

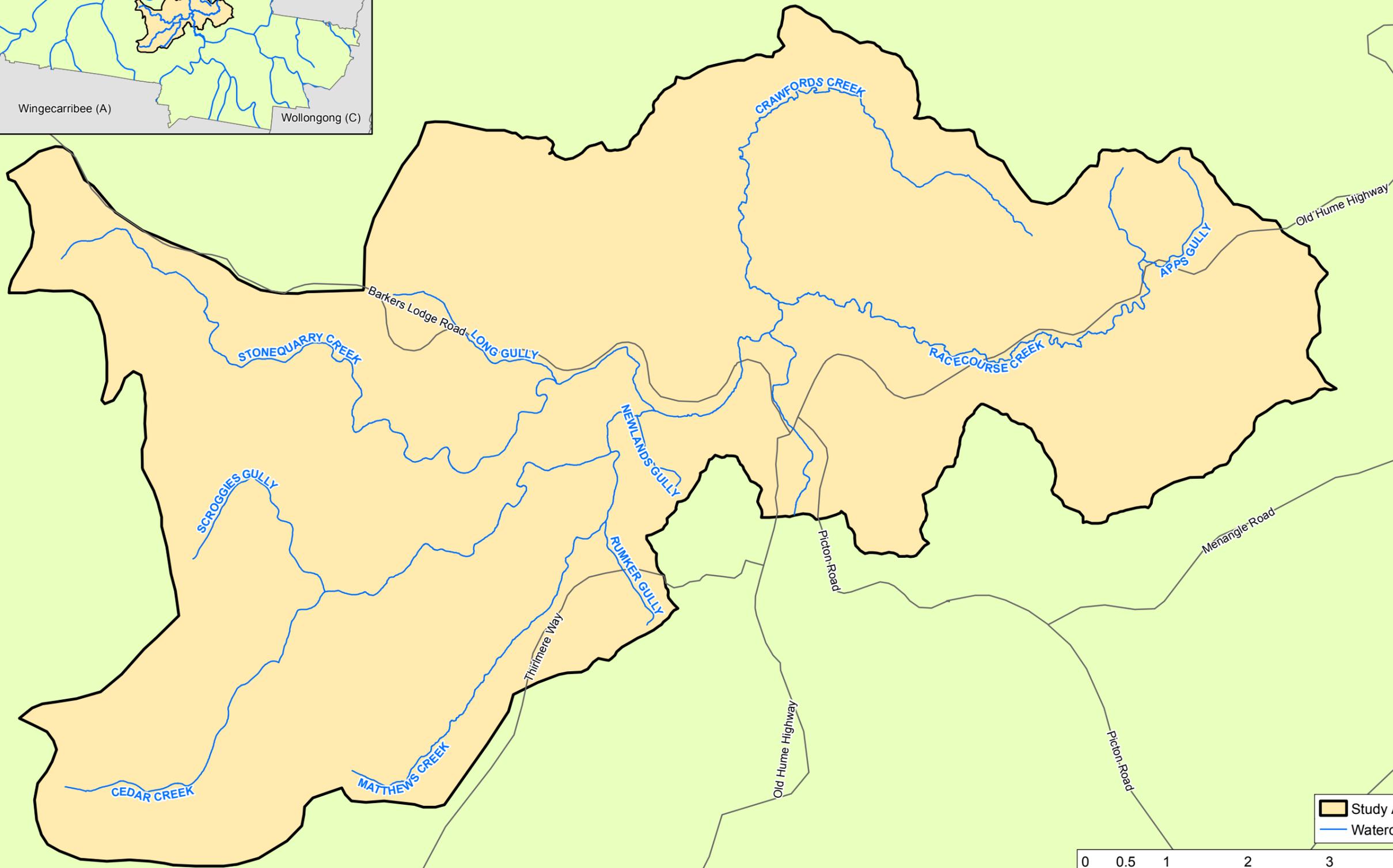
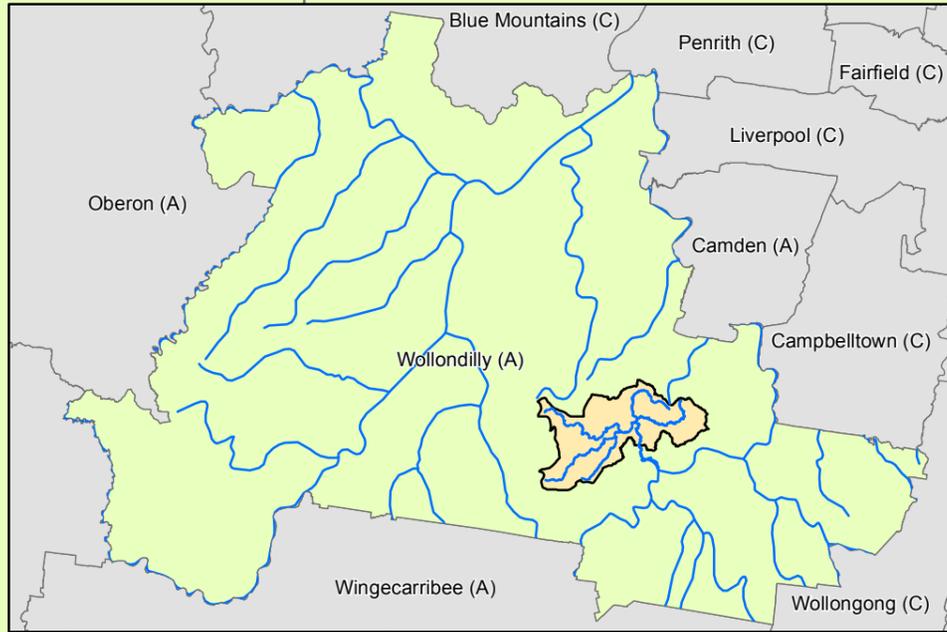
STONEQUARRY CREEK (PICTON) FLOOD STUDY UPDATE FINAL VOLUME II

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FIGURE 1
LOCALITY MAP



Study Area
Watercourse



FIGURE 2
STUDY AREA TOPOGRAPHY

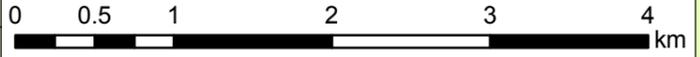
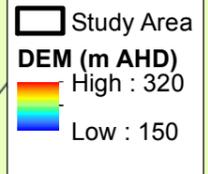
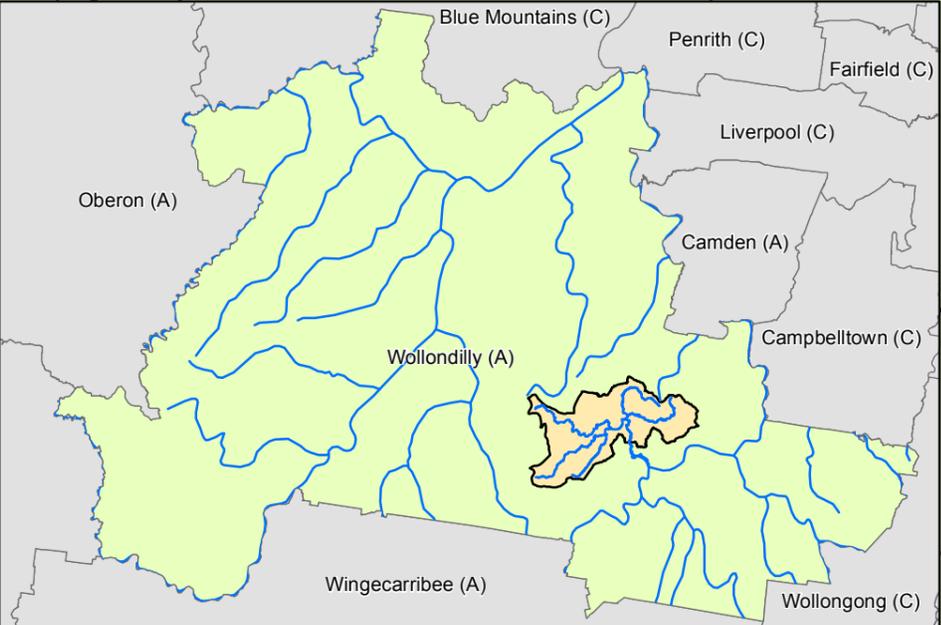
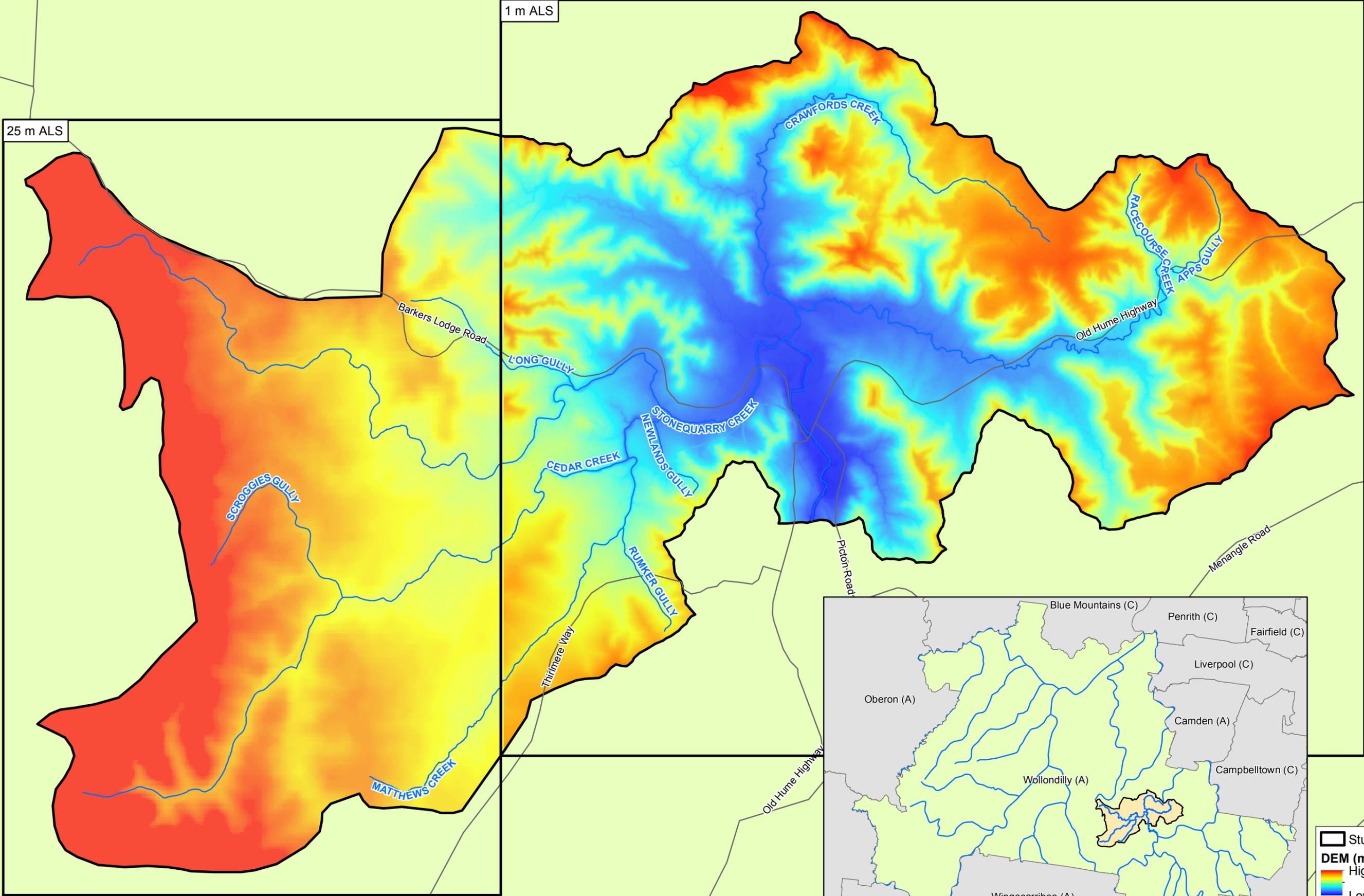
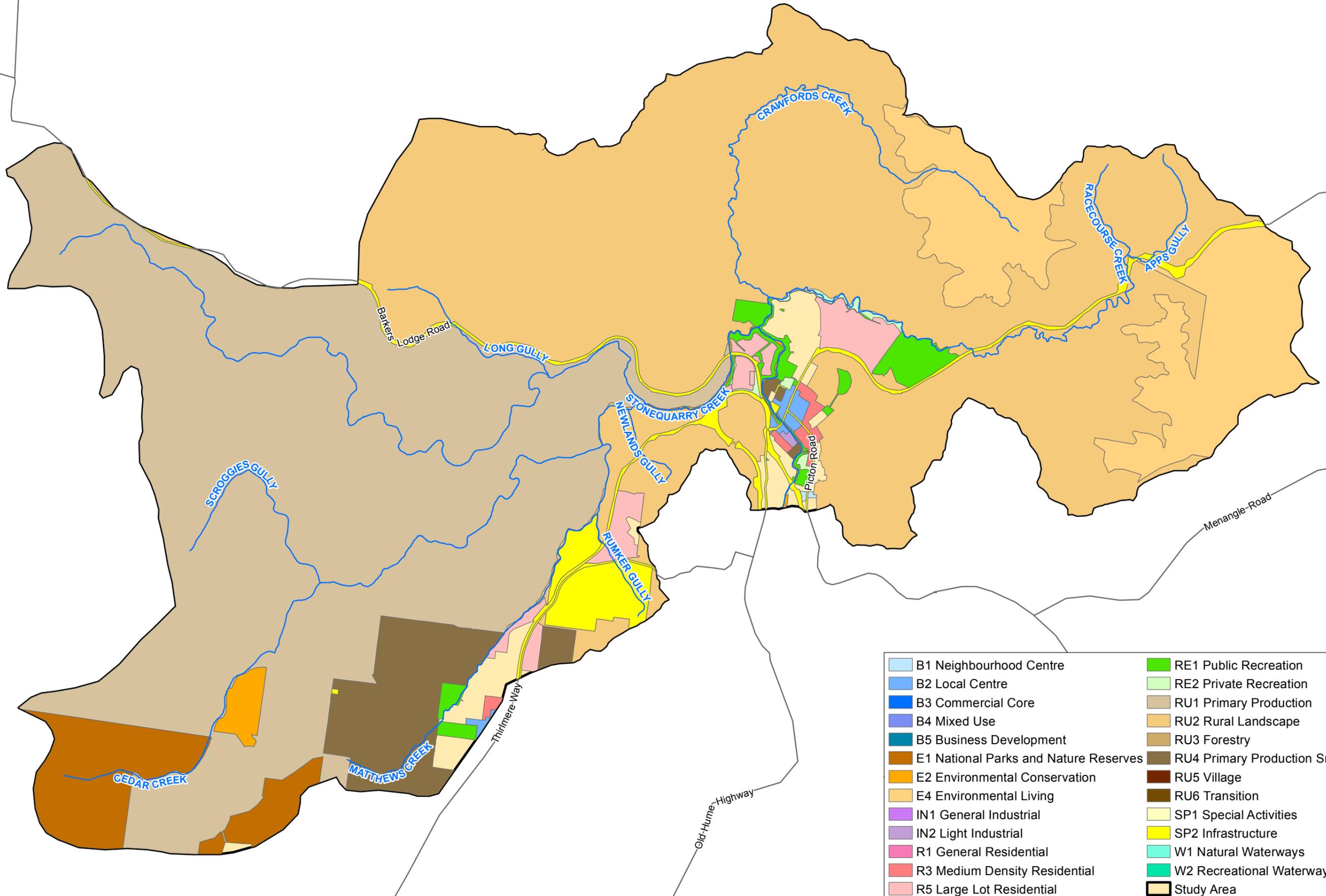


FIGURE 3
**PICTON LEP 2011
 LAND USE ZONES**



- | | |
|---------------------------------------|-----------------------------------|
| B1 Neighbourhood Centre | RE1 Public Recreation |
| B2 Local Centre | RE2 Private Recreation |
| B3 Commercial Core | RU1 Primary Production |
| B4 Mixed Use | RU2 Rural Landscape |
| B5 Business Development | RU3 Forestry |
| E1 National Parks and Nature Reserves | RU4 Primary Production Small Lots |
| E2 Environmental Conservation | RU5 Village |
| E4 Environmental Living | RU6 Transition |
| IN1 General Industrial | SP1 Special Activities |
| IN2 Light Industrial | SP2 Infrastructure |
| R1 General Residential | W1 Natural Waterways |
| R3 Medium Density Residential | W2 Recreational Waterways |
| R5 Large Lot Residential | Study Area |



FIGURE 4

RECORDED AND ANECDOTAL HISTORIC FLOOD MARKS

1910
Flood smaller than that of 1930.

1963
3 Ft. deep, high velocity watercourses into the creek on the Picton Post trail

1969
157.04 mAHD recorded at Middleton's Store.

1969
157.12 mAHD measured at Residence on Menangle St West.

1969
158.03 mAHD measured at Cottage on Elizabeth St.

1956
0.76 m in St Mark's Church.

1930
2 days of rainfall
Water entered St Mark's Church.

1930
2 days of rainfall
Flood levels reached over the handrails of Stonequarry Creek Bridge.

1911
3 days of rainfall
Creek rose over the town bridge. Several residents evacuated to seek higher ground.

1930
2 days of rainfall
Water was within 3 feet (~0.9 m) of the verandah of the Royal George Hotel.

1969
157.52 mAHD measured at Picton Hotel.

1930
2 days of rainfall
Argyle Street was inundated up to the bridge and experienced high velocity flows.

1969
157.56 mAHD measured at Westpac Bank.

1952
7 days of rainfall
6 Inches (~150 mm) of rainfall over 7 days recorded at Picton Post Office.

1969
157.14 mAHD measured at Picton Plaza.

1911
3 days of rainfall
871 Points (~310 mm) of rainfall recorded at Picton Post Office.

1930
2 days of rainfall
770 Points (~270 mm) of rainfall recorded at Picton Post Office.

1943
6 days of rainfall
929 Points (~330 mm) of rainfall over 6 days recorded at Picton Post Office.

1943
6 days of rainfall
Water rose above the stone supports of the bridge, but did not cover the decking.

1969
156.58 mAHD measured at residence opposite Showgrounds.

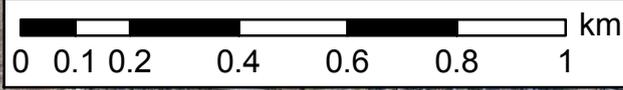
1943
6 days of rainfall
Argyle Street was inundated for hundreds of yards. Low situated houses were badly affected.

1930
2 days of rainfall
P. Brookes' House was inundated up to the gate.

1930
2 days of rainfall
G. Bells' House on Menangle Street was waist-high in water.

1930
2 days of rainfall
Many houses and farms flooded near Stonequarry Creek.

- Flood Marks
- Location of a Surveyed High Water Mark (HWM), June 2016
- TUFLOW Hydraulic Model Extent
- 1% AEP Flood Extent



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FLOODS AT PICTON.

—

PICTON, Friday.

It has been raining since Wednesday night. Up till 9 o'clock this morning 871 points have fallen. The creek has risen over the town bridge, and several people had to leave their houses and seek higher shelter.

The Sun – 'Floods at Picton', Friday, 13th January 1911.

SPLENDID RAIN

The heaviest rain, however, occurred yesterday (Wednesday), and continued throughout the whole day, when a tremendous quantity of water over-flowed Argyle-street for hundreds of yards, and made its way into lowly-situated homes. At the bridge over Stonequarry Creek, the water rose above the stone supports, but did not cover the decking.

The Picton Post – 'Splendid Rain', Thursday, 20th May 1943.

Picton. March 17.

WEATHER.—We undoubtedly got our share of the rain this time—more than enough in fact. When the back water began to flow in upon the low-lying streets, covering them in some places from kerb to kerb, appearances were rather alarming. A close watch was kept upon the rapidly rising creek, especially as the waters neared the floor of the bridge. Had they risen another foot, the town would have been flooded and serious damage done, as the quantity of drift wood and rubbish forced back by the beams of the bridge would have created a kind of dam compelling the stream to make its escape elsewhere, and so flooding the town. However, "all's well that ends well." The streets are dry again, and the stream is nearly down to its normal level.

