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Scenic Rim Flood Modelling

Logan River Flood Modelling – Consolidated Final Report

Scenic Rim Regional Council

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Contents

Appendices

Appendix B

Calibration plots

Figures

Tables

1 Introduction

1.1 Study background

Scenic Rim Regional Council (SRRC) is seeking to gain a better understanding of the Region's Natural Hazard (Flood) characteristics. Aurecon has undertaken flood studies across the Scenic Rim Regional Council (SRRC) area for seven major waterway systems including Logan River, Albert River, Bremer River, Teviot Brook, Warrill Creek, Purga Creek and Upper Coomera River. These studies involved the development of catchment wide models for each of the waterways, covering the majority of creeks and tributaries.

Aurecon were originally commissioned by SRRC to undertake flood modelling of each system to provide SRRC with flood extents, heights, velocities and hazard categories for the 1% AEP event. This modelling focussed on providing information to assist Council with strategic planning objectives.

Council recognised that whilst the 1% AEP event provided important information on large scale flooding across each catchment, understanding the behaviour of more frequent events was also important in particular when looking at risk to properties, access and egress routes during floods and for disaster management planning.

As such, Council commissioned Aurecon to update the flood models for each of its seven major catchments to include assessment of the 2%, 5% and 10% AEP flood events.

This report consolidates and presents the investigation completed for the Logan River catchment.

1.2 Study area

The Logan River is a large river system which discharges into Moreton Bay with its upstream catchment boundary at the Queensland/New South Wales border between Mount Lindesay and Mount Ernest. The catchment is predominantly rural particularly in its upper reaches. The Scenic Rim Local Government boundary extends to Mount Wilbraham and defines the lower extent of this study.

1.3 Study objectives

SRRC initially requested a flood study that was compliant with the current State Planning Policy (and associated guidelines) and the relevant requirements of the Building Act 1975 (Act). The flood study is to provide Council with the ability to designate a flood hazard area under Section 13 of the Act.

The second stage objective was to provide information to assist with Council's disaster management planning and response functions. The following tasks were undertaken as part of this two-stage assessment:

- Hydrologic modelling of the catchment and calibration against selected historical events
- Hydraulic modelling of Logan River and joint calibration with the hydrologic model
- Preparation of 1% AEP flood mapping presenting flood inundation extents, flood depths, flow velocities and hazard rating
- Identification of the minimum and maximum flood levels for each property inundated by the 1% AEP event
- Updated hydrologic and hydraulic modelling for the 10%, 5% and 2% AEP events
- Updated definition of minor, moderate and major flood events at each key stream gauge location to enable Council to inform BOM (and to update the current flood gauges)
- Review of the current flood gauge network to ascertain whether there are any further locations where flood gauges could/should be located
- Review of the correlation between gauge height, flooding event and scale of event, and
- Preparation of flood mapping for the additional events presenting flood inundation extents, flood depths, flow velocities and hazard ratings

The work undertaken to achieve the above objectives is documented in the following report.

The Scenic Rim Flood Hazard Management and Disaster Mitigation Assessment Project for the Logan River catchment is a joint initiative of Scenic Rim Regional Council, the Queensland Government and the Australian Government.

2 Study Data

A number of datasets have been collated, reviewed and adopted for use in this project as described below.

2.1 Previous studies

The Logan River RAFTS model was adapted from a model original developed by Logan City Council (LCC) as part of the 2014 hydrology study analysing the Teviot Brook, Albert and Logan catchments.

2.2 Survey Data

2.2.1 Aerial LiDAR Survey

SRRC's 2011 Aerial LiDAR Survey (ALS) data was utilised as the basis for topographic representation within the Logan River catchment as per the 2016 study. ALS data typically produces levels within an accuracy of ±150 mm and a horizontal accuracy of ±300 mm.

The ALS data was verified against ground survey (2013) of Permanent Survey Marks (PSM). The ALS data was found to provide elevations within ±300 mm of the ground survey PSM. This is considered a reasonably accurate representation of the topography and confirmed that the LiDAR was suitable for use in the hydraulic model.

In 2017, Council also provided data generated by SEQ Catchments 2013 which provided refinement of the topographic data. However, it was found that this data did not provide coverage of the Logan River catchment only in the upper reaches of the Warrill Creek catchment and as such it was not used for the additional flood modelling.

No bathymetric data was provided for this study and it was noted for the 1% AEP modelling that the river bed definition was limited by the presence standing water. Whilst this limitation was not considered significant for the 1% AEP event due to the high proportion of overbank flow in the major storm event, it was considered more significant for the analysis of minor to moderate storm events due to the higher proportion of flow conveyed within the banks.

2.2.2 Structure data

2.2.2.1 1% AEP event

Structure details for a number of bridges were provided by SRRC. The bridge information was limited with no As-Constructed details available. The following simplified assumptions have been made regarding bridge structures:

- It has been assumed that the bridge deck has the same level as the adjacent road level
- The thickness of the deck has been assumed to be 900 mm
- A blockage factor of 20% has been assumed to allow for pier losses

2.2.2.2 2%, 5% and 10% AEP events

To assist with providing information for emergency management response critical road crossings were identified within the Logan River Catchment. This was carried out in consultation with Council. Detailed field survey was commissioned to obtain structure details for incorporation into the hydraulic model. In the Logan River catchment, the following crossings were surveyed:

- Dunn Bridge, Allan Creek Road at Allan Creek Crossing
- Allan Struss Bridge, Allan Creek Road at Logan River Crossing
- Il- Bogan Bridge, Beaudesert-Boonah Road at Logan River Crossing
- Williams Bridge, Mount Lindsay Highway at Logan River Crossing
- Knapp Junction Bridge, Kooralbyn Road at Knapp Creek Crossing
- Lamington Bridge, Christmas Creek Road at Christmas Creek Crossing
- Todd Bridge, Boonah-Rathdowney Road at Logan River Crossing
- Ralston Bridge, Running Creek Road at Running Creek Crossing

Using this field survey improvements were made to the bathymetric representation within the current model. This is discussed further in Section 5.5.3.2.

2.3 GIS data

The following GIS datasets were provided by SRRC which were utilised as per the 2016 study:

- Aerial imagery – High resolution 2013 aerial imagery
- GIS based hydraulic structures data. Details regarding refinements to the modelling of hydraulic structures is provided in Section 5.5.3.2.
- Updated DCDB (2017)

These datasets have been utilised for the generation of flood mapping and tabulated flood levels.

2.4 Calibration data

2.4.1 Stream gauge data

A review of the stream gauge data within the project extents was undertaken. Whilst the LCC hydrologic model calibration focussed upon the Yarrahappini and Round Mountain gauges there are several additional gauges within the area reported by either the Bureau of Meteorology (BoM) or the Department of Natural Resources and Mines (DNRM). In addition to the three historical events previously modelled (1974, 1990 and 2013), the 1991 event has been included given its importance within the Logan River catchment for the Scenic Rim Local Government area.

The complete available stream gauge information for each of the historical flood events is detailed in Table 1 with the location of each of these gauges presented in Figure A-3 (Appendix B).

Table 1 Available stream gauge information

Gauge Location	Owner	Years of record	Calibration Event			
			1974	1990	1991	2013
Forest Home	DNRM	61	✓	✓	✓	✓
Ward Road	DNRM	7	n/a	n/a	n/a	✓
Dieckmans Bridge	DNRM	49	✓	✓	✓	✓
Rathdowney	DNRM	41	✓	✓	✓	✓
Rudds Lane	DNRM	22	✓	n/a	n/a	n/a
Tramway Lane	DNRM	8	n/a	n/a	n/a	✓

Gauge Location	Owner	Years of record	Calibration Event			
			1974	1990	1991	2013
Round Mountain	DNRM	55	✓	✓	✓	✓
Rudds Lane TM	BoM	24	n/a	n/a	n/a	✓
Yarrahappini	DNRM	45	✓	✓	✓	✓

2.4.1 1991 Rainfall data

As discussed previously three of the calibration events, 1974, 1990 and 2013, had already been modelled by LCC, therefore only rainfall data for the 1991 event was sourced for this investigation. The rainfall stations used for the calibration of the 1991 event are displayed in Figure A-4a (Appendix B). Only two pluviographs were available to represent rainfall patterns across the catchment, located at Beaudesert and Maroon Dam.

2.4.2 Surveyed historical flood markings

Surveyed historical flood markings across the catchment were provided by SRRC for the 1974, 1976 and 1991 events. This consisted of surveyed flood levels at properties. This data is of particular importance as it provides historical records through some of the smaller creeks such as Cannon Creek, for which there is no gauged data. There are a significant number of records in this dataset for the 1991 flood event. This event is characterised as being particularly large in the upper reaches of the catchment and therefore useful for calibration to the larger flows at locations such as Forest Home and Rathdowney.

2.5 Report terminology

This report adopts the latest approach to design flood terminology as detailed in the updated *Australian Rainfall and Runoff – Book 1 Terminology* (AR&R, National Committee on Water Engineering, 2016). Therefore, all design events are discussed in terms of Annual Exceedance Probability (AEP) using percentage probability (eg 1% AEP design event).

Table 2, an extract of Figure 1.2.1 from Book 1 (AR&R, 2016), details the relationship between Annual Recurrence Interval (ARI) and AEP for a range of design events.

Table 2 Extract from Figure 1.2.1 AR&R adopted terminology

AEP (%)	AEP (1 in x)	Average recurrence interval (ARI)
10.00	10	9.49
5.00	20	20
2.00	50	50
1.00	100	100
0.50	200	200
0.20	500	500

As can be seen from Table 2, the difference between AEP and ARI is minimal for the 10 year ARI event and above. This range of events reflects a focus on flooding therefore use of the AEP terminology has been adopted.

3 Models Development

3.1 Hydrologic Model

The LCC RAFTS hydrologic model of the Logan River catchment was considered suitable for use and adopted for this study. RAFTS is a runoff routing model and an industry standard tool commonly used for hydrologic studies.

3.1.1 Modelling extents

The Upper Logan River sub-model adopted for this assessment extends from the upper limits of the catchment down to Yarrahappini and was previously calibrated for the 1974, 1990 and 2013 events. Calibration was undertaken using gauge records at Yarrahappini and Round Mountain. Figure A-1, Appendix A, presents the Upper Logan River hydrologic model layout and extents.

3.2 LCC RAFTS model parameters

As noted above the adopted LCC Upper Logan catchment hydrologic model was calibrated to the 1974, 1990 and 2013 flood events. The LCC RAFTS model flood routing used the Muskinghum-Cunge channel routing method. This specifies the storage constant and weighting factors (k and x) to be applied between nodes. These were previously entered directly into the LCC RAFTS model and the source calculations for these storage factors are not available.

The LCC RAFTS also includes a storage coefficient multiplication factor 'Bx'. This uniformly modifies all subcatchment Storage Time Delay Coefficient values. The previously used storage factors 'k', 'x' and 'Bx' were assumed appropriate and adopted for use in this study. Review of the hydrographs from RAFTS shows a reasonable match in terms of flood time lag supporting the use of the previously developed storage factors.

The following parameters were adopted for the LCC RAFTS model for each calibration event.

Table 3 LCC RAFTS model calibration event parameters

Event	Calibration parameters		
	IL (mm)	CL (mm/hr)	Bx
1974	50.0	0.50	1.4
1990	10.0	2.20	1.4
2013	130.0	2.50	1.4

The LCC Upper Logan River RAFTS model has an inflow representing the Teviot Brook catchment. This inflow hydrograph is applied just upstream of Yarrahappini. The Teviot Brook RAFTS sub-model was not provided for use in this assessment. The Teviot Brook hydrographs for the 1974, 1990 and 2013 calibration events were provided with the Upper Logan River sub-model.

3.3 Hydraulic model

3.3.1 Software platform and modelling approach

A combined 1-dimensional (1D) and 2-dimensional (2D) hydraulic modelling approach was adopted for this study. The Logan River hydraulic model has been developed to cover the entire floodplain, and a number of tributaries, and includes representation of the major hydraulic structures and topographic features that influence flood behaviour. Adoption of the 2D modelling software enabled floodplain and breakout flows to be accurately represented. The upper extremes of the river and the tributaries have been modelled as 1D channels connected to the 2D domain. Modelling these steeper narrow tributaries in the 1D domain allows the channel to be represented in a greater definition within the model. Cross-sections for the 1D channels were made at a minimum of 300 m intervals.

Modelling has been undertaken using the TUFLOW software (version 2013-12-AC).

3.3.2 Modelling extents

The extent of the Logan River system modelled and mapped matches the extents shown on the Queensland Reconstruction Authority (QRA) website as the 2010/11 Interim flood lines for the SRRC area. The model extends from Moorang to Lower Mount Walker and includes an area of approximately 180 km^2. The adopted model extents are presented in Figure A-2 (Appendix A). During the calibration process, some of the upper reach tributaries that were originally modelled in 1D were converted into the 2D domain due to the significant overbank flow for the 1% AEP event.

3.3.3 Topography

The hydraulic model was based on topographic information sourced from the 2011 LiDAR survey provided by SRRC. The topography is represented in the hydraulic model using a 20 m grid size. This grid size allows sufficient detail for the channel and floodplain representation in the hydraulic model whilst allowing for reasonable model run times. The 1D channels are represented with cross-sections at a minimum interval of 300 m. These sections were sourced from 2011 LiDAR survey.

3.3.4 Initial roughness assumptions

Initial surface roughness values used in the hydraulic model are presented in Table 4 and were based on accepted industry values. Land use types were identified for areas using aerial photography provided.

Table 4 Adopted roughness/Manning's n values

Land use type	Manning's n
Floodplains	0.060
Logan River and tributaries	0.070
1D Channels	0.045

3.3.5 Hydraulic structures

Only limited information for existing bridge structures was available with no As-Constructed details available. The following bridges have been included in the hydraulic model:

- Alan Struss Bridge crossing at Logan River
- Il-Bogan Bridge crossing at Logan River
- Josephville Bridge crossing at Logan River
- Dunn Bridge crossing at Allan Creek
- Beaudesert-Boonah Road Bridge crossing at Allan Creek
- Rail Bridge crossing at Allan Creek

There are a number of other bridges throughout the catchment that have not been included in the model due to a combination of a lack of available data and expectations that they will be overtopped under the 1% AEP event and therefore of limited impact on peak water levels.

3.3.6 Boundary conditions

The RAFTS model outputs were applied as inflows into the TUFLOW model. Total inflows from catchments upstream of the hydraulic model extents were applied at the upstream model boundary and local inflows from areas within the TUFLOW model were applied throughout the model.

A normal depth boundary condition was applied at the downstream boundary. Since the downstream boundary is not a well-defined water level, a stage-discharge relationship was used in TUFLOW to define the boundary condition.

4 Calibration

4.1 Process of calibration

Four events were used in the model calibration process being 1974, 1990, 1991 and 2013. Inflow hydrographs from the RAFTS model were incorporated into the TUFLOW hydraulic model at a number of locations within the study area. The hydraulic model was run and the resulting water levels and discharges compared to the stream gauge data and recorded flood levels.

An iterative joint calibration approach was then undertaken with both hydrologic and hydraulic model parameters adjusted to achieve the best match against the available recorded historical data.

The 1991 event was not previously considered by LCC and therefore there was no Teviot Brook flow data available for this calibration in the RAFTS model. The Logan River RAFTS model, developed as part of the 2007 study was reviewed and included delineation of Teviot Brook. This model was previously calibrated for the 1991 event and was used to establish a 1991 calibration inflow hydrograph for Teviot Brook.

It is noted that whilst the RAFTS parameters have been varied for the various event calibrations, the Teviot Brook inflow hydrograph for each event has been adopted as per the previous studies.

4.2 Calibration targets

Ideally, the following tolerances are indicative of a good calibration:

Table 5 Calibration targets

Water level	Discharge
+/- 0.15m at stream gauges	+/- 10%

For flood levels derived from flood marks or debris levels a lesser tolerance of +/- 0.50 m for peak levels applies.

4.3 Calibration results summary

Overall, a reasonable calibration has been achieved based on the available information and the objectives of this study. As discussed above an iterative calibration process was followed with the following parameters adjusted to achieve the best match to the available historical data:

- Rainfall temporal patterns for 1991 event
- Initial and continuing loss rates for each historical event
- Roughness values on the Logan River and its tributaries
- The extent of 1D branches as compared to 2D domain

The results of the calibration process were discussed with SRRC as the calibration progressed to confirm acceptance of the outcomes. This report presents the final calibration results only however the other results were presented and reviewed by SRRC.

The final calibration results are presented in Table 6 to Table 9 for each of the four historical events. Graphical plots (Figures B1 to B47) presenting the comparison of model results against the recorded stream gauge data are provided in Appendix B. Figure A-4B is a plan for the 1991 historical event has also been prepared to show the calibration outcomes across the floodplain extents. This includes comparison against the stream gauge levels and debris marks where available. This is provided in Appendix A.

Overall whilst a successful calibration has been achieved the modelling undertaken has identified the following limitations/issues:

- There are difficulties in matching the recorded stream gauge results in the upper parts of the catchment. This is likely to be due to the distribution of pluviograph data available across the catchment for each event – without a pluviograph in the upper part of the catchment it is challenging to represent event rainfall in these locations.
- The Round Mountain stream gauge seems to fail on a regular basis towards the peak of the flood event for larger events – matching of the shape of the hydrograph has been achieved but confirmation of the match of peak levels is therefore not possible.

4.3.1 Calibration results 1974 event

From the peak water levels presented in Table 6 and the event hydrographs presented in Appendix B the following conclusions on the 1974 calibration were drawn.

Table 6 1974 event – Observed vs modelled level results at stream gauges

Gauge	Peak Gauge Recording (m AHD)	TUFLOW Peak WSL (m AHD)	Difference (m)
Forest Home	112.09	112.18	+0.09
Dieckmans Bridge	98.14	98.70	+0.56
Rudds Lane	93.73	95.36	+1.63
Rathdowney	87.01	88.17	+1.16
Round Mountain*	59.36	60.69	+1.33
Yarrahappini	31.22	30.82	-0.4

*Gauge failed during event so recorded peak level too low

- Forest Home Gauge
  - Quick increase in flows/water levels over short period recorded at the stream gauge which cannot be replicated by the modelling even with very low loss rates. Volume in modelled event also lower than that recorded
  - Likely that the rainfall information available in terms of temporal pattern does not represent local rainfall conditions in this hilly area
- Dieckmans Bridge
  - Rainfall temporal pattern may be influencing ability match shape
- Rudds Lane
  - Peak flows and levels overestimated and peakier than recorded dataset. Slower response being indicated by gauge as compared to model results
  - Would need significant change in loss parameters to improve match in this location
- Rathdowney
  - Reasonable match in terms of shape as compared to previous gauges but still high on peak levels
- Round Mountain
  - Recorded gauge peak water level discounted in previous studies due to gauge failure during event

- Overall shape a reasonable match to stream gauge
- 2007 Model results were 60.84 m AHD – reasonably close to those predicted by current model

- Yarrahappini
  - All tested scenarios show that the overall volume is lower than that estimated at gauge – note that changing loss rates does not change this comparison much
  - Reasonable match to peak water levels achieved
- Overall summary
  - Available temporal patterns limit the ability to represent rainfall in upper reaches more accurately with some volume of the event not being represented

4.3.2 Calibration results 1990 event

From the peak water levels presented in Table 7 and the event hydrographs in Appendix B the following conclusions on the 1990 calibration were drawn.

Table 7 1990 event – Observed vs modelled level results at stream gauges

Gauge	Peak Gauge Recording (m AHD)	TUFLOW Peak WSL (m AHD)	Difference (m)
Forest Home	111.76	111.79	+0.03
Dieckmans Bridge	97.95	97.58	-0.37
Rathdowney	84.90	85.87	+0.97
Round Mountain*	55.79	58.87	+3.08
Yarrahappini	25.22	24.62	-0.6

* Problems with peak levels recorded at gauge

- Forest Home
  - As with 1974 event there is a significant rapid increase in peak flow and levels near the peak of the event that is not being replicated by the models
  - The flows are derived using a rating curve from the stream gauge and if the rating curve is extrapolated at higher levels this may be influencing the estimated discharges
  - There is a significant difference in the volumes between that recorded and that estimated by the model again indicating that the rainfall data may not adequately represent local conditions
- Dieckmans Bridge
  - Reasonable match in terms of peak flow but over estimation in terms of peak level and loss rate changes not greatly adjusting outcomes. Overall modelled shape peakier than recorded event and looks to include more volume. Again, this may relate to available rainfall/temporal patterns
  - Odd rapid change in recorded levels at tail end of event, possible issues with the data from this gauge
- Rathdowney
  - Model results peaking earlier but reasonable comparison between volumes
- Round Mountain
  - Again, there are concerns regarding the peak levels/flows recorded at this stream gauge. Good match in terms of shape and rising/falling limbs of hydrographs.
- Yarrahappini
  - Modelled hydrograph peaking later than recorded event with some initial flood volume missing in model this relates to temporal patterns used
- Overall summary
  - Available temporal patterns limit the ability to represent rainfall in upper reaches more accurately

4.3.3 Calibration results 1991 event

Only two pluviographs available to represent rainfall patterns across the catchment, located at Beaudesert and Maroon Dam. From the peak water levels presented in Table 8 and the event hydrographs in Appendix B the following conclusions on the 1991calibration were drawn.

Table 8 1991 event – Observed vs modelled level results at stream gauges

Gauge	Peak Gauge Recording (m AHD)	TUFLOW Peak WSL (m AHD)	Difference (m)
Forest Home	115.41	115.24	-0.17
Dieckmans Bridge	100.64	100.82	0.18
Rathdowney	89.49	90.80	1.31
Round Mountain	60.86	61.43	0.57
Yarrahappini	29.27	28.88	-0.39

- Forest Home
  - As for the two previous events the sharp increase in flows/levels at peak is not being replicated by the hydraulic model
  - Overall shape apart from peak is reasonable match
- Dieckmans Bridge
  - Reasonable match in terms of shape. Flows and levels not matched on all three peaks of this event but good match on largest peak.
- Rathdowney
  - Good match in terms of shape for levels and most of flow hydrograph. Peak of flow hydrograph from hydraulic model significantly higher than gauge.
- Round Mountain
  - Volume in model well above that recorded
  - Flows and levels overestimated
- Yarrahappini
  - Reasonable match in terms of level and flows, with volume still over-estimated in model
- Recorded peak water levels from stream gauges and debris marks are presented in Figure A-4B (Appendix A)
  - In Forest Home area, the model is predicting lower levels than those recorded – this is likely to relate to not having a temporal pattern that represents rainfall event in upstream catchment
  - Around Rathdowney the model is higher than the recorded debris levels and the stream gauge
  - At Round Mountain, the model is predicting water levels around 0.5m above the recorded levels – not far outside the proposed tolerance limits
  - Between Round Mountain and Yarrahappini the model results are generally a lot closer to the recorded levels
- Overall summary
  - Overall volumes in model appear high with peak water levels generally on the high side

4.3.4 Calibration results 2013 event

This event was not previously modelled in 2007 but is one of the calibrated events from the LCC RAFTS model. Several loss rates scenarios were tested for this event and there are seven stream gauge locations at which to compare model results.

From the peak water levels presented in Table 9 and the event hydrographs in Appendix B the following conclusions on the 2013 calibration were drawn.

Table 9 2013 event – Observed vs modelled level results at stream gauges

Gauge	Peak Gauge Recording (m AHD)	TUFLOW Peak WSL (m AHD)	Difference (m)
Forest Home	113.10	112.77	-0.33
Ward Road	103.99	106.10	+2.11
Dieckmans Bridge	97.22	98.33	+1.11
Rudds Lane	92.01	92.63	+0.62
Tramway Lane	83.43	82.67	-0.76
Rathdowney	87.90	88.40	+0.50
Round Mountain*	59.27	59.86	+0.59
Yarrahappini	28.18	26.87	-1.31

* Problems peak levels recorded at gauge

- Forest Home
  - Better representation of shape of event as compared to previous events but still not getting up to peak levels
  - Volume in model appears lower than recorded – will relate to rainfall data
- Ward Road
  - Model not representing peaky nature of event – rainfall data applied to model does not appear to reflect local catchment rainfall with differences in timing of peak and shape
- Dieckmans Bridge
  - Reasonable match in shape as compared to above gauges but too much volume
- Rathdowney
  - Reasonable match in shape as above but missing second burst on tail – likely this rainfall not included in model
- Round Mountain
  - Issues with this stream gauge at the peak again so cannot compare peaks
  - Reasonable match in terms of shape and overall volume excluding the peak
- Yarrahappini
  - Reasonable match in terms of levels and shape but underestimating volume

4.4 Adopted calibration parameters

As detailed above, a joint calibration exercise was undertaken and the parameters in Table 10 were adopted for the RAFTS model for each historical event. The parameters that were used in the LCC hydrology study were also adopted in the joint calibration as they provided the most accurate results and provides a uniform approach between Councils.

Table 10 RAFTS model calibration parameters

Event	Joint Calibration		LCC Modelling	
	IL (mm)	CL (mm/hr)	IL (mm)	CL (mm/hr)
1974	50	0.5	50	0.5
1990	10	2.2	10	2.2
1991	60	1.5	-	-
2013	130	2.5	130	2.5

Aerial photography was used to define the land use within the study area and industry accepted values of Manning's 'n' roughness were applied. Calibration of the hydraulic model was then used to refine the values. The adopted roughness values are presented in Table 11 and Table 12**.**

Table 11 Adopted roughness/Manning's n values

Land use type	Manning's n
Floodplains	0.060
Logan River and tributaries	0.070

Table 12 Manning's roughness values applied to 1D tributaries

Tributary	Description	Manning's roughness
Allan Creek	Clean, winding some pools and stones	0.045
Sandy Creek	Clean, winding some pools and stones	0.045
Tamrookum Creek	Clean, winding some pools and stones	0.045
Oaky Creek	Clean, winding some pools and stones	0.045
Christmas Creek	Clean, winding some pools and stones	0.045
Knapp Creek	Clean, winding some pools and stones	0.045
Running Creek	Trees within main channel	0.100

5 Design events

As the design event modelling was undertaken in two stages, the following section of the report covers the 1% AEP event first then the additional design events and refinements undertaken for those events.

5.1 1% AEP event

Model calibration parameters for each historical event were established through the joint calibration process. The parameters adopted for calibration and the results of the flood frequency analysis were used to formulate design event parameters for the 1% AEP. The adopted 1% AEP design event parameters are detailed in Table 13. The final parameters adopted were consistent with the LCC modelling parameters.

Table 13 1% AEP event parameters

Design Event	Calibration parameters		
	Initial Loss Rate (mm)	Continuing Loss Rate (mm/hr)	Bx
1% AEP	0	0.5	1.4

Using the calibrated hydrologic and hydraulic models, modelling of the 1% AEP event was undertaken. The 1987 rainfall (IFD) and temporal patterns were adopted from Australian Rainfall and Runoff (AR&R).

5.2 Flood frequency analysis

A flood frequency analysis (FFA) using the available stream gauge data at Forest Home, Round Mountain, Dieckmans Bridge, Rathdowney and Yarrahappini was undertaken to estimate the peak flow for the 1% AEP design event. This was then used to confirm the design event modelling parameters.

The FFA is limited by the historical data available each site. Each gauge is well rated to a specific level where afterwards the gauge relies on extrapolation of the rating curve. Table 14 outlines the key details of each of the gauges used in the FFA. However, despite the limitations of the historical data, the FFA provides an appropriate reference point against which to compare the design event results and refine parameters.

Table 14 Stream gauge summary

Site no	Site	Catchment Area (km²)	Zero gauge (m AHD)	Maximum Gauged level (m)	Maximum Gauged Flow (m³/s)
145010A	Dieckmans Bridge	128	92.998	97.098	104.2
145003B	Forest Home	175	107.577	110.677	105.1
145020A	Rathdowney	533	75.385	85.828	382.8
145008A	Round Mountain	1262	44.025	58.906	1047.6
145014A	Yarrahappini	2416	10.465	28.825	2844.0

The Dieckmans Bridge gauge is well rated to flows up to 105 m^3/s but relies on extrapolation of the rating curve for higher flows. The predicted 1% AEP flow at Dieckmans Bridge is 664 m^3/s, which is slightly lower than the FFA 1% AEP estimate of 707 m^3/s at this location. As seen in Figure 1 the predicted flow clearly follows the trend of the FFA.

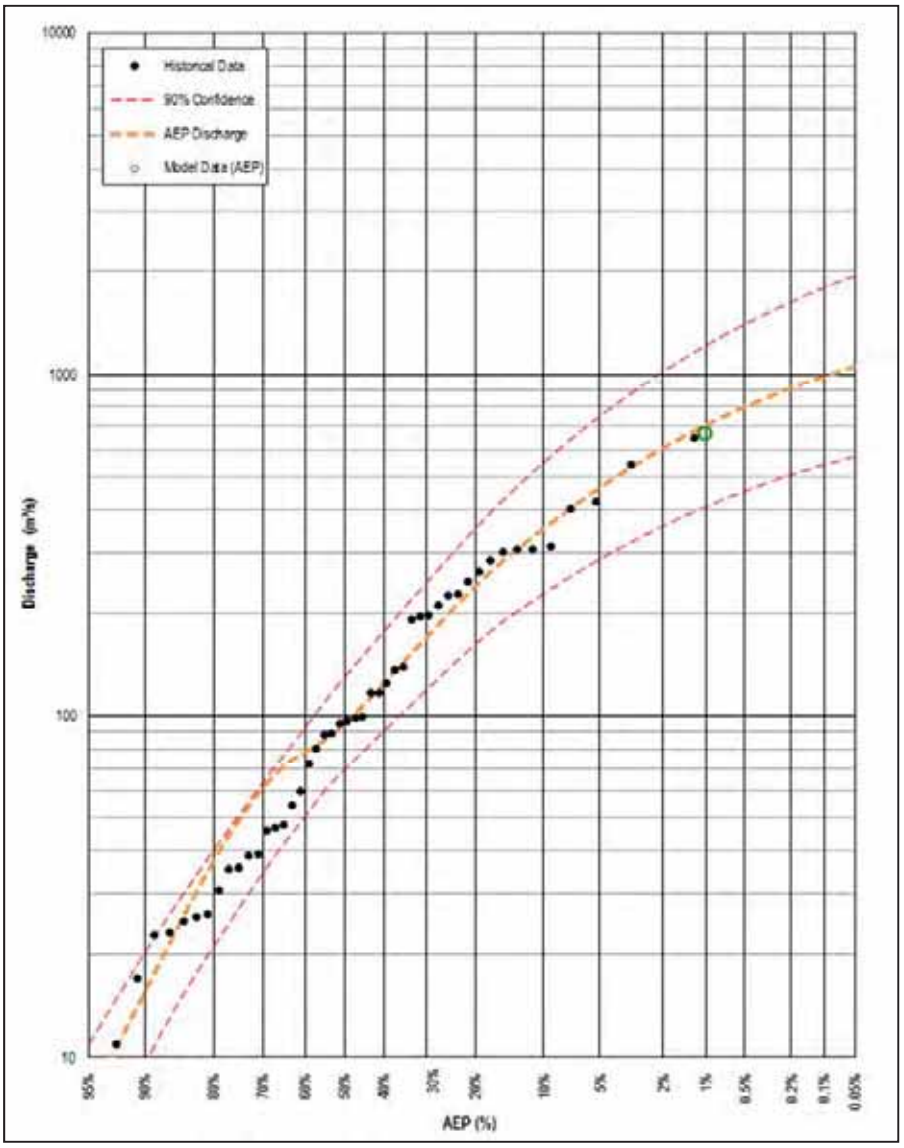

Figure 1 Flood frequency analysis – Dieckmans Bridge Gauge

Figure 2 displays the FFA for the Forest Home gauge. The Forest Home gauge is well rated to flows up to 105 m^3/s but relies on extrapolation of the rating curve for higher flows. The predicted 1% AEP flow at Forest Home is 868 m^3/s, which is lower than the FFA 1% AEP estimate of 1247 m^3/s at this location. The two key limiting factors of this analysis was that there is only 42 years of records at the gauge and the 1% AEP is in the extrapolation region of the rating curve.

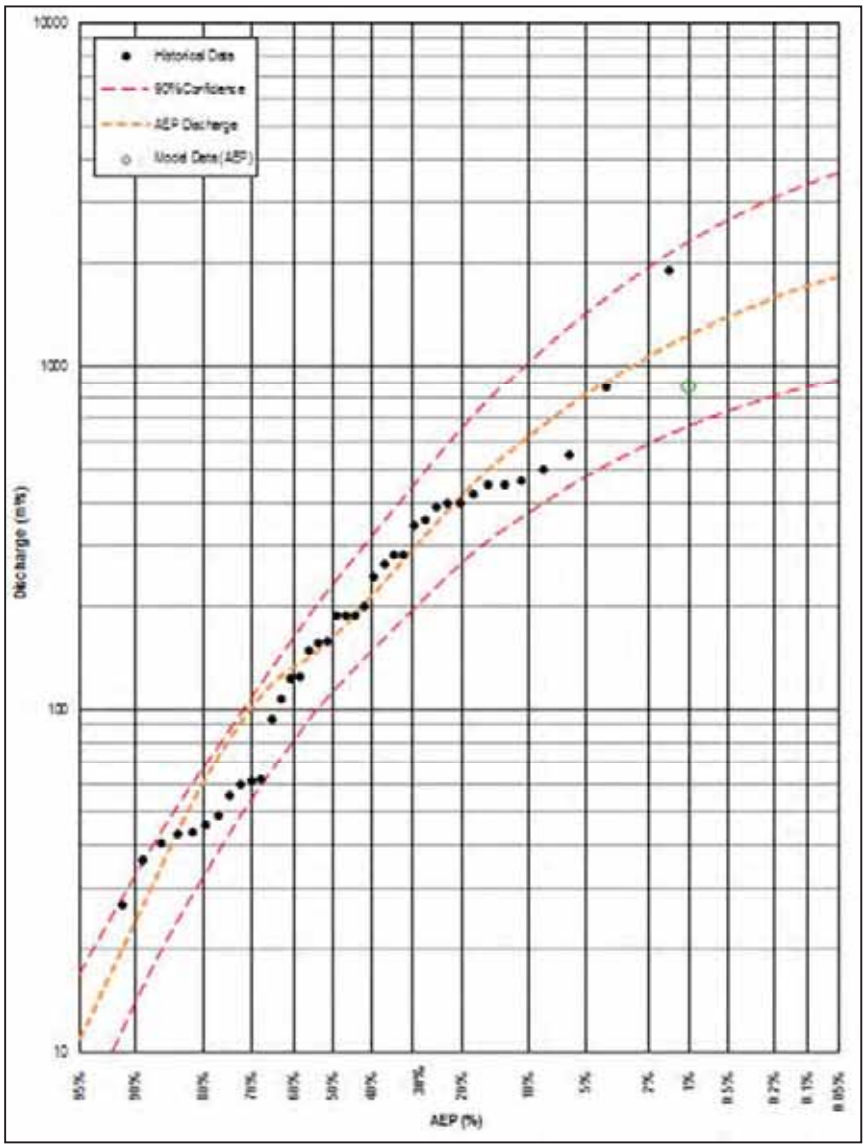

Figure 2 Flood frequency analysis – Forest Home Gauge

The Rathdowney gauge is well rated to flows up to 383 m^3/s but relies on extrapolation of the rating curve for higher flows. The predicted 1% AEP flow at Rathdowney is 1998 m^3/s, which is slightly higher than the FFA 1% AEP estimate of 1745 m^3/s at this location. As seen in Figure 3 the predicted flow clearly follows the trend of the FFA.

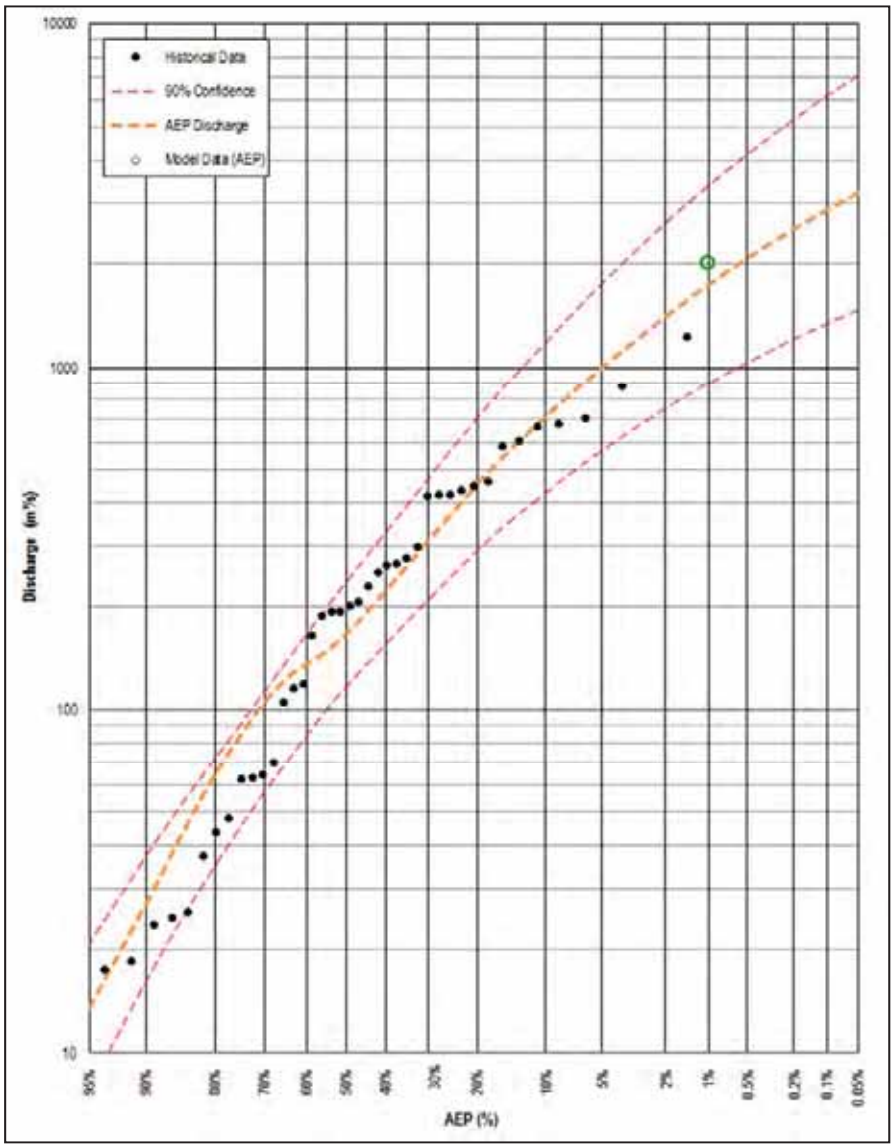

Figure 3 Flood frequency analysis – Rathdowney Gauge

The Round Mountain gauge is well rated to flows up to 1045 m^3/s but relies on extrapolation of the rating curve for higher flows. The predicted 1% AEP flow at Round Mountain is 3857 m^3/s, which is higher than the FFA 1% AEP estimate of 2796 m^3/s at this location. The Round Mountain stream gauge seems to fail on a regular basis towards the peak of the flood event for larger events which is the likely attribute to the significantly lower FFA peak flow estimate.

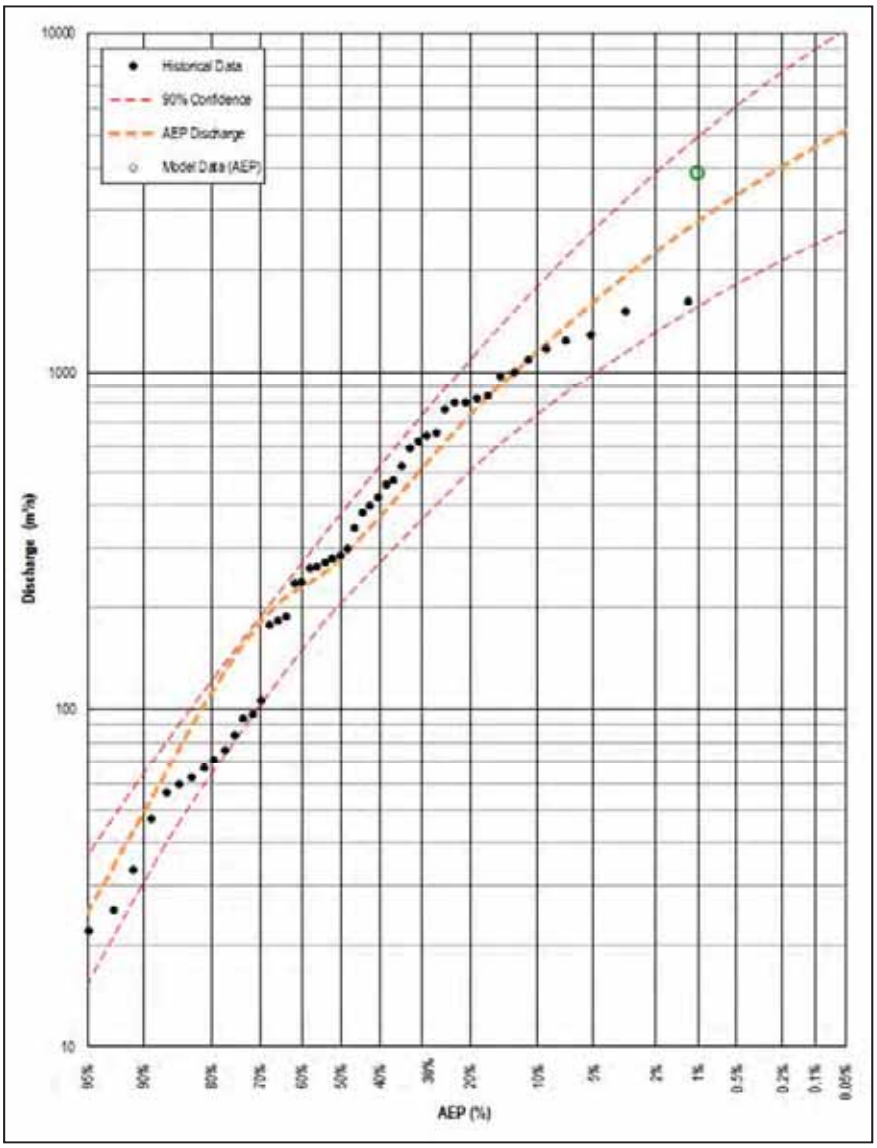

Figure 4 Flood frequency analysis – Round Mountain Gauge

The Yarrahappini gauge is well rated to flows up to 2844 m^3/s but relies on extrapolation of the rating curve for higher flows. The predicted 1% AEP flow at Yarrahappini is 3704 m^3/s which is lower than the FFA 1% AEP estimate of 4836 m^3/s at this location. Two key limiting factors of this analysis were that there is only 46 years of records at the gauge and the 1% AEP is in the extrapolation region of the rating curve. Figure 5 displays the FFA for the Yarrahappini gauge.

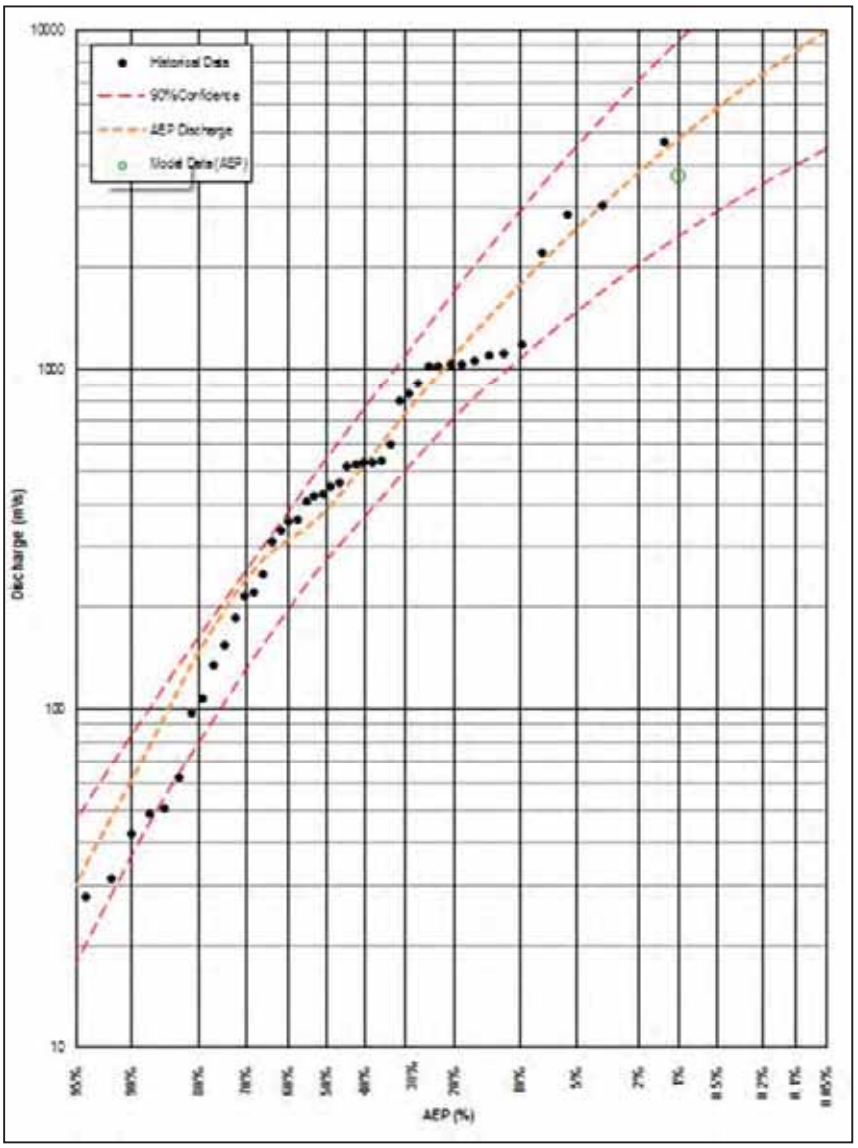

Figure 5 Flood frequency analysis – Yarrahappini Gauge

5.3 IFD Sensitivity testing

In 2014 Australian Rainfall and Runoff (AR&R) was undergoing a significant update. Revised Intensity-Frequency-Duration (IFD) curves were derived and provided for sensitivity testing for new flood studies as it was important to be aware of the potential changes and the implications for peak flood level estimation.

A sensitivity run was undertaken adopting the 2013 rainfall (IFD) data in the RAFTS hydrologic model. The results were assessed against the design event modelling prepared using the 1987 IFD. The 24 hour 1% AEP event was analysed. The results are presented in Figure A-9.

The peak water surface levels across the catchment generally show an increase of up to 500 mm using the 2013 IFD data. A summary of the peak surface level predictions using the 2013 IFD data is presented in Table 15. The impacts of the 2013 IFD on flood levels and extents are significant and provide Council with an indication of potential changes that will arise as a result of the new IFD data. The formal adoption of the 2013 IFD dataset is yet to be confirmed by AR&R but Aurecon suggests Council make a conservative freeboard allowance for the current flood levels.

Table 15 IFD sensitivity testing

Gauge	Change in Peak Water Level (m)
Forest Home	+0.48
Dieckmans Bridge	+0.30
Rathdowney	+0.30
Round Mountain	+0.37
Yarrahappini	+0.45

5.4 Bromelton off-stream storage sensitivity analysis

A sensitivity run was performed where the Bromelton off stream storage was removed from the model. The results of this analysis are presented in Figure A-10. The critical duration 1% AEP event was analysed. The sensitivity analysis shows that the off-stream storage causes a localised afflux of approximately 500 mm to the surrounding area.

5.5 2%, 5% and 10% AEP events

5.5.1 Hydrology

Parameterisation of the URBS model for the 10%, 5% and 2% AEP events was based on the calibrated 1% AEP event hydrologic model. The event independent Alpha, Beta and m parameters were retained as per the calibrated 1% AEP event Logan River RAFTS model.

The LCC RAFTS 2%, 5% and 10% AEP events were adopted for this study. In the 1% AEP event, the Aerial Reduction Factor (ARF) was removed. This was done to better represent the flows in the upper extents of the catchment. The ARF was also removed for the 2%, 5% and 10% AEP events.

Initial and continuing loss rates are typically adjusted across the range of design events to reflect the likelihood of lower levels of catchment saturation antecedent to more minor events. Loss parameters were defined for the lower event. Adopted RAFTS model parameters are shown in Table 16.

Table 16 Logan River RAFTS model design event parameters

Design Event	Calibration parameters	
	Initial Loss Rate (mm)	Continuing Loss Rate (mm/hr)
2% AEP	0	0.5
5% AEP	13	1.5
10% AEP	20	1.9

5.5.2 Hydraulics

The calibrated TUFLOW model developed to investigate the 1% AEP flooding behaviour within the Logan River catchment was adopted to assess the additional smaller design events. The model was developed using a 20 m grid resolution and was intended for investigation of the rare flooding events during which a significant proportion of flooding occurs as overland flow outside of defined watercourse banks. The model also used 1d channels to represent the narrower tributaries in the upstream extents of the catchment. A number of model refinements have been undertaken to more accurately assess the smaller design events as detailed in the following sections.

5.5.3 Model refinements

5.5.3.1 Initial indicative low flow modelling

As an initial step, inflow hydrographs for the 1% AEP were scaled down to represent a minor/moderate storm scenario. The results from this simulation were used to inform and assess which hydraulic structures should be included in the hydraulic model refinement and to review locations where additional bathymetric data may be required. This simulation was only used to guide model development and the results of this simulation are not presented in this report.

5.5.3.2 Hydraulic structures

Improvements to the representation of hydraulic structures details and watercourse bathymetry has been achieved using new ground survey undertaken by Aurecon in July 2017. Locations for ground survey were based on review of the initial modelling and discussions between Council and Aurecon. Waterway crossings were identified that were of significance in terms of understanding flooding impacts on access through the Logan River catchment during flood events. The following aspects were considered in the selection of locations for survey and model refinement:

- Consequence of overtopping in terms of population affected by inundation and loss of access
- Likelihood of overtopping in minor/moderate storm events
- Degree of inundation in minor/moderate storm events.

In light of the above, Table 17 details the Logan River crossing locations selected for survey. These structures have been included in the refined hydraulic model.

Table 17 Surveyed Logan River crossings

Locality	Description	Structure Type	Key structure dimensions (m)	Deck/Road Level (m AHD)
Gleneagle	Dunn Bridge at Allan Creek Crossing, Allan Creek Road	Concrete bridge	62.0m (l) x 10.2 (w)	39.93m AHD
Gleneagle	Alan Struss Bridge at Logan River Crossing, Allan Creek Road	Concrete bridge	69.3m (l) x 8.2m (w)	38.1m AHD
Bromelton	II-Bogan Bridge at Logan River Crossing, Beaudesert-Boonah Road	Concrete bridge	118.9m (l) x 11.0m (w)	47.6m AHD
Laravale	Williams Bridge – Logan River Crossing at Mount Lindsay Highway	Concrete bridge	66.6m (l) x 8.2m (w)	60.6m AHD
Tamrookum	Knapp Junction Bridge – Knapp Creek Crossing at Kooralbyn Road	Concrete bridge	35.8m (l) x 9.8m (w)	70.5m AHD
Lamington	Lamington Bridge at Christmas Creek Crossing, Christmas Creek Road	Concrete bridge	39.3m (l) x 4.9m (w)	60.6m AHD
Barney View	Todd Bridge – Logan River Crossing at Boonah Rathdowney Road	Timber bridge	70.3m (l) x 7.2m (w)	99.9m AHD
Rathdowney	Ralston Bridge – Running Creek Crossing at Running Creek Road	Timber bridge	27.8m (l) x 6.1m (w)	98.0m AHD

5.5.3.3 Bathymetry

Improvements to the hydraulic model bathymetry have been made in the vicinity of each of the surveyed waterway crossings and populated areas. In addition to the actual bridge and culvert structures, survey of the watercourse was undertaken both upstream and downstream at each location. This has enabled an improved representation of the conveyance area at each crossing structure and improved delineation between in and out of bank flow conditions.

6 Modelling results

6.1 Climate change

There are several aspects of design flood estimation that are likely to be impacted by climate change. These include:

- Rainfall Intensity-Frequency-Duration (IFD) relationships
- Rainfall temporal patterns
- Continuous rainfall sequences
- Antecedent conditions and baseflow regimes
- Compound extremes (eg riverine flooding combined with storm surge inundation)

Typically, the approach to addressing climate change in flood studies is through consideration of sea-level rise (SLR) and/or increased rainfall intensities. SRRC is located in the upper reaches of the Bremer River drainage basin and therefore is unlikely to be influenced by sea-level rise. The effect of climate change on the Logan River flood levels was therefore assessed for increased rainfall intensity predictions only.

The latest AR&R (2016) recommendations on climate change consider two Representative Concentration Pathways (RCPs) for greenhouse gas and aerosol concentrations driving climate change for the East Coast Cluster – RCP4.5 & RCP8.5. AR&R (2016) recommends using RCP4.5 as the minimum design basis but notes RCP8.5 should be considered where *'additional expense can be justified on socioeconomic and environmental grounds'*. This guideline recommends an increase in rainfall intensity of 12% for RCP4.5 and 22% for RCP8.5 to the 2090 planning horizon.

Table 18 Predicted increased rainfall intensity (AR&R, 2016)

Representative Concentration Pathway	Temperature increase (°C) at 2090 horizon	Increase in rainfall intensity (%)
4.5	2.25	12
8.5	4.10	22

For the 1% AEP event both Scenarios RCP4.5 and RCP8.5 were assessed and the results are presented on the figures in Appendix A. This includes afflux maps representing the difference in peak flood levels between the climate change and no-climate change scenarios.

SRRC have adopted the 1% AEP event with the RCP4.5 scenario for their Planning Scheme. This event has been used to set levels for development across the region.

For the 10% to 2% AEP events, the climate change investigation is based on RCP 4.5 only.

6.2 Mapping

The TUFLOW model results were analysed and a series of maps (Appendix A) were developed to present the results for each modelled return period. Four sets of maps were produced to display:

- Inundation extents with peak water surface levels – these maps present 1 m contours of the peak water surface levels
- Peak depths – these maps present peak depth contours in 0.5 m bands up to a depth of 5 m, with the lower band separated into two bands covering 0 to 0.3 m and 0.3 to 0.5 m
- Peak velocities – these maps present peak velocity contours in 0.5 m bands up to a velocity of 5 m/s
- Hazard maps – Guidelines for presentation of flood mapping are provided in the Australian Emergency Management Handbook Series (2013) produced by Emergency Management Australia (EMA). The guidelines include categorisation for flood hazard as shown below in Figure 6.
  The prepared hazard maps have used a simplified version of this classification, where only 3 levels are outlined (Low, Medium and High Hazard). Each of these simplified bands represent 2 bands within the EMA classification.

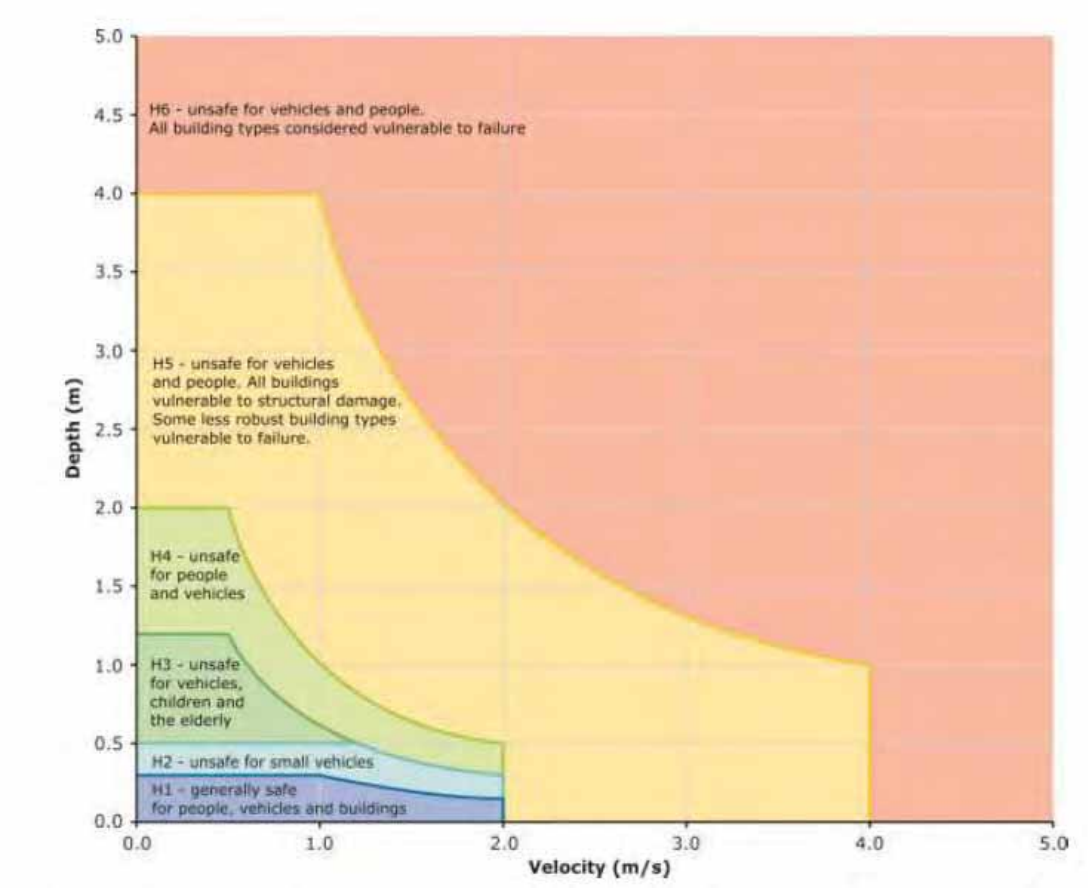

Figure 6 EMA revised flood hazard classification. ***Source: Australian Emergency Management Handbook Series (2013) - Technical flood risk management guideline: Flood hazard***

The flood maps accompanying this report provide a regional overview of the modelling results and are supplemented by GIS data to be supplied to SRRC which can be interrogated to provide further detail. A list of the figures and the full set of maps is presented in Appendix A.

6.3 Property flood levels

Peak water levels at properties affected by each of the design events were determined from the flood modelling results. The results are tabulated by property and will be provided to Council in spreadsheet format.

6.4 Design event discharges

Peak design event discharges are shown below in Table 19. The table shows the increasing in peak discharge both with severity of the event and increasing distance travelled downstream through the catchment.

Table 19 Design event (AEP) peak discharges at key locations

Location	Peak Discharge (m^3/s)		
	10% AEP	5% AEP	2% AEP
II-Bogan Bridge, Beaudesert-Boonah Road	1050	2401	3467
Dunn Bridge Allan Creek Road	102	148	345
Allan Struss Bridge, Allan Creek Road	973	1547	3646
Williams Bridge, Mt Lindsay Highway	1930	2820	4166
Knapp Junction Bridge, Kooralbyn	299	406	560
Lamington Bridge, Christmas Creek Road	223	295	392
Todd Bridge, Boonah-Rathdowney Road	714	1005	1403
Ralston Bridge, Running Creek Road	376	531	754

6.5 Road closures

Management of flooding related road closure risk and timing is key to effective emergency planning and response functions. An understanding of the timing and location of road closures will enable emergency services to forewarn residents of impending loss of access prior to the arrival of the flood. Closure of key road crossings have been reviewed for the 10%, 5% and 2% AEP design events. Road closure risk findings are discussed further below.

6.5.1 Design event road closures

Closure of key road crossings has been reviewed for the 10%, 5%, 2% and 1% AEP design events. Figure F has been prepared and presents the estimated flooded width for each AEP for each key crossing within the Logan River catchment. In addition, peak flood levels for each AEP have been presented for each stream gauge within the catchment. Historical flood levels at the stream gauge are also presented.

This mapping can be used in conjunction with predicted gauge levels that the BoM issue during events to give Council's response team an understanding of the likely crossings that will be inundated and to assist in guiding response measures.

6.6 Gauge rating review

A network of stream alert gauges is owned and operated by various agencies which are used to provide early warning of flooding and for flood forecasting operations by the Bureau of Meteorology (BoM). The stream alert gauges provide classifications for flood severity corresponding to various gauge depths. The descriptors for these classifications as provided by the BoM are as follows:

- **Minor Flooding:** This causes inconvenience such as closing of minor roads and the submergence of low level bridges and makes the removal of pumps located adjacent to the river necessary.
- **Moderate Flooding:** This causes the inundation of low lying areas requiring the removal of stock and/or the evacuation of some houses. Main traffic bridges may be closed by flood waters.
- **Major Flooding:** This causes inundation of large areas, isolating towns and cities. Major disruptions occur to road and rail links. Evacuation of many houses and business premises may be required. In rural areas, widespread flooding of farmland is likely.

It is understood that the gauge flood classification levels may not be reflective of the actual flood severity at some locations. A review the gauge level flood classifications has therefore been undertaken as detailed in the following sections.

6.6.1 Yarrahappini alert gauge

The Yarrahappini alert gauge is located north of Cedar Grove on the Logan River. The gauge is in a partially suburban area surrounded primarily by pasture and some housing. The current flood classification gauge levels for the Yarrahappini alert gauge are shown in Table 20.

Table 20 Existing BoM flood classifications – Yarrahappini alert gauge

Flood height (m)		
Minor	**Moderate**	**Major**
Yarrahappini Alert (Station #040940)		
10.0	14.0	16.0

A review of flood classification levels in light of modelled flooding conditions is provided below in Table 21. The review indicates that the current flood classifications at the Yarrahappini alert are adequate.

Table 21 Yarrahappini alert gauge analysis

Water level (m AHD)	Gauge Level (m)	Flood condition description	Flood classification
20.5	**10.0**	▪ Peak flood waters overtop the banks of the Logan River main channel upstream of the gauge ▪ Farmland upstream of the gauge is partially flooded directly adjacent to the river ▪ Farmland directly adjacent to the tributaries upstream of the gauge are partially flooded	Minor
24.5	**14.0**	▪ Some minor access roads/tracks upstream of the gauge are overtopped ▪ The inundation of the farmland upstream of the gauge is more extensive ▪ Scrubby Creek is overtopping and there is significant inundation of farmland directly adjacent to the tributary.	Moderate
26.5	**16.0**	▪ Large areas of farmland upstream of the gauge are inundated ▪ Some habitable properties have become inundated while others are isolated ▪ Flood waters are approaching a large number of habitable properties and some properties require evacuation	Major

6.6.2 Round Mountain alert gauge

The Round Mountain alert gauge is located 2km downstream of the Mount Lindesay Highway crossing of Logan River. This gauge is in a rural area surrounded primarily by farmland and grazing land. Kooralbyn town is located on a tributary upstream of the gauge. The current flood classification gauge levels for the Round Mountain alert gauge are shown in Table 22.

Table 22 Existing BoM flood classifications – Round Mountain alert gauge

Flood height (m)		
Minor	**Moderate**	**Major**
Round Mountain Alert (Station #040945)		
6.0	9.5	13.0

A review of flood classification levels in light of modelled flooding conditions is provided below in Table 23. The review indicates that the current flood classifications at Round Mountain alert are understated. The local tributaries surrounding this gauge are not considered for this analysis.

Table 23 Round Mountain alert gauge analysis

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
56.5	**12.5**	▪ At the upper limit of this range, peak flood waters start to overtop the banks of the Logan River main channel upstream and downstream of the gauge ▪ Minor access roads/tracks are overtopped leaving some properties isolated	Minor
57.6	**13.6**	▪ Significant inundation of farmland ▪ Round Mountain Road is overtopped upstream of the gauge	Moderate
58.8	**14.8**	▪ Round Mountain Road is also overtopped downstream of the gauge causing isolation of a significant number of properties ▪ Further inundation of local access roads ▪ Widespread inundation of farmland ▪ Some habitable properties are inundated	Major

6.6.3 Tramway Lane stream gauge

The Tramway Lane stream gauge is located on Christmas Creek in a rural area upstream of Tramway Road crossing. There are currently no published flood classification levels for this gauge. The primary land use in the area is grazing with associated farm dwellings. The area is sparsely populated as is typical for rural grazing areas. Whilst gauge flood classifications were not available from the BoM for the Tramway Lane gauge, flood gauge level classifications are suggested below based on the BoM hazard rating descriptors in light of population and land use characteristics of the Tramway road area.

Table 24 Tramway Lane stream gauge level analysis

Proposed Water level (m AHD)	Peak flood conditions description	Suggested flood classification
RL 83.0	▪ Flood waters overtop the banks of Christmas Creek ▪ Some minor access roads/tracks are cut and some properties are isolated	Minor

Proposed Water level (m AHD)	Peak flood conditions description	Suggested flood classification
RL 83.4	▪ More minor access roads/tracks are overtopped cutting access to some properties ▪ More properties become isolated ▪ There is significant inundation of farmland upstream of the gauge ▪ Tramway Road is overtopped	Moderate
RL 84.3	▪ Christmas Creek Road is overtopped cutting access to a number of properties upstream of the gauge ▪ There is significant inundation of farmland upstream and downstream of the gauge ▪ Tamrookum Church Road is overtopped	Major

6.6.4 Rudds Lane alert gauge

The Rudds Lane alert gauge is located immediately downstream of the Rudds Lane crossing of Christmas Creek. This gauge is in a rural area surrounded primarily by pasture and grazing land. The current flood classification gauge levels for the Rudds Lane alert gauge are shown in Table 25.

Table 25 Existing BoM flood classifications – Rudds Lane alert gauge

Flood height (m)		
Minor	**Moderate**	**Major**
Rudds Lane Alert (Station #040944)		
4.0	5.5	6.5

A review of flood classification levels in light of modelled flooding conditions is provided below in Table 26. The review indicates that the current flood classifications at Rudds Lane alert are understated.

Table 26 Rudds Lane alert gauge analysis

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
93.5	**6.0**	▪ At the upper limit of this range, peak flood waters start to overtop the banks of the Christmas Creek main channel upstream of the gauge ▪ Rudds Lane is overtopped between the Rudds Lane/George Lane junction and Christmas Creek Road ▪ Some farmland is inundated	Minor
94.2	**6.7**	▪ Widespread inundation of farmland ▪ Floodwaters are encroaching on Christmas Creek Road	Moderate
94.8	**7.3**	▪ Rudds Lane is completely inundated past north of George Lane ▪ Extensive flooding of farmland ▪ Further inundation of local access roads/tracks	Major

6.6.5 Rathdowney alert gauge

The Rathdowney alert gauge is located just south of the Rathdowney township and upstream of the Running Creek Road crossing of the Logan River. This gauge is in a rural area surrounded primarily by pasture and grazing land to the south and the Rathdowney township directly to the north.
The current flood classification gauge levels for the Rathdowney Alert gauge are shown in Table 27.

Table 27 Existing BoM flood classifications – Rathdowney alert gauge

Flood height (m)		
Minor	**Moderate**	**Major**
Rathdowney Alert (Station #040946)		
3.0	6.0	9.0

A review of flood classification levels in light of modelled flooding conditions is provided below in Table 28. The review indicates that the current flood classifications at the Rathdowney alert are understated. The local tributaries surrounding this gauge are not considered for this analysis.

Table 28 Rathdowney Lane alert gauge analysis

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
85.8	**10.4**	▪ At the upper limit of this range, flood waters start to overtop the banks of the Logan River main channel upstream and downstream of the gauge ▪ Significant inundation of pasture land ▪ Mount Lindesay Highway is overtopped	Minor
86.9	**11.5**	▪ Boonah Rathdowney Road is overtopped ▪ Mount Lindesay Highway is overtopped by Logan River at the Running Creek Road intersection ▪ Local access roads/tracks are overtopped ▪ Some habitable properties become inundated	Moderate
89.3	**13.9**	▪ Widespread inundation of pastureland ▪ All major access roads become further inundated ▪ A significant number of habitable properties become overtopped or isolated	Major

6.6.6 Dieckmans Bridge alert gauge

The Dieckmans Bridge alert gauge is located immediately downstream of the Running Creek Road crossing of Running Creek. This gauge is in a rural area surrounded primarily by pasture and grazing land. The current flood classification gauge levels for the Dieckmans Bridge alert gauge are shown in Table 29.

Table 29 Existing BoM flood classifications – Dieckmans Bridge alert gauge

Flood height (m)		
Minor	**Moderate**	**Major**
Dieckmans Bridge Alert (Station #040944)		
4.0	5.5	6.5

A review of flood classification levels in light of modelled flooding conditions is provided below in Table 30. The review indicates that the current flood classifications at the Dieckmans Bridge alert are understated.

Table 30 Dieckmans Bridge alert gauge analysis

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
98.5	**5.5**	▪ At the upper limit of this range, flood waters start to overtop the banks of the waterway downstream of the gauge ▪ Small areas of pasture land downstream of the gauge are inundated ▪ Shallow inundation of Running Creek Road north of the gauge ▪ Some local access roads/tracks are overtopped ▪ Potential isolation of one habitable property	Minor
99.6	**6.6**	▪ Significant flooding of farmland downstream of the gauge ▪ More local access roads/tracks are overtopped ▪ More extensive inundation of Running Creek Road cutting access to a number of properties ▪ Moloney Road is overtopped cutting direct access to several properties	Moderate
100.2	**7.2**	▪ Widespread inundation of the floodplain and farmland downstream of the gauge ▪ Innisplain Road is overtopped downstream of the gauge ▪ Farm buildings become inundated ▪ More local access roads/tracks are overtopped ▪ More properties become isolated	Major

6.6.7 Forest Home gauge

The Forest Home gauge is located west of the Rathdowney township. It is upstream of the Running Creek Road crossing of the Logan River. This gauge is in a rural area surrounded primarily by pasture and grazing land. The current flood classification gauge levels for the Rathdowney alert gauge are shown in Table 31.

Table 31 Existing BoM flood classifications – Forest Home gauge

Flood height (m)		
Minor	**Moderate**	**Major**
Forest Home TM (Station #040946)		
3.0	6.0	9.0

A review of flood classification levels in light of modelled flooding conditions is provided below in Table 32. The review indicates that the current flood classifications at the Forest Home gauge are inadequate.

Table 32 Forest Home gauge analysis

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
103.78	**3.8**	▪ BOM information denotes that Addis Bridge (downstream of the gauge) deck level is at 3.8m (gauge level). Therefore, the minor gauge level is also at 3.8m to denote the point this bridge is overtopped. This bridge provides access to a number of properties.	Minor
113.88	**10.3**	▪ At the upper limit of this range, flood waters start to overtop the banks of the main channel ▪ Minor access roads/tracks are overtopped ▪ A small number of properties have lost access	Moderate
117.50	**17.5**	▪ The peak flood height in the 100 Year ARI event reach 117.5mAHD. At no point do these heights register as a major according to the BOM rating system. At no point does a property become inundated. ▪ Bigriggen Road is overtopped ▪ Boonah Rathdowney Road is overtopped	Major

6.6.8 Beaudesert alert gauge

The Beaudesert alert gauge is located downstream of the Beaudesert Township adjacent to the Mount Lindesay Highway. It is adjacent to the industrial estate at Enterprise Drive. This gauge has the township to the east and primarily pasture land to the west. The current flood classification gauge levels for the Beaudesert Alert gauge are shown in Table 33.

Table 33 Existing BoM flood classifications – Beaudesert alert gauge

Flood height (m)		
Minor	**Moderate**	**Major**
Beaudesert Alert (Station #145918)		
5.5	7.8	8.3

A review of flood classification levels in light of modelled flooding conditions is provided below in Table 34Table 23. The review indicates that the current flood classifications at the Beaudesert alert are inadequate.

Table 34 Beaudesert alert gauge analysis

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
34.55	**5.1**	▪ At the upper limit of this range, flood waters start to overtop the banks of the Logan River main channel and the tributary running through the Beaudesert Township. ▪ Significant inundation of pasture land ▪ Several minor access/tracks roads are cut ▪ Telemon Street is overtopped and access is lost ▪ Several non-habitable properties are inundated	Minor

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
35.05	**5.6**	▪ More extensive inundation of pasture lands ▪ McKee Street is overtopped ▪ Mount Lindesay Highway is overtopped ▪ Several habitable properties become inundated	Moderate
37.75	**8.3**	▪ All minor access roads/tracks are overtopped ▪ Beaudesert Boonah Road is overtopped ▪ Major roads are overtopped and access is lost to a large number of houses in the Beaudesert Township ▪ Inundation of habitable properties both upstream and downstream of the gauges	Major

6.6.9 Bromelton Weir TW TM stream gauge

The Bromelton Weir TW TM gauge is located on Logan River in a rural area upstream 5 km's upstream of the Beaudesert Boonah Road crossing. There are currently no published flood classification levels for this gauge. The primary land use in the area is grazing with associated farm dwellings. The area is sparsely populated as is typical for rural grazing areas. Whilst gauge flood classifications were not available from the BoM for the Bromelton Weir TW TM gauge, flood gauge level classifications are suggested below based on the BoM hazard rating descriptors in light of population and land use characteristics of the Tramway road area.

Table 35 Bromelton Weir TW TM gauge level analysis

Proposed Water level (m AHD)	Peak flood conditions description	Suggested flood classification
RL 48.1	▪ Flood waters overtop the banks of Logan River ▪ Some minor access roads/tracks are cut and some properties are isolated	Minor
RL 50.0	▪ More minor access roads/tracks are overtopped cutting access to some properties ▪ More rural properties become isolated ▪ There is significant inundation of farmland upstream and downstream of the gauge ▪ Mount Lindesay Highway is overtopped upstream of the gauge ▪ Numerous properties in Beaudesert township are inundated ▪ Round Mountain Road is overtopped ▪ Josephville Road is overtopped	Moderate

Proposed Water level (m AHD)	Peak flood conditions description	Suggested flood classification
RL 51.5	■ Beaudesert Boonah Road is overtopped ■ There is significant inundation of farmland upstream and downstream and downstream of the gauge ■ Numerous rural properties are overtopped or isolated ■ Numerous properties in Beaudesert township are inundated ■ Sandy Creek Road is overtopped	Major

6.6.10 Kooralbyn Bridge alert gauge

The Kooralbyn Bridge alert gauge is located on Cannon Creek in a rural at the Wellington Bundock Drive crossing. There are currently no published flood classification levels for this gauge. The primary land use is residential for the Kooralbyn township. Whilst gauge flood classifications were not available from the BoM for the Bromelton Weir TW TM gauge, flood gauge level classifications are suggested below based on the BoM hazard rating descriptors in light of population and land use characteristics of the Tramway road area.

Table 36 Kooralbyn Bridge alert gauge level analysis

Proposed Water level (m AHD)	Peak flood conditions description	Suggested flood classification
RL 86.9	■ Flood waters overtop the banks of Cannon Creek ■ Some minor access roads/tracks are overtopped ■ Routley Drive is just overtopped, still trafficable ■ Hinchcliffe Drive is overtopped ■ Half of the sports field upstream of the gauge is inundated	Minor
RL 88.5	■ Numerous minor access roads/tracks are overtopped cutting access to some urban properties ■ Wellington Bundock Drive is overtopped at Kooralbyn Bridge ■ Routley Drive is just overtopped and trafficable ■ Kooralbyn Drive is overtopped ■ There is significant inundation of the sports field and open areas upstream of the gauge ■ Several school buildings are inundated	Moderate
RL 89.3	■ Wellington Bundock Drive is overtopped at multiple locations ■ Most of the school is inundated ■ Numerous urban properties are overtopped or isolated ■ Kooralbyn Road is overtopped ■ Knapp Creek Road is overtopped	Major

6.6.11 Opportunities for additional alert gauges

It is suggested that Dulbuolla gauge is converted from manual to automatic recording and located at the confluence of Running Creek and Logan River. This will give better warning to the townships downstream.

7 Conclusions

Scenic Rim Regional Council (SRRC) has undertaken work to gain a better understanding of the region's Natural Hazard (Flood) characteristics for a range of events from relatively frequent (10% AEP) to rare (1% AEP). This flood study has been undertaken for the Logan River catchment within Council's boundaries to provide Council with detailed flood information across the catchment.

Hydrologic modelling has been carried out using the established LCC RAFTS model. Hydraulic modelling of the main floodplain areas has been carried out through the development of a 2D TUFLOW hydraulic model. Refinement of modelling parameters was carried out through a joint calibration of the hydrologic and hydraulic models. Calibration of the models was undertaken against stream gauge records for four historical flood events.

Design event modelling for the 1%, 2%, 5% and 10% AEP events was undertaken. Mapping of the modelling results has been prepared and includes flood inundation extents, peak water levels, depths, velocities and hazard zoning in accordance with current guidelines.

Two climate change scenarios were assessed for the 1% AEP flood event to the 2090 planning horizon. Allowances for climate change considered 12% and 22% increases in rainfall intensities as recommended in AR&R (2016).

The RCP 4.5 climate change scenario was assessed for the additional flood events to the 2090 planning horizon. Allowances for climate change for the 10%, 5% and 2% AEP events considered 12% increases in rainfall intensities as recommended in AR&R (2016).

For planning purposes, a tabulation of peak water levels for each design event at properties within the catchment has been prepared. This information and the GIS mapping will be provided in digital format to Council.

8 Assumptions, limitations and recommendations

The following limitations relate to this study:

- Calibration
  - The calibration and verification exercise was undertaken for four events. Although the calibration was successful there were limitations due to the accuracy of the available information.
  - The hydrologic model assumes existing development conditions
  - The available calibration events for the hydraulic model was limited due to limited historic level data within the study area
- 1% AEP event
  - The hydraulic structures modelled in the 1% event are limited to the detail available at the time of analysis
  - The hydraulic modelling for the 1% AEP event adopted a 20 m grid hydraulic model. This model resolution may not be representative of features such as small local drainage channels.
- 2%, 5% and 10% AEP events
  - The hydraulic structures modelled are limited to the detail provided except where survey has been undertaken at agreed locations
  - The hydraulic modelling presented for these events adopted a 20 m grid hydraulic model. This model resolution may not be representative of features such as small local drainage channels.
- General
  - Hydraulic models are influenced by the boundary conditions. Areas of flooding in proximity of the downstream boundary condition should be investigated with caution. Note that the downstream boundary is outside of the Scenic Rim Regional Council boundary.
  - Information presented in this report is indicative only and may vary, depending upon the level of catchment and floodplain development. Filling of land or excavation and levelling may alter the ground levels locally at any time, whilst errors may occur from place to place in local ground elevation data from which the model has been developed.

