

QUEANBEYAN-PALERANG REGIONAL COUNCIL
QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

DECEMBER 2020

VOLUME 2 – FIGURES

COPYRIGHT NOTICE



This document, Queanbeyan Floodplain Risk Management Study and Plan 2020, is licensed under the [Creative Commons Attribution 4.0 Licence](#), unless otherwise indicated.

Please give attribution to: © Queanbeyan-Palerang Regional Council 2020

We also request that you observe and retain any notices that may accompany this material as part of the attribution.

Notice Identifying Other Material and/or Rights in this Publication:

The author of this document has taken steps to both identify third-party material and secure permission for its reproduction and reuse. However, please note that where these third-party materials are not licensed under a Creative Commons licence, or similar terms of use, you should obtain permission from the rights holder to reuse their material beyond the ways you are permitted to use them under the [Copyright Act 1968](#). Please see the Table of References at the rear of this document for a list identifying other material and/or rights in this document.

Further Information

For further information about the copyright in this document, please contact:

Queanbeyan-Palerang Regional Council

256 Crawford Street, Queanbeyan

council@qprc.nsw.gov.au

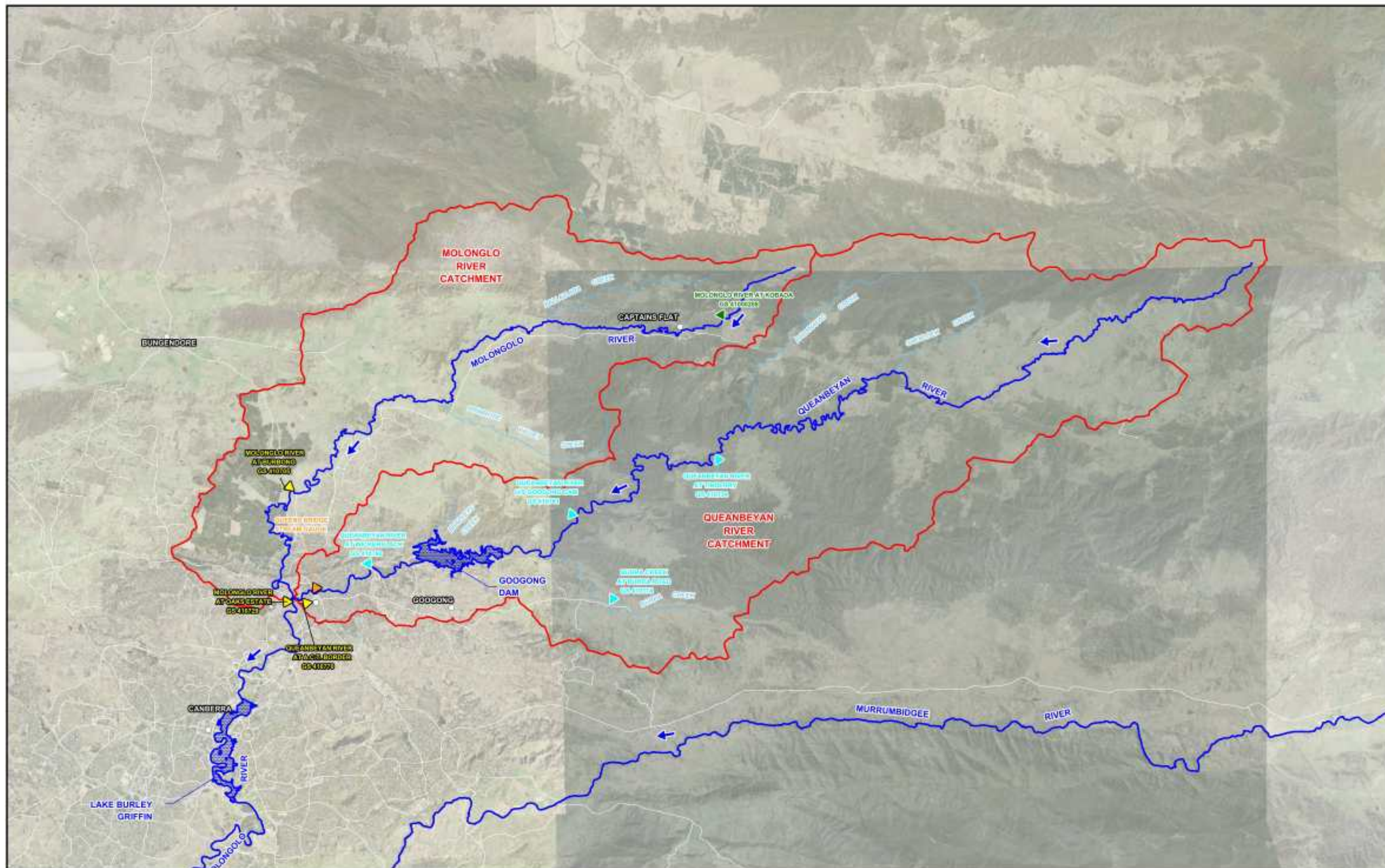
1300 735 025

DISCLAIMER

The [Creative Commons Attribution 4.0 Licence](#) contains a Disclaimer of Warranties and Limitation of Liability. In addition: ***This document (and its associated data or other collateral materials, if any, collectively referred to herein as the 'document') were produced by Lyall & Associates Consulting Water Engineers for Queanbeyan-Palerang Regional Council only. The views expressed in the document are those of the author(s) alone, and do not necessarily represent the views of the Queanbeyan-Palerang Regional Council. Reuse of this study or its associated data by anyone for any other purpose could result in error and/or loss. You should obtain professional advice before making decisions based upon the contents of this document.***

LIST OF FIGURES

- 1.1 Study Location Plan
- 2.1 Existing Drainage System at Queanbeyan (2 sheets)
- 2.2 Indicative Extent and Depths of Inundation - 1% AEP (2 Sheets)
- 2.3 Indicative Extent and Depths of Inundation - PMF (2 Sheets)
- 2.4 Design Water Surface Profiles – Queanbeyan and Molonglo Rivers (2 Sheets)
- 2.5 Time of Rise of Floodwaters at Location of Bridge Crossings
- 2.6 Rate of Rise of Floodwaters at Queens Bridge
- 2.7 Indicative Extent and Depths of Inundation – Local Catchment Flooding in Queanbeyan CBD - 1% AEP
- 2.8 Indicative Extent of Inundation and Location of Vulnerable Development and Critical Infrastructure (2 Sheets)
- 2.9 Potential Impact of Future Urbanisation on Local Catchment Flooding Patterns in Vicinity of Queanbeyan CBD – 1% AEP
- 2.10 Potential Impact of a 10% Increase in Rainfall Intensities on Flooding Patterns – 1% AEP (2 Sheets)
- 2.11 Potential Impact of a 30% Increase in Rainfall Intensities on Flooding Patterns – 1% AEP (2 Sheets)
- 2.12 Flood Hazard and Hydraulic Categorisation of Floodplain - 1% AEP (2 Sheets)
- 2.13 Flood Hazard and Hydraulic Categorisation of Floodplain – Local Catchment Flooding in Vicinity of Queanbeyan CBD - 1% AEP
- 2.14 Queanbeyan LEP 2012 Zoning
- 3.1 Potential CBD Levee Alignments
- 3.2 Longitudinal Sections along Potential CBD Levee Alignments
- 3.3 Typical Cross Sections Showing Kings Highway Upgrade Options
- 3.4 Impact of Kings Highway Upgrade Option 1D on Main Stream Flood Behaviour
- 3.5 Impact of Kings Highway Upgrade Option 2A on Main Stream Flood Behaviour
- 3.6 Flood Emergency Response Planning Classifications – 1% AEP (2 Sheets)
- 3.7 Flood Emergency Response Planning Classifications – PMF (2 Sheets)



2500 0 2500 5000 7500 m

Scale: 1:250,000

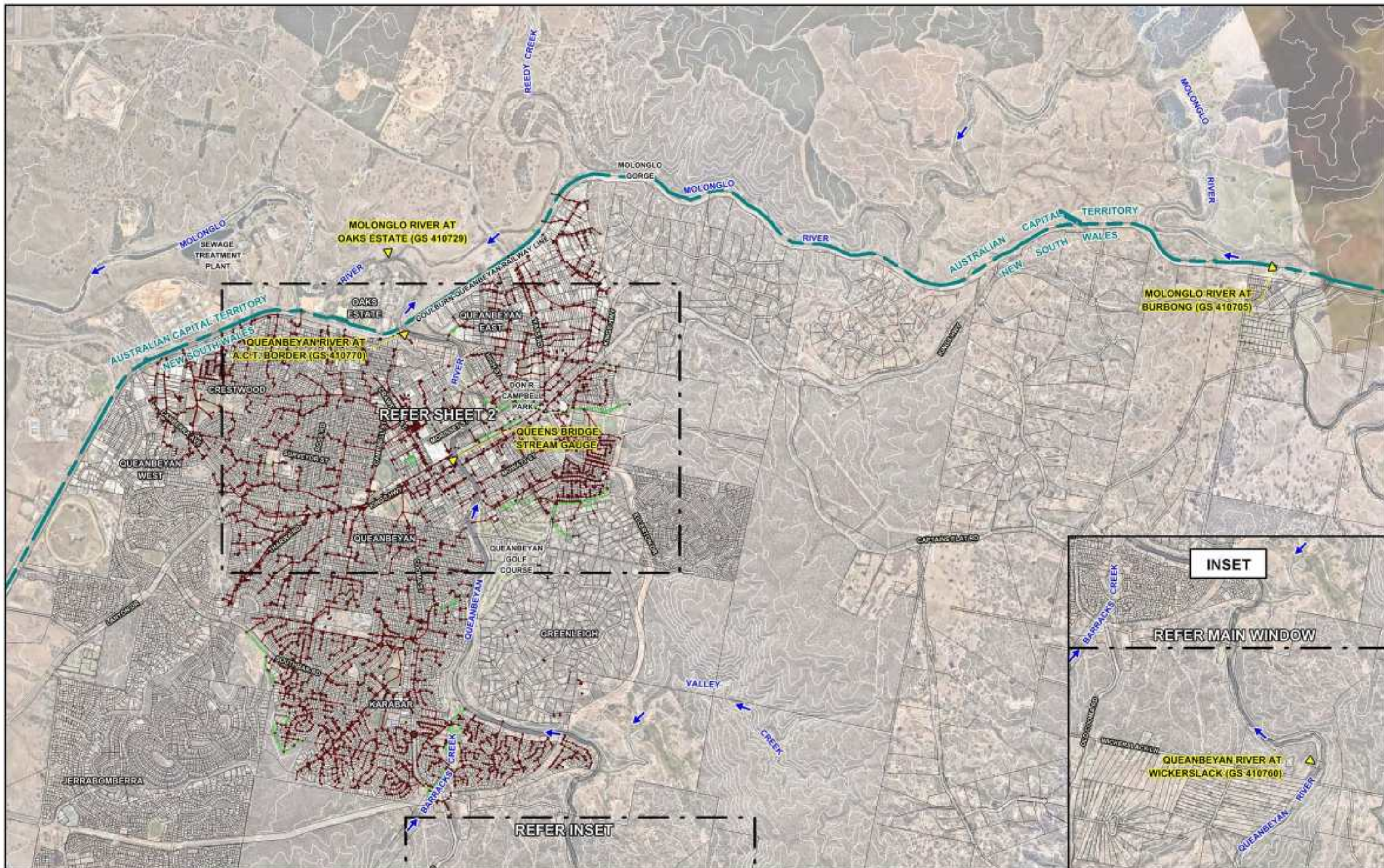
LEGEND

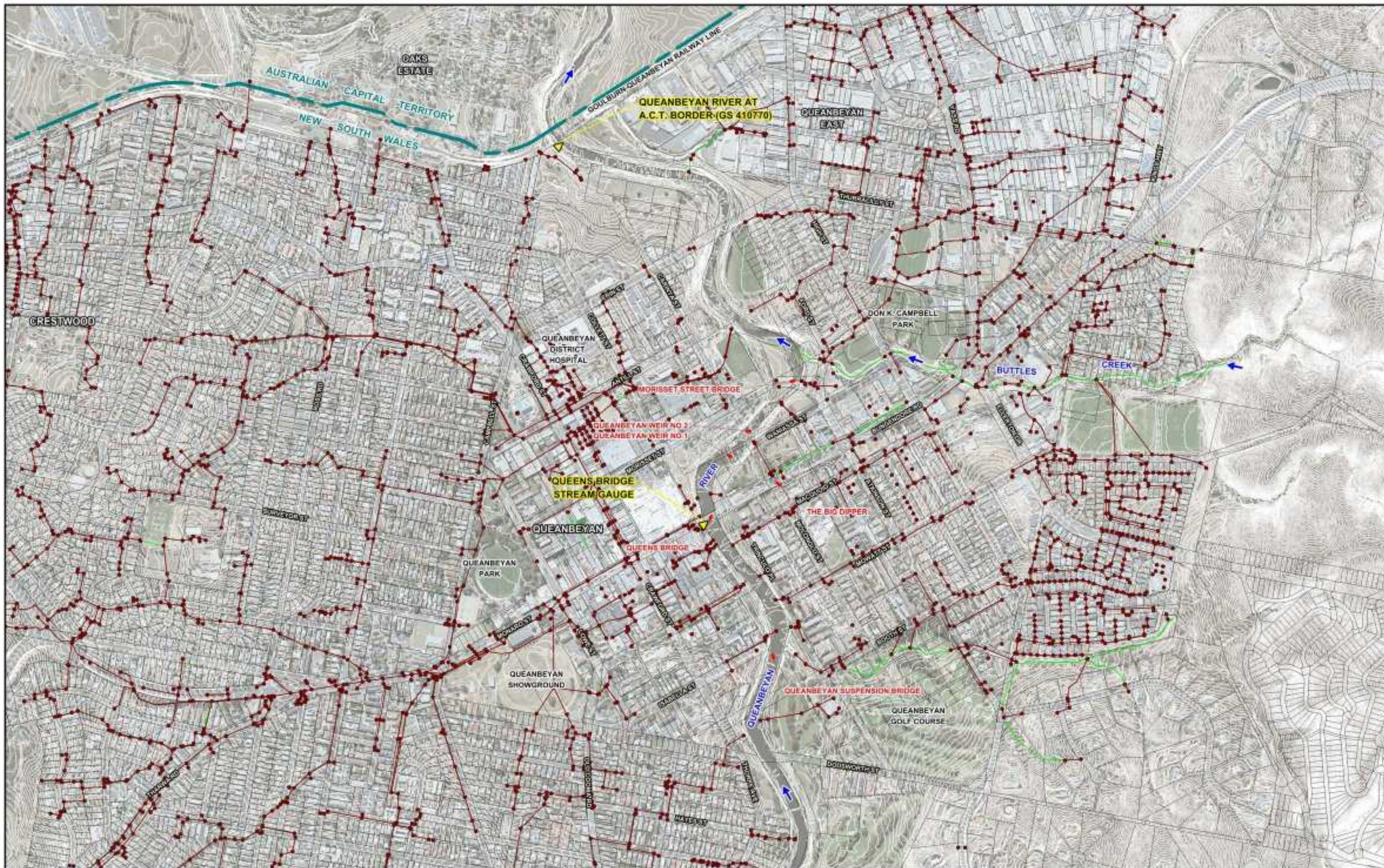
— Catchment Boundary	▲ Manually Read Stream Gauge
	▲ IconWater Stream Gauge
	▲ EPSDD Stream Gauge
	▲ WaterNSW Stream Gauge

**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 1.1

STUDY LOCATION PLAN





N

100 0 100 200 300 m

Scale: 1:10,000

LEGEND

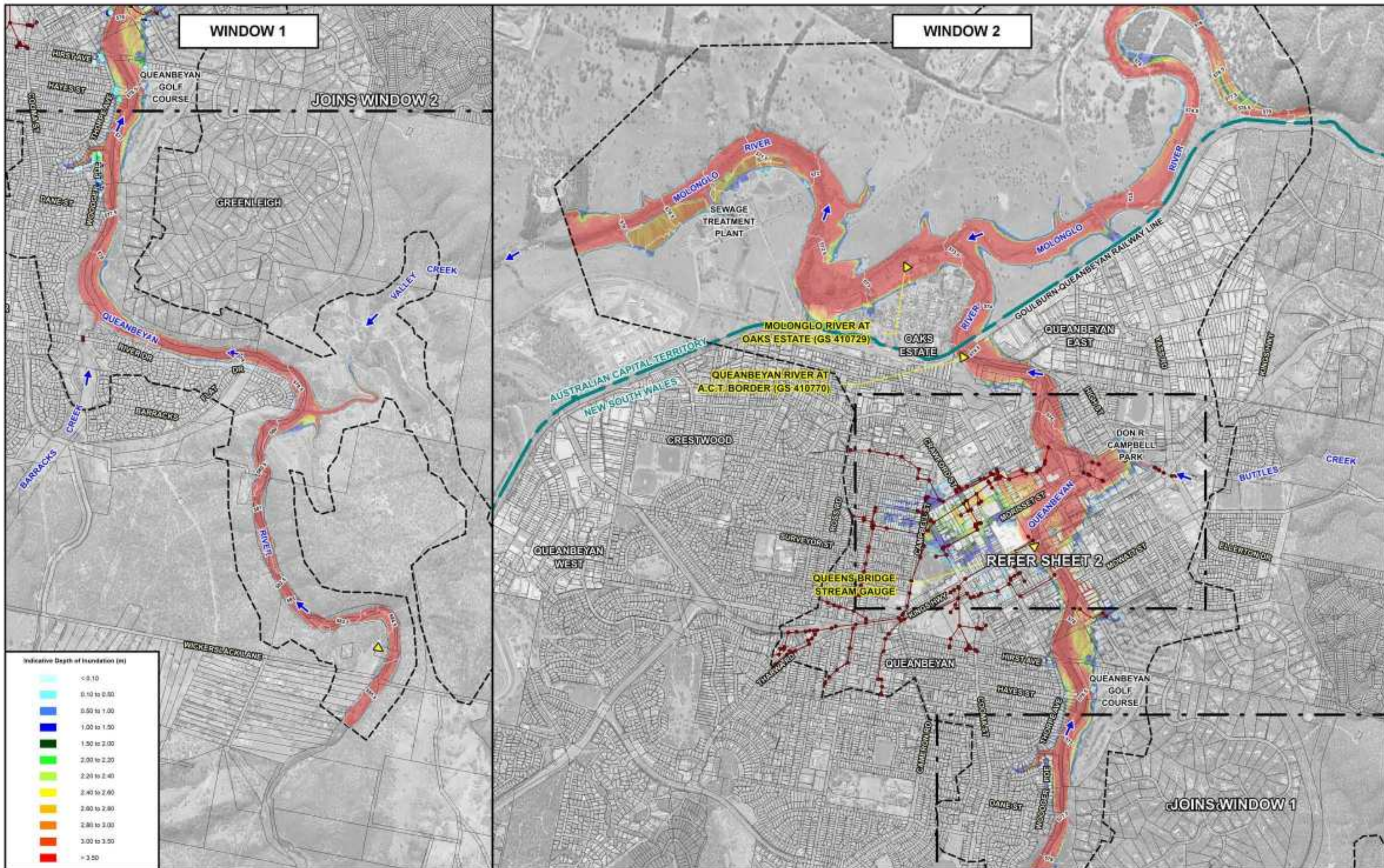
- Existing Piped Stormwater Drainage System
- Existing Stormwater Channel
- ▼ Stream Gauge

**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 2.1
(Sheet 2 of 2)

Document Set ID: 1169204
Version: 1, Version Date: 15/03/2021

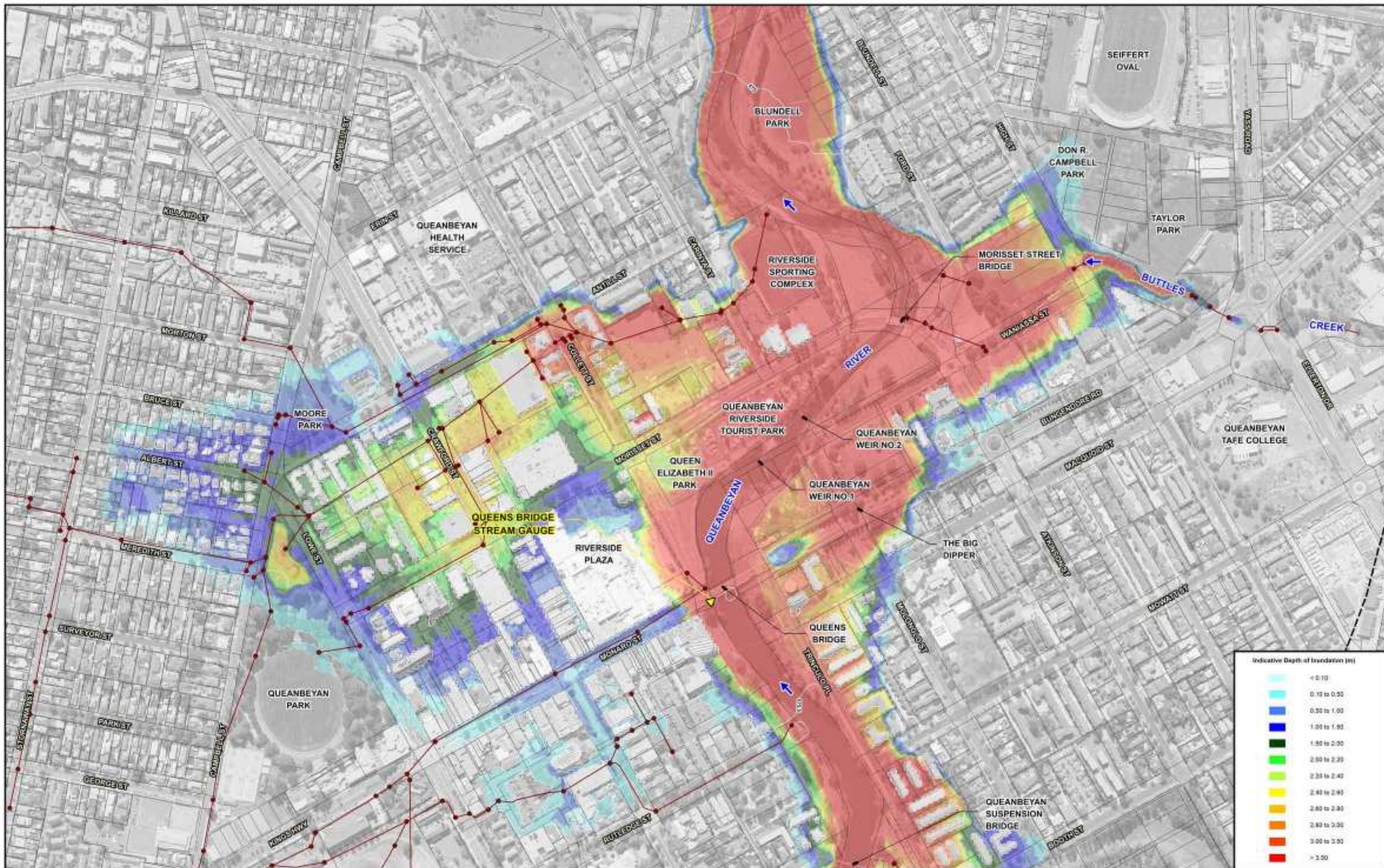
EXISTING DRAINAGE SYSTEM AT QUEANBEYAN



**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 2.2
(Sheet 1 of 2)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
1% AEP



Scale: 1:5,000

Lyall & Associates

NOTE:

The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

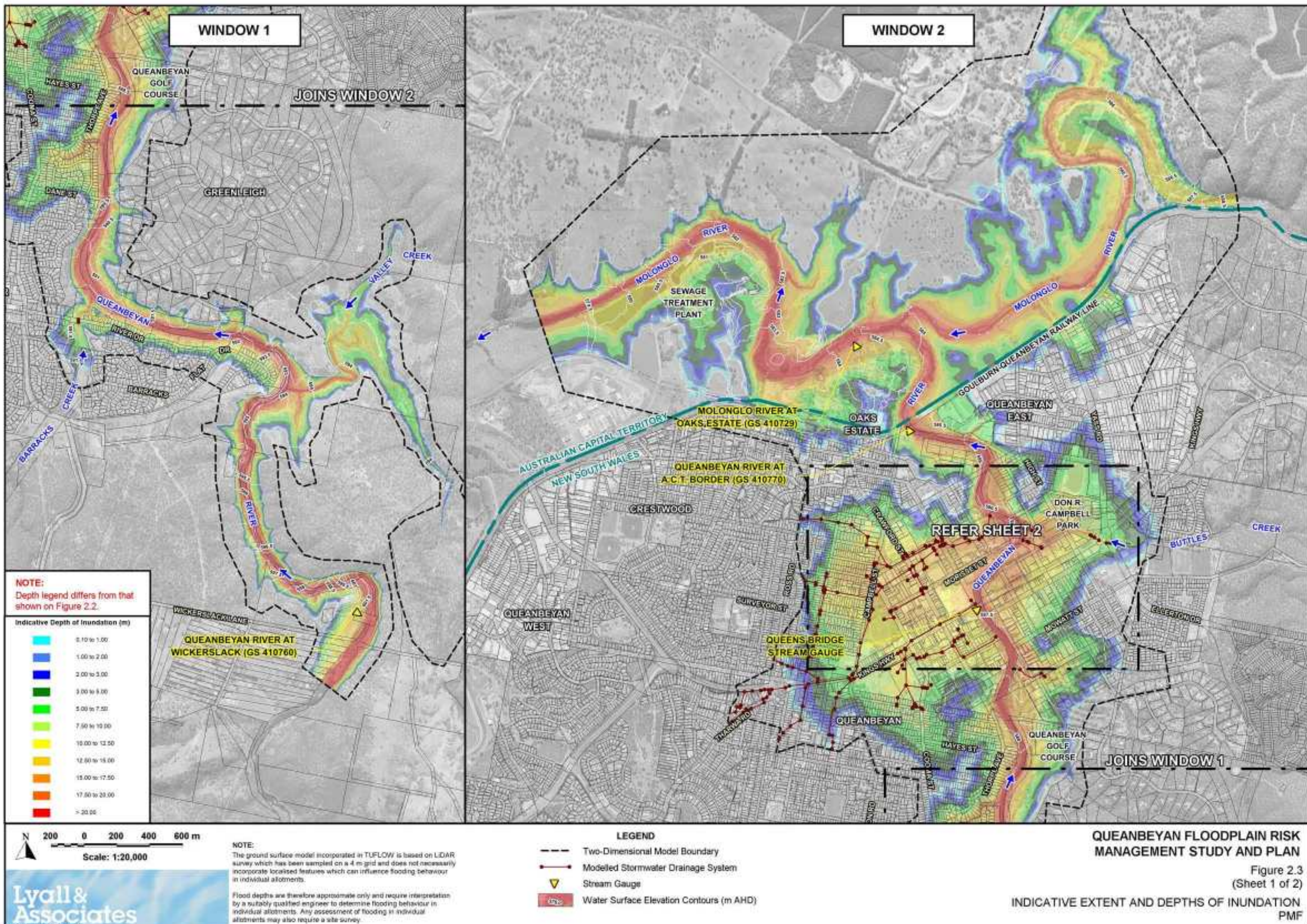
LEGEND

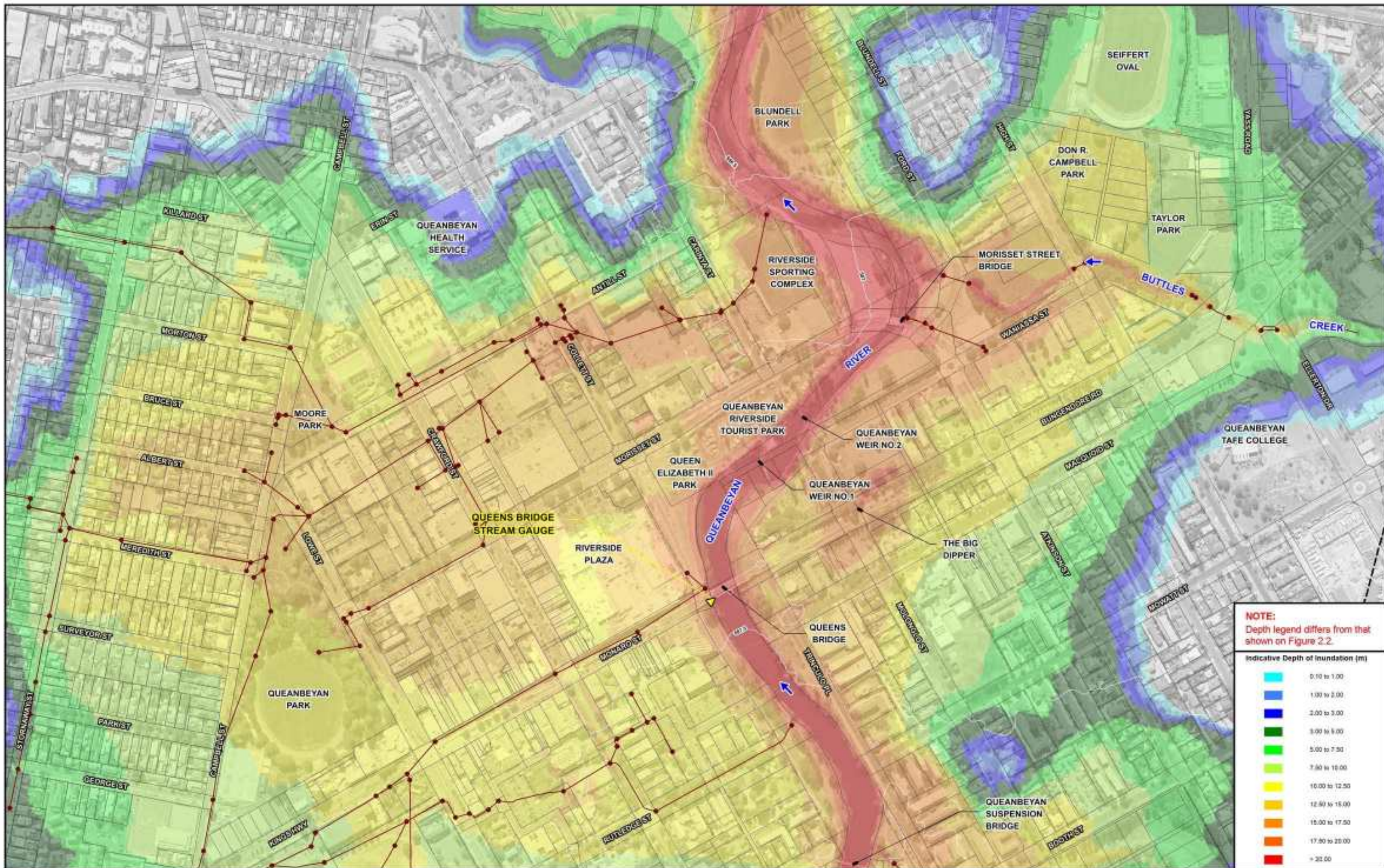
- Two-Dimensional Model Boundary
- Modelled Stormwater Drainage System
- ▼ Stream Gauge
- Water Surface Elevation Contours (m AHD)

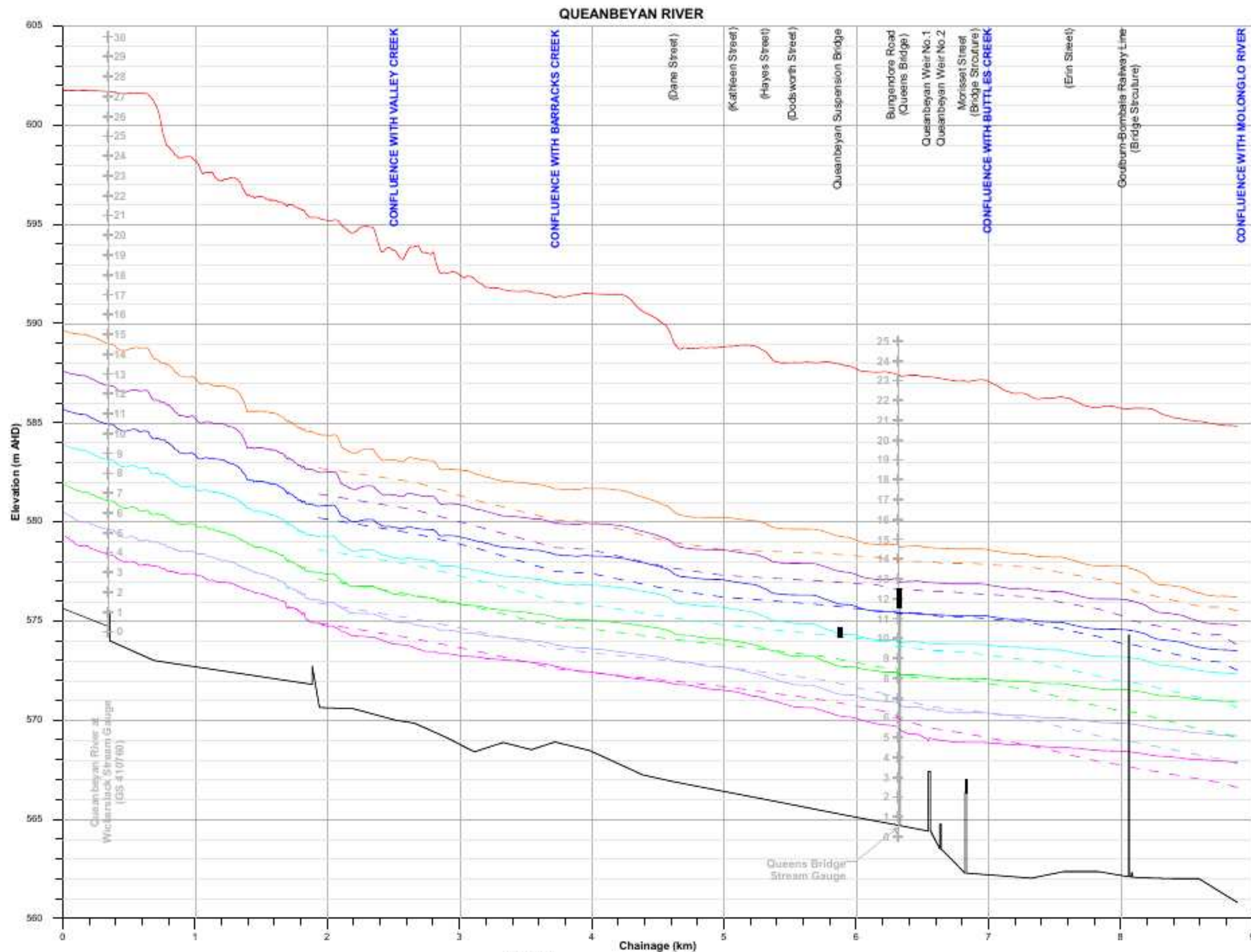
QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.2
(Sheet 2 of 2)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
1% AEP



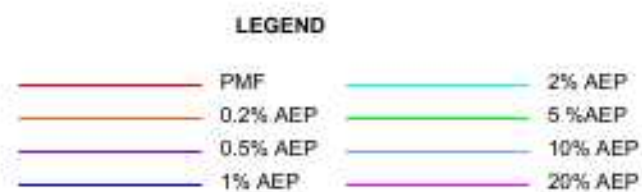
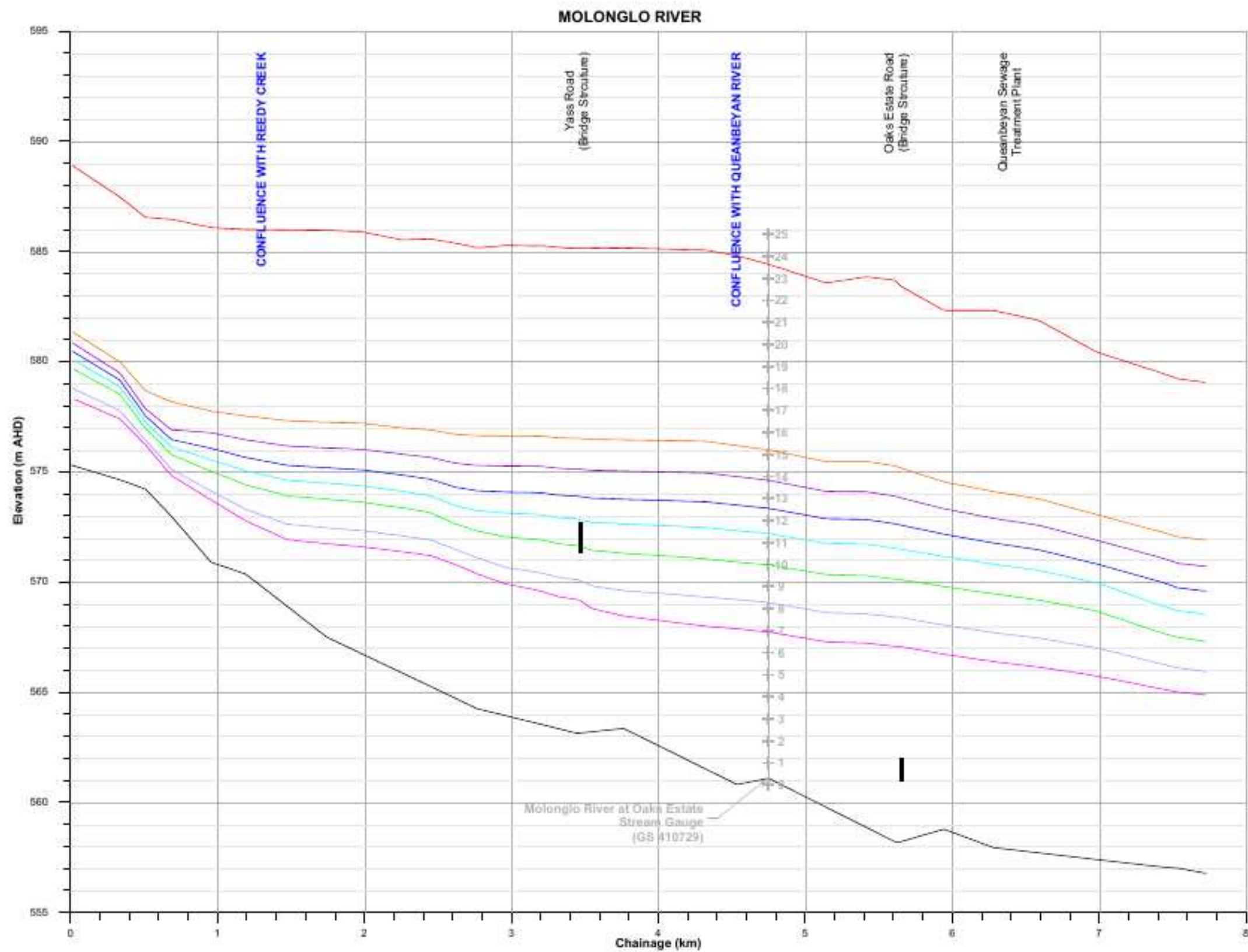




**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 2.4
(Sheet 1 of 2)

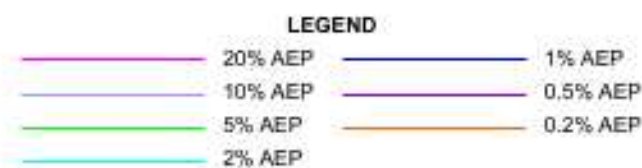
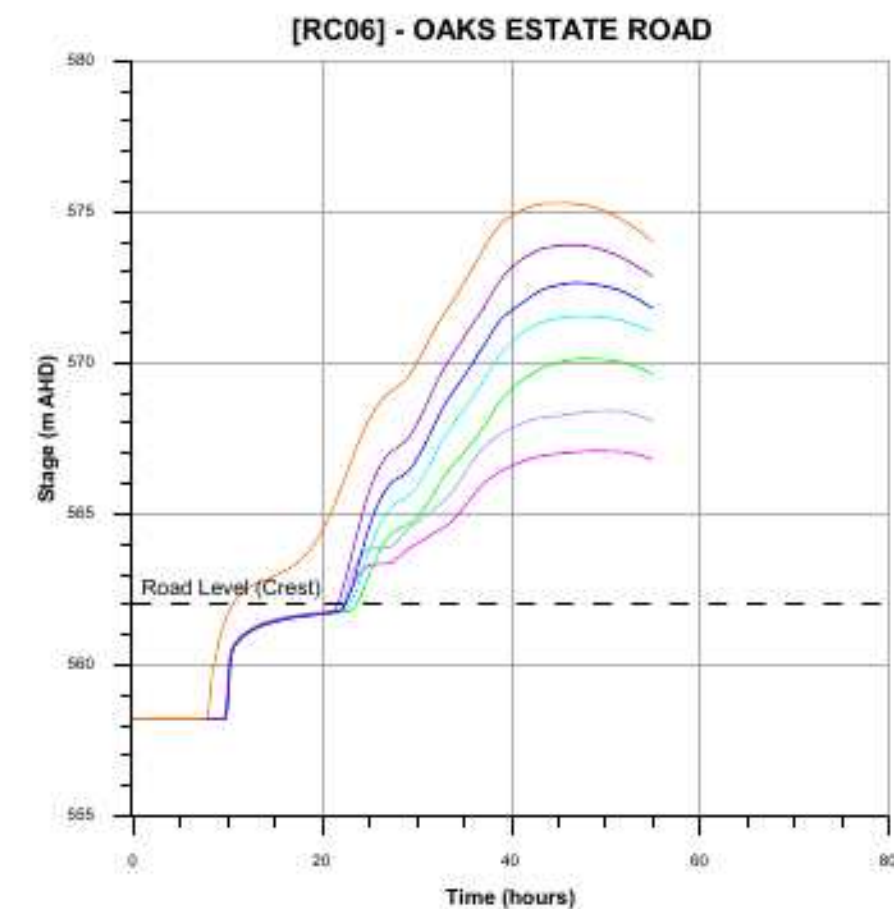
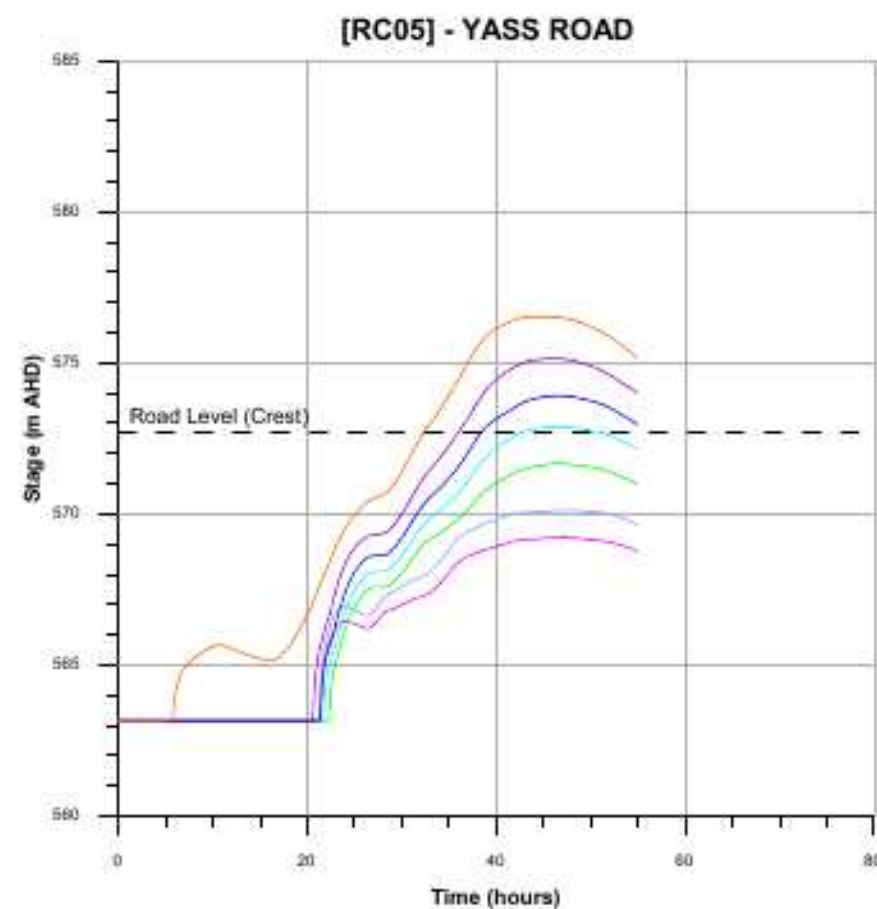
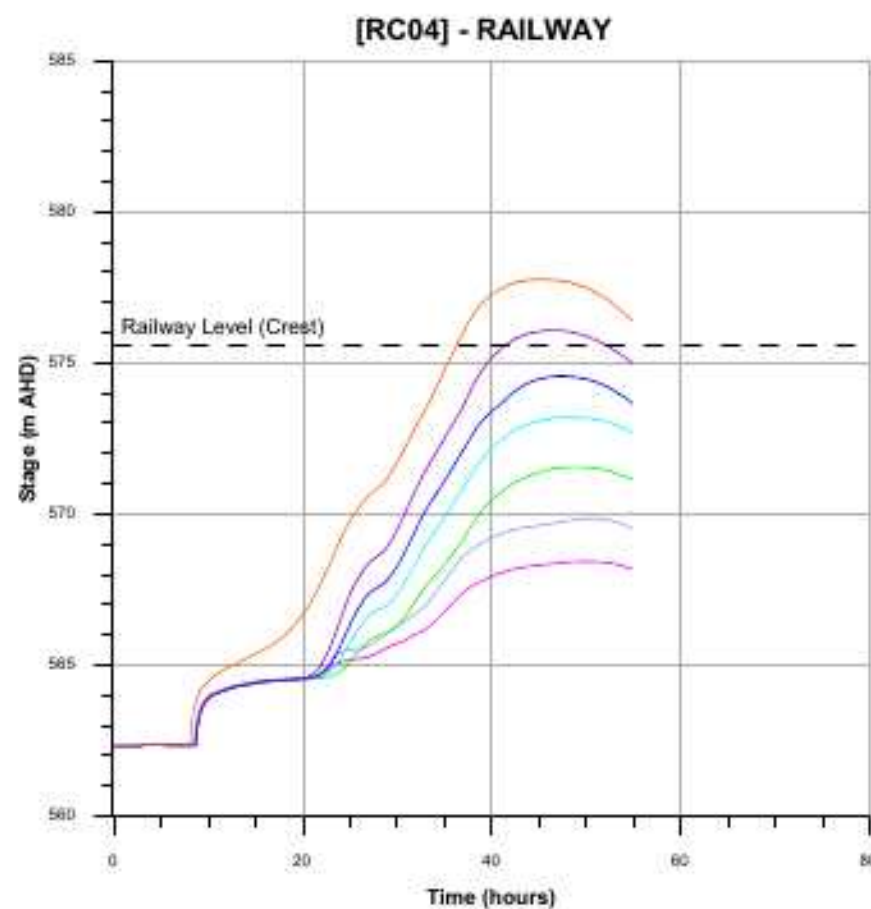
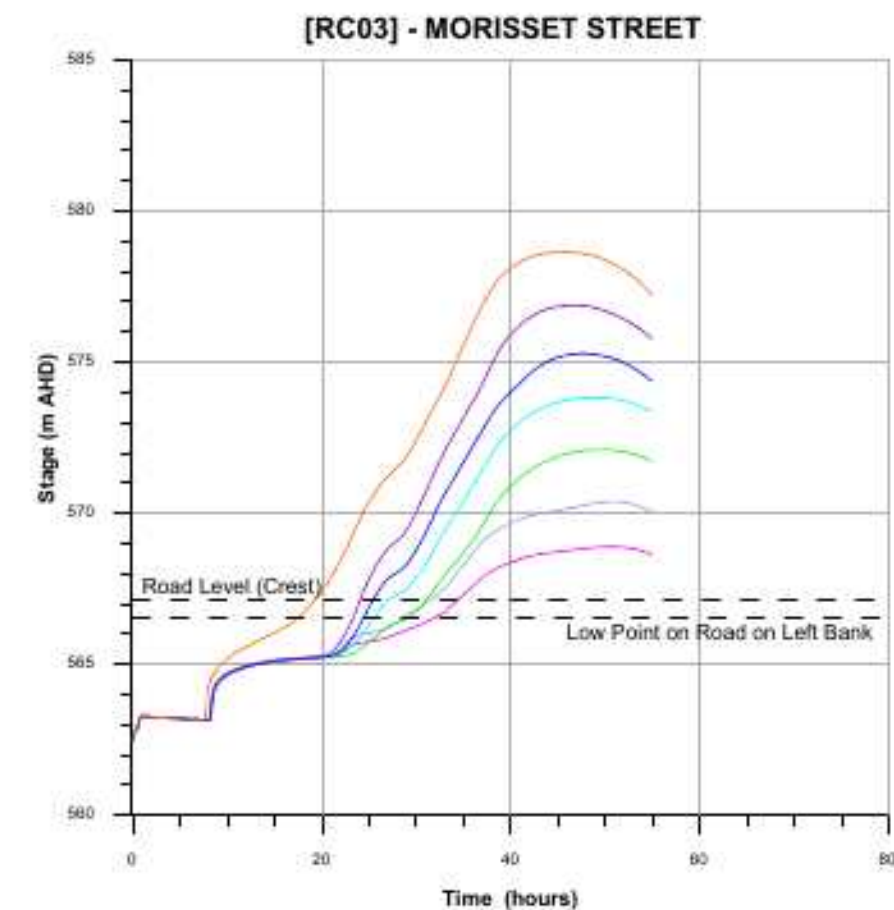
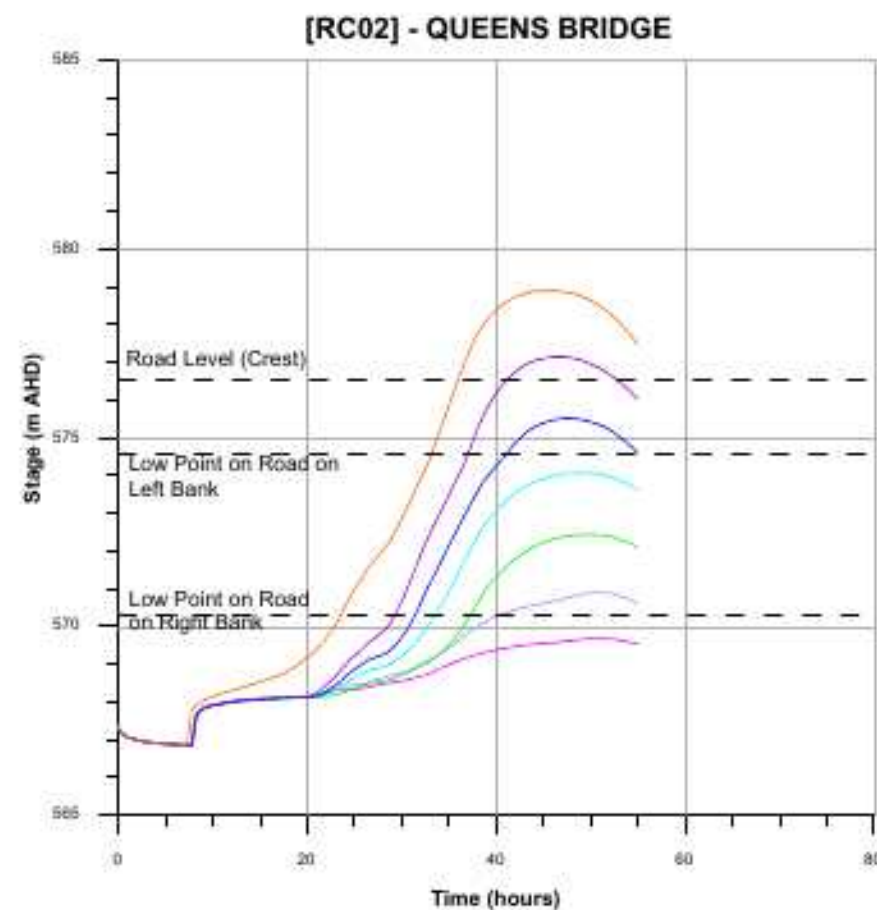
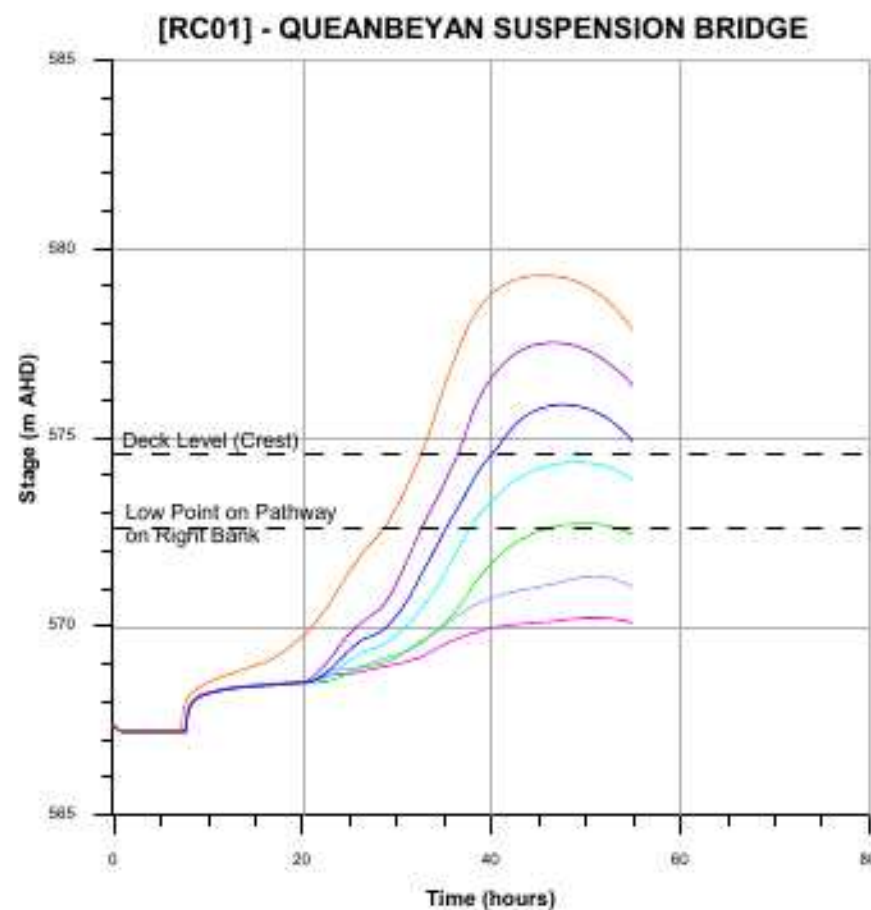
DESIGN WATER SURFACE PROFILES
QUEANBEYAN AND MOLONGLO RIVERS