Australian Town and Country Journal – 'Picton', Saturday, 22nd March 1890.

**Early Days Of
Picton**

—
FLOODS

In the year 1860 the Stonequarry Creek rose so high that the bridge was swept away, and the water drove several families from their homes to seek higher ground. The Church of England had about one foot of water in it, and the creek extended up nearly as far as where Mr. Warters now lives. In February, 1863, another flood came down the creek and washed away the scaffolding of the Viaduct, then in course of construction. The Hawkesbury River at that time rose 27 feet. Other floods occurred in 1873, and about 1880, but Ald. Graham was, I think, the only resident seriously inconvenienced.

The Picton Post – 'Early Days of Picton: Floods', Thursday, 19th December 1946.

The Rainfall.

The heaviest rain experienced in Picton for a number of years was registered during the past week. Mr. T. Moraghan's drapery shop was also flooded, the water being about a foot deep in the shop. The water damaged a good deal of stock, Mr. Moraghan estimating his loss at £50. The creek was the highest seen for about 30 years. Water was laying about the streets in every direction, and several houses in low-lying parts of the town were flooded. Mrs. Murray in Menangle-street West, and Mr. J. York in Argyle-street, had to be removed from their houses. Mr. J. Corbett's blacksmith shop also suffered, the water being as high as his bellows. The water also got into the lower portion of Messrs. G. Barr & Sons store, a cellar being filled with water. Owing to a dam on Mr. Spearing's farm bursting portion of Menangle-street was under water, which reached as far as the kitchen of Mrs. Reeves' residence.

The Picton Post – 'The Rainfall', Wednesday 18th January 1911.

**Severe Storm and
Floods**

—
Picton Deluged

—
Wide Area Suffers from Flood Waters

—
BUSINESS PREMISES SWAMPED

In Picton, the storm raged in violence, and in a very short while Stonequarry Creek was running a banker, then broke over the banks, sweeping over the handrails of the bridge, the flood rushing through Moraghan's, Dunk's garage, and George Anthony's. The water also came through Storie's premises. On the other side of Argyle Street, the shops also suffered, Humphrey's and Barr's having a deal of stuff damaged. Argyle Street, from the bridge to Wells' paper shop, was transformed into a miniature lake, with the water rushing through Ashcroft's shops like a raging torrent.

as Sunday's. Old hands state that there have been larger floods here, and the water has actually been up to the Police Station, and well up to the counter at the ancient Royal George Hotel. On this occasion, it was within about three feet of the verandah of the George.

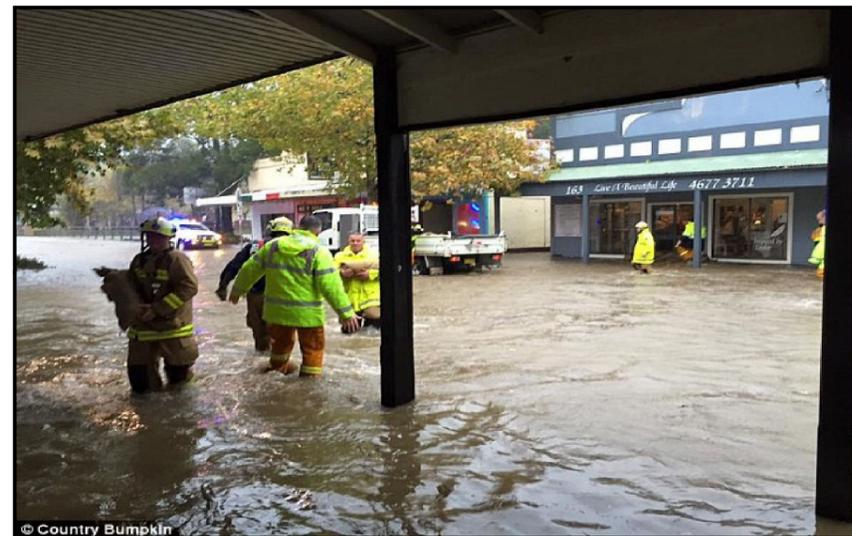
The Picton Post – 'Severe Storm and Floods', Wednesday, 4th June 1930.



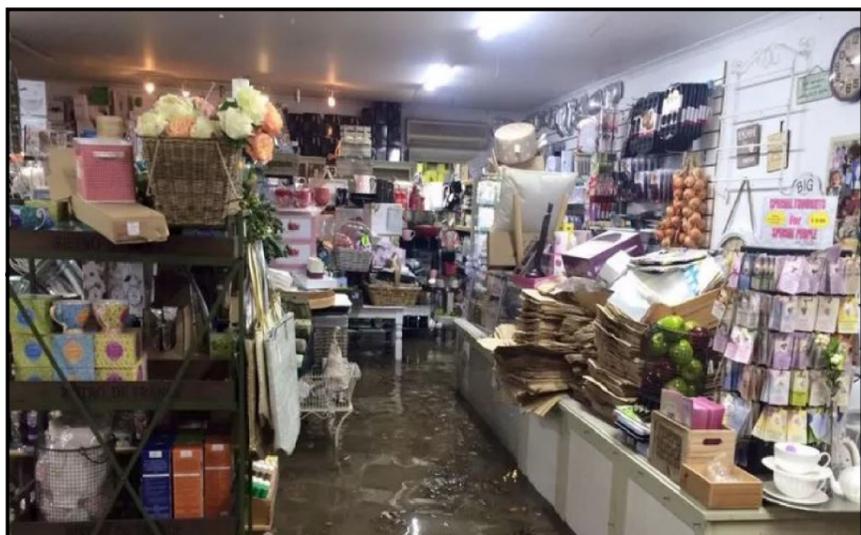
Roads during flood, Wollodilly Leisure Centre 2016



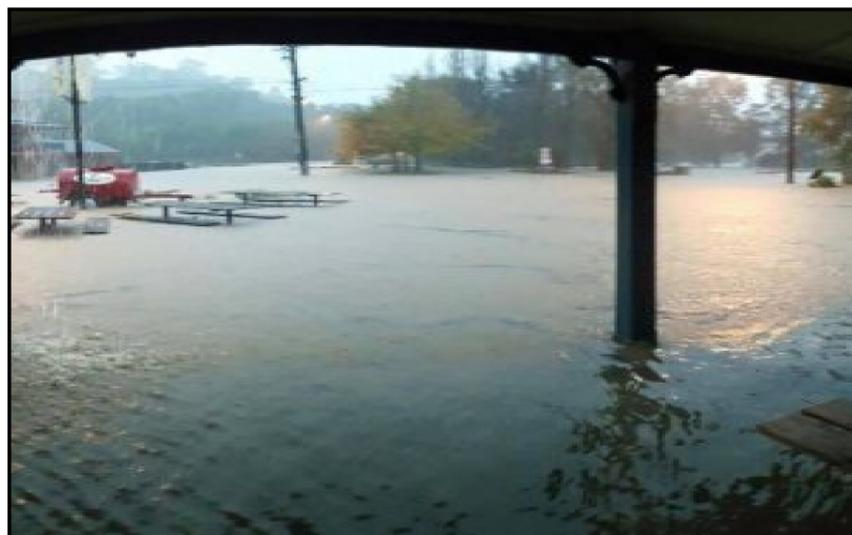
Stonequarry Creek at Argyle St Bridge, ABC 2016



Argyle St - Flood height, Daily Mail 2016



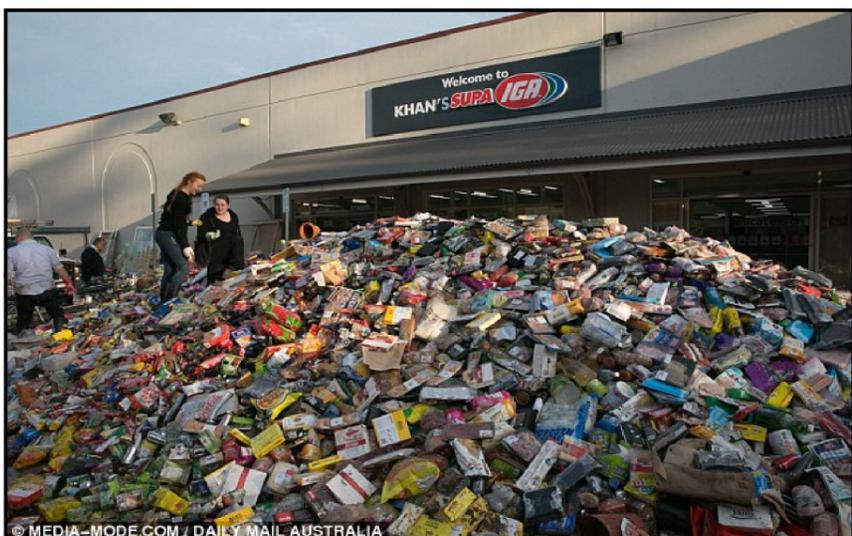
Argyle St (Country Bumpkin gift shop), Daily Mail 2016



Argyle St (George IV Inn), South West Voice 2016



Damaged homes after the event, Perth Now 2016



Argyle St (Khan's SUPA IGA), Perth Now 2016



Streets of Picton - Flood height, Daily Mail 2016



Stonequarry Creek in flood, Picton Fire and Rescue 2016

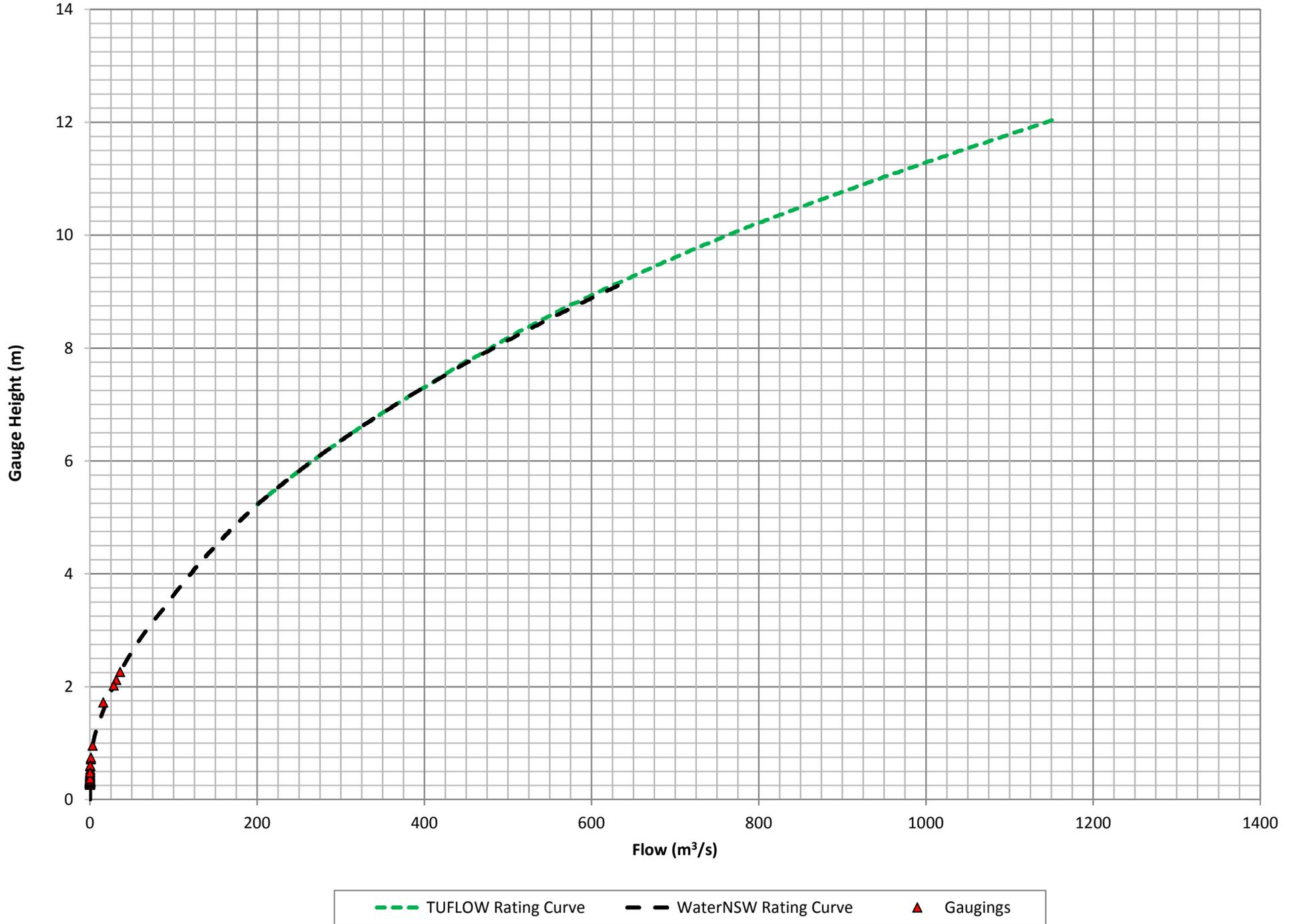


FIGURE 7
PICTON - 212053
RATING CURVE AND GAUGINGS
STONEQUARRY CREEK GAUGE

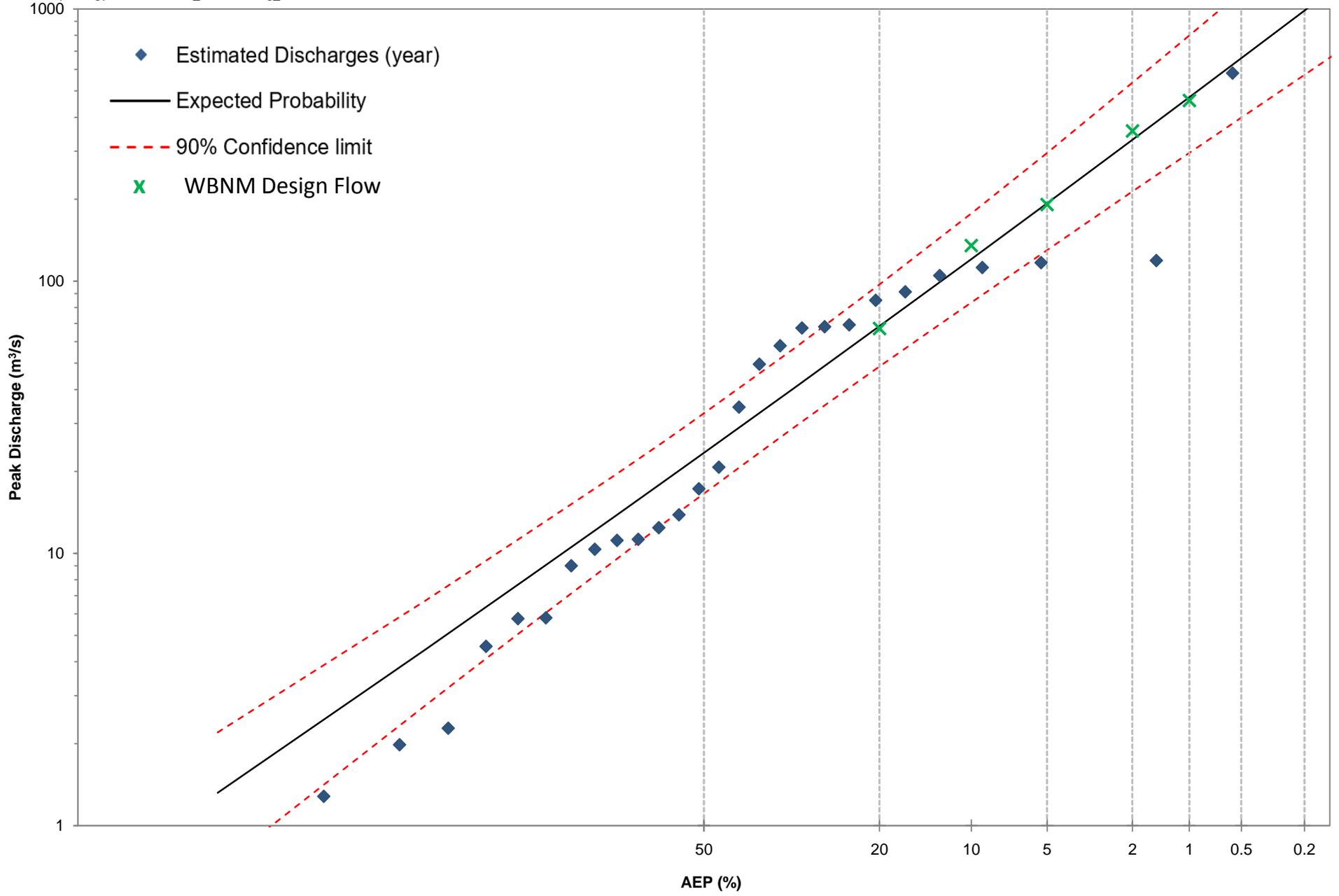
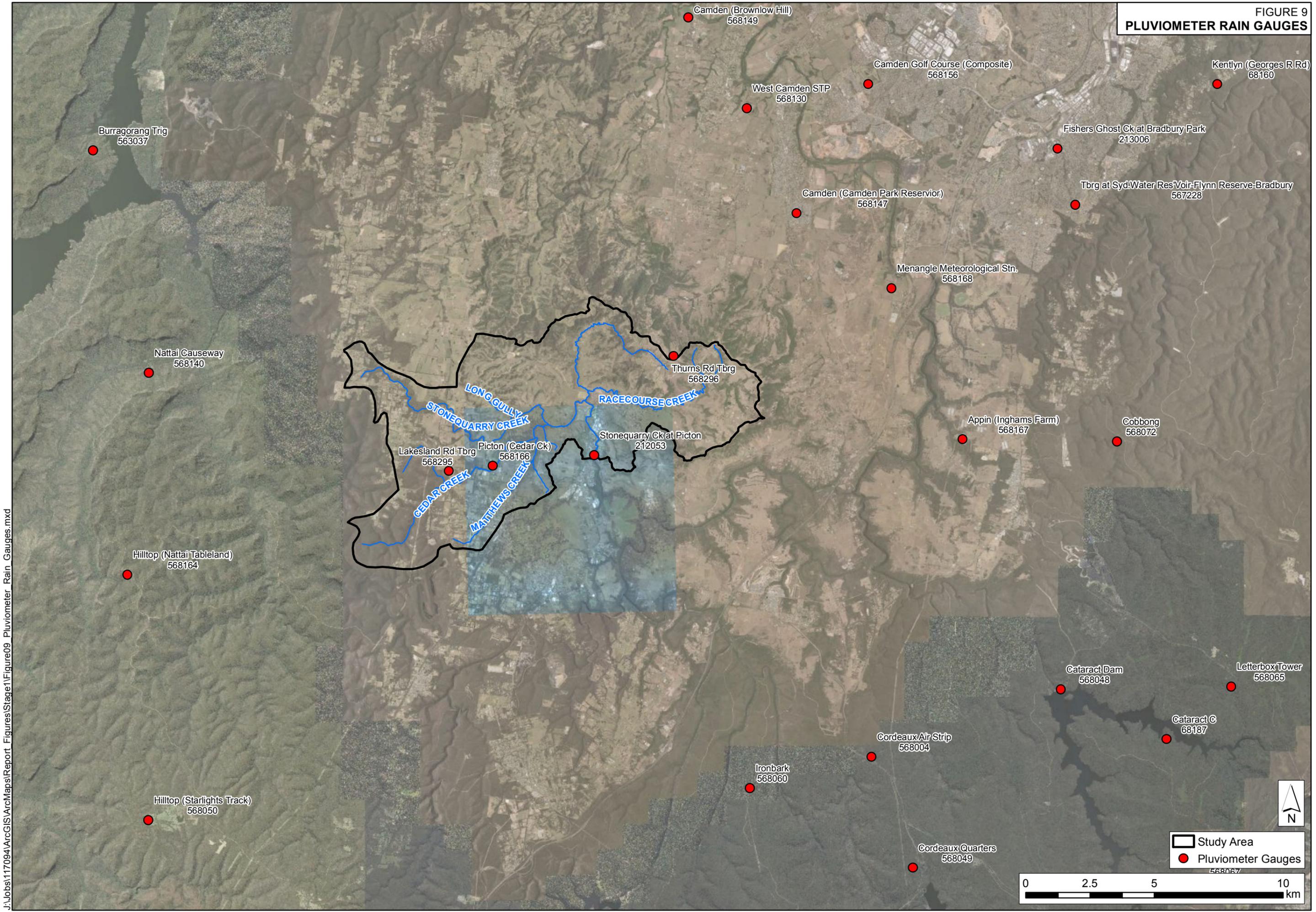


