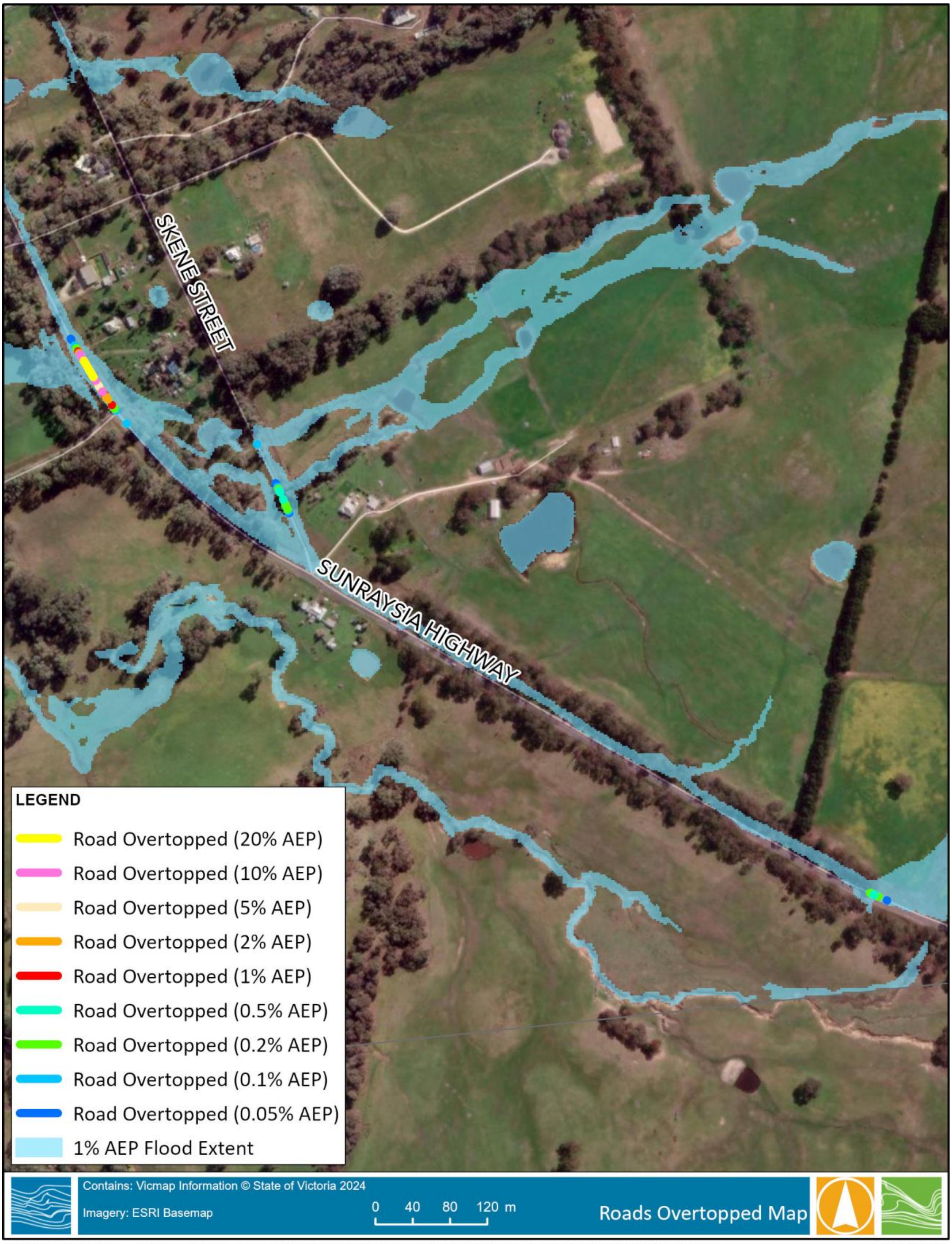


Figure 3-6 Impassable roads in Lexton – East

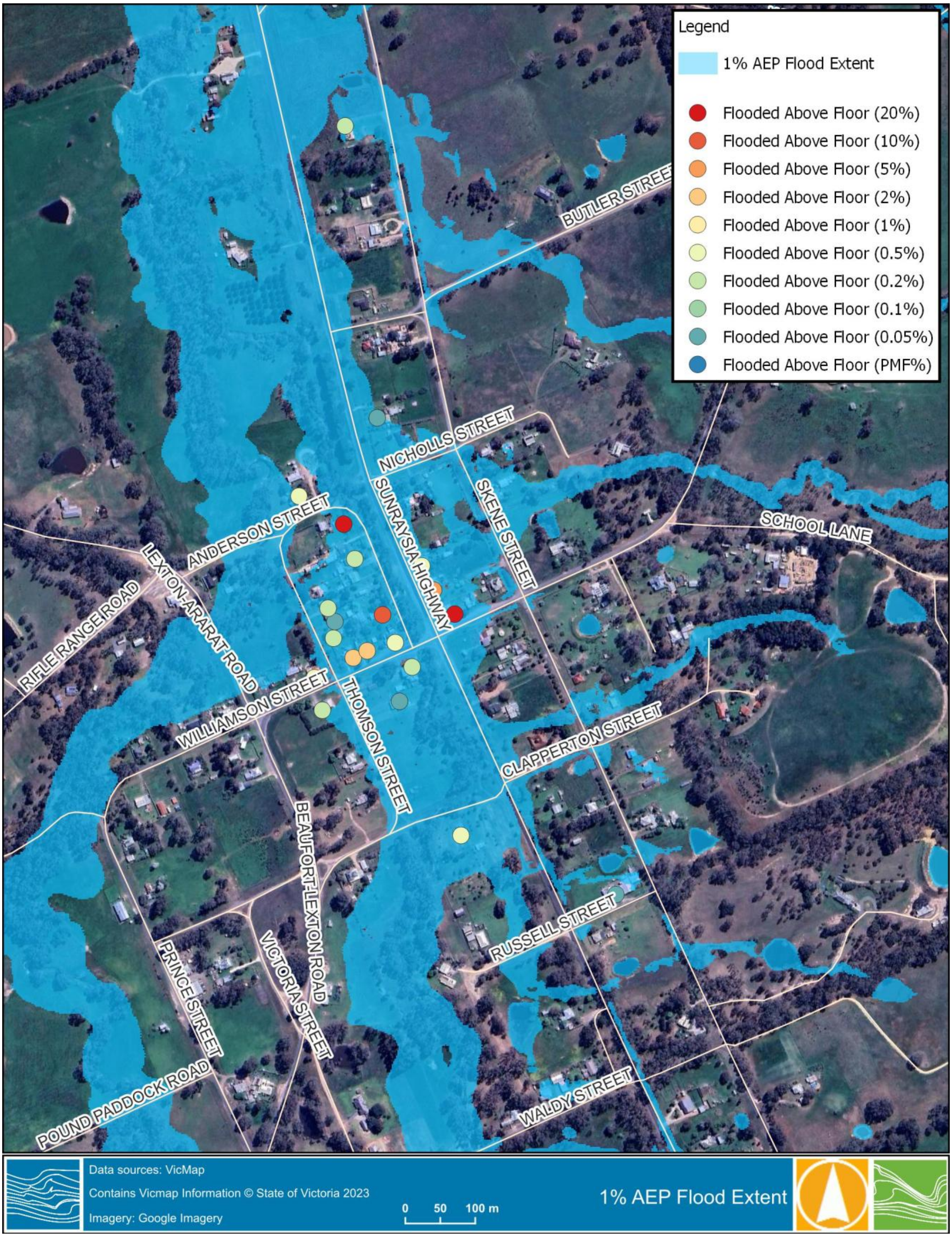


Figure 3-7 **Properties flooded above floor**

3.2.5 Flood intelligence card

Flood mapping was produced to identify the consequences of flooding for various design flood events. Combined with the flood forecasting procedure describes in Section 3.1, the flood consequence table allows emergency services and council to quickly understand the likely impacts of flooding and plan accordingly. The flood intelligence card 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 50%, 20%, 10%, 5%, 1%, 0.5%, 0.2% and 0.1% AEP events in succession (as a combined list if likely impacts). It is also recommended that the reader refer to the standard 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.

It should be noted that the road impacts column is based on flood depths exceeding 0.3 m (as detailed in Section 3.2.2) and not just when water overtops the road.

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”.

As a result of the nature of flooding at Lexton, residents may have very limited time to respond after the start of rain. It is recommended that each commercial property that is prone to flooding should have sandbags prepared to act immediately after the flood warning or severe weather warning is issued. Residents are likely to want access to sandbags as soon as possible after it becomes apparent that flooding is likely. Residents using sandbags need to be aware of the correct way to lay sandbags and also be aware that due to the length of inundation some water will pass through the bags. Flood Response Plans should be prepared for properties at risk of inundation to inform the community on appropriate actions before, during and after the flood.

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

Rainfall Intensity Triggers	Annual Exceedance Probability (AEP)	Estimated Lexton Flows (m³/s)	Isolated Properties	Houses flooded above floor	Roads Impacts (unsafe to drive)	Action Consequence / Impact
~ 25 mm in 1 hour ~ 34 mm in 3 hours ~ 43 mm in 6 hours ~ 55 mm in 12 hours	20% (~ 1 in 5 year)	63	5 Goldsmith St, Lexton 11 Goldsmith St, Lexton 13 Goldsmith St, Lexton 15 Goldsmith St, Lexton 19 Goldsmith St, Lexton 36 Anderson Street, Lexton	19 Goldsmith St, Lexton 3550 Sunraysia Hwy, Lexton	Anderson Street Butler Street Clapperton Street Gladstone Street Goldsmith Street Lexton - Ararat Road Nicholls Street Pound Paddock Road Prince Street Russell Street Sunraysia Highway Thomson Street Waldy Street West Street Williamson Street	VICSES sandbag as required at the predicted inundated buildings. Victoria Police evacuate buildings as needed along Goldsmith Street. Evacuate known vulnerable people at 5 Goldsmith St, Lexton Council and Regional Roads Victoria to deploy road closure signs as needed. Place "water over road signs" at impacted roads. Priority should be given to main roads at Lexton - Ararat Road, Sunraysia Highway and Williamson Street. Set up sand bagging centre at CFA. Shelter in place for affected houses should be set up. For residents on the east side of Sunraysia Highway, **Toll Bar Park** should be used. For residents on the west side of Sunraysia Highway, **the corner of Clapperton Street and Beaufort-Lexton Road** should be used.