**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 2.4
(Sheet 2 of 2)

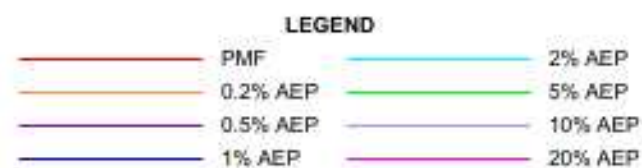
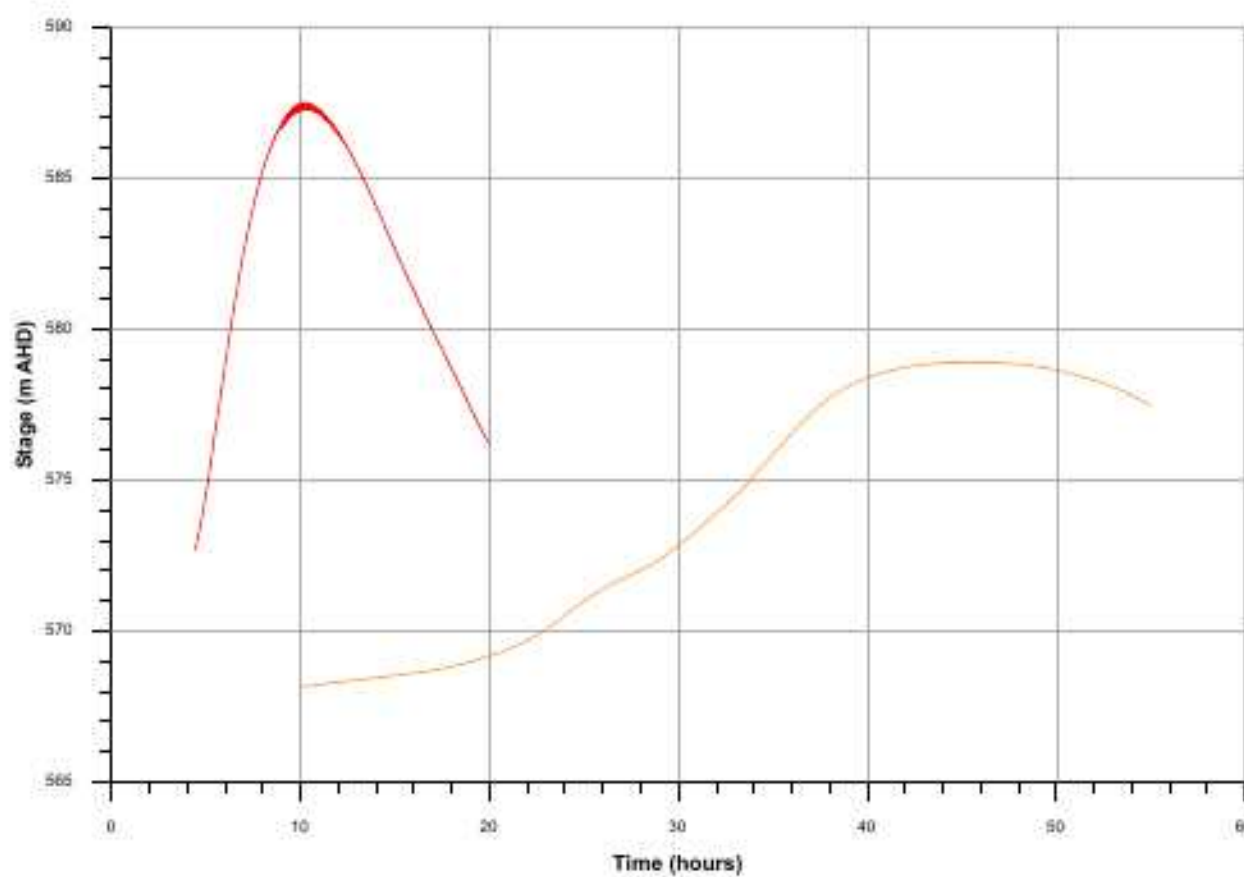
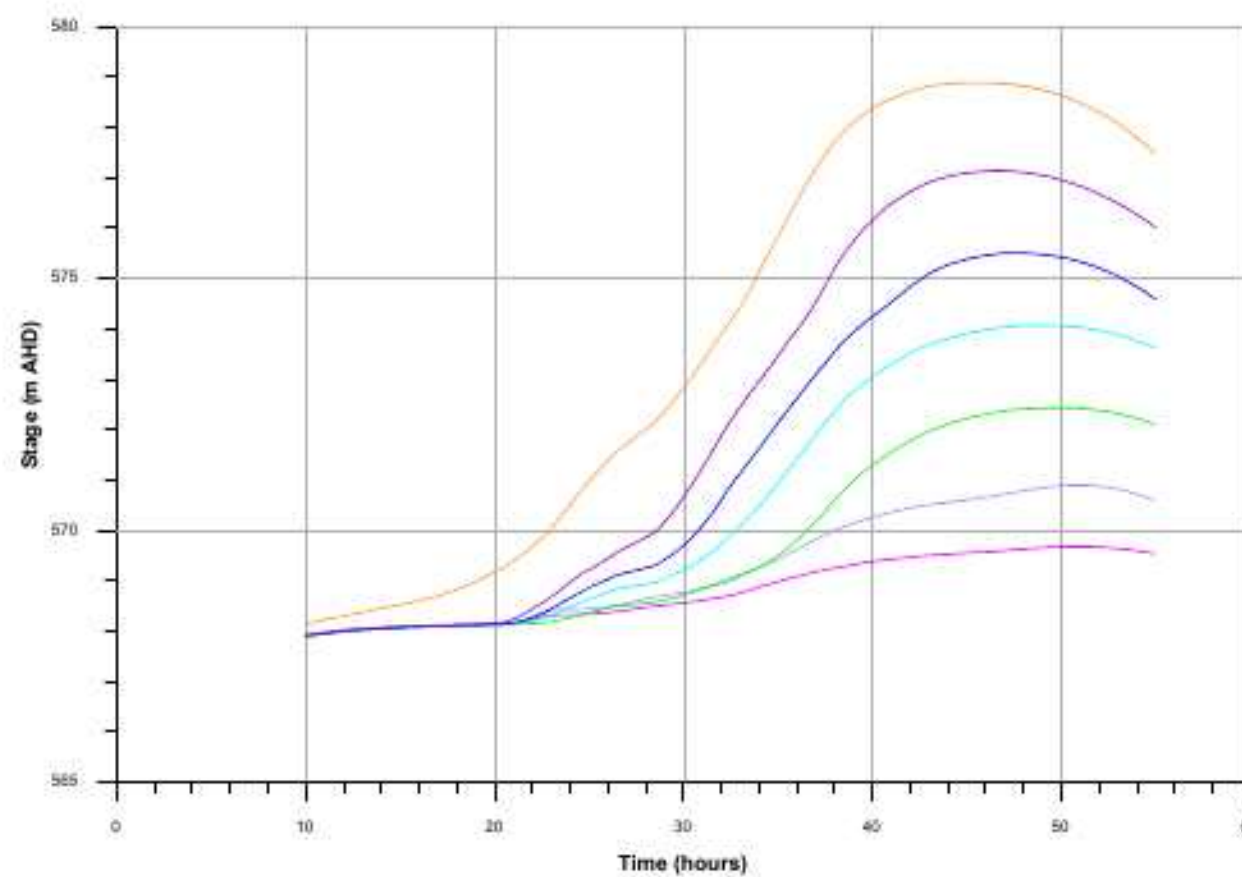
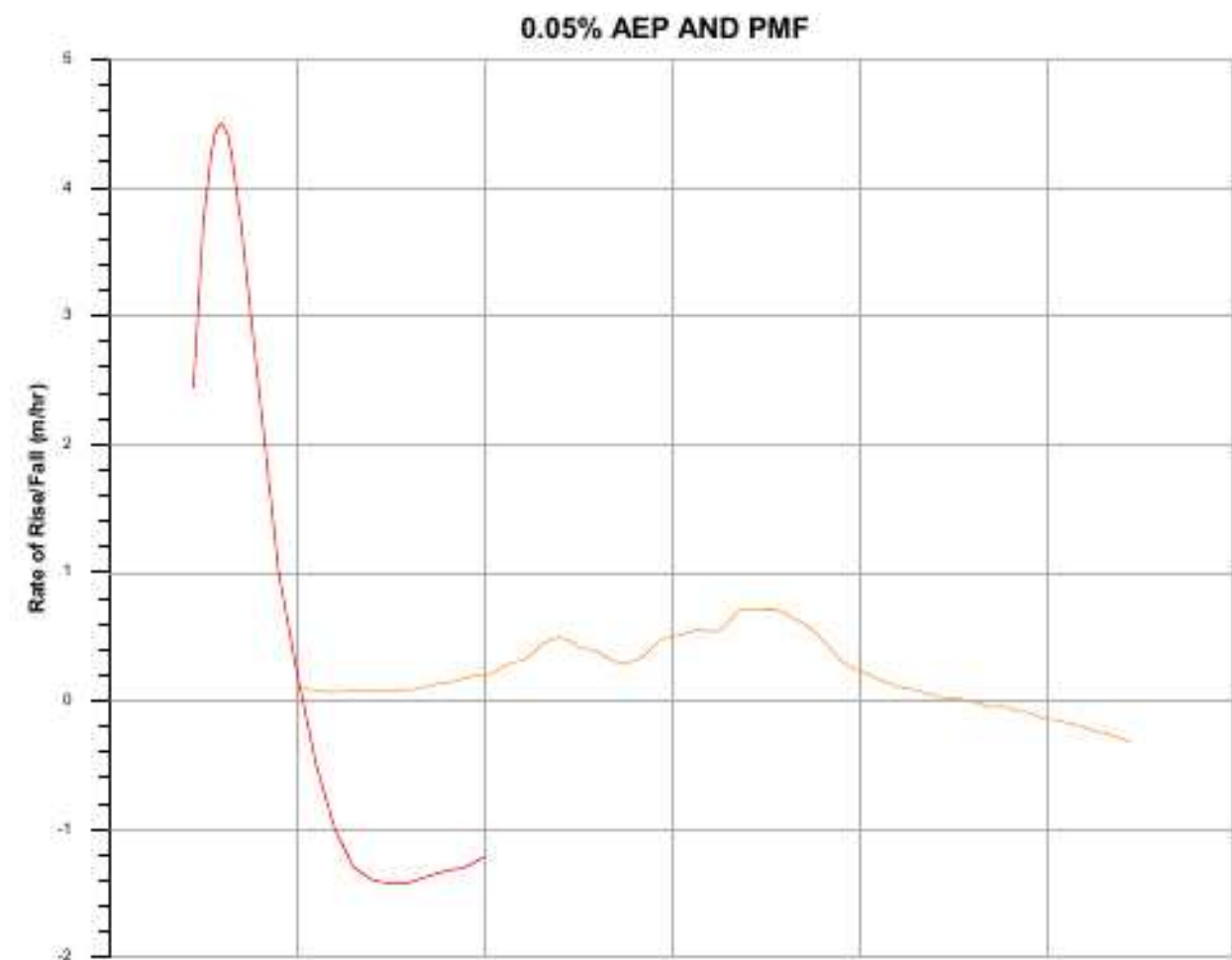
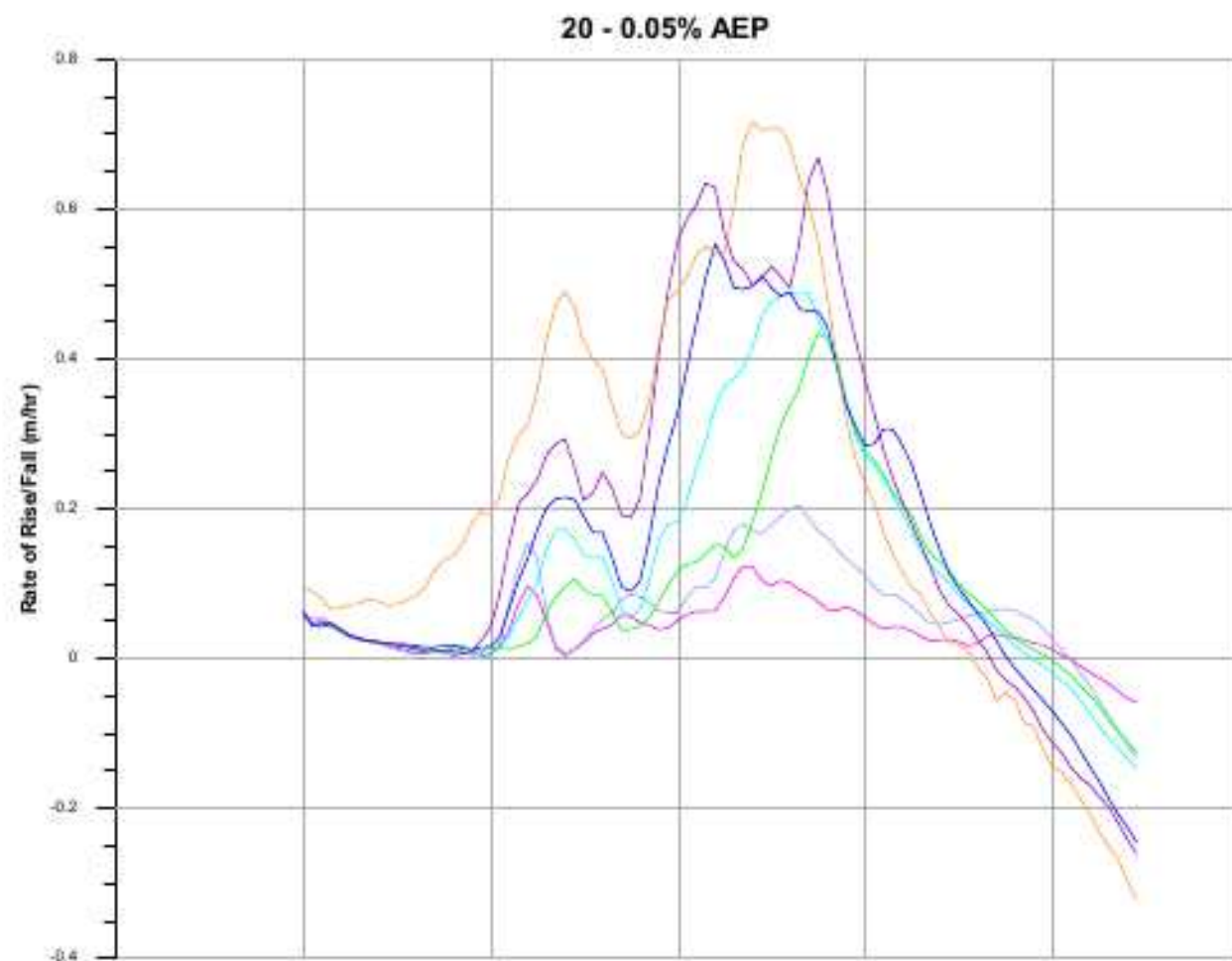
DESIGN WATER SURFACE PROFILES
QUEANBEYAN AND MOLONGLO RIVERS



**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 2.5

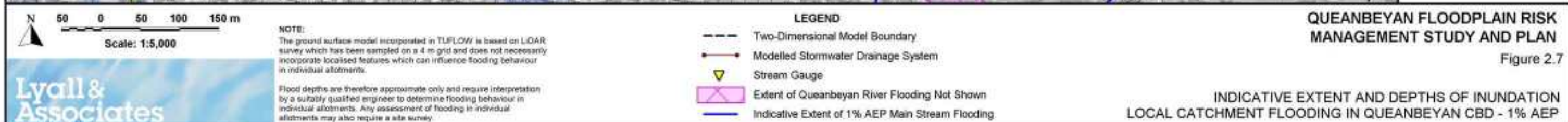
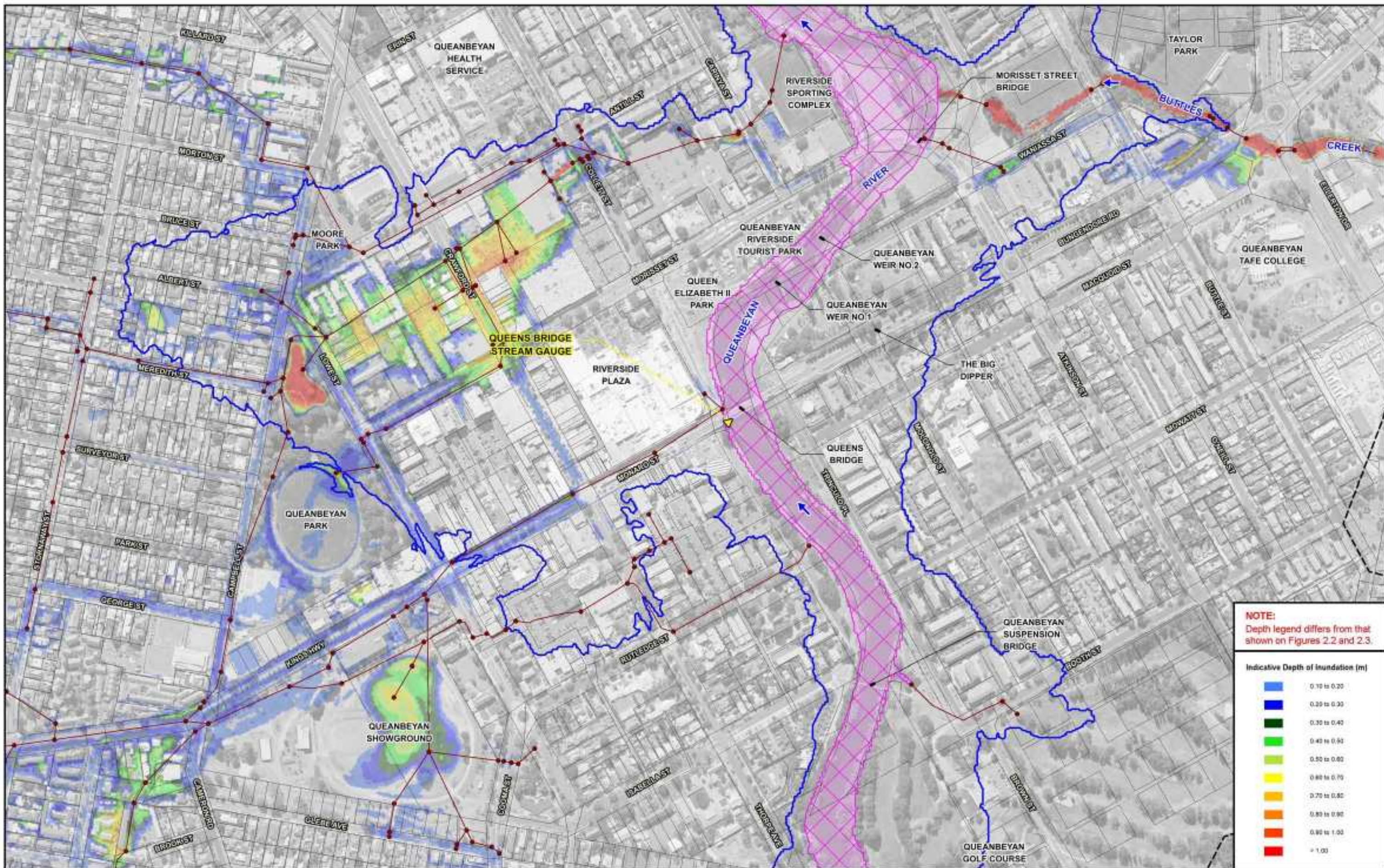
TIME OF RISE OF FLOODWATERS
AT LOCATION OF BRIDGE CROSSINGS

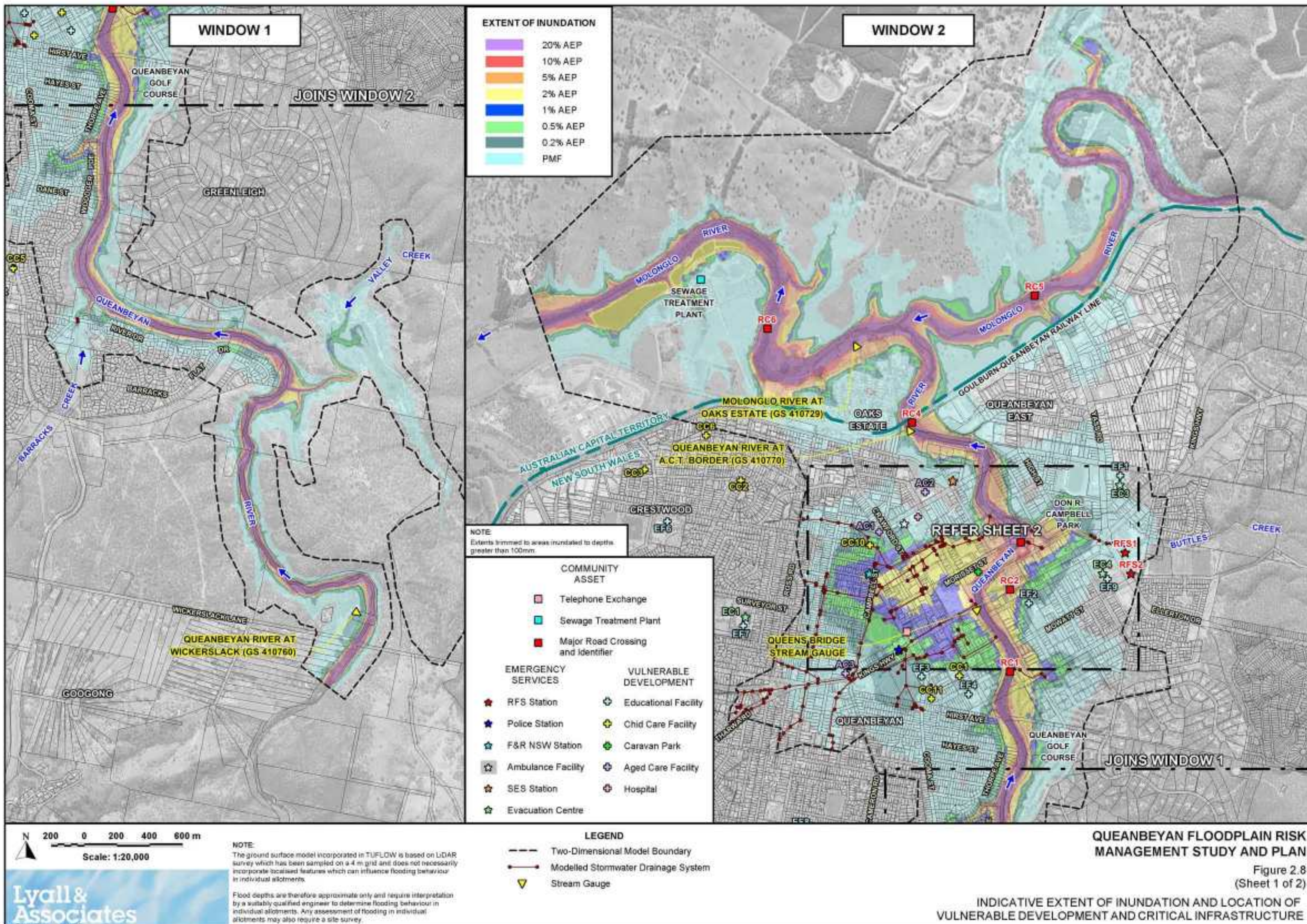


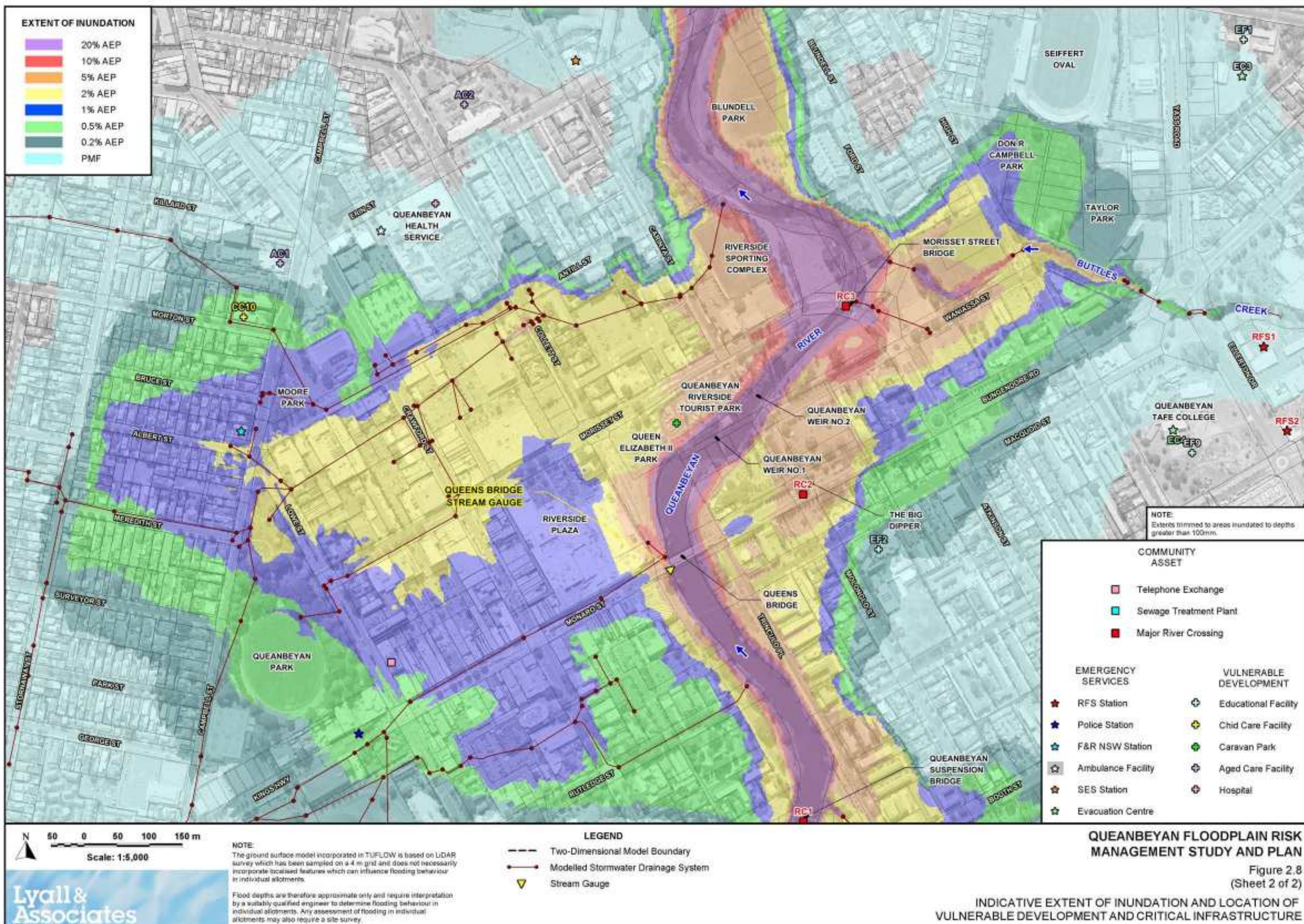
**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 2.6

**RATE OF RISE OF FLOODWATERS
AT QUEENS BRIDGE**









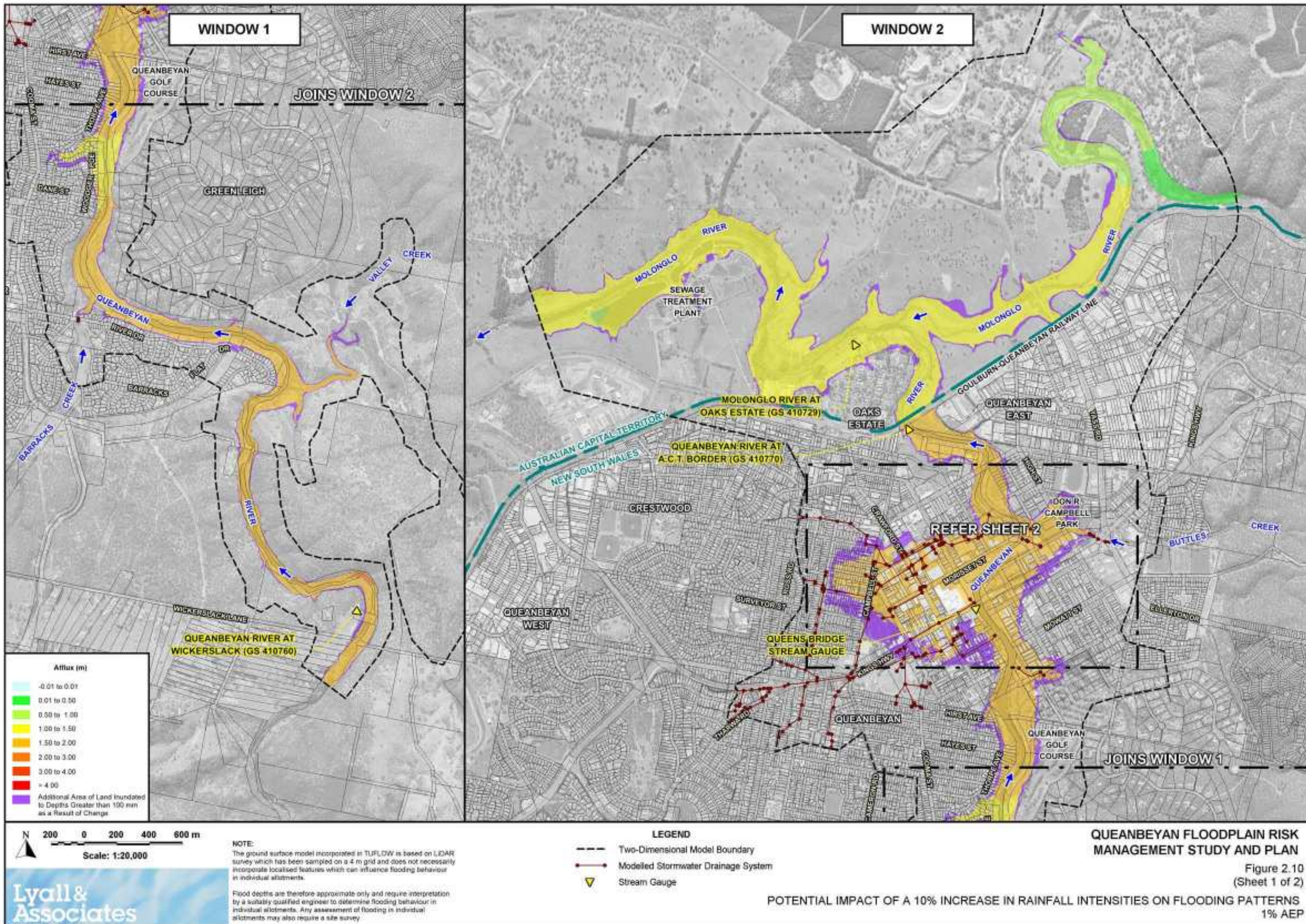
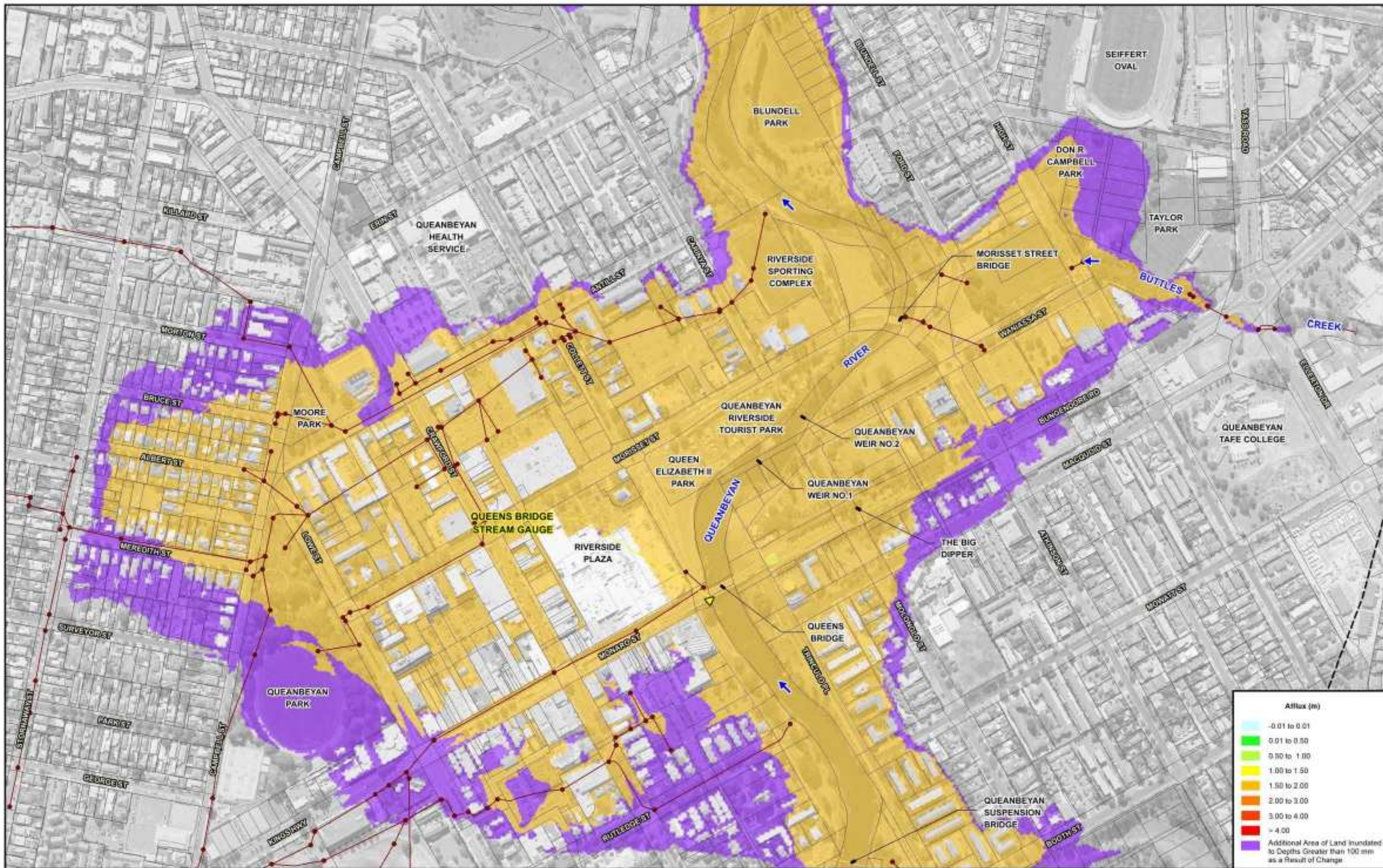


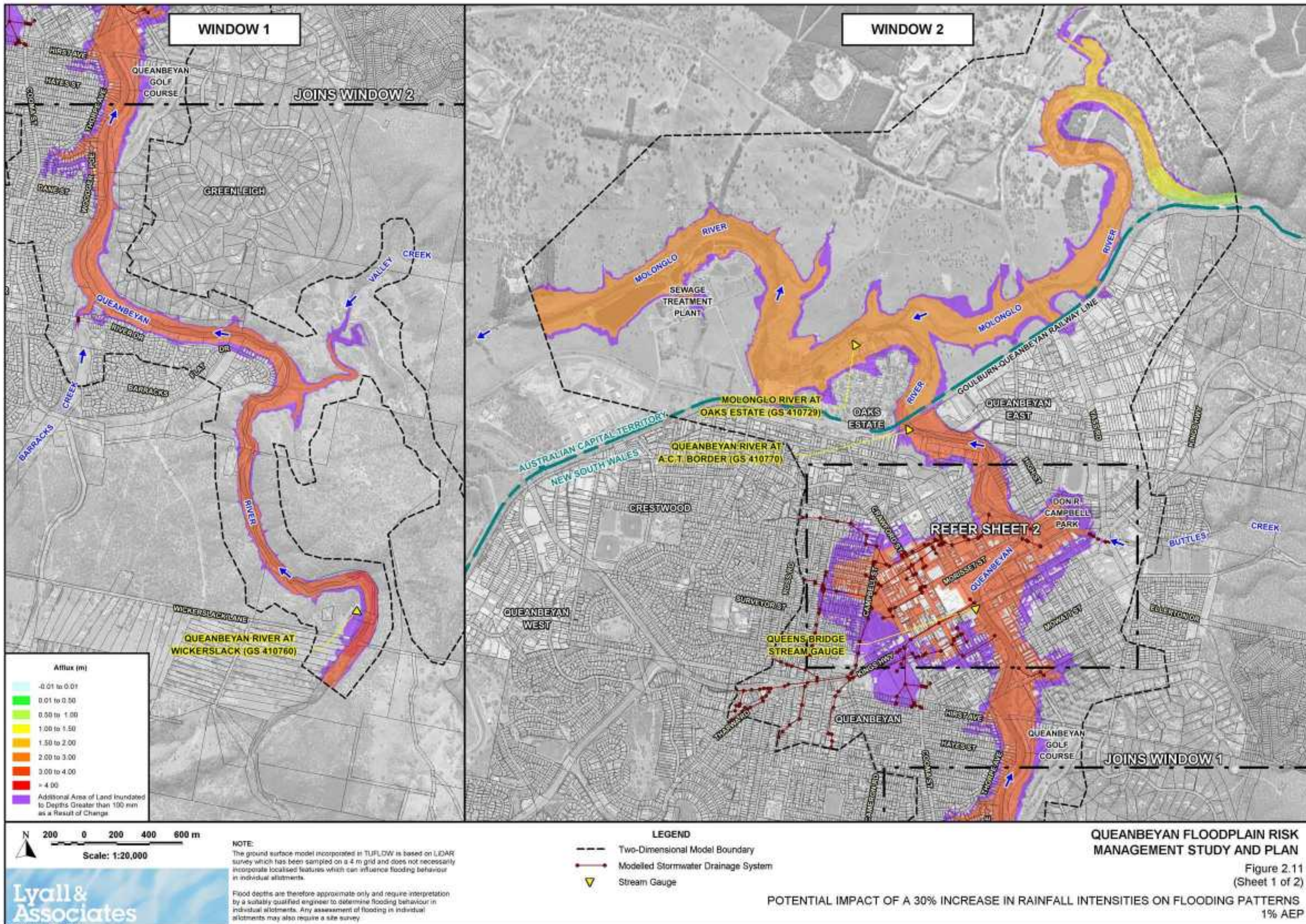
Figure 2.10
(Sheet 1 of 2)

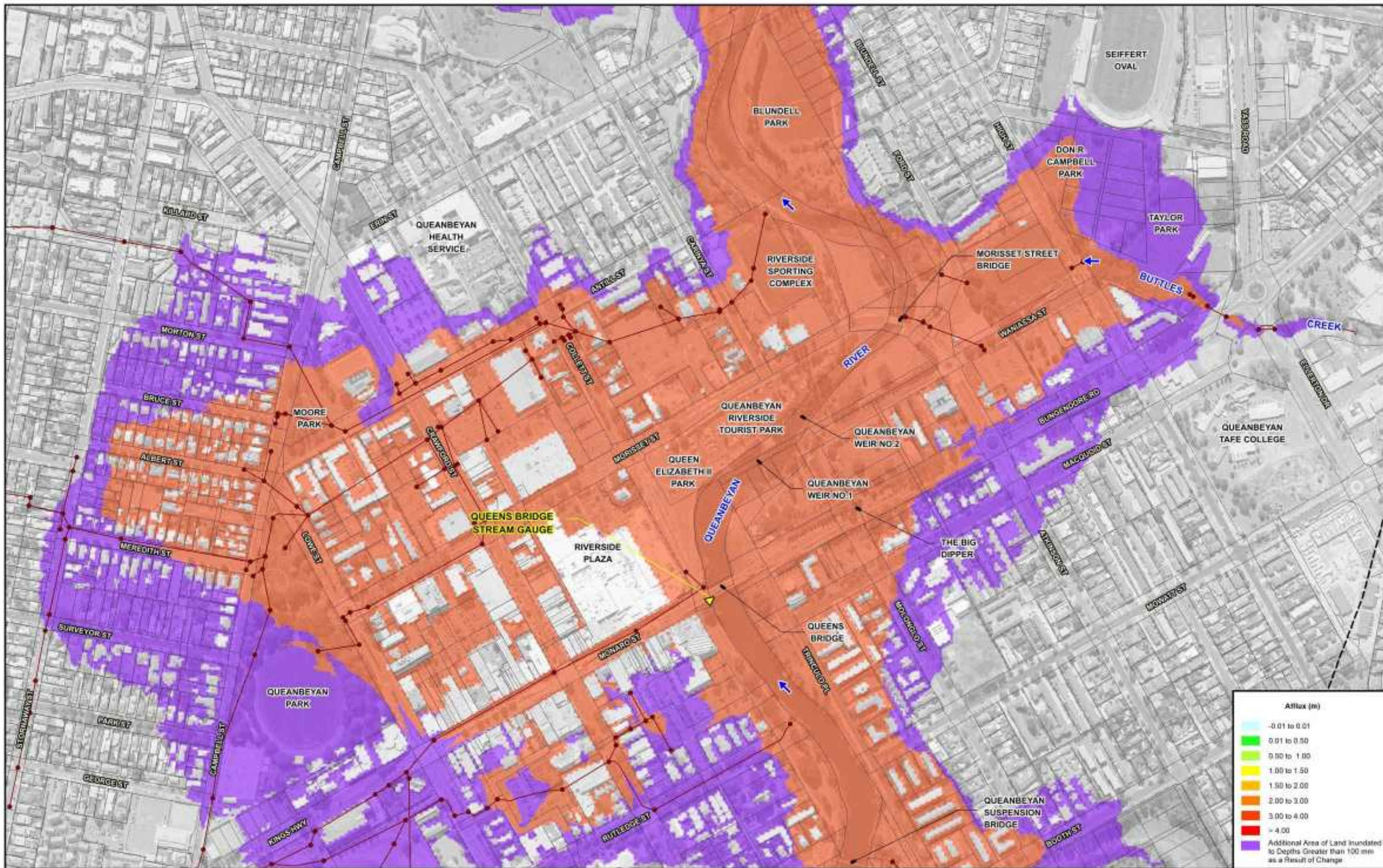


QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.10
(Sheet 2 of 2)

POTENTIAL IMPACT OF A 10% INCREASE IN RAINFALL INTENSITIES ON FLOODING PATTERNS
1% AEP





Scale: 1:5,000

Lyll & Associates

NOTE:

The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

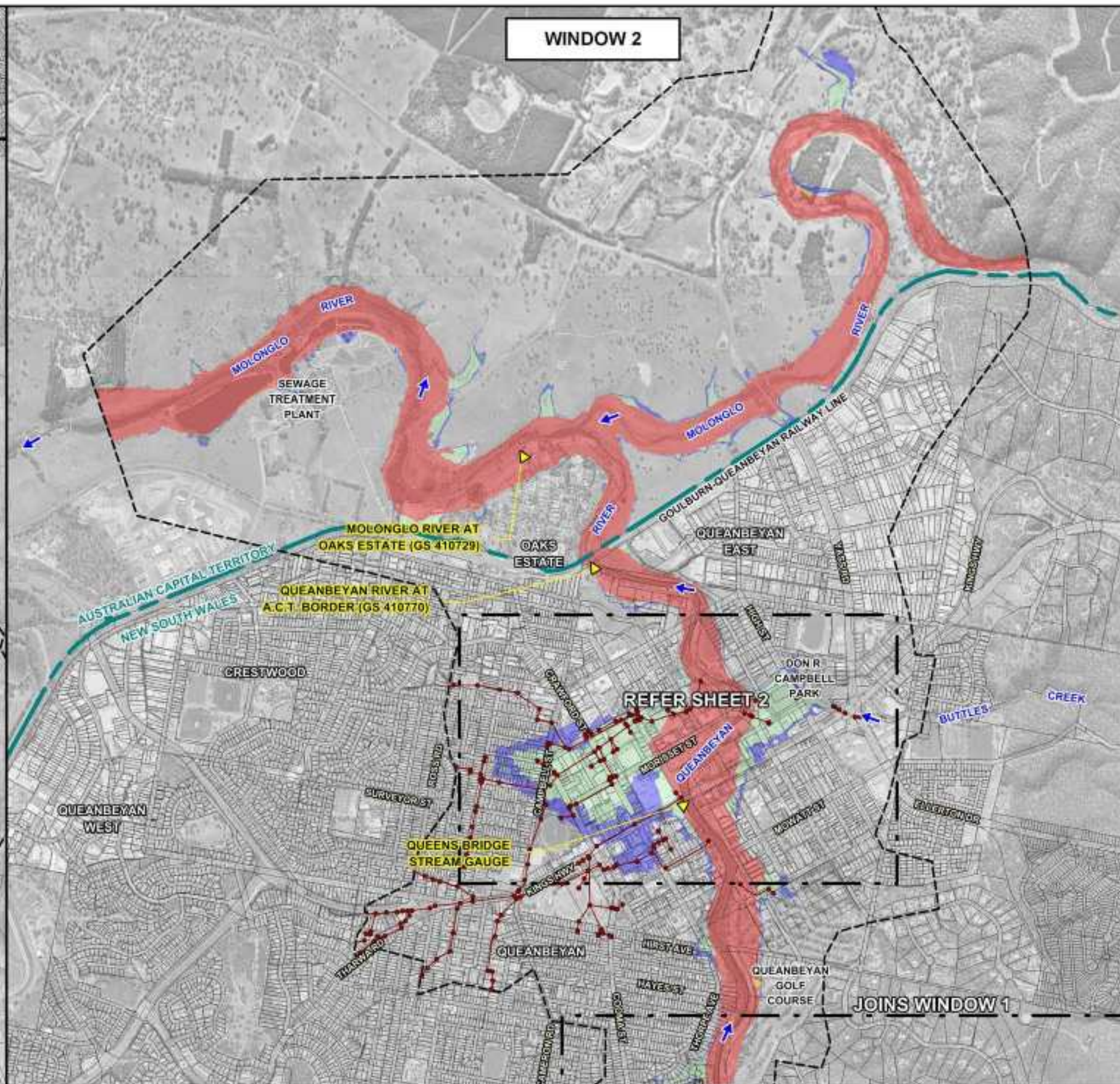
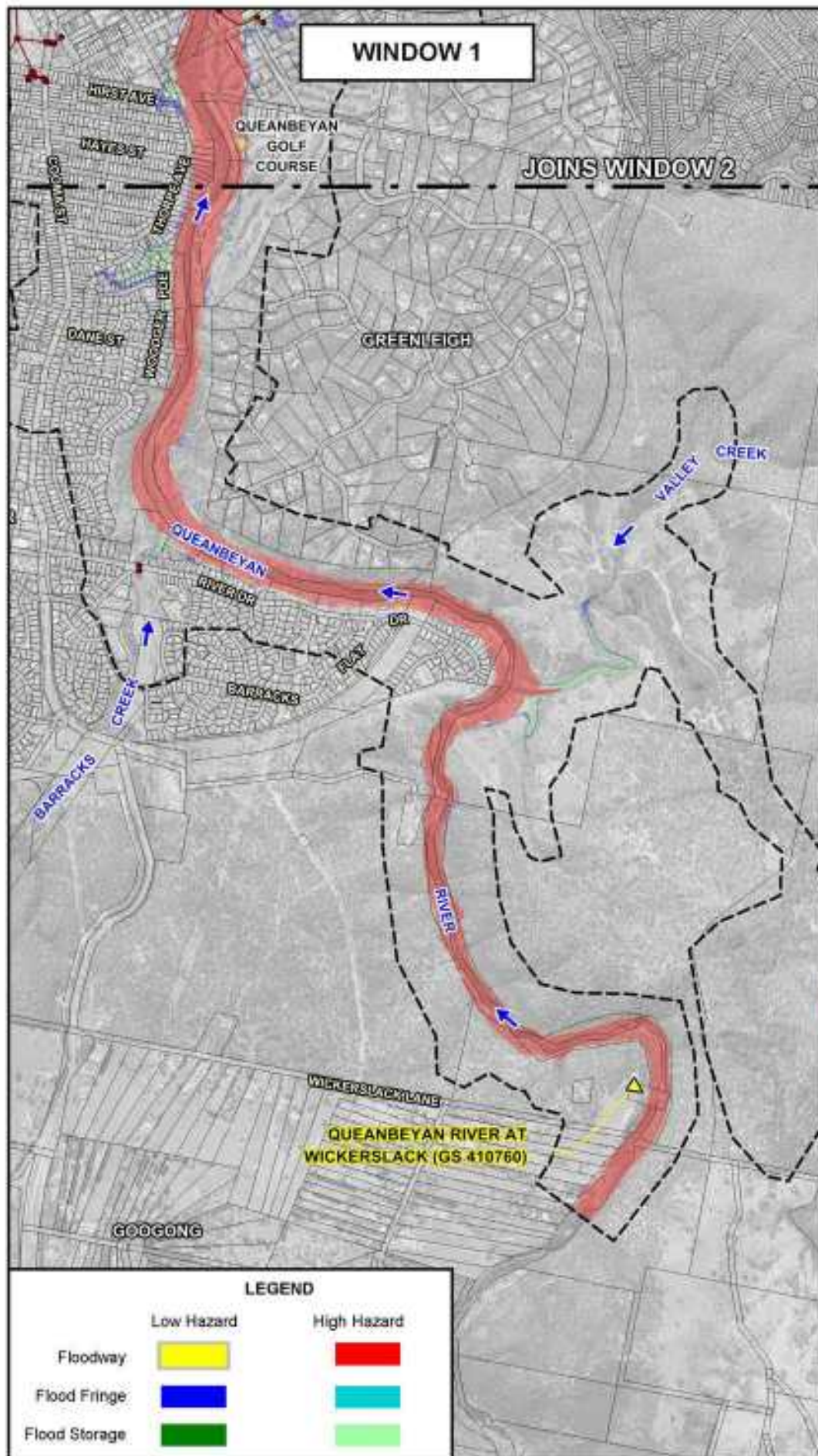
LEGEND

- Two-Dimensional Model Boundary
- Modelled Stormwater Drainage System
- ▼ Stream Gauge

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.11
(Sheet 2 of 2)

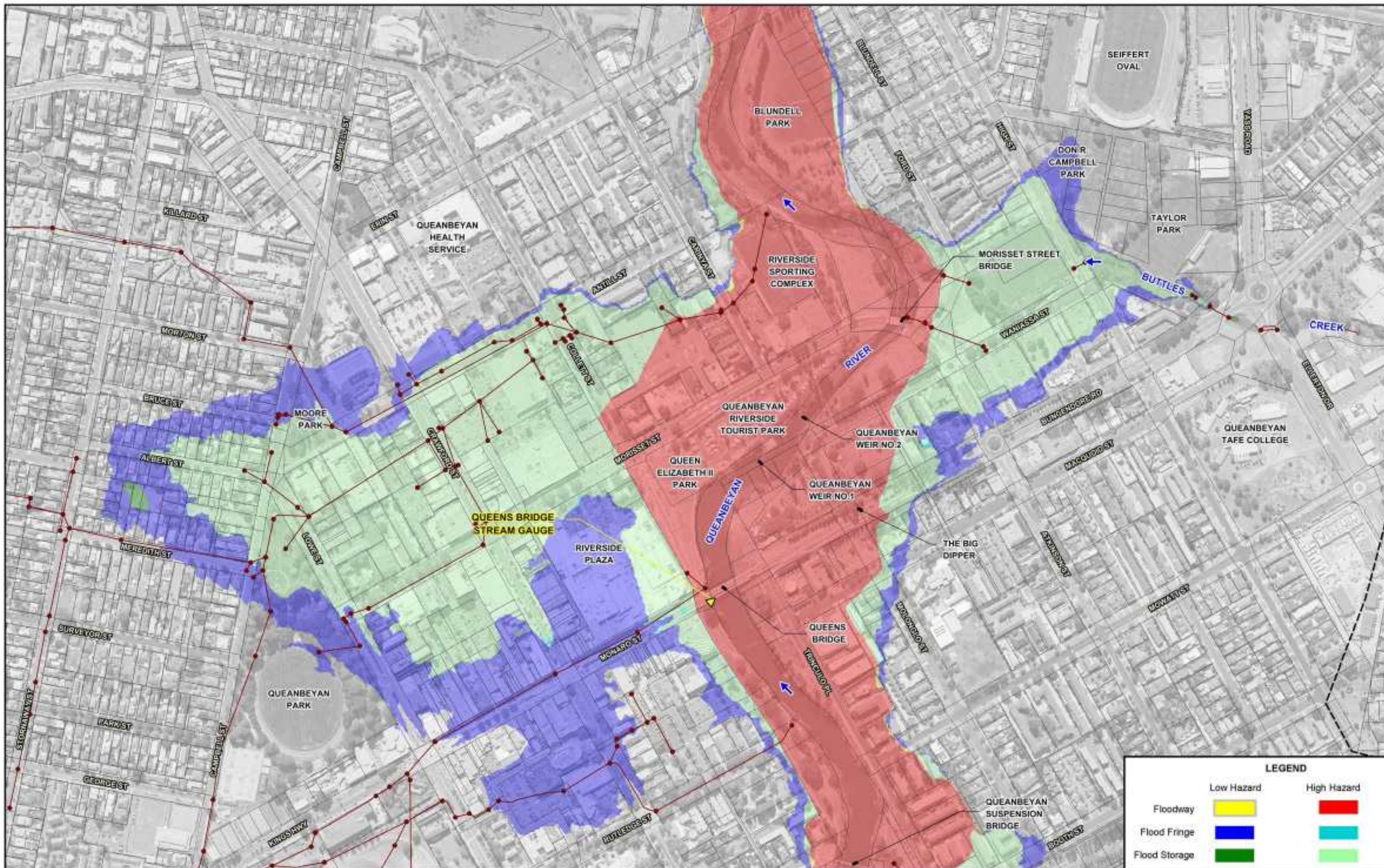
POTENTIAL IMPACT OF A 30% INCREASE IN RAINFALL INTENSITIES ON FLOODING PATTERNS
1% AEP



QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.12
(Sheet 1 of 2)

FLOOD HAZARD AND HYDRAULIC CATEGORISATION OF FLOODPLAIN
1% AEP



Scale: 1:5,000

Lyall & Associates

NOTE

The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.12
(Sheet 2 of 2)

FLOOD HAZARD AND HYDRAULIC CATEGORISATION OF FLOODPLAIN
1% AEP



LEGEND			
Low Hazard		High Hazard	
Floodway		Floodway	
Flood Fringe		Flood Fringe	
Flood Storage		Flood Storage	

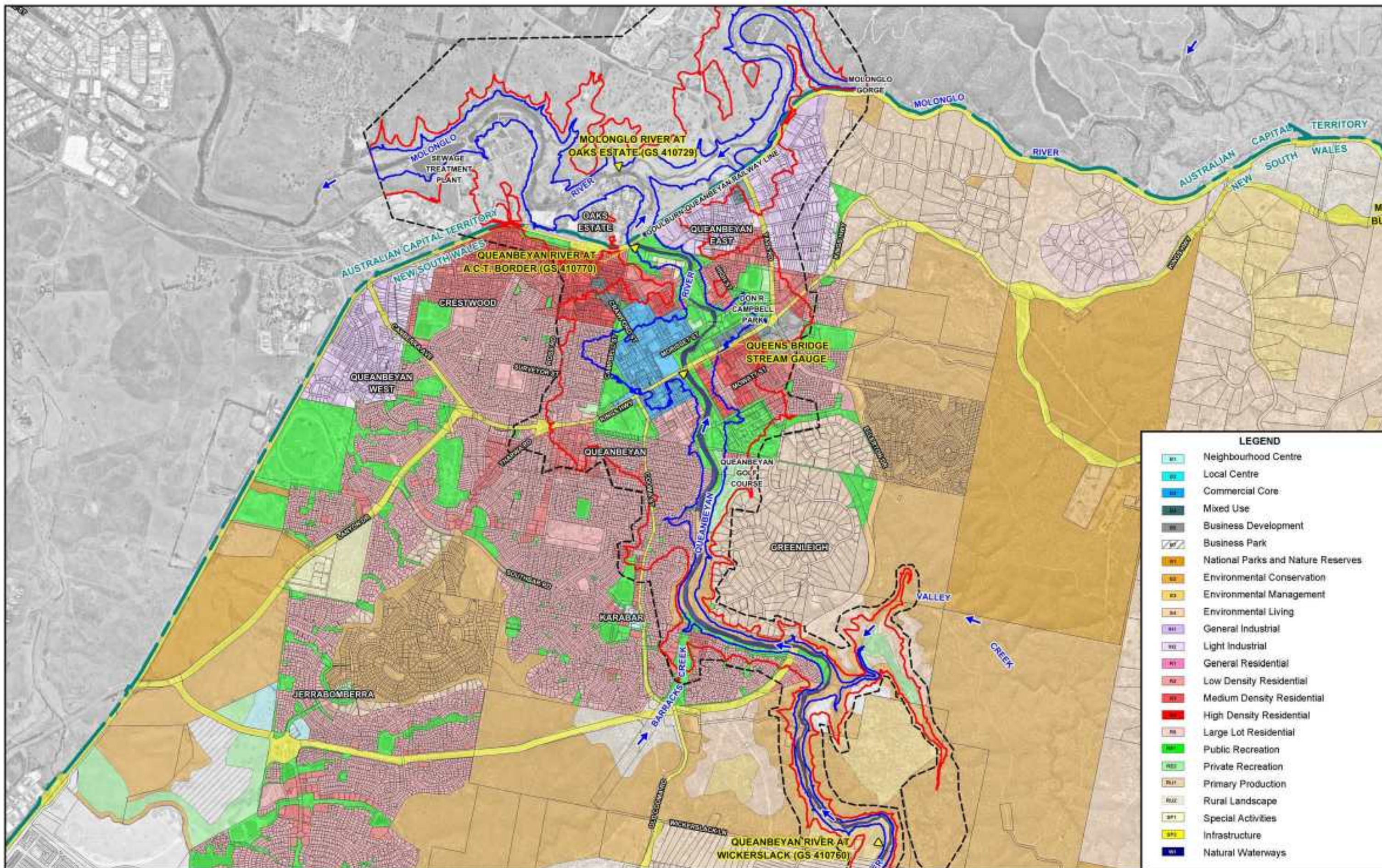
- LEGEND**
- Two-Dimensional Model Boundary
 - Modelled Stormwater Drainage System
 - ▼ Stream Gauge

NOTE
 The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.
 Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.13

FLOOD HAZARD AND HYDRAULIC CATEGORISATION OF FLOODPLAIN
 LOCAL CATCHMENT FLOODING IN VICINITY OF QUEANBEYAN CBD - 1% AEP



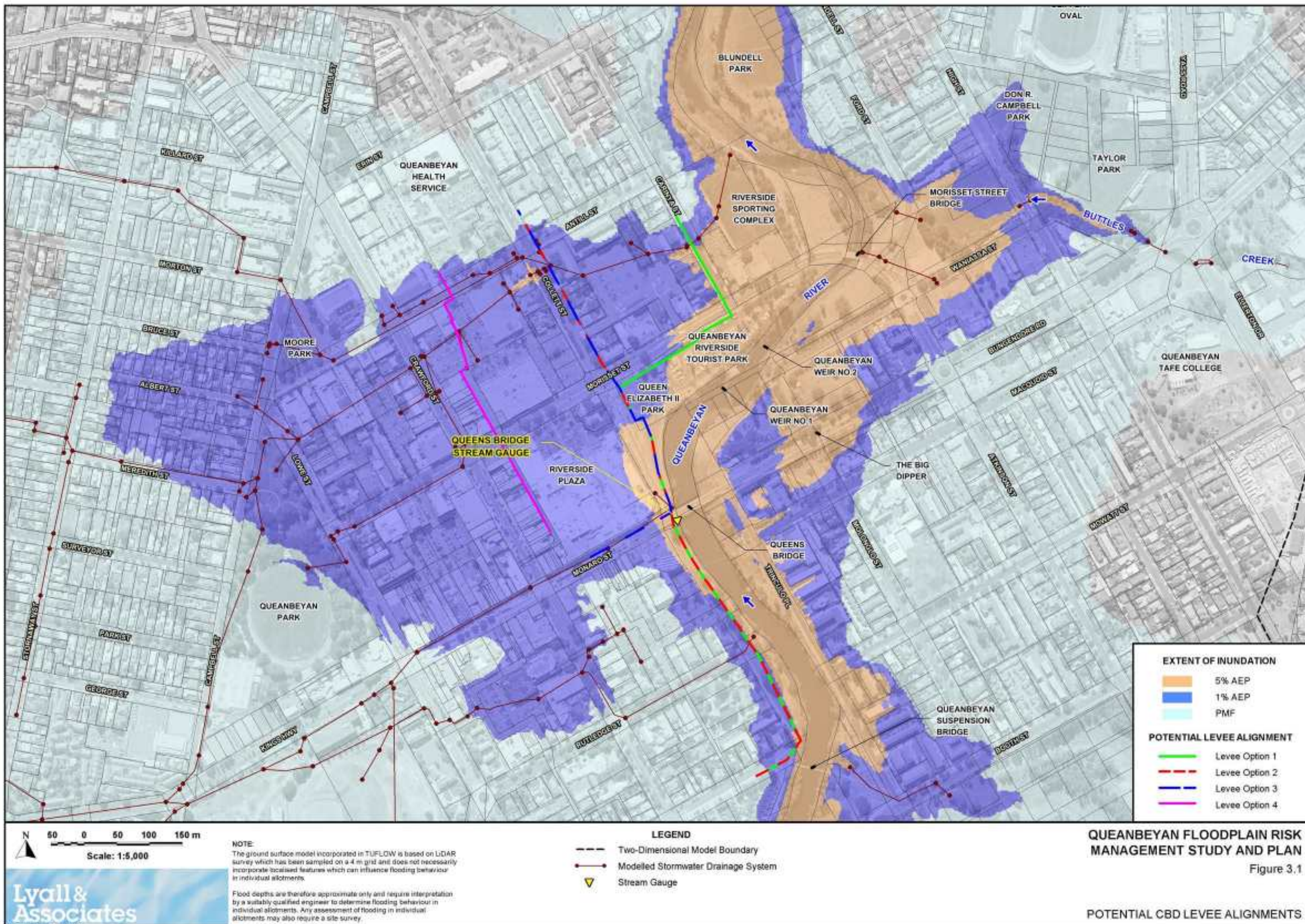
**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

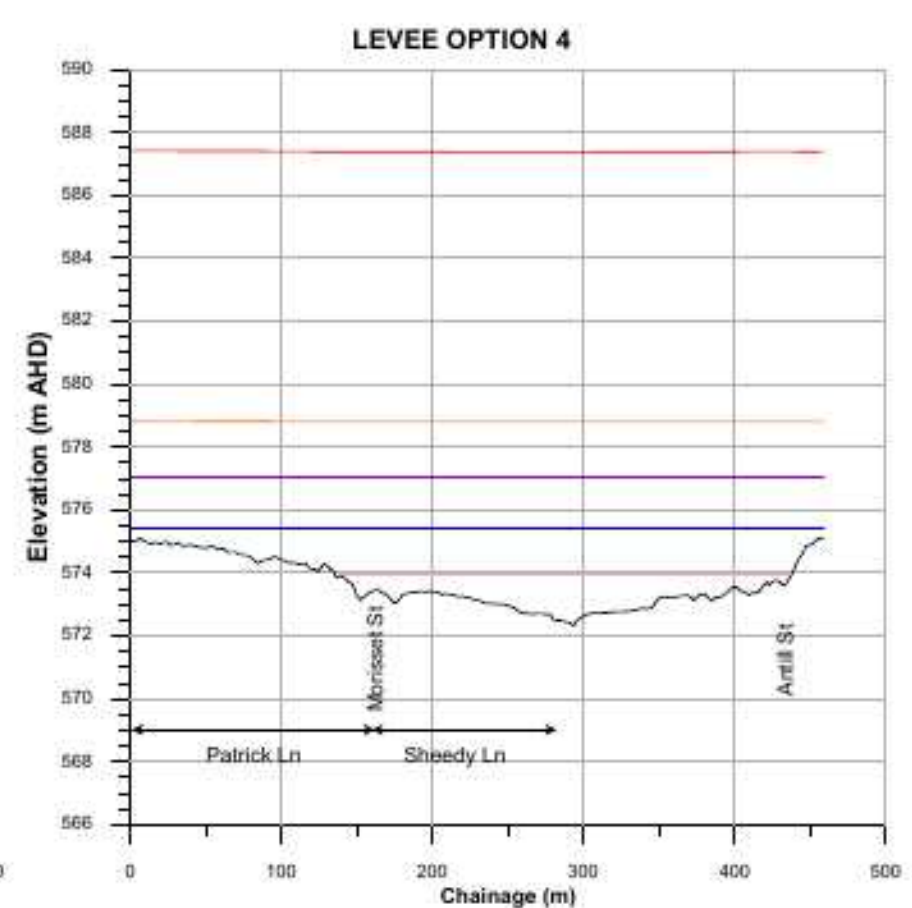
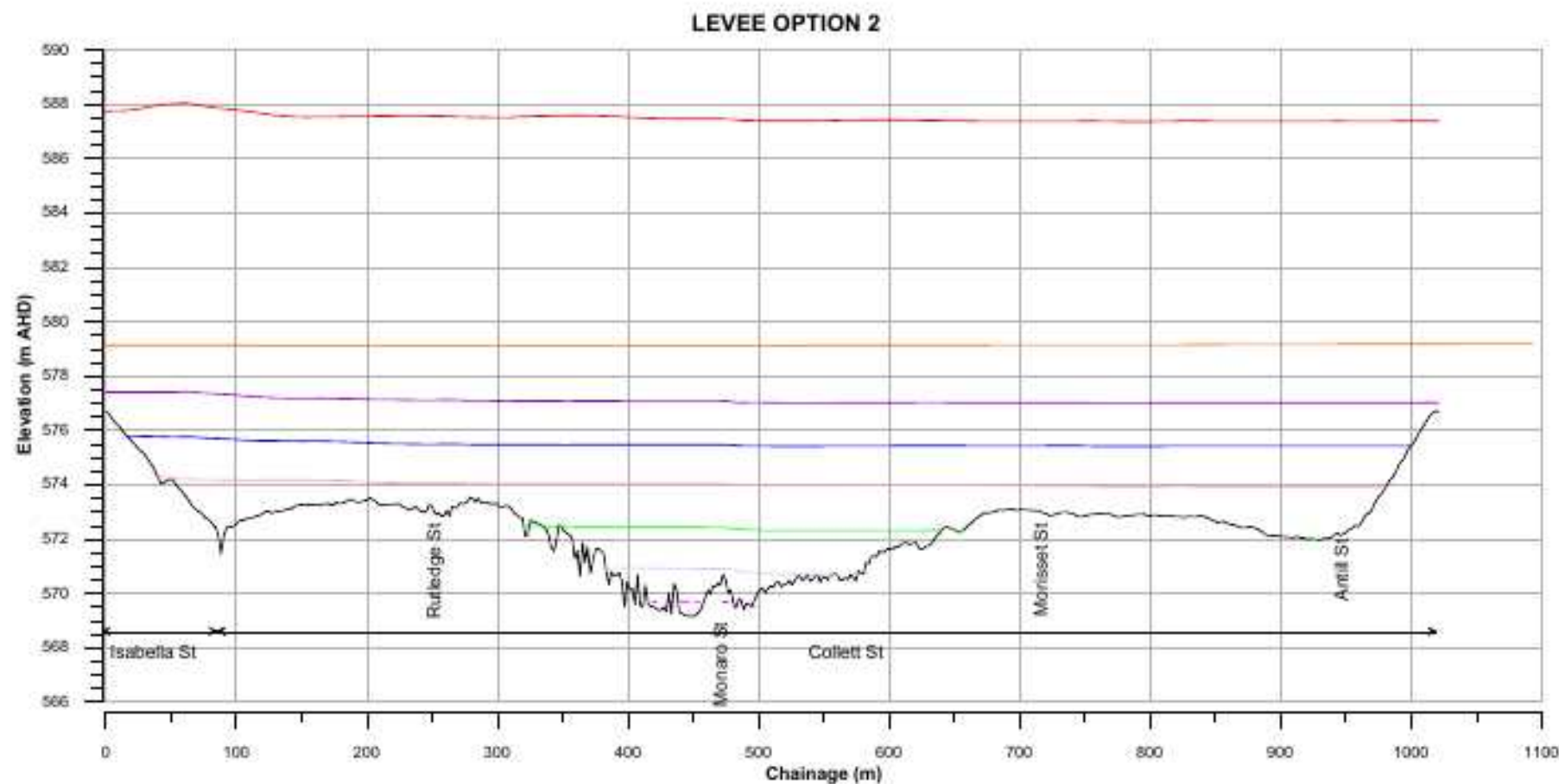
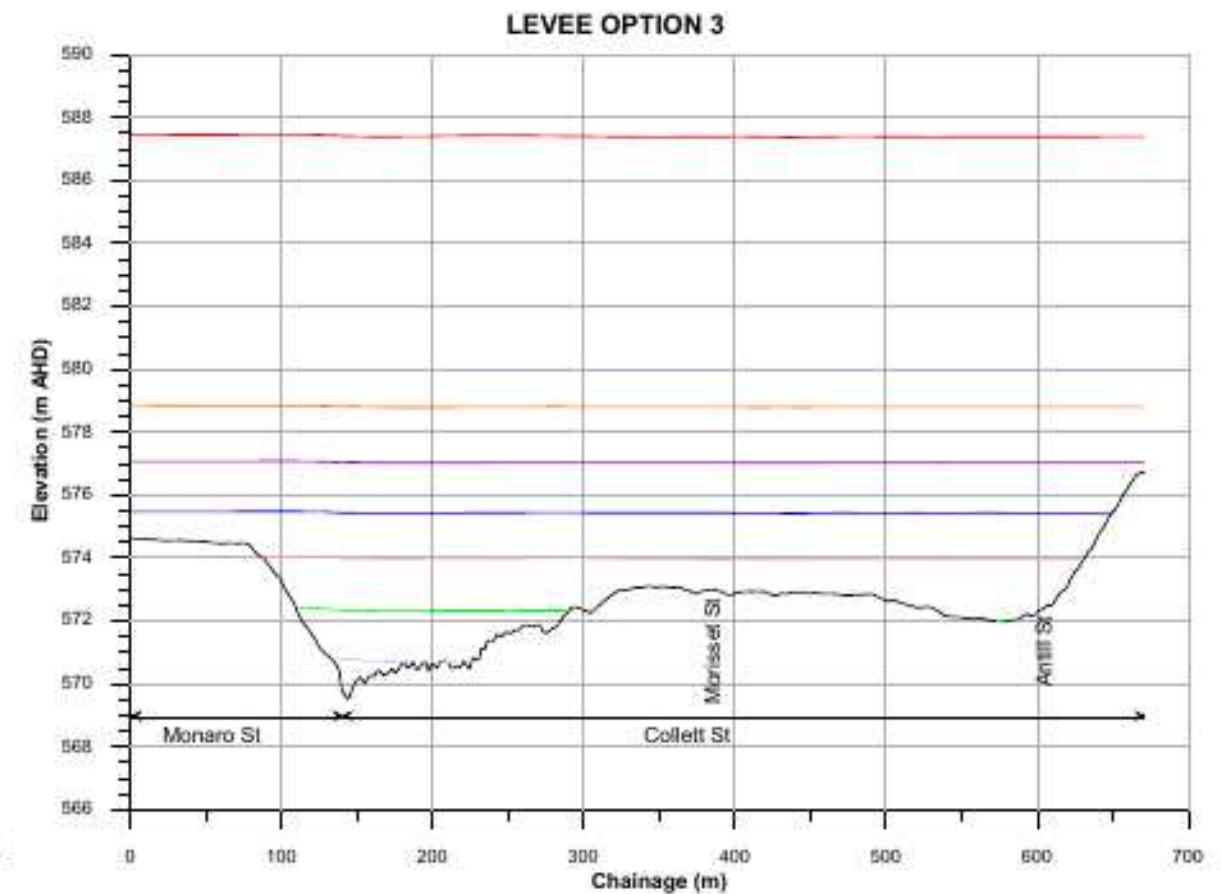
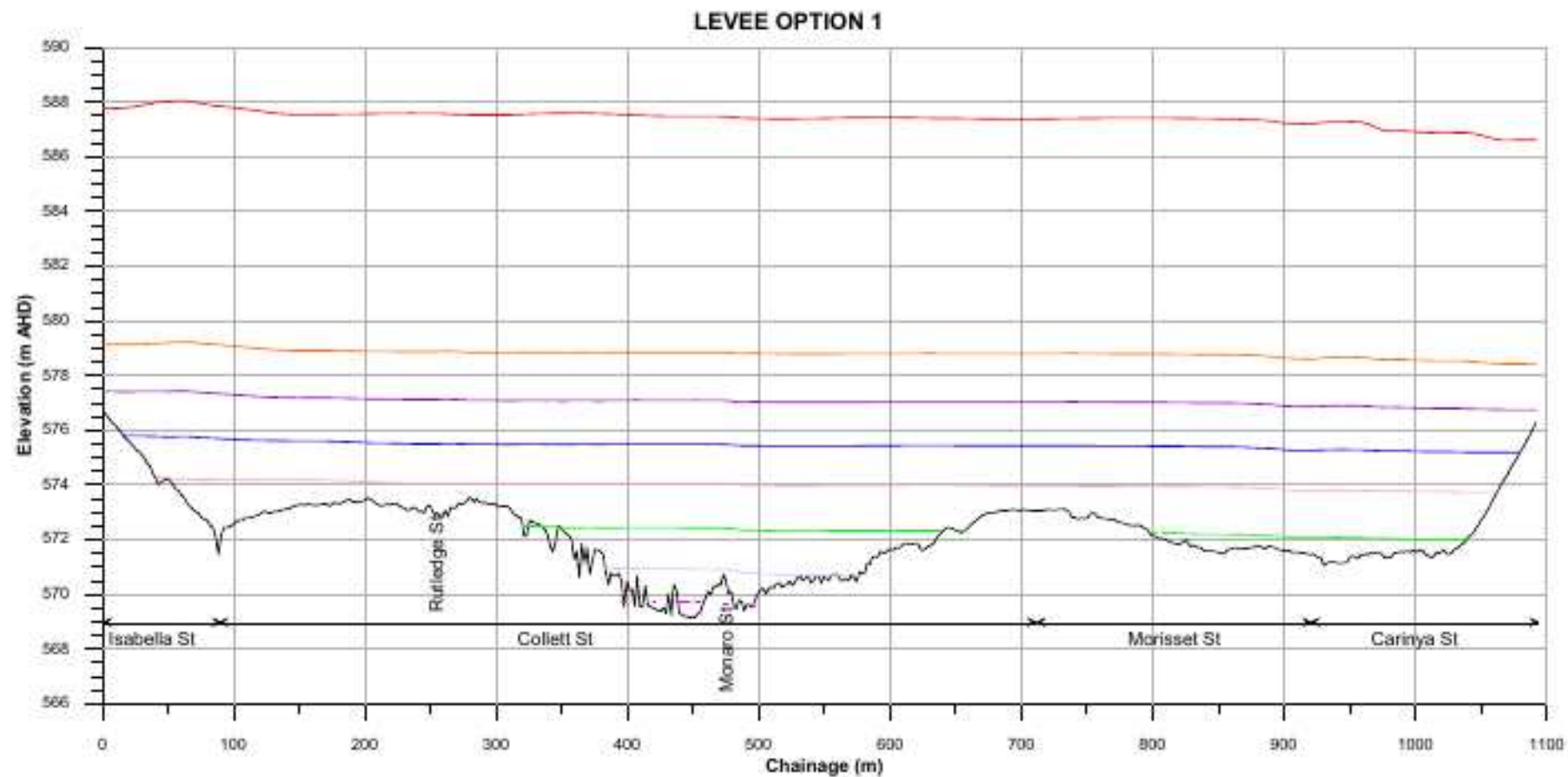
Figure 2.14

QUEANBEYAN LEP 2012 ZONING

Scale: 1:30,000

**Lycall &
Associates**

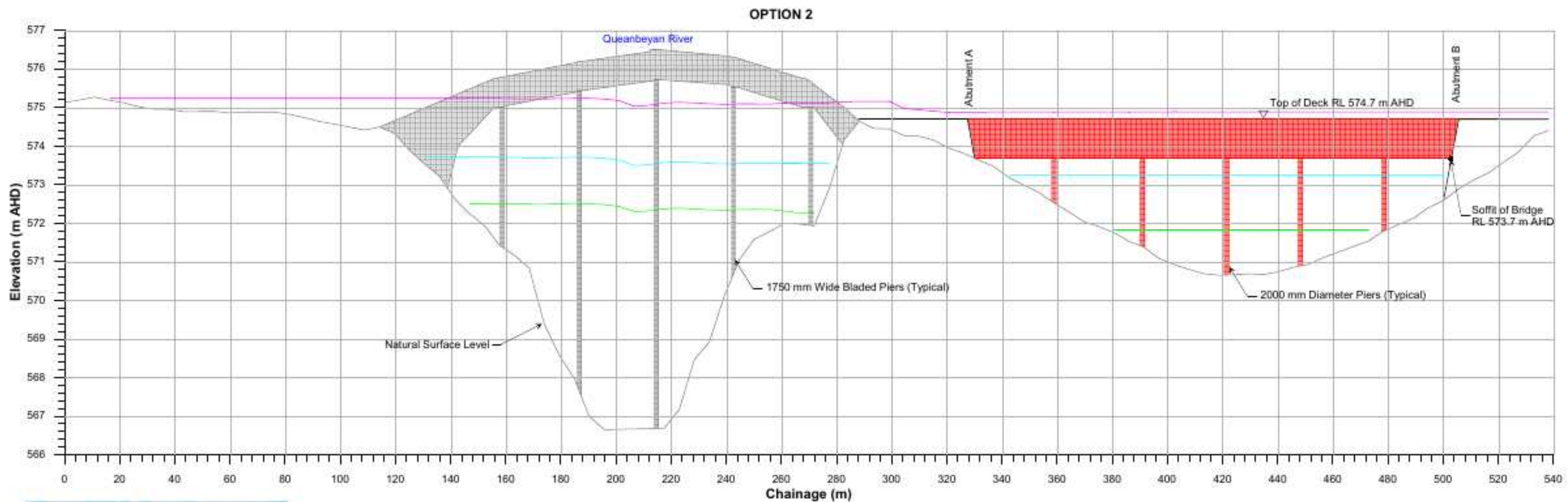
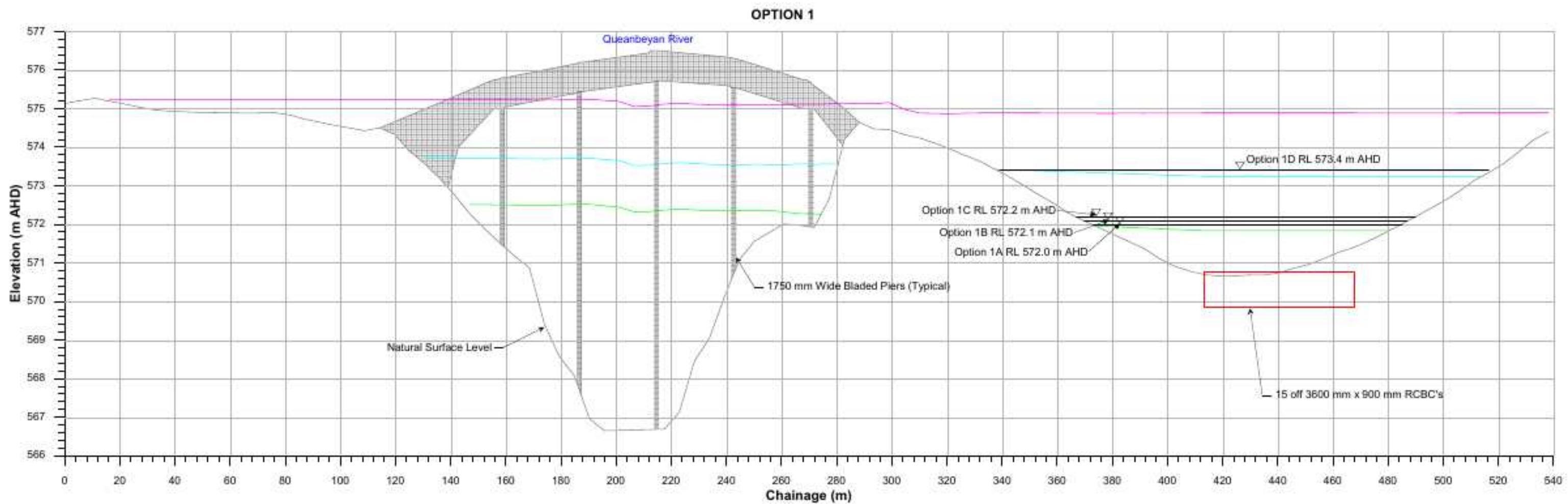




**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 3.2

LONGITUDINAL SECTIONS ALONG POTENTIAL CBD LEVEE ALIGNMENTS



NOTE:

1. Cross sections drawn looking in the downstream direction.
2. Peak flood levels based on results generated by the Kings Highway TUFLOW Model.

WATER SURFACE PROFILES

- 100 year ARI
- 50 year ARI
- 20 year ARI

**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure 3.3

TYPICAL CROSS SECTIONS SHOWING KINGS HIGHWAY UPGRADE OPTIONS

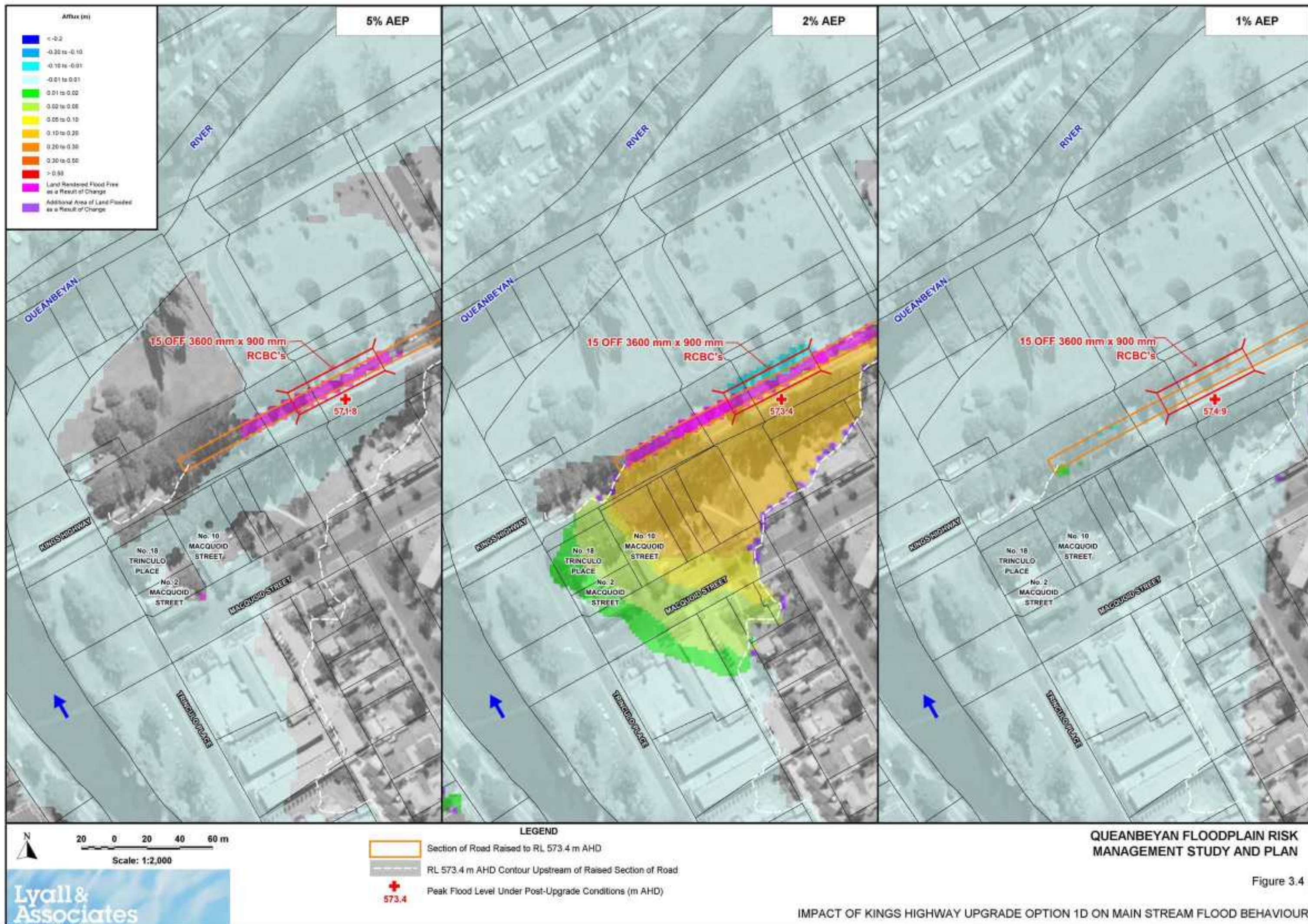
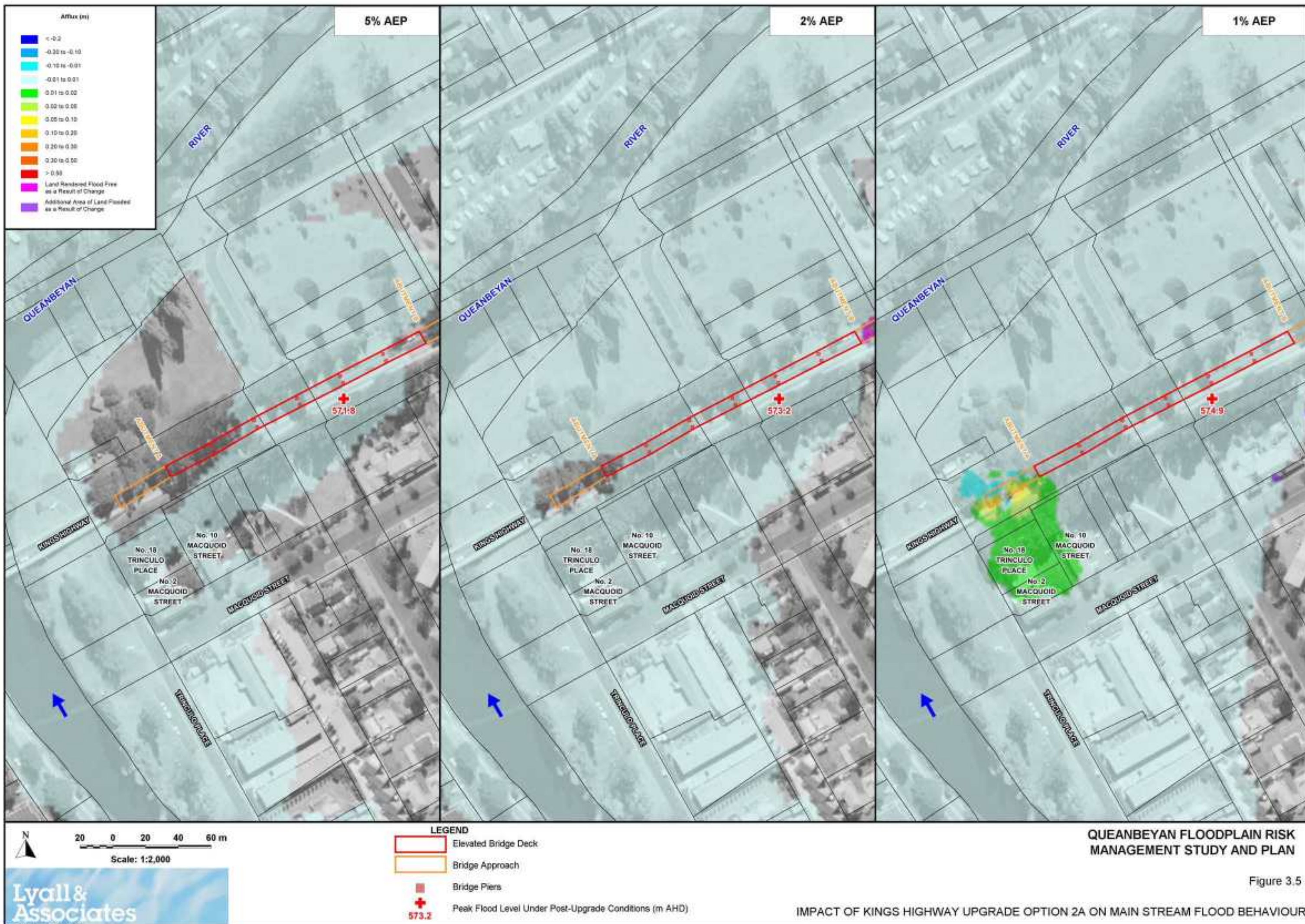


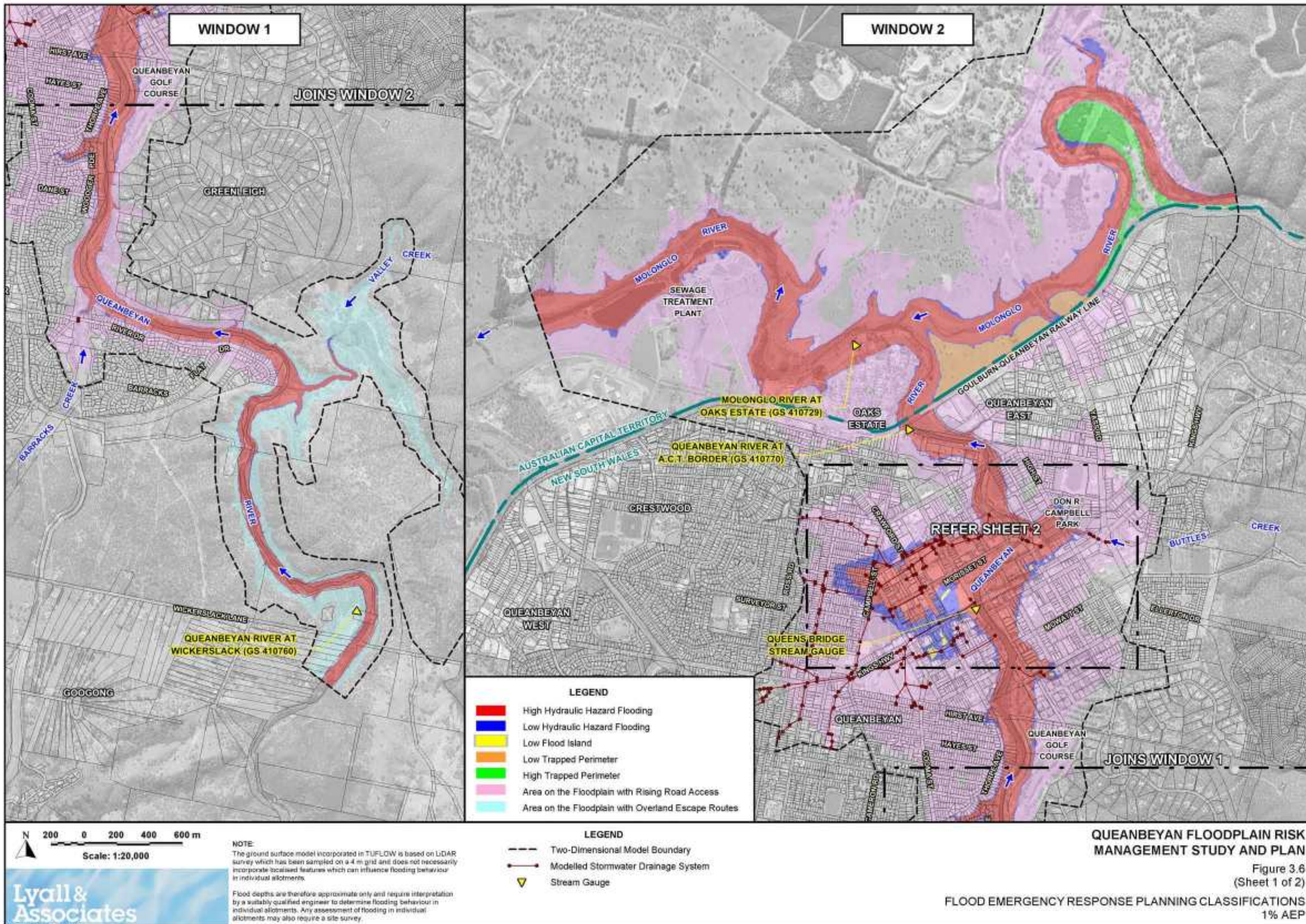
Figure 3.4

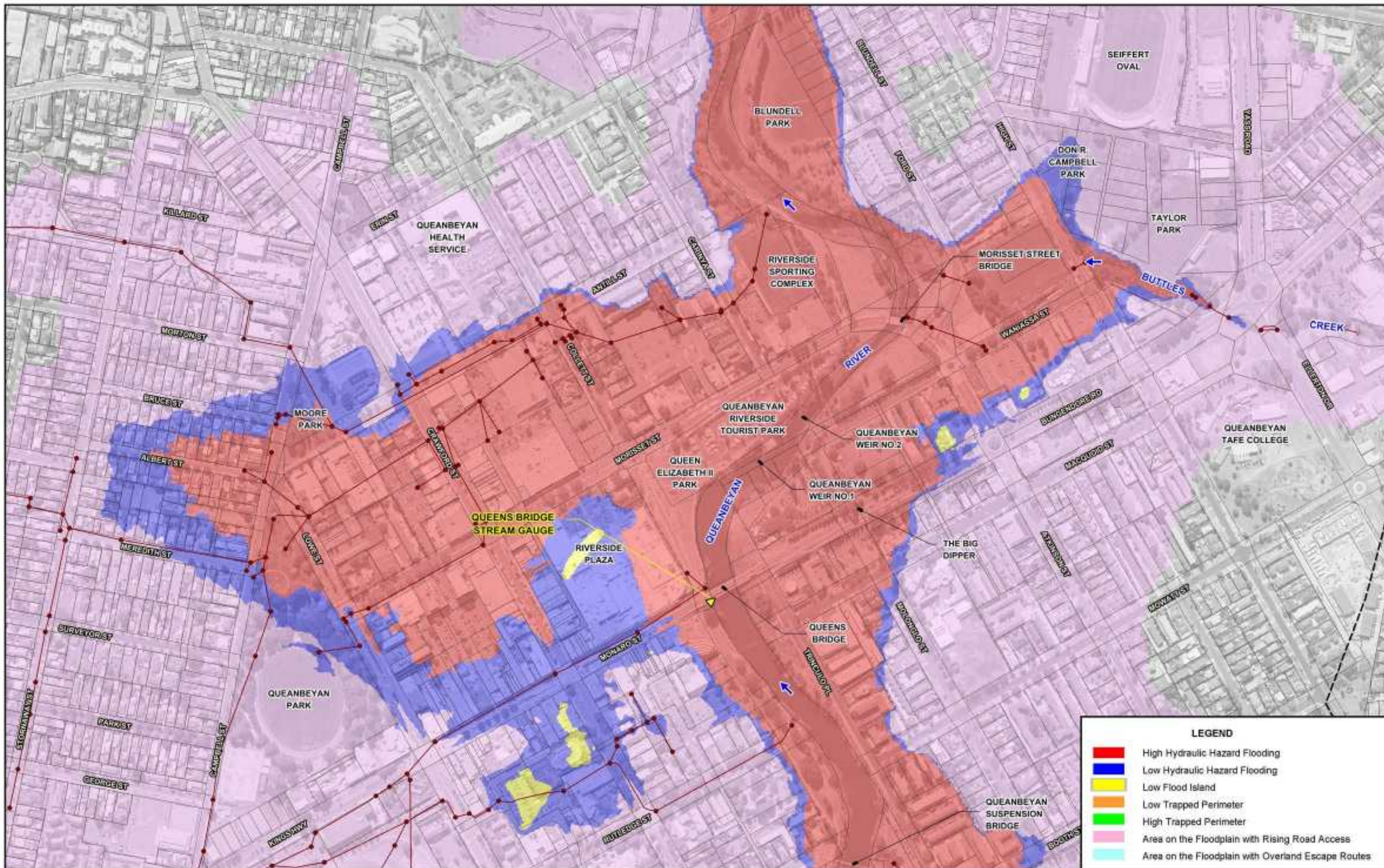
IMPACT OF KINGS HIGHWAY UPGRADE OPTION 1D ON MAIN STREAM FLOOD BEHAVIOUR

Document Set ID: 1169204

Version: 1, Version Date: 15/03/2021







Scale: 1:5,000

Lyall & Associates

NOTE

The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

LEGEND

- Two-Dimensional Model Boundary
- Modelled Stormwater Drainage System
- ▼ Stream Gauge

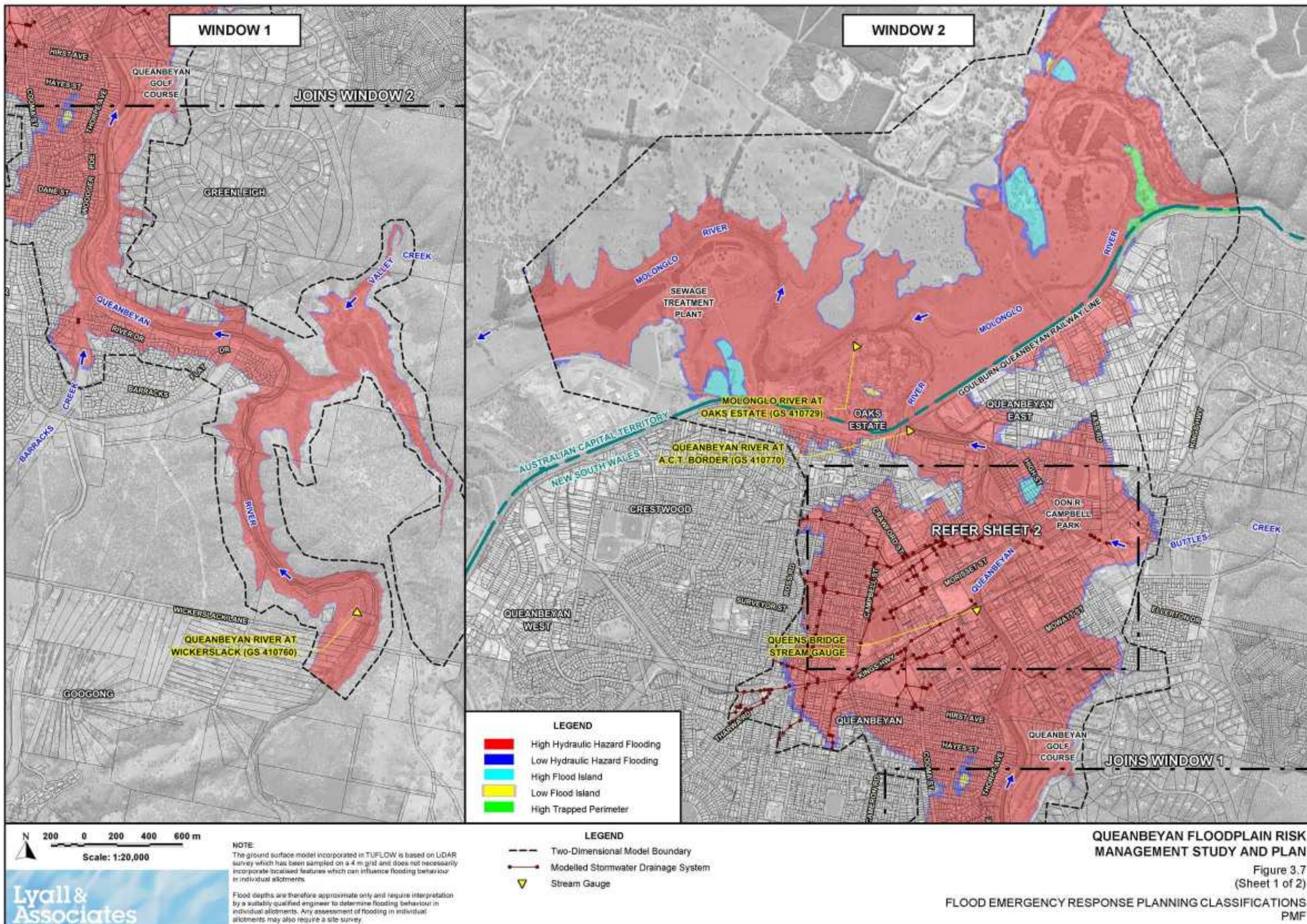
LEGEND

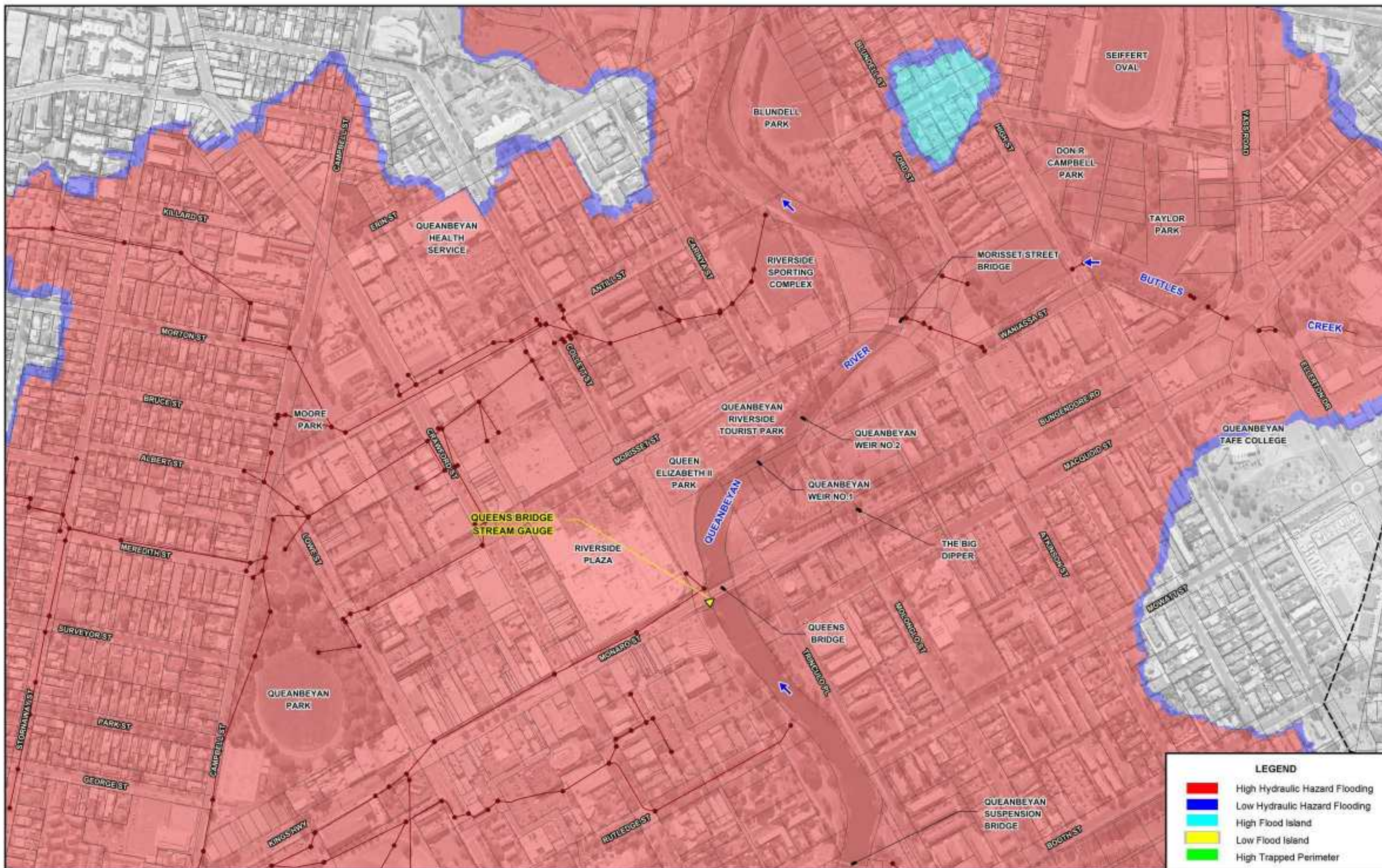
- High Hydraulic Hazard Flooding
- Low Hydraulic Hazard Flooding
- Low Flood Island
- Low Trapped Perimeter
- High Trapped Perimeter
- Area on the Floodplain with Rising Road Access
- Area on the Floodplain with Overland Escape Routes

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 3.6
(Sheet 2 of 2)

FLOOD EMERGENCY RESPONSE PLANNING CLASSIFICATIONS
1% AEP





LEGEND

- High Hydraulic Hazard Flooding
- Low Hydraulic Hazard Flooding
- High Flood Island
- Low Flood Island
- High Trapped Perimeter

Scale: 1:5,000



NOTE
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.
Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

LEGEND

- Two-Dimensional Model Boundary
- Modelled Stormwater Drainage System
- Stream Gauge