FIGURE 8
FLOOD FREQUENCY ANALYSIS
T30 - PICTON

FIGURE 9
PLUVIOMETER RAIN GAUGES



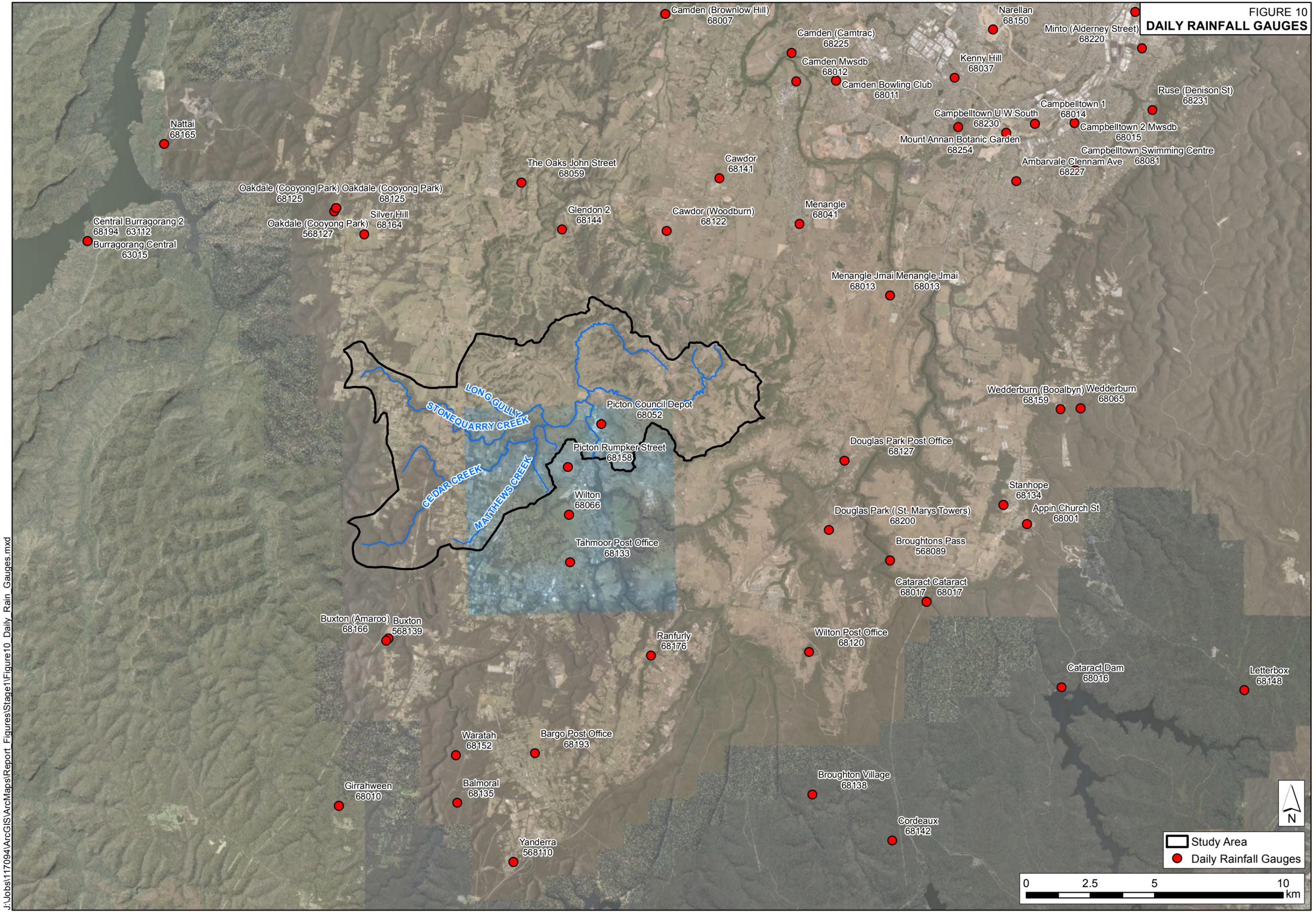
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Study Area
Pluviometer Gauges

0 2.5 5 10 km



DAILY RAINFALL GAUGES

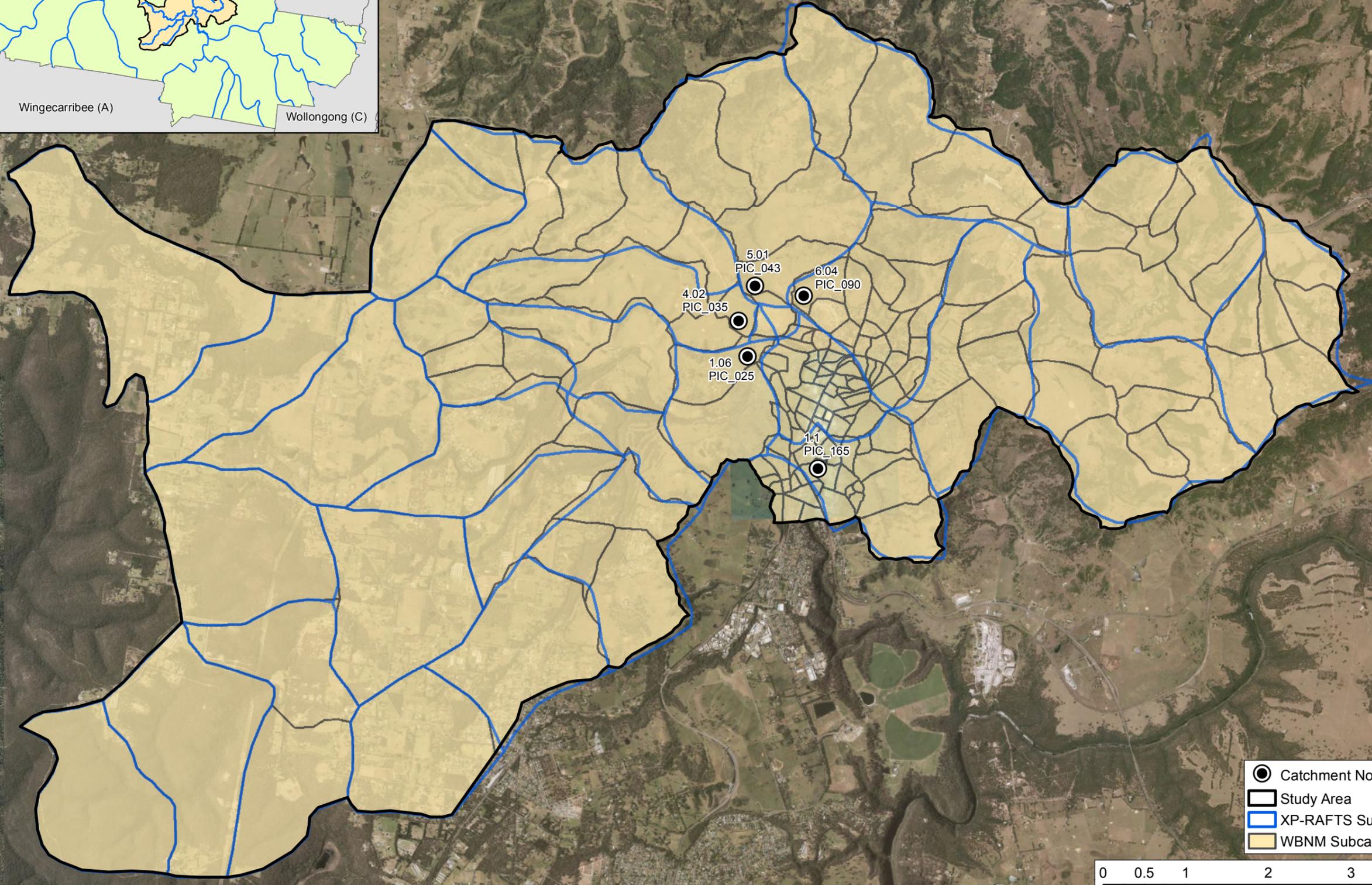
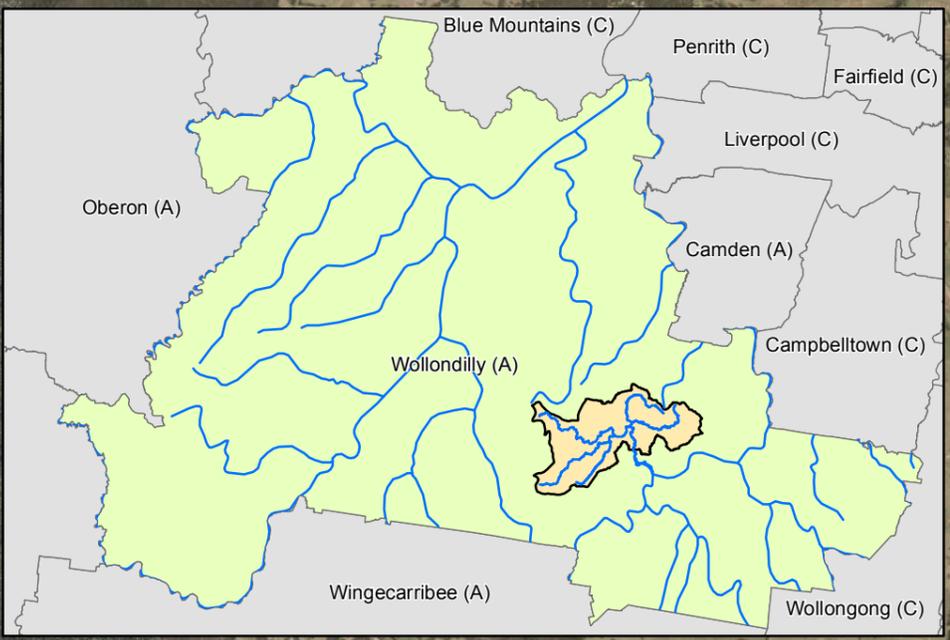


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Study Area
● Daily Rainfall Gauges



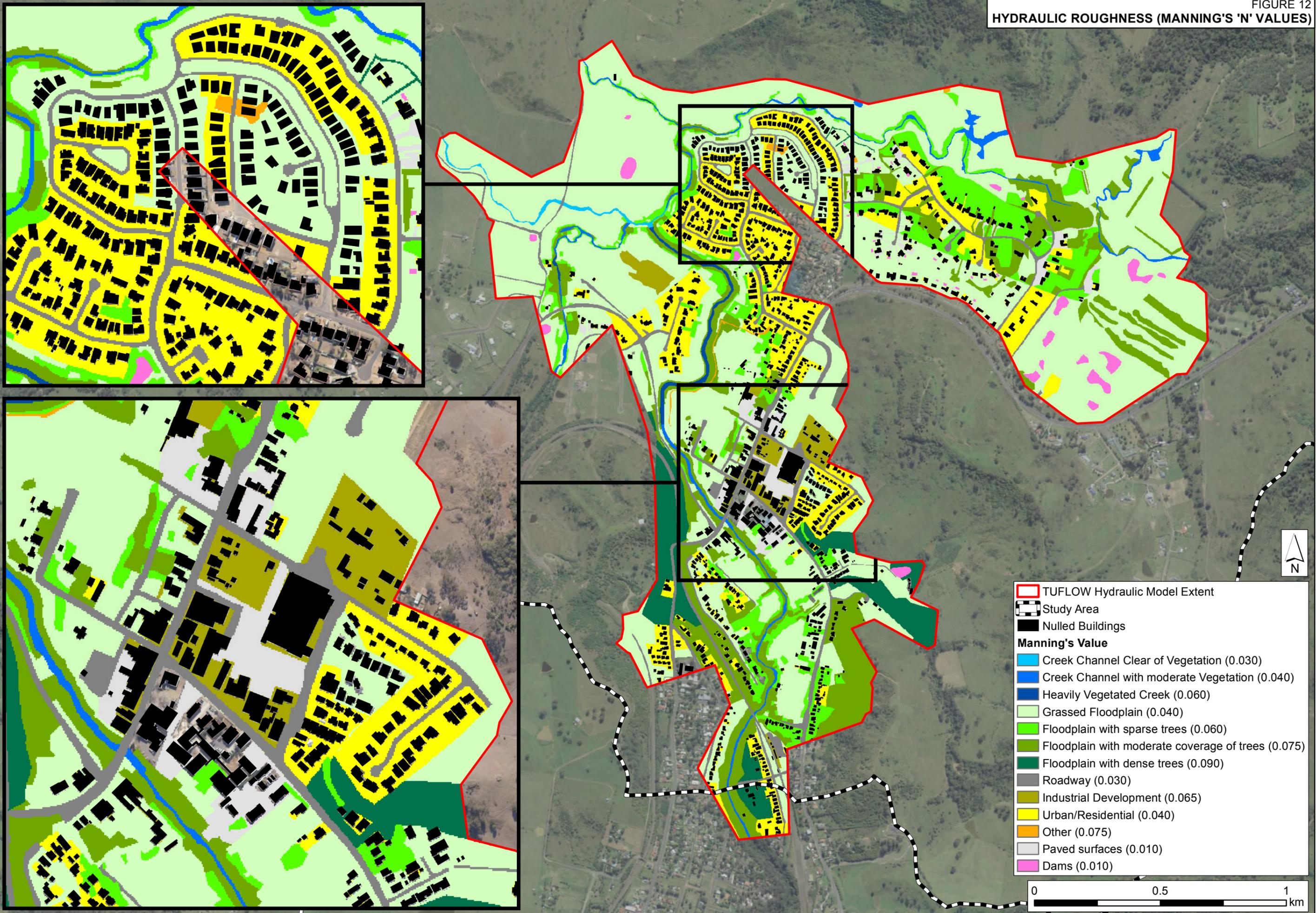
FIGURE 11
WBNM HYDROLOGIC MODEL
SUBCATCHMENT DELINEATION



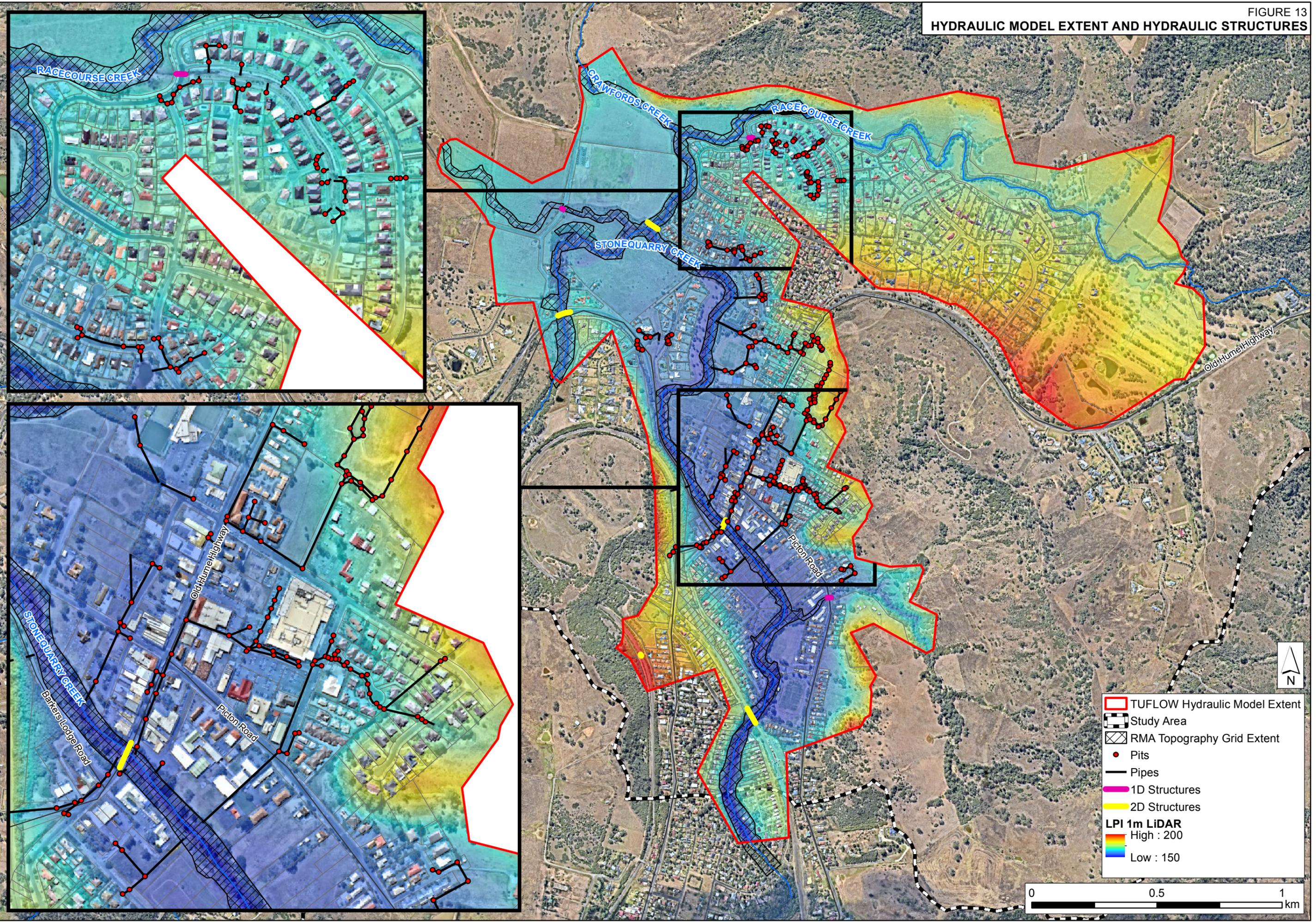
- Catchment Node
- ▭ Study Area
- ▬ XP-RAFTS Subcatchments
- ▭ WBNM Subcatchments



HYDRAULIC ROUGHNESS (MANNING'S 'N' VALUES)



