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Scenic Rim Flood Modelling

Upper Coomera River Flood Modelling – Consolidated Final Report

Scenic Rim Regional Council

14 December 2017
Revision: 0
Reference: 255060

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Document control record

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Document control						aurecon
Report title		Upper Coomera River Flood Modelling – Consolidated Final Report				
Document ID		255060-007-REP-HH-001-0	**Project number**		255060	
File path		255060-007-REP-HH-001-0-Upper Coomera River Flood Model Consolidated Report.doc				
Client		Scenic Rim Regional Council				
Client contact		Scott Turner, Manager Planning	**Client reference**		-	
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier (if required)**	**Approver**
0	14 December 2017	Final Issue	J Di Trapani	T Graham	-	T Graham
Current revision		**0**				

Approval			
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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 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 Upper Coomera River catchment.

1.2 Study area

The Coomera River catchment extends north from the Queensland-New South Wales border ranges to the coastal suburb of Coomera, between Brisbane and the Gold Coast. The area of interest for the flood modelling is the upper reaches of the Coomera River from the upper end of Illinbah Road to downstream of the confluence with Back Creek. The study area is presented in Figure A1, Appendix B.

The Coomera River catchment is well developed downstream of Clagiraba, including the suburbs of Oxenford and Coomera. However, within the study area, development is predominantly rural residential. The outer areas of Canungra are within the catchment, including the Canungra Army Camp. Other centres include Witheren, Ferny Glen and Illinbah. At Witheren there is a camping ground and at Canungra there is a Golf Course.

A major tributary, Back Creek, joins the river downstream of Canungra. Other minor tributaries join the river within and downstream of the study area. The Scenic Rim local government area extends to downstream of Witheren. Areas further downstream are within the Gold Coast City Council area.

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 the Upper Coomera 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 Upper Coomera 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 Gold Coast City Council (GCCC) is responsible for the Coomera River hydrological model. An URBS model of the catchment, as developed by GHD in 2000, was provided as the starting point for this assessment including a sub-catchment layout in GIS format. In addition, calibration data for the February 2010 event was provided by GCCC, in the form of recorded level data at the Canungra Army Camp gauge and recorded rainfall in the catchment.

The current Upper Coomera River URBS model was adapted from the model originally developed by GHD (2000) for the Gold Coast City Council (GCCC). This model was recalibrated by Aurecon as part of the current investigation.

2.2 Survey Data

2.2.1 Aerial LiDAR Survey

SRRC provided LiDAR data for the study area (date stamped February 2012). This data was provided to Aurecon as 1 m grid Digital Elevation Model (DEM) (xyz) tiles. Metadata was not provided with the LiDAR data however it is generally considered to have a vertical accuracy of ± 0.15 m and a horizontal accuracy of ± 0.30 m.

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

2.2.2 Field Survey

To assist with providing information for emergency management response critical road crossings were identified within the Upper Coomera 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 Upper Coomera River catchment, the following crossings were surveyed:

- Illimbah Road – Bennets Crossing
- Upper Coomera Road – Jerome Bridge
- Beechmont Road – Witherin Sharp Bridge

Using this field survey improvements were made to the bathymetric representation within the current model. This is discussed further in Section 4.2.3.2.

2.3 Hydraulic structure data

Structure details for a number of bridges and culverts were also provided by SRRC, including the TMR owned RJ Hinze Coomera River Bridge. This information was supplemented by measurements collected during the site visit, as discussed in Section 2.4.

2.4 Site inspection

A site inspection was carried out on 14 February 2013 to capture and check structure details, hydraulic roughness parameters and catchment details for input to the modelling. Structure details for many of the hydraulic structures were measured during this site visit.

Refer Appendix A for the structure proformas completed from this visit.

2.5 GIS data

The following GIS datasets were provided by SRRC:

- Aerial imagery – High resolution 2013 aerial imagery
- GIS based hydraulic structures data
- Updated DCDB (2017)

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

2.6 Surveyed floor levels

SRRC provided surveyed flood levels throughout the catchment in GIS format for a number of historic events, including:

- January 2013
- February 2010
- January 2008
- 1996
- 1974
- 1953

The events chosen for calibration (2008, 2010) were based on the amount of observed data available within the study area. The rainfall data and Canungra Army Camp gauge level data for the 2008 event was sourced from the Bureau of Meteorology. Information pertaining to the Canungra Army Camp gauge was sourced from DNRM's Watershed website.

2.7 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 1, 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 1 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

AEP (%)	AEP (1 in x)	Average recurrence interval (ARI)
2.00	50	50
1.00	100	100
0.50	200	200
0.20	500	500

As can be seen from Table 1, the difference between AEP and ARI is minimal for 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 Hydrologic modelling

3.1 Baseline hydrologic model

The URBS model, developed by GHD in 2000, was used for this assessment. Data provided included:

- The URBS vector and sub-catchment files
- The sub-catchment layout in GIS format
- A rating curve at the Canungra Army Camp gauge
- Pre-generated design storm files using the GCCC adopted IFD relationship, for a range of storms from the 20% AEP event up to the 0.2% AEP event

Figure A1, Appendix B, shows the sub-catchment layout as provided by GCCC and adopted for the study. Minor modification was made to the model to provide hydrographs at required locations within the hydraulic model. The tables below show the parameters adopted by GHD, their calibration results and the resulting design discharge estimates at Canungra, within the study area.

Table 2 Adopted model parameters for the GHD 2000 hydrological study

	Alpha	m	Beta	IL (mm)	CL (mm/hr)
Calibration	0.0067	0.62	1.8	37.1	1.7
Design flood estimation	0.0067	0.62	1.8	0.0	1.7

Table 3 Calibration results from the GHD 2000 hydrological study

Event	Peak modelled height at Canungra (m)	Peak modelled discharge at Canungra (m^3/s)	Delta H (m)
1967	7.3	912	-1.74
1974	6.8	755	-0.96
1989	7.6	556	-0.53

Table 4 Results from the GHD 2000 study

AEP	Duration (hrs)	Rainfall depth on upper sub-catchments (mm)	Peak discharge at Canungra (m^3/s)
2%	12	261.6	734
1%	12	293.9	842
0.5%	12	327.1	953

The model was run with the GHD adopted calibration parameters and the provided storm files. The design flows given in the GHD report were not able to be replicated and estimates approximately

20% higher at Witheren (9 hour event) were produced. In addition, the critical duration for Canungra was found to be 9 hours, rather than the documented 12 hours in the GHD report. GCCC were consulted but the discrepancy was not resolved. As the model was being recalibrated it was decided this would not be pursued further.

3.2 Hydrologic model recalibration

Significant rainfall events have occurred within the Coomera River catchment in recent years with flood observations captured for the following events:

- January 2013
- February 2010
- January 2008

The URBS model was recalibrated to the January 2008 and February 2010 events as there were a number of flood level observations available throughout the catchment. Details of the calibration are described below.

3.2.1 Available data

3.2.1.1 Streamflow gauge records

There is one operating stream flow gauge within the study area, at the Canungra Army Camp, which was used to compare the hydrologic and hydraulic model performance. It has been operating since 1962 and has had 251 gauging's recorded.

Table 5 Streamflow gauge used for calibration

Station number	Station name	Period	Gauge zero (m AHD)
146010A	Canungra Army Camp	1962 to current	81.62

The rating curve for the gauge significantly influences the calibration of both the hydrological and hydraulic model. Rating curves are updated over time to capture additional gauging's but also to account for changes in the cross section. The control weir for the gauge is formed by improved natural rock. It is not expected this would have changed significantly over time, however the banks could have which would affect the higher flows. The maximum gauged stage is 4.51 m, captured in 1983, corresponding to a discharge of 185 m^3/s. The maximum observed stage was 7.63 m in 1989 indicating a rating ratio of 0.60.

Rating Table No. 9 was provided with the model and both Table No. 9 and No. 12 were used by GHD in their study. Table No. 15 was the current curve at the time of the January 2008 event and Table No. 20 (the latest) was valid for the February 2010 event. Table No. 20 has been used for both events as it available from DNRM. For the 2008 event the curve was manually extended by sight to capture the peak observed water level. Image 1 shows the adopted rating curve.

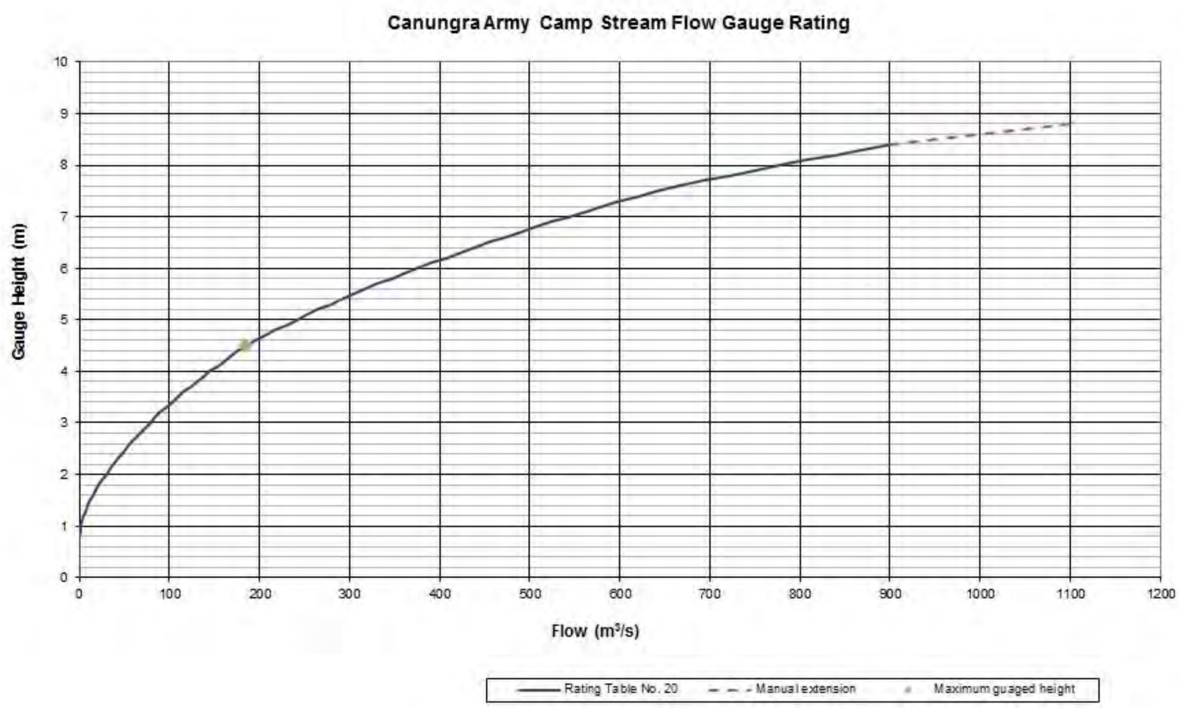

Image 1 Canungra Army Camp stream flow gauge rating curve

Significant discrepancies were found with the published gauge information, as shown in Table 6. The BOM data was adopted for this assessment as it was more consistent with the surveyed flood levels.

Table 6 Discrepancies with gauge information

Details	BOM	DNRM
Gauge Zero	81.62 mAHD	76.72 mAHD
Peak 2008 water level (date)	8.6m gauge height (5/1/08)	7.2m gauge height (6/1/08)

3.2.1.2 ALERT rainfall data

A number of ALERT rainfall stations are located within the catchment. The following were used in the recalibration of the model:

Table 7 ALERT rainfall stations used for calibration

Station number	Station name
040845	Binna Burra AL
040844	Beechmont AL
040376	Tyungun AL (data was not available for the 2008 event)
540290	Canungra Army AL
040930	Laheys Lookout AL
540291	Calgiraba Road AL
040335	Mt Tamborine AL

3.2.2 January 2008 calibration event

According to the DNRM data (recognising the discrepancy discussed above), the 2008 event is the fourth highest level recorded at the gauge since the record began in 1962, behind 1989, 2013 and 1967. The height recorded in 2008 is only 0.4 m lower than the maximum recorded in 1989.

Image 2 and Image 3 show the calibration achieved. This shape was not well matched but a good match for the flood volume has been achieved. The shape of the hydrograph for the 2008 event could indicate that the gauge failed at the peak. The table below shows the model parameters adopted for the 2008 event. It is considered that a reasonable calibration was achieved for 2008.

Table 8 January 2008 model parameters

	Alpha	m	Beta	IL (mm)	CL (mm/hr)
Design flood estimation	0.0062	0.62	3.4	20.0	0.0

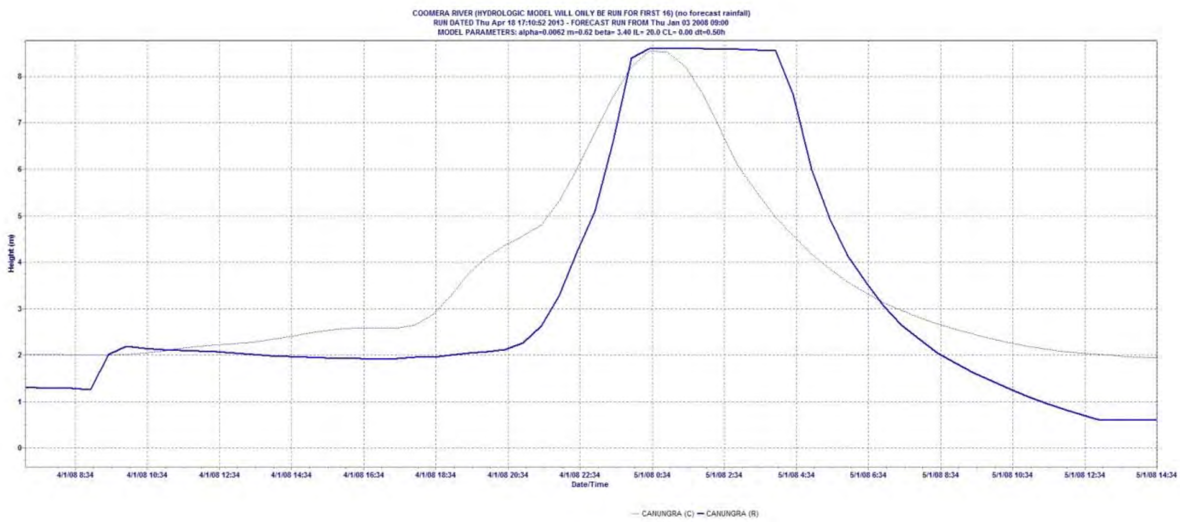

Image 2 2008 event – observed vs modelled level at Canungra Army Camp Gauge

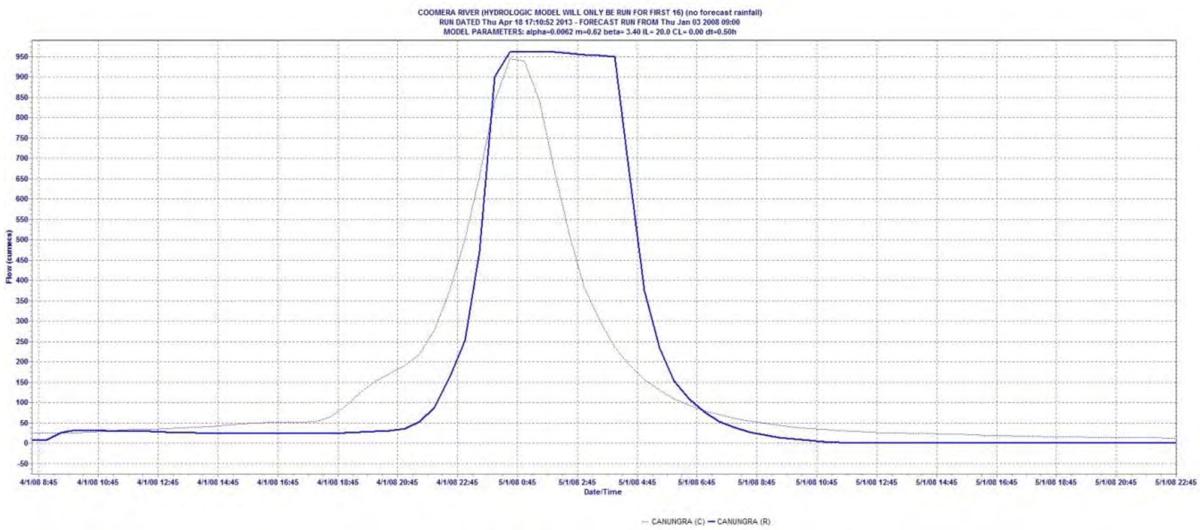

Image 3 2008 event – observed vs modelled discharge at Canungra Army Camp Gauge

3.2.3 February 2010 calibration event

It is considered that a good calibration was achieved for 2010. The table below shows the model parameters adopted for the 2010 event. Image 4 and Image 5 show the calibration achieved.

Table 9 February 2010 model parameters

	Alpha	m	Beta	IL (mm)	CL (mm/hr)
Design flood estimation	0.0067	0.62	3.5	46.0	3.2

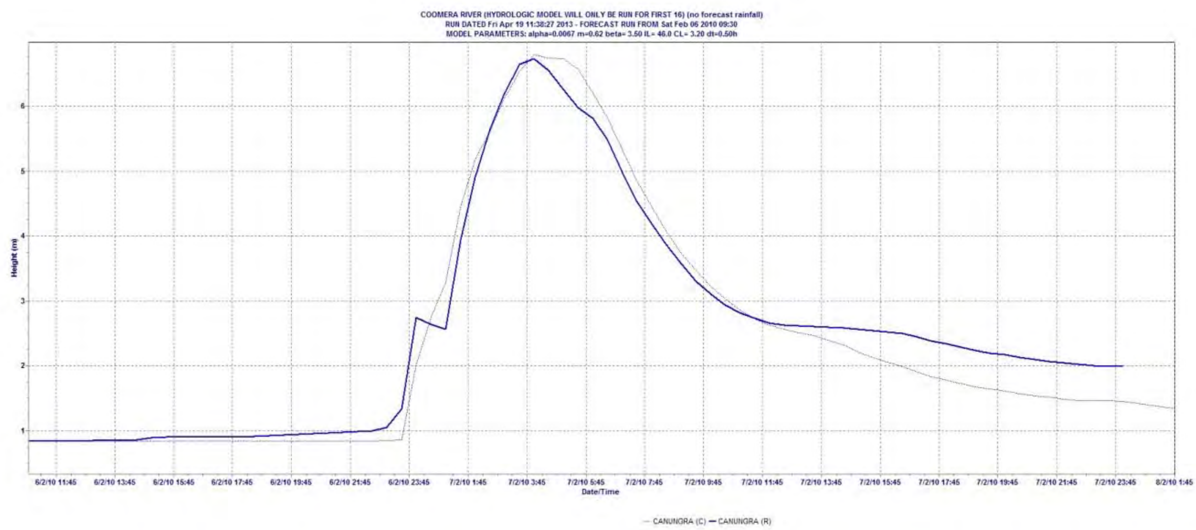

Image 4 2010 event – observed vs modelled level at Canungra Army Camp Gauge

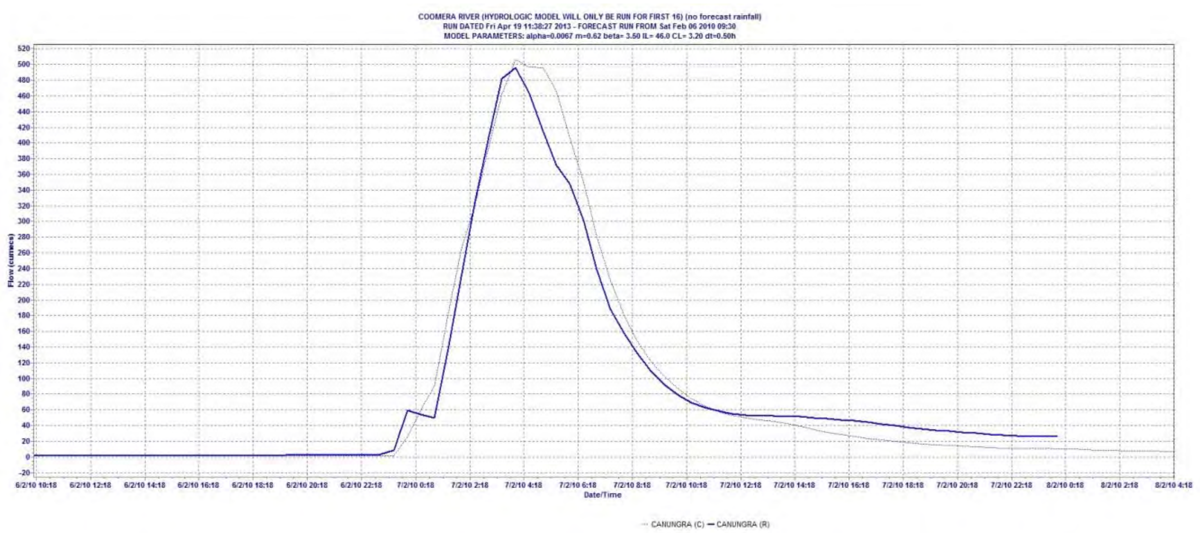

Image 5 2010 event – observed vs modelled discharge at Canungra Army Camp Gauge

3.3 Adopted model parameters

Table 10 shows the model parameters adopted for the design flood estimation. They were derived by taking the weighted average of each calibration event parameter (in the current assessment), based on the peak discharge. Only the 2008 and 2010 events were considered in this process as they represent the river channel geometry over recent years. When the 2008 and 2010 events were simulated with the average parameters, a reasonable result was achieved for both events.
The average calibration parameters derived in the 2000 GHD study were also simulated for the 2008 and 2010 events, with the updated rating curve, and again showed reasonable results indicating consistency across the studies.

Table 10 Adopted model parameters for the current study

	Alpha	m	Beta	IL (mm)	CL (mm/hr)
Calibration	0.0064	0.62	3.4	29.0	1.1
Design flood estimation	0.0064	0.62	3.4	0.0	1.1

3.4 Design event rainfall depths

The design rainfall depths provided with the GHD model were used for this assessment, as these are the rainfall depths currently adopted by GCCC. To model spatial variation in rainfall intensity, the catchment was divided into three regions. The area of interest for this study crossed Group 1 and Group 2. The GHD report (2000) should be referenced for full details of the rainfall derivation.

Table 11 Design event rainfall depths on sub-catchments 1-6, 10 (Group 1)

Duration (hr)	AEP		
	2%	1%	0.5%
6	171.1	189.7	208.5
9	212.9	237.2	262.1
12	248.5	278.1	308.4

Table 12 Design event rainfall depths on sub-catchments 7, 8, 9, 11-16* (Group 2)

Duration (hr)	AEP		
	2%	1%	0.5%
6	180.9	201.3	222.1
9	224.5	251.2	278.5
12	261.6	293.9	327.1

* Limit of this study

3.5 Design event discharge estimates

Using the adopted model parameters and the updated rating curve, the URBS model was run for the 2, 1 and 0.5% AEP events. The 6, 9 and 12 hour duration events were simulated to ensure the critical duration was considered. The following peak modelled discharges were derived using the recalibrated URBS model:

Table 13 Design peak discharges from recalibrated URBS model

Location	AEP		
	2%	1%	0.5%
Witheren	710	810	910
Canungra Army Gauge	810	920	1040

The current estimates are approximately 10% higher than those reported in the GHD report.

3.6 10%, 5% and 2% AEP events

The 1% AEP URBS model was adapted to extract 10%, 5% and 2% AEP discharge hydrographs for use in the TUFLOW model. Parameterisation of the URBS model for the 10%, 5% and 2% AEP events was based on the calibrated 1% model developed for the 2013 Upper Coomera River Study.
The event independent Alpha, Beta and m parameters were retained as per the calibrated 1% AEP event Upper Coomera River URBS model.

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 have been adopted as per the Brisbane River Catchment Flood Study (BRCFS) URBS models for the 10% 5% and 2% events. The BRCFS URBS models were developed for several other catchments in the SRRC region and therefore considered appropriate for the Upper Coomera River catchment. Adopted URBS model parameters are shown in Table 14.

Table 14 Upper Coomera River URBS model design event parameters

Design Event	Calibration parameters				
	Initial Loss Rate (mm)	Continuing Loss Rate (mm/hr)	Alpha, α	Beta, β	m
2% AEP	8	1.7	0.0064	3.4	0.62
5% AEP	16	1.7	0.0064	3.4	0.62
10% AEP	24	1.7	0.0064	3.4	0.62

4 Hydraulic modelling

Hydraulic modelling of the Upper Coomera River was initially undertaken in 2013 and focussed upon the 1% AEP event only. The following sections discuss the model development process. The model layout is presented in Figure A1, Appendix B.

4.1 Hydraulic model development

4.1.1 Software selection

The TUFLOW modelling package was selected for the development of the Upper Coomera River model. It is widely used within the industry and its flexibility readily supports future development of the model should additional analyses be required.

4.1.2 Model grid

A 10 m grid spacing was adopted for this assessment as it provided a reasonable balance between resolution and model run times. The river has a top of bank width of approximately 40 m (4 to 5 cells wide). Initial depths of flooding for the 1% AEP event were in the order of 6 m. A smaller grid size would have compromised the accuracy of the model as the shallow water equations on which the hydraulic model is based are less valid once the depth of the water is greater than the cell size.

4.1.3 Topography

A 2 m grid Digital Terrain Model (DTM) was developed from the LiDAR data described in Section 2.2. The model topography was based upon this DTM.

No modification was made to the topography as the river was well represented by the DTM and there were no other significant hydraulic controls in the model area, such as road embankments.

Performance of the DTM was able to be assessed at the Canungra Army Camp Gauge, where there was a cross section available. Image 6 illustrates the LiDAR performance at the stream flow gauge. It can be seen that approximately 1 m of the low flow conveyance has not been captured by the LiDAR.

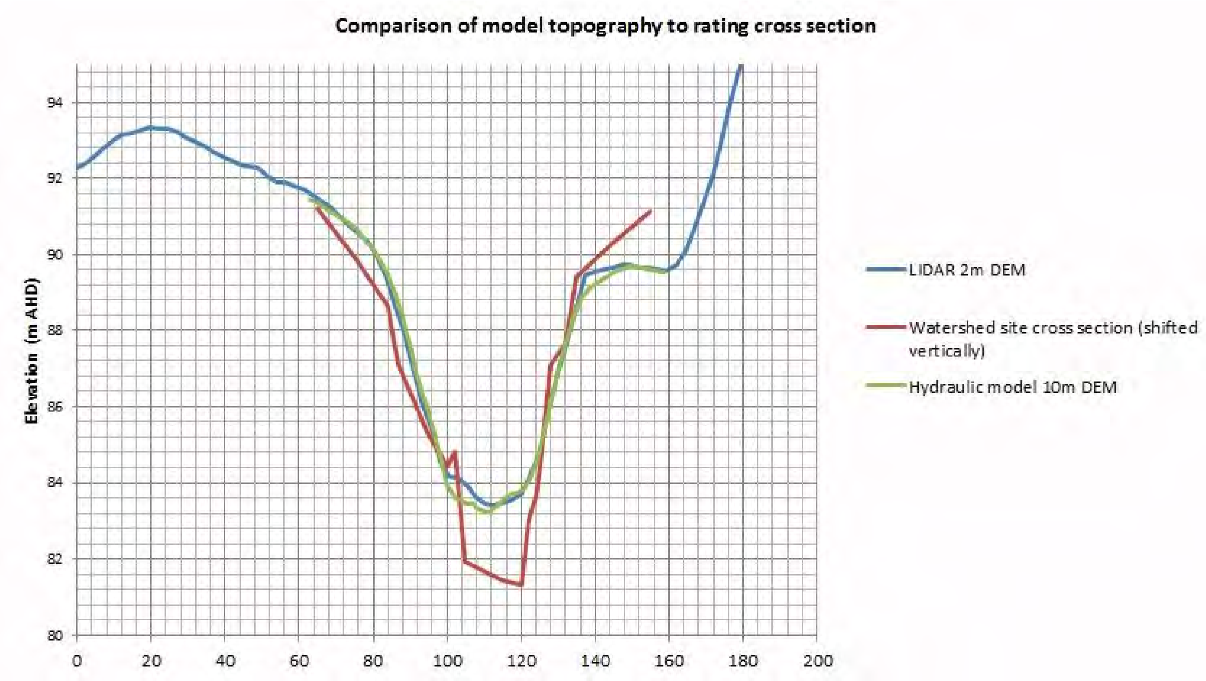

Image 6 Assessment of LIDAR definition at stream flow gauge

4.1.4 Land use type

The 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 (refer Section 0). The adopted roughness values are presented in Table 15.

Table 15 Post-calibration Manning's 'n' roughness values

Land Use Type	Manning's n
Low Density Residential	0.090
Dense Vegetation	0.120
Low Vegetation	0.035
Road Reserve	0.030
River Corridor	0.035

4.1.5 Hydraulic structures

There are a number of low level crossings of the Upper Coomera River within the study area, as described in the proformas contained in Appendix A. Basic measurements were recorded during the site visit and are approximate. These were supplemented with data supplied by SRRC.
These structures have been excluded from the hydraulic model, as it was considered they were not hydraulically significant for the events of interest. Most of the structures are low level causeway structures that would be hydraulically drowned during a 2% AEP event.

There are a number of larger bridge structures that cross the river within the study area. It can be seen in Table 23 that the estimated design floods either reach deck level for these structures or are 2 to 3 m above deck level. Minor local flood impacts may be experienced due to these structures, particularly where a structure has become blocked by debris. There was evidence of significant debris deposit upstream of Sharp Bridge and Rowe Bridge. However, for this assessment, the overall objective is to provide catchment wide flood response information to support development planning and emergency management. As such, these structures were not considered to be hydraulically significant.

Although a significant structure, the RJ Hinze Bridge is located near the boundary of the hydraulic model and therefore estimated flood levels are impacted by the downstream boundary conditions. Given that the deck level of 78.22 m AHD is above the design flood levels estimated it was considered reasonable to exclude this structure.

4.1.6 Tributaries

There are a number of small tributaries of the Upper Coomera River that join the main river within the study area, including:

- Price Creek
- Flying Fox Creek
- Unknown, near Tucker Lane
- Unknown, near Corcoran Crescent
- Unknown, near Wau Road
- Back Creek

The tributaries are considered in the hydrologic model but only the Upper Coomera River has been specifically modelled within the hydraulic model. Inflows from the tributary are generally applied where the tributary joins the river. However, for Price Creek, the inflow is applied at the centroid of the sub-catchment to align with the hydrologic model extraction locations. The mapping therefore includes the lower reach of this creek. Likewise, the lower reach of Back Creek is shown although flood levels in this area are affected by the downstream model boundary conditions, as discussed in the following section. The DTM generally has some tributary channel definition and as such the mapping may illustrate backing up of water within the other tributaries.

4.1.7 Boundary conditions

The URBS 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 fixed level downstream boundary was applied. Due to the steepness of the channel upstream of the RJ Hinze Coomera River Bridge, effects of the boundary are not conveyed upstream to the key areas of interest. Refer to Section 5.5.2 for a discussion on sensitivity investigations undertaken on the downstream boundary level. Flood level estimates provided within the vicinity of the bridge should be considered with reduced accuracy.

Table 16 Fixed level boundary applied

Event	Fixed level downstream boundary (m AHD)
January 2008 calibration	66.0
February 2010 calibration	66.0
2% AEP (50 year ARI)	75.0
1% AEP (100 year ARI)	75.0
0.5% (200 year ARI)	75.0

4.2 10%, 5% and 2% AEP events

The calibrated TUFLOW model developed as part of the 2013 study which investigated 1% AEP flooding behaviour within the Upper Coomera River catchment was adopted for the 2017 assessment of the 10%, 5% and 2% AEP events. The original hydraulic model was developed using a 10 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 following sections provide details of the updated modelling for the other AEP events.

4.2.1 Software platform and modelling approach

The 2-dimensional (2D) TUFLOW modelling approach used for the 2013 Upper Coomera River Flood study was retained for updated modelling. The 2013 study used TUFLOW version 2012-05-AE which has since been updated. TUFLOW version 2016-03-AD was tested and adopted for this study. A comparison of results using both versions showed primarily similar results with localised differences of +/- 10cm, overall the differences were negligible.

Key component datasets such as the Manning's n roughness layer and the topographic dataset were retained as per the 1 % AEP model.

4.2.2 Inflow boundary conditions

The URBS model outputs were applied as inflows into the TUFLOW model in the same locations as used for the 1% AEP model. Local inflows were applied throughout the model domain.

4.2.3 Model refinements for other AEPs

4.2.3.1 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 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.

4.2.3.2 Hydraulic structures

Improvements to the representation of hydraulic structures details and watercourse bathymetry has been achieved using new ground survey undertaken by Aurecon in May 2017. Locations for ground survey were decided 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 Upper Coomera 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 Upper Coomera River crossing locations selected for survey. These structures have been included in the refined hydraulic model.

Table 17 Surveyed Upper Coomera River crossings

Locality	Structure Type	Key structure dimensions (m)	Deck/Road Level (m AHD)
Illimbah Road, Bennets Crossing	Concrete box culvert with floodway	5 /1.2(w) x 1.2 (h)	176.01
Upper Coomera Road, Jerome Bridge	Timber bridge	37.0 (l) x 7.0(w)	134.01

Locality	Structure Type	Key structure dimensions (m)	Deck/Road Level (m AHD)
Beechmont Road, Witherin Sharp Bridge	Timber bridge	23.5 (l) x 6.5 (w)	106.20

4.2.4 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 to improved delineation between in and out of bank flow conditions.

4.2.5 Grid resolution

The 1% AEP model was developed using a 10m square grid resolution which was appropriate for the assessment of major flooding during which a large portion of the flood is typically conveyed outside of the watercourse. However, for the 10% to 2% AEP events, a greater portion of catchment discharge flows within the banks of the watercourse. As the upper reaches of Upper Coomera River are less than 10m wide in a number of locations, the model resolution was increased to 5m. By increasing the grid resolution, better definition of watercourse bathymetry is achieved allowing an improved representation of bed and bank levels and overall cross-section conveyance area.

To complement the smaller grid size, a Z-Shape utilising elevations from the DEM traced the major channel to enforce a flow path. This flow path better represents the channel and therefore more accurately represents the flow conditions.

4.2.6 Downstream boundary condition

The 2013 study used a fixed level downstream boundary. However, this study conducted a sensitivity analysis to compare a normal depth boundary. The results from this sensitivity analysis showed significantly different results near the downstream boundary.

A normal depth boundary provided more realistic results and was adopted for this study. Due to the steepness of the channel upstream of the boundary, boundary effects on the study area are not expected.

5 Hydraulic model calibration

The January 2008 and February 2010 events were simulated in the hydraulic model and a calibration of the Mannings ‘n’ roughness performed.

Inflow hydrographs from the calibrated hydrologic model were incorporated into the hydraulic model at a number of locations along the study area. The hydraulic model was run and the resulting water levels and discharges compared to the observed data. For the 2010 event, this was limited to the recorded peak level at the gauge. For the 2008 event, the gauge location was checked in addition to the locations where surveyed levels were provided. Different overland roughness and channel roughness values were tested to improve the calibration.

5.1 Calibration targets

Ideally, the following tolerances are achieved before a good calibration has been considered to be achieved:

Table 18 Calibration targets

Water level	Discharge
+/- 0.15m at stream gauges +/- 0.30m at other locations	+/- 10%

5.2 Calibration result

Table 19 shows the calibration achieved at the Canungra Army Camp gauge for both the 2008 and 2010 events.

Table 20 shows the comparison of modelled versus observed 2008 event levels at various locations within the study area. Image 7 and Image 8 show the performance at the Canungra Army Camp Gauge. The flood extents and depths for the study area are shown in Figures A2 and A3, Appendix B.

Table 19 Observed vs modelled level and discharge at the Canungra Army Camp Gauge

	2008 Event		**2010 Event**	
	Observed	Modelled	Observed	Modelled
Peak water level (mAHD)	90.22	90.87 (+0.65)	88.35	88.60 (+0.25)
Peak discharge (m3/s)	962	919 (+4%)	495	502 (+1%)

Table 20 January 2008 model performance

Point number	Location	Observed water level (mAHD)	Modelled water level (mAHD)	Difference (Modelled – Observed)
1	Northern end of Illinbah Road, upstream of Tabletop Road	241.28	241.50	0.22
2		228.23	228.93	0.7
3		224.69	225.36	0.67
4		223.42	224.18	0.76
5		221.49	220.12	-1.37
6		207.94	208.35	0.41
7		203.64	203.23	-0.41
8	Philip Gray Road bridge (Mollenhagen Bridge)	186.84	187.29	0.45
9	Bennets Crossing on Illinbah Road	179.38	179.48	0.1
10	Rowe Road Bridge	165.75	165.52	-0.23
11	Pine Creek outlet near Rowe Road turnoff	158.12	158.39	0.27
12	South of Welsh Road	152.81	154.37	1.56
13	Flying Fox Creek Bridge	143.09	143.26	0.17
14	Jerome Bridge	136.4	136.34	-0.06
15	Tucker Lane	119.72	120.55	0.83
16	Witheren Camp Ground (Sharp Bridge)	108.92	110.17	1.25
17	Alloah Road	105.58	106.74	1.16
	Canungra Army Camp Gauge	90.22	90.87	0.65
	Average difference (in absolute terms)			**0.6**

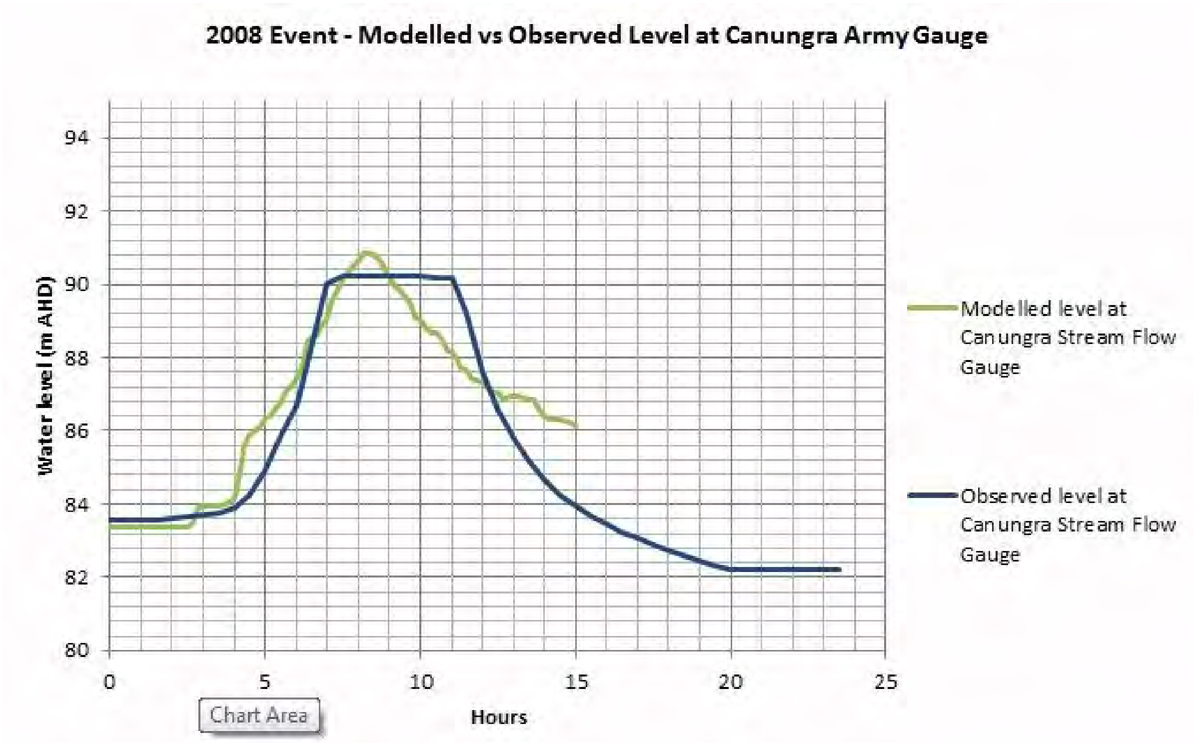

Image 7 2008 event – observed vs modelled water level at Canungra Army Camp Gauge

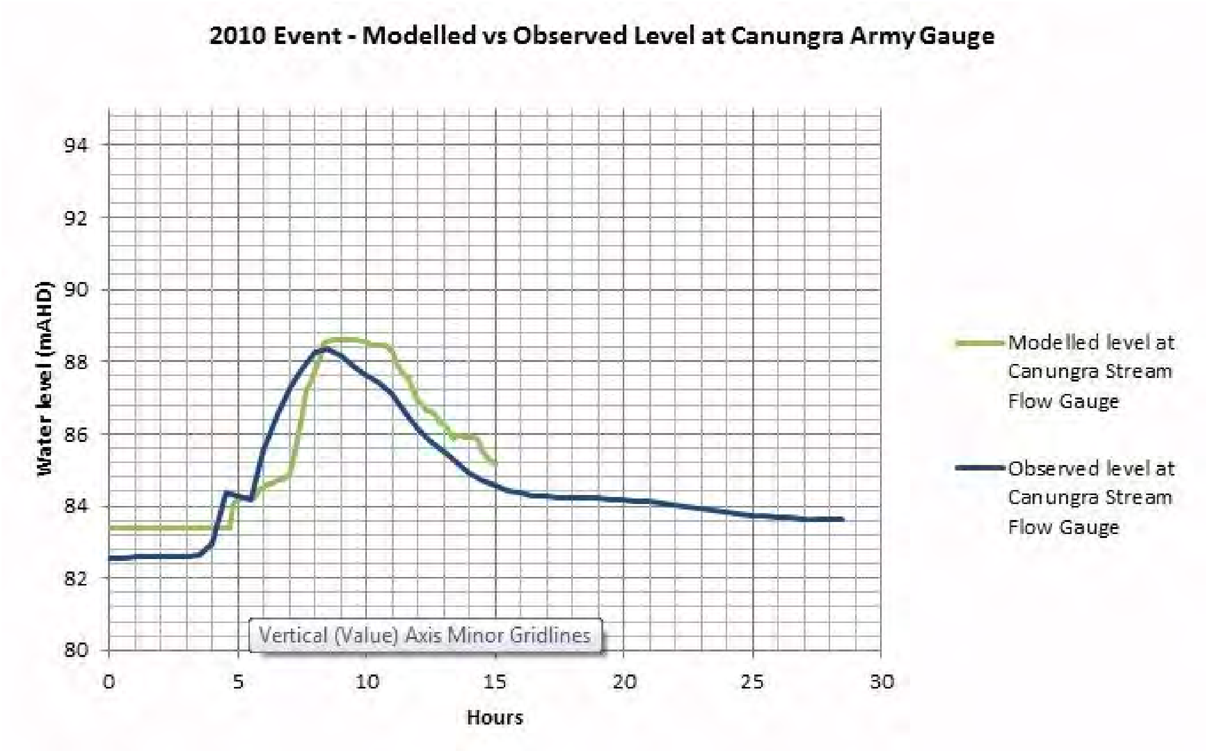

Image 82010 event – observed vs modelled water level at Canungra Army Camp Gauge

5.3 Discussion

The calibration for the 2008 event within the hydraulic model was difficult for a number of reasons:

- The stream gauge does not appear to have recorded the peak of the event
- The difference between the observed and modelled levels varied along the reach; this could be due to variations in the channel slope, the channel width and the bed / overbank roughness contributing to the model responding differently in different reaches.
- Generally, an overestimation of water levels indicates that the Manning's 'n' roughness should be reduced. However, the steepness of the river coupled with a smooth channel introduced model instabilities.

Given the steepness of the channel and corresponding flood slope, a horizontal error of 50 m could alter the reading by 0.5 m vertically in comparing the observed and modelled flood levels. This may be influencing the comparison of results version surveyed levels.

Overall the calibration for the 2008 event is considered to be reasonable and sufficient for the purposes of the study. The mapping will support development control and disaster management planning. Modelled levels are generally higher than those observed which is conservative for the purposes of planning.

Whilst not being within +/-0.15 m, the 2010 event is considered to have achieved a good calibration, based on the results at the gauge only. The timing of the hydrograph peak is within 1 hour which is also considered to be good.

Overall it is considered that a reasonable calibration has been achieved based on the information available.

5.4 Assessment of the hydraulic model performance at the Canungra gauge

As discussed in Section 3.2.1.1, the stage-discharge rating relationship adopted for the Canungra Army Camp gauge significantly influences the calibration performance. During the hydrologic modeling, this relationship defines discharges to be applied to the hydraulic model. The hydraulic model determines water levels at the gauge based on these discharges which are then compared to what was observed.

The rating has been gauged up to a discharge of 185 m^3/s, significantly less than the discharges being considered for the calibration and design events. Above this value, the rating has not been verified by site data and has been estimated. The process for this estimation is not known. Image 9 shows the adopted rating as well as the stage-discharge hydraulic model results at the gauge location for the January 2008, February 2010 and 1% AEP design events. It can be seen that the hydraulic model compares well with the official rating up to a discharge of approximately 500 m^3/s but diverges above that. For an observed stage of 8.6 m gauge height (observed 2008 event) the discharge ranges from 800 to 1000 m^3/s. This could imply that discharges 20% too high are being applied to the model, if the hydraulic model rating is to be trusted over the official rating curve. A reduction in discharges would subsequently reduce predicted flood levels and improve calibration performance.

Alternatively, the discrepancy could indicate that the hydraulic model requires further refinement, specifically a reduced channel roughness value to reduce modelled levels. The Manning's 'n' value applied to the river channel is 0.035. In the upper reaches where the channel is wide with minimal vegetation, a reduction to 0.03 could be justified. However, at the gauge location, the bed is relatively rocky with relatively dense vegetation on the banks. A lower Manning's 'n' is not considered appropriate at this location.

It is considered that the current rating is possibly overestimating discharges in the high flows section of the curve and as a result the modeling has conservatively overestimated flood levels, as demonstrated in the calibration results.

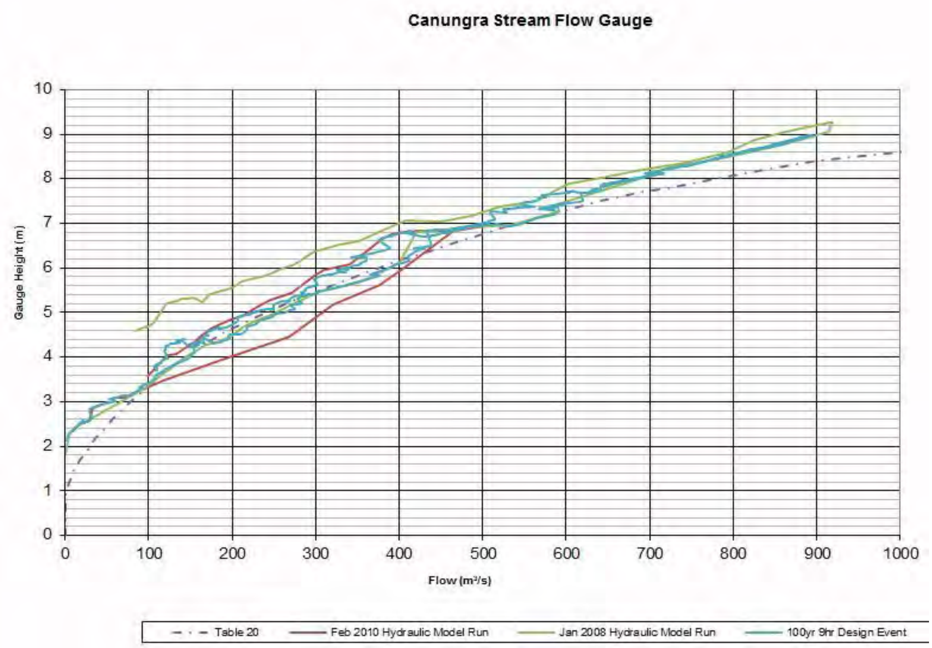

Image 9 Comparison of the Canungra gauge rating curve and the hydraulic model stage-discharge relationships

5.5 Additional validation of hydraulic model

In addition to the calibration of the models, as discussed in preceding sections, other cross checks have been made to confirm the robustness of modelled outputs.