~ 31 mm in 1 hour ~ 41 mm in 3 hours ~ 51 mm in 6 hours ~ 66 mm in 12 hours	10% (~ 1 in 10 year)	87	30 Russell St, Lexton 3566 Sunraysia Hwy, Lexton 3556 Sunraysia Hwy, Lexton 3550 Sunraysia Hwy, Lexton 3554 Sunraysia Hwy, Lexton	5 Goldsmith St, Lexton		
~ 36 mm in 1 hour ~ 48 mm in 3 hours ~ 59 mm in 6 hours ~ 76 mm in 12 hours	5% (~ 1 in 20 year)	112		3554 Sunraysia Hwy, Lexton		
~ 44 mm in 1 hour ~ 58 mm in 3 hours ~ 71 mm in 6 hours ~ 91 mm in 12 hours	2% (~ 1 in 50 year)	151		44 Williamson St, Lexton 48 Williamson St, Lexton	Lexton - Talbot Road Lexton Recreation Reserve Access Road	
~ 51 mm in 1 hour ~ 66 mm in 3 hours ~ 81 mm in 6 hours ~ 103 mm in 12 hours	1% (~ 1 in 100 year)	178		4 Lexton-Ararat Rd, Lexton 15 Goldsmith St, Lexton		
~ 57 mm in 1 hour ~ 75 mm in 3 hours ~ 92 mm in 6 hours ~ 117 mm in 12 hours	0.5% (~ 1 in 200 year)	226	39 Williamson St, Lexton 48 Williamson St, Lexton 44 Williamson St, Lexton Lexton Po, 1 Goldsmith St, Lexton	23 Thomson St, Lexton 3521 Sunraysia Hwy, Lexton 3556 Sunraysia Hwy, Lexton 36 Anderson St, Lexton Post Office, 1 Goldsmith St, Lexton	Robertson Street Skene Street	
~ 66 mm in 1 hour ~ 87 mm in 3 hours ~ 106 mm in 6 hours ~ 135 mm in 12 hours	0.2% (~ 1 in 500 year)	264	11 Thomson St, Lexton 18 Thomson St, Lexton 20 Williamson St, Lexton	13 Goldsmith St, Lexton 187 Skene St, Lexton 28 Thomson St, Lexton 32 Thomson St, Lexton 39 Williamson St, Lexton 53 Williamson St, Lexton		

Rainfall Intensity Triggers	Annual Exceedance Probability (AEP)	Estimated Lexton Flows (m^3/s)	Isolated Properties	Houses flooded above floor	Roads Impacts (unsafe to drive)	Action Consequence / Impact
~ 74 mm in 1 hour ~ 96 mm in 3 hours ~ 118 mm in 6 hours ~ 150 mm in 12 hours	0.1% (~ 1 in 1000 year)	307	28 Thomson St, Lexton 30 Thomson St, Lexton 32 Thomson St, Lexton 187 Skene St, Lexton	11 Goldsmith St, Lexton 7 Nicholls St, Lexton		
~ 81 mm in 1 hour ~ 106 mm in 3 hours ~ 130 mm in 6 hours ~ 165 mm in 12 hours	0.05% (~ 1 in 2000 year)	352		134 Skene St, Lexton 30 Thomson St, Lexton 3582 Sunraysia Hwy, Lexton 54 Russell St, Lexton		
74 mm over 3 days	September 2010			**Known buildings inundated:** 19 Goldsmith St, Lexton		
223 mm over 5 days	January 2011			**Known buildings inundated:** 19 Goldsmith St, Lexton		
76 mm over 3 days	September 2016			**Known buildings inundated:** 19 Goldsmith St, Lexton		
94 mm over 4 days	6 October 2022			**Known buildings inundated:** 19 Goldsmith St, Lexton 5 Goldsmith St, Lexton 3550 Sunraysia Hwy 187 Skene St, Lexton		
86 mm over 3 days	13 October 2022			**Known buildings inundated:** 19 Goldsmith St, Lexton 5 Goldsmith St, Lexton 3550 Sunraysia Hwy		

4 TOTAL FLOOD WARNING SYSTEM

4.1 Overview

A Total Flood Warning System (TFWS) is intended to encompass all of the elements required to produce an appropriate timely response to flooding. The lead guiding document for the development of the TFWS in Australia is Manual 21 – Flood Warning (Attorney-General's Department, 2009). The core elements of the TFWS are shown in Figure 4-1.