HYDRAULIC MODEL EXTENT AND HYDRAULIC STRUCTURES

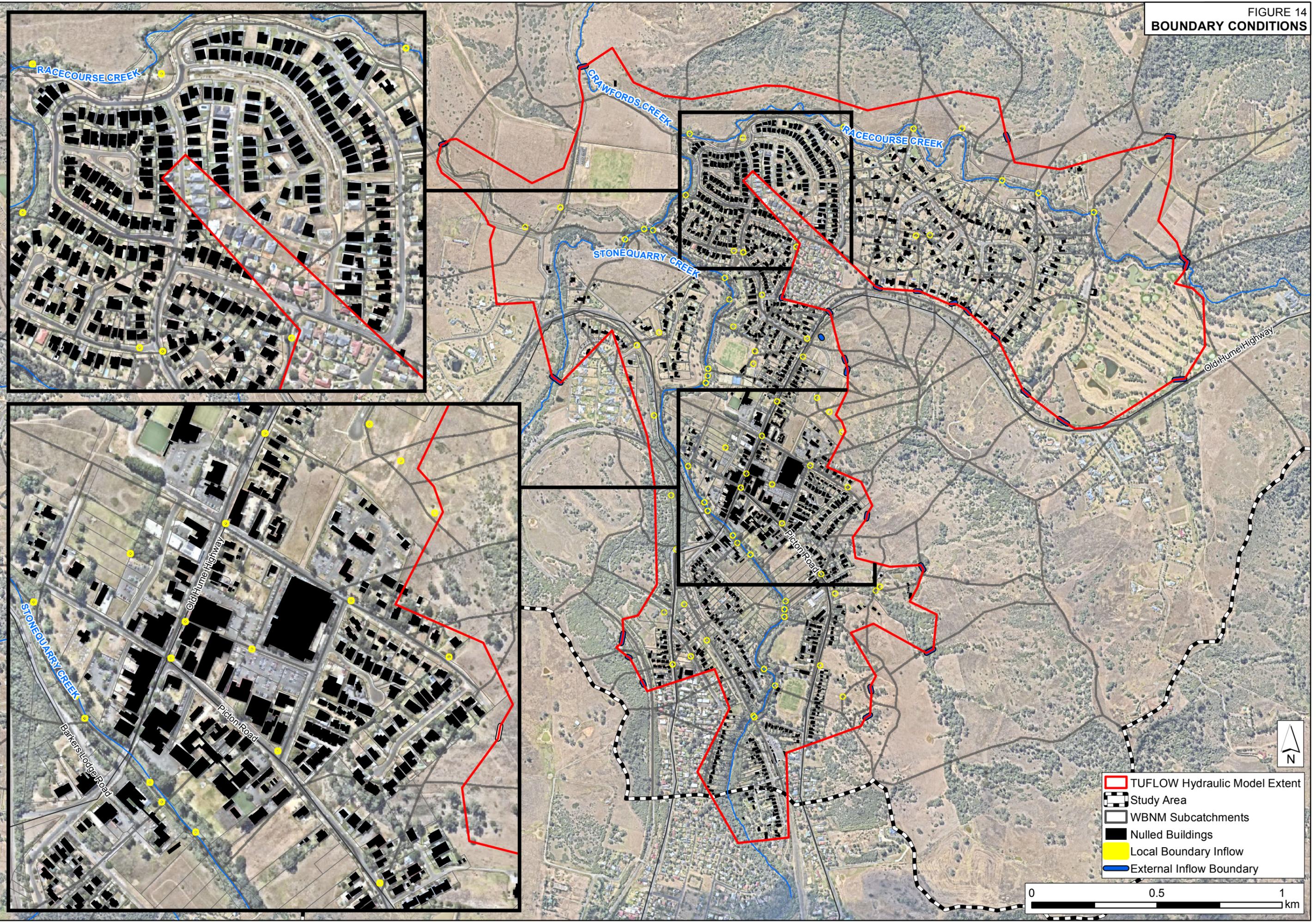


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-  TUFLOW Hydraulic Model Extent
-  Study Area
-  RMA Topography Grid Extent
-  Pits
-  Pipes
-  1D Structures
-  2D Structures
- LPI 1m LiDAR**
-  High : 200
-  Low : 150

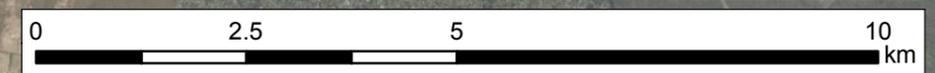
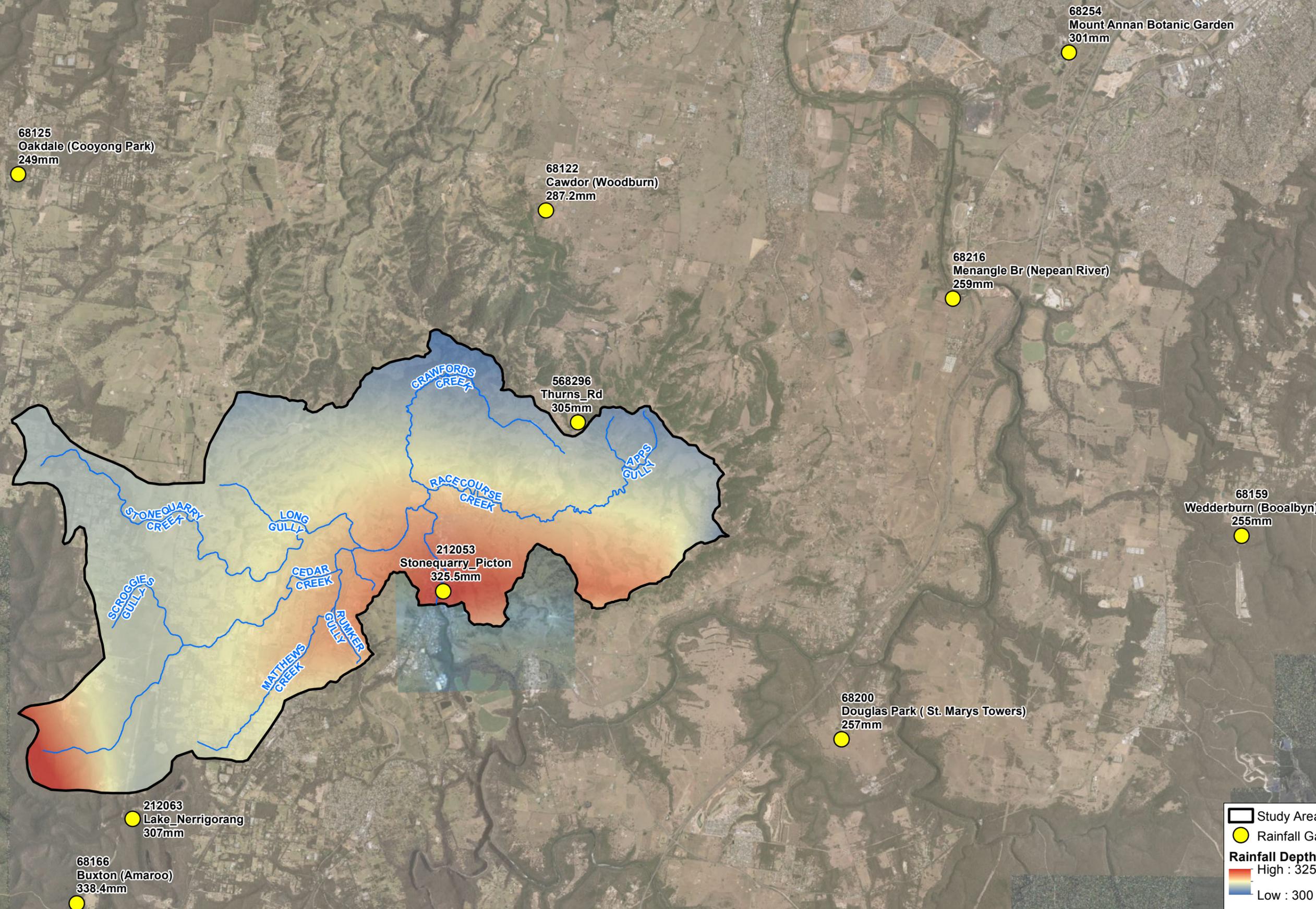
0 0.5 1 km

FIGURE 14
BOUNDARY CONDITIONS



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FIGURE 15
 JUNE 2016 CALIBRATION EVENT
 RAINFALL DATA



Study Area
● Rainfall Gauges
Rainfall Depth (mm)
 High : 325
 Low : 300

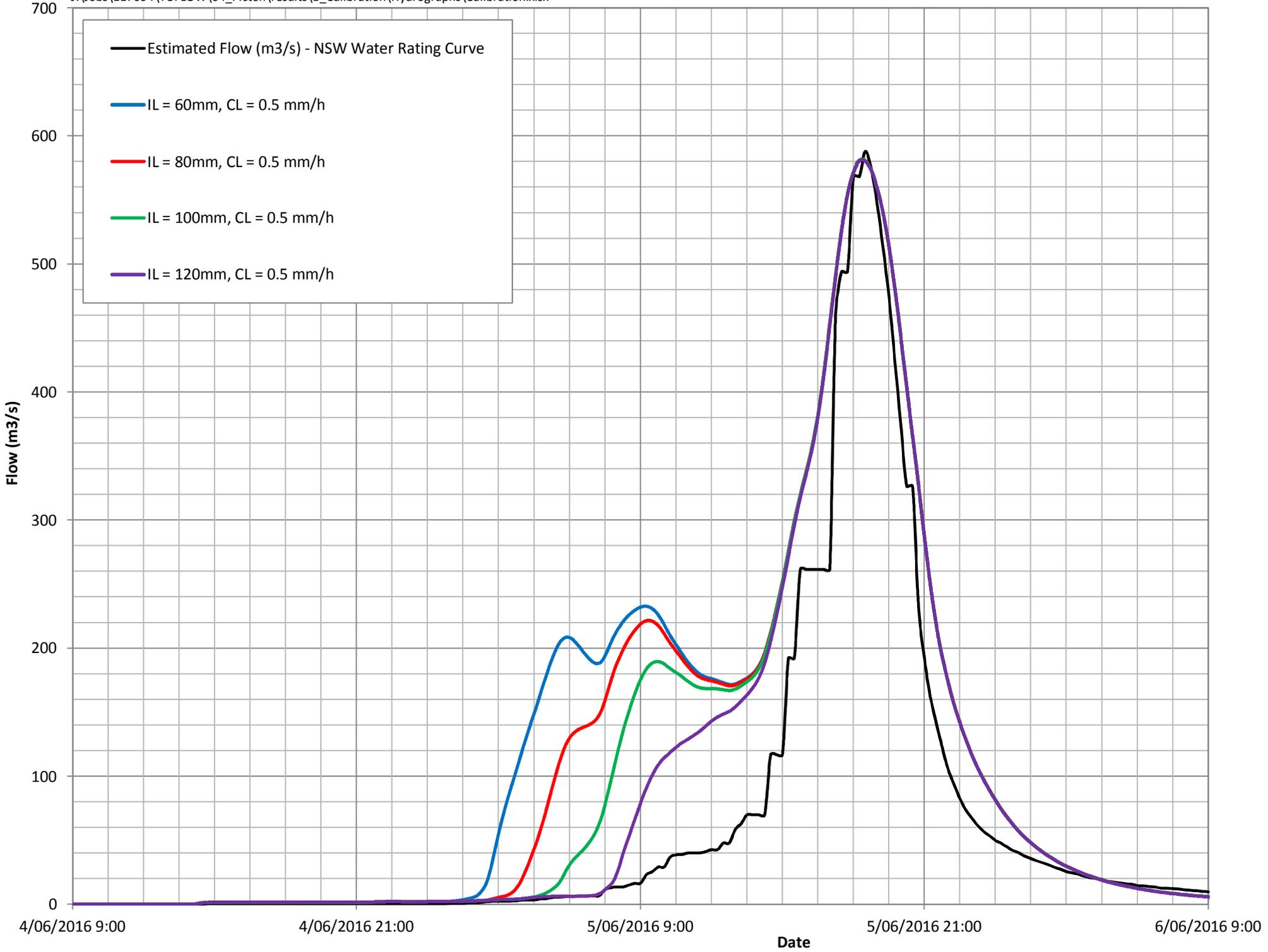


FIGURE 16
JUNE 2016 CALIBRATION EVENT
COMPARISON HYDROGRAPH

2016 CALIBRATION EVENT WITH COMPARISON TO HIGH WATER MARKS
PEAK FLOOD DEPTHS

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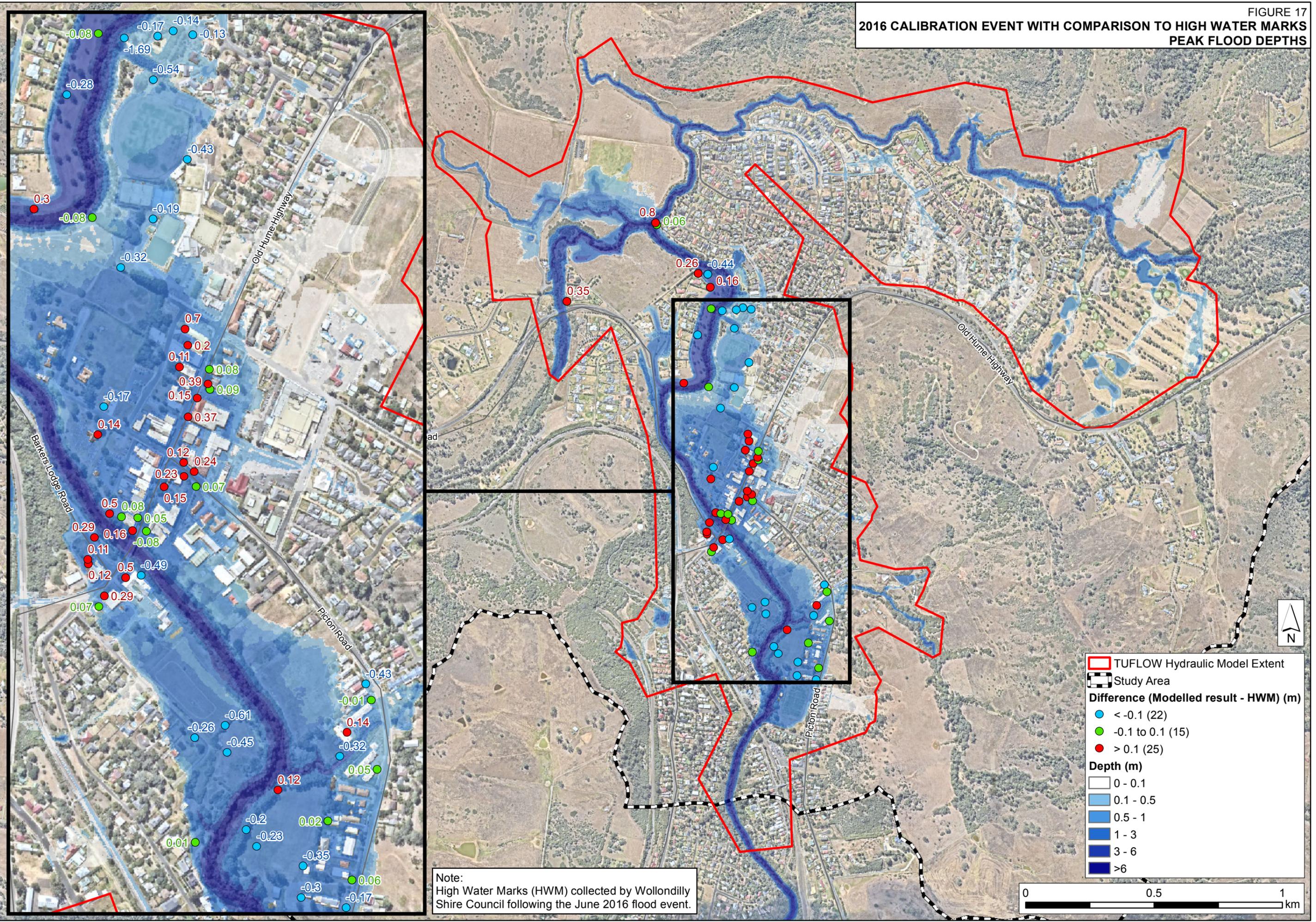


FIGURE 18
SPATIALLY VARYING IFD
1% AEP EVENT - 12 HOUR DURATION

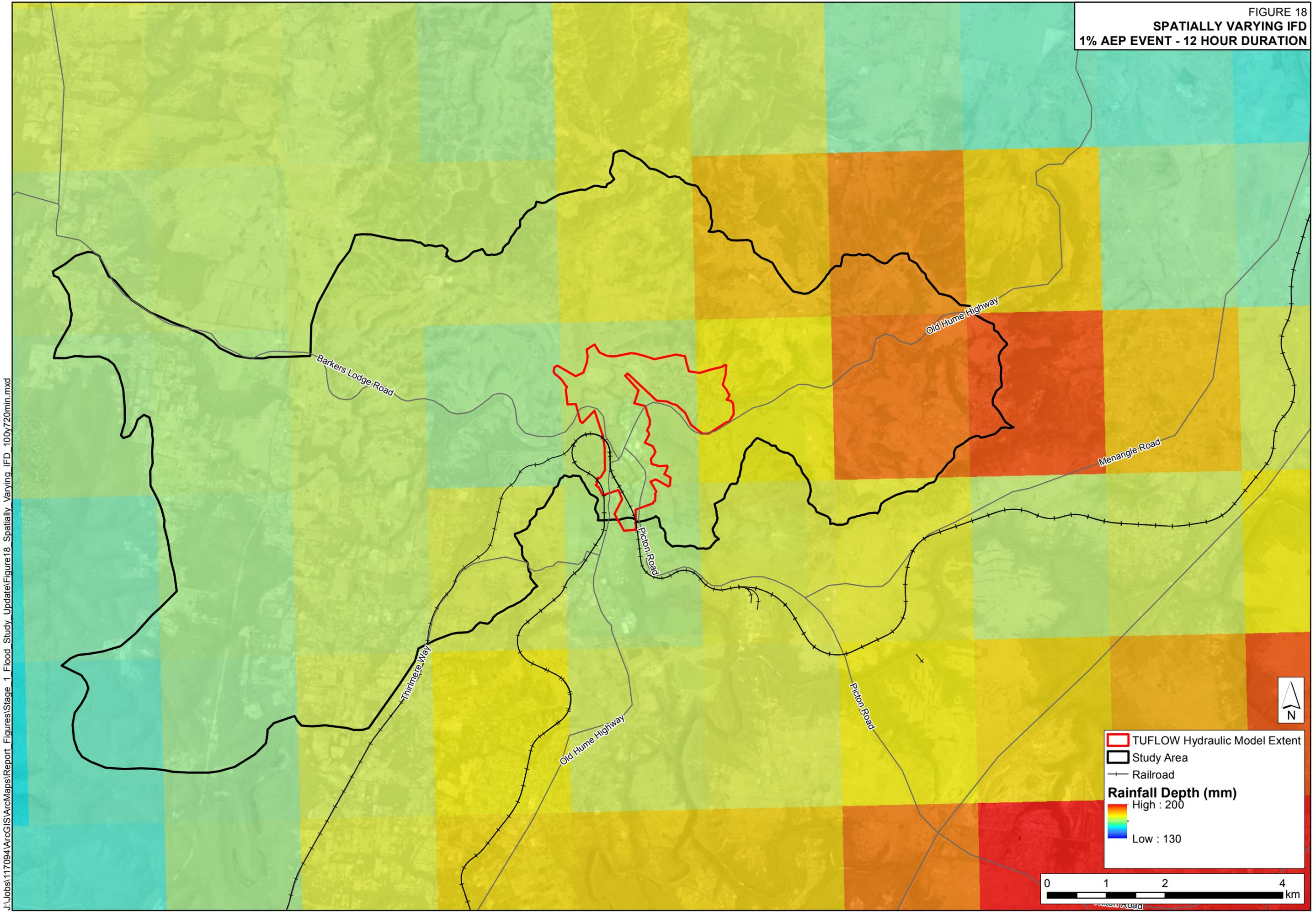
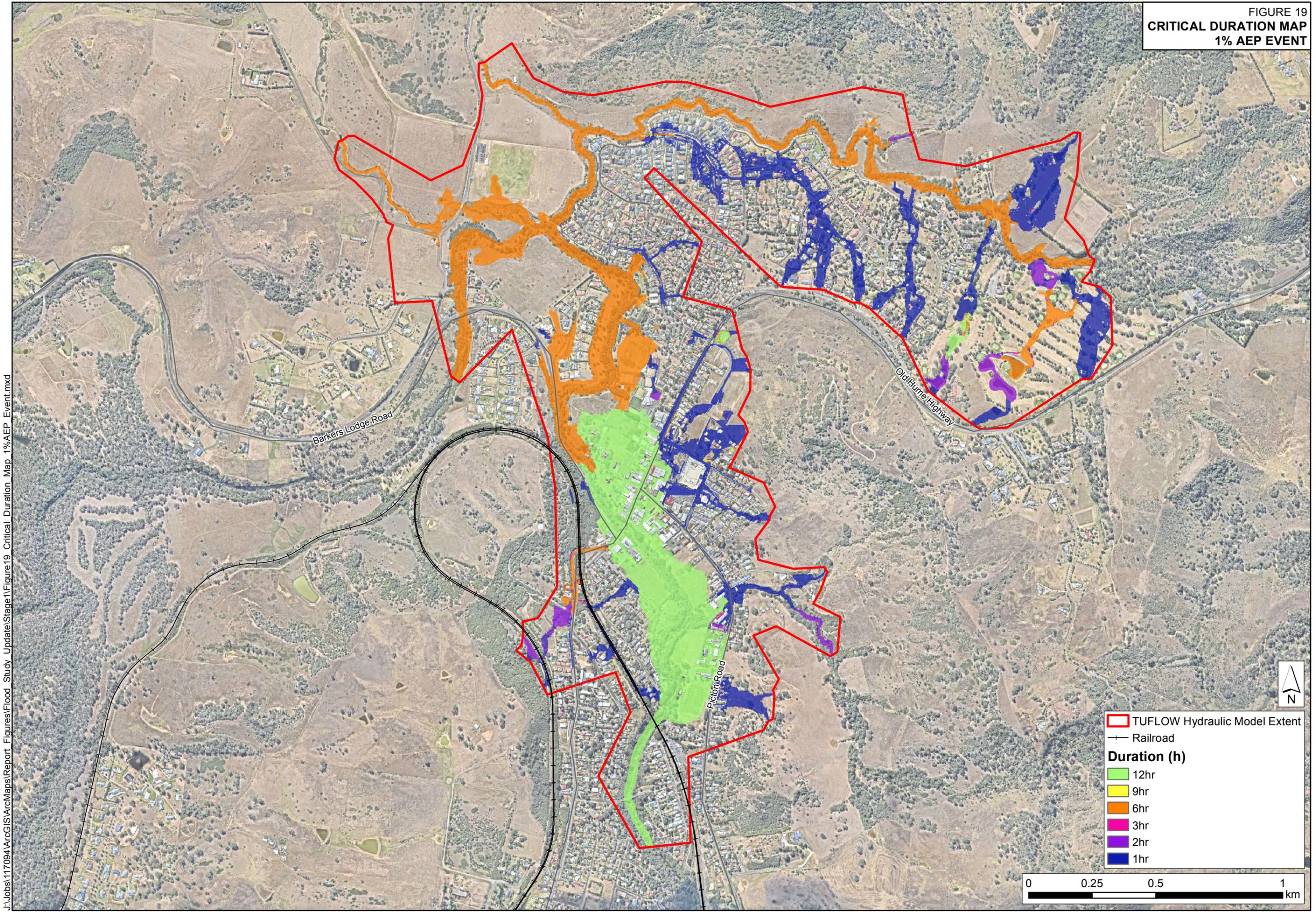