5.5.1 Performance of hydrologic and hydraulic models

For the Upper Coomera River model, the extent of the hydrologic and hydraulic models is similar. This supports the comparison of routing of a flood hydrograph within the two models. Image 10 below shows the comparison at the Canungra Army Camp gauge. It can be seen that the shape of the hydrograph is matched well but the hydraulic model delays the timing of the peak by approximately 2 hours.

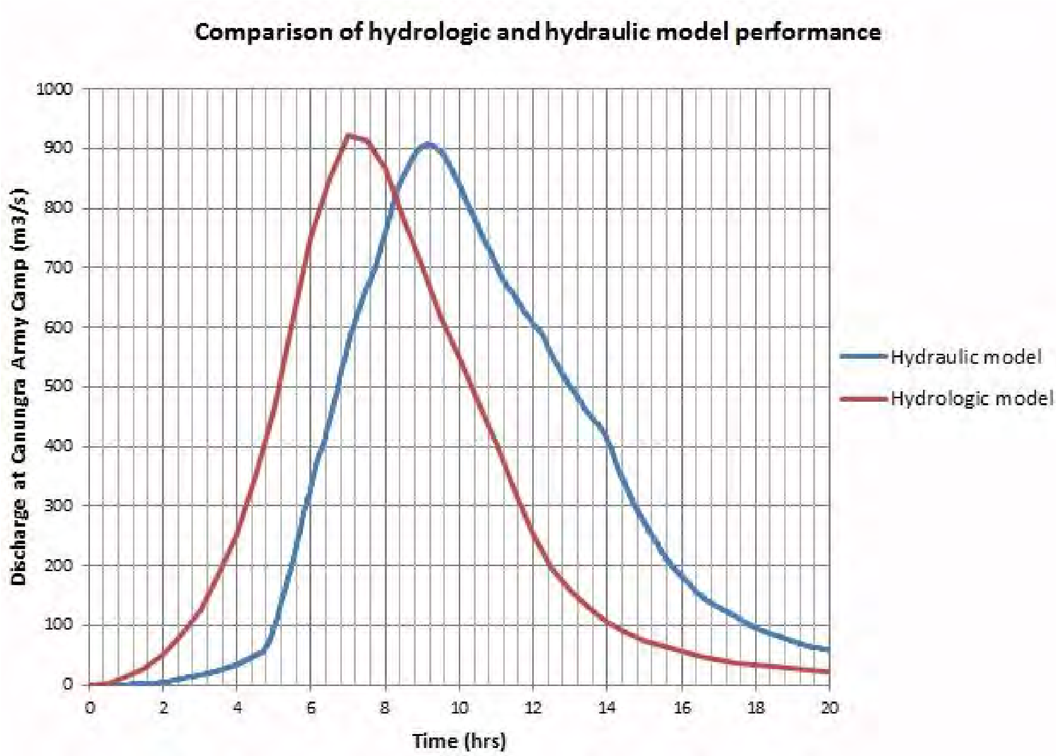

Image 10 Comparison of hydrologic and hydraulic model performance

5.5.2 Downstream boundary sensitivity analysis

As discussed in Section 4.1.6, a fixed level downstream boundary has been chosen for model stability improvement. The level adopted for the design runs was based on initial model runs. A sensitivity analysis was undertaken to assess the impact of this boundary. The 1% AEP event was used for this assessment. Table 21 shows the results of the analysis:

Table 21 Result of downstream boundary sensitivity analysis

Location	Modelled level (mAHD) for given downstream boundary		
	70 mAHD	75 mAHD – baseline	80 mAHD
Downstream boundary	70.00 (-5.00)	75.00	80.00 (+5.00)
RJ Hinze Bridge (approx. 2km upstream)	75.30 (-0.81)	76.11	80.37 (+4.26)
Canungra Army Camp Gauge	90.55 (-0.03)	90.58	90.56 (+0.02)
Alloah Road	106.65 (-0.01)	106.66	106.66 (0.00)

It can be seen that modelled levels are affected in the vicinity of the RJ Hinze Bridge but are sufficiently diminished by the Canungra Army Camp Gauge. As such, modelled outputs downstream of the gauge should be considered with reduced accuracy.

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 Upper Coomera River drainage basin and therefore is unlikely to be influenced by sea-level rise. The effect of climate change on the Upper Coomera River flood levels was therefore assessed for increased rainfall intensity predictions only.

The 1% AEP flood modelling included investigation of the climate change impacts associated with Representative Concentration Pathways (RCPs) 4.5 and 4.8 as defined in AR&R (2016). For the 10% to 2% AEP events, the climate change investigation is based on RCP 4.5 only due to the nearer term timeline associated with these events.

Table 22 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

For the 1% AEP event both Scenarios RCP4.5 and RCP8.5 were assessed and the results are presented on the figures in Appendix B. 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 (presented in Appendix B) 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 – Revised guidelines for presentation of flood mapping are now provided in the Australian Emergency Management Handbook Series (2013) produced by Emergency Management Australia (EMA). This handbook and its supporting flood risk management guidelines are intended to replace the SCARM guidelines under which the previous mapping was prepared. The revised guidelines include a revised categorisation for flood hazard which is shown below in Figure 1. The 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.

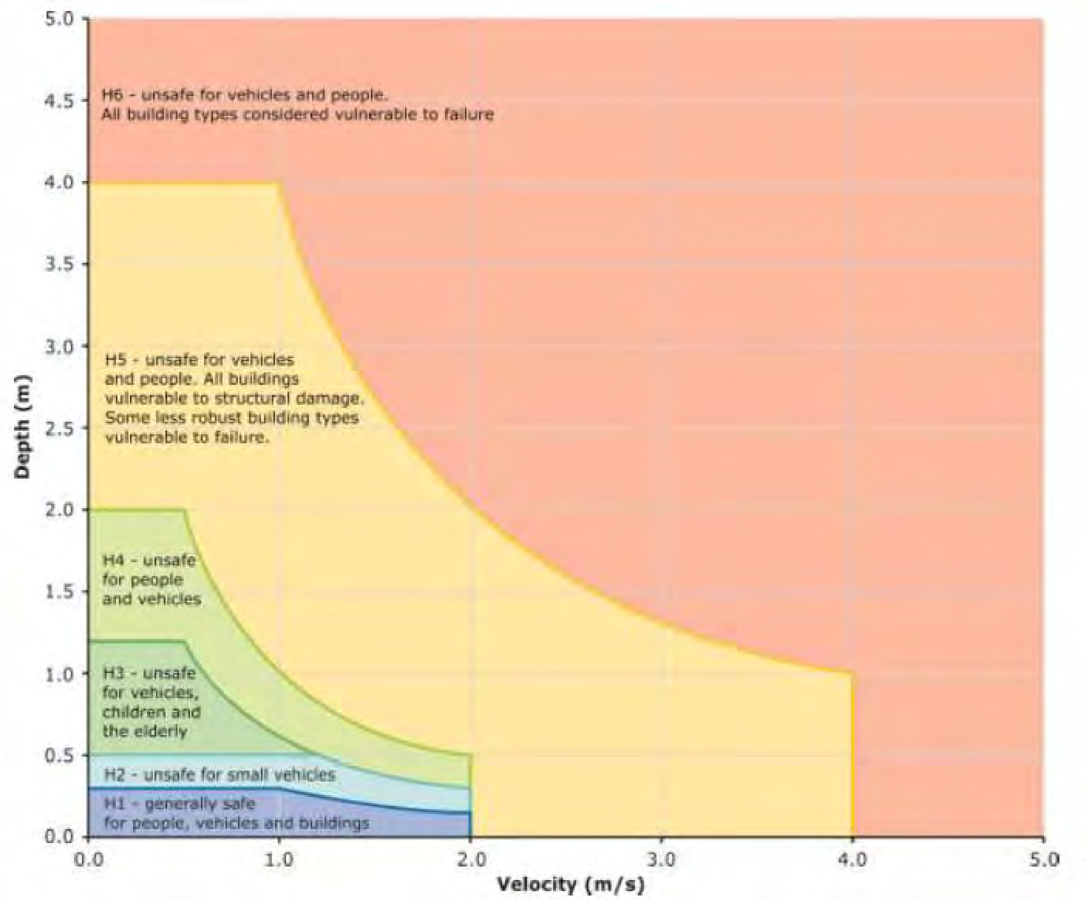

Figure 1 EMA revised flood hazard classification. ***Source: Australian Emergency Management Handbook Series (2013) - Technical flood risk management guideline: Flood hazard***

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 B.

The flooding characteristics of the Upper Coomera River are typical of headwater systems – narrow floodplains and fast flowing water. For all events considered, the flood waters generally remain in the main channel with consistent break out areas, particularly at Witheren. The velocity and hazard patterns are also relatively consistent between events. During the site visit undertaken during February 2013, it was evident that significant restoration works have been required following recent flood events, resulting from scour.

Throughout the study area, the main road follows the river, crossing it at regular intervals. During a significant flood, most of these crossings are inundated by significant depths of water and extreme hazard conditions are observed. Table 23 summarises flooding of the significant bridge structures. These conditions impact significantly on accessibility for residents of the area. Community education on flood safety is vital to ensure residents understand the hazardous conditions.

Table 23 Inundation of bridge structures

Bridge name	Approx deck level* (m AHD)	Design flood level range (2%-0.5% AED) (m AHD)	Comment
RJ Hinze Bridge	78.22	N/A	Deck level above estimated design flood levels
Sharp Bridge, Beechmont Road	106.7	109.7-110.2	Flood levels approximately 3m above deck
Jerome Bridge, Upper Coomera Road	135.9	136.1-136.6	Flood levels at approximate deck level
Rowe Bridge, Rowe Road	162.6	164.5-165.1	Flood levels approximately 2m above deck
Bass Bridge, Illinbah Road	221.0	220.6-220.9	Flood levels at approximate deck level

* Based on DEM and bridge information provided

Some property flooding is predicted for the 2% AEP event in Witheren. A small number of additional, isolated property impacts are observed further up the catchment.

Considering the flood levels observed during the 2008 event, the design flood levels suggest the event was between a 2% and 1% AEP event.

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 24 and Table 25. The table shows the increase in peak discharge both with severity of the event and increasing distance travelled downstream through the catchment.

Table 24 Design event (AEP) peak discharges at key locations

Location	Peak Discharge (m^3/s)		
	10% AEP	5% AEP	2% AEP
Bennets Crossing, Illimbah Road	251	352	404
Jerome Bridge, Upper Coomera Road	343	482	554
Witherin Sharp Bridge, Beechmont Road	413	579	665

Peak modelled water levels at key locations are presented in Table 25. Generally, the critical duration for this reach of the Coomera River is 9 hours.

Table 25 Design event peak flood levels at key locations

Point number	Location	Peak level (mAHD)		
		2% AEP	1% AEP	0.5% AEP
1	Northern end of Illinbah Road, upstream of Tabletop Road	241.26	241.34	241.36
2		228.45	228.60	228.76
3		-	225.16	225.27
4		223.34	223.60	223.79
6		208.18	208.22	208.29
8	Philip Gray Road bridge (Mollenhagen Bridge)	186.85	187.04	187.22
9	Bennets Crossing on Illinbah Road	178.97	179.08	179.19
10	Rowe Road Bridge	164.35	164.75	164.93
11	Pine Creek outlet near Rowe Road turnoff	157.97	158.13	158.32
12	South of Welsh Road	153.77	154.03	154.27
15	Tucker Lane	120.00	120.42	120.67
16	Witheren Camp Ground (Sharp Bridge)	109.79	109.98	110.23
17	Alloah Road	106.52	106.66	106.79
	Canungra Army Camp Gauge	90.12	90.528	91.29

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 Upper Coomera 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.

6.5.2 Alternate access routes

The majority of the roads affected by flooding in the Upper Coomera River catchment are local access roads providing connection for a small number of properties to Beechmont Road to both the north and south. Due to the minor nature of these accesses there are no alterative access routes.

In the 2% AEP event, it is likely that Beechmont Road will be overtopped at Witherin Sharp Bridge and again approximately 1.5km north along the road. This event will cause loss of access to all properties connected to Upper Coomera Road. There are no alternative access routes.

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 Canungra Army Camp alert gauge

The Canungra Army Camp stream gauge is located downstream of the Kokoda Barracks. These barracks and the area closely surrounding is the most populated section of the catchment. Due to the presence of a major arterial (Beaudesert-Nerang Road), Kokoda Barracks and numerous dwellings, flooding severity has the potential to cover the full range of BoM classifications from minor to major. The current flood classification gauge levels for the Canungra Army Camp gauge are shown in Table 26.

Table 26 Existing BoM flood classifications – Canungra Army Camp gauge

Flood height (m)		
Minor	**Moderate**	**Major**
Canungra Army Alert (Station #540290)		
5.0	6.0	7.0

A review of flood classification levels in light of modelled flooding conditions is provided below in Table 27. The review indicates that the current flood classifications at Canungra Army Camp gauge are overstated with respect to their respective gauge levels.

Table 27 Canungra Army Camp gauge analysis

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
86.1	**8.1**	▪ At the upper limit of this range, peak flood waters overtop the banks of the Upper Coomera River main channel around the gauge ▪ Minor roads in the surrounding area are starting to overtop ▪ The Sports field upstream of the gauge is partially flooded	Minor
89.0	**11.4**	▪ Flooding in Sports field and pasture land to the South of Kokoda Barracks is more extensive ▪ Additional pasture land to the east of Beechmont Road is now partially inundated ▪ No inundation of dwellings or habitable buildings	Moderate

Water level (m AHD)	Gauge Level (m)	Flood condition description	Suggested flood classification
90.0	**12.4**	▪ Widespread inundation of the Sports field and pasture land south of the Kokoda Barracks ▪ Widespread inundation of the pasture land east of Beechmont Road ▪ Beechmont Road is overtopped and access is not possible ▪ Beaudesert-Nerang Road is overtopped and access is not possible	Major

The following figure outlines the area around the Canungra Army Gauge.

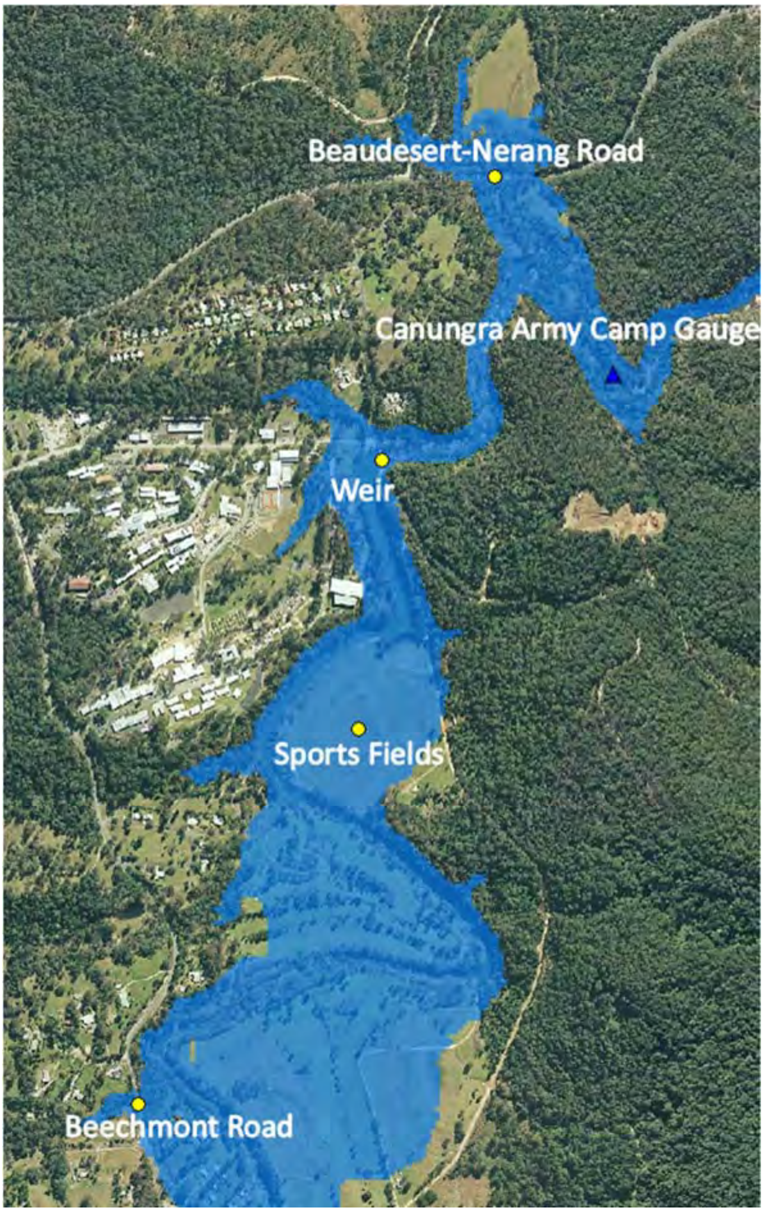

Figure 2 Canungra Army Gauge Location and 1% AEP Inundation Extent

6.6.2 Opportunities for additional alert gauges

Due to the relatively rural nature of the Upper Coomera River catchment and low population, no specific additional alert gauging locations are recommended. The current gauge is closely situated to the most populated section of the catchment. The remainder of the catchment is sparsely populated and due to the low level of population at risk, it does not require an additional gauge.

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 Upper Coomera River catchment within Council's boundaries to provide Council with detailed flood information across the catchment.

Hydrologic modelling has been carried out using an established URBS 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 10 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 5 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

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Appendices

Appendix A
Structure proformas

Structure ID	Number 1
Location and description	Beaudesert-Nerang Road, upstream of Back Creek crossing RJ Hinze Bridge
Picture detail	Photo taken from left abutment looking at downstream face
Form of structure	• 4 span bridge, 2 land road • Angled concrete rectangular piers • Stone abutments • Low flow channel on right side
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Handrail height – 380mm above kerb Deck thickness – 250mm Headstock thickness – not measured *Deck level – 78.22m AHD* *Span length – 21.5 - 21.75m (total length – 129.5m)*
Comments (baseflow, bed material/bank vegetation)	Heavily vegetated overbank Sandy bed with long grass Water flowing in low flow channel (site visit followed wet period)
Proximity to built-up area	No buildings located near bridge
Included in model?	NO

Structure ID	Number 2
Location and description	Canungra Army Camp Weir
Picture detail	No access
Form of structure	Low level inline weir
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	No access
Comments (baseflow, bed material/bank vegetation)	No access
Proximity to built-up area	No access
Included in model?	NO

Structure ID	Number 3
Location and description	Alloah Road; within Canungra Golf Club
Picture detail	Photo taken from left bank looking at upstream face
Form of structure	• Low level causeway; combination of bridge span and weir • Single lane
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Length – 25m Deck thickness – 140mm Level of soffit above waterline – 450mm
Comments (baseflow, bed material/bank vegetation)	Heavily vegetated overbank Water flowing Lots of debris present – large blockage potential Sharp bend immediately downstream
Proximity to built-up area	No buildings near crossing
Included in model?	NO

Structure ID	Number 4
Location and description	Alloah Road; entry to Canungra Golf Club
Picture detail	Photo taken from left bank looking upstream
Form of structure	• Low level causeway; combination of bridge and culverts (concrete and wood) • 4 span (2 culverts, 2 bridge spans), single lane • Concrete block barriers on deck
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Length – 15m Culverts clear width – 3m Bridge clear width – 3m Deck thickness – 250-280mm Level of soffit above waterline – 900mm
Comments (baseflow, bed material/bank vegetation)	Vegetated overbank – grass, trees and shrubs Gravelly bed with large shrubs present mid-stream, low weir upstream Water flowing Lots of debris present – large blockage potential
Proximity to built-up area	Some buildings at top of left bank
Included in model?	NO

Structure ID	Number 5
Location and description	Beechmont Road, Witheren Sharp Bridge
Picture detail	Photo taken from right bank, upstream of bridge
Form of structure	• Timber bridge and piers • 4 span, 2 lane
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Deck thickness – estimated as 1.2m Pier thickness – estimated as 750mm Height to soffit – estimated as 3.5m *Longest span length – 9.5m (total length – 37.3m)* *Width – 6.2m* *Bed to deck – 4.5m*
Comments (baseflow, bed material/bank vegetation)	Some properties upstream including caravan park
Proximity to built-up area	No buildings near bridge
Included in model?	NO

Structure ID	**Number 6**
Location and description	Tucker Lane
Picture detail	No access
Form of structure	Low level crossing
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	No access
Comments (baseflow, bed material/bank vegetation)	No access
Proximity to built-up area	No buildings near crossing
Included in model?	NO

Structure ID	Number 7
Location and description	Upper Coomera Road, north of Ferny Glen, Jerome Bridge
Picture detail	Photo taken from left abutment looking at upstream face
Form of structure	• Low level timber bridge • 3 span, single lane • Lower level causeway with 7 pipes • Additional RBC on left bank
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Timber bridge deck thickness – 600mm Level of soffit above causeway level approx. 2m Pipe diameter (in causeway) – 450mm Culvert size – 2100mmx750mm *Longest span length – 9.2m (total length – 28.1m)* *Width – 6.8m* *Bed to deck – 3.9m*
Comments (baseflow, bed material/bank vegetation)	Baseflow travelling at approx. 1-2 m/s Grass overbank areas with large trees Wire fence immediately upstream
Proximity to built-up area	No buildings near bridge
Included in model?	NO

Structure ID	Number N/A
Location and description	Upper Coomera Road, Flying Fox Creek
Picture detail	N/A
Form of structure	• Low level timber bridge • Single lane
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Handrail ~ 800mm high Deck ~ 2m above water *3 span* *Longest span length – 6.8m (total length – 32.7m)* *Width – 4.4m* *Bed to deck – 4.4m*
Comments (baseflow, bed material/bank vegetation)	N/A
Proximity to built-up area	N/A
Included in model?	NO (outside of model area)

Structure ID	**Number 8**
Location and description	Welsh Road, private access (structure not confirmed from aerial photography)
Picture detail	No access
Form of structure	• Low level crossing, if anything
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	No access *2 span, single lane* *Longest span length – 9.5m (total length – 18.8m)* *Width – 3.8m* *Bed to deck – 2.5m*
Comments (baseflow, bed material/bank vegetation)	No access
Proximity to built-up area	No buildings near bridge
Included in model?	NO

Structure ID	Number 9
Location and description	Private access off Upper Coomera Road
Picture detail	Photo taken from right bank
Form of structure	• Low level timber/concrete causeway • Single lane
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Approx. deck 500mm thickness Approx. 500mm above waterline
Comments (baseflow, bed material/bank vegetation)	Grass overbank with some trees
Proximity to built-up area	House on left bank
Included in model?	NO

Structure ID	Number 10
Location and description	Rowe Road, Rowe Bridge
Picture detail	Photo taken from left bank looking at upstream face
Form of structure	• Low level concrete bridge • 2 span, single lane
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Length – 18m Deck thickness – 700mm Level of deck above waterline – 1.8m *Span length – 9m (total length – 16.8m)* *Width – 3.5m* *Bed to deck – 2.1m*
Comments (baseflow, bed material/bank vegetation)	Vegetated banks, grass overbank Debris present Rocky bed with some vegetation
Proximity to built-up area	Buildings on overbank area on left
Included in model?	NO

Structure ID	Number 11
Location and description	Off Illinbah Road, opposite Price Creek Road, private access
Picture detail	No access
Form of structure	Low level crossing
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	No access
Comments (baseflow, bed material/bank vegetation)	No access
Proximity to built-up area	Buildings on left overbank area
Included in model?	NO

Structure ID	Number 12
Location and description	Illinbah Road, Bennetts Crossing
Picture detail	Photo taken looking at downstream face from right bank
Form of structure	• Low level causeway • Single lane • Culvert and concrete d/s apron
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	5xRCBC (900mm high x 1.2m wide) 5m long (in direction of flow)
Comments (baseflow, bed material/bank vegetation)	Vegetated banks, pasture overbank with some trees Rocky bed with some vegetation
Proximity to built-up area	No buildings near crossing
Included in model?	NO

Structure ID	Number 13
Location and description	Phillip Gray Road, Mollenhagen Bridge
Picture detail	Photo taken from right bank, upstream
Form of structure	• Low level timber bridge • 3 spans, single lane
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Deck thickness – 550mm Piers – approx. 0.4m diameter Level of deck above waterline – 1.5m *Longest span length – 9m (total length – 27.2m)* *Width – 3.6m* *Bed to deck – 2m*
Comments (baseflow, bed material/bank vegetation)	Some remediation works have occurred on the banks Grassy overbank
Proximity to built-up area	Houses on right overbank
Included in model?	NO

Structure ID	Number 14
Location and description	Illinbah Road, Mahony #1 Crossing
Picture detail	Photo taken from right bank, downstream
Form of structure	• Low level causeway • Single lane • Culvert and concrete d/s apron
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	2xRCBC (600mm high x 2.4m wide) 3m long (in direction of flow)
Comments (baseflow, bed material/bank vegetation)	Significant erosion has occurred and some remediation works have occurred on the aprons Rocky bed Grassy overbank with large trees
Proximity to built-up area	Buildings on left overbank area
Included in model?	NO

Structure ID	Number 15
Location and description	Illinbah Road, Mahony #2 Crossing
Picture detail	Photo taken looking at upstream catchment
Form of structure	• Low level causeway • Single lane • Culverts and concrete d/s apron • Highflow bypass
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	2xRCBC (900mm high x 2.4m wide) 3m long (in direction of flow) 2xRCBC (600mm high x 1.8m wide) - bypass
Comments (baseflow, bed material/bank vegetation)	Significant erosion has occurred (including asphalt over culverts) and some remediation works have occurred on the aprons Rocky bed Grassy overbank with large trees
Proximity to built-up area	No buildings close to crossing
Included in model?	NO

Additional low level access crossings in vicinity of Number 15:

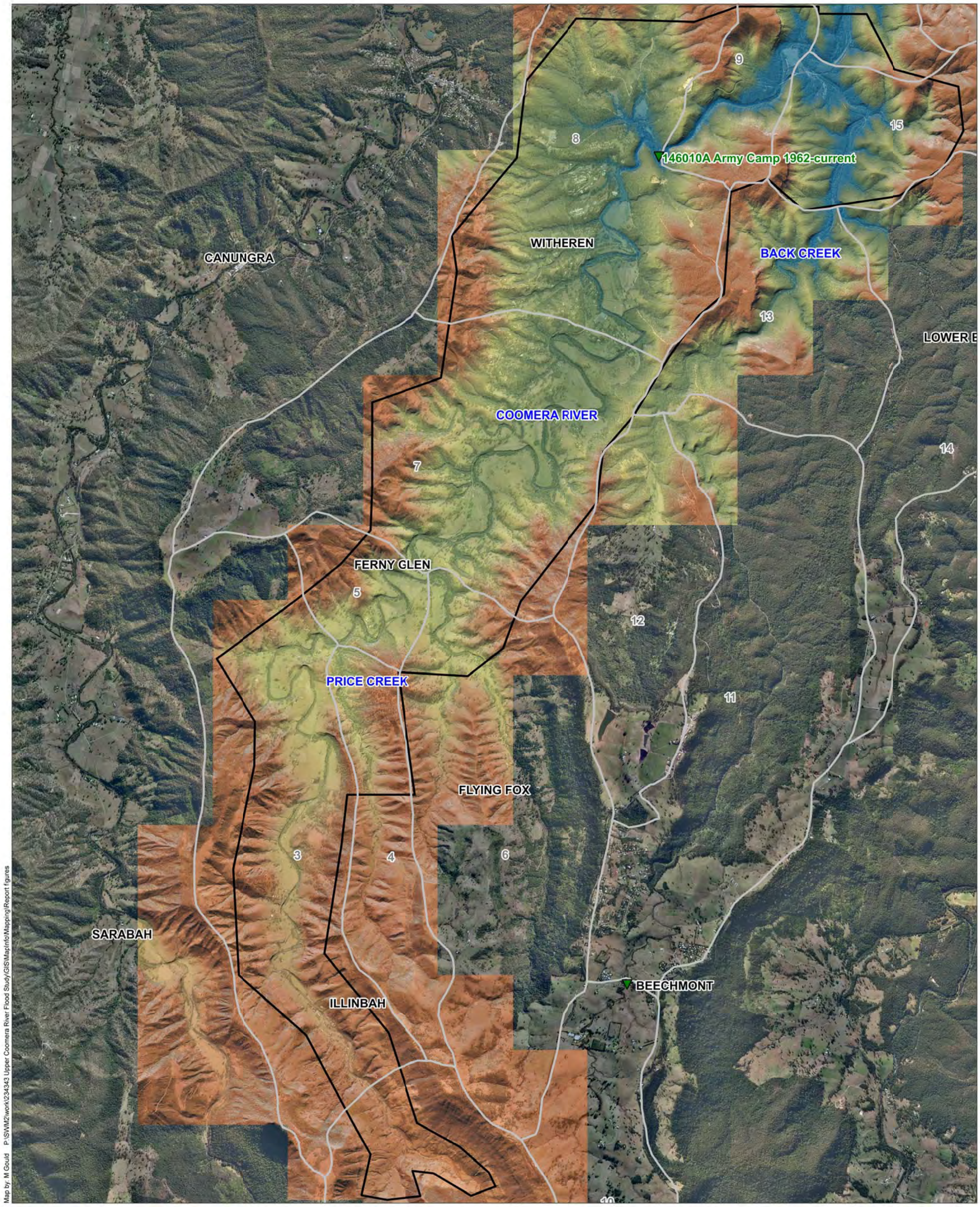
Structure ID	Number 16
Location and description	Illinbah Road, Bass Bridge
Picture detail	Photo taken from left bank looking upstream
Form of structure	• Concrete bridge • Single lane, 3 span
Dimensions (as measured approximately on site) *Italics indicate information provided by SRRC*	Deck thickness ~ 600mm Piers – approx. 0.8m diameter *Longest span length – 13m (total length – 39m)* *Width – 4.5m* *Bed to deck – 3.3m*
Comments (baseflow, bed material/bank vegetation)	Rocky bed Grassy overbank with large trees
Proximity to built-up area	No buildings close to crossing
Included in model?	NO

Additional low level access crossings in vicinity of Number 17:

Appendix B Figures

Figure	Description
Figure A1	Study Area
Figure A2	2008 Model Calibration
Figure A3	2010 Model Calibration
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 v 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

aurecon



Legend

▭	Model area
▭	Sub-catchment boundaries

Notes:
1. This map must not be used without consideration of, or reference to, the explanatory notes provided in the accompanying Upper Coomera Flood Study Report, so as to understand the important limitations and conditions on such use.
2. The flood information shown in this map is based on an assumed fixed water level at the downstream model boundary. Water level, depth, velocity and hazard estimates given downstream of the RJ Hinze Bridge are presented with a reduced level of accuracy due to this assumption.

Date: 22/04/2013 Version: 3 Job No: 234343

Projection: MGA Zone 56

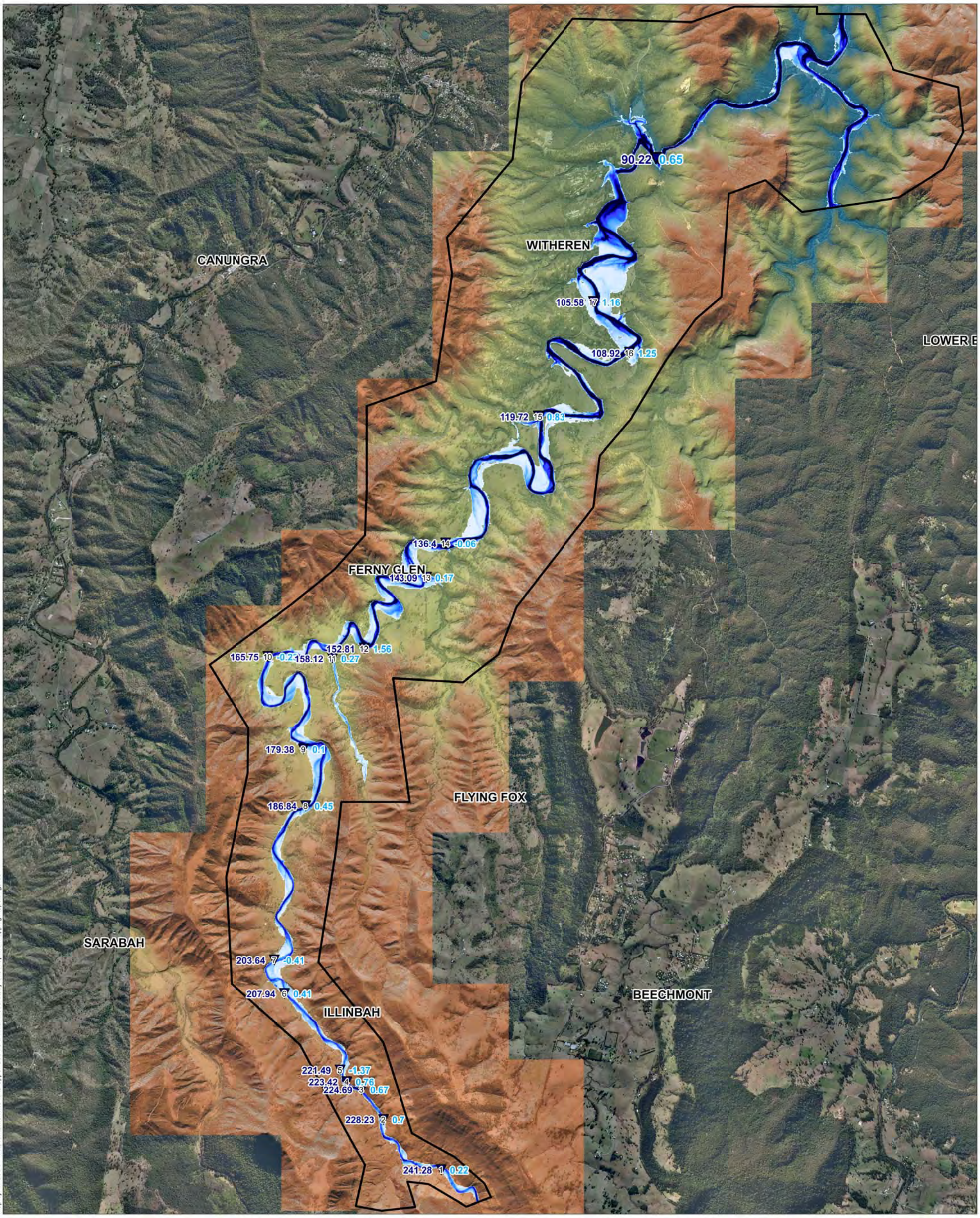
A3 scale 1:50,000

Upper Coomera River Flood Study

Figure A1

Study Area

aurecon



Map by: M Gould P:\SWM2\work\234343 Upper Coomera River Flood Study\GIS\MapInfo\Mapping\Report figures

Legend

Model area

Observed flood level (m AHD, as provided by SRRC)
Difference between modelled and observed flood level (m)

Notes:

1. This map must not be used without consideration of, or reference to, the explanatory notes provided in the accompanying Upper Coomera Flood Study Report, so as to understand the important limitations and conditions on such use.

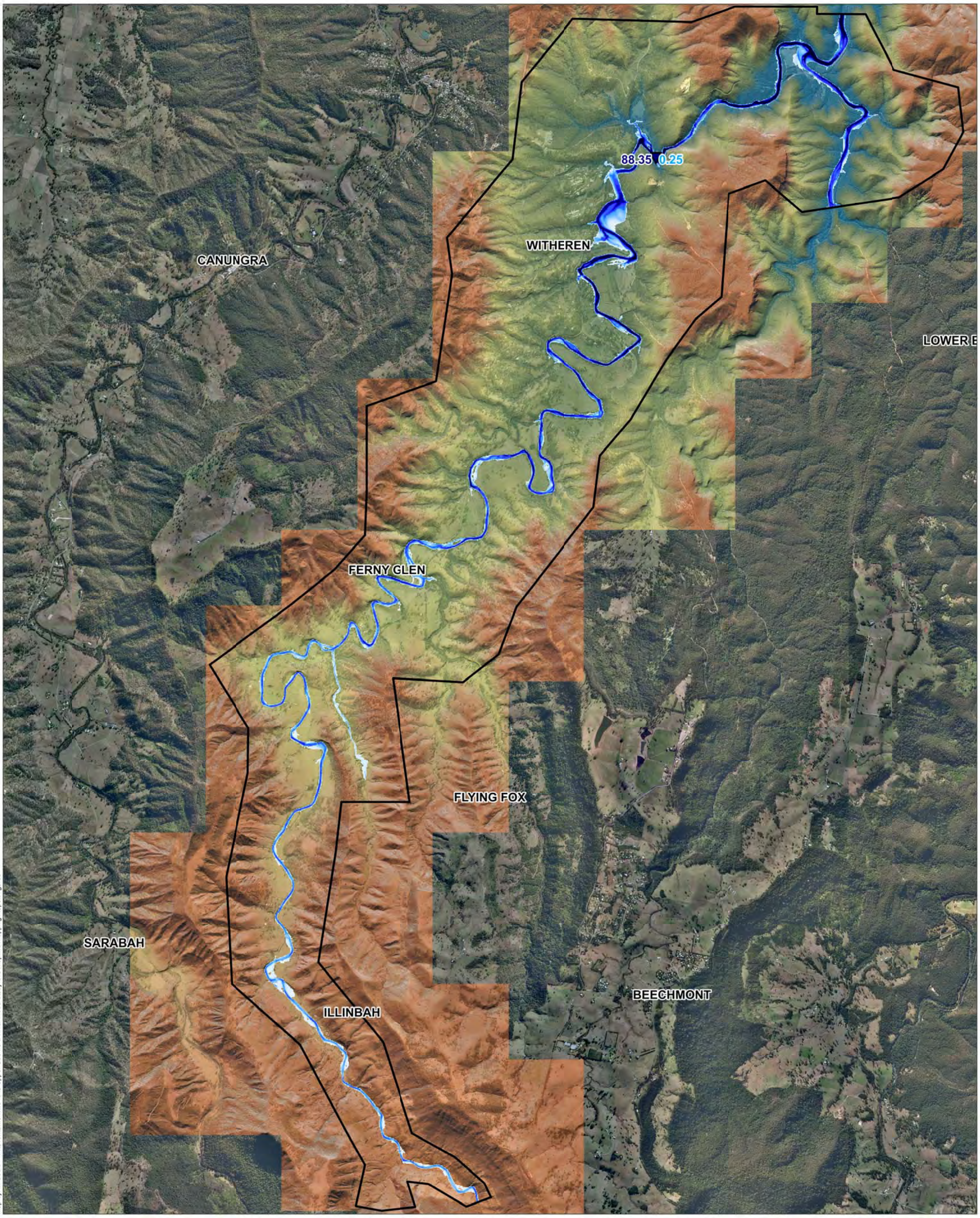
2. The flood information shown in this map is based on an assumed fixed water level at the downstream model boundary. Water level, depth, velocity and hazard estimates given downstream of the RJ Hinze Bridge are presented with a reduced level of accuracy due to this assumption.

Date: 22/04/2013 Version: 2 Job No: 234343
Projection: MGA Zone 56
A3 scale 1:50,000

Upper Coomera River Flood Study **Figure A2**

2008 Model Calibration

aurecon



Map by: M Gould P:\SWM2\work\234343 Upper Coomera River Flood Study\GIS\MapInfo\Mapping\Report figures

Legend

Model area

▼ **Observed flood level (m AHD)**
Difference between modelled and observed flood level (m)

Notes: 1. This map must not be used without consideration of, or reference to, the explanatory notes provided in the accompanying Upper Coomera Flood Study Report, so as to understand the important limitations and conditions on such use.

2. The flood information shown in this map is based on an assumed fixed water level at the downstream model boundary. Water level, depth, velocity and hazard estimates given downstream of the RJ Hinze Bridge are presented with a reduced level of accuracy due to this assumption.

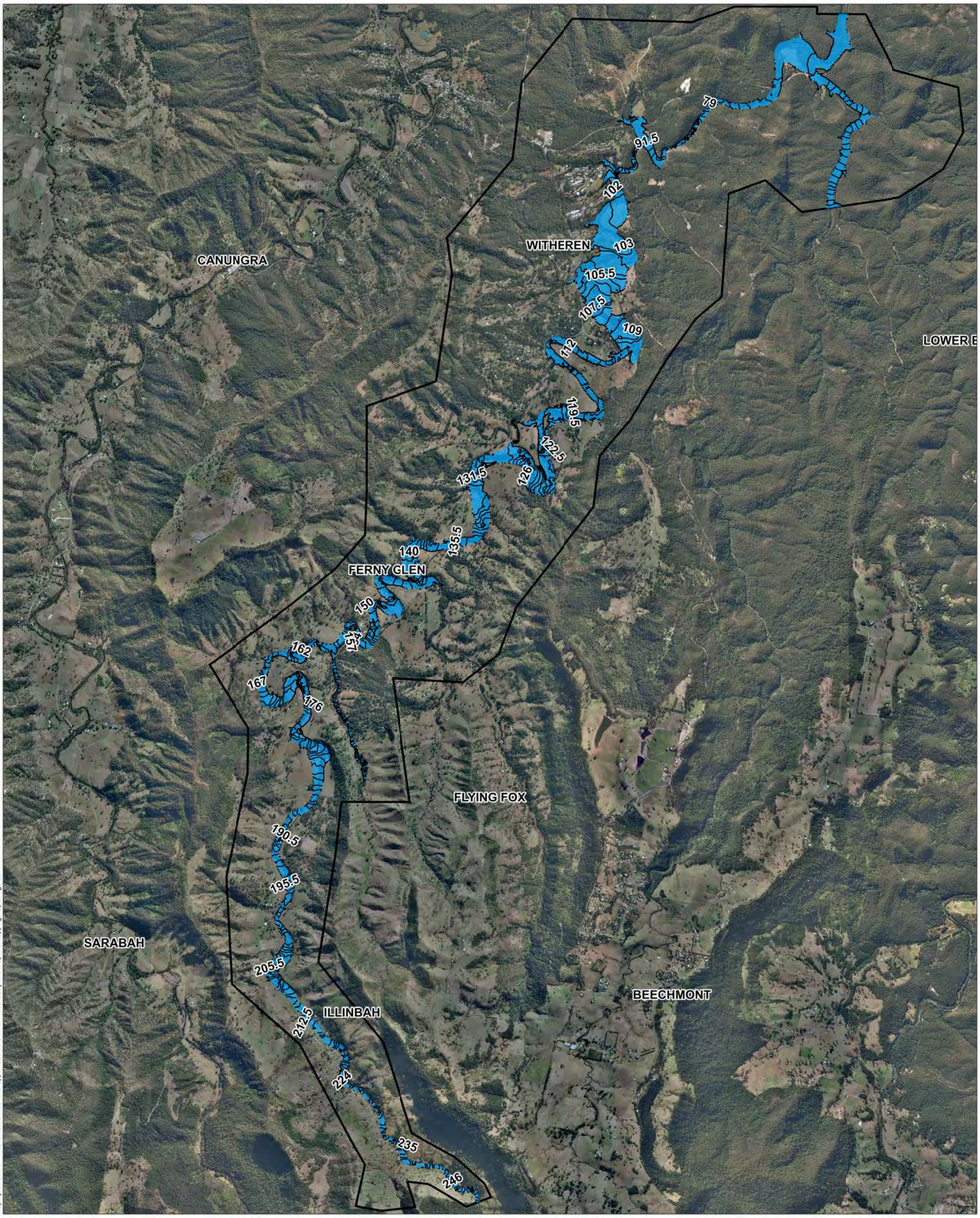
FINAL

Date: 22/04/2013 Version: 2 Job No: 234343
Projection: MGA Zone 56
A3 scale 1:50,000

Upper Coomera River Flood Study **Figure A3**

2010 Model Calibration

aurecon



Legend

Inundation Extents

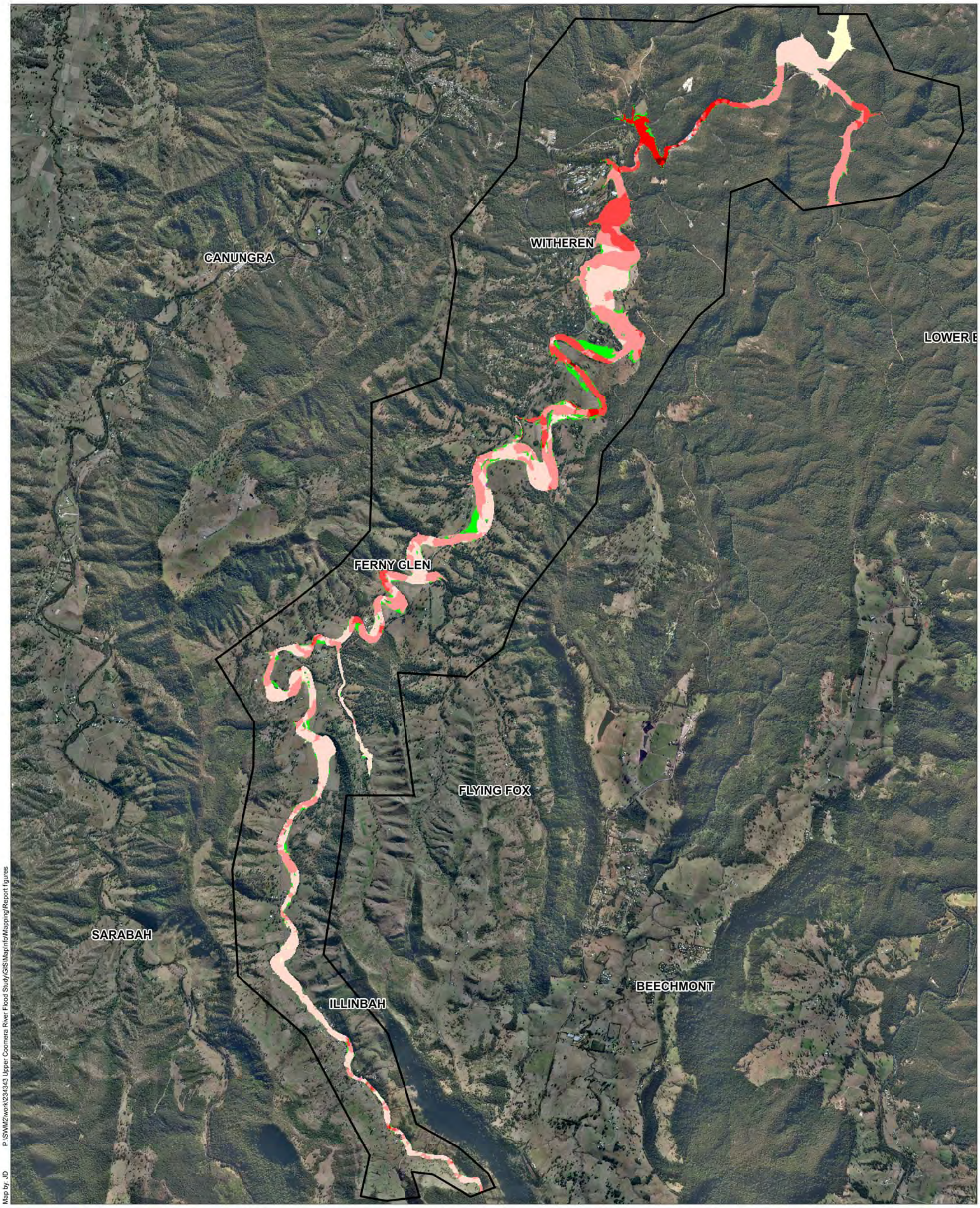
0.5m (AHD) Peak Water Surface Level Contour

Notes:
1. This map must not be used without consideration of, or reference to, the explanatory notes provided in the accompanying Upper Coomera Flood Study Report, so as to understand the important limitations and conditions on such use.
2. The flood information shown in this map is based on an assumed fixed water level at the downstream model boundary. Water level, depth, velocity and hazard estimates given downstream of the RJ Hinze Bridge are presented with a reduced level of accuracy due to this assumption.