9 References

Aurecon 2015, Logan River Flood Study – Final Report

BMT WBM, 2010, TUFLOW User Manual

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Carroll, DG, 2009, URBS Manual – A Rainfall Runoff Routing Model for Flood Forecasting and Design

CSIRO, 2000, Floodplain Management in Australia: Best Practice Principles and Guidelines, SCARM Report

Emergency Management Australia, 2013, Managing the floodplain: a guide to best practice in flood risk management in Australia – Handbook 7

Institution of Engineers Australia, 1998, Australian Rainfall & Runoff: A guide to Flood Estimation

Institution of Engineers Australia, 2016, Australian Rainfall & Runoff: A guide to Flood Estimation

Queensland Government, 2015, Building Act 1975

Seqwater, 2013, Wivenhoe and Somerset Dam Optimisation Study

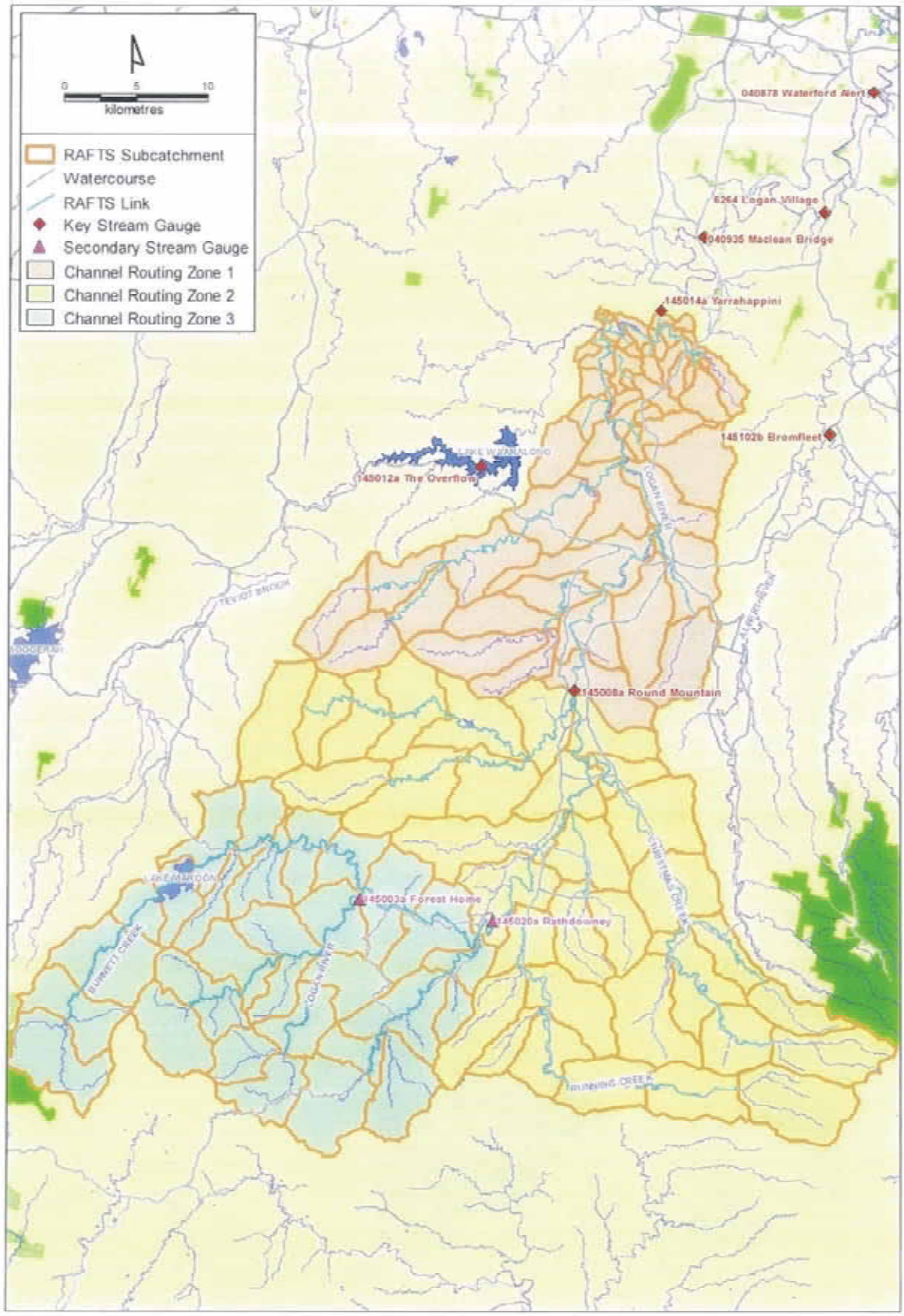
Aurecon, 2015, Brisbane River Catchment Flood Study

Appendices

Appendix A
Figures

Figure	Description
Figure A-1	RAFTS Layout
Figure A-2	Hydraulic Model Layout
Figure A-3	Stream Gauge Locations
Figure A-4A	1991 Rainfall Gauge Locations
Figure A-4B	February 1991 Calibration
Figure A-9	1% AEP Event – 2013 IFD Difference Map
Figure A-10	Bromelton Off-stream Storage Sensitivity Results
Figure B1	1% AEP Event – Inundation Extent Map
Figure B2-a	1% AEP Event – 4.5 Climate Change Scenario – Afflux Map
Figure B2-b	1% AEP Event – 8.5 Climate Change Scenario – Afflux Map
Figure B3-a	1% AEP Event – Inundation Extent Map with 4.5 Climate Change Scenario
Figure B3-b	1% AEP Event – Inundation Extent Map with 8.5 Climate Change Scenario
Figure B4	1% AEP Event – 4.5 Climate Change Scenario – Inundation Extent Map
Figure B5	1% AEP Event – 4.5 Climate Change Scenario – Peak Velocities Map
Figure B6	1% AEP Event – 4.5 Climate Change Scenario – Peak Depth Map
Figure B7	1% AEP Event – 4.5 Climate Change Scenario – Peak Hazard Map
Figure C1	2% AEP Event – Inundation Extent Map
Figure C2	2% AEP Event – Peak Velocities Map
Figure C3	2% AEP Event – Peak Depth Map
Figure C4	2% AEP Event – Hazard Map
Figure C5-a	2% AEP Event – Inundation Extent Map with 4.5 Climate Change Scenario
Figure C5-b	2% AEP Event – 4.5 Climate Change Scenario – Afflux Map
Figure D1	5% AEP Event – Inundation Extent Map
Figure D2	5% AEP Event – Peak Velocities Map
Figure D3	5% AEP Event – Peak Depth Map
Figure D4	5% AEP Event – Hazard Map
Figure D5-a	5% AEP Event – Inundation Extent Map with 4.5 Climate Change Scenario
Figure D5-b	5% AEP Event – 4.5 Climate Change Scenario - Afflux Map
Figure E1	10% AEP Event – Inundation Extent Map

Figure E2	10% AEP Event – Peak Velocities Map
Figure E3	10% AEP Event – Peak Depth Map
Figure E4	10% AEP Event – Hazard Map
Figure E5-a	10% AEP Event – Inundation Extent Map with 4.5 Climate Change Scenario
Figure E5-b	10% AEP Event – 4.5 Climate Change Scenario - Afflux Map
Figure F	Emergency Response Mapping



Map by: TU P:\SWMWork\241425 Logan River\GIS\Fig001_1_RAFTS_Model_Layout.wor

Legend

Notes:

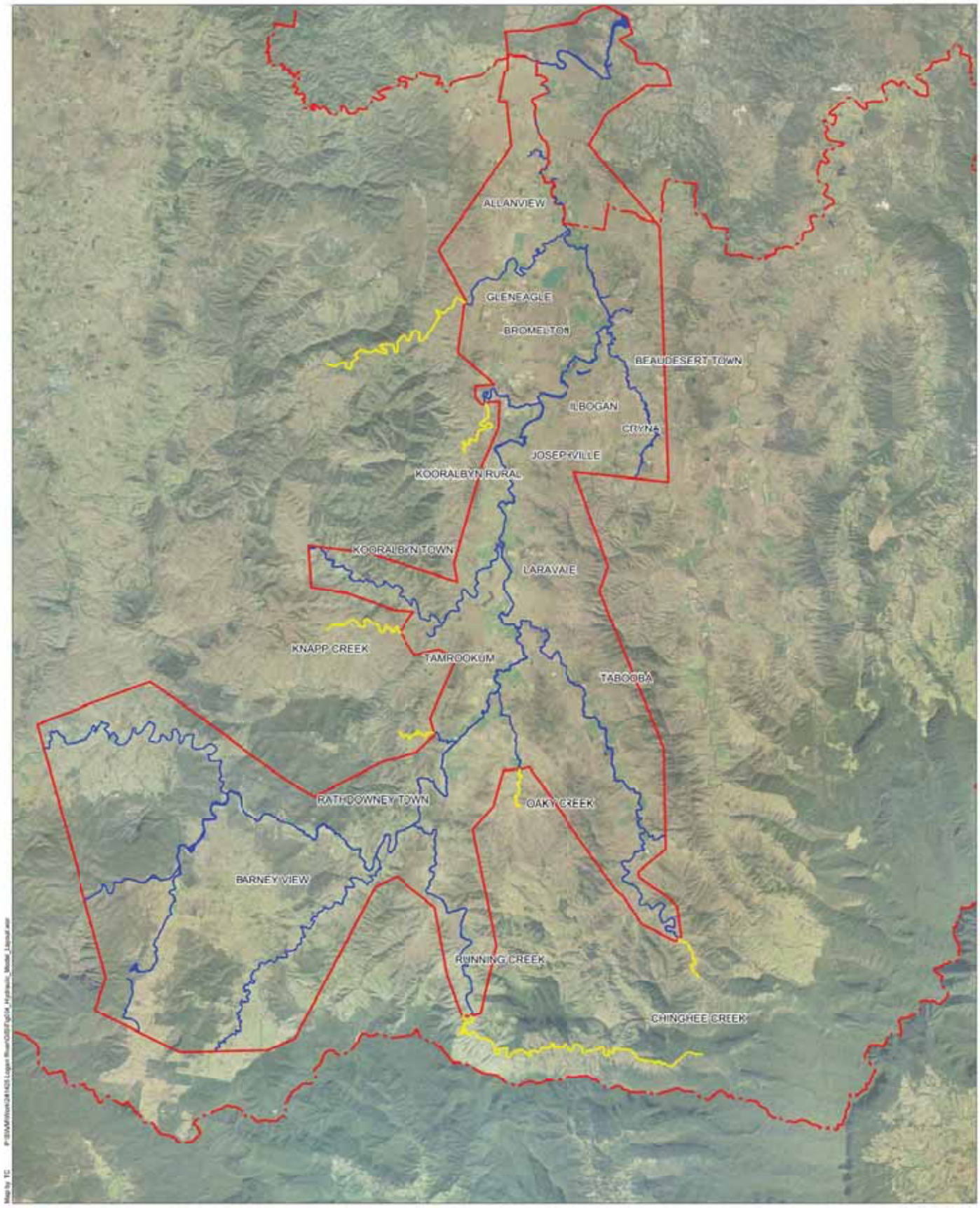
Not to Scale

Date: 12/12/2014 Version: A Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study **Figure A-1**

RAFTS Layout - Sourced from Logan City Council



Legend

- 2D model boundary
- Channel land use
- 1D network extent
- SRRC Boundary

Notes:

A3 scale 1:200,000

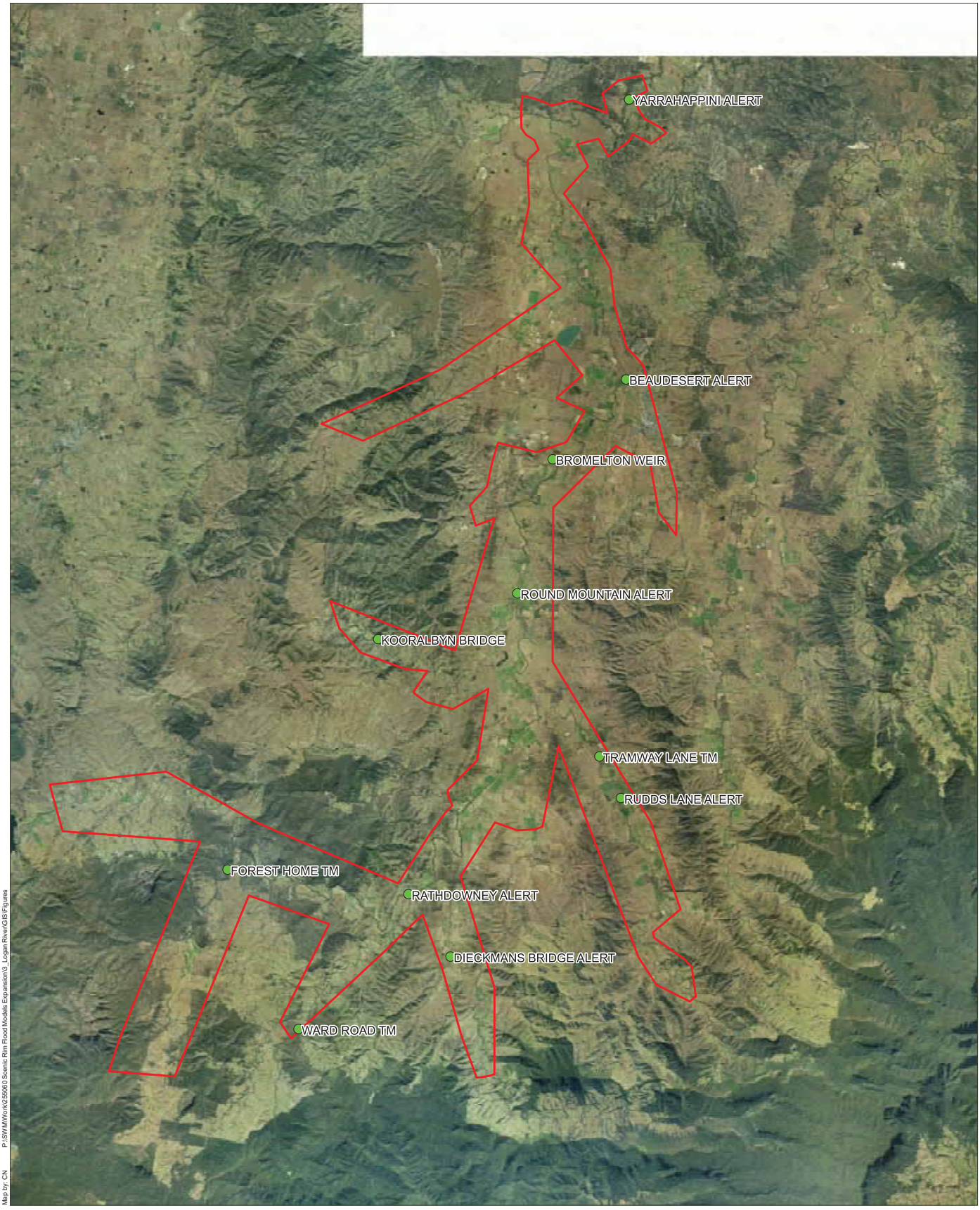
0 5,000 m 10,000 m

Date: 12/12/2014 Version: A Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study Figure A-2

Hydraulic Model Layout



Map by: CN P:\SW\Work\255060 Scenic Rim Flood Models Expansion\3_Logan River\GIS\Figures

Legend

Notes:

1:200,000

0 5,000 m 10,000 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study

Figure A-3

Stream Gauge Locations

Map by: TC P:\SWMWork\241425 Logan River\GIS\Fig\02_1991_rainfall_gauge_locations.mxd

Legend

- Rainfall station location
- 2D model boundary
- SRRC Boundary

Notes:

A3 scale 1:400,000

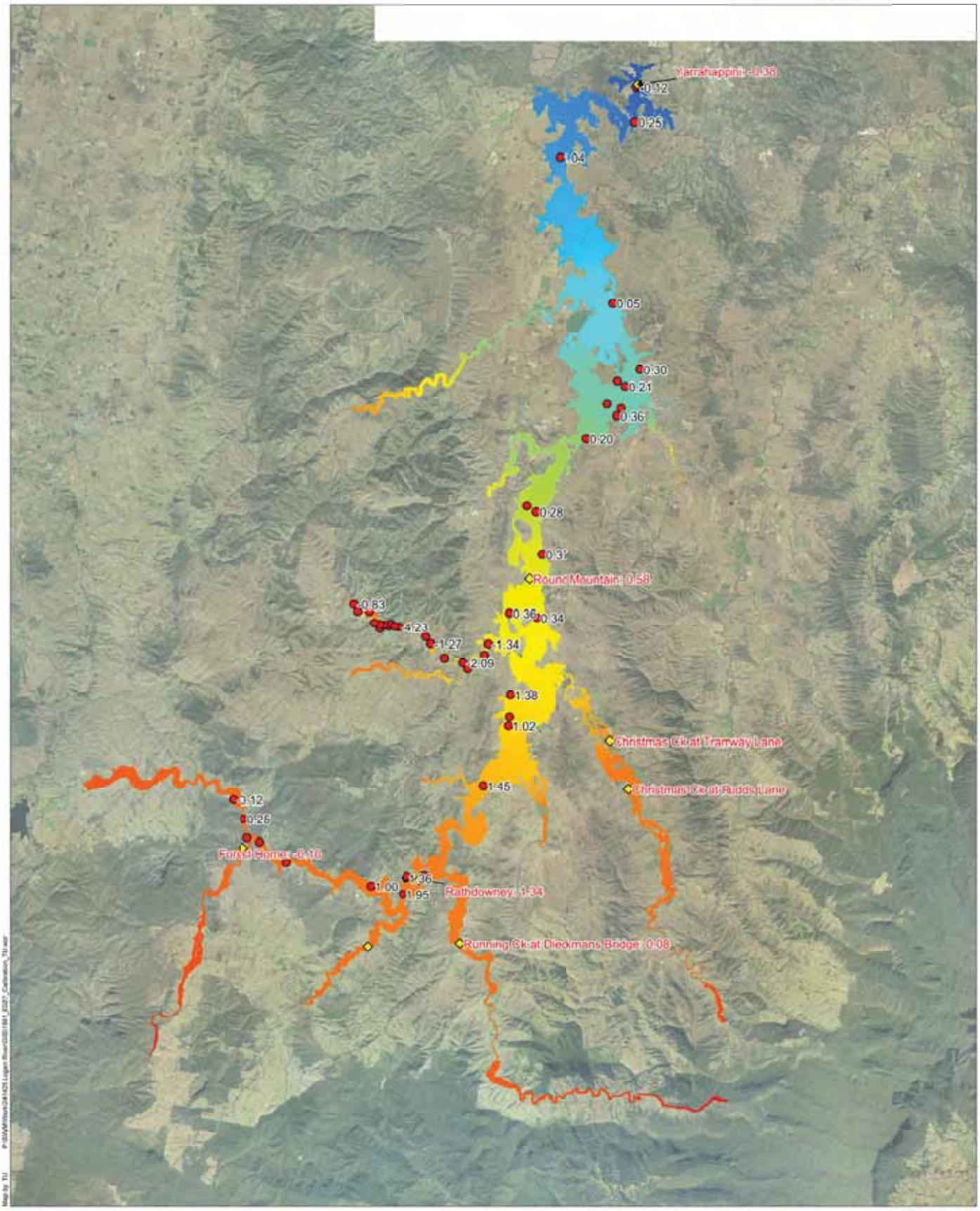
0 10,000 m 20,000 m

Date: 12/12/2014 Version: A Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study **Figure A-4A**

1991 Rainfall Gauge Locations



Legend

- Debris Mark
- Gauge Location

Notes:

A3 scale 1:200,000

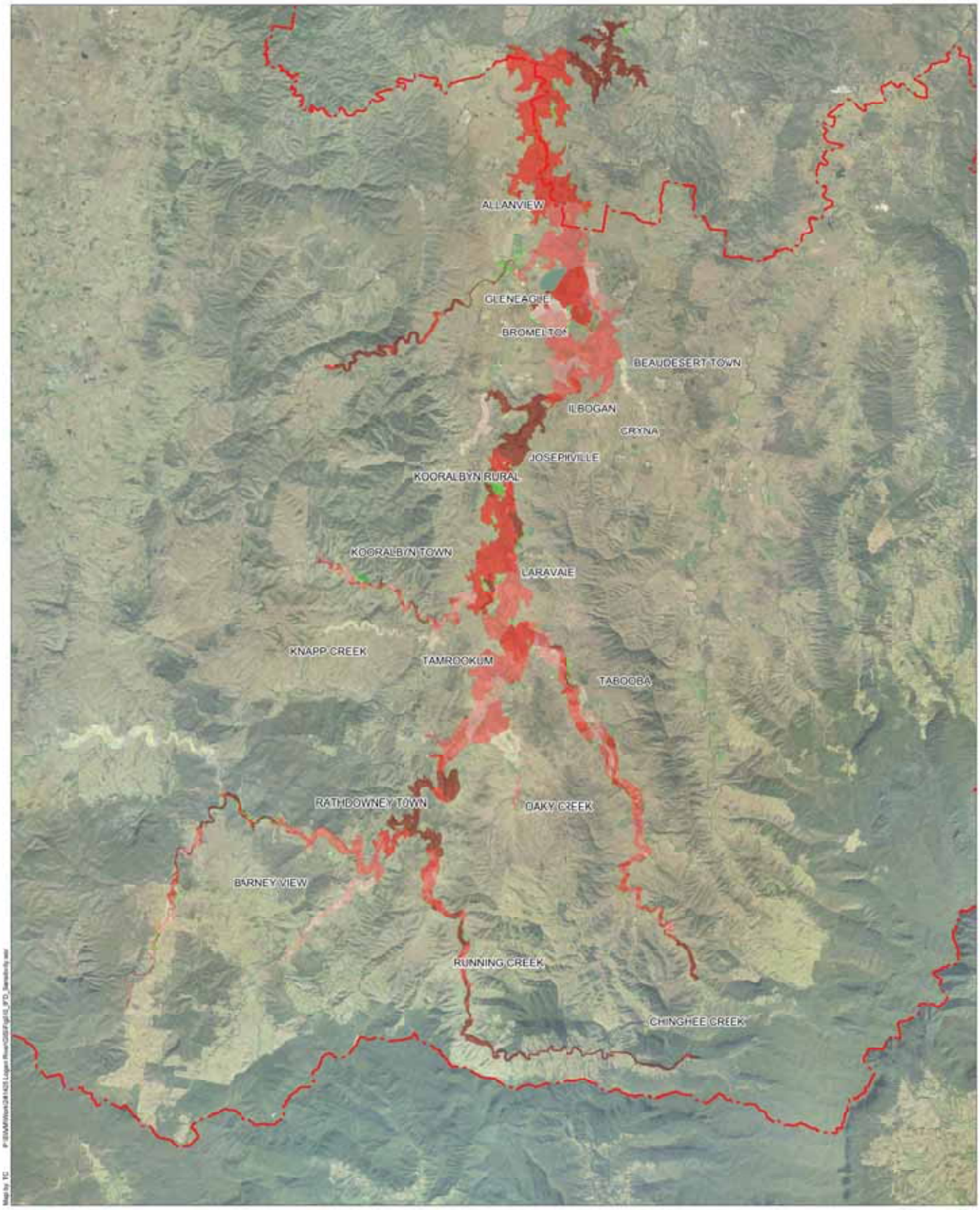
0 5 km 10 km

Date: 12/12/2014 Version: 0 Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study **Figure A-4B**

February 1991 Calibration



Legend

SRRC Boundary

Afflux (m):

< -0.40	0.03 to 0.10
-0.40 to -0.30	0.10 to 0.20
-0.30 to -0.20	0.20 to 0.30
-0.20 to -0.10	0.30 to 0.40
-0.10 to -0.03	> 0.40
-0.03 to 0.03	

Was Dry Now Wet
Was Wet Now Dry

Notes:

A3 scale 1:200,000

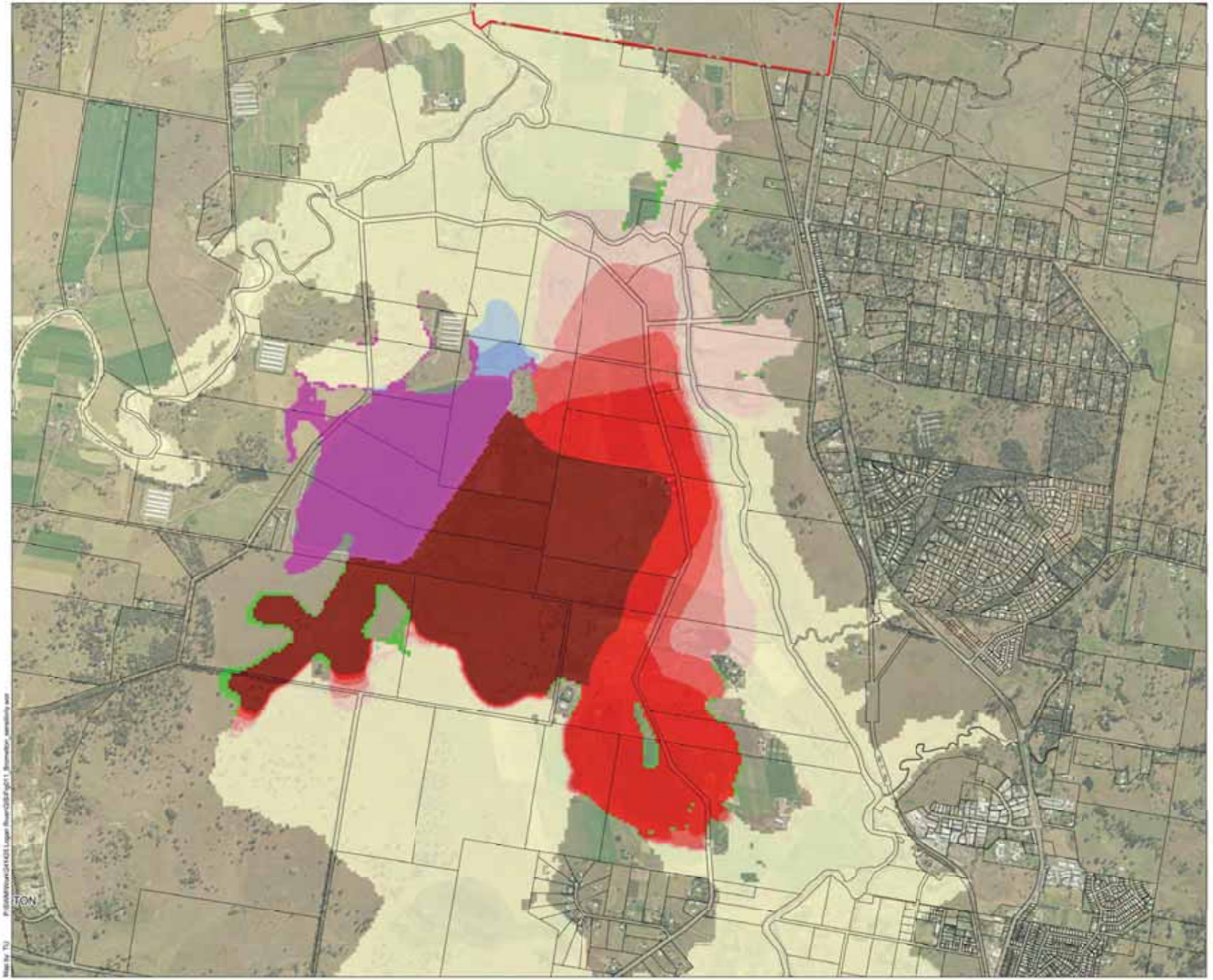
0 5,000 m 10,000 m

Date: 12/12/2014 Version: 0 Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study **Figure A-9**

1% AEP Event - 2013 IFD Difference Map



A3 scale 1:25,000

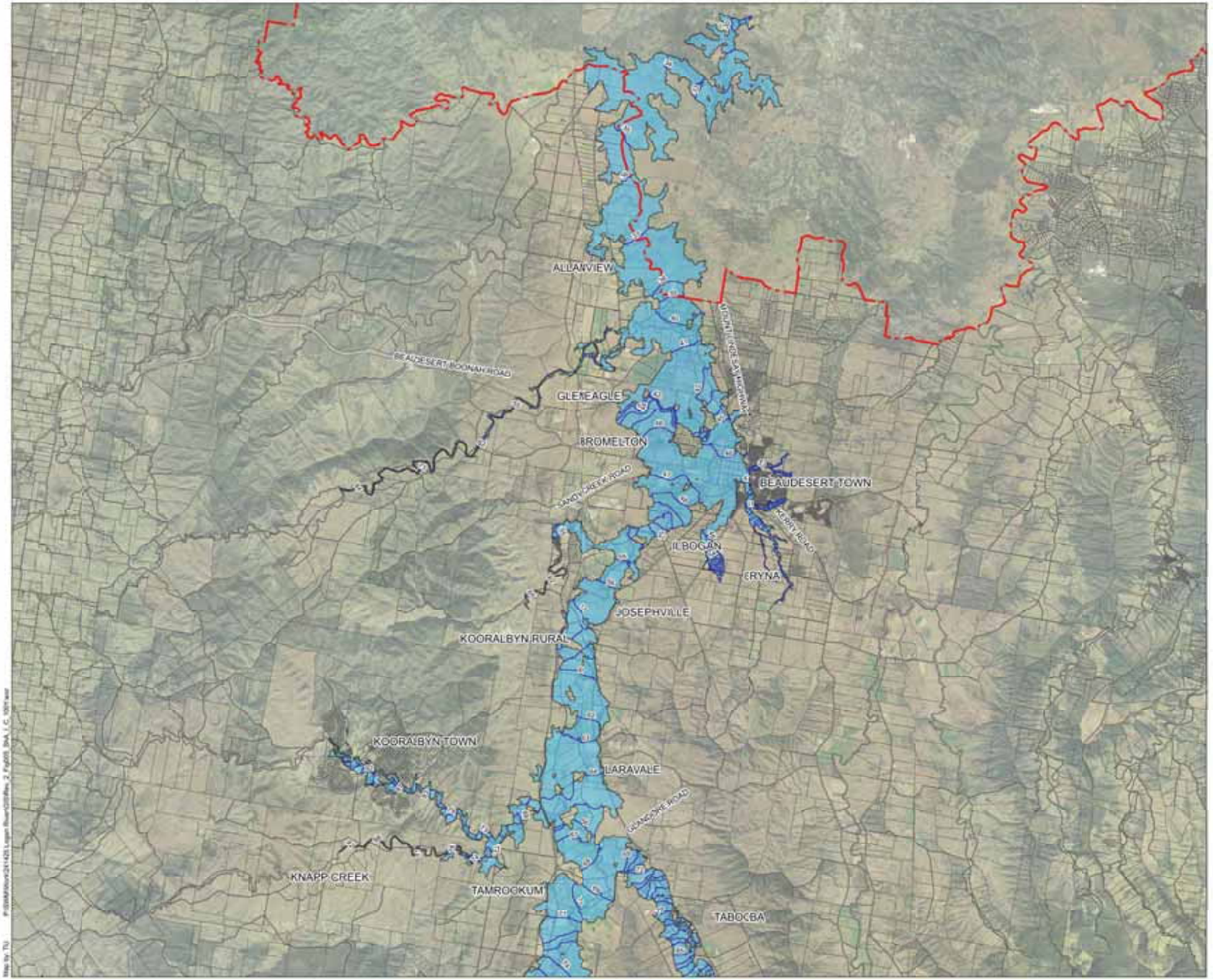
0 625 m 1,250 m

Date: 12/12/2014 Version: 0 Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study **Figure A-10**

Bromelton Off-stream Storage Sensitivity Results



aurecon

legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extents
- Peak Water Level Contour [m AHD]

Notes:

A3 scale 1:150,000

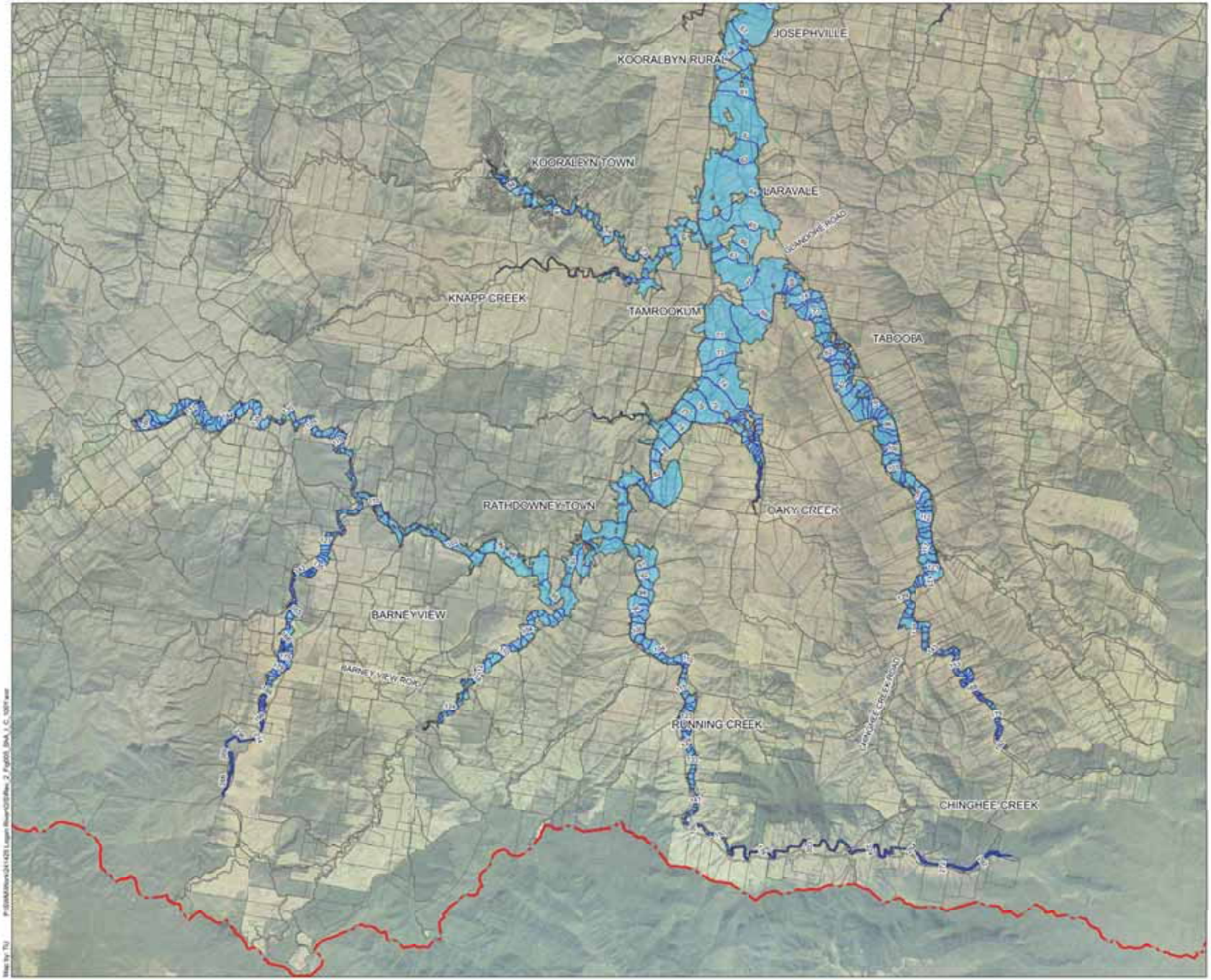
0 3,750 m 7,500 m

Date: 04/06/2015 Version: 2 Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study Figure B1 - a

1% AEP Event - Inundation Extent & Peak Water Levels



aurecon

legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extents
- Peak Water Level Contour [m AHD]

Notes:

A3 scale 1:150,000

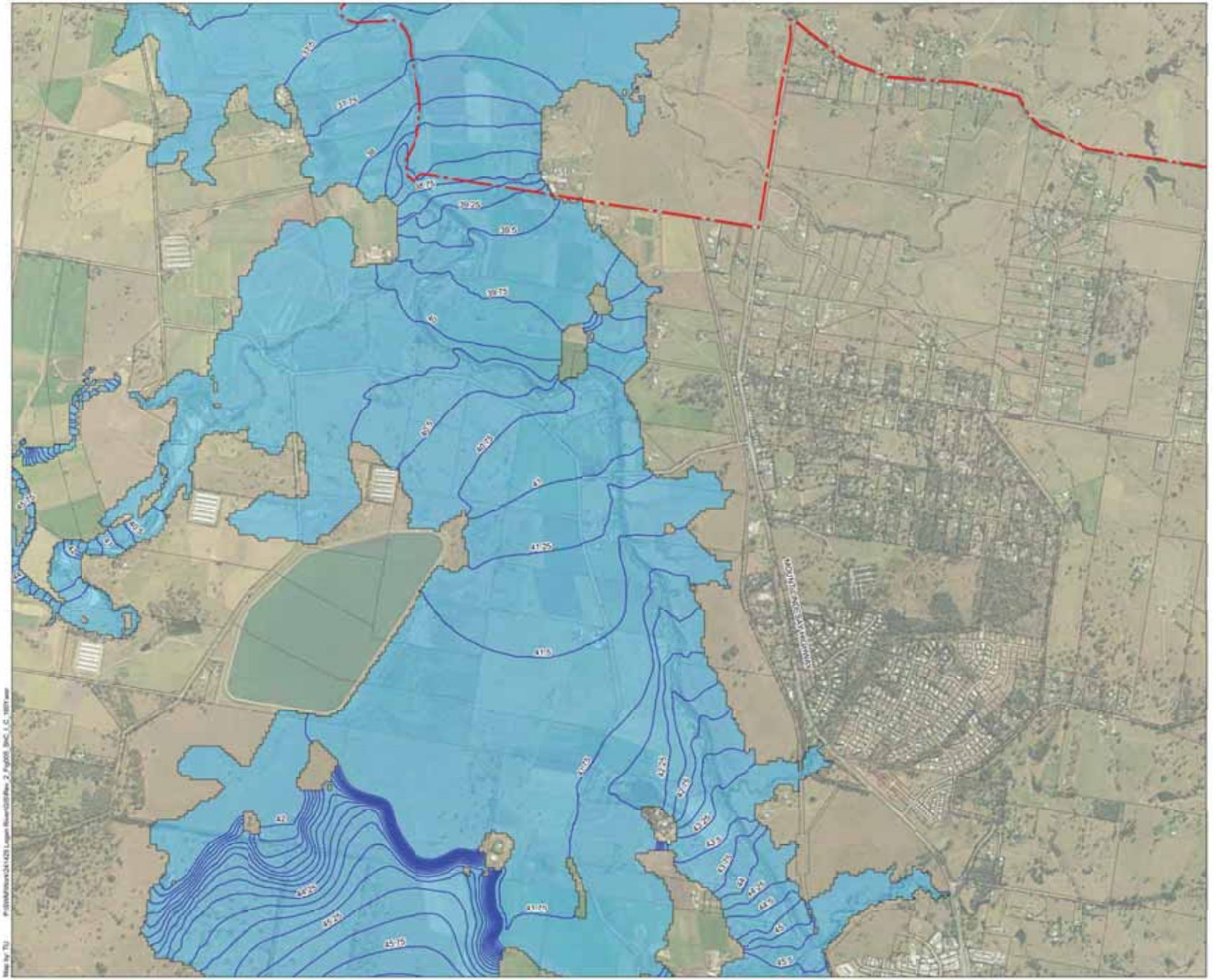
0 3,750 m 7,500 m

Date: 04/06/2015 Version: 2 Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study **Figure B1 - b**

1% AEP Event - Inundation Extent & Peak Water Levels



aurecon

Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extents
- Peak Water Level Contour [m AHD]

Notes:

A3 scale 1:25,000

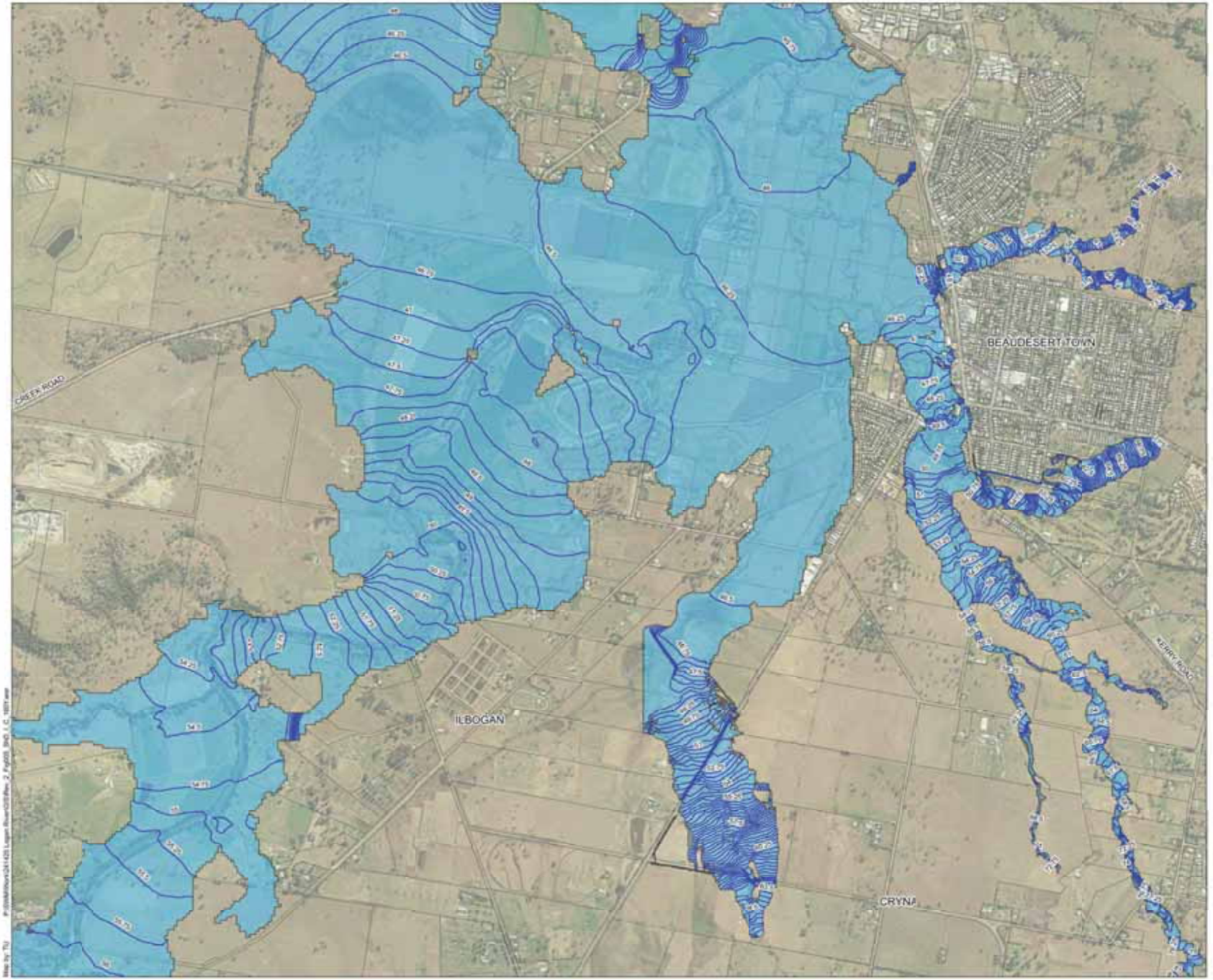
0 625 m 1,250 m

Date: 04/06/2015 Version: 2 Job No: 241425

Projection: MGA Zone 56

Logan River Flood Study **Figure B1 - c**

1% AEP Event - Inundation Extent & Peak Water Levels



aurecon

legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extents
- Peak Water Level Contour [m AHD]

Notes:

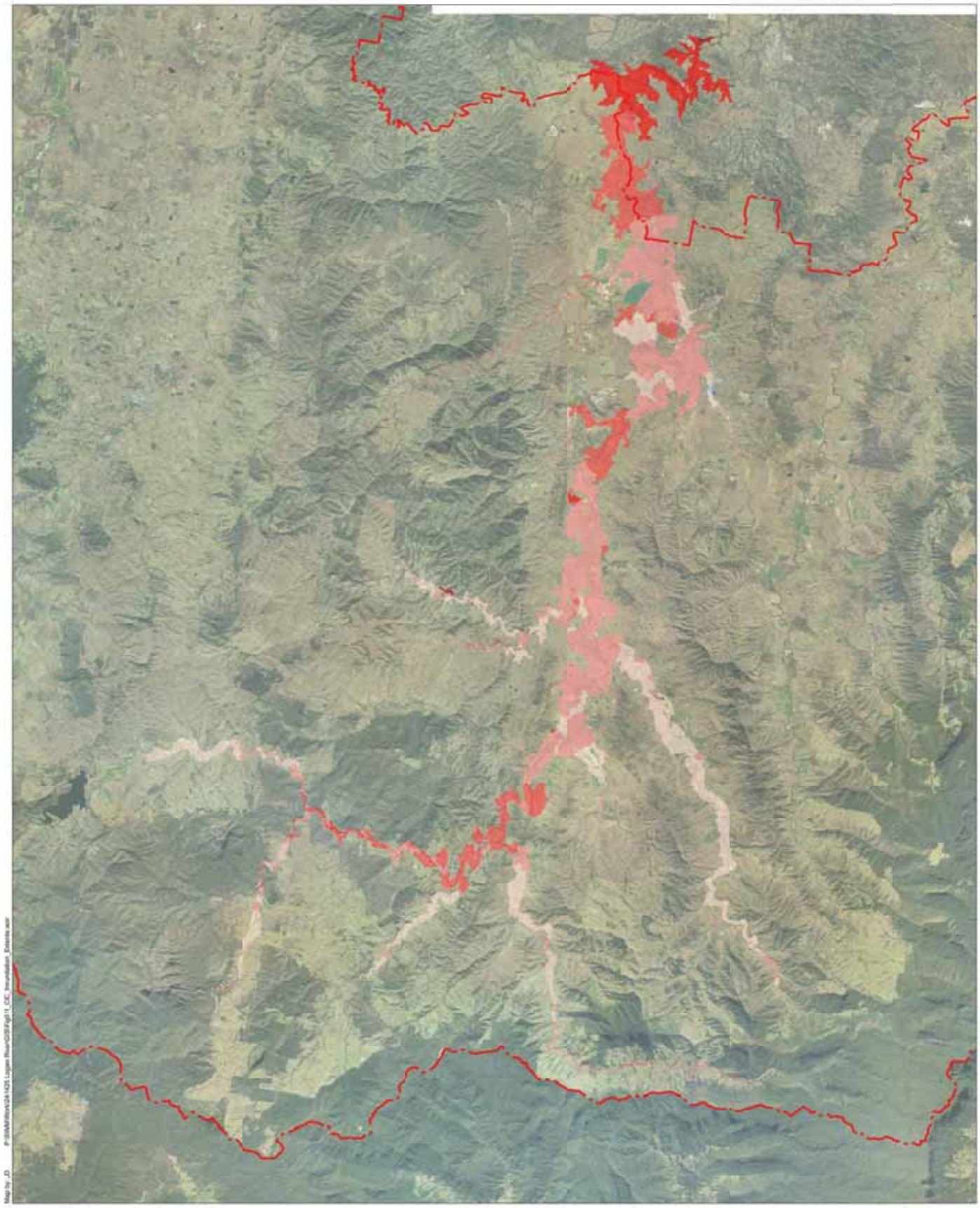
A3 scale 1:25,000

0 625 m 1,250 m

Date: 04/06/2015 Version: 2 Job No: 241425

Logan River Flood Study Figure B1 - d

1% AEP Event - Inundation Extent & Peak Water Levels



Legend

Afflux (m)

< -0.80	0.03 to 0.20
-0.80 to -0.60	0.20 to 0.40
-0.60 to -0.40	0.40 to 0.60
-0.40 to -0.20	0.60 to 0.80
-0.20 to -0.03	0.80 to 1.20
-0.03 to 0.03	> 1.20

Was Dry Now Wet
Was Wet Now Dry

SRRC Boundary

Notes:

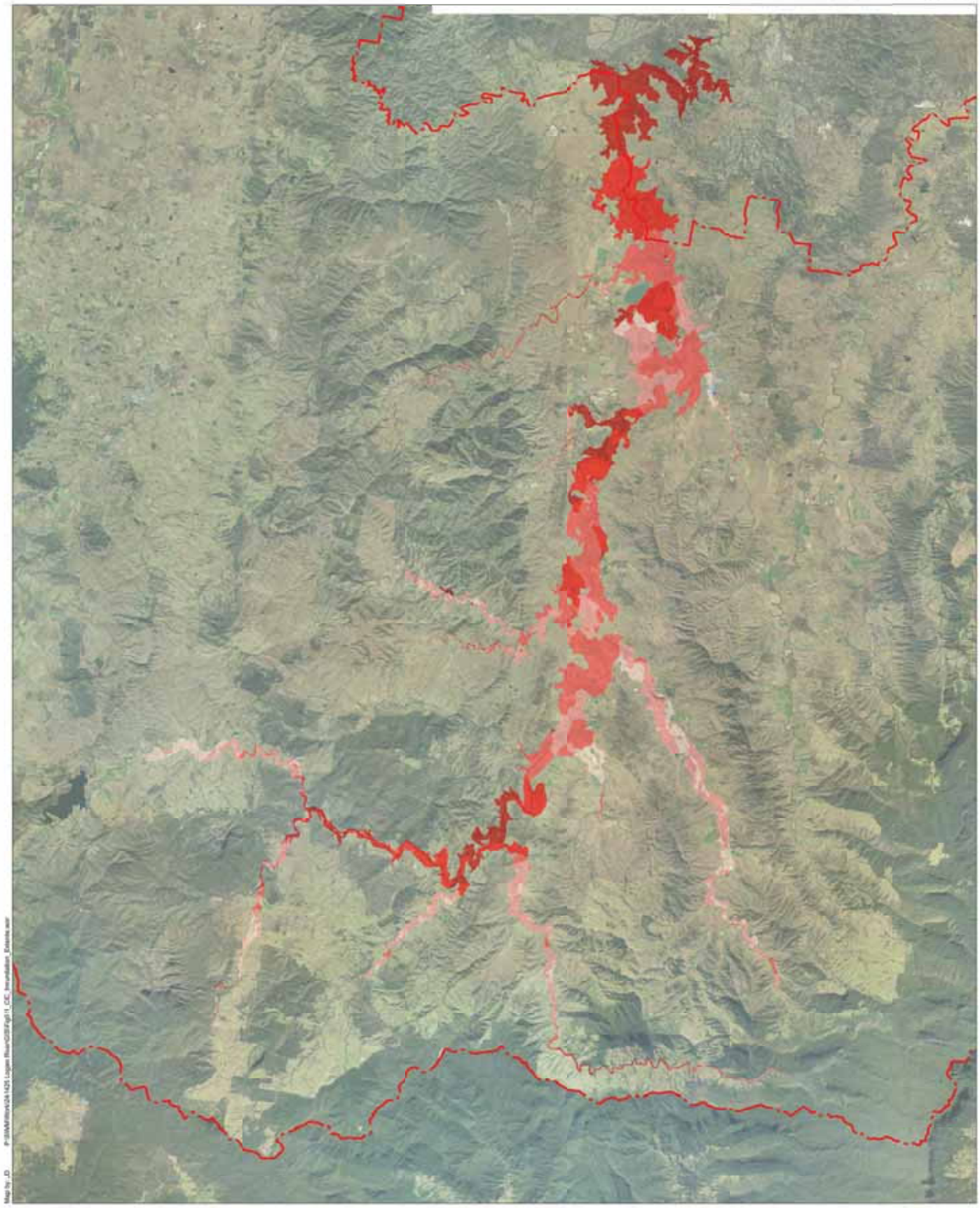
A3 scale 1:200,000

0 5,000 m 10,000 m

Date: 09/06/2016 Version: A Job No: 241425

Logan River Flood Study Figure B2 - a

1% AEP Event - Climate Change Scenario 4.5 - Afflux Map



Legend

Afflux (m)

< -0.80	0.03 to 0.20
-0.80 to -0.60	0.20 to 0.40
-0.60 to -0.40	0.40 to 0.60
-0.40 to -0.20	0.60 to 0.80
-0.20 to -0.03	0.80 to 1.20
-0.03 to 0.03	> 1.20

Was Dry Now Wet
Was Wet Now Dry

SRRC Boundary

Notes:

A3 scale 1:200,000

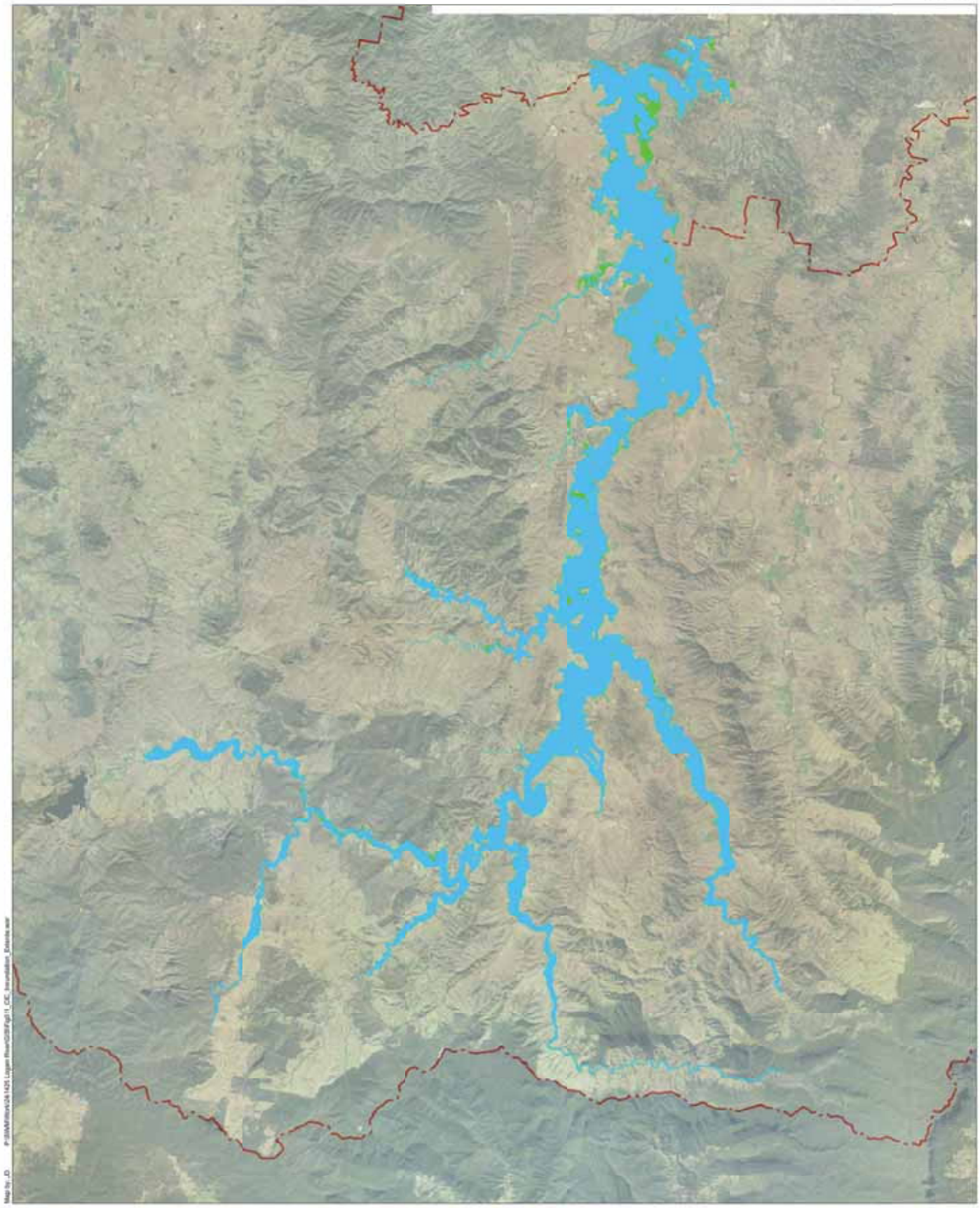
0 5,000 m 10,000 m

Date: 09/06/2016 Version: A Job No: 241425

Logan River Flood Study Figure B2 - b

1% AEP Event - Climate Change Scenario 8.5 - Afflux Map

aurecon



Legend

- SRRC Boundary
- Existing Scenario
- Climate Change Scenario 4.5

Notes:

A3 scale 1:200,000

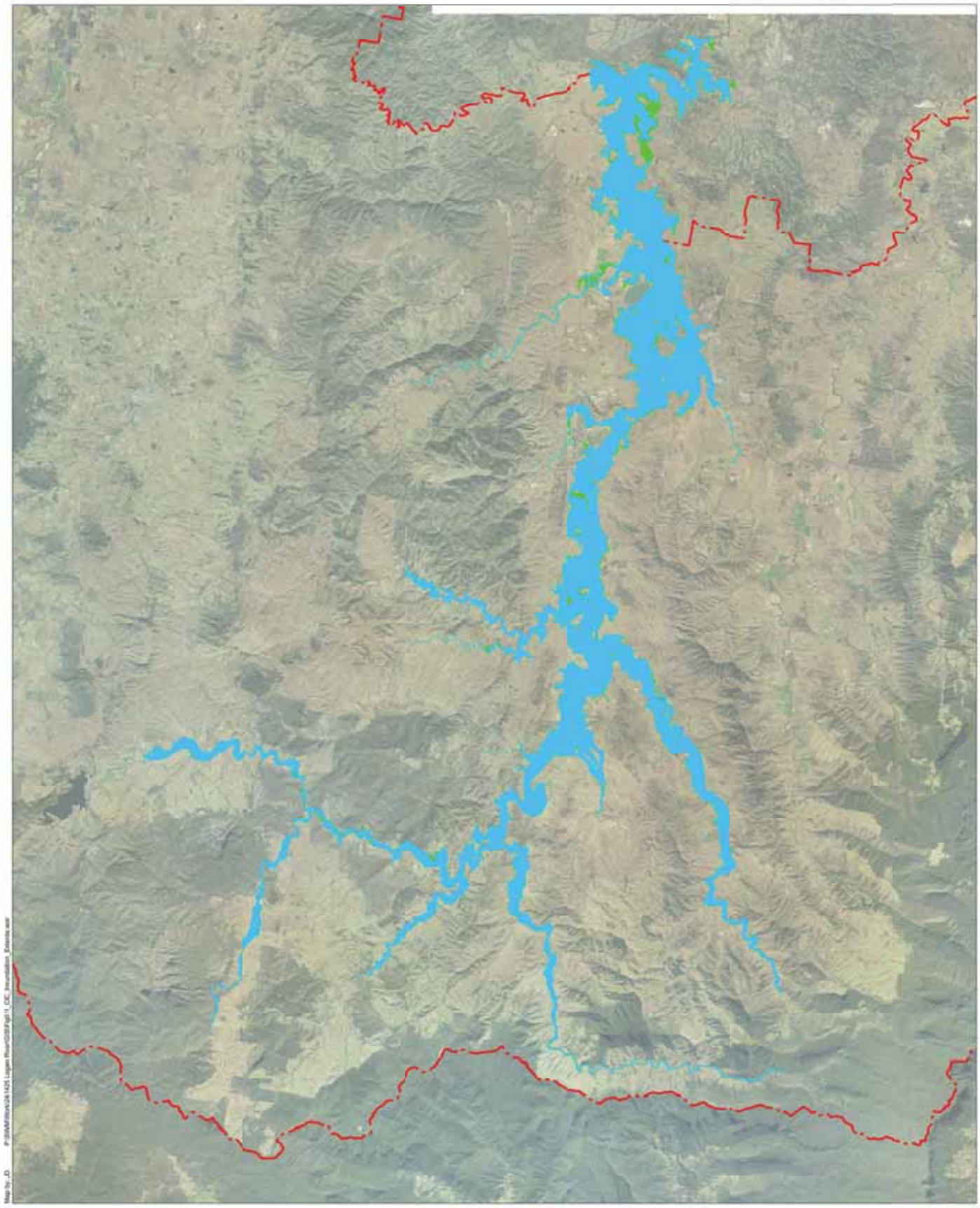
0 5,000 m 10,000 m

Date: 09/06/2016 Version: A Job No: 241425

Logan River Flood Study Figure B3 - a

1% AEP Event - Climate Change Scneario 4.5 - Inundation Extent

aurecon



Legend

- SRRC Boundary
- Existing Scenario
- Climate Change Scenario 4.5

Notes:

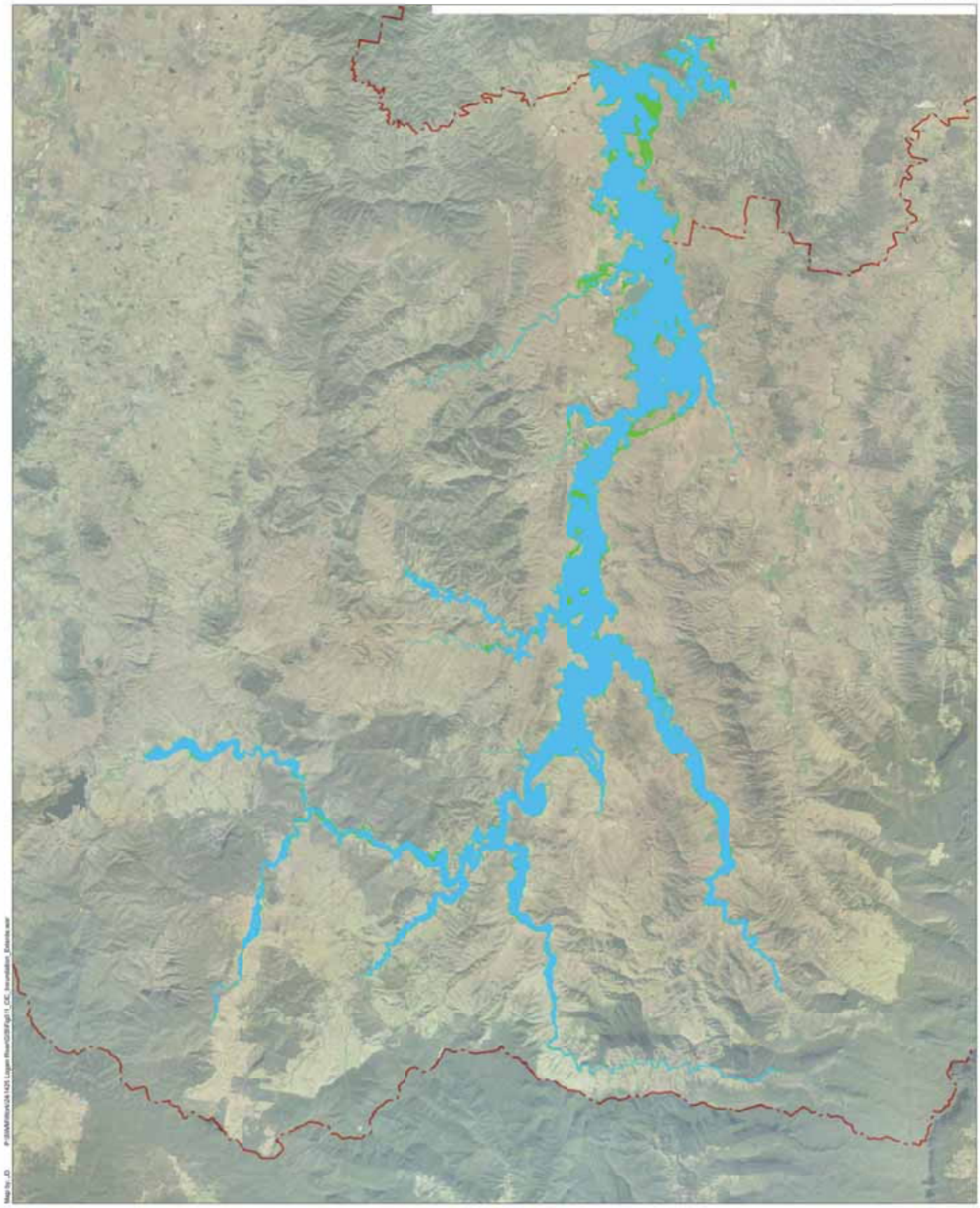
A3 scale 1:200,000

0 5,000 m 10,000 m

Date: 09/06/2016 Version: A Job No: 241425

Logan River Flood Study Figure B3 - a

1% AEP Event - Climate Change Scneario 4.5 - Inundation Extent



Legend

- SRRC Boundary
- Existing Scenario
- Climate Change Scenario 4.5

Notes:

A3 scale 1:200,000

0 5,000 m 10,000 m

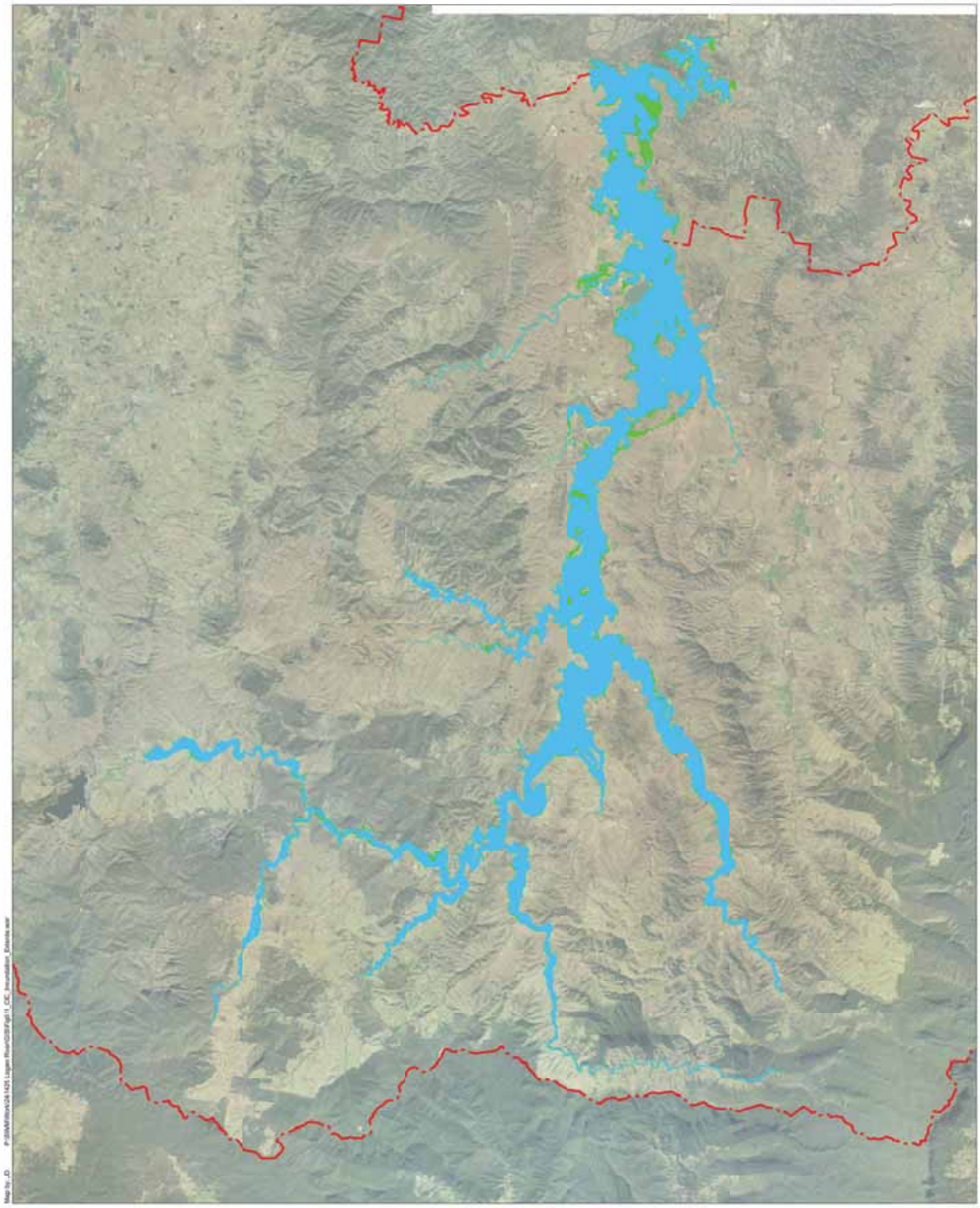
Date: 09/06/2016 Version: A Job No: 241425

Projection: MGA Zone 55

Logan River Flood Study Figure B3 - b

1% AEP Event - Climate Change Scneario 8.5 - Inundation Extent

aurecon



Legend

- SRRC Boundary
- Existing Scenario
- Climate Change Scenaric 4.5

Notes:

A3 scale 1:200,000

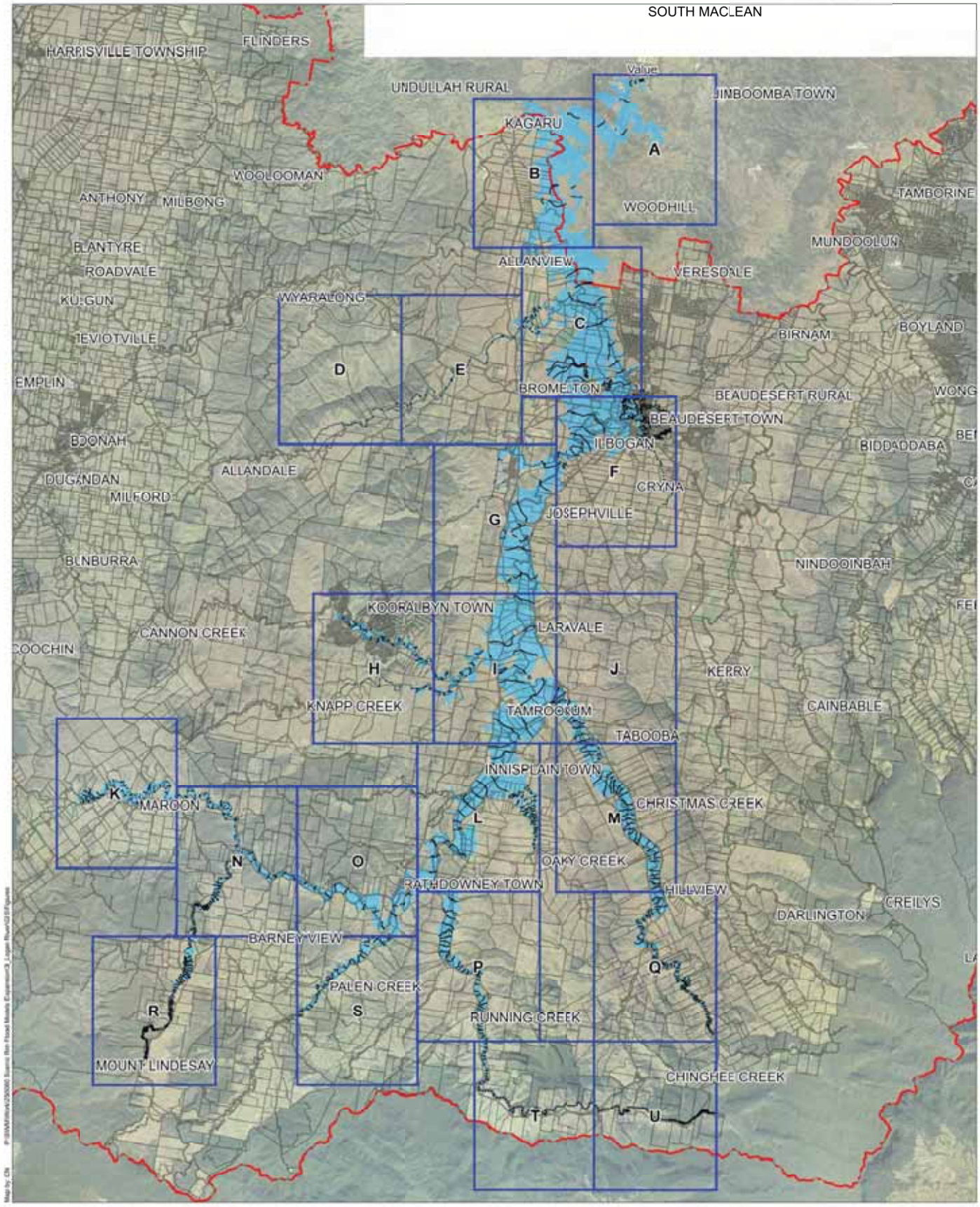
0 5,000 m 10,000 m

Date: 09/06/2016 Version: A Job No: 241425

Projection: MGA Zone 55

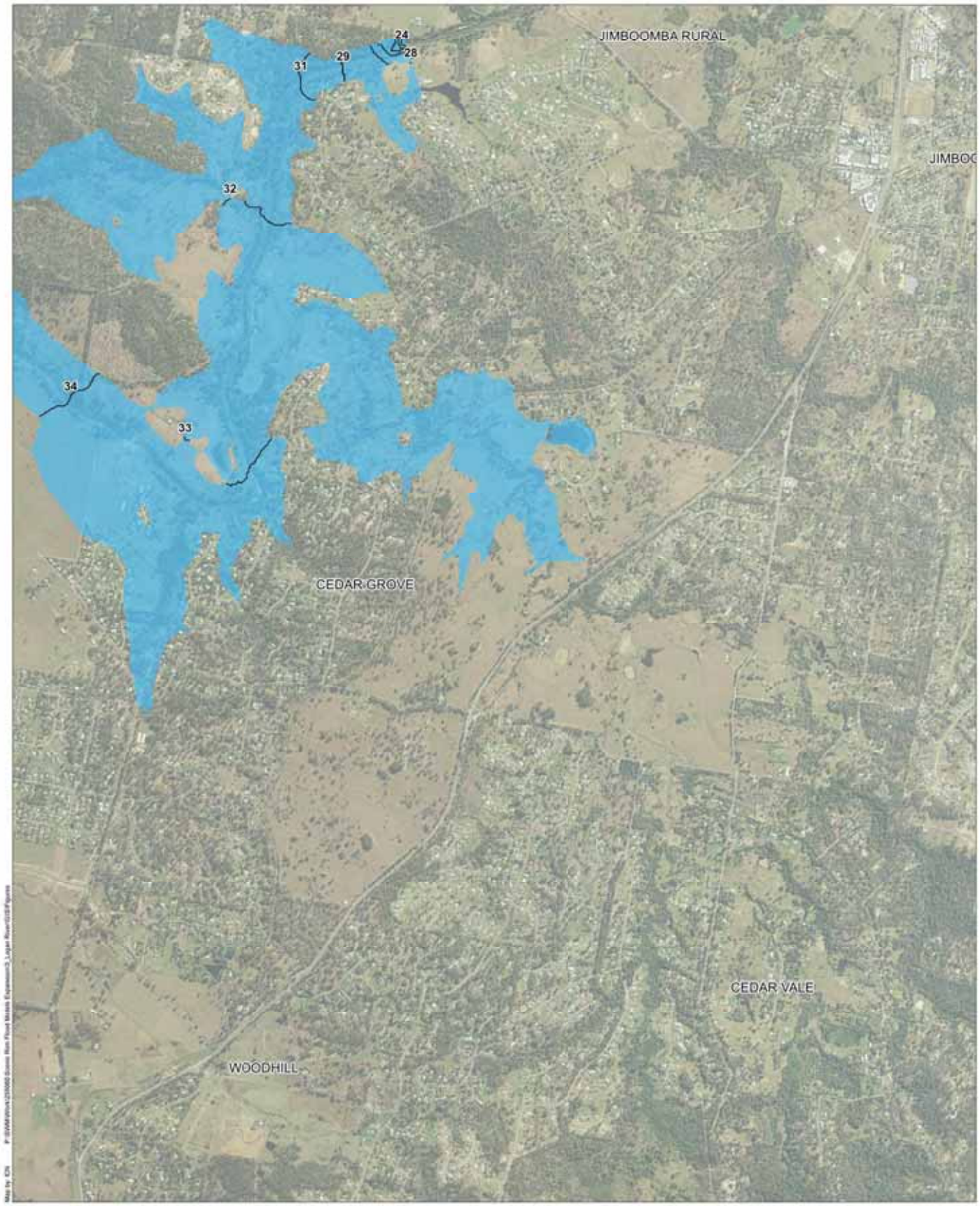
Logan River Flood Study Figure B3 - b

1% AEP Event - Climate Change Scneario 8.5 - Inundation Extent



Logan River Flood Study **Figure B4**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

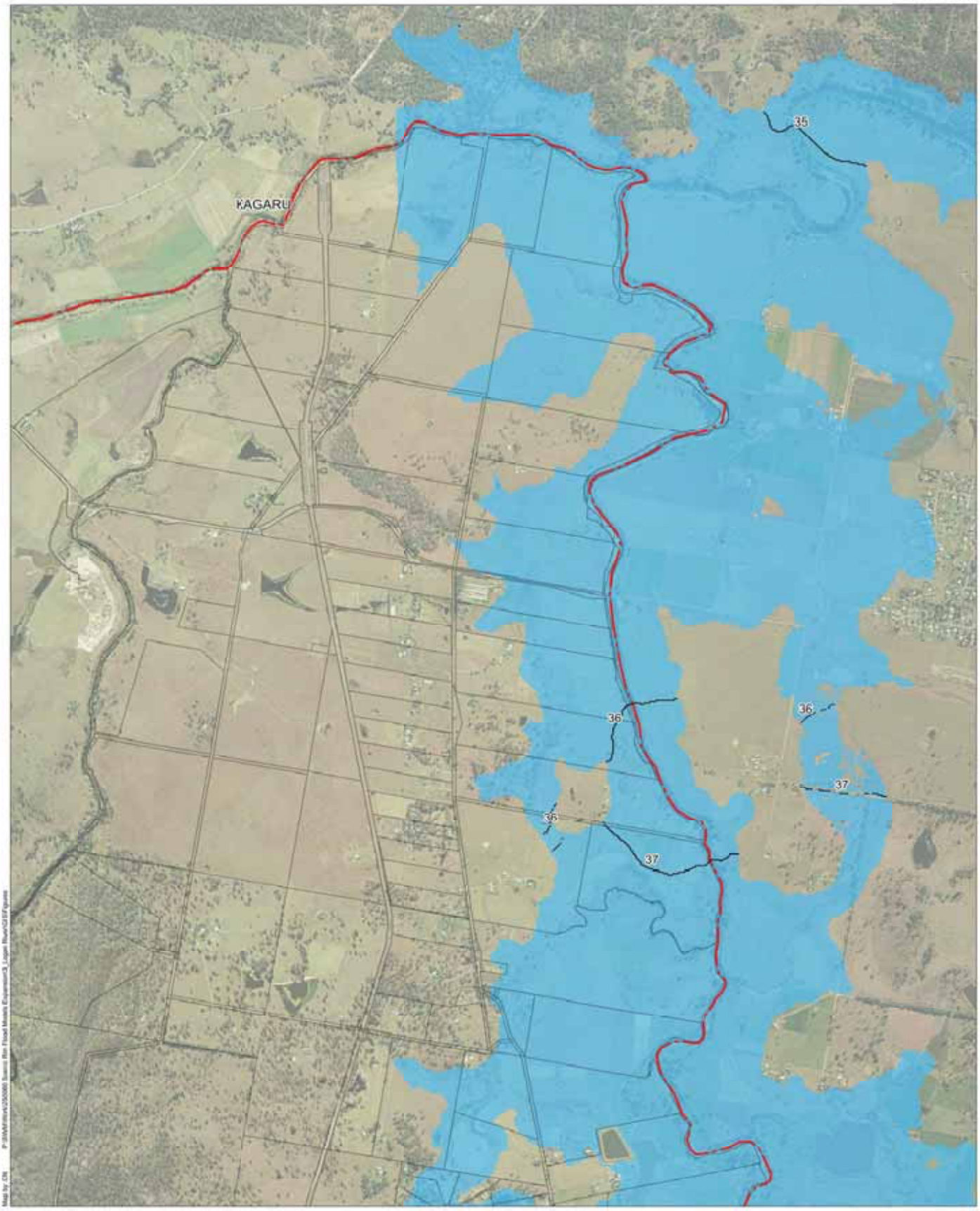
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B4-a

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

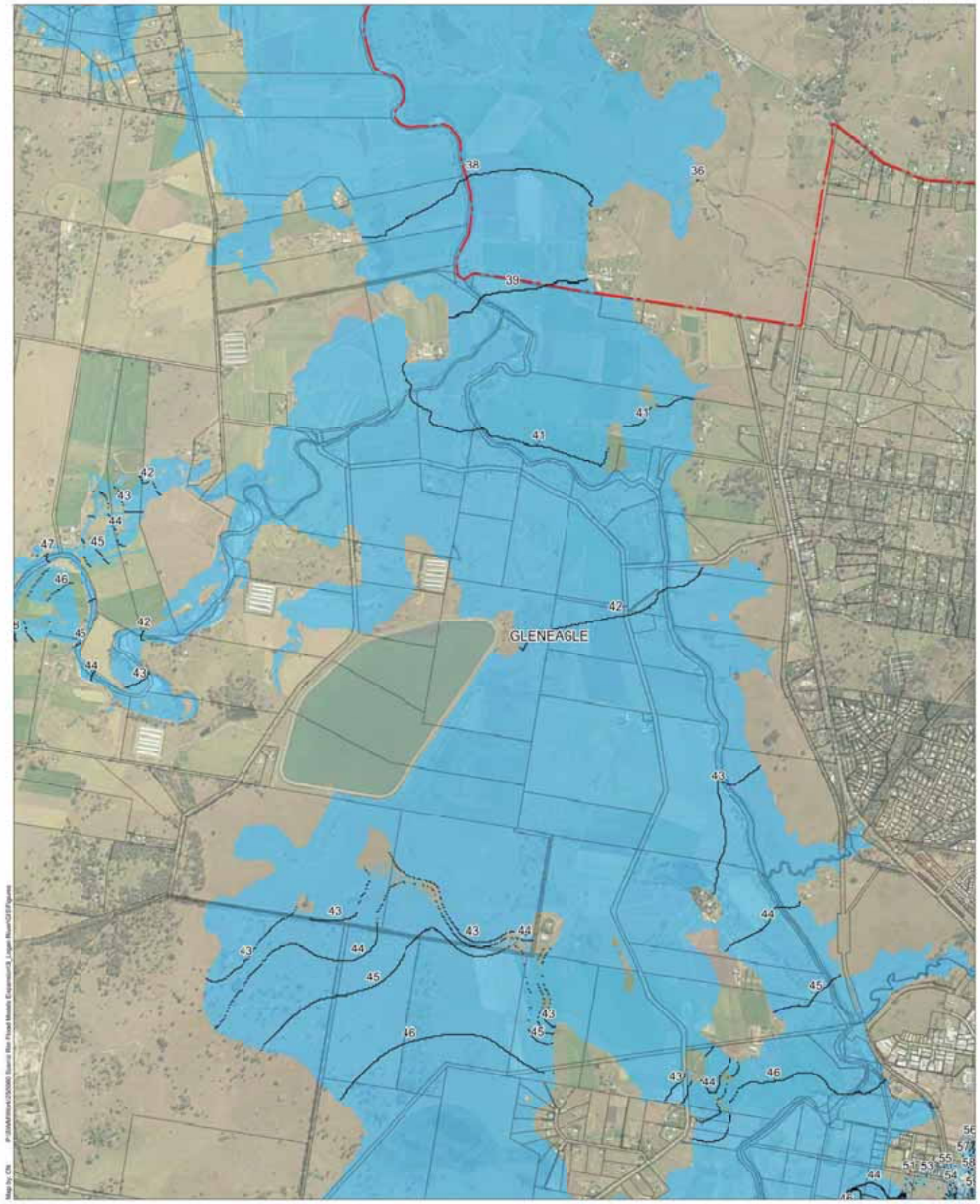
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study **Figure B4-b**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

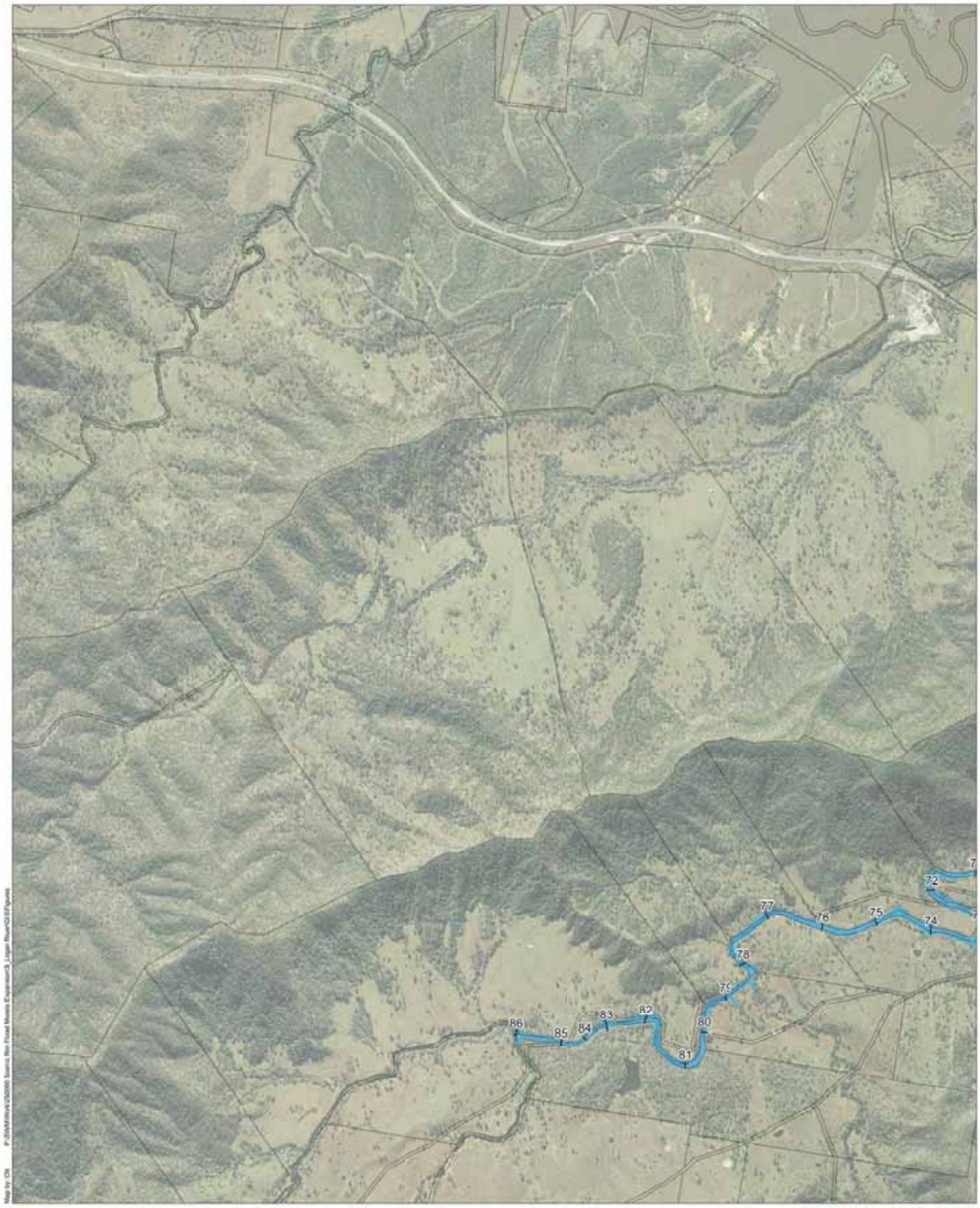
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B4-c**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

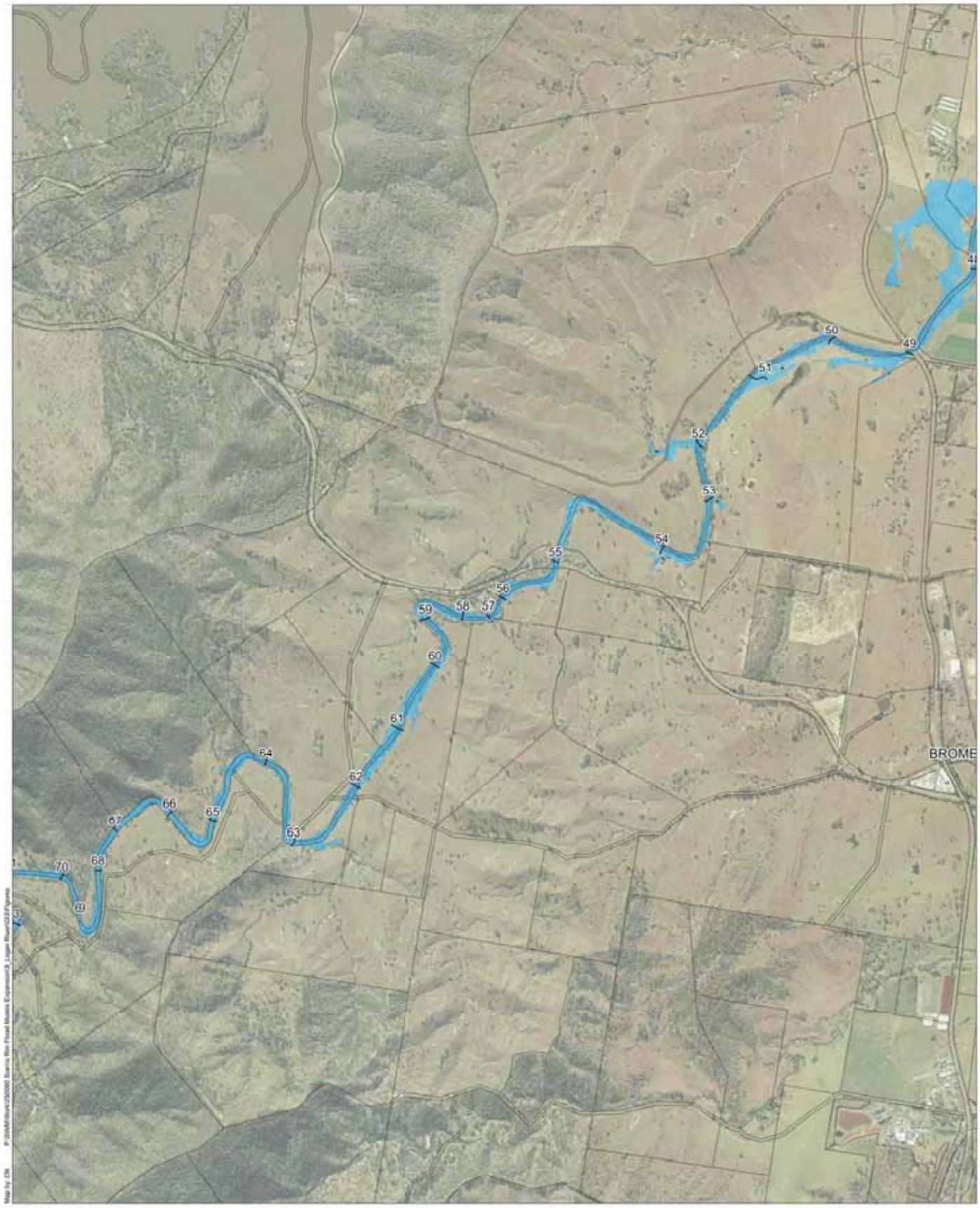
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B4-d**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

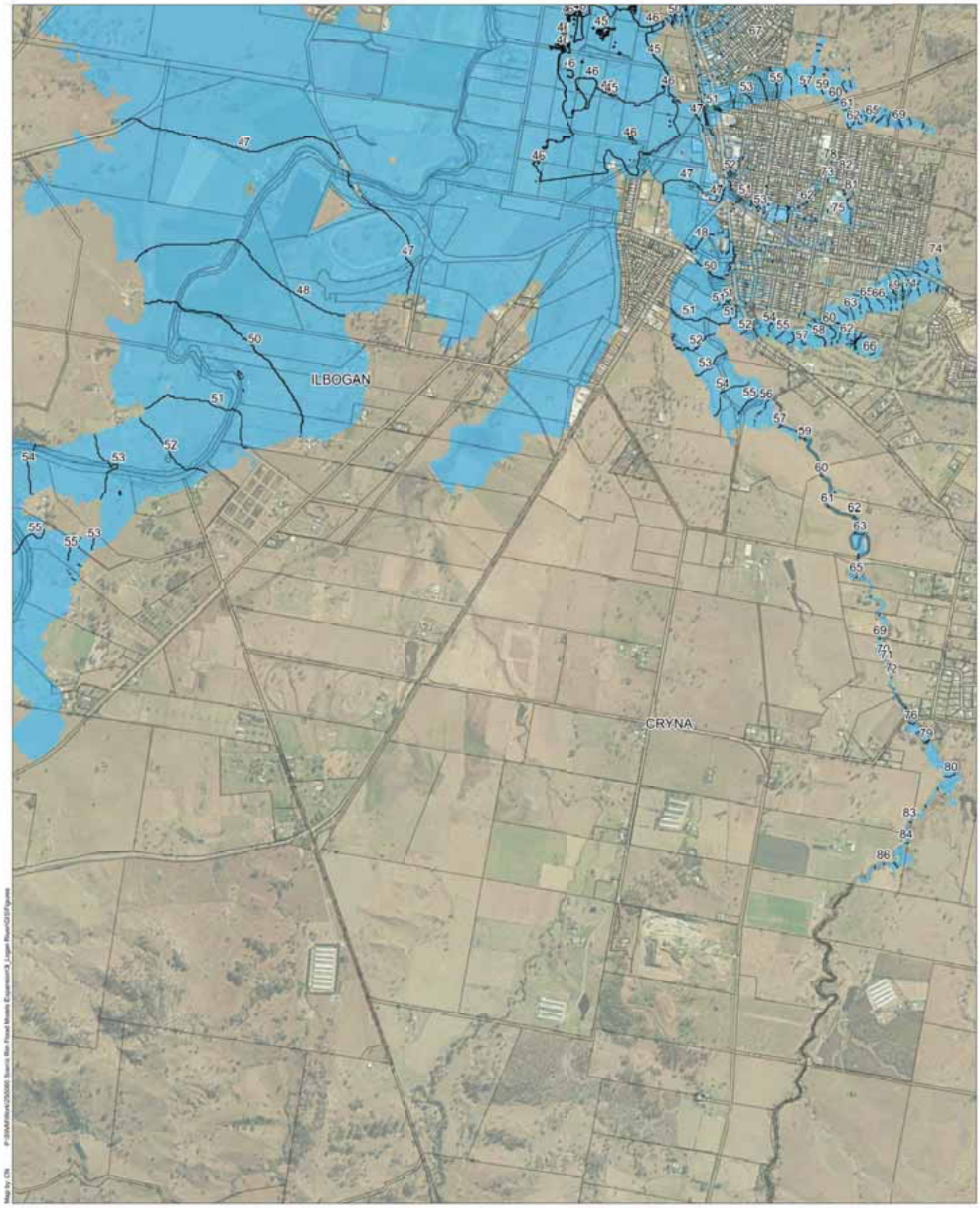
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B4-e**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