FIGURE 19
CRITICAL DURATION MAP
1% AEP EVENT



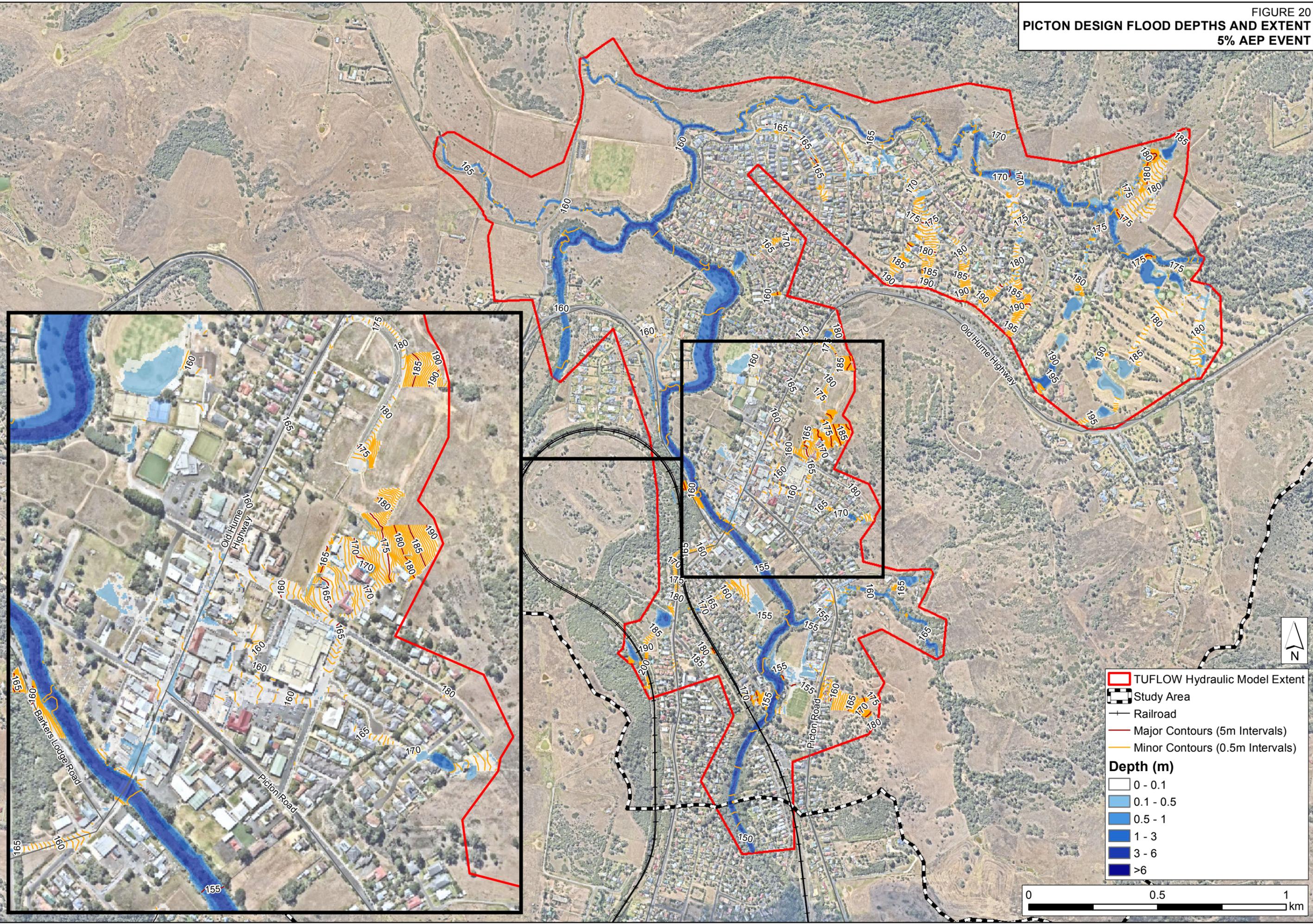
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Legend:

- TUFLOW Hydraulic Model Extent
- Railroad
- Duration (h)**
- 12hr
- 9hr
- 6hr
- 3hr
- 2hr
- 1hr

0 0.25 0.5 1 km

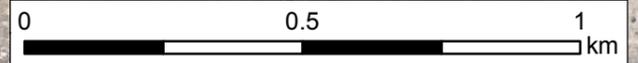
FIGURE 20
PICTON DESIGN FLOOD DEPTHS AND EXTENT
5% AEP EVENT



- TUFLOW Hydraulic Model Extent
- Study Area
- Railroad
- Major Contours (5m Intervals)
- Minor Contours (0.5m Intervals)

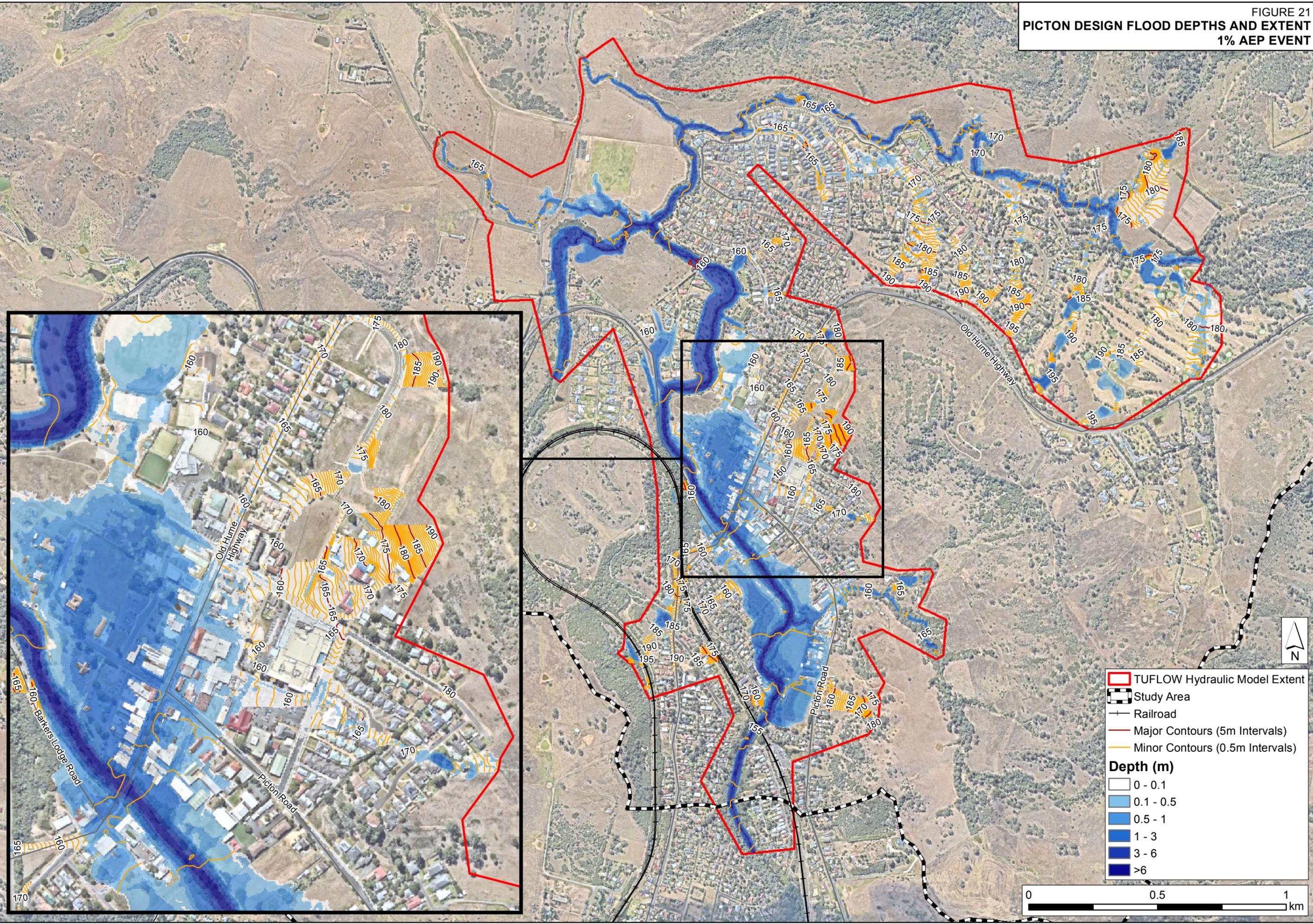
Depth (m)

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 6
- >6



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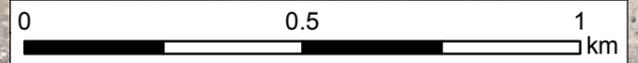
FIGURE 21
PICTON DESIGN FLOOD DEPTHS AND EXTENT
1% AEP EVENT



- TUFLOW Hydraulic Model Extent
- Study Area
- Railroad
- Major Contours (5m Intervals)
- Minor Contours (0.5m Intervals)

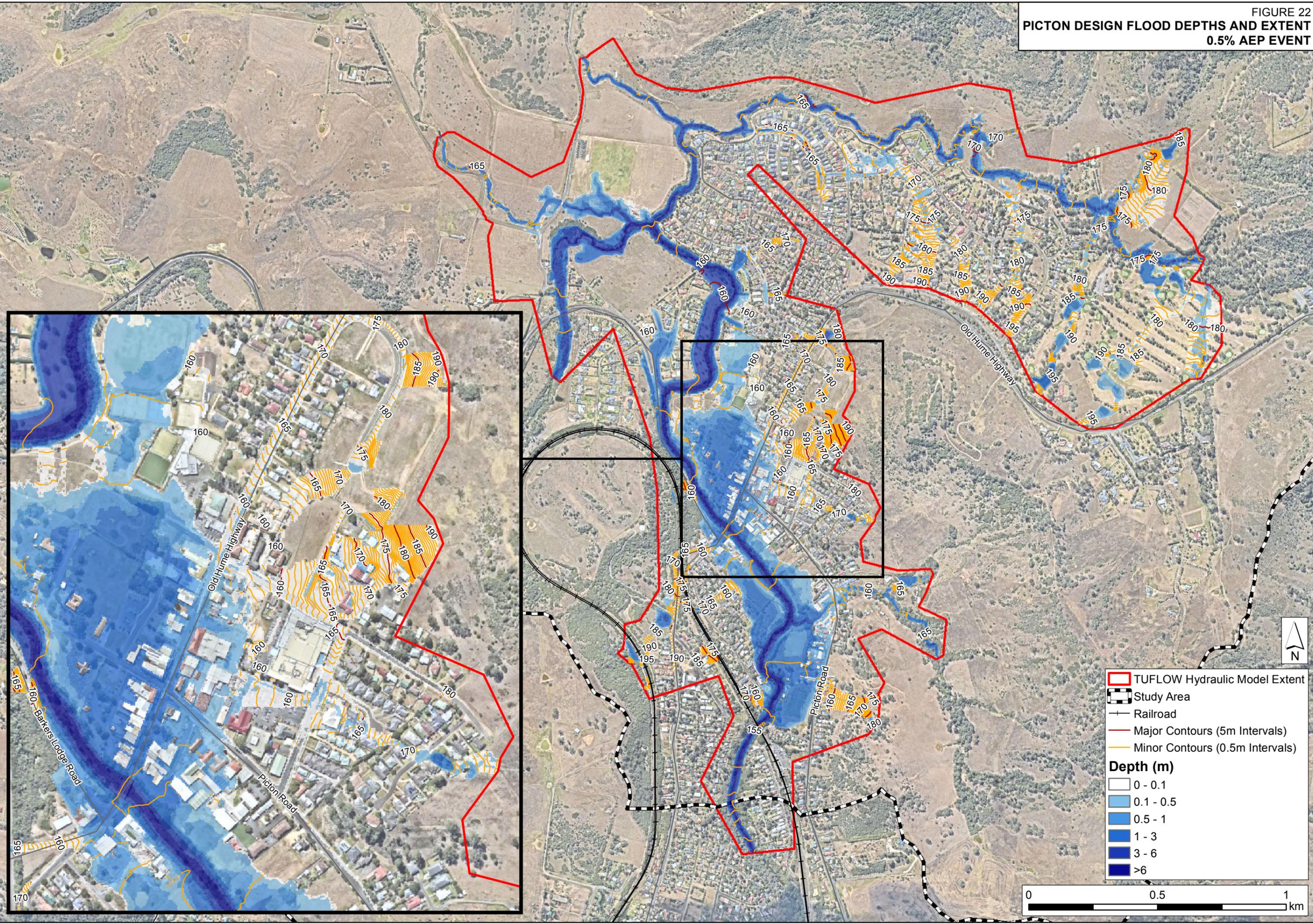
Depth (m)

	0 - 0.1
	0.1 - 0.5
	0.5 - 1
	1 - 3
	3 - 6
	>6



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FIGURE 22
PICTON DESIGN FLOOD DEPTHS AND EXTENT
0.5% AEP EVENT



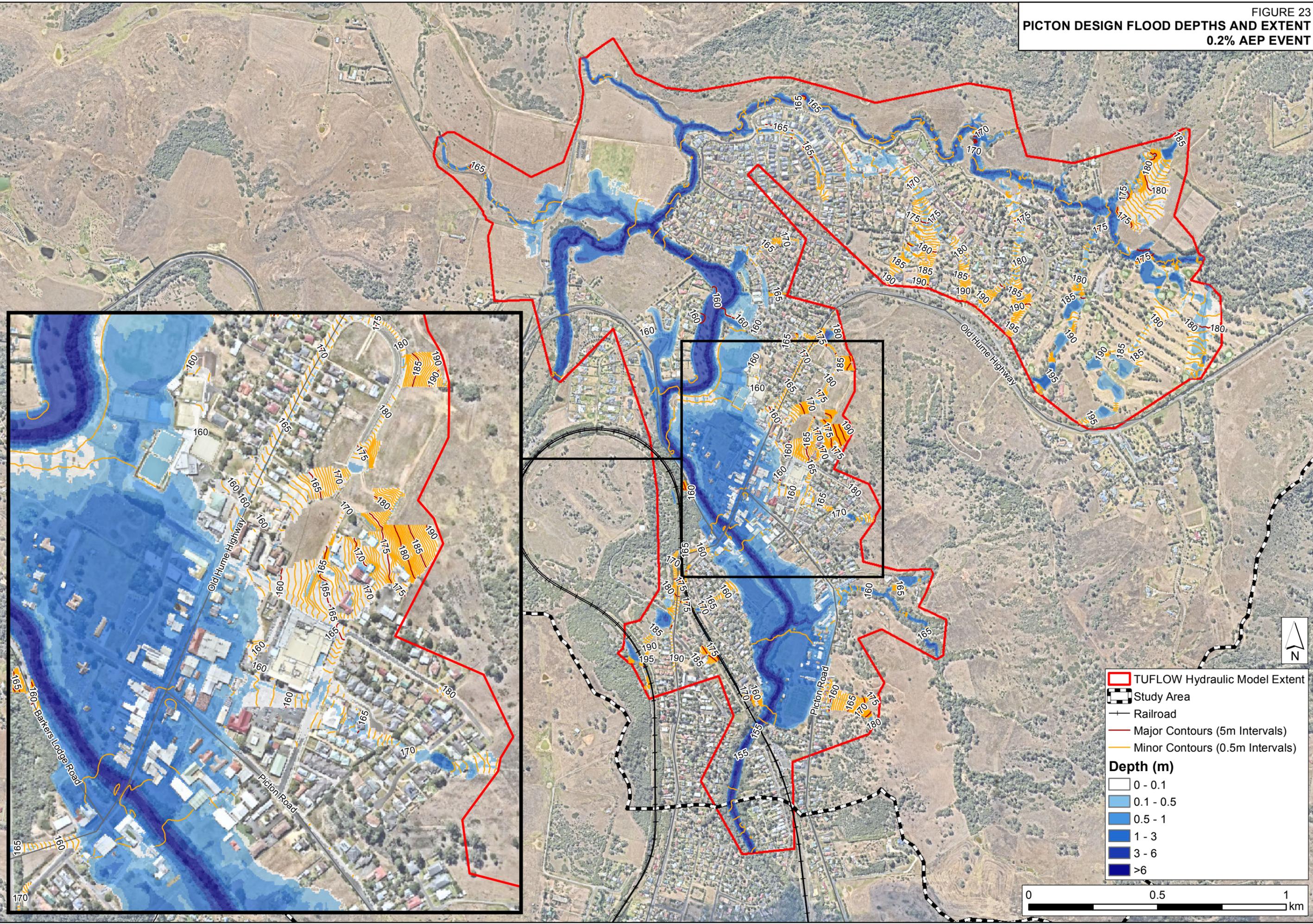
- TUFLOW Hydraulic Model Extent
- Study Area
- Railroad
- Major Contours (5m Intervals)
- Minor Contours (0.5m Intervals)

Depth (m)