Date: 22/04/2013 Version: 2 Job No: 234343
Projection: MGA Zone 56
A3 scale 1:50,000

Upper Coomera River Flood Study **Figure B1**

1% AEP Event - Inundation Extent



Legend

Afflux (m)

- < -0.80
- -0.80 to -0.60
- -0.60 to -0.40
- -0.40 to -0.20
- -0.20 to -0.03
- -0.03 to 0.03
- 0.03 to 0.20
- 0.20 to 0.40
- 0.40 to 0.60
- 0.60 to 0.80
- 0.80 to 1.20
- > 1.20
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

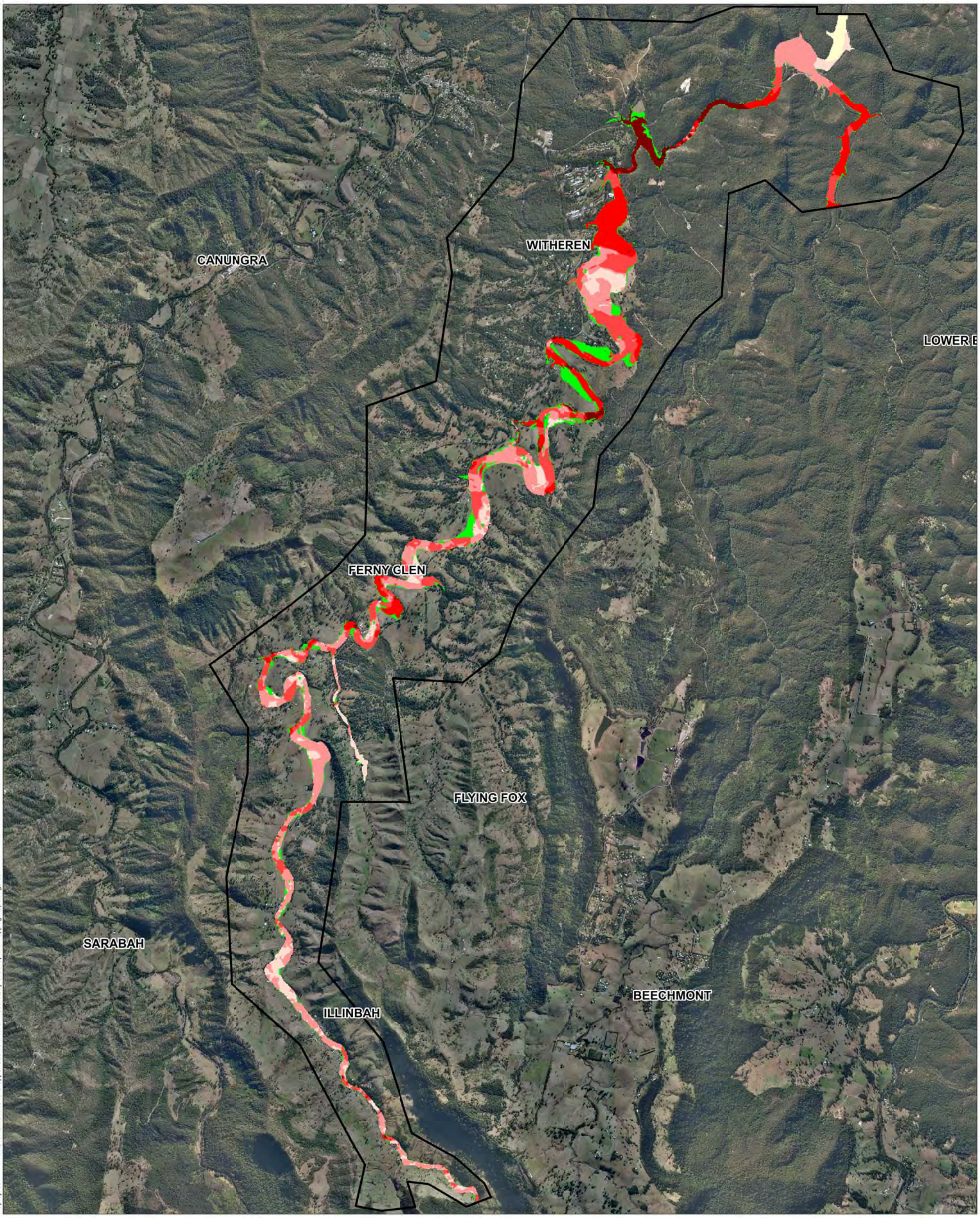
1. This map must not be used without consideration of, or reference to, the explanatory notes provided in the accompanying Upper Coomera Flood Study Report, so as to understand the important limitations and conditions on such use.
2. The flood information shown in this map is based on an assumed fixed water level at the downstream model boundary. Water level, depth, velocity and hazard estimates given downstream of the RJ Hinze Bridge are presented with a reduced level of accuracy due to this assumption.

Date: 16/05/2016 Version: 2 Job No: 234343
Projection: MGA Zone 56
A3 scale 1:50,000

Upper Coomera River Flood Study **Figure B2-a**

Climate Change Scenario 4.5 - 1% AEP Afflux Map

aurecon



Legend

Afflux (m)

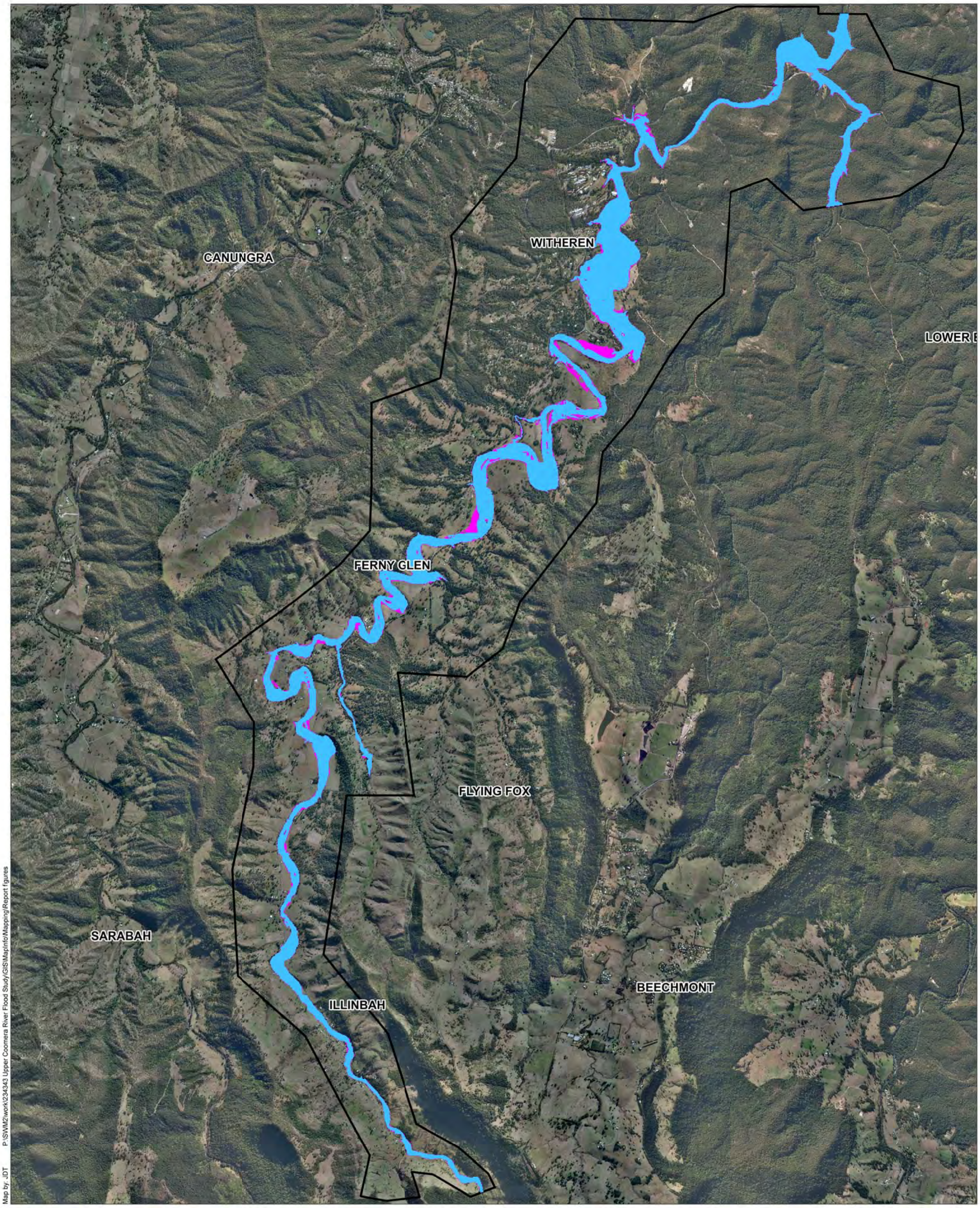
- < -0.80
- -0.80 to -0.60
- -0.60 to -0.40
- -0.40 to -0.20
- -0.20 to -0.03
- -0.03 to 0.03
- 0.03 to 0.20
- 0.20 to 0.40
- 0.40 to 0.60
- 0.60 to 0.80
- 0.80 to 1.20
- > 1.20
- Was Dry Now Wet
- Was Wet Now Dry

Notes:
1. This map must not be used without consideration of, or reference to, the explanatory notes provided in the accompanying Upper Coomera Flood Study Report, so as to understand the important limitations and conditions on such use.
2. The flood information shown in this map is based on an assumed fixed water level at the downstream model boundary. Water level, depth, velocity and hazard estimates given downstream of the RJ Hinze Bridge are presented with a reduced level of accuracy due to this assumption.

Date: 16/05/2016 Version: 2 Job No: 234343
Projection: MGA Zone 56
A3 scale 1:50,000

Upper Coomera River Flood Study **Figure B2-b**

Climate Change Scenario 8.5 - 1% AEP Afflux Map



Legend

- Existing Scenario
- Climate Change Scenario 4.5

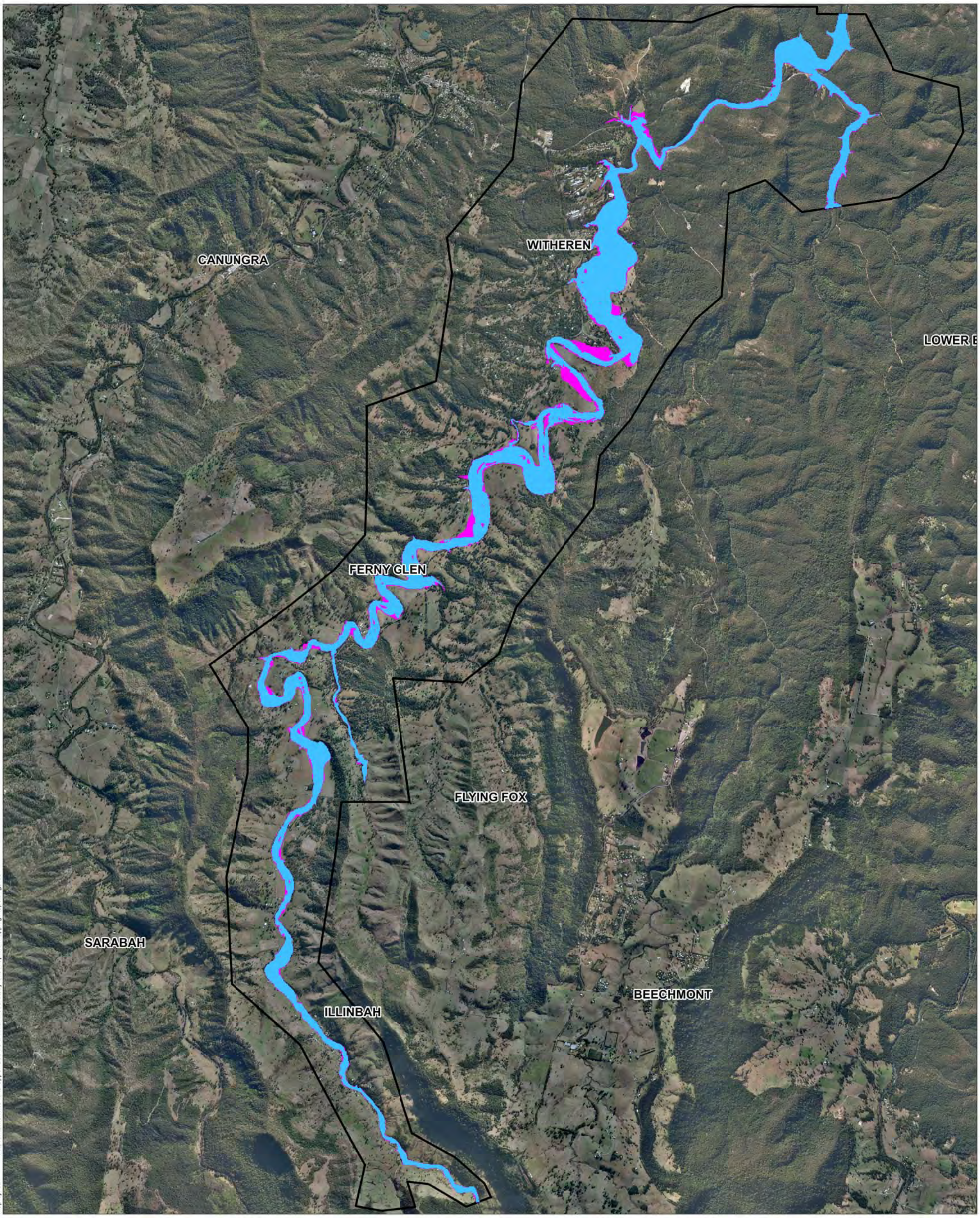
Notes:
1. This map must not be used without consideration of, or reference to, the explanatory notes provided in the accompanying Upper Coomera Flood Study Report, so as to understand the important limitations and conditions on such use.
2. The flood information shown in this map is based on an assumed fixed water level at the downstream model boundary. Water level, depth, velocity and hazard estimates given downstream of the RJ Hinze Bridge are presented with a reduced level of accuracy due to this assumption.

Date: 16/05/2016 Version: 2 Job No: 234343
Projection: MGA Zone 56
A3 scale 1:50,000

Upper Coomera River Flood Study **Figure B3-a**

Climate Change Scenario 4.5 - 1% AEP Inundation Extent

aurecon



Legend

- Existing Scenario
- Climate Change Scenario 8.5

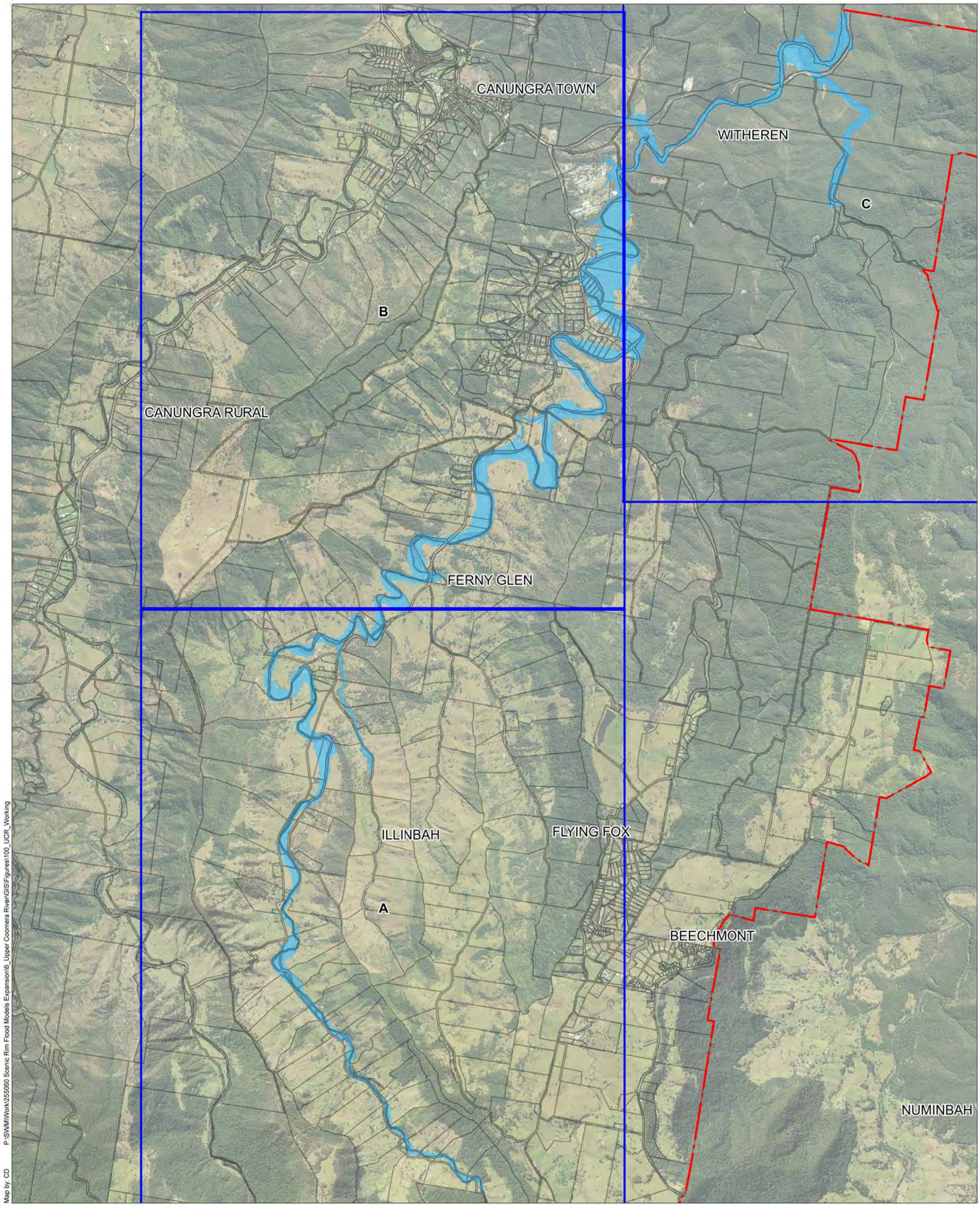
Notes:
1. This map must not be used without consideration of, or reference to, the explanatory notes provided in the accompanying Upper Coomera Flood Study Report, so as to understand the important limitations and conditions on such use.
2. The flood information shown in this map is based on an assumed fixed water level at the downstream model boundary. Water level, depth, velocity and hazard estimates given downstream of the RJ Hinze Bridge are presented with a reduced level of accuracy due to this assumption.

Date: 16/05/2016 Version: 2 Job No: 234343
Projection: MGA Zone 56
A3 scale 1:50,000

Upper Coomera River Flood Study **Figure B3-b**

Climate Change Scenario 8.5 - 1% AEP Inundation Extent

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:50,000

0 | 1,250 m | 2,500 m

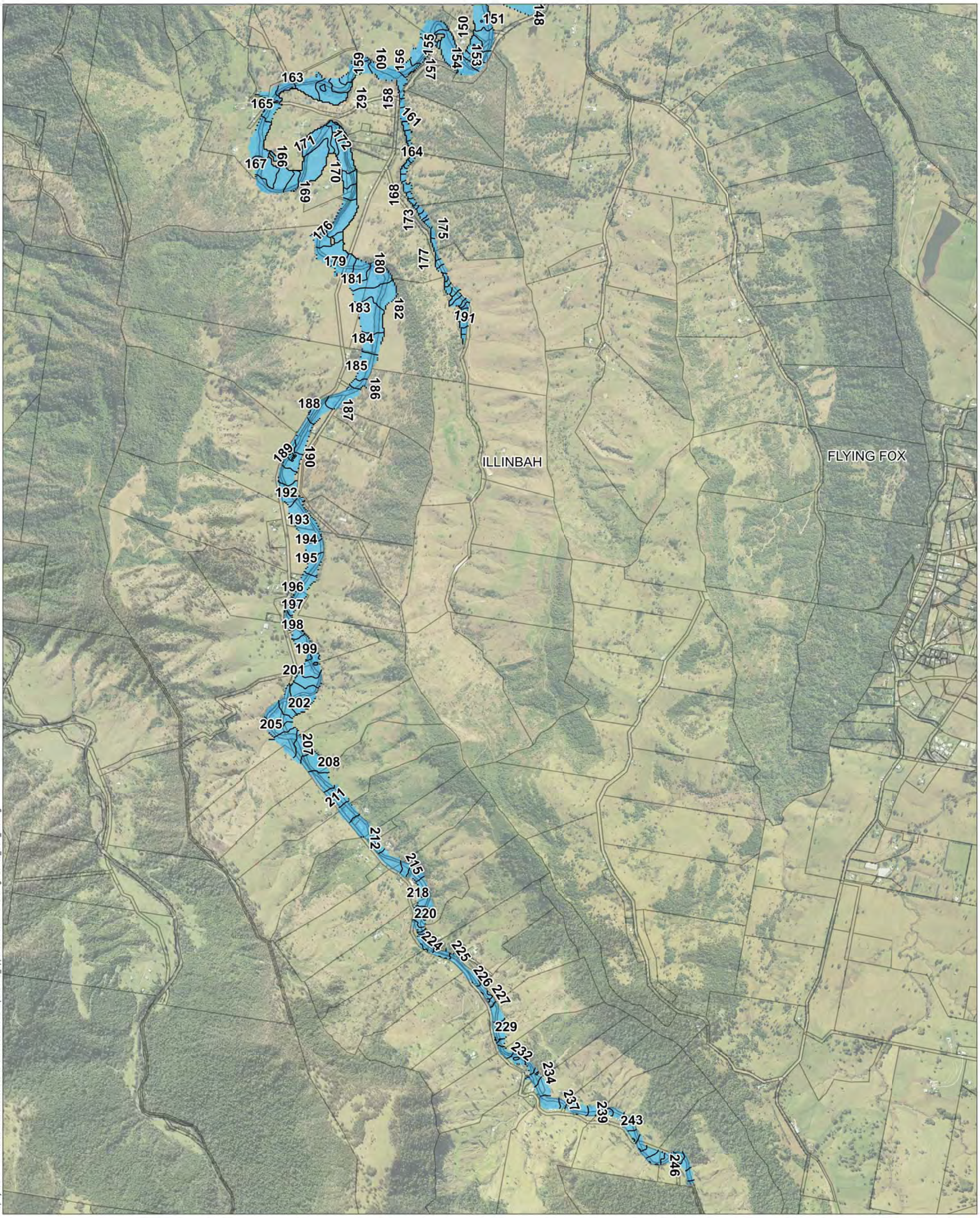
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B4**

1% AEP Event Climate Change Scenario 4.5 - Inundation Extent

aurecon



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Map by: CD

Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

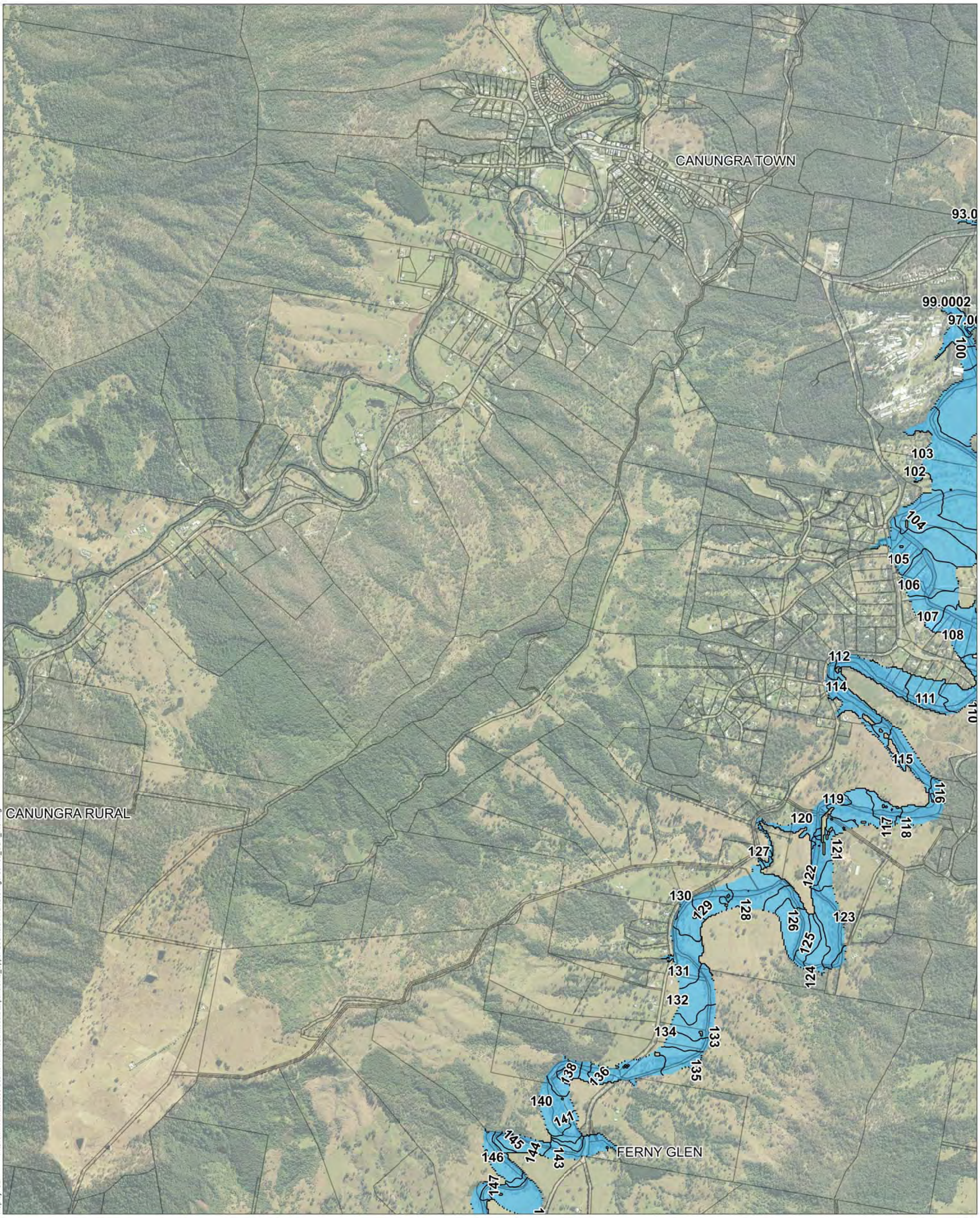
0 625 m 1,250 m

Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera 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

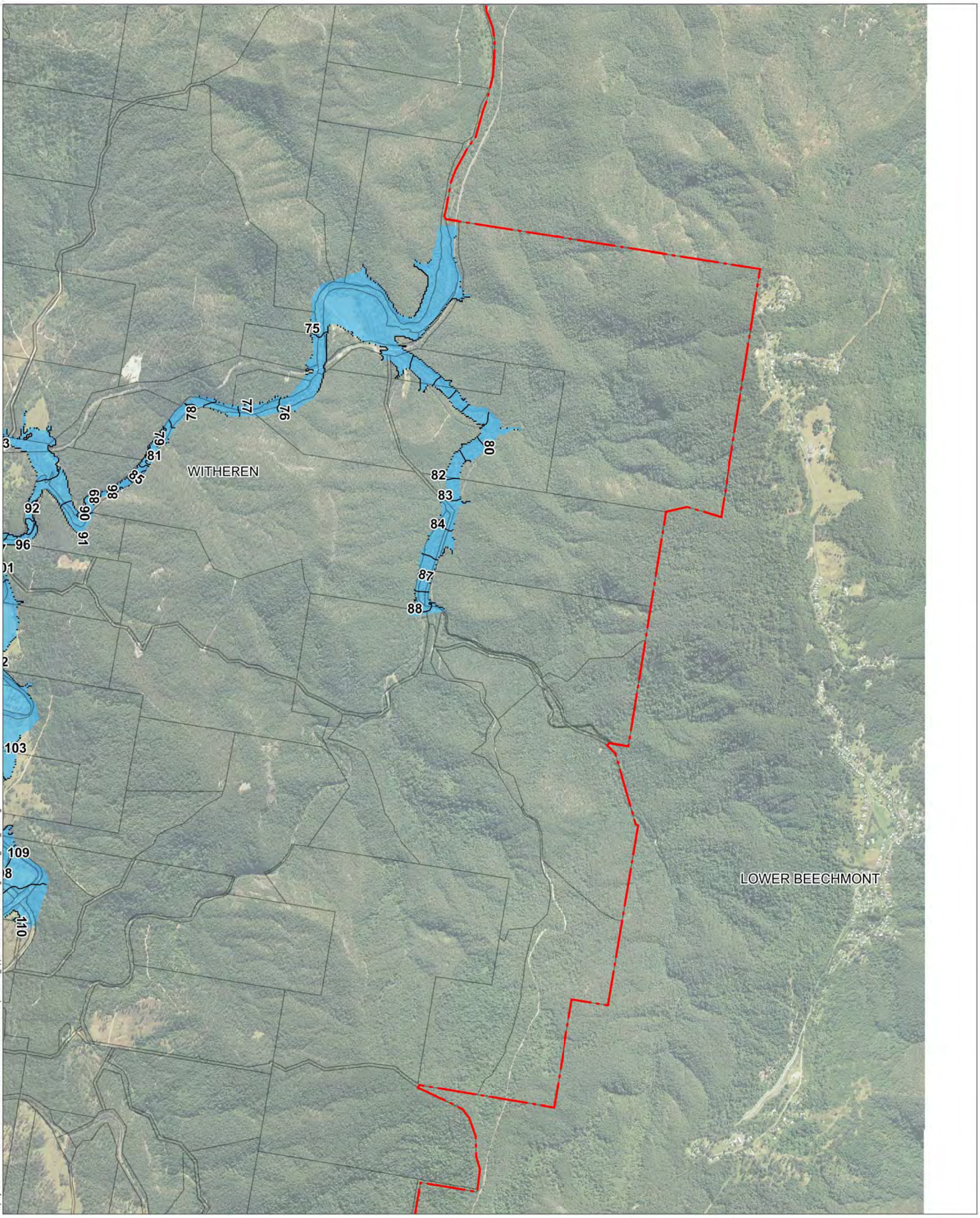
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B4-b**

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

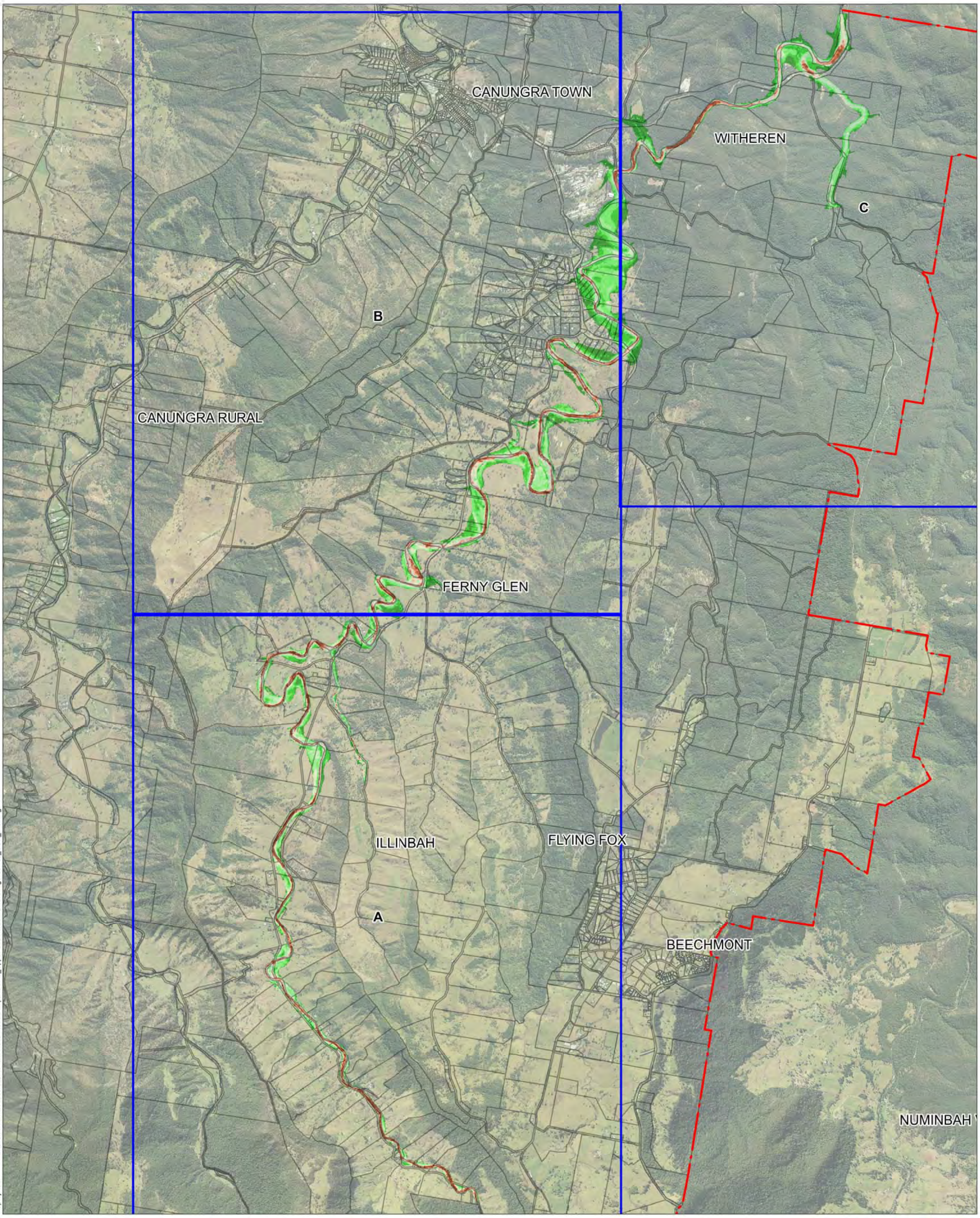
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B4-c**

1% AEP Event Climate Change Scenario 4.5 - Inundation Extent

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:

1:50,000

0 1,250 m 2,500 m

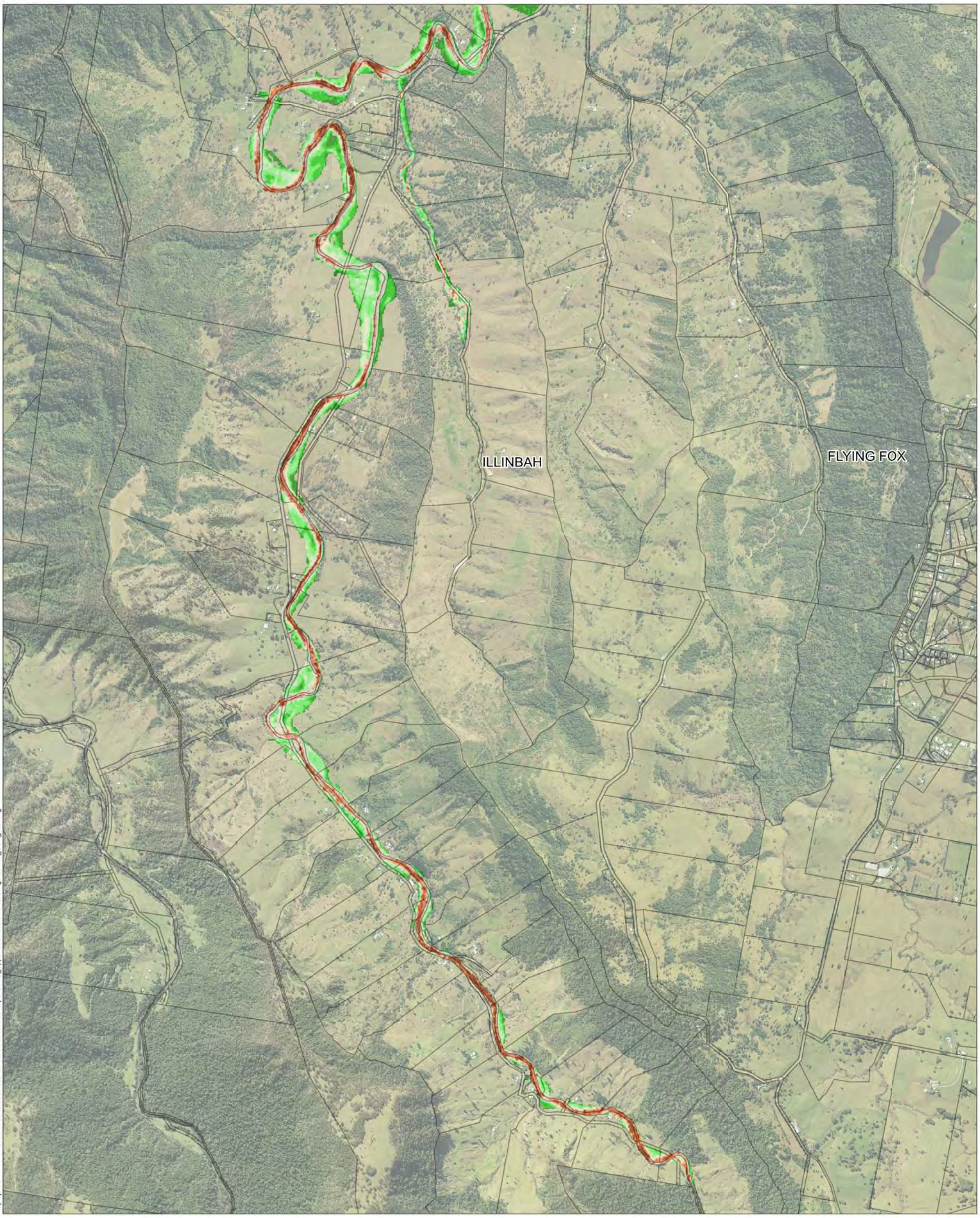
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B5**

1% AEP Event Climate Change Scenario 4.5 - Peak Velocities

aurecon



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: 21/07/2017 Version: 0 Job No: 255060

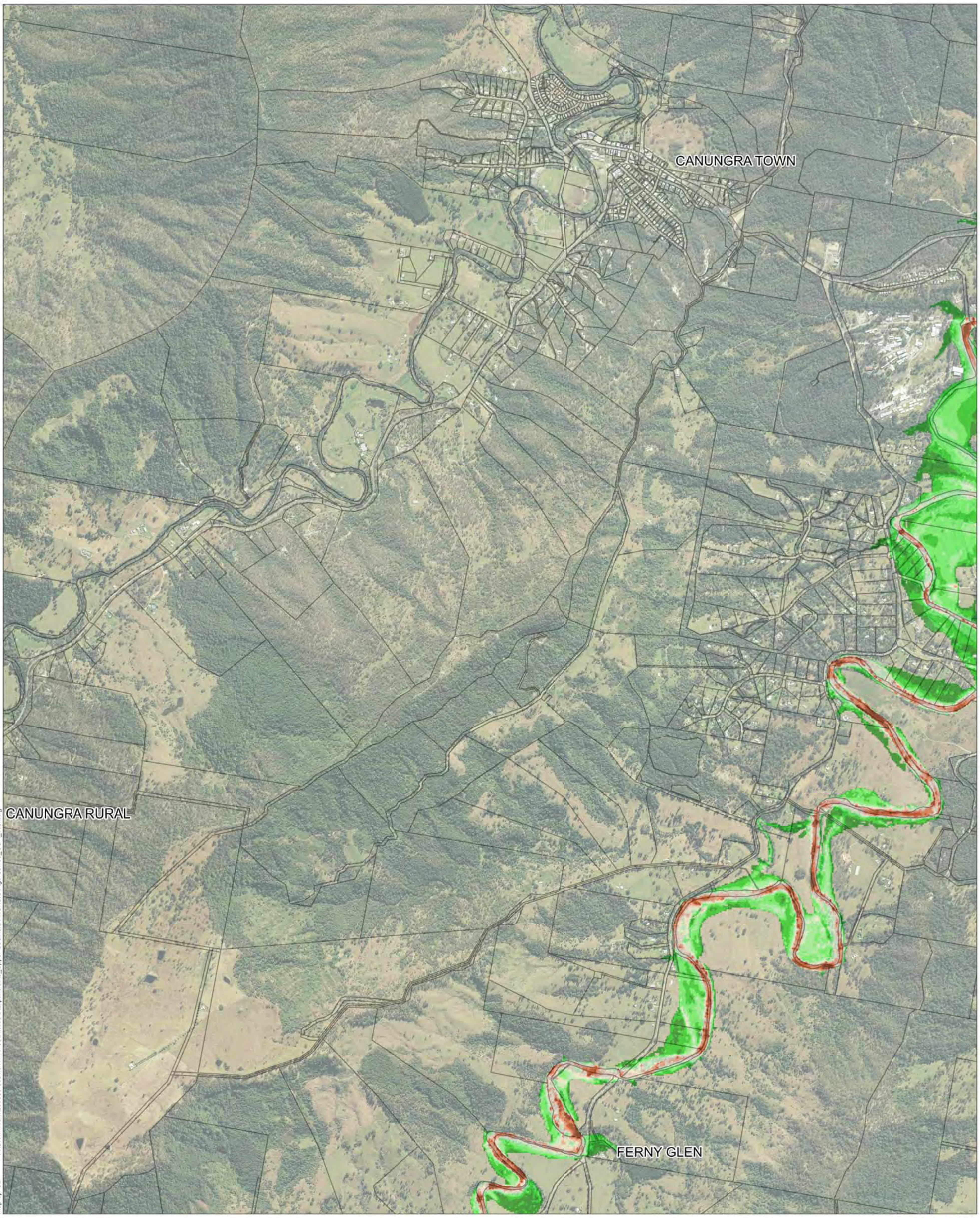
Projection: MGA Zone 56

Upper Coomera River Flood Study

Figure B5-a

1% AEP Event Climate Change Scenario 4.5 - Peak Velocities

aurecon



Map by: CD P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\100_UCR_Working

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

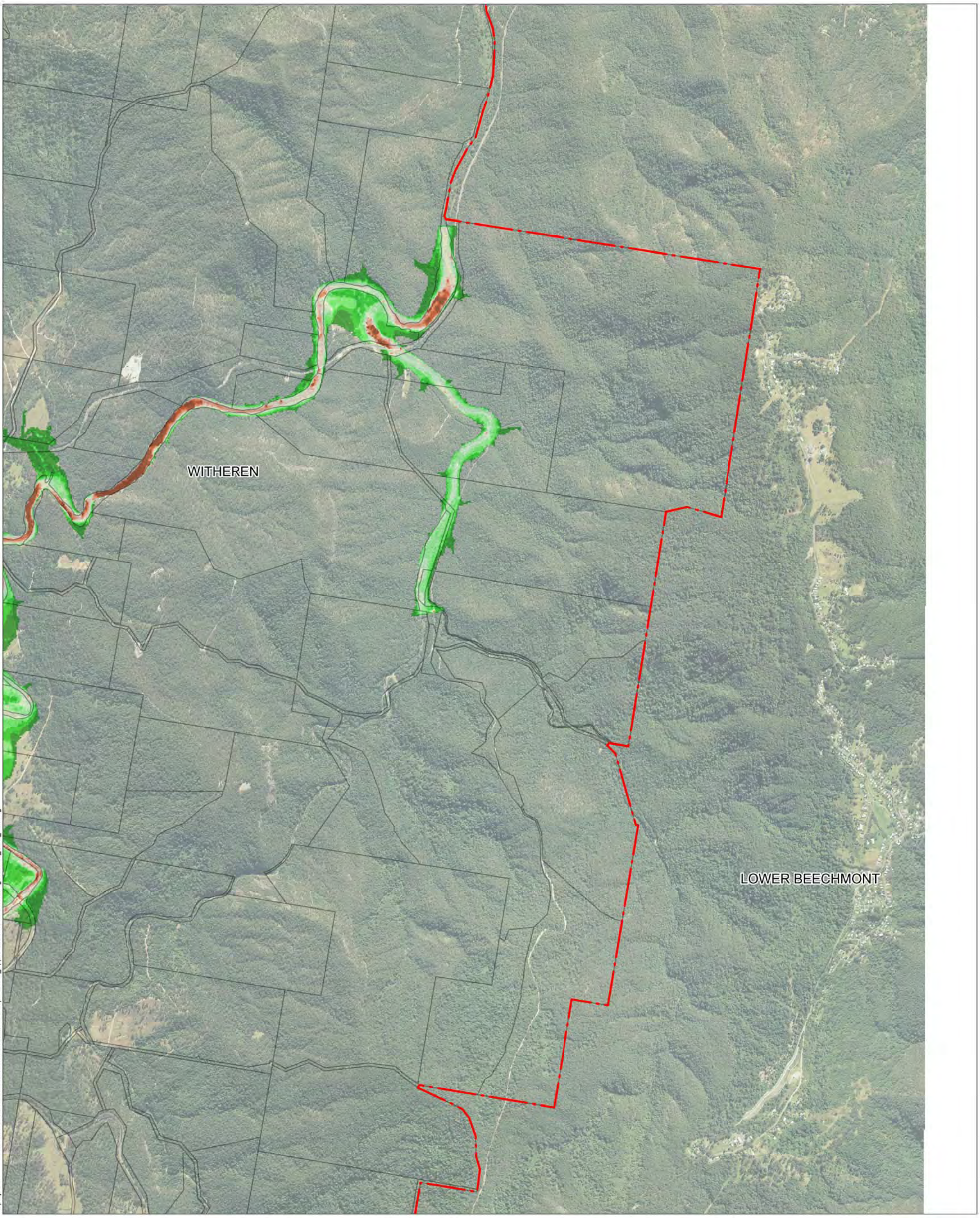
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B5-b**

1% AEP Event Climate Change Scenario 4.5 - Peak Velocities

aurecon



Legend

Velocity (m/s)