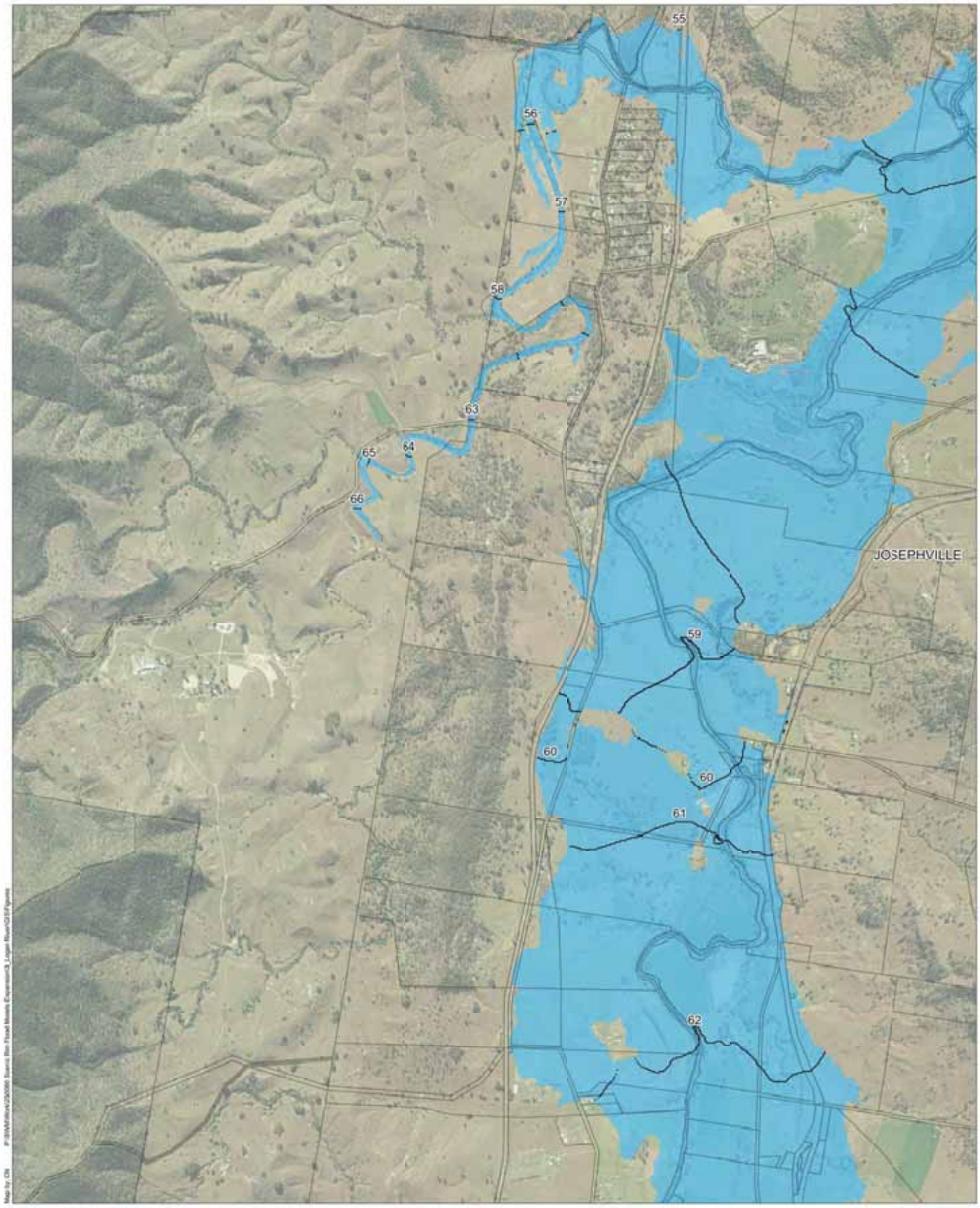
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-f

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

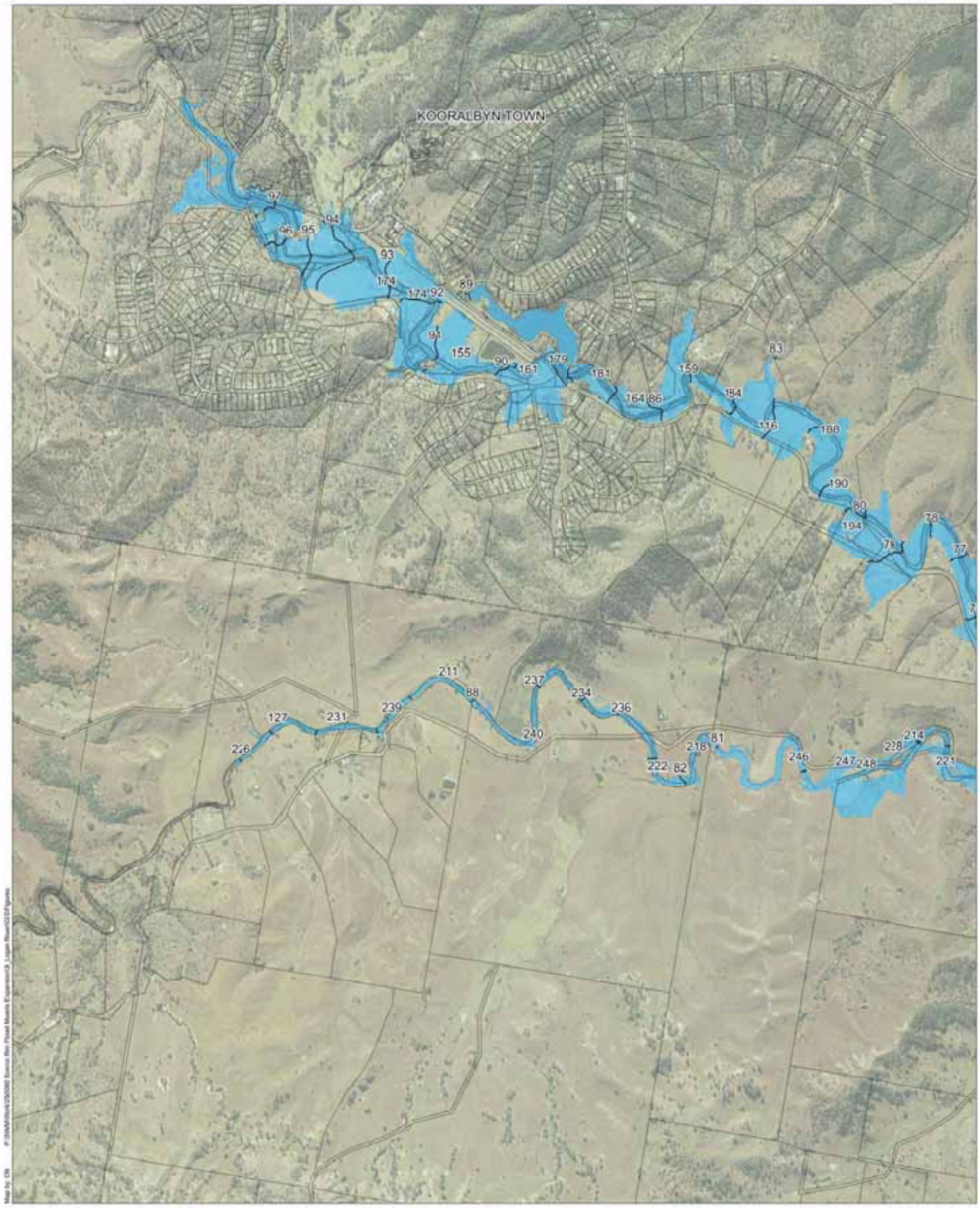
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study **Figure B4-g**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

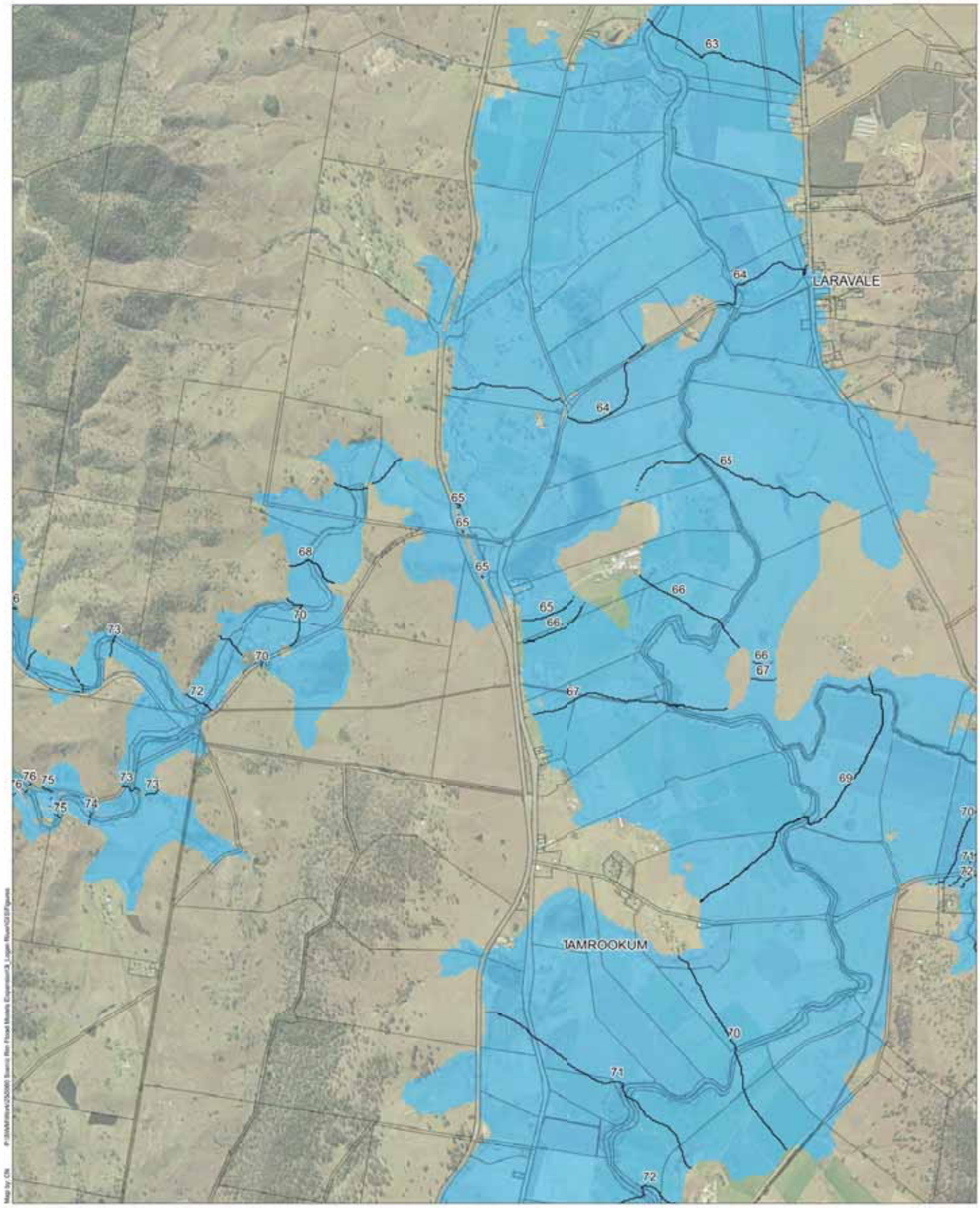
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study **Figure B4-h**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

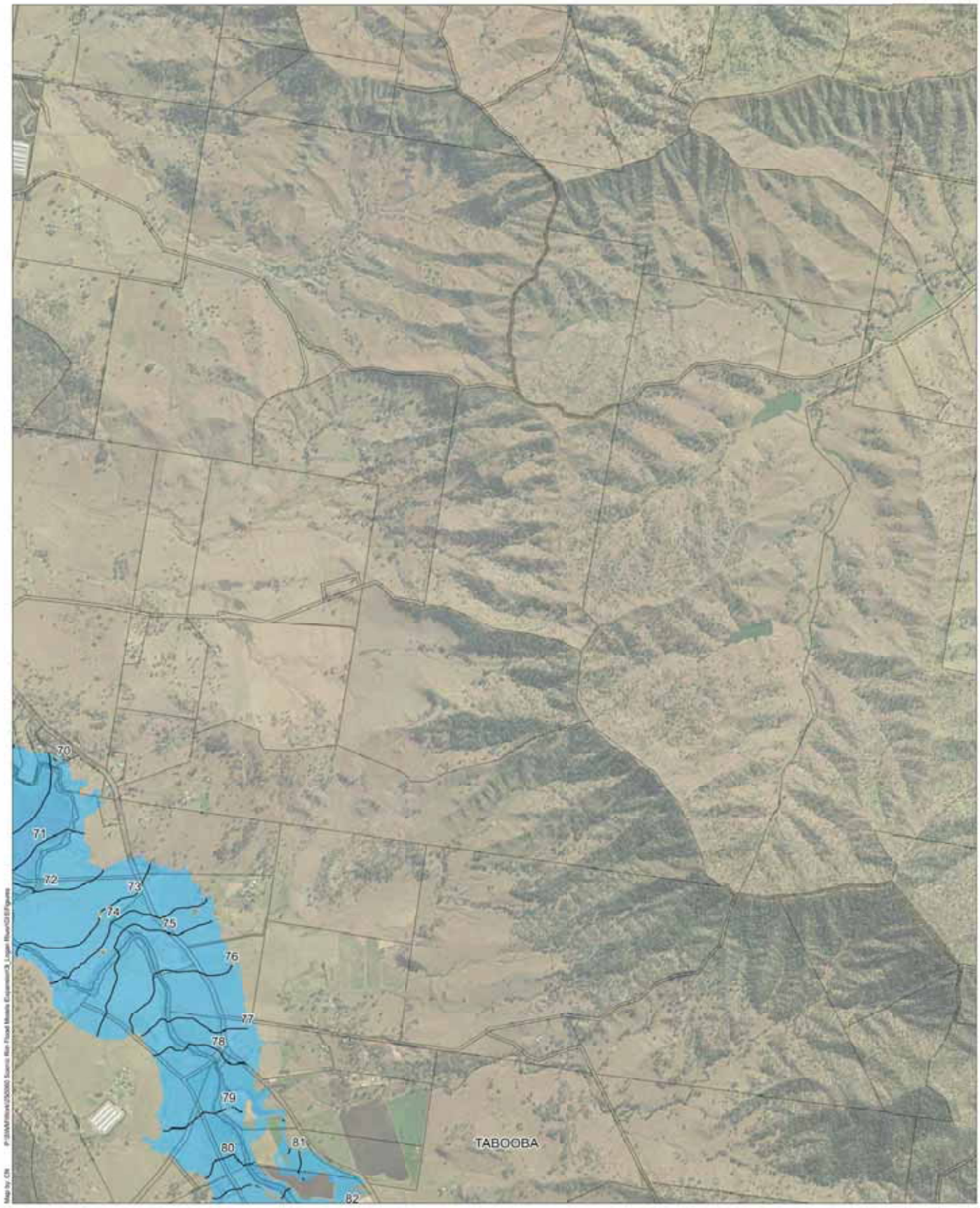
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B4-i**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

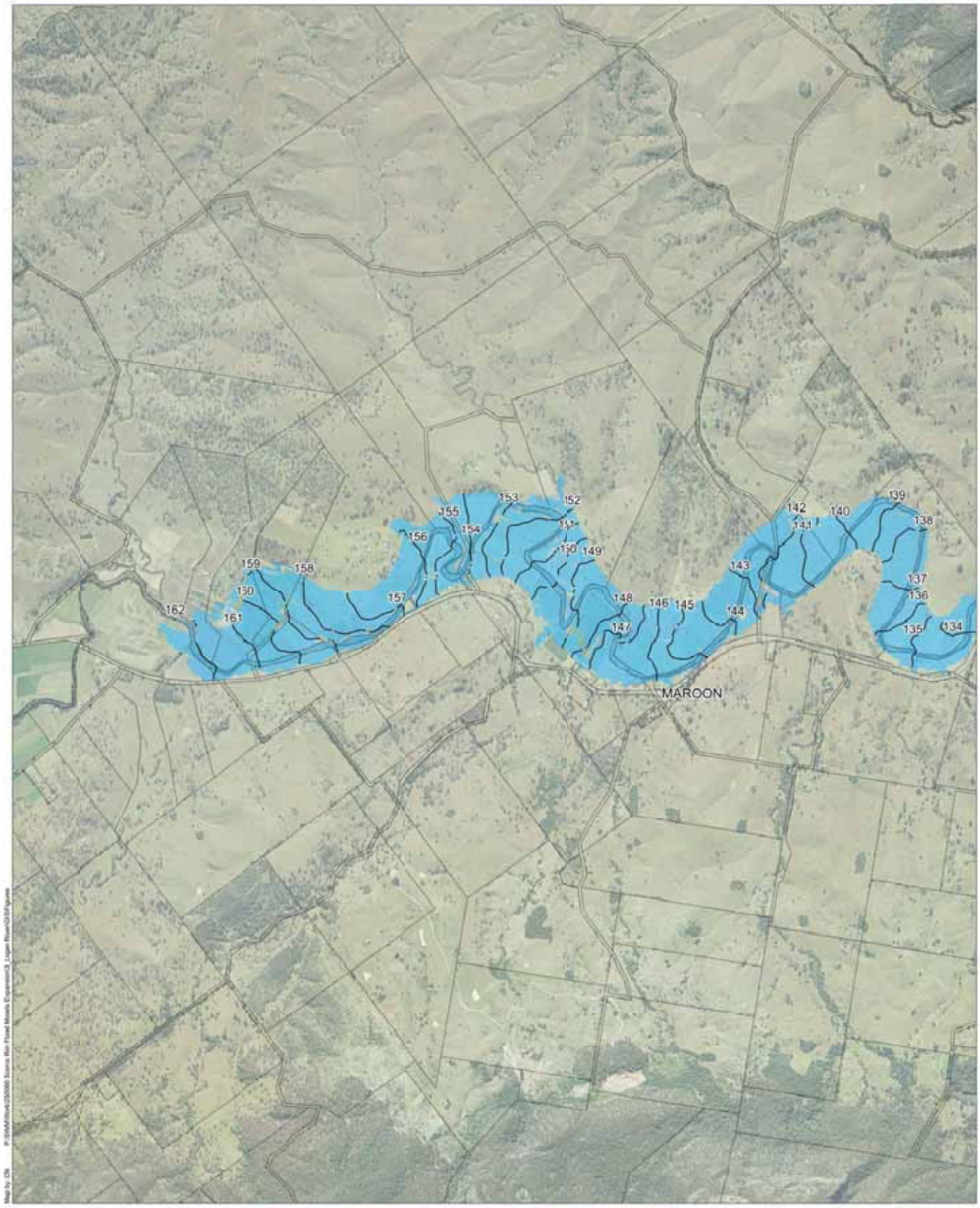
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study **Figure B4-j**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

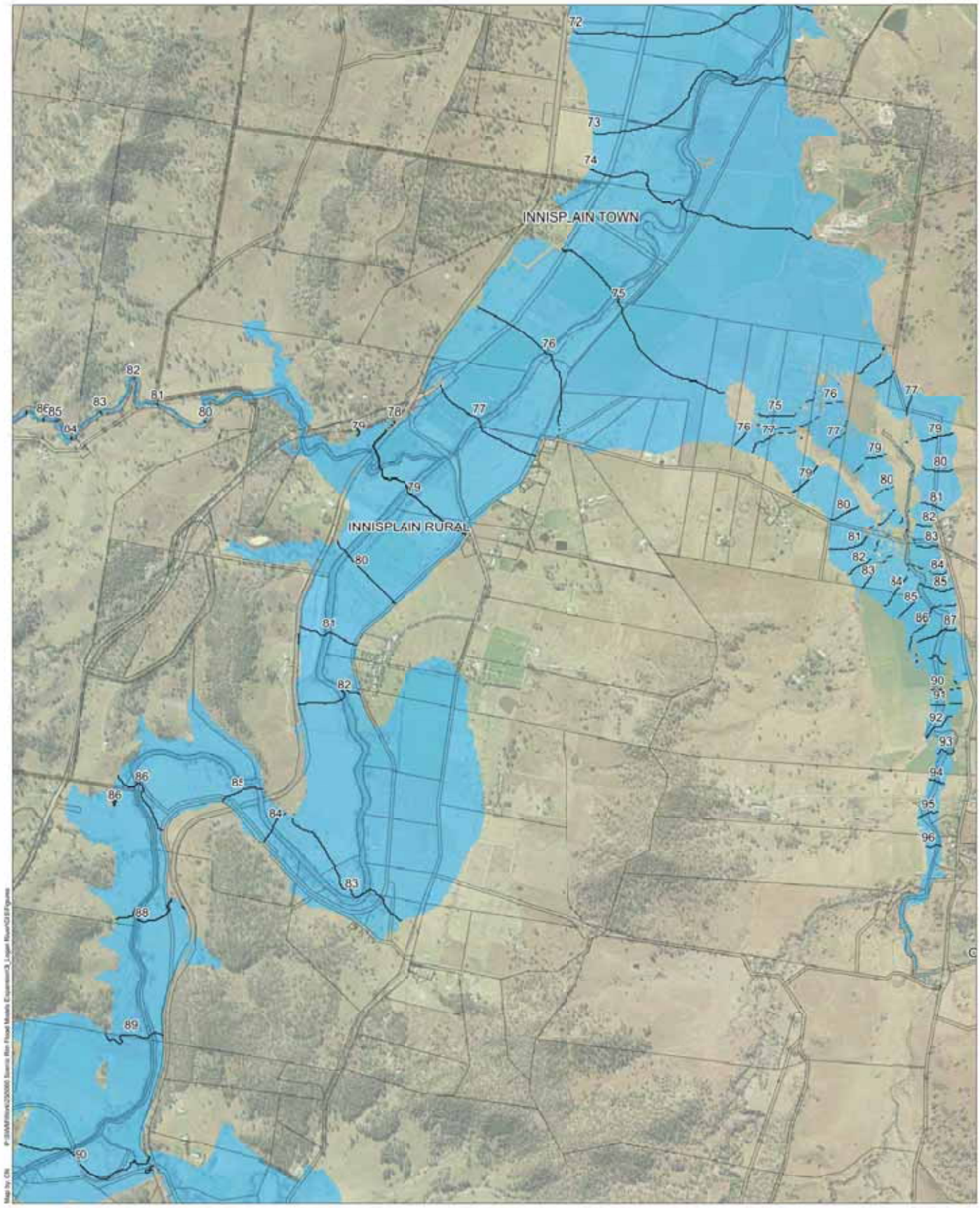
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-k

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

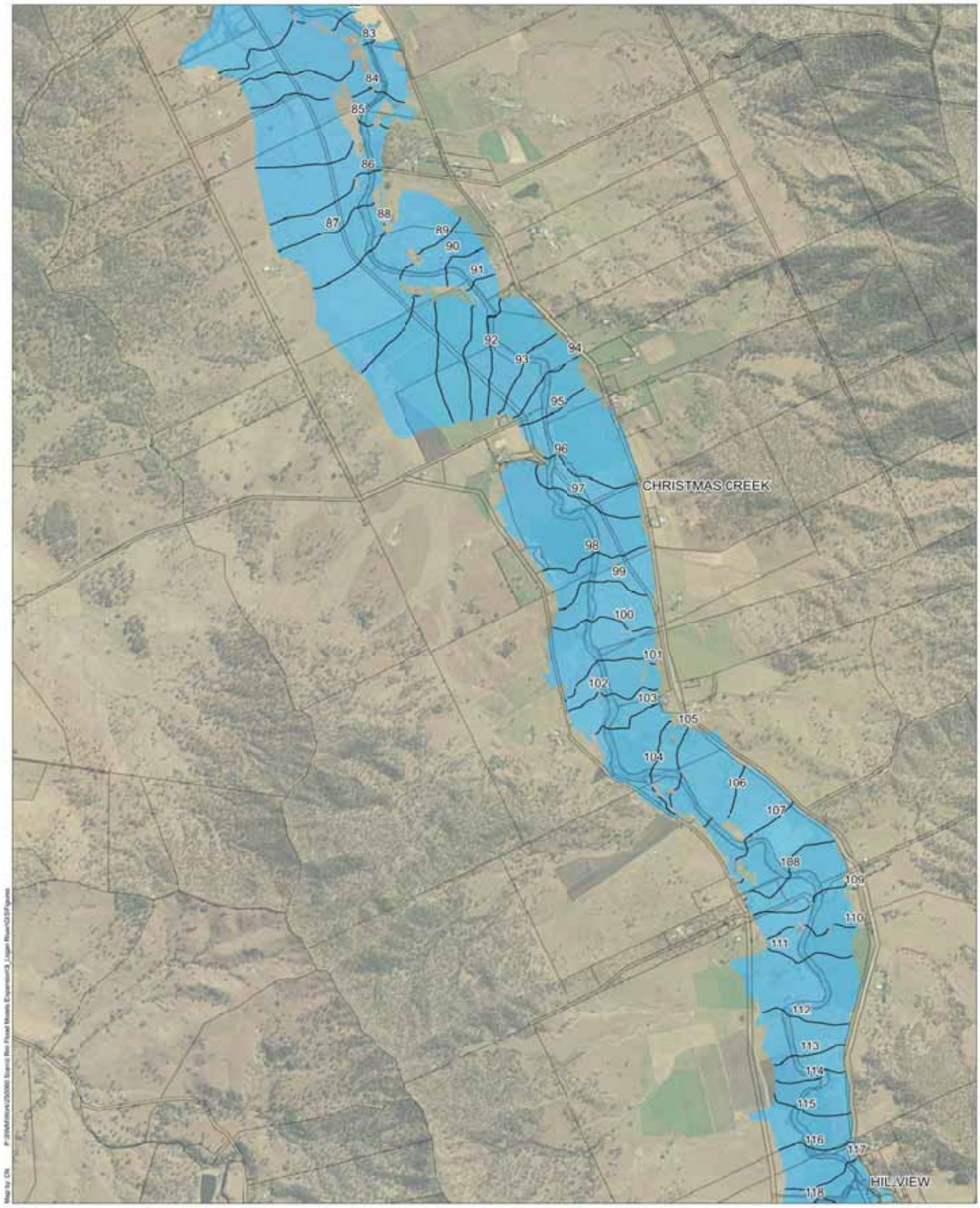
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-I

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B4-m**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent

Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

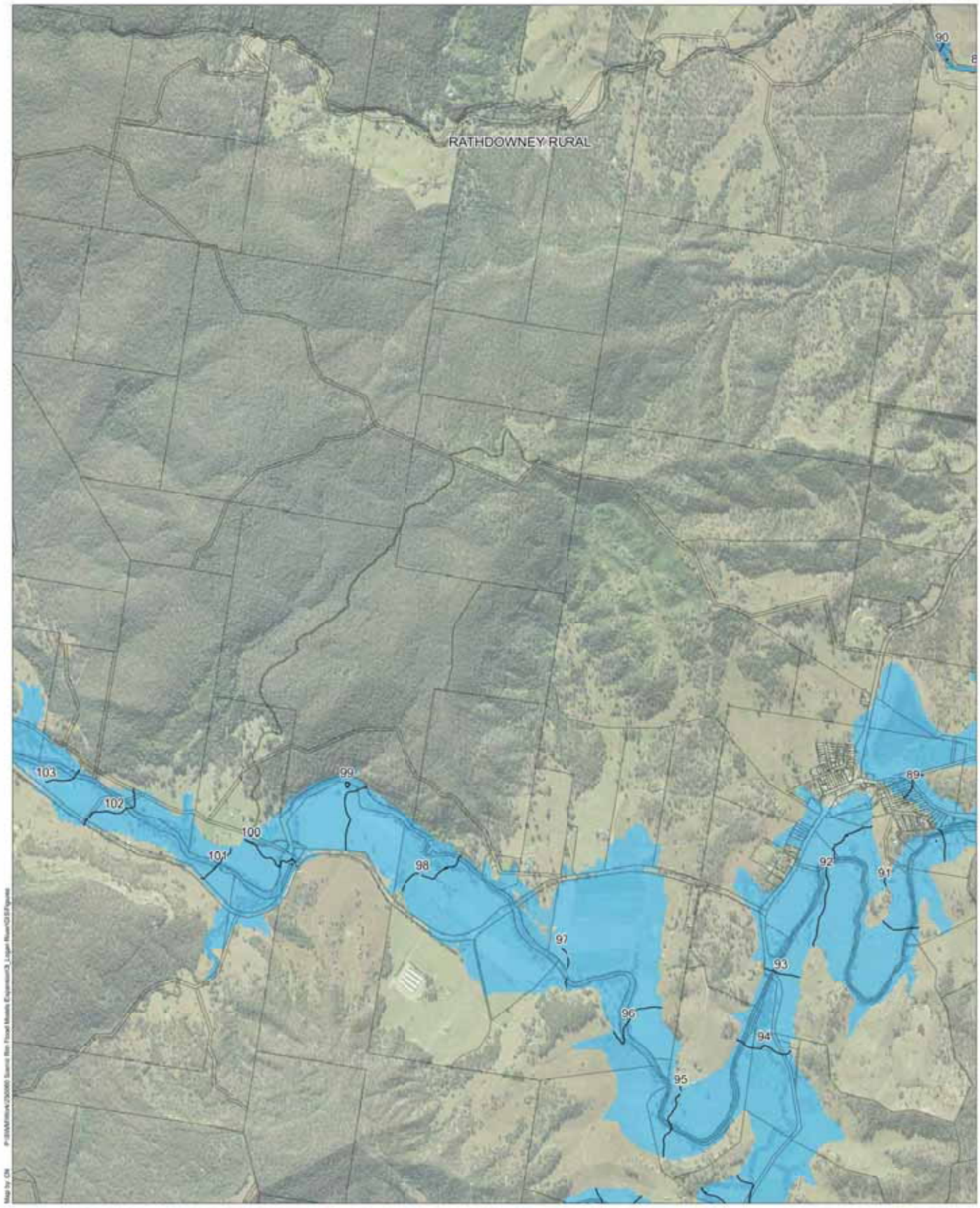
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study **Figure B4-n**

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

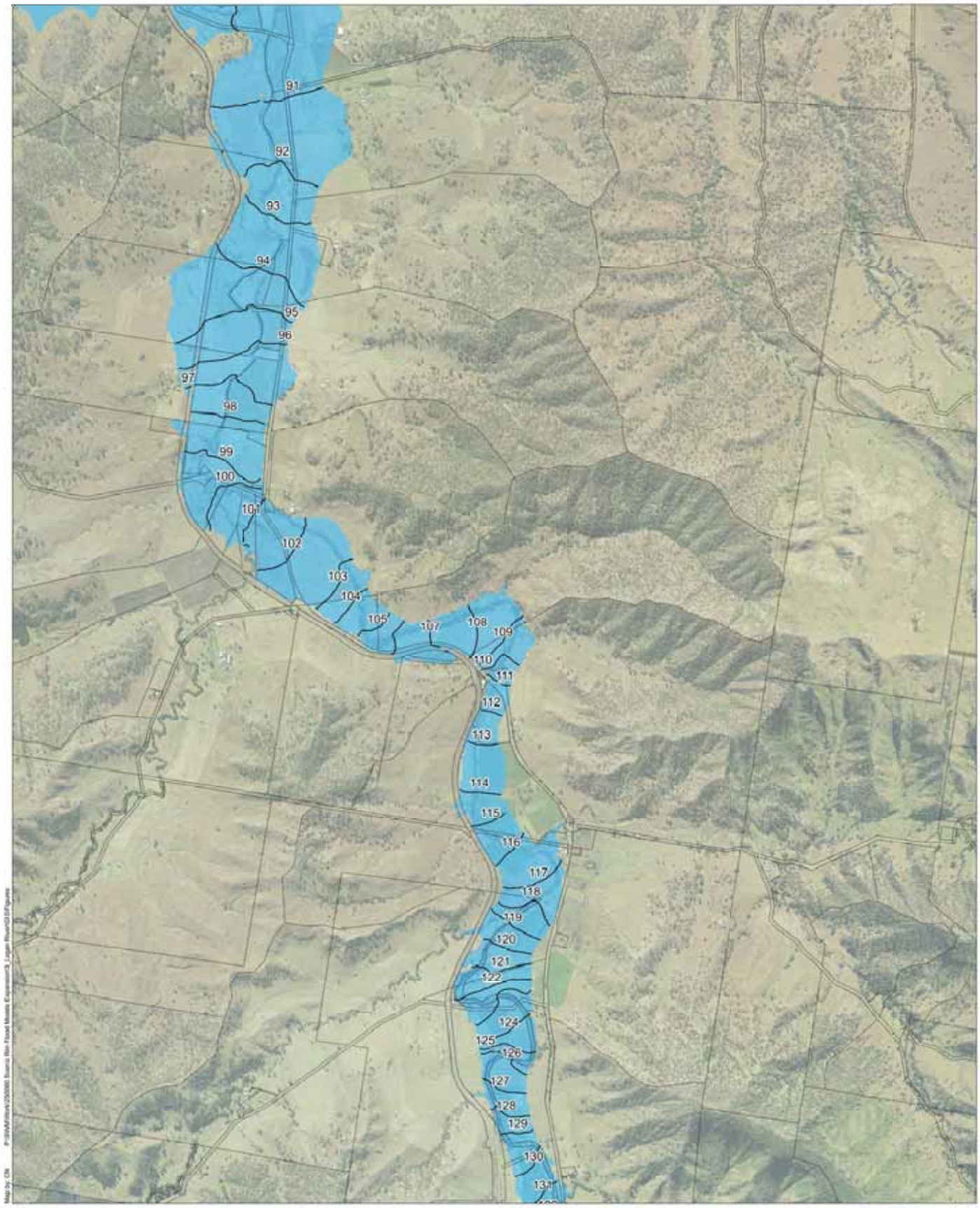
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-o

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

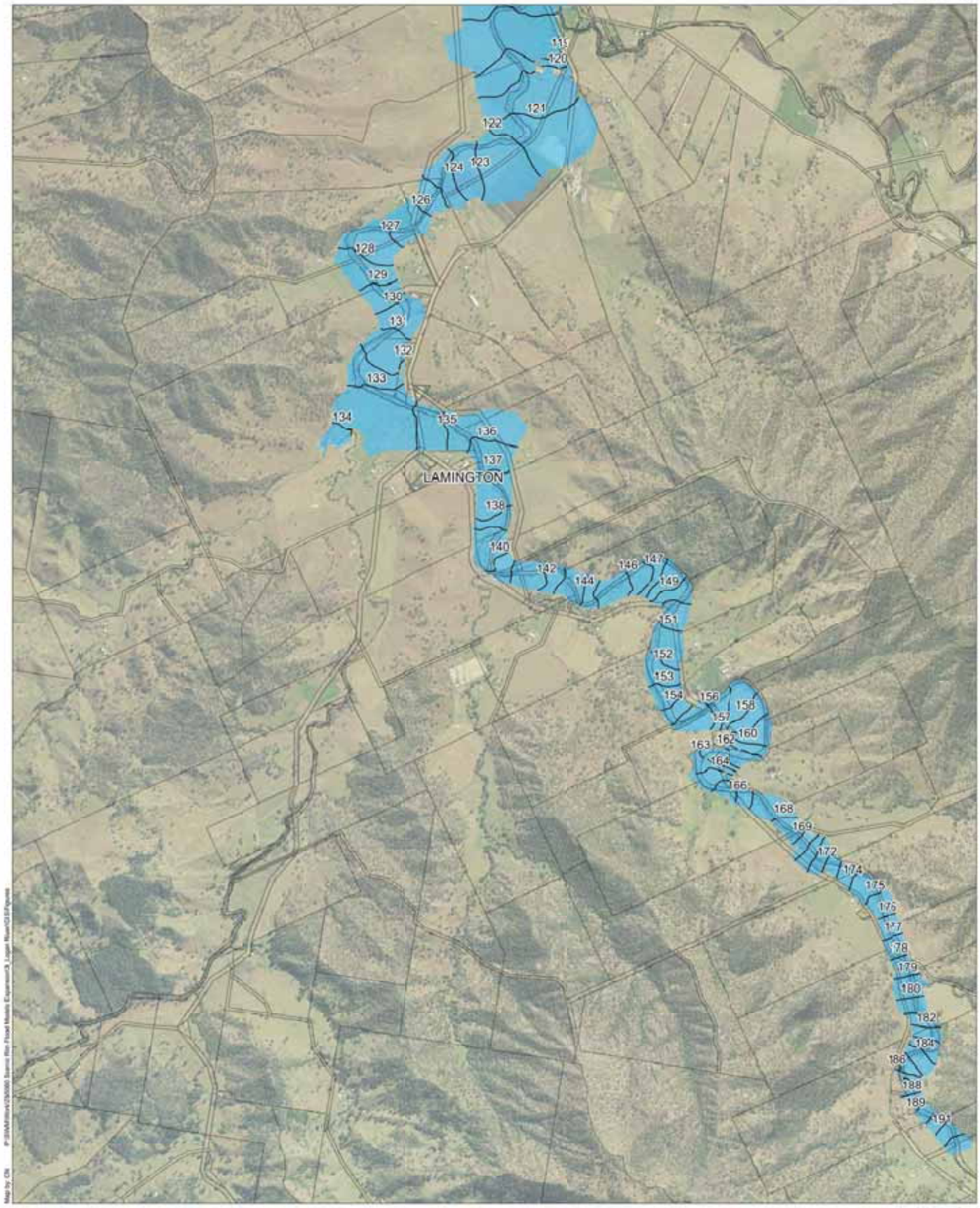
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-p

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

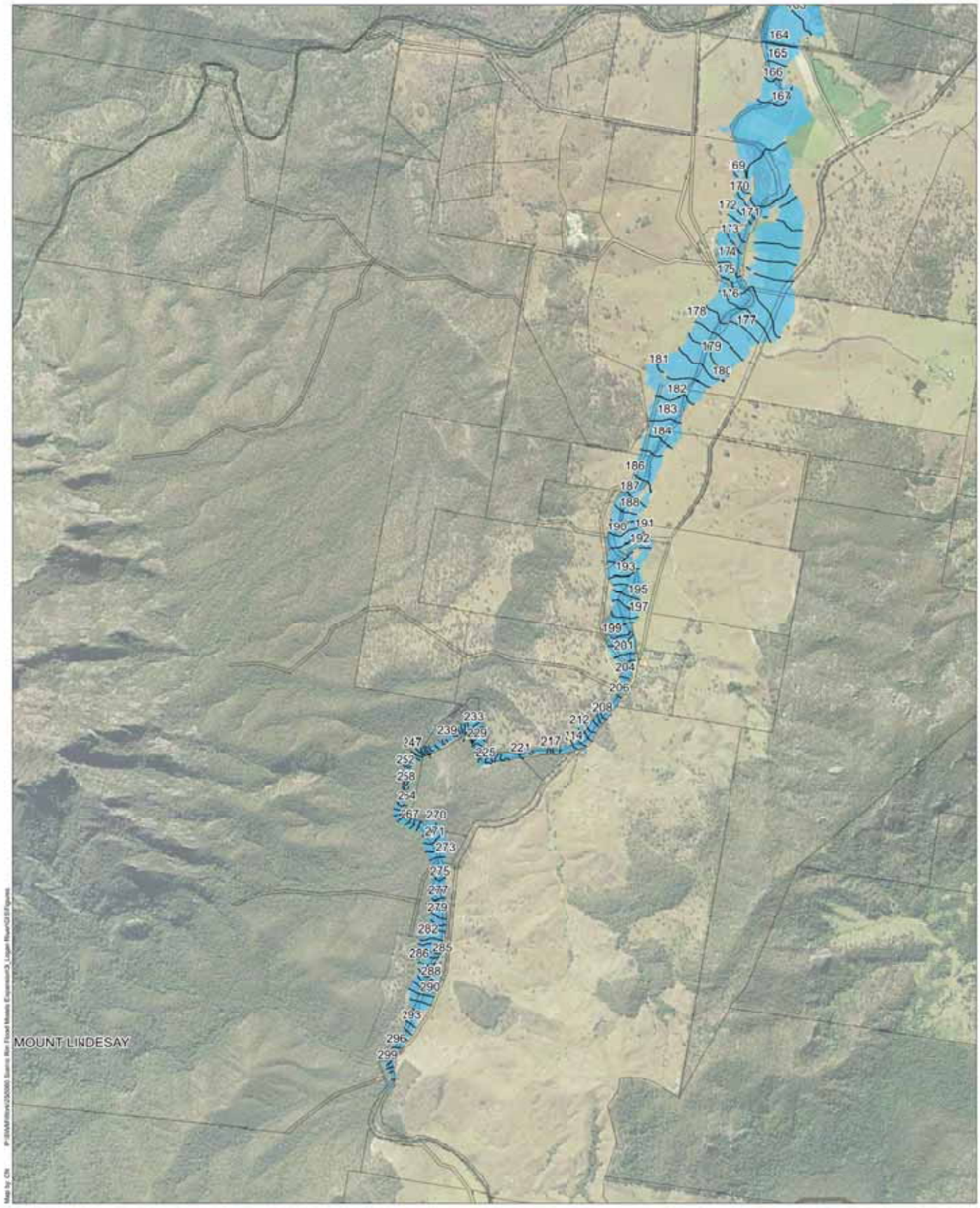
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-q

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

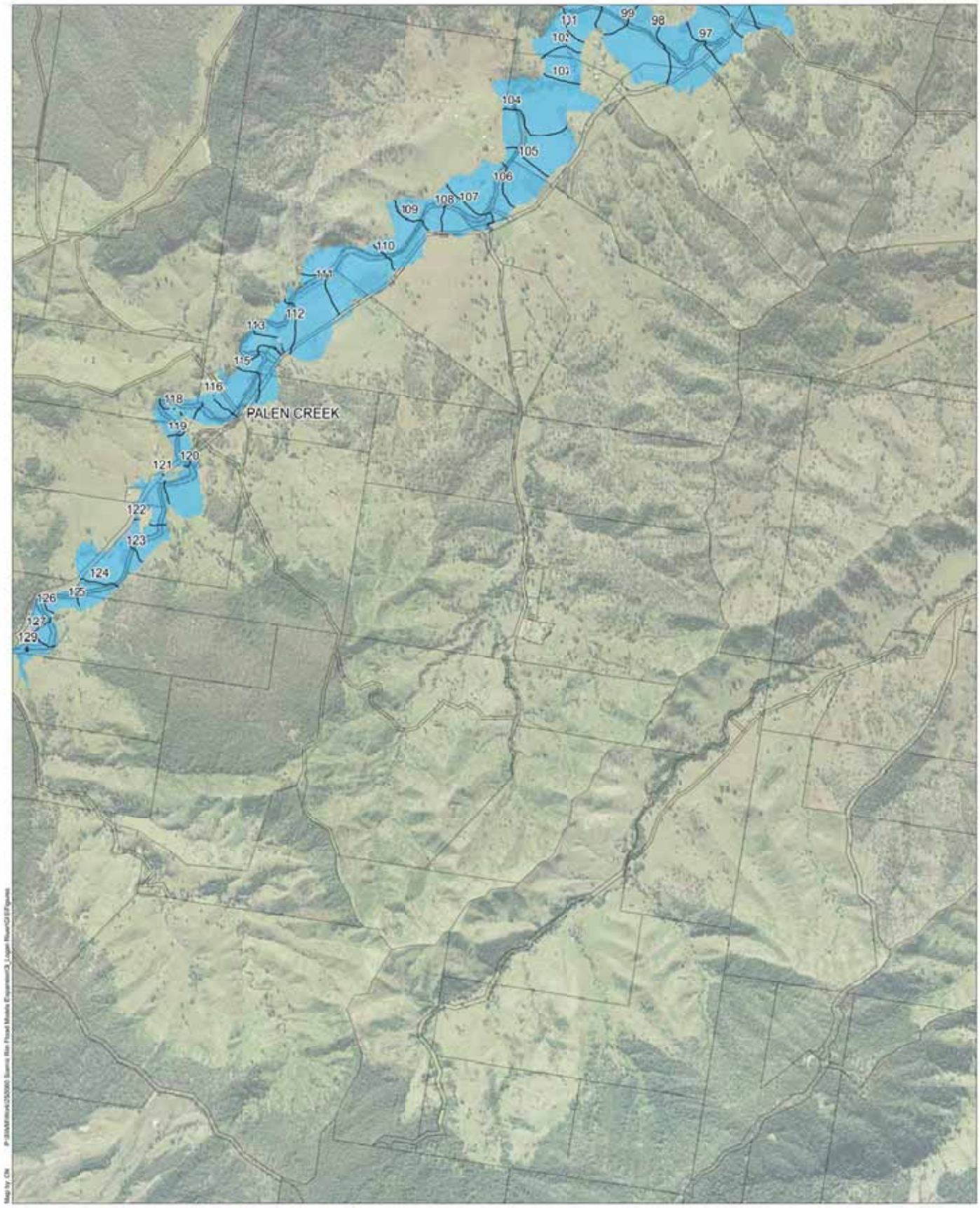
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-r

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

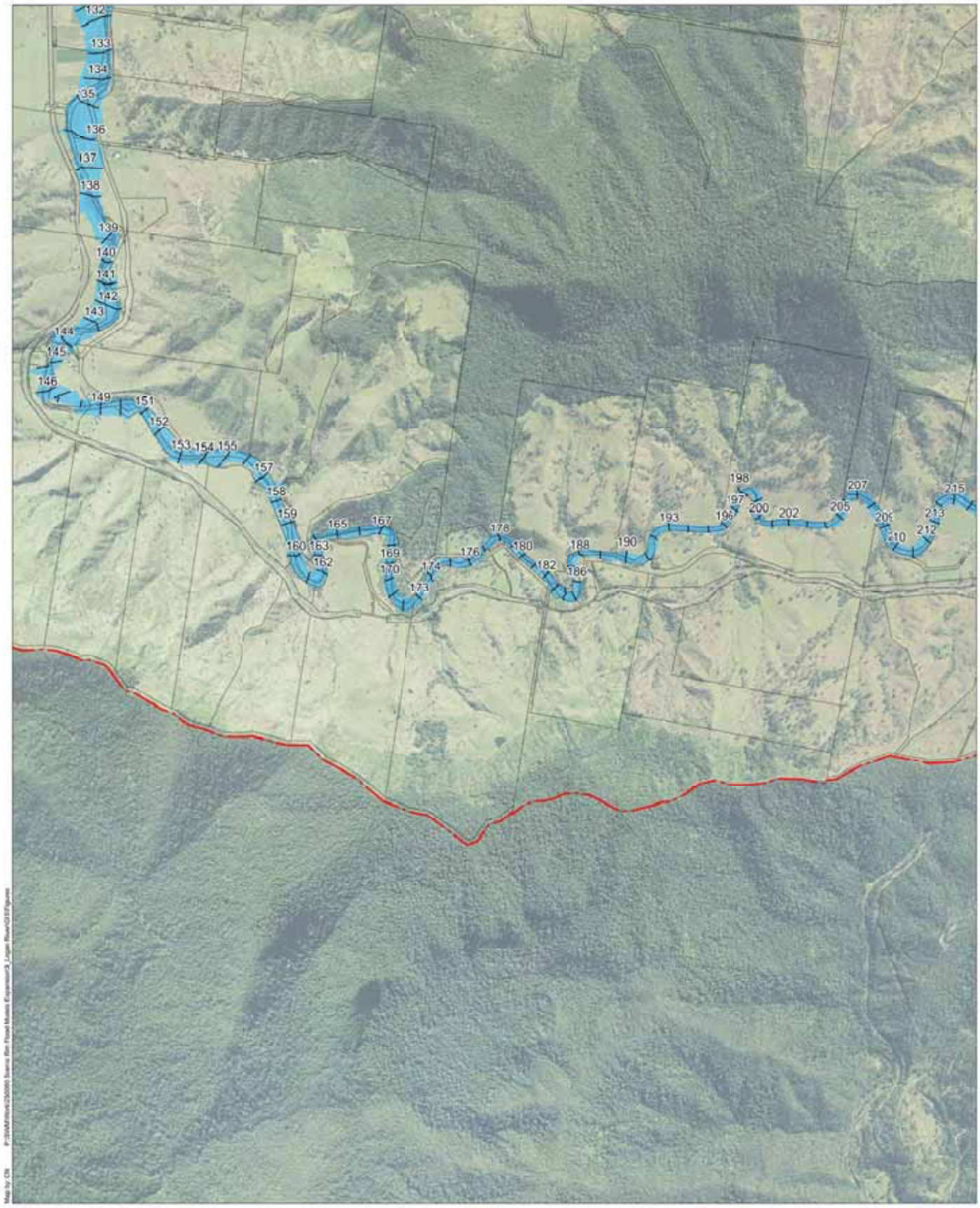
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-s

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

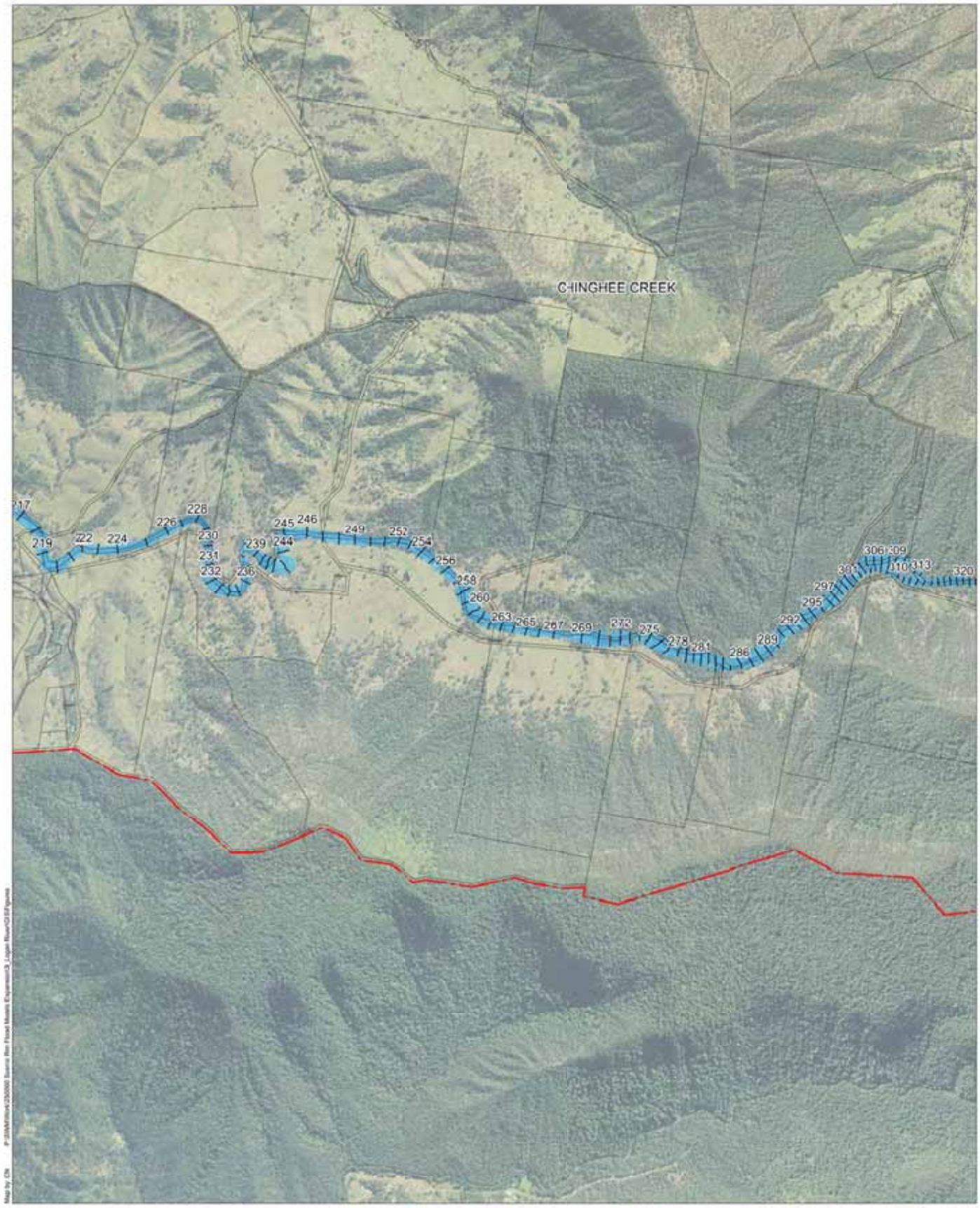
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B4-t

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

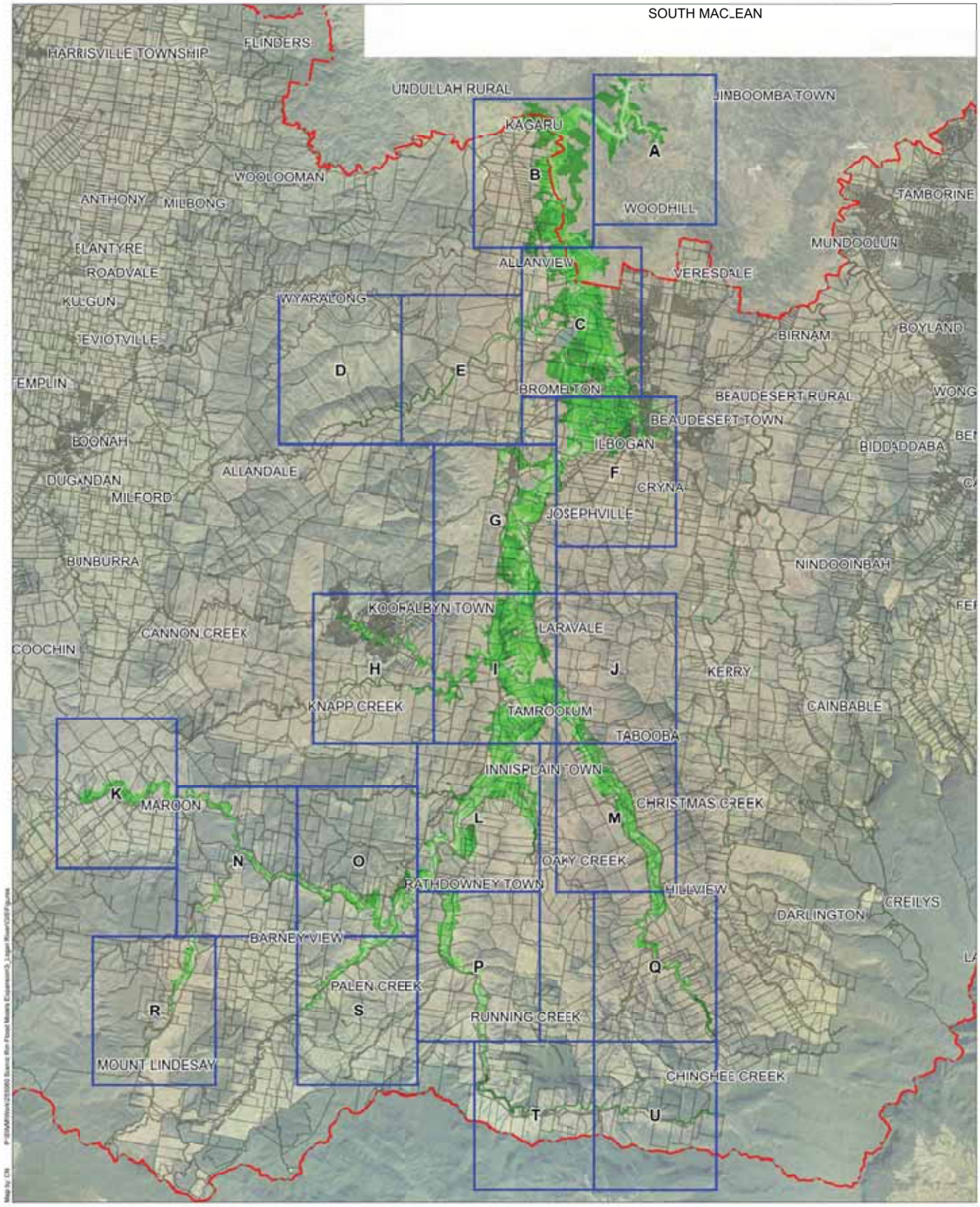
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B4-u

1% AEP Event - Climate Change Scenario 4.5 Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary

Velocity (m/s)

- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- 4.5 to 5.0
- > 5.0

Notes:

1:200,000

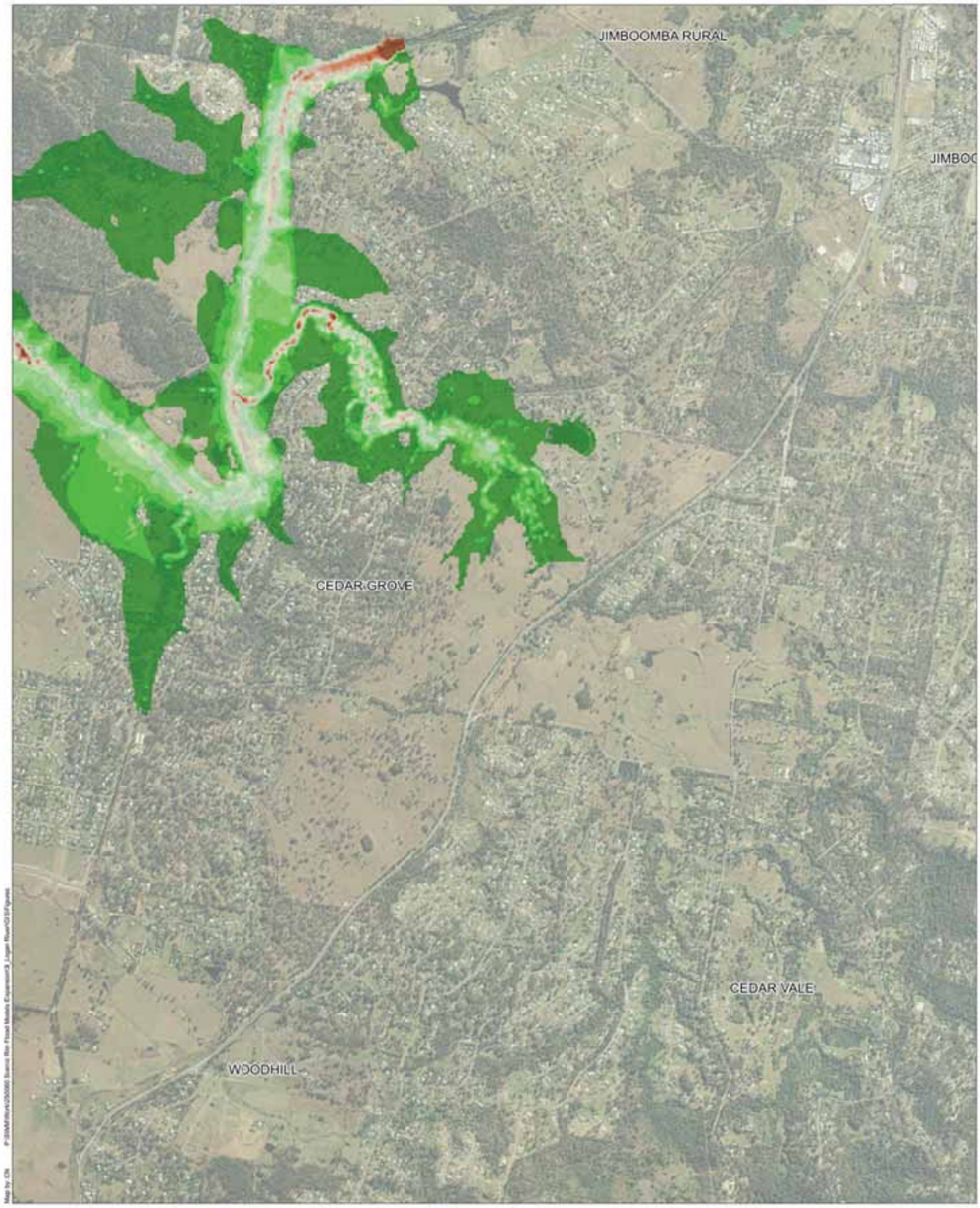
0 5,000 m 10,000 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B5**

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

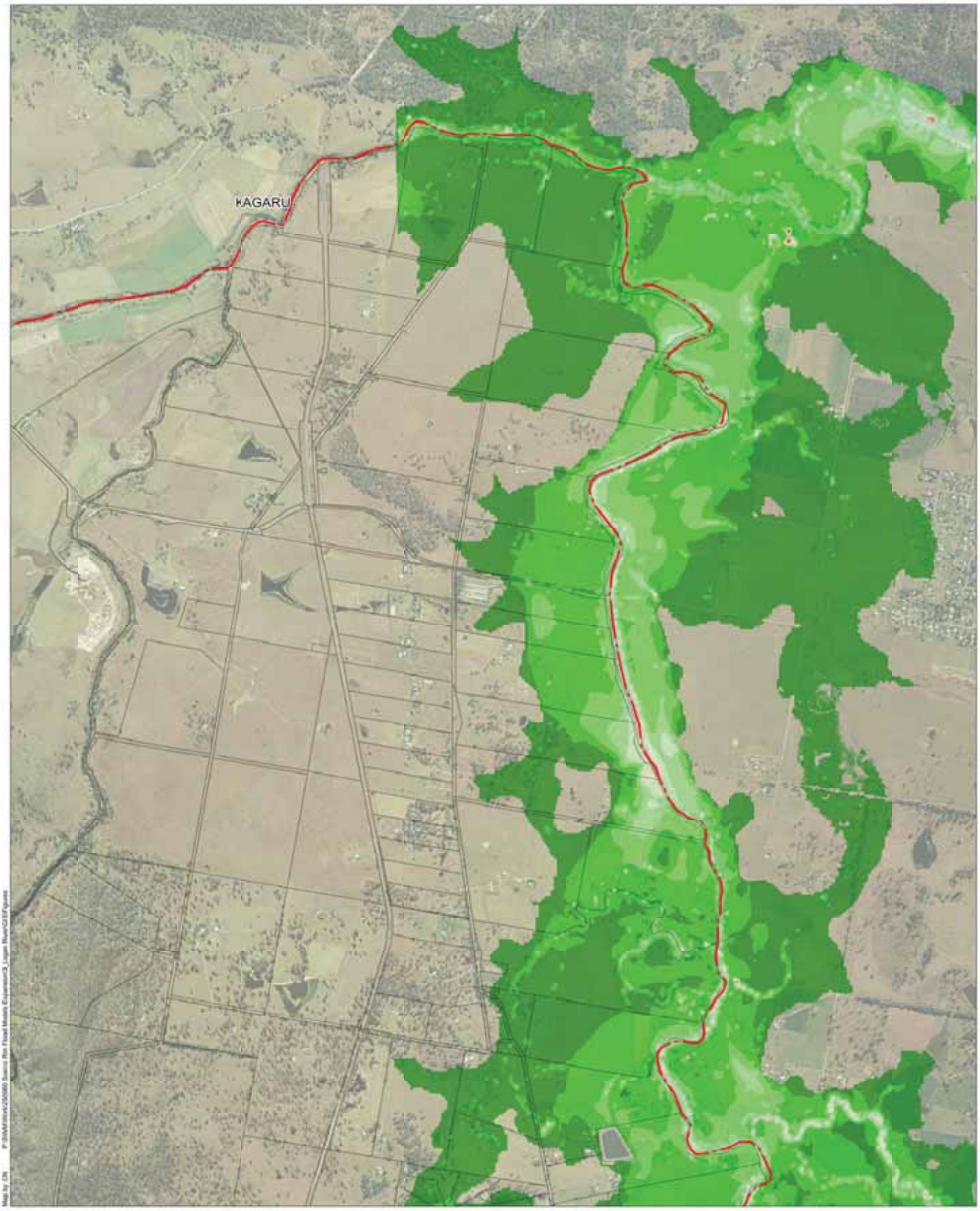
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B5-a

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

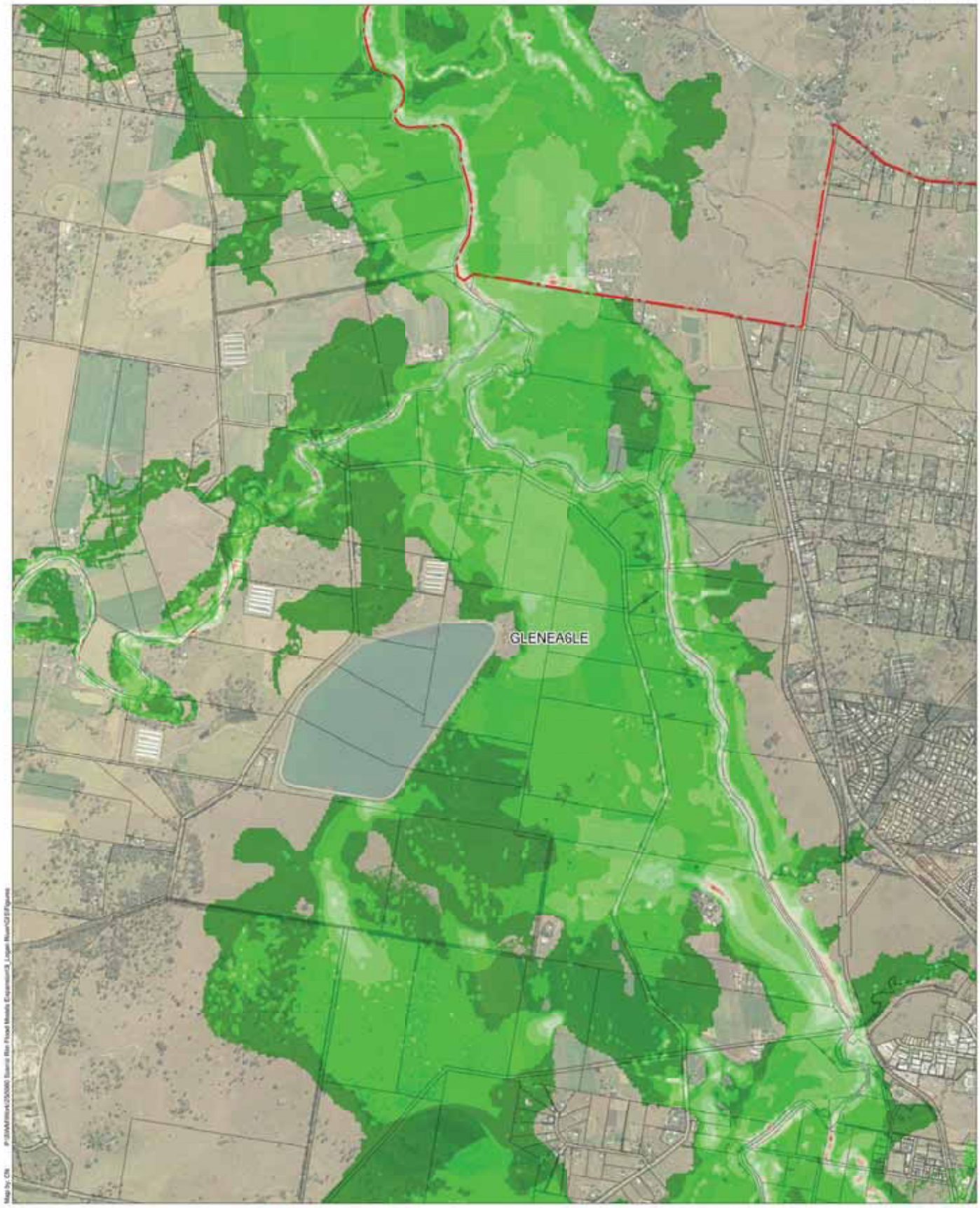
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-b

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

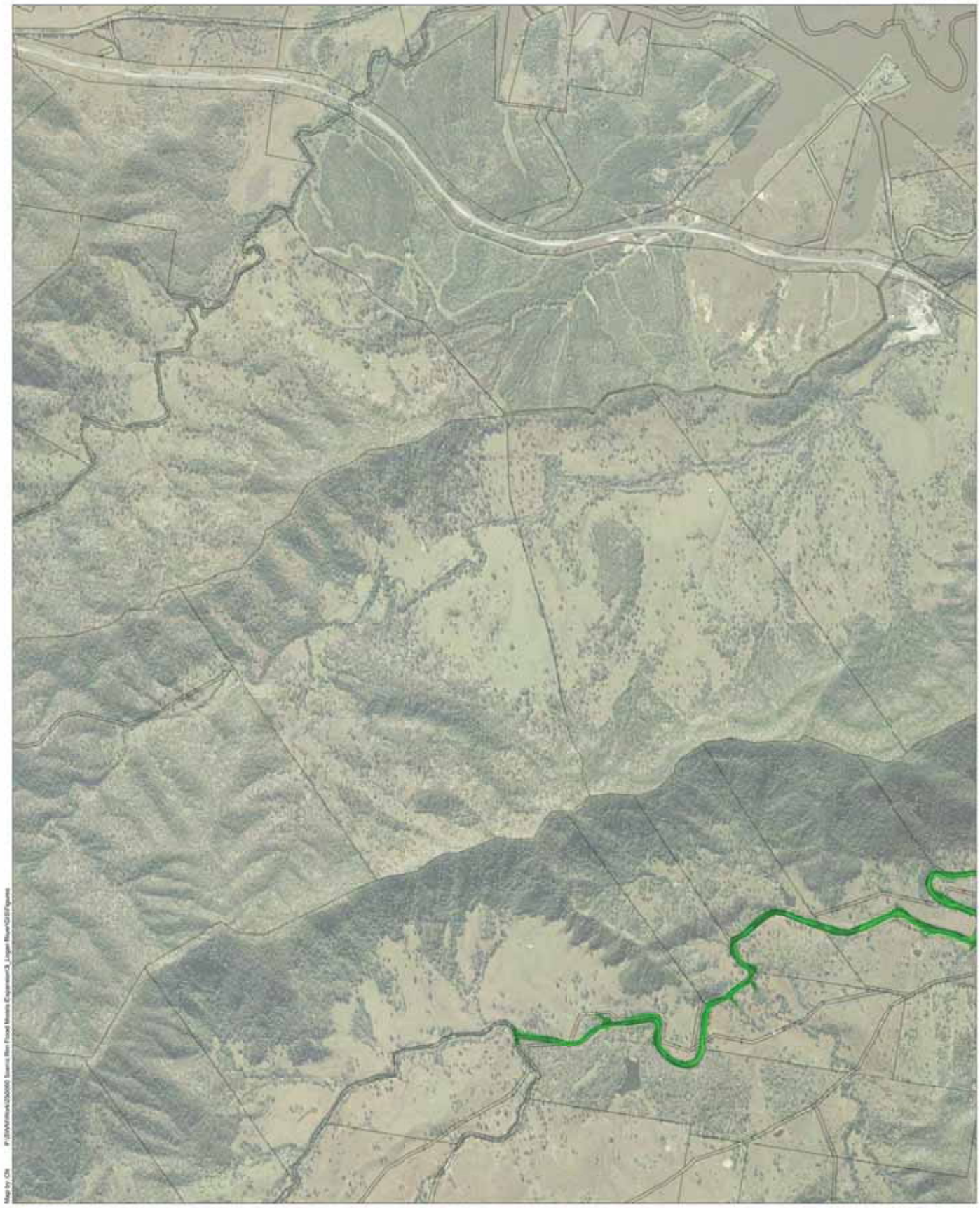
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-c

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

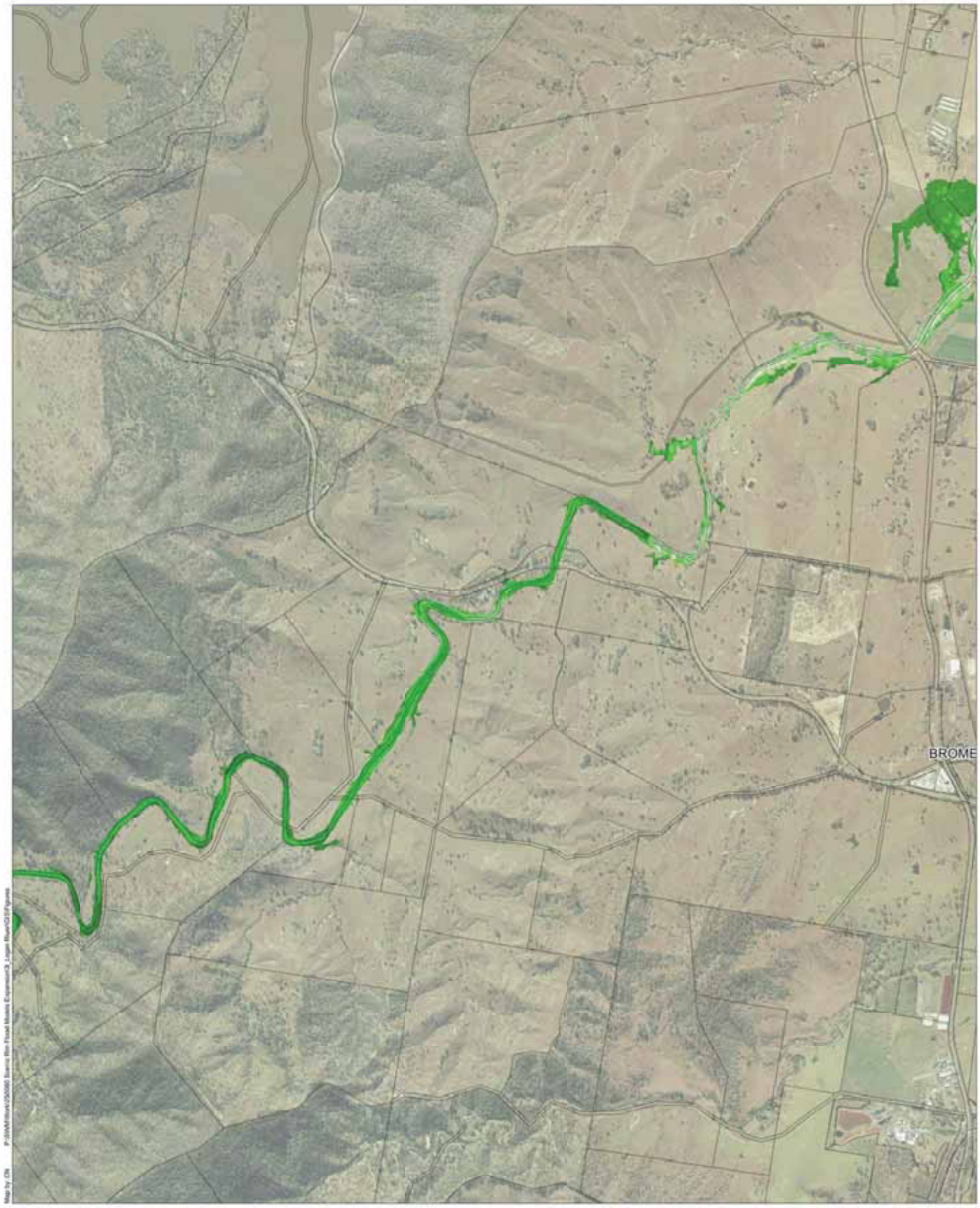
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-d

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- 4.5 to 5.0
- > 5.0

Notes:

1:25,000

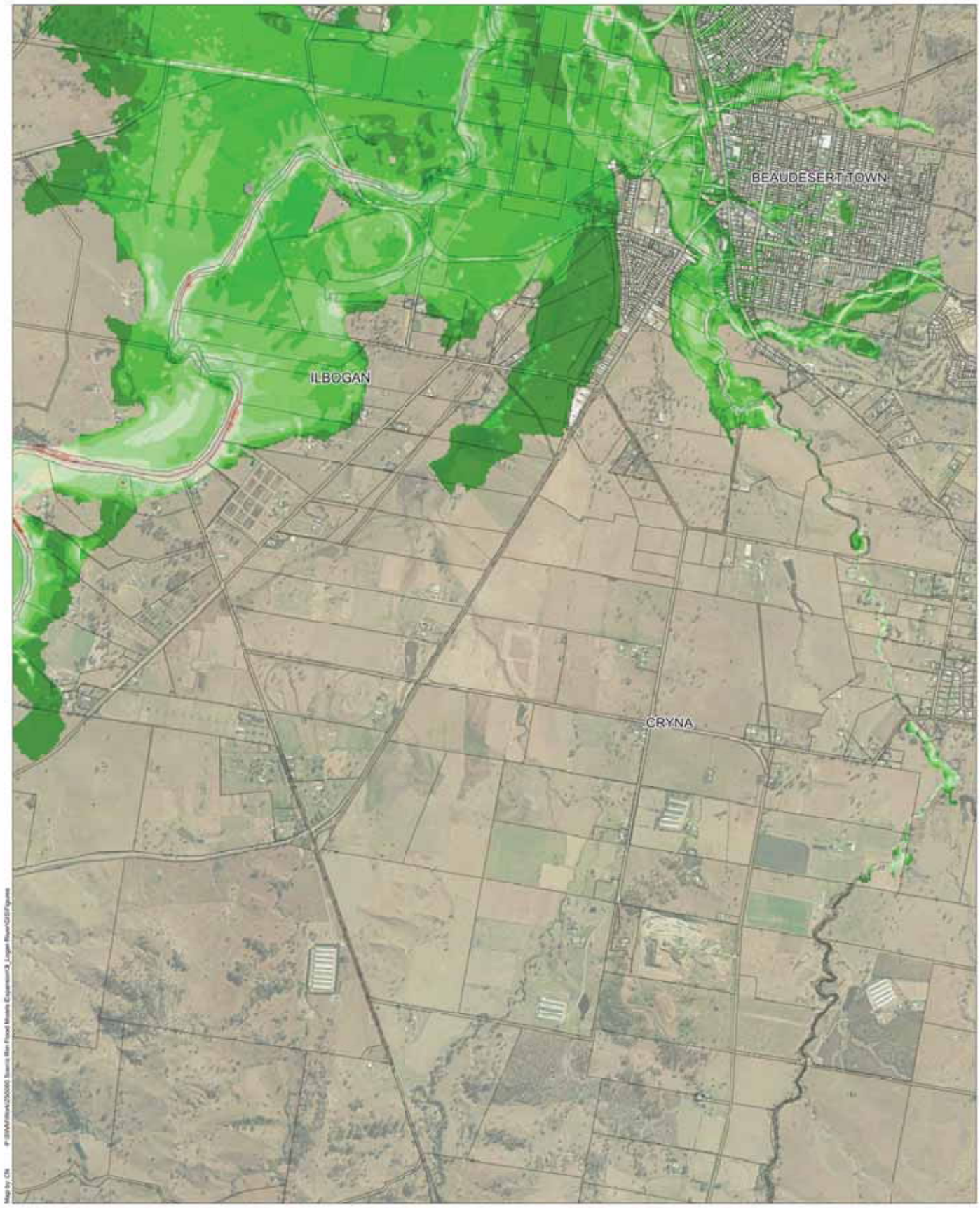
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study **Figure B5-e**

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

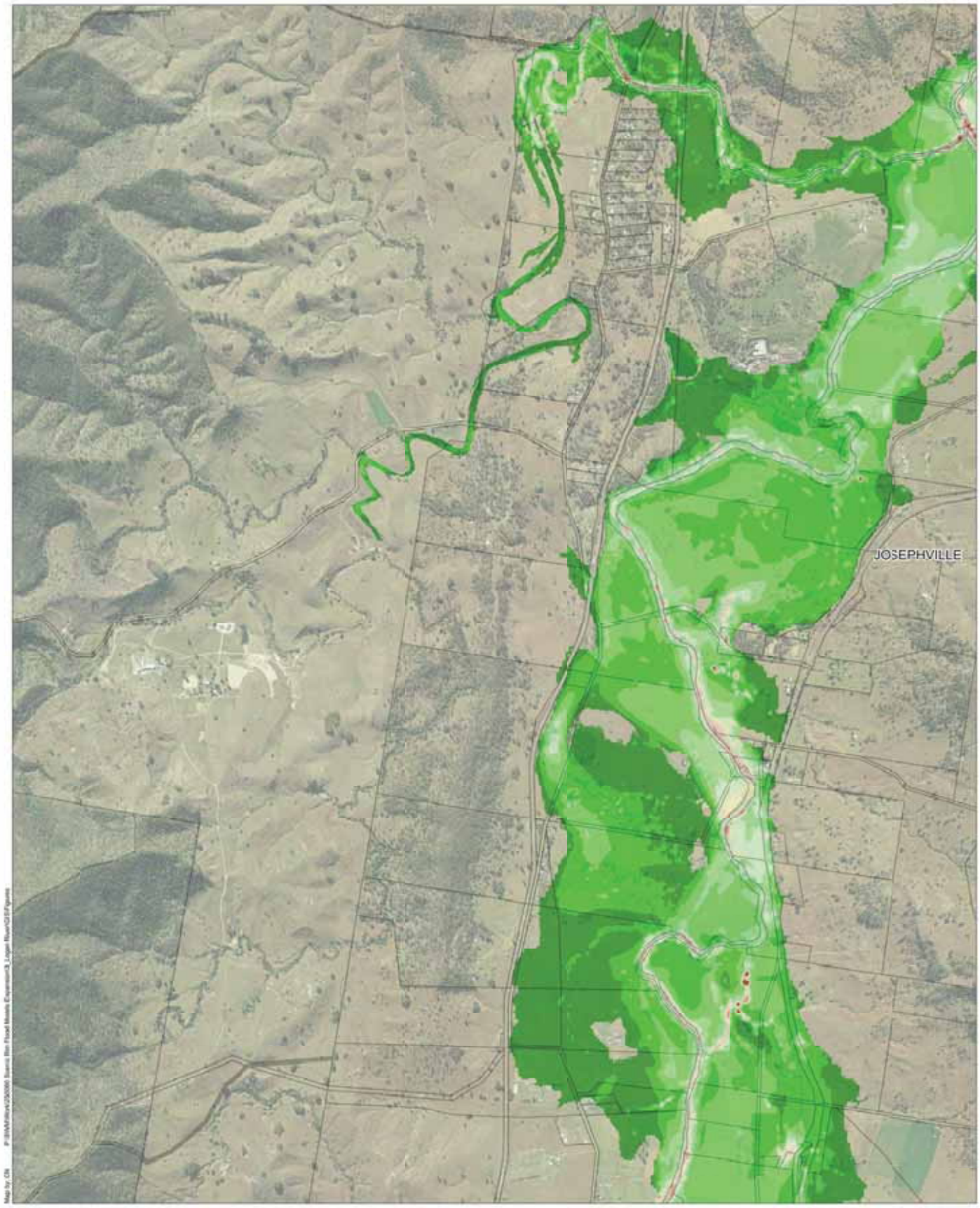
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B5-f**

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

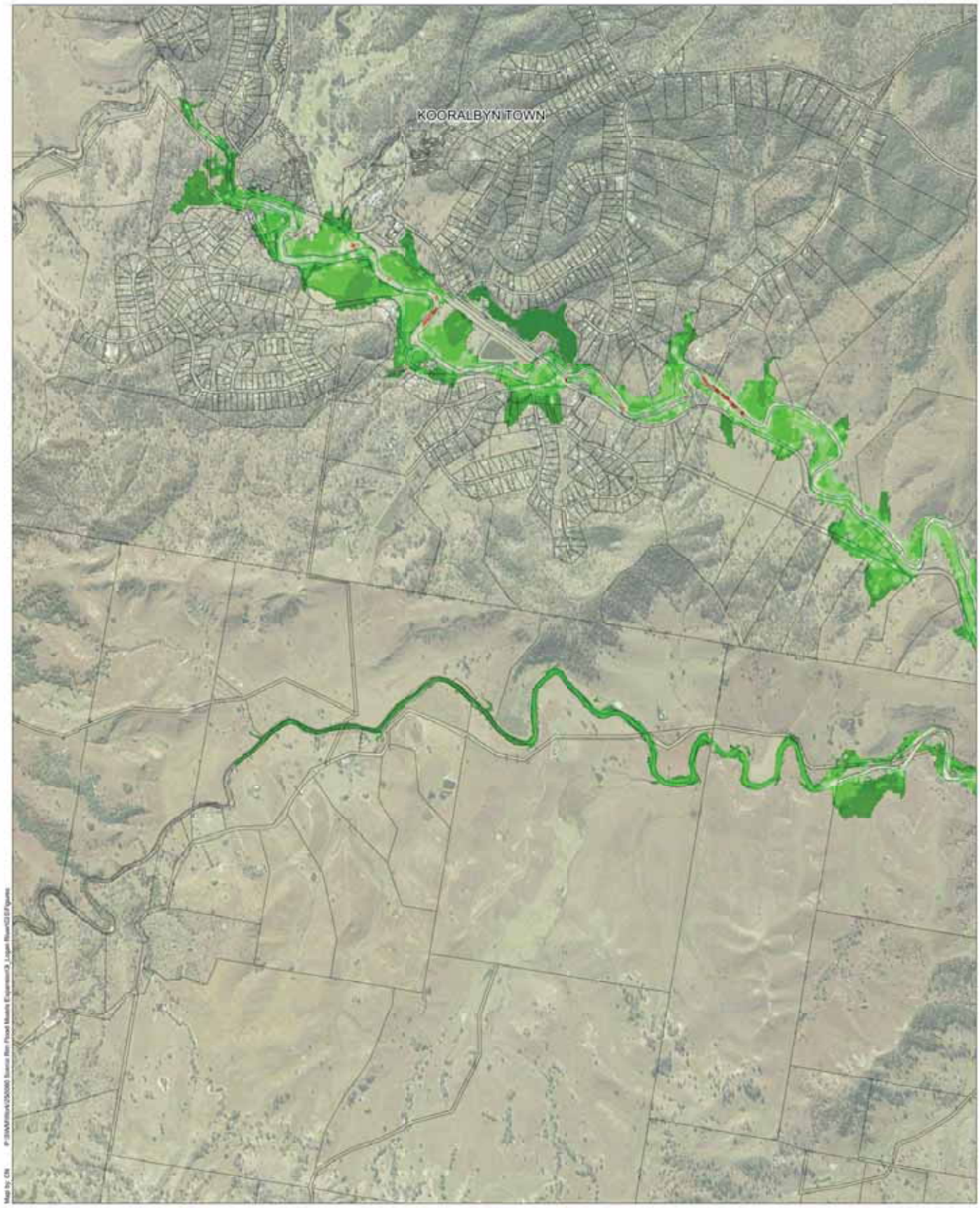
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B5-g