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

APPENDIX B

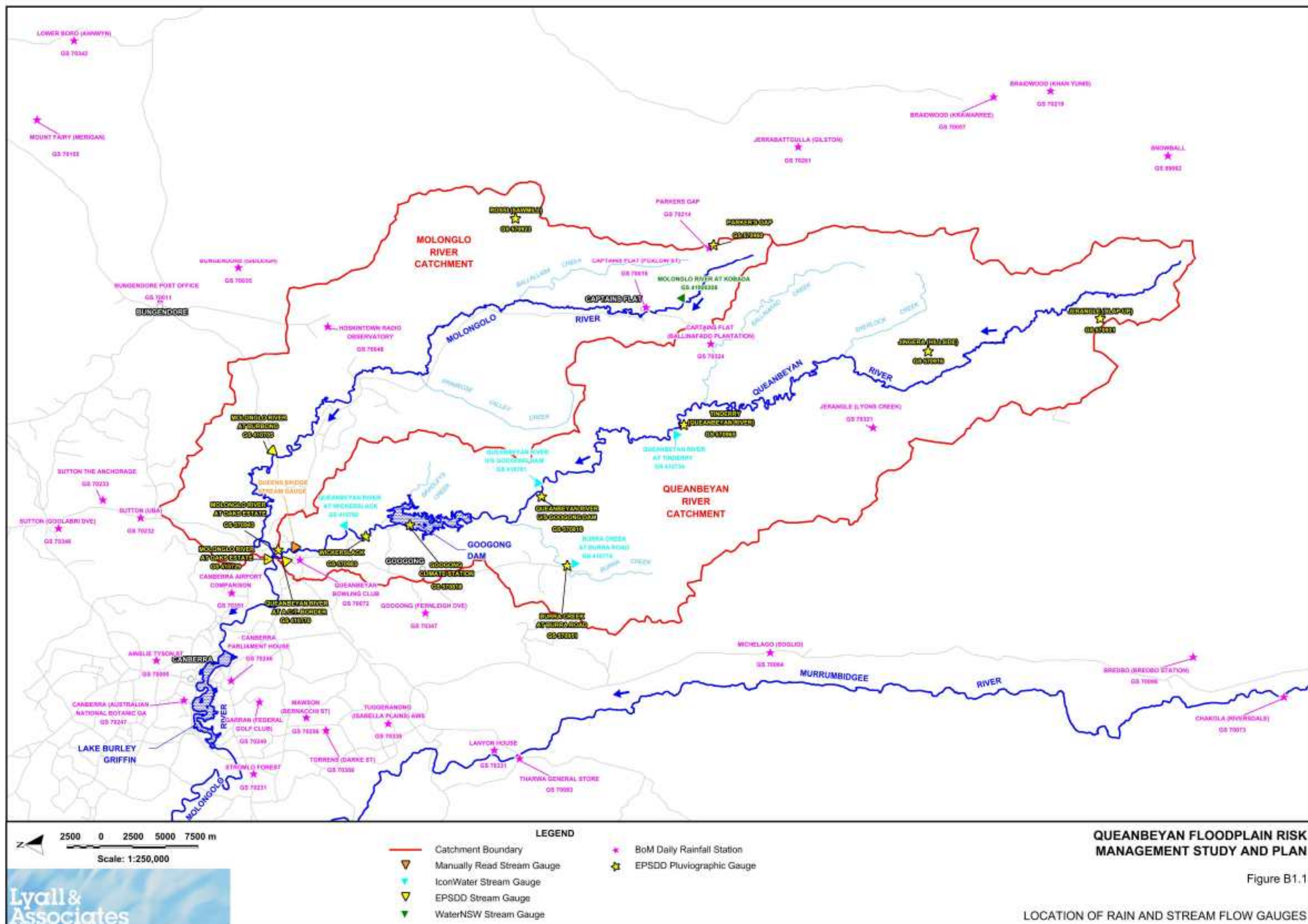
HISTORIC FLOOD DATA

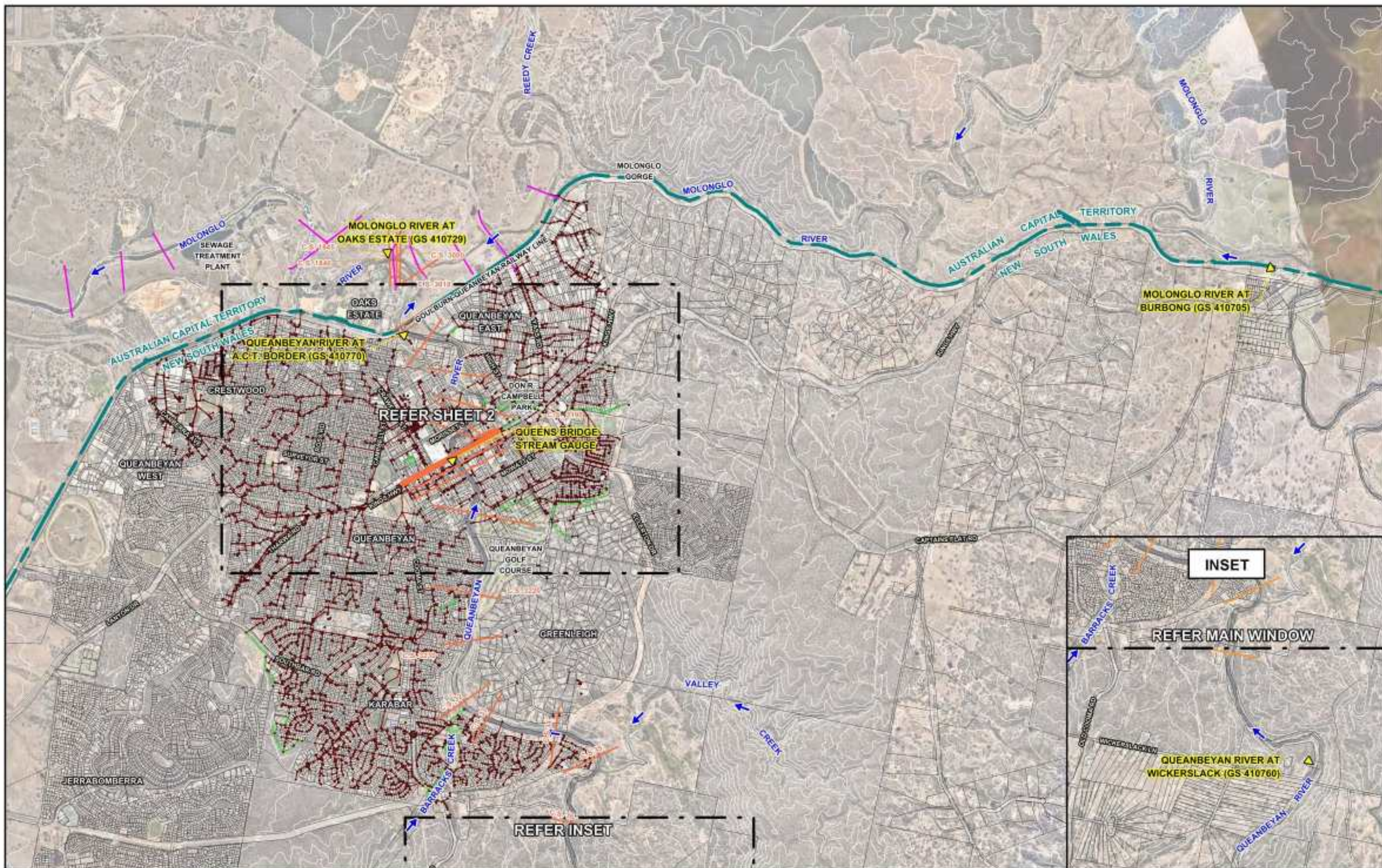
LIST OF FIGURES (APPENDIX B)

- B1.1 Location of Rain and Stream Flow Gauges
- B1.2 Location of Historic Flood Marks and Sources of Data at Queanbeyan (2 Sheets)

- B3.1 Cumulative Rainfall – December 2010 Storm
- B3.2 Isohyetal Map – Rain Days of 9 and 10 December 2010
- B3.3 Intensity-Frequency-Duration Curves and Historic Rainfall (5 Sheets)

- B4.1 Rating Curves and Cross Section – Queanbeyan River at Wickerslack Stream Gauge (GS 410760)
- B4.2 Recorded Discharge Hydrographs – August 1974 Flood
- B4.3 Recorded Discharge Hydrographs and Googong Dam Details – October 1976 Flood
- B4.4 Recorded Discharge Hydrographs and Googong Dam Details – December 2010 Flood
- B4.5 Flood Frequency Relationship – Log-Pearson 3 Annual Series 1913-2017 – Queanbeyan River at Googong Stream Gauge (GS 410701)
- B4.6 Flood Frequency Relationship – Log-Pearson 3 Annual Series 1977-2017 – Queanbeyan River at Wickerslack Stream Gauge (GS 410760)
- B4.7 Flood Frequency Relationship – Log-Pearson 3 Annual Series 1913-2017 – Queanbeyan River at Wickerslack Stream Gauge (GS 410760)
- B4.8 Flood Frequency Relationship – Log-Pearson 3 Annual Series 1930-2017 – Molonglo River at Burbong Stream Gauge (GS 410705)





N 300 0 300 600 900 m
Scale: 1:30,000

Lyll & Associates

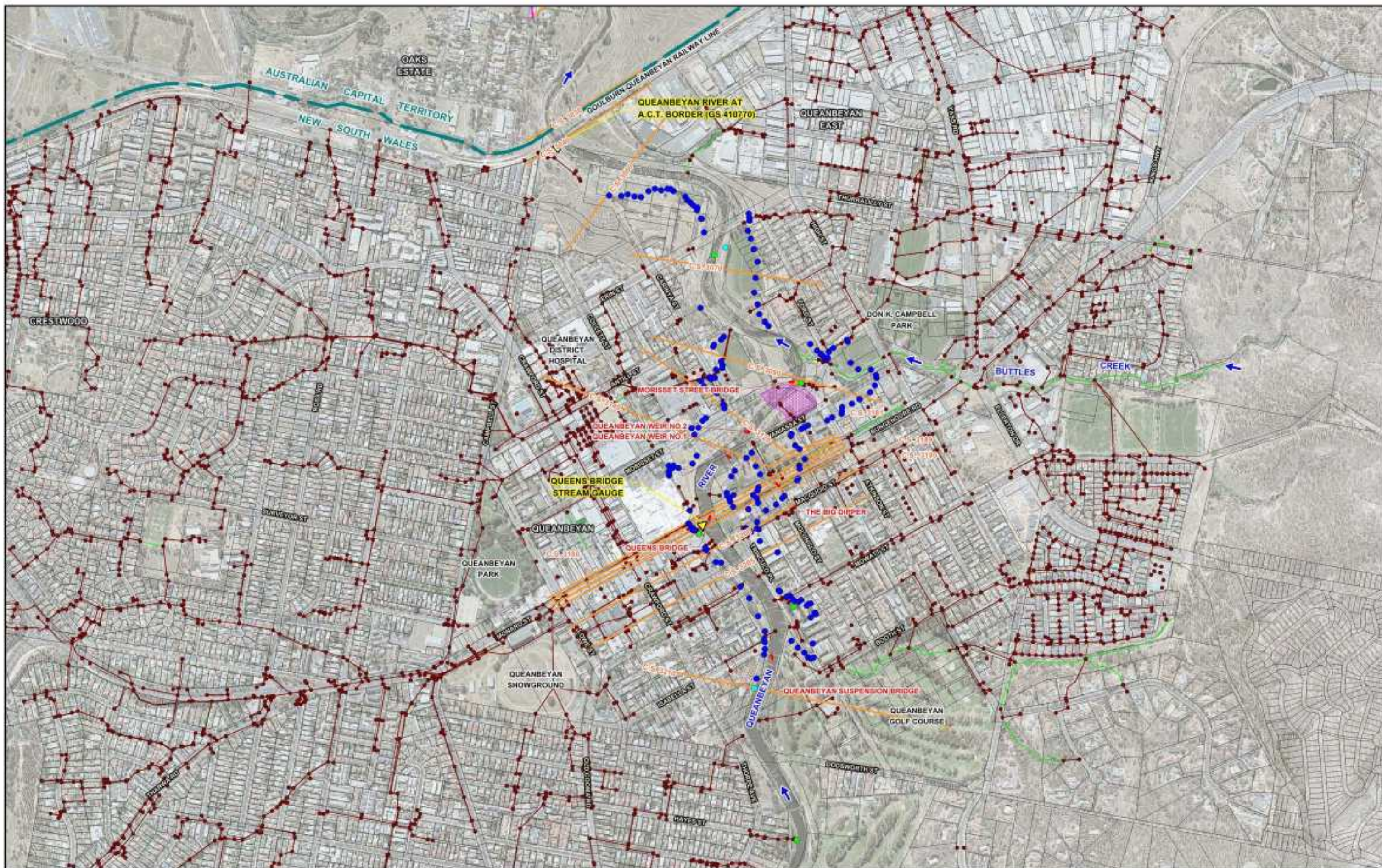
LEGEND

- Existing Piped Stormwater Drainage System
- Existing Stormwater Channel
- ▼ Stream Gauge
- Surveyed Cross Section (Lyll & Associates, 2008)
- Surveyed Cross Section (DWR, 1992)

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.2
(Sheet 1 of 2)

LOCATION OF HISTORIC FLOOD MARKS AND SOURCES OF DATA AT QUEANBEYAN



N
100 0 100 200 300 m
Scale: 1:10,000

- May 1925 Flood Mark
- August 1974 Flood Mark
- October 1976 Flood Mark
- December 2010 Flood Mark
- Stream Gauge

LEGEND

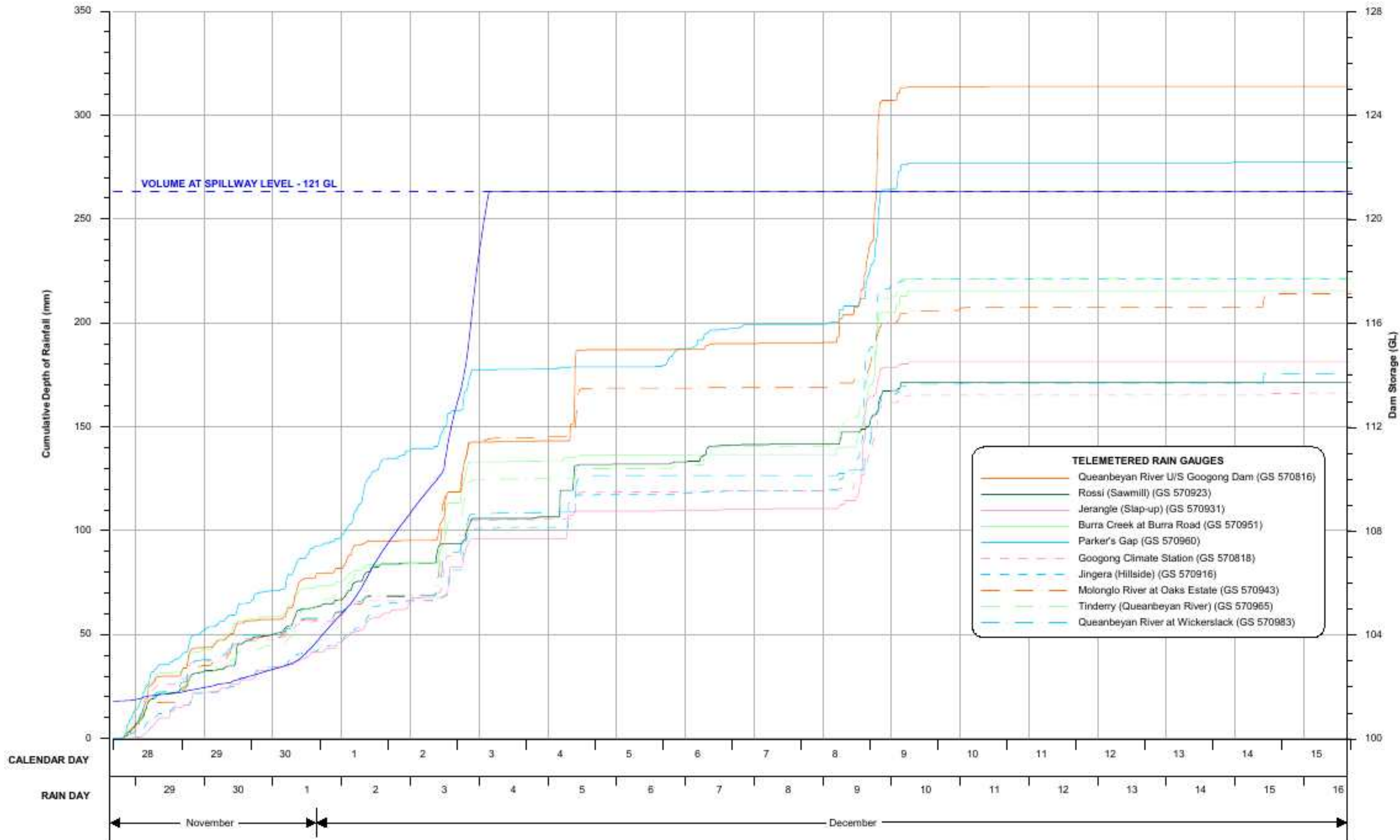
- Existing Piped Stormwater Drainage System
- Existing Stormwater Channel
- Extent of Detailed Ground Survey
- Surveyed Cross Section (Lyall & Associates, 2008)
- Surveyed Cross Section (DWR, 1992)

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.2
(Sheet 2 of 2)

LOCATION OF HISTORIC FLOOD MARKS
AND SOURCES OF DATA AT QUEANBEYAN

Lyall & Associates



NOTE :
Time zero on calendar day axis = 00:00 hours on 28 November 2010

LEGEND

Storage Volume

**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure B3.1

CUMULATIVE RAINFALL
DECEMBER 2010 STORM

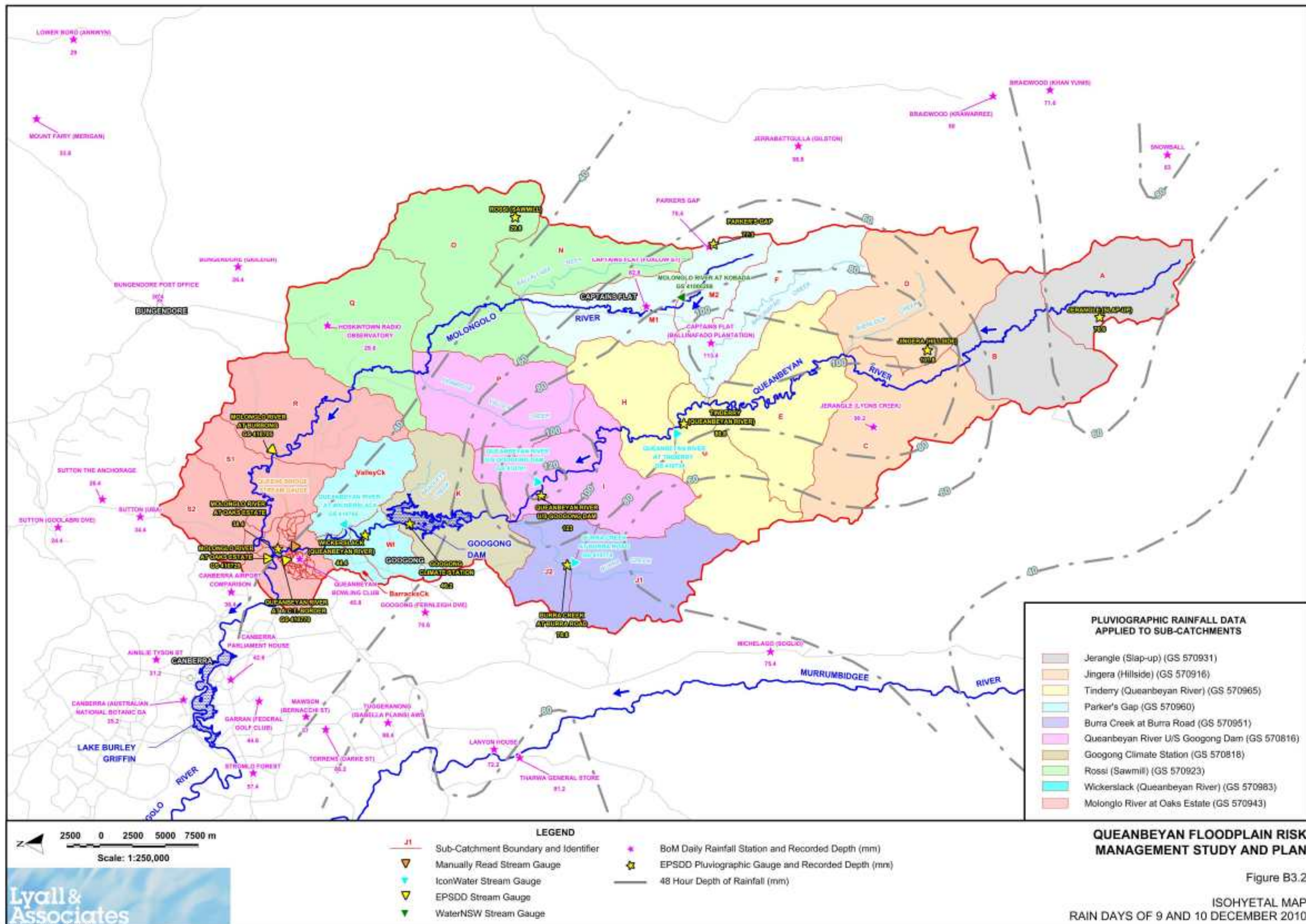
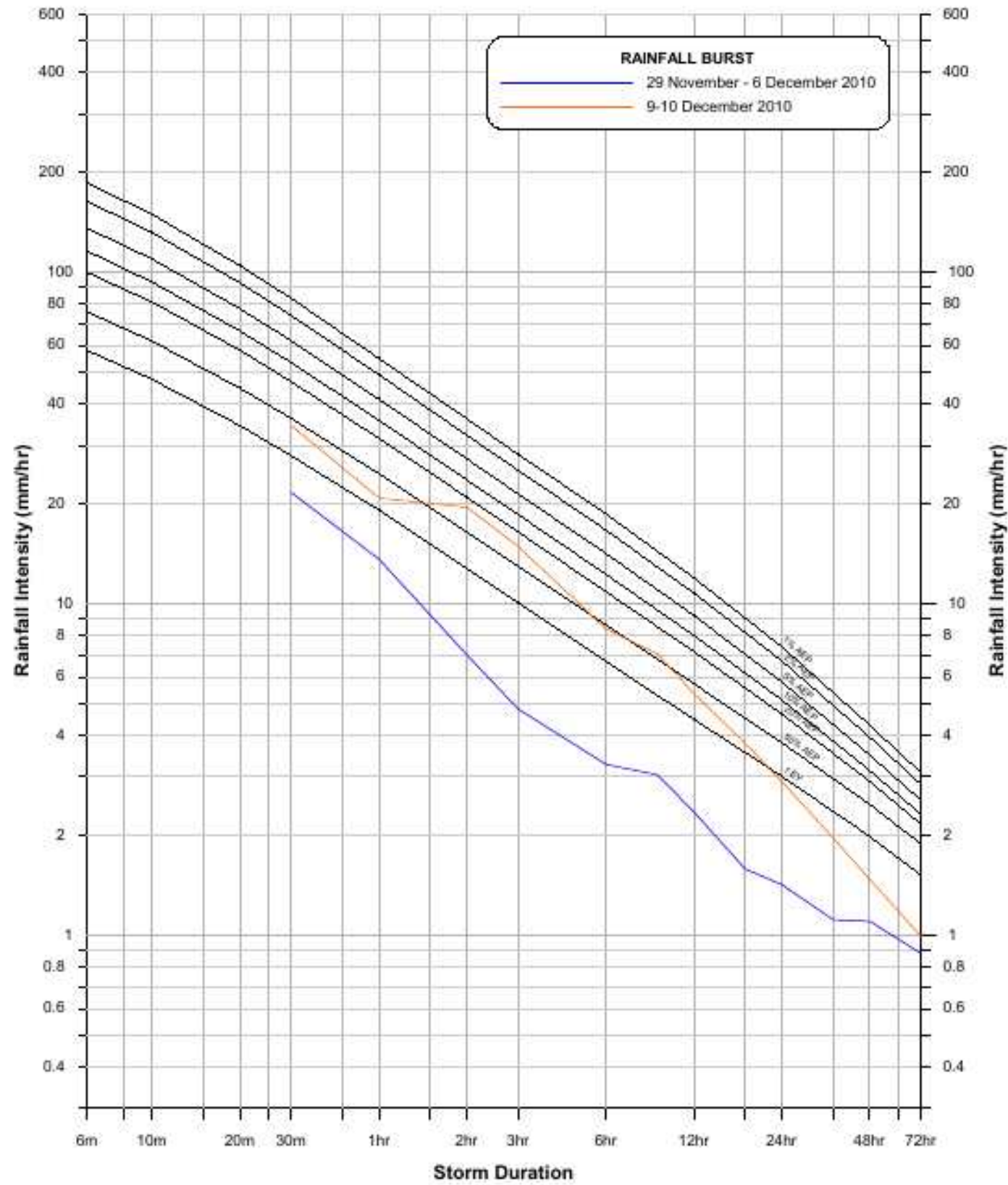


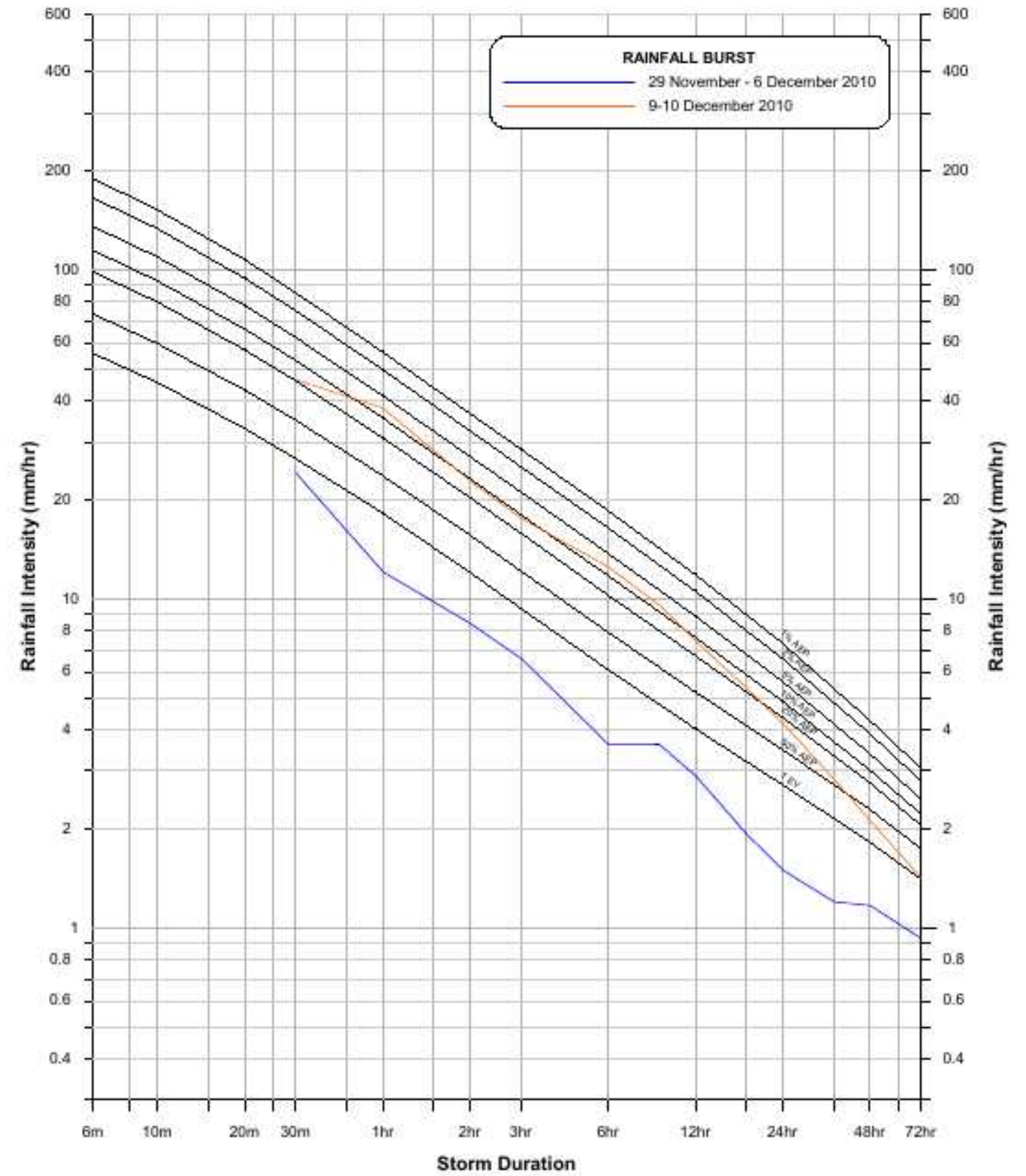
Figure B3.2

ISOHYETAL MAP
RAIN DAYS OF 9 AND 10 DECEMBER 2010

**JERANGLE (SLAP-UP)
(GS 570931)**



**JINGERA (HILLSIDE)
(GS 570916)**

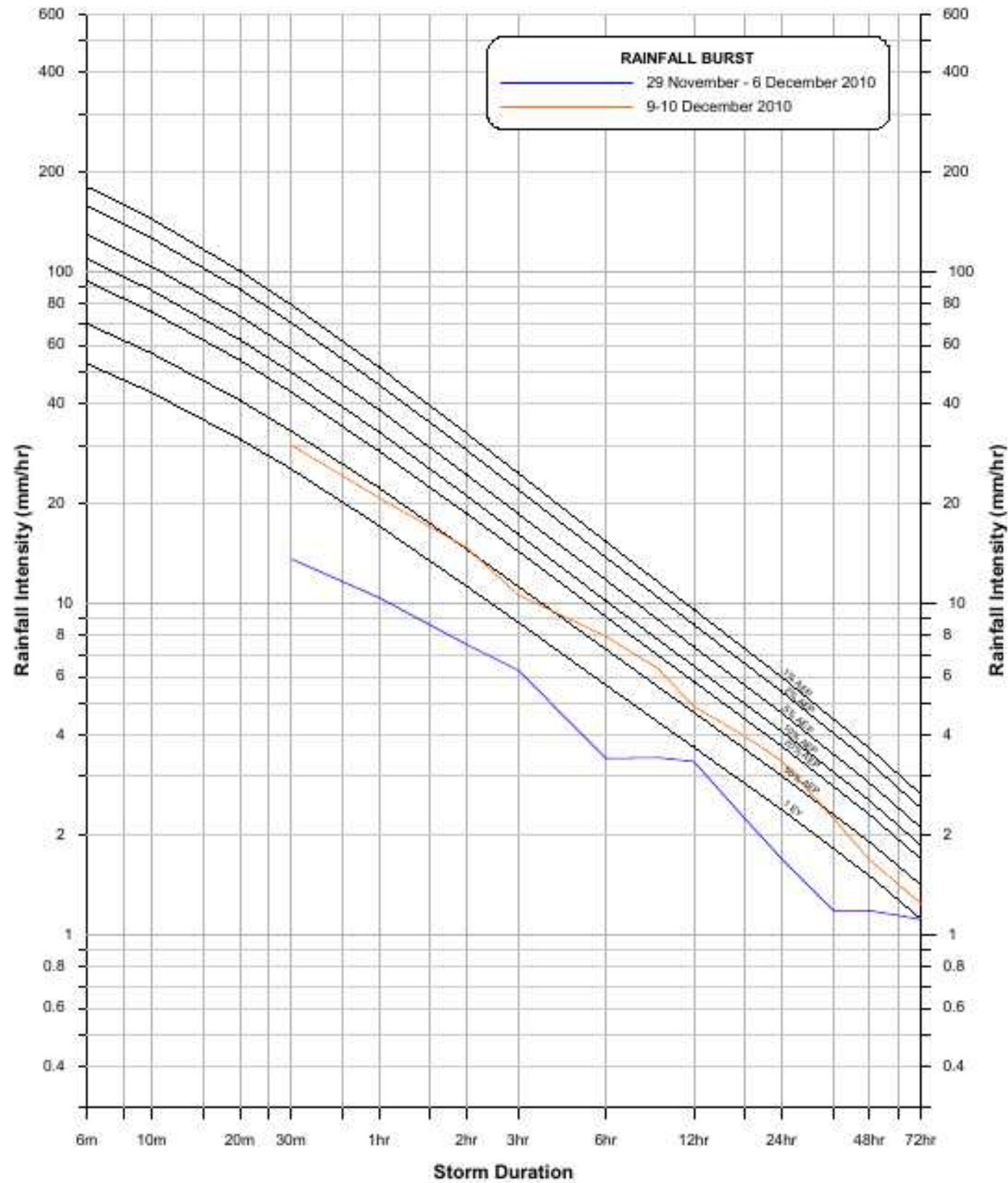


**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

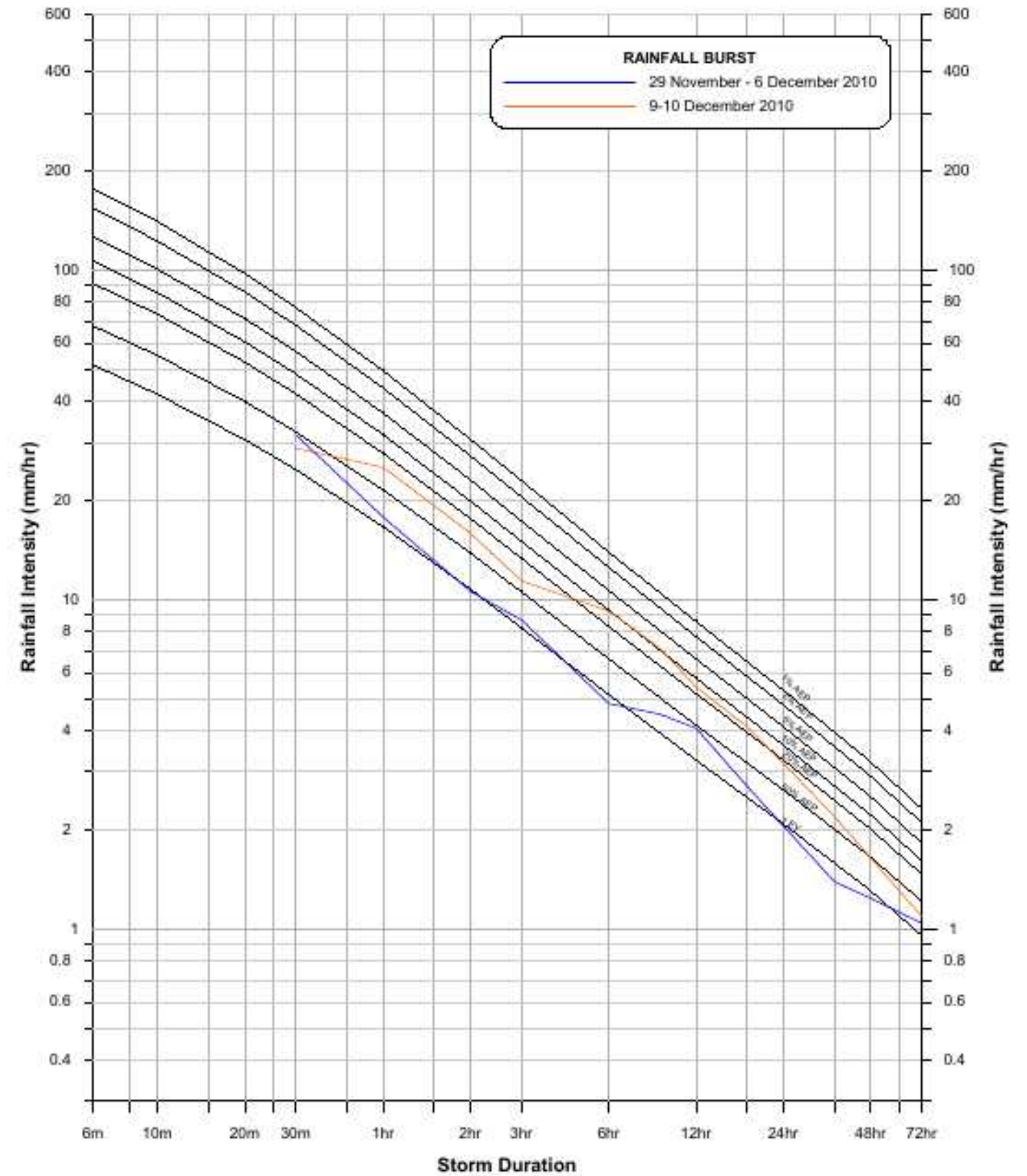
Figure B3.3
(Sheet 1 of 5)

INTENSITY-FREQUENCY-DURATION CURVES
AND HISTORIC RAINFALL

**TINDERRY (QUEANBEYAN RIVER)
(GS 570965)**



**BURRA CREEK AT BURRA ROAD
(GS 570951)**

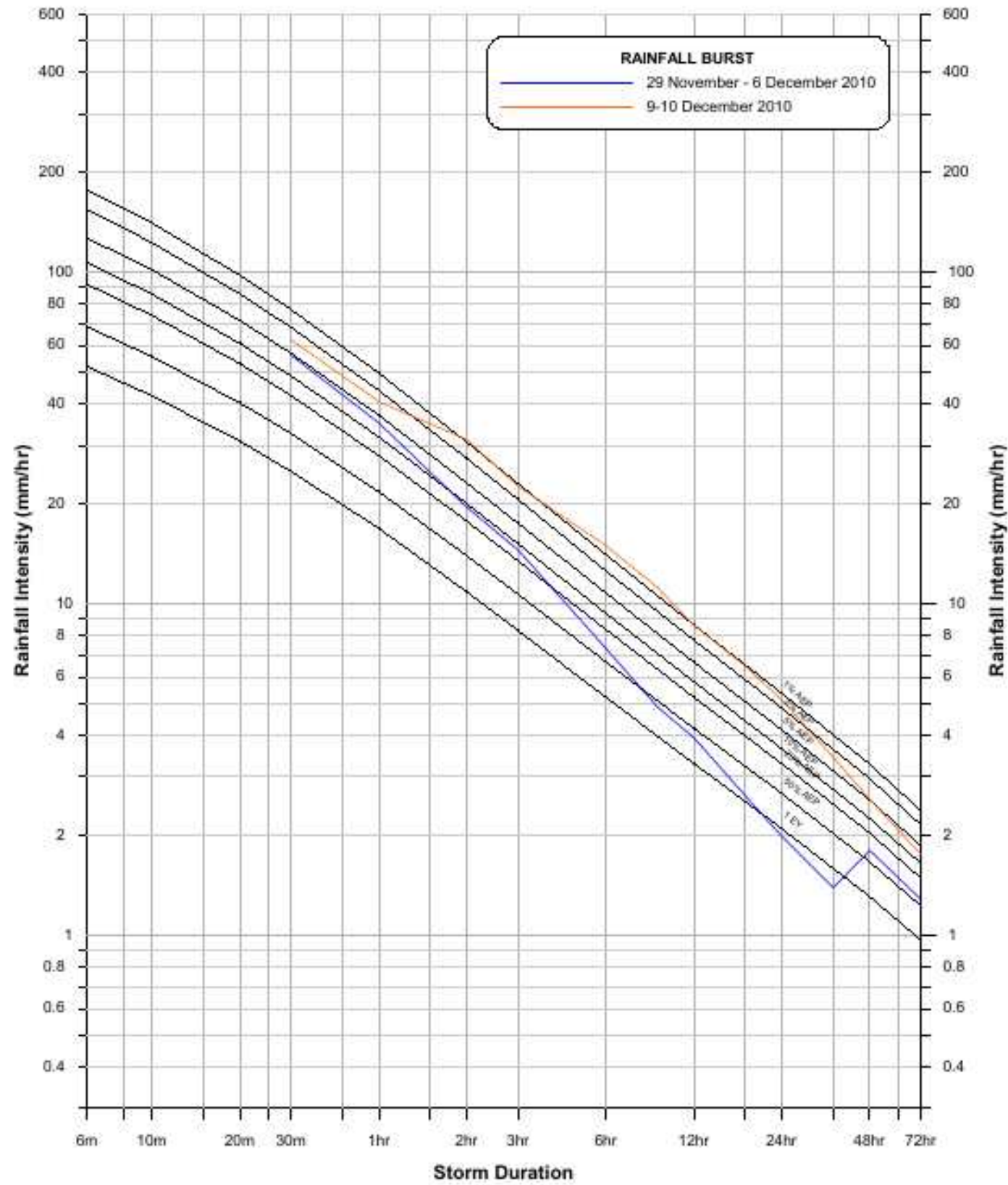


**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

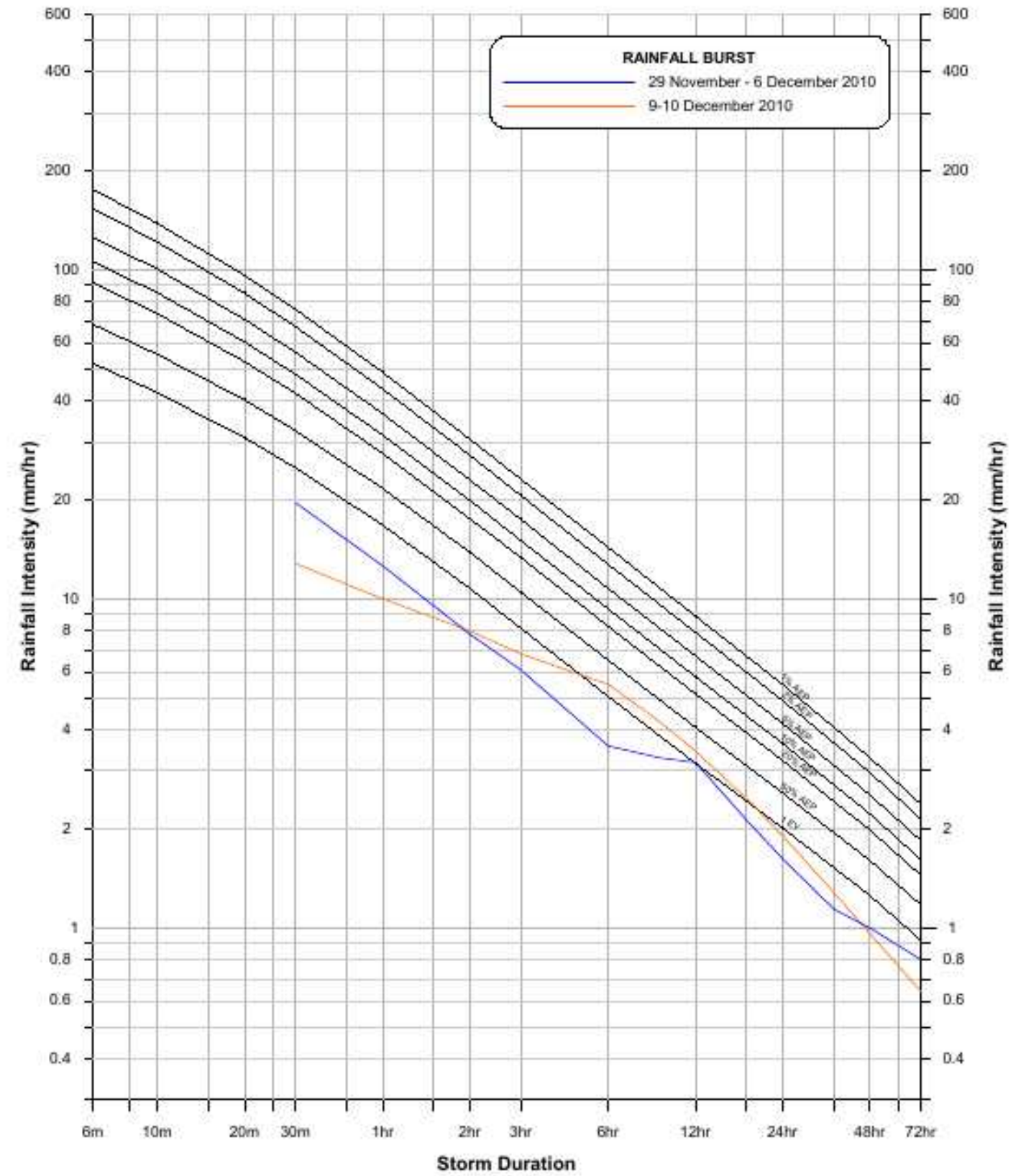
Figure B3.3
(Sheet 2 of 5)

INTENSITY-FREQUENCY-DURATION CURVES
AND HISTORIC RAINFALL

**QUEANBEYAN RIVER U/S GOOGONG DAM
(GS 570816)**



**GOOGONG CLIMATE STATION
(GS 570818)**

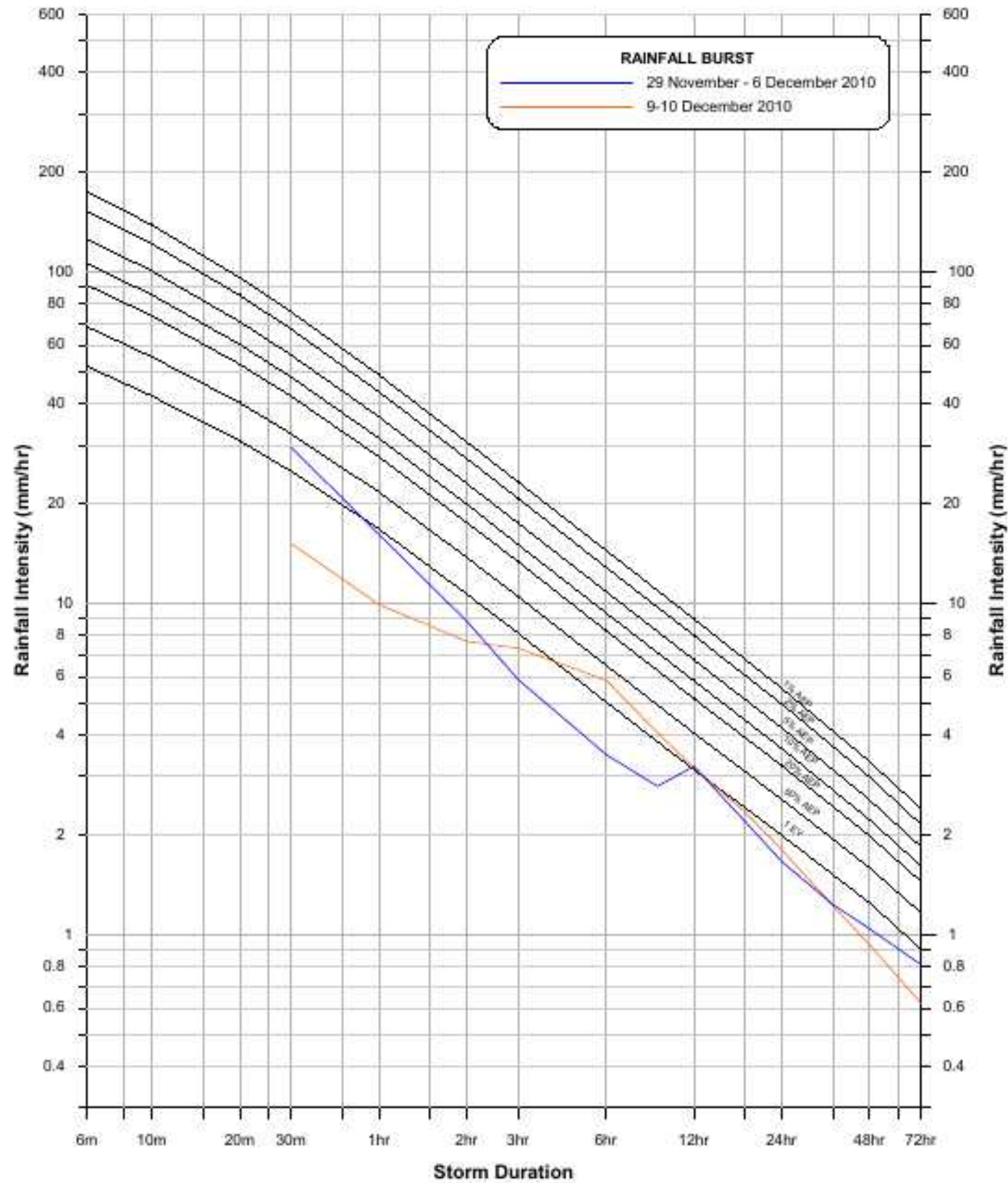


**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

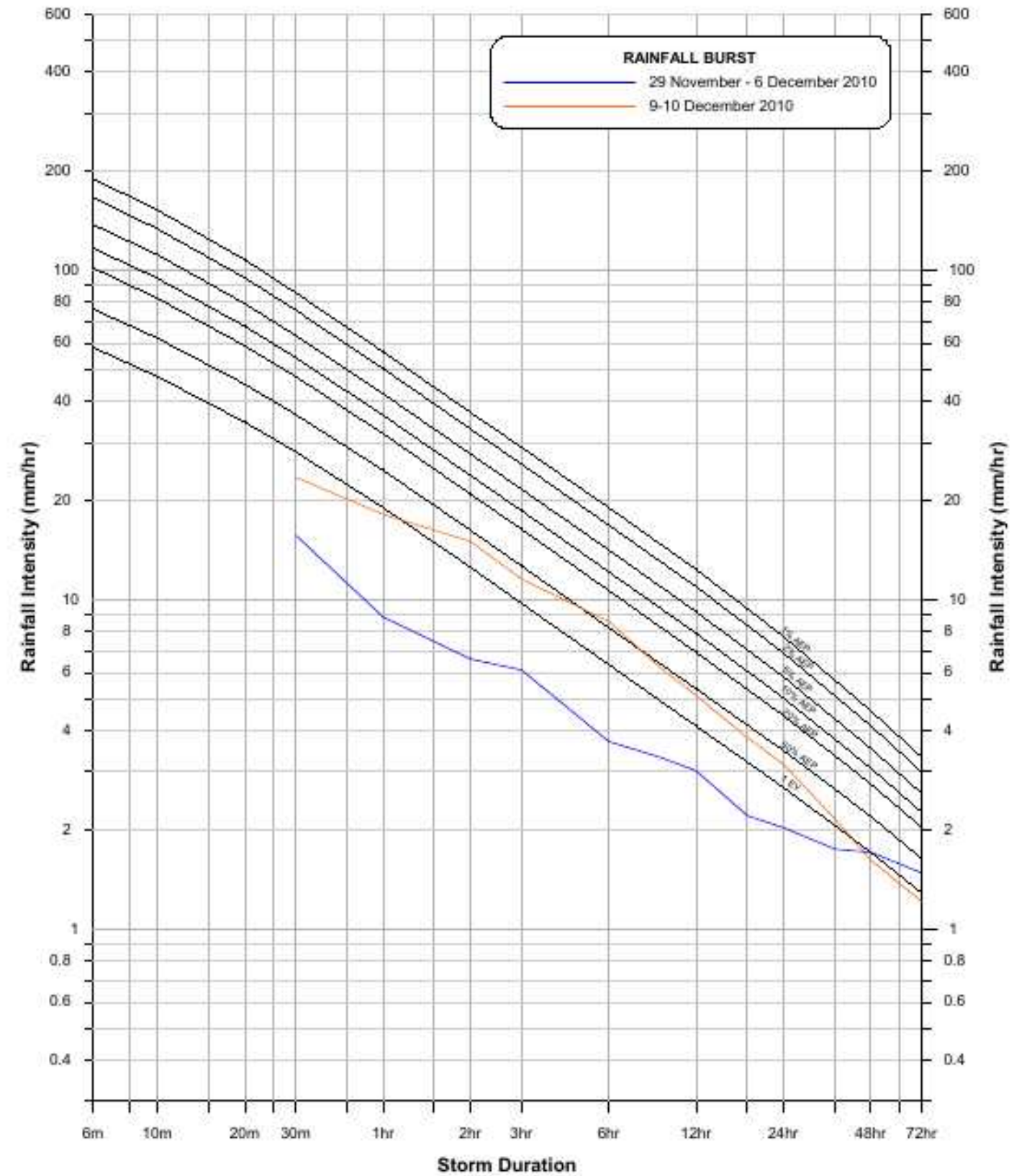
Figure B3.3
(Sheet 3 of 5)