SRRC Boundary

Cadastral Boundary

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

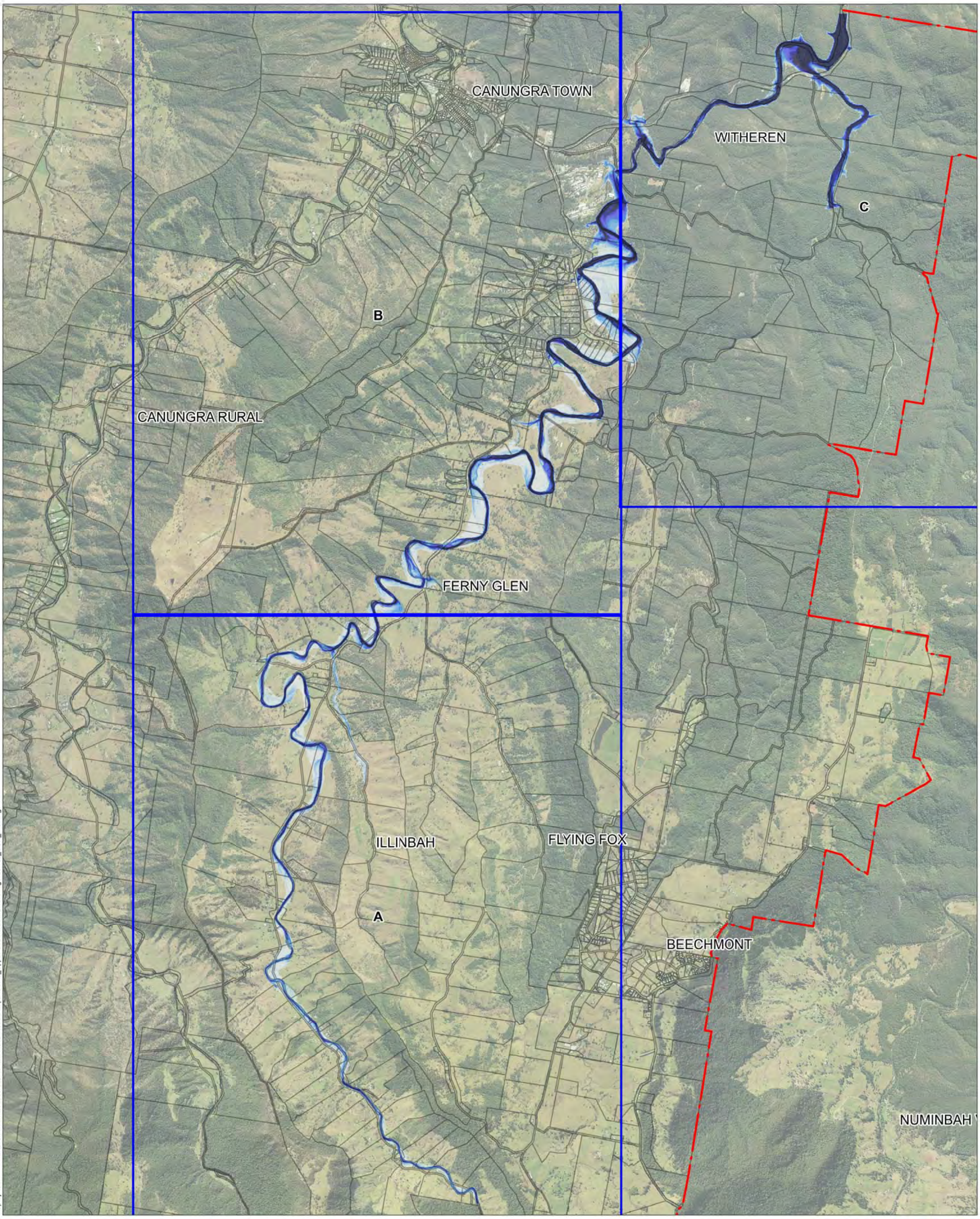
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B5-c**

1% AEP Event Climate Change Scenario 4.5 - Peak Velocities

aurecon



Map by: CD
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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

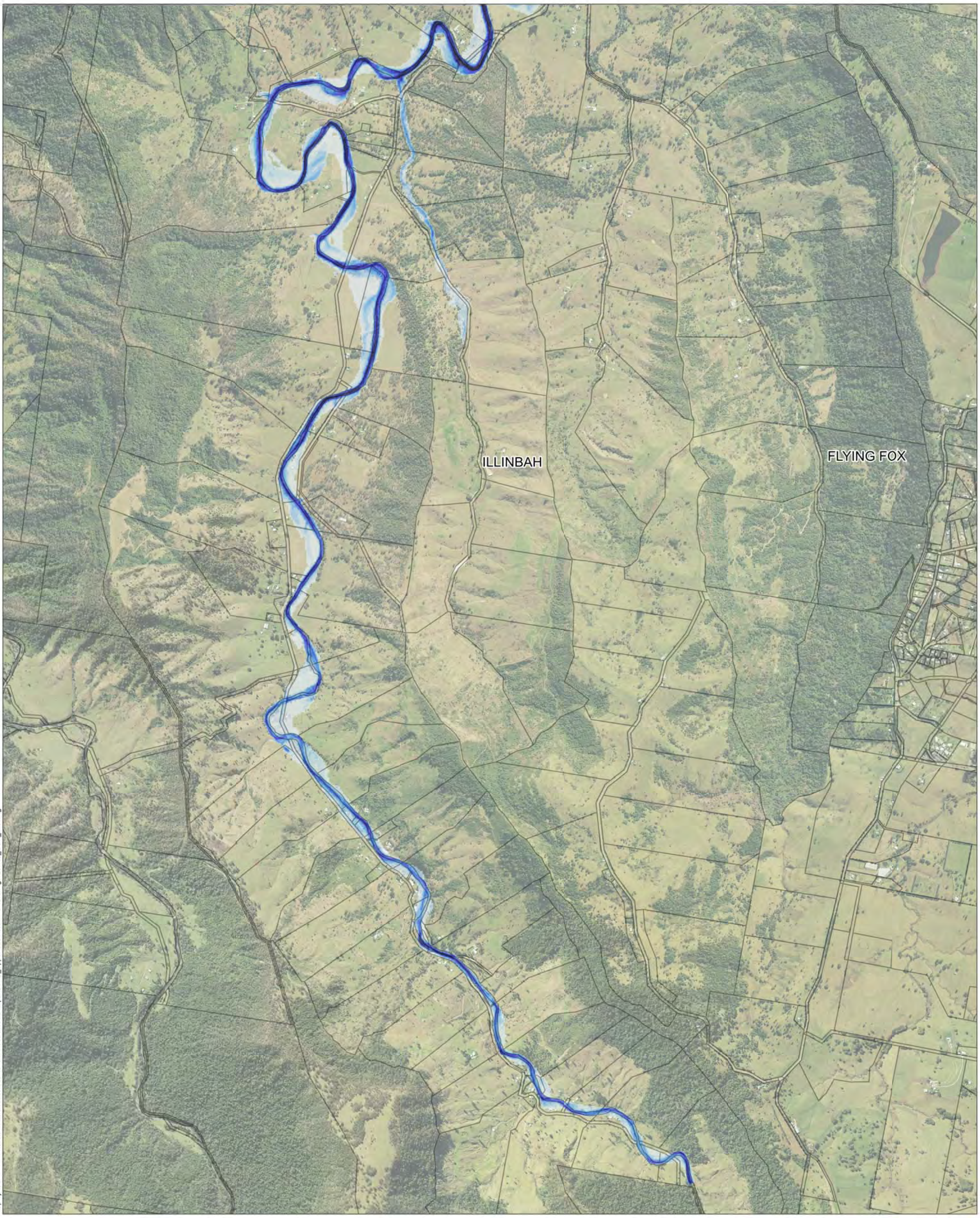
Notes:

1:50,000
0 1,250 m 2,500 m

Date: 21/07/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B6**

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



Map by: CD   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\100_UCR_Working

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

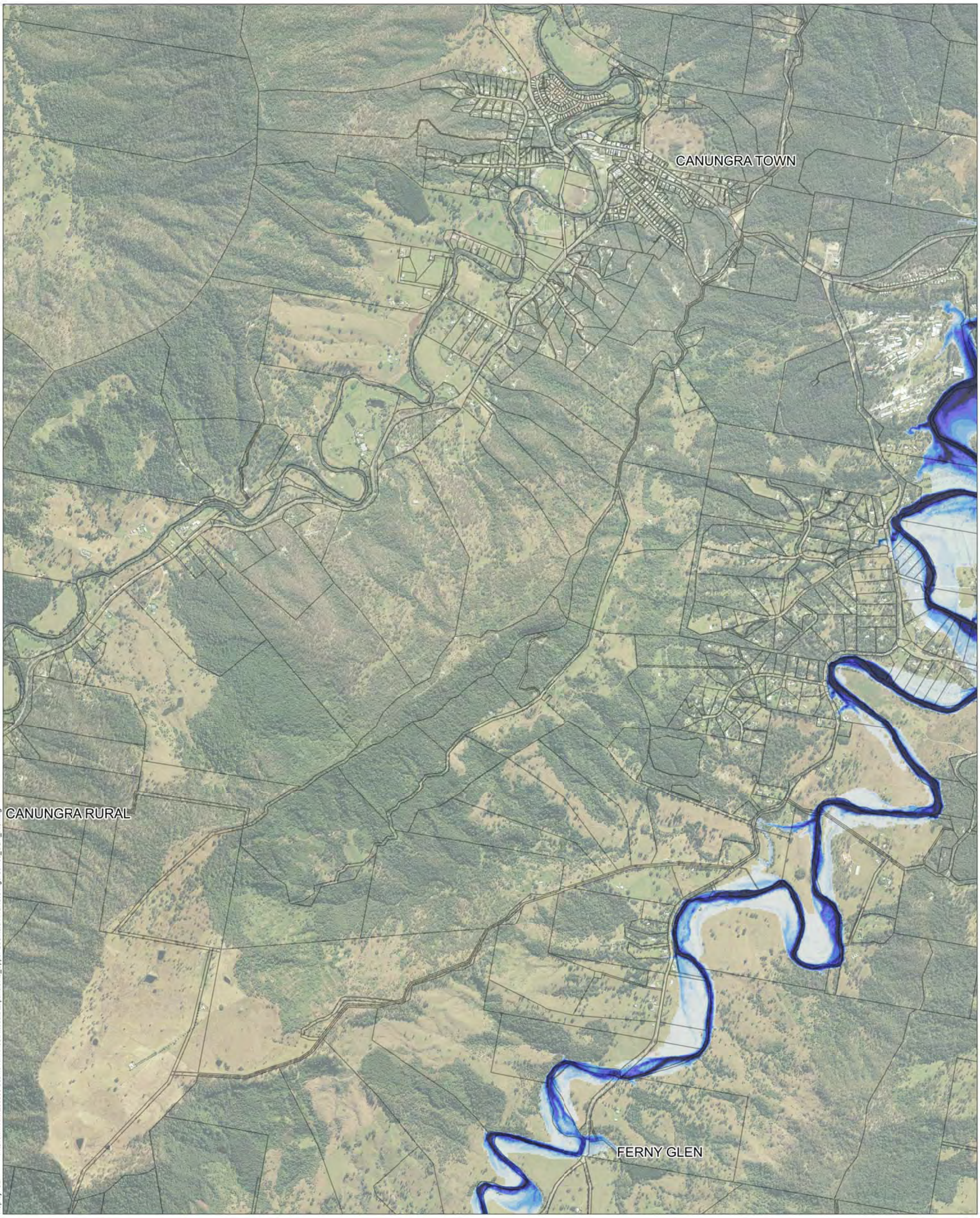
0 625 m 1,250 m

Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study Figure B6-a

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



Legend

Depth (m)

SRRC Boundary	0.0 to 0.5	3.0 to 3.5
Cadastral Boundary	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

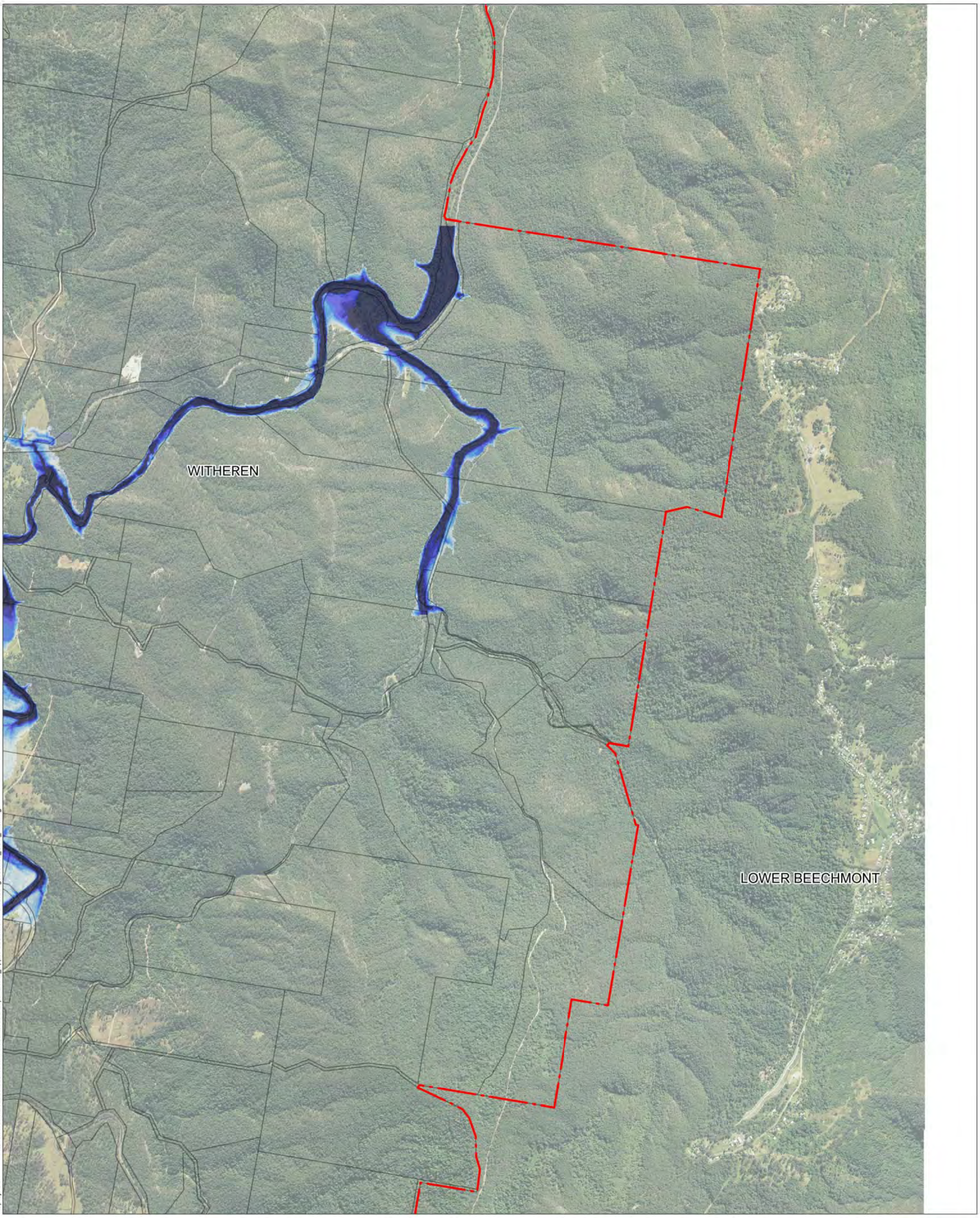
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B6-b**

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

aurecon



Map by: CD

P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\100_UCR_Working

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

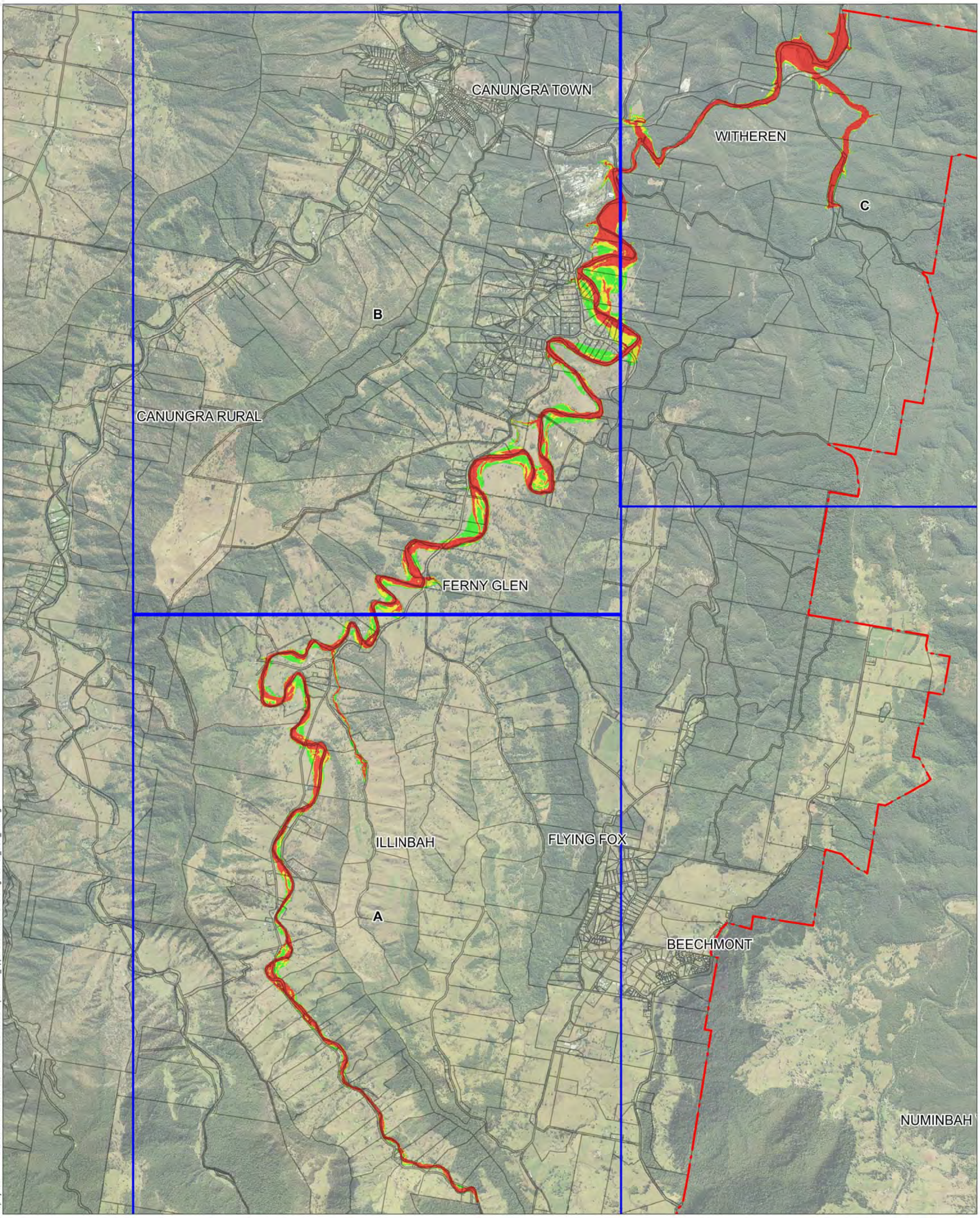
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B6-c**

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

aurecon



Legend

SRRC Boundary
Cadastral Boundary

Low Hazard
Medium Hazard
High Hazard

Notes:

1:50,000

0 1,250 m 2,500 m

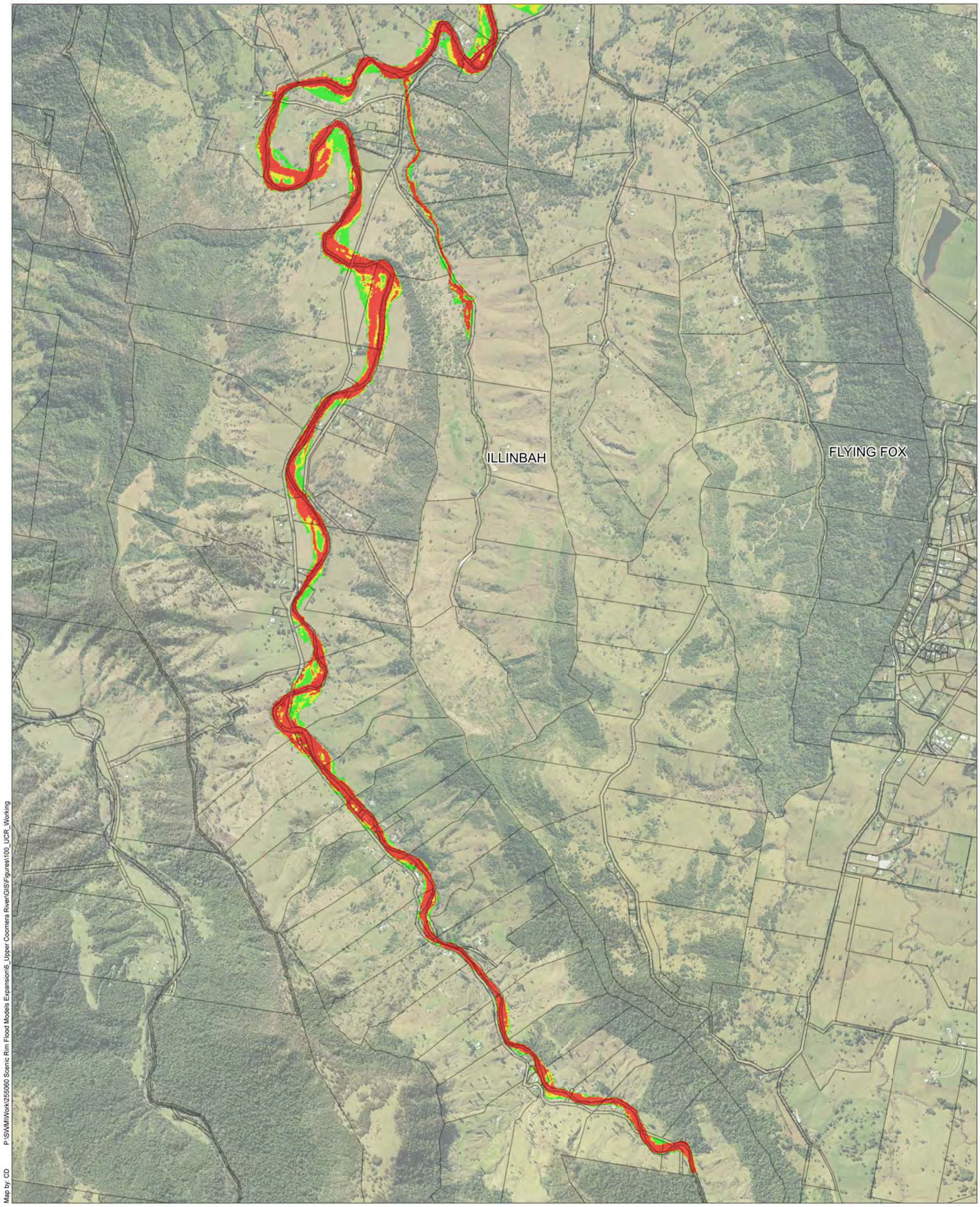
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B7**

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

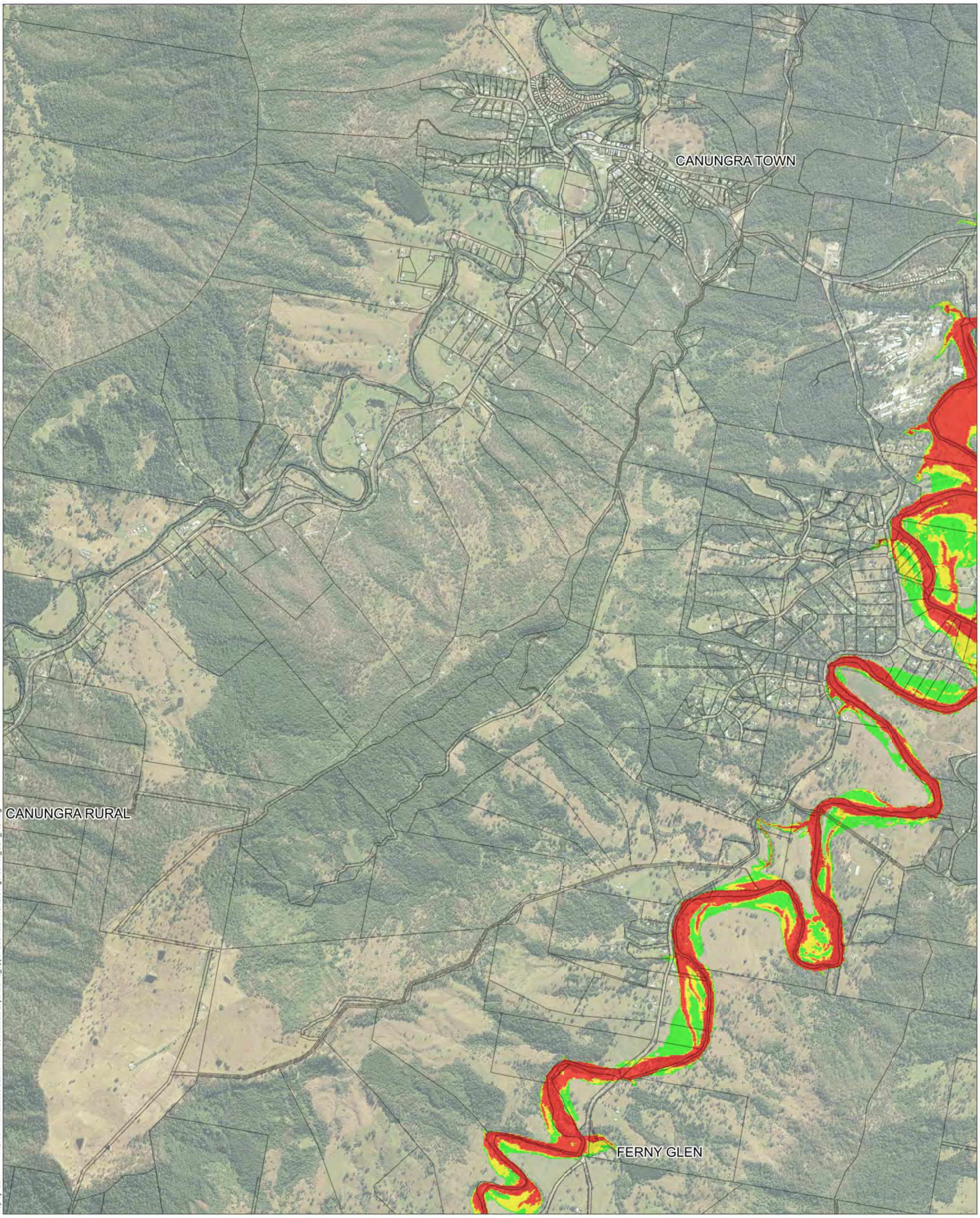
Date: 21/07/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B7-a**

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

aurecon



Map by: CD P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\100_UCR_Working

Legend

SRRC Boundary
Cadastral Boundary

Low Hazard
Medium Hazard
High Hazard

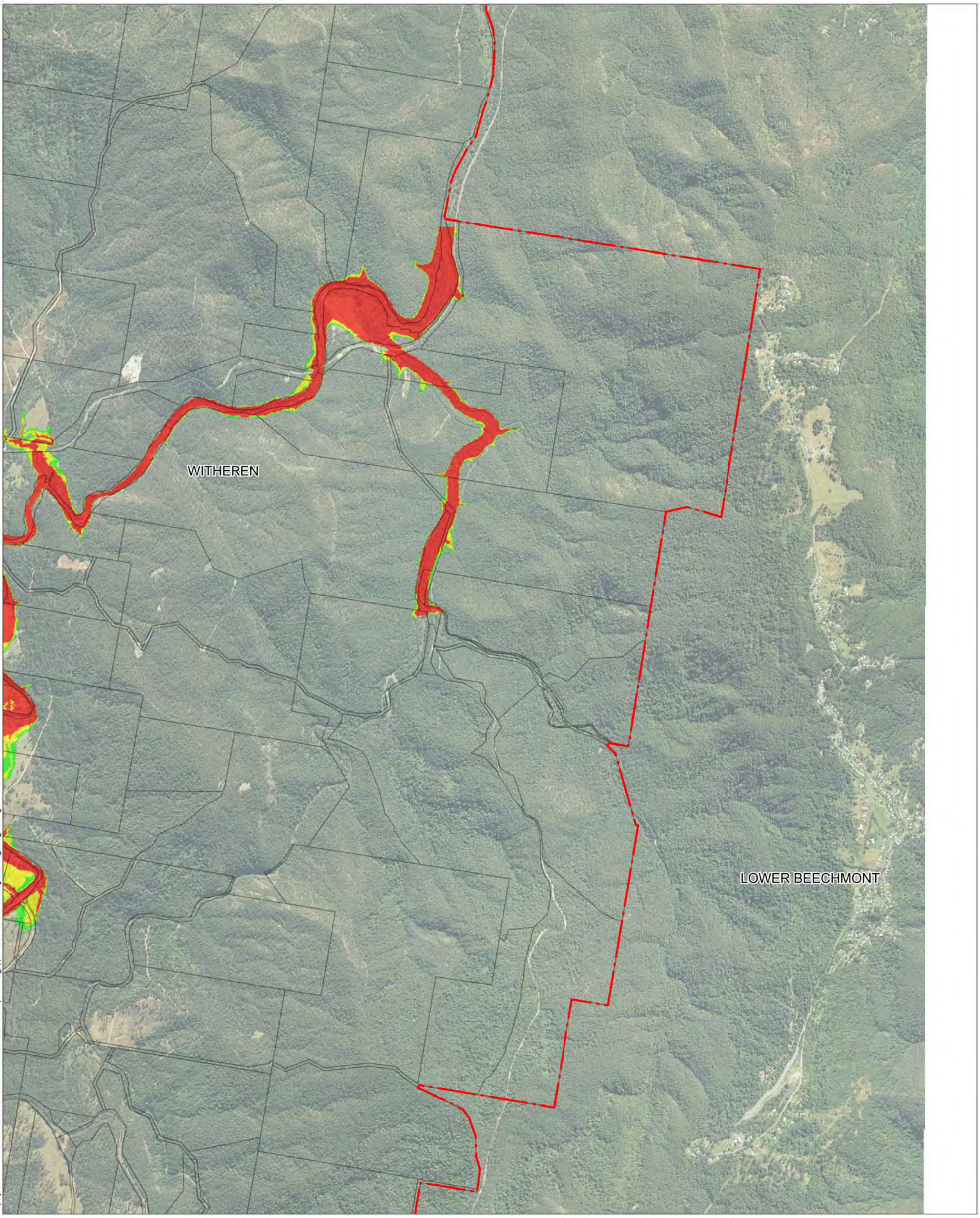
Notes:

1:25,000
0 625 m 1,250 m

Date: 21/07/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure B7-b**

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



Map by: CD   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\100_UCR_Working

Legend

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

Notes:

1:25,000

0   625 m   1,250 m

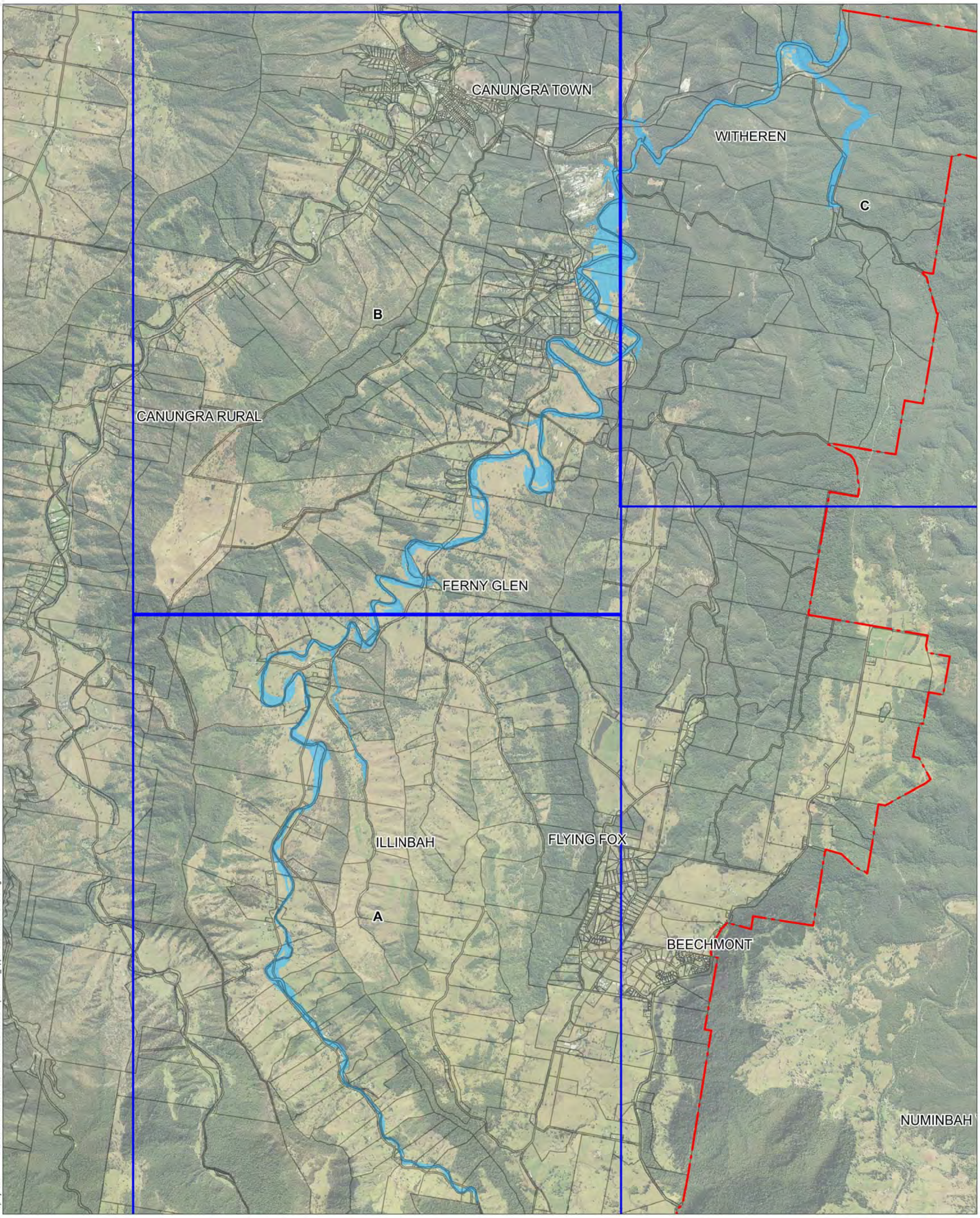
Date: 21/07/2017   Version: 0   Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study   **Figure B7-c**

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

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\5_Upper Coomera River\GIS\Figures\

Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:50,000

0   1,250 m   2,500 m

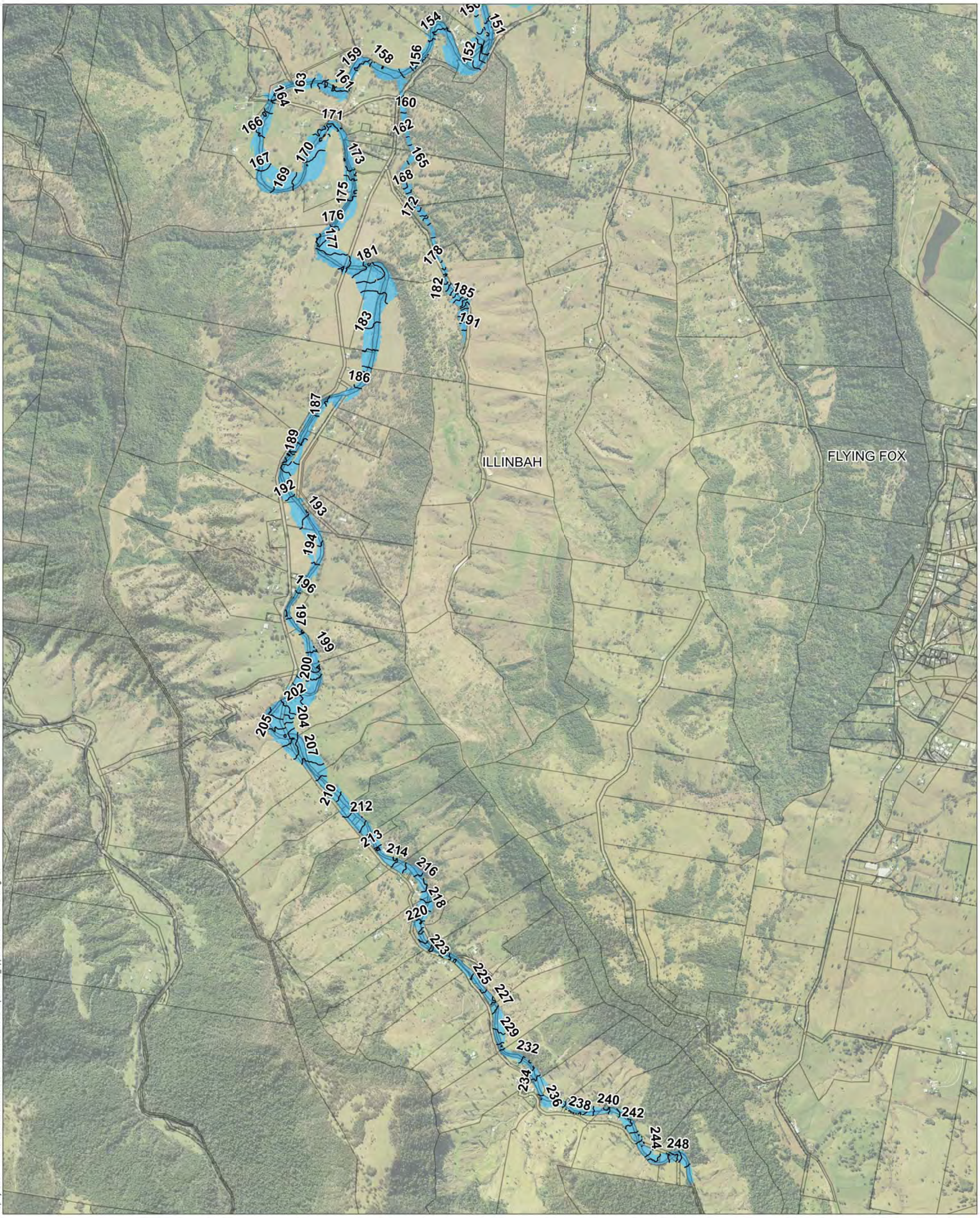
Date: 23/06/2017   Version: 0   Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C1**

2% AEP Event - Inundation Extent

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

0   625 m   1,250 m

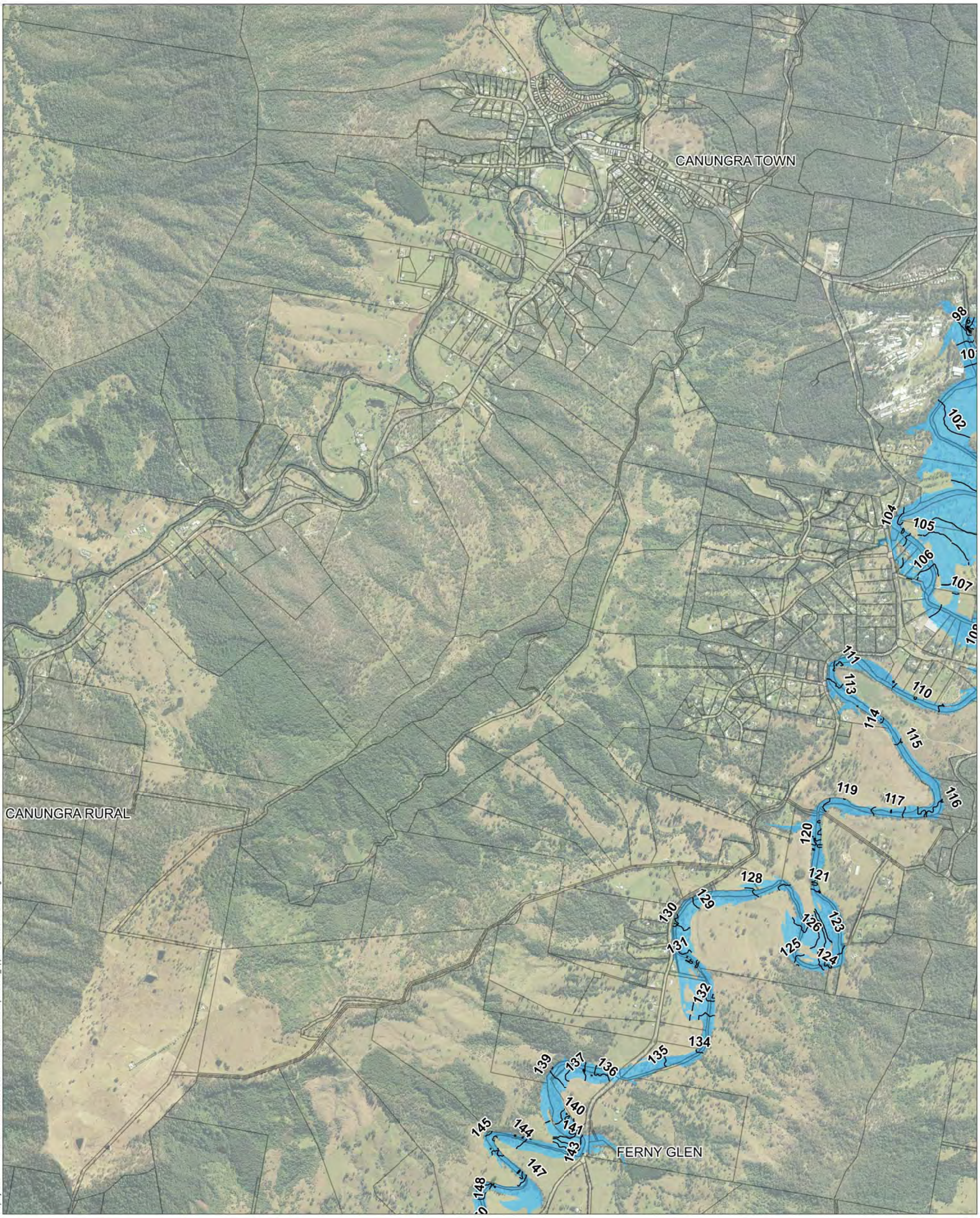
Date: 23/06/2017   Version: 0   Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study   **Figure C1-a**

2% AEP Event - Inundation Extent

aurecon



P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Map by: JDT

Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

0 625 m 1,250 m

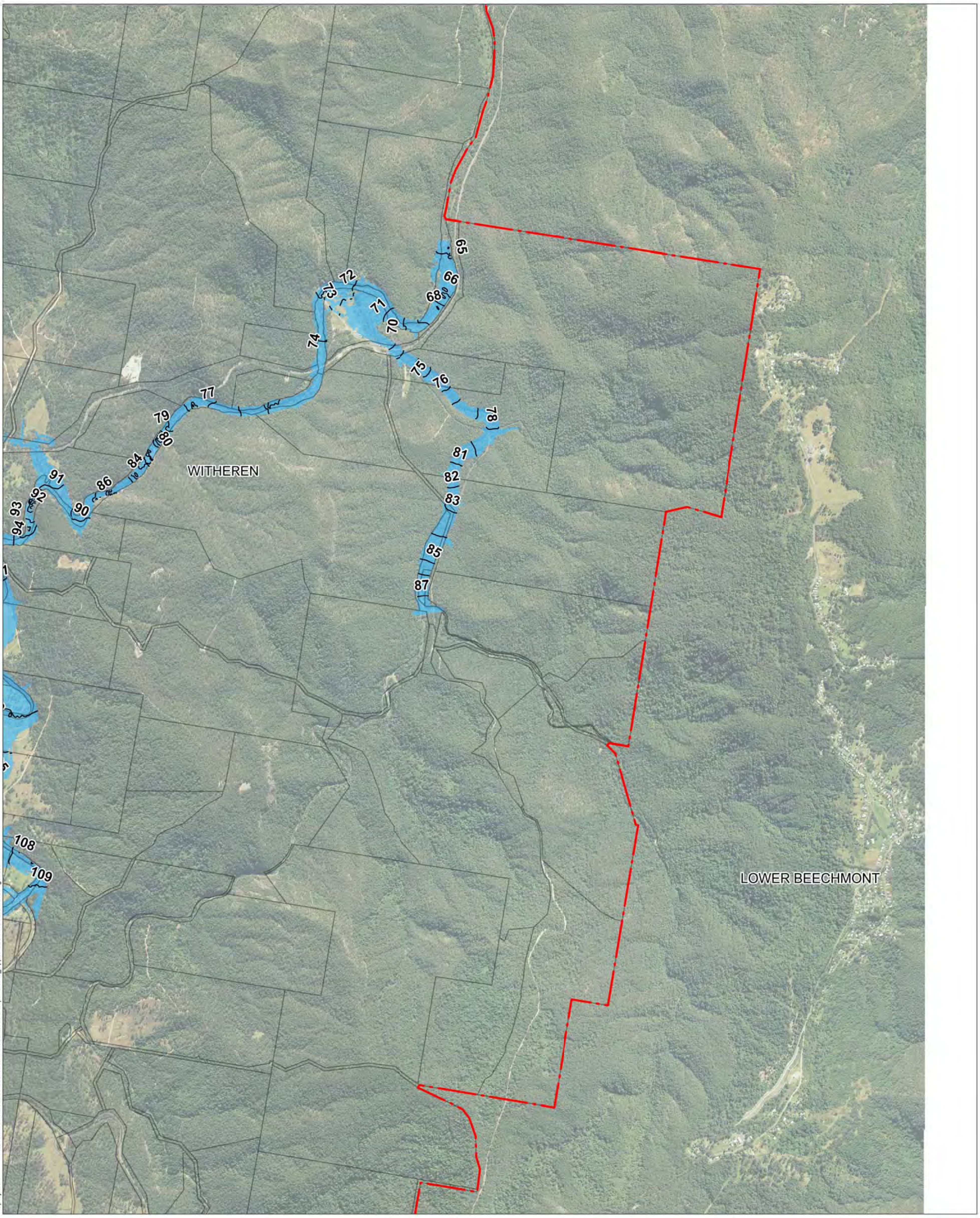
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C1-b**