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

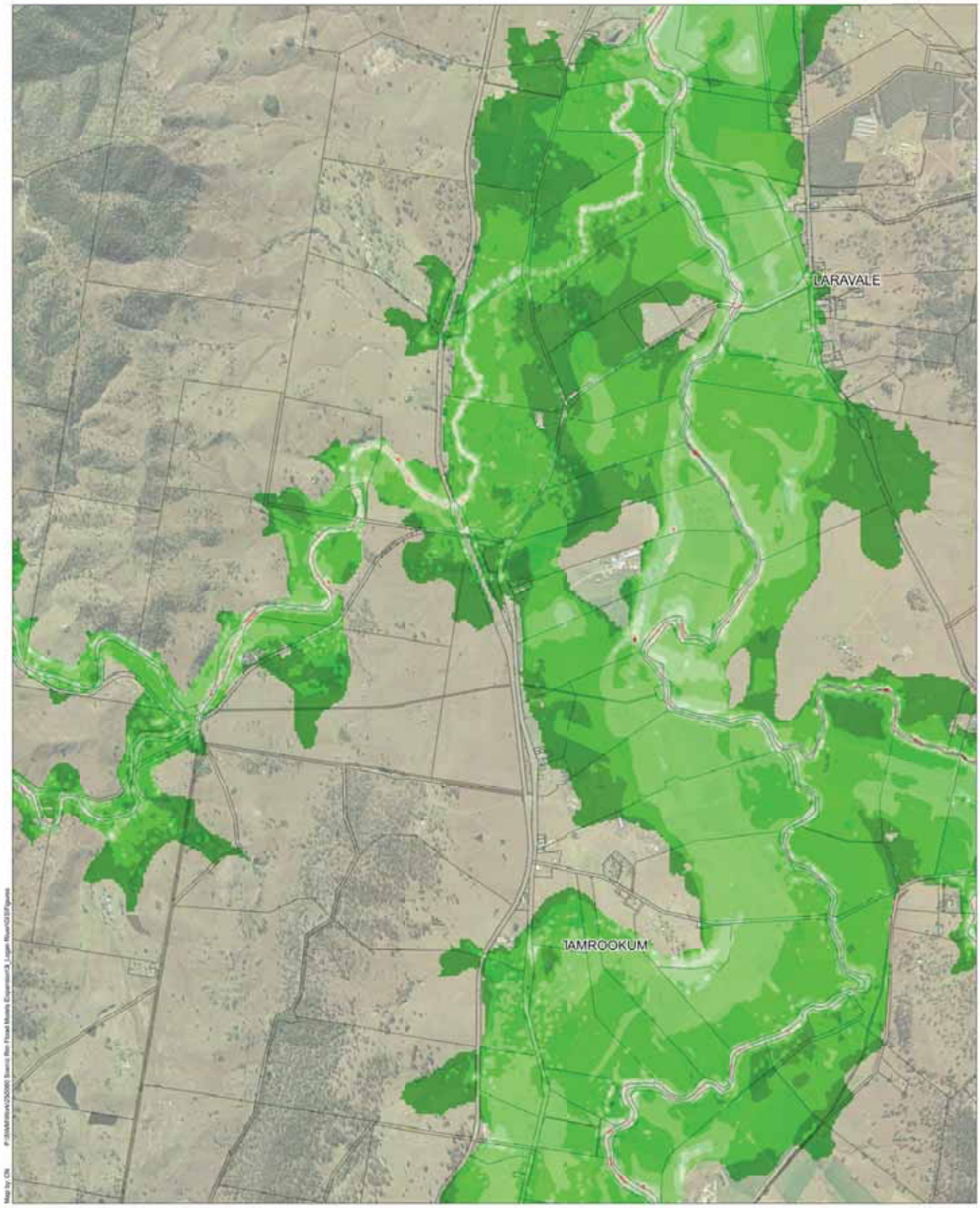
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-h

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

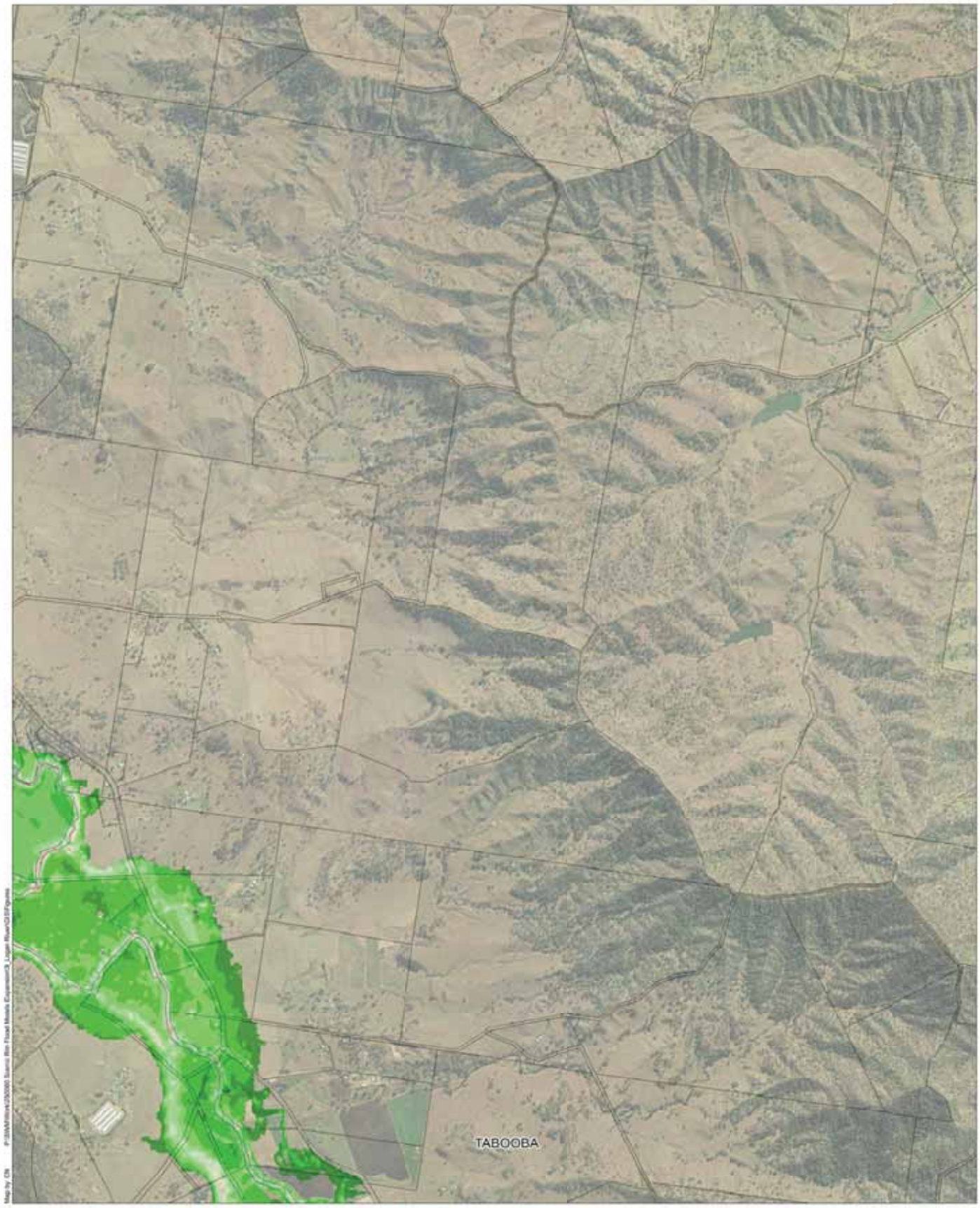
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B5-i

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

0 625 m 1,250 m

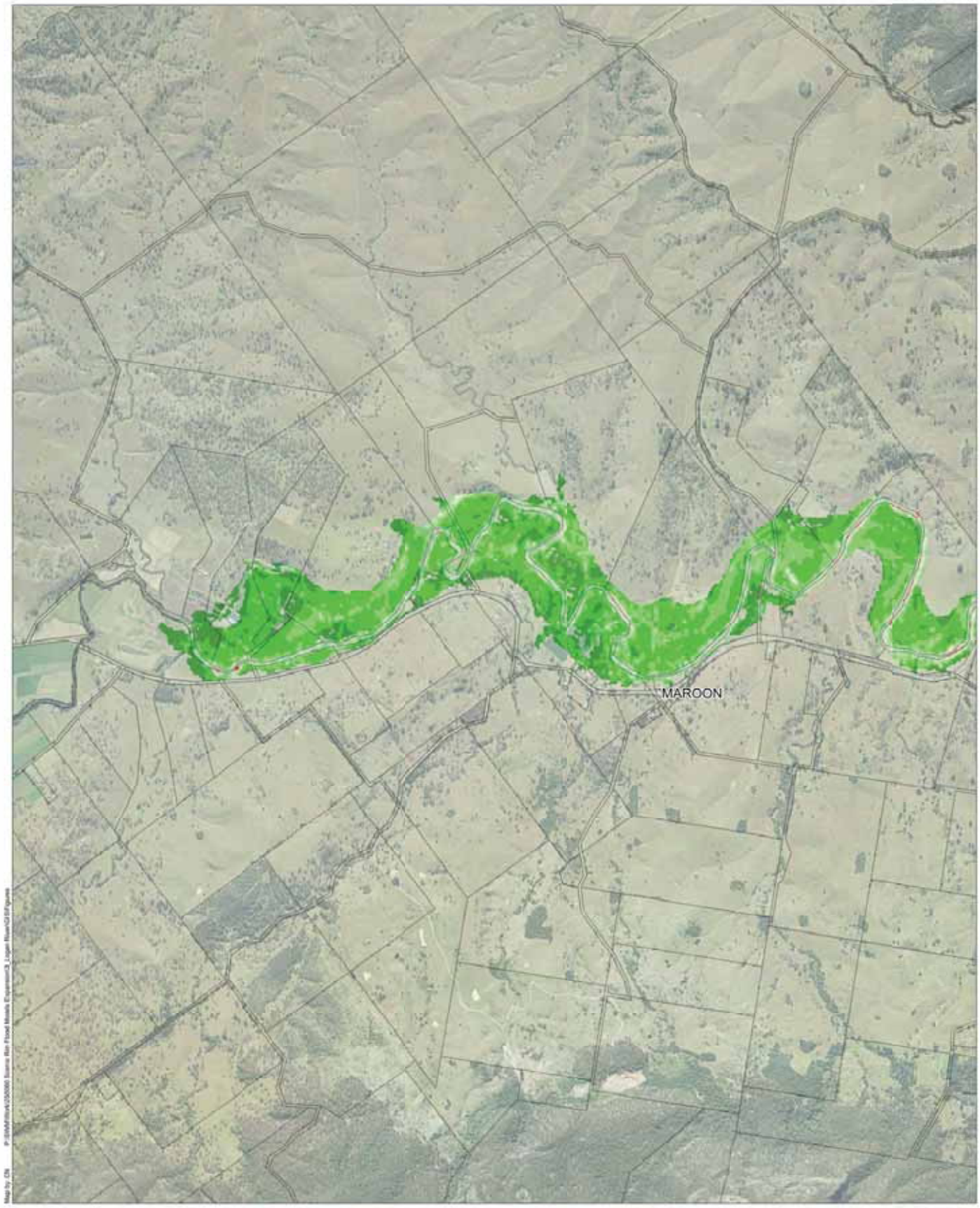
Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study Figure B5-j

1% AEP Event - Climate Change Scenario 4.5 Climate Change Scenario

4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- 4.5 to 5.0
- > 5.0

Notes:

1:25,000

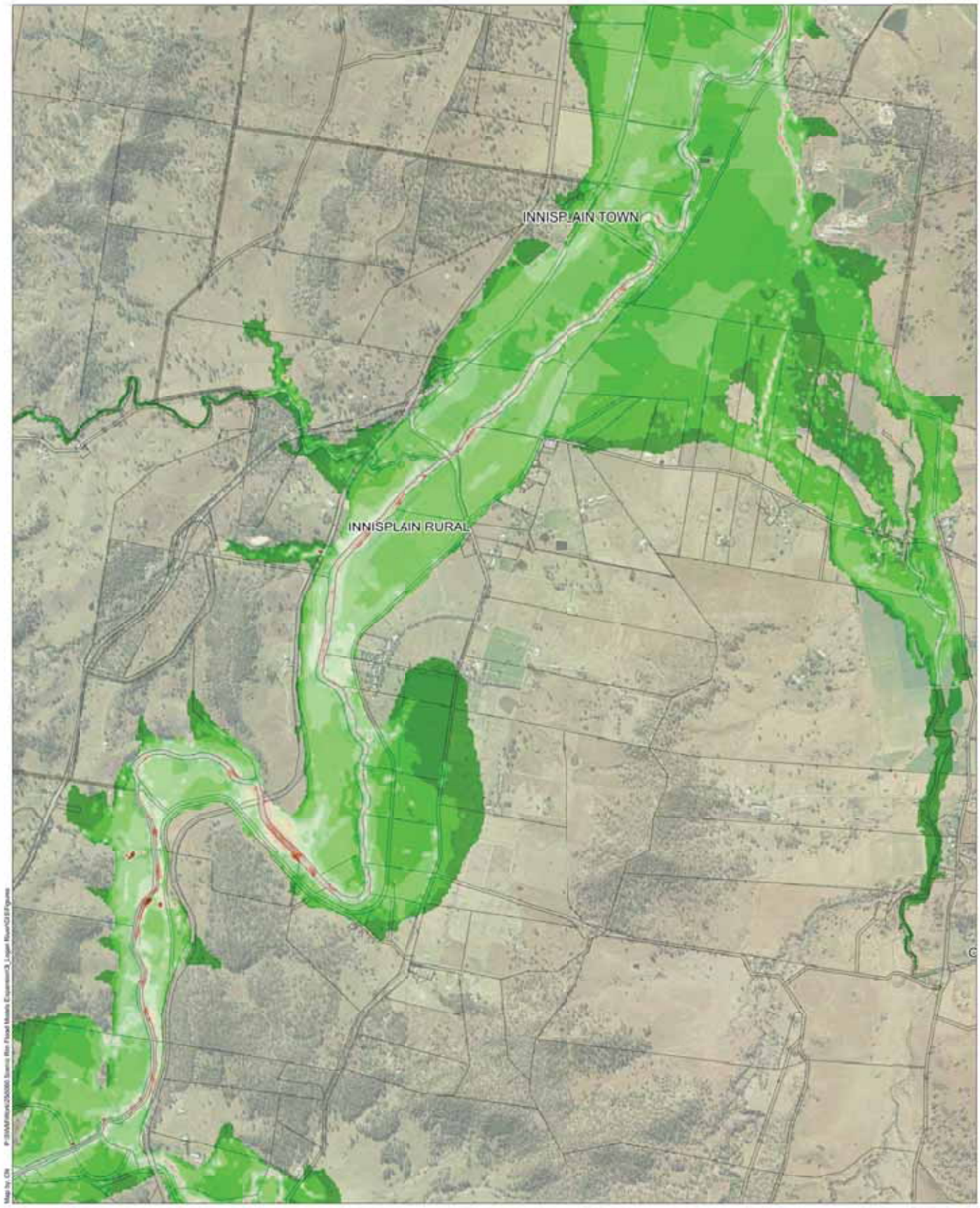
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study **Figure B5-k**

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-I

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities

Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

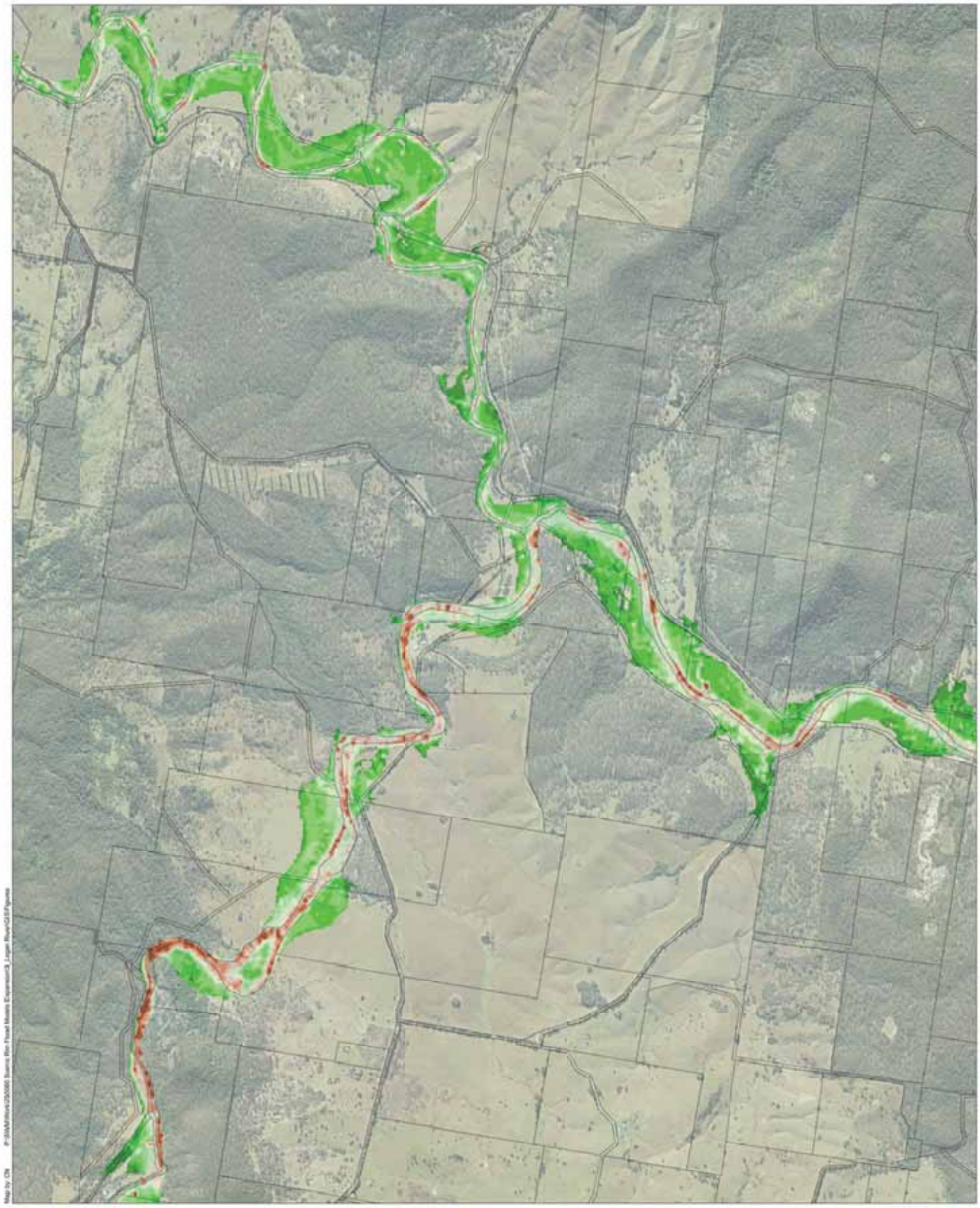
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-m

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

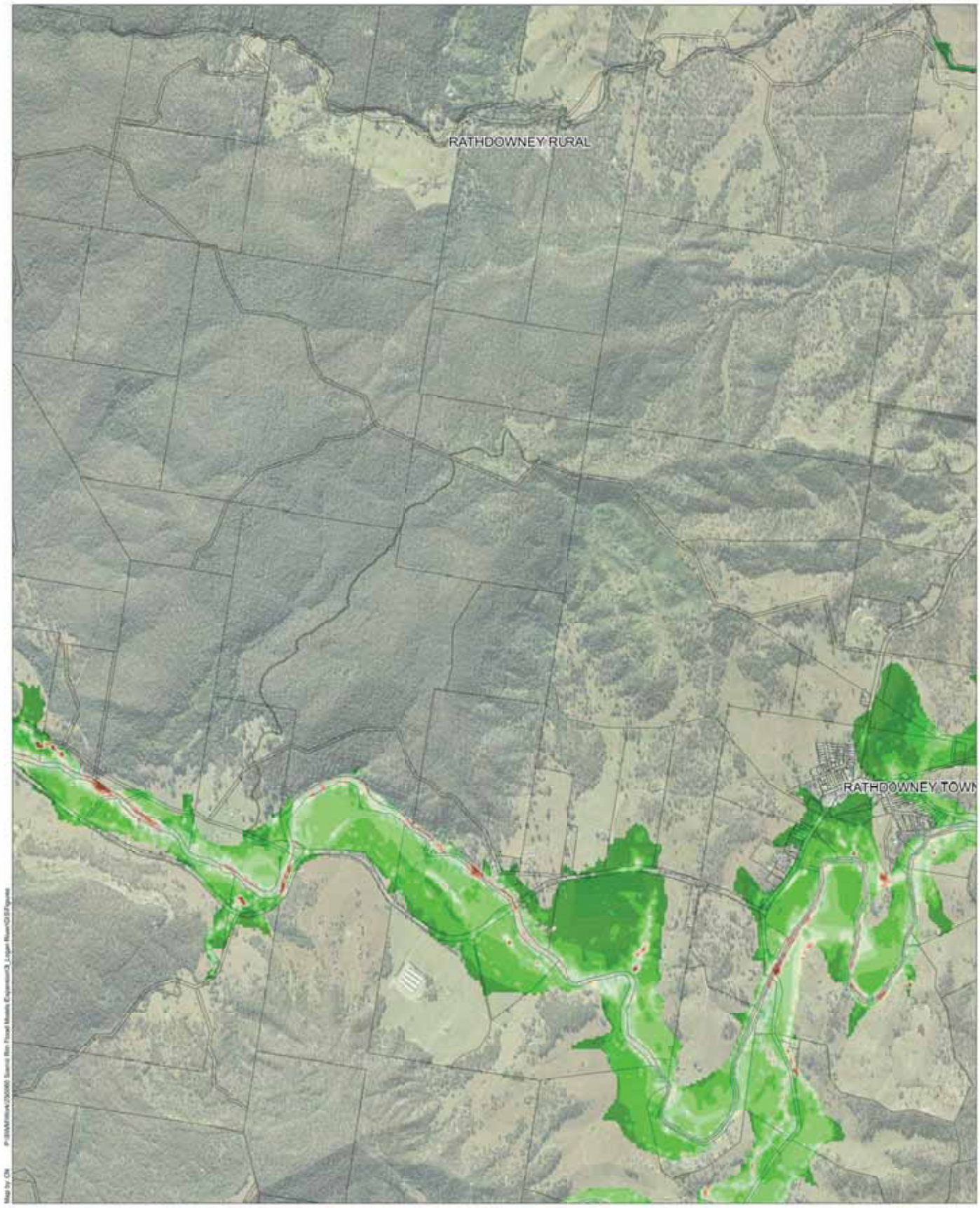
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study Figure B5-n

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

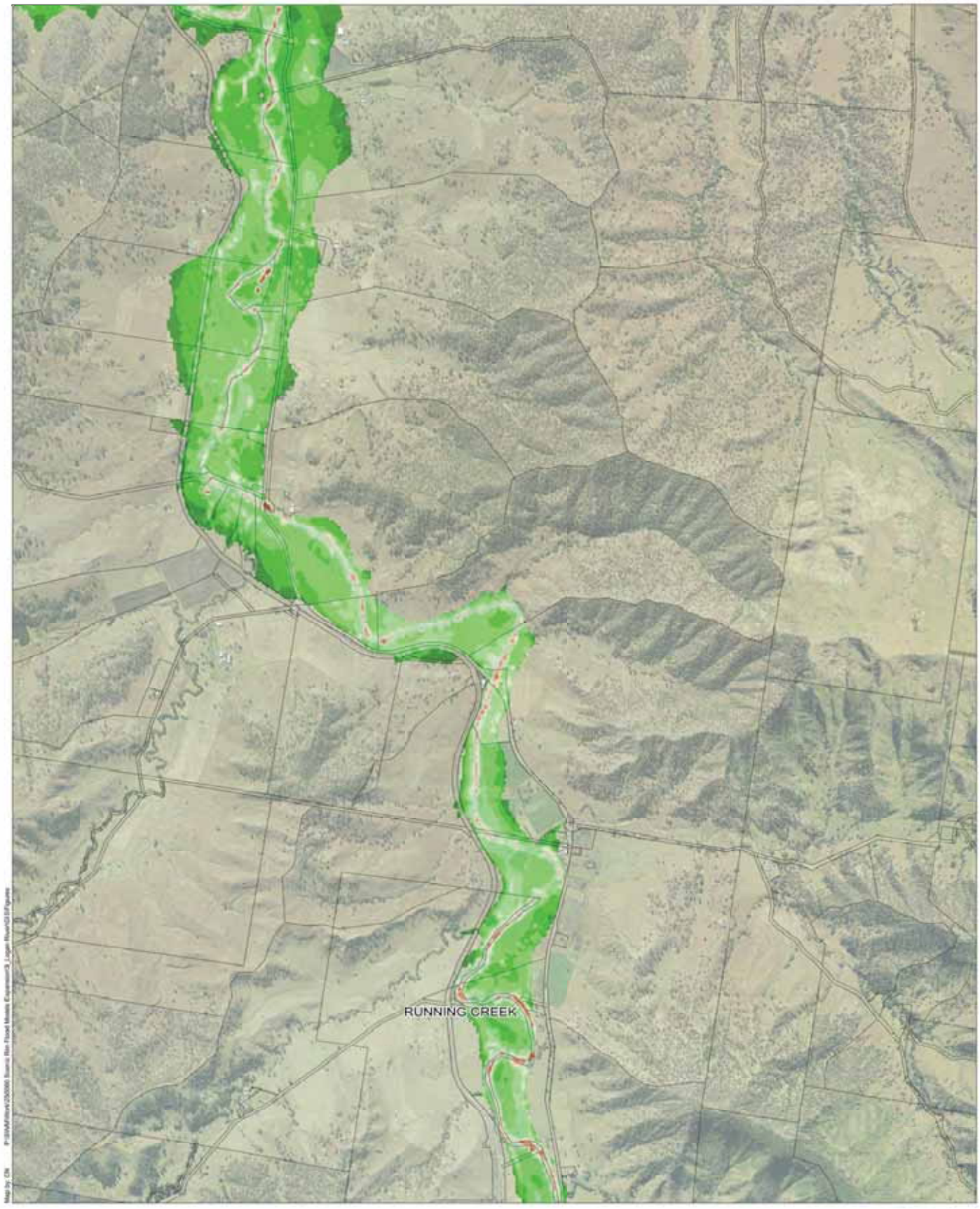
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study **Figure B5-o**

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

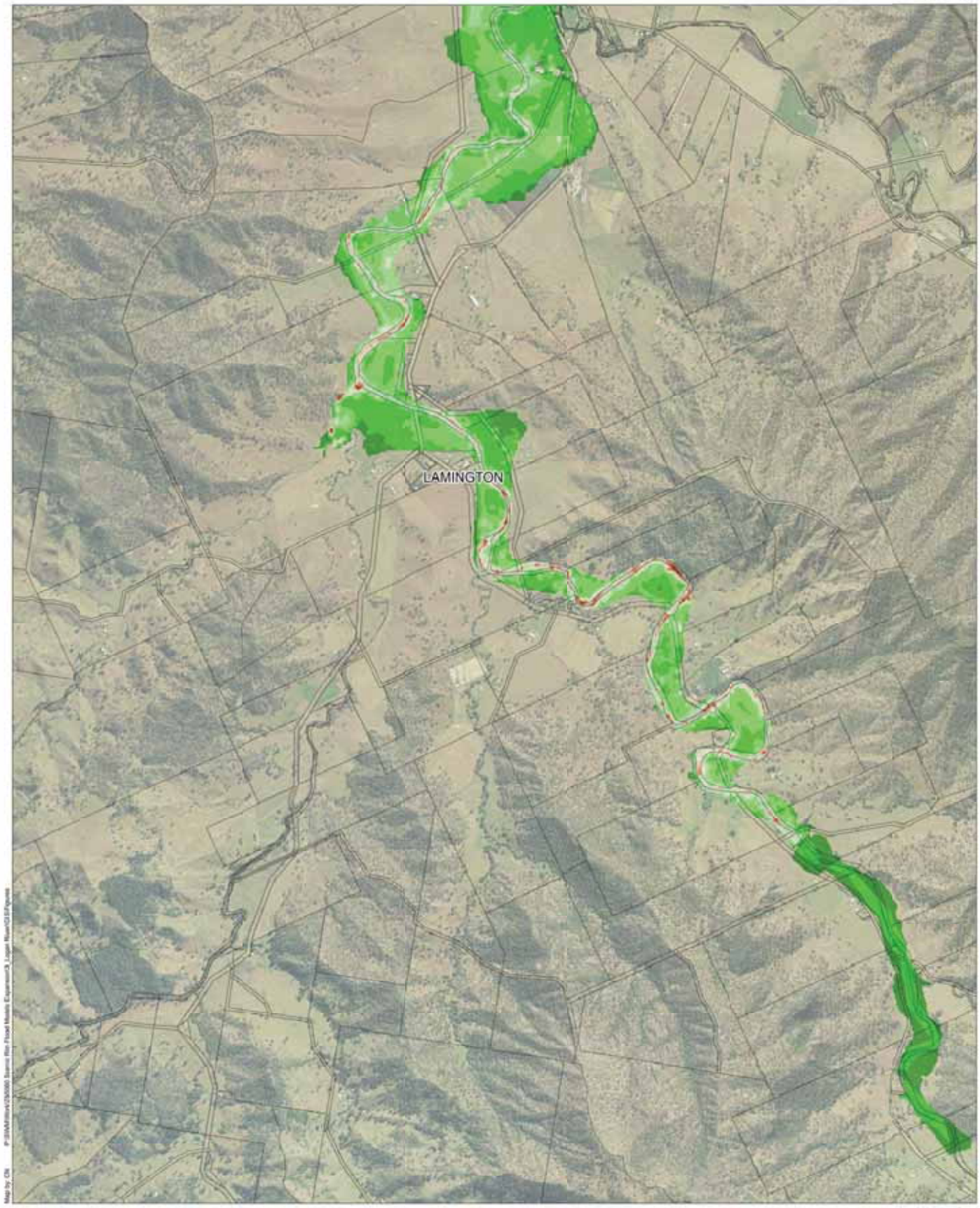
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study Figure B5-p

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

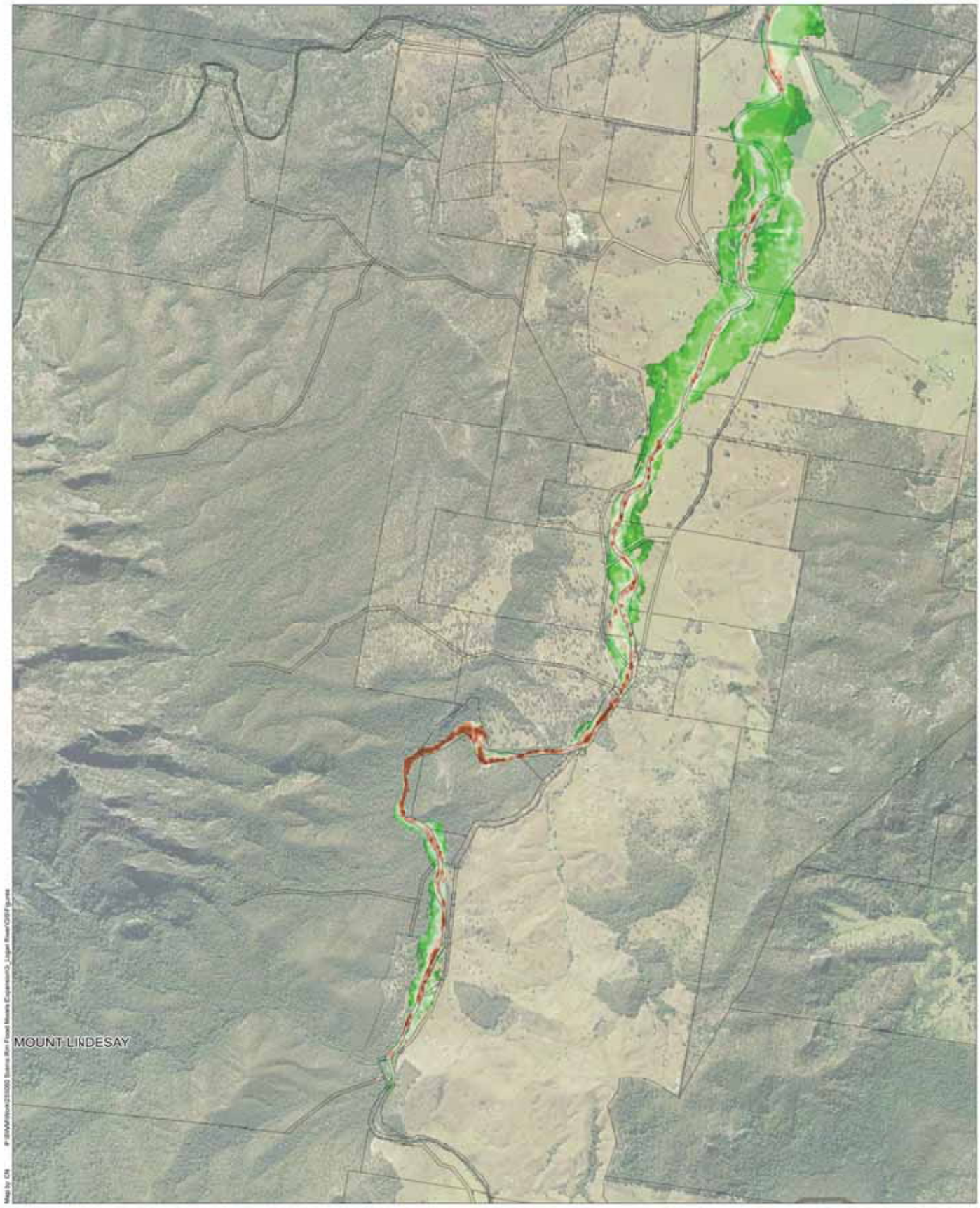
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B5-q

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

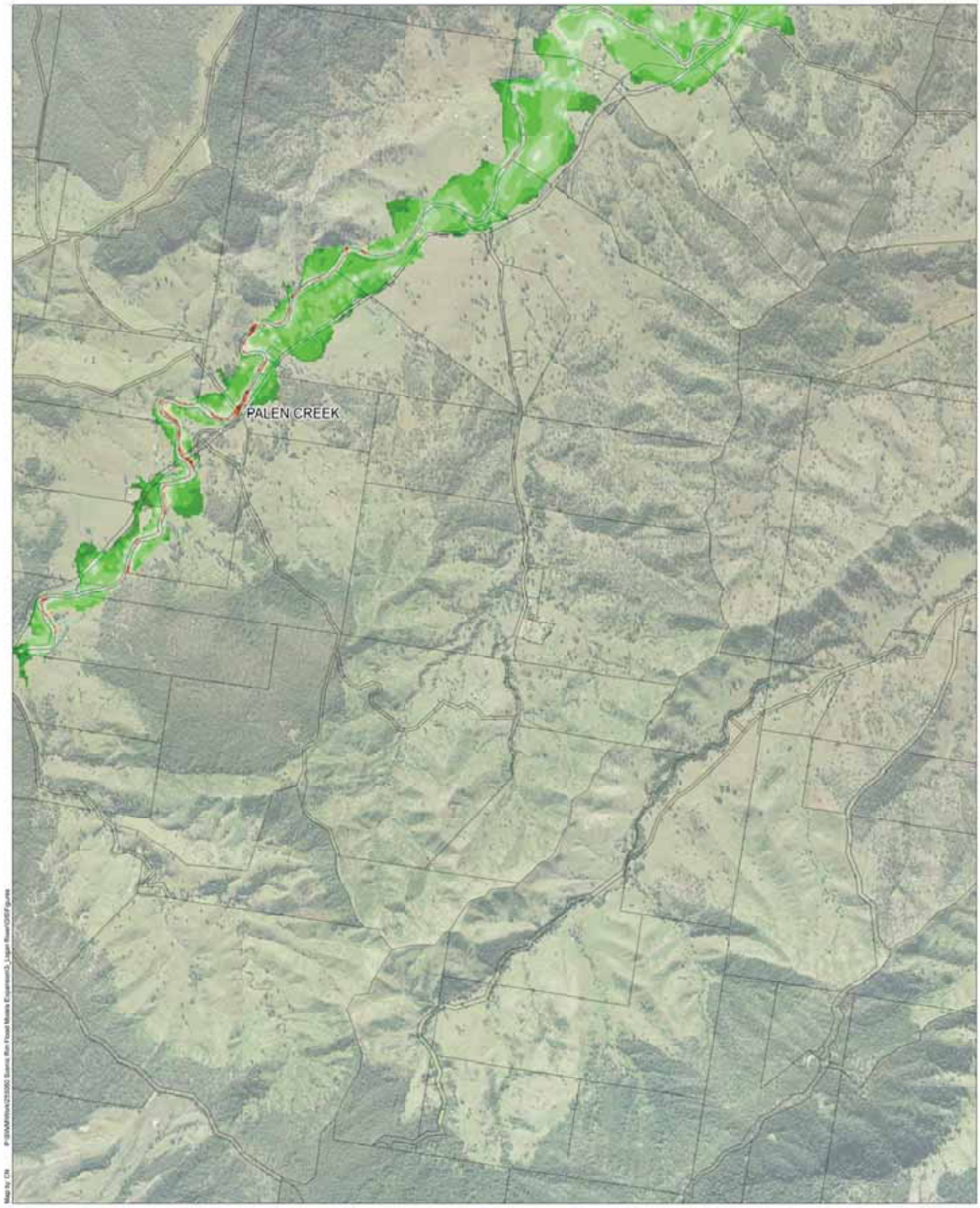
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-r

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

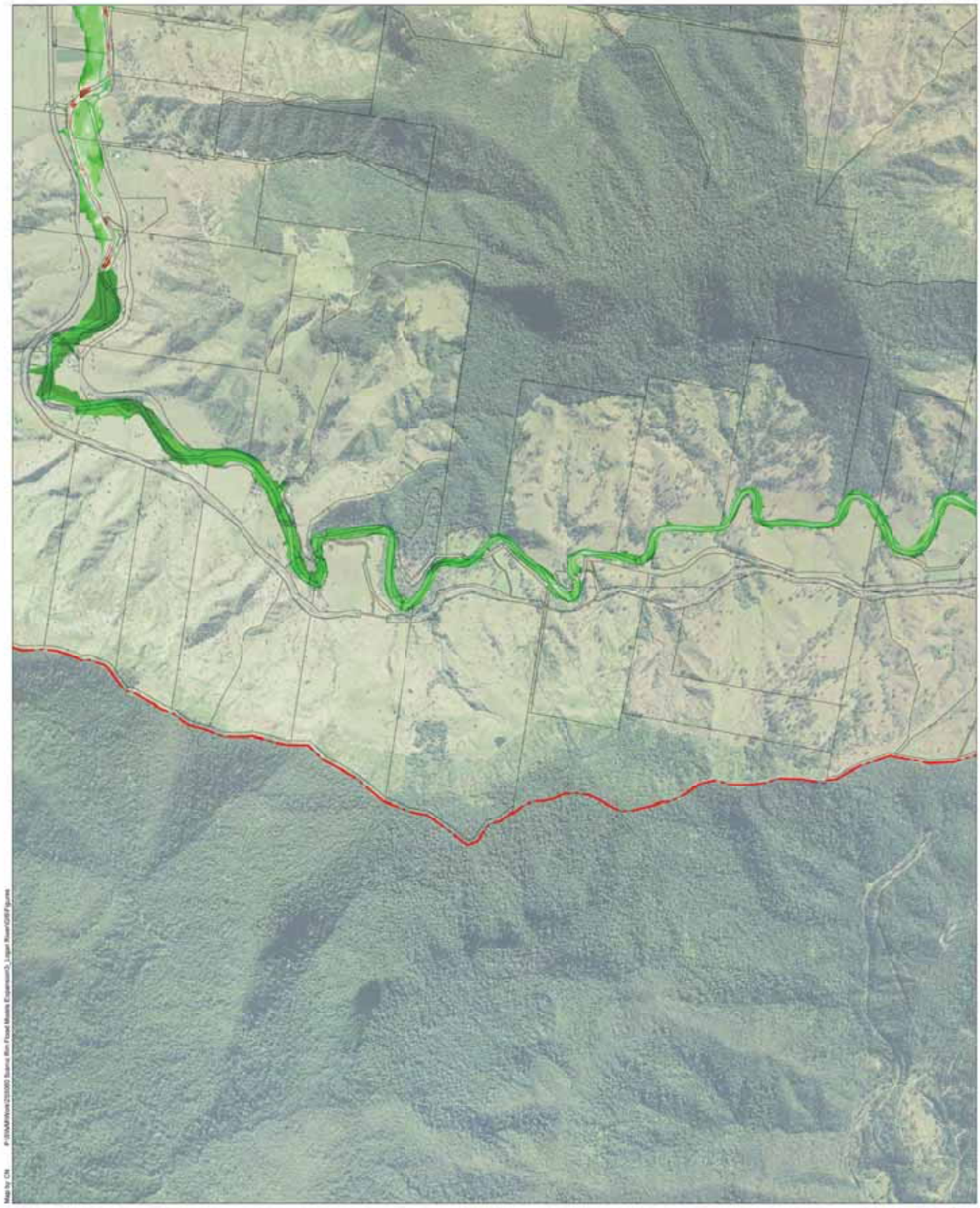
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-s

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

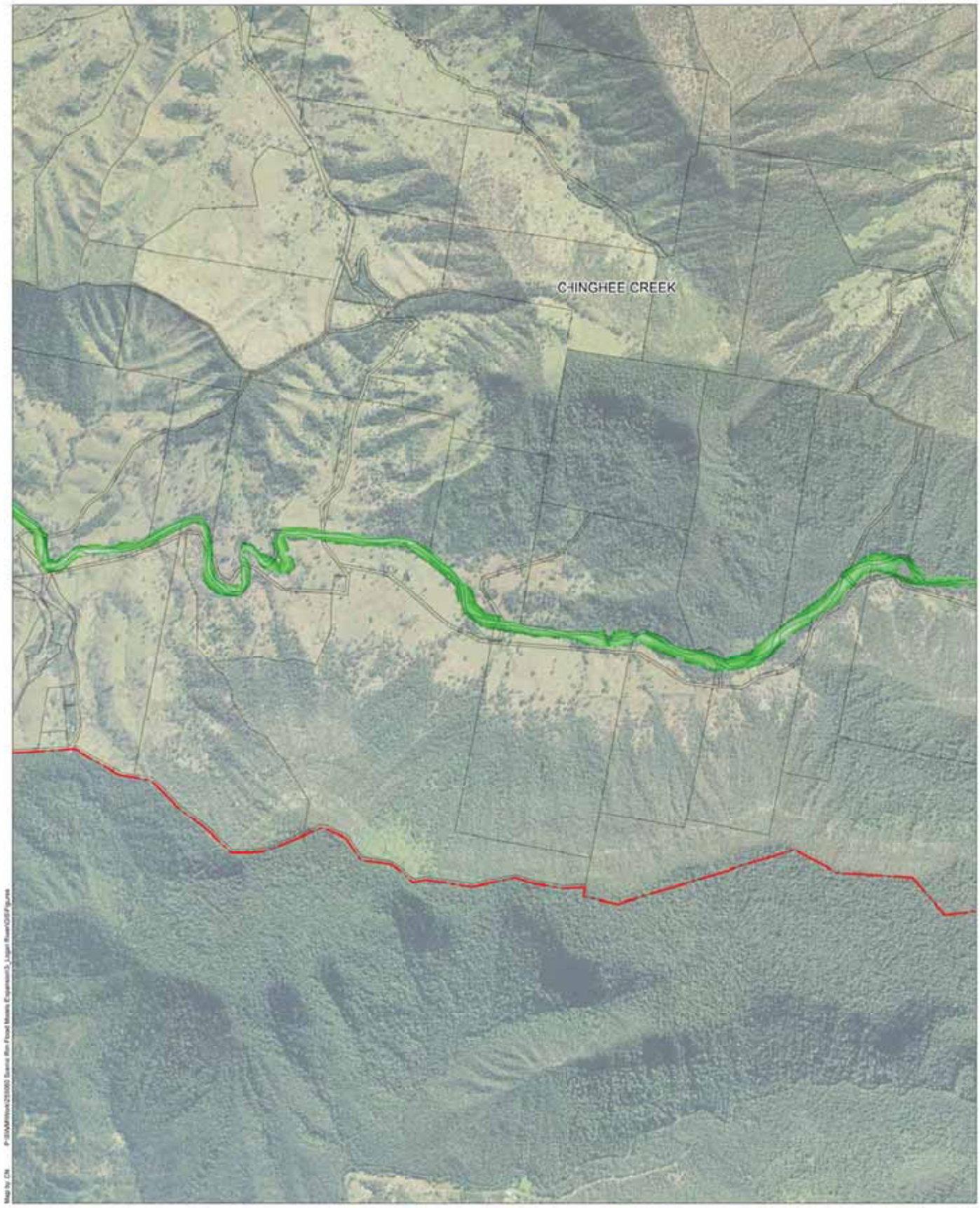
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-t

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

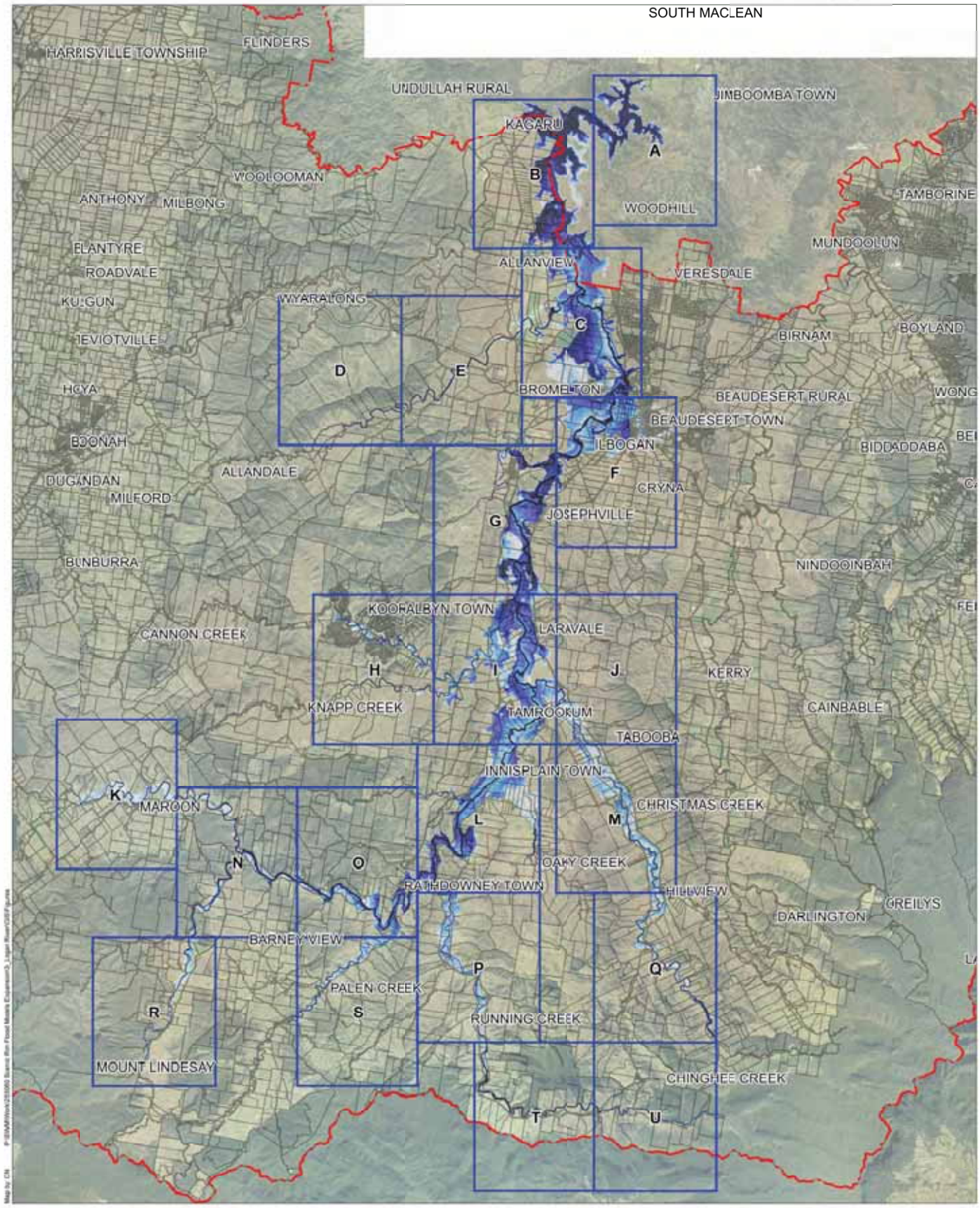
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B5-u

1% AEP Event - Climate Change Scenario 4.5 Peak Velocities



Legend

- SRRC Boundary
- Cadastral Boundary

Depth (m)

- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- 4.5 to 5.0
- > 5.0

Notes:

1:200,000

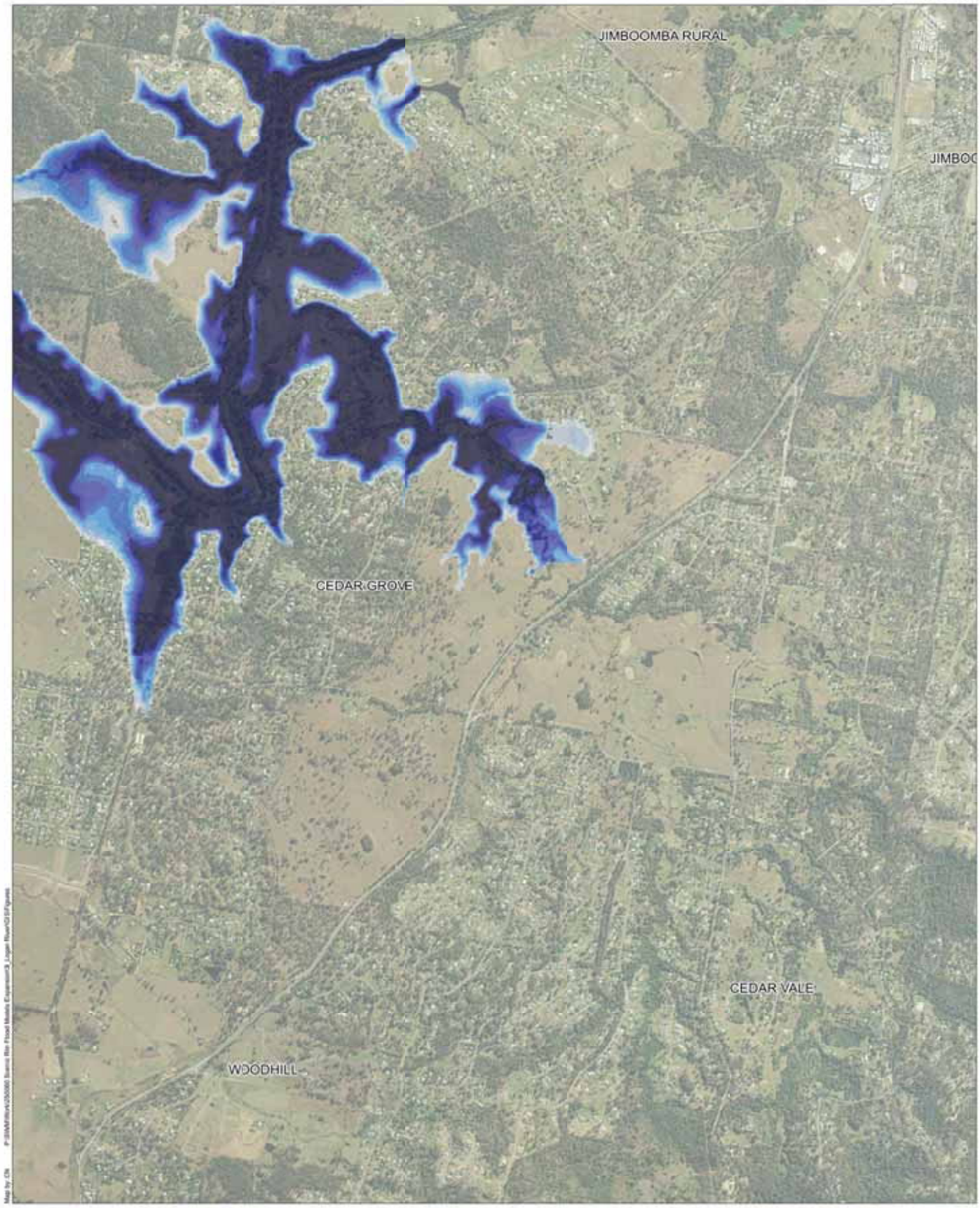
0 5,000 m 10,000 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B6

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

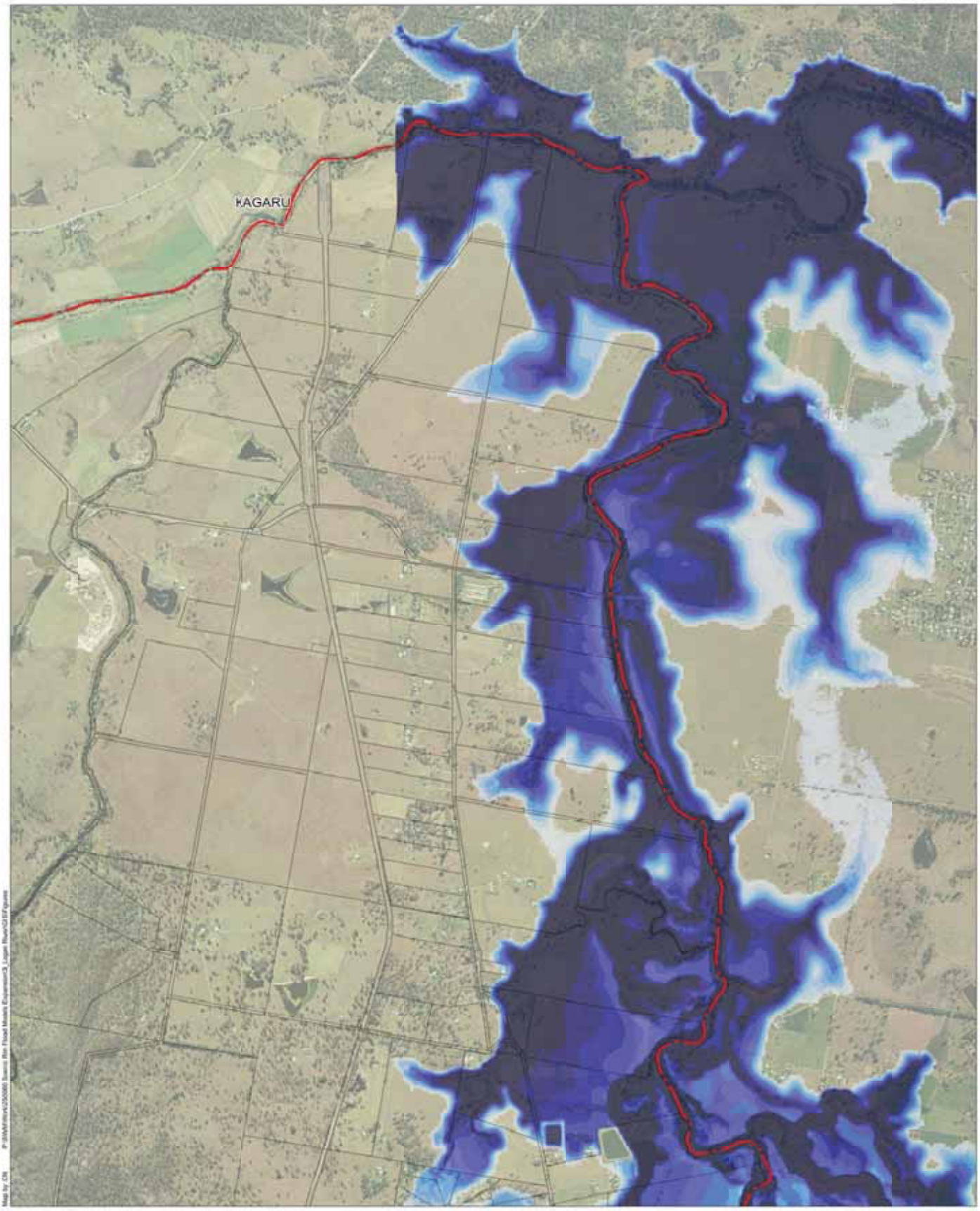
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-a

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

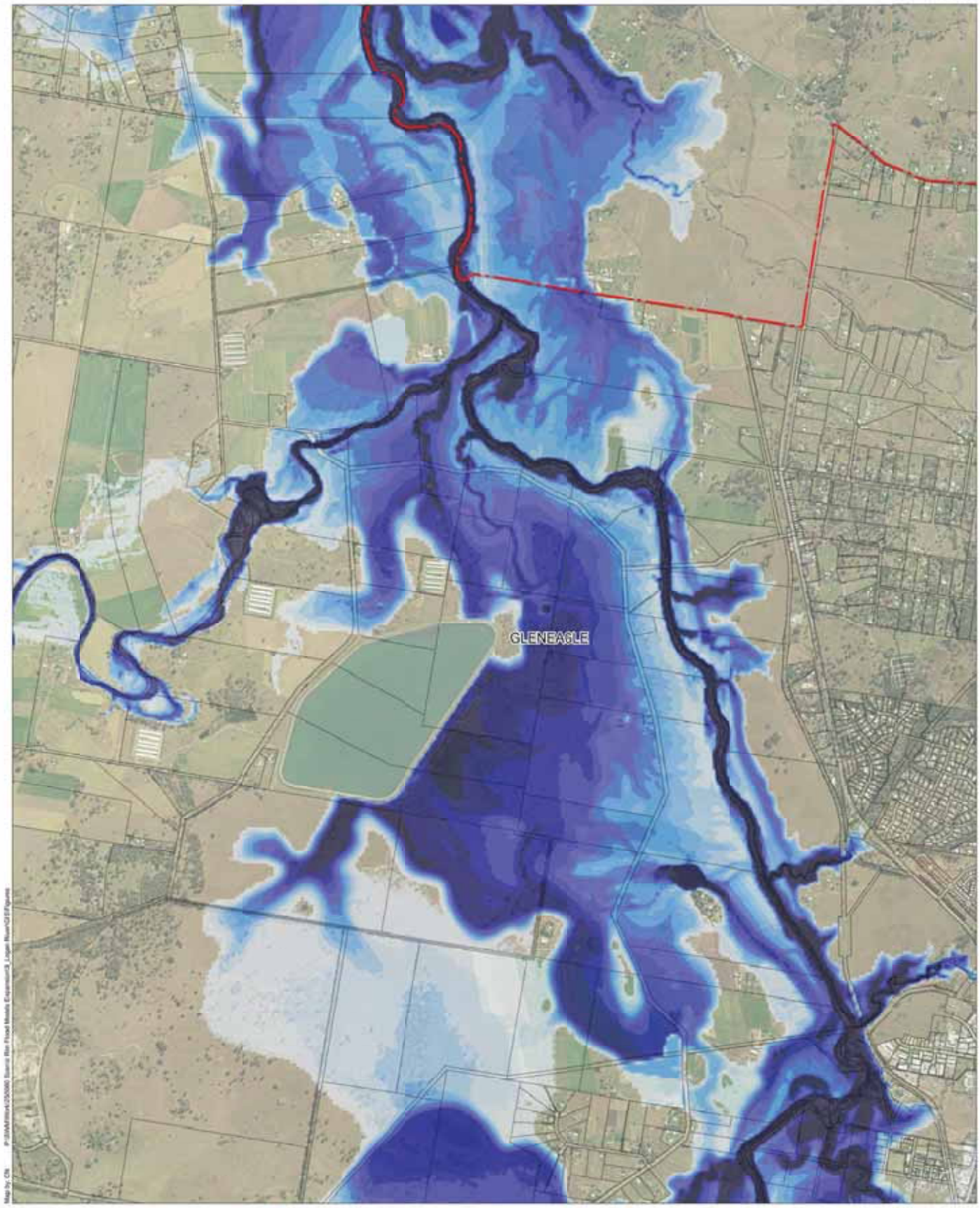
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study Figure B6-b

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

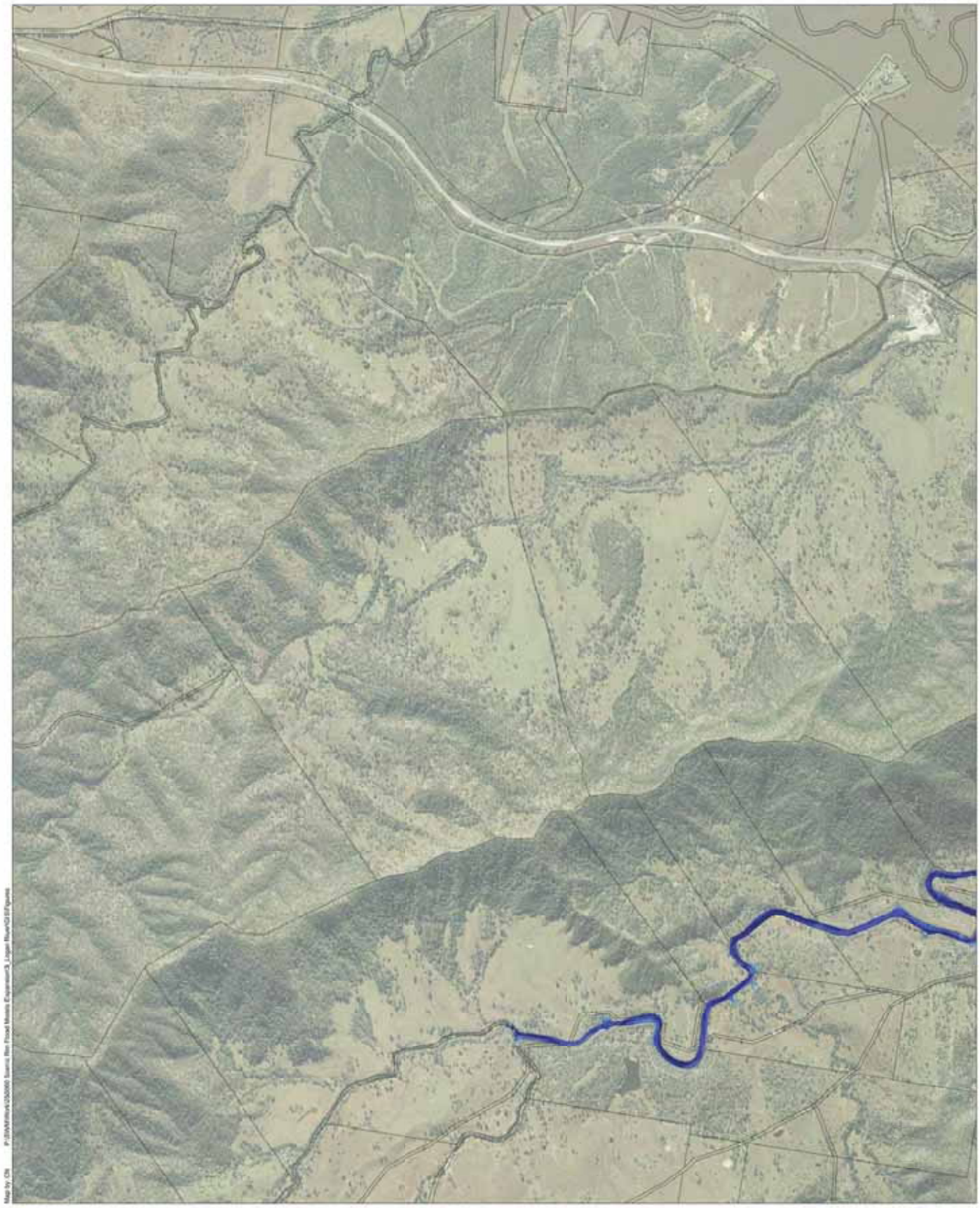
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-c

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

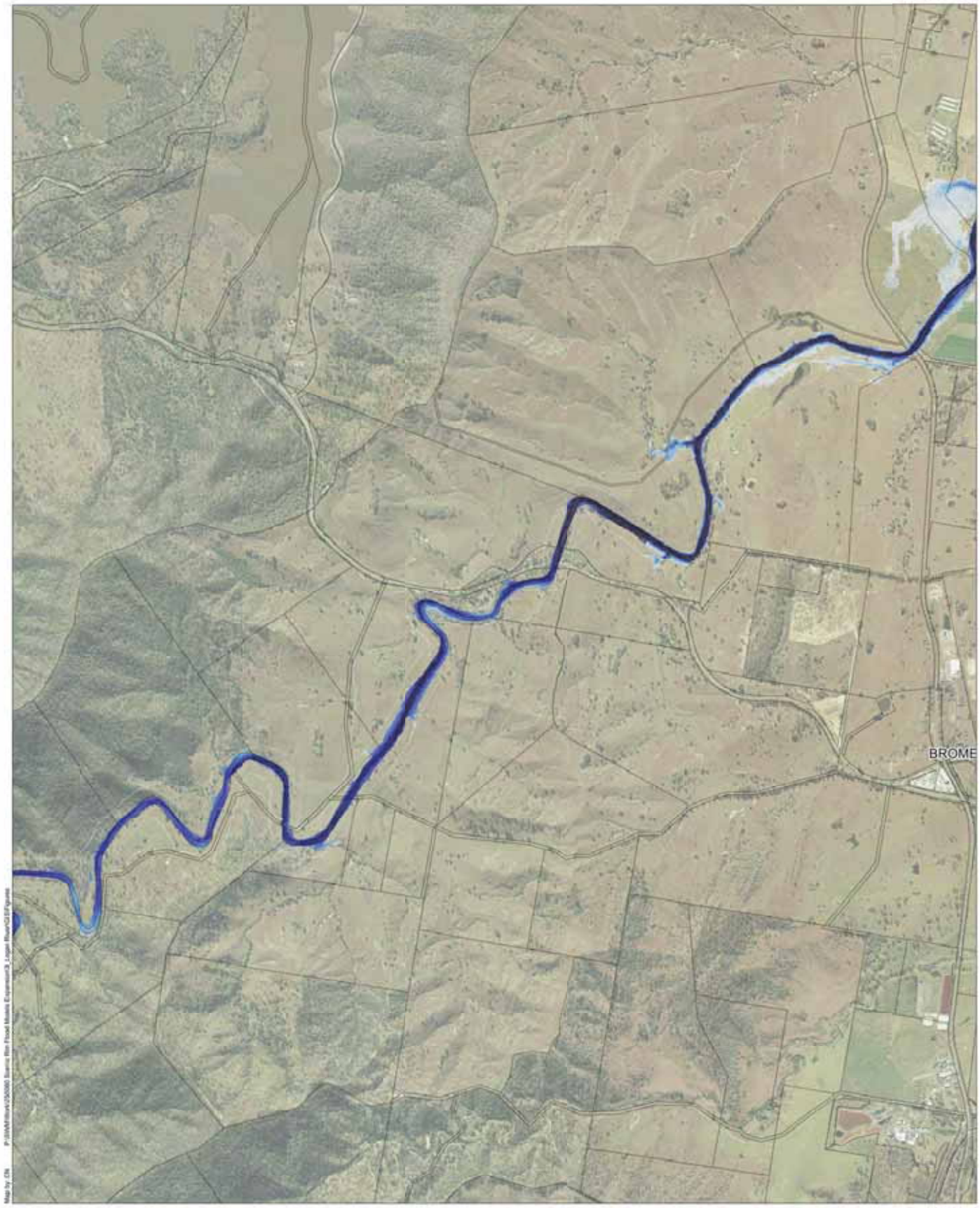
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study **Figure B6-d**

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

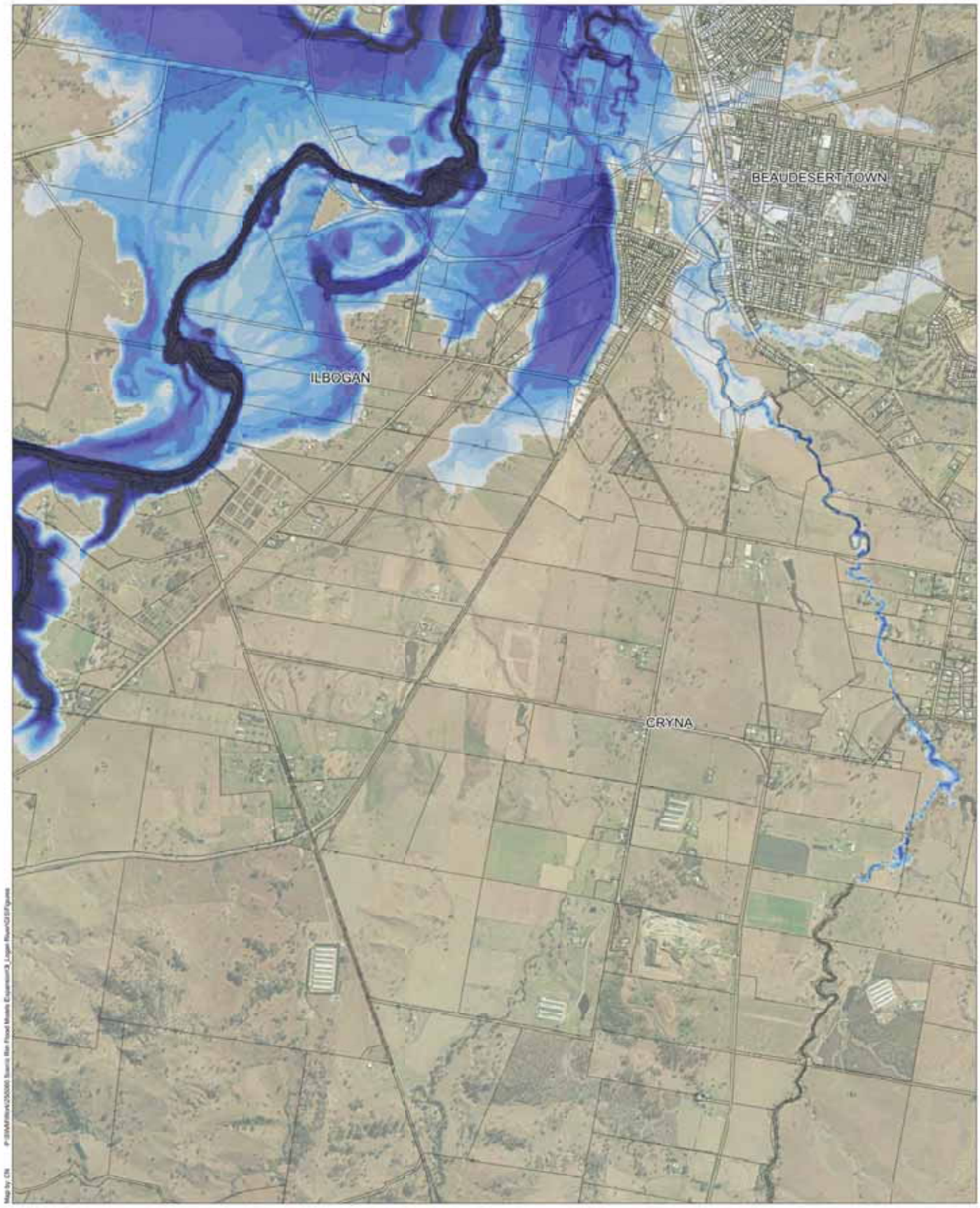
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study Figure B6-e

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

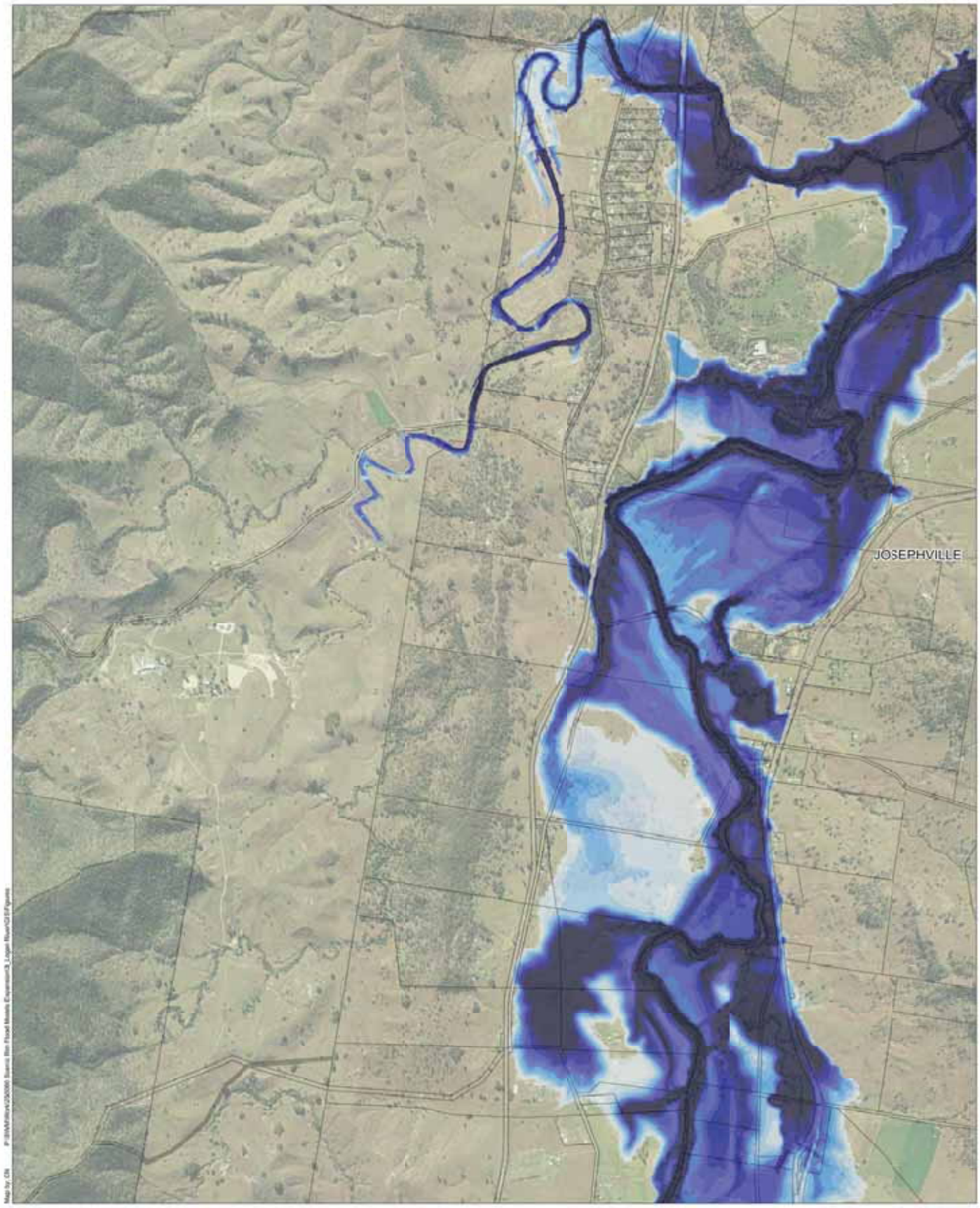
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-f

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

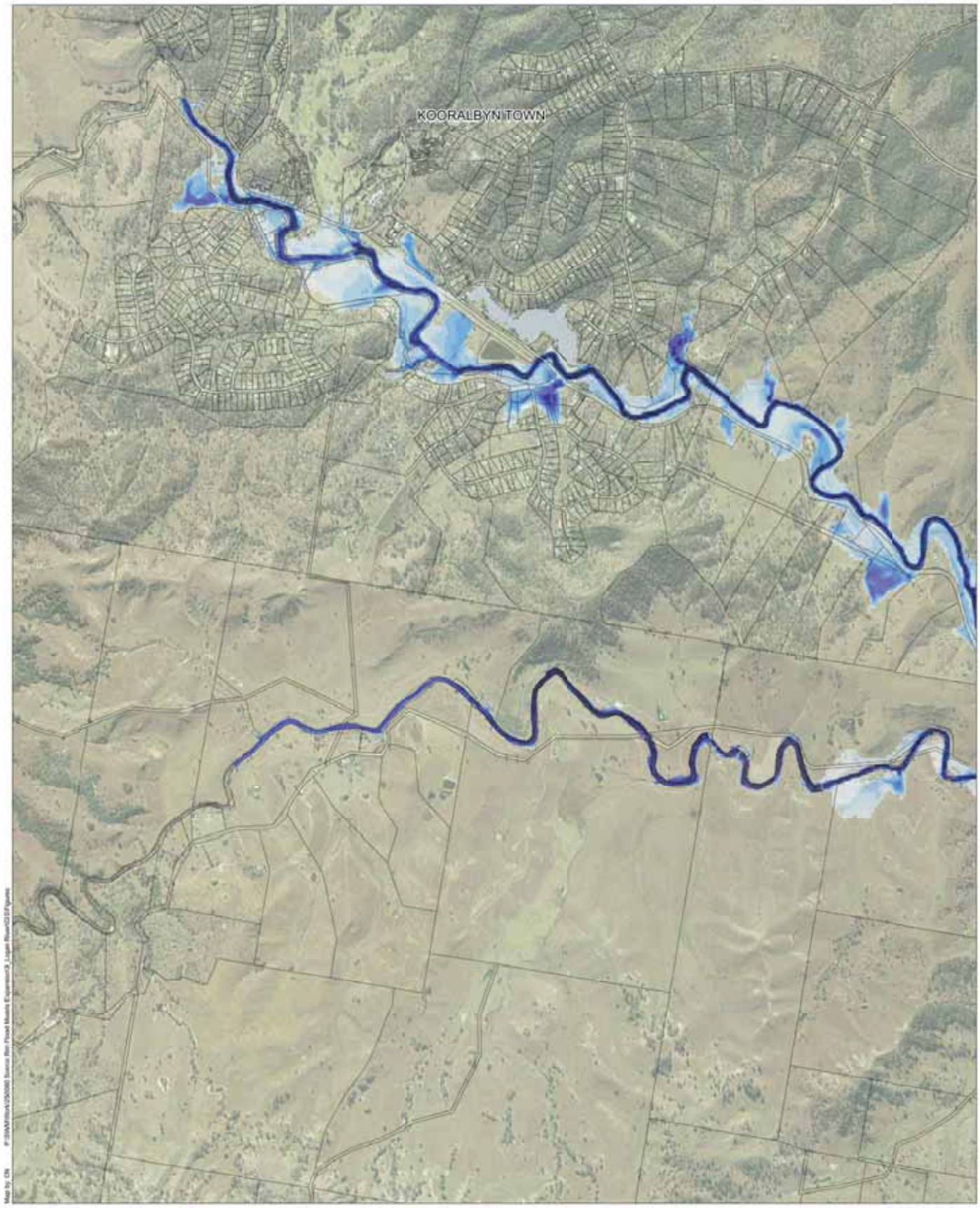
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study **Figure B6-g**

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

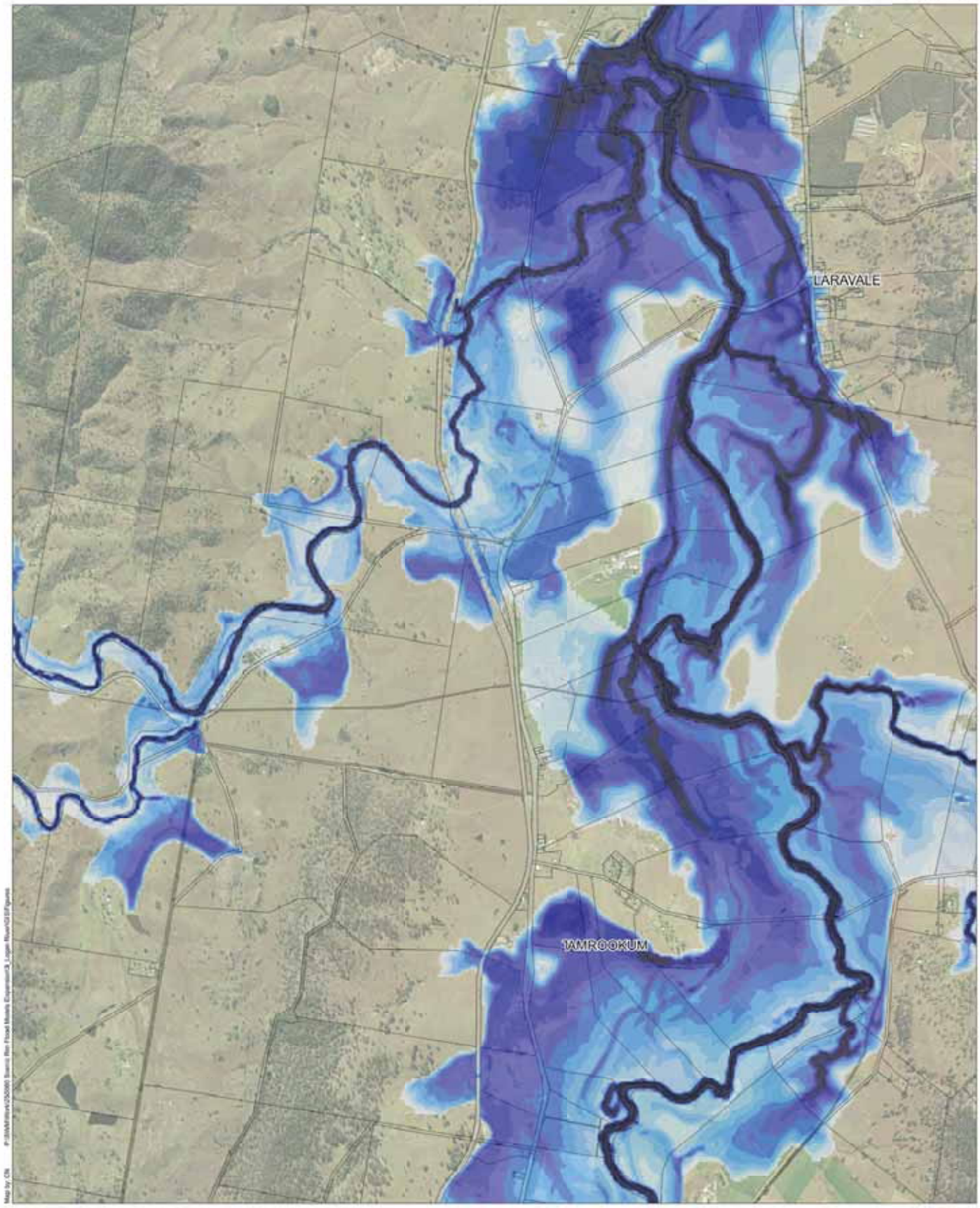
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-h

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

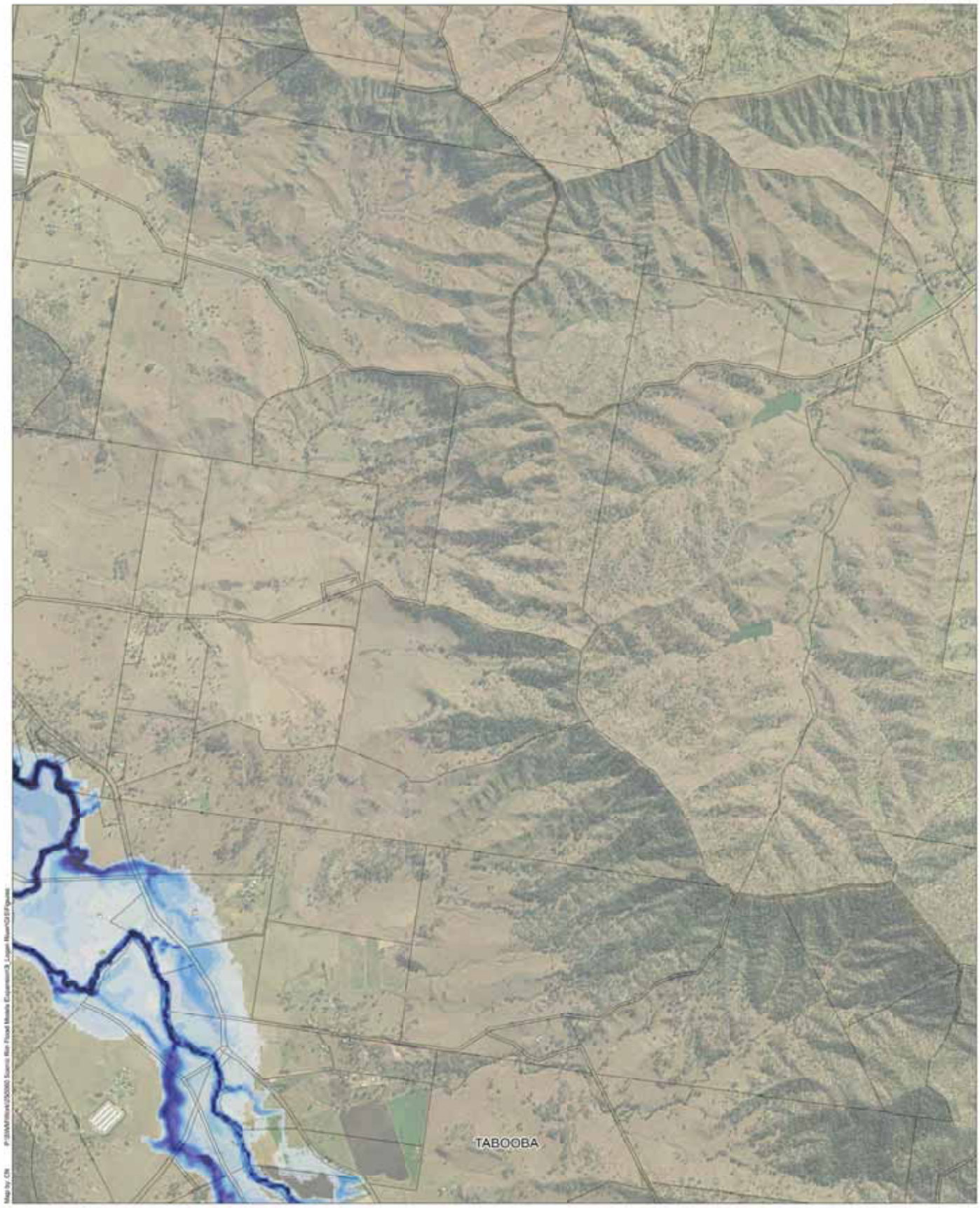
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure B6-i