INTENSITY-FREQUENCY-DURATION CURVES
AND HISTORIC RAINFALL

**WICKERSLACK (QUEANBEYAN RIVER)
(GS 570983)**



**PARKERS GAP
(GS 570960)**

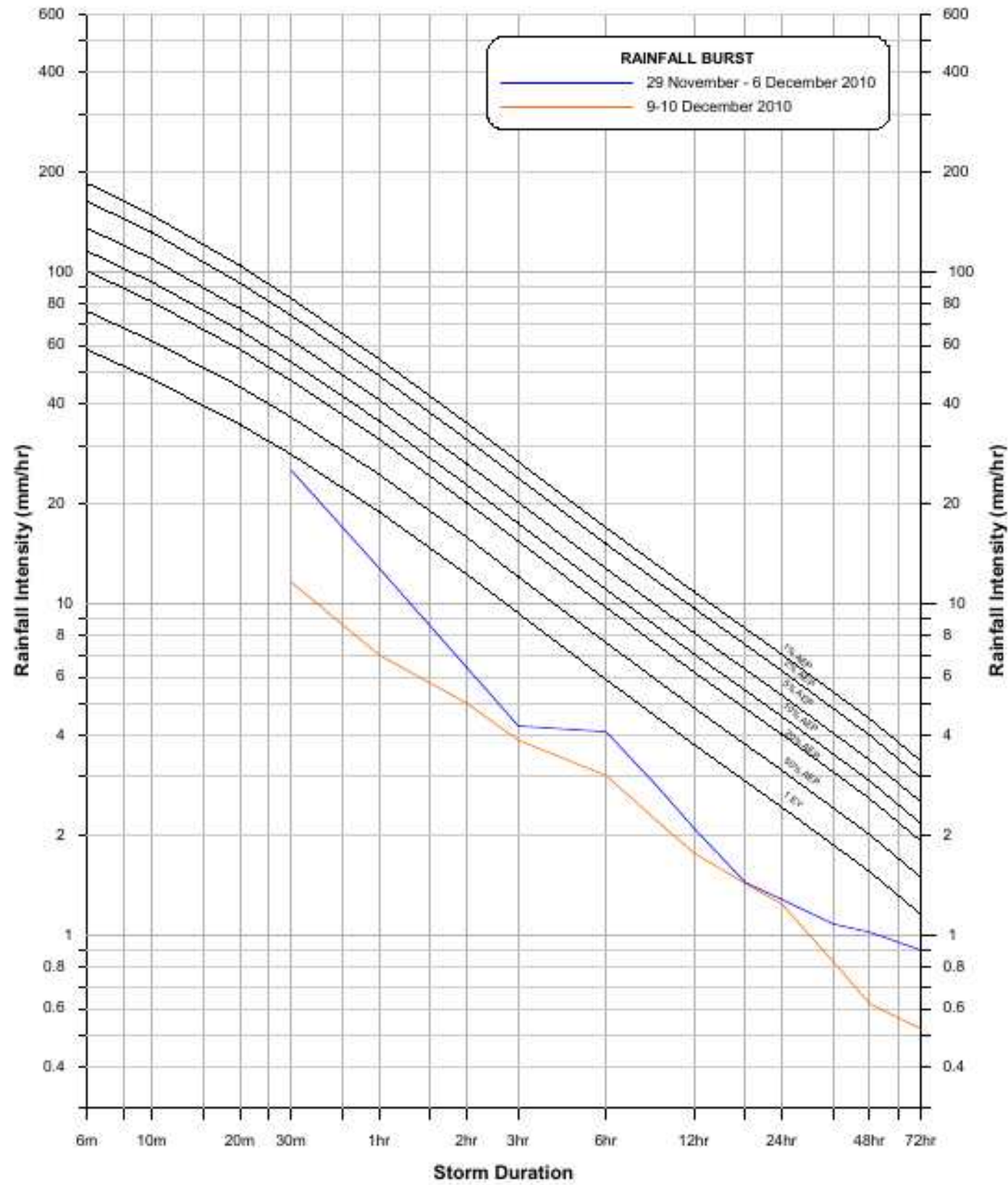


**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

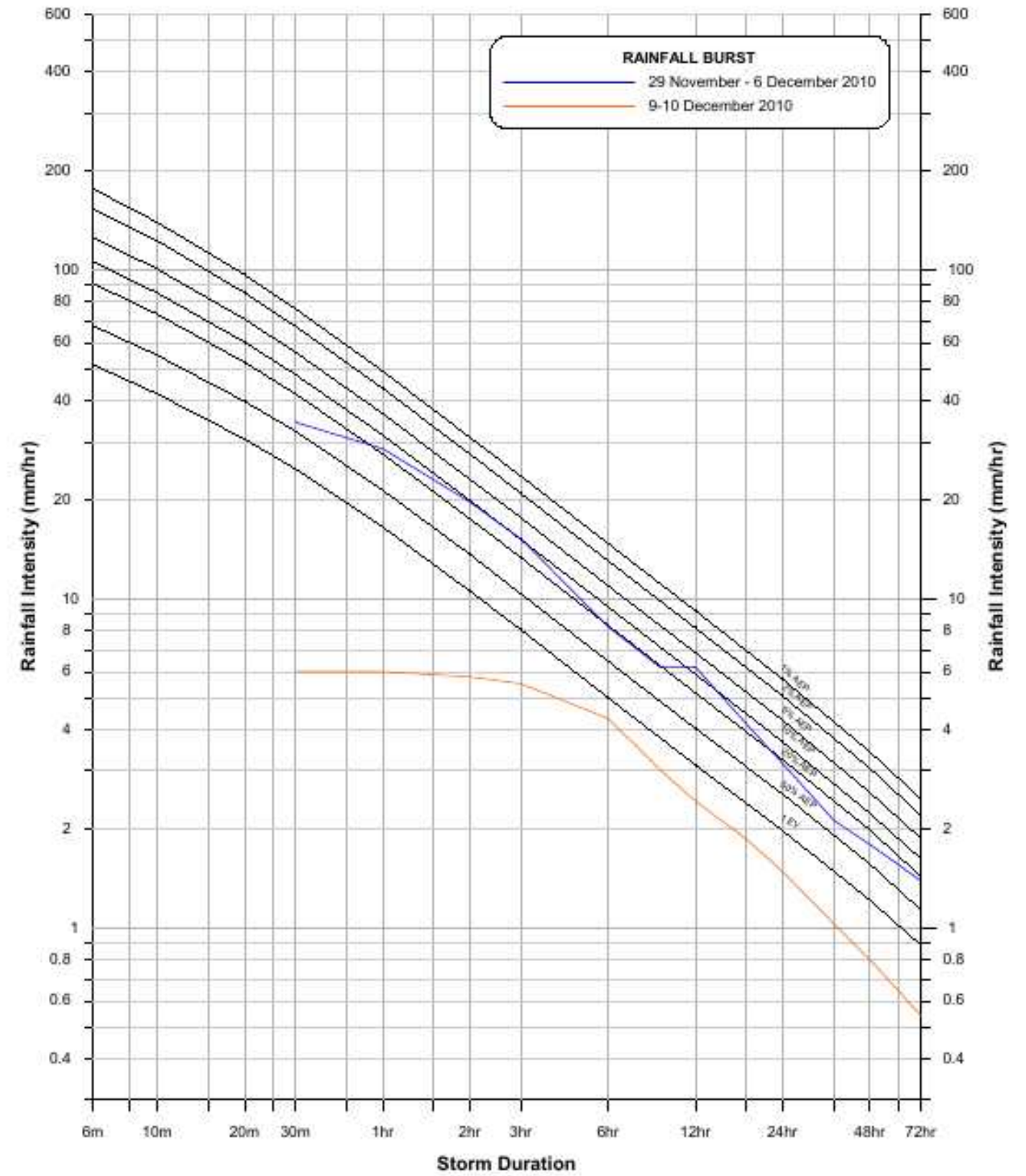
Figure B3.3
(Sheet 4 of 5)

INTENSITY-FREQUENCY-DURATION CURVES
AND HISTORIC RAINFALL

**ROSSI (SAWMILL)
(GS 570923)**



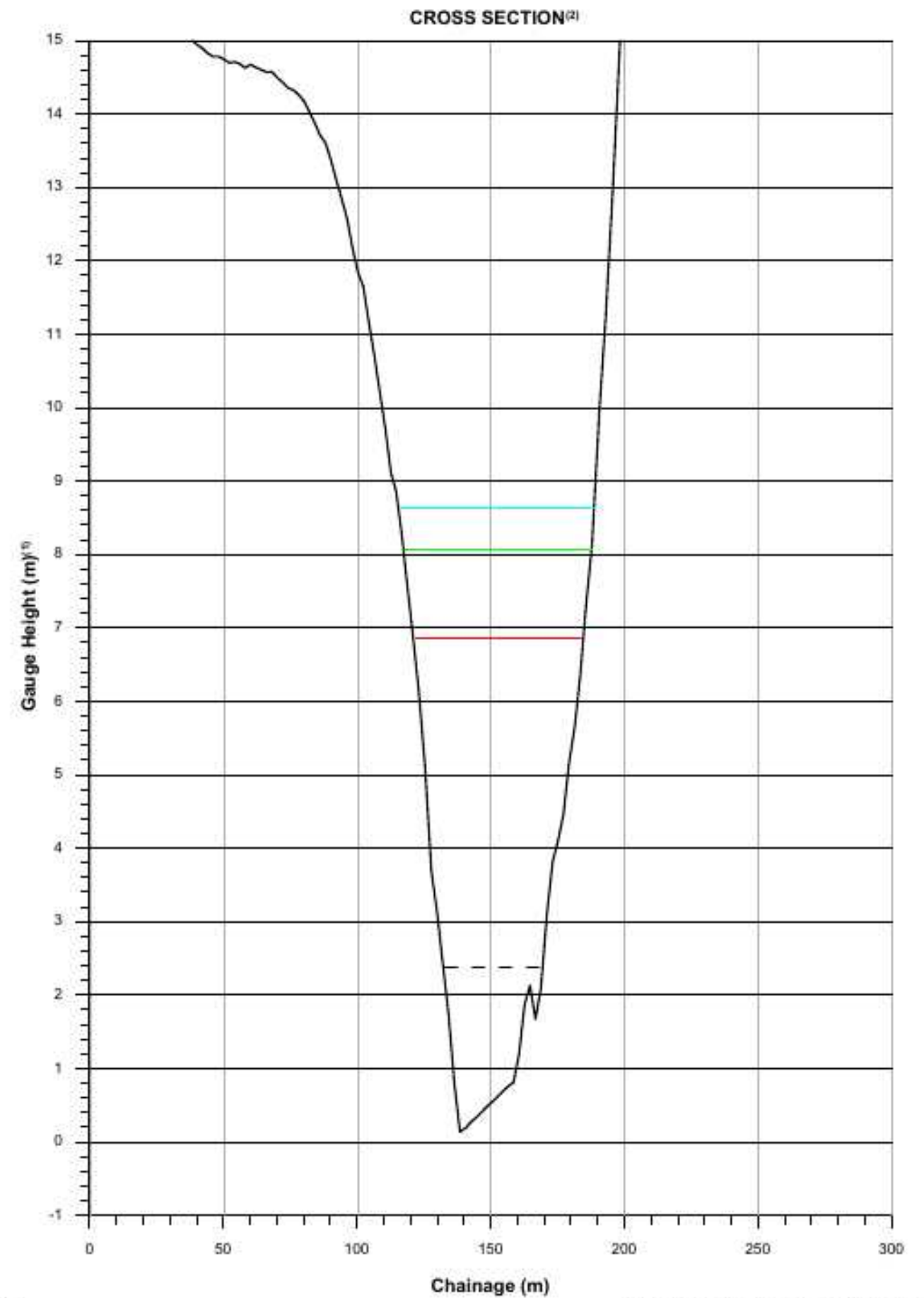
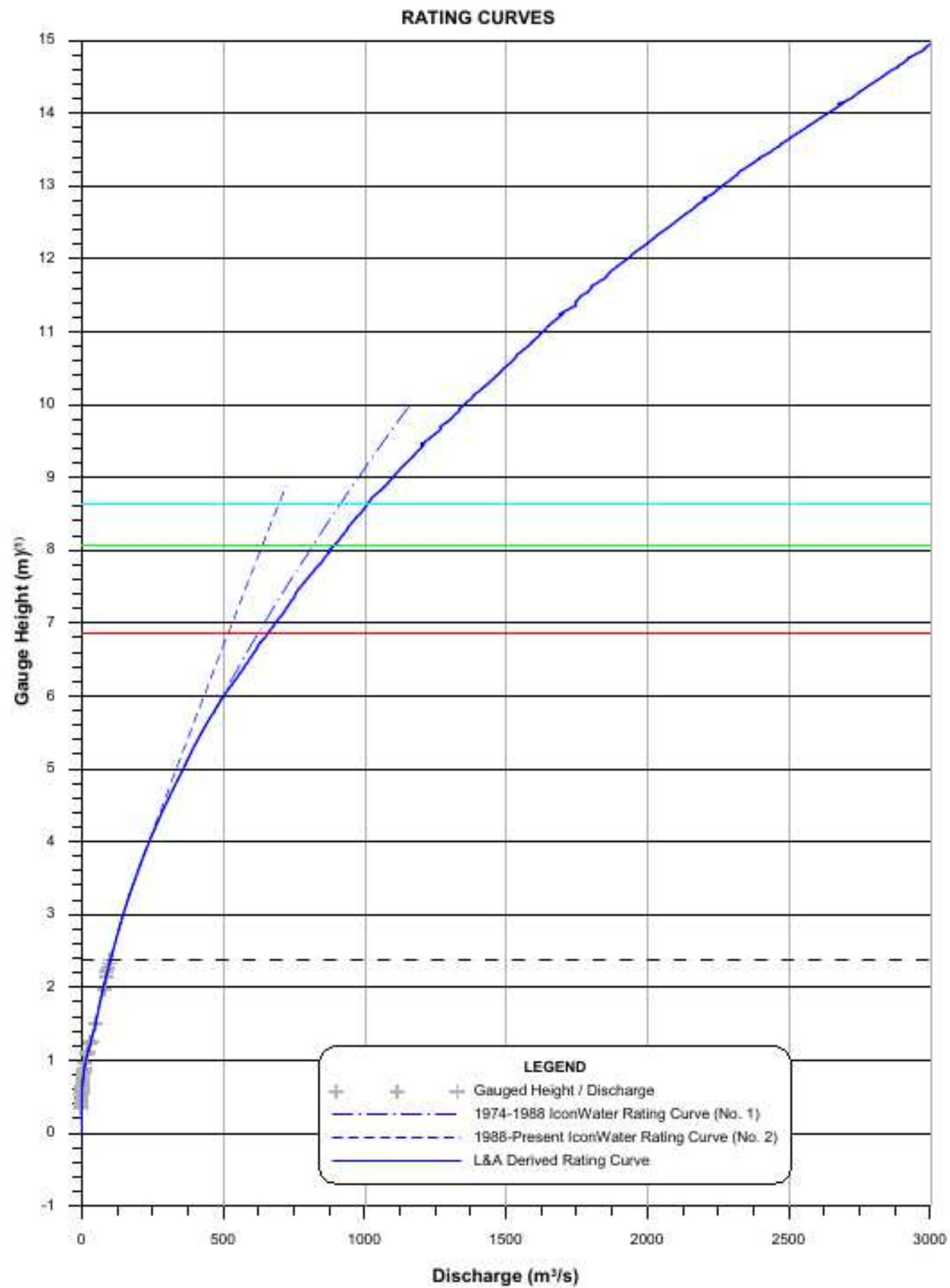
**MOLONGLO RIVER AT OAKS ESTATE
(GS 570943)**



**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure B3.3
(Sheet 5 of 5)

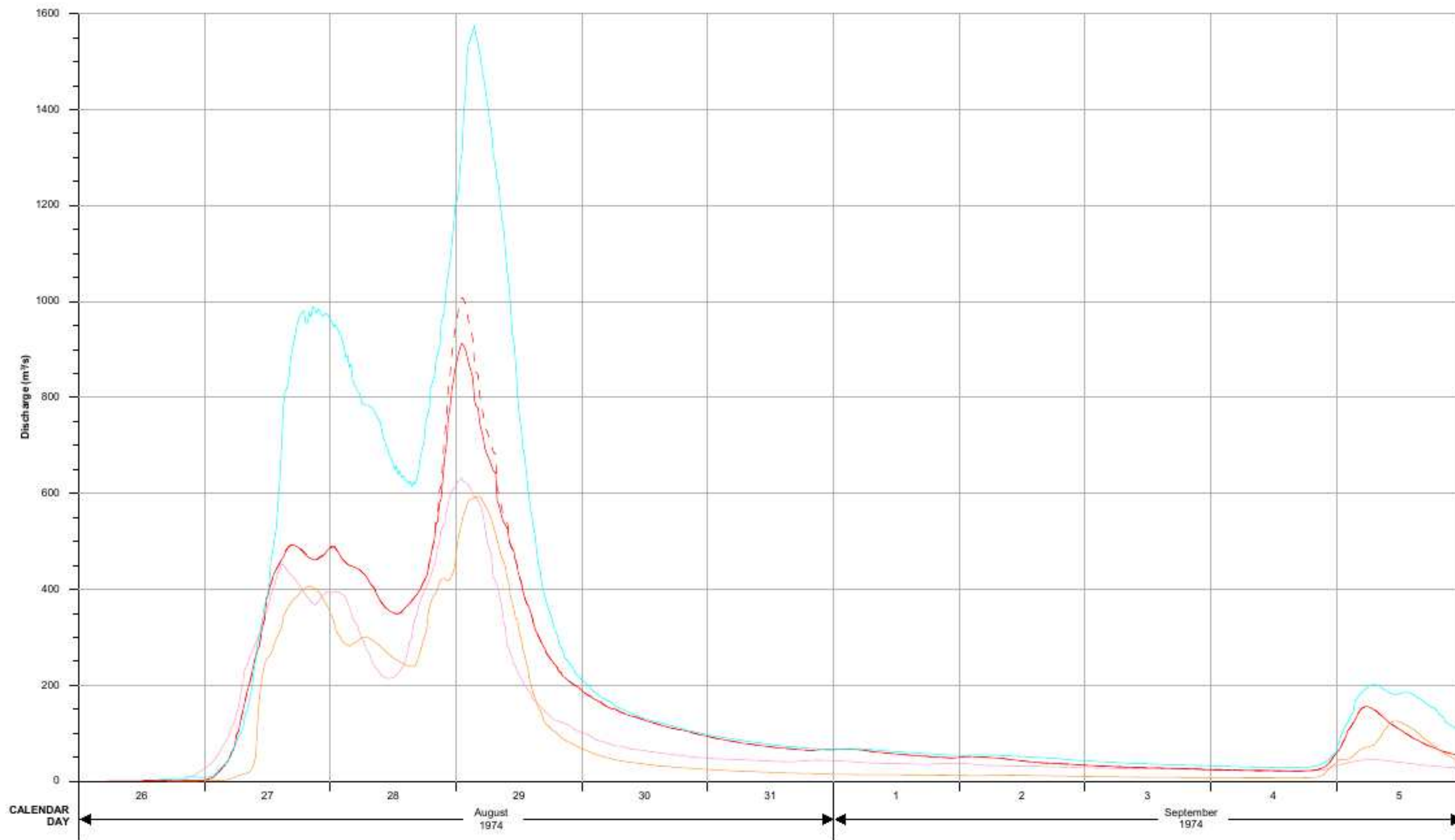
INTENSITY-FREQUENCY-DURATION CURVES
AND HISTORIC RAINFALL



QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B4.1

RATING CURVES AND CROSS SECTION
QUEANBEYAN RIVER AT WICKERSLACK STREAM GAUGE (GS 410760)



LEGEND

- Queanbeyan River at Tinderry (GS 410734)
- Queanbeyan River at Wickerslack (GS 410760)¹⁾
- Molonglo River at Burbong (GS 410705)
- Molonglo River at Oaks Estate (GS 410729)

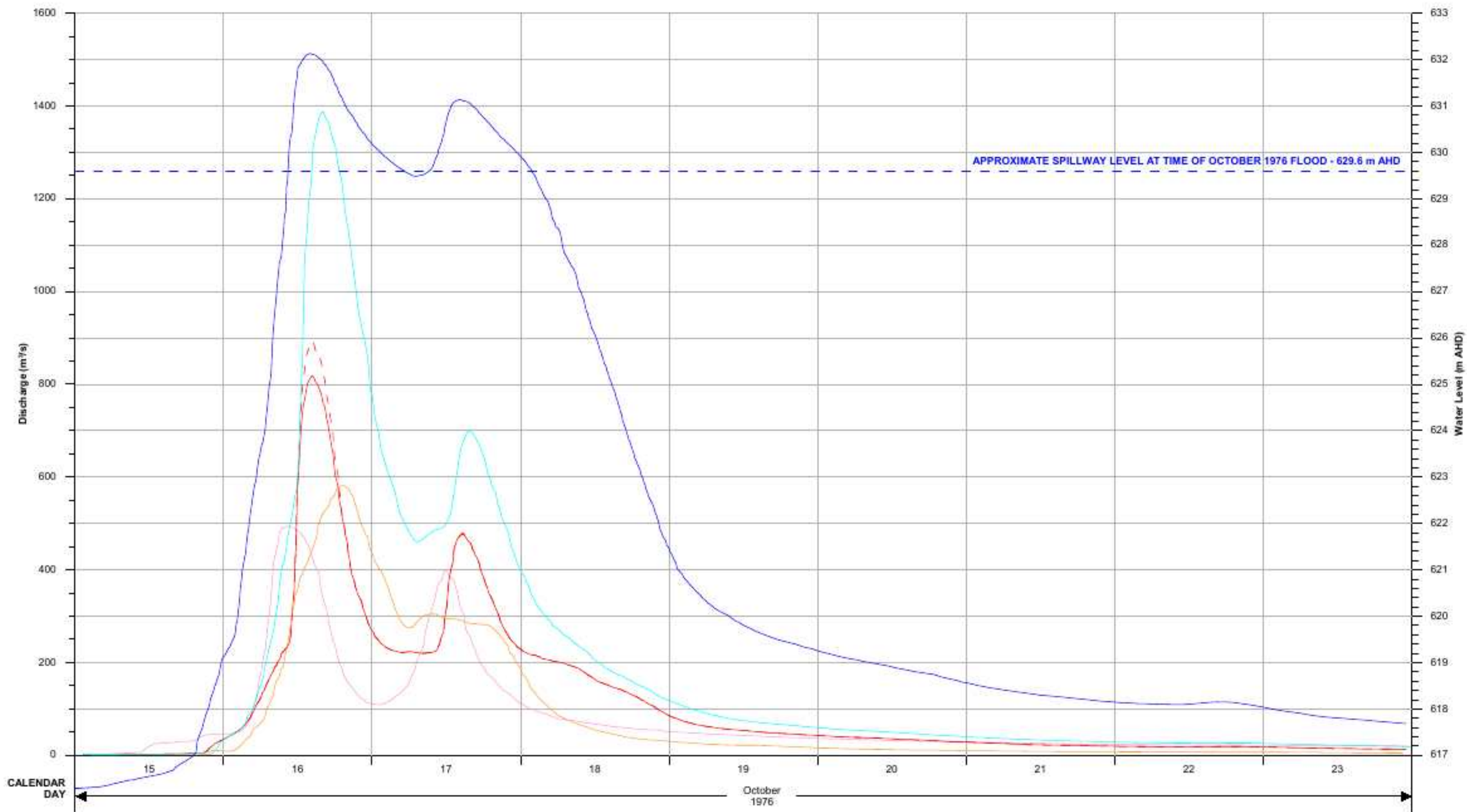
NOTES:

1. Time zero on calendar day axis = 00:00 hours on 26 August 1974.
2. Googong Dam was not present at the time of the August 1974 Flood.
3. Dashed line represents recorded discharge based on L&A Derived Rating Curve.

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B4.2

RECORDED DISCHARGE HYDROGRAPHS
AUGUST 1974 FLOOD



LEGEND

- Queanbeyan River at Tinderry (GS 410734)
- Queanbeyan River at Wickerslack (GS 410760)²⁾
- Molonglo River at Burbong (GS 410705)
- Molonglo River at Oaks Estate (GS 410729)
- Water Level - Googong Dam

NOTES:

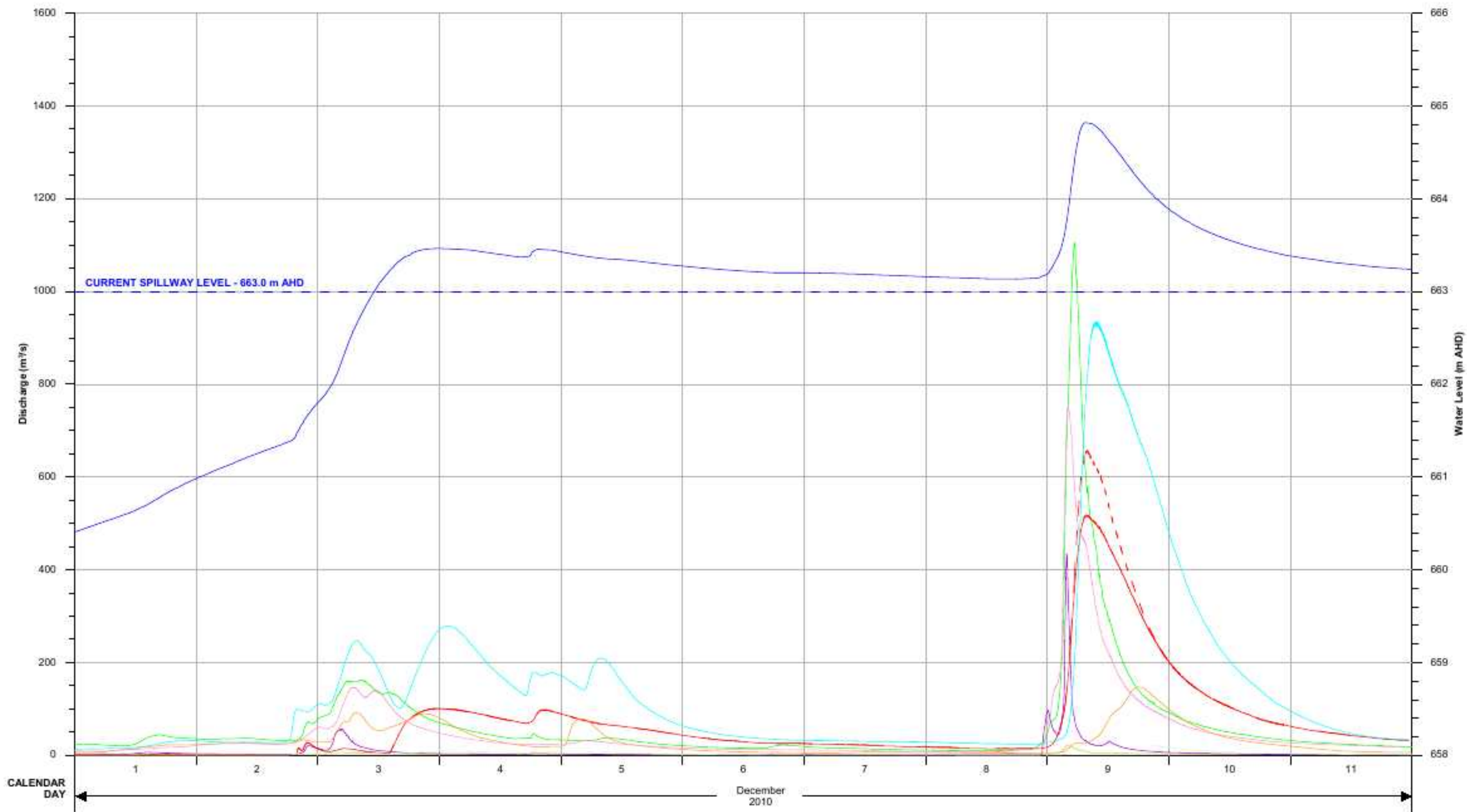
1. Time zero on calendar day axis = 00:00 hours on 15 October 1976.
2. Googong Dam was under construction at the time of the 1976 Flood.
3. Dashed line represents recorded discharge based on L&A Derived Rating Curve.

**Lycall &
Associates**

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B4.3

RECORDED DISCHARGE HYDROGRAPHS AND GOOGONG DAM DETAILS
OCTOBER 1976 FLOOD



LEGEND

- Queanbeyan River at Tinderry (GS 410734)
- Queanbeyan River U/S Googong Dam (GS 410781)
- Burra Creek at Burra Road (GS 410774)
- Queanbeyan River at Wickerslack (GS 410760)(2)
- Molonglo River at Burbong (GS 410705)
- Molonglo River at Oaks Estate (GS 410729)
- Molonglo River at Kobada (GS 41000208)⁽¹⁾
- Queanbeyan River at A.C.T. Border (GS 410770)
- Water Level - Googong Dam

NOTES:

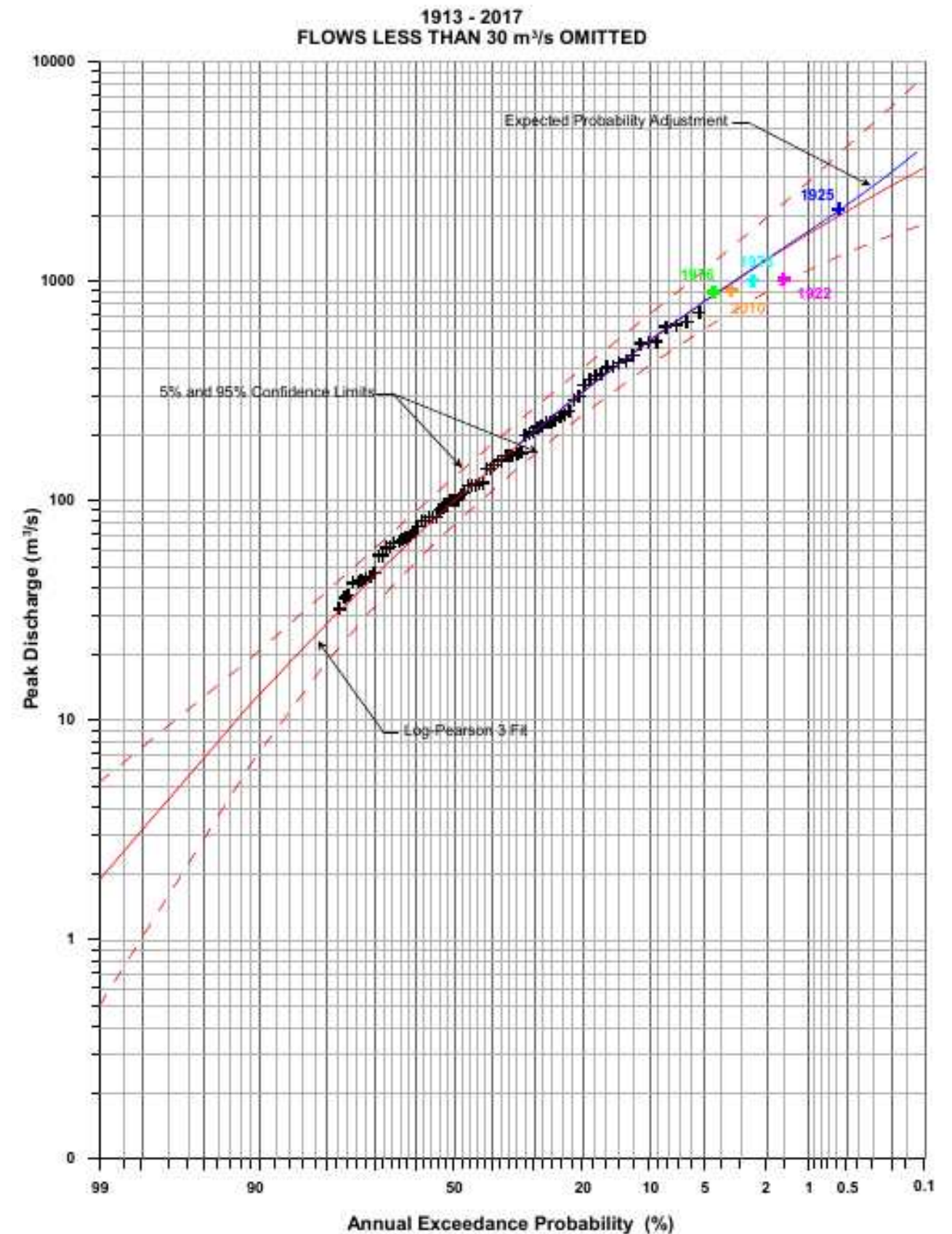
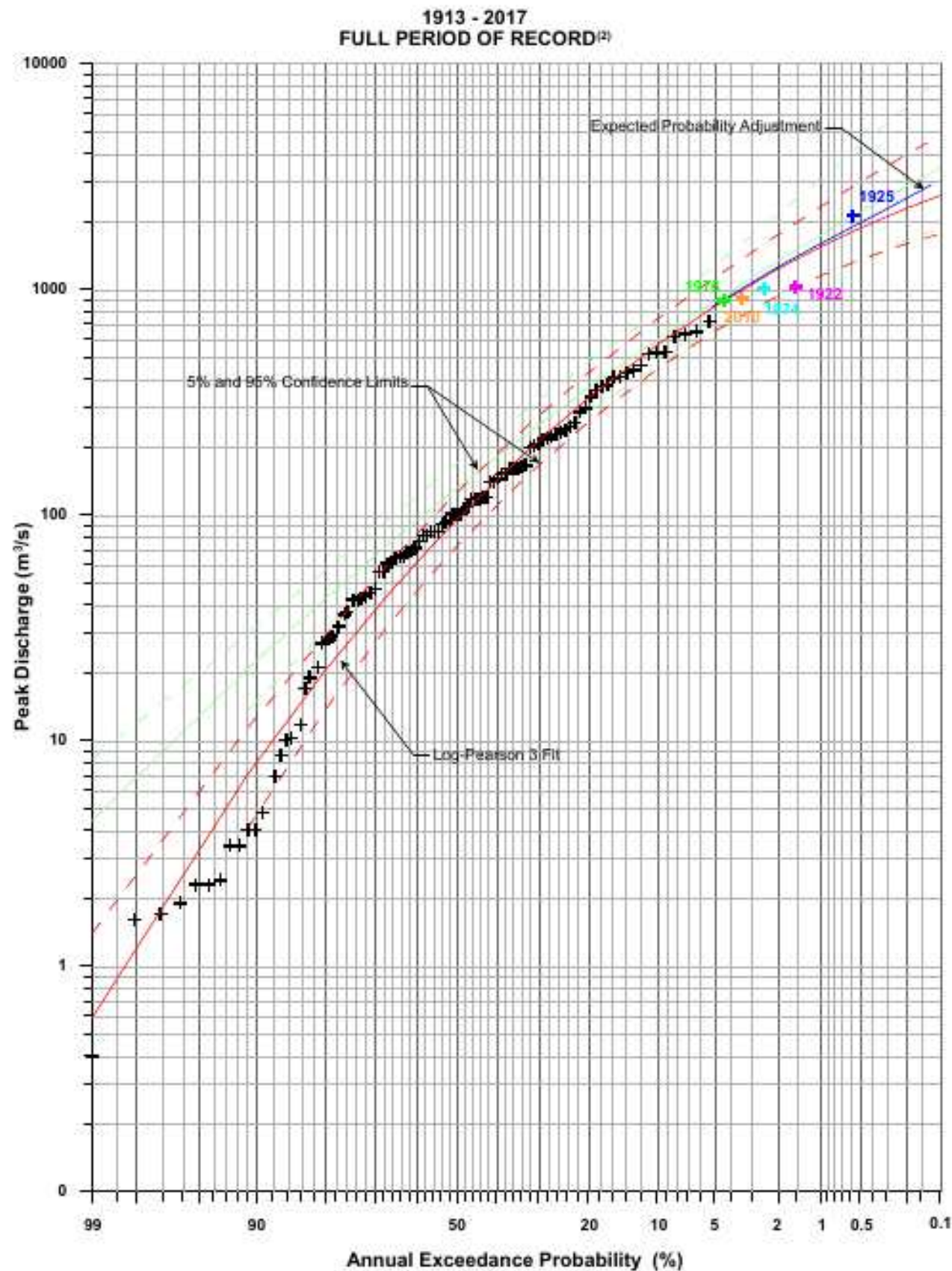
1. Time zero on calendar day axis = 00:00 hours on 1 December 2010.
2. Dashed line represents recorded discharge based on L&A Derived Rating Curve.
3. Discharge not recorded between 06:15 and 20:40 hours on 9 December 2010.

**Lycall &
Associates**

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B4.4

RECORDED DISCHARGE HYDROGRAPHS AND GOOGONG DAM DETAILS
DECEMBER 2010 FLOOD



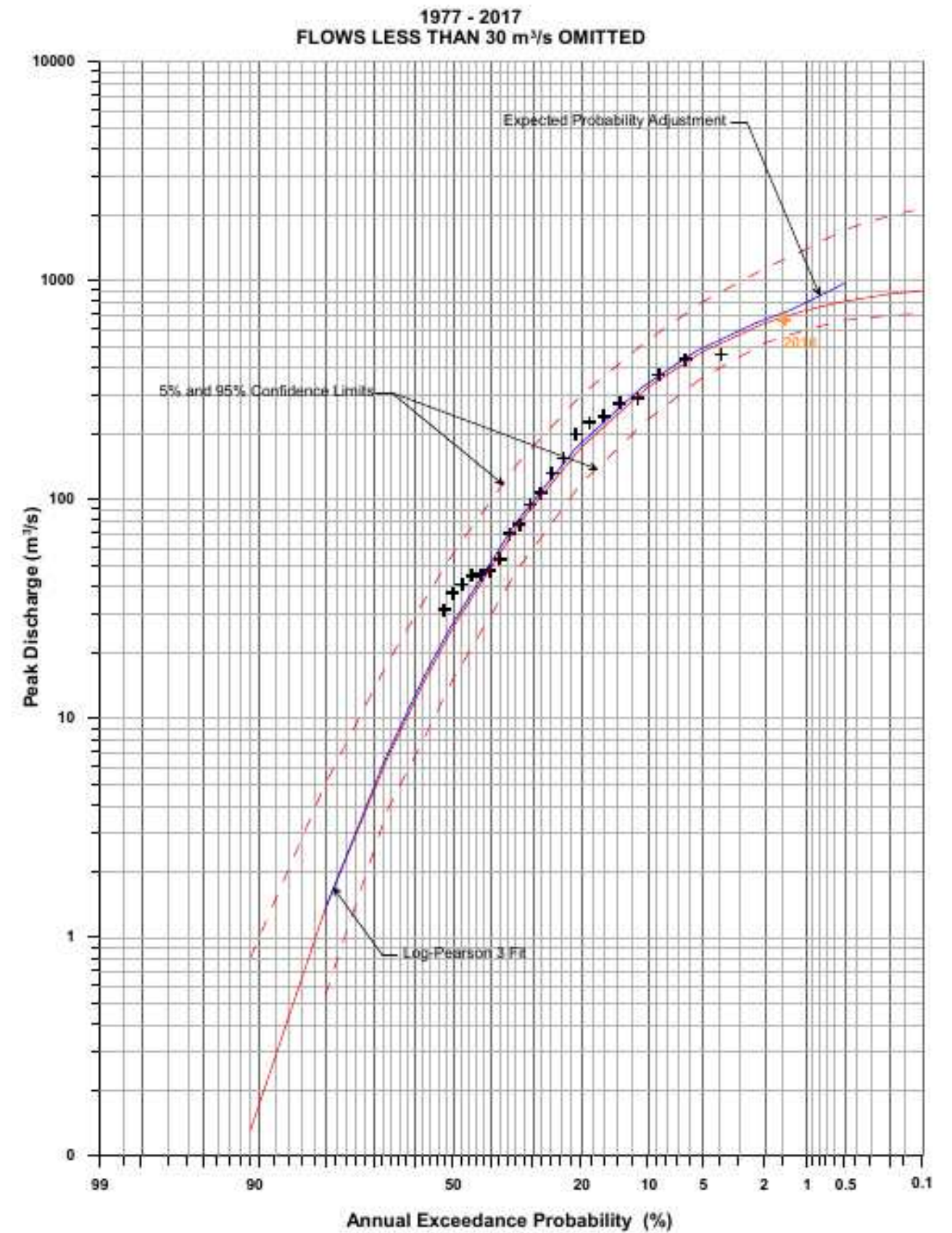
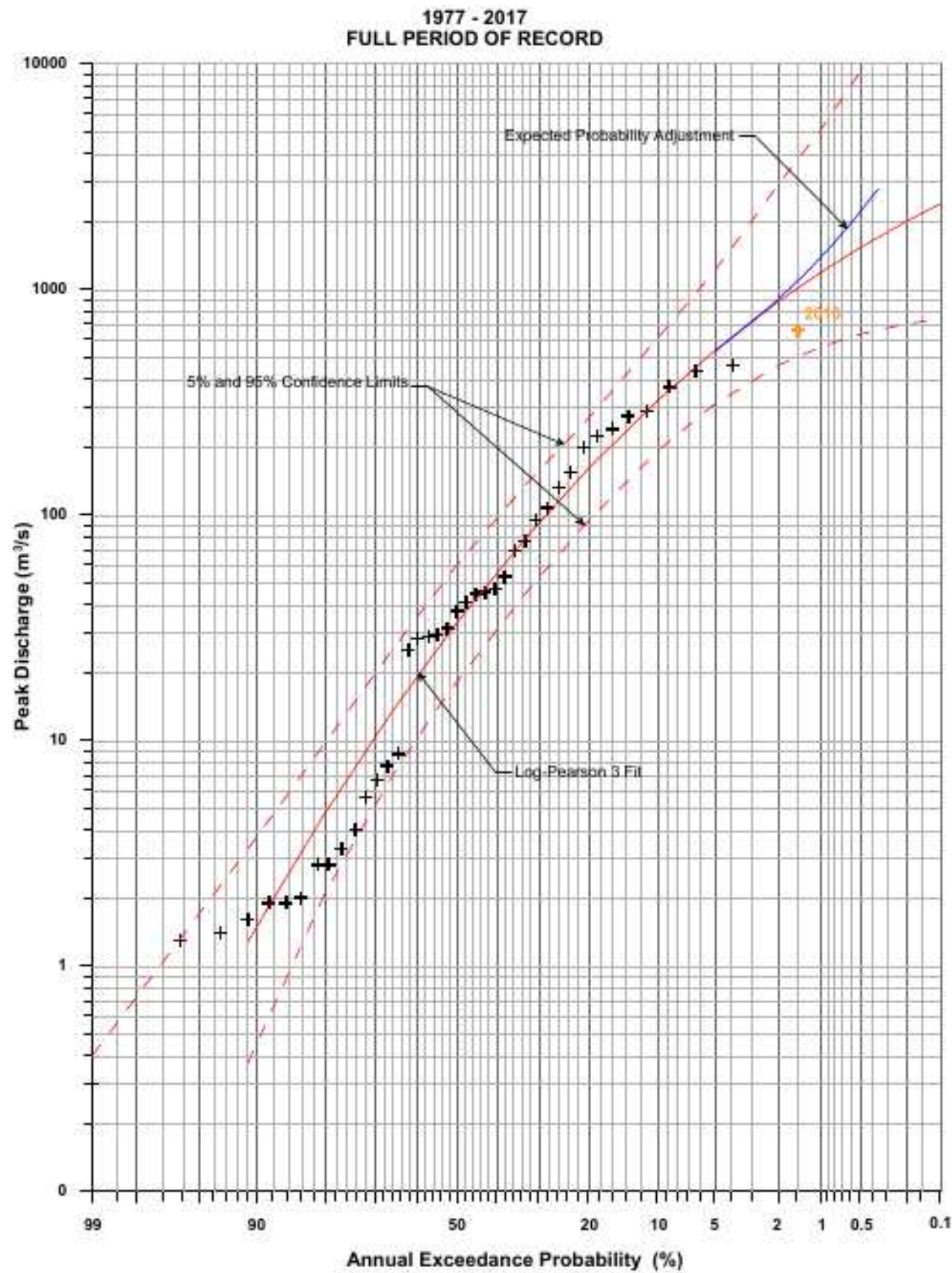
NOTES:

1. Flood frequency relationship based on pre-Googong Dam flows in the Queanbeyan River at the decommissioned Googong stream gauge. Annual peak flows for period of record after construction of the dam (i.e. 1977-2017) have been derived by converting post-dam peak flows recorded at the Wickslock stream gauge using the pre- versus post-dam flow relationship presented in DWR, 1992 (refer Columns D and E in Table C2.2).
2. Red lines show flood frequency relationship based on full period of record (i.e. 1913-2017), while green lines show flood frequency relationship based on same period of record used in DWR, 1992 (i.e. 1913-1991).

QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN

Figure B4.5

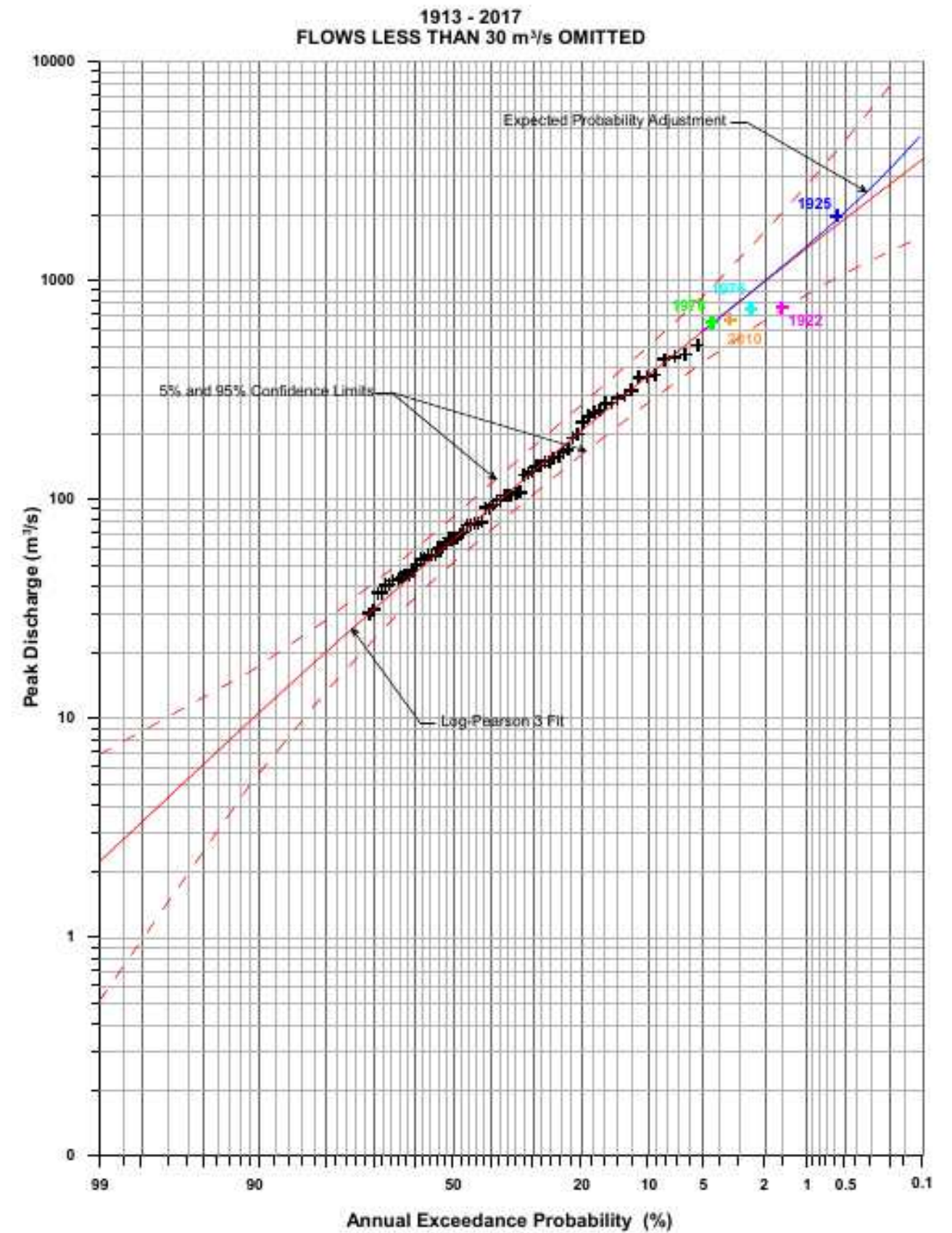
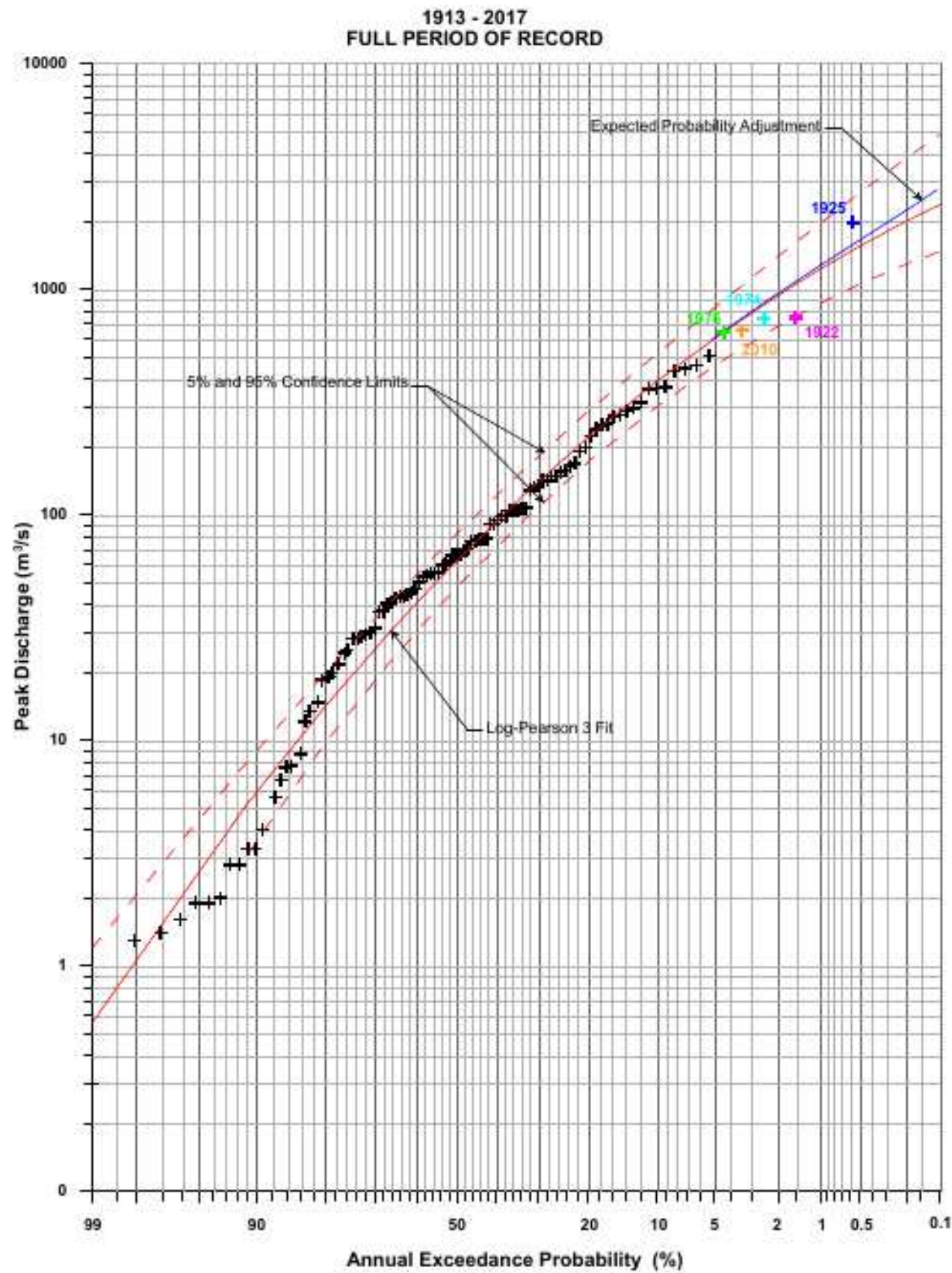
FLOOD FREQUENCY RELATIONSHIP
LOG-PEARSON 3 ANNUAL SERIES 1913-2017
QUEANBEYAN RIVER AT GOOGONG STREAM GAUGE (GS 410701)



**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure B4.6

FLOOD FREQUENCY RELATIONSHIP
LOG-PEARSON 3 ANNUAL SERIES 1977-2017
QUEANBEYAN RIVER AT WICKERSLACK STREAM GAUGE (GS 410760)



**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

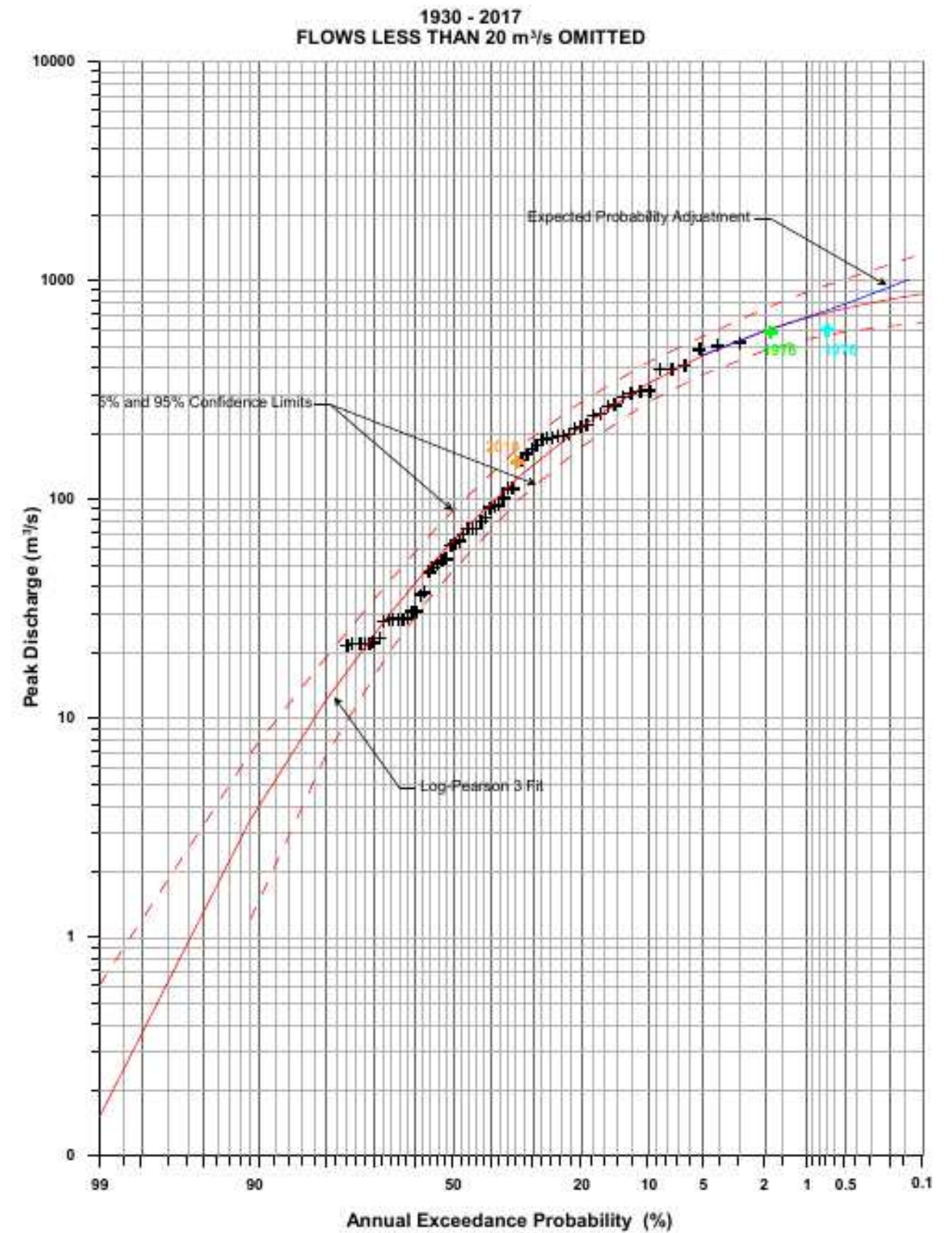
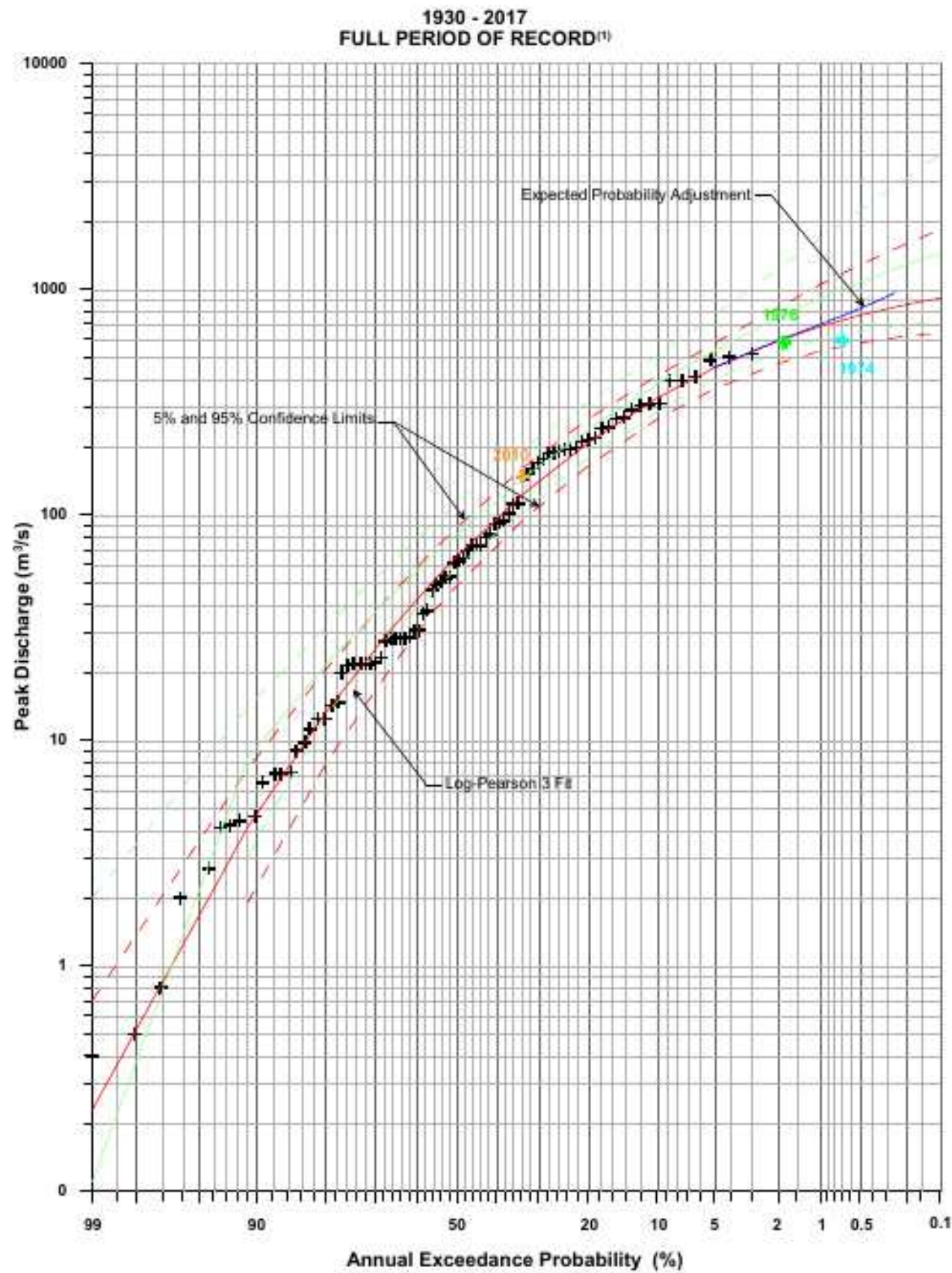
Figure B4.7

FLOOD FREQUENCY RELATIONSHIP
LOG-PEARSON 3 ANNUAL SERIES 1913-2017
QUEANBEYAN RIVER AT WICKERSLACK STREAM GAUGE (GS 410760)



NOTE:

Flood frequency relationship based on post-Googong Dam flows in the Queanbeyan River at the Wickerslack stream gauge. Annual peak flows for period of record prior to construction of the dam (i.e. 1913-1975) have been derived by comparing pre-dam flows at the Googong stream gauge using the pre- versus post-dam flow relationship presented in DWR, 1992 (refer Columns D and E in Table C2.2).