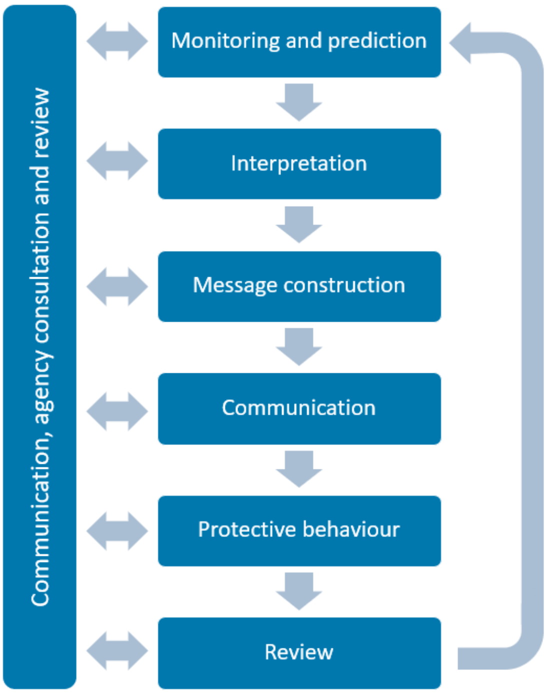


Figure 4-1 Total Flood Warning System elements

The information produced by a flood investigation generally relates to the "monitoring and prediction" and "interpretation" elements. Flood mapping, damages and intelligence produced by the study will be valuable in interpreting incoming data. Some of the elements of the study (for example the "Flood/No Flood" tool produced in the MFEP can aid with prediction.

Flood monitoring generally refers to monitoring rainfall and stream levels but may include other aspects such as storage levels and catchment conditions to name a few. Locations to monitor will depend on the available data sources and the catchment of interest.

Message construction, communication, and protective behaviour are outside the scope of a flood investigation; however, would generally be completed from within an Incident Control Centre (if one has been set up) and the applicable Incident Management Team controlling the incident. Formal flood warning messages in Victoria fall within the remit of the Bureau of Meteorology and fall within two classes: Flood Watches and Flood Warnings.

Flood Watches are general warnings covering a large area and are not specific to particular waterways or townships. They can be delivered well before flooding is expected to arise and are often based on forecast rainfalls. Flood Warnings, on the other hand, are specific to a location and will predict how high the water will peak at that location. Flood Warnings are often related to Flood Class Levels.

Review of the available information should take place after any event, or any other discovery of new flood information as appropriate. Historic events should be added to the available information, particularly the MFEP, as they occur.

Manual 21 stresses that for the TFWS to "work effectively, these components must all be present, and they must be integrated rather than operating in isolation from each other." When designing a TFWS, Manual 21 advises that the following points need to be addressed:

- The system must meet the needs of its clients including identifying:
  - Levels of flooding at which warnings are required.
  - The impacts at the different levels of flooding.
  - Warning time the community requires and what can be provided.
  - Appropriate subject matter content for warning messages.

  - The ways in which warning messages are to be disseminated.
  - The frequency of warning updates.
- The system must be part of the emergency management arrangements established by the relevant State or Territory as defined in disaster or emergency management plans.
- The review of the system must be carried out by all emergency agencies and by the community itself.
- The roles of the emergency agencies must be clearly defined for each component of the system.
- The system must be incorporated into the wider floodplain management.
- The system should be regularly tested and maintained.

A TFWS is the ideal tool to manage flood response, however for locations dominated by flash flooding such as Lexton, flood warnings play a limited role due to the limited flood warning time, limited duration of inundation and limited ability to respond in a way which may reduce flood risk and damage.

4.2 Existing flood warning system

4.2.1 Understanding the flood risk

The flood modelling and mapping completed as part of this study has provided a basis for good agency and council understanding of risk in a range of flood events across the study area. It is critical to the success of TFWS formation that those living in the floodplain (and particularly landholders) also understand the flood risk. If people don't know they are at risk of flooding, they will invariably not heed warnings. According to the Victorian Floodplain Management Strategy, "flood study outputs must provide flood-prone communities with concrete information about the real-world consequences of floods of different sizes". (Department of Environment, Land, Water and Planning, 2016).

As a result of this flood investigation, there will need to be amendments to PSC's planning scheme. The extent of flood prone properties identified during the study will be documented in the planning scheme.

Community members will be able to access flood risk property information through Council and hopefully via the VicData website.

4.2.2 Emergency Management Planning

Local councils are required to prepare a MFEP pursuant to Section 20 of the Emergency Management Act 1986 (as amended). The MFEP is a sub plan to the council's MFEP and should be consistent with the EMMV and the Victoria Flood Emergency Plan (Victoria State Emergency Service, 2012). The PSC MFEP contains flood intelligence information for Lexton based on the Lexton Preliminary Flood Study (Utilis, 2018). This provides high-level information on flooding in Lexton and should be updated with more detailed flood information produced in the current study.

The purpose of this MFEP is to detail arrangements for the planning, preparedness/prevention, response and recovery from flood incidents within the Lexton municipality. As such, the scope of the Plan is to:

- Identify the flood risk to the Lexton municipality.
- Support the implementation of measures to minimise the causes and impacts of flood incidents within the PSC municipality.
- Detail response and recovery arrangements including preparedness, incident management, command and control.
- Identify linkages with local, regional and state emergency and wider planning arrangements with specific emphasis on those relevant to flood.

This report provides details of recommended emergency operation activities to be conducted at different flood levels for the study area. These flood intelligence cards should be incorporated into the PSC Flood Emergency Plan and replace the existing information for Lexton.

4.2.3 Community Flood Education

Community flood education helps people learn how to prepare for and respond to floods (including to flood warnings). The prime outcome is public safety, with a secondary outcome being protection of property.

A Local Flood Guide is used to explain local flood risks for communities at risk. Local flood guides exist for other communities within PSC and one should be prepared for Lexton based on the information from this study. This includes advice for communities on how to prepare and respond to flood events and who to contact in the event of a flood. It should be produced based on the information in this report. Other future community flood education activities are also recommended and it should be noted that during community consultation undertaken during this project it was apparent the community was generally well aware of their flood risk, generally due to the recent frequency of previous flooding.