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

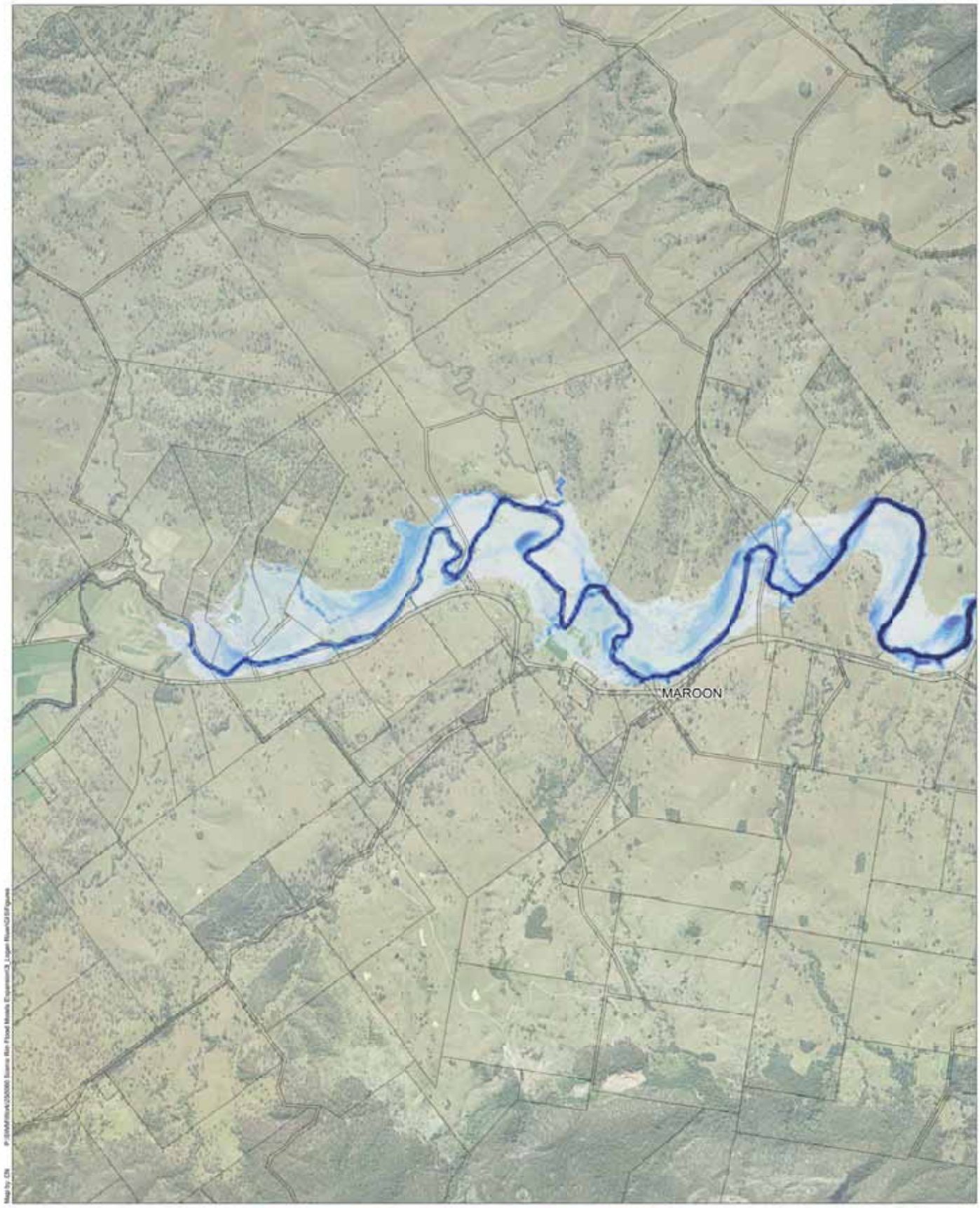
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study Figure B6-j

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

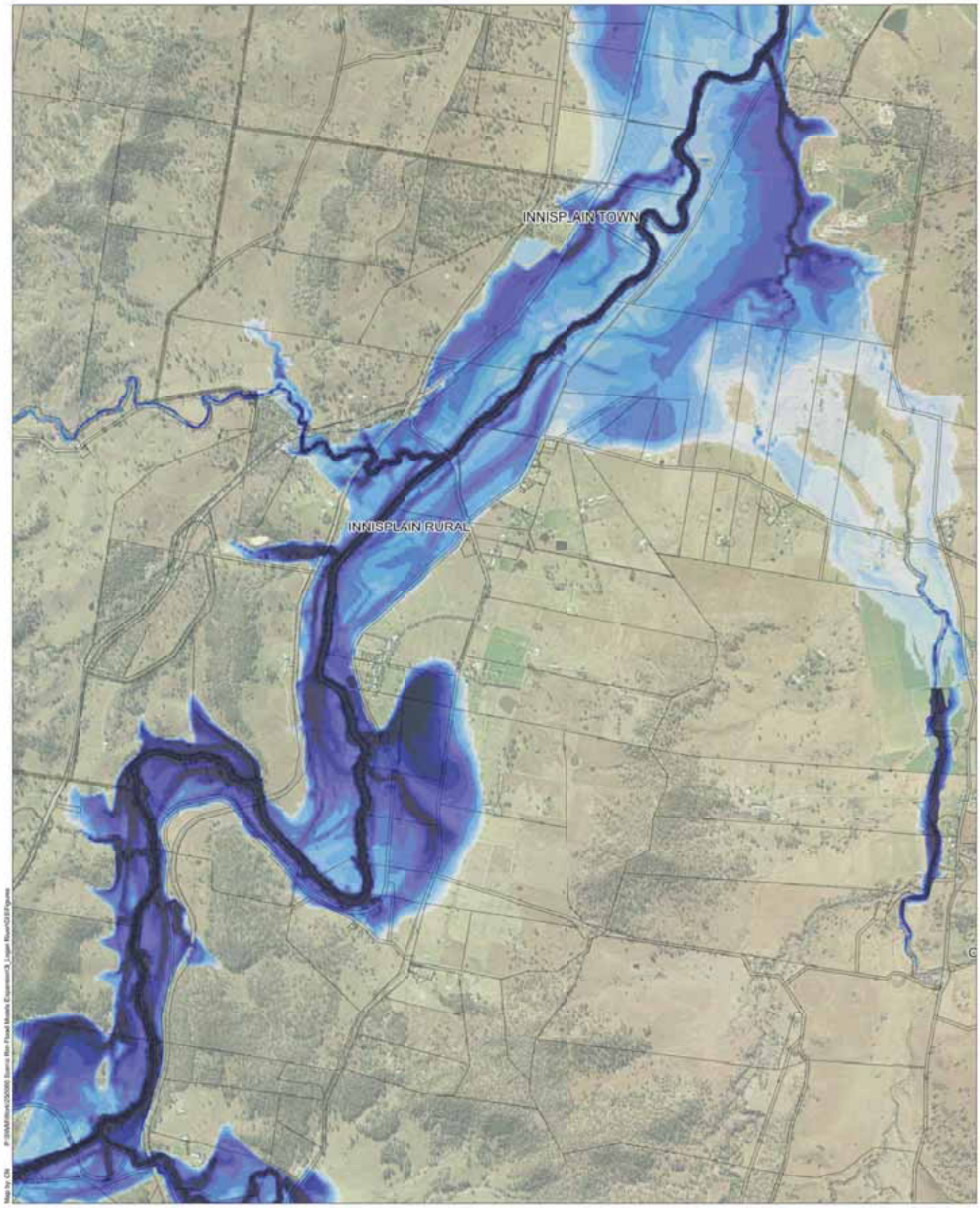
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-k

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

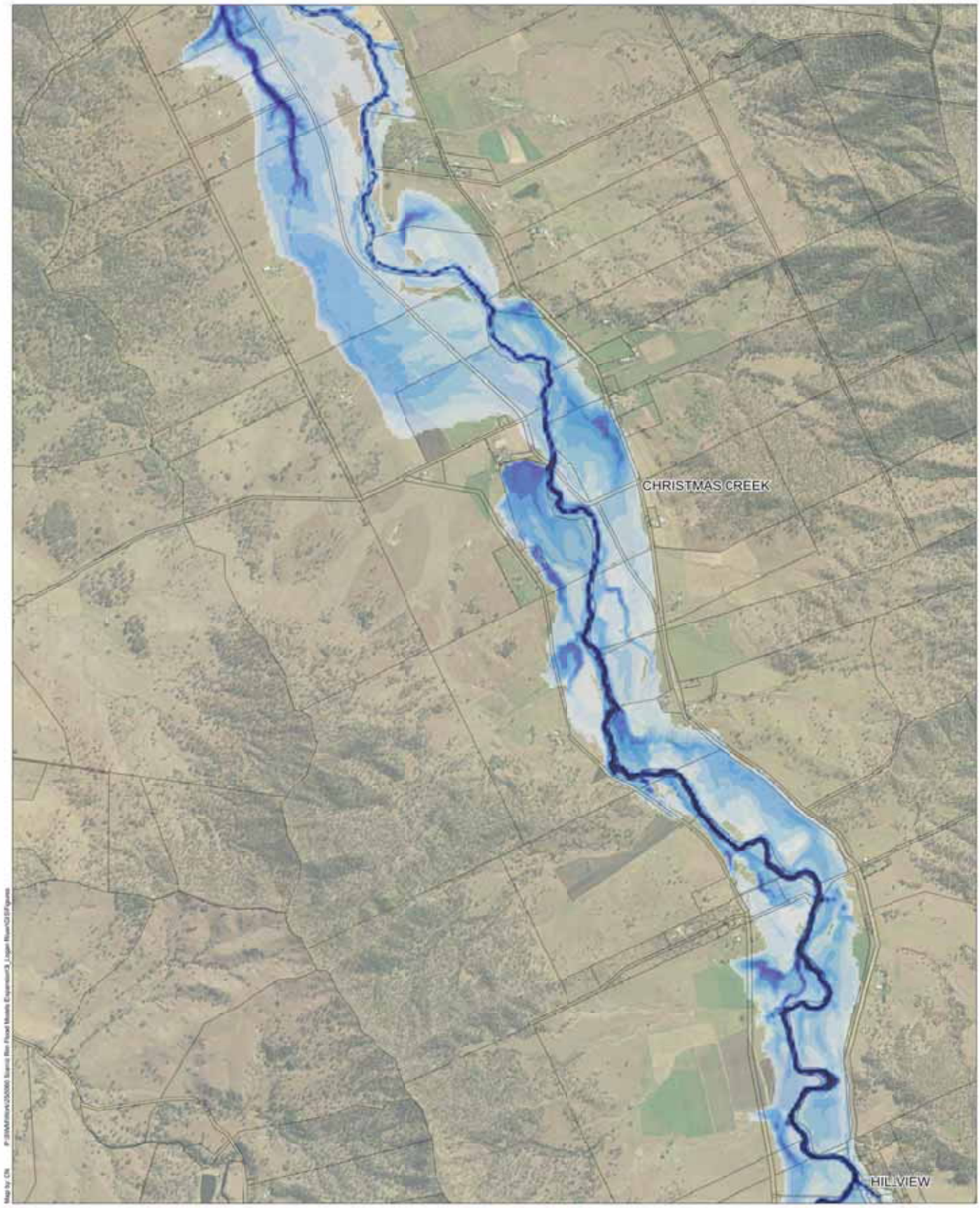
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-I

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

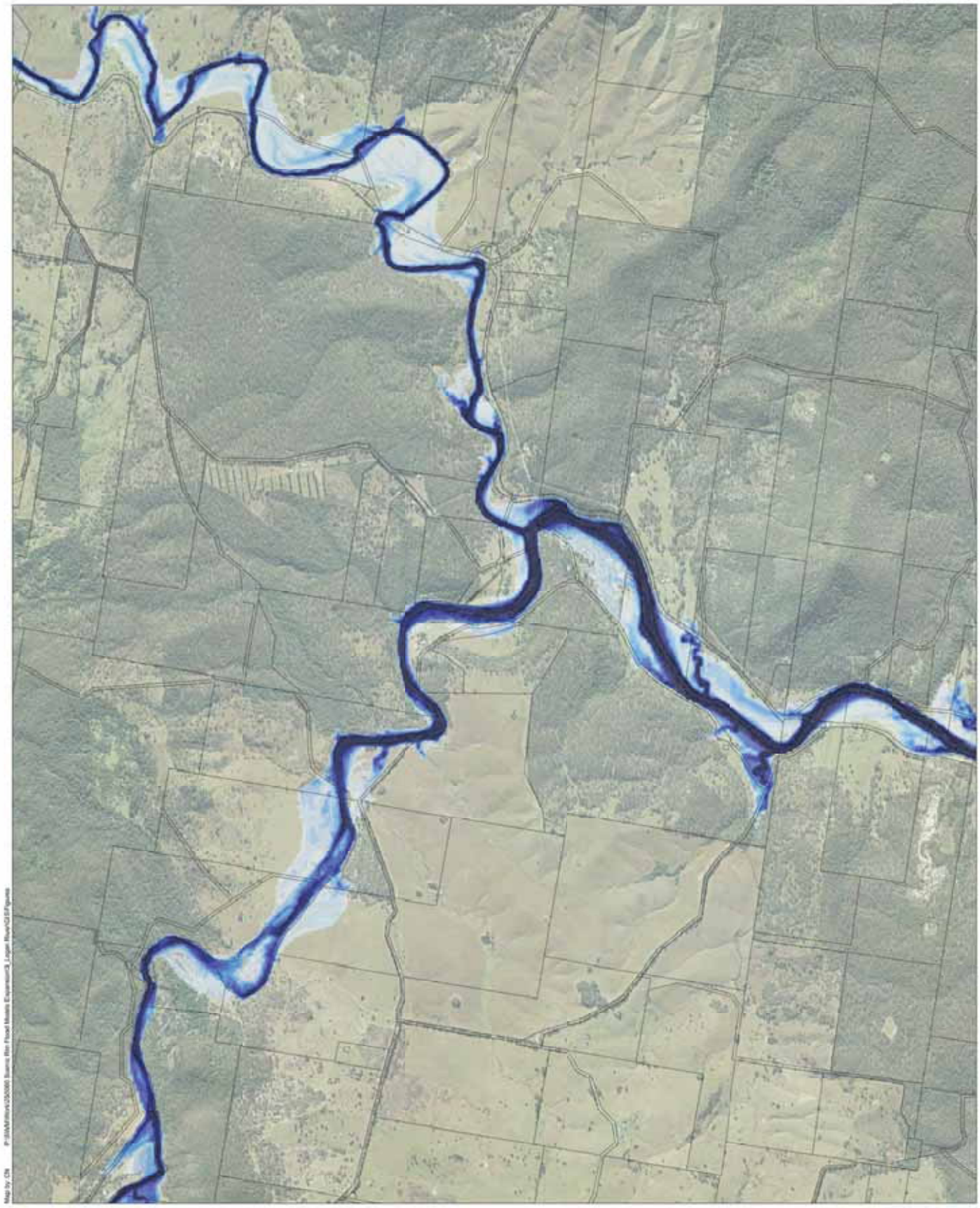
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B6-m**

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

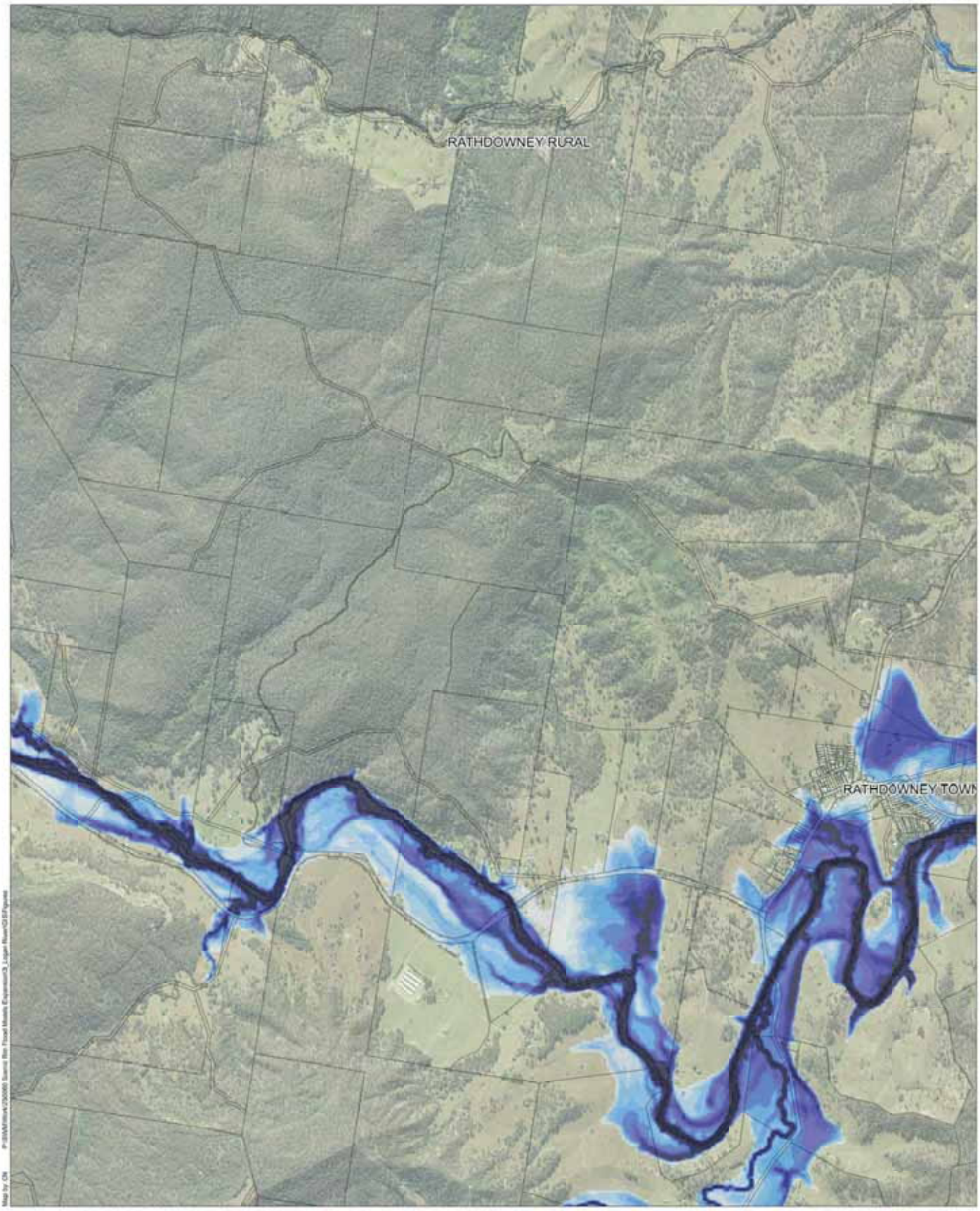
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-n

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

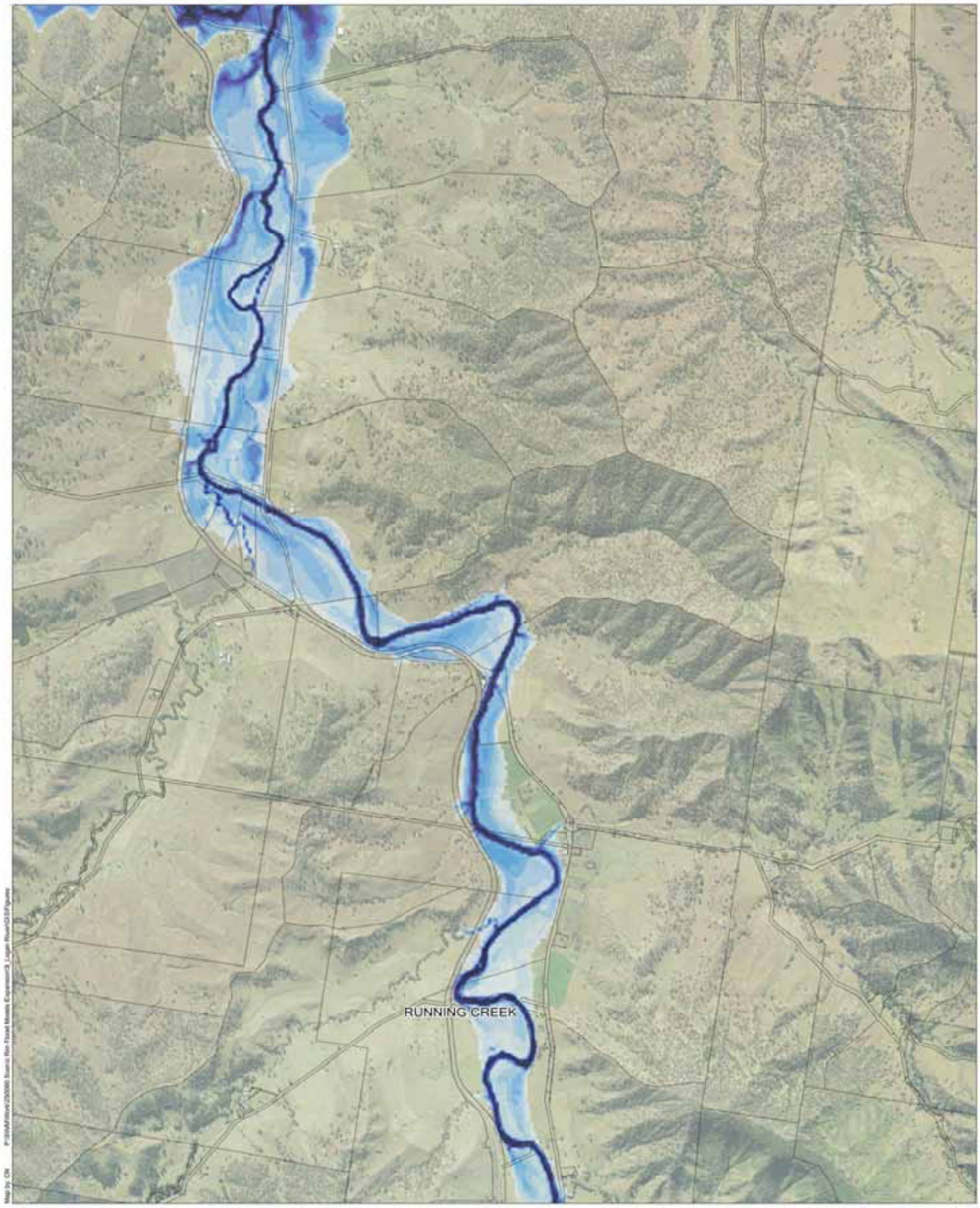
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-o

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

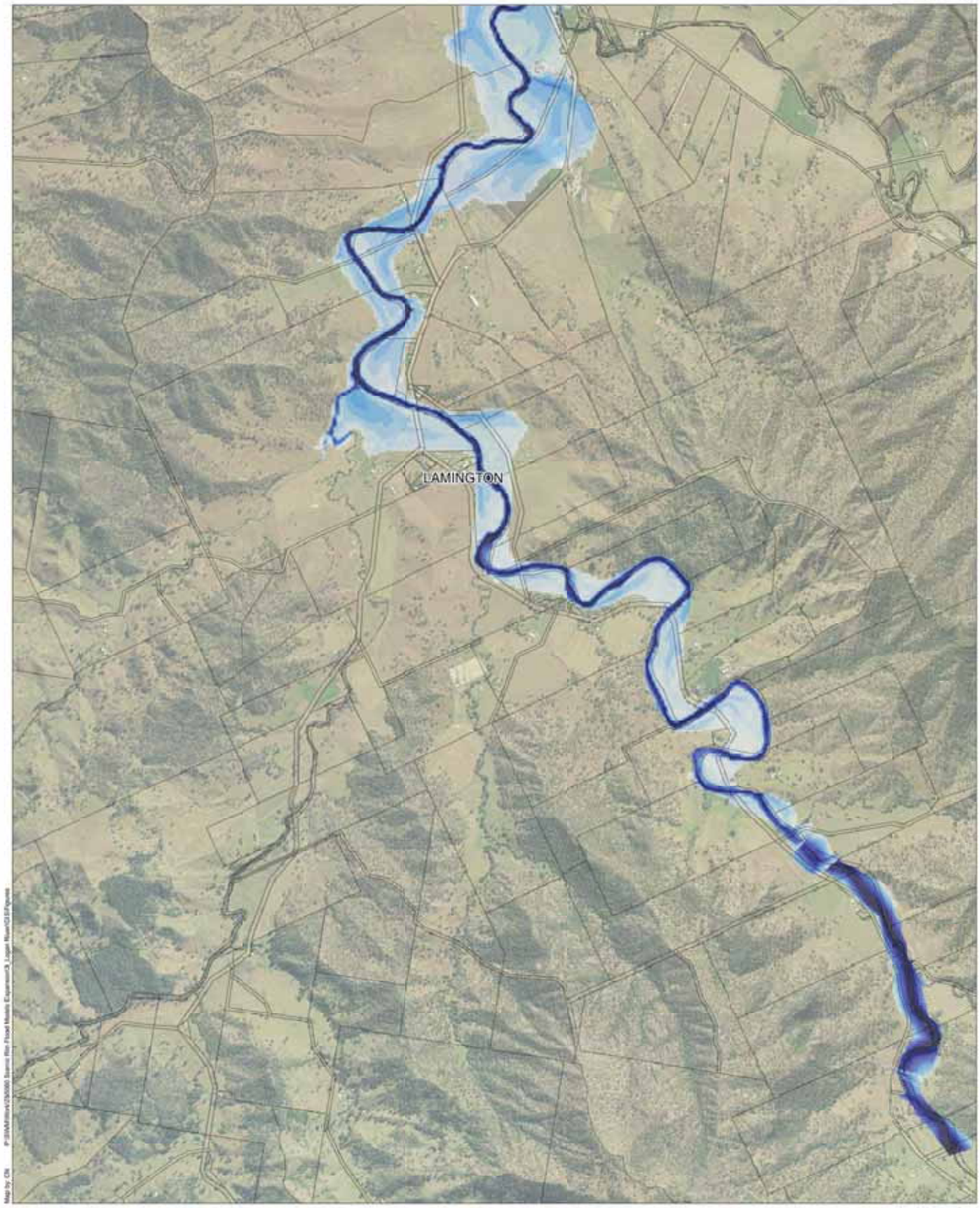
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-p

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

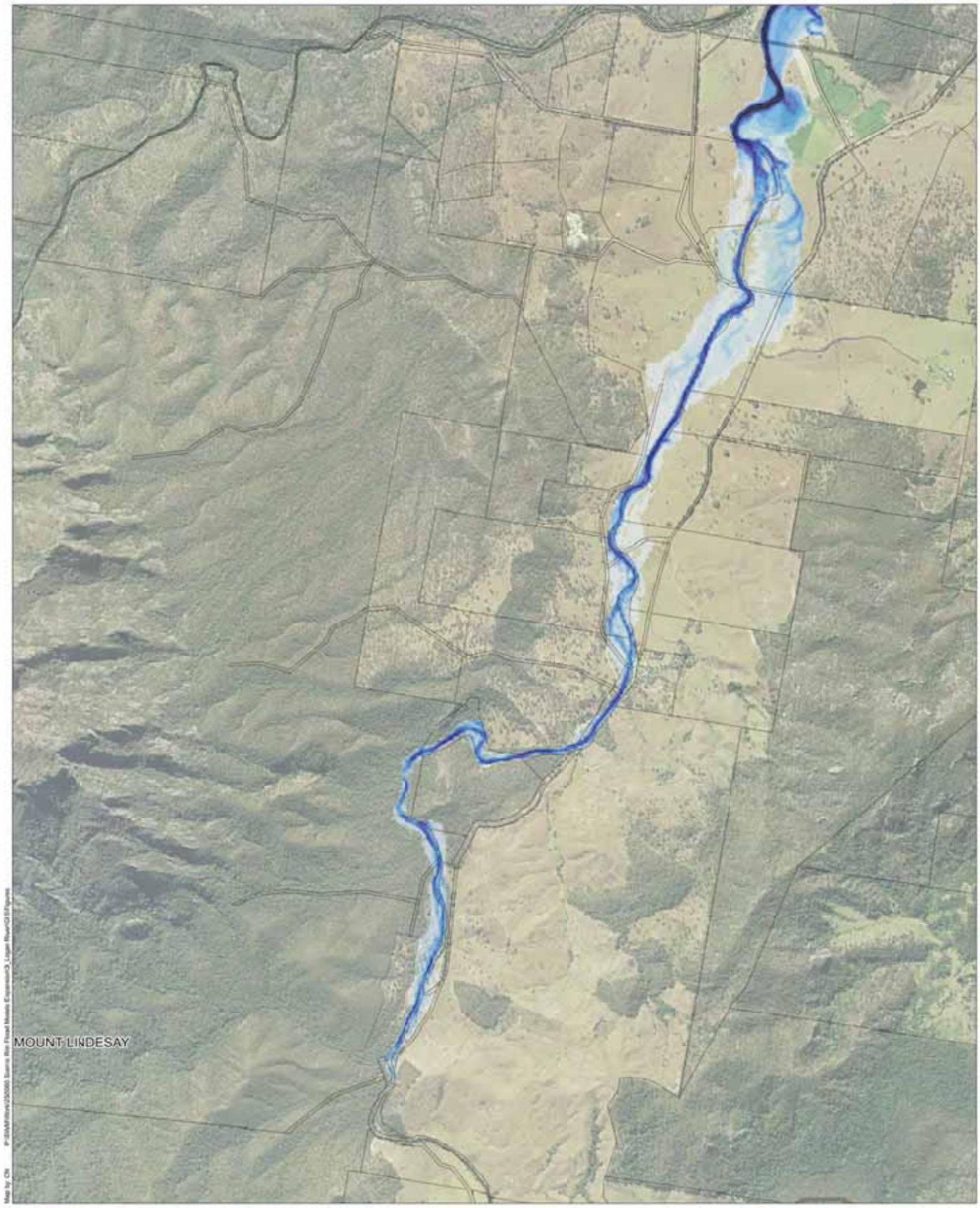
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-q

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

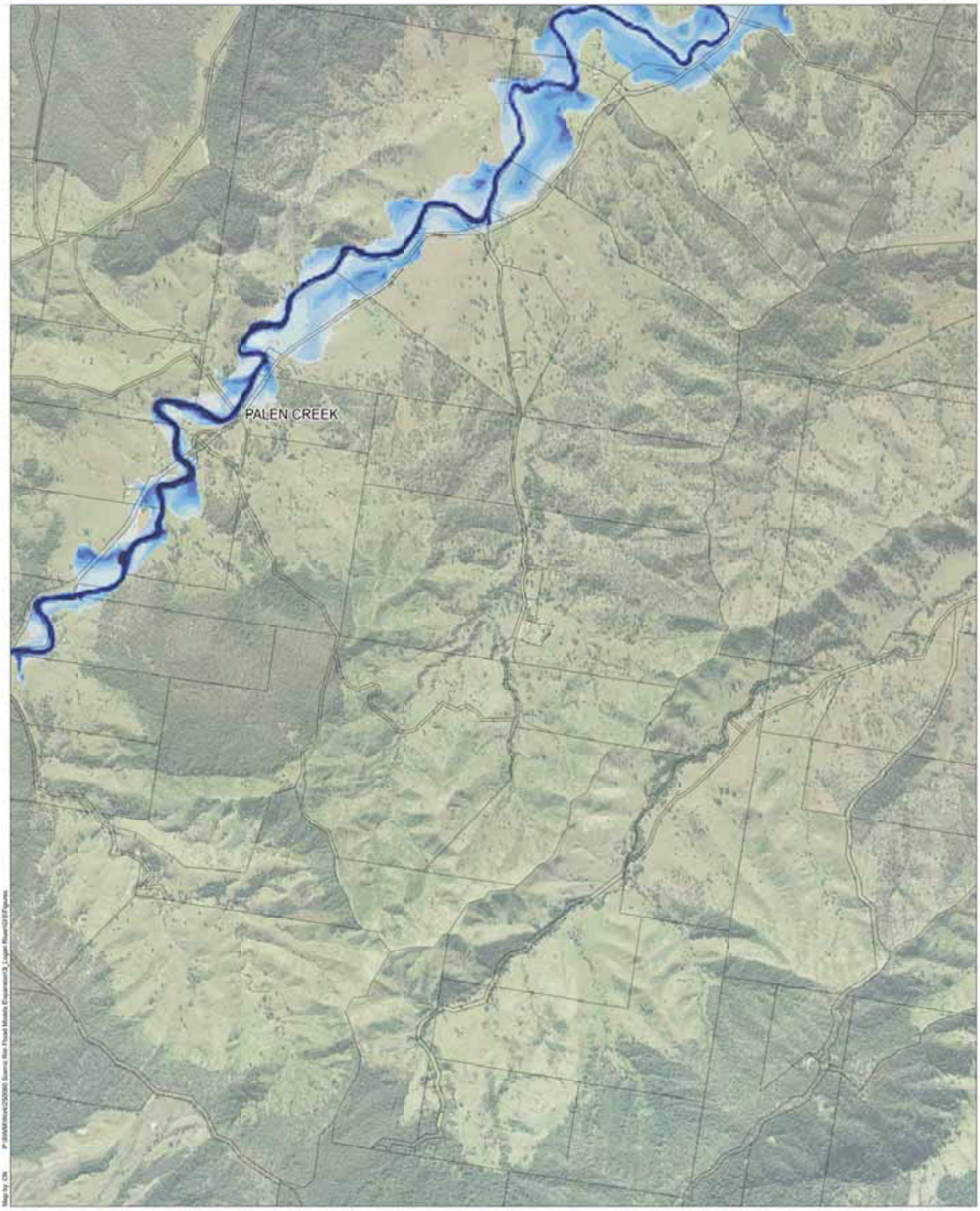
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-r

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study Figure B6-s

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map

Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-t

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map

Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

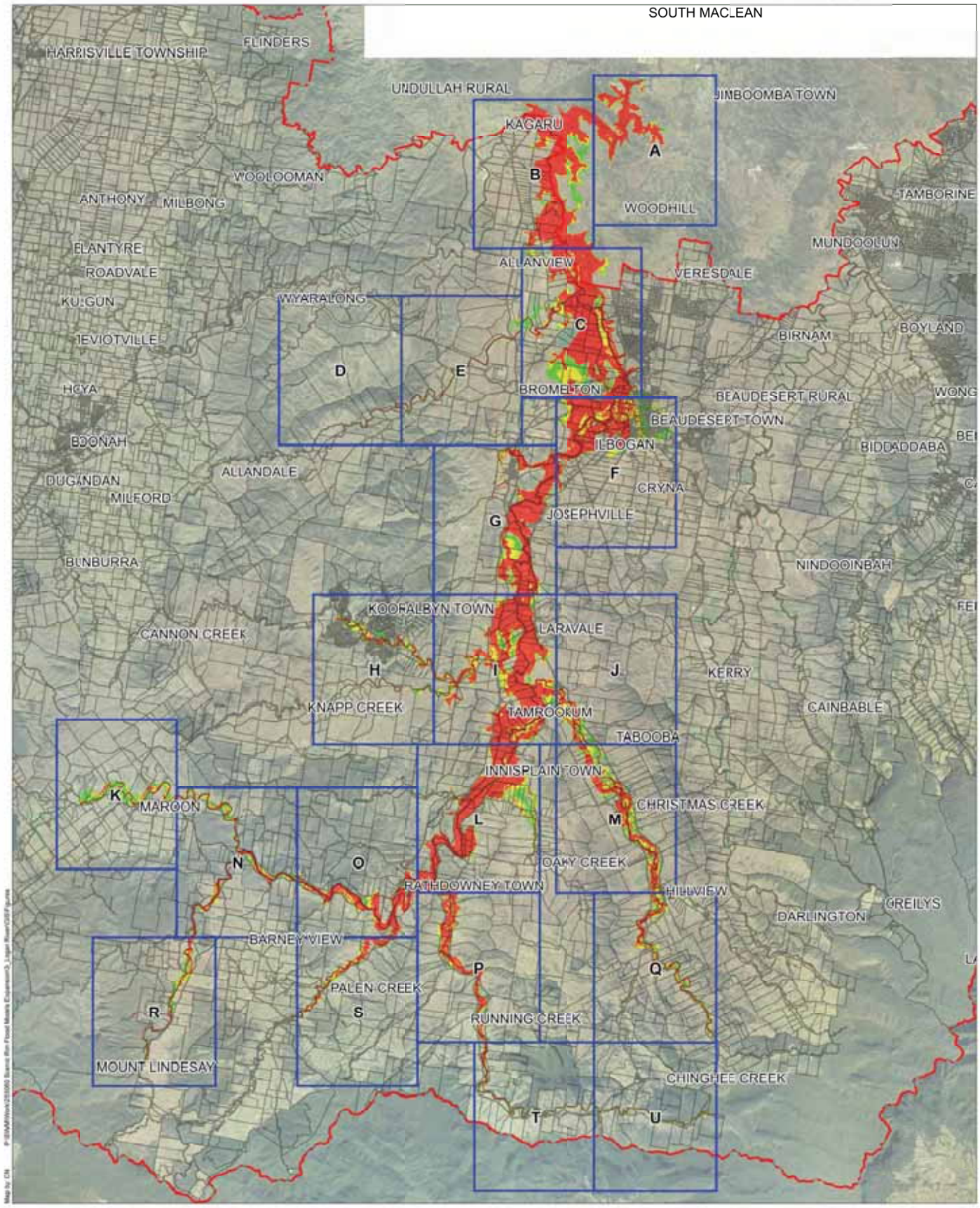
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B6-u

1% AEP Event - Climate Change Scenario 4.5 Peak Depth Map



Legend

- SRRC Boundary
- Cadastral Boundary
- Low Hazard
- Medium Hazard
- High Hazard

Notes:

1:200,000

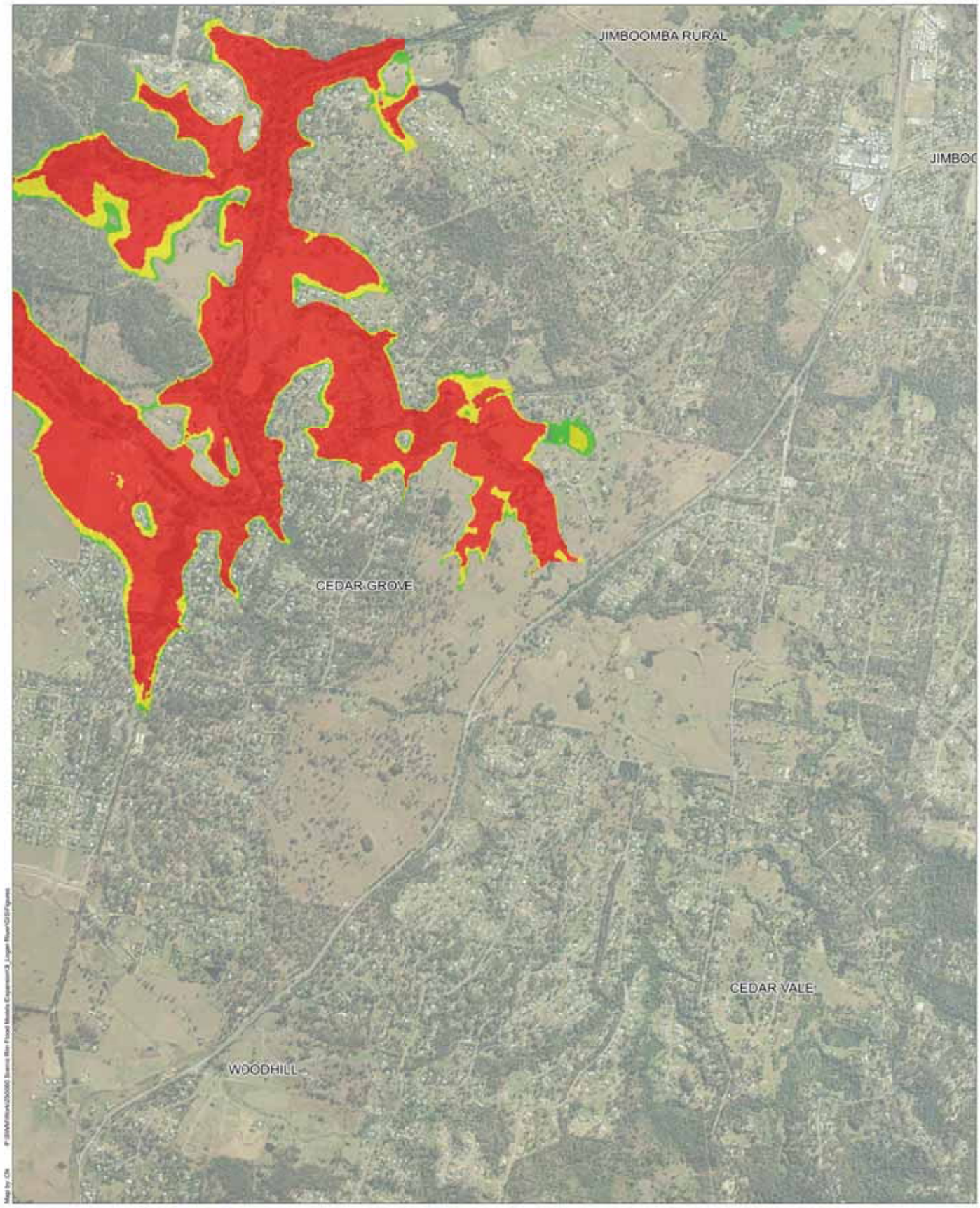
0 5,000 m 10,000 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure B7**

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

- SRRC Boundary
- Cadastral Boundary
- Low Hazard
- Medium Hazard
- High Hazard

Notes:

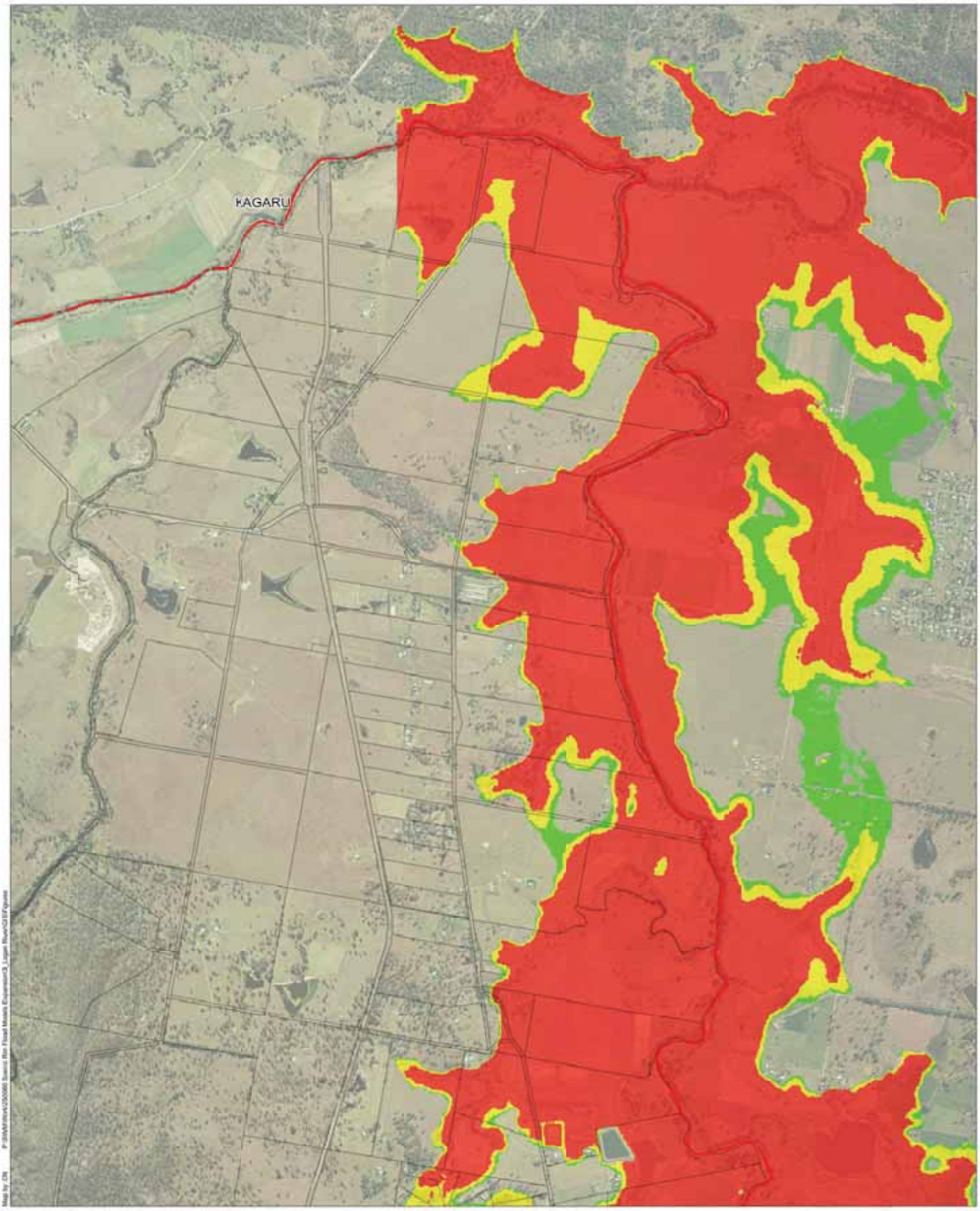
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study **Figure B7-a**

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

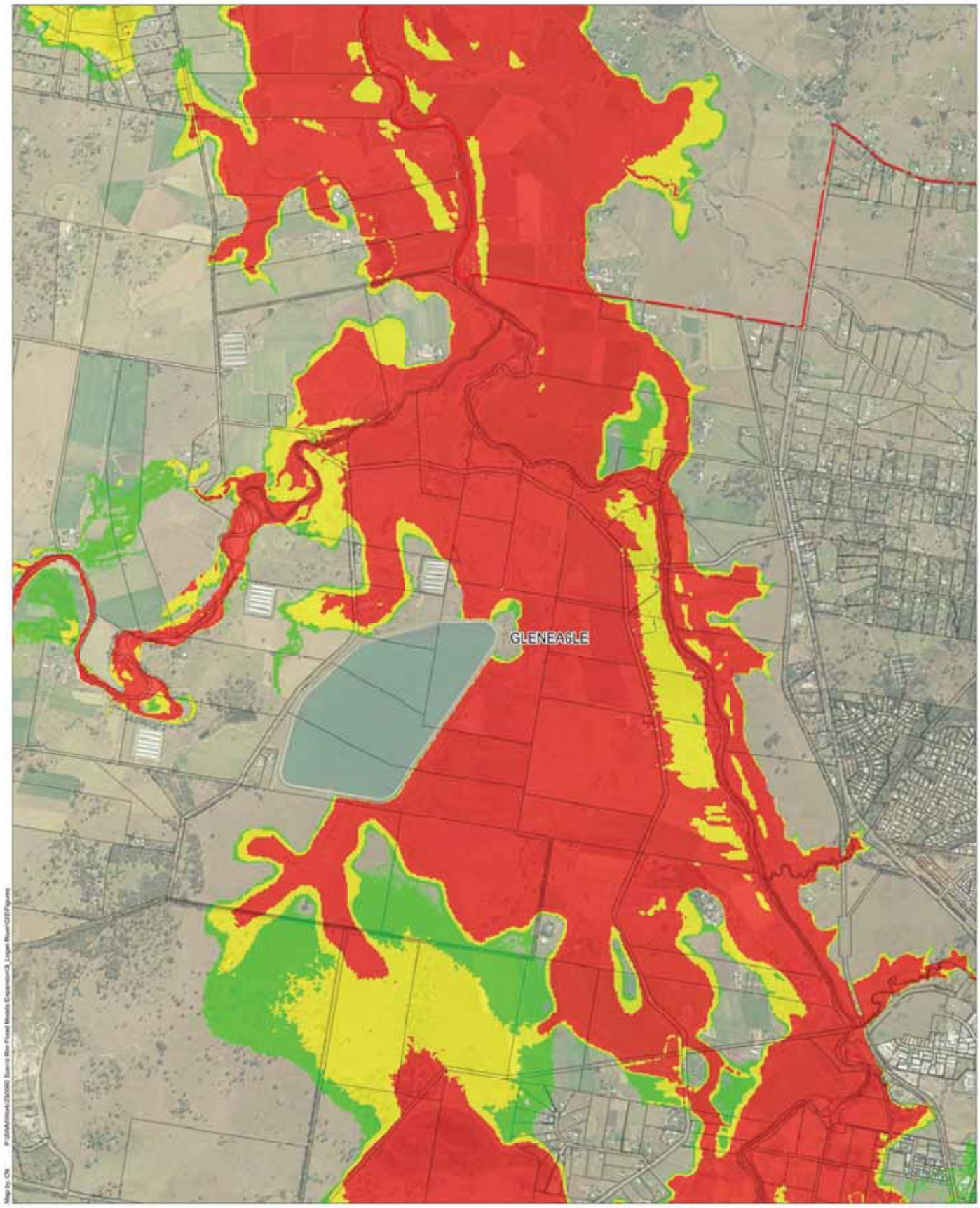
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-b

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-c

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map

Legend

- SRRC Boundary
- Cadastral Boundary
- Low Hazard
- Medium Hazard
- High Hazard

Notes:

1:25,000

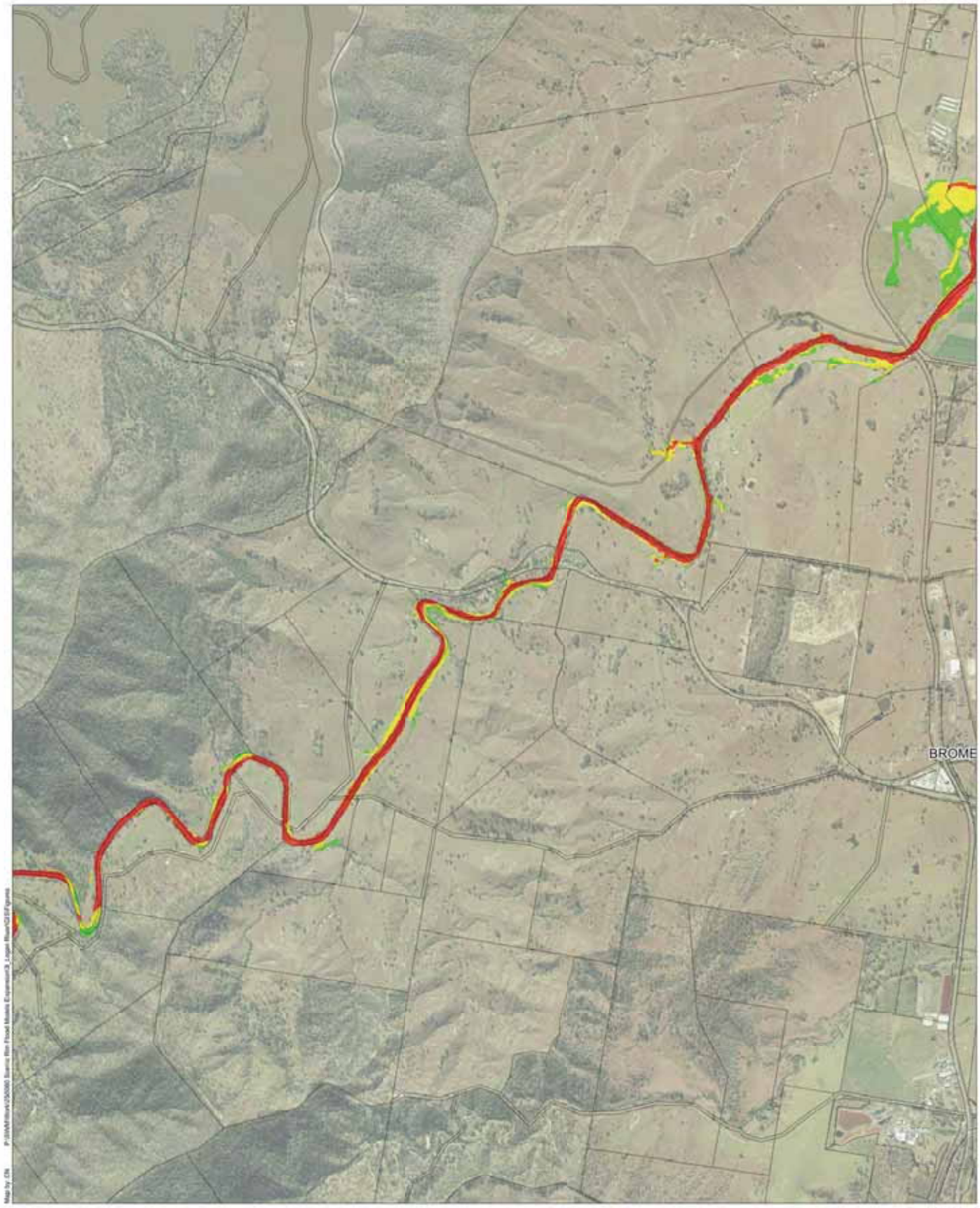
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 55

Logan River Flood Study Figure B7-d

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

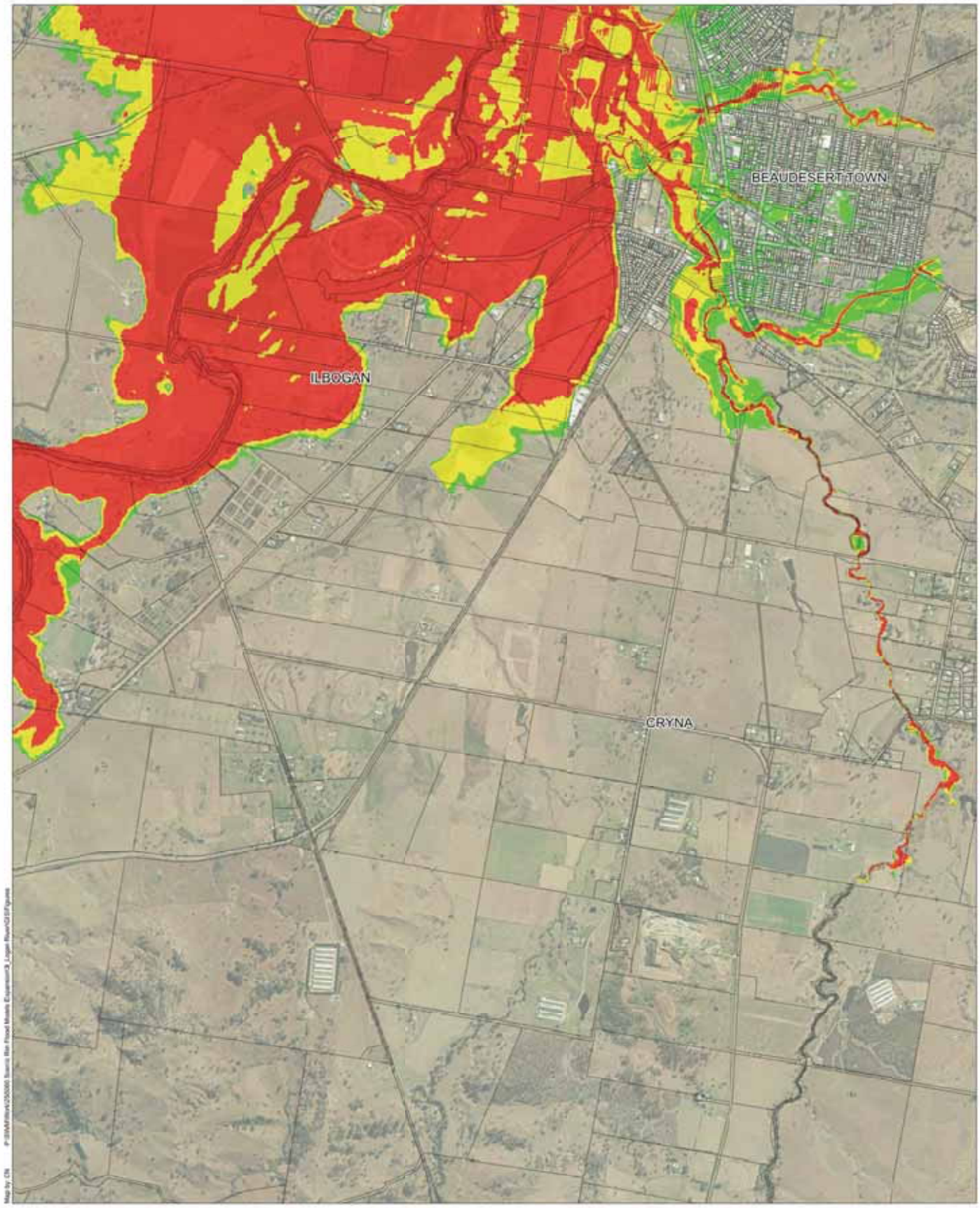
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-e

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

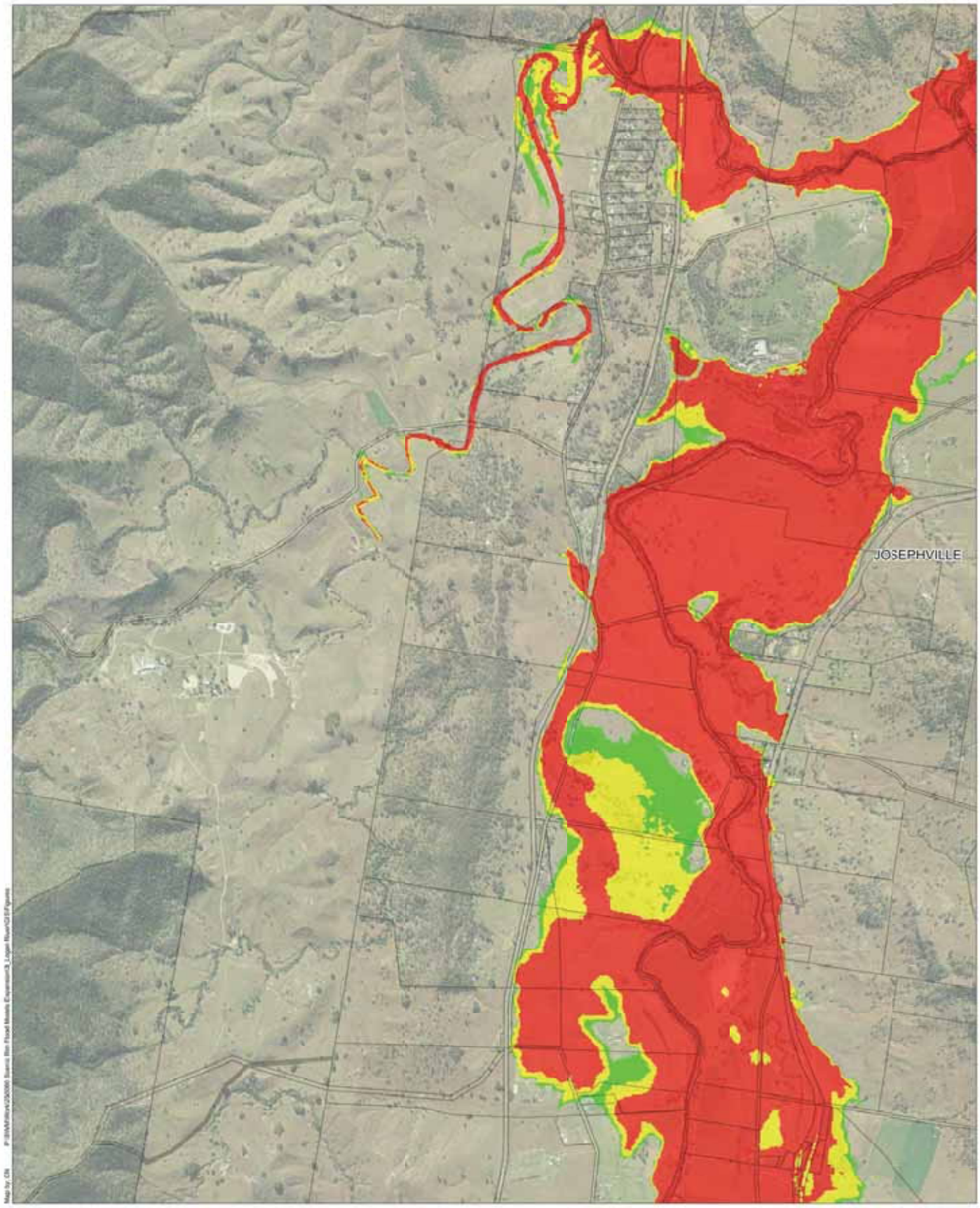
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-f

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

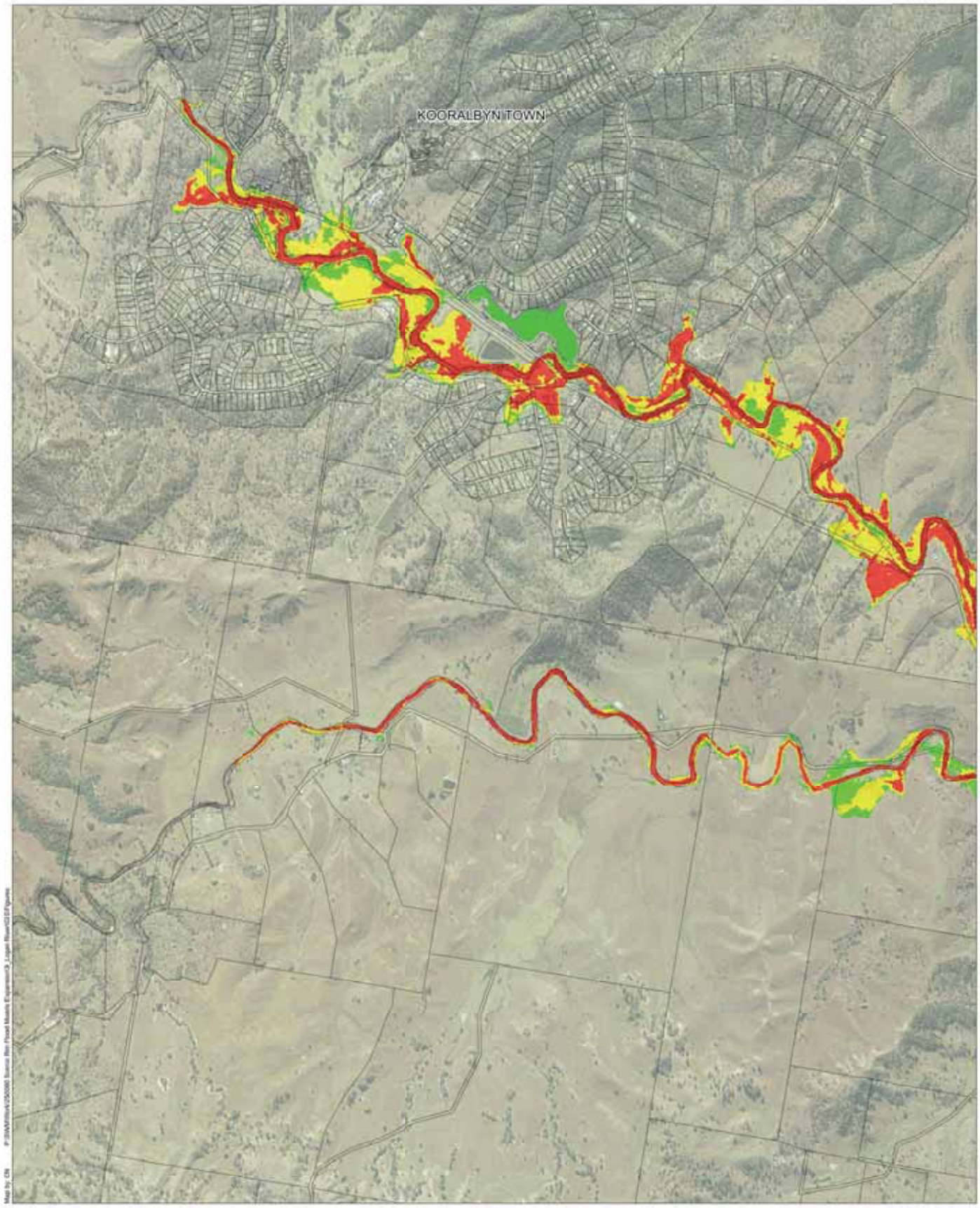
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-g

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

1:25,000

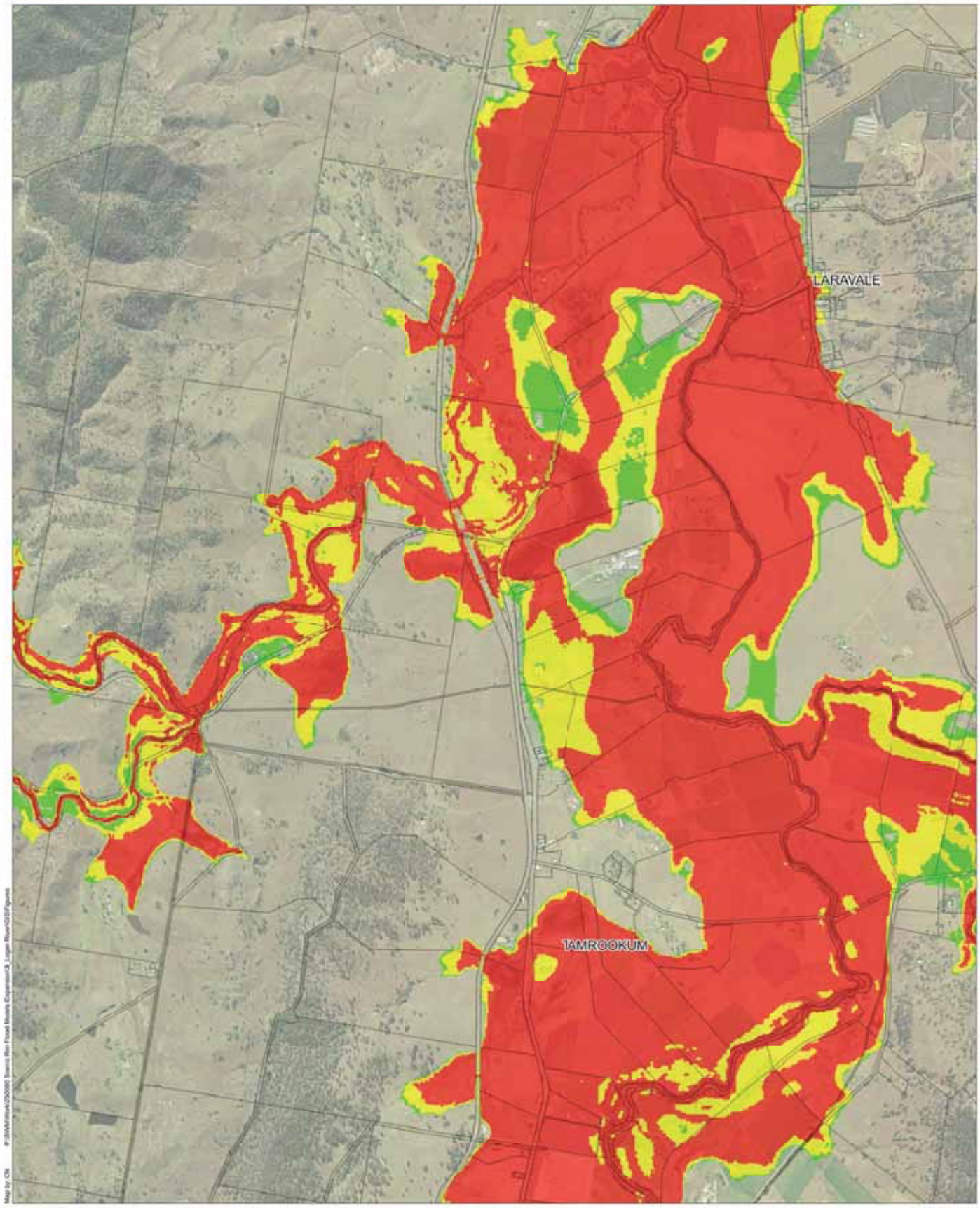
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-h

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map

aurecon



Legend

- SRRC Boundary
- Cadastral Boundary
- Low Hazard
- Medium Hazard
- High Hazard

Notes:

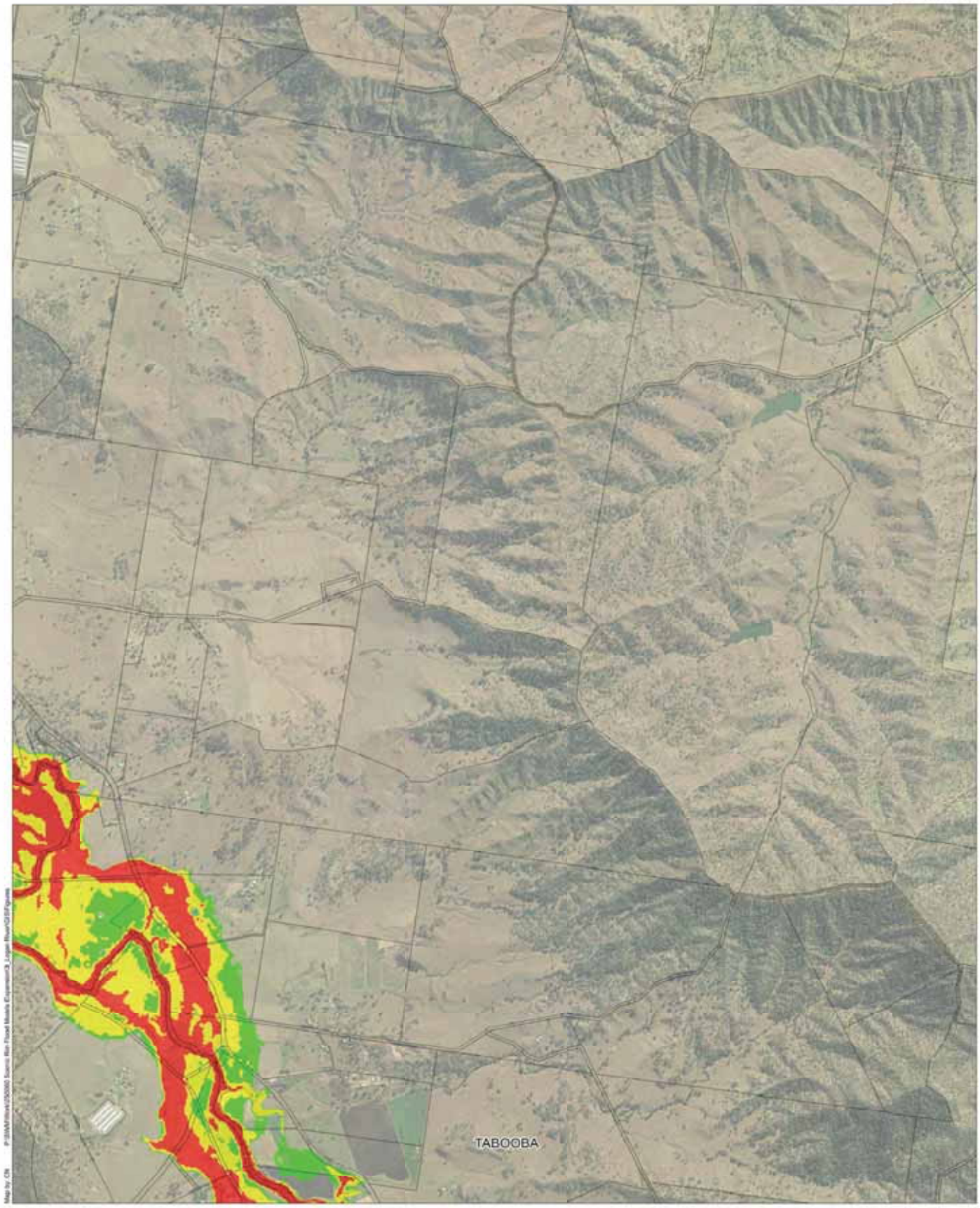
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-i

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

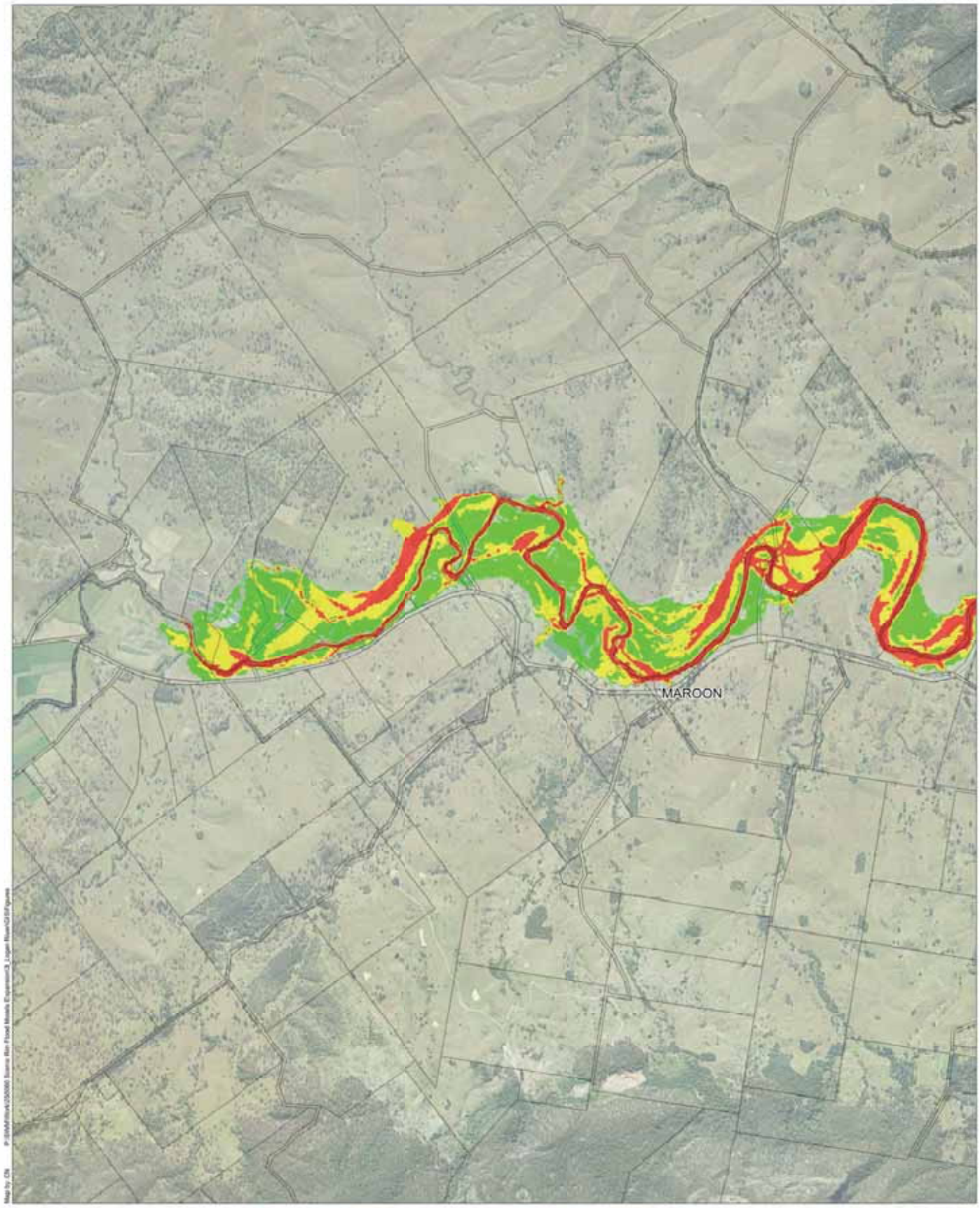
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-j

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

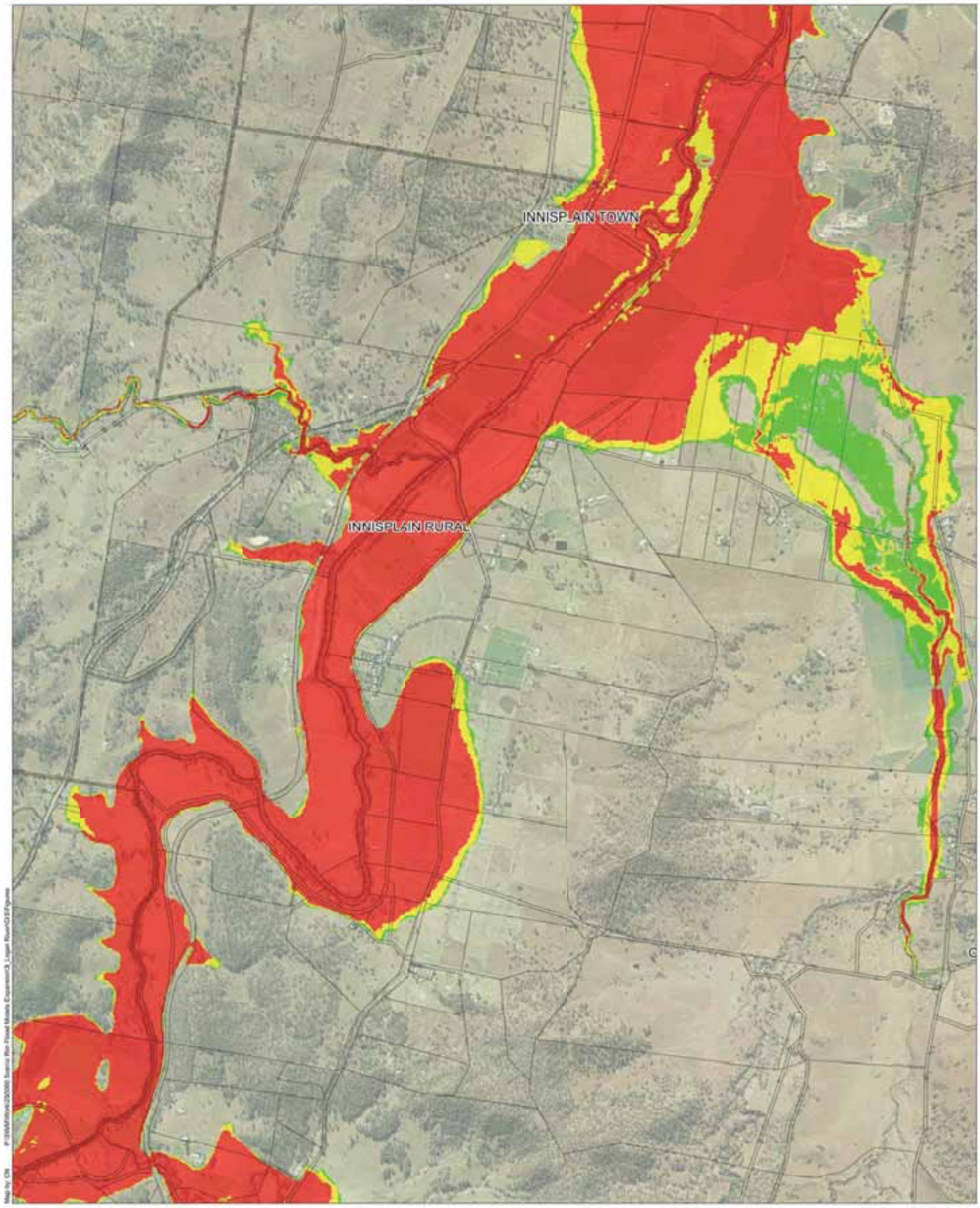
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-k

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

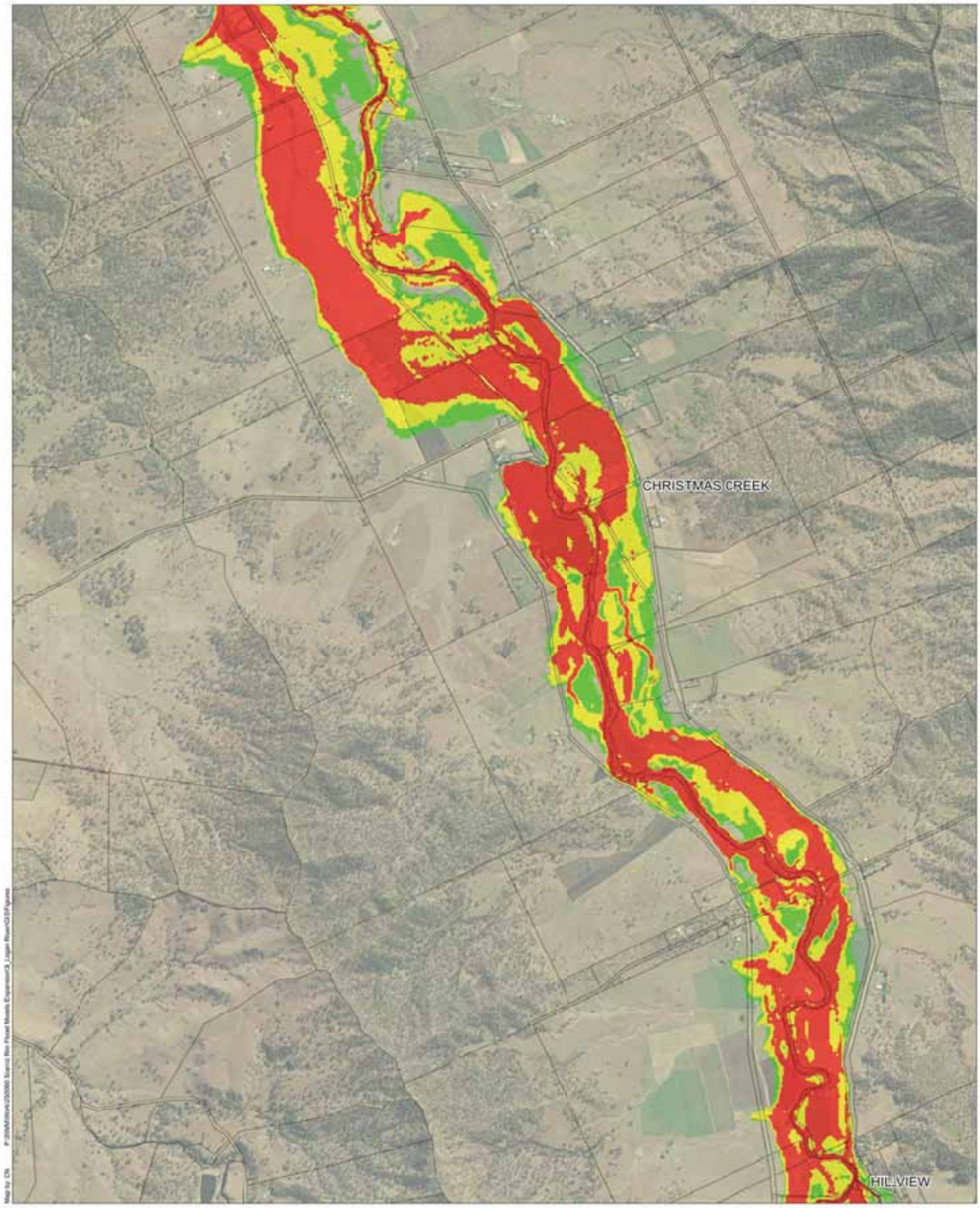
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-I

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

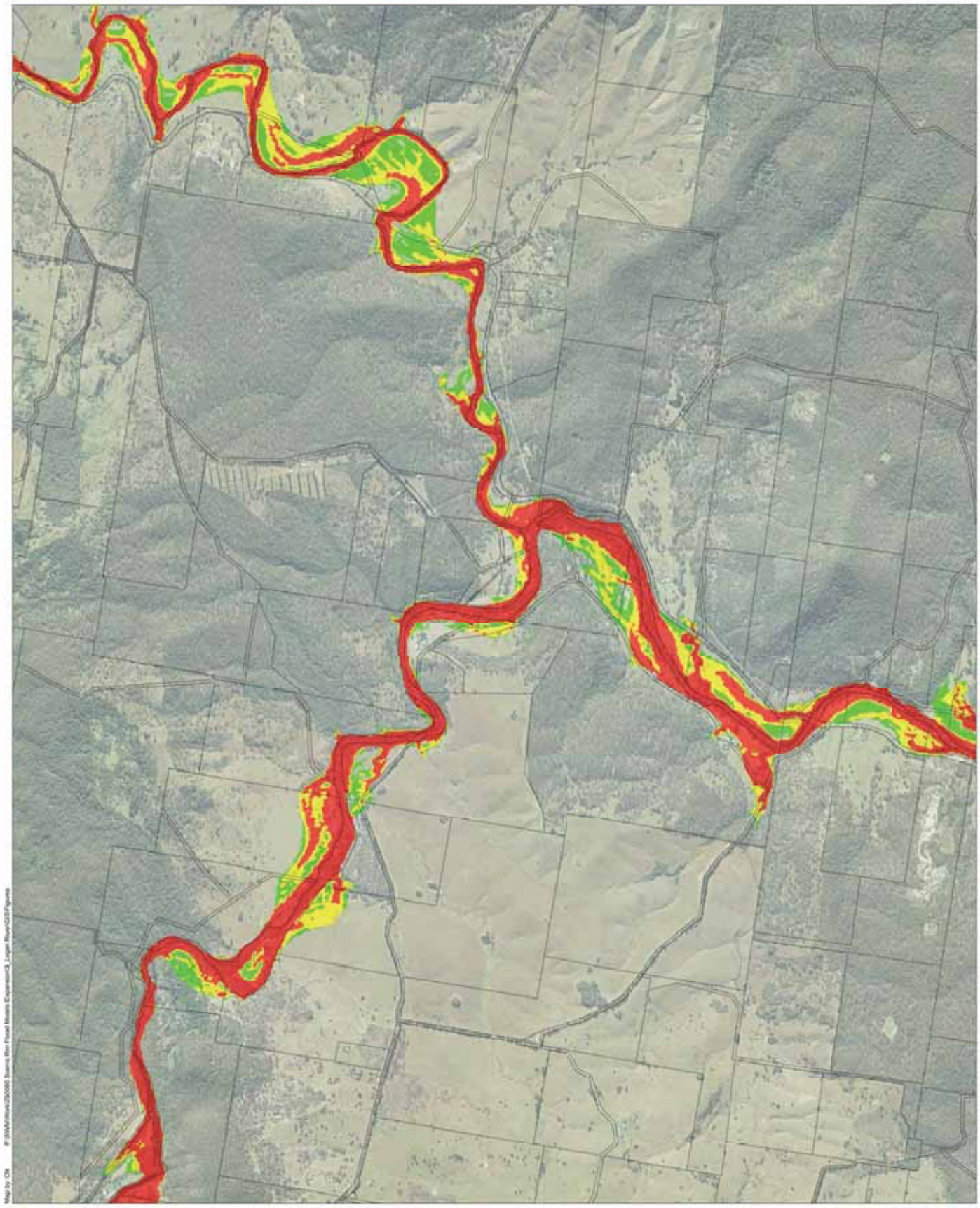
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-m