	0 - 0.1
	0.1 - 0.5
	0.5 - 1
	1 - 3
	3 - 6
	>6

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FIGURE 23
PICTON DESIGN FLOOD DEPTHS AND EXTENT
0.2% AEP EVENT



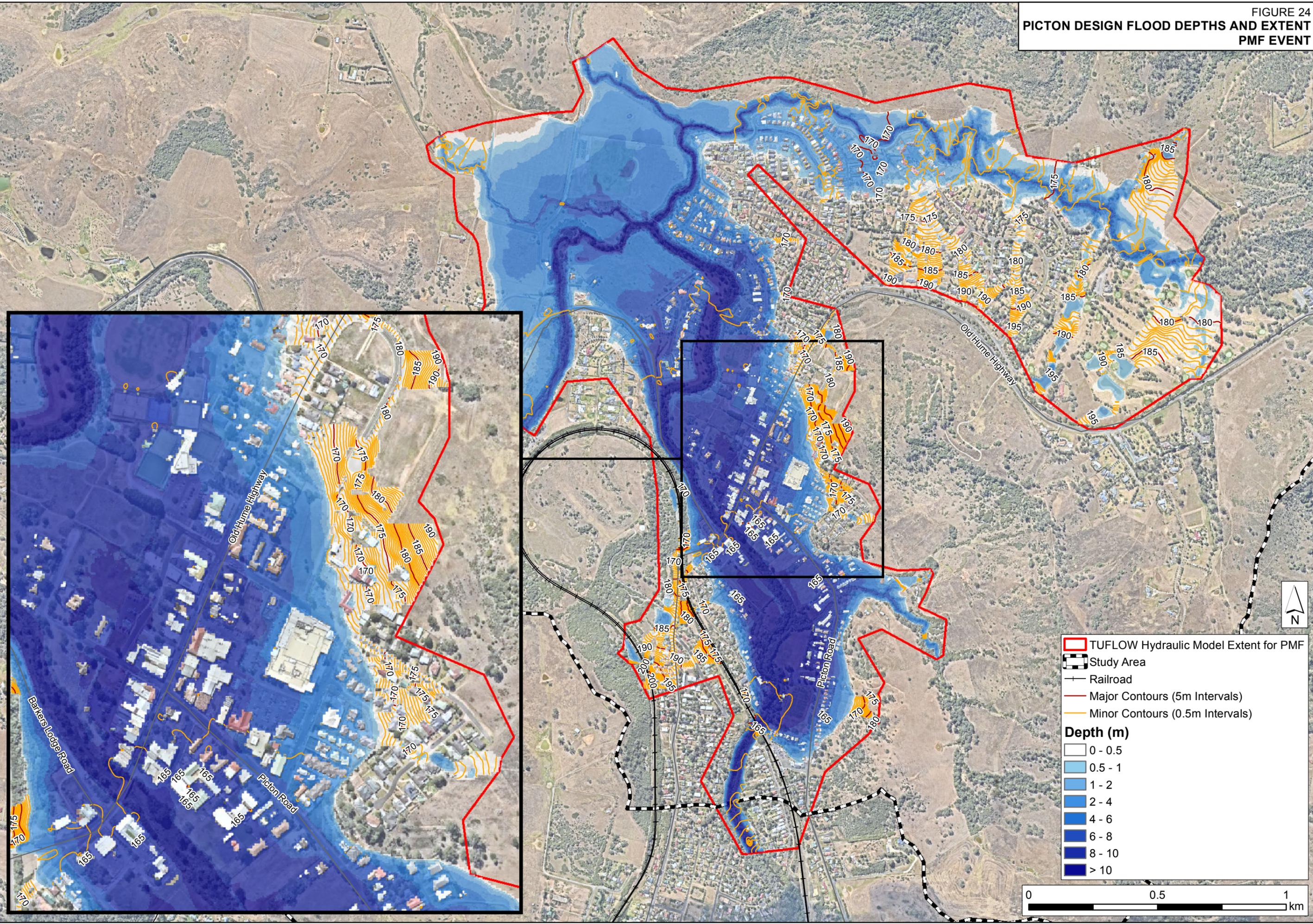
- TUFLOW Hydraulic Model Extent
- Study Area
- Railroad
- Major Contours (5m Intervals)
- Minor Contours (0.5m Intervals)

Depth (m)

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 6
- >6

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FIGURE 24
**PICTON DESIGN FLOOD DEPTHS AND EXTENT
 PMF EVENT**



TUFLOW Hydraulic Model Extent for PMF
 Study Area
 Railroad
 Major Contours (5m Intervals)
 Minor Contours (0.5m Intervals)

Depth (m)

	0 - 0.5
	0.5 - 1
	1 - 2
	2 - 4
	4 - 6
	6 - 8
	8 - 10
	> 10

FIGURE 25
PICTON DESIGN FLOOD VELOCITY
5% AEP EVENT

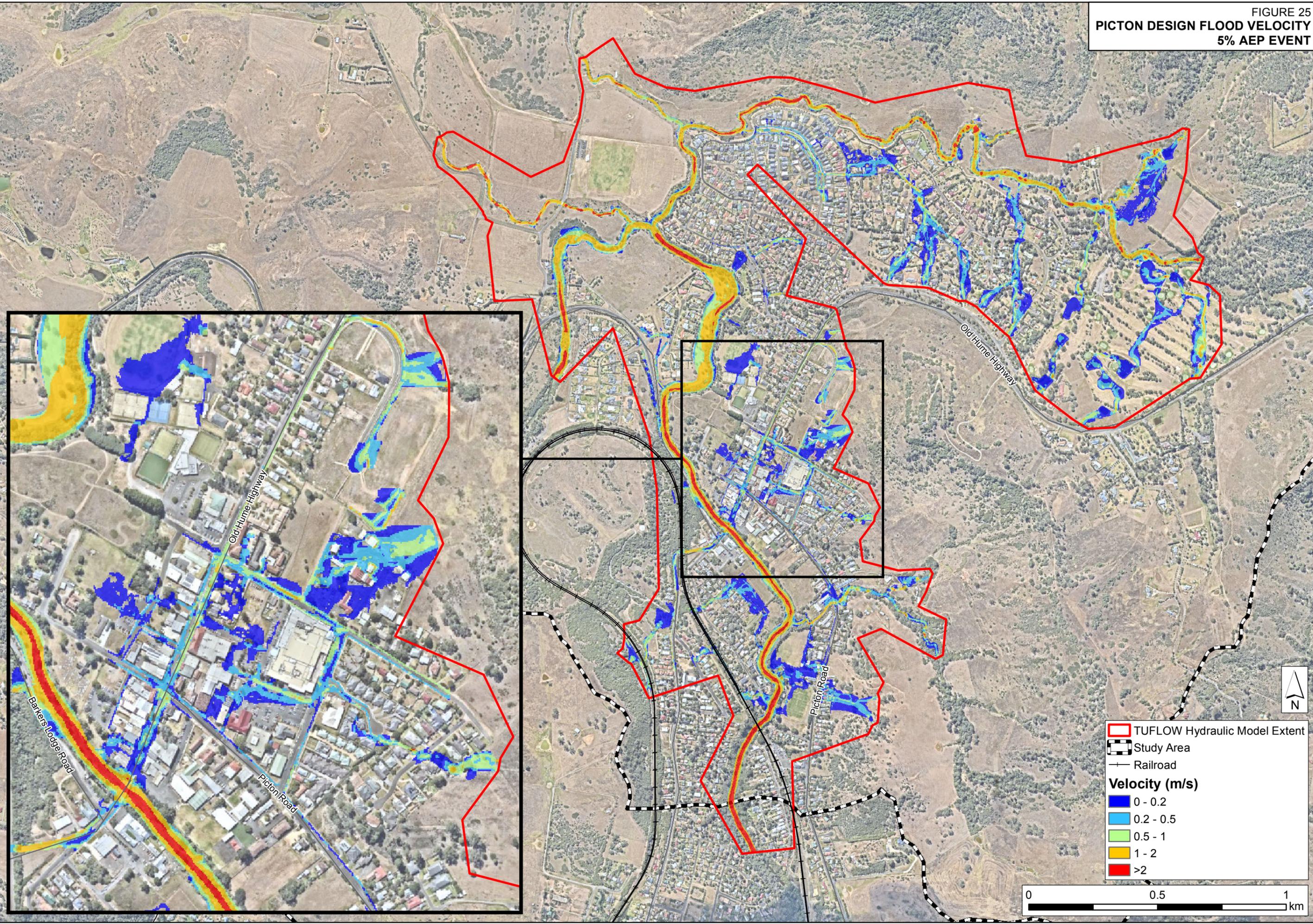


FIGURE 26
PICTON DESIGN FLOOD VELOCITY
1% AEP EVENT

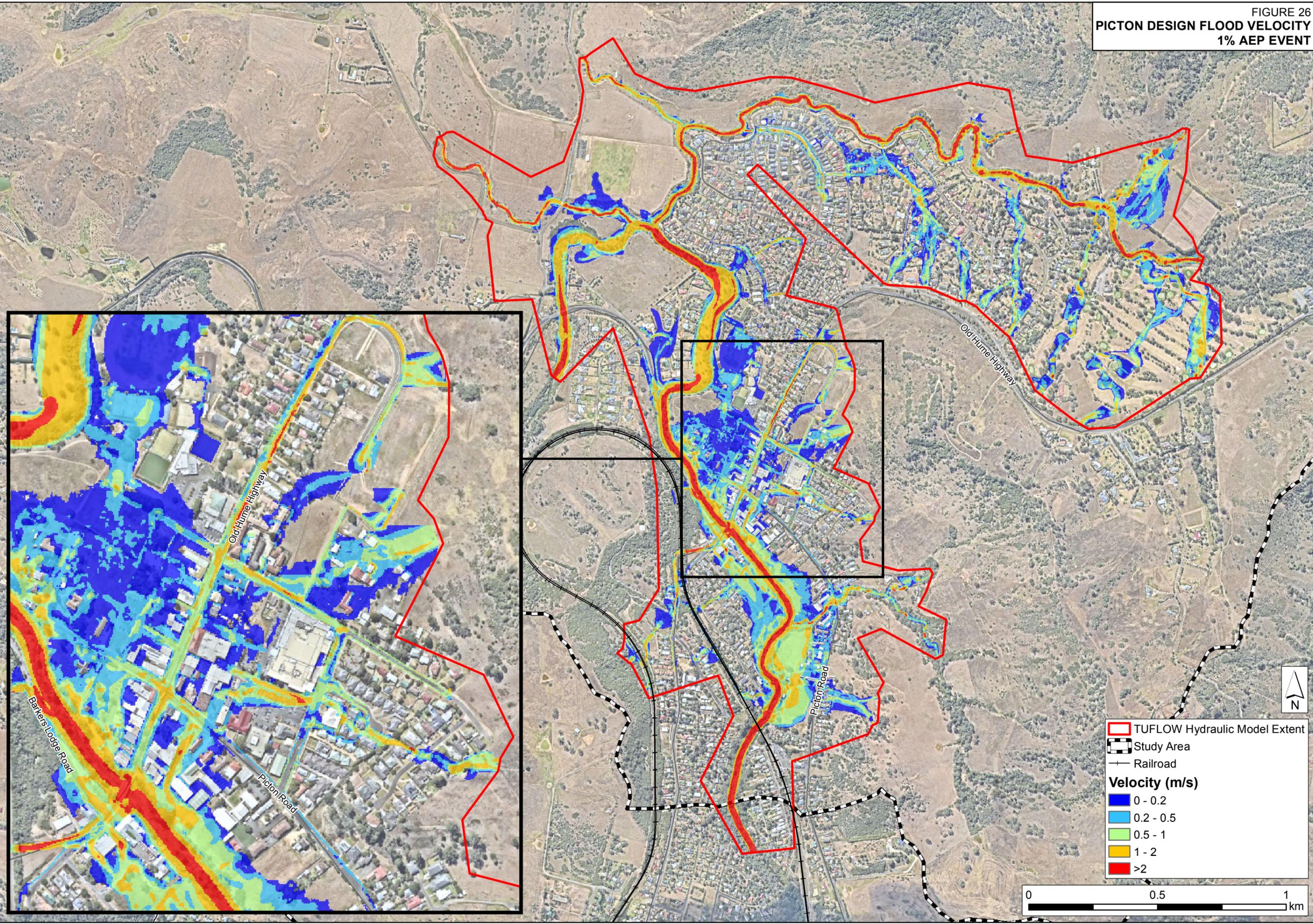
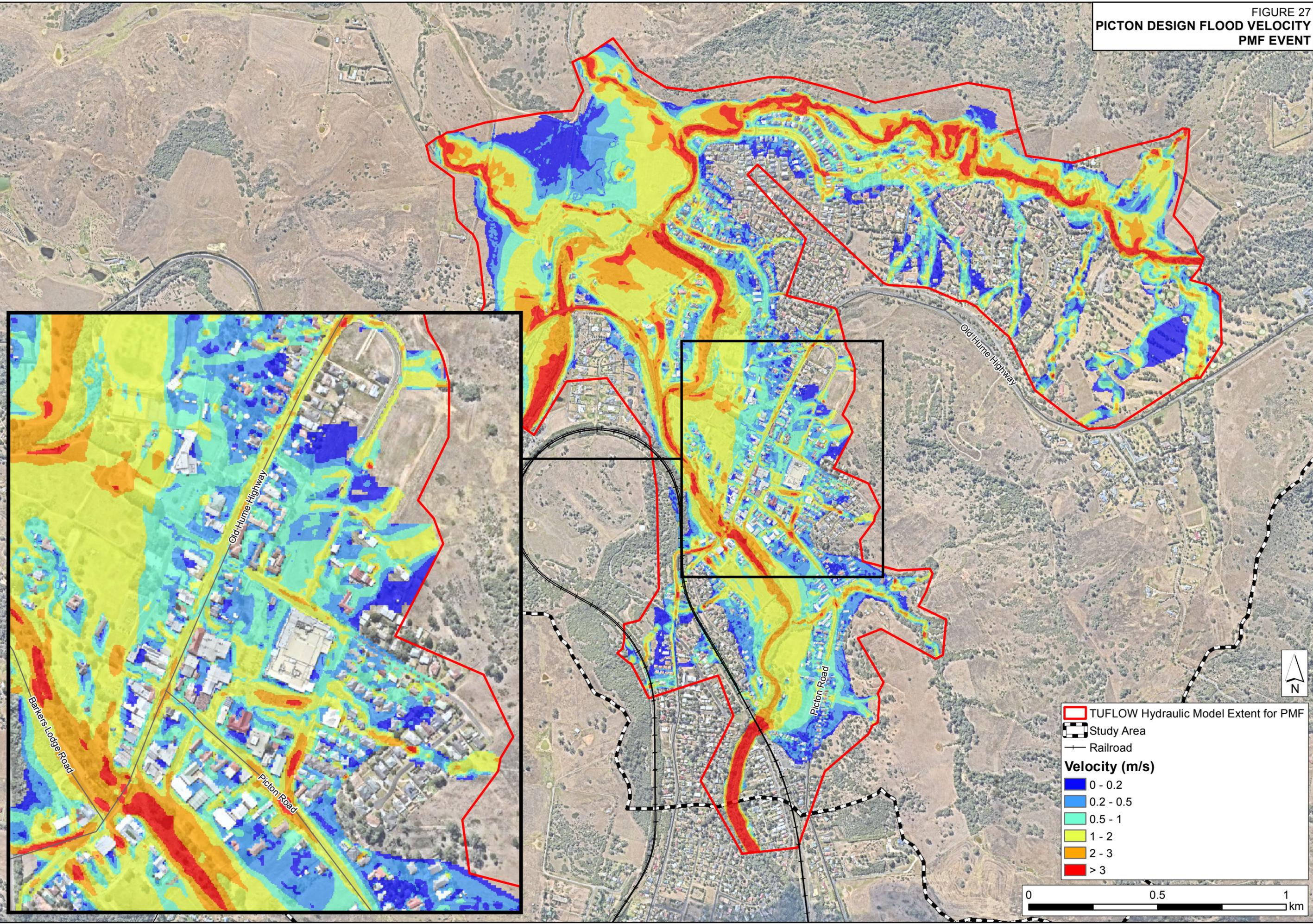