NOTE:

1. Red lines show flood frequency relationship based on full period of record (i.e. 1930-2017), while green lines show flood frequency relationship based on same period of record used in DWR, 1992 (i.e. 1930-1991).

APPENDIX C
FLOOD STUDY UPDATE

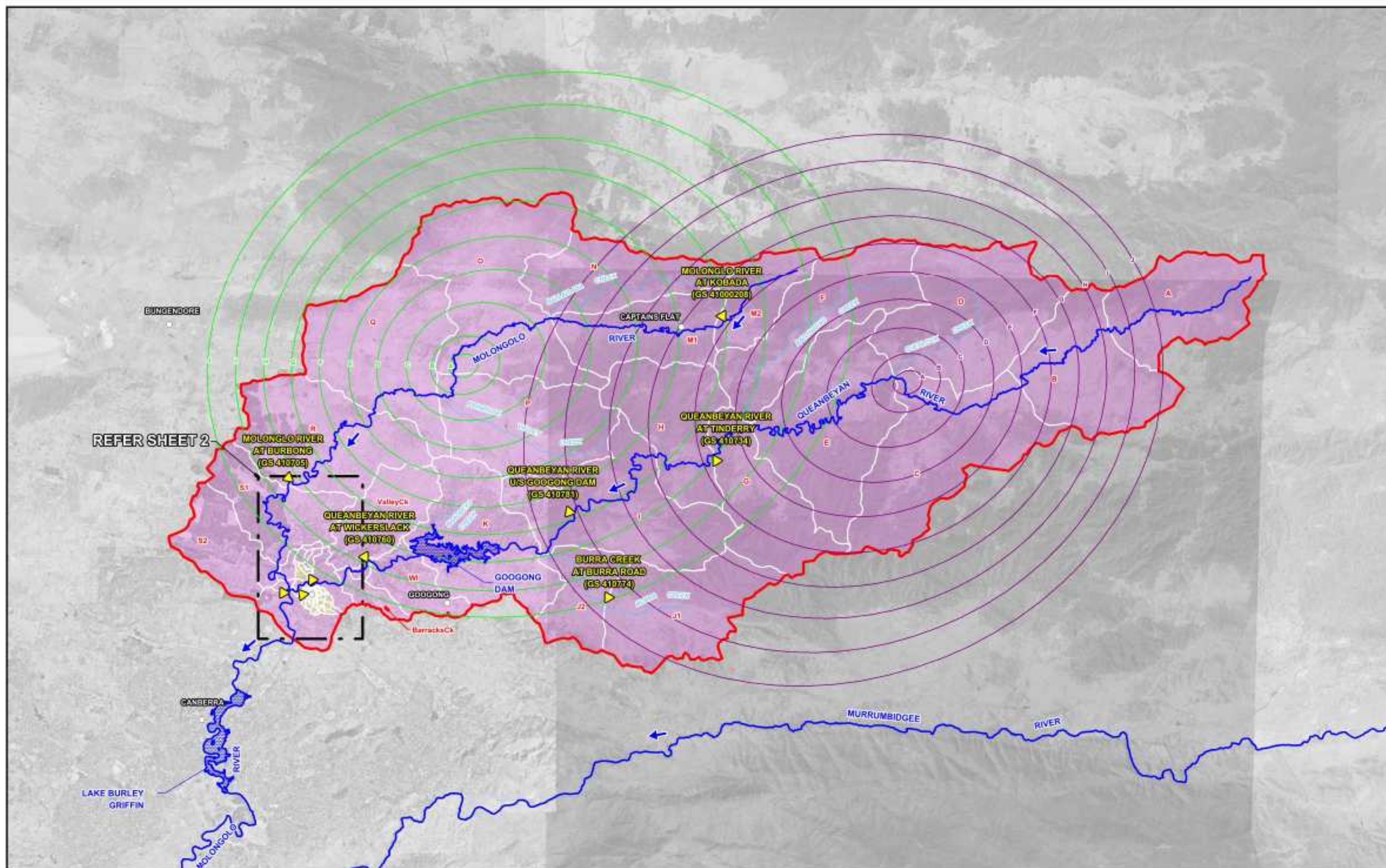
LIST OF FIGURES (APPENDIX C)

- C1.1 Queanbeyan Hydrologic Model Layout (2 Sheets)
- C1.2 Modelled and Recorded Discharge Hydrographs – December 2010 Flood

- C2.1 Queanbeyan TUFLOW Model Layout (2 Sheets)
- C2.2 TUFLOW Schematisation of Floodplain
- C2.3 TUFLOW Model Results – May 1925 Flood
- C2.4 TUFLOW Model Results – August 1974 Flood
- C2.5 TUFLOW Model Results – October 1976 Flood
- C2.6 TUFLOW Model Results – December 2010 Flood (2 Sheets)
- C2.7 Water Surface Profiles – Historic Flood Events (2 Sheets)

- C3.1 Design Inflow Hydrographs

- C4.1 Indicative Extent and Depths of Inundation – 20% AEP (2 Sheets)
- C4.2 Indicative Extent and Depths of Inundation – 10% AEP (2 Sheets)
- C4.3 Indicative Extent and Depths of Inundation – 5% AEP (2 Sheets)
- C4.4 Indicative Extent and Depths of Inundation – 2% AEP (2 Sheets)
- C4.5 Indicative Extent and Depths of Inundation – 0.5% AEP (2 Sheets)
- C4.6 Indicative Extent and Depths of Inundation – 0.2% AEP (2 Sheets)
- C4.7 Sensitivity of Flood Behaviour to 20% Increase in Hydraulic Roughness Values – 1% AEP (2 Sheets)
- C4.8 Sensitivity of Flood Behaviour to Reduction in Hydraulic Roughness Values in Lower Reaches of Molonglo River – 1% AEP (2 Sheets)
- C4.9 Sensitivity of Flood Behaviour to Partial Blockage of Hydraulic Structures – Main Stream Flooding Only - 1% AEP (2 Sheets)
- C4.10 Sensitivity of Flood Behaviour to Partial Blockage of Hydraulic Structures – Local Catchment Flooding in Vicinity of Queanbeyan CBD - 1% AEP



REFER SHEET 2

MOLONGLO RIVER
AT BURBONG
(GS 410705)

QUEANBEYAN RIVER
AT WICKERSLACK
(GS 410760)

QUEANBEYAN RIVER
UP GOOGONG DAM
(GS 410781)

BURRA CREEK
AT BURRA ROAD
(GS 410774)

MOLONGLO RIVER
AT KOBADA
(GS 41000208)

QUEANBEYAN RIVER
AT TINDERRY
(GS 410734)

- Catchment Boundary
- Stream Gauge
- Wickerslack PMP Ellipse

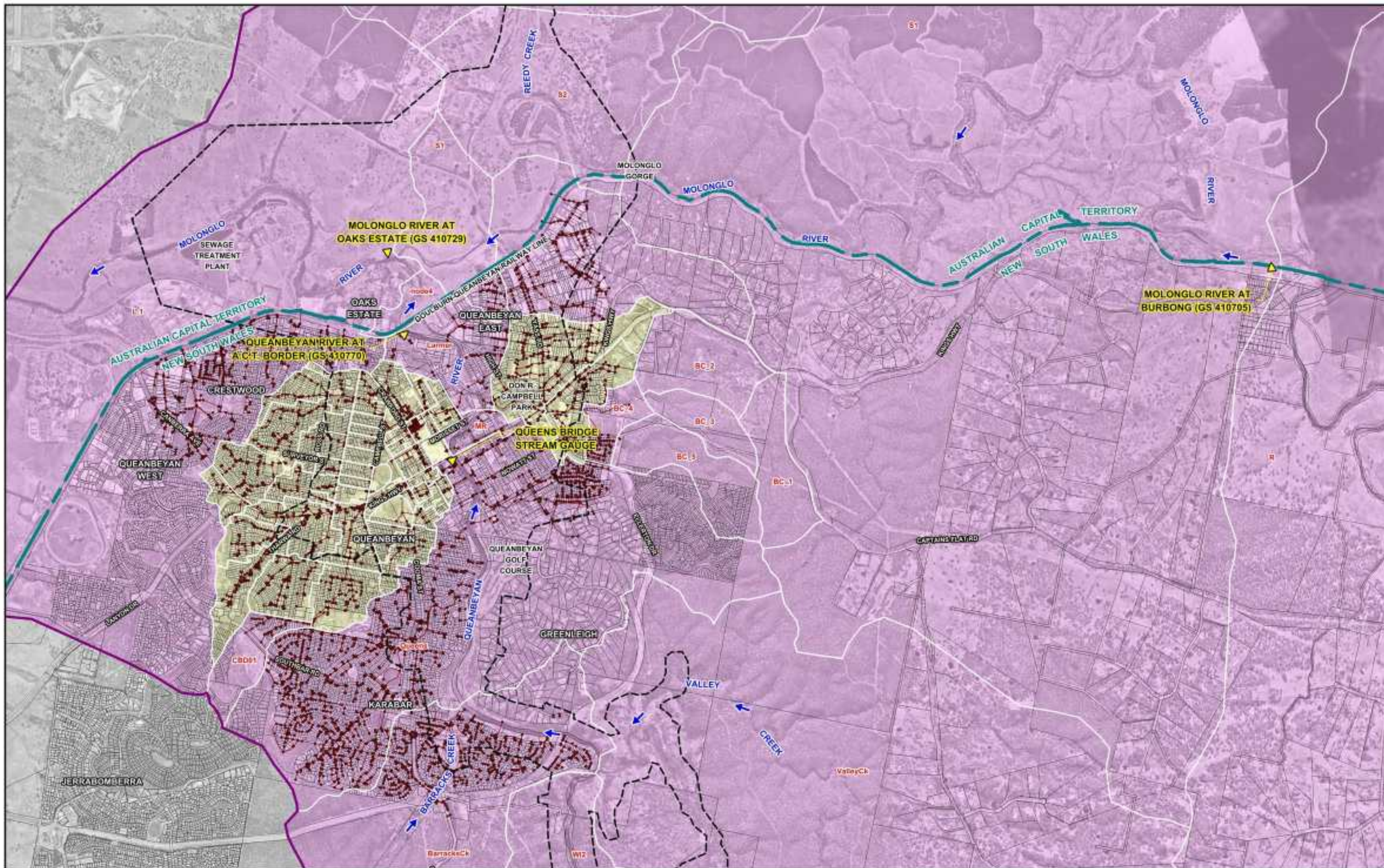
LEGEND

- RAFTS Sub-Catchment Boundary and Identifier
- ILSAX Sub-Catchment Boundary
- Burbong PMP Ellipse

QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN

Figure C1.1
(Sheet 1 of 2)

QUEANBEYAN HYDROLOGIC MODEL LAYOUT



N 300 0 300 600 900 m
Scale: 1:30,000

Lyal & Associates

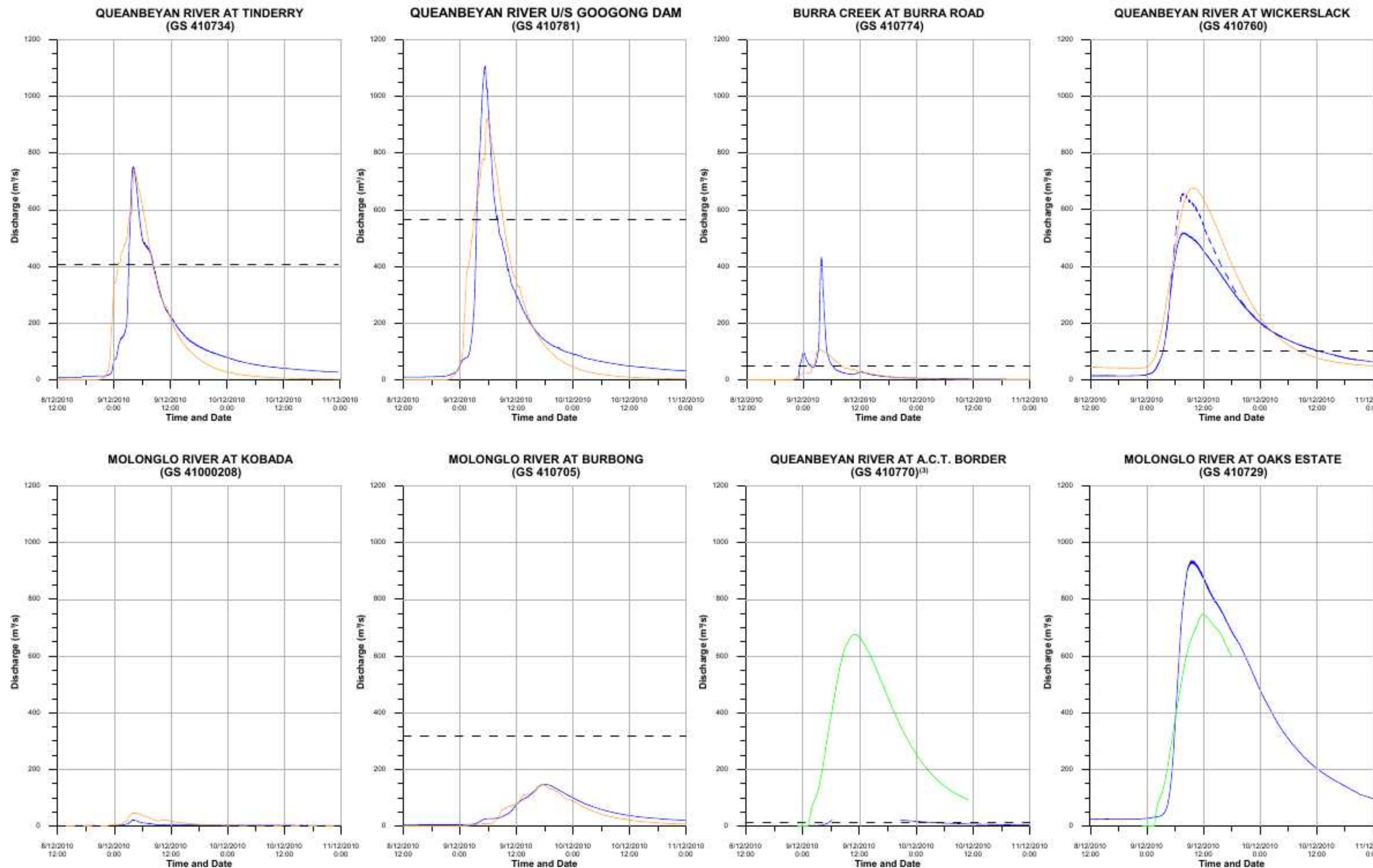
LEGEND

- Stream Gauge
- Stormwater Network
- Two-Dimensional Model Boundary
- RAFTS Sub-Catchment Boundary and Identifier
- ILSAX Sub-Catchment Boundary

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure C1.1
(Sheet 2 of 2)

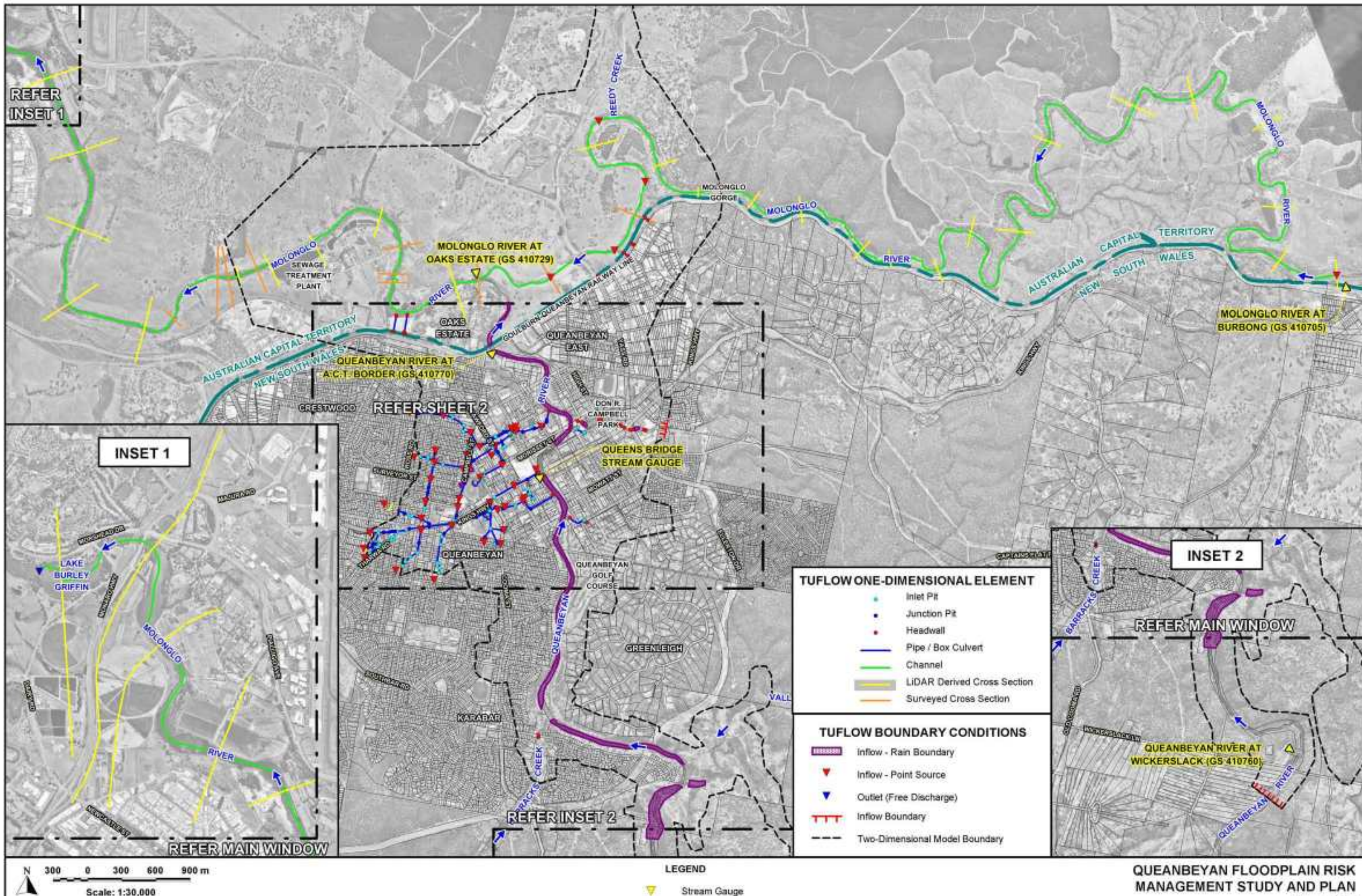
QUEANBEYAN HYDROLOGIC MODEL LAYOUT

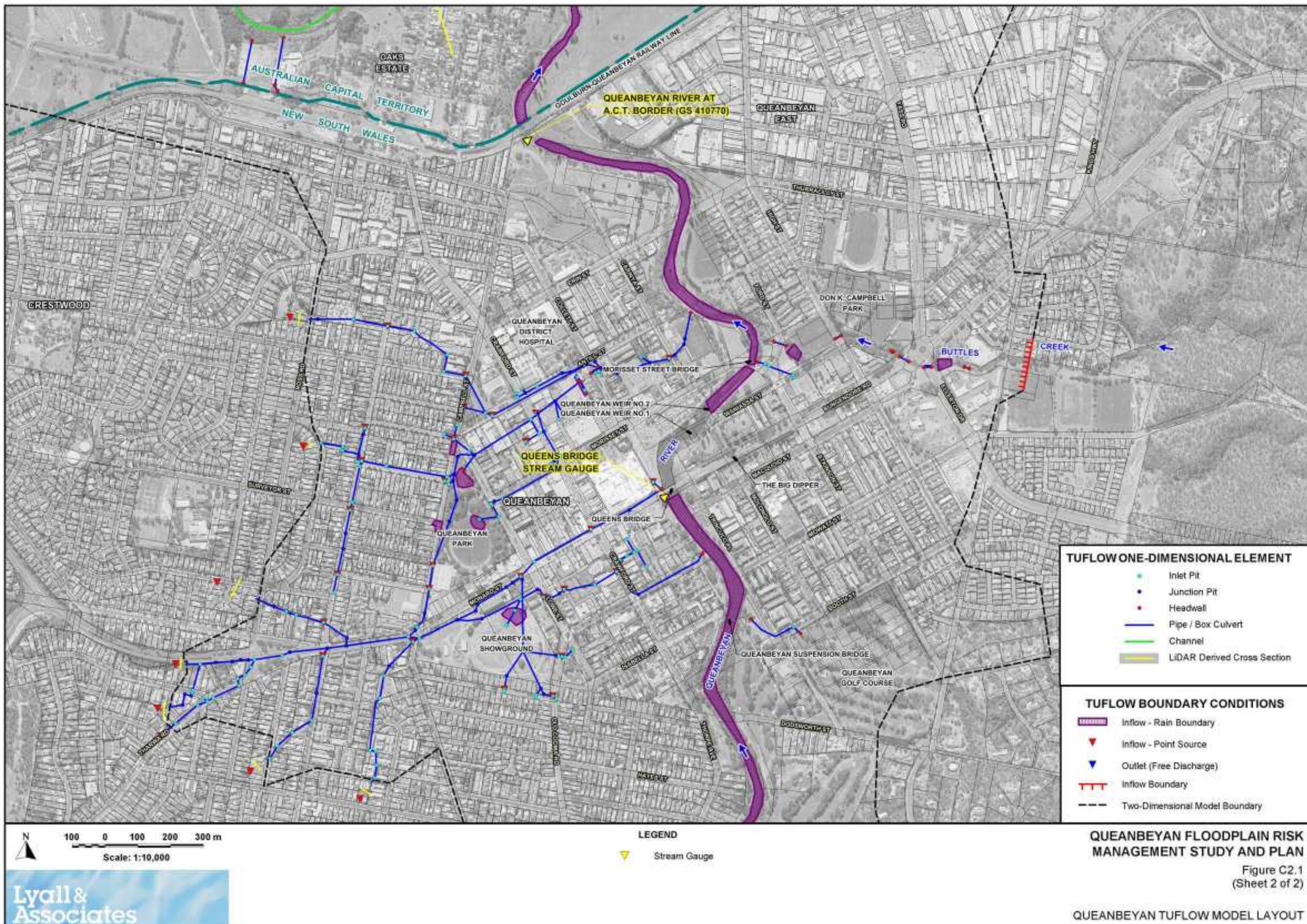


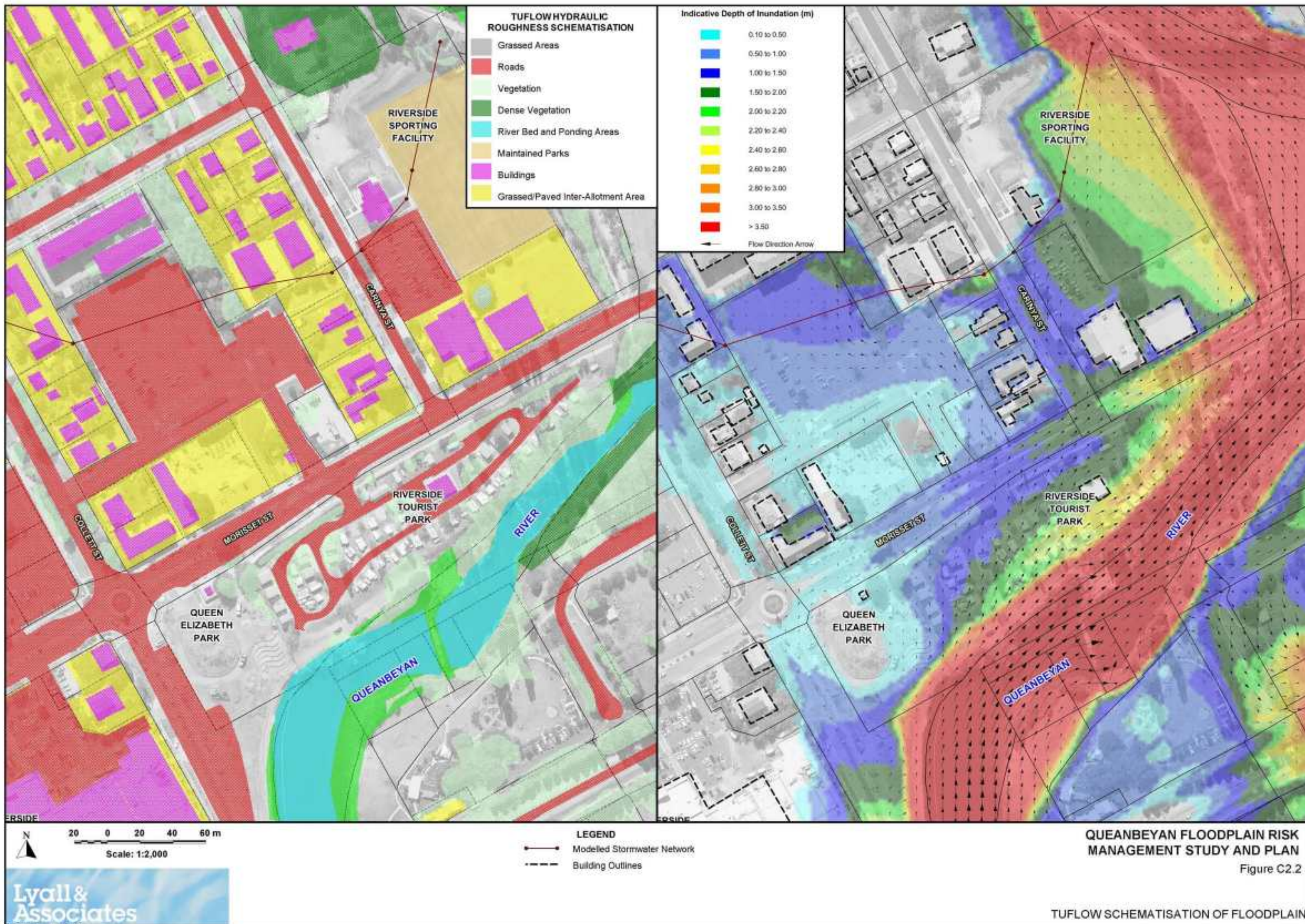
QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

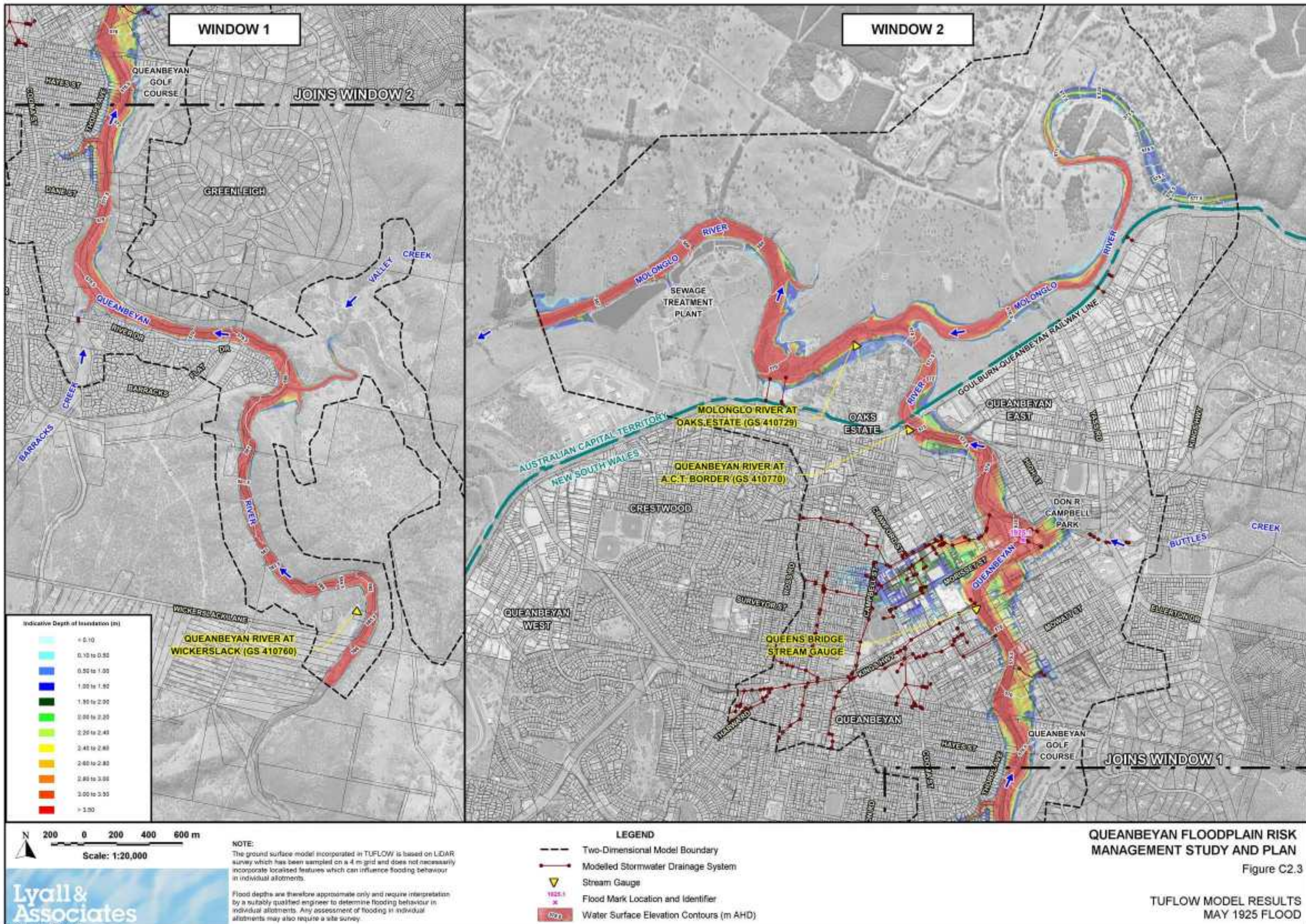
Figure C1.2

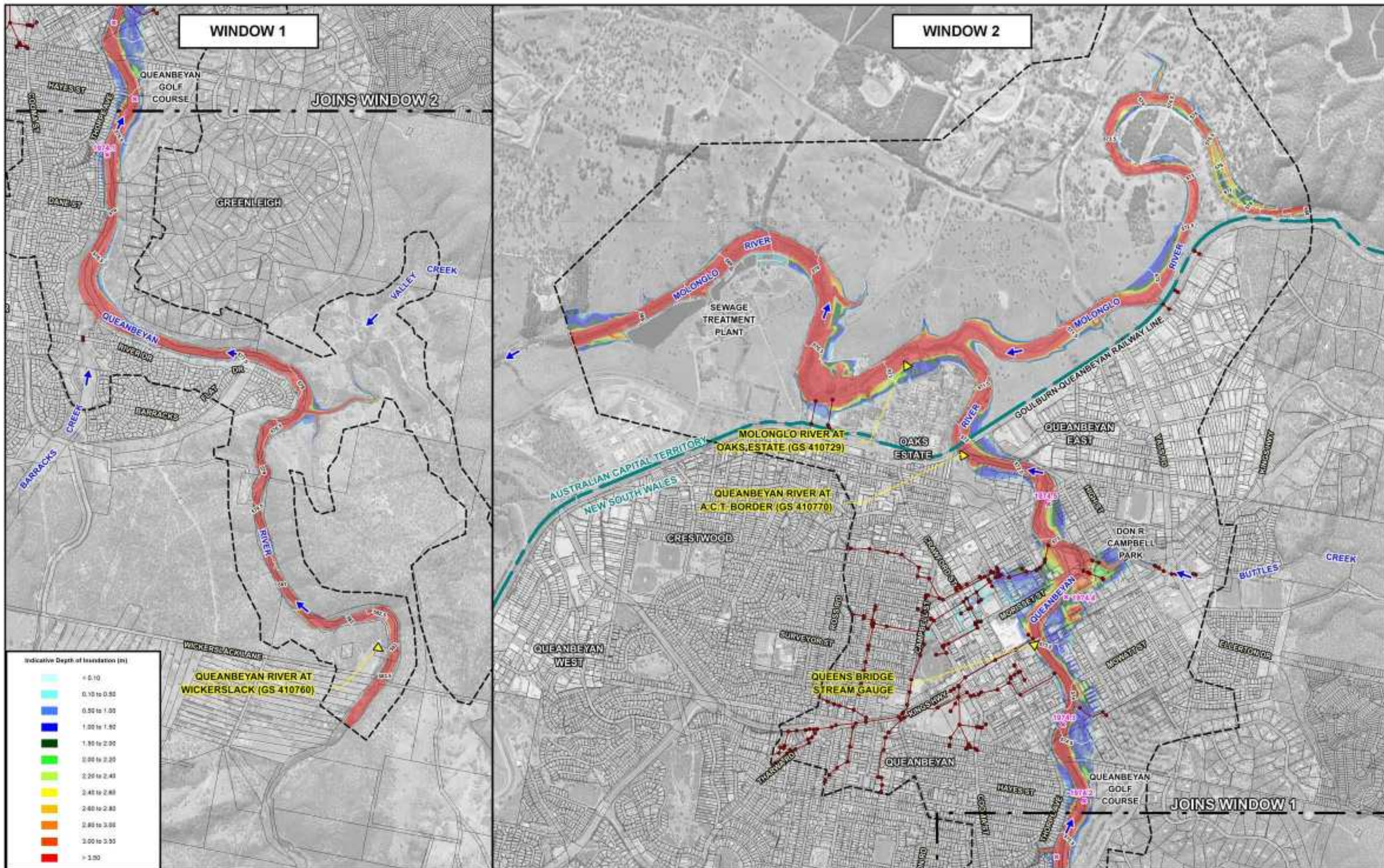
MODELLED AND RECORDED DISCHARGE HYDROGRAPHS
DECEMBER 2010 FLOOD







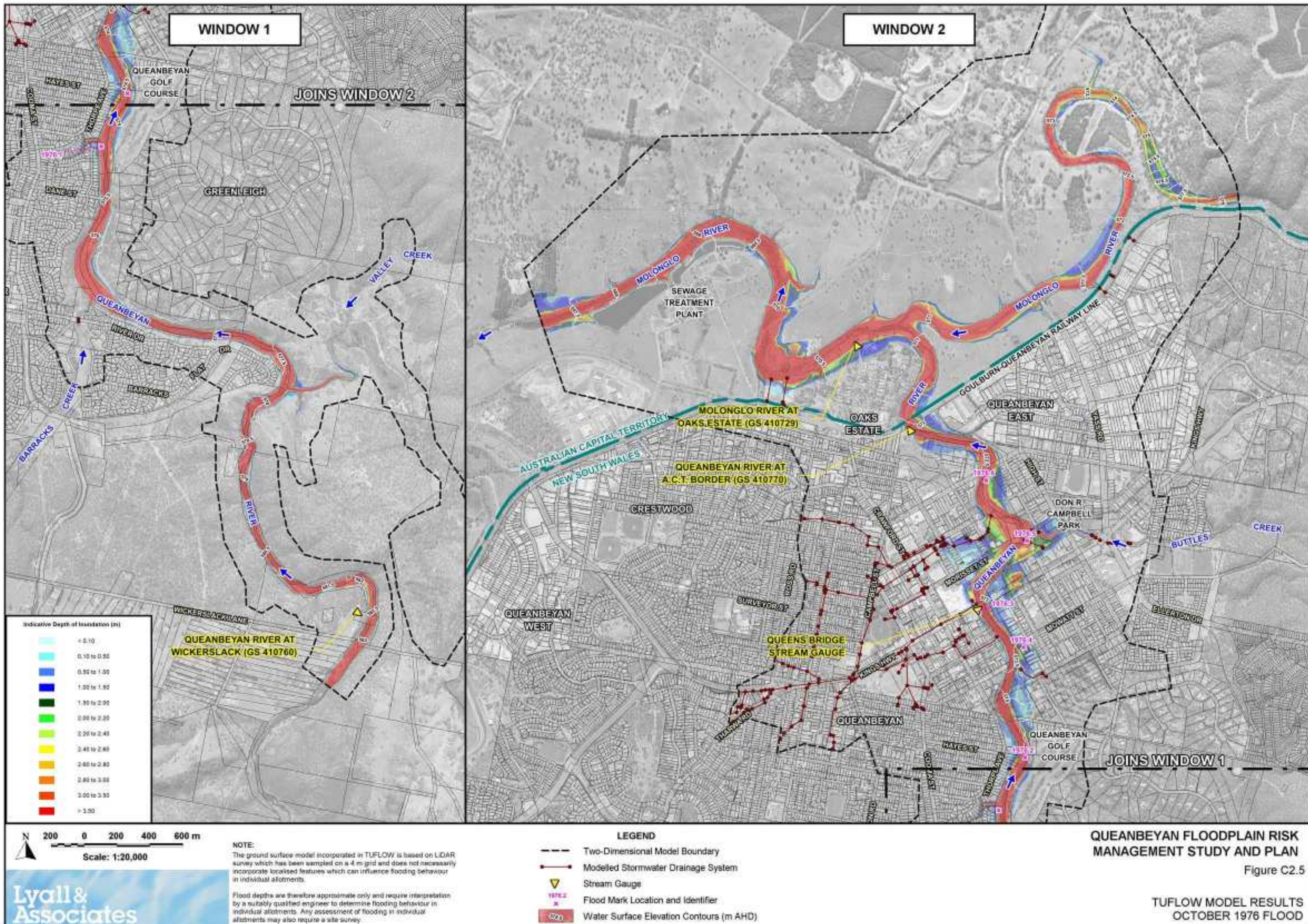


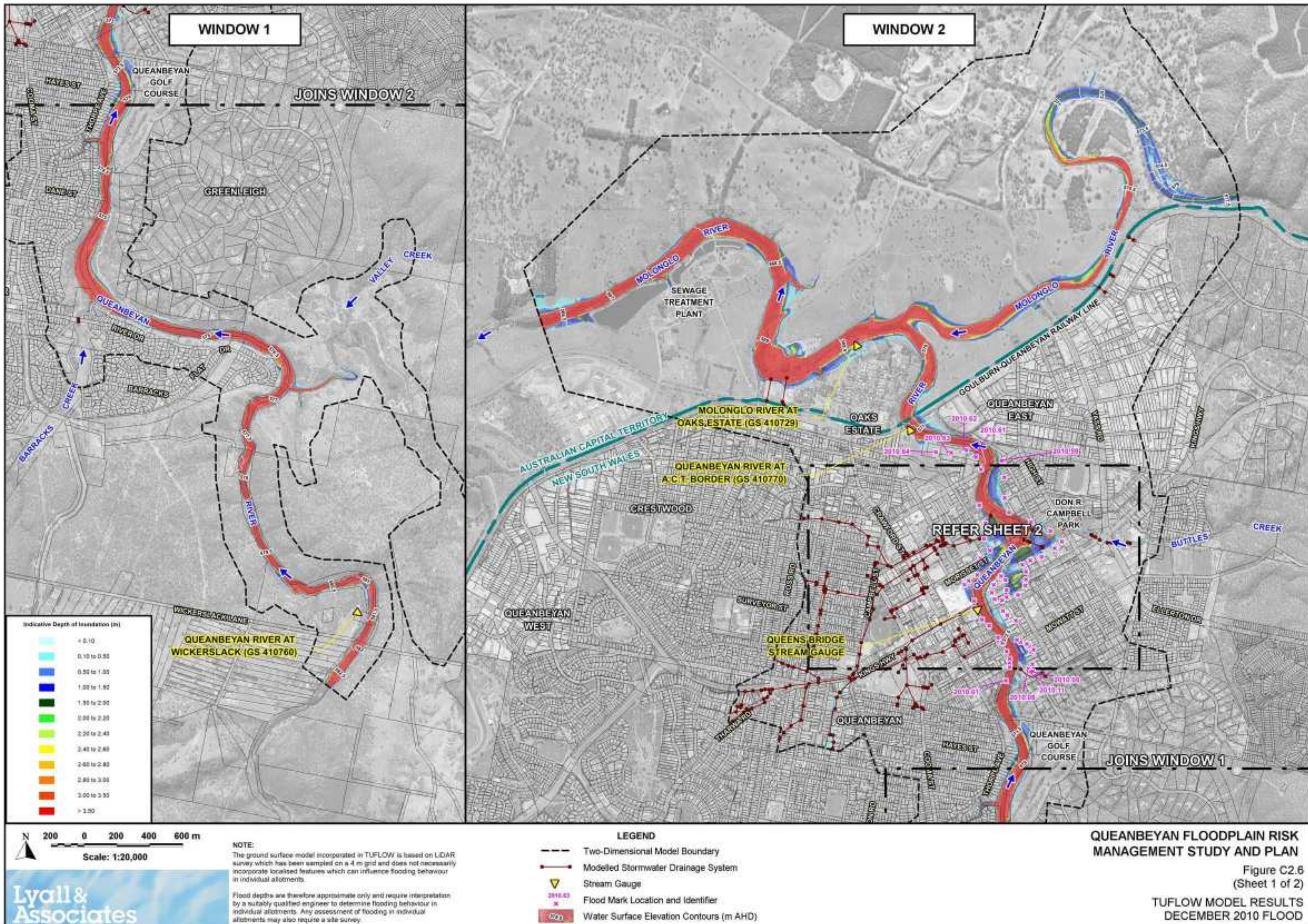


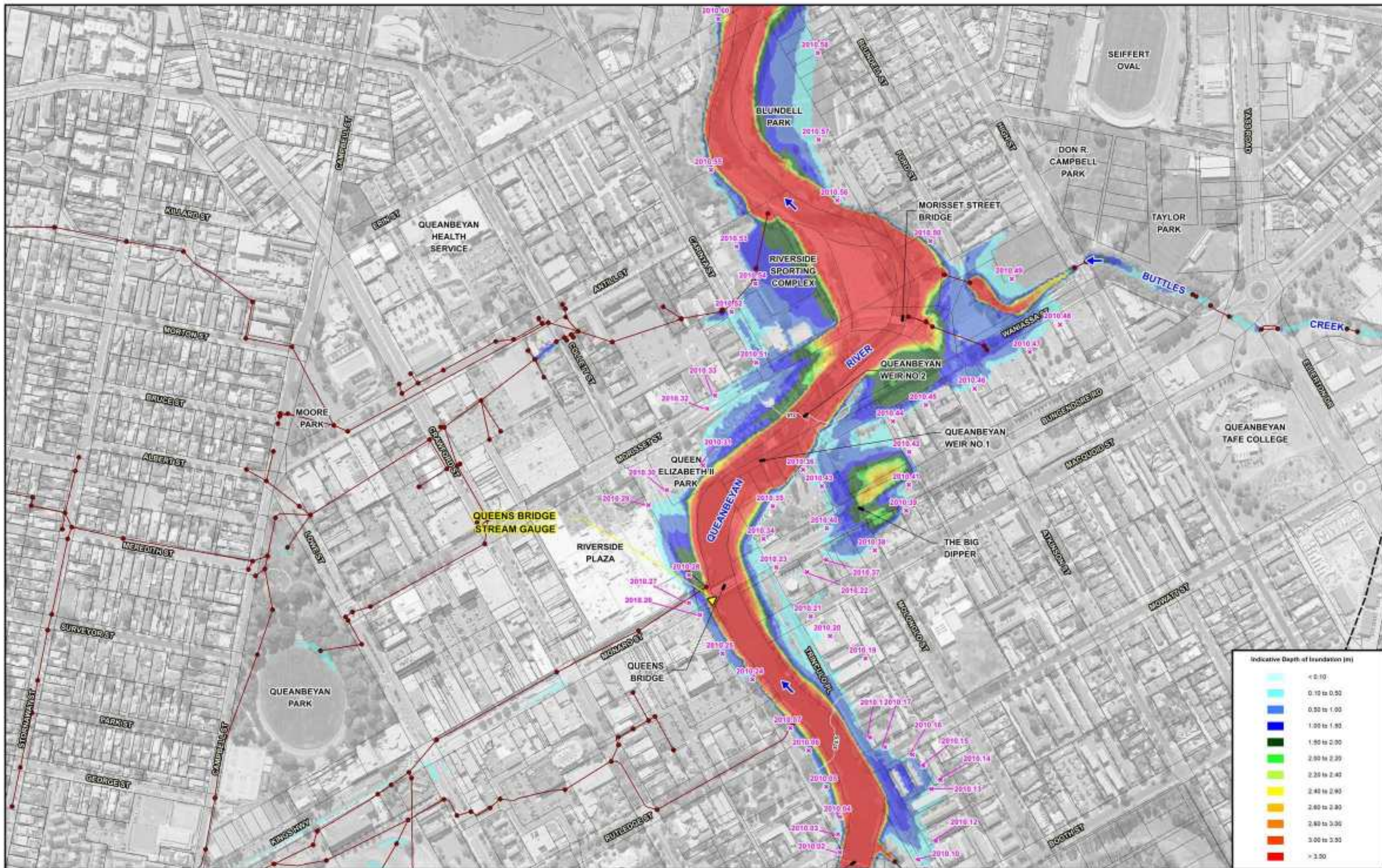
QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN

Figure C2.4

TUFLOW MODEL RESULTS
AUGUST 1974 FLOOD







QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure C2.6
(Sheet 2 of 2)

TUFLOW MODEL RESULTS
DECEMBER 2010 FLOOD

Scale: 1:5,000

Lyall & Associates

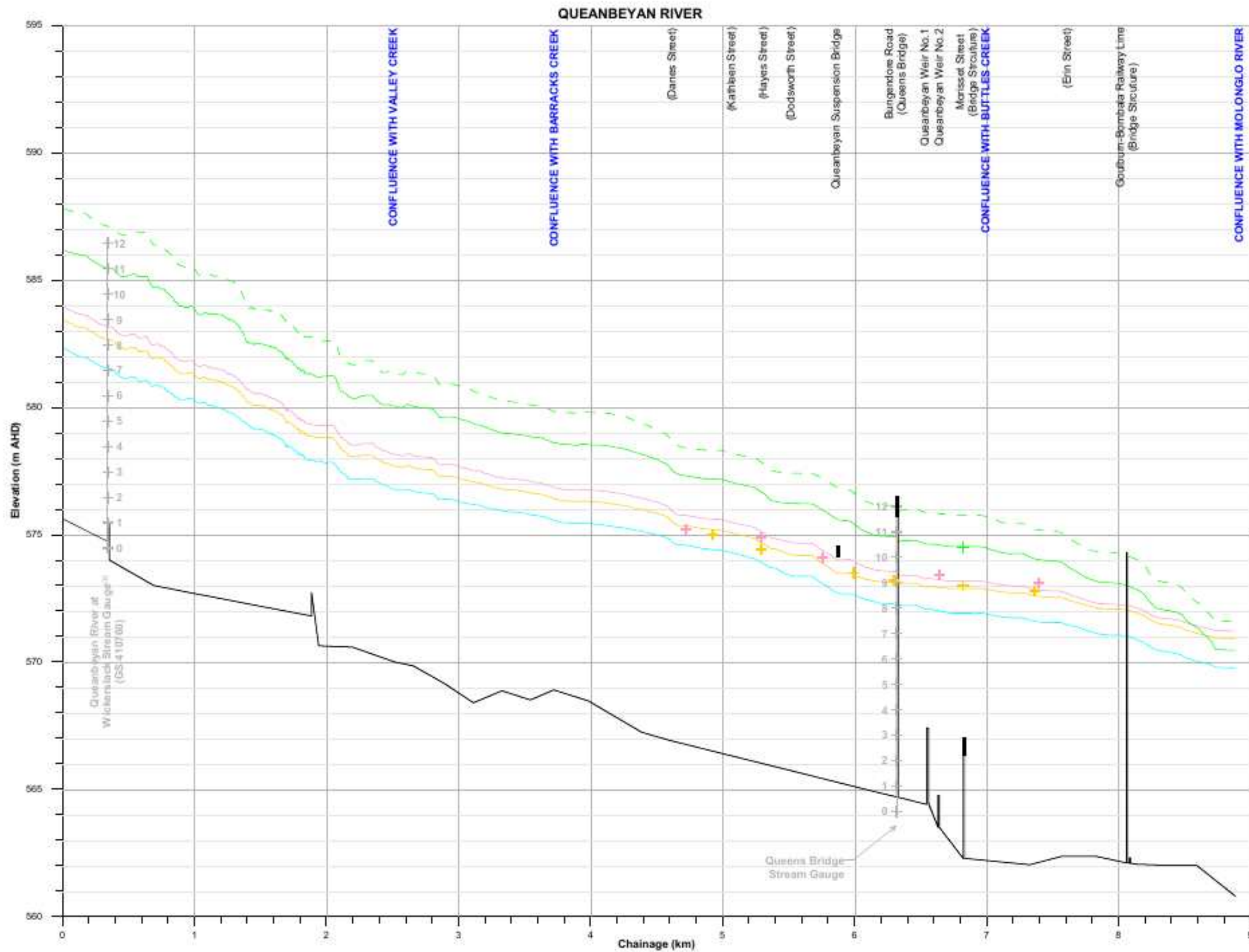
NOTE:

The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

LEGEND

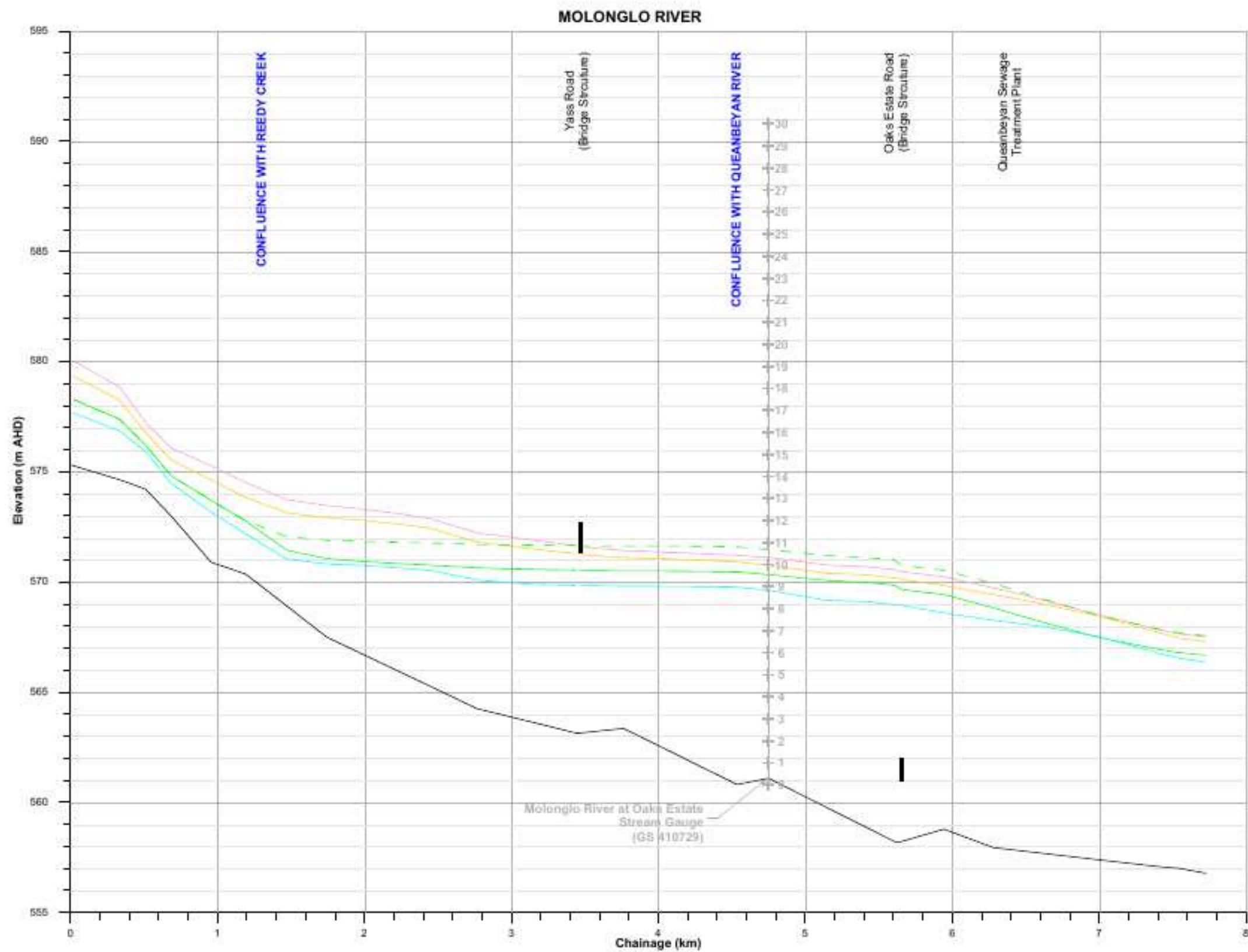
- Two-Dimensional Model Boundary
- Modelled Stormwater Drainage System
- Stream Gauge
- Flood Mark Location and Identifier
- Water Surface Elevation Contours (m AHD)



**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure C2.7
(Sheet 1 of 2)

**WATER SURFACE PROFILES
HISTORIC FLOOD EVENTS**



NOTE:

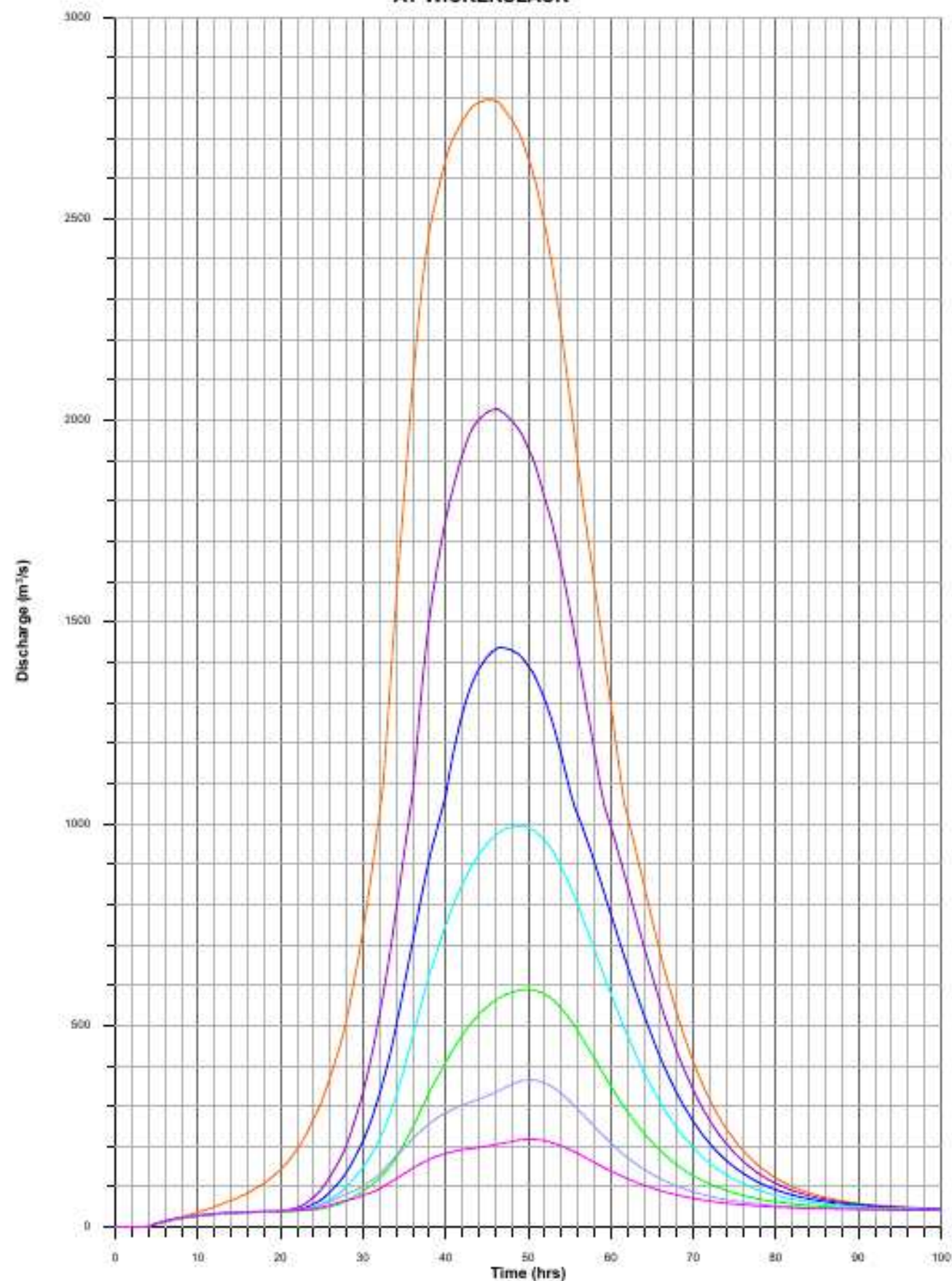
Solid lines represent May 1925 water surface profile based on the Lower Estimate of the peak flow in the Queanbeyan River (i.e. 1,800 m³/s), while the dashed line represents the surface profile based on the Upper Estimate of peak flow in the Queanbeyan River (i.e. 2,120 m³/s).

**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

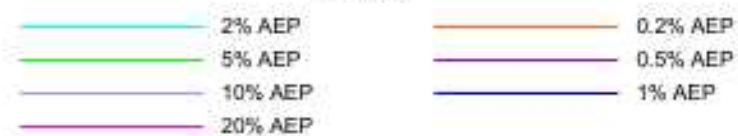
Figure C2.7
(Sheet 2 of 2)

WATER SURFACE PROFILES
HISTORIC FLOOD EVENTS

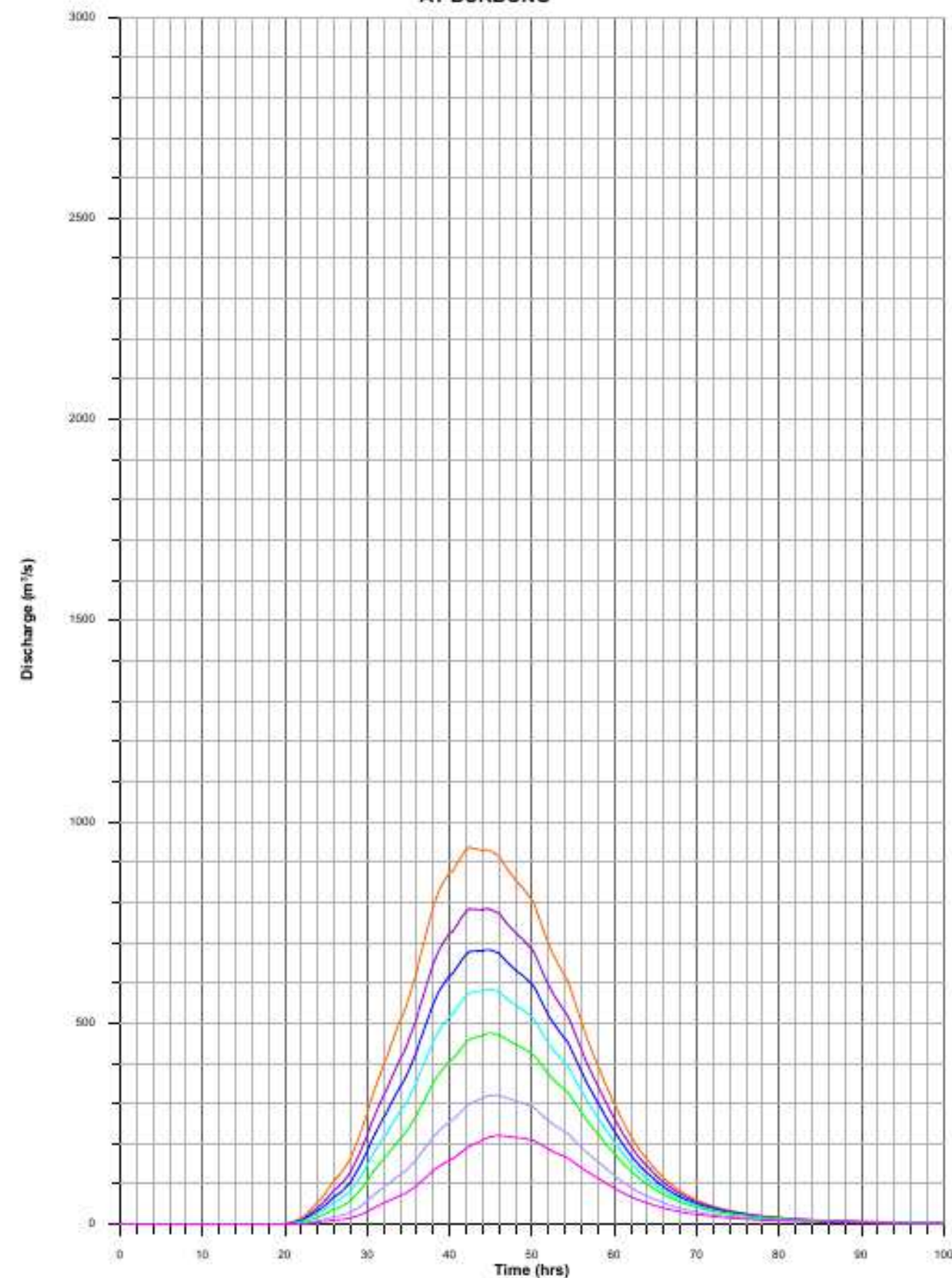
DESIGN INFLOW HYDROGRAPHS
AT WICKERSLACK



LEGEND



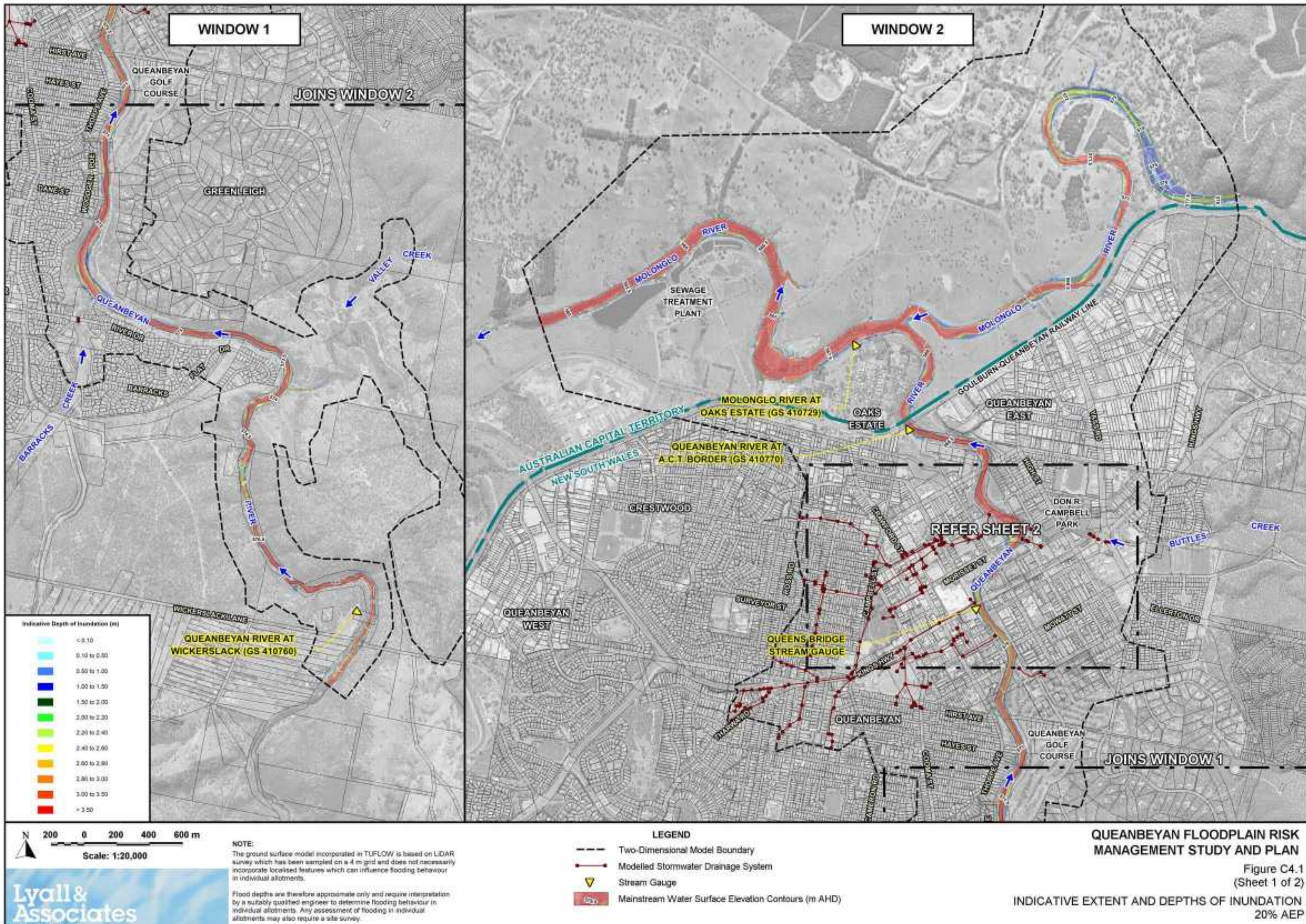
DESIGN INFLOW HYDROGRAPHS
AT BURBONG

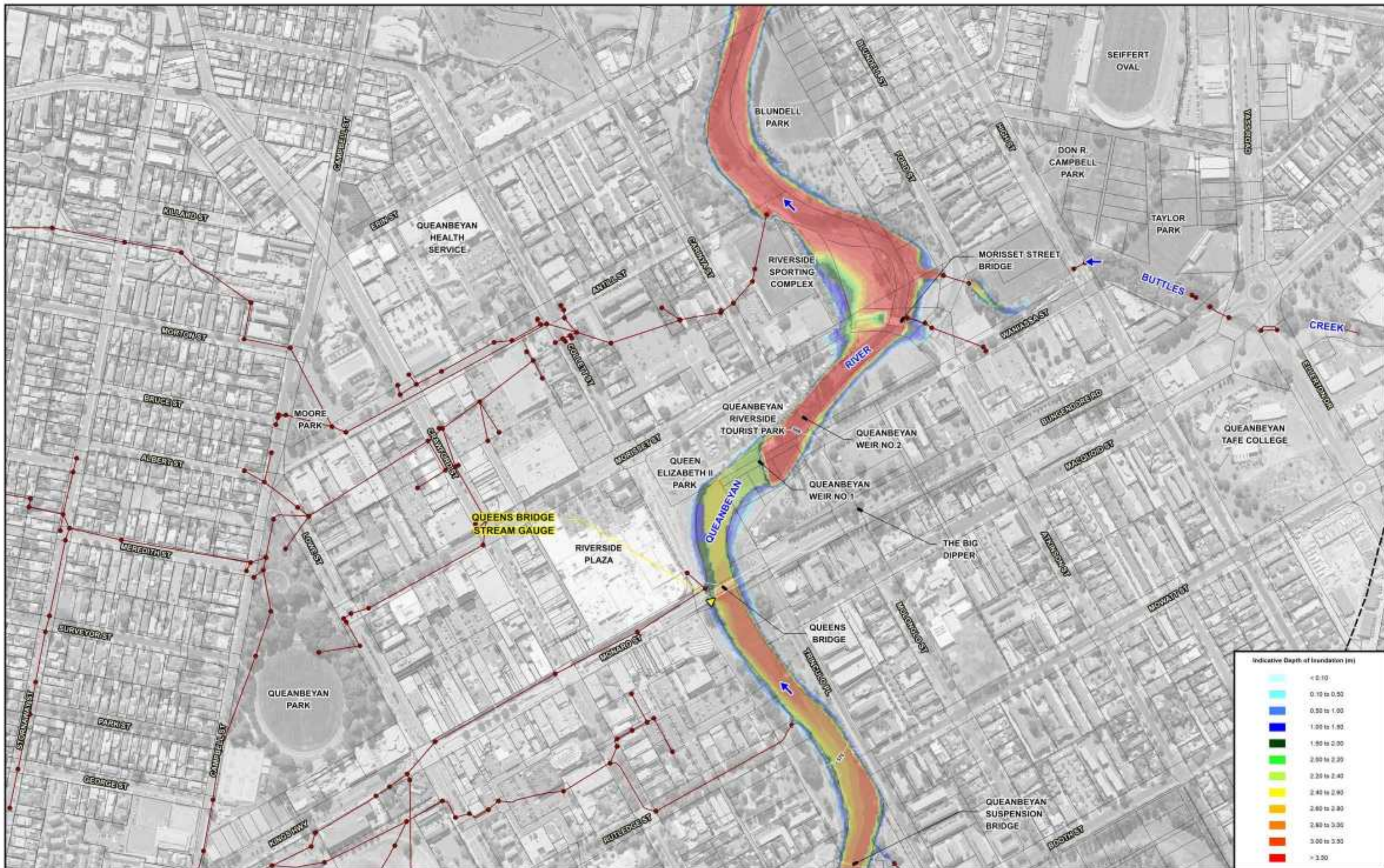


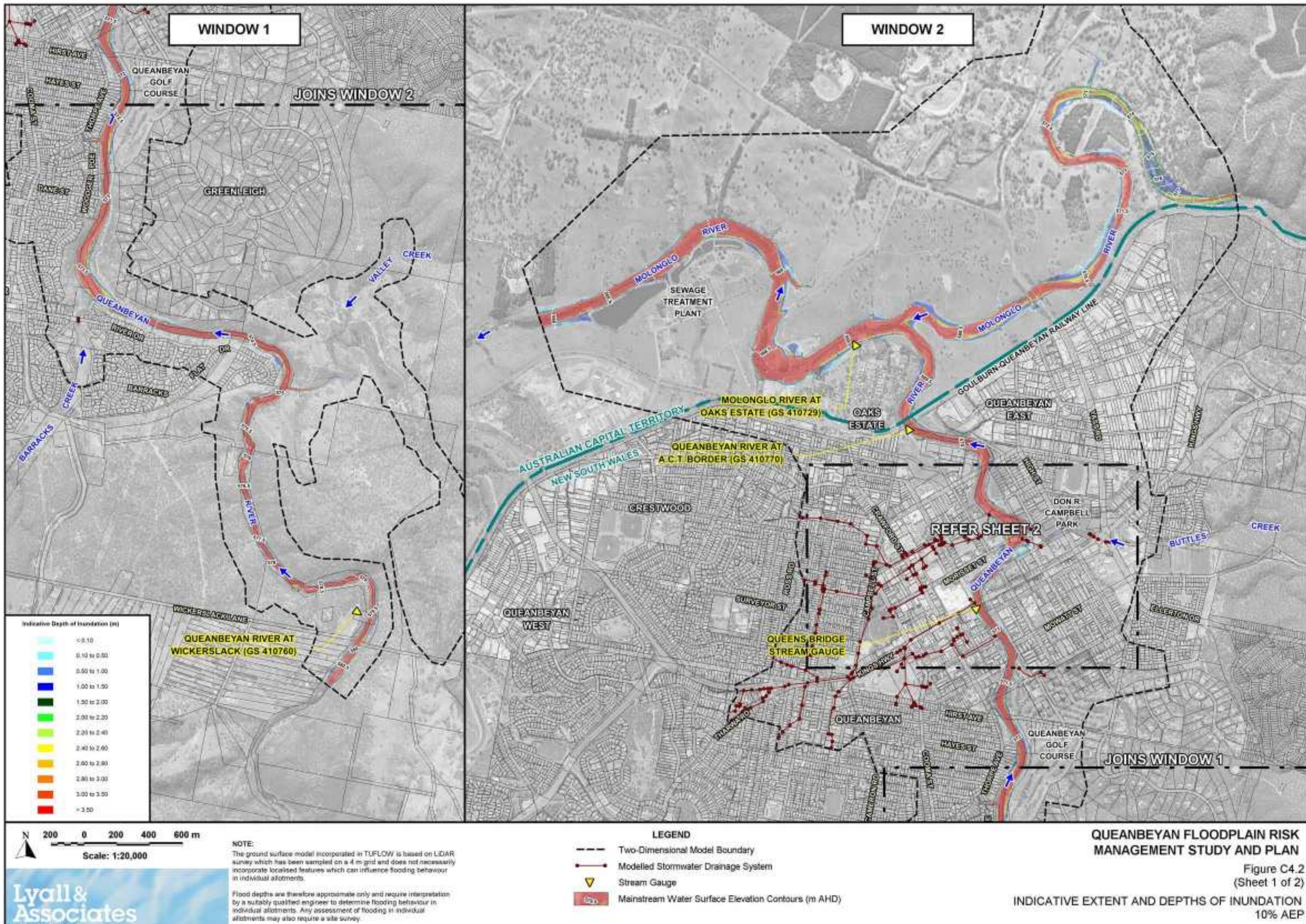
QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN

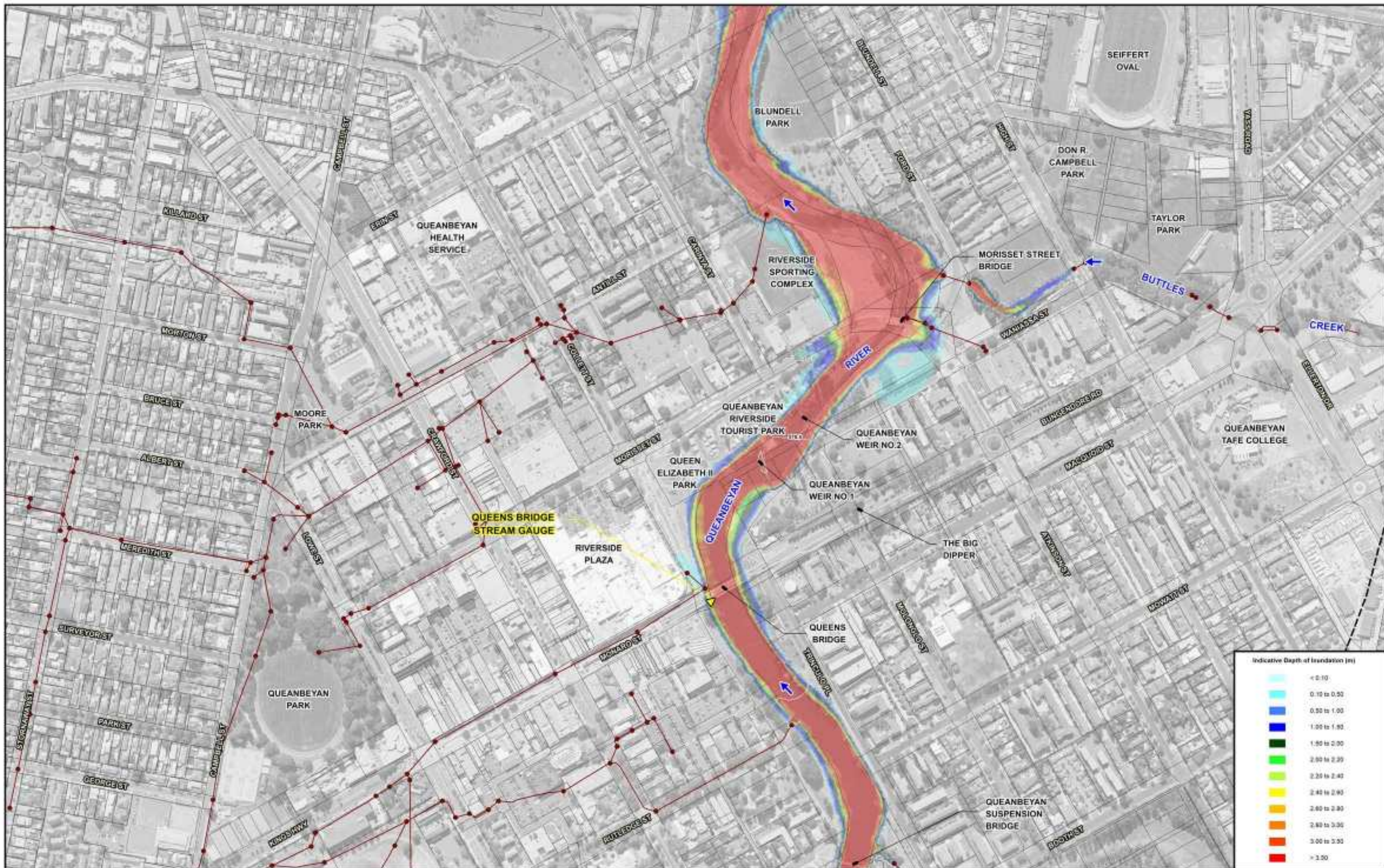
Figure C3.1

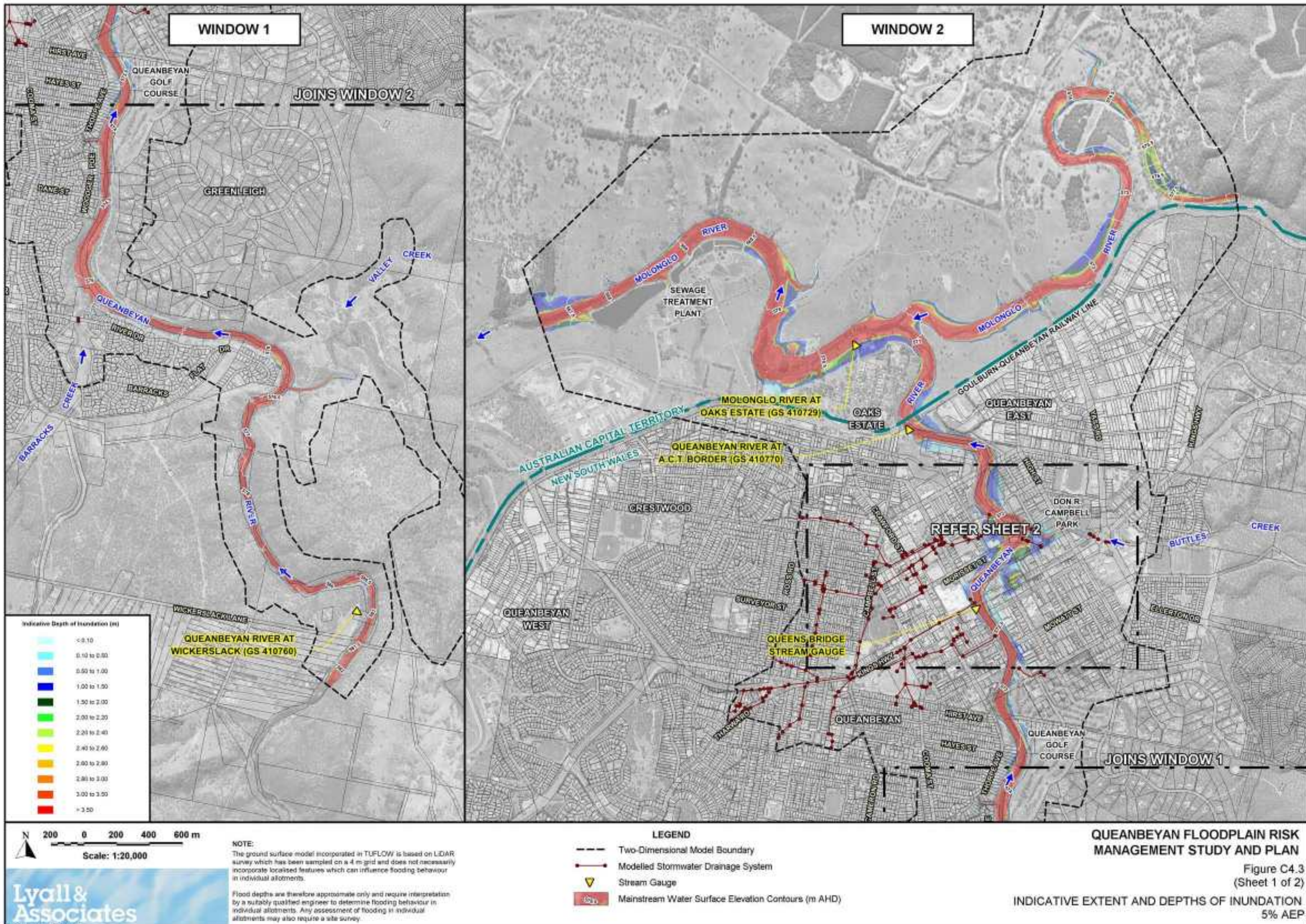
DESIGN INFLOW HYDROGRAPHS

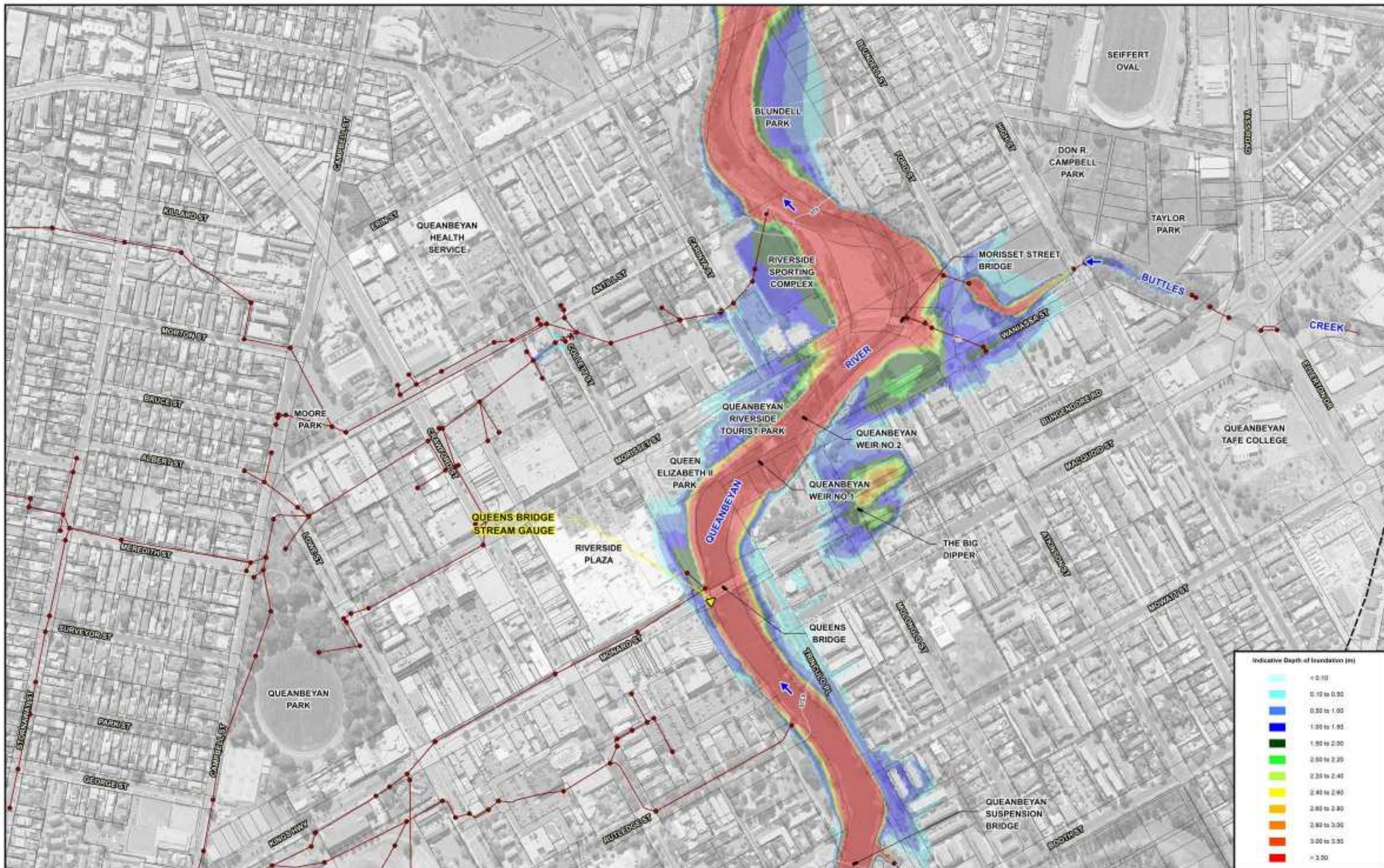








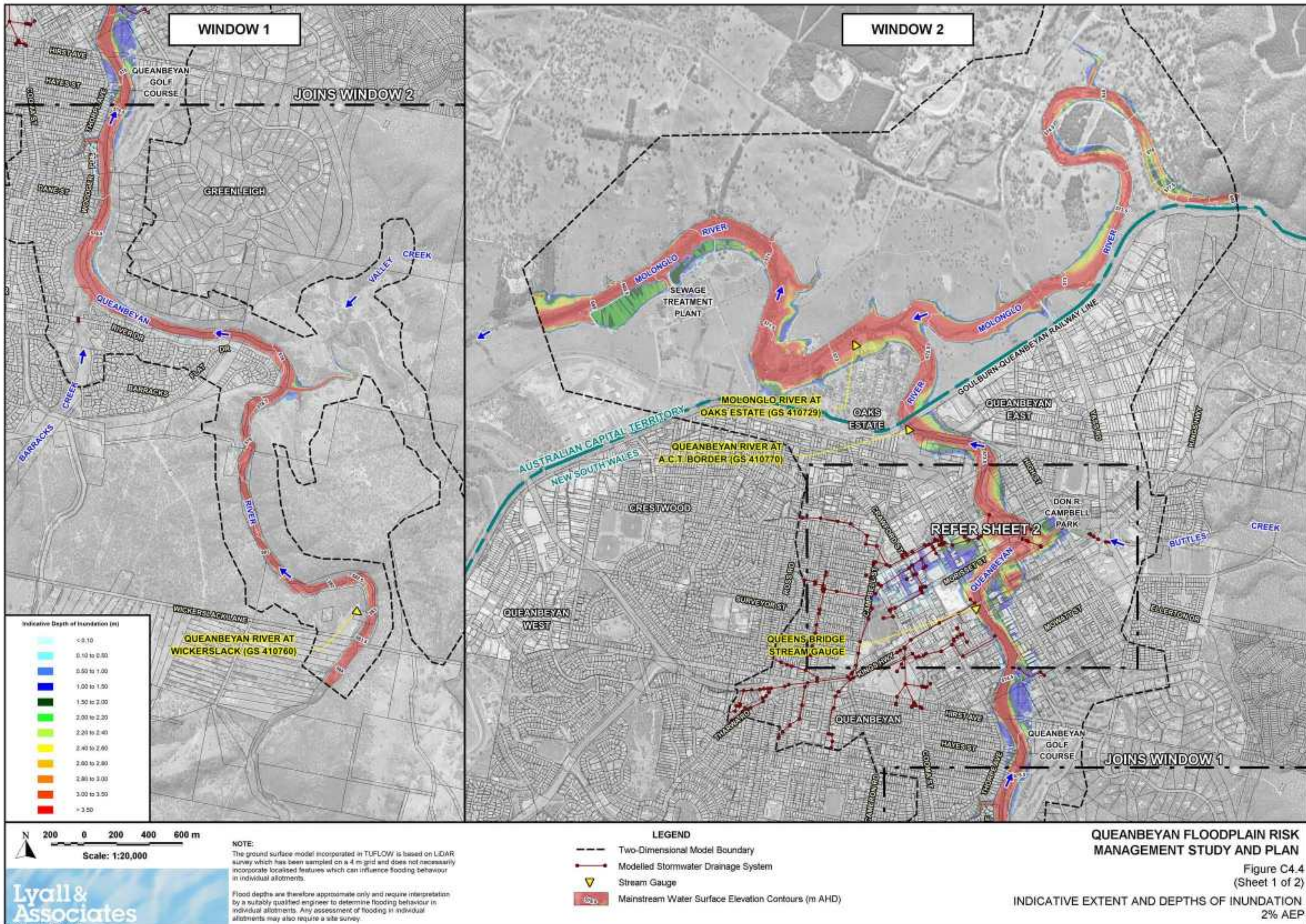


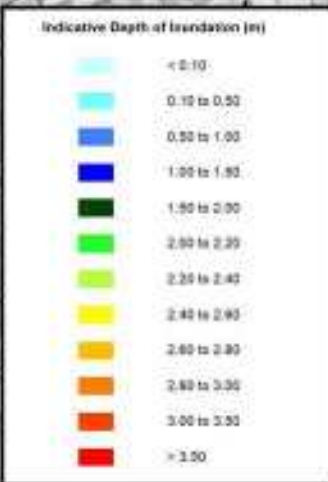
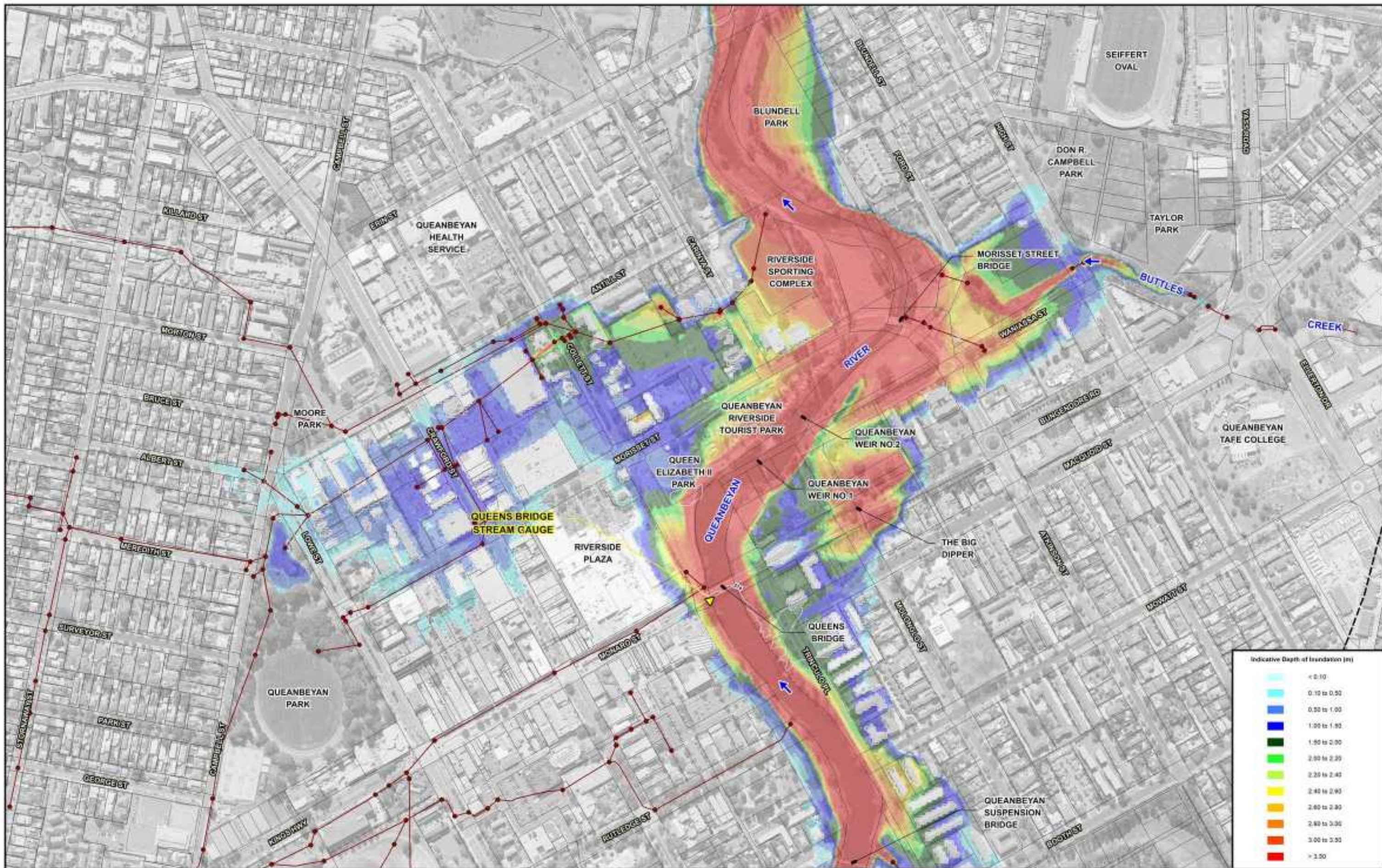


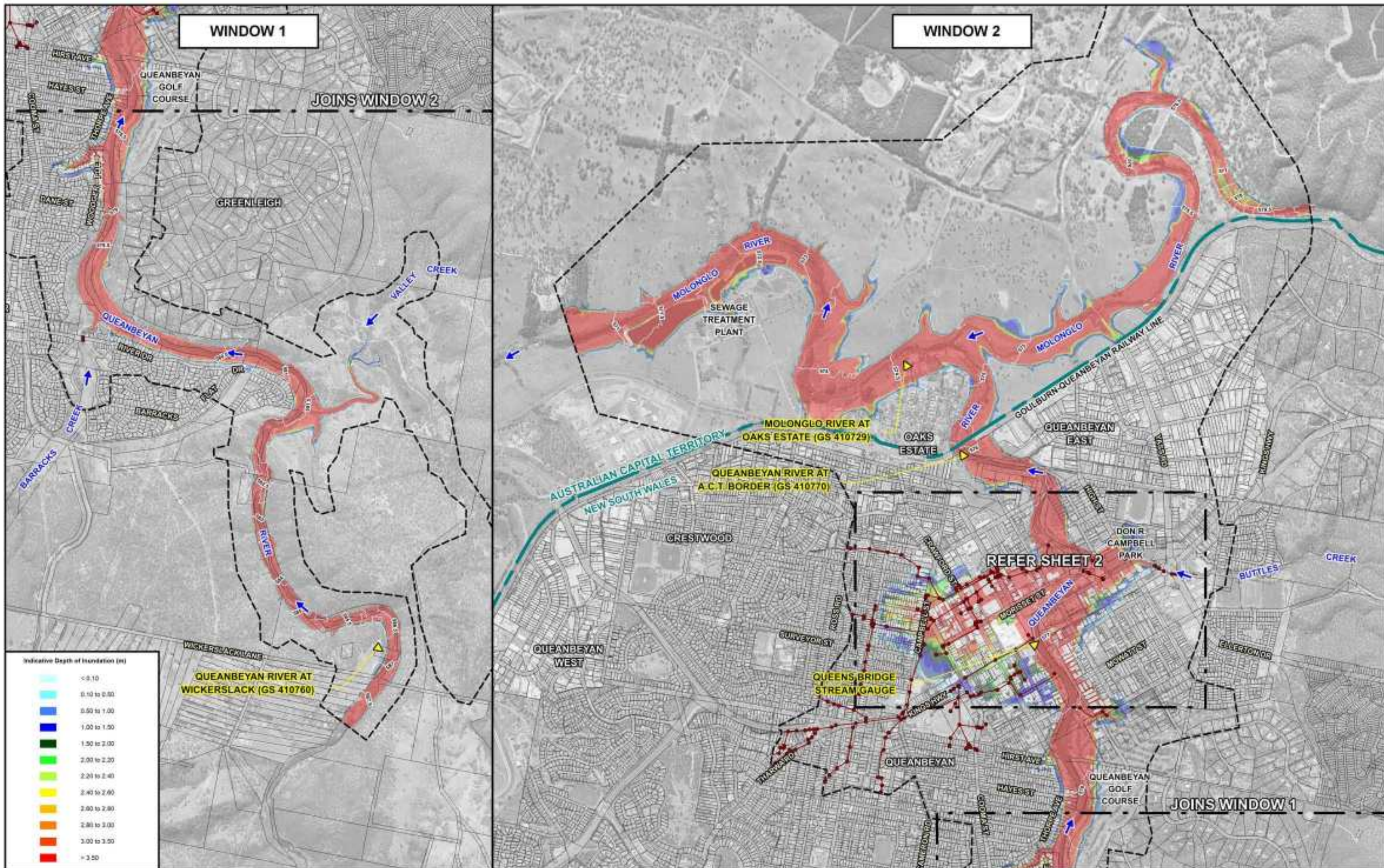
QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

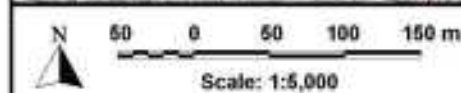
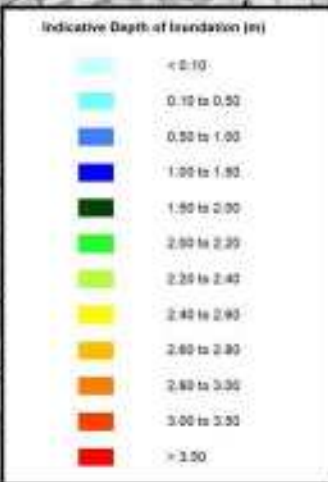
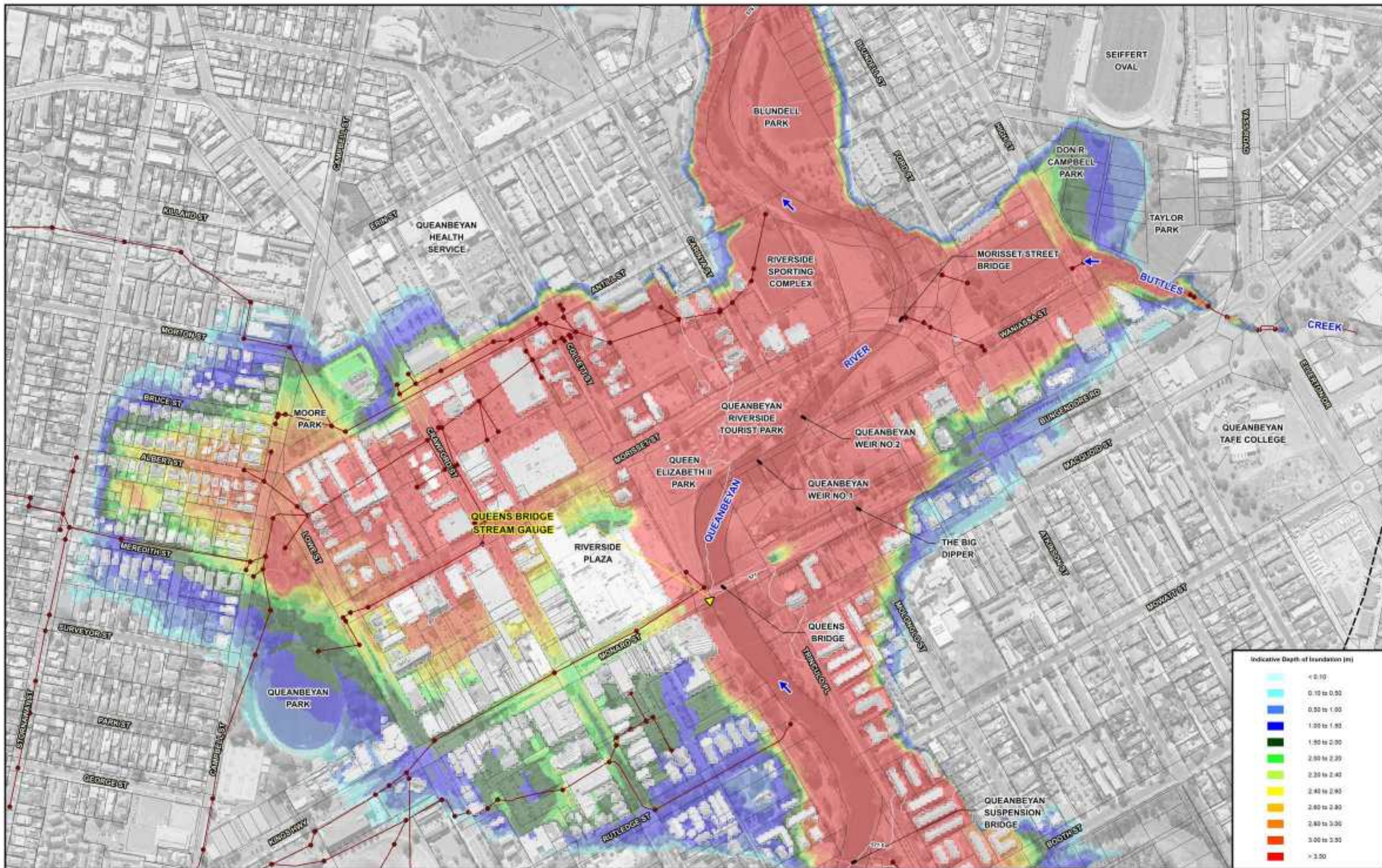
Figure C4.3
(Sheet 2 of 2)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
5% AEP









Lyall & Associates

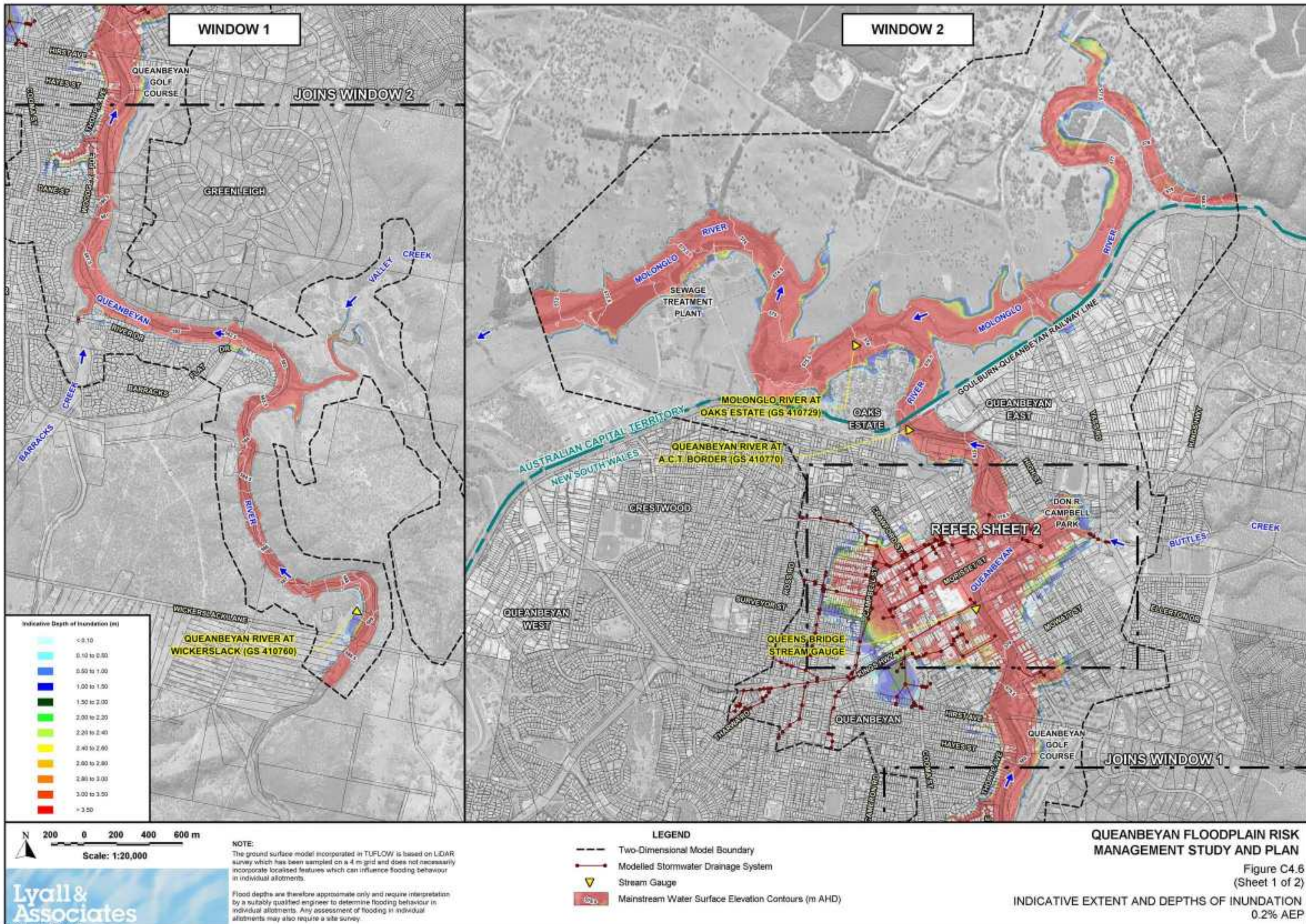
NOTE:
The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