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

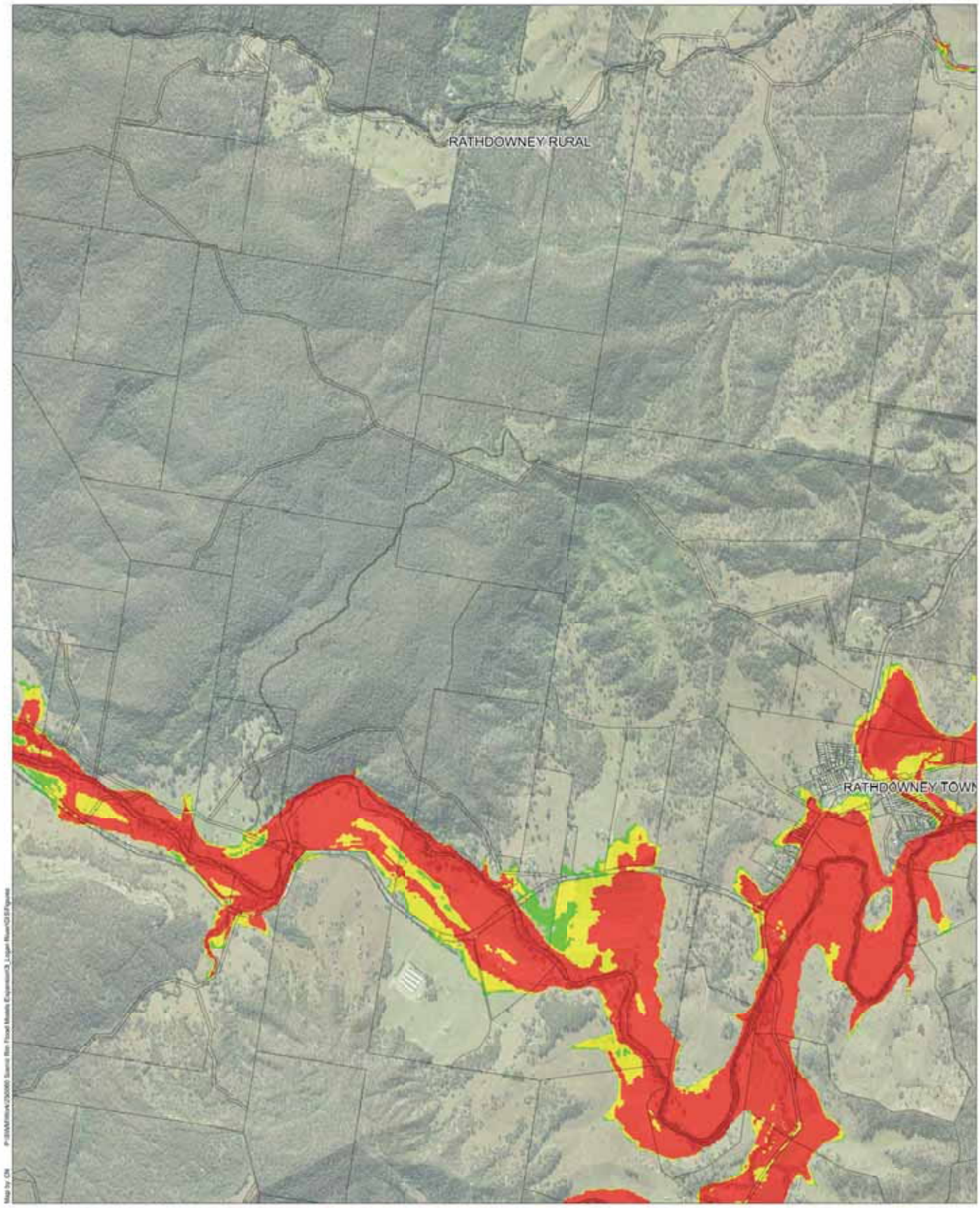
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-n

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

- SRRC Boundary
- Cadastral Boundary
- Low Hazard
- Medium Hazard
- High Hazard

Notes:

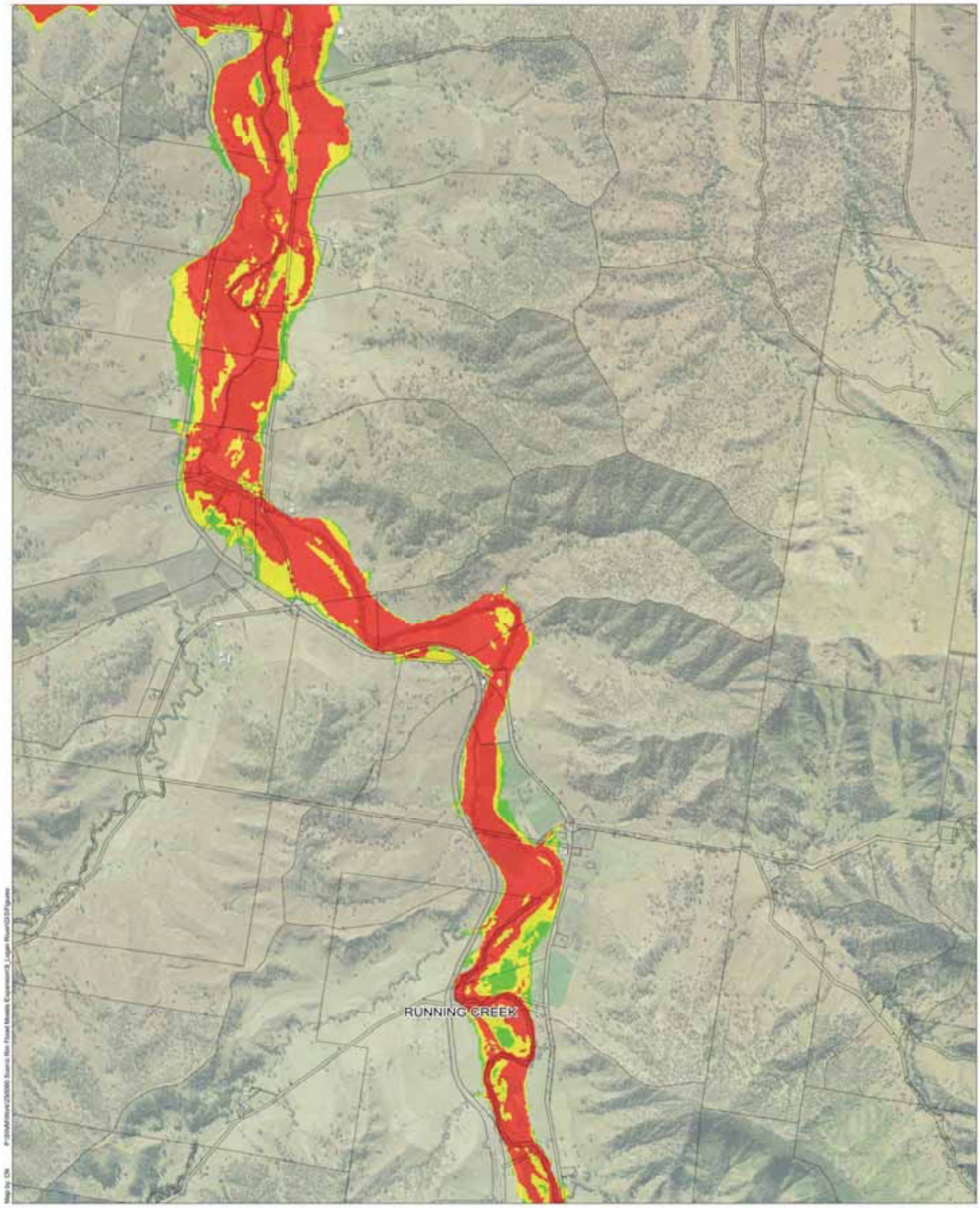
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-o

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

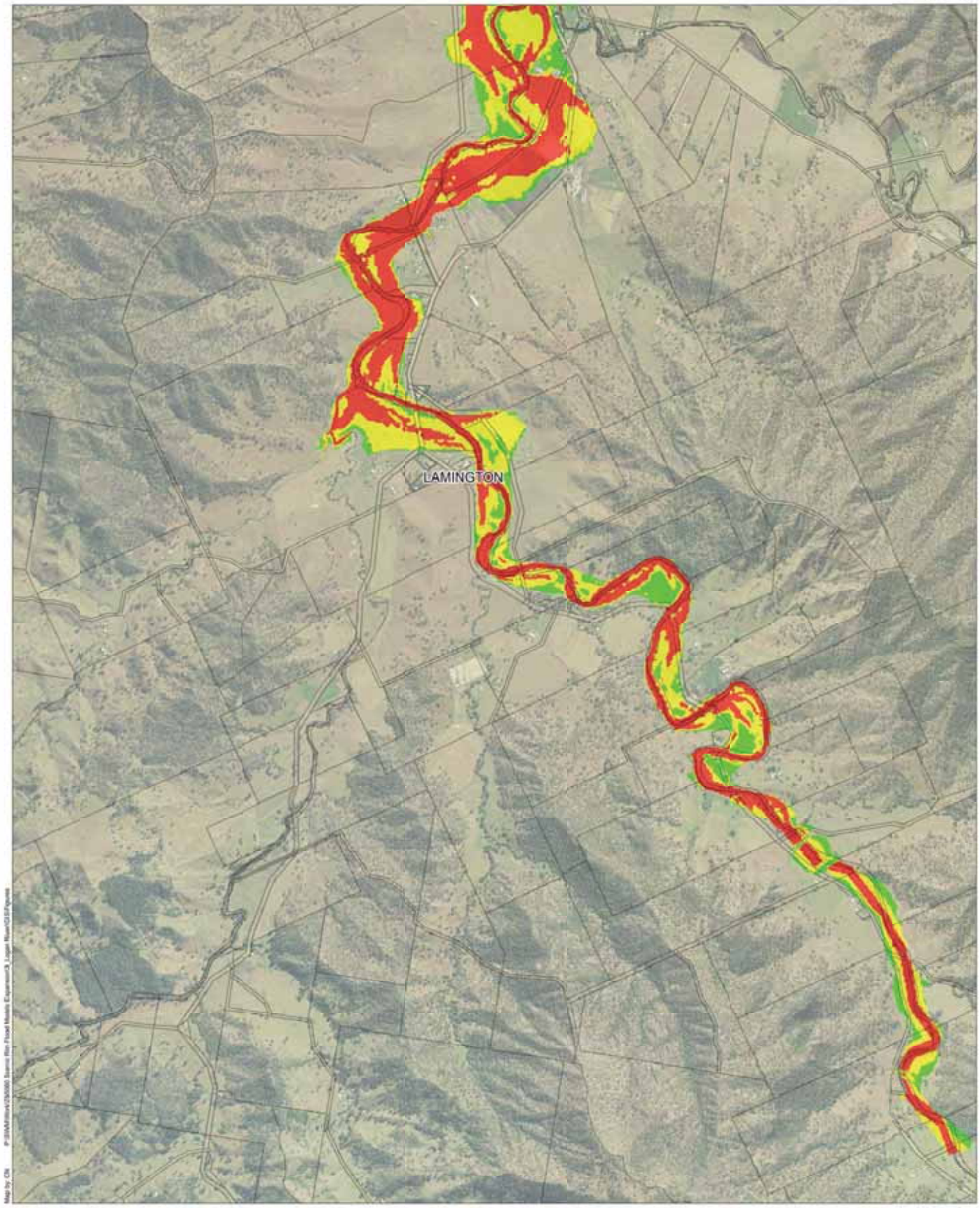
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-p

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

1:25,000

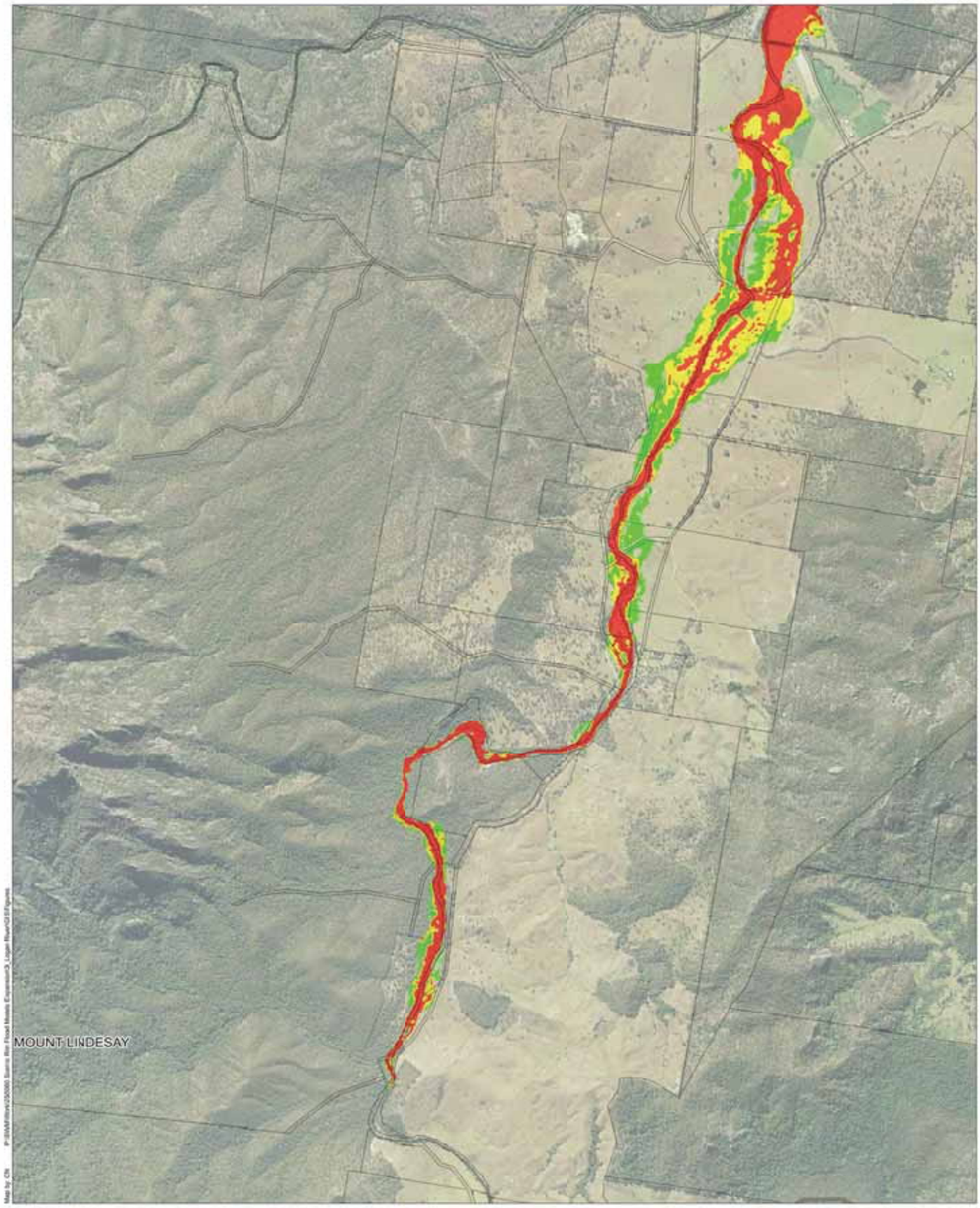
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-q

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

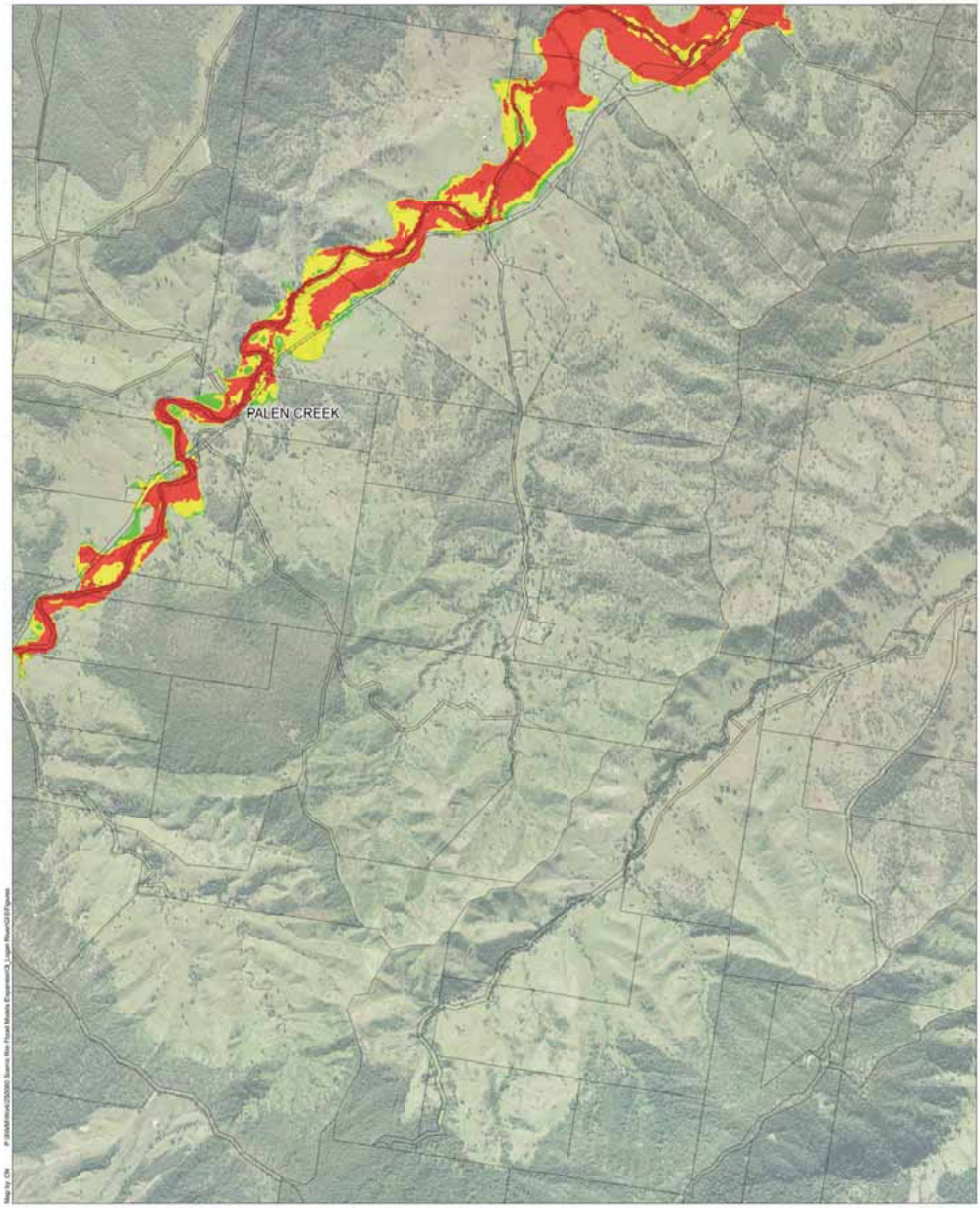
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-r

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

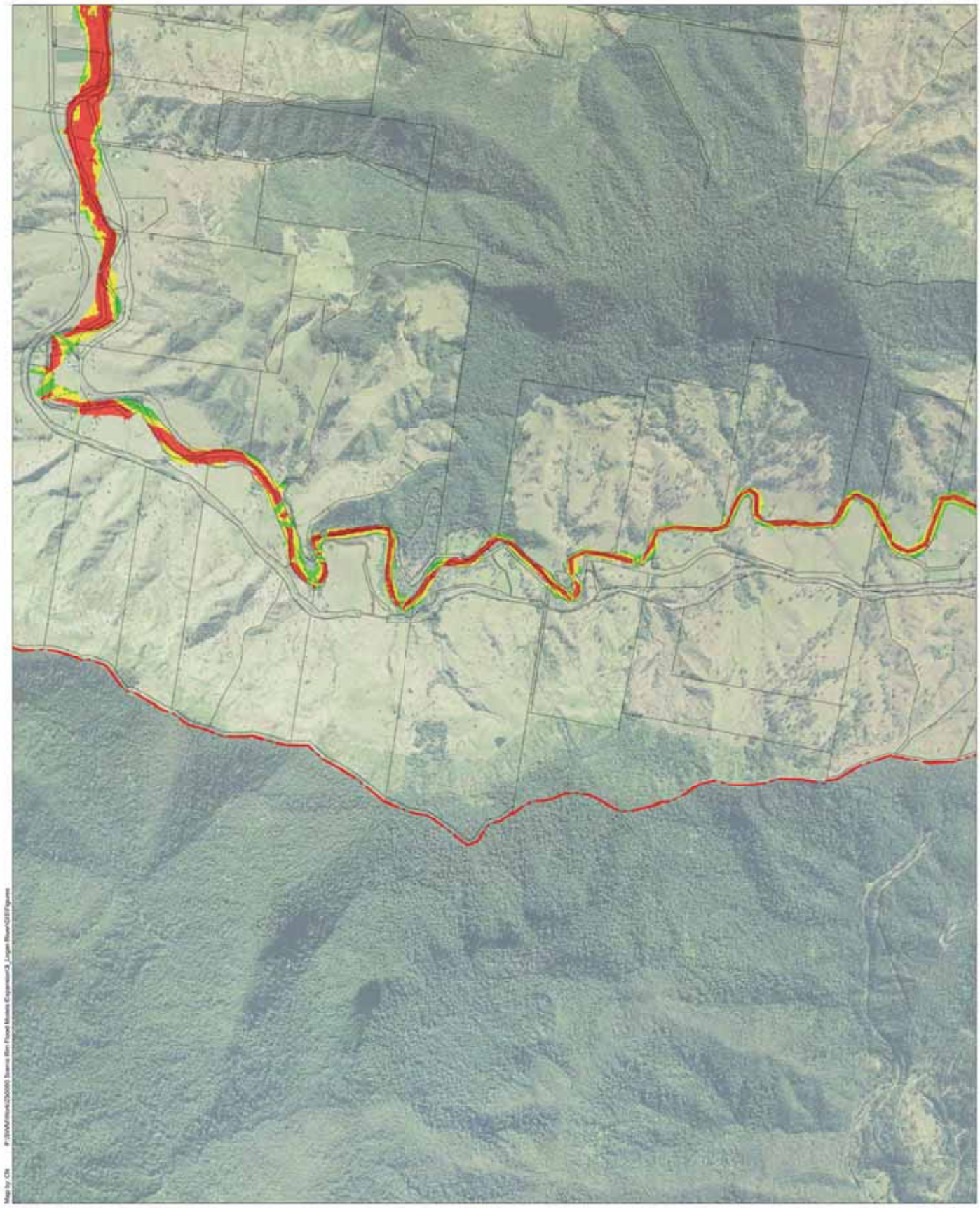
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-s

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

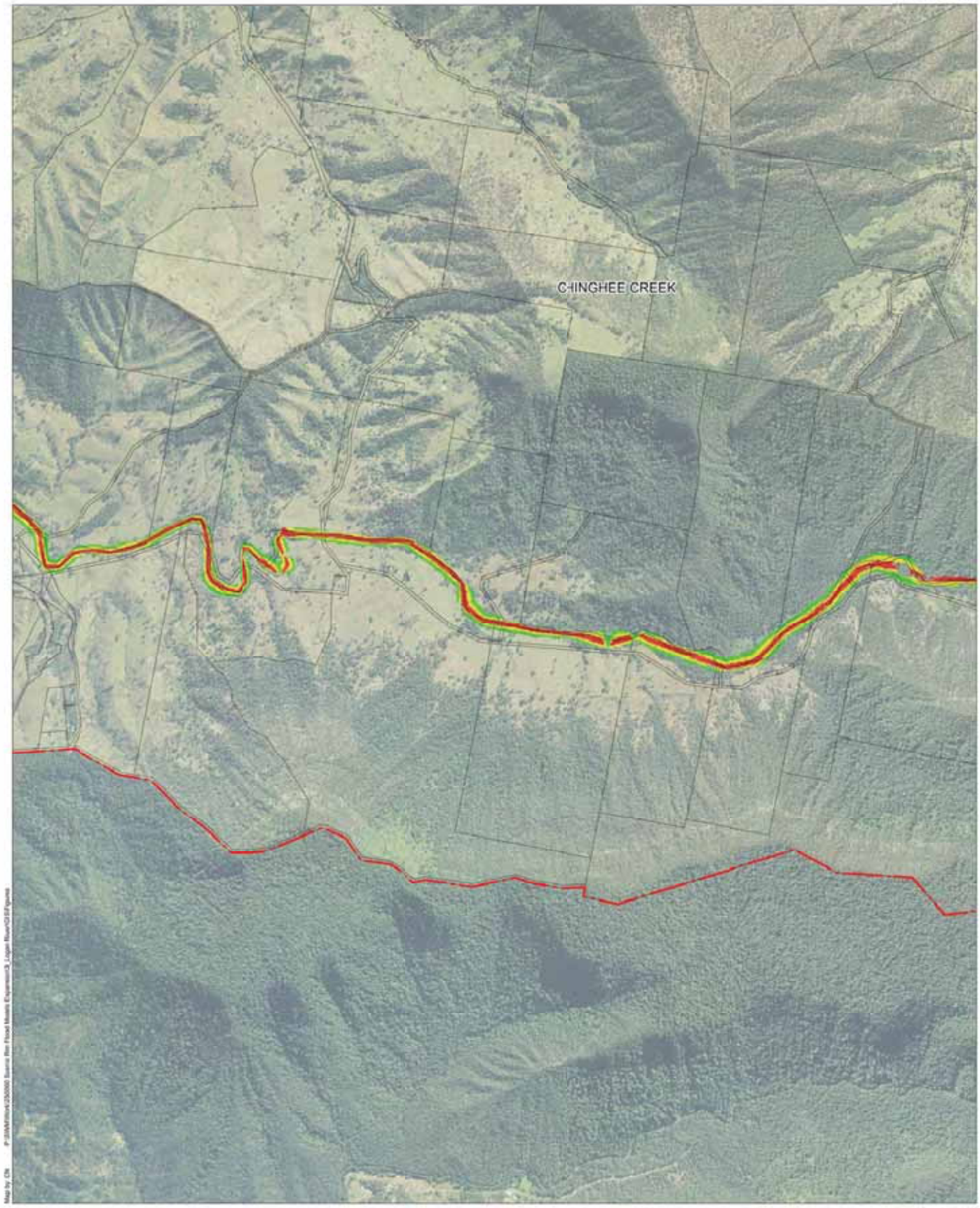
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Logan River Flood Study Figure B7-t

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

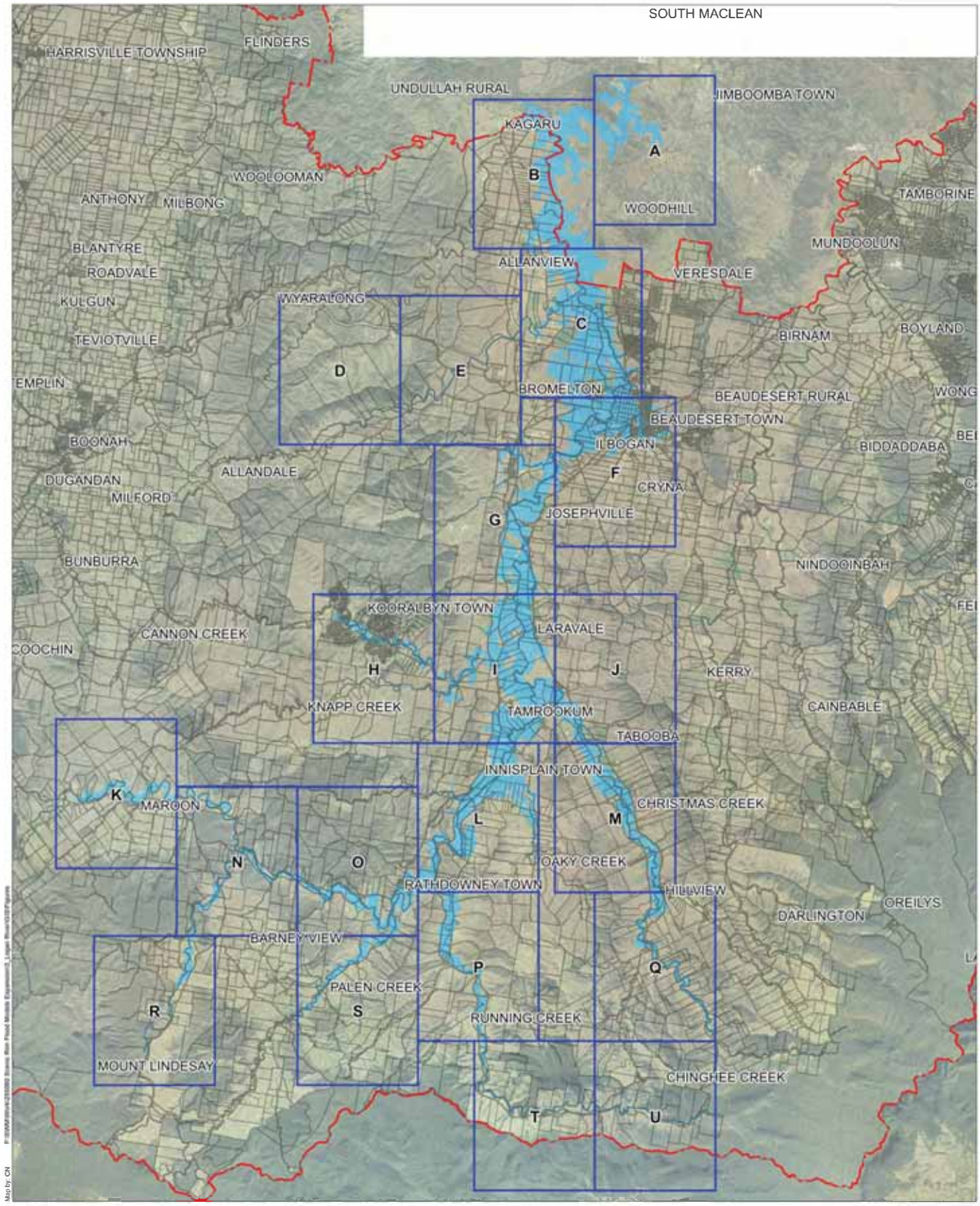
1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

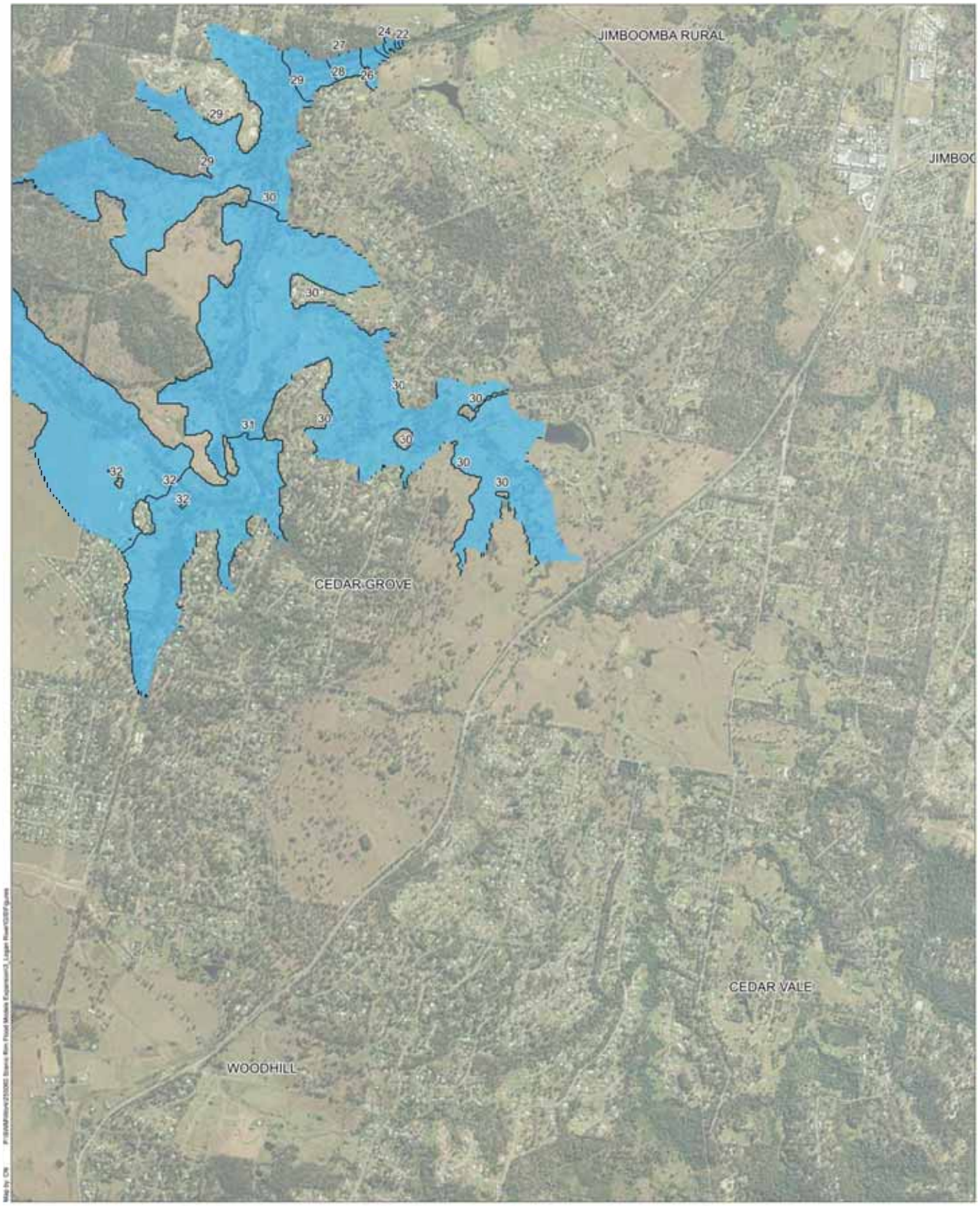
Logan River Flood Study Figure B7-u

1% AEP Event - Climate Change Scenario 4.5 Peak Hazard Map



Logan River Flood Study **Figure C1**

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

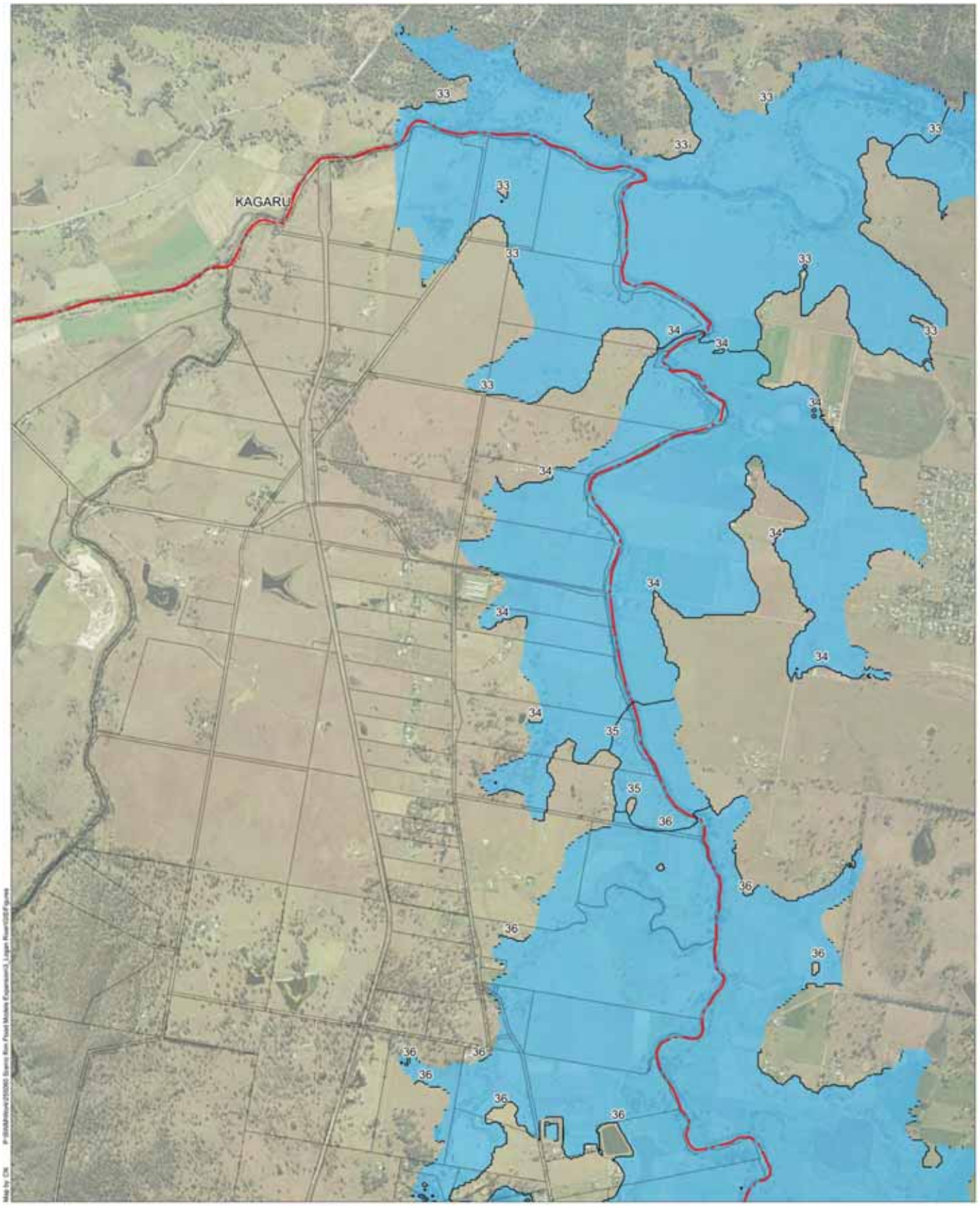
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-a

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

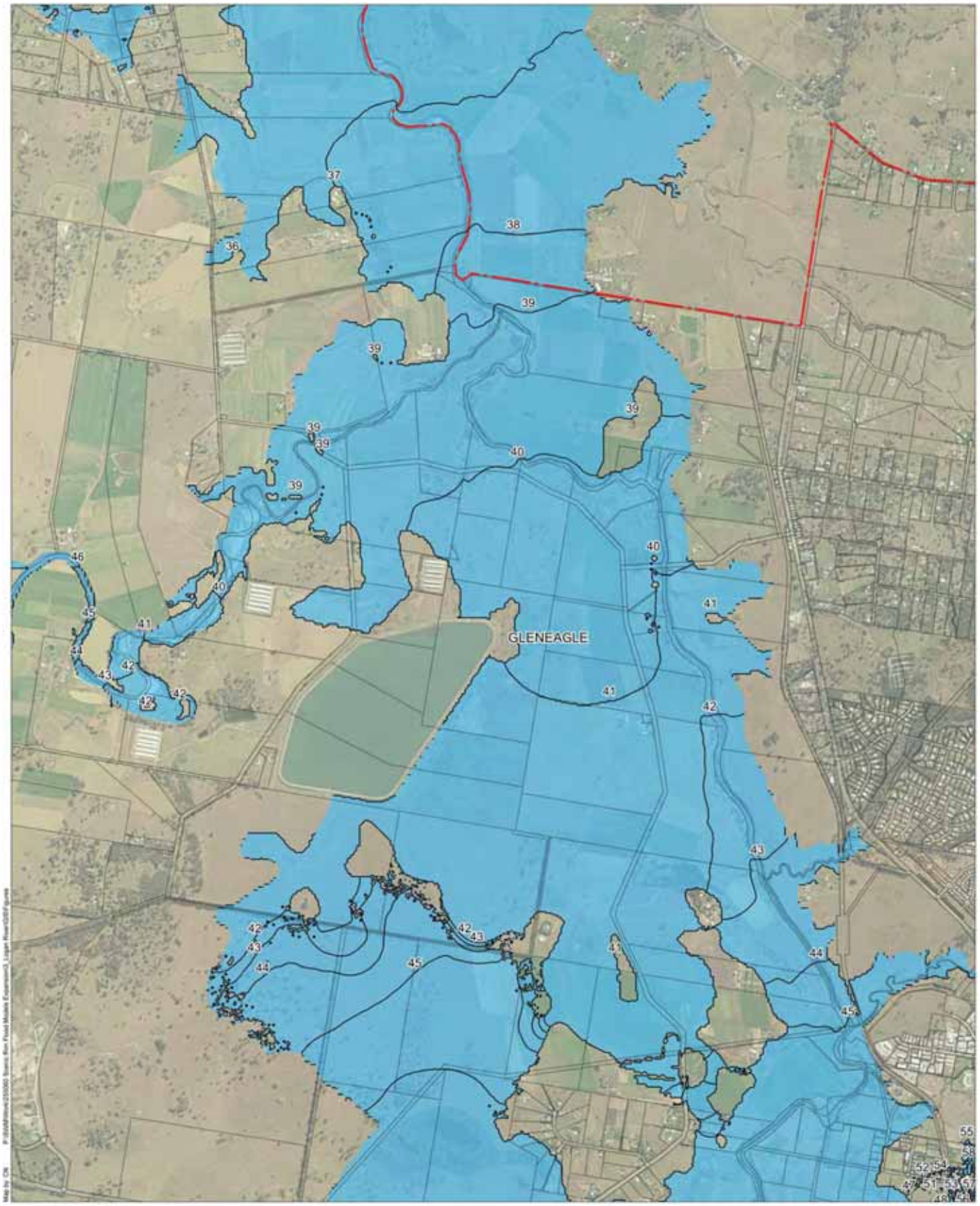
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-b

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

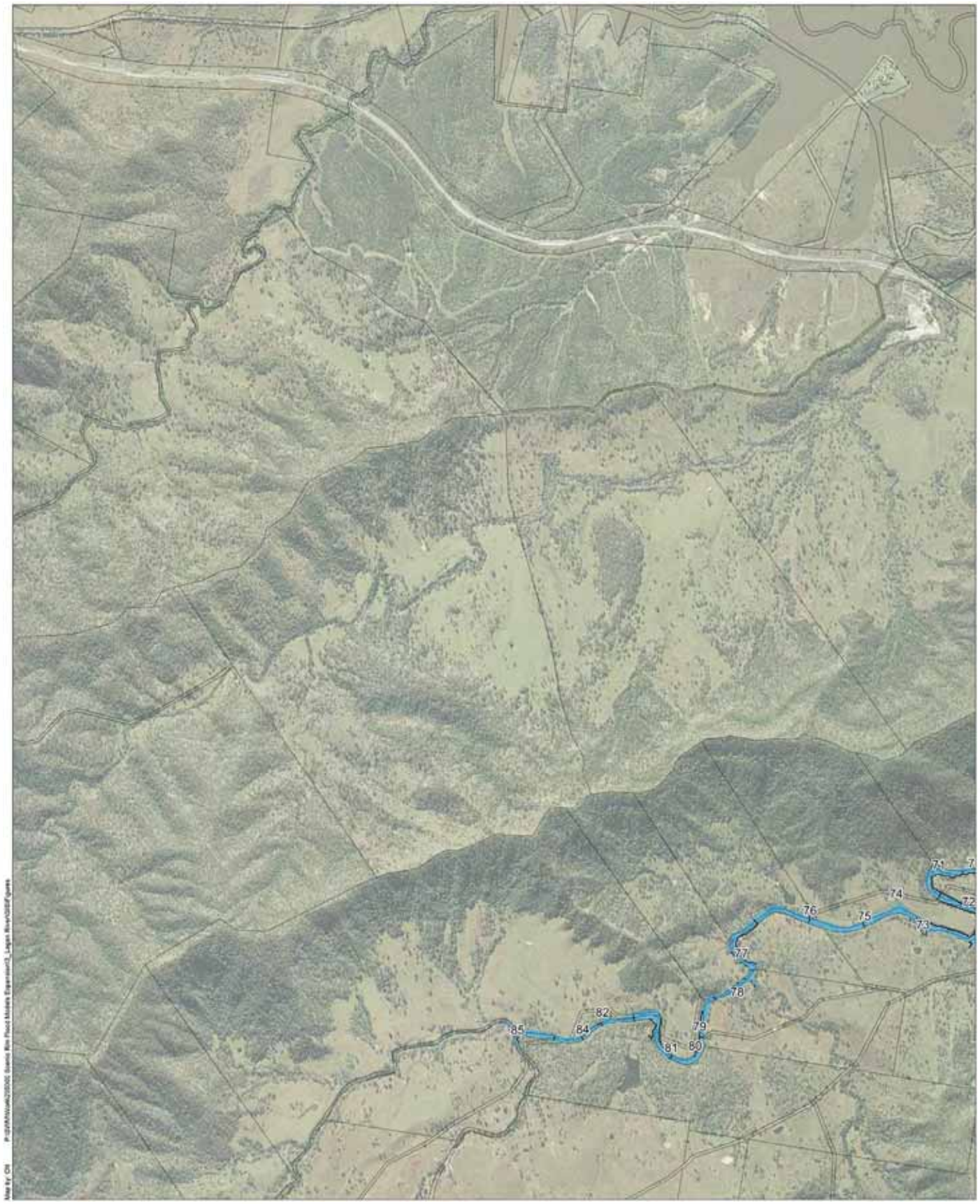
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-c

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

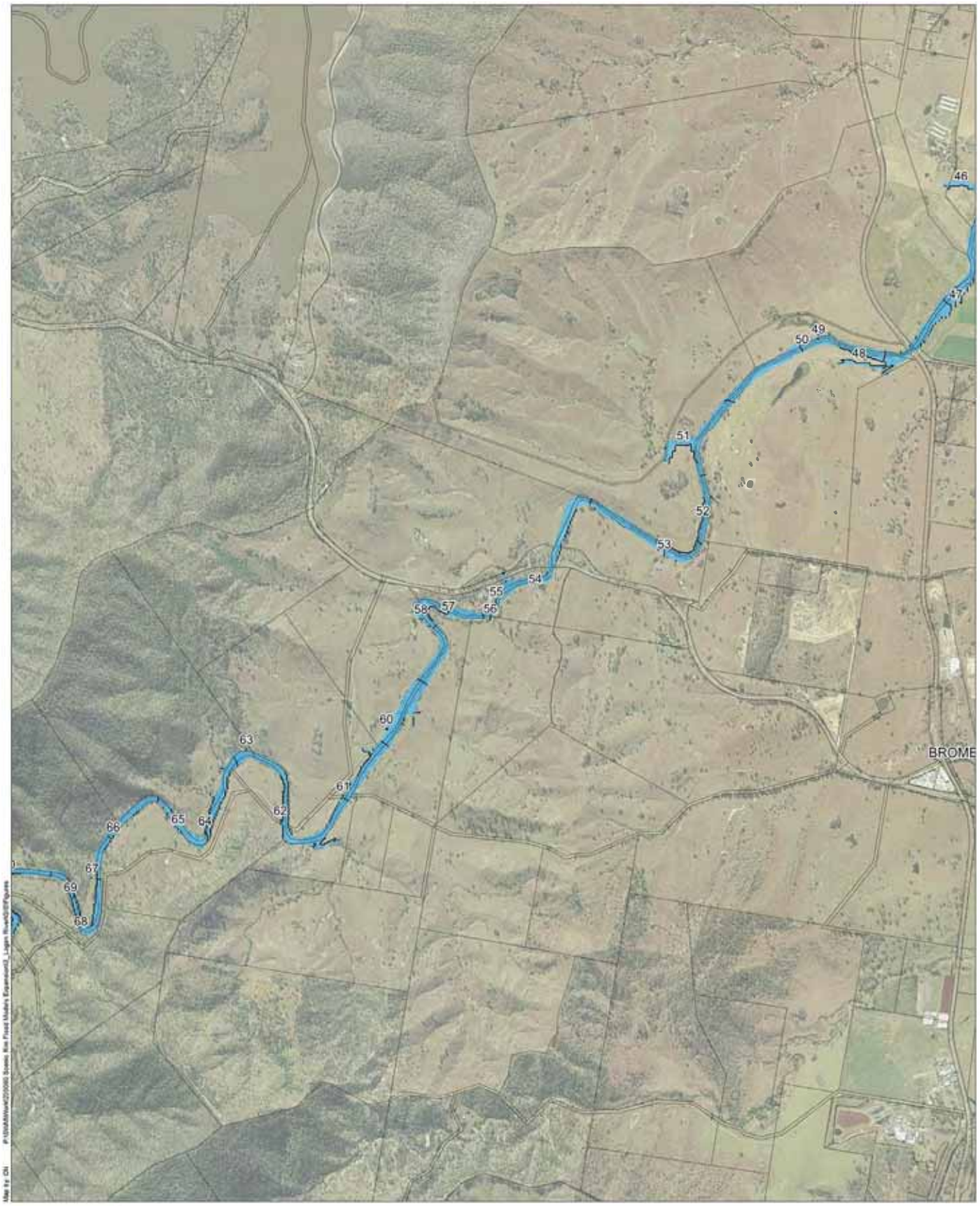
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-d

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

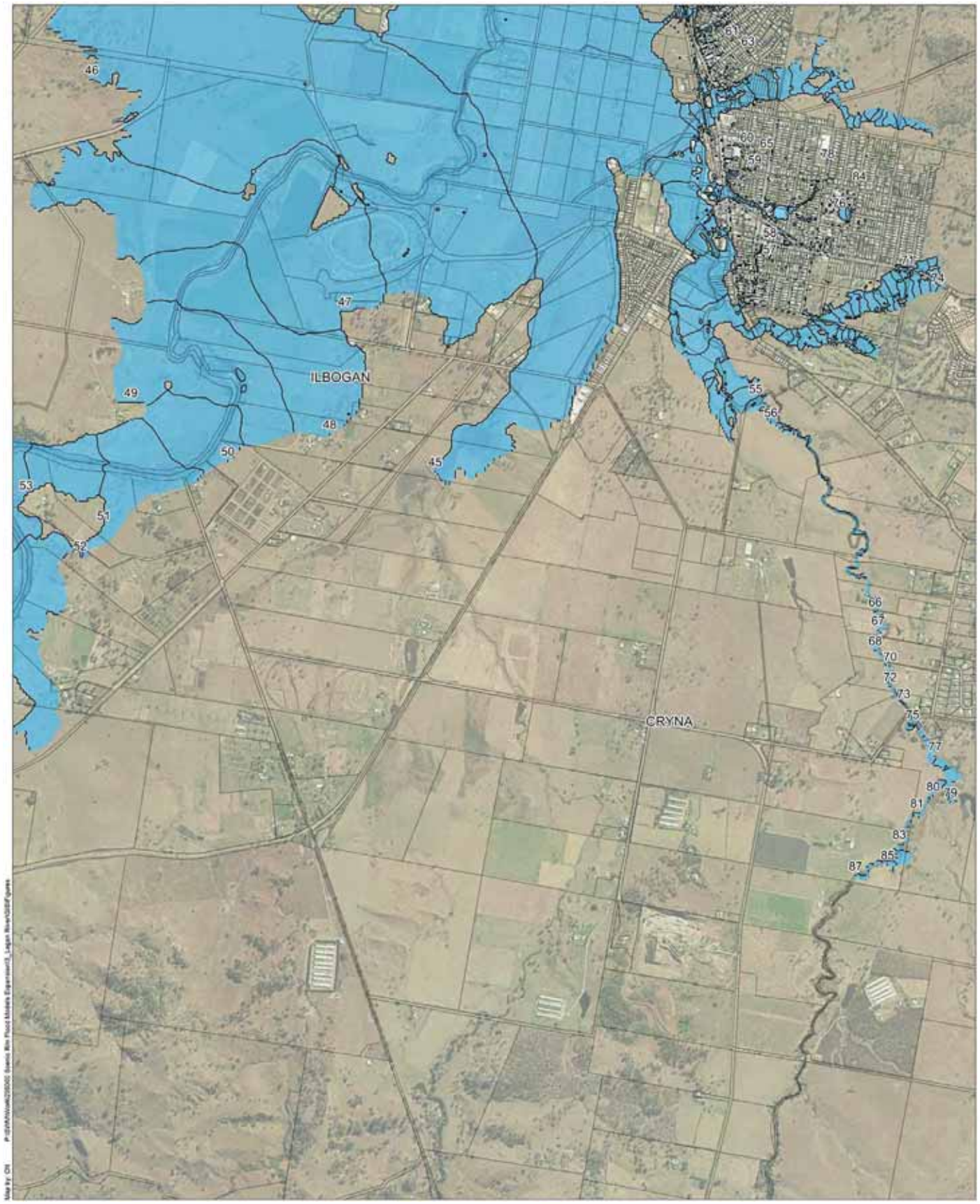
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-e

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

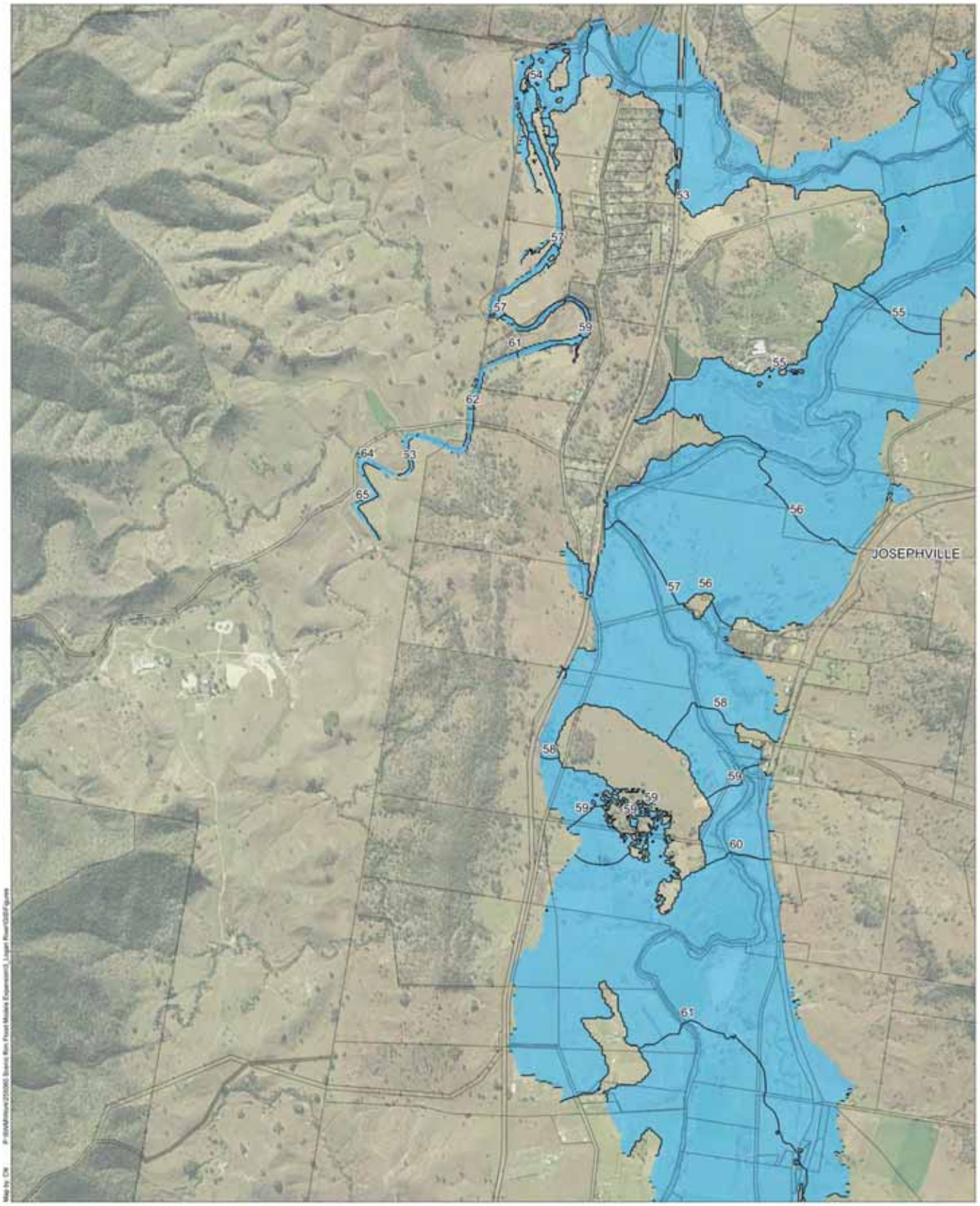
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-f

2% AEP Event - Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-g

2% AEP Event - Inundation Extent

Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

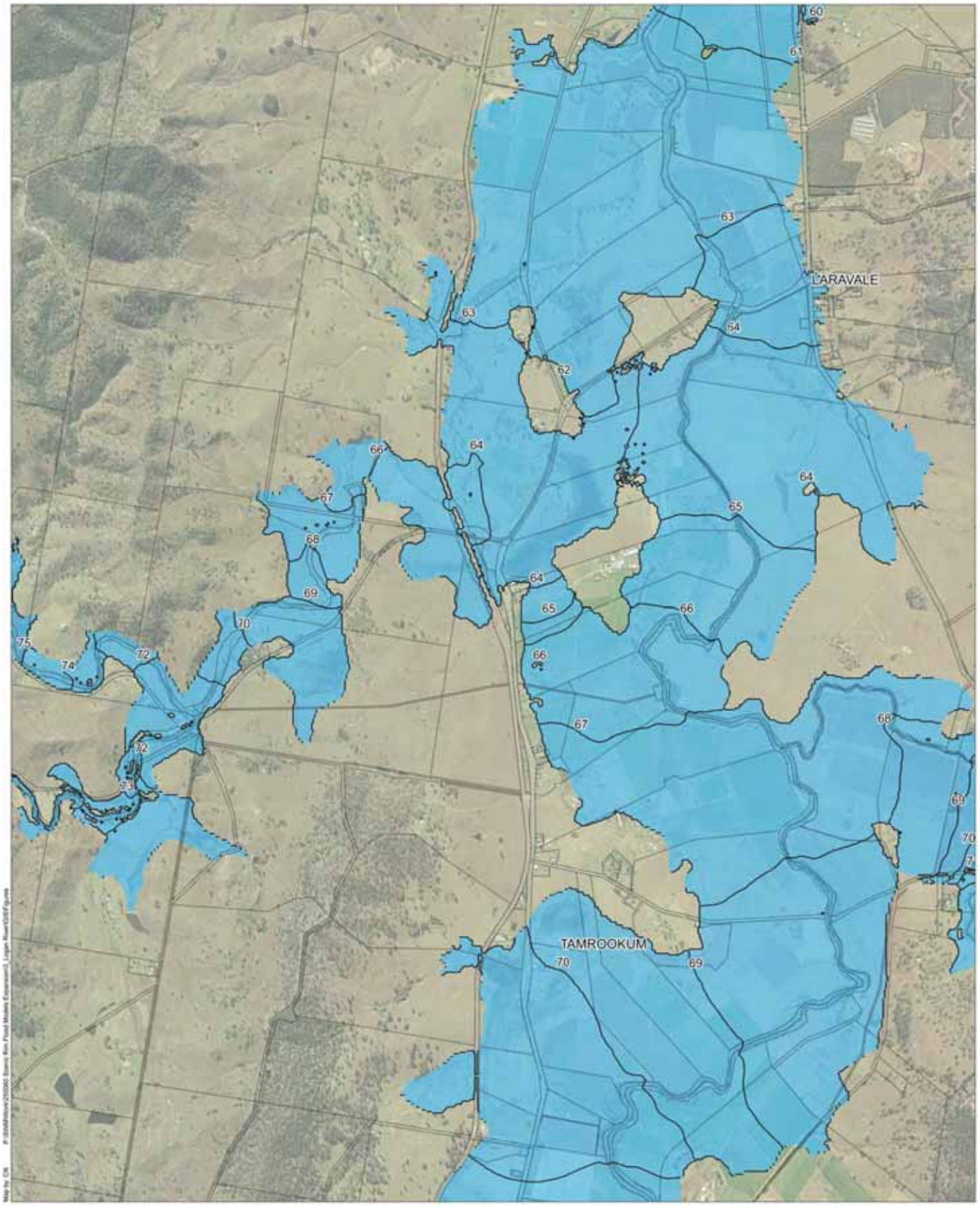
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-h

2% AEP Event - Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

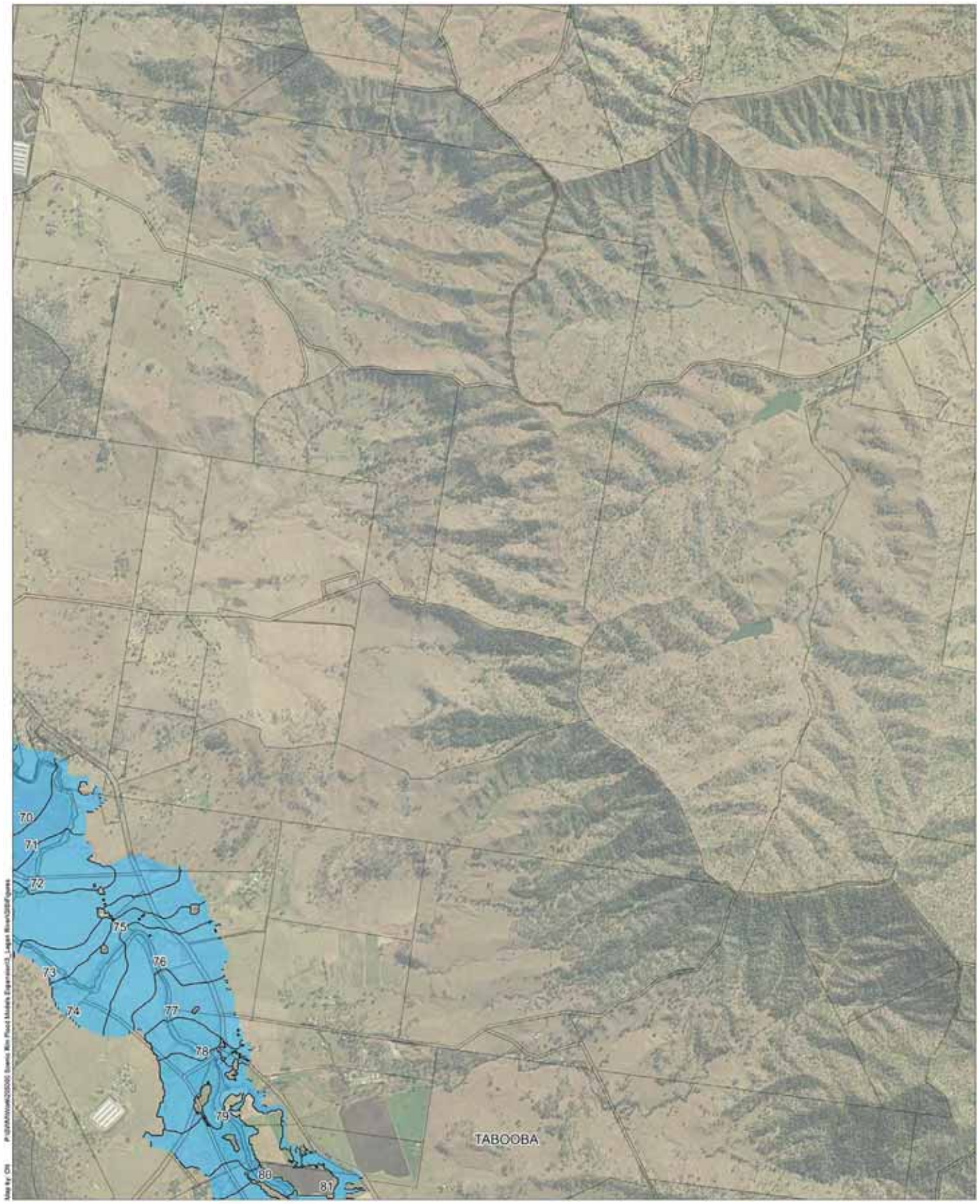
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-i

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

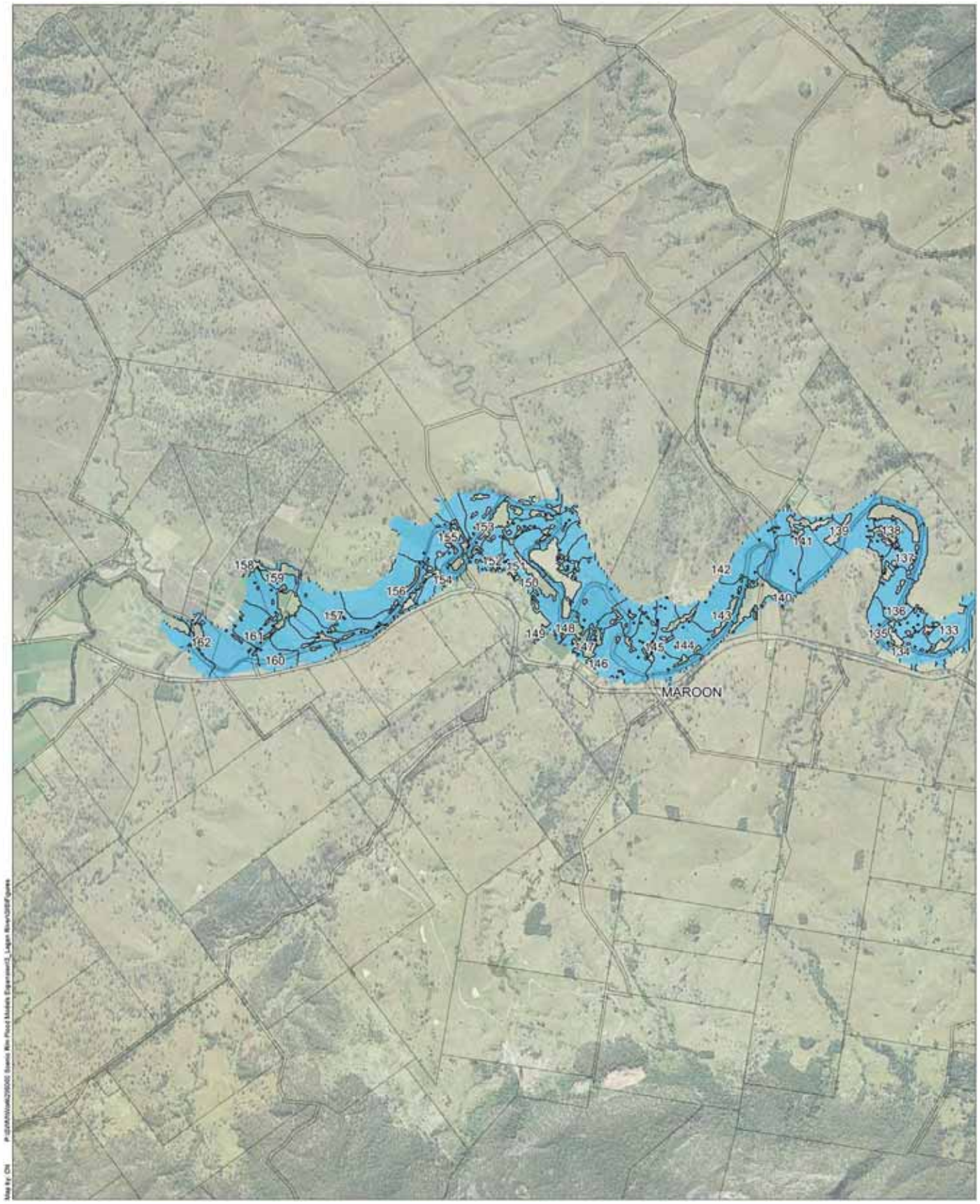
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure C1-j**

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

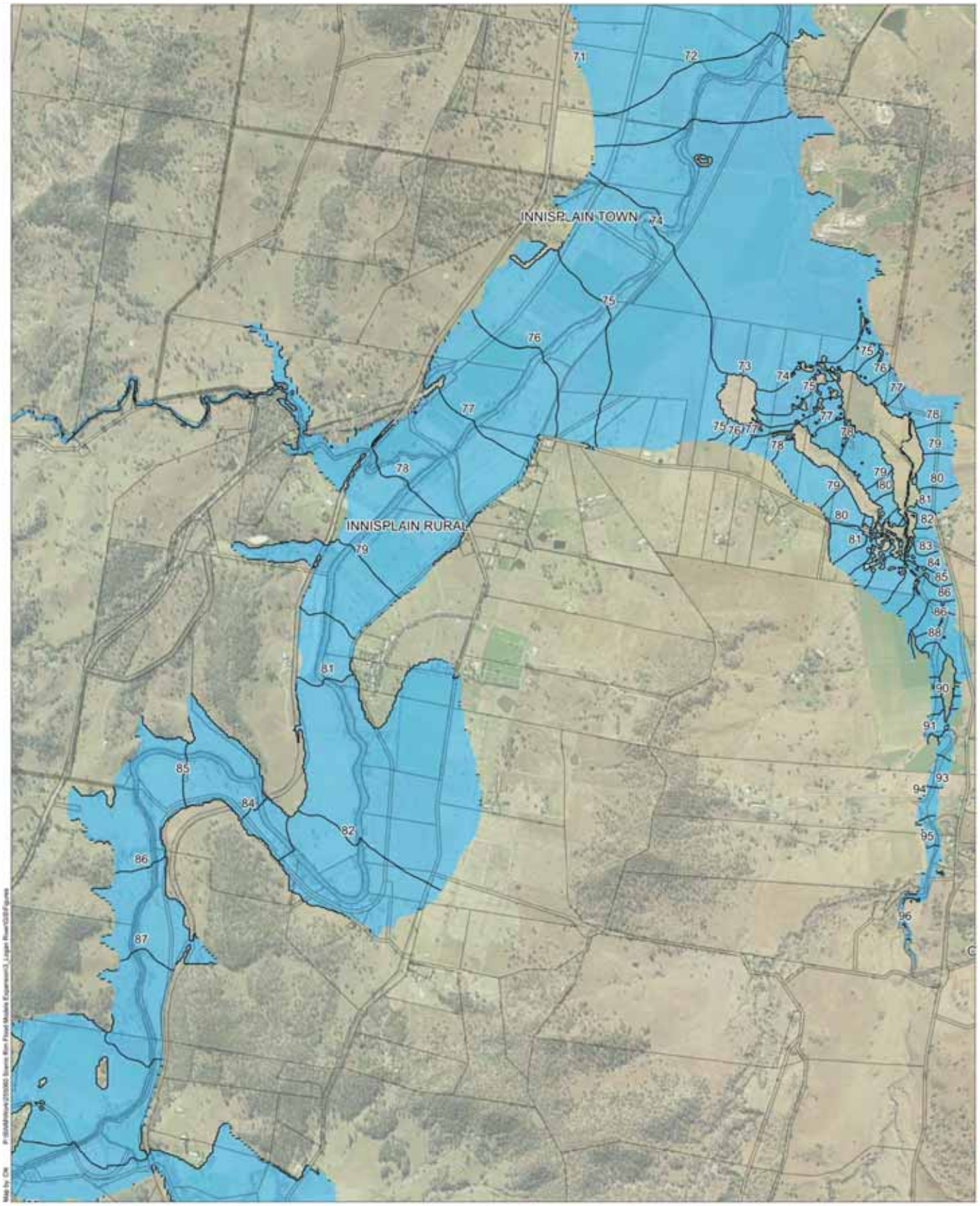
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-k

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

0 625 m 1,250 m

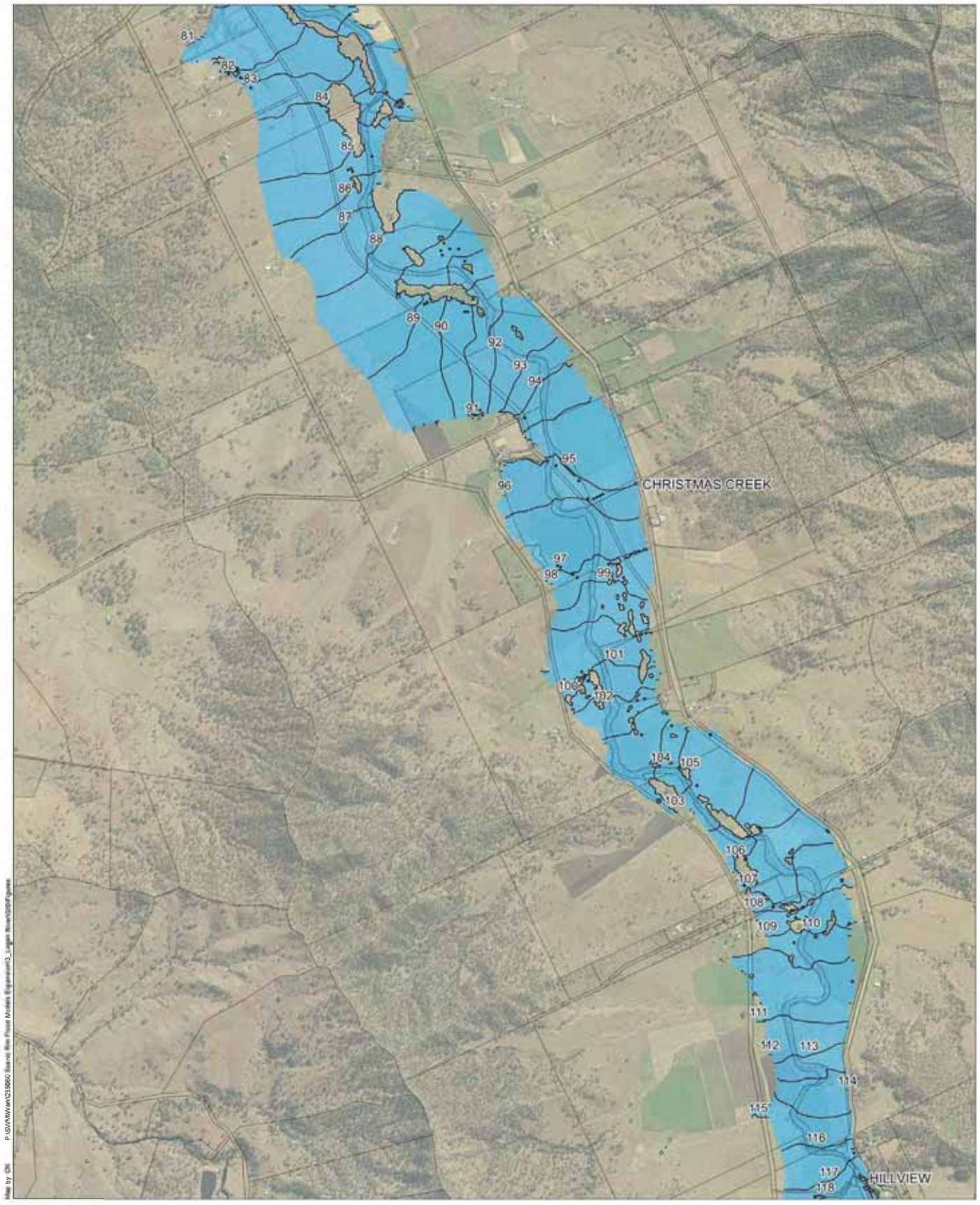
Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure C1-I**

2% AEP Event - Inundation Extent

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

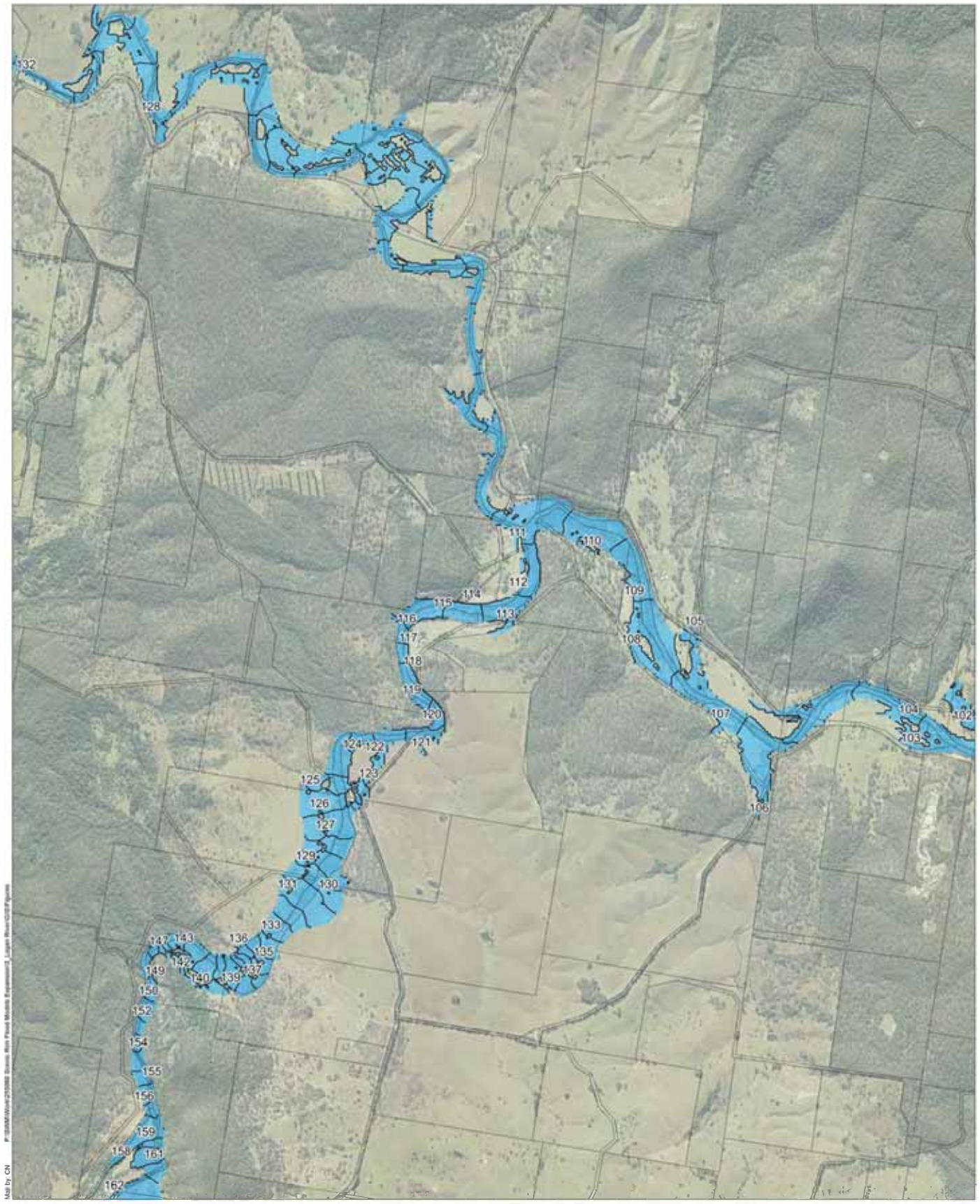
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-m

2% AEP Event - Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

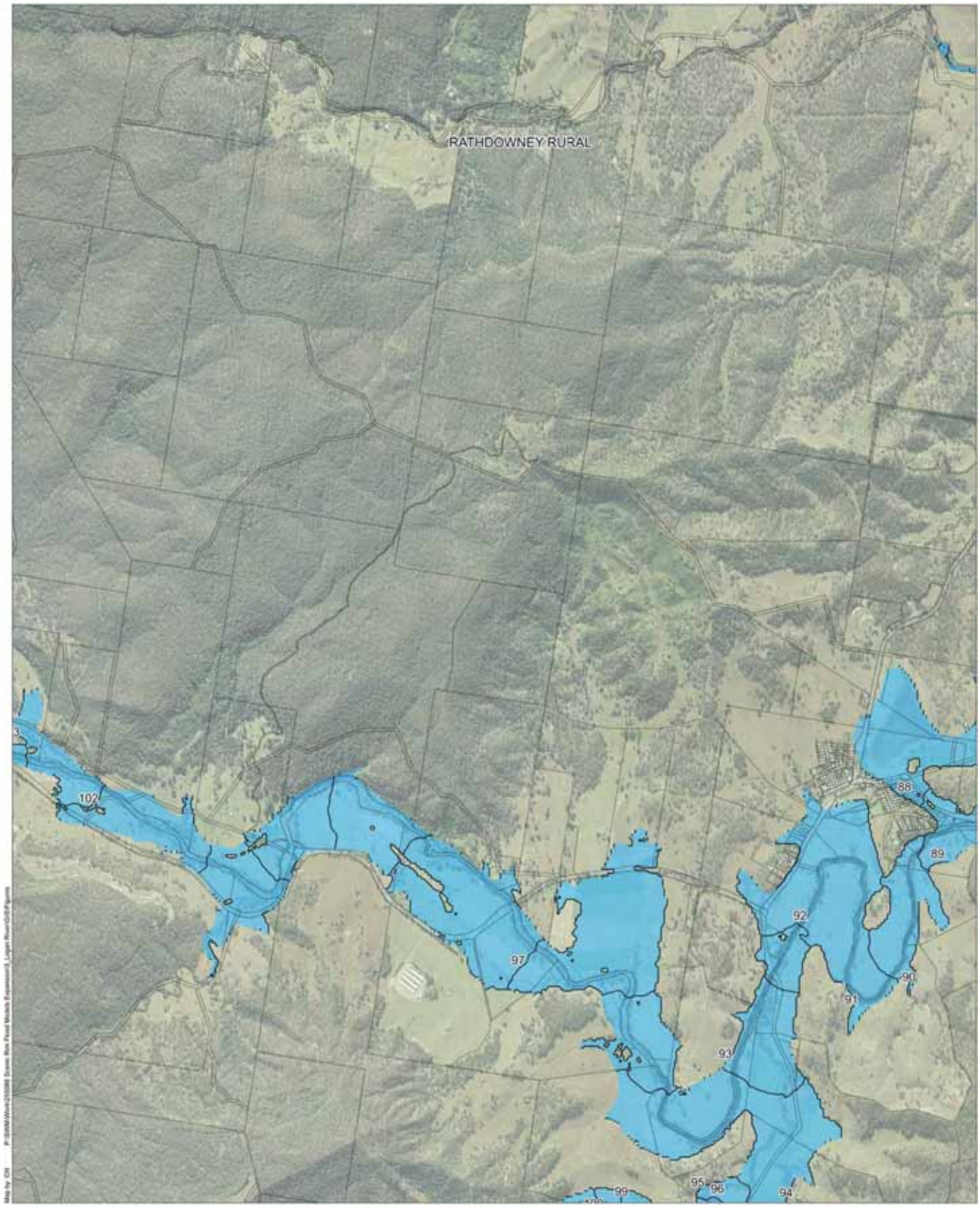
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-n

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

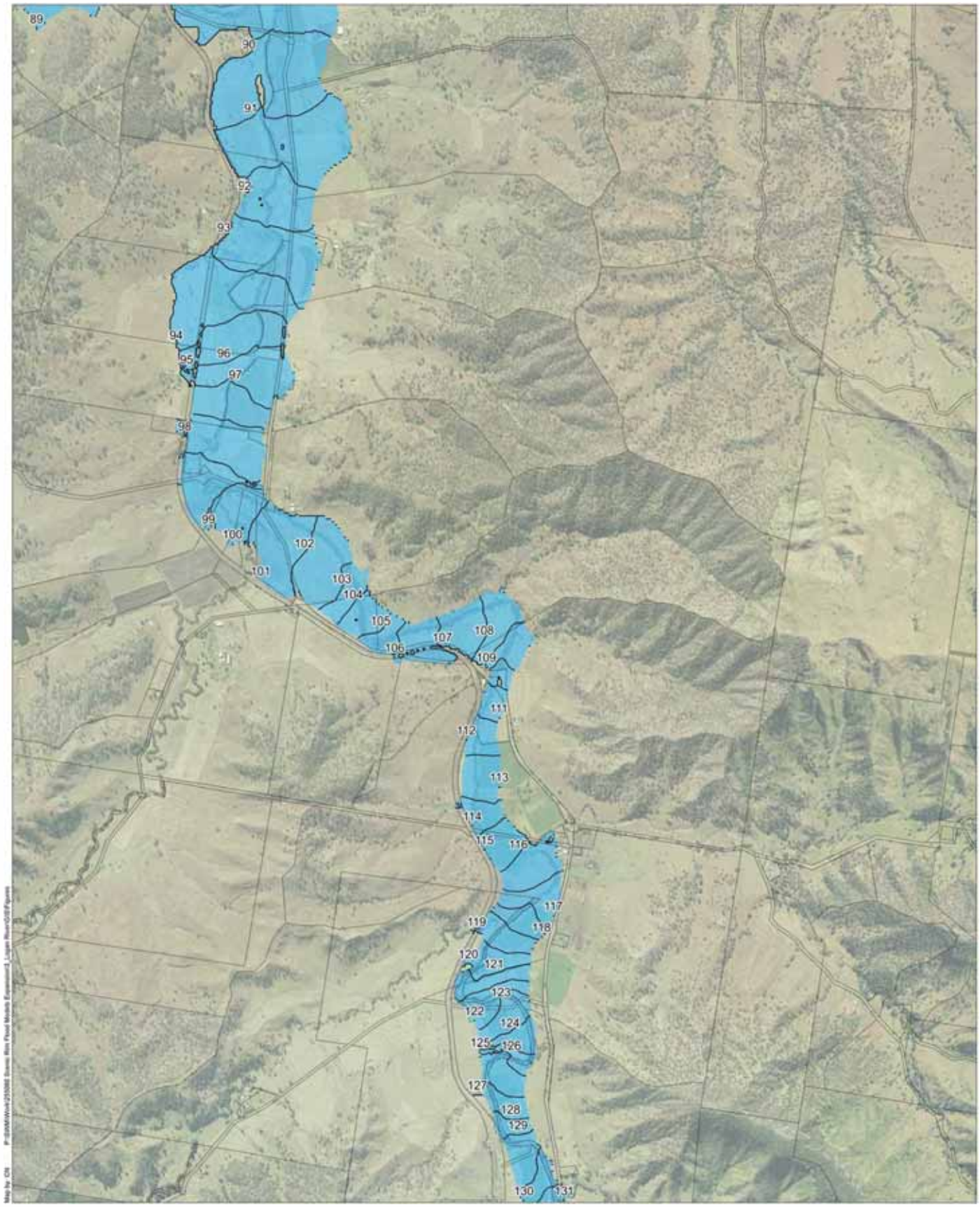
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure C1-o**