4.2.4 Data collation

Section 2 of this report details the available flood intelligence data for Lexton. It has been used in the development of the modelling and mapping used to determine the description of catchment and flood behaviour (Section 1.3), flood peak travel times (Section 2.1) and the information which will be inserted to the PSC MFEP (Section 3).

4.2.5 Prediction

The BoM maintains and funds the prediction services for the locations defined in the BoM Service Level Specification for Flood Forecasting and Warning Services. Maintenance includes continually improving prediction techniques.

As part of its prediction services, the BoM issues Flood Watches and Flood Warnings. A Flood Watch provides early advice of potential riverine flooding to emergency services and communities at risk of flooding. Flood Watches are issued when the combination of forecast rainfall and catchment or other hydrological conditions indicate that there is a significant risk of potential flooding. Flood Warnings are issued by the BoM to advise that flooding is occurring or expected to occur in a geographical area based on defined criteria. Flood Warnings may include either qualitative or quantitative predictions or may include a statement about future flooding that is more generalised.

The type of prediction provided depends on the quality of real-time rainfall and river level data, the capability of rainfall and hydrological forecast models and the level of service required. It should be noted that there is no flood class detail provided by the BoM due to the lack of streamflow gauge within the Burnbank Creek catchment.

According to Manual 21 (page 18), 'warning lead time' is the time between the issuing of a message containing a prediction and the time when the predicted height is reached. In essence, it is the effective time in which communities can act if guided by authorities.

Section 2.1 described the typical travel time along Lexton Creek and Burnbank Creek with most events peaking between 2 hours and 10 hours after the onset of rainfall. Due to the nature of the critical storm durations within the township catchment, the warning time of flooding at Lexton is limited and the BoM may only provide Flood Watch information relevant to Lexton. No Flood Warnings will be produced.

4.2.6 Interpretation

Local flood studies produce updated flood mapping that can be used in prediction and the communication of flood warnings to affected communities. DEECA includes updated flood mapping and flood behaviour information in the flood intelligence platform.

According to Manual 21 (page 21), “operational coordination and communication are essential between the prediction agency and the lead response agency involved in the reception and interpretation of predictions. Onsite reports provide valuable feedback to the prediction agency on the impacts of flooding and on the accuracy of the predictions. Information on forecast accuracy can be used to adjust hydrological prediction models so future forecasts can be made more accurate”.

For a flood in the study area, the BoM as the prediction agency would liaise with lead response agency (VICSES) at the state, regional and local level. Both agencies would interpret flood data through the appropriate level of Incident Control Centre (ICC). As a flood impacts on the community itself, it is worthwhile for response agencies to develop knowledge of the local conditions and potential reactions, both within the physical and social environments.

It should be noted that the Lexton CFA have provided an important flood response role in the past and are likely to provide important flood response roles in the future. The CFA are likely to be the most capable government agency to respond to rapid onset flood events.

The current report and its associated flood intelligence cards through the PSC Flood Emergency Plan will inform flood predictions in the study area.

It should be noted that DEECA has developed a web-based tool that provides a range of flood information, before, during and after floods. FloodZoom (only available to emergency agencies) brings together flood forecasts, flood mapping, real-time river height gauges and property data to provide flood response agencies with improved knowledge of likely flood impacts.

The intelligence provided to the ICC may be enriched by the crowdsourcing of data from an upper catchment information group of landholders organised by North Central CMA. This crowdsourcing process involves identifying and training ‘flood observers’: local landholders that are willing to photograph and/or verbally describe flood heights at certain reference points. This data can be phoned into the ICC to provide real-time intelligence in addition to flood models etc. However, local consultation showed that these crowdsources may have to help protect themselves, others and property and thus are not able to provide data in some floods.

4.2.7 Message construction

Flood Bulletins for Lexton should advise residents of potential road closures and to stay out of floodwaters.

Flood communication (e.g. Flood Bulletins) should be in simple language talking about impacts of potential flooding on the local communities in the study area and required actions including possible evacuation. It should consistently advise people of either stream heights or rainfall depths.

The rapid catchment response and very short time between rainfall and flooding should be acknowledged with at-risk residents and businesses in the Lexton area needing to conduct preparedness activities before the flood even begins. Each property that is prone to flooding should have sandbags prepared to act immediately after the flood warning is issued. Residents will want access to sandbags as soon as possible after it becomes apparent that flooding is likely.

4.2.8 Message Communication

Manual 21 (page 51) identifies two different types of message communication based on target audience:

- General warnings are disseminated ('broadcast') to whole communities or regions.
- Specific warnings are intended for individuals or parts of communities to reflect the need for 'narrowcasting' to specific audiences who may have specific characteristics or be at different kinds of risk.

General warnings are communicated by VICSES through the appropriate level ICC using Emergency Management Common Operating Picture (EM-COP) which links to the media, emergency service websites, the VICSES Flood and Storm Information Line and social media.

For riverine flooding, specific warnings are communicated by the ICC using Emergency Alert (providing location warning messages to mobile phones and landlines). VICSES (or a delegated authority such as the CFA) also use local and personal communication methods such as doorknocking, community meetings, and community bulletins.

4.2.9 Response

Flood response actions are outlined in the PSC MFEP Intelligence Card (Section 3). Given the likelihood inundation in Lexton will only be prefaced by Flood Watches or Thunderstorm Warnings from the BoM, the response to flooding will need to be rapid and the MFEP used as a guide only with on ground response actions guided by observed inundation. Council and VICSES will likely lead this response in their respective roles.

4.2.10 Community participation

An important way of attaining shared responsibility is through community participation in disaster management. A VICSES unit is stationed in Lexton and local people can participate in flood emergencies including warning through volunteering.

4.2.11 Review of warning systems

The flood warning system in the study area needs to be reviewed regularly (e.g. through a system monitoring and evaluation process). Local communities should participate in the review of the local flood warnings e.g. through pre-existing committees or community groups.

PSC Municipal Emergency Management Planning Committee is an appropriate body to review flood warning systems through its governance of the MFEP (which includes a section on flood warning). This plan needs to be reviewed:

- Following any new flood study
- Following changes in non-structural and/or structural flood mitigation measures
- After the occurrence of a significant flood event within Lexton

4.2.12 Existing capability

Currently, there is no formal flood warning system in place for the upstream Lexton catchment. Additionally, there are no streamflow gauges within the catchment. Due to this, official flood warning capability for the Lexton catchment is limited to the issue of a Flood Watch for the area. Note a Flood Watch is not necessarily guaranteed to be issued prior to flooding.

The Doctors Creek rainfall gauge reports sub-daily rainfalls to DEECA and is located very close to the catchment. This gauge is expected to capture rainfall in the upstream catchment reasonably well.