FIGURE 27
PICTON DESIGN FLOOD VELOCITY
PMF EVENT



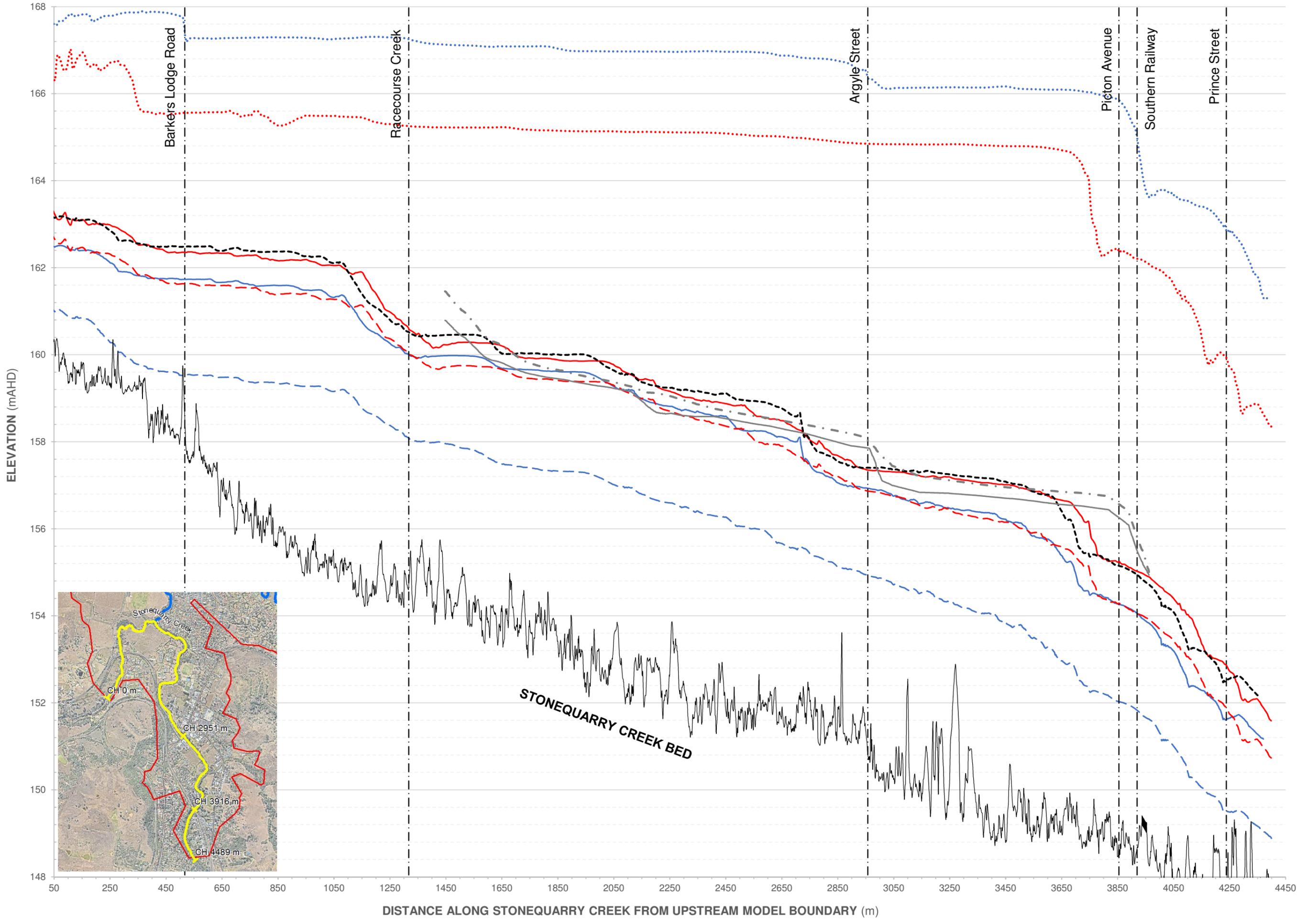


FIGURE 28
STONEQUARRY CREEK
PEAK WATER LEVEL PROFILE

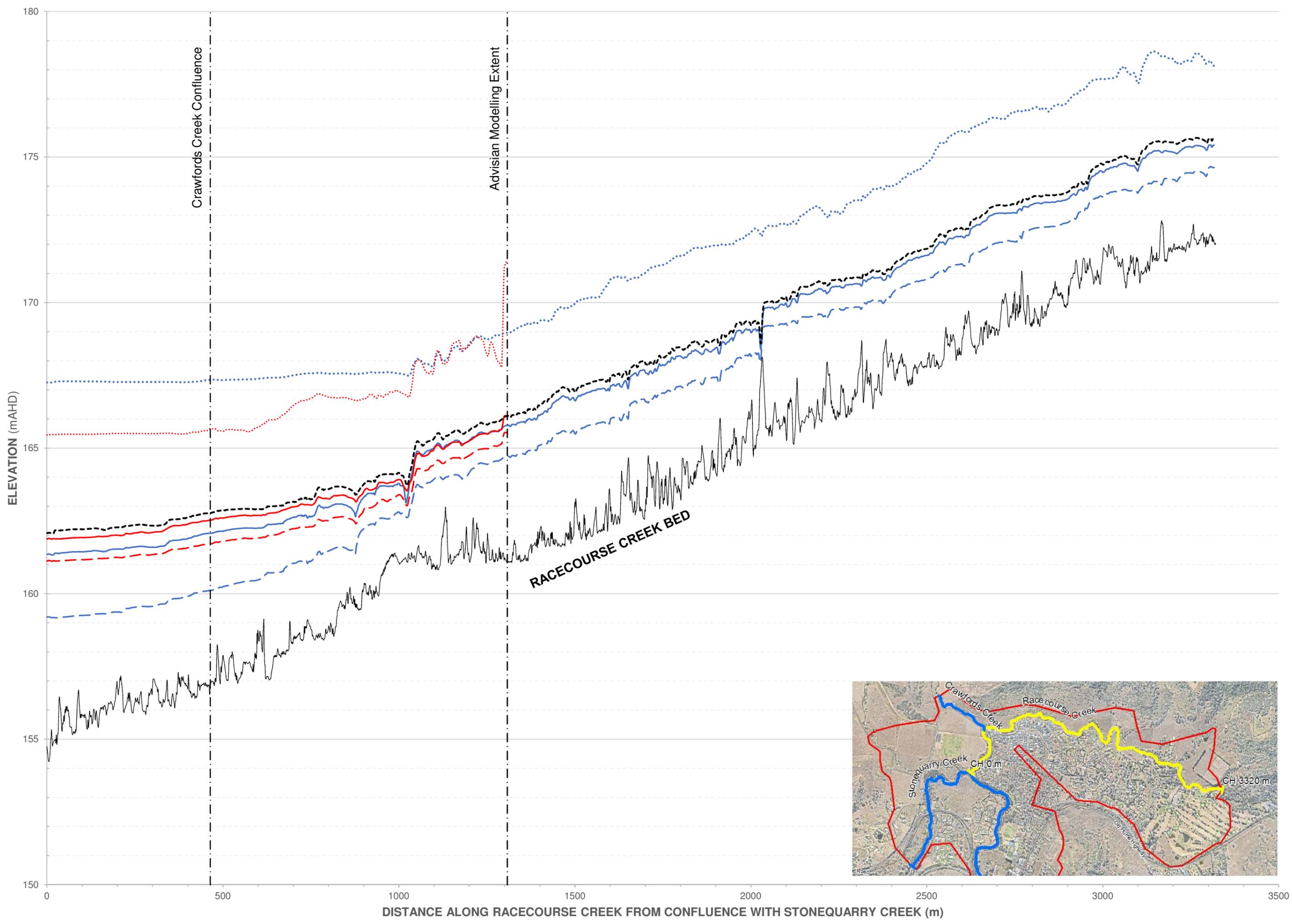
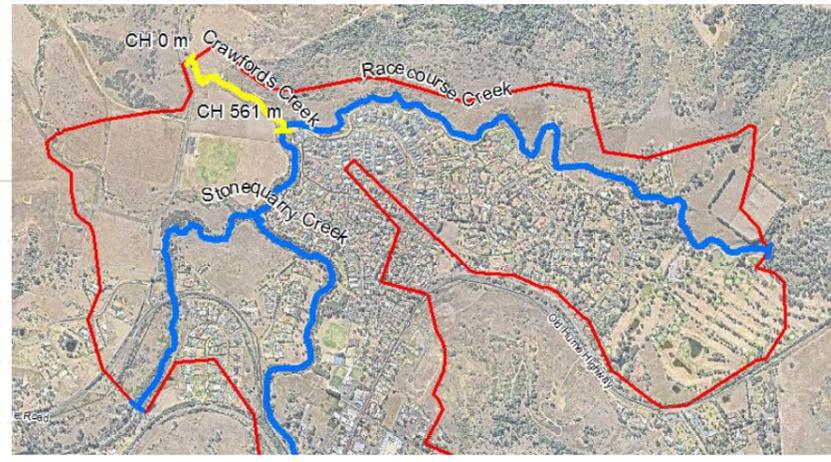
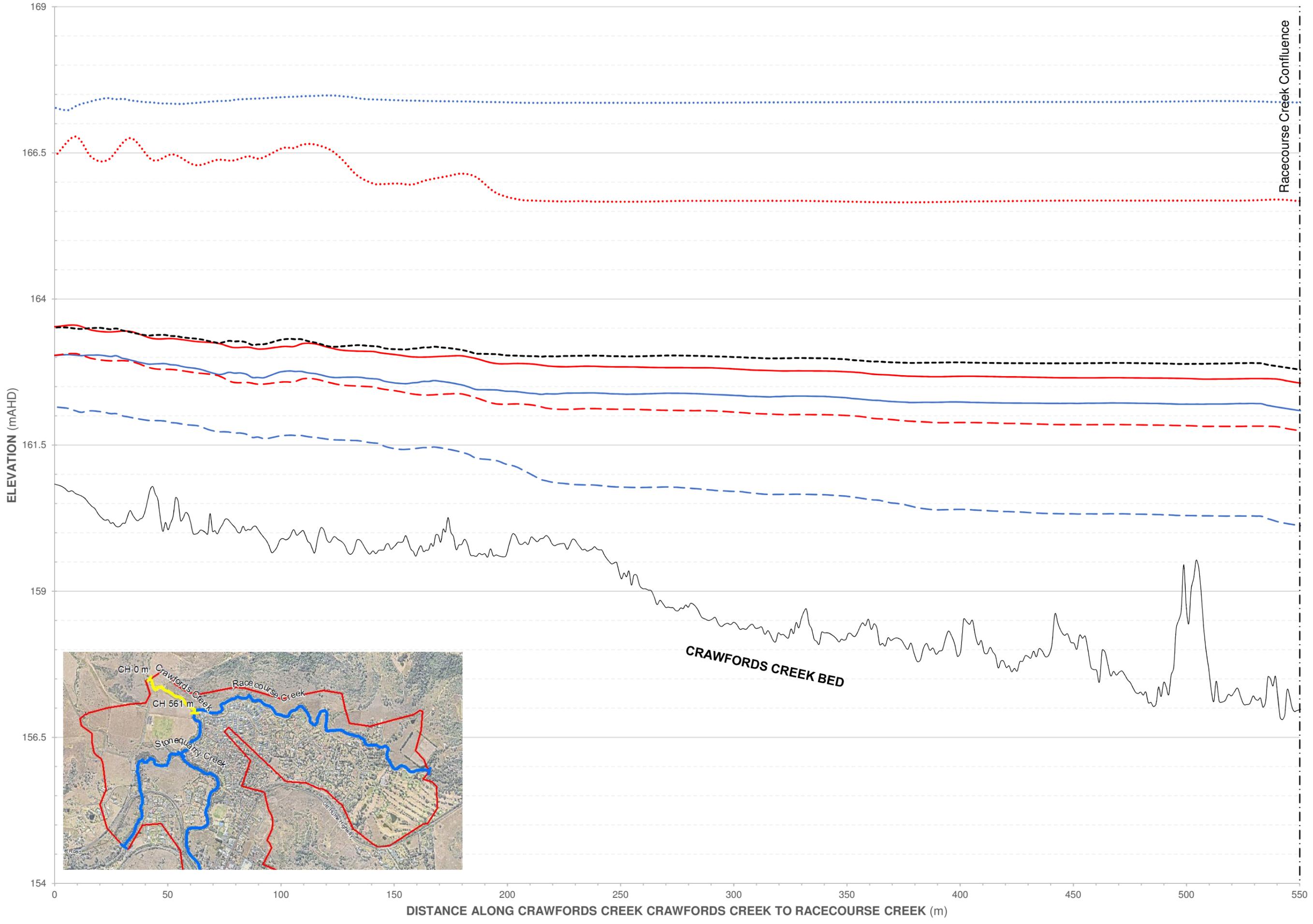


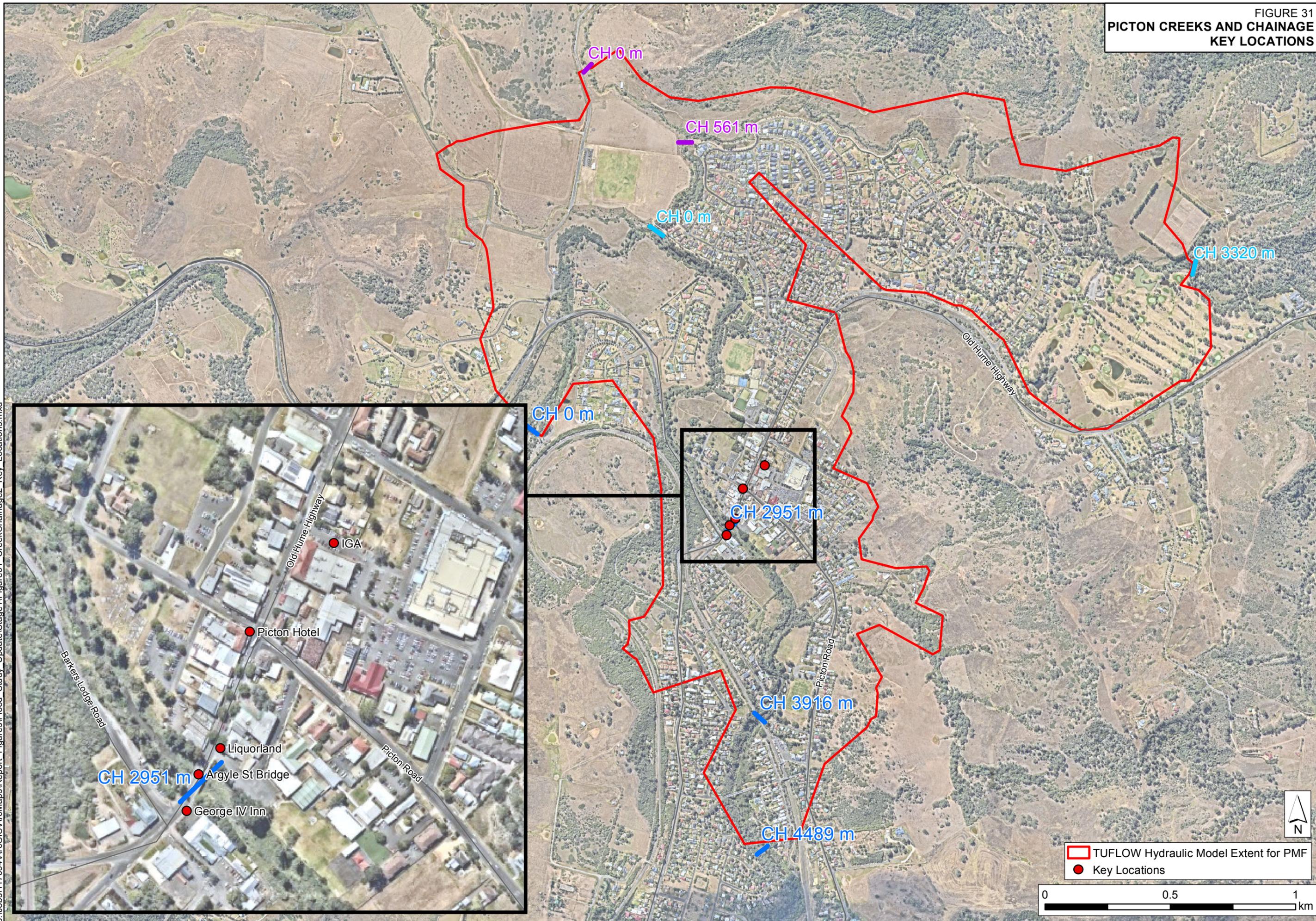
FIGURE 29
RACECOURSE CREEK
PEAK WATER LEVEL PROFILE



..... TUFLOW_PMF
 —— TUFLOW_1%AEP
 - - - TUFLOW_5%AEP
 RMA-2_PMF
 —— RMA-2_1%AEP
 - - - RMA-2_5%AEP
 - - - - JUN16_Event
 —— DEM

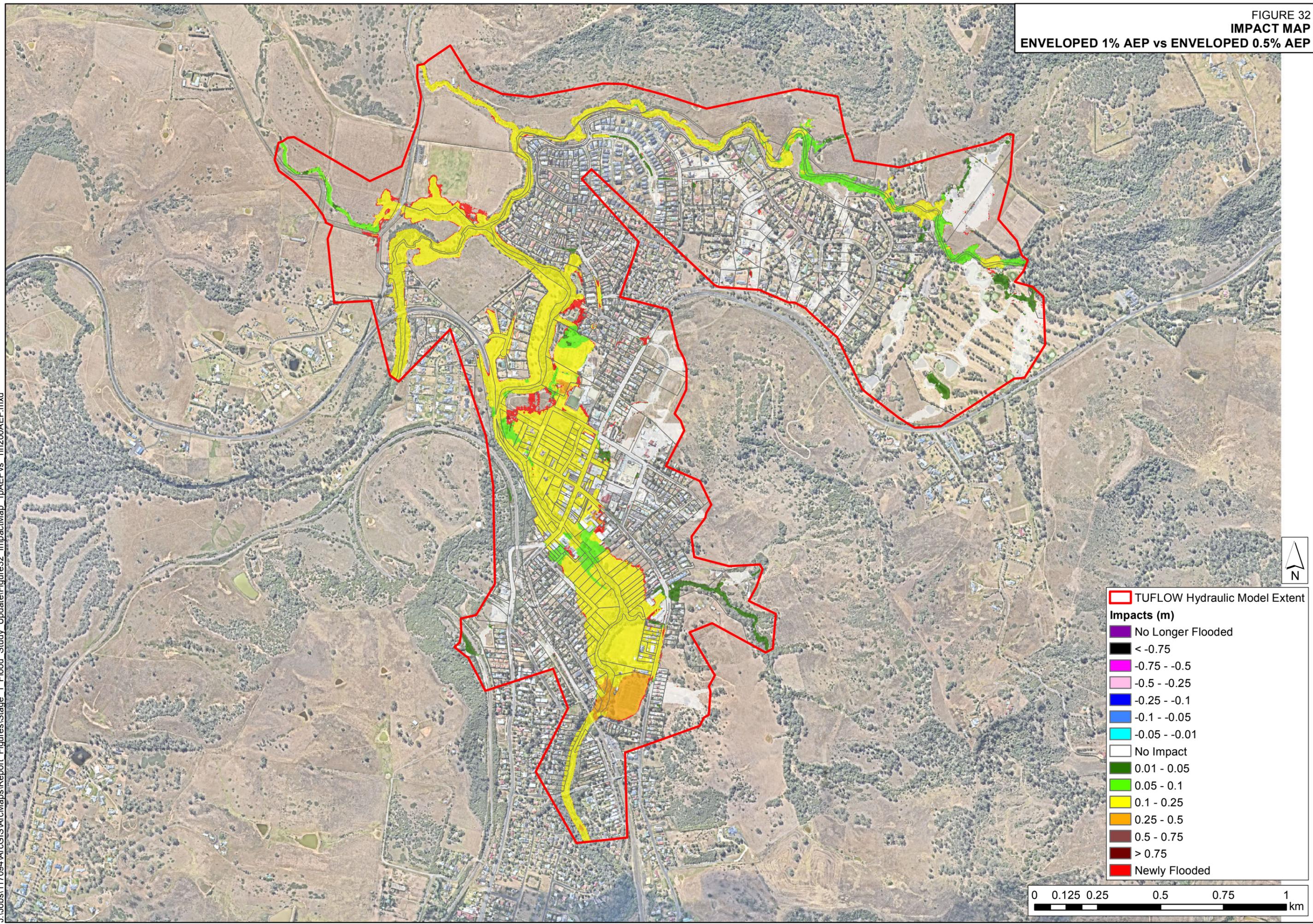
FIGURE 30
 CRAWFORDS CREEK
 PEAK WATER LEVEL PROFILE

FIGURE 31
PICTON CREEKS AND CHAINAGE
KEY LOCATIONS



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FIGURE 32
IMPACT MAP
ENVELOPED 1% AEP vs ENVELOPED 0.5% AEP

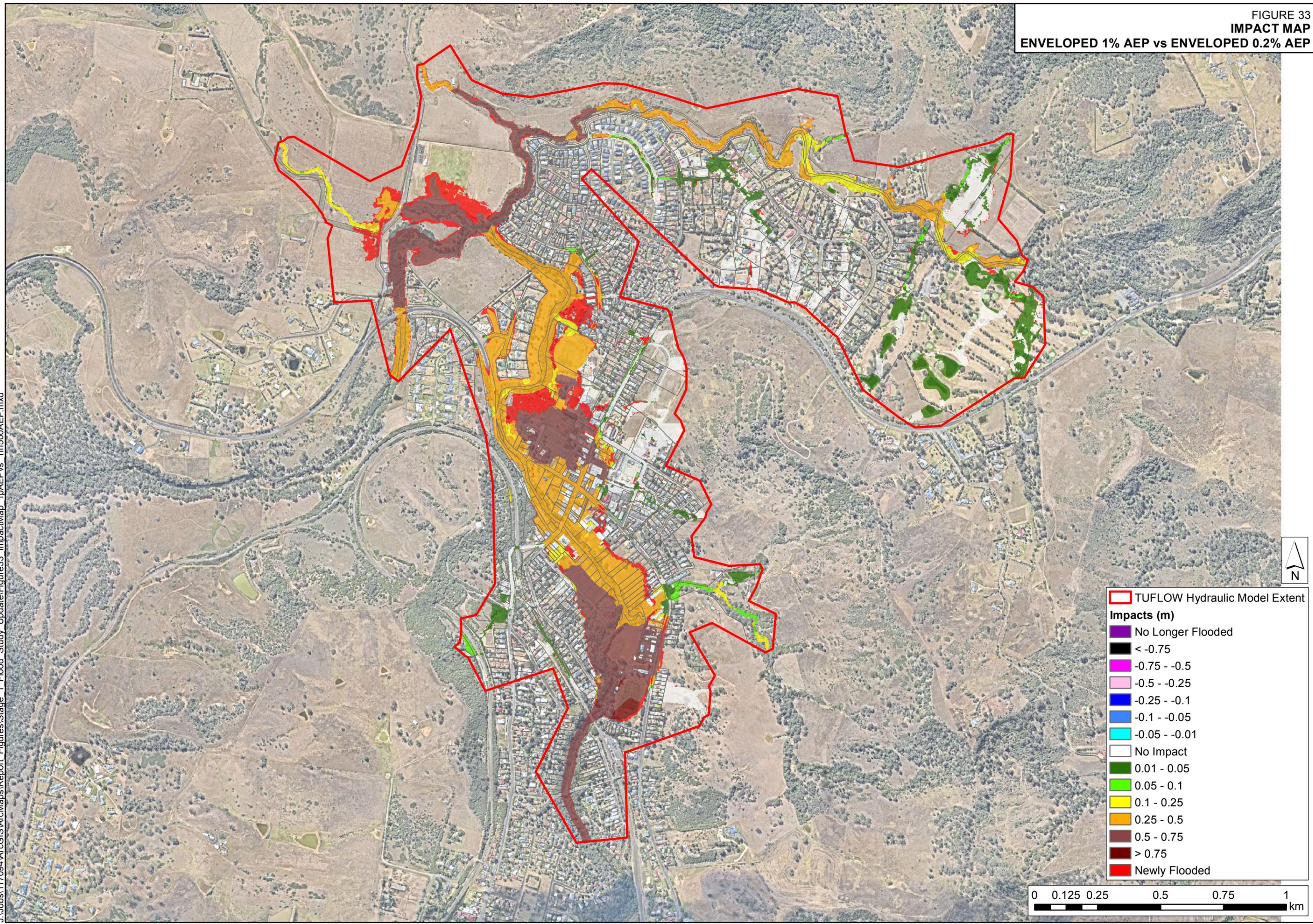


- TUFLOW Hydraulic Model Extent
- Impacts (m)**
- No Longer Flooded
- < -0.75
- 0.75 - -0.5
- 0.5 - -0.25
- 0.25 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Impact
- 0.01 - 0.05
- 0.05 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- > 0.75
- Newly Flooded

0 0.125 0.25 0.5 0.75 1 km



FIGURE 33
IMPACT MAP
ENVELOPED 1% AEP vs ENVELOPED 0.2% AEP



- TUFLOW Hydraulic Model Extent
- Impacts (m)**
- No Longer Flooded
- < -0.75
- 0.75 - -0.5
- 0.5 - -0.25
- 0.25 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Impact
- 0.01 - 0.05
- 0.05 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- > 0.75
- Newly Flooded