2% AEP Event - Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

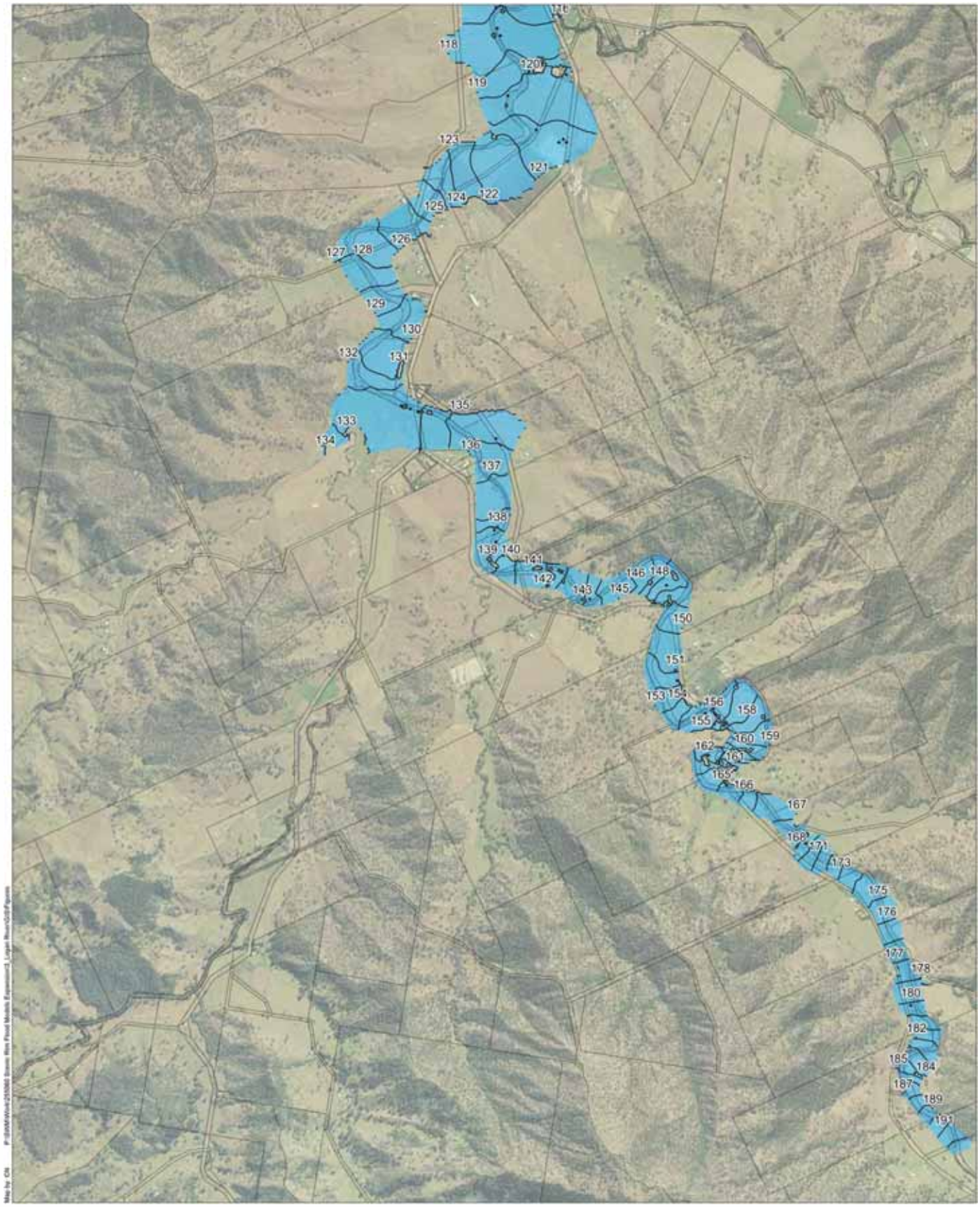
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-p

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

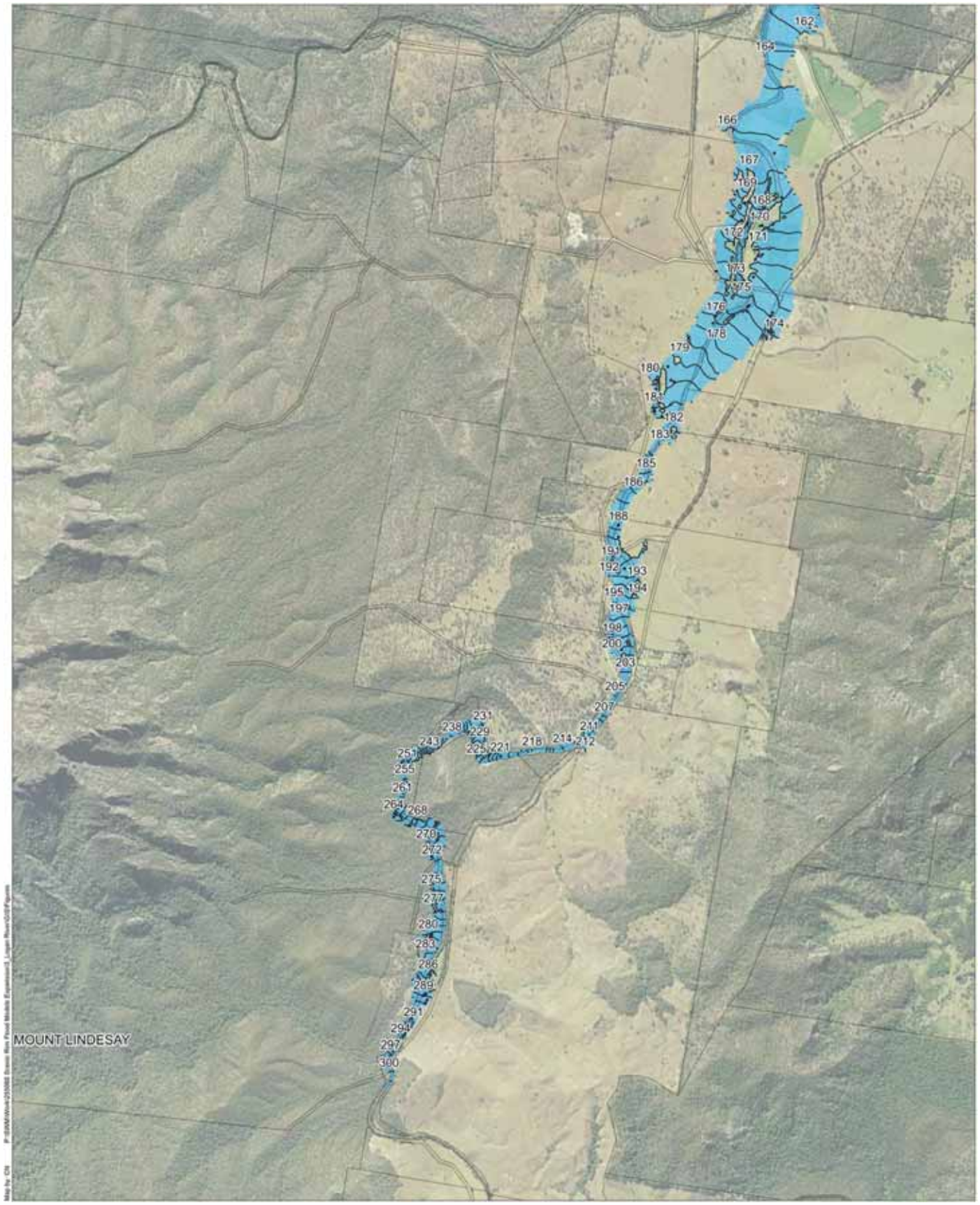
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-q

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

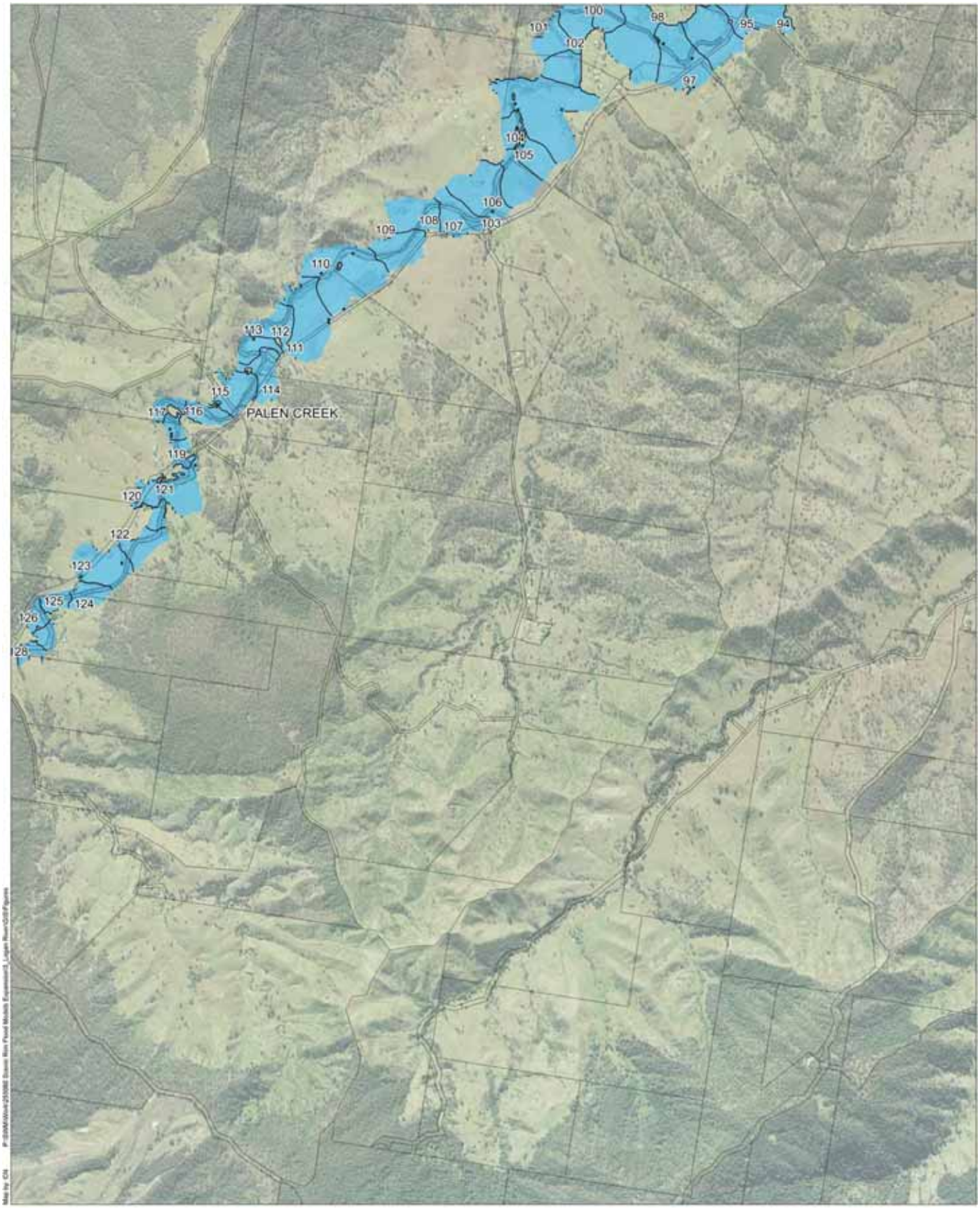
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-r

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

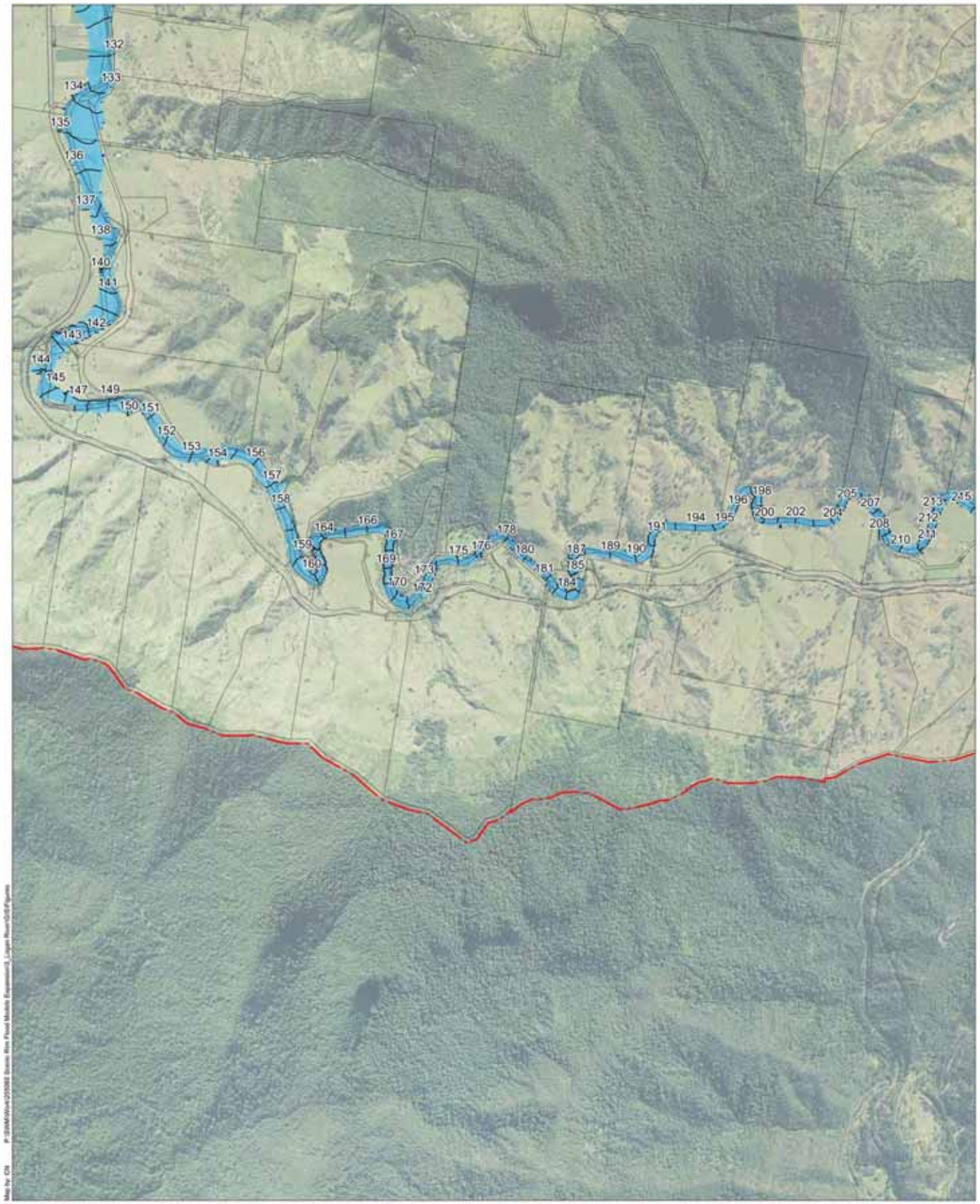
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-s

2% AEP Event - Inundation Extent



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes

1:25,000

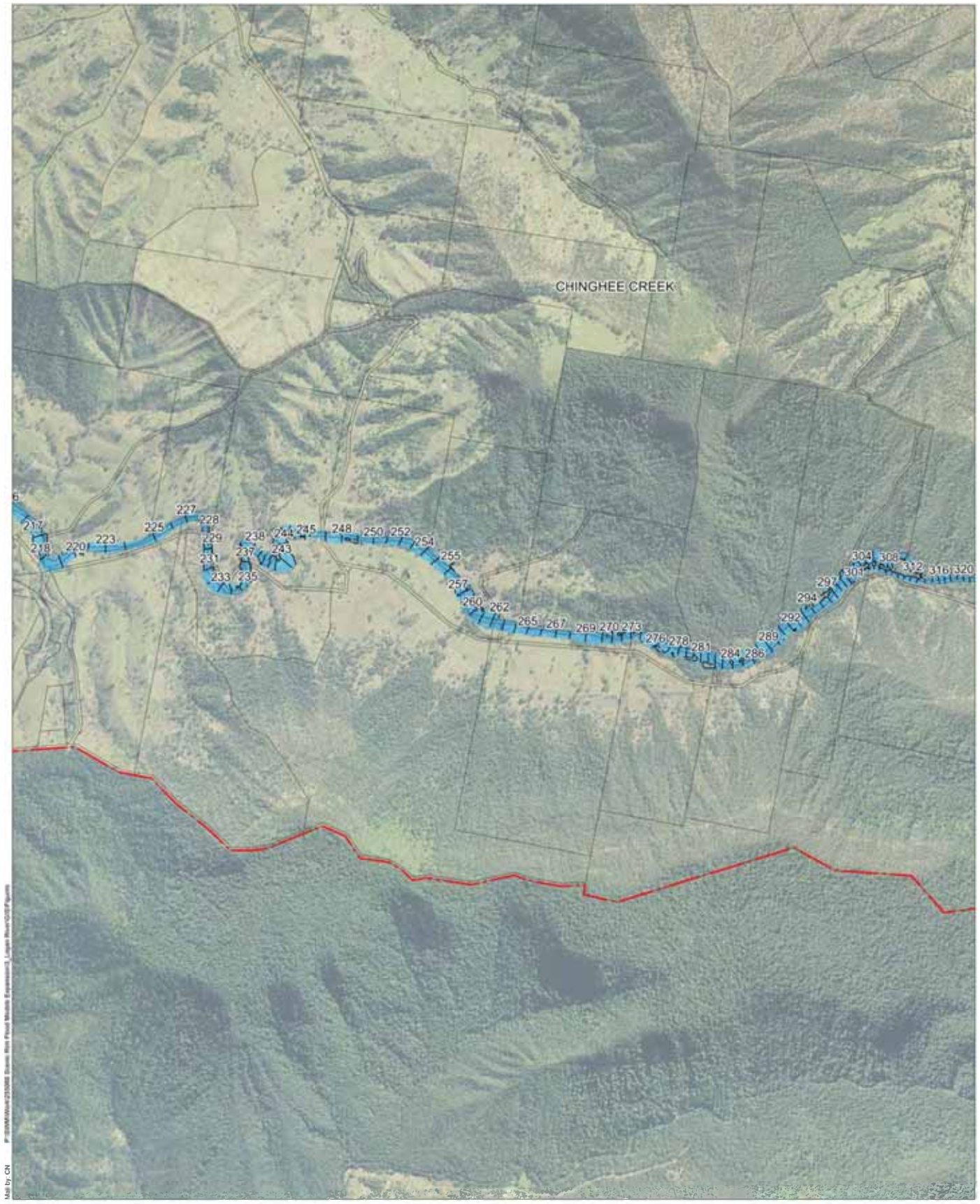
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C1-t

2% AEP Event - Inundation Extent



Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Peak Water level Contour (mAHD)

Notes:

1:25,000

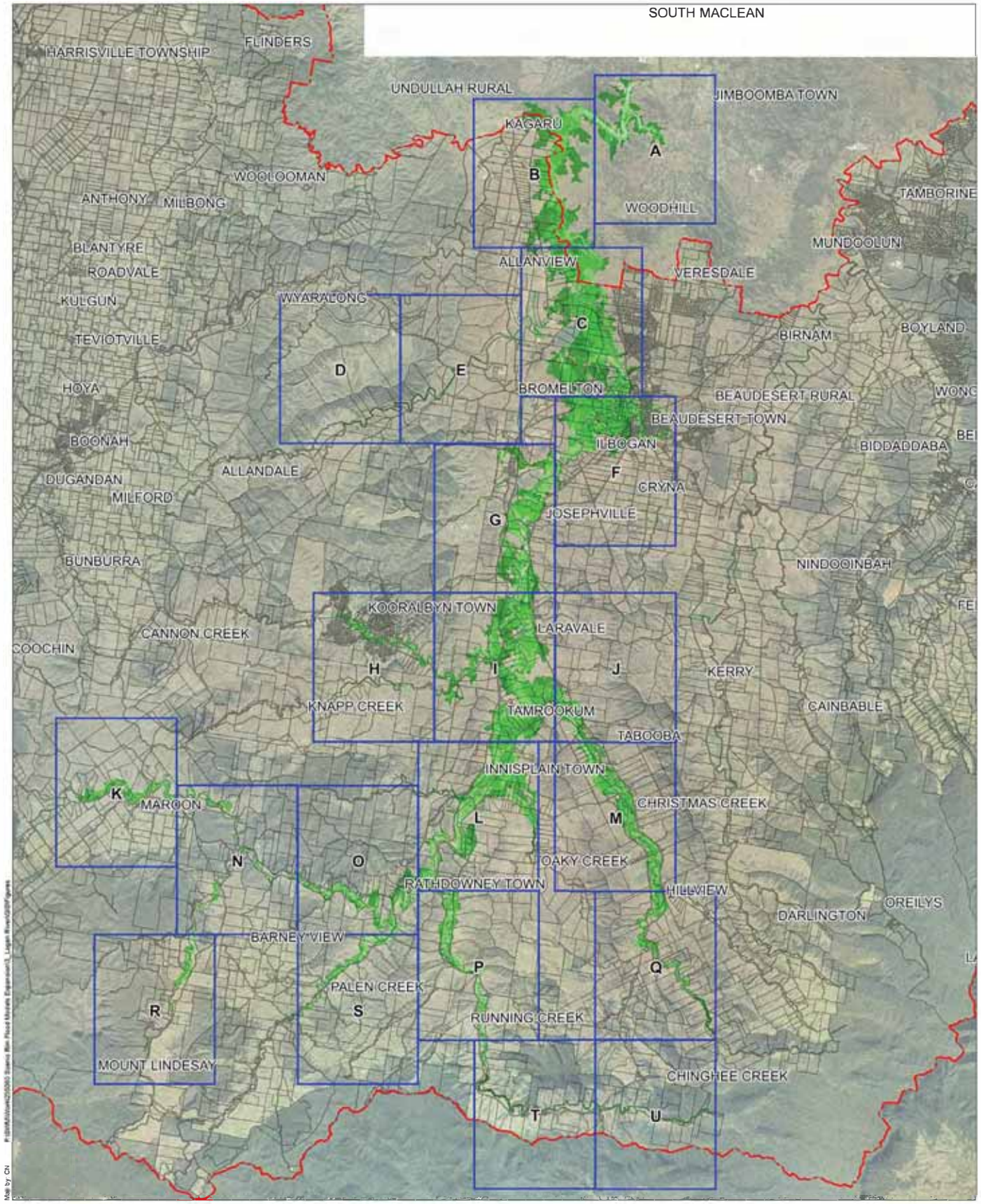
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

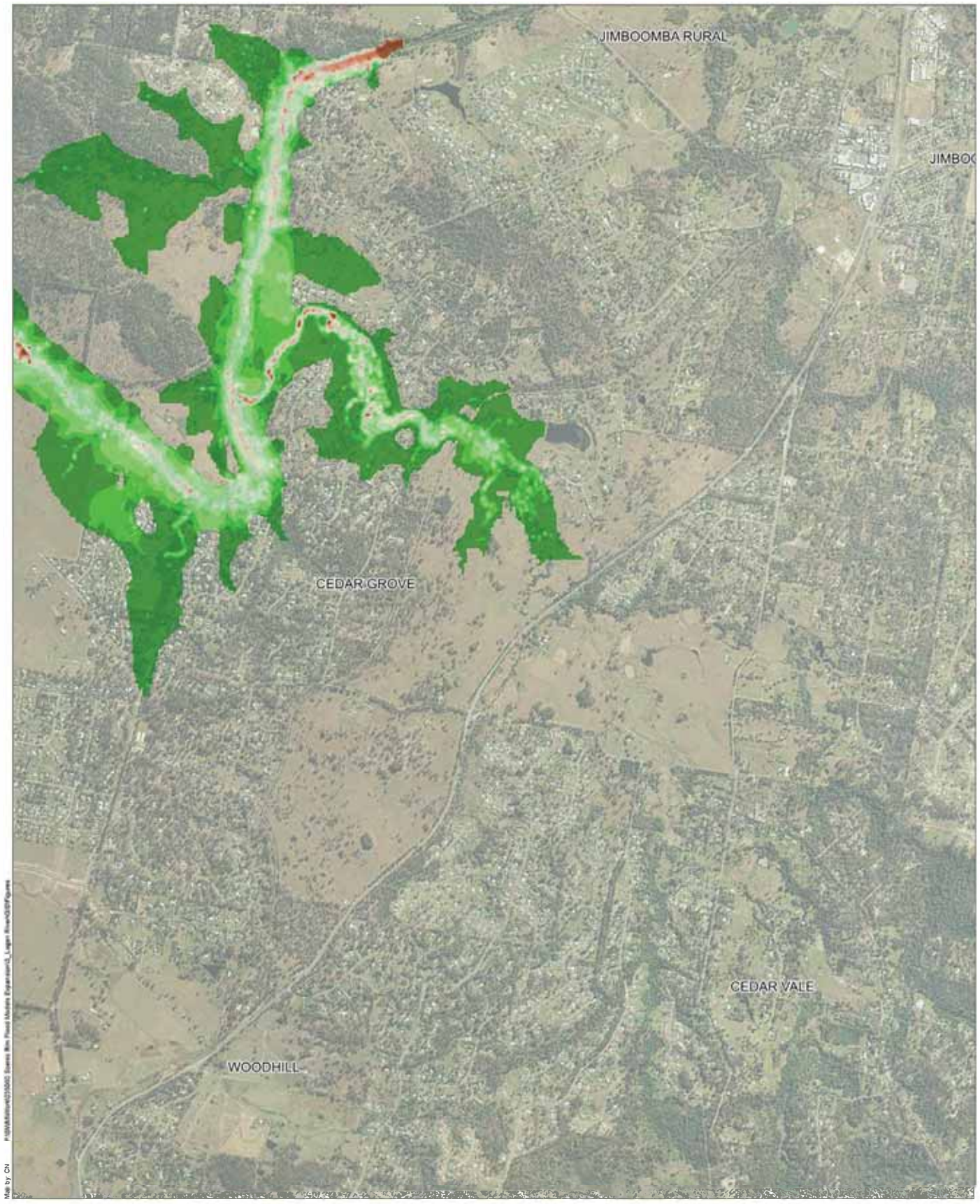
Logan River Flood Study Figure C1-u

2% AEP Event - Inundation Extent



Logan River Flood Study **Figure C2**

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

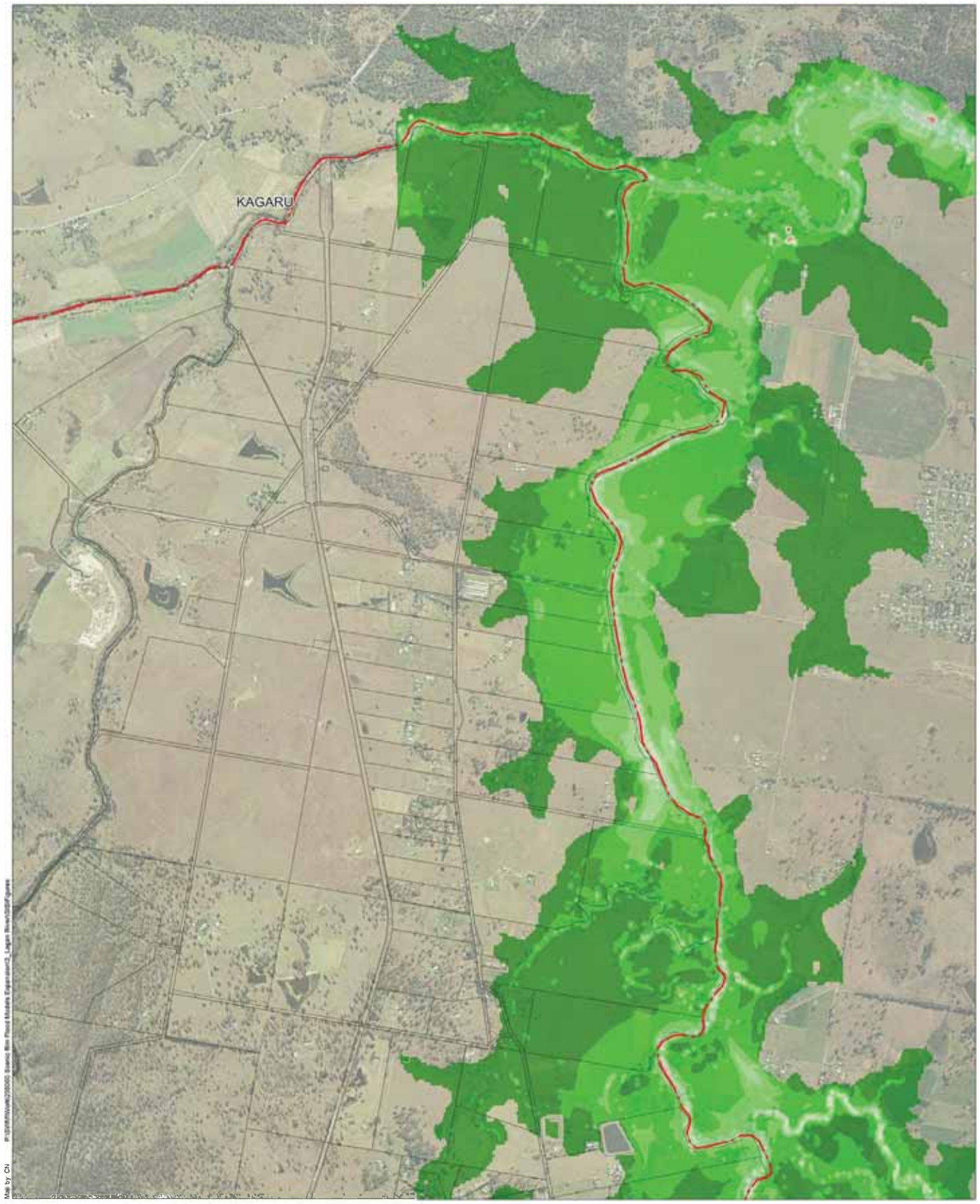
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-a

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

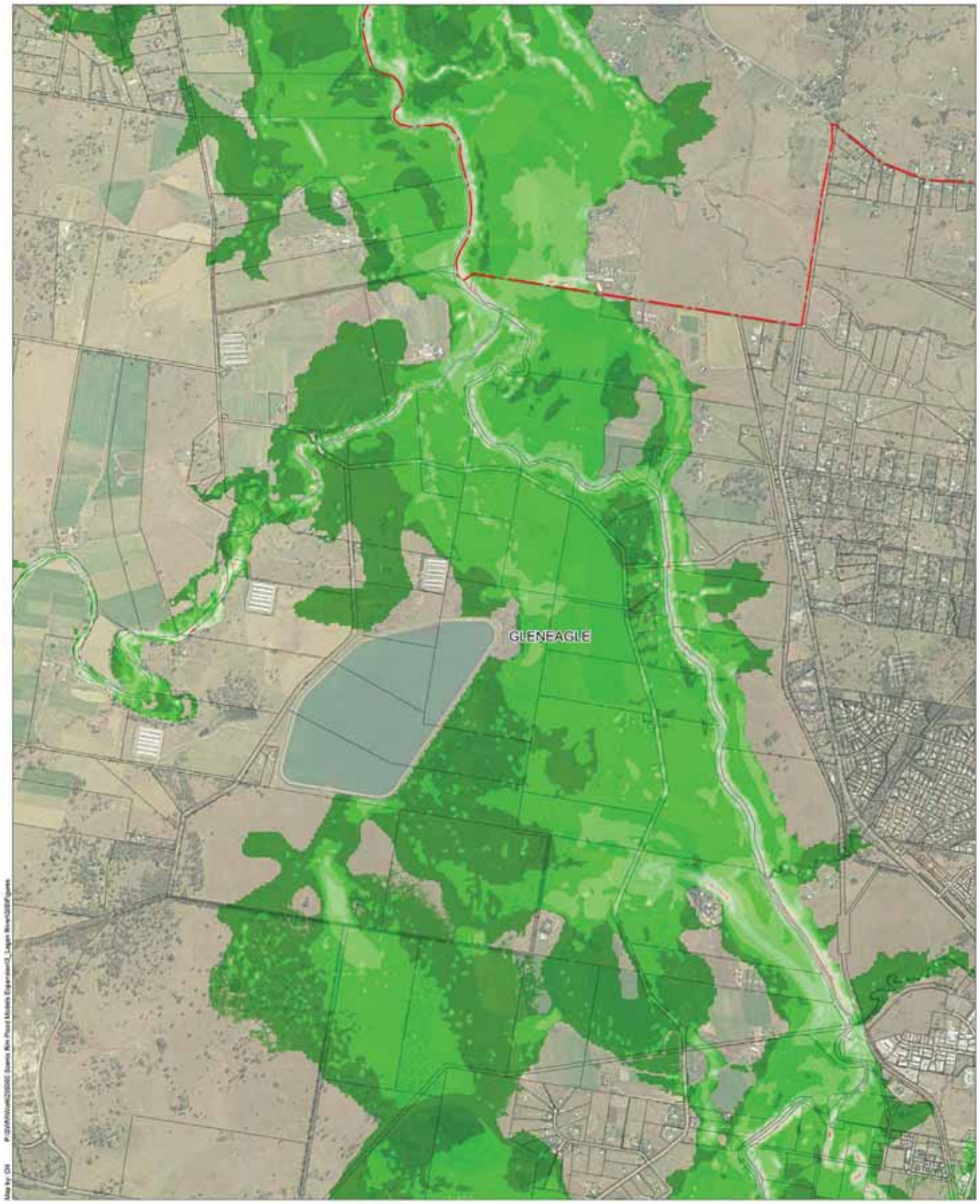
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-b

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

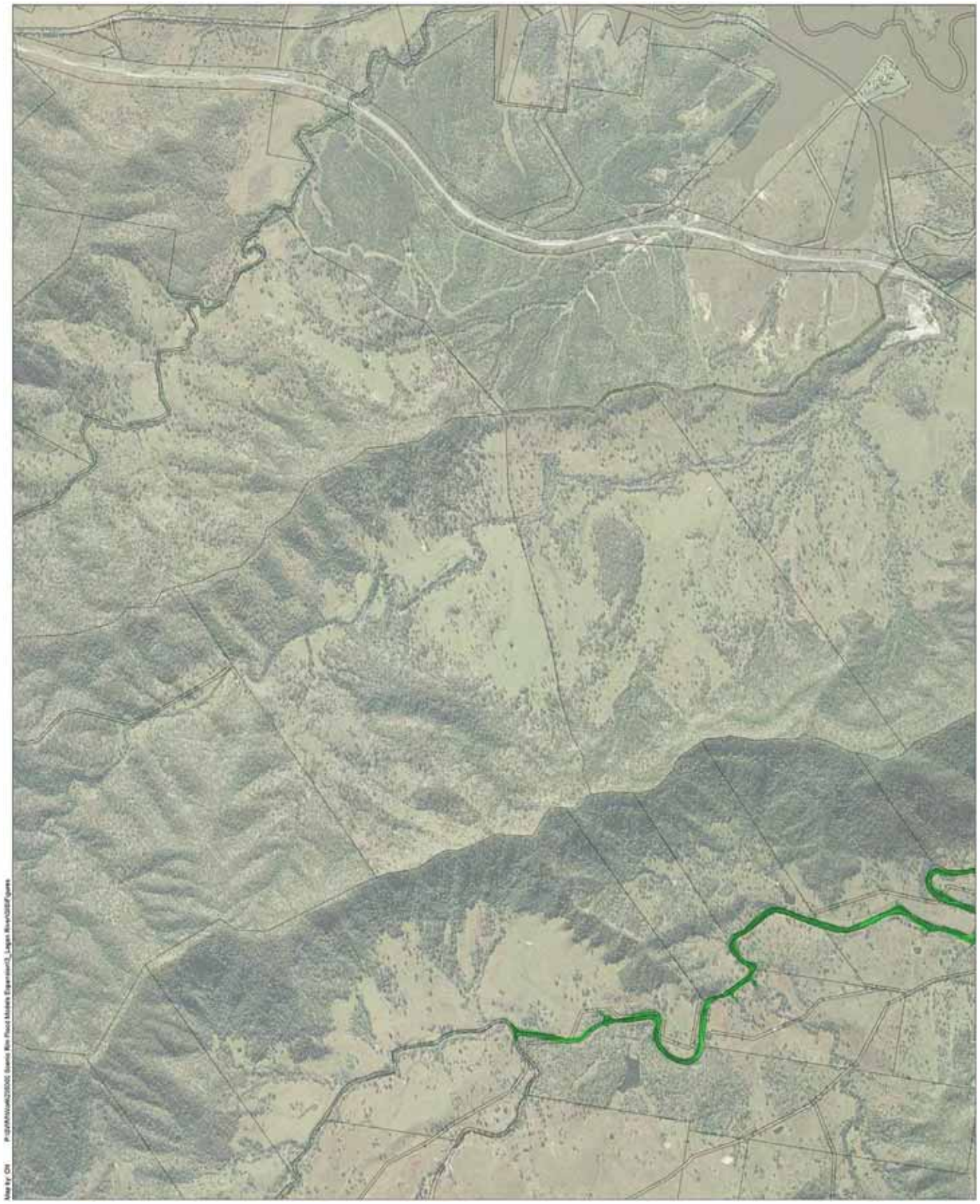
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-c

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

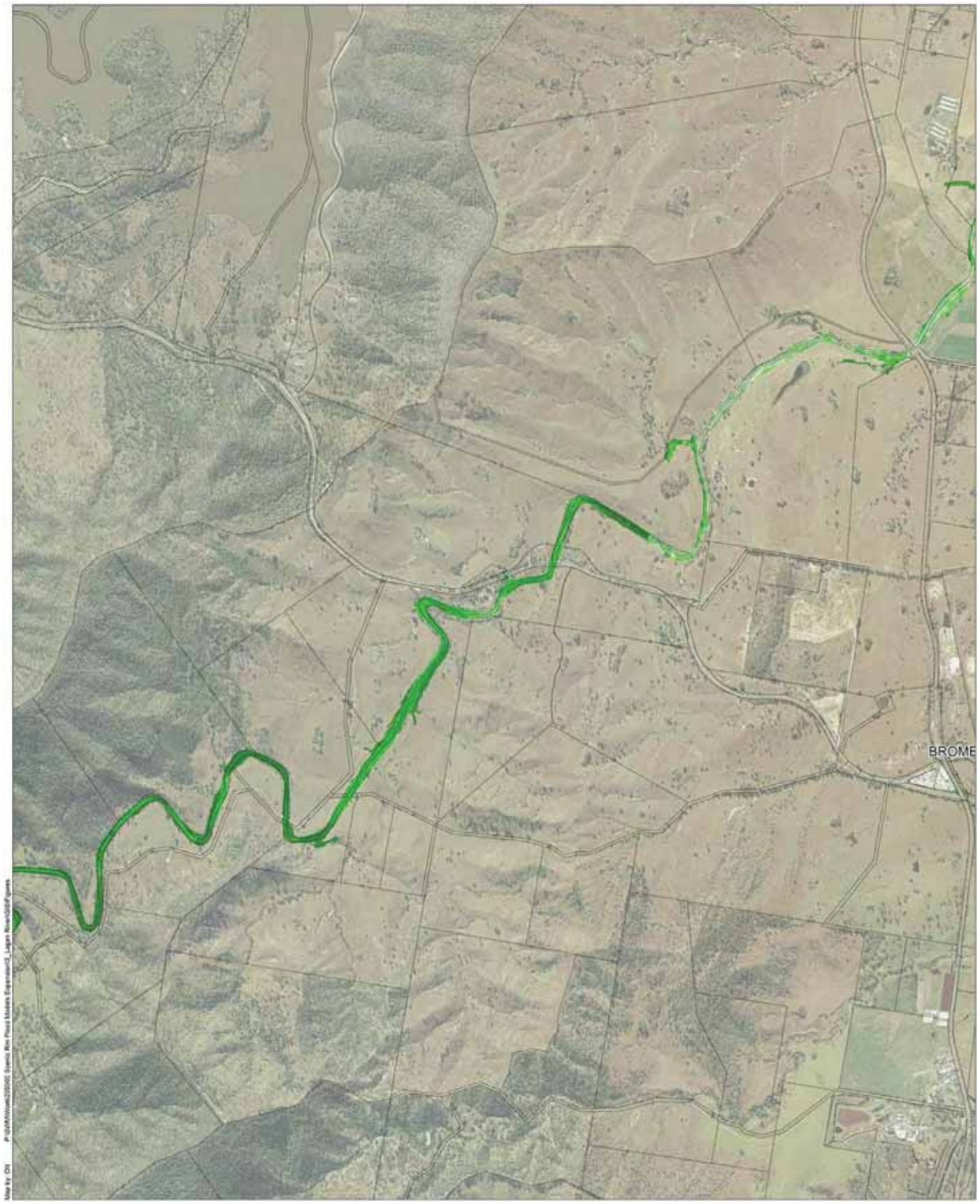
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-d

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

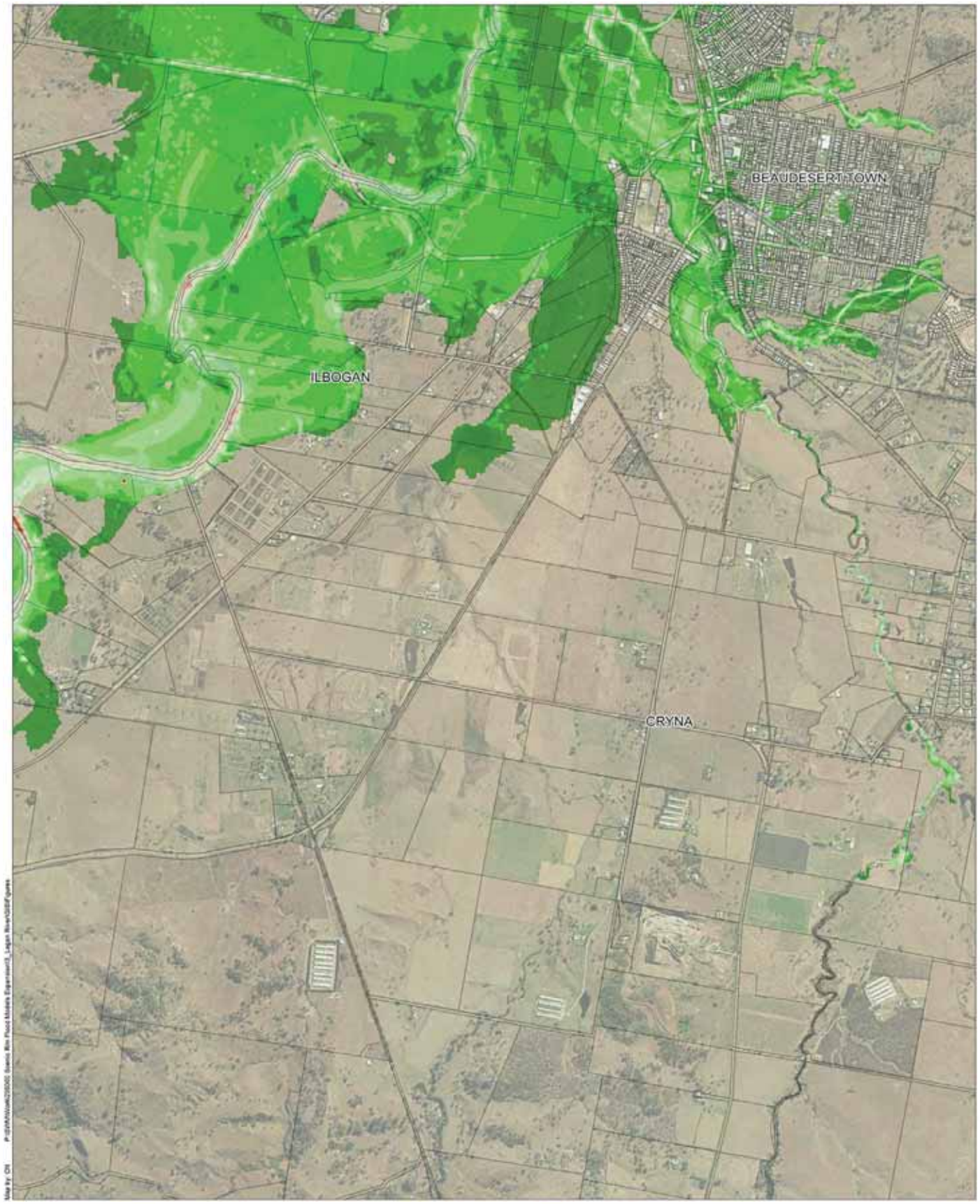
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-e

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

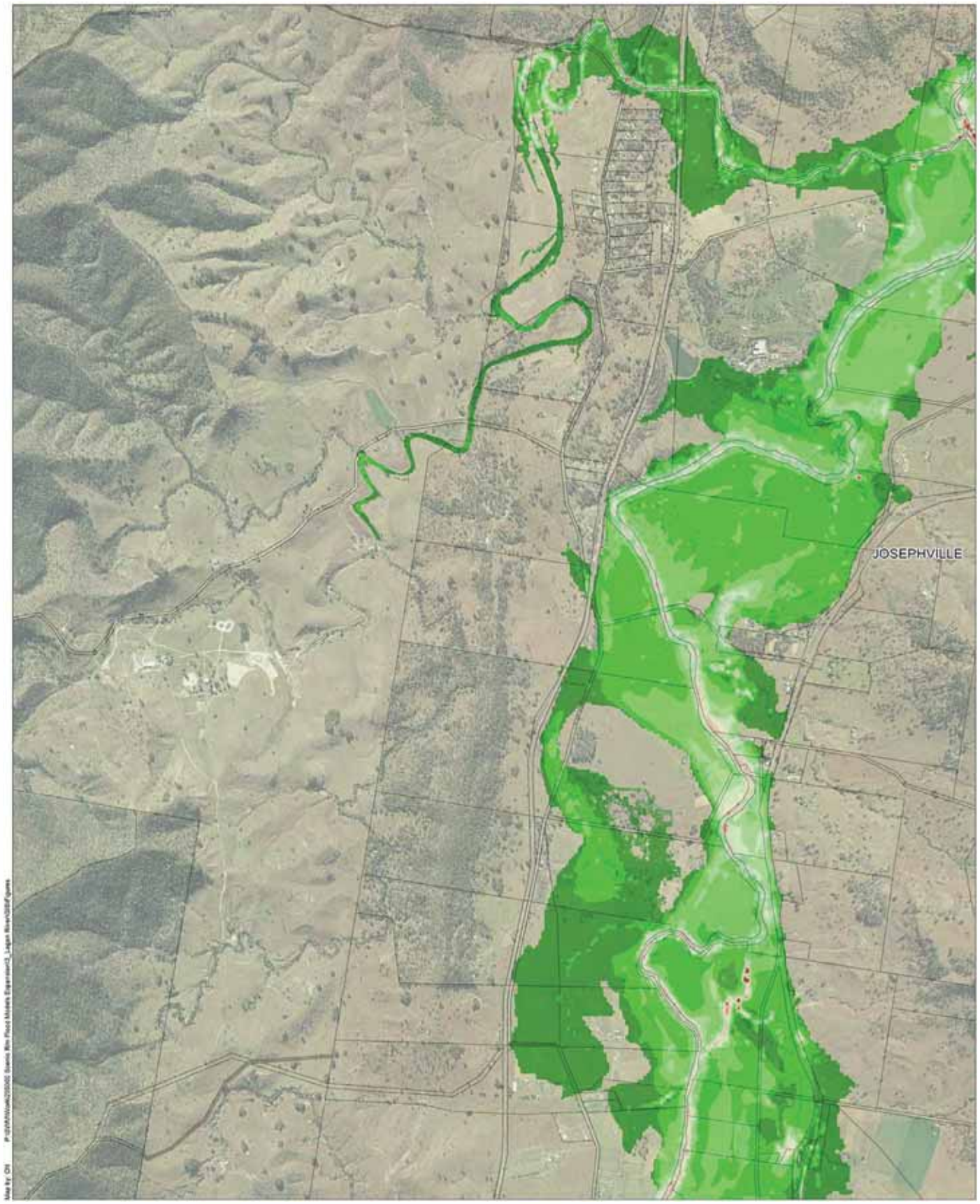
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-f

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

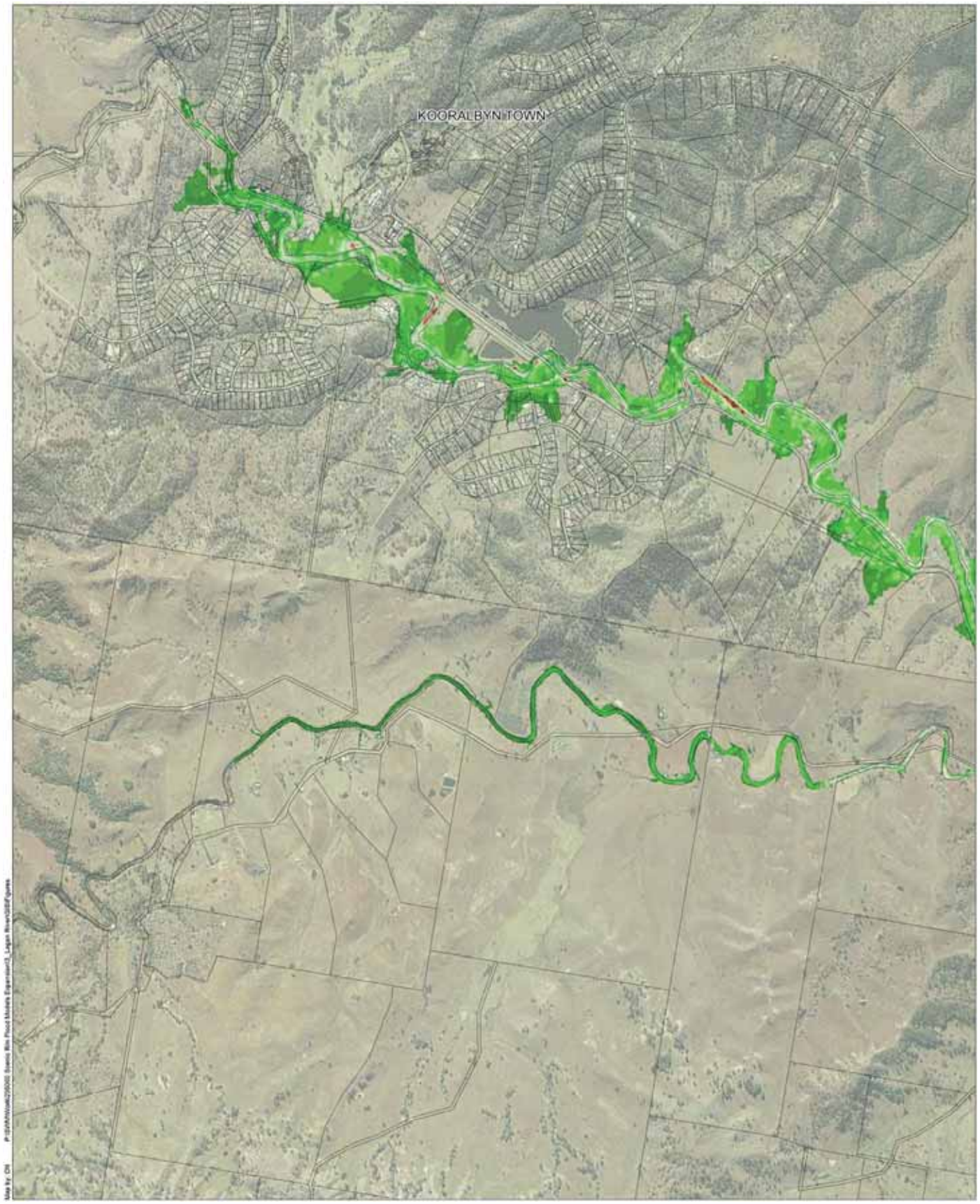
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-g

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

0 625 m 1,250 m

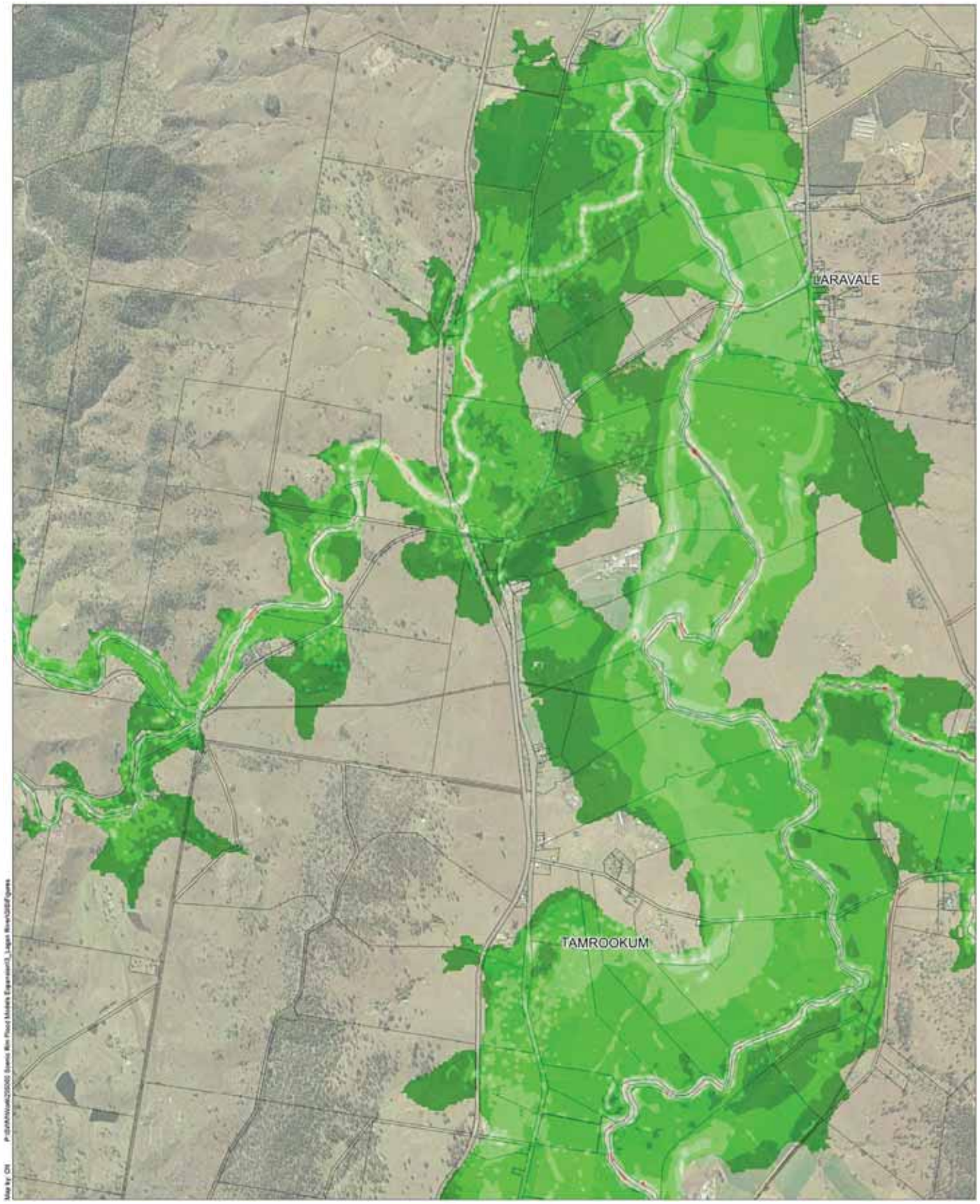
Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-h

2% AEP Event - Peak Velocities

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

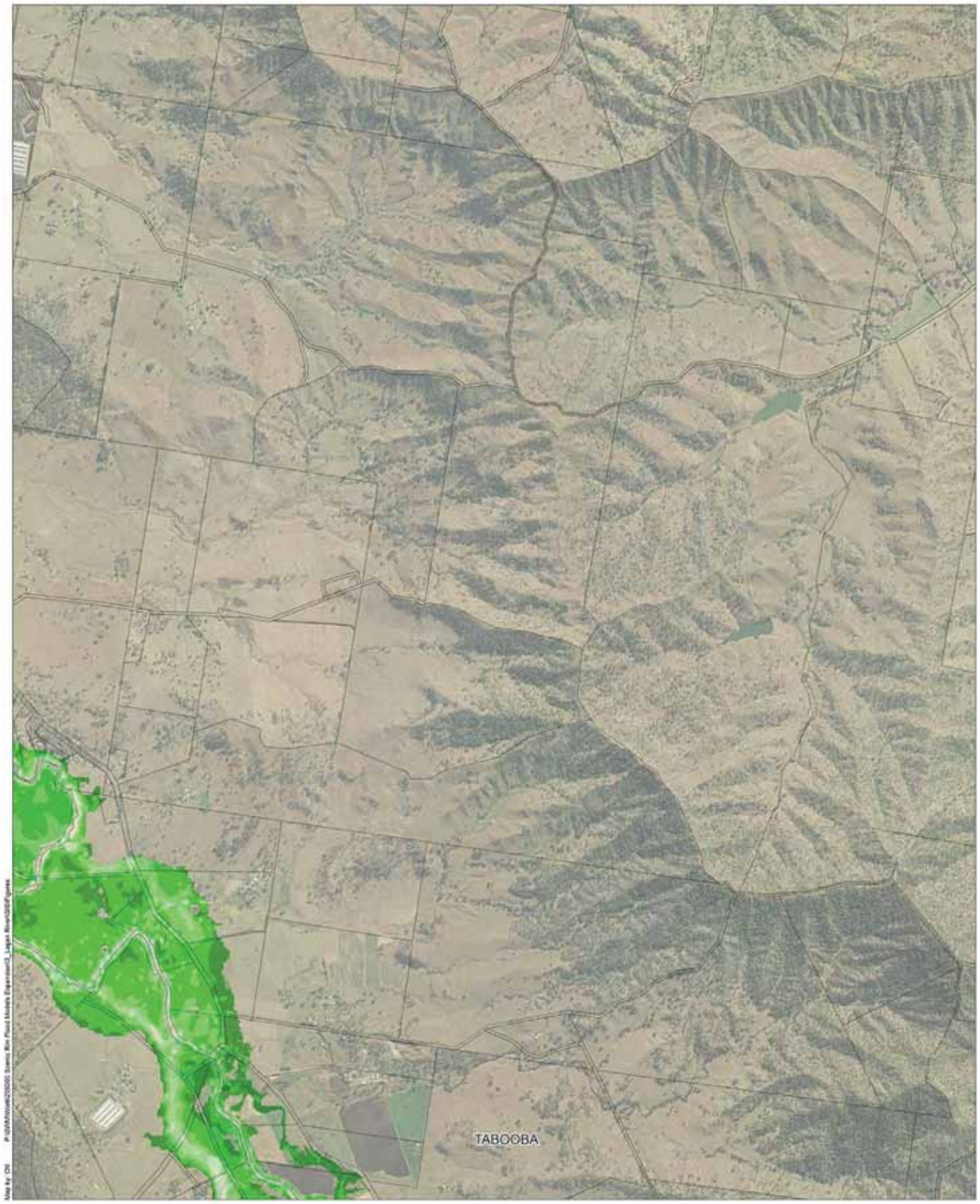
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-i

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

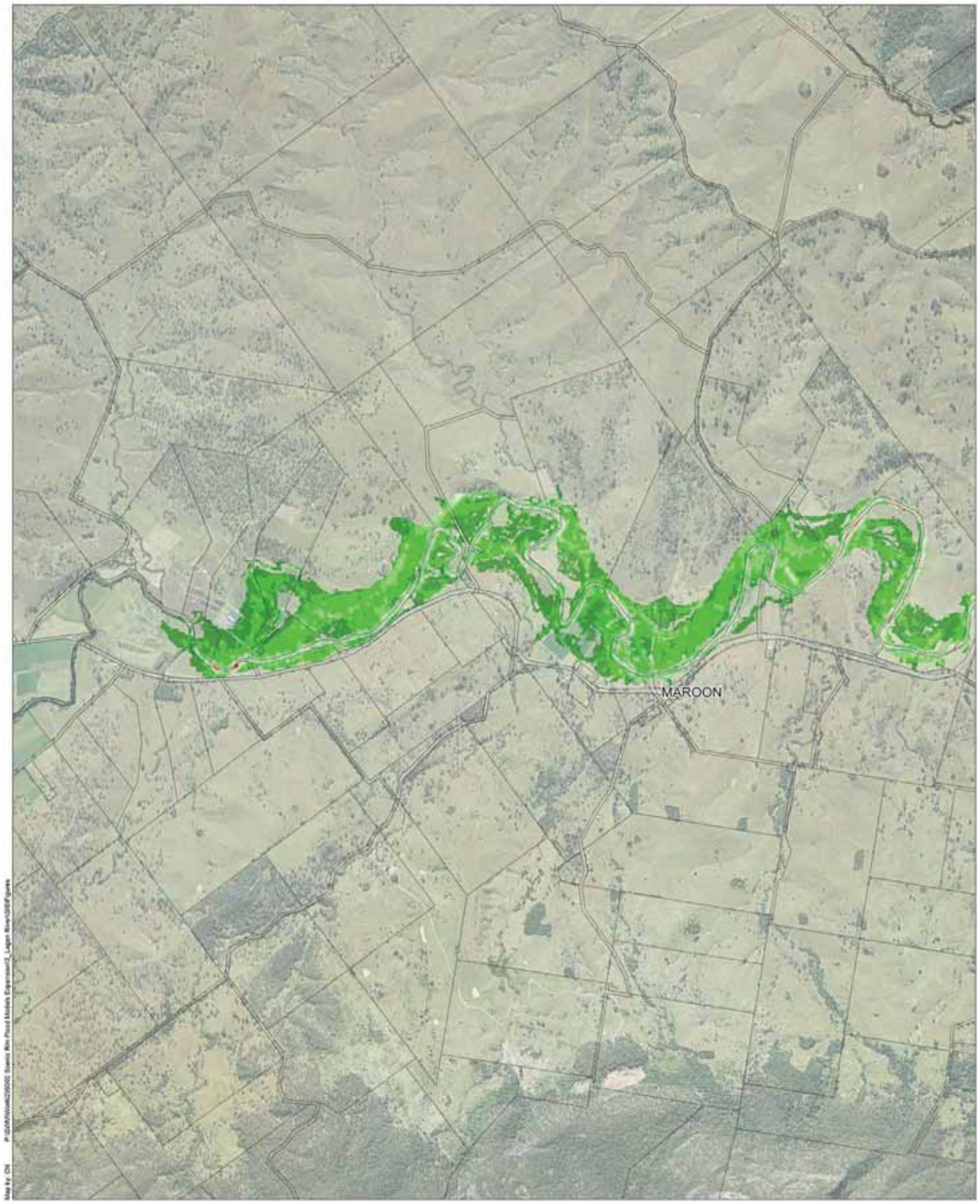
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-j

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

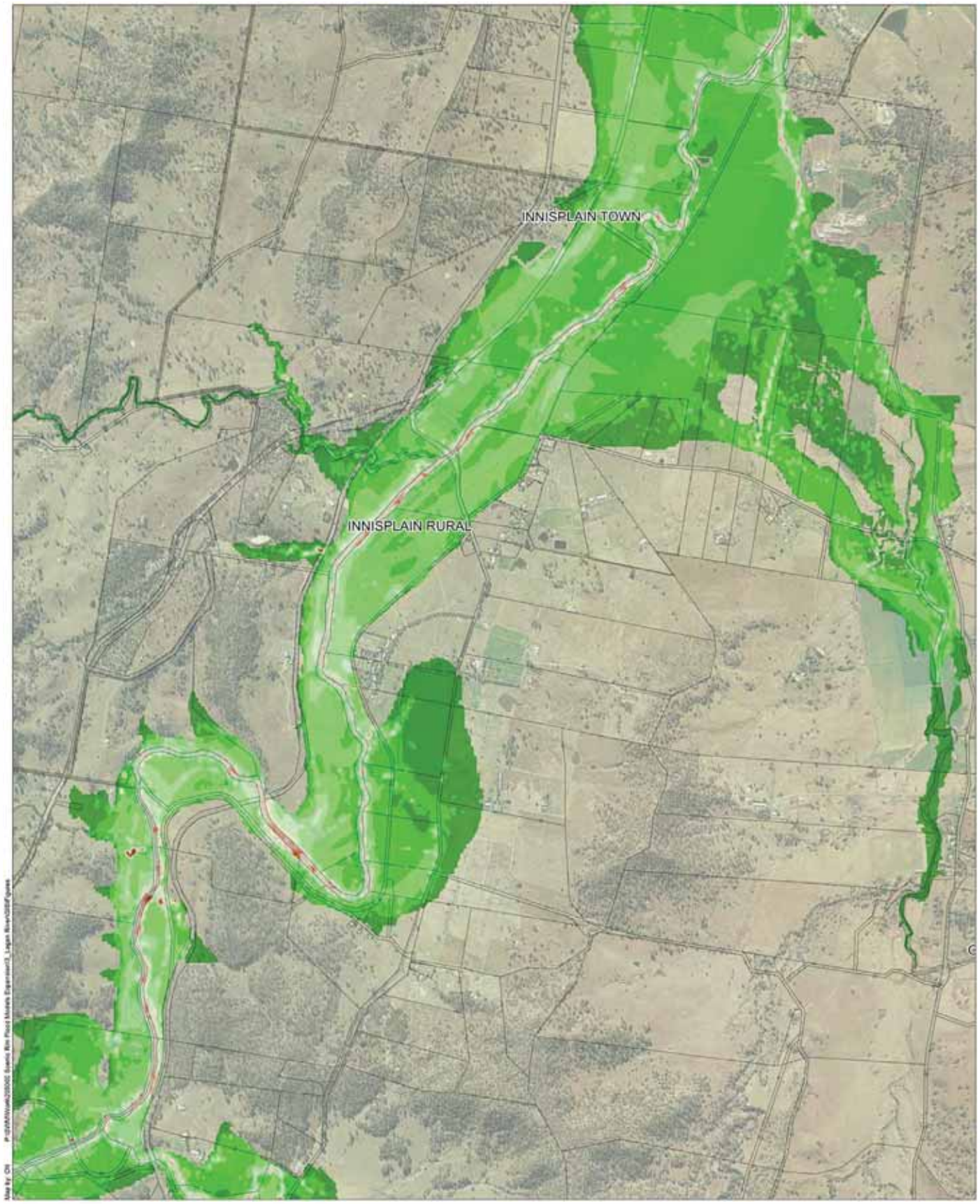
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-k

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-I

2% AEP Event - Peak Velocities

Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

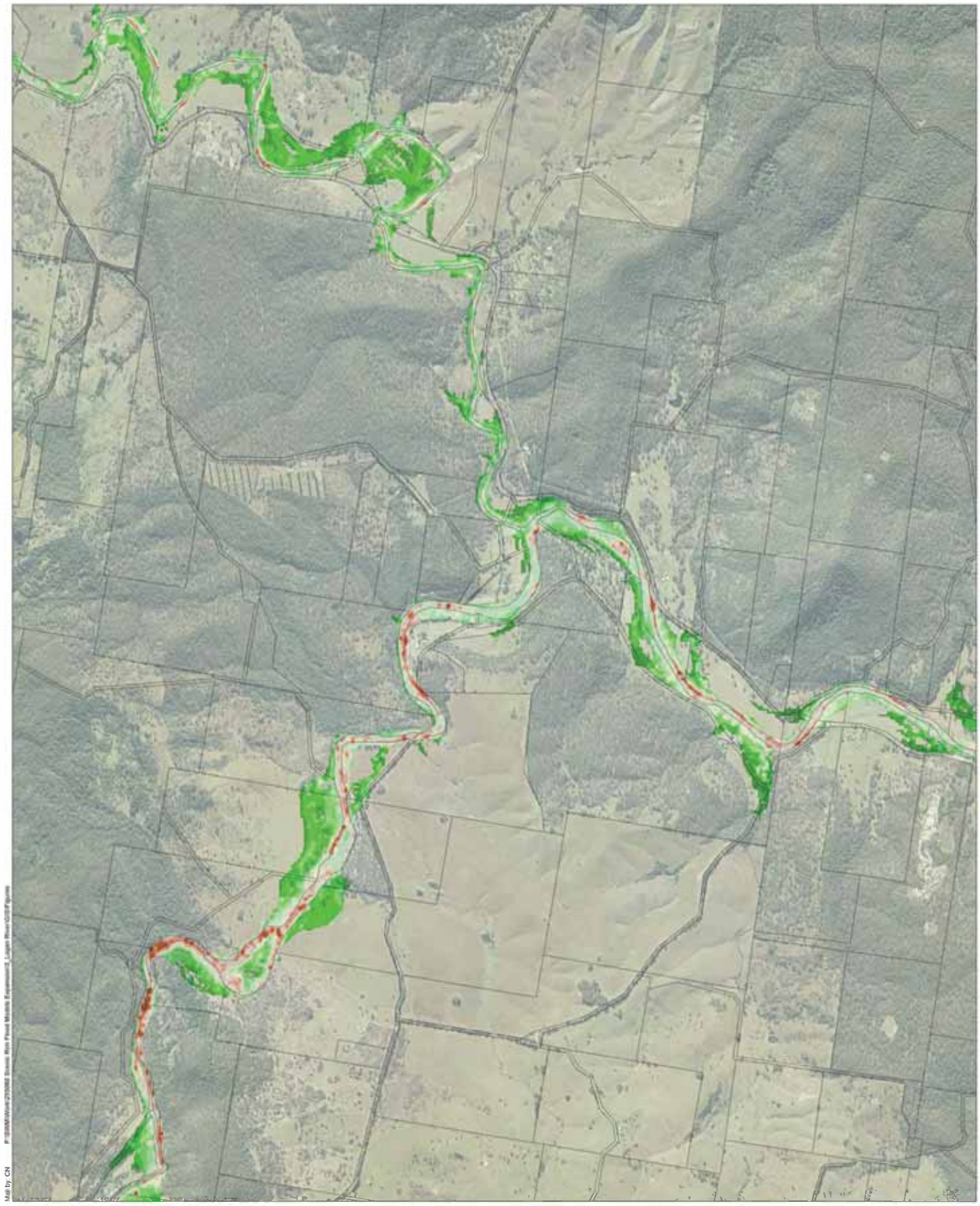
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-m

2% AEP Event - Peak Velocities



Legend

Velocity (m/s)

- SRRC Boundary
- Cadastral Boundary
- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- 4.5 to 5.0
- > 5.0

Notes:

1:25,000

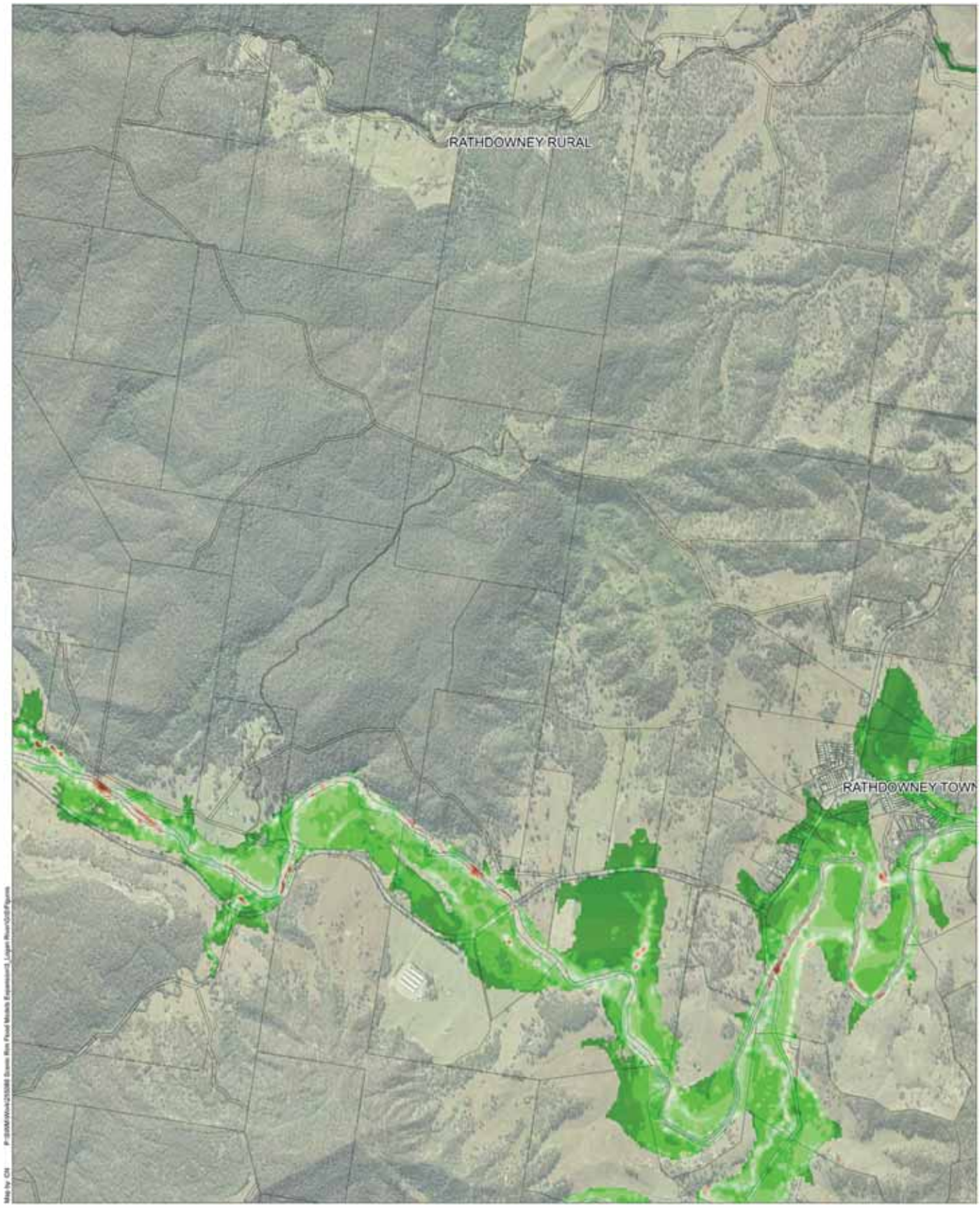
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure C2-n**

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

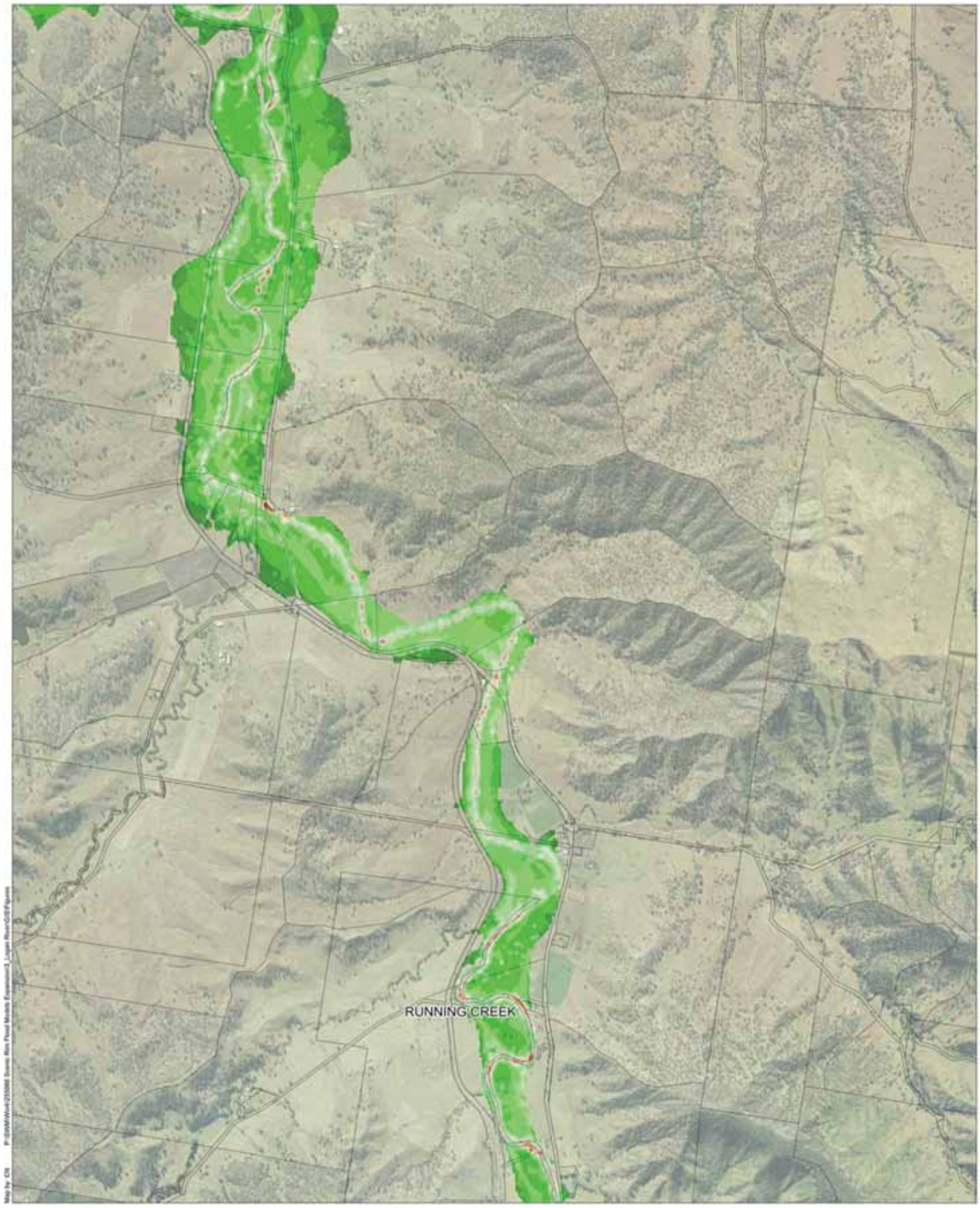
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-o

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

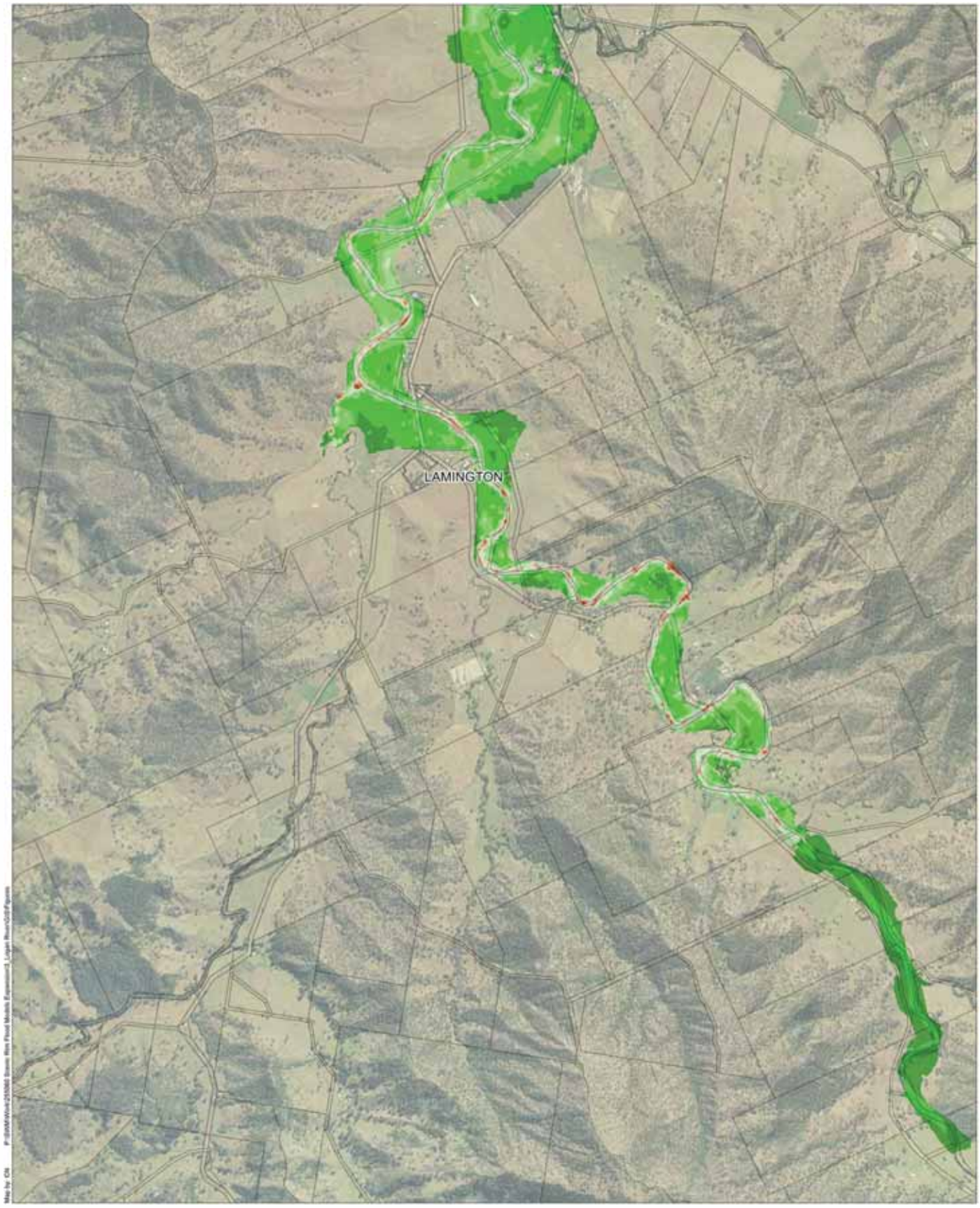
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-p

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

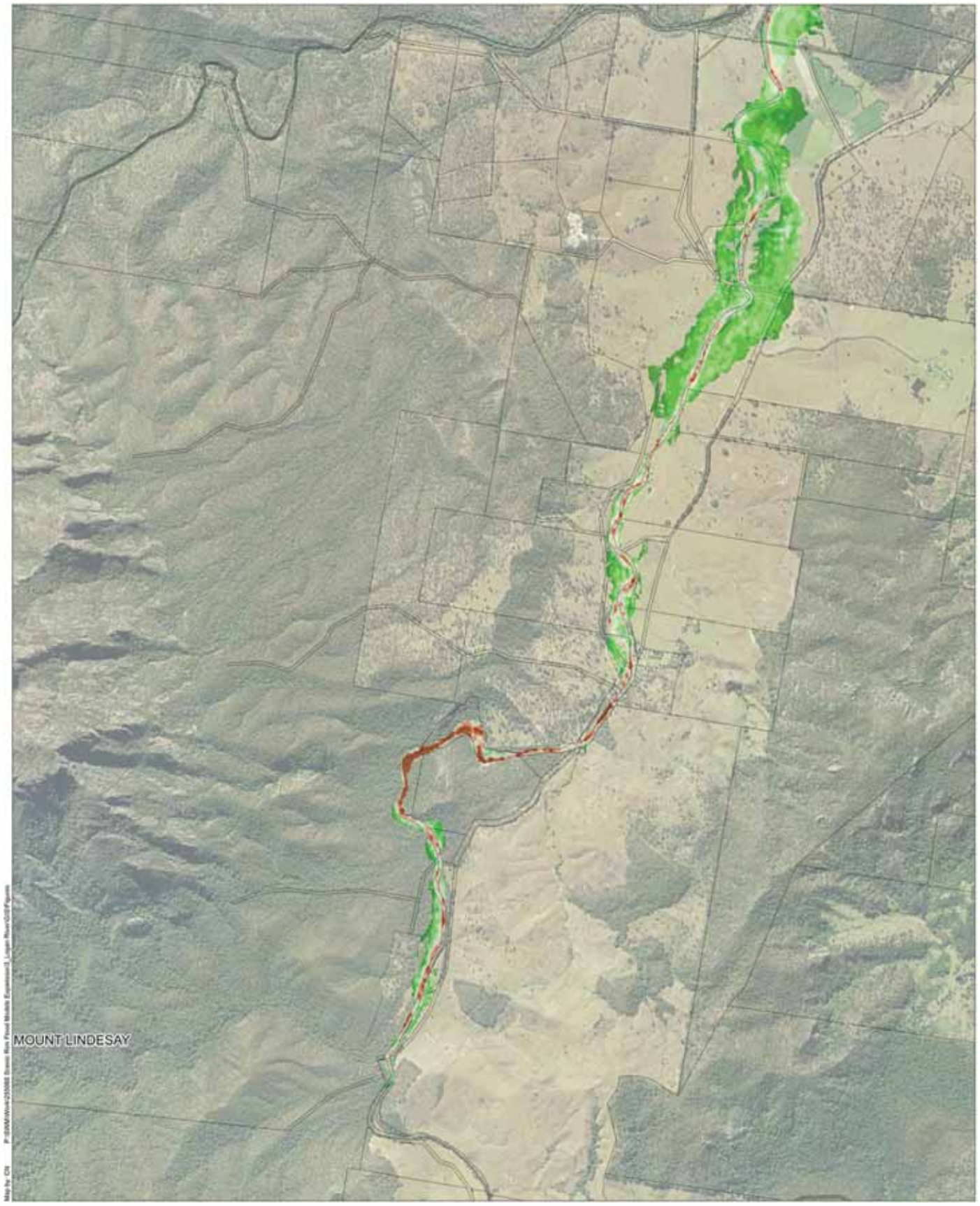
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-q