4.2.13 Potential capability

Given a sub-daily rainfall gauge already exists near to the study catchment, additional rainfall gauges would provide limited benefit. In general, flood data monitoring could benefit from the placement of a streamflow gauge within the catchment. However, the catchment response of typically 2-10 hours from onset of rainfall to peak flood, and even less time from start of creek rising to peak flood, means that a streamflow gauge may not provide warning time sufficient to enact response actions other than evacuation or shelter in place. The costs associated with installation and maintenance of a gauging station would likely exceed the benefits. Similarly, using rainfall gauge data to predict flash flooding within Lexton may also be of limited use for flood warning.

4.3 Improvements

The existing flood warning system lacks stream gauging capabilities and a detailed MFEP for Lexton. This Lexton Flood Intelligence and Warning Report and its associated flood intelligence cards provide improved flood data and interpretation for a local TFWS. However, there are several suggested actions that will improve the existing flood warning system to help develop a TFWS in the study area, these are as follows:

- Enable community members to access the latest flood risk information from PSC's planning scheme.
- Incorporate flood intelligence cards from this Flood Intelligence and Warning Report into the PSC MFEP.
- Produce a local flood guide for Lexton based on this report.
- Conduct other future community flood education activities across the study area based on findings of the report.
- Ensure that flood communication (e.g. Flood Bulletins) are presented in simple language talking about impacts of potential flooding on the local communities in the study area and required actions including possible evacuation. It should consistently advise people of either stream heights or flow volumes.
- Communicate the rapid catchment response to intense rainfall events, meaning that there is limited warning time once a rainfall event commences. Residents need to observe rainfall forecast and take relevant precautions, particularly if evacuation is necessary.
- Ensure that all people in the community (including newcomers and renters) have the opportunity to be included in community flood education and engagement before, during and after flood events.
- Check that the Vulnerable Persons Register is updated and used during a flood emergency.
- Any community flood education should reiterate the message from VicSES regarding the risks of attempting to drive through flood waters. This is the most common cause of flood related fatalities.
- Consider other ways in which the community can participate in the design, implementation and review of the TFWS.
- Amend the MFEP to describe the practical integration of the local flood warning system.
- Investigate the application of rainfall radar for Lexton, enabling a spatial understanding of rainfall depths across the township and associated catchments.

5 SUMMARY

This report details the background information used to produce flood intelligence and flood warning for inclusion in the Pyrenees Shire Council Municipal Flood Emergency Plan (MFEP). The report should be used as a reference document during flood events to confirm flood response actions required.

Several flood intelligence products have been developed to improve flood response capability for Lexton, 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. Due to the nature of flooding in Lexton, the community have very limited time to respond to an event. The typical warning time is likely to be between 2 – 10 hours. The isolated road and flooded properties were outlined in this report based on each modelled event. A flood intelligence card was developed to help council understand the potential impact for a range of design event.

Much of the flood intelligence information contained in this report will be included in a draft revision of the PSC MFEP 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. Rainfall radar could be investigated to improve the spatial understanding of rainfall extent and intensity and therefore improve flood warning.