2% AEP Event - Inundation Extent

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

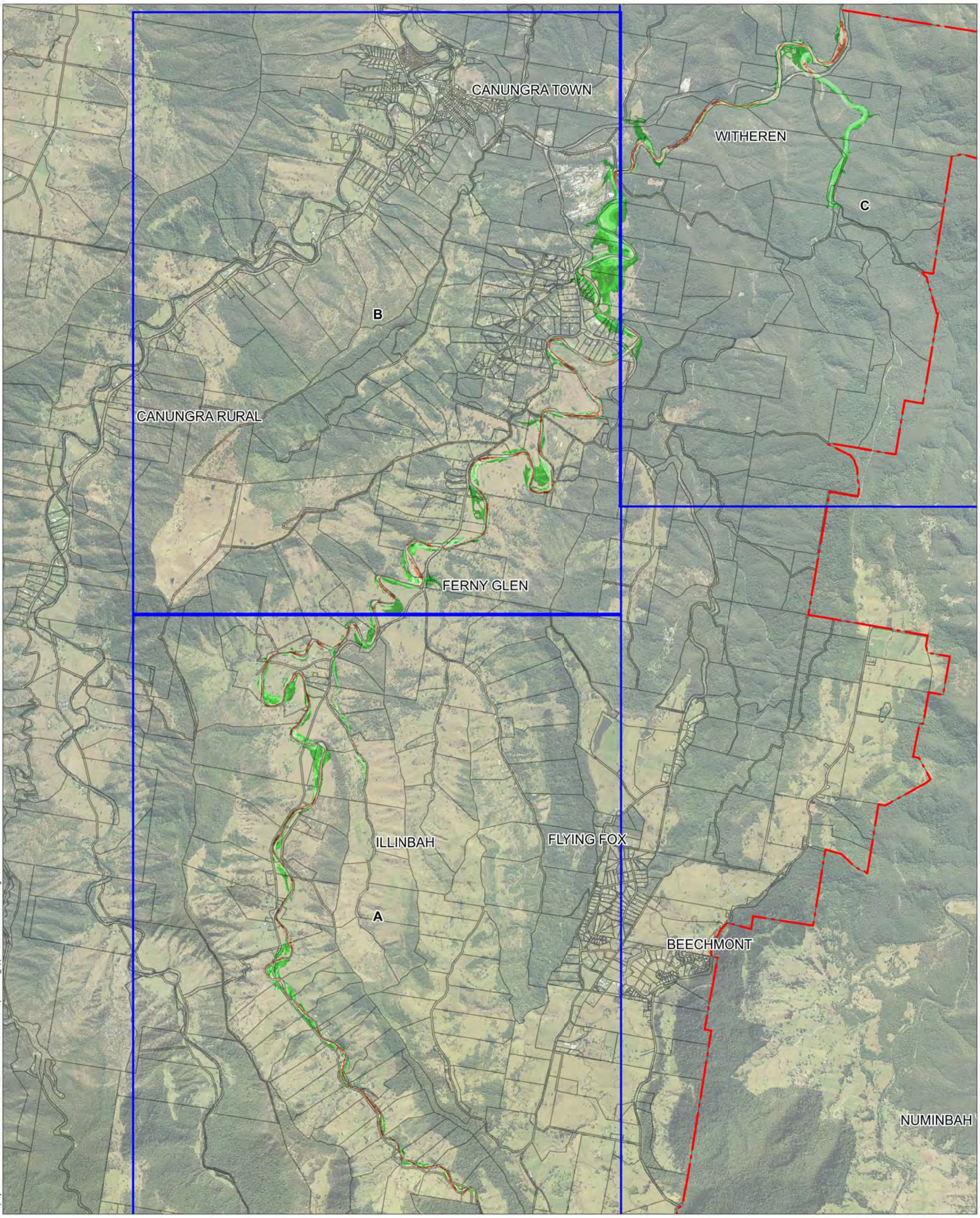
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C1-c**

2% AEP Event - 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:

1:50,000

0 | 1,250 m | 2,500 m

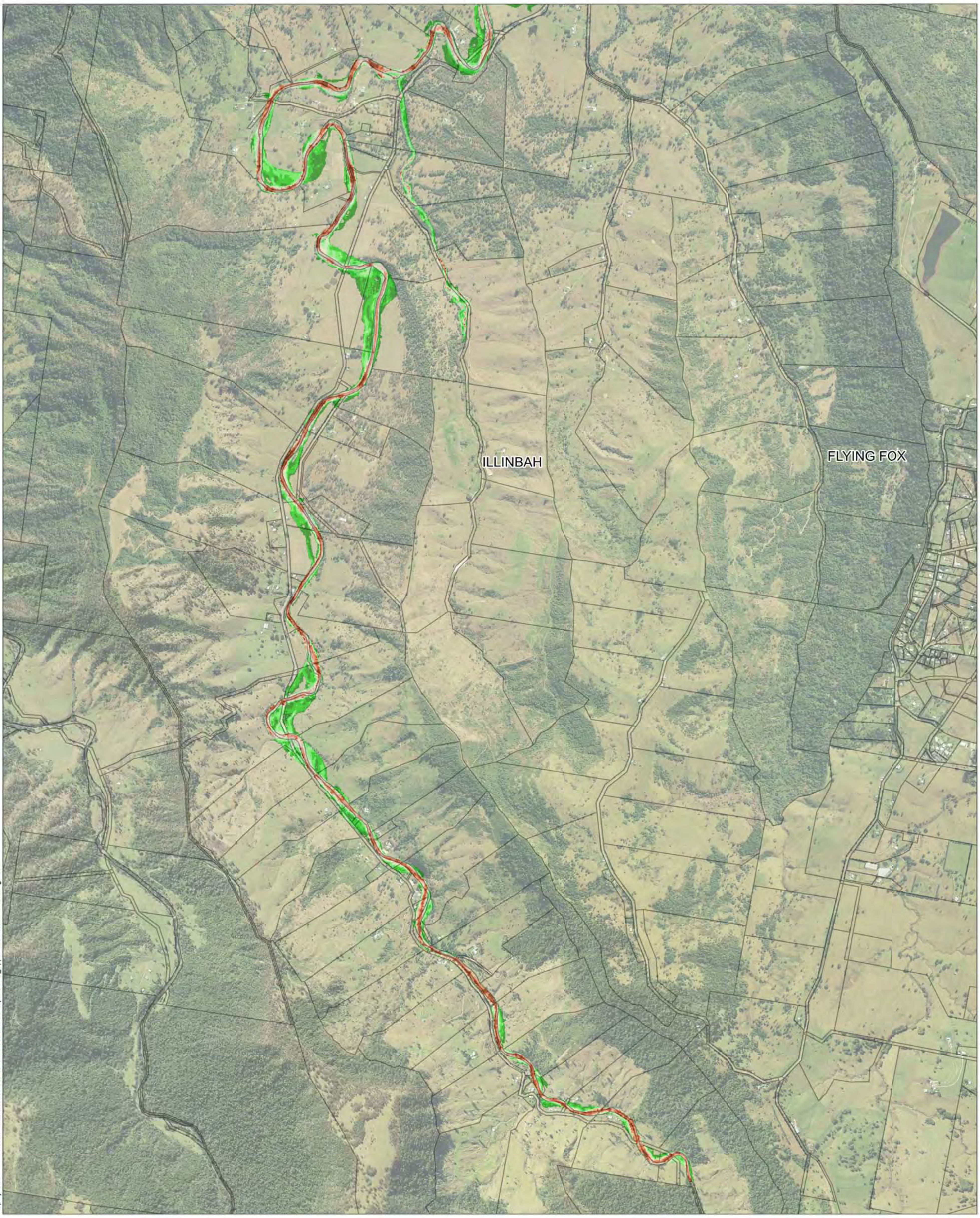
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C2**

2% AEP Event - Peak Velocities

aurecon



Legend

Velocity (m/s)

SRRC Boundary	0.0 to 0.5
Cadastral Boundary	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

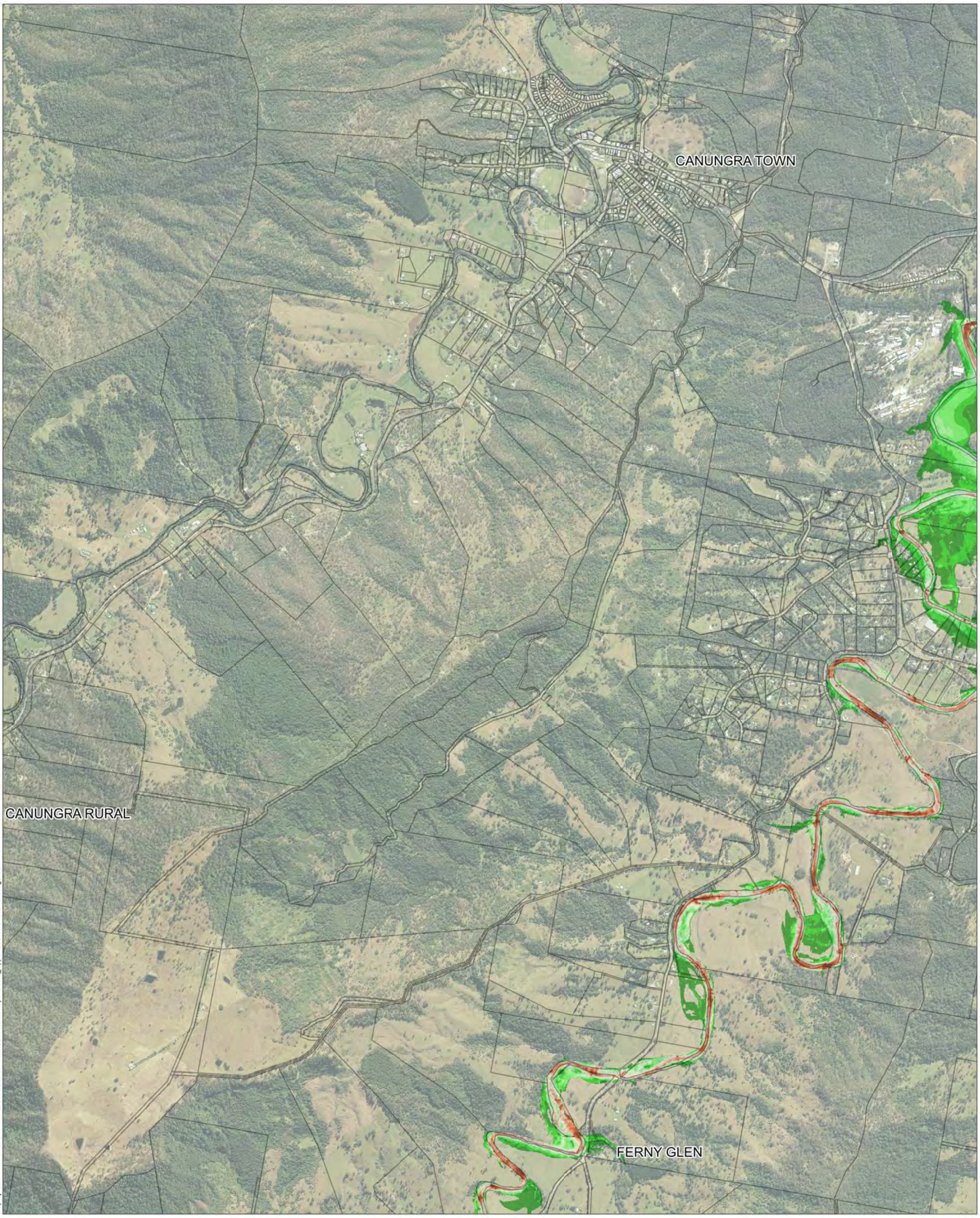
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C2-a**

2% AEP Event - Peak Velocities

aurecon



Legend

Velocity (m/s)

SRRC Boundary		0.0 to 0.5	3.0 to 3.5
Cadastral Boundary		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

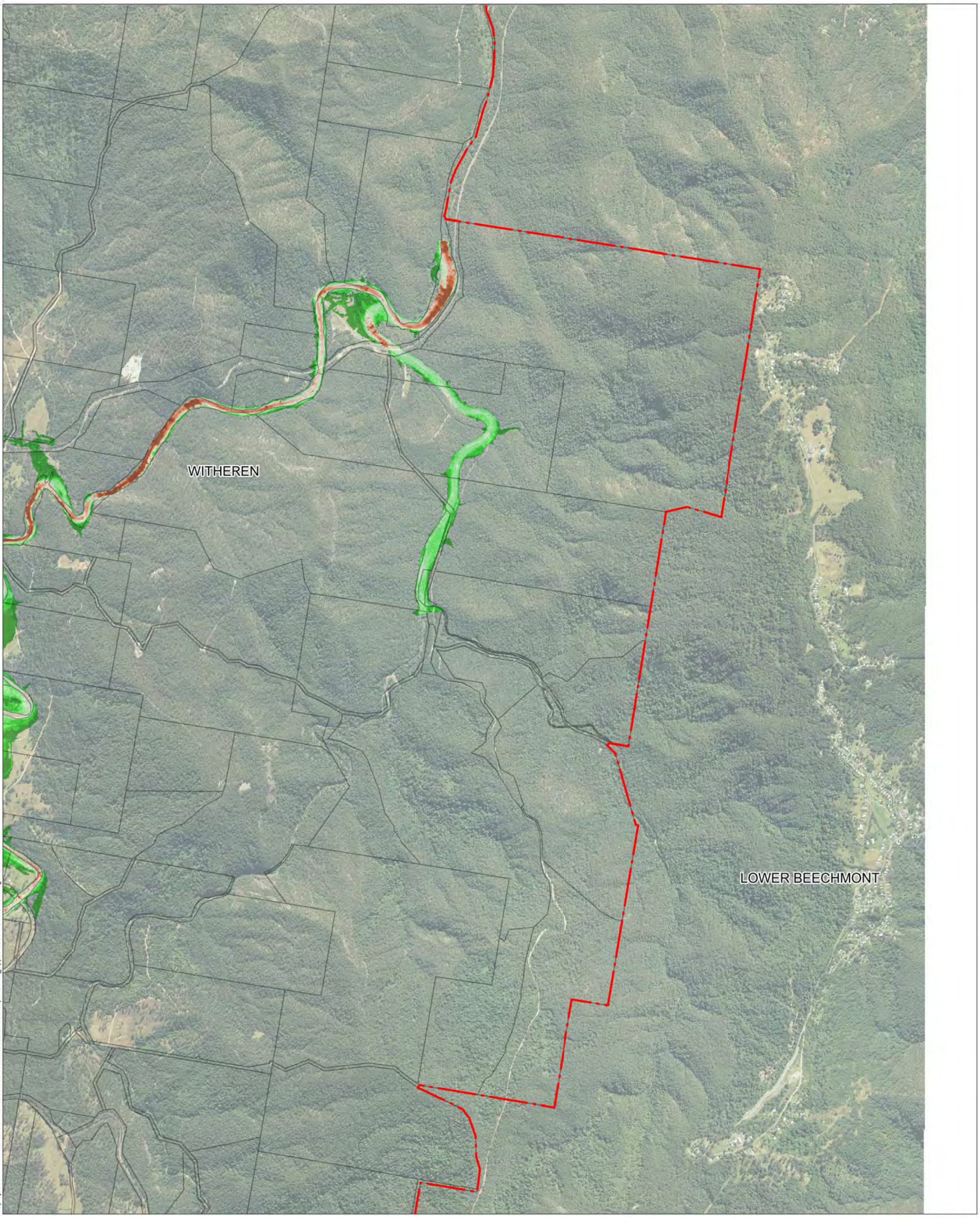
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C2-b**

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

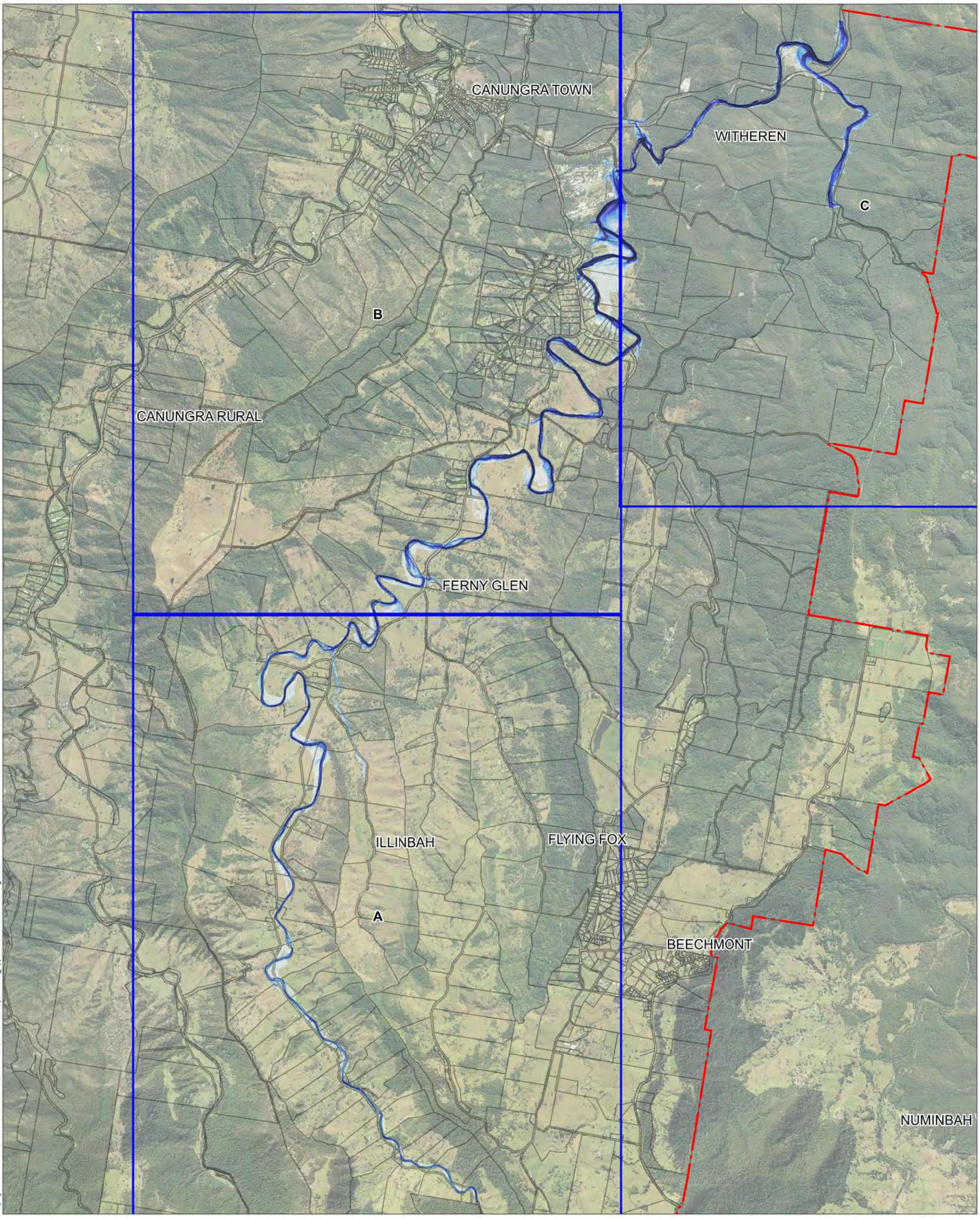
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C2-c**

2% AEP Event - Peak Velocities

aurecon



Legend

Depth (m)

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:

1:50,000

0 | 1,250 m | 2,500 m

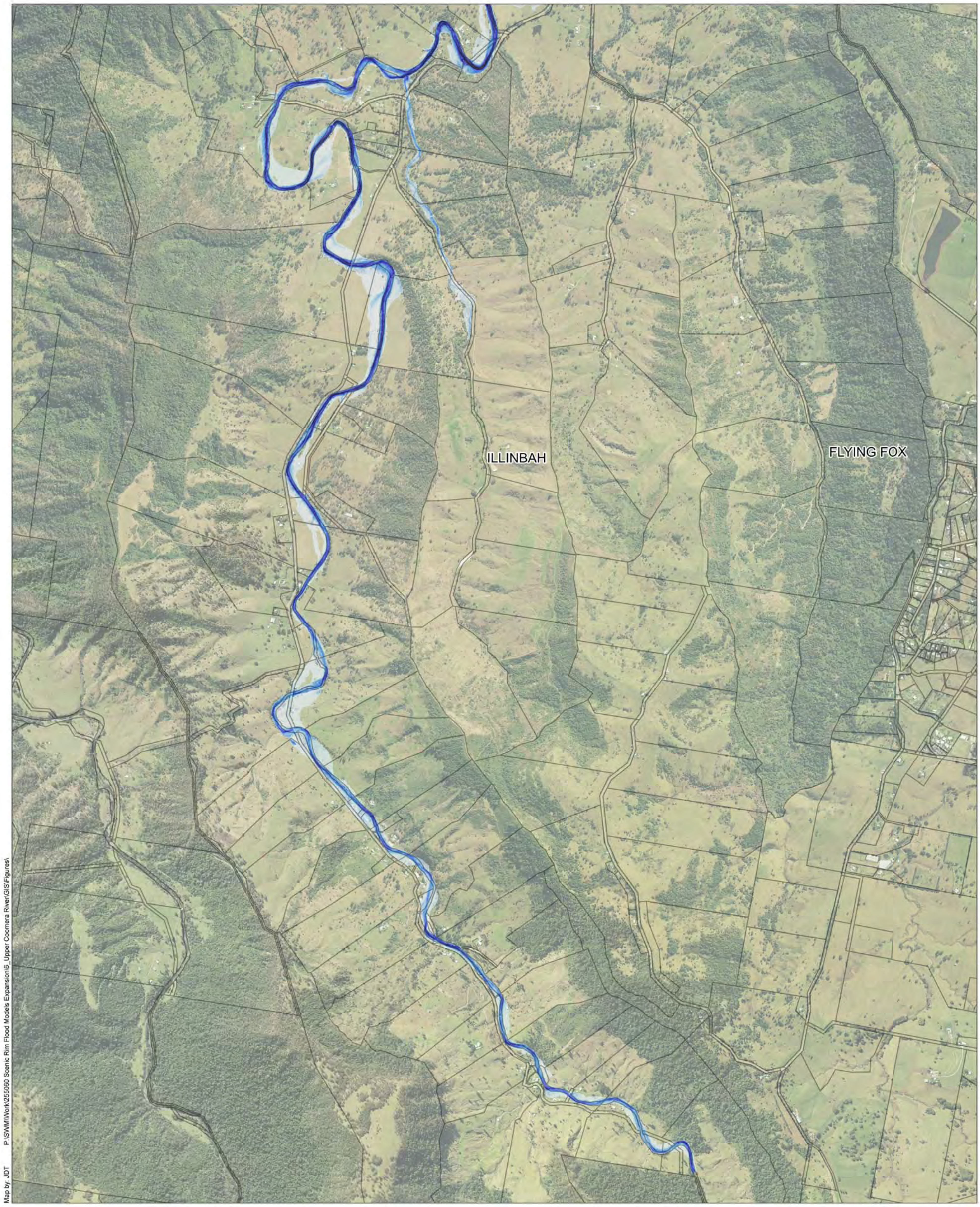
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C3**

2% AEP Event - Peak Depth Map

aurecon



Legend

SRRC Boundary	Depth (m)	0.0 to 0.5	3.0 to 3.5
Cadastral Boundary		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

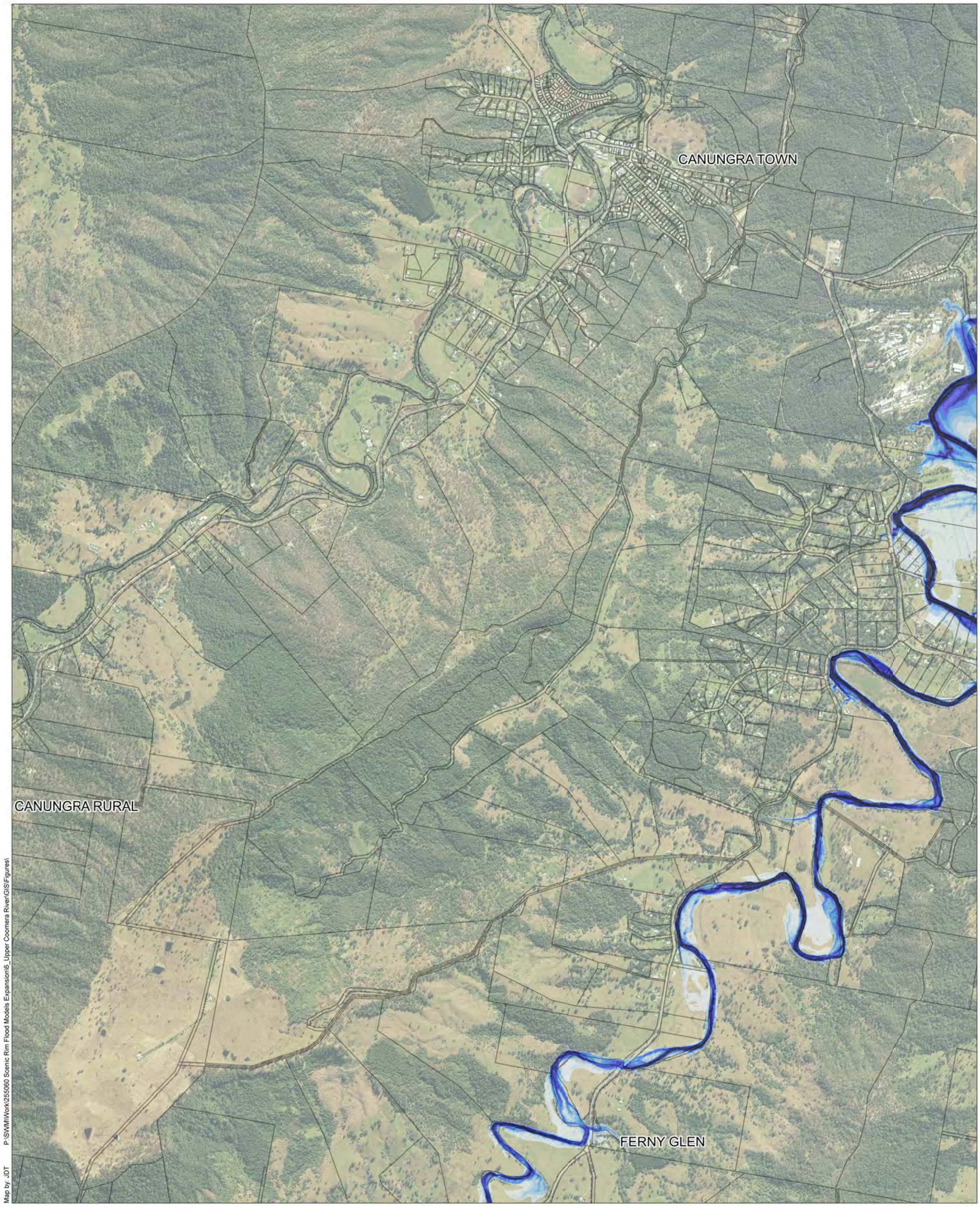
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study Figure C3-a

2% AEP Event - Peak Depth Map

aurecon



Legend

Depth (m)

SRRC Boundary	0.0 to 0.5	3.0 to 3.5
Cadastral Boundary	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: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C3-b**

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:

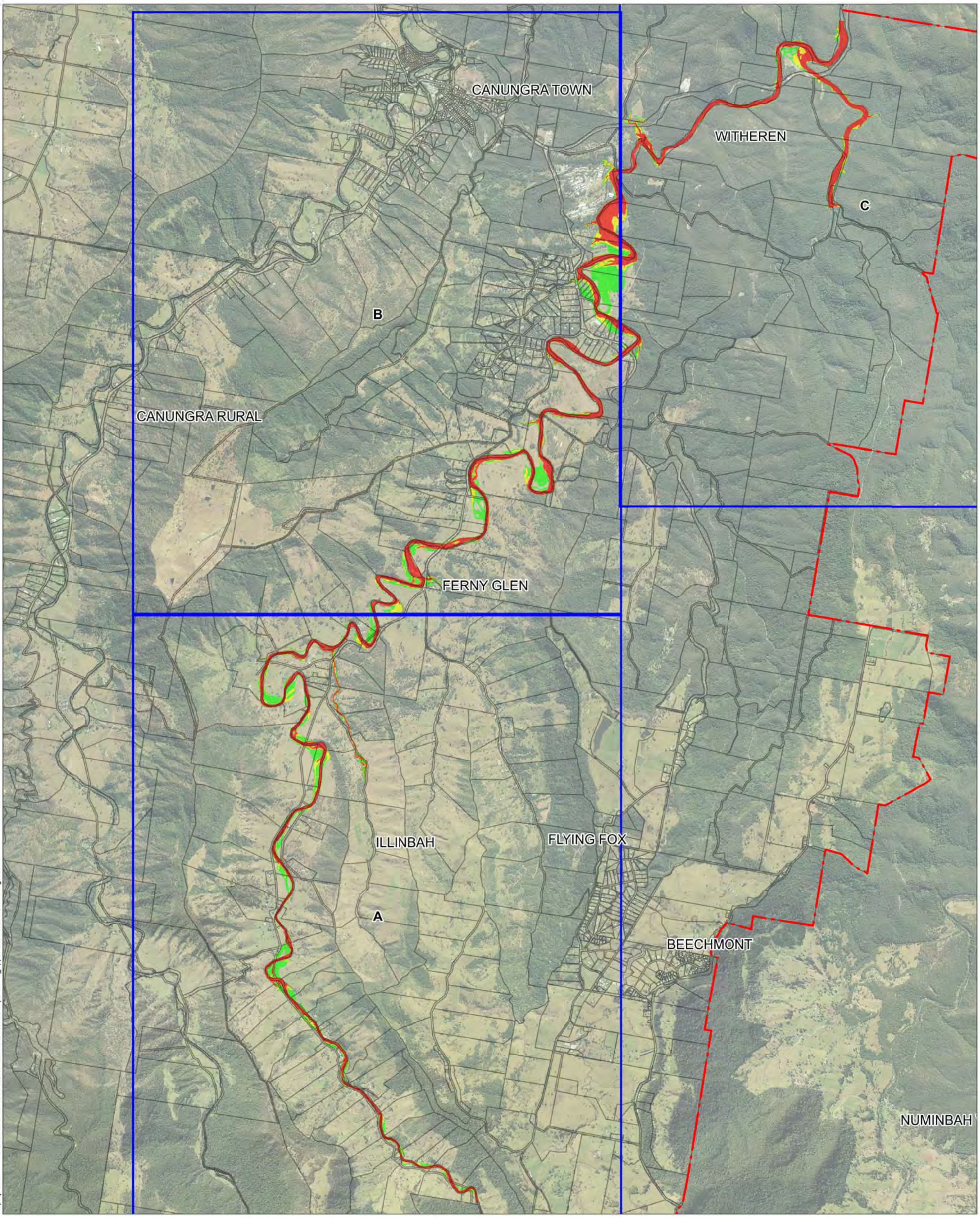
1:25,000
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C3-c**

2% AEP Event - Peak Depth Map

aurecon



Map by: JDT P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

1:50,000

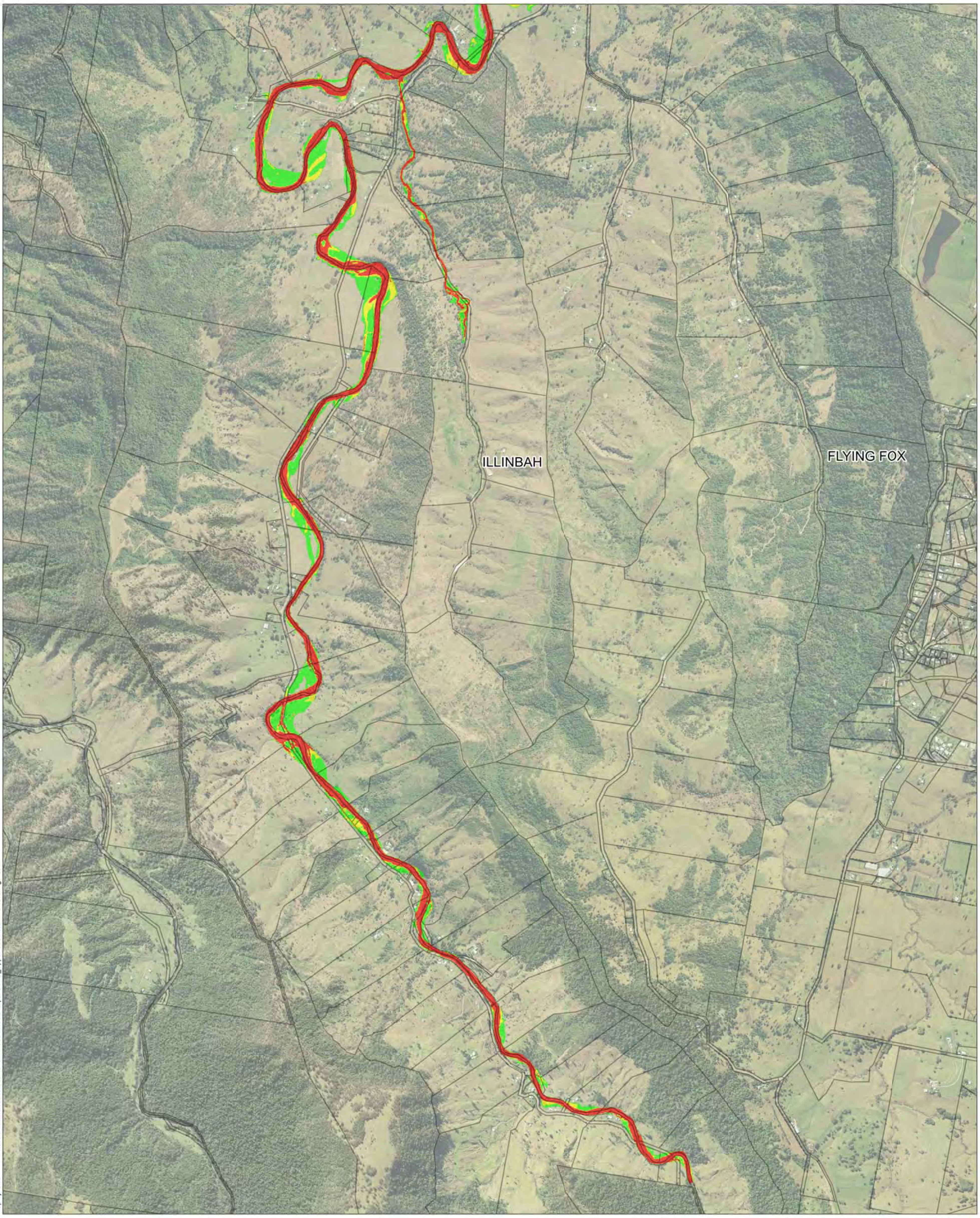
0 1,250 m 2,500 m

Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C4**

2% AEP Event - Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

1:25,000

0 625 m 1,250 m

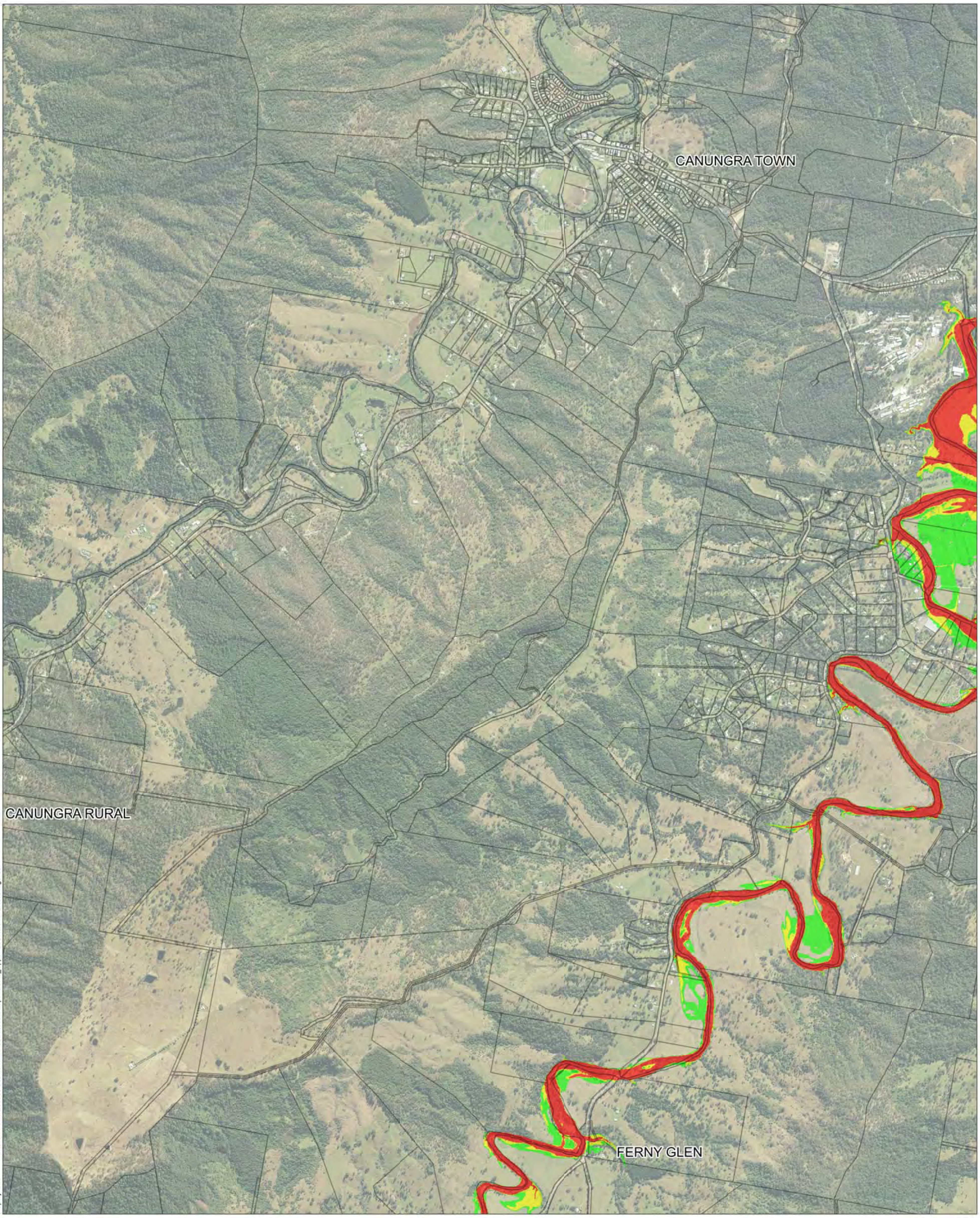
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C4-a**

2% AEP Event - Peak Hazard Map

aurecon



Map by: JDT P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

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

Notes:

1:25,000

0 625 m 1,250 m

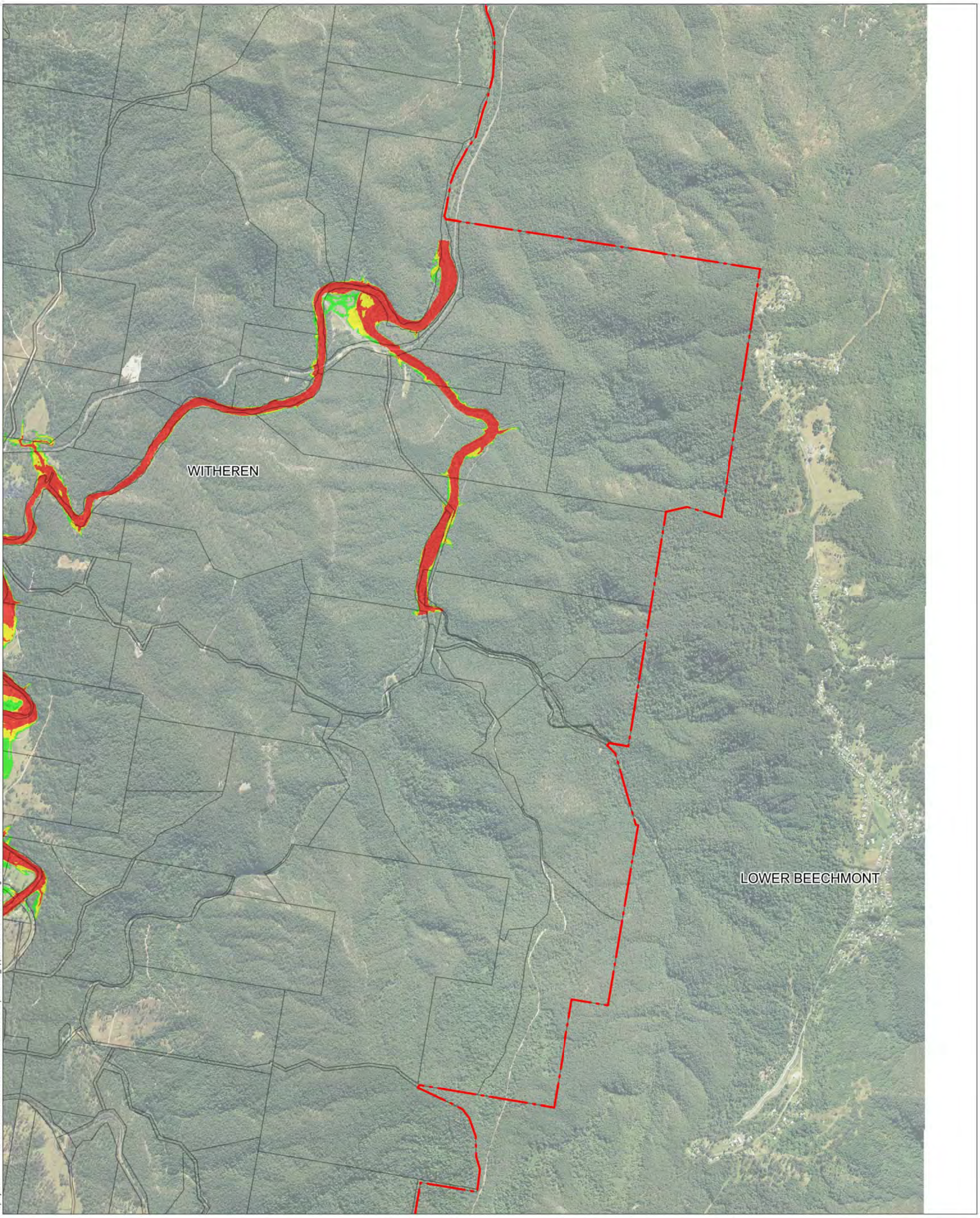
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C4-b**

2% AEP Event - Peak Hazard Map

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

SRRC Boundary
Cadastral Boundary
Low Hazard
Medium Hazard
High Hazard

Notes:

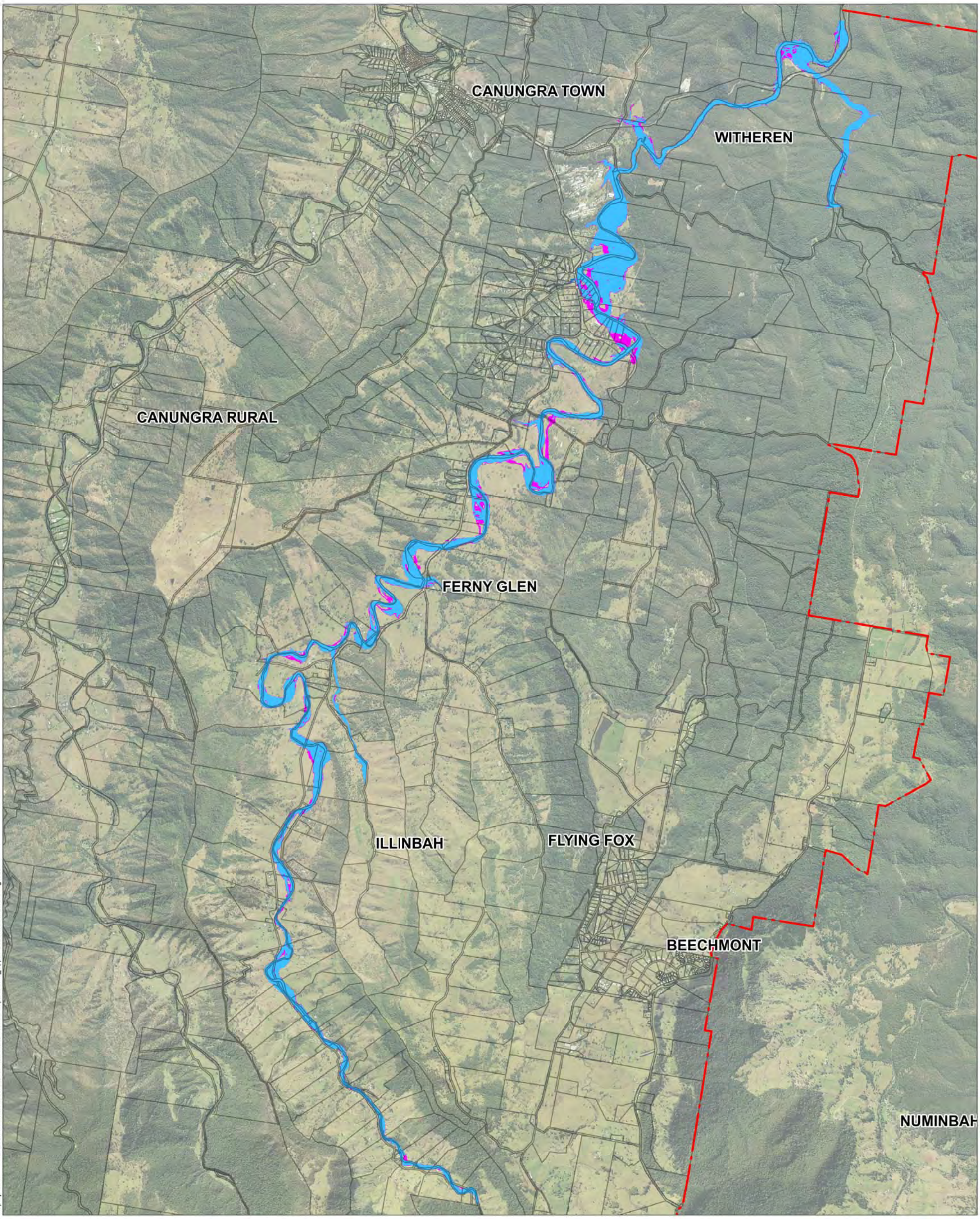
1:25,000
0   625 m   1,250 m

Date: 23/06/2017   Version: 0   Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study   **Figure C4-c**

2% AEP Event - Peak Hazard Map

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\5_Upper Coomera River\GIS\Figures\

Legend

SRRC Boundary
Cadastral Boundary

Existing Scenario Inundation Extents
Climate Change Scenario 4.5 Inundation Extent

Notes:

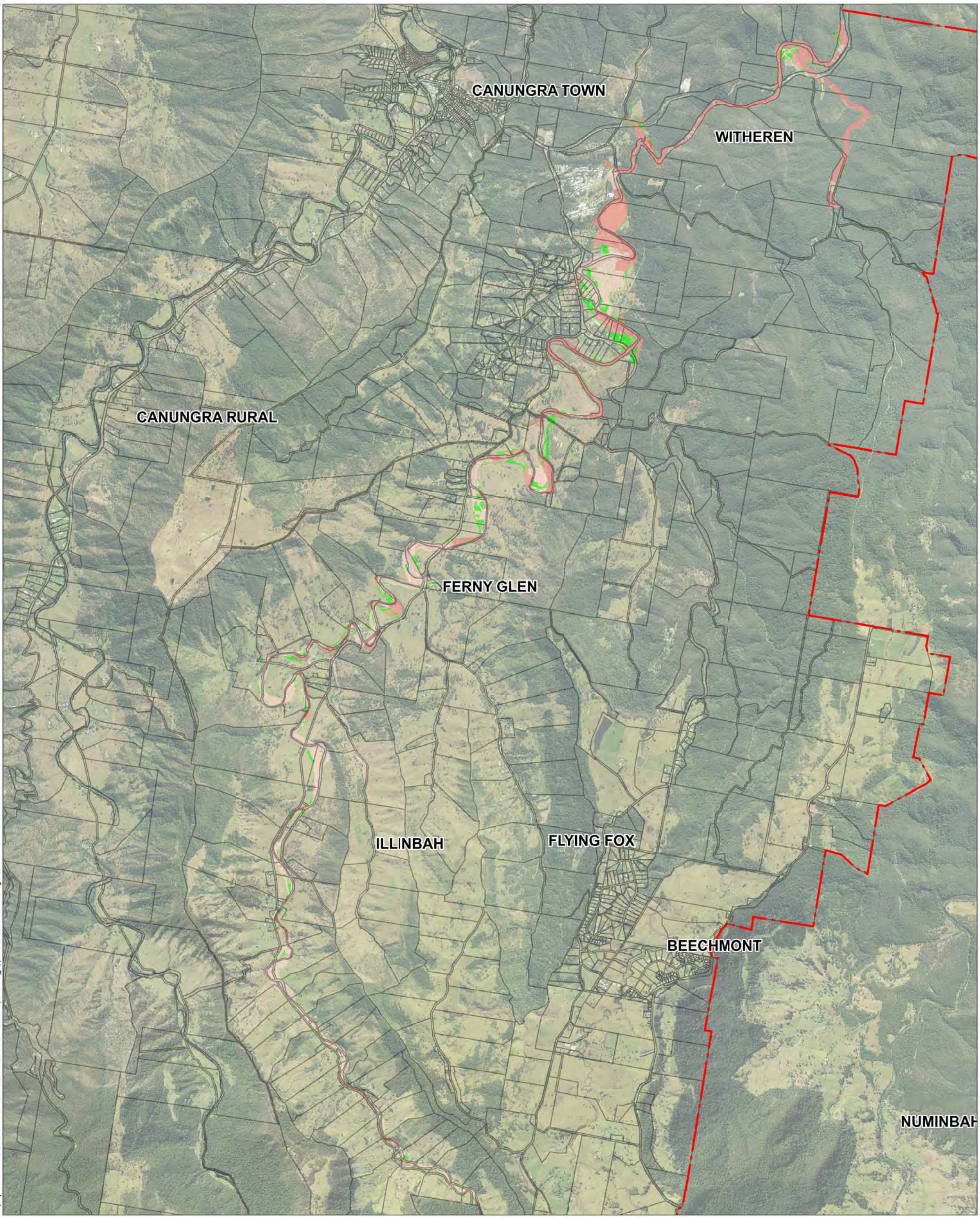
1:50,000
0   1,250 m   2,500 m

Date: 25/05/2017   Version: 0   Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study   **Figure C5-a**

Climate Change Scenario 4.5 - 2% AEP Event Inundation Extent

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Afflux (m)

- < -0.80
- -0.80 to -0.60
- -0.60 to -0.40
- -0.40 to -0.20
- -0.20 to -0.03
- -0.03 to 0.03
- 0.03 to 0.20
- 0.20 to 0.40
- 0.40 to 0.60
- 0.60 to 0.80
- 0.80 to 1.20
- > 1.20
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

1:50,000

0 1,250 m 2,500 m

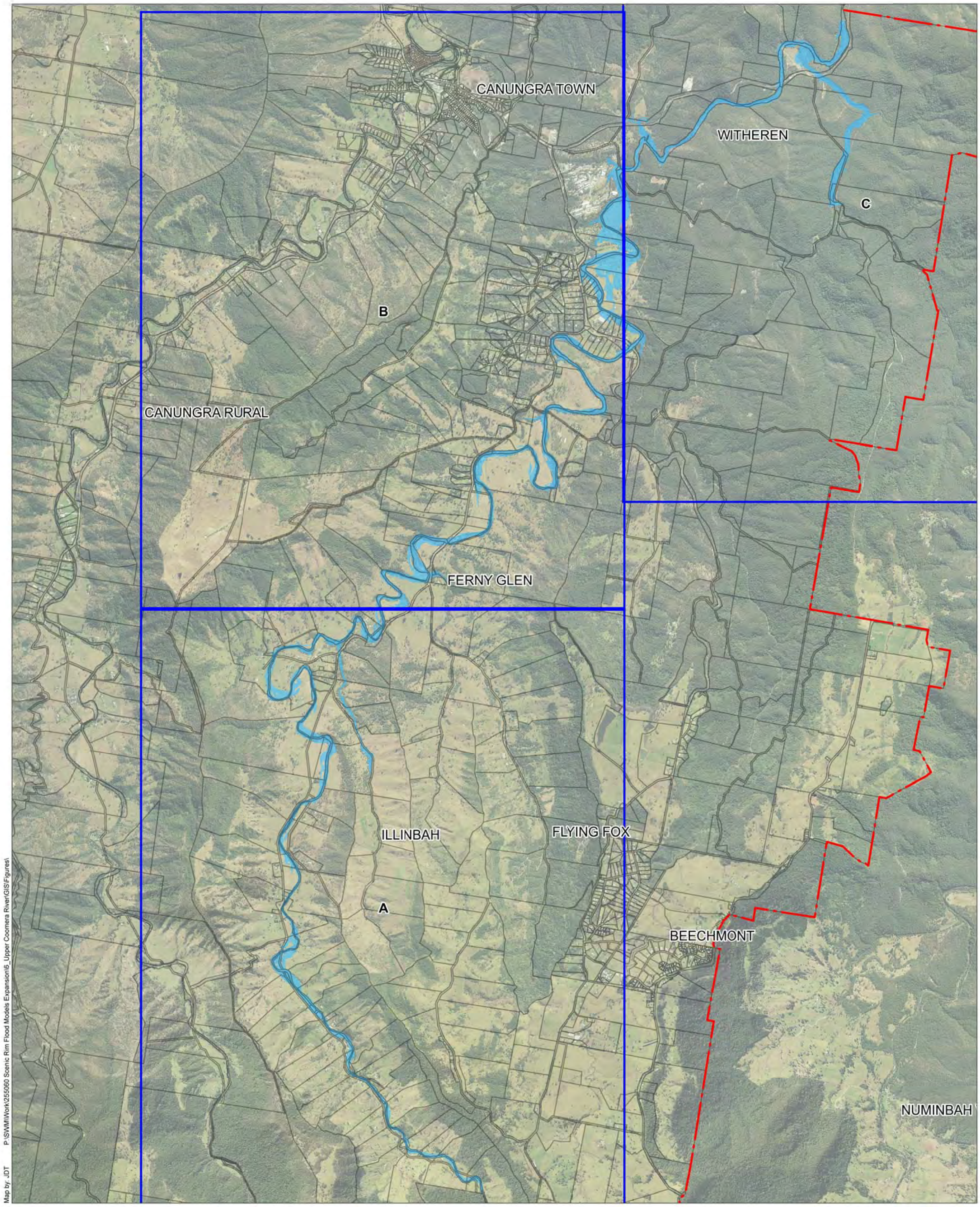
Date: 25/05/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure C5-b**

Climate Change Scenario 4.5 - 2% AEP Event Afflux Map

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:50,000

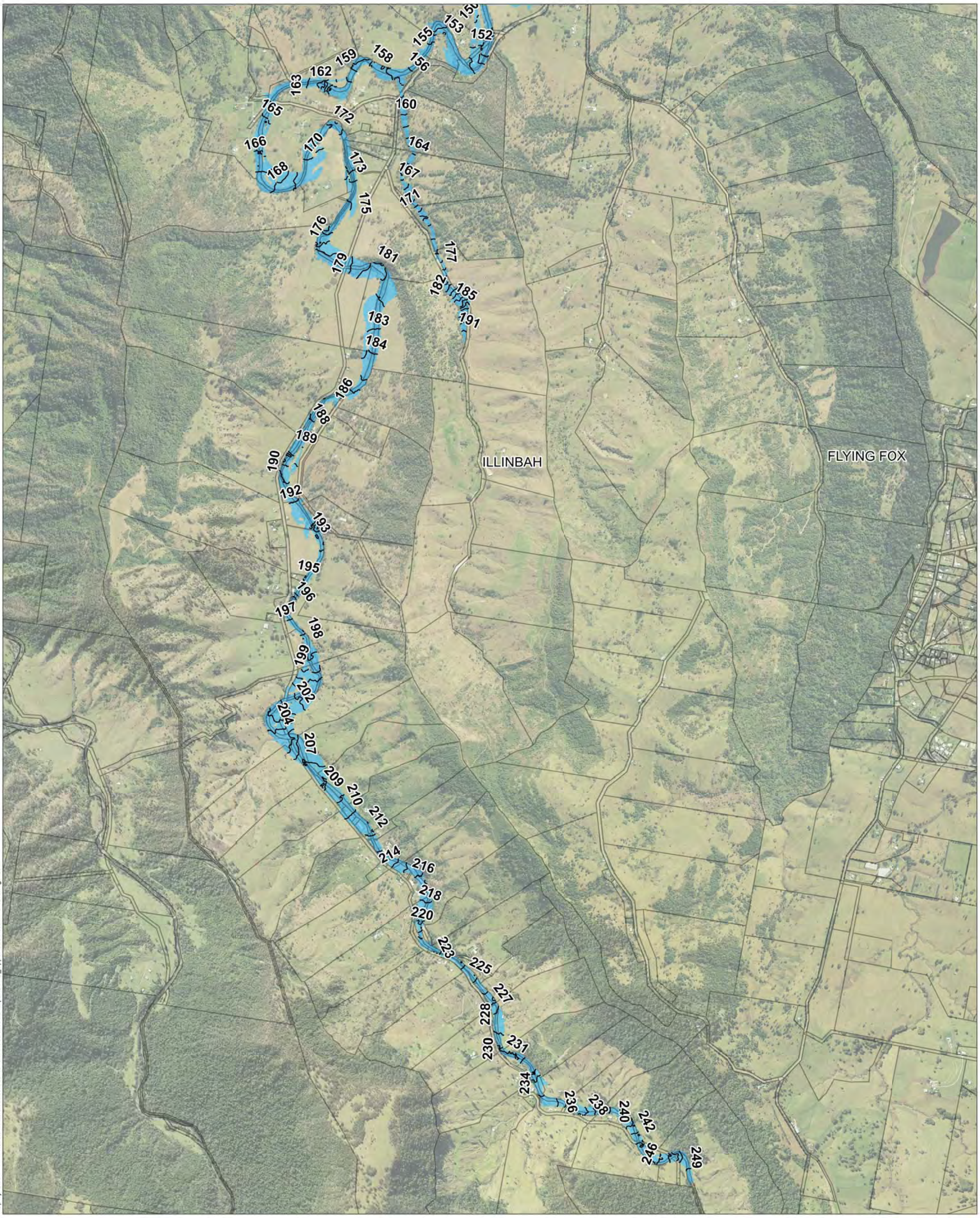
0 1,250 m 2,500 m

Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D1**

5% 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: 23/06/2017 Version: 0 Job No: 255060

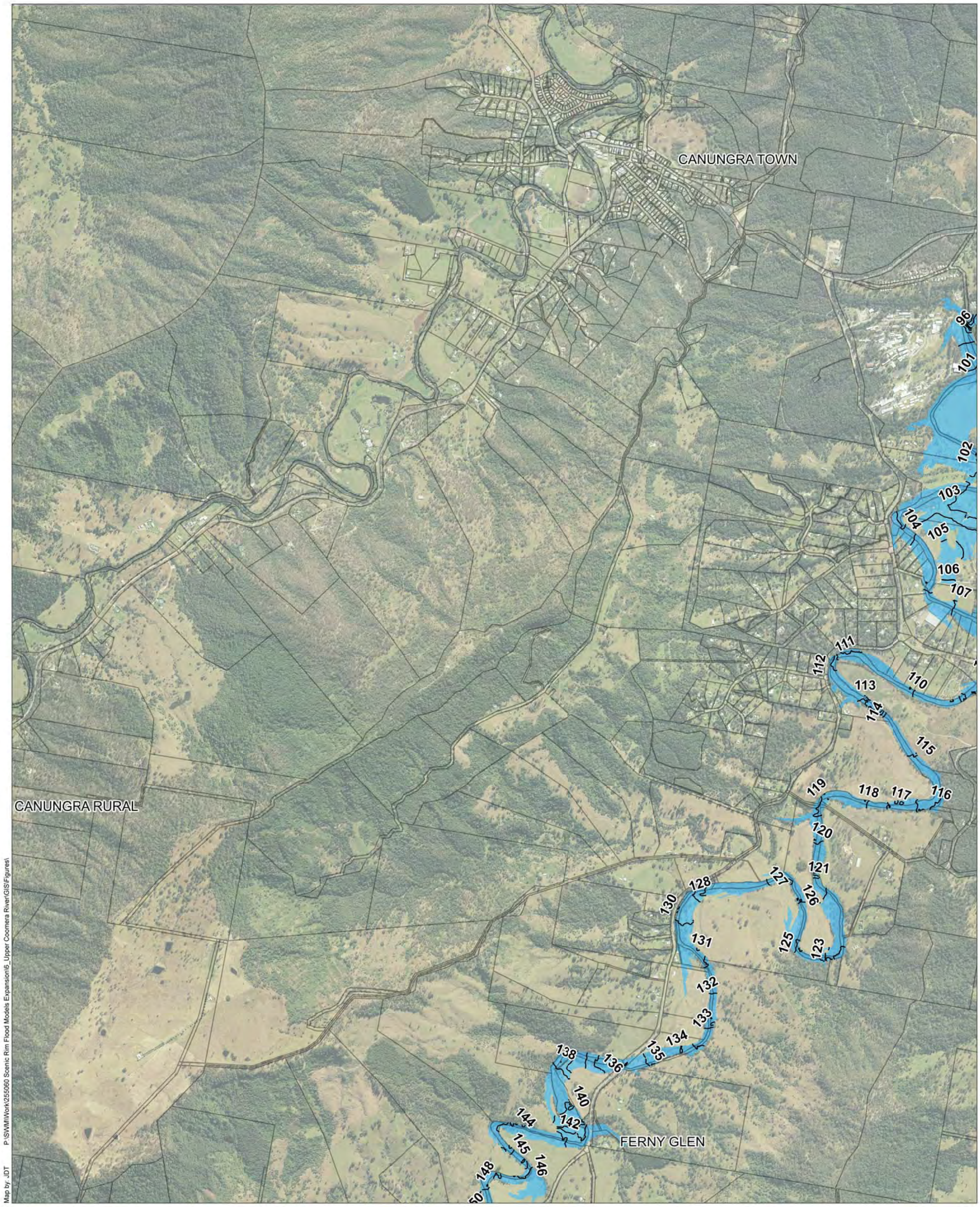
Projection: MGA Zone 56

aurecon

Upper Coomera River Flood Study **Figure D1-a**

5% 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

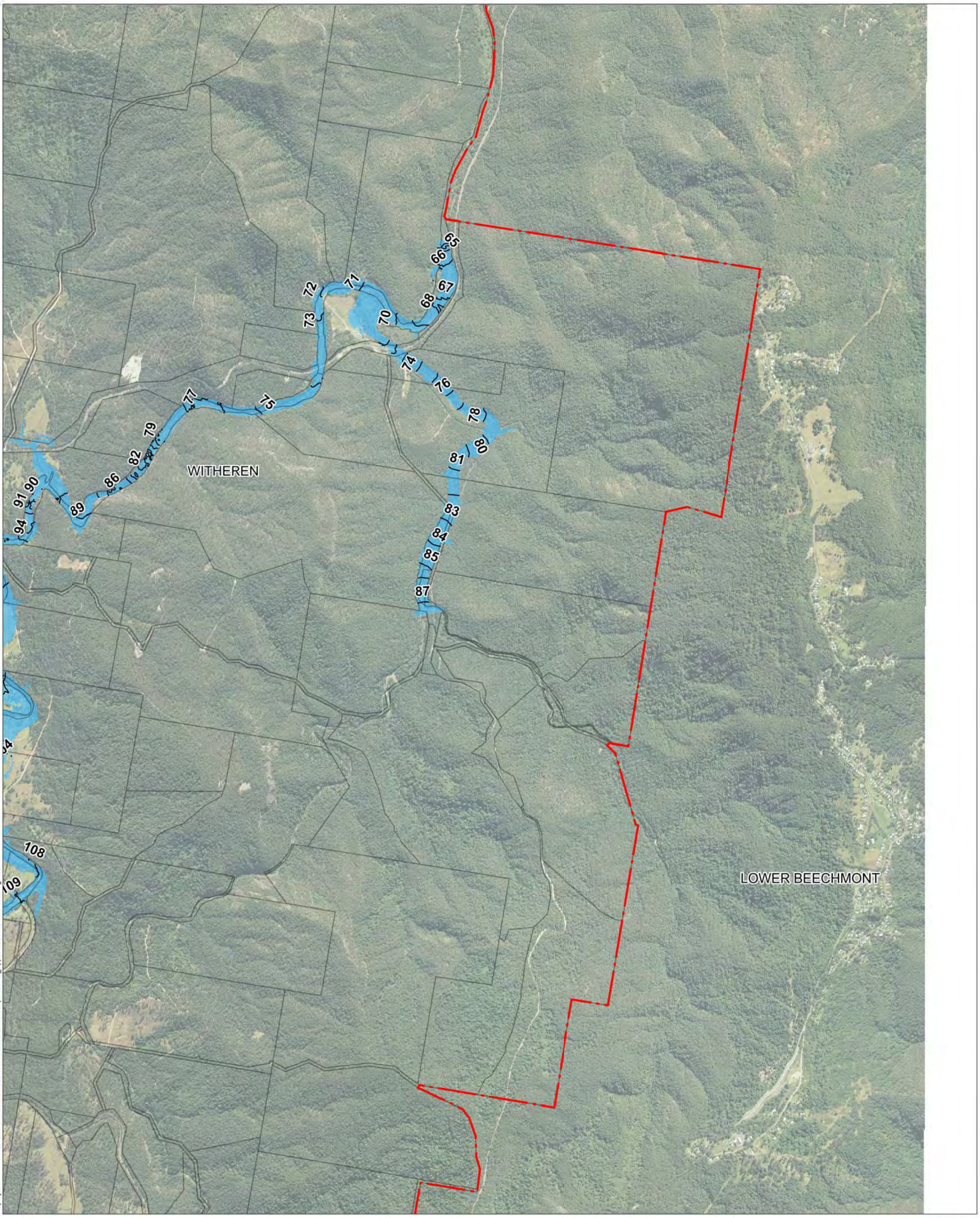
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D1-b**

5% AEP Event - Inundation Extent

aurecon



Map by: JDT P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

0 625 m 1,250 m

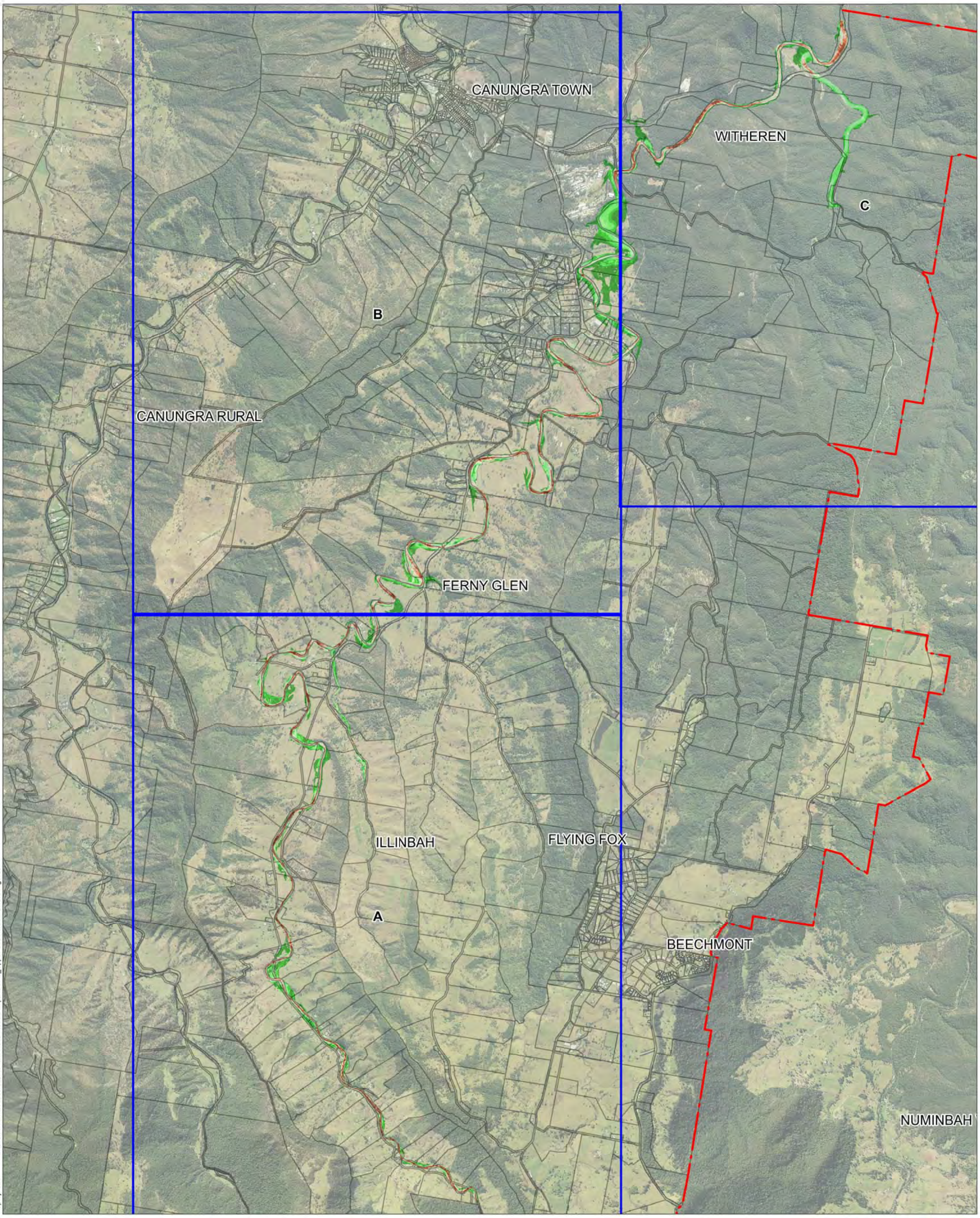
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D1-c**

5% AEP Event - Inundation Extent

aurecon



Map by: JDT

P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

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:

1:50,000

0 1,250 m 2,500 m

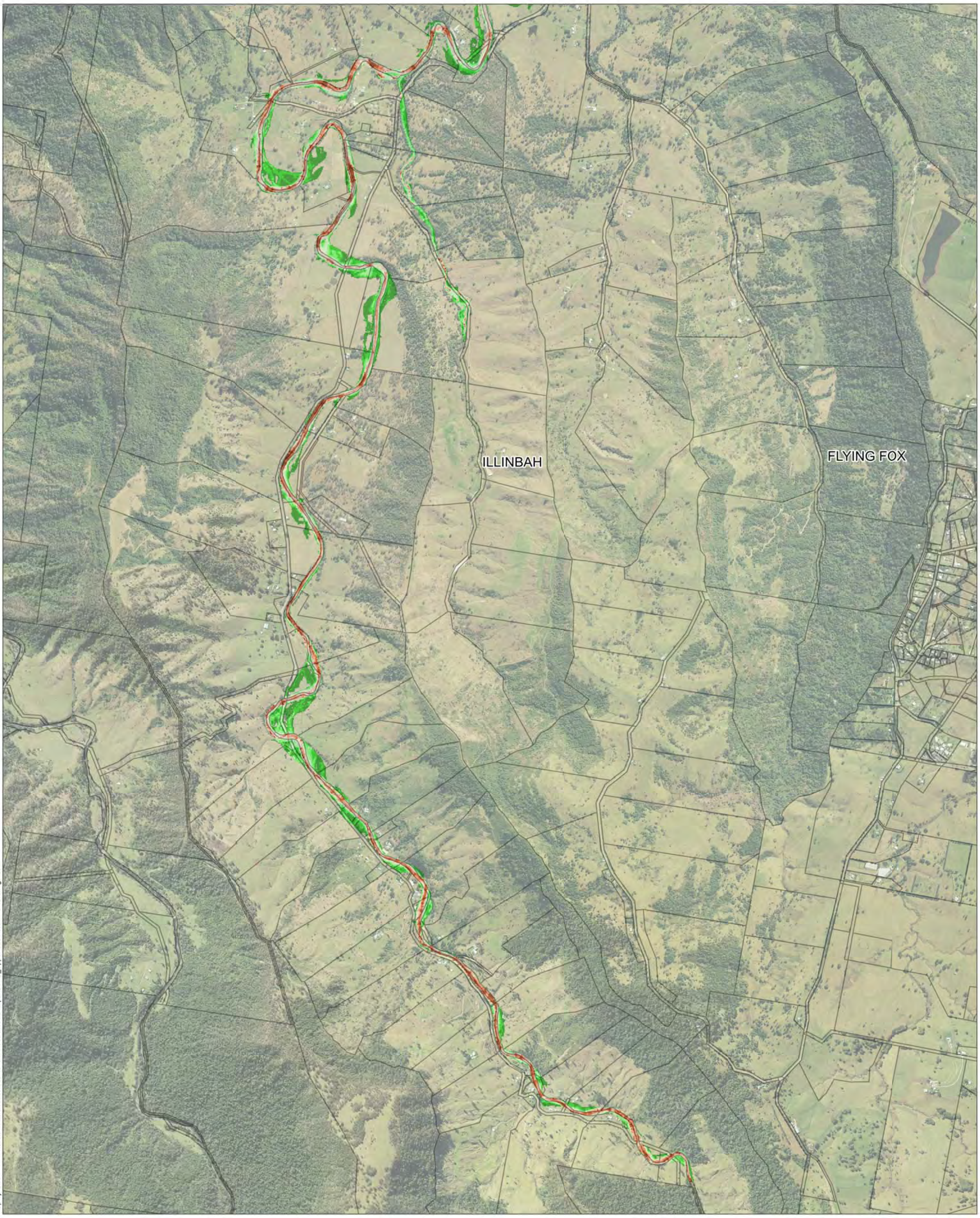
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D2**

5% AEP Event - Peak Velocities

aurecon



Legend

Velocity (m/s)

SRRC Boundary	0.0 to 0.5
Cadastral Boundary	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

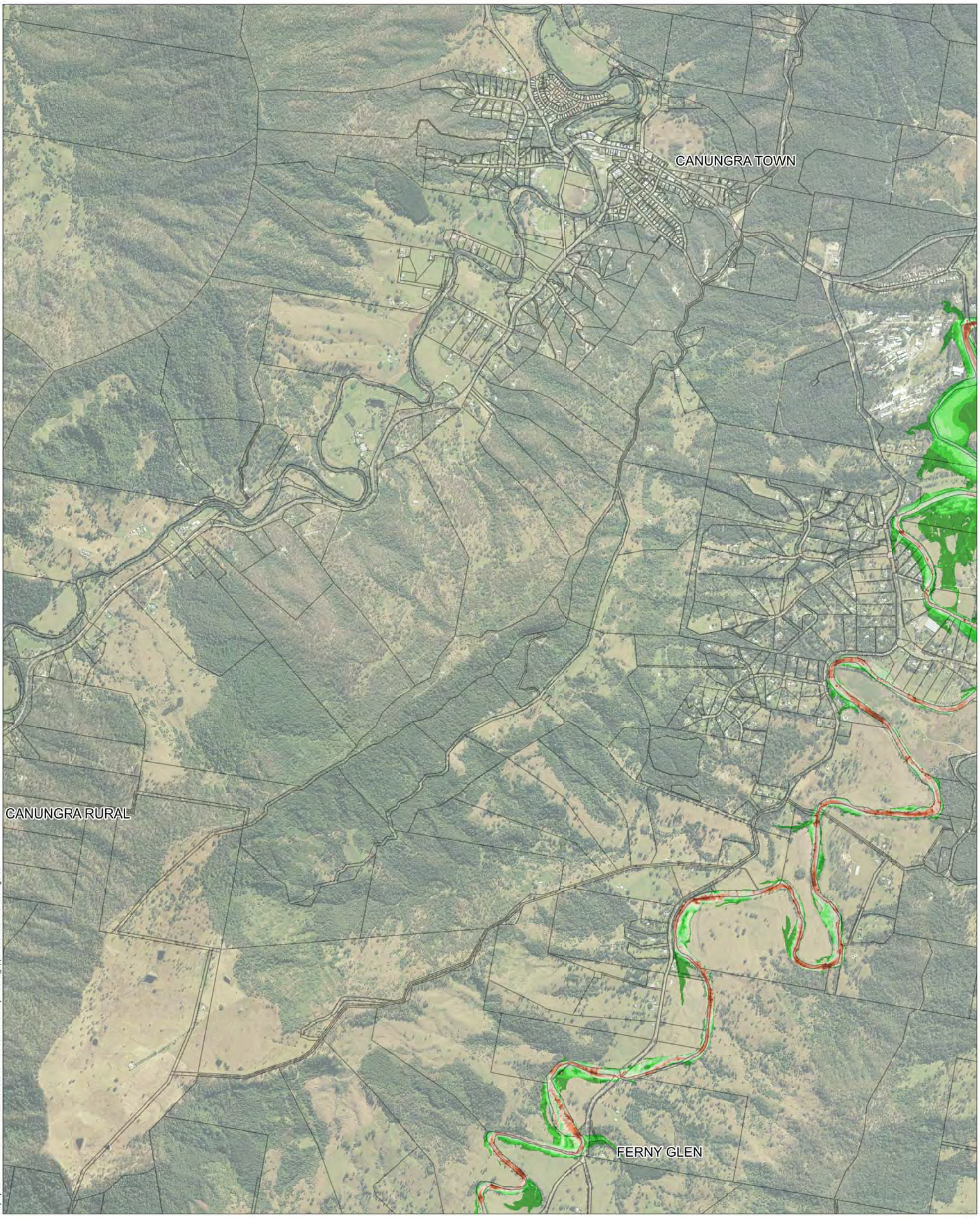
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D2-a**

5% AEP Event - Peak Velocities

aurecon



P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Map by: JDT

Legend

Velocity (m/s)

SRRC Boundary	0.0 to 0.5	3.0 to 3.5
Cadastral Boundary	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

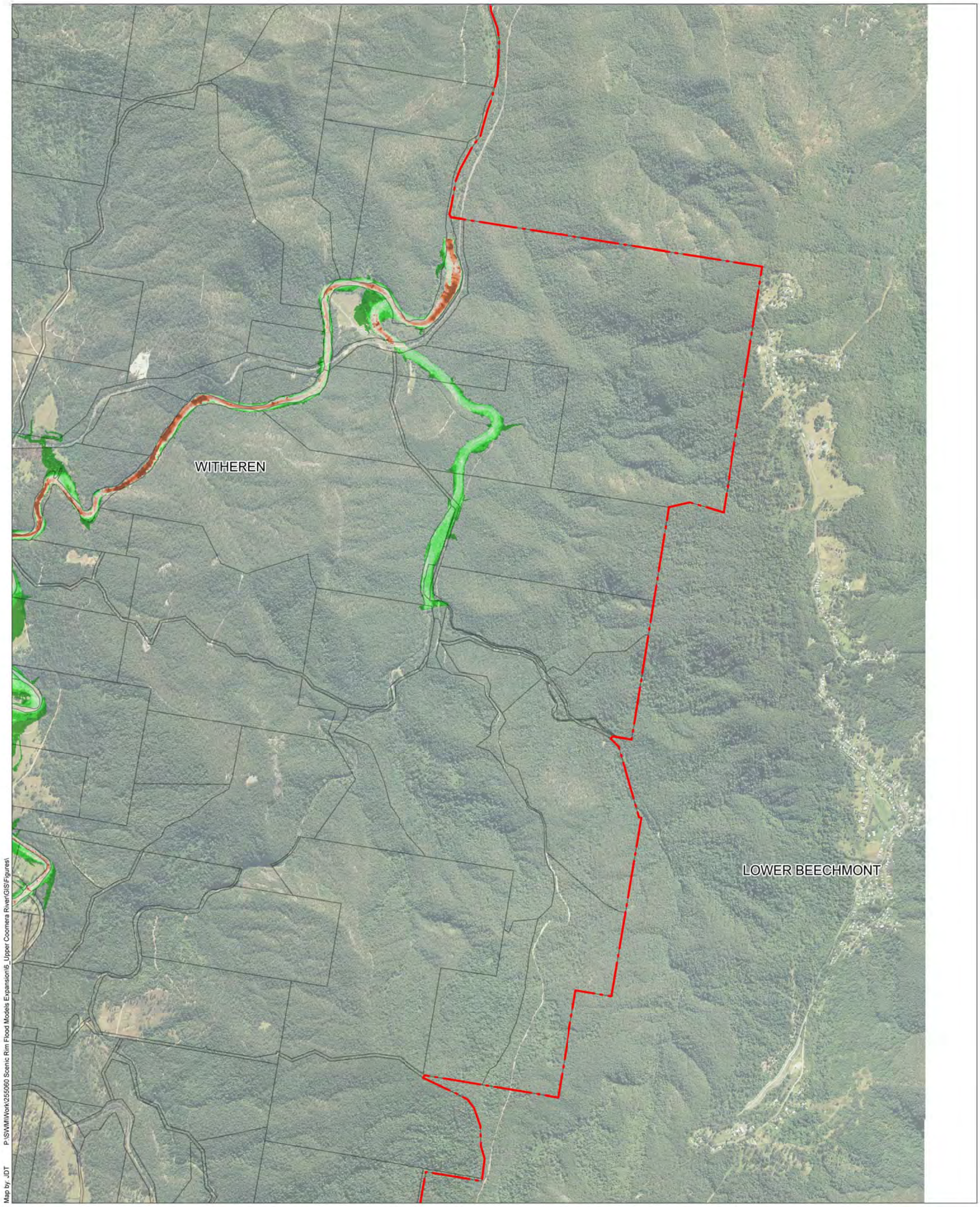
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D2-b**

5% AEP Event - Peak Velocities

aurecon



Legend

Velocity (m/s)

SRRC Boundary	0.0 to 0.5	3.0 to 3.5
Cadastral Boundary	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

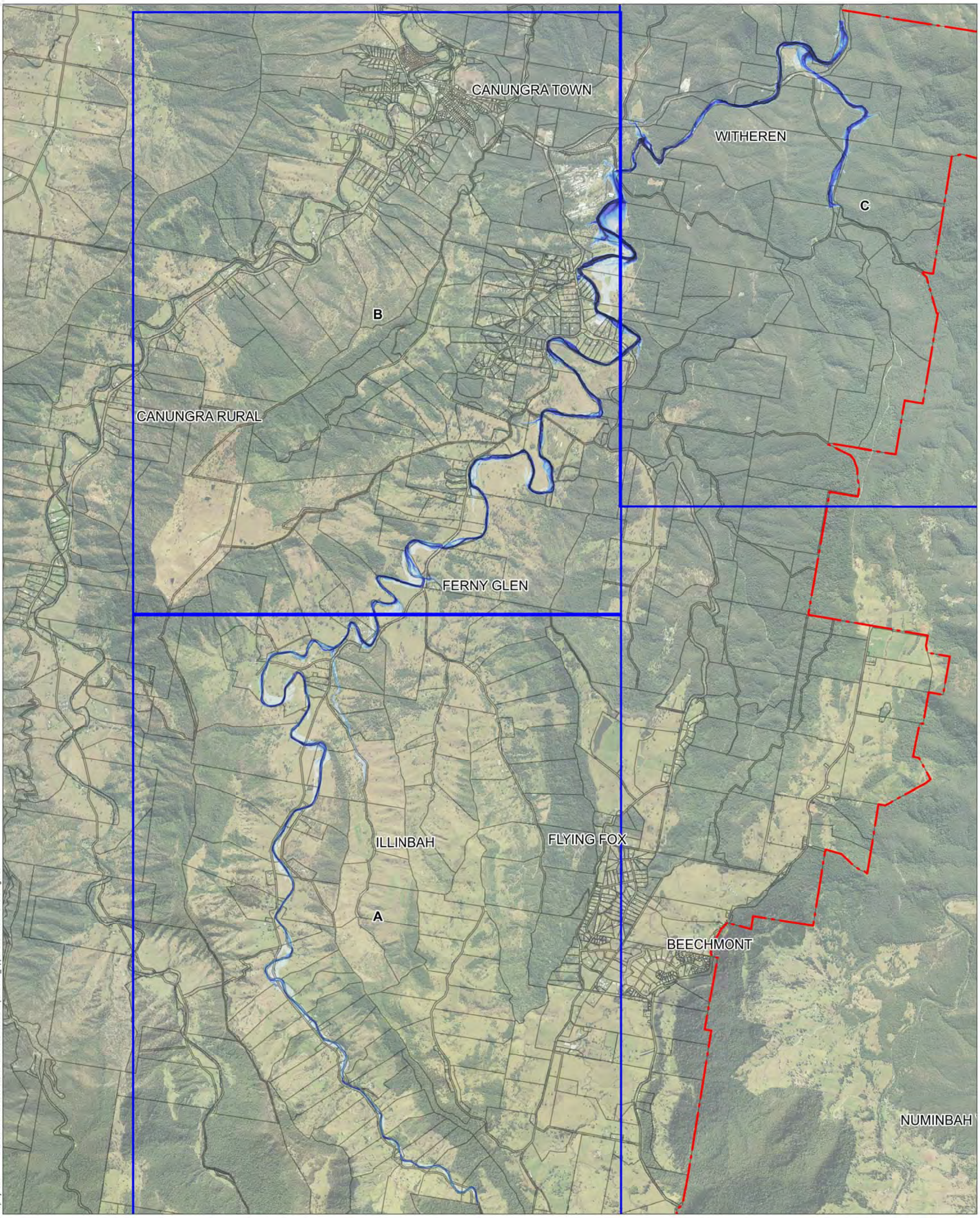
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D2-c**

5% AEP Event - Peak Velocities

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

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:

1:50,000

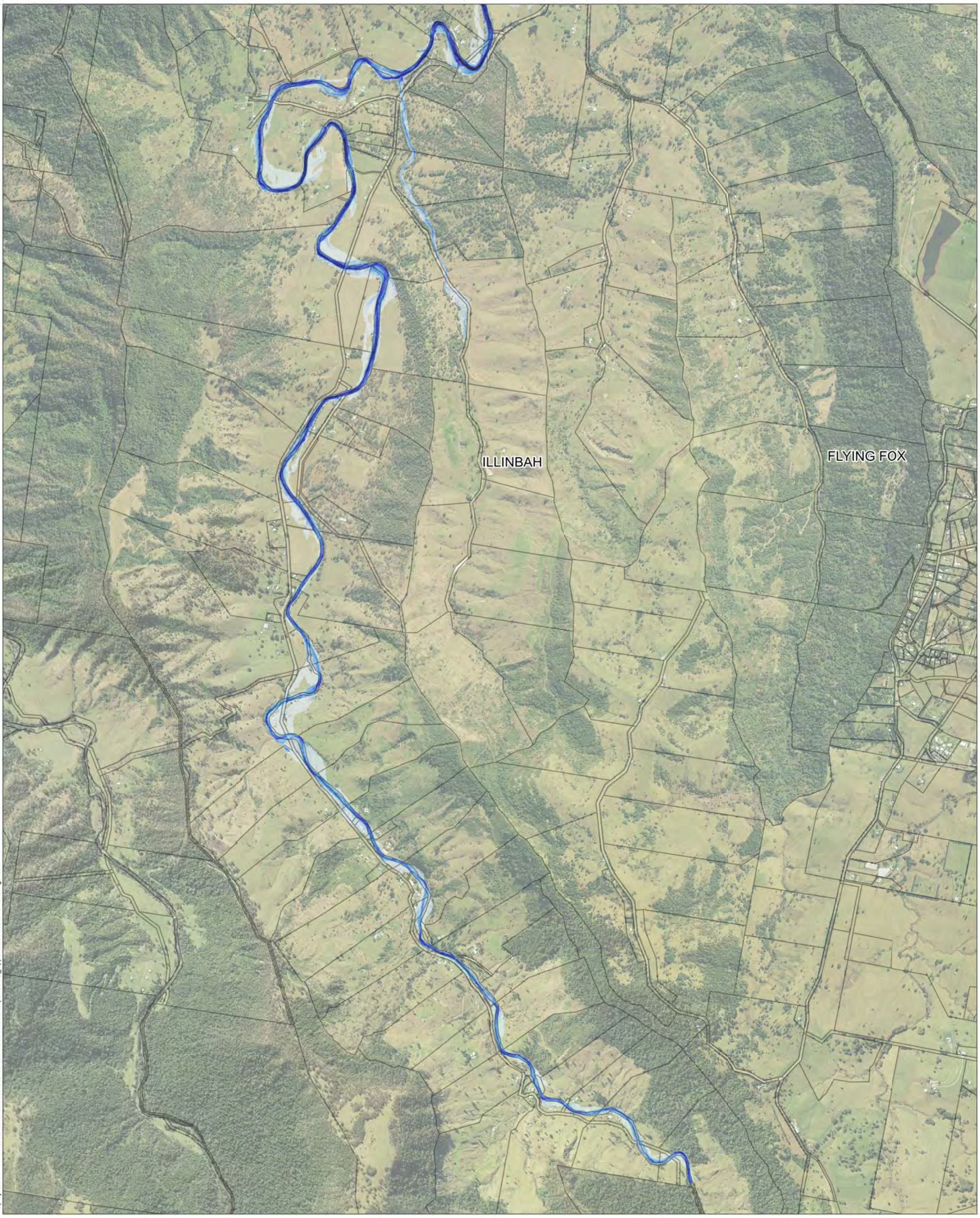
0   1,250 m   2,500 m

Date: 23/06/2017   Version: 0   Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D3**

5% AEP Event - Peak Depth Map



Legend

Depth (m)

- 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

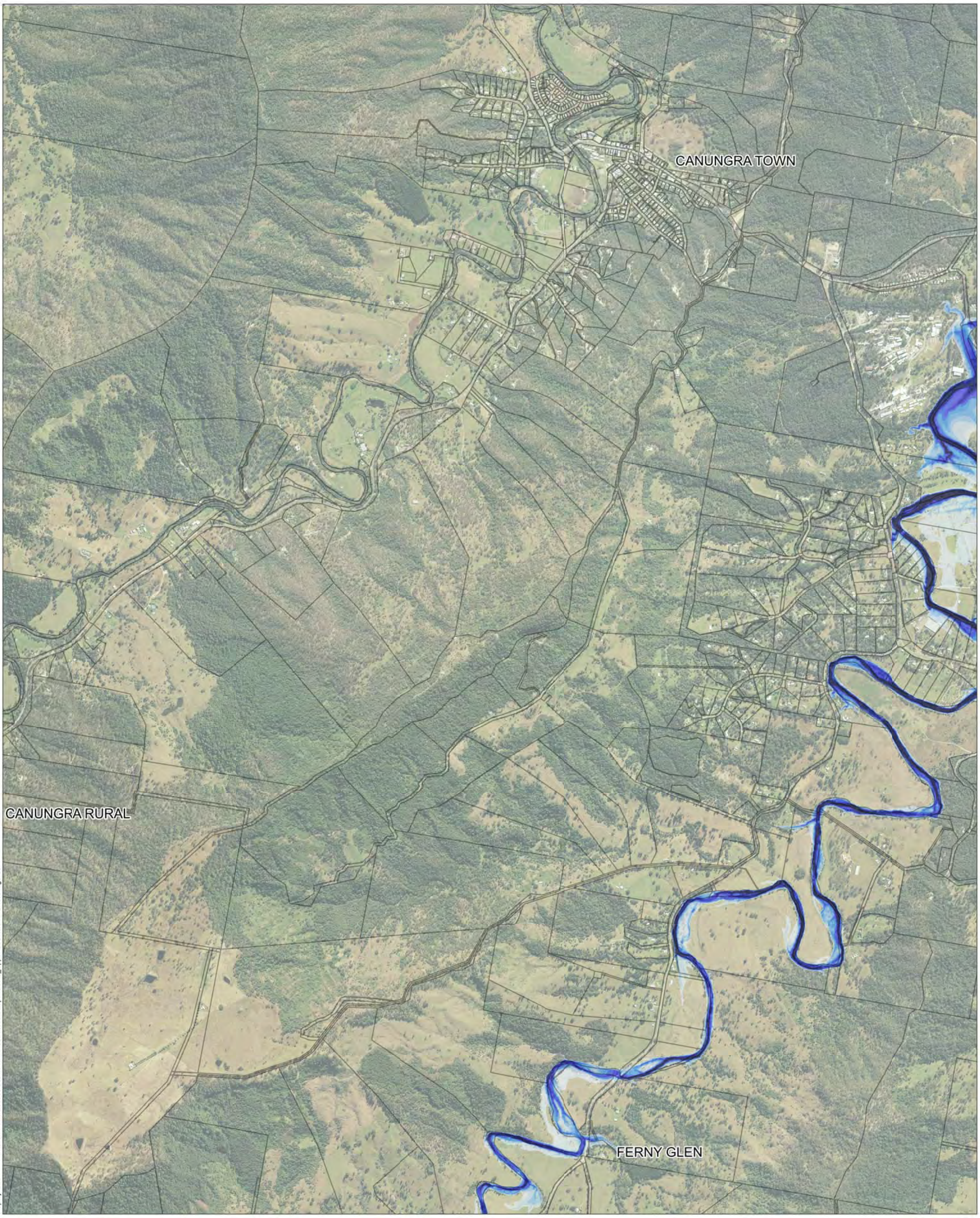
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D3-a**

5% AEP Event - Peak Depth Map

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

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: 23/06/2017   Version: 0   Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study   **Figure D3-b**

5% AEP Event - Peak Depth Map

aurecon

Map by: JDT P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

Notes:

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

1:25,000

0 625 m 1,250 m

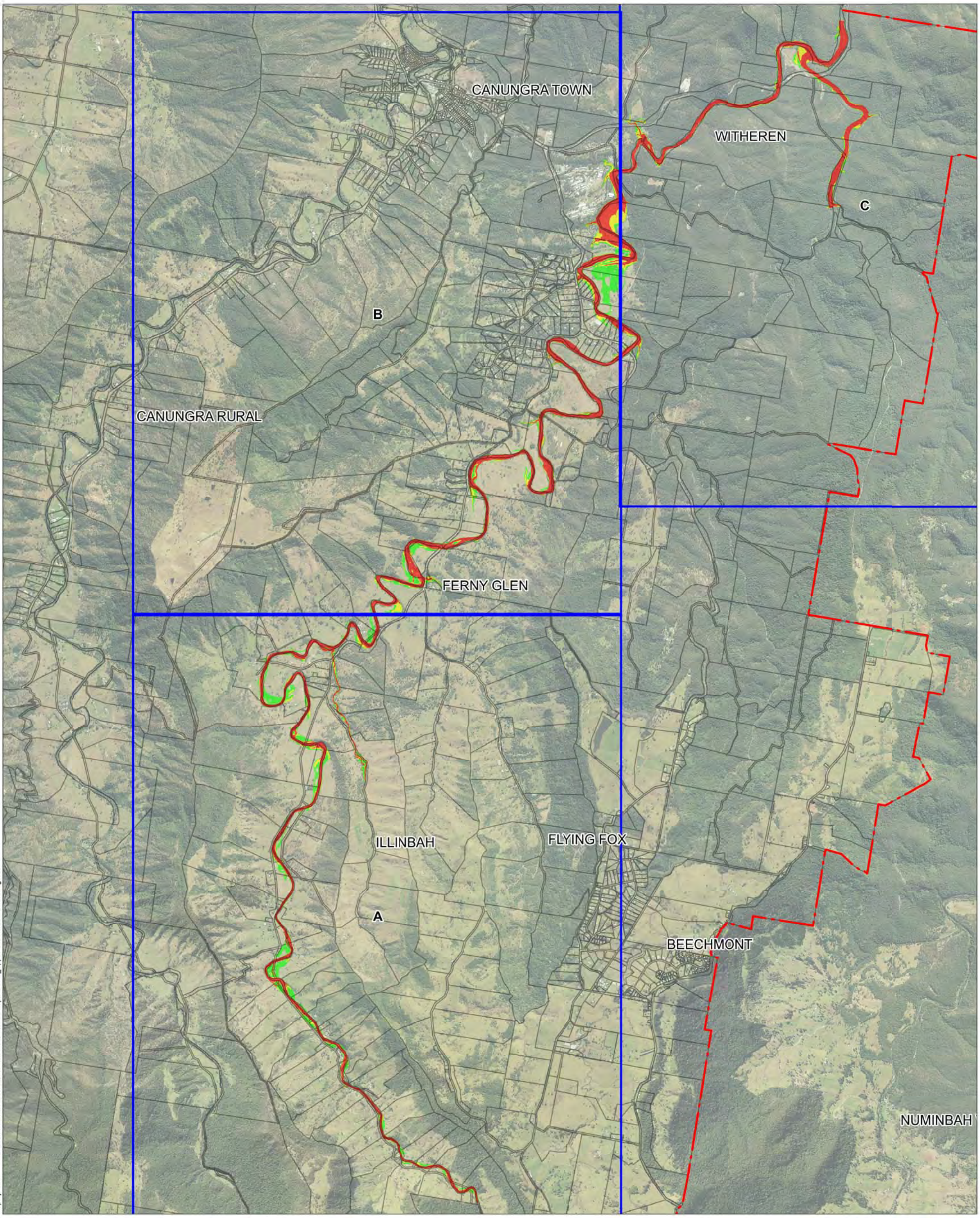
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D3-c**

5% AEP Event - Peak Depth Map

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

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

Notes:

1:50,000

0   1,250 m   2,500 m

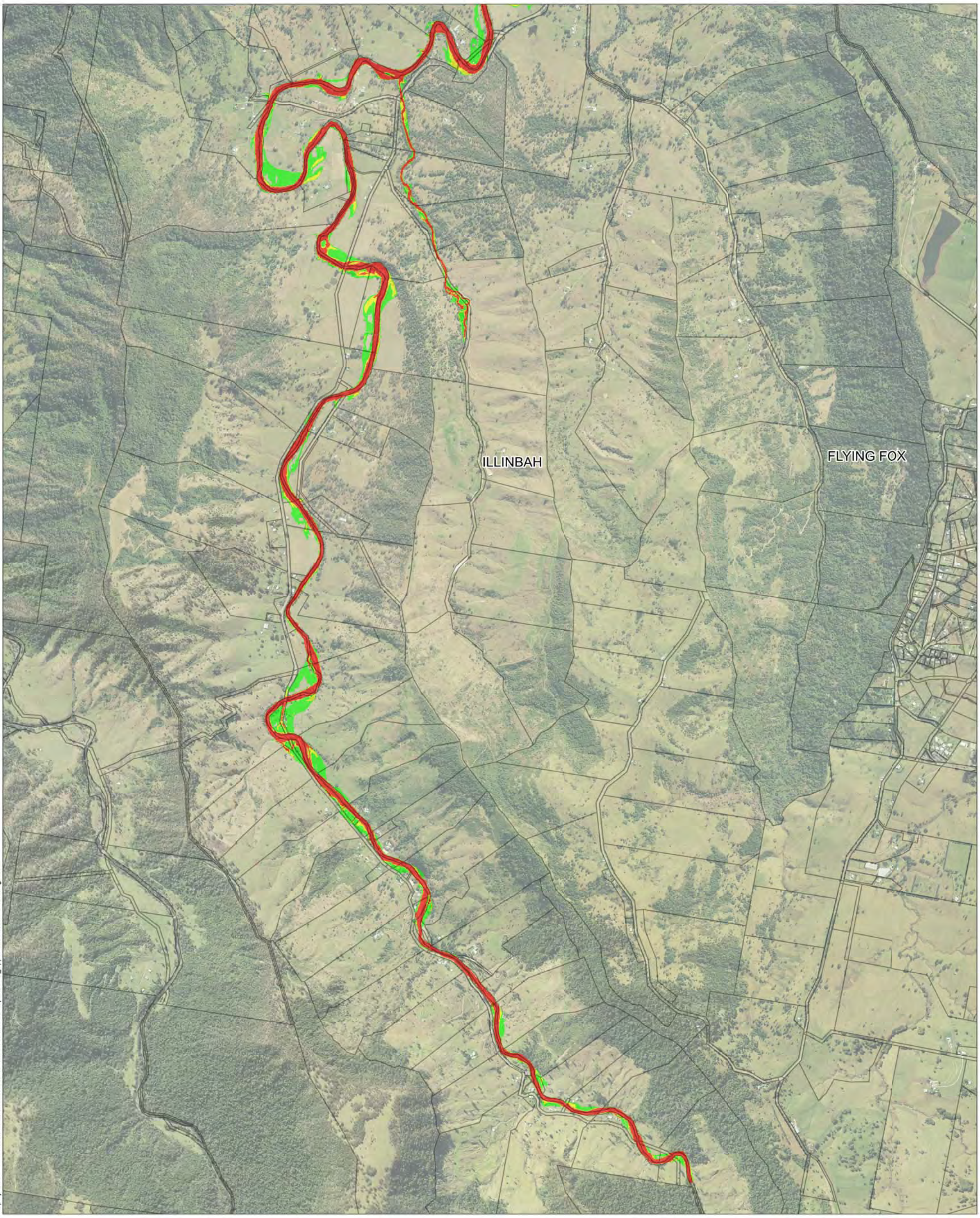
Date: 23/06/2017   Version: 0   Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study   **Figure D4**

5% AEP Event - Peak Hazard Map

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

SRRC

Cadastral

Low Hazard

Medium Hazard

High Hazard

Notes:

1:25,000

0   625 m   1,250 m

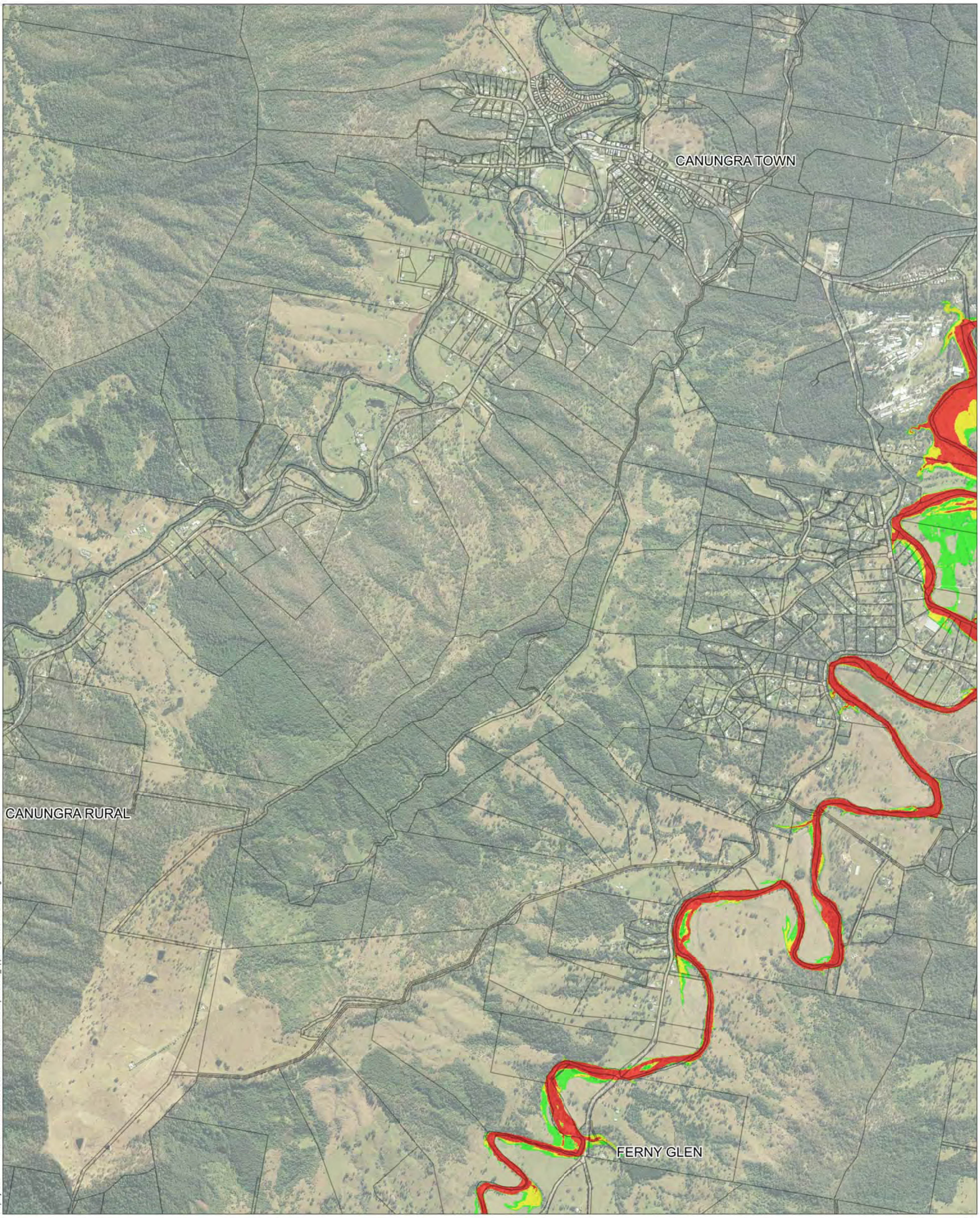
Date: 23/06/2017   Version: 0   Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study   **Figure D4-a**

5% AEP Event - 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: 23/06/2017 Version: 0 Job No: 255060

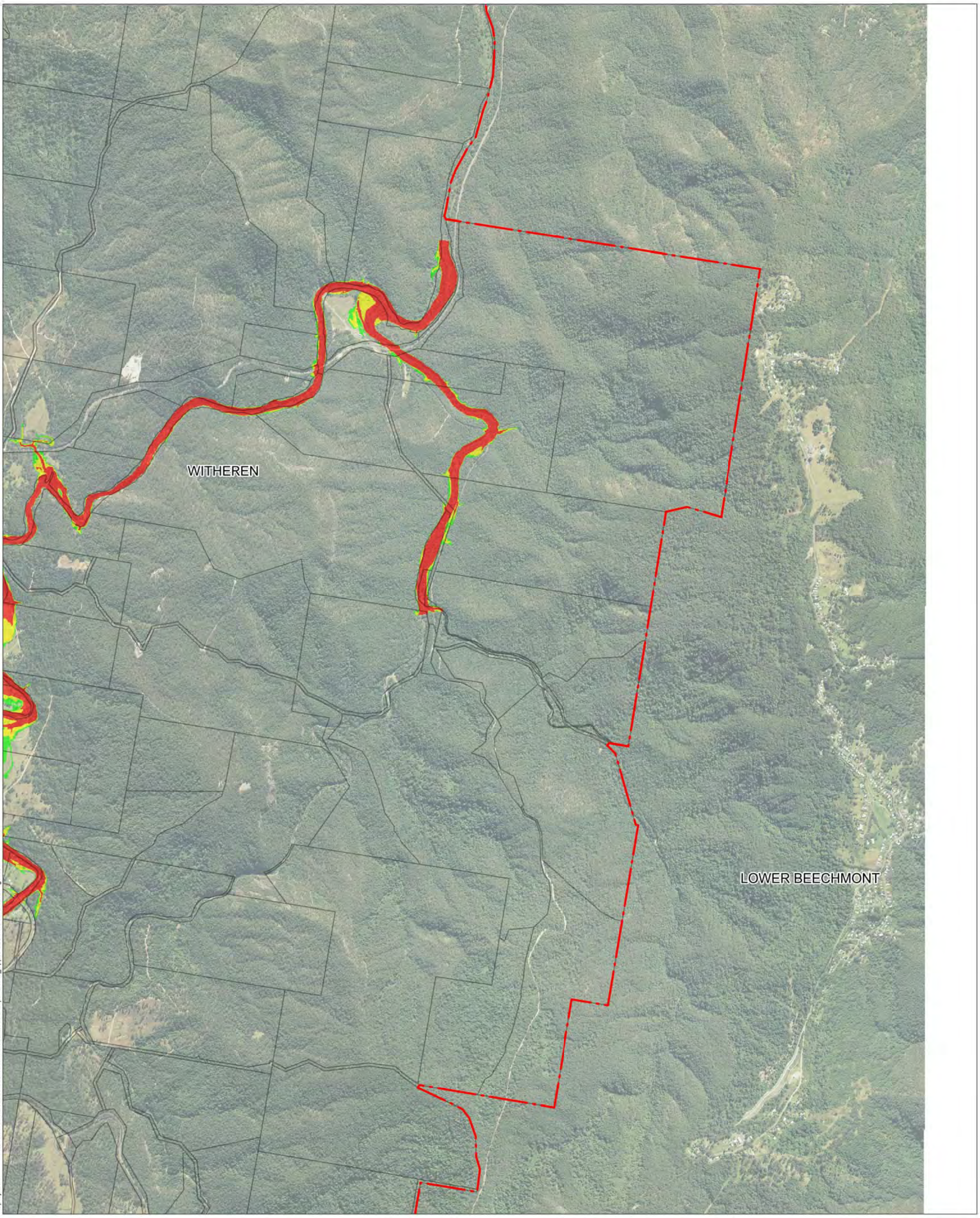
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D4-b**

5% AEP Event - Peak Hazard Map

Document Set ID: 10154456
Version: 1, Version Date: 21/12/2017

aurecon



Legend

SRRC Boundary
Cadastral Boundary
Low Hazard
Medium Hazard
High Hazard

Notes:

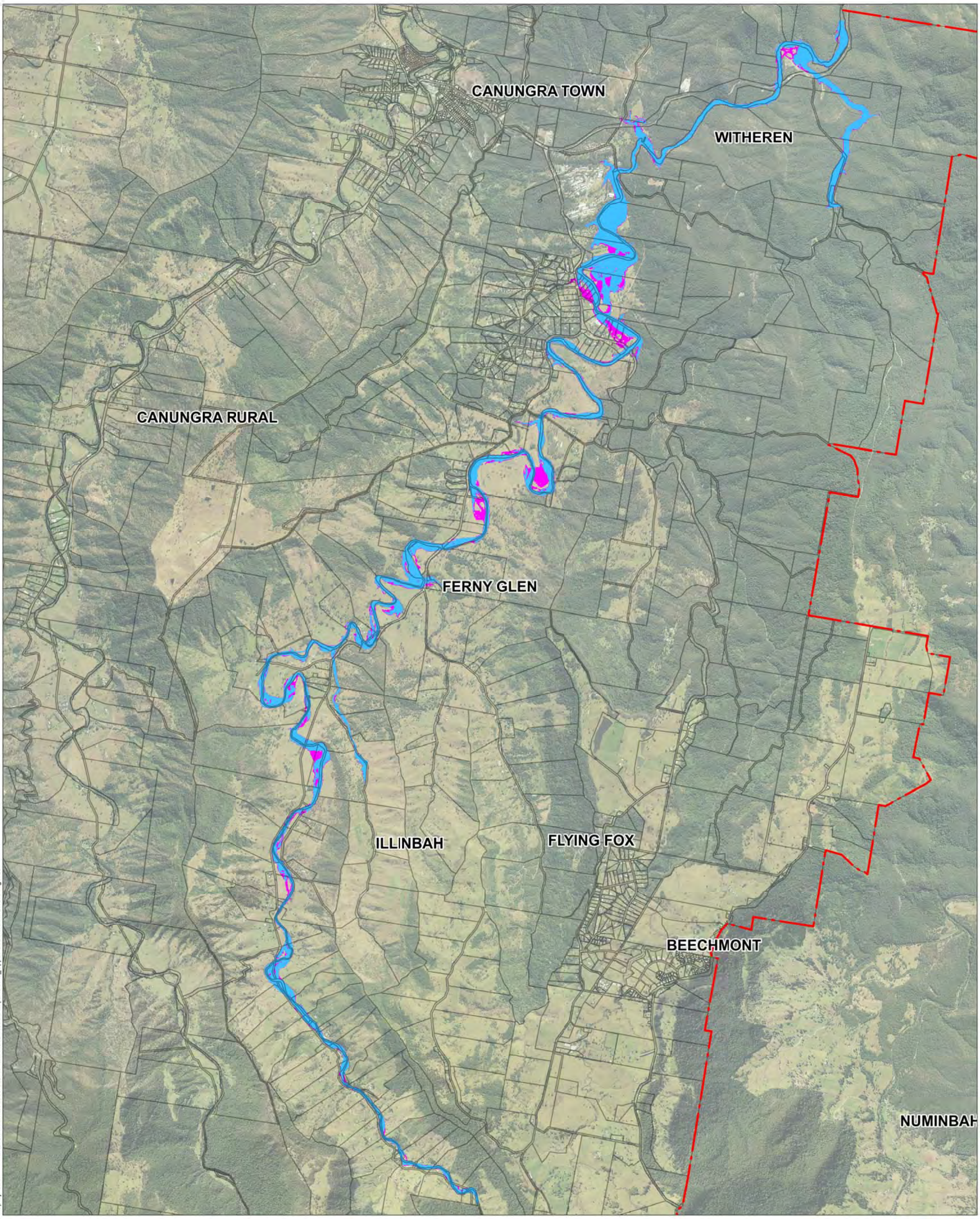
1:25,000
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study Figure D4-c

5% AEP Event - Peak Hazard Map

aurecon



Map by: JDT P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

SRRC Boundary
Cadastral Boundary

Existing Scenario Inundation Extents
Climate Change Scenario 4.5 Inundation Extent

Notes:

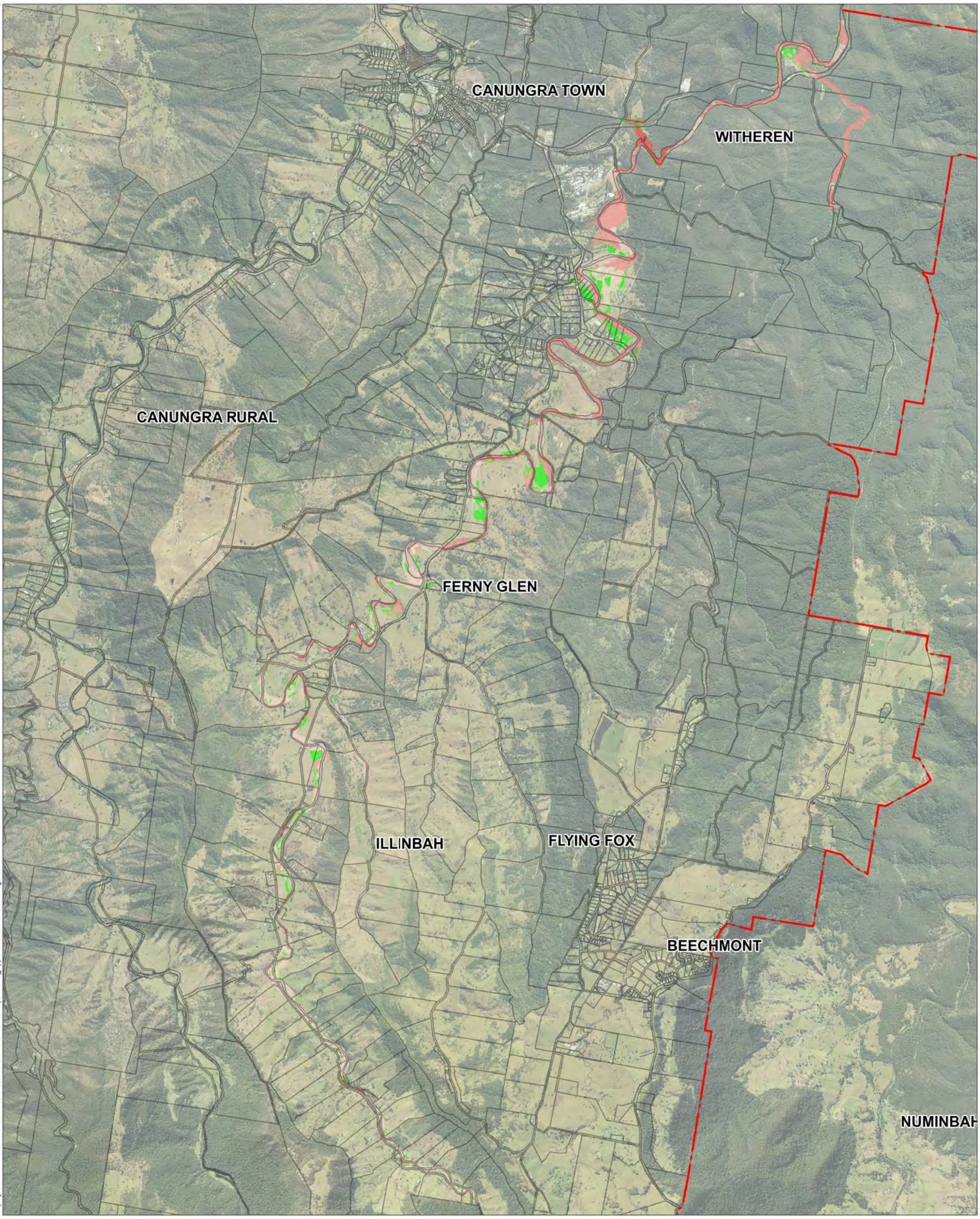
1:50,000
0 1,250 m 2,500 m

Date: 25/05/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure D5-a**

Climate Change Scenario 4.5 - 5% AEP Event Inundation Extent

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Afflux (m)

- < -0.80
- -0.80 to -0.60
- -0.60 to -0.40
- -0.40 to -0.20
- -0.20 to -0.03
- -0.03 to 0.03
- 0.03 to 0.20
- 0.20 to 0.40
- 0.40 to 0.60
- 0.60 to 0.80
- 0.80 to 1.20
- > 1.20
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

1:50,000

0 1,250 m 2,500 m

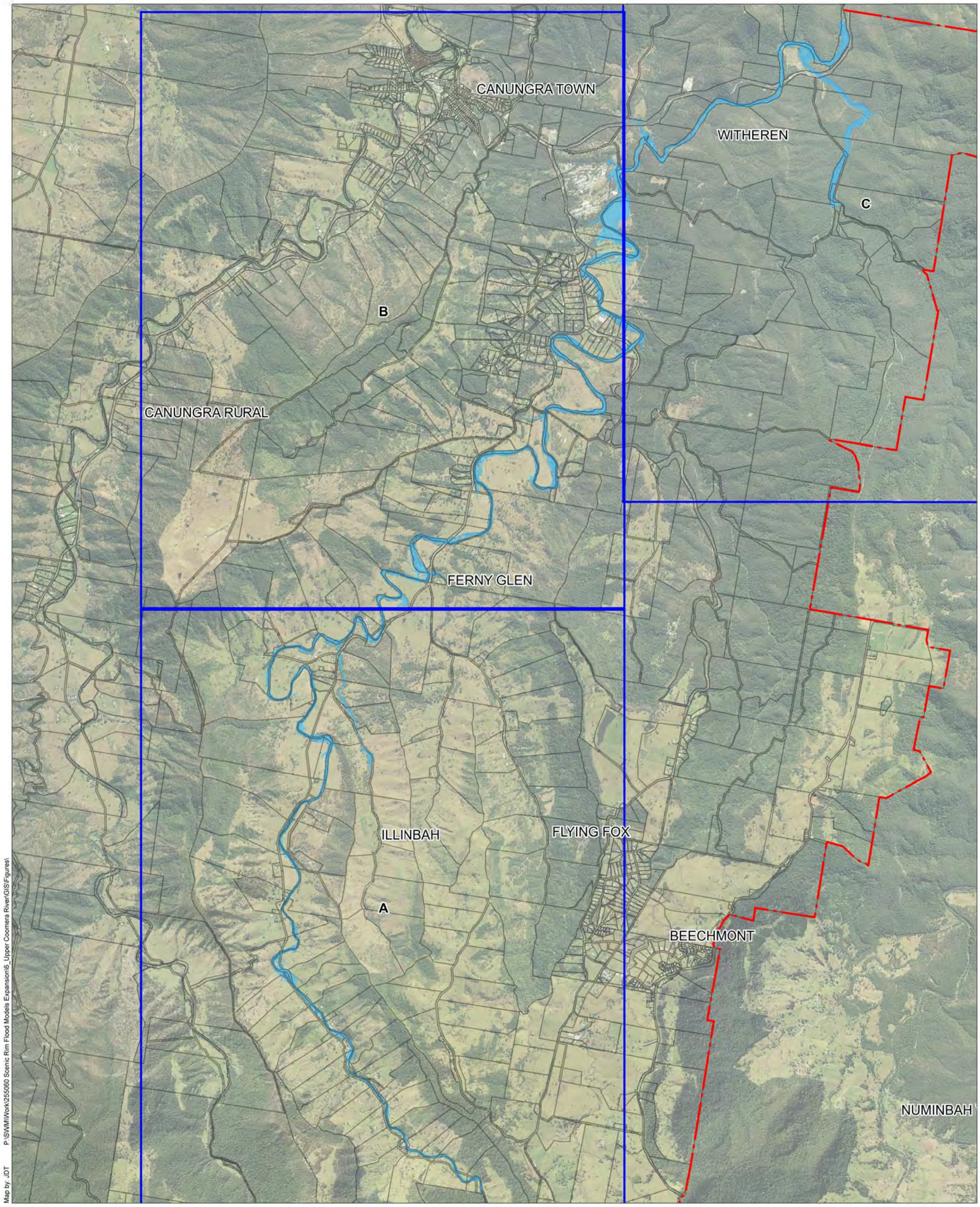
Date: 25/05/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study

Figure D5-b

Climate Change Scenario 4.5 - 5% AEP Event Afflux Map



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:50,000

0 1,250 m 2,500 m

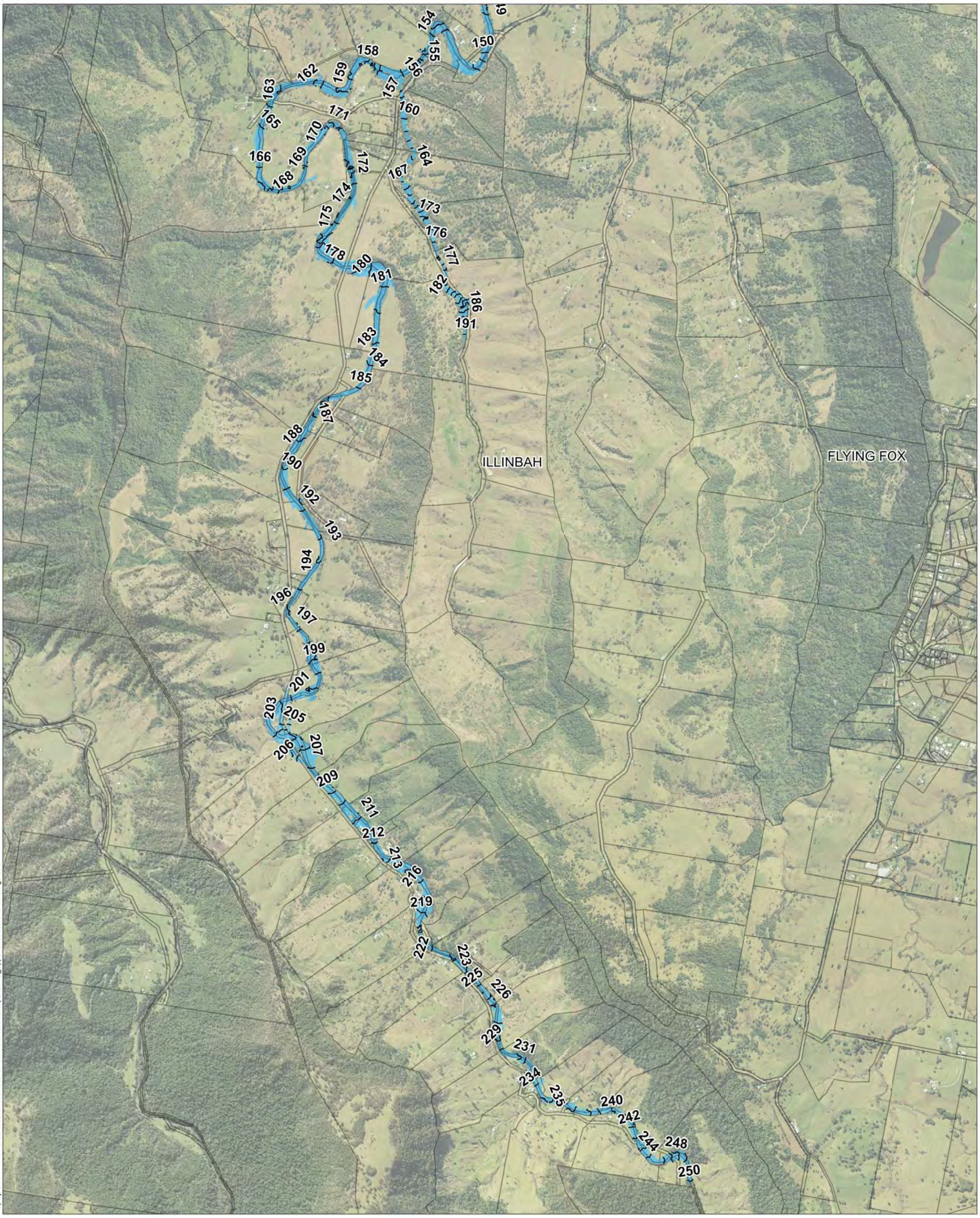
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E1**

10% AEP Event - Inundation Extent

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

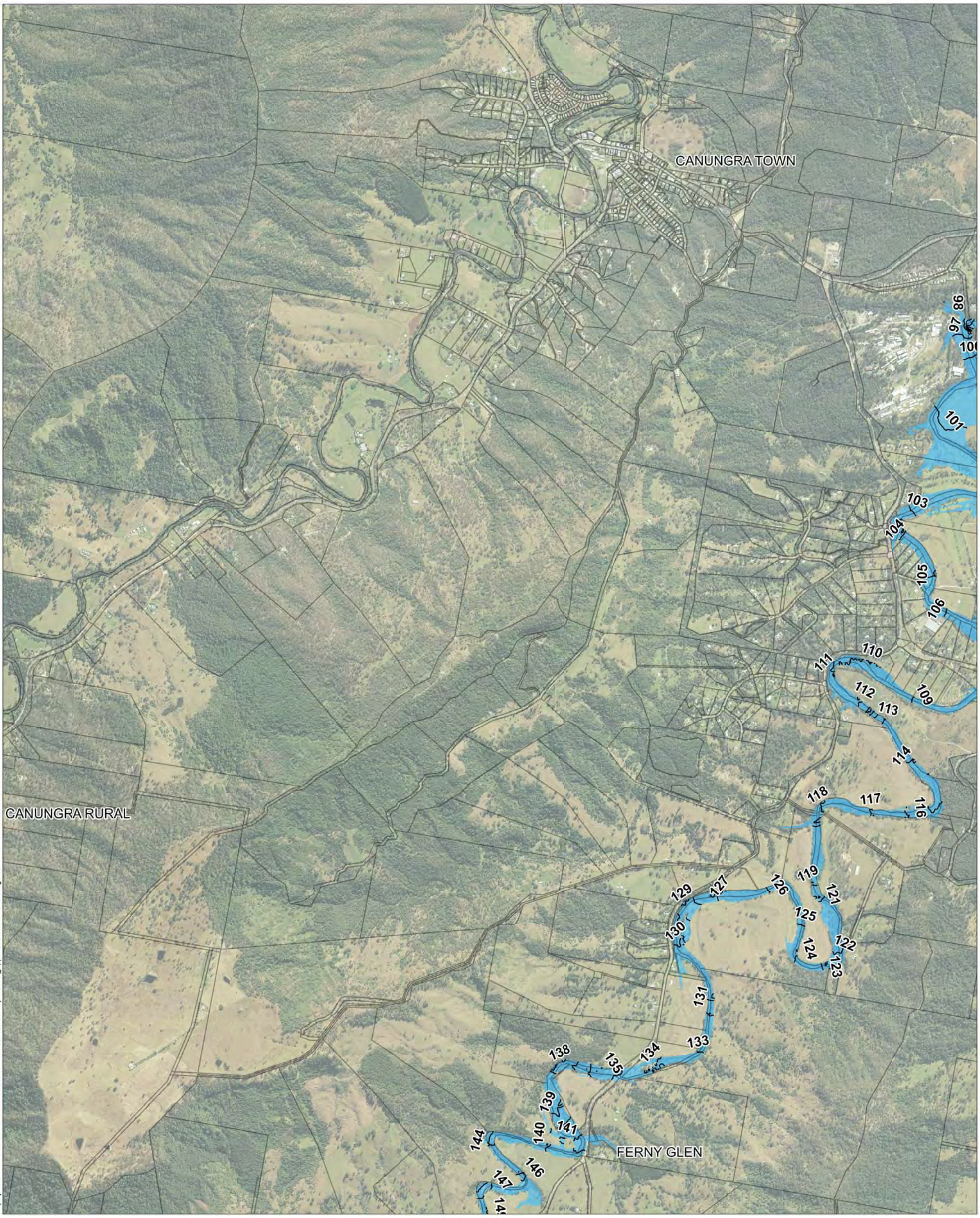
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E1-a**

10% 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

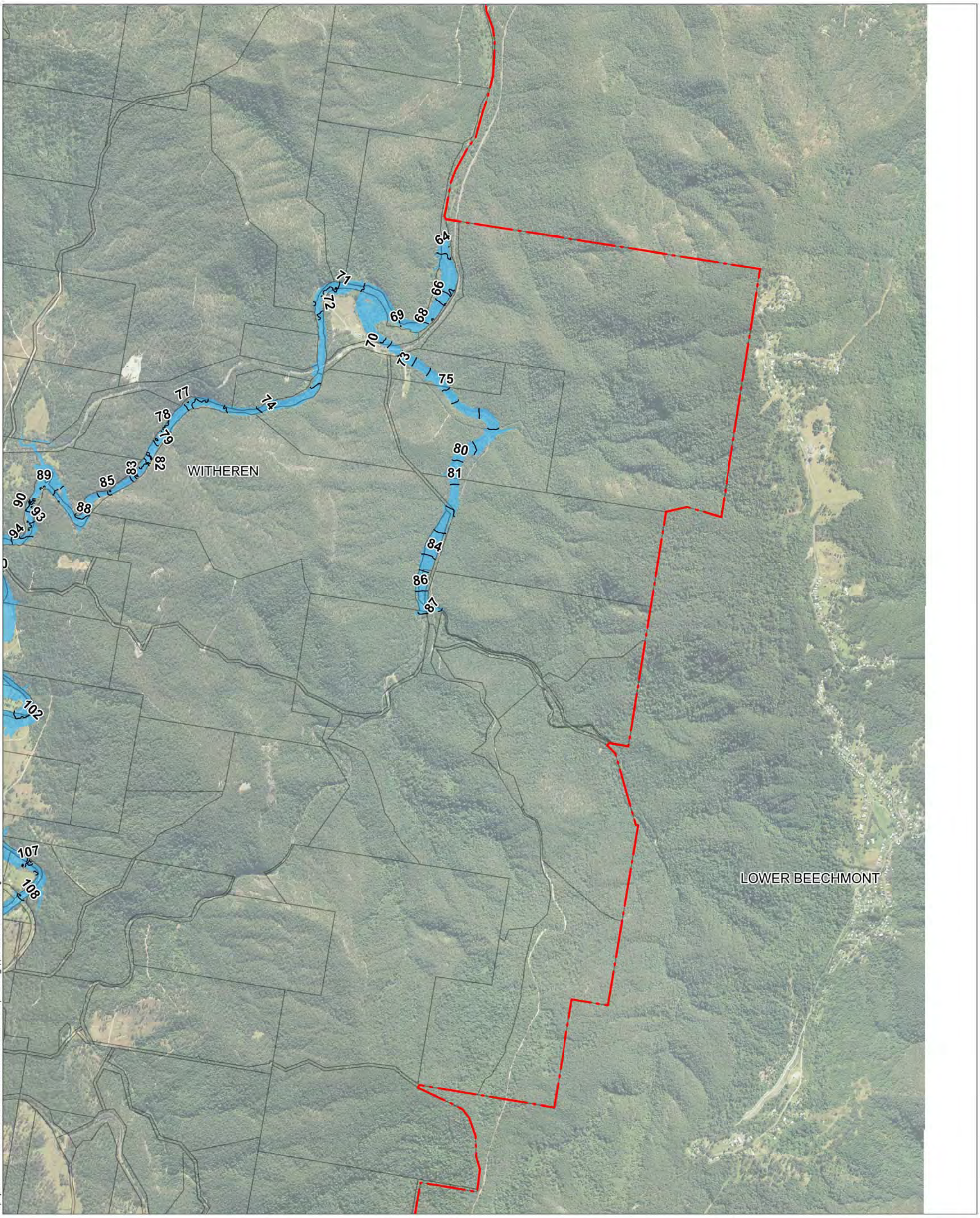
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E1-b**

10% AEP Event - Inundation Extent

aurecon



Legend

SRRC Boundary

Cadastral Boundary

Inundation Extent

Peak Water level Contour (mAHD)

Notes:

1:25,000

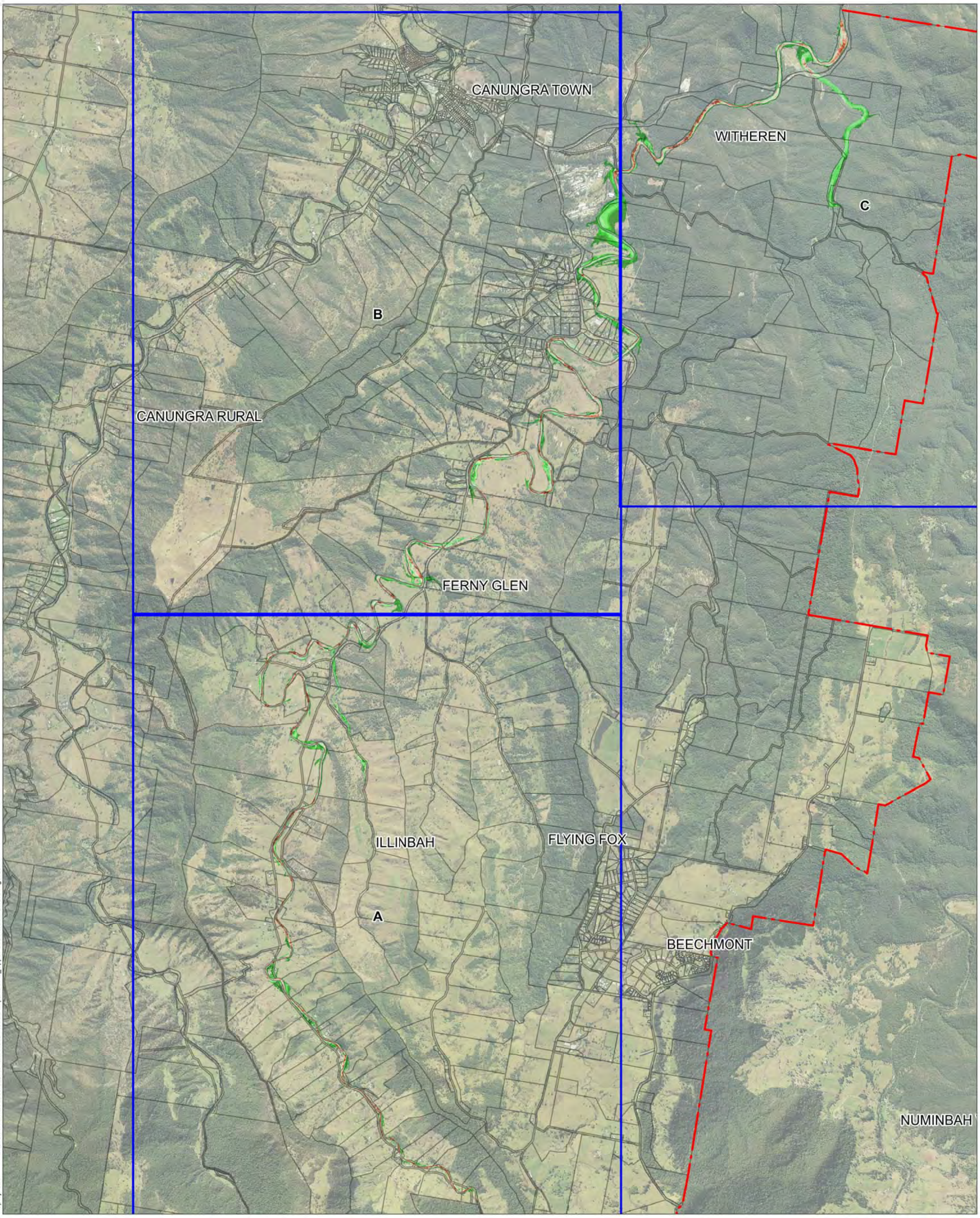
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E1-c**

10% AEP Event - Inundation Extent



Legend

Velocity (m/s)

SRRC Boundary	0.0 to 0.5	3.0 to 3.5	
Cadastral Boundary	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:

1:50,000

0 | 1,250 m | 2,500 m

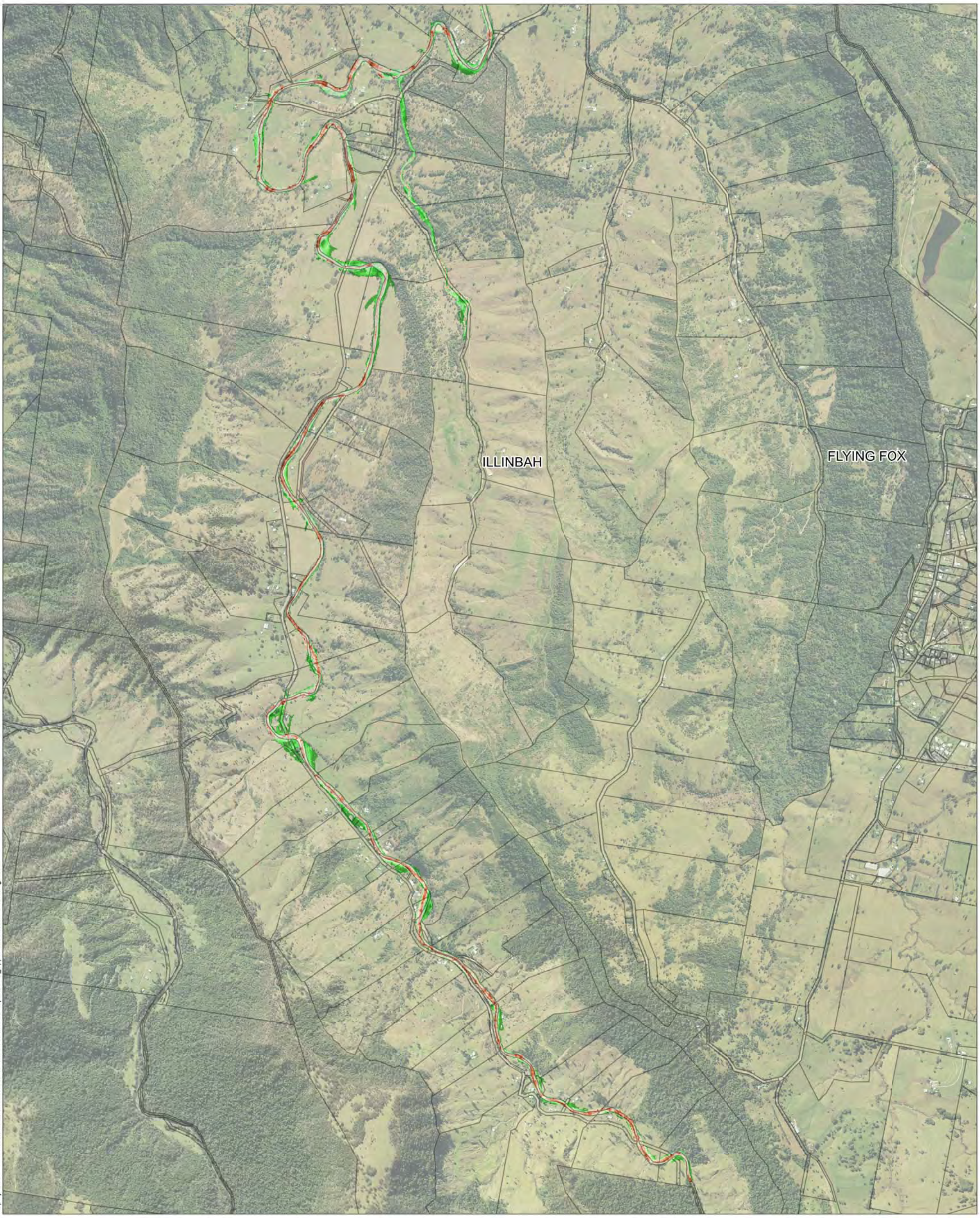
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E2**