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

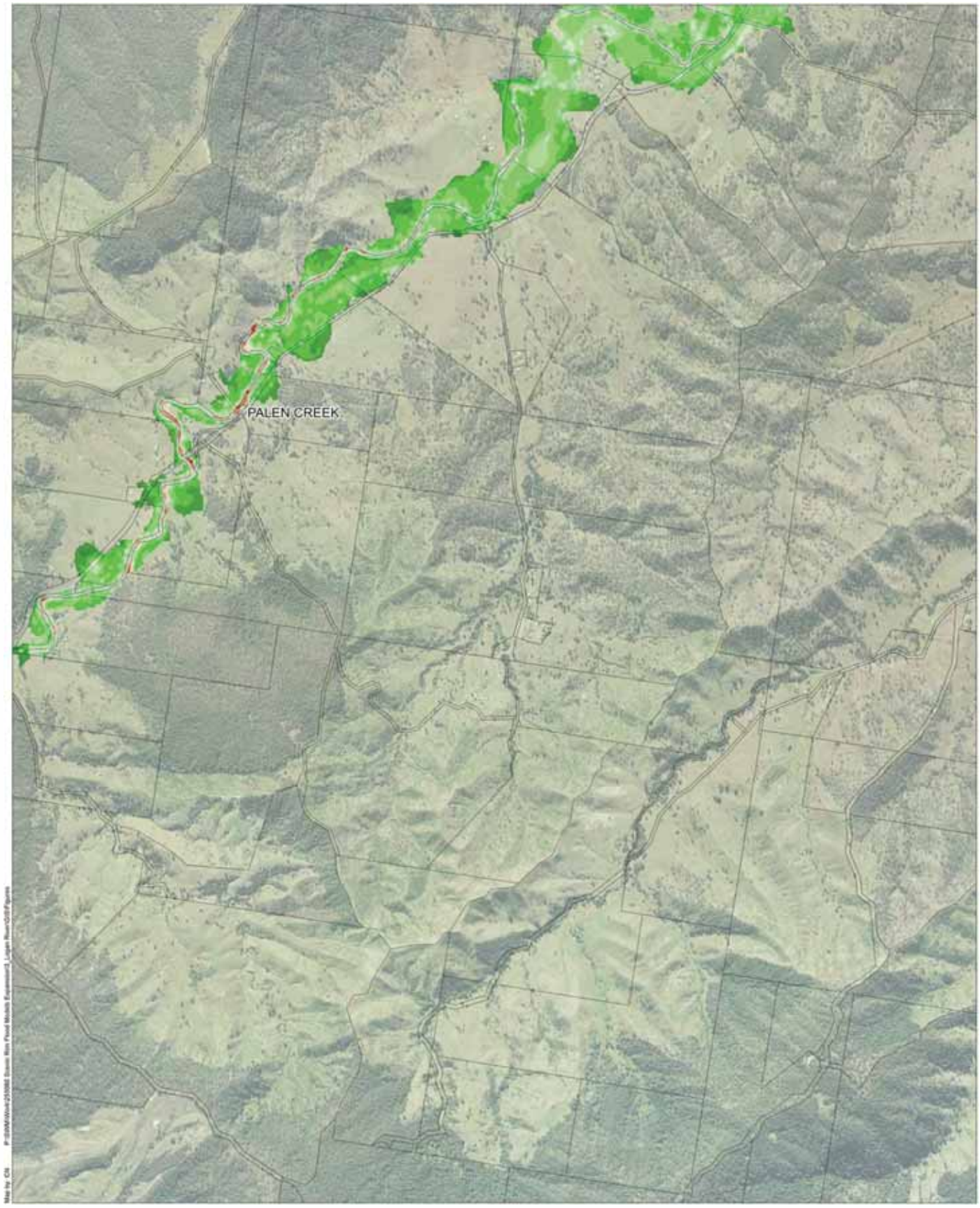
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-r

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

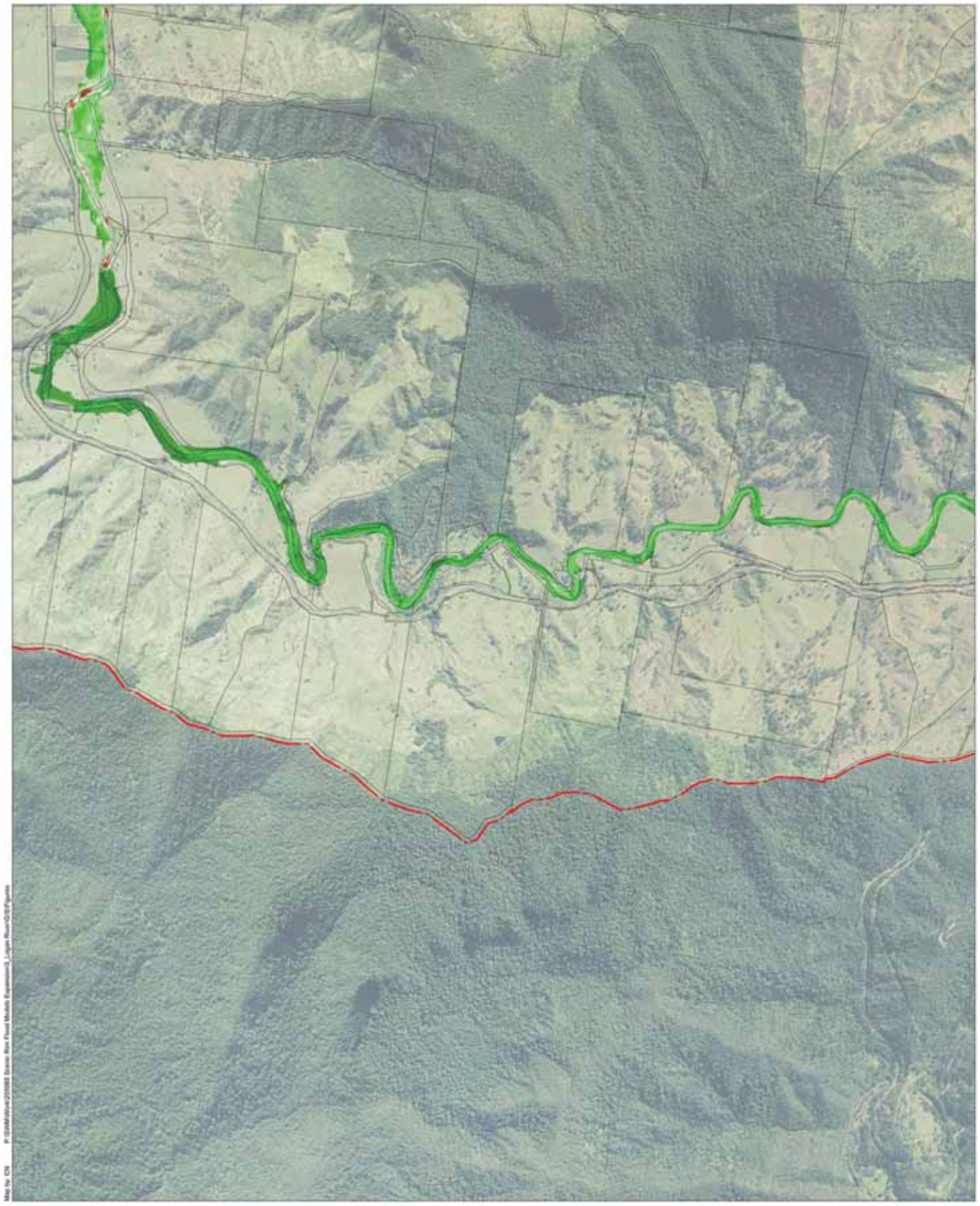
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-s

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study **Figure C2-t**

2% AEP Event - Peak Velocities

Legend

SRRC Boundary

Cadastral Boundary

Velocity (m/s)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

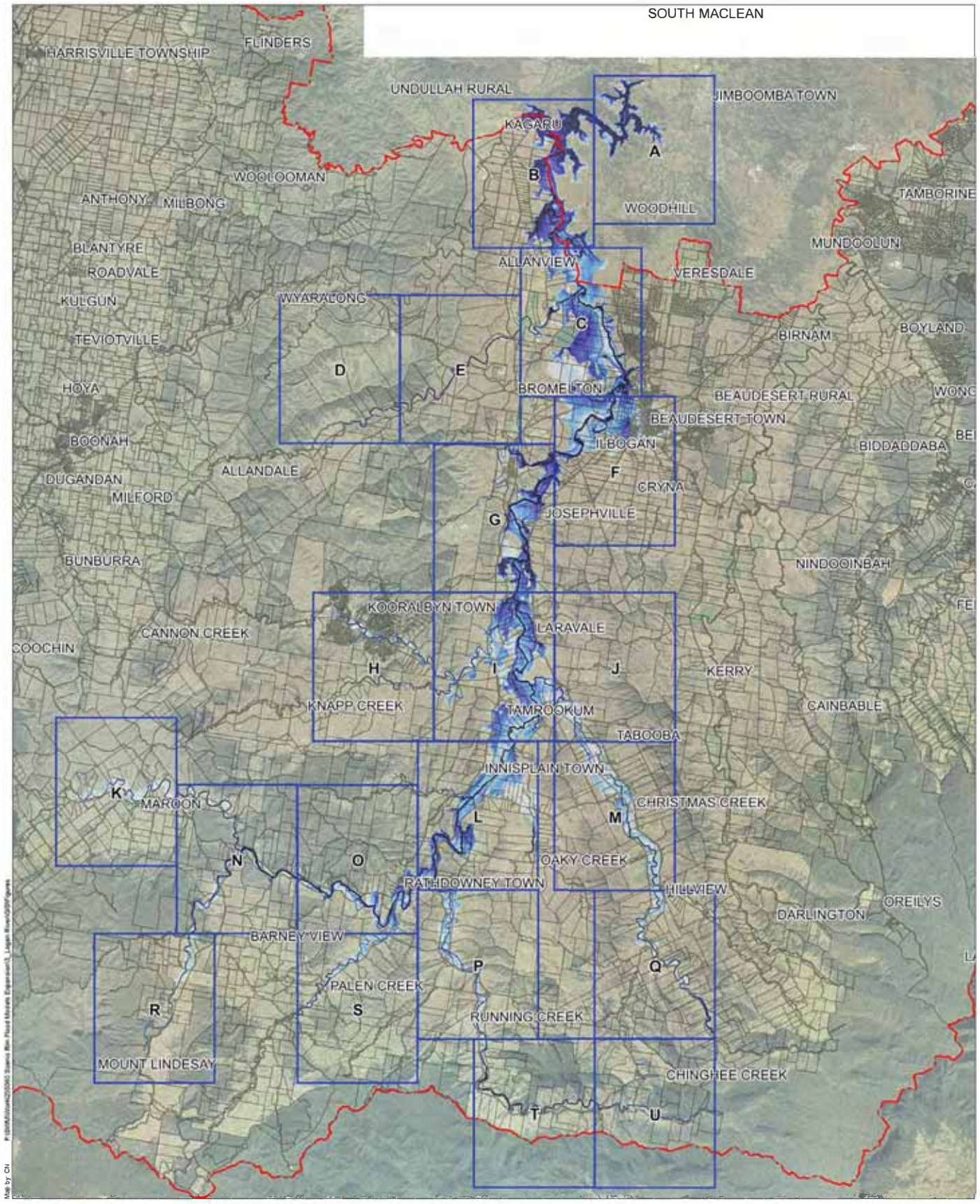
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C2-u

2% AEP Event - Peak Velocities



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:200,000

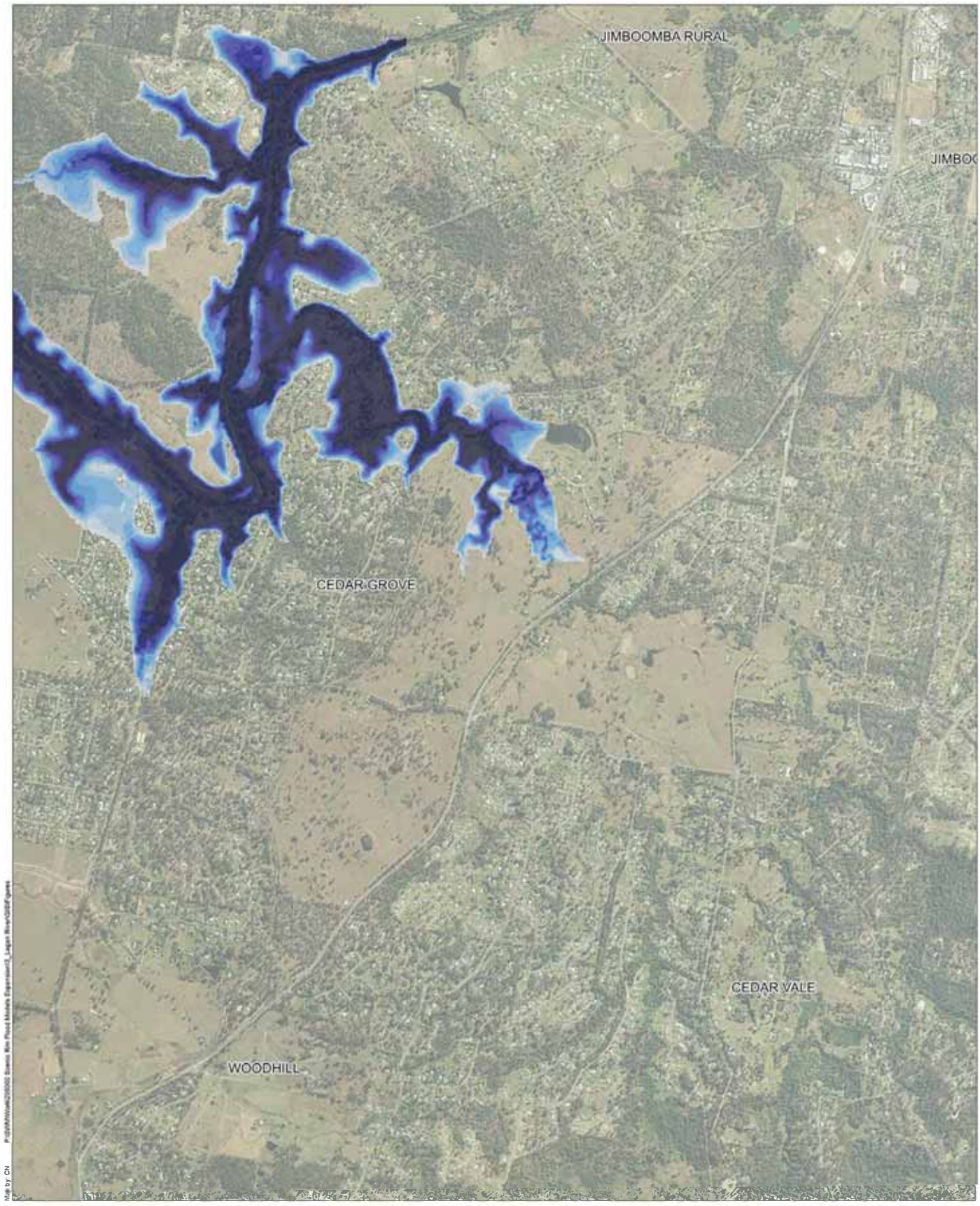
0 5,000 m 10,000 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

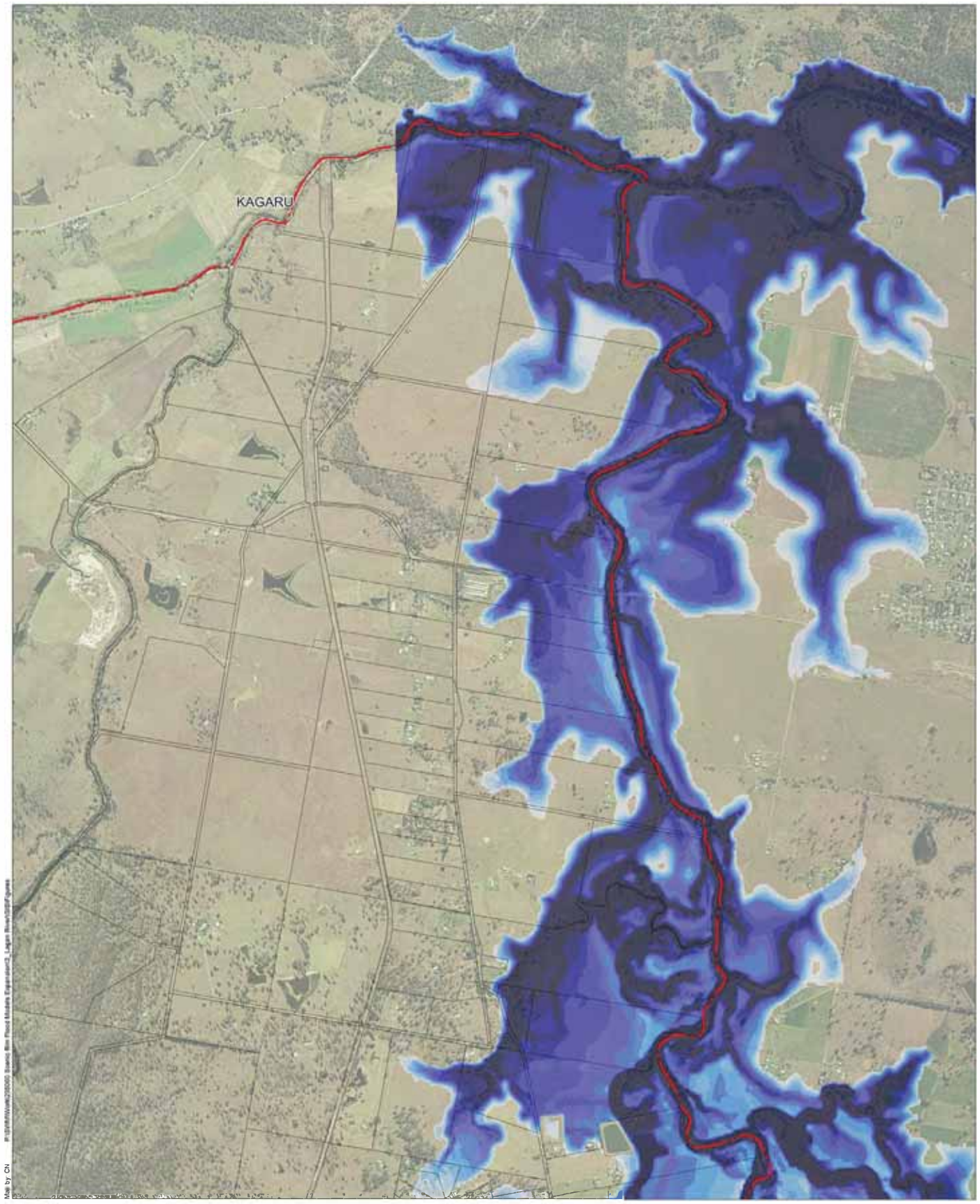
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-a

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

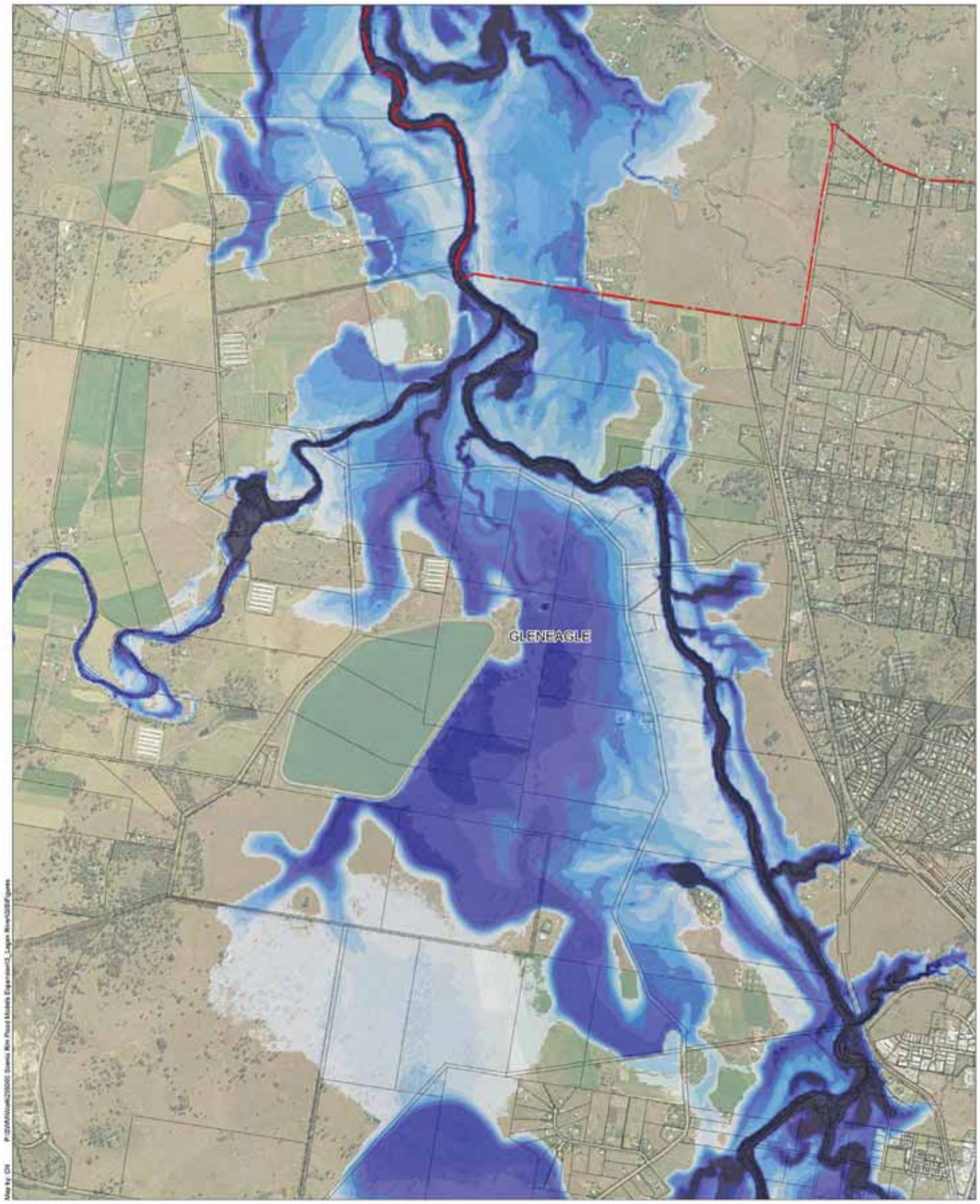
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-b

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

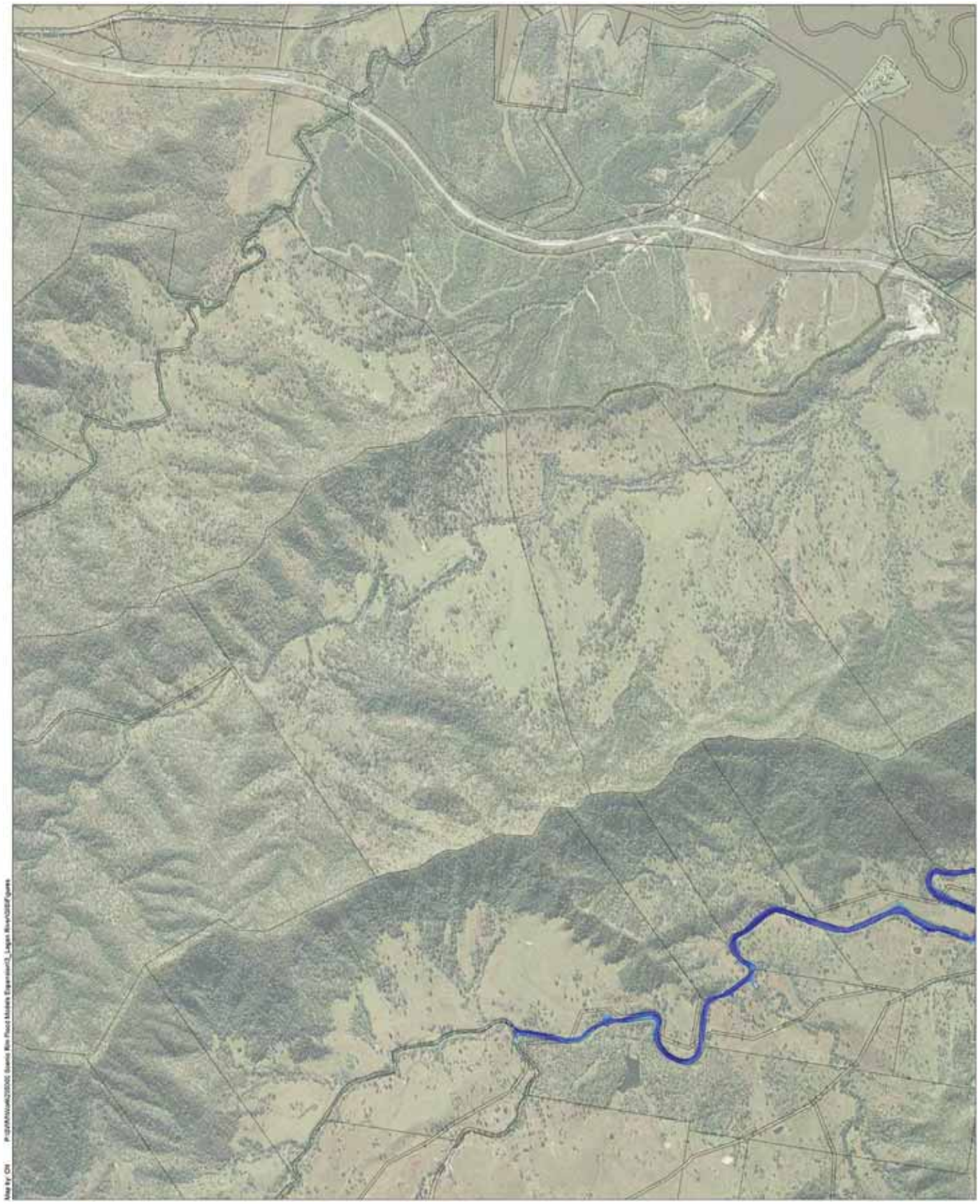
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-c

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

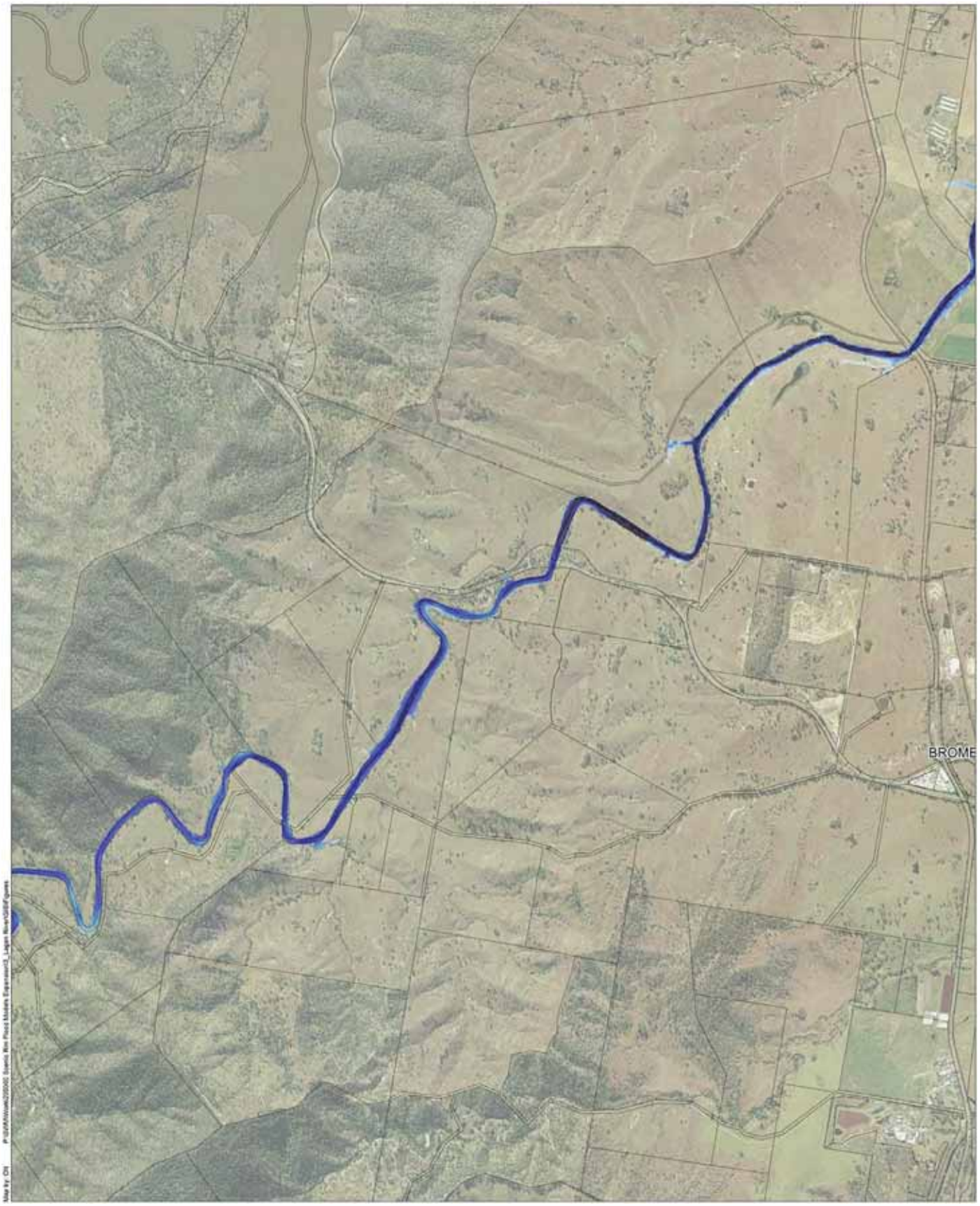
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-d

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

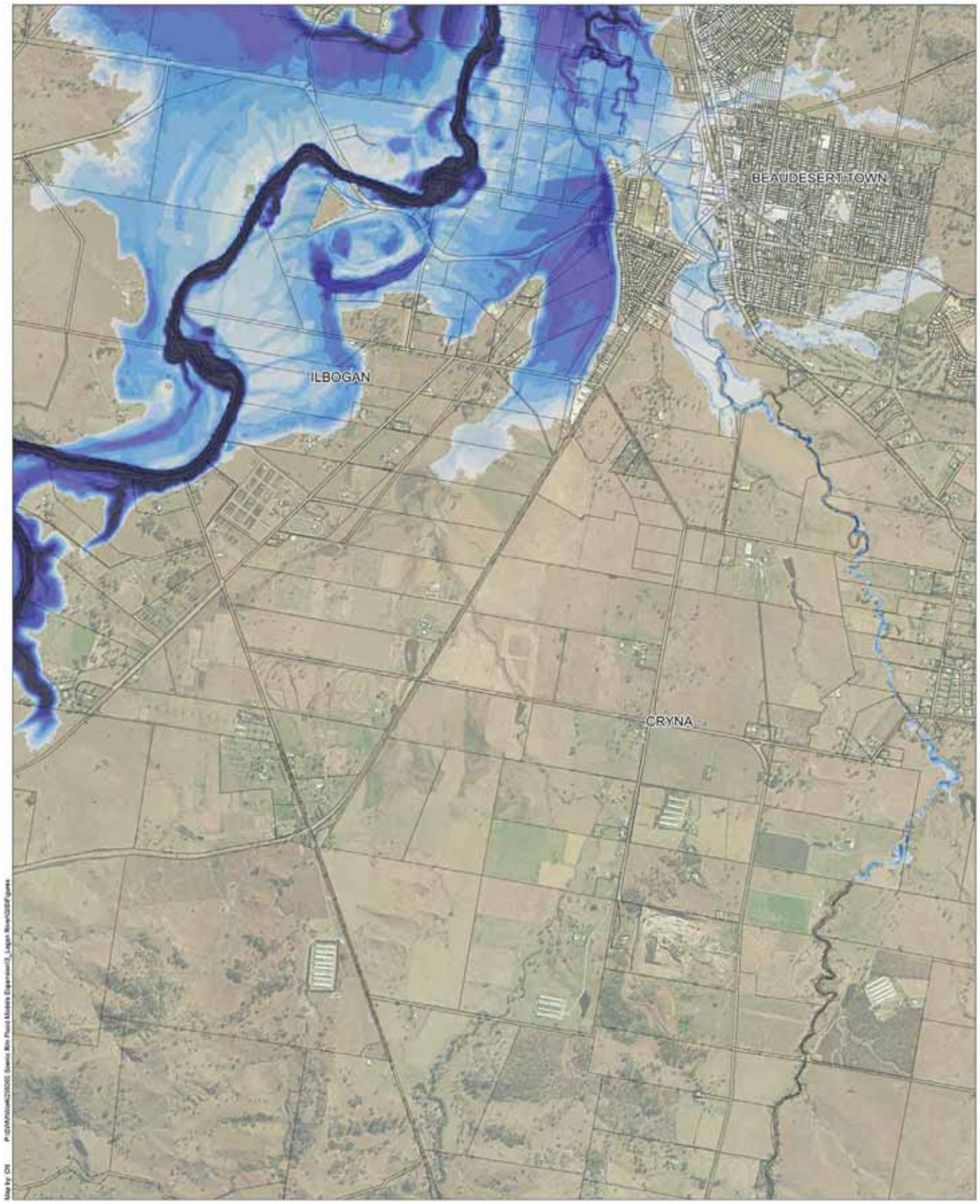
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-e

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

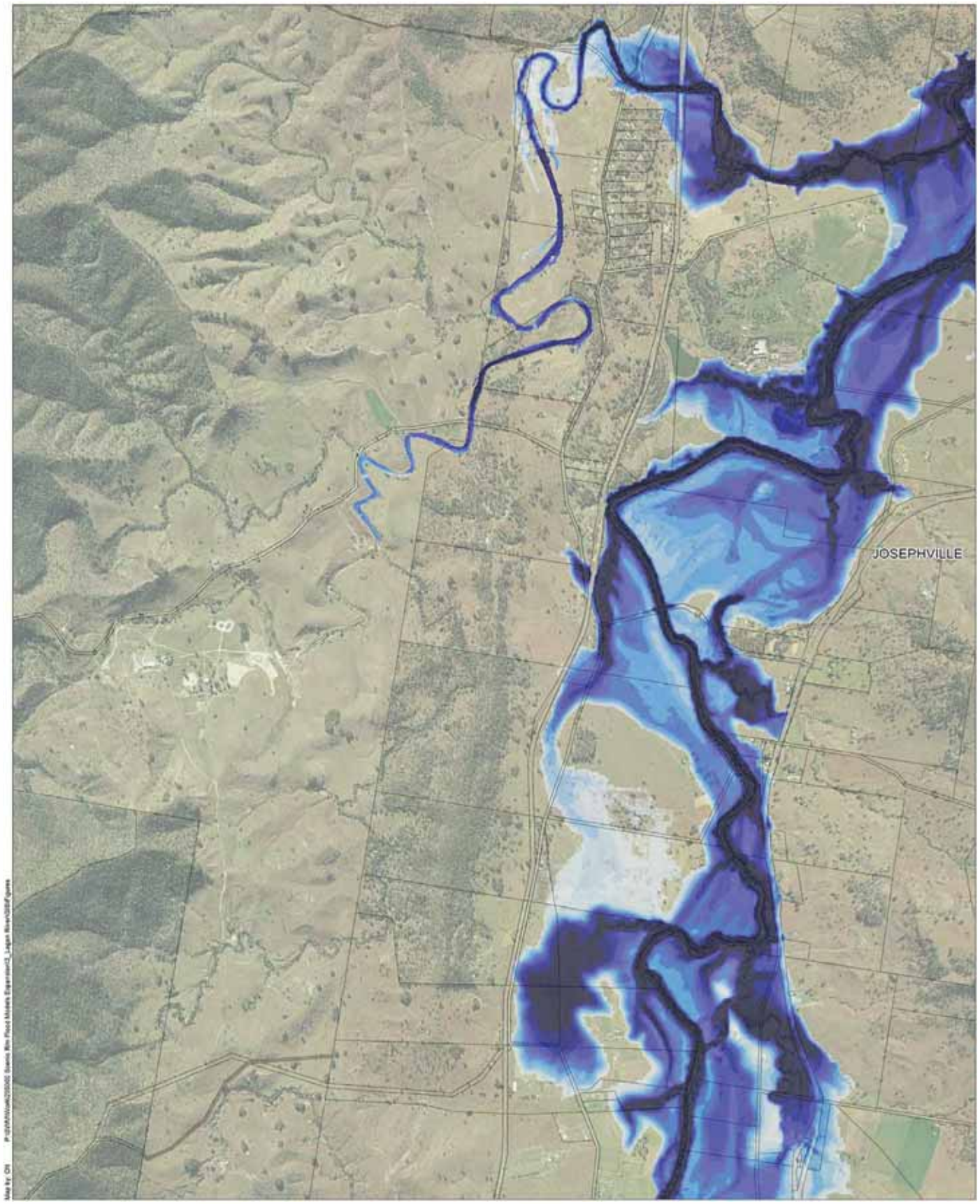
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-f

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

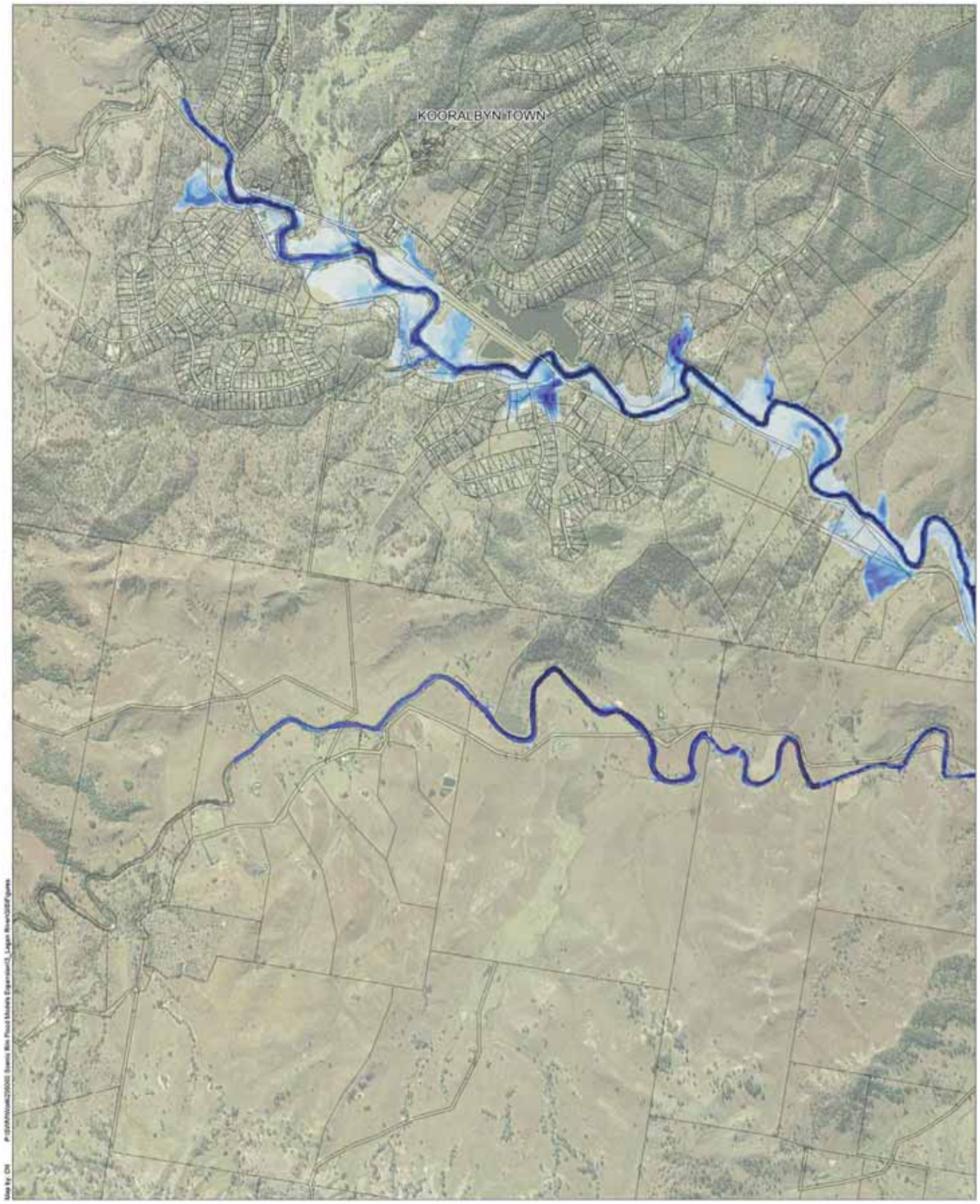
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-g

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

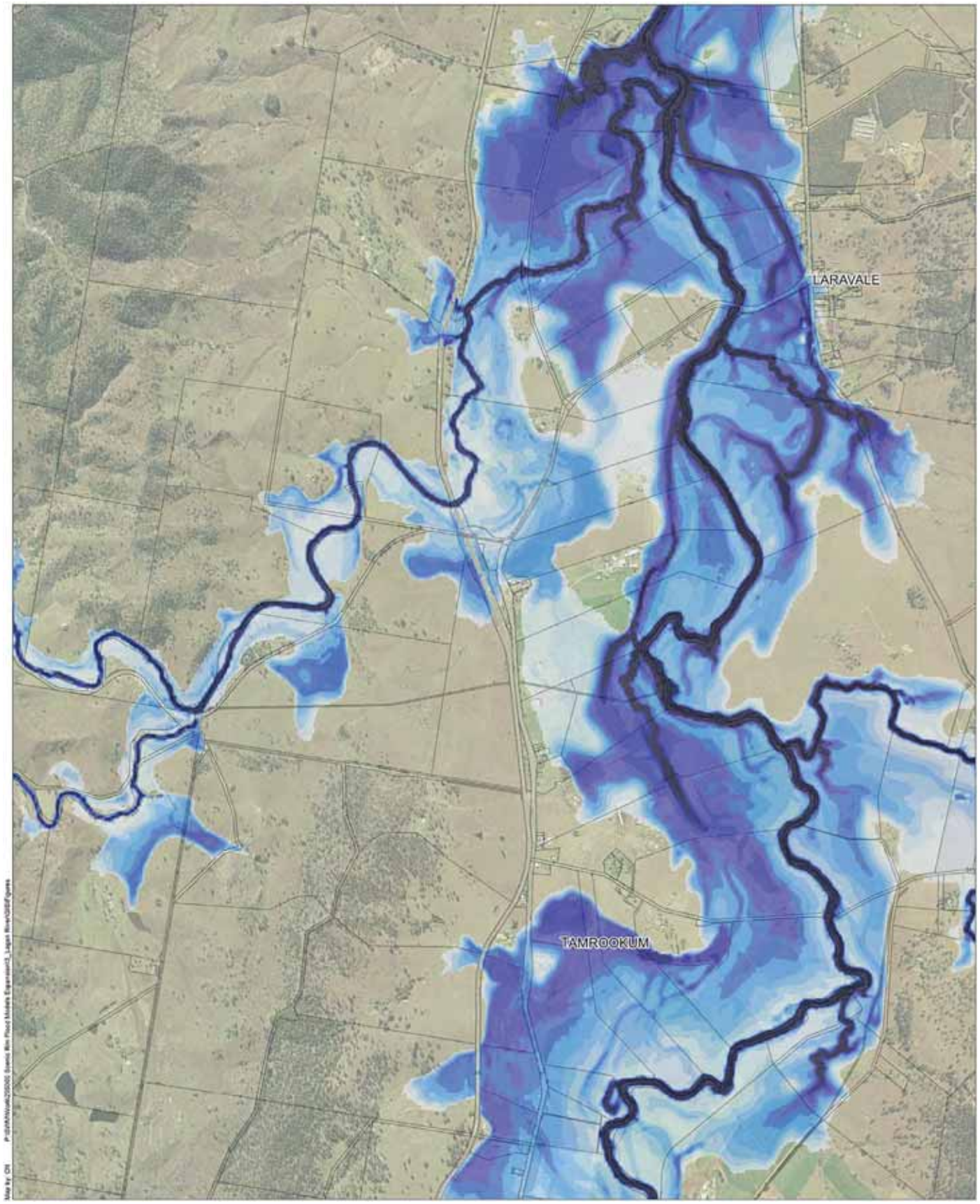
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-h

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

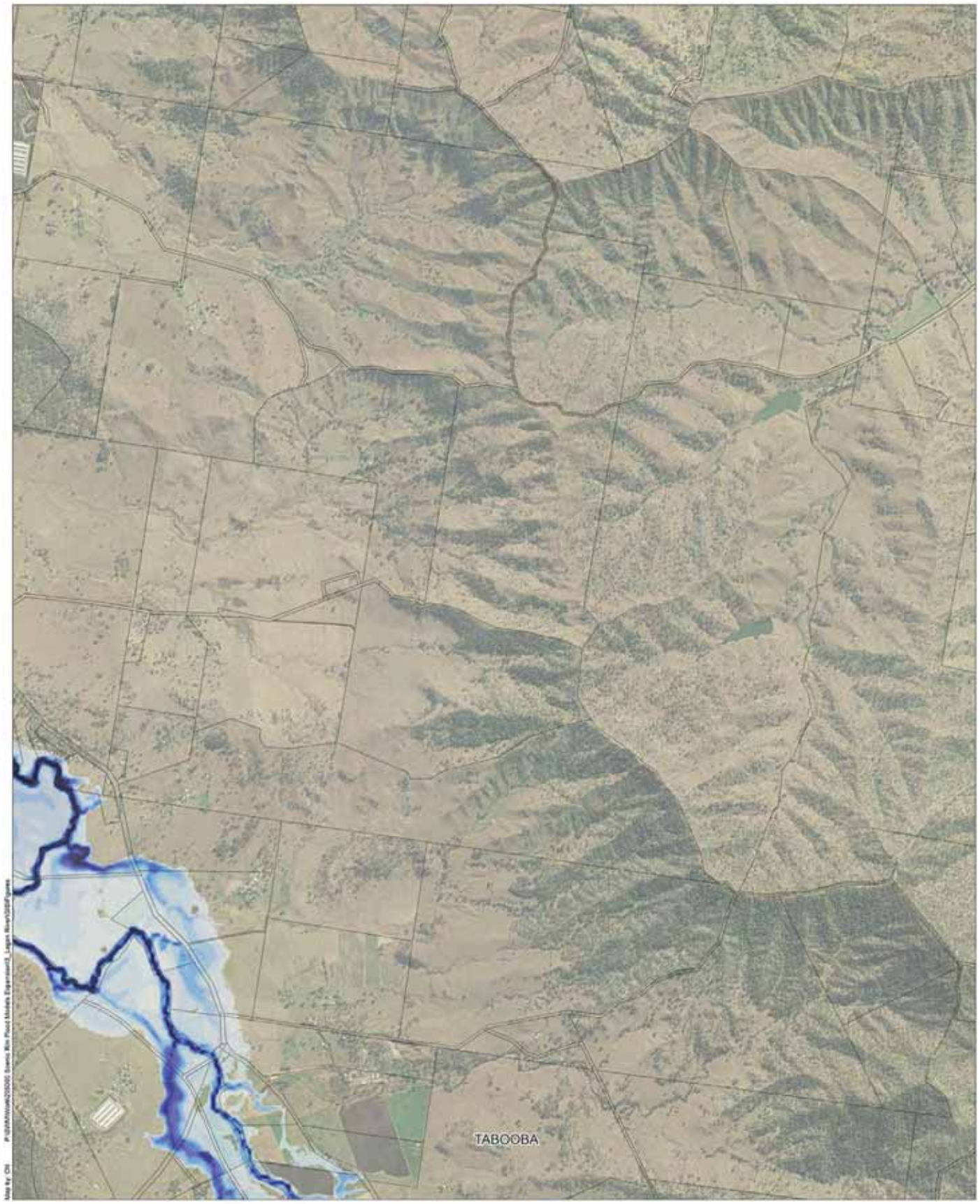
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-i

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

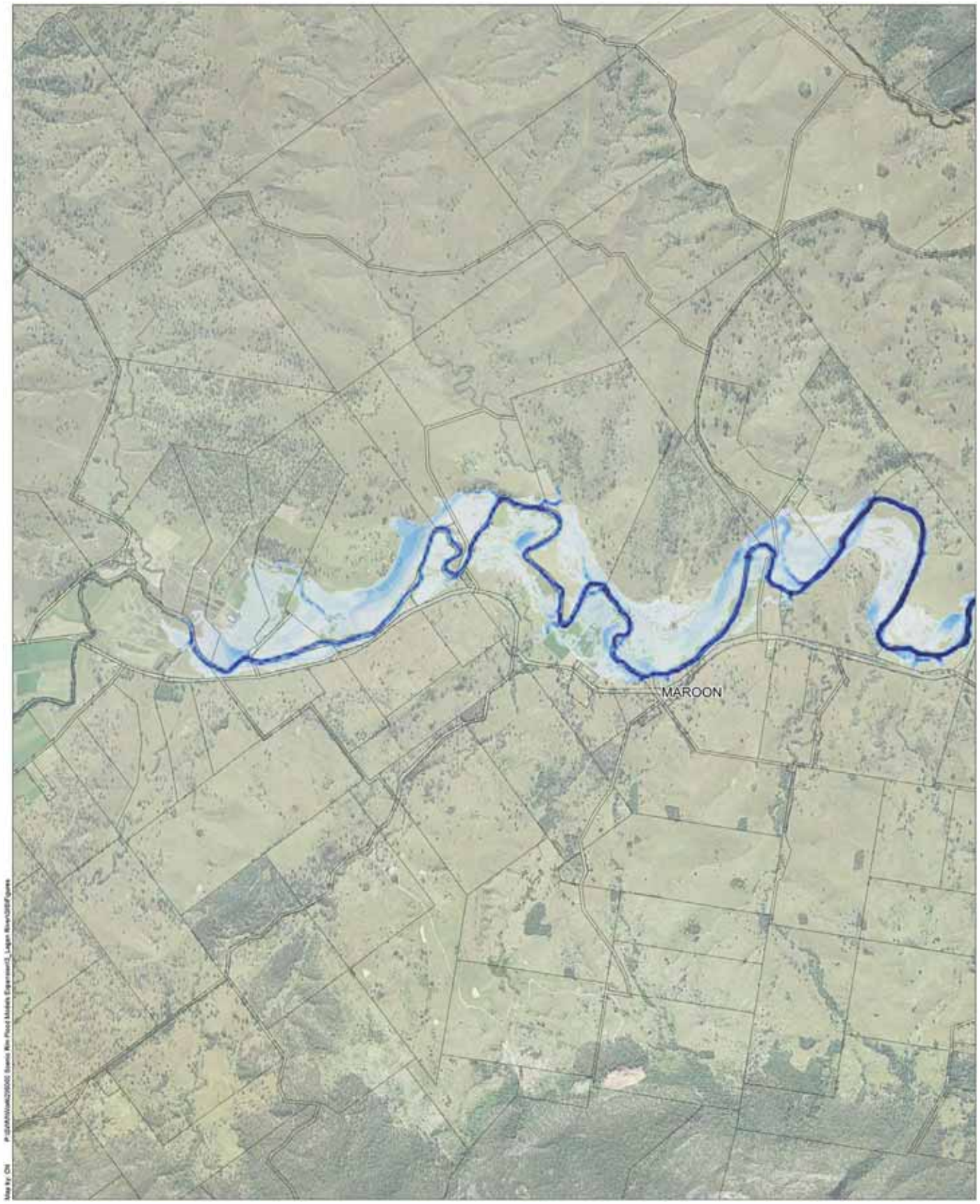
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-j

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

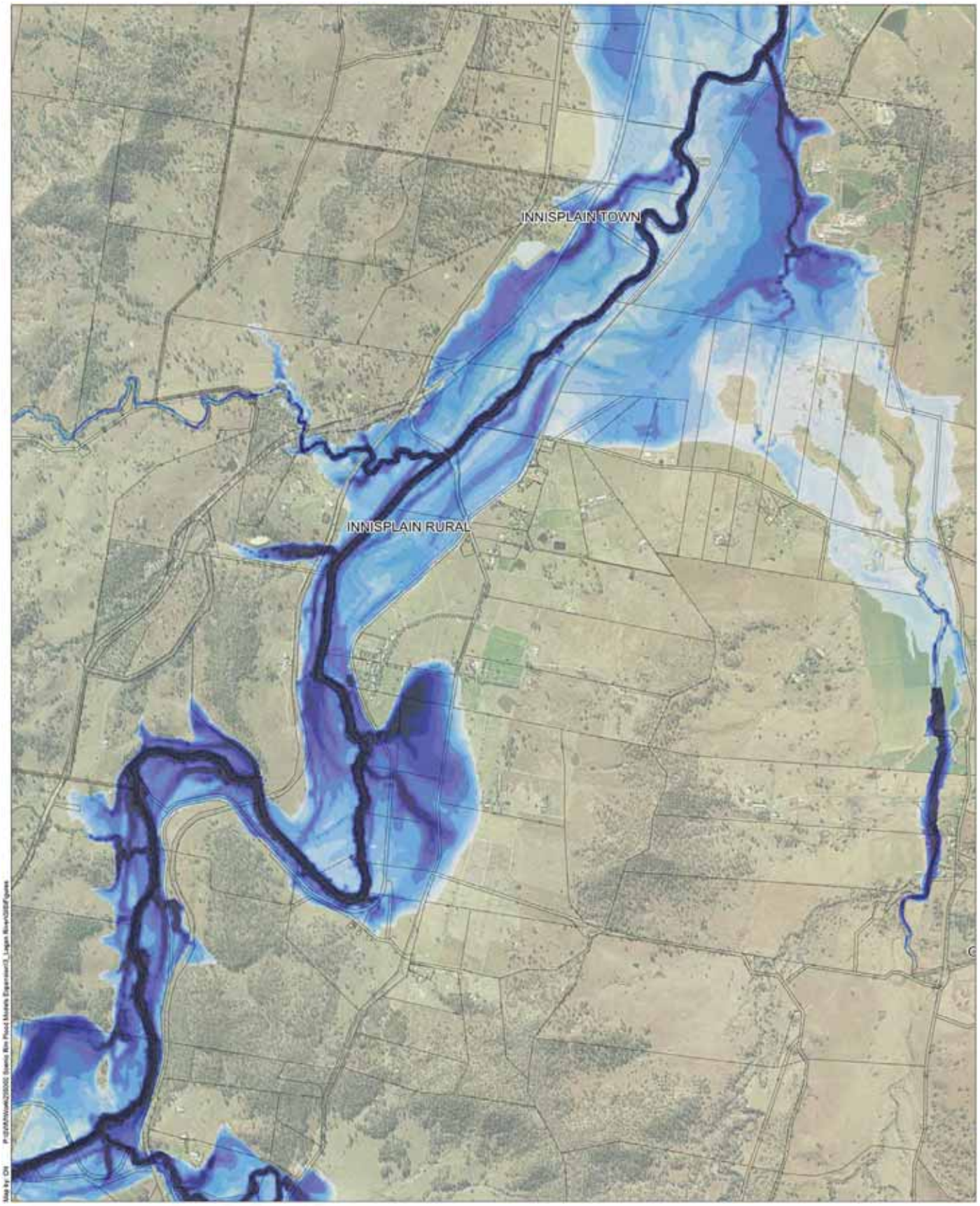
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-k

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

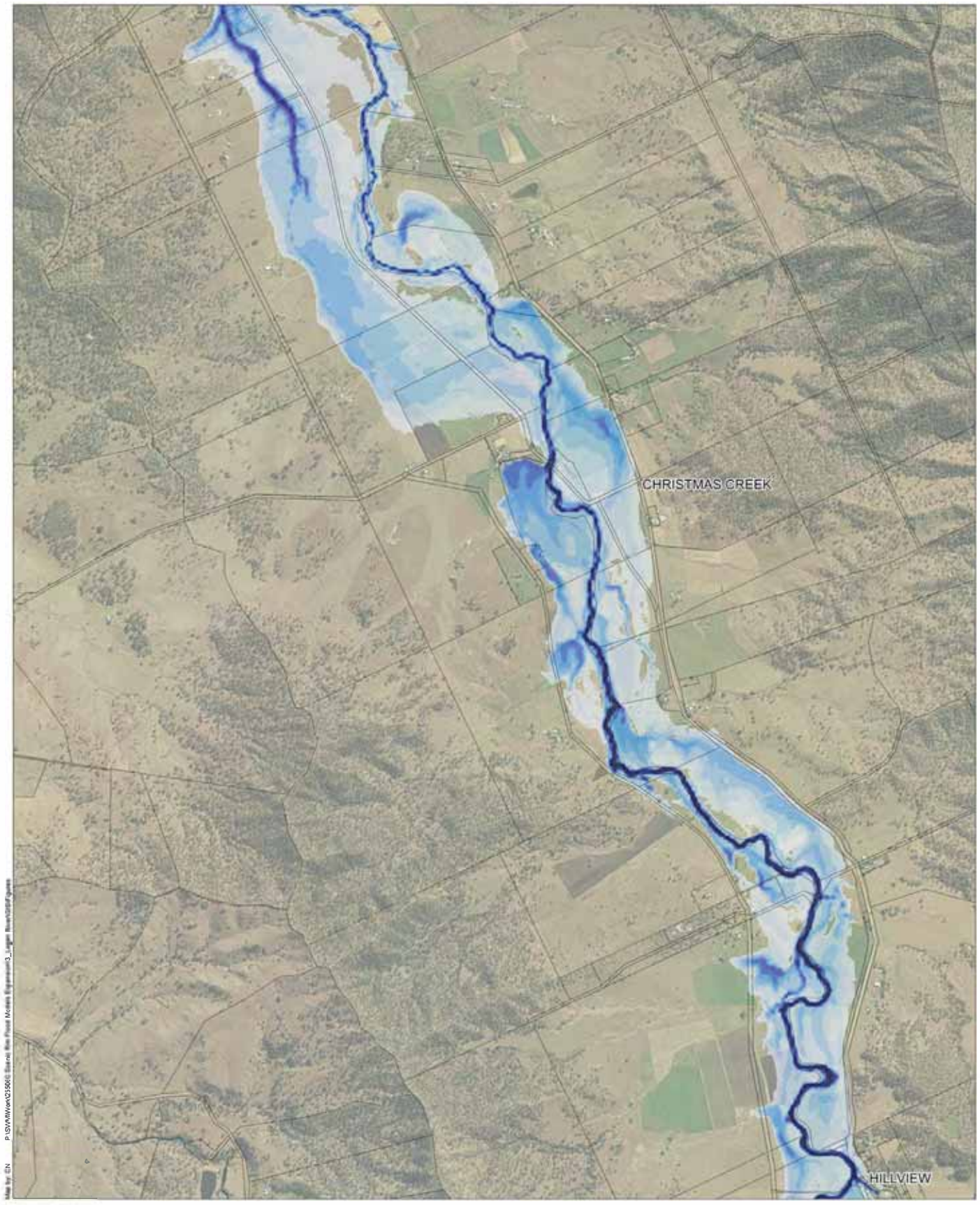
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-I

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

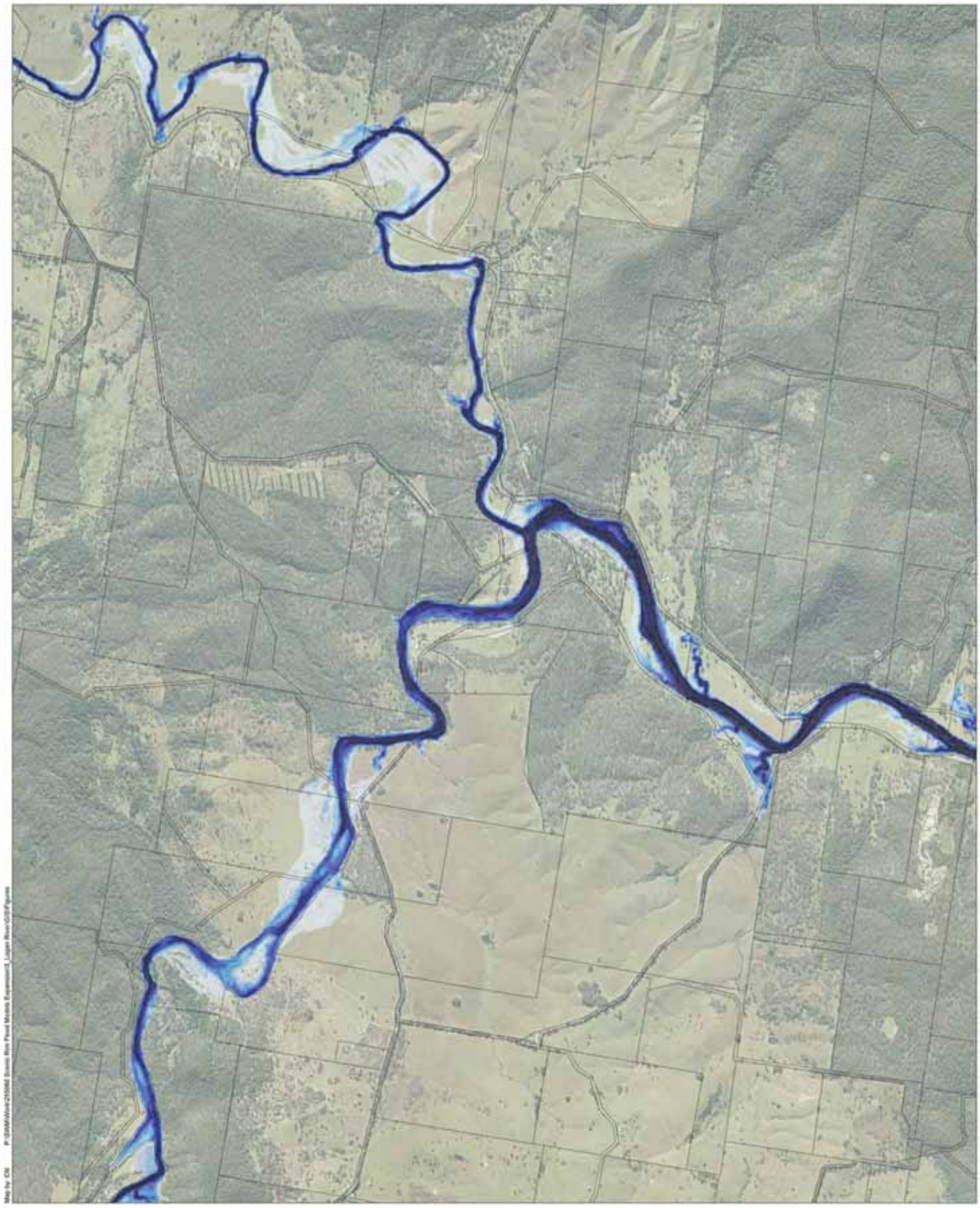
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-m

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

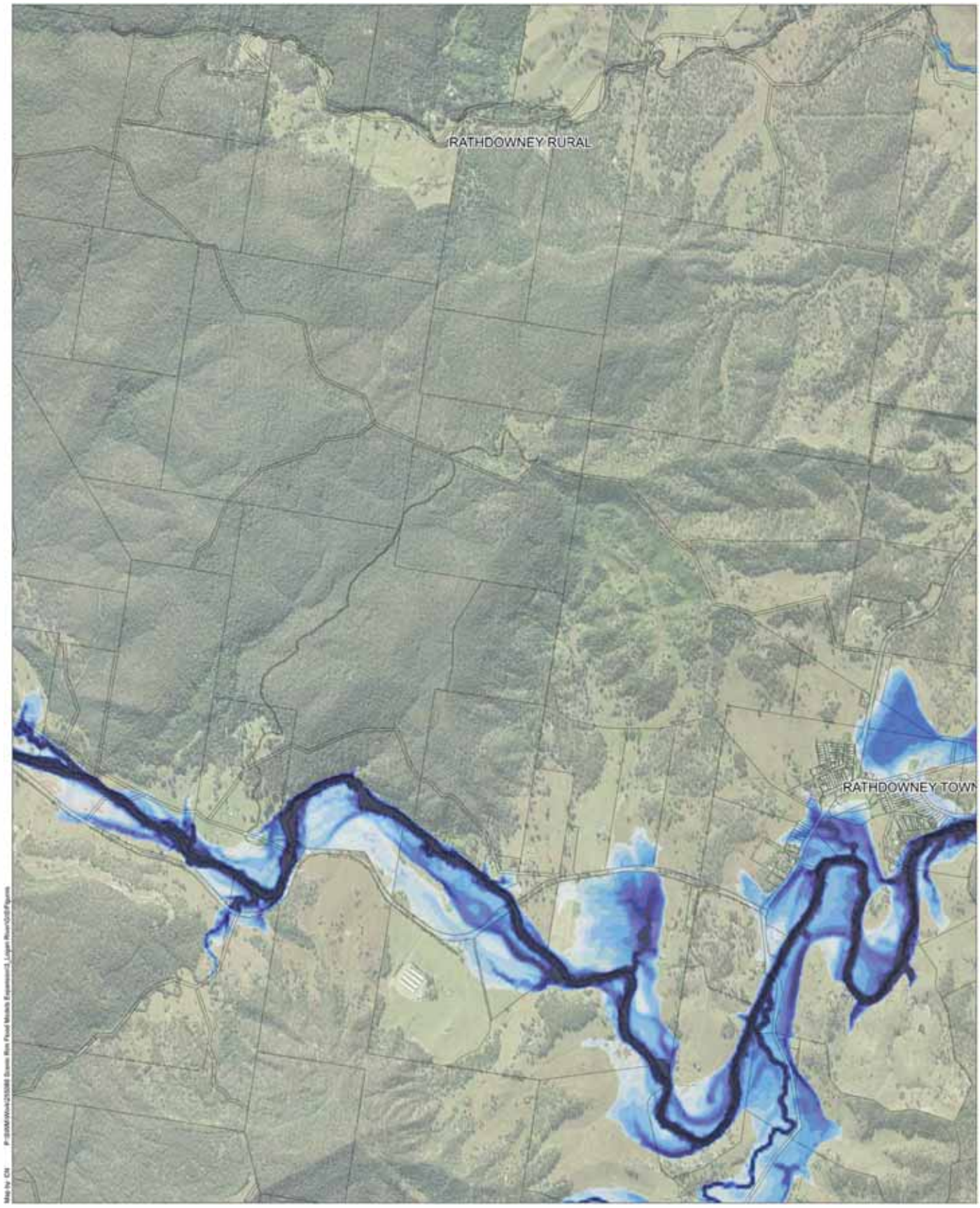
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-n

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

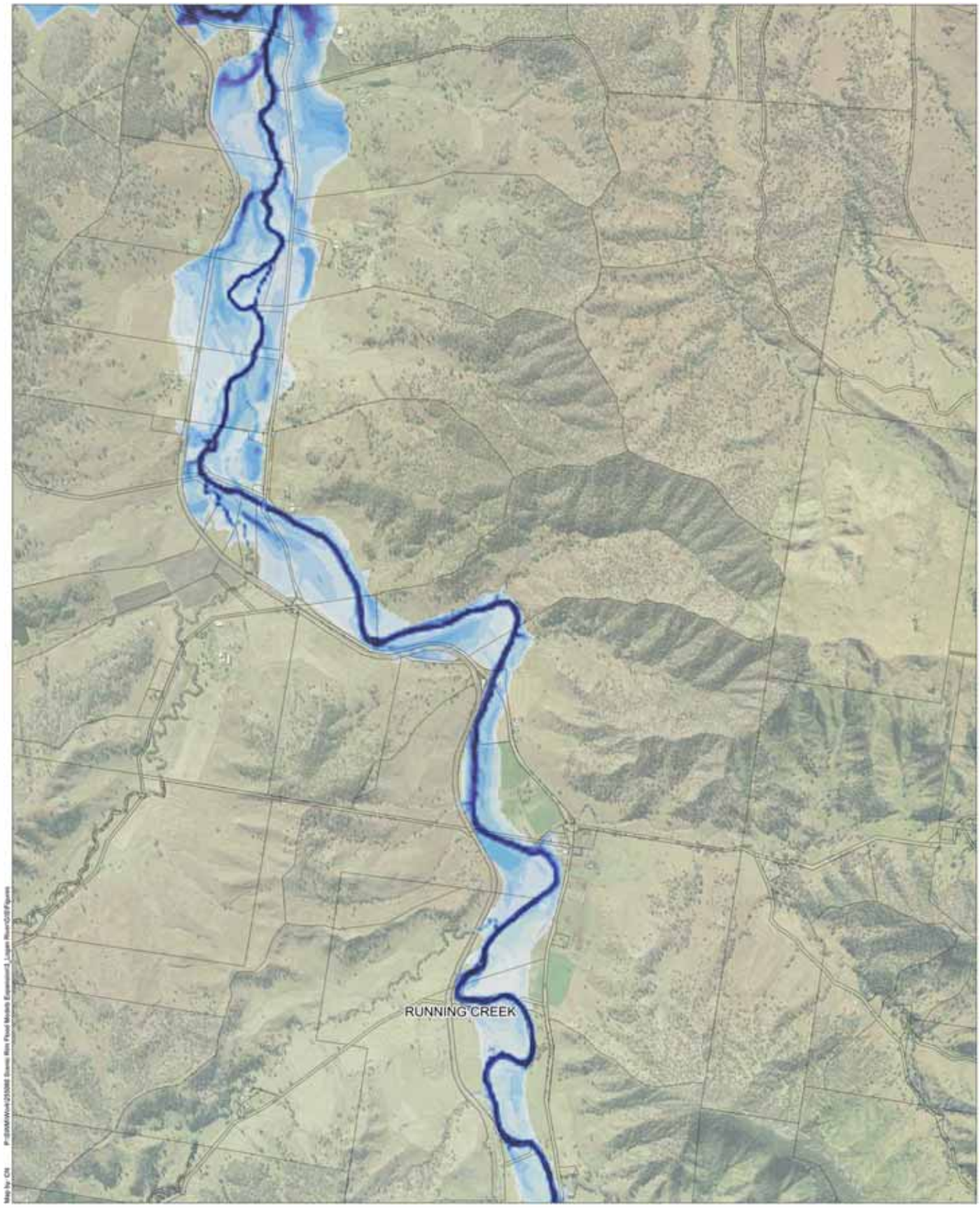
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-o

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

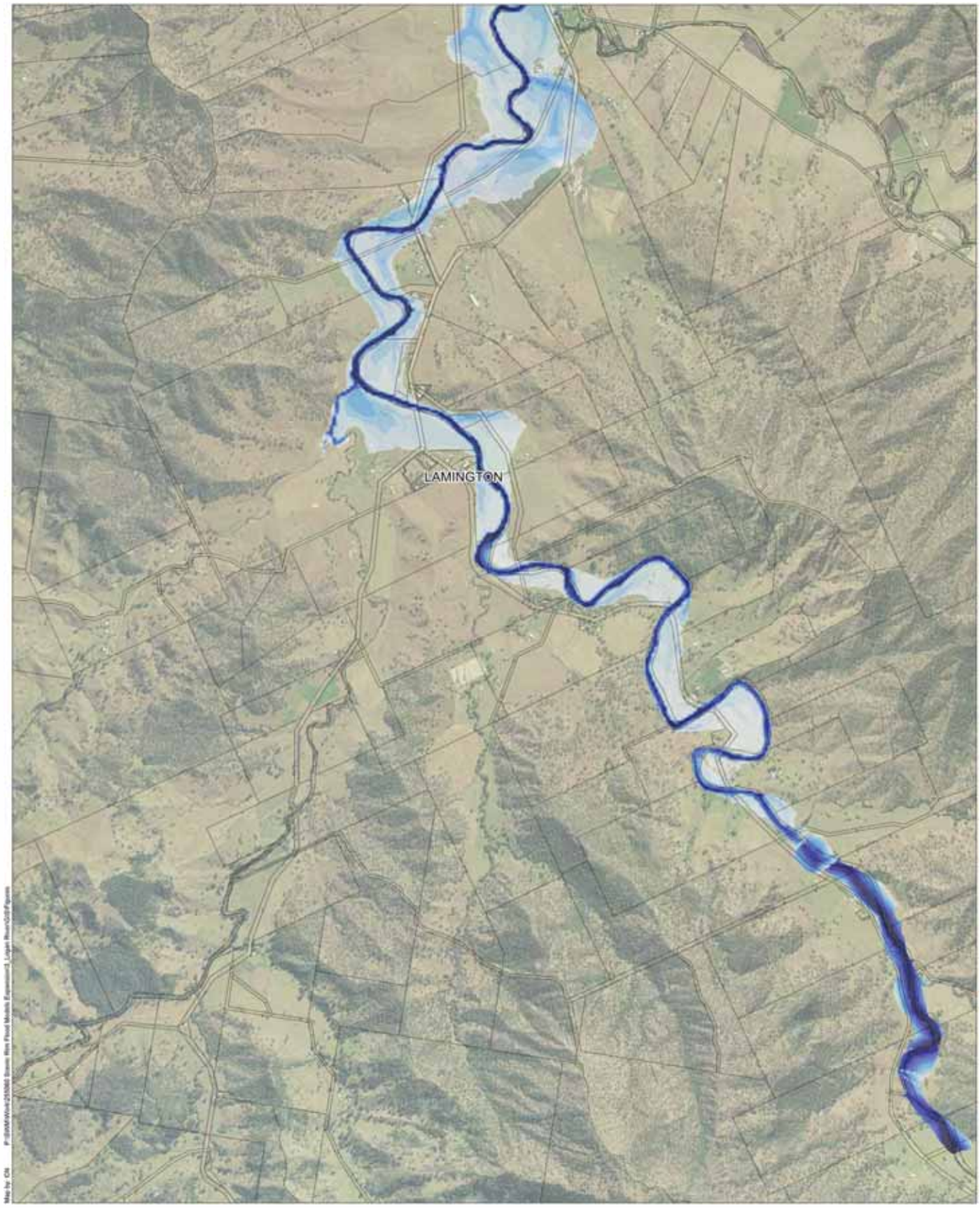
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-p

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

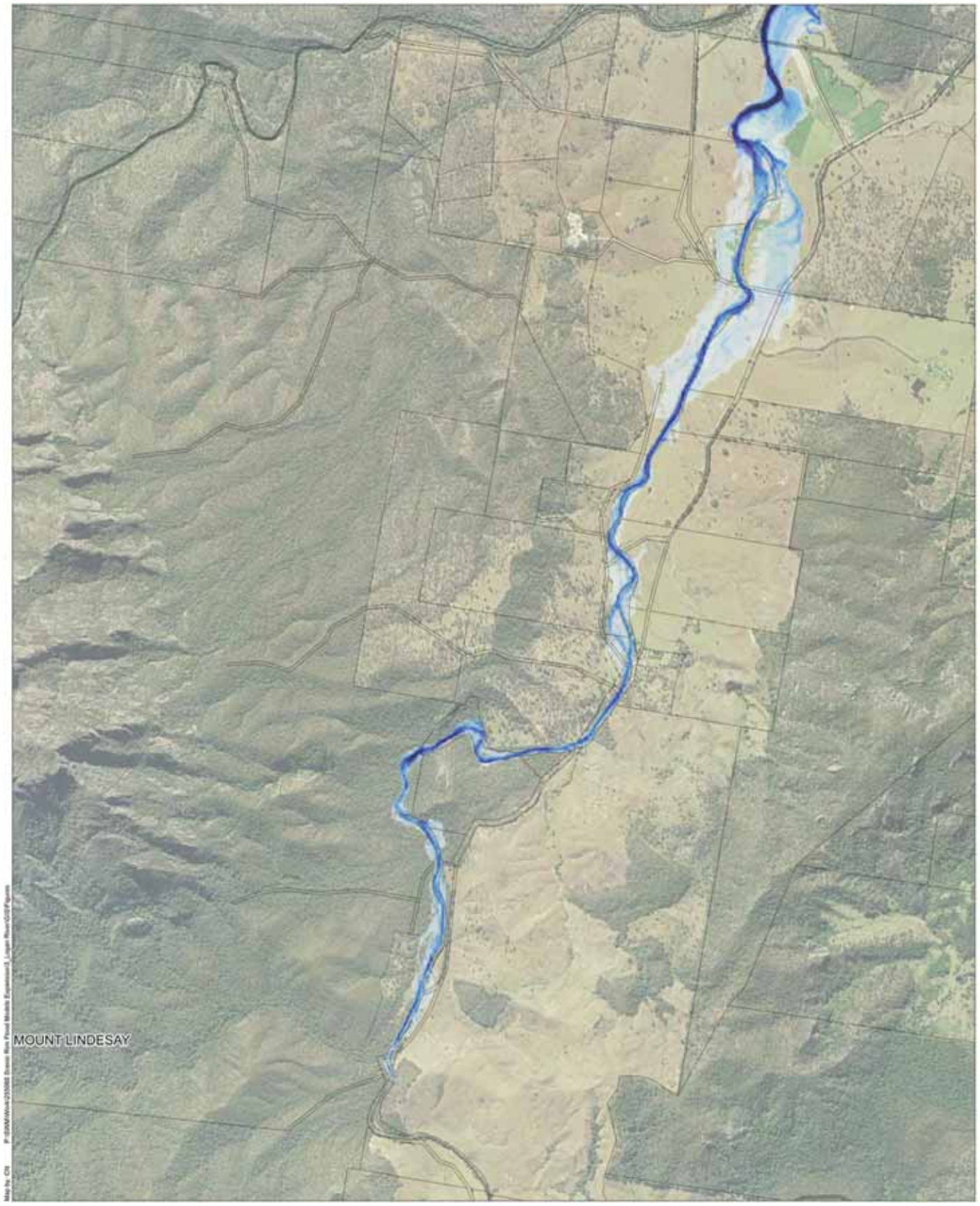
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-q

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

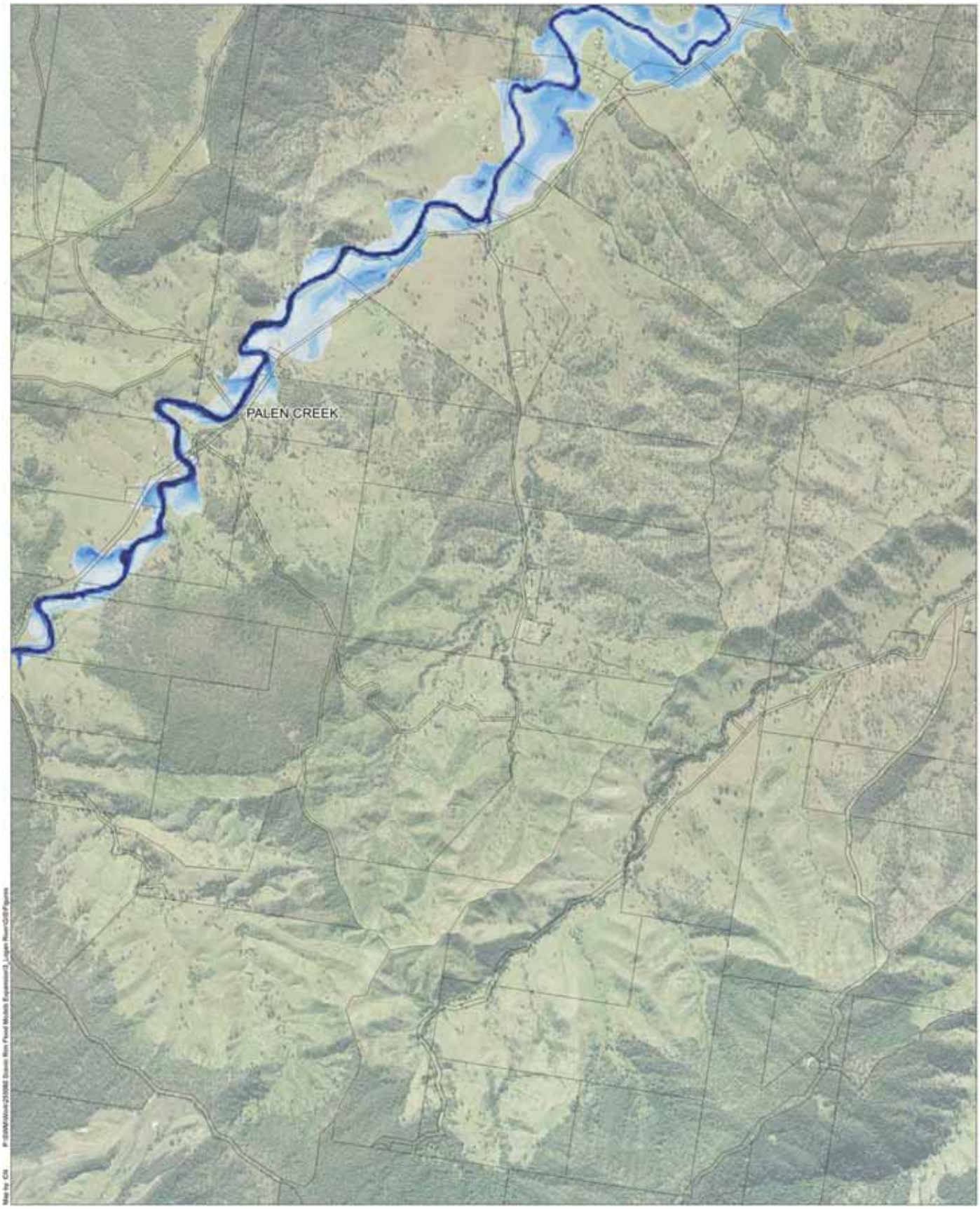
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-r

2% AEP Event - Peak Depth Map



Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-s

2% AEP Event - Peak Depth Map

Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5	3.0 to 3.5
0.5 to 1.0	3.5 to 4.0
1.0 to 1.5	4.0 to 4.5
1.5 to 2.0	4.5 to 5.0
2.0 to 2.5	> 5.0
2.5 to 3.0	

Notes:

1:25,000

0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-t

2% AEP Event - Peak Depth Map

aurecon

Legend

SRRC Boundary

Cadastral Boundary

Depth (m)

0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
2.0 to 2.5
2.5 to 3.0
3.0 to 3.5
3.5 to 4.0
4.0 to 4.5
4.5 to 5.0
> 5.0

Notes:

1:25,000

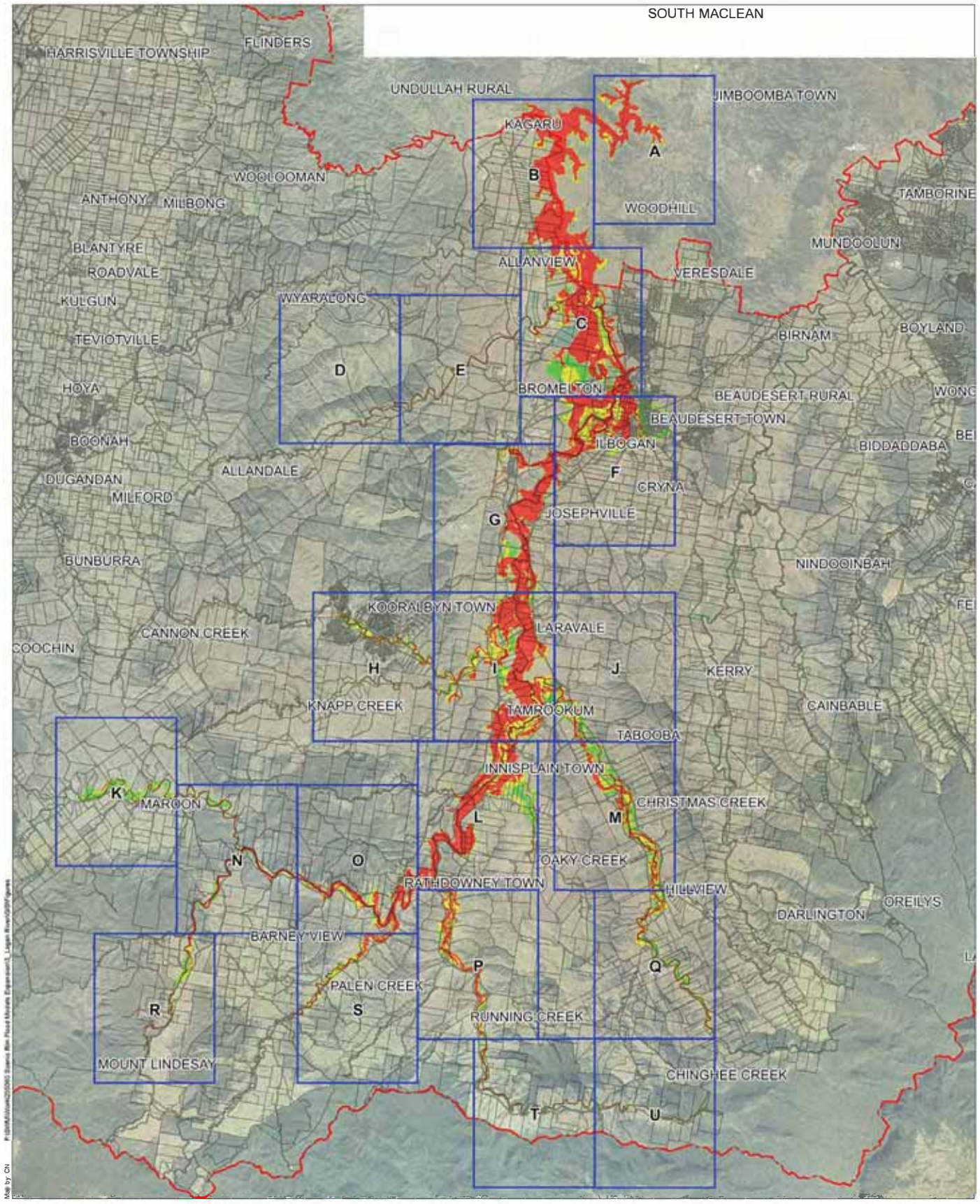
0 625 m 1,250 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C3-u

2% AEP Event - Peak Depth Map



Legend

- SRRC Boundary
- Cadastral Boundary
- Low Hazard
- Medium Hazard
- High Hazard

Notes:

1:200,000

0 5,000 m 10,000 m

Date: 18/08/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Logan River Flood Study Figure C4

2% AEP Event - Peak Hazard Map