APPENDIX A ISOLATED AREAS

Figure 5-1 Isolated Areas – 20% AEP Event

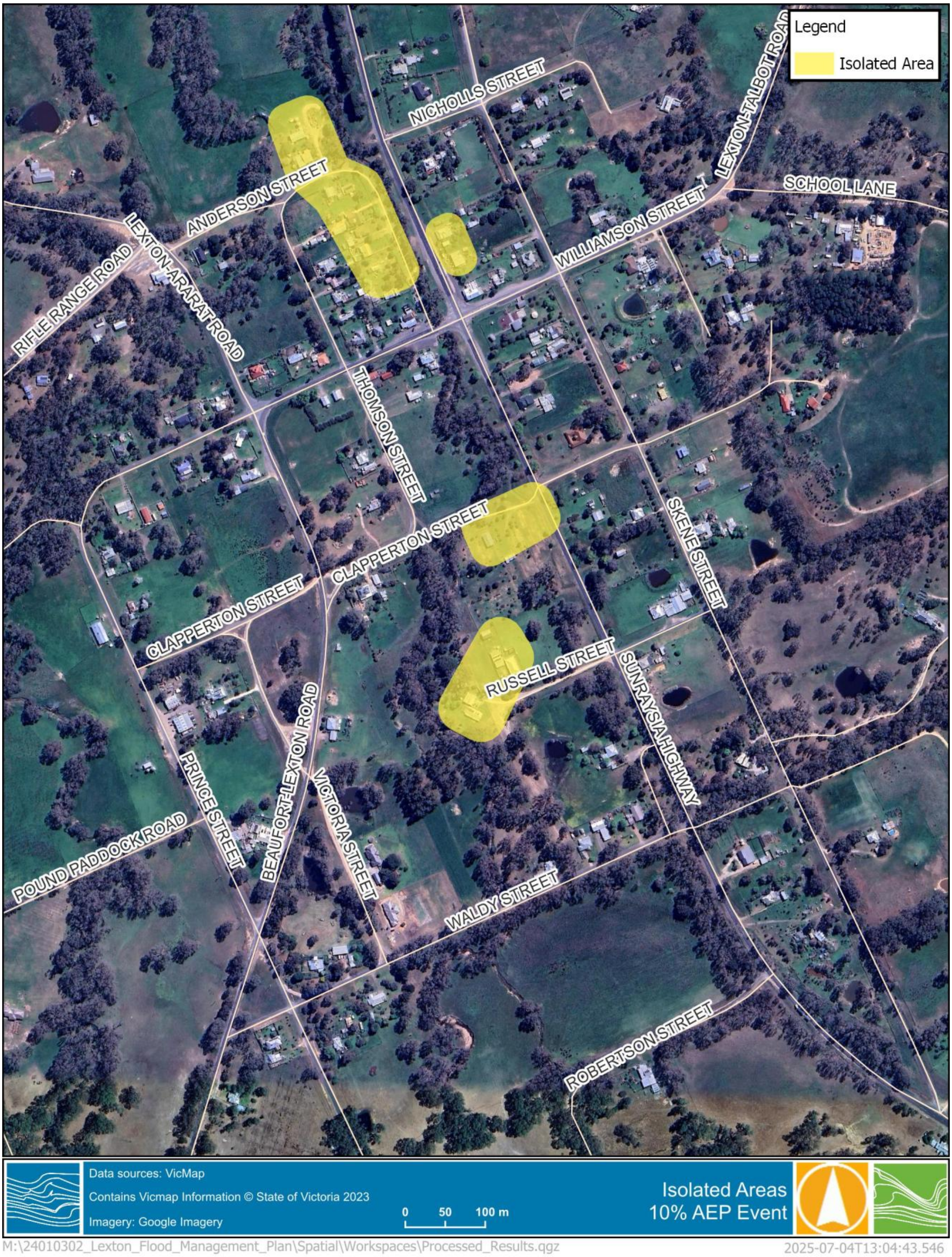


Figure 5-2 Isolated Areas – 10% AEP Event

Figure 5-3 Isolated Areas – 5% AEP Event

Figure 5-4 Isolated Areas – 2% AEP Event

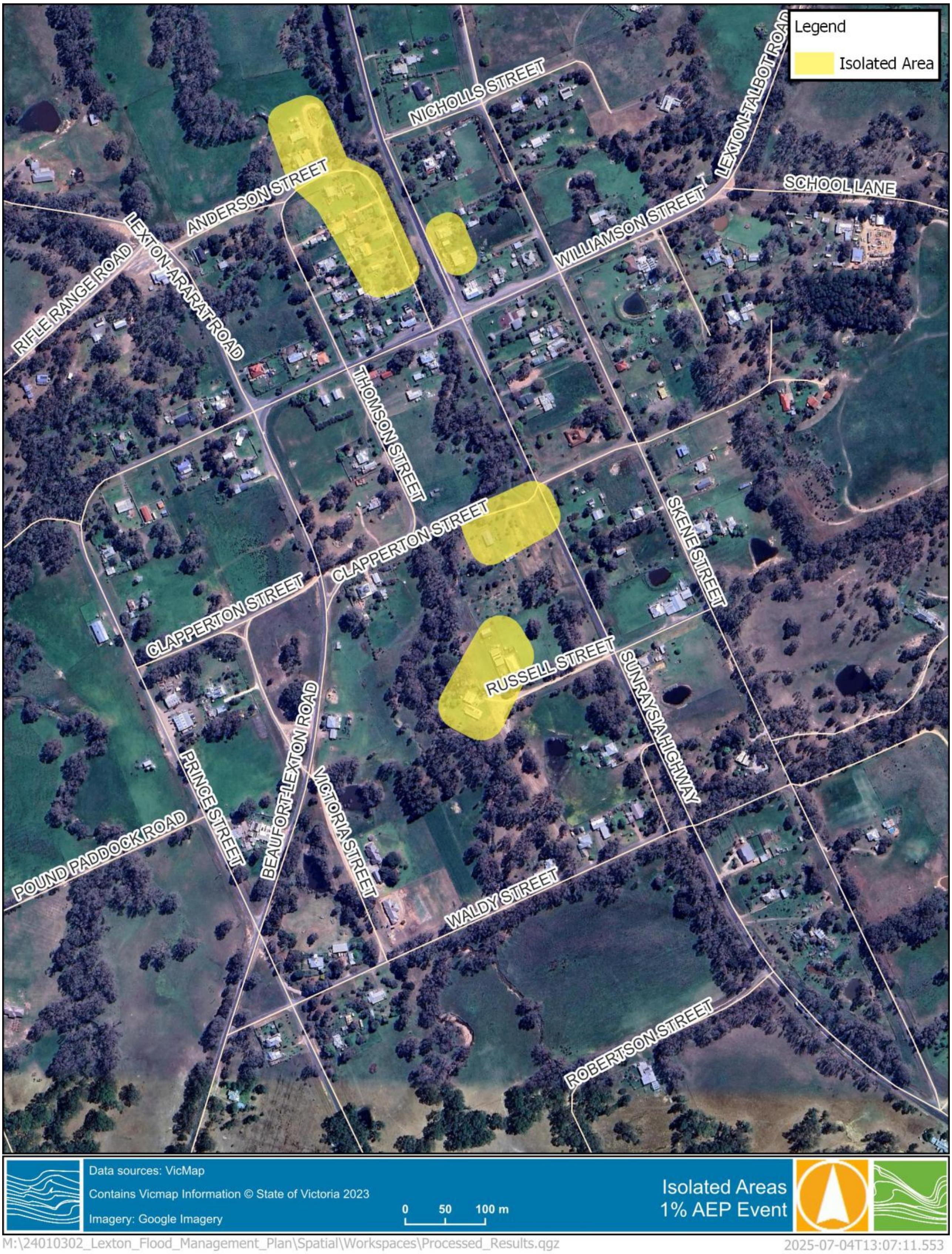
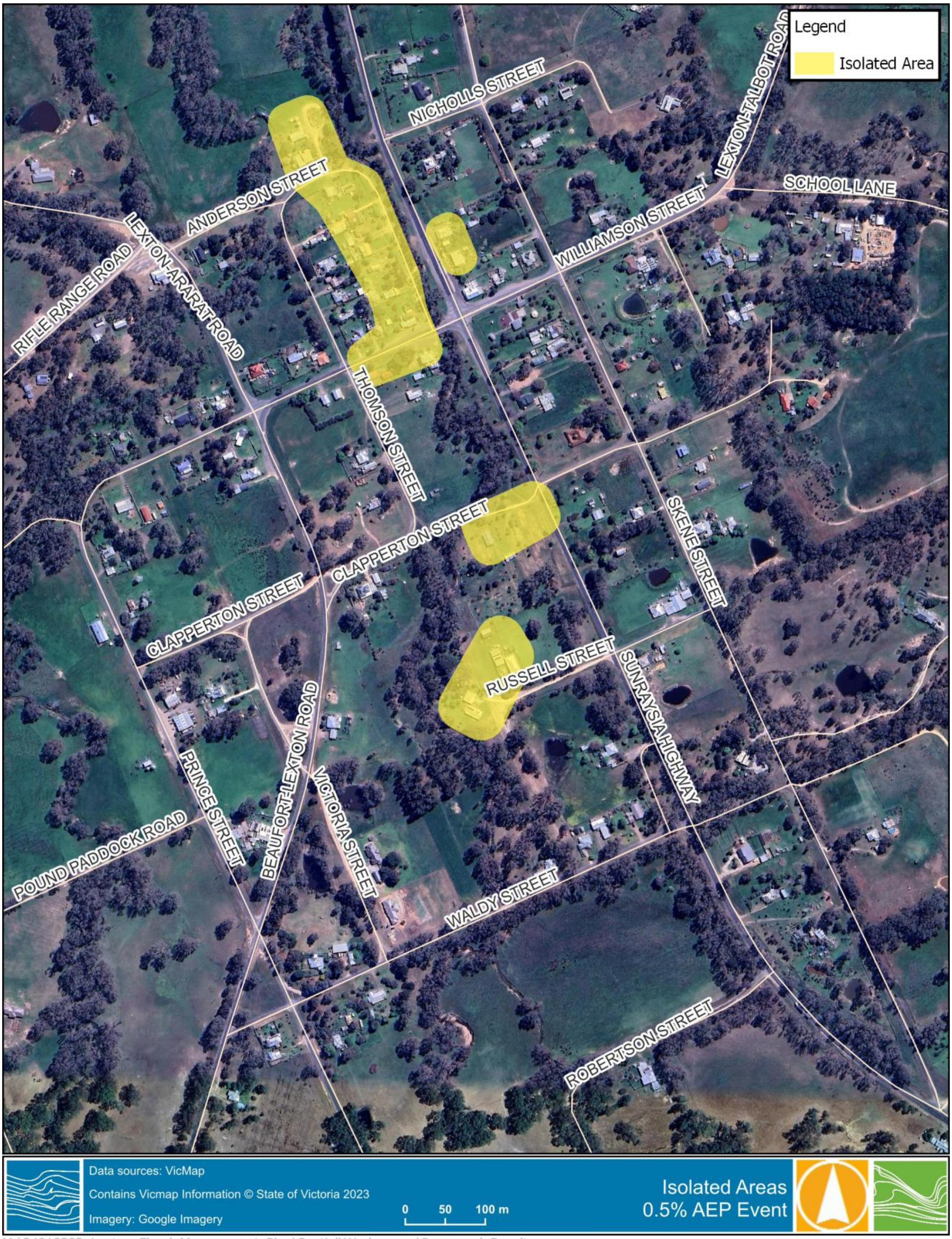