10% AEP Event - Peak Velocities

aurecon



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

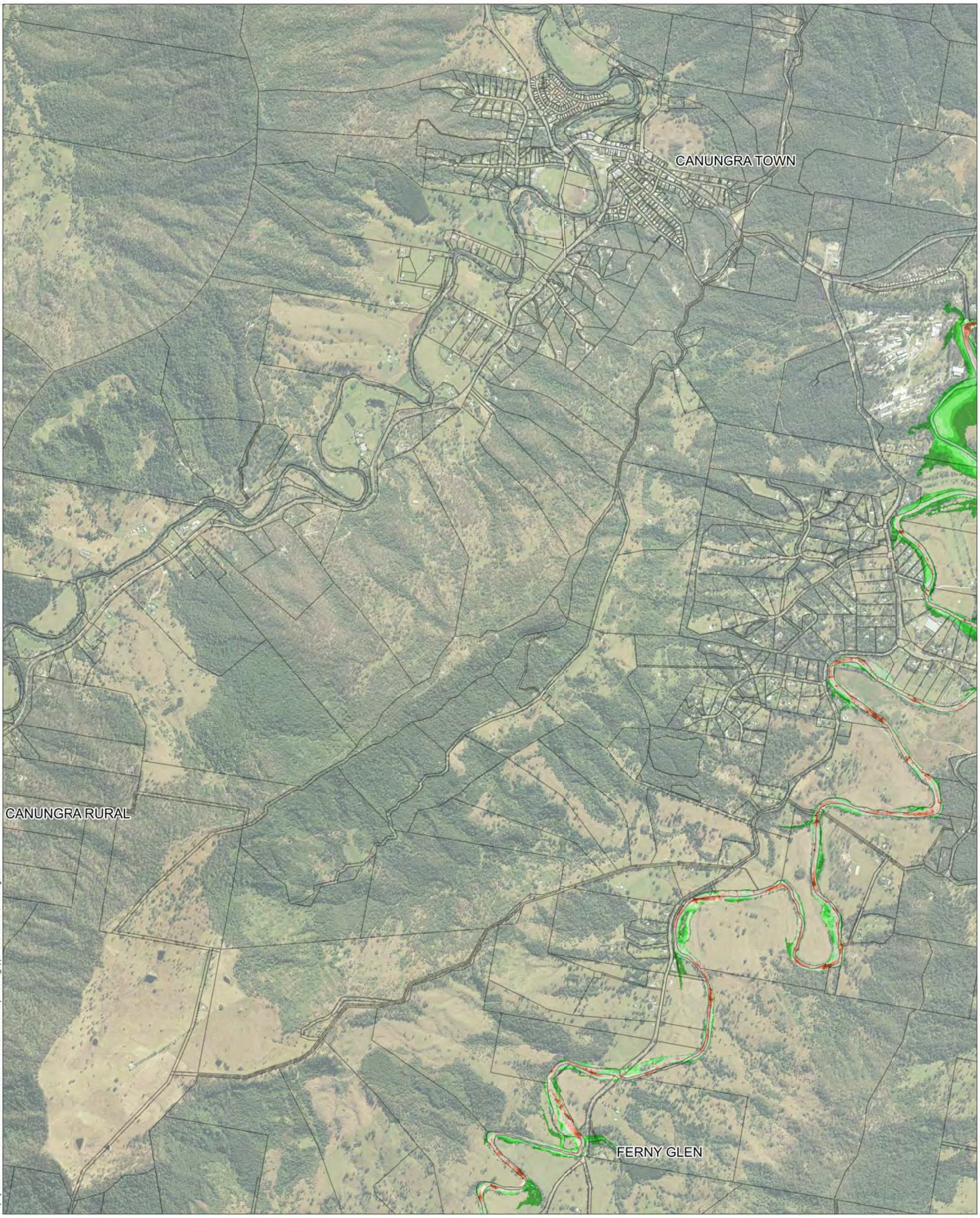
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E2-a**

10% AEP Event - Peak Velocities

aurecon



Map by: JDT P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

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

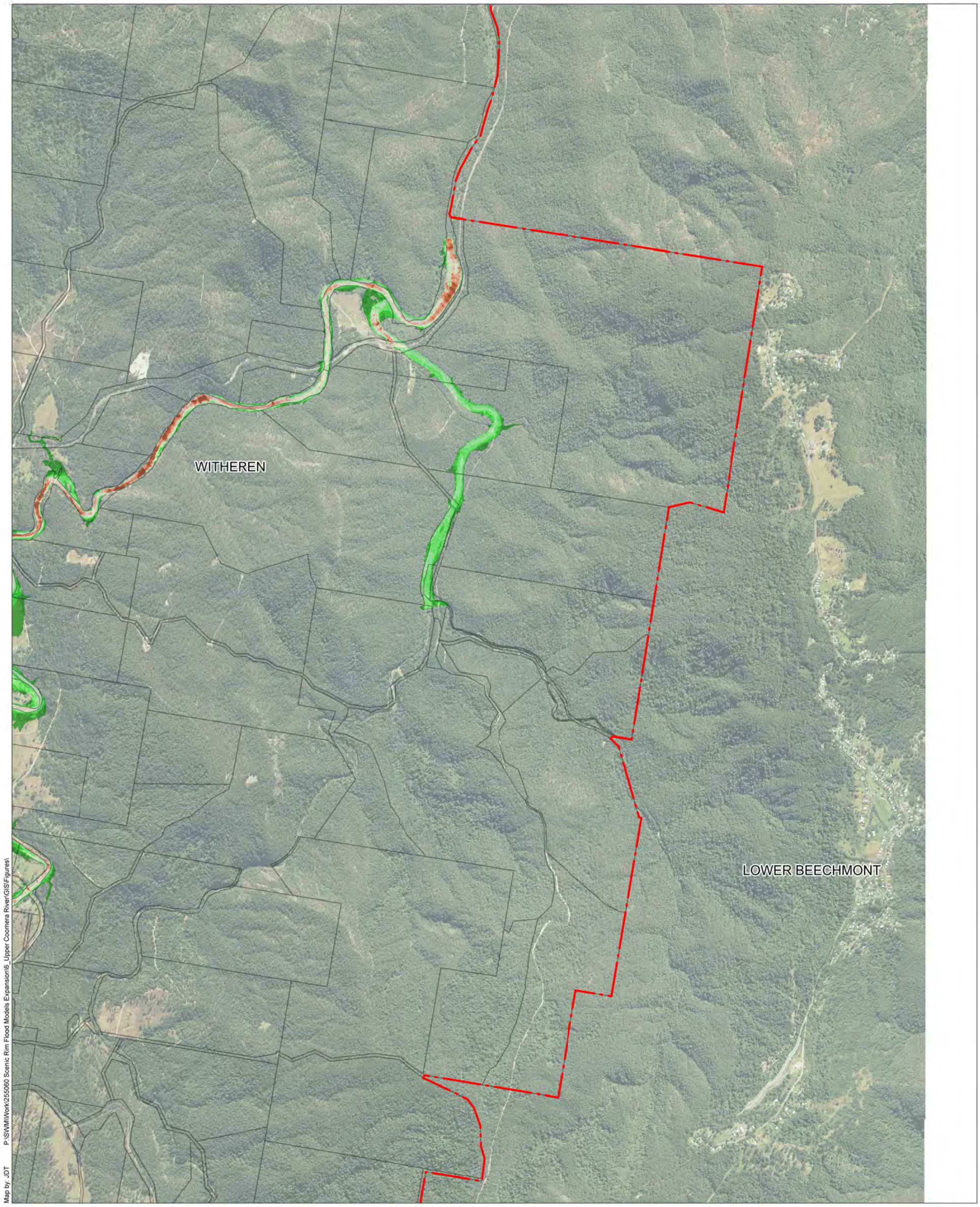
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E2-b**

10% AEP Event - Peak Velocities

aurecon



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

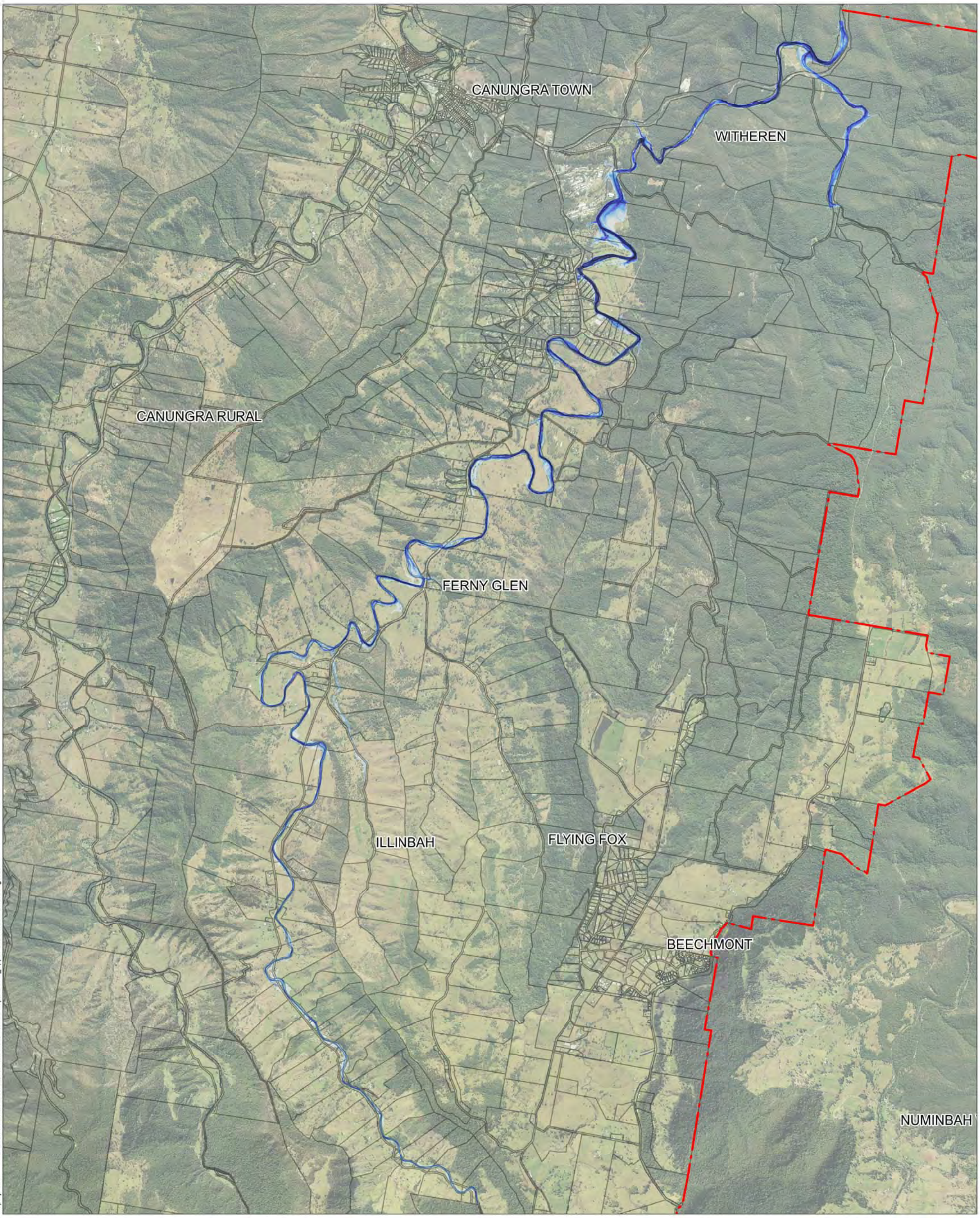
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E2-c**

10% AEP Event - Peak Velocities

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

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:

1:50,000

0   1,250 m   2,500 m

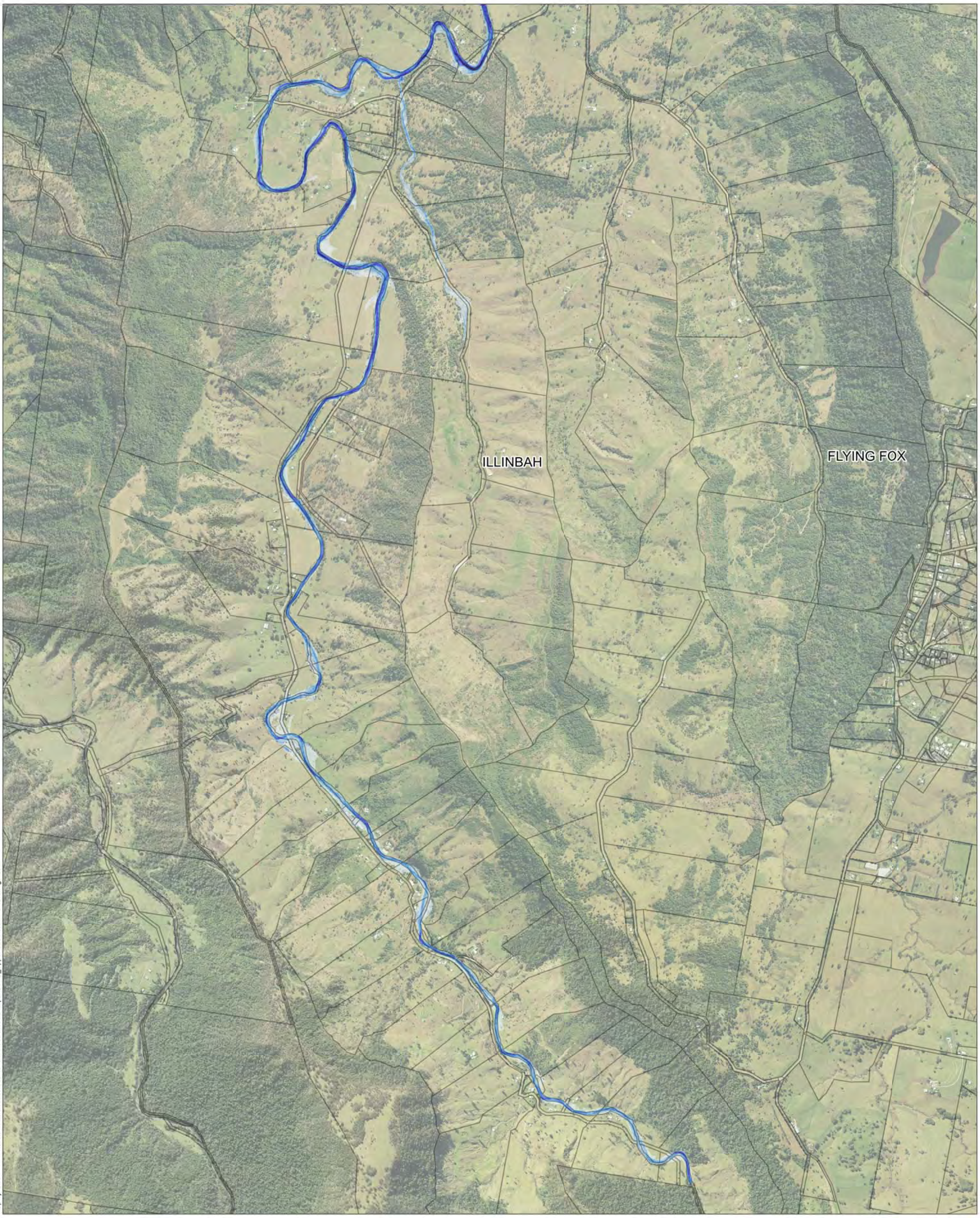
Date: 23/06/2017   Version: 0   Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study   **Figure E3**

10% AEP Event - Peak Depth Map

aurecon



Legend

Depth (m)

SRRC Boundary	0.0 to 0.5	3.0 to 3.5
Cadastral Boundary	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:

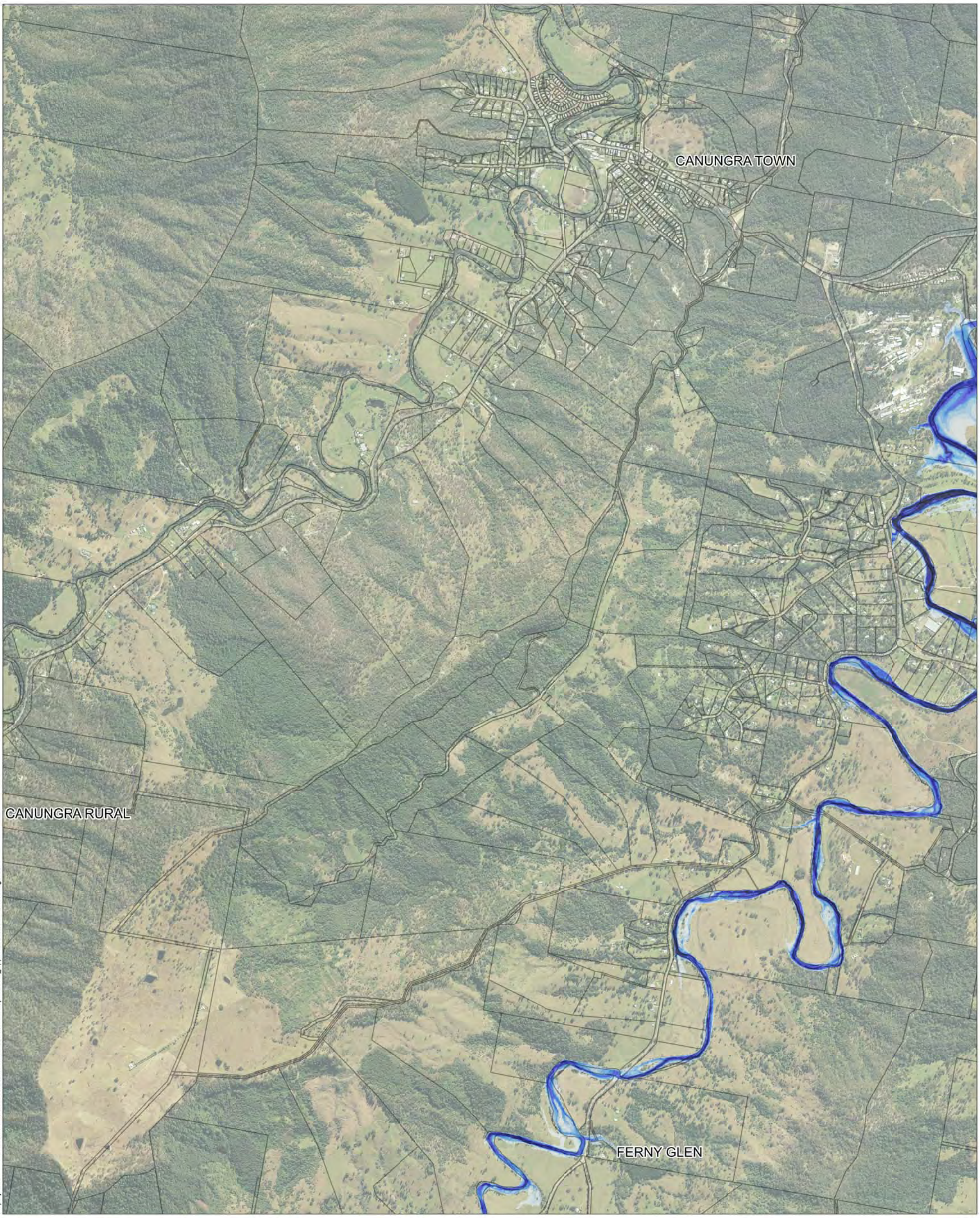
1:25,000
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E3-a**

10% AEP Event - Peak Depth Map

aurecon



Legend

SRRC Boundary	Depth (m)	
Cadastral Boundary	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: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E3-b**

10% 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

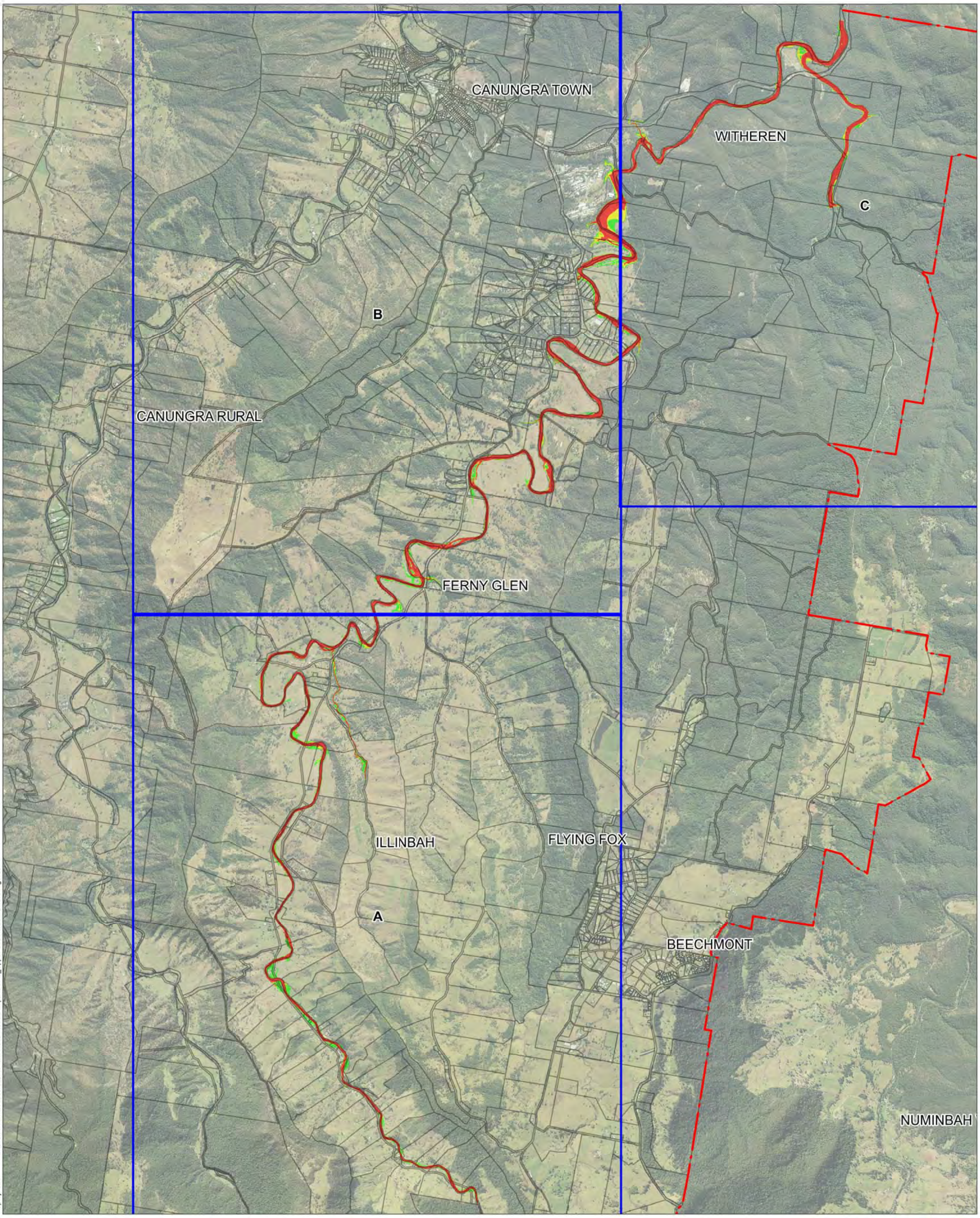
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E3-c**

10% AEP Event - Peak Depth Map

aurecon



Map by: JDT

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Legend

SRRC Boundary

Cadastral Boundary

Low Hazard

Medium Hazard

High Hazard

Notes:

1:50,000

0 1,250 m 2,500 m

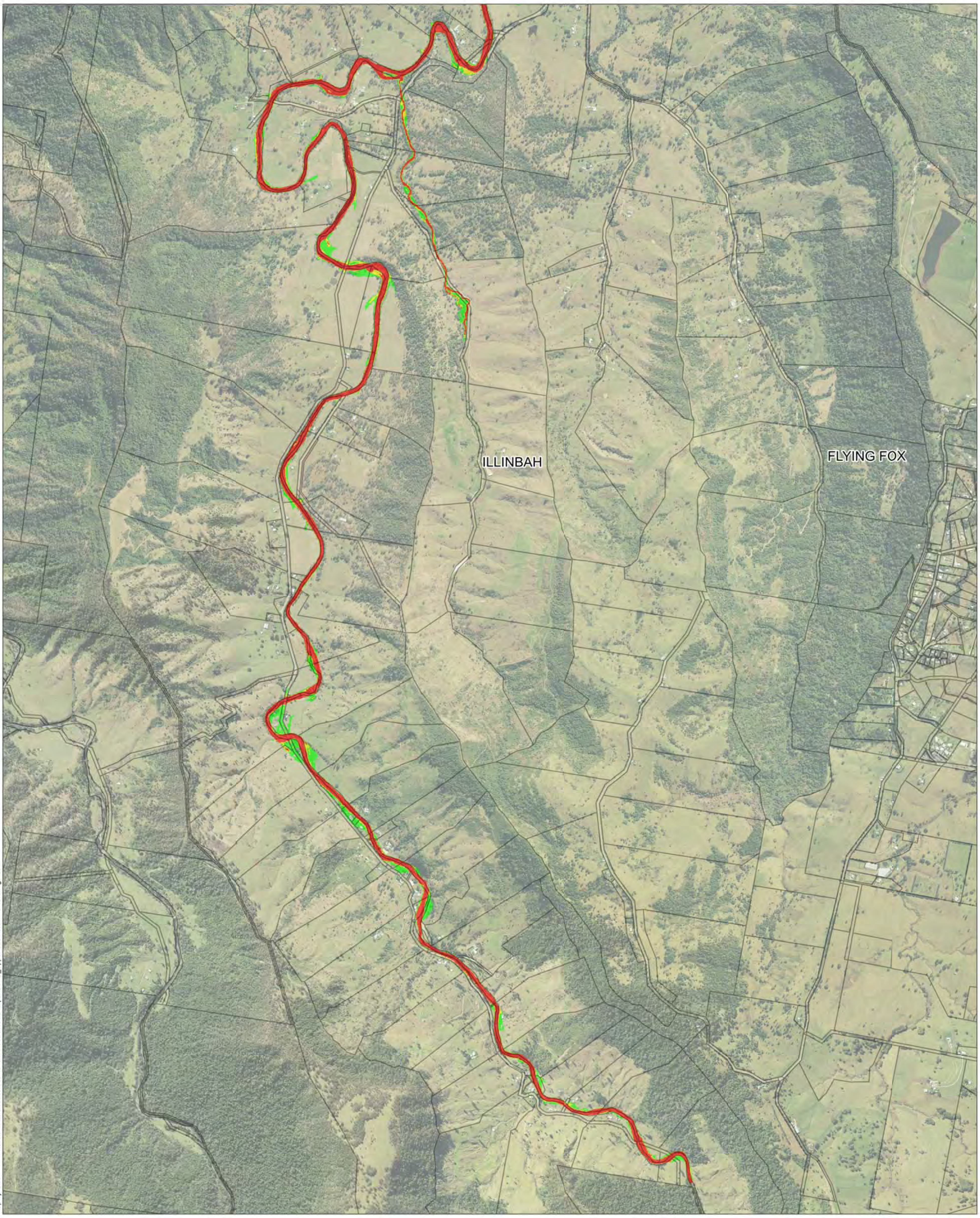
Date: 23/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E4**

10% AEP Event - Peak Hazard Map

aurecon



Map by: JDT   P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

SRRC Boundary
Cadastral Boundary
Low Hazard
Medium Hazard
High Hazard

Notes:

1:25,000
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E4-a**

10% AEP Event - Peak Hazard Map

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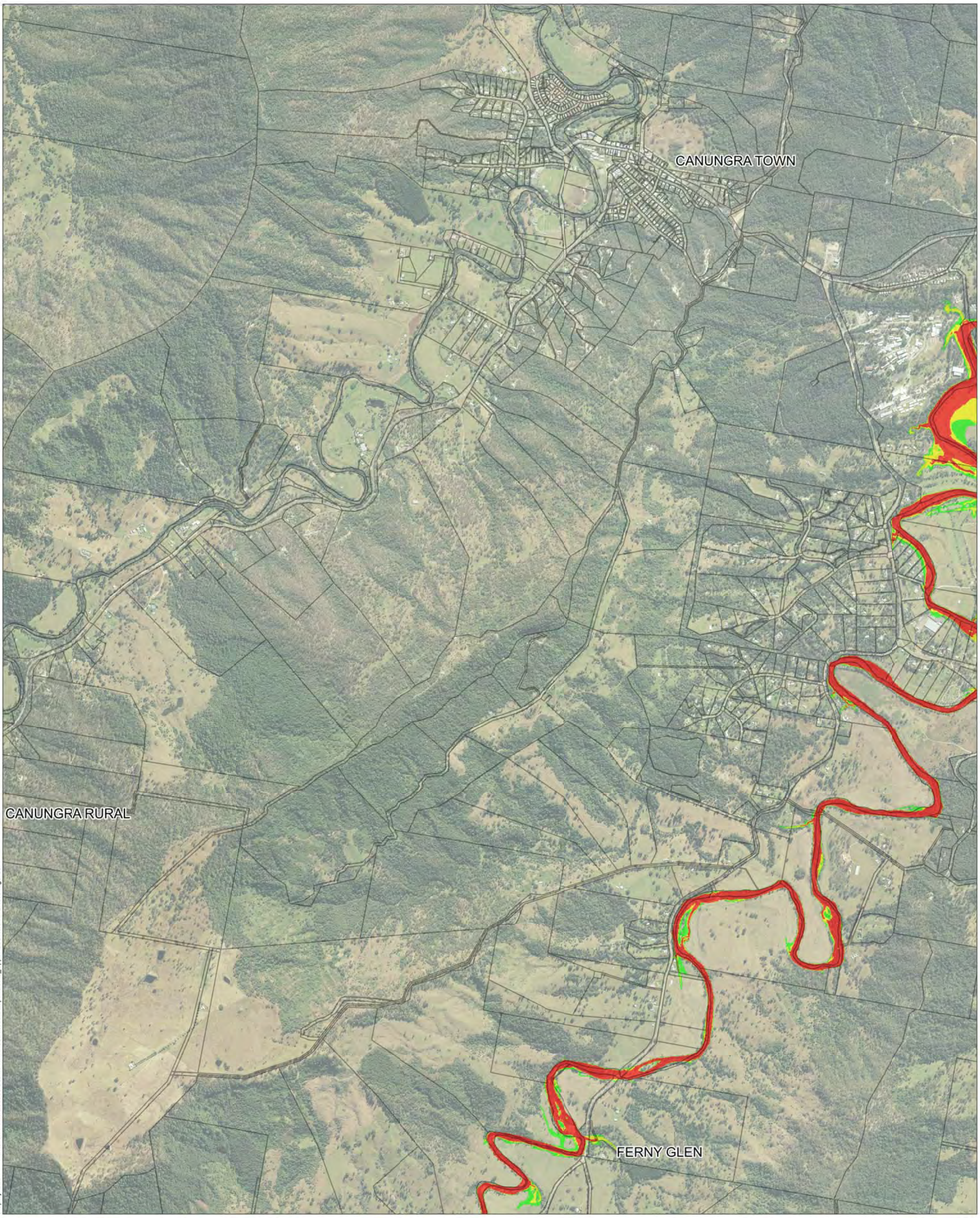
Version: 1, Version Date: 21/12/2017

aurecon



Legend

SRRC Boundary
Cadastral Boundary
Low Hazard
Medium Hazard
High Hazard

Notes:

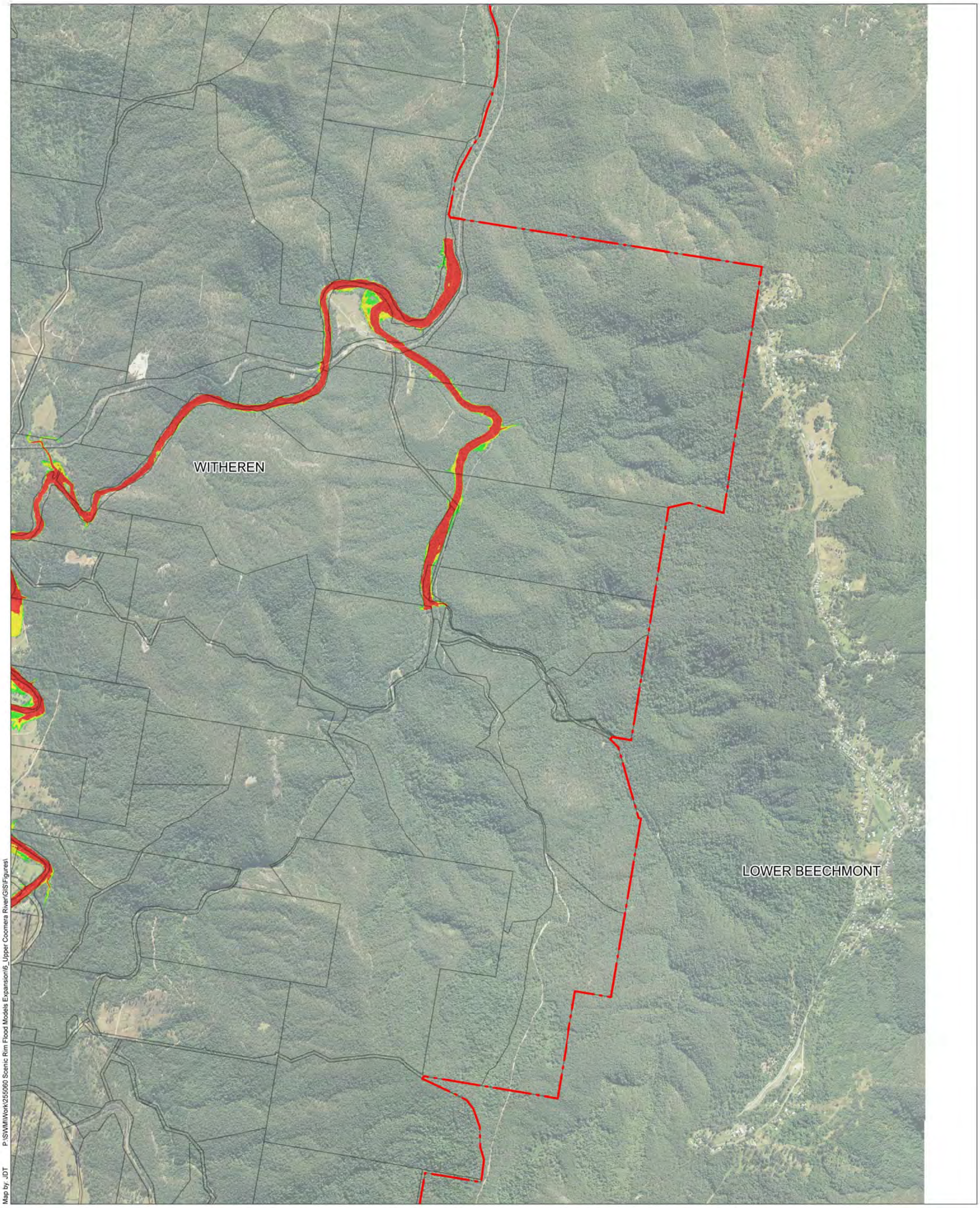
1:25,000
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E4-b**

10% AEP Event - Peak Hazard Map

aurecon



Legend

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

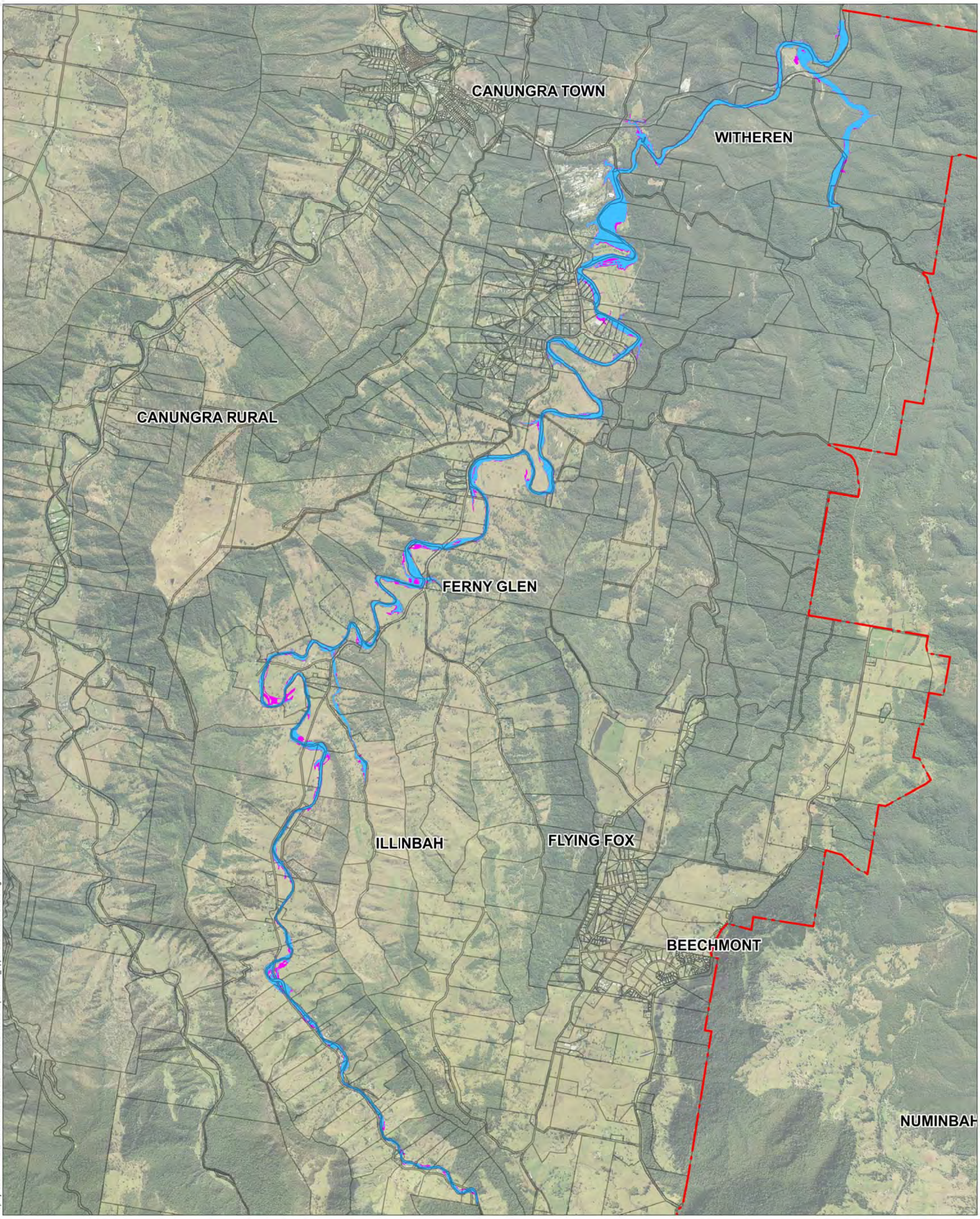
Notes:

1:25,000
0 625 m 1,250 m

Date: 23/06/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study **Figure E4-c**

10% AEP Event - Peak Hazard Map



Legend

SRRC Boundary

Cadastral Boundary

Existing Scenario Inundation Extents

Climate Change Scenario 4.5 Inundation Extent

Notes:

1:50,000

0 1,250 m 2,500 m

Date: 25/05/2017 Version: 0 Job No: 255060

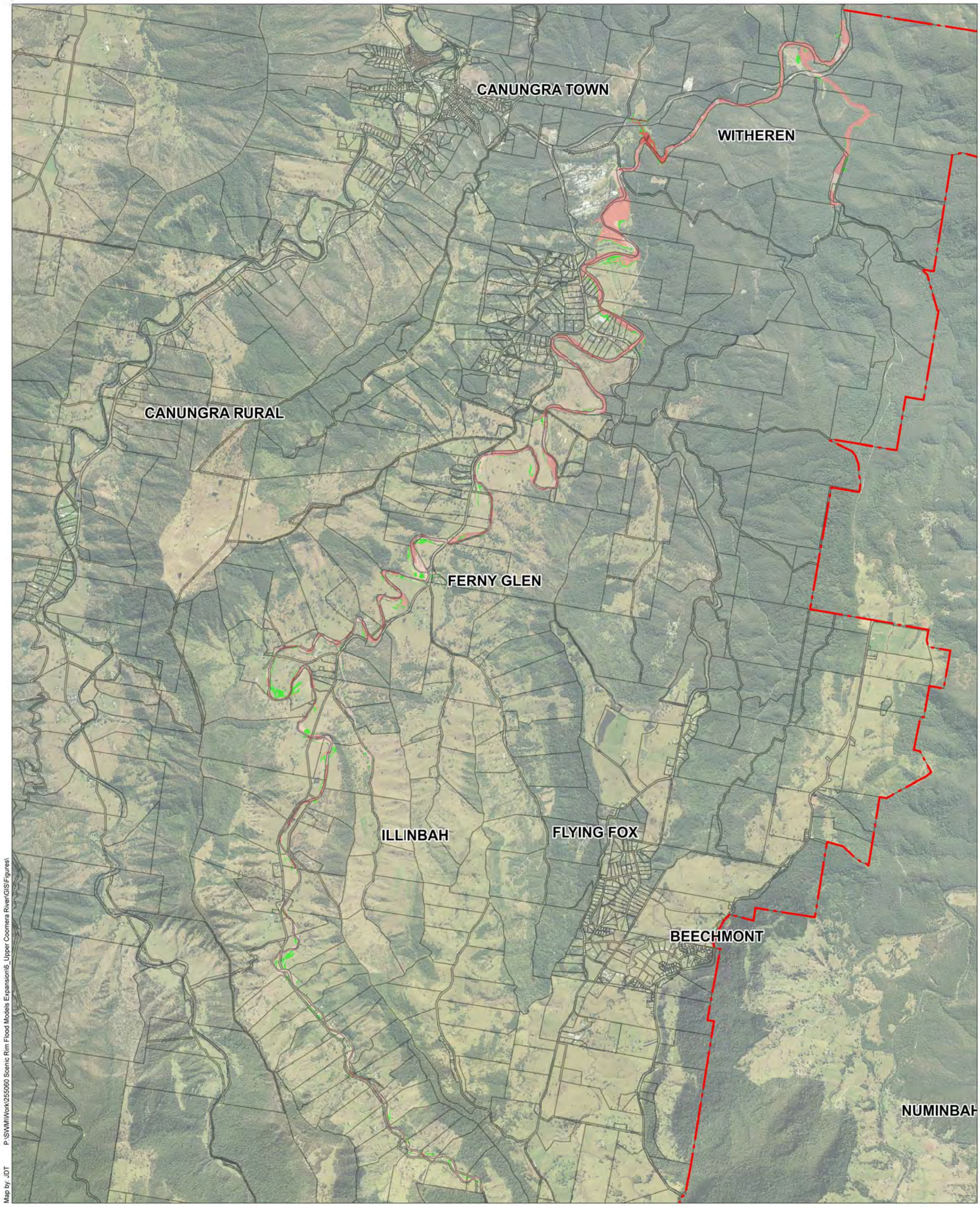
Projection: MGA Zone 56

Upper Coomera River Flood Study

Figure E5-a

Climate Change Scenario 4.5 - 10% AEP Event Inundation Extent

aurecon



Legend

SRRC Boundary
Cadastral Boundary

Afflux (m)
< -0.80
-0.80 to -0.60
-0.60 to -0.40
-0.40 to -0.20
-0.20 to -0.03
-0.03 to 0.03
0.03 to 0.20
0.20 to 0.40
0.40 to 0.60
0.60 to 0.80
0.80 to 1.20
> 1.20
Was Dry Now Wet
Was Wet Now Dry

Notes:

1:50,000
0 1,250 m 2,500 m

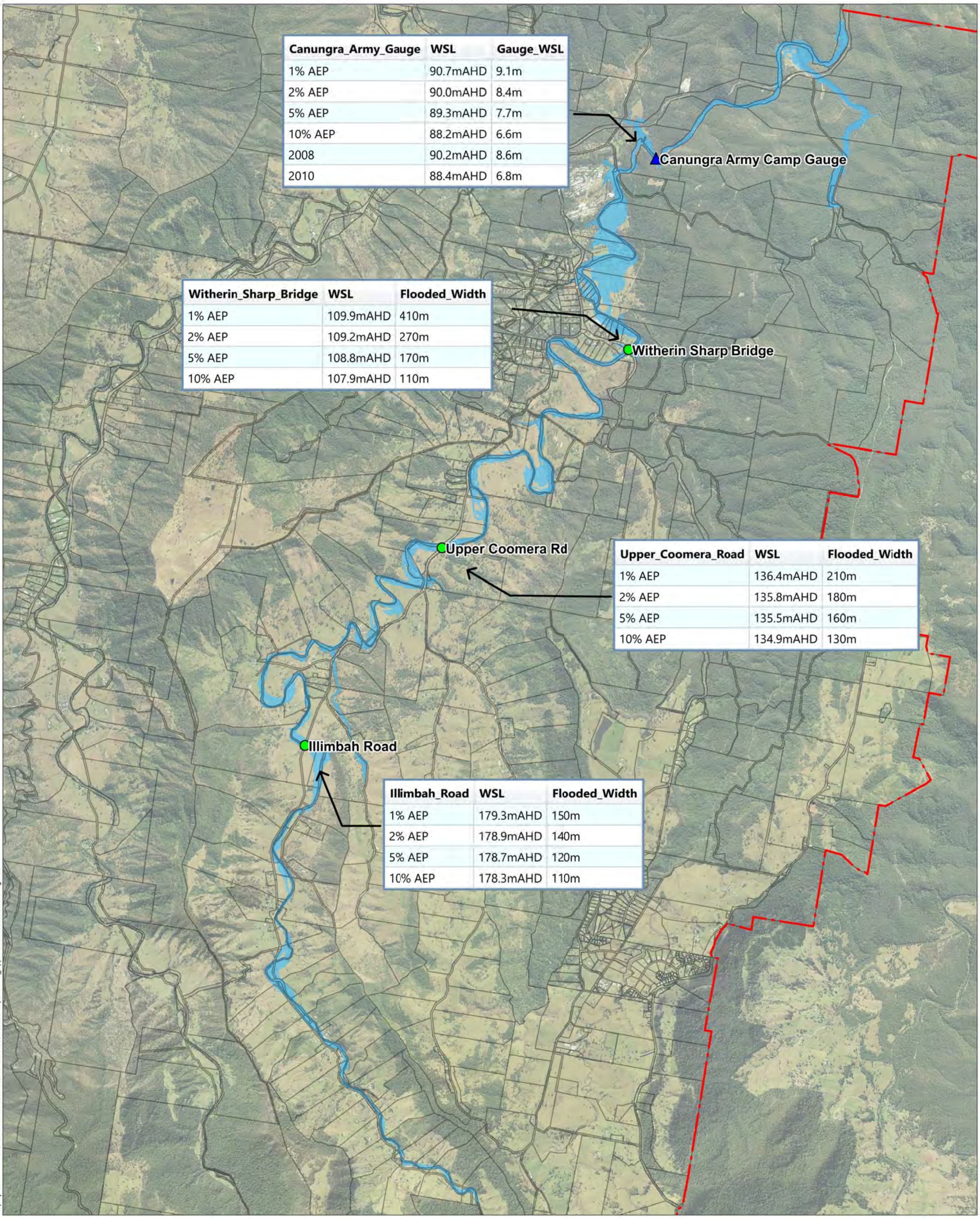
Date: 25/05/2017 Version: 0 Job No: 255060
Projection: MGA Zone 56

Upper Coomera River Flood Study

Figure E5-b

Climate Change Scenario 4.5 - 10% AEP Event Afflux Map

aurecon



Canungra_Army_Gauge	WSL	Gauge_WSL
1% AEP	90.7mAHD	9.1m
2% AEP	90.0mAHD	8.4m
5% AEP	89.3mAHD	7.7m
10% AEP	88.2mAHD	6.6m
2008	90.2mAHD	8.6m
2010	88.4mAHD	6.8m

Witherin_Sharp_Bridge	WSL	Flooded_Width
1% AEP	109.9mAHD	410m
2% AEP	109.2mAHD	270m
5% AEP	108.8mAHD	170m
10% AEP	107.9mAHD	110m

Upper_Coomera_Road	WSL	Flooded_Width
1% AEP	136.4mAHD	210m
2% AEP	135.8mAHD	180m
5% AEP	135.5mAHD	160m
10% AEP	134.9mAHD	130m

Illimbah_Road	WSL	Flooded_Width
1% AEP	179.3mAHD	150m
2% AEP	178.9mAHD	140m
5% AEP	178.7mAHD	120m
10% AEP	178.3mAHD	110m

Map by: JDT P:\SWM\Work\255060 Scenic Rim Flood Models Expansion\6_Upper Coomera River\GIS\Figures\

Legend

- SRRC Boundary
- Cadastral Boundary
- Inundation Extent
- Road Crossing
- Stream Gauge

Notes:

1:100,000

0 2,500 m 5,000 m

Date: 22/06/2017 Version: 0 Job No: 255060

Projection: MGA Zone 56

Upper Coomera River Flood Study Figure F

Emergency Response Mapping - Stream Gauge & Road Crossing Details

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