0 0.125 0.25 0.5 0.75 1 km

FIGURE 34
HYDRAULIC CATEGORISATION
5% AEP EVENT

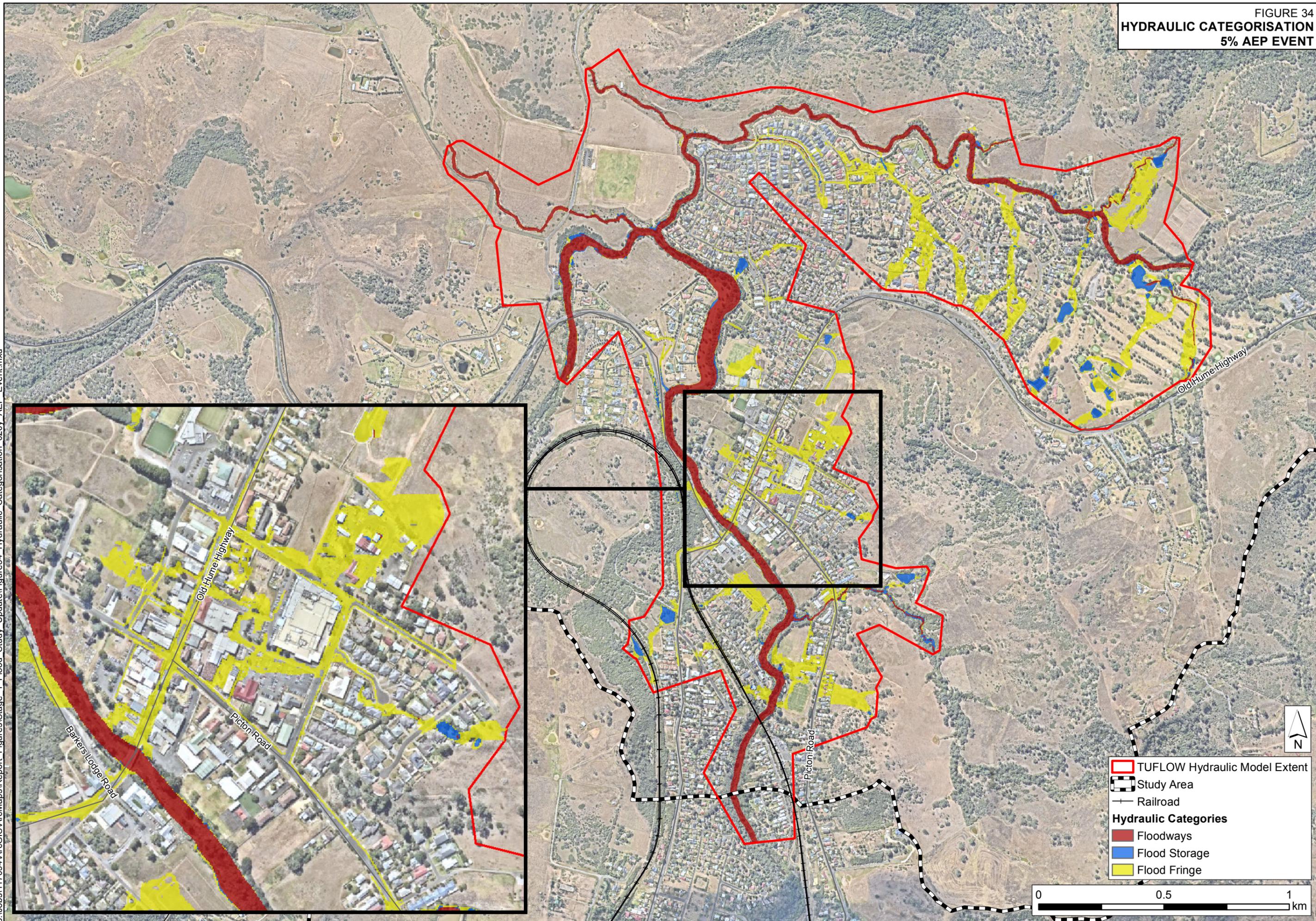


FIGURE 35
HYDRAULIC CATEGORISATION
1% AEP EVENT

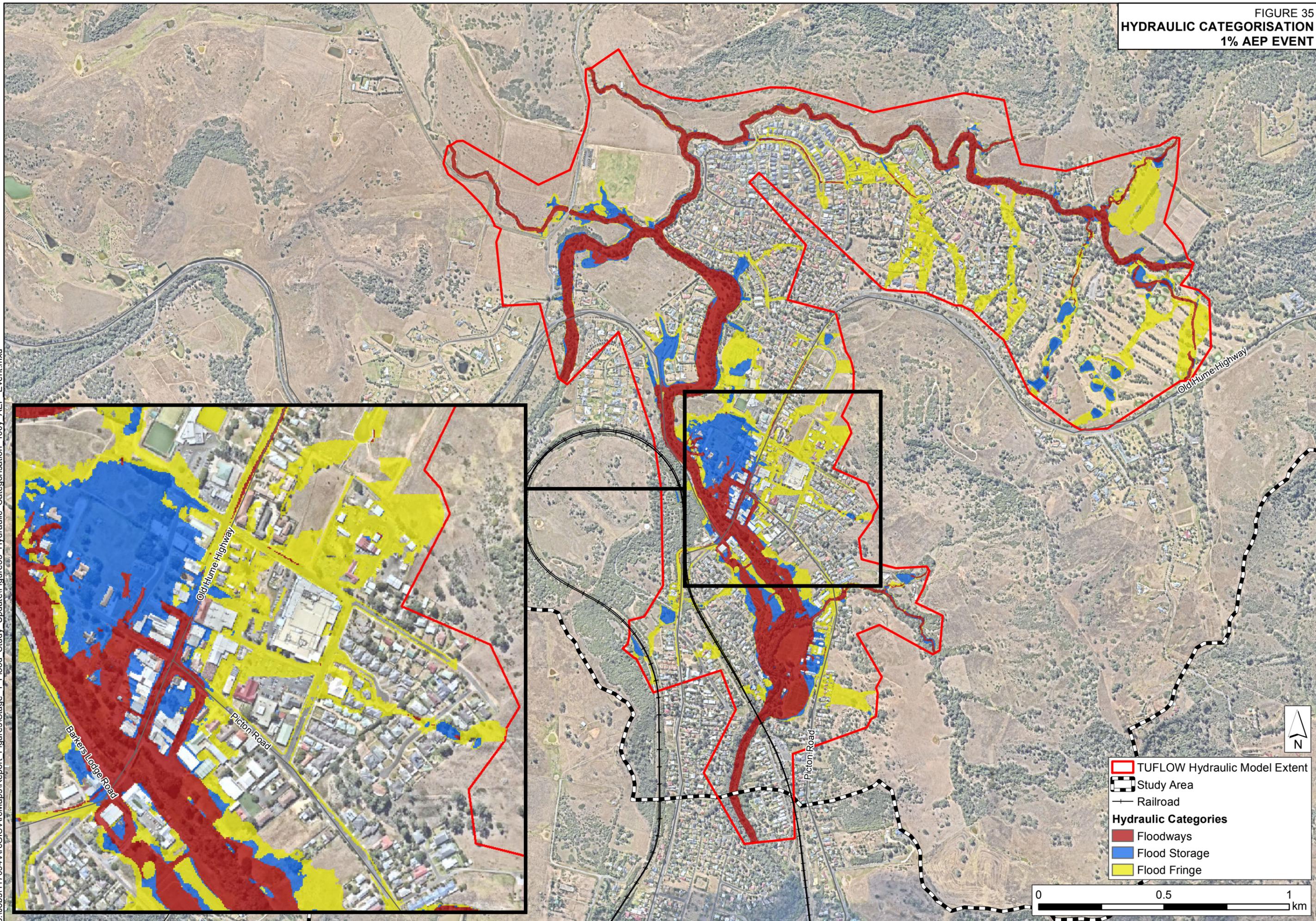


FIGURE 36
HYDRAULIC CATEGORISATION
PMF EVENT

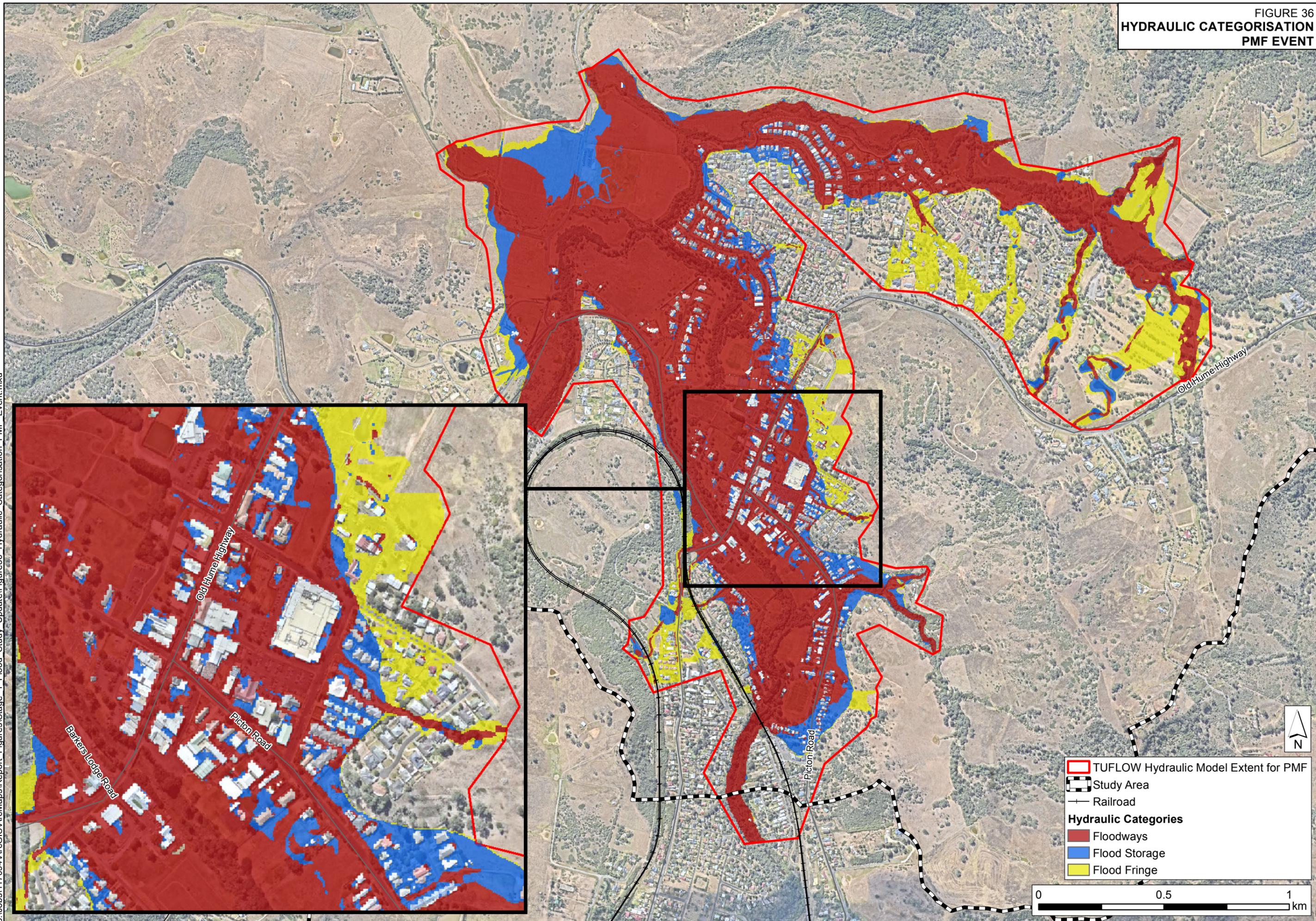
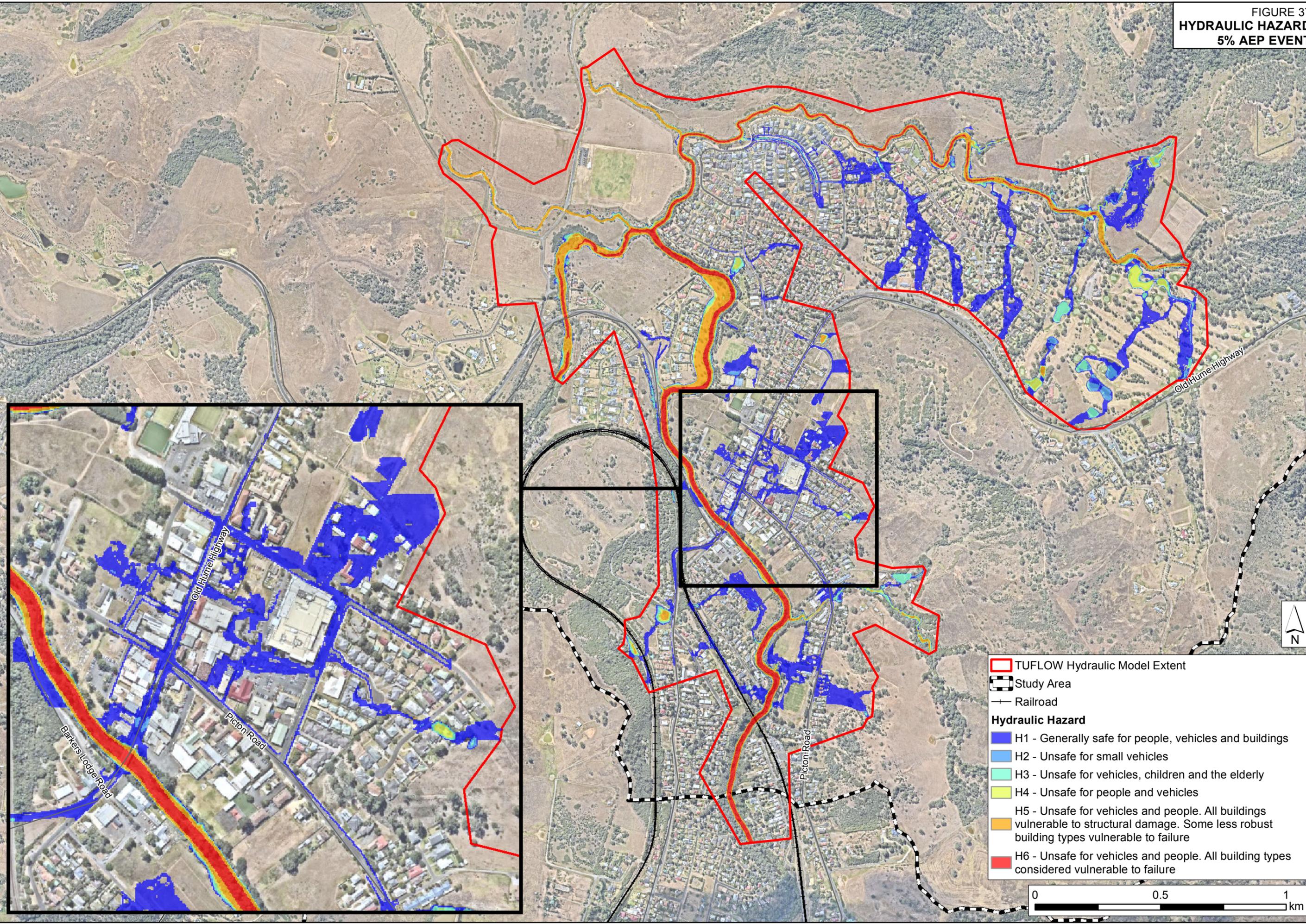


FIGURE 37
 HYDRAULIC HAZARD
 5% AEP EVENT



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TUFLOW Hydraulic Model Extent
 Study Area
 Railroad

Hydraulic Hazard

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure

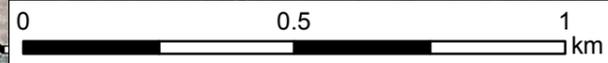
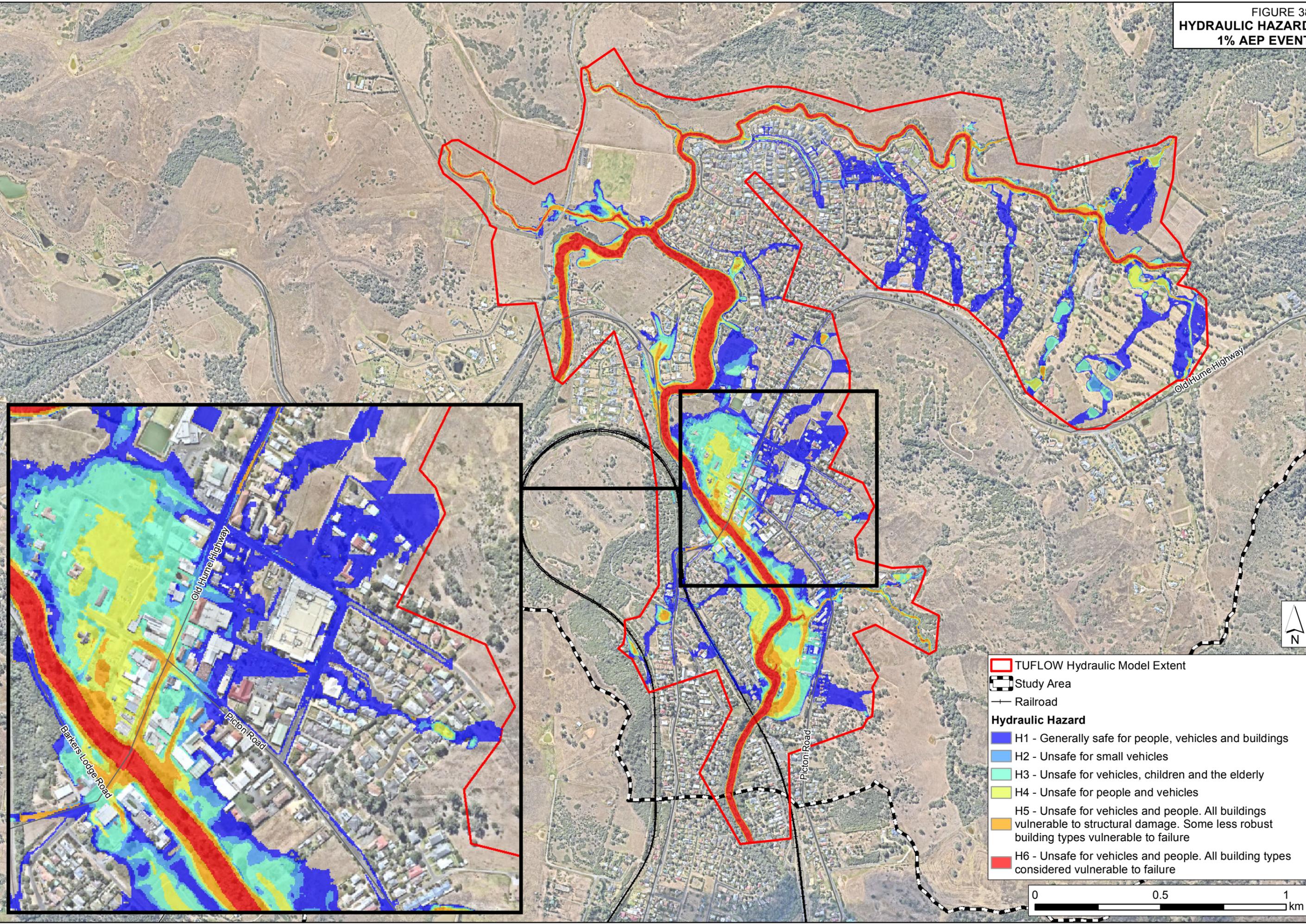


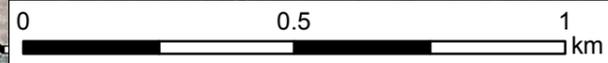
FIGURE 38
HYDRAULIC HAZARD
1% AEP EVENT



TUFLOW Hydraulic Model Extent
 Study Area
 Railroad

Hydraulic Hazard

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure



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FIGURE 39
HYDRAULIC HAZARD
PMF EVENT