Figure 5-5 Isolated Areas – 1% AEP Event



M:\24010302_Lexton_Flood_Management_Plan\Spatial\Workspaces\Processed_Results.qgz 2025-07-04T13:05:09.160

Figure 5-6 Isolated Areas – 0.5% AEP Event

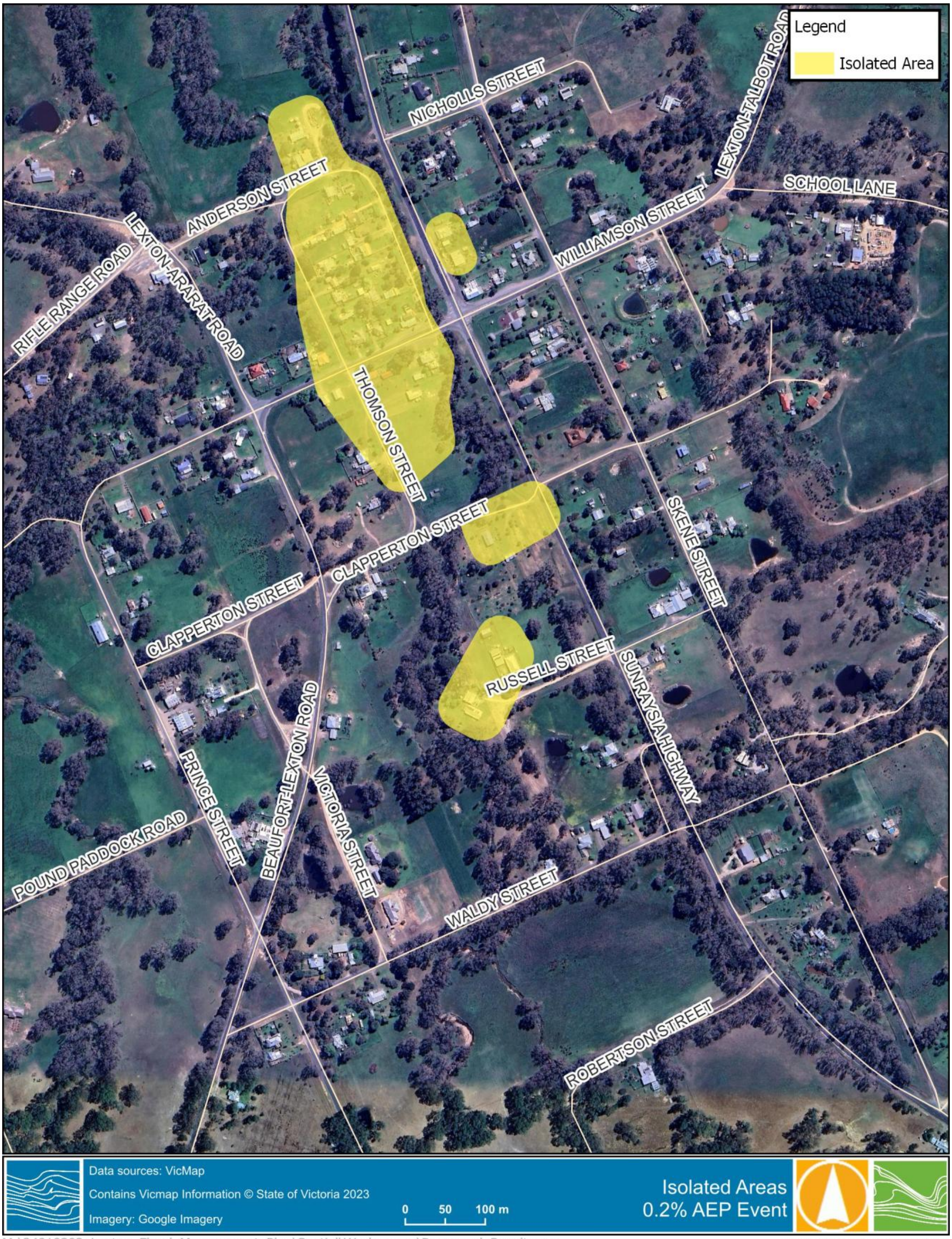


Figure 5-7 Isolated Areas – 0.2% AEP Event

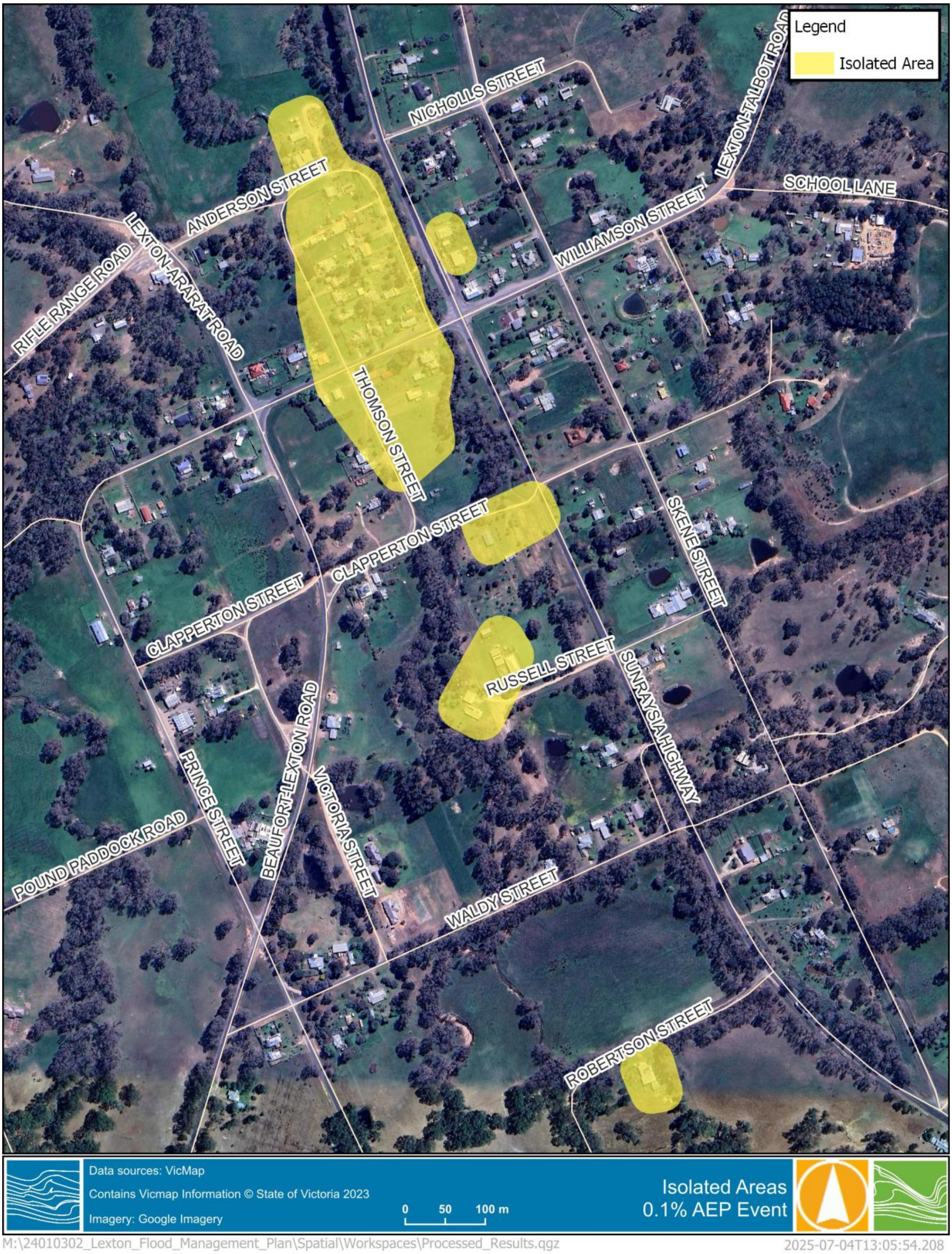


Figure 5-8 Isolated Areas – 0.1% AEP Event

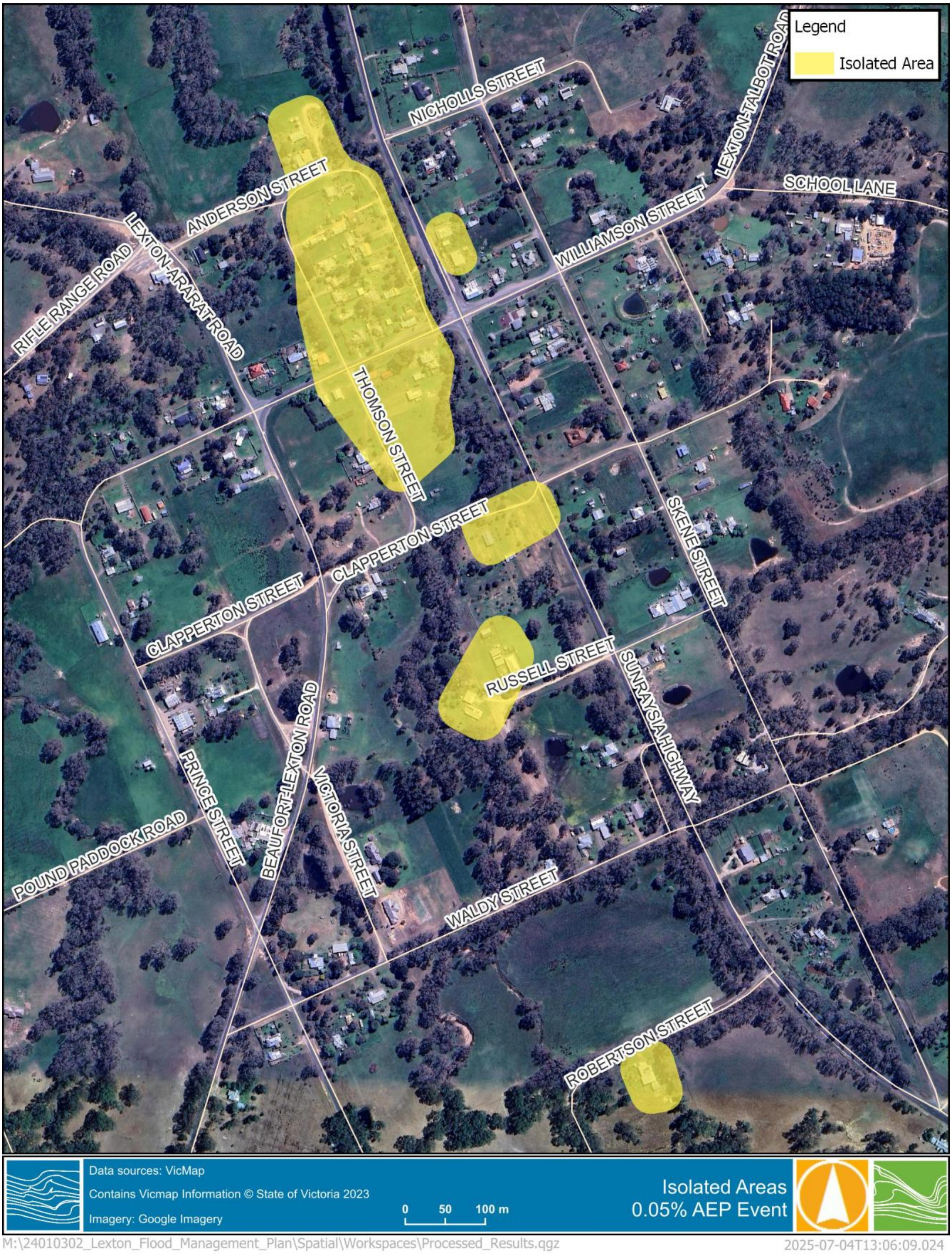


Figure 5-9 Isolated Areas – 0.05% AEP Event

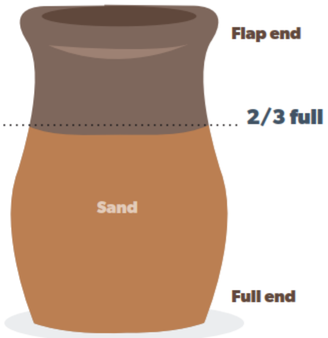
APPENDIX B VIC SES SANDBAGGING

Sandbagging

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

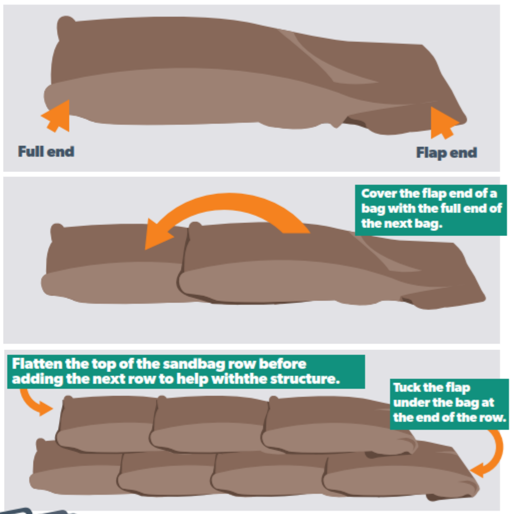
How do I fill a sandbag?

- 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.