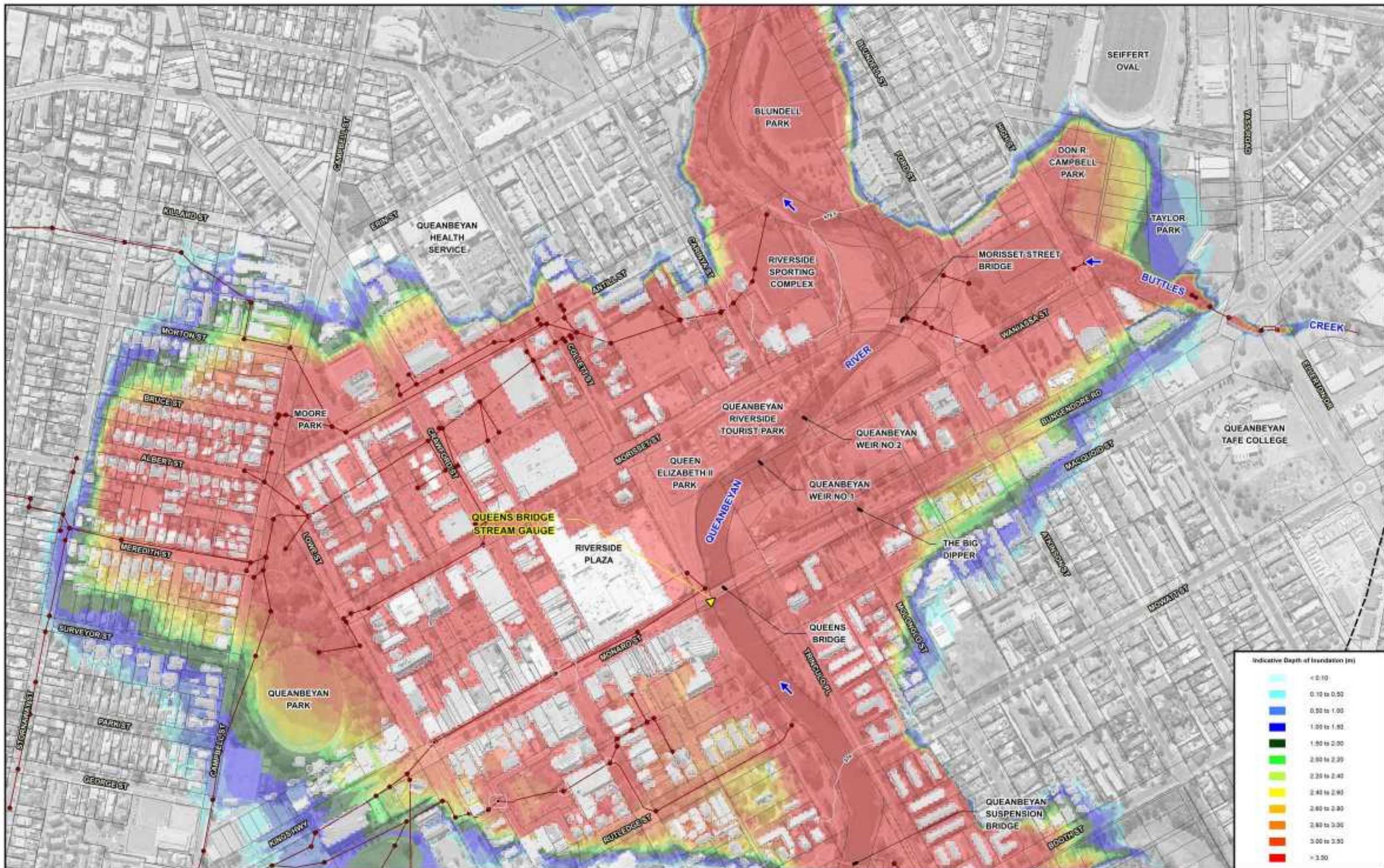
Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

- LEGEND**
- Two-Dimensional Model Boundary
 - Modelled Stormwater Drainage System
 - ▼ Stream Gauge
 - Mainstream Water Surface Elevation Contours (m AHD)

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure C4.5
(Sheet 2 of 2)
**INDICATIVE EXTENT AND DEPTHS OF INUNDATION
0.5% AEP**





Scale: 1:5,000

Lvall & Associates

NOTE:

The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

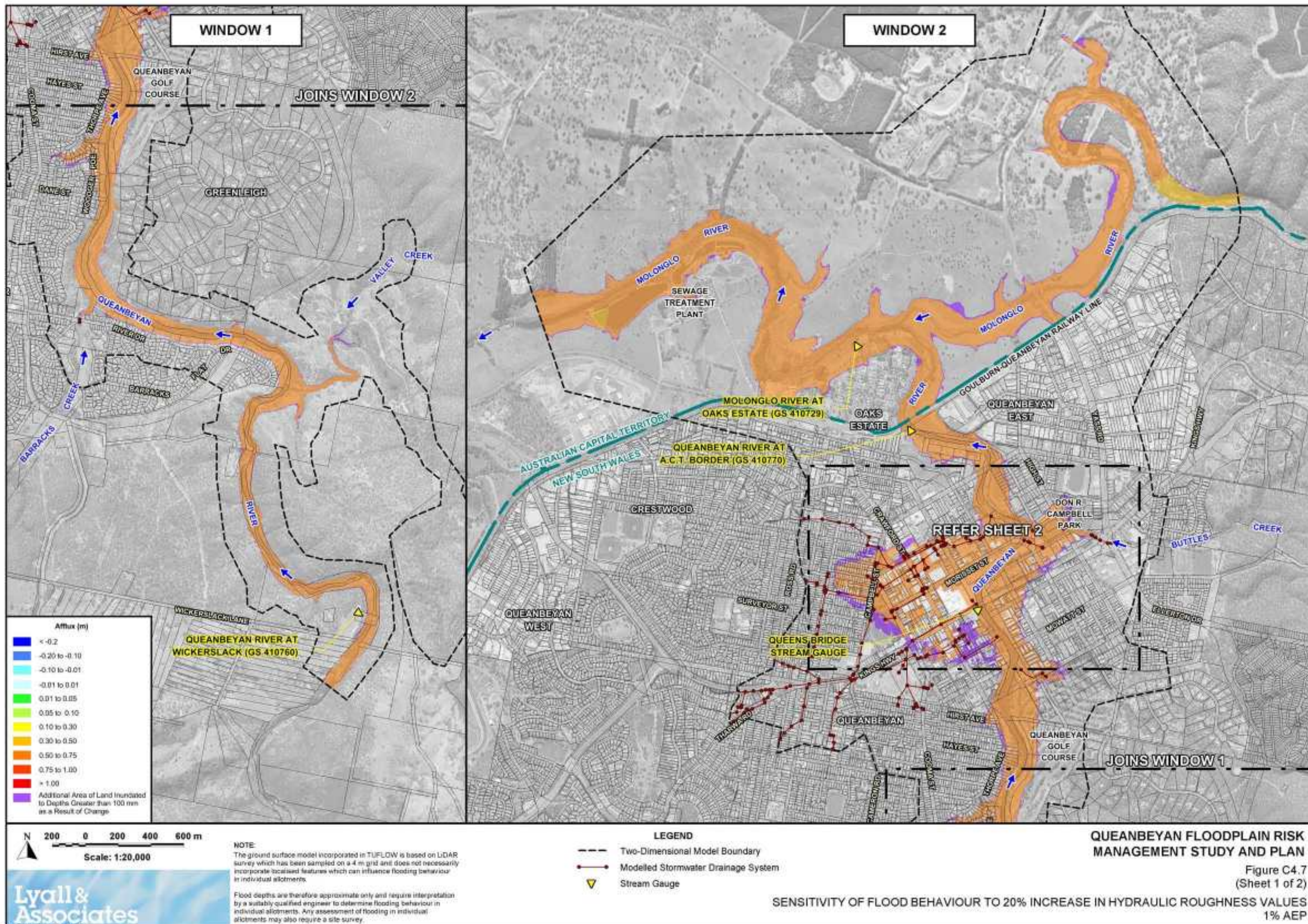
LEGEND

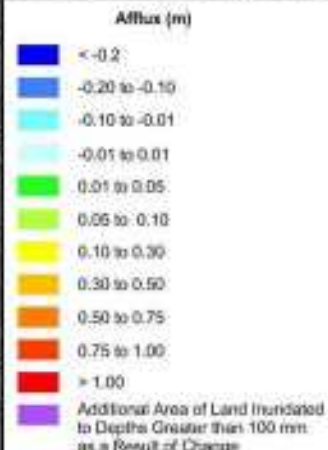
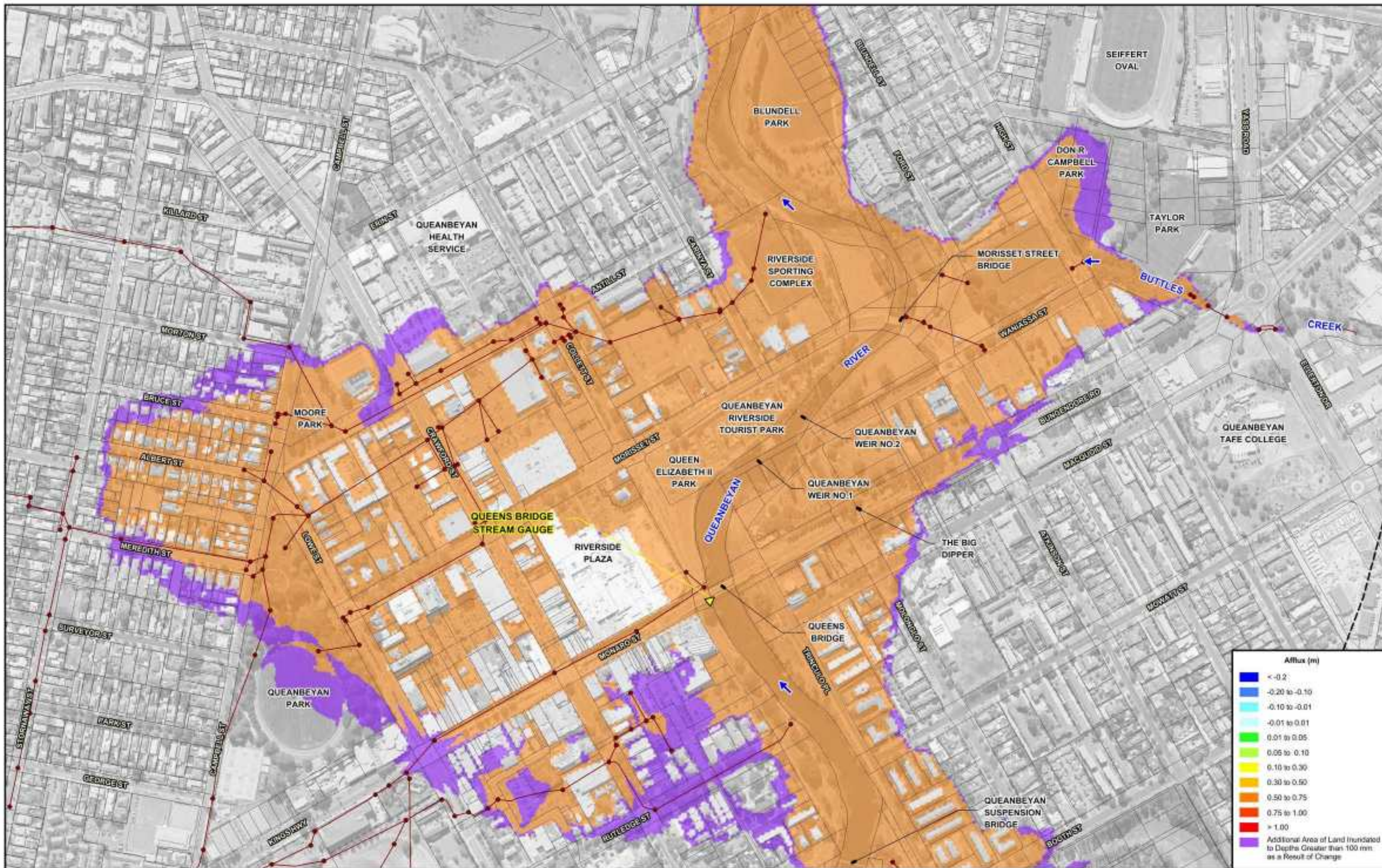
- Two-Dimensional Model Boundary
- Modelled Stormwater Drainage System
- ▼ Stream Gauge
- Mainstream Water Surface Elevation Contours (m AHD)

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure C4.6
(Sheet 2 of 2)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
0.2% AEP





Scale: 1:5,000

Lyall & Associates

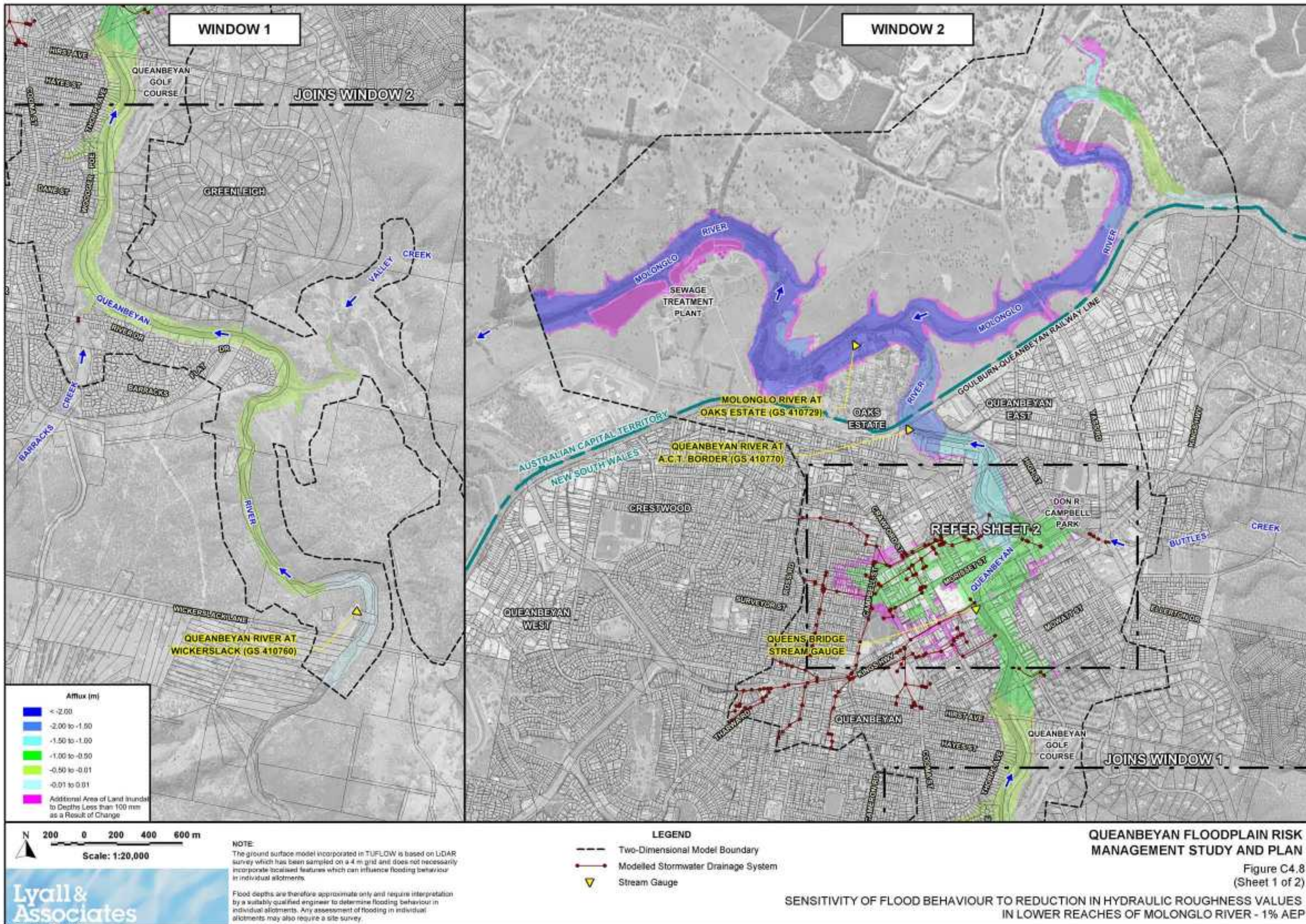
NOTE
The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.
Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

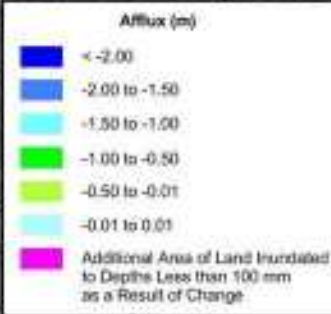
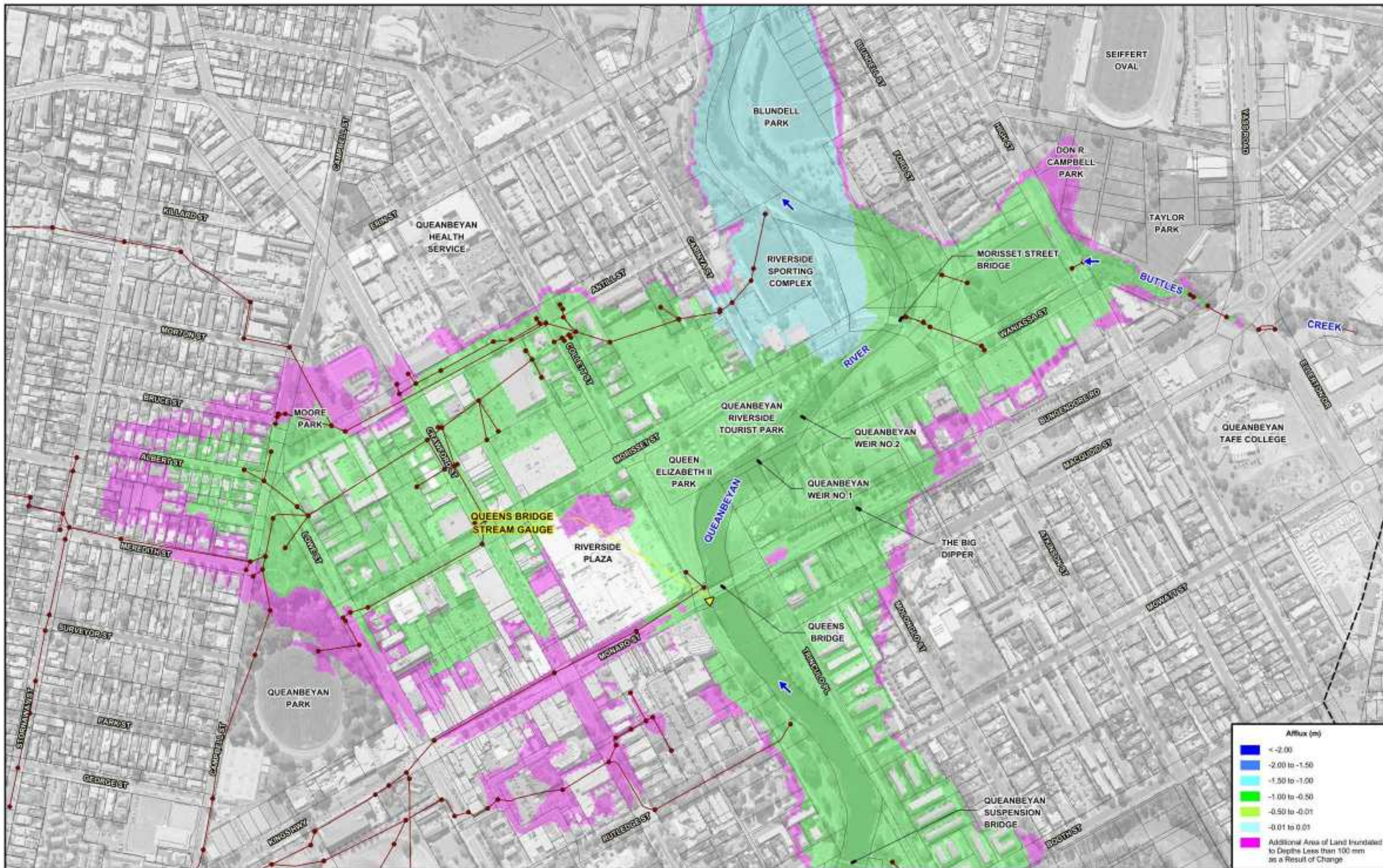
- LEGEND**
- Two-Dimensional Model Boundary
 - Modelled Stormwater Drainage System
 - Stream Gauge

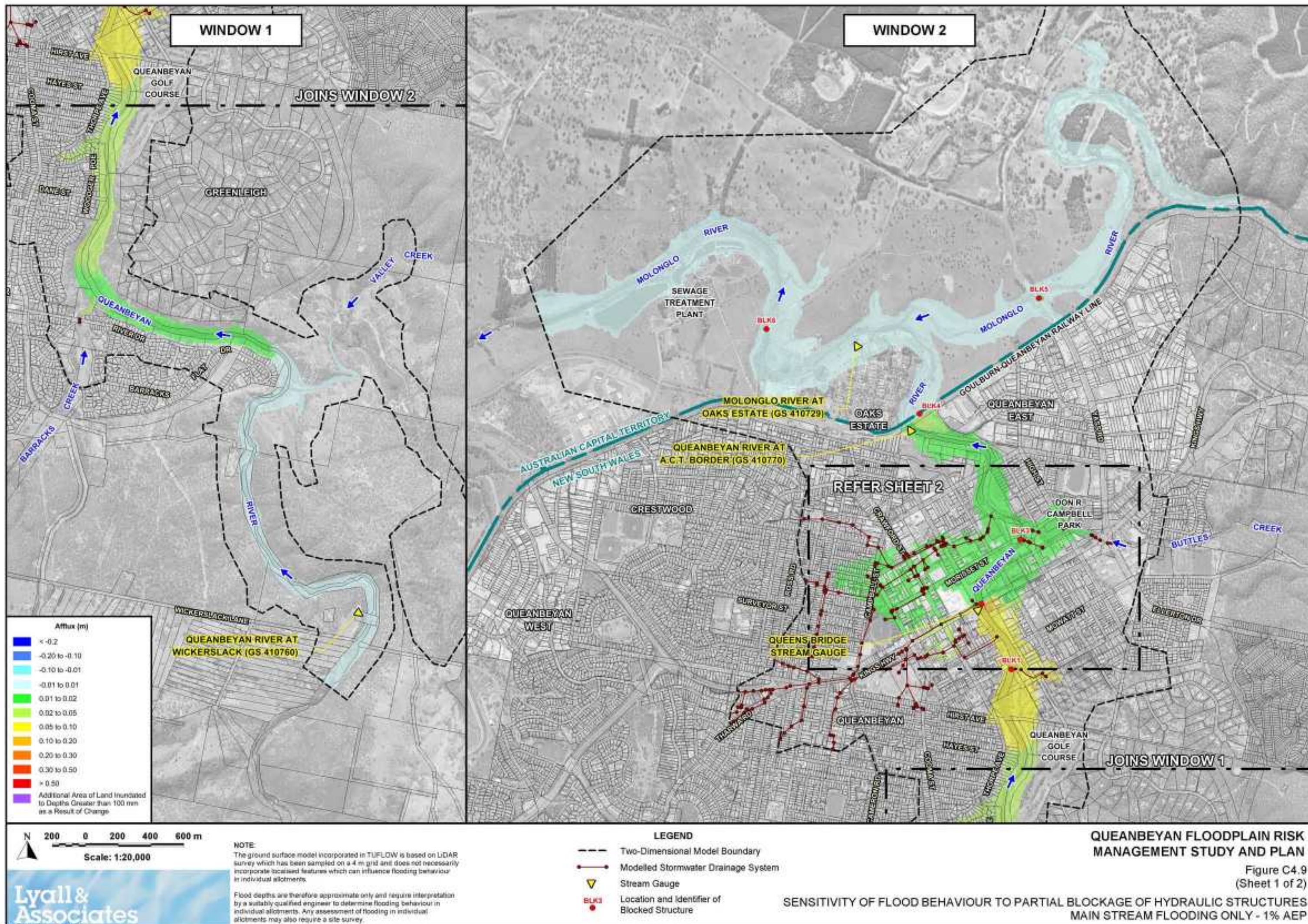
QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

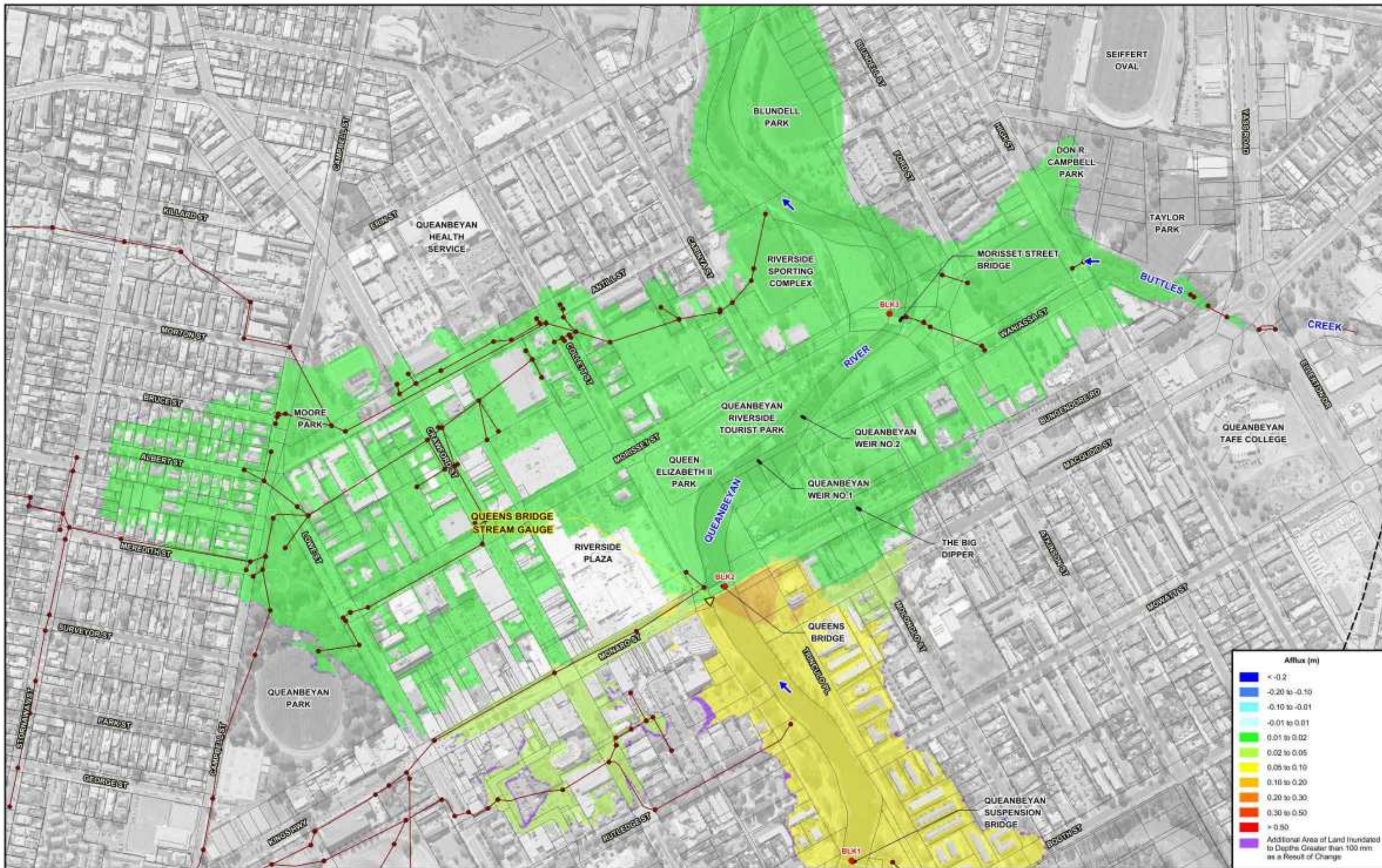
Figure C4.7
(Sheet 2 of 2)

**SENSITIVITY OF FLOOD BEHAVIOUR TO 20% INCREASE IN HYDRAULIC ROUGHNESS VALUES
1% AEP**











QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure C4.10

SENSITIVITY OF FLOOD BEHAVIOUR TO PARTIAL BLOCKAGE OF HYDRAULIC STRUCTURES
LOCAL CATCHMENT FLOODING IN VICINITY OF QUEANBEYAN CBD - 1% AEP

Scale: 1:5,000

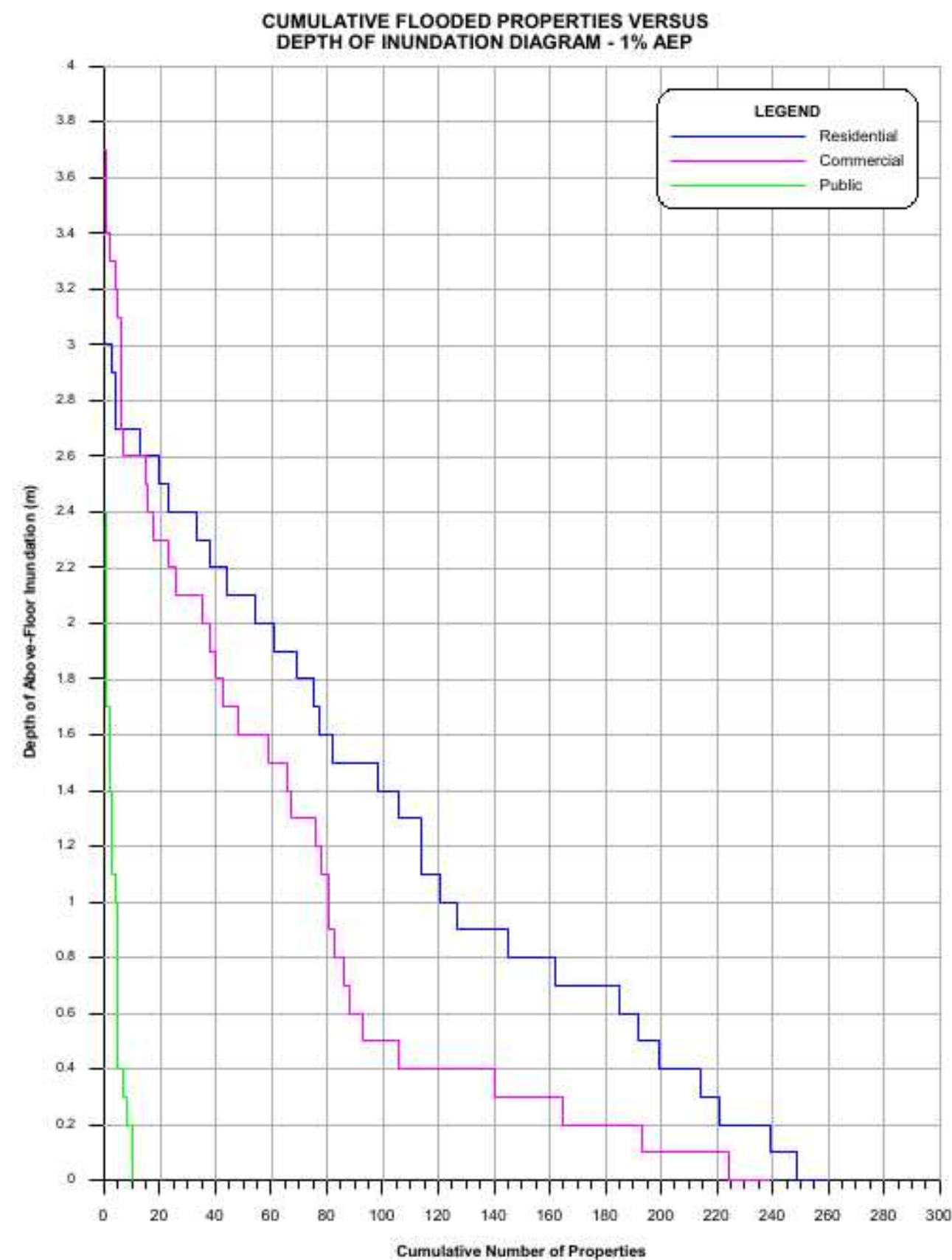
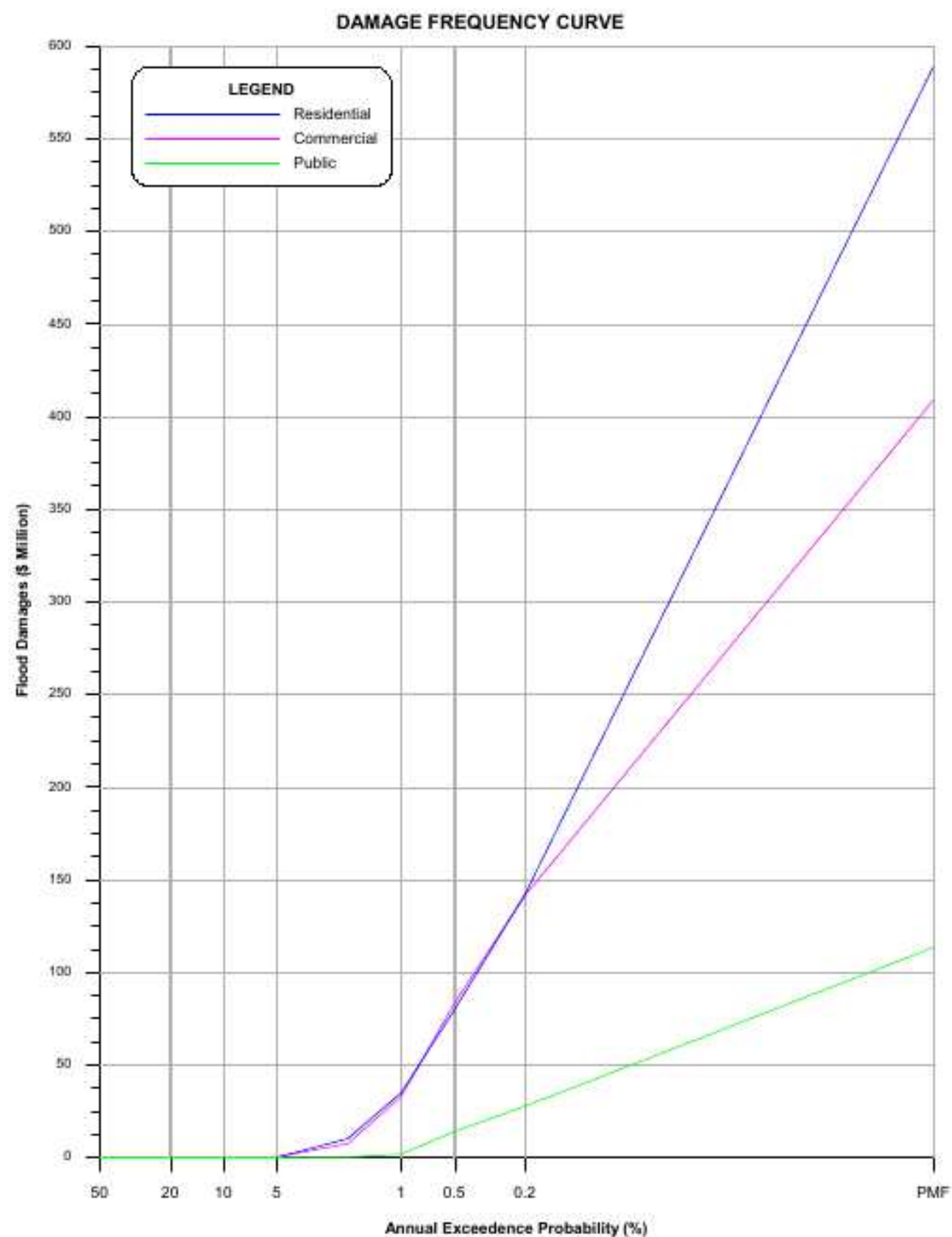
Lyall & Associates

APPENDIX D

FLOOD DAMAGES

LIST OF FIGURES (APPENDIX D)

D8.1 Damage - Frequency Curves and Cumulative Flooded Properties versus Depth of Inundation Diagram – 1% AEP

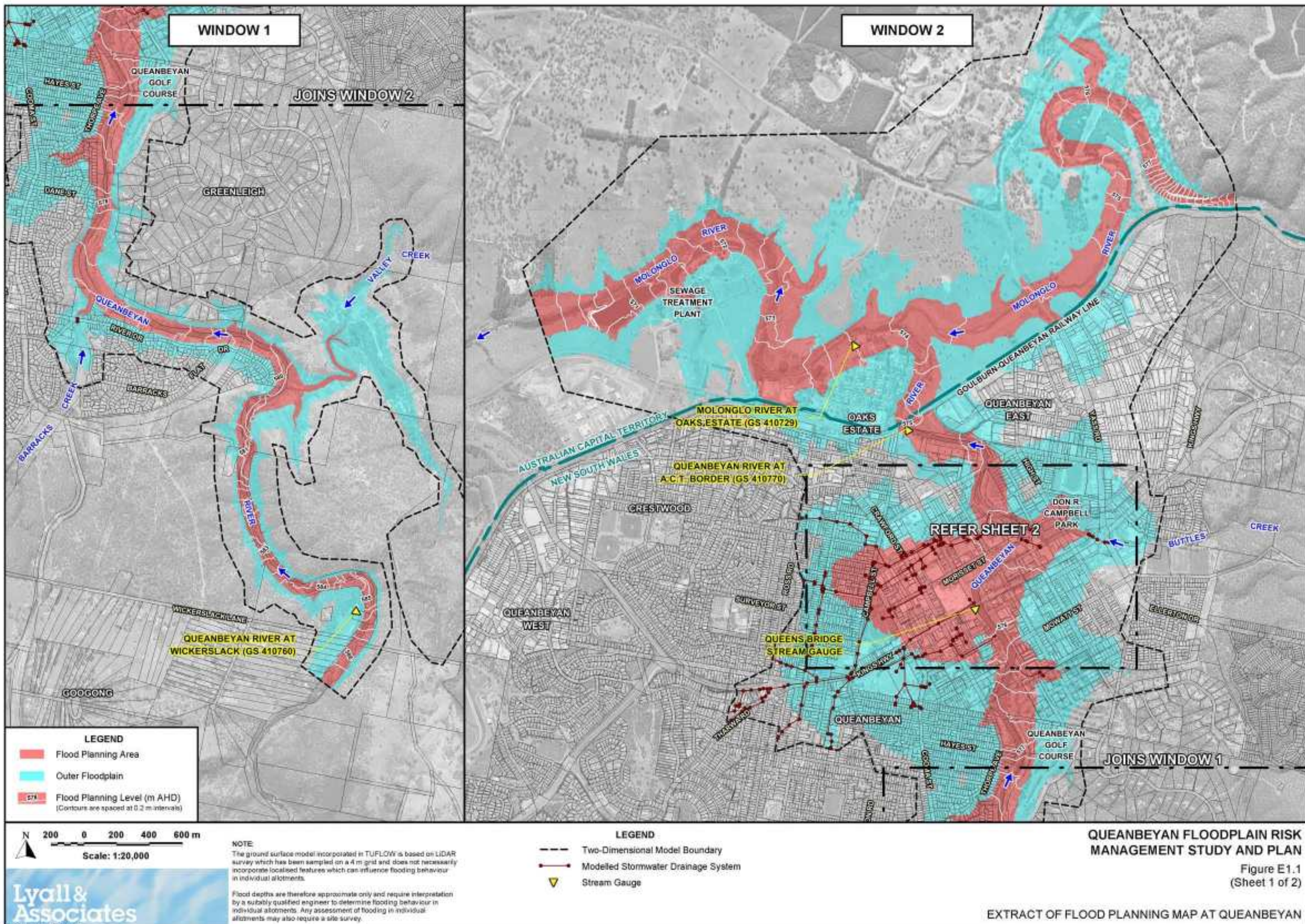


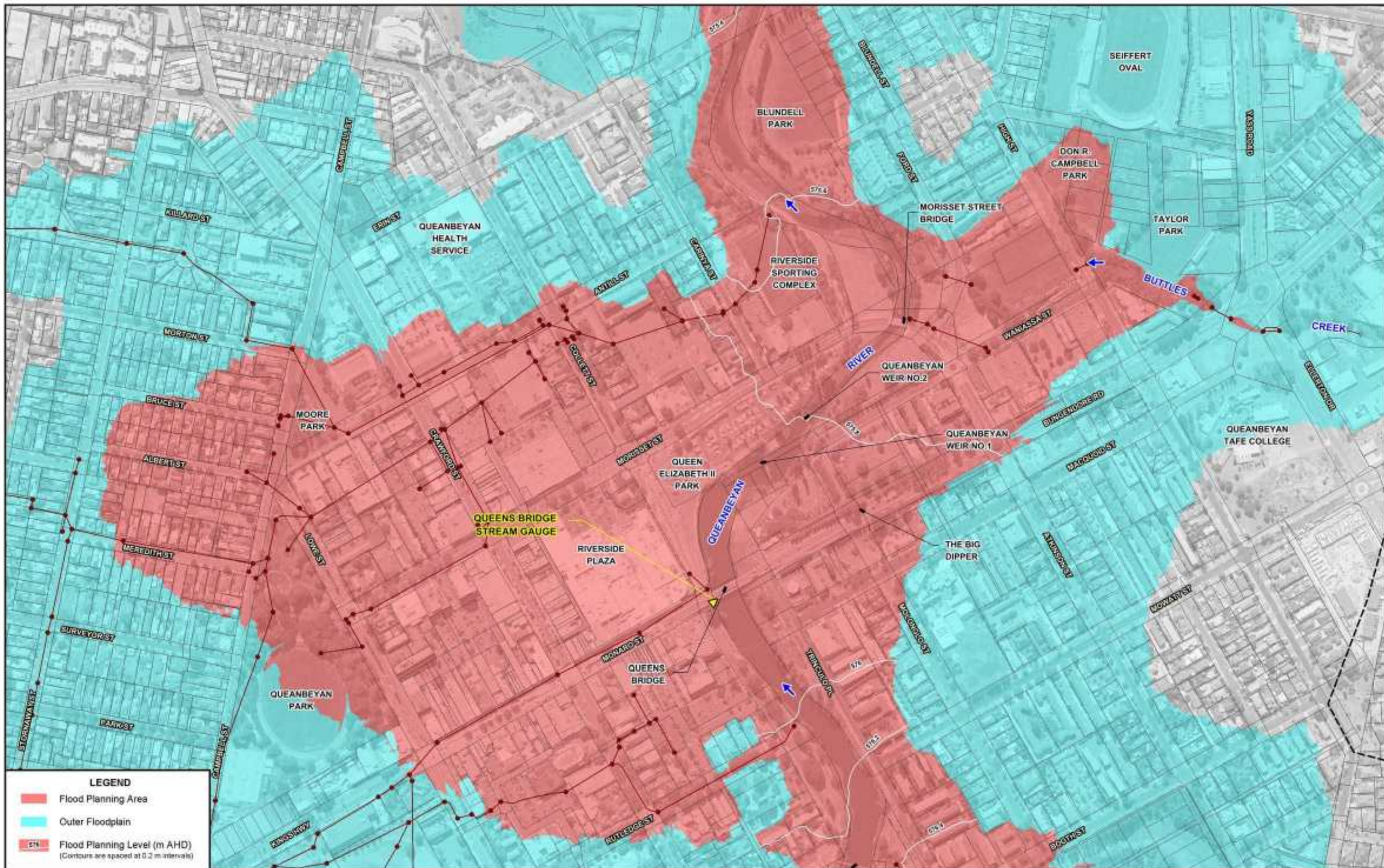
APPENDIX E

DRAFT FLOOD POLICY

LIST OF FIGURES (APPENDIX E)

- E1.1 Extract of Flood Planning Map at Queanbeyan (2 sheets)
- E1.2 Queanbeyan Flood Hazard Map (2 sheets)





LEGEND

- Flood Planning Area
- Outer Floodplain
- Flood Planning Level (m AHD)
(Contours are spaced at 0.2 m intervals)

Scale: 1:5,000

0 50 100 150 m

Lyll & Associates

NOTE

The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

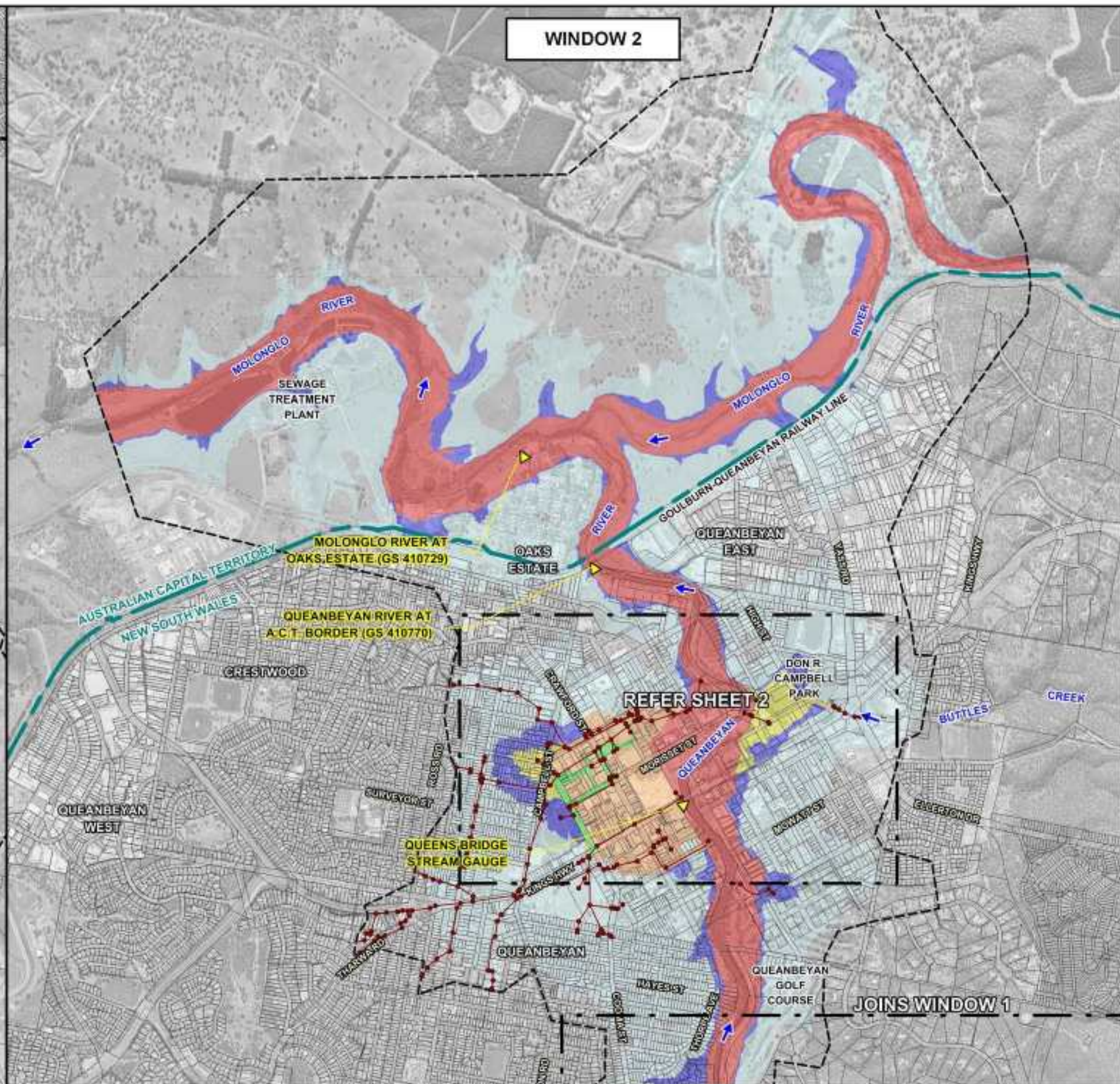
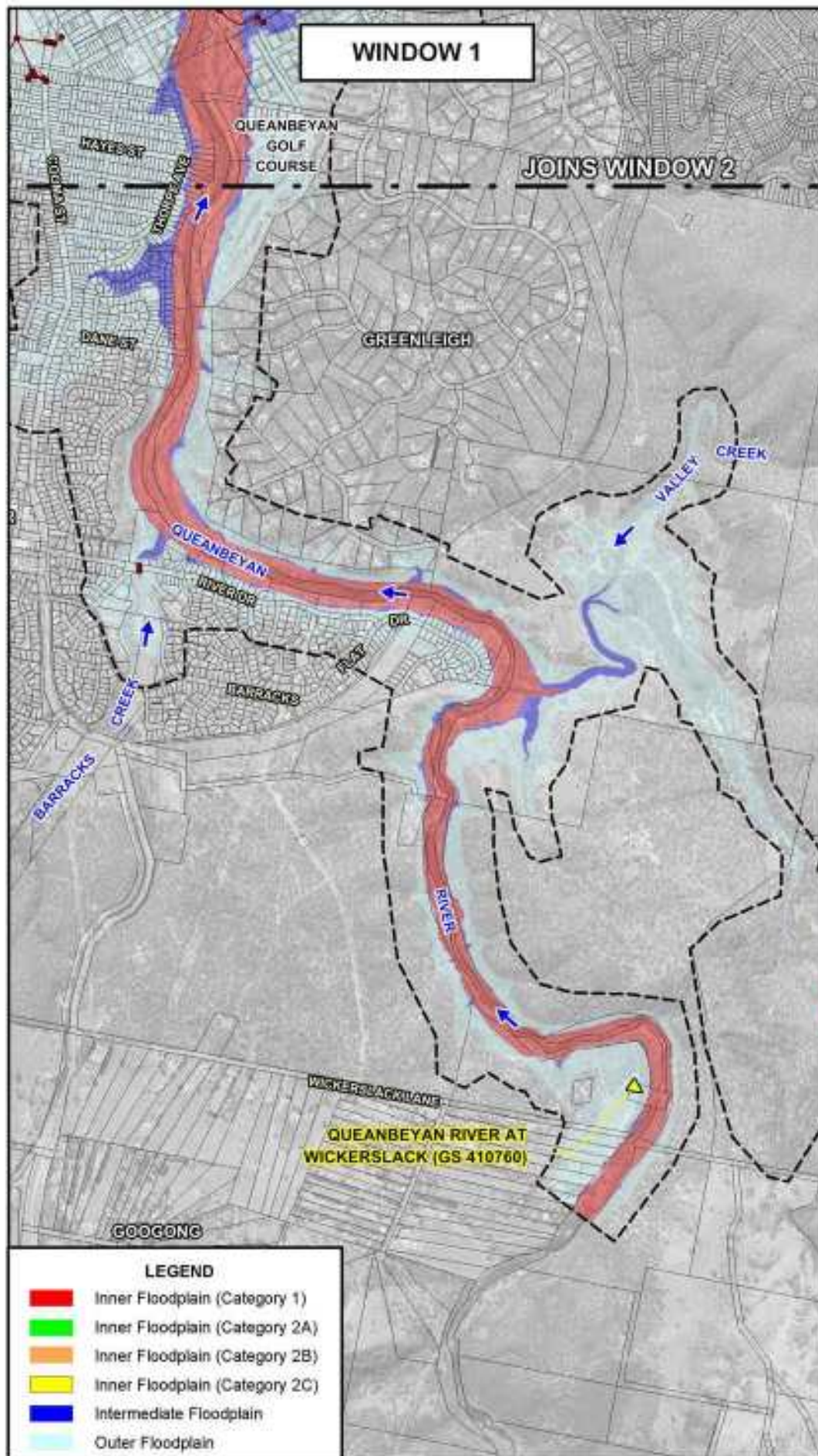
LEGEND

- Two-Dimensional Model Boundary
- Modelled Stormwater Drainage System
- Stream Gauge

**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure E1.1
(Sheet 2 of 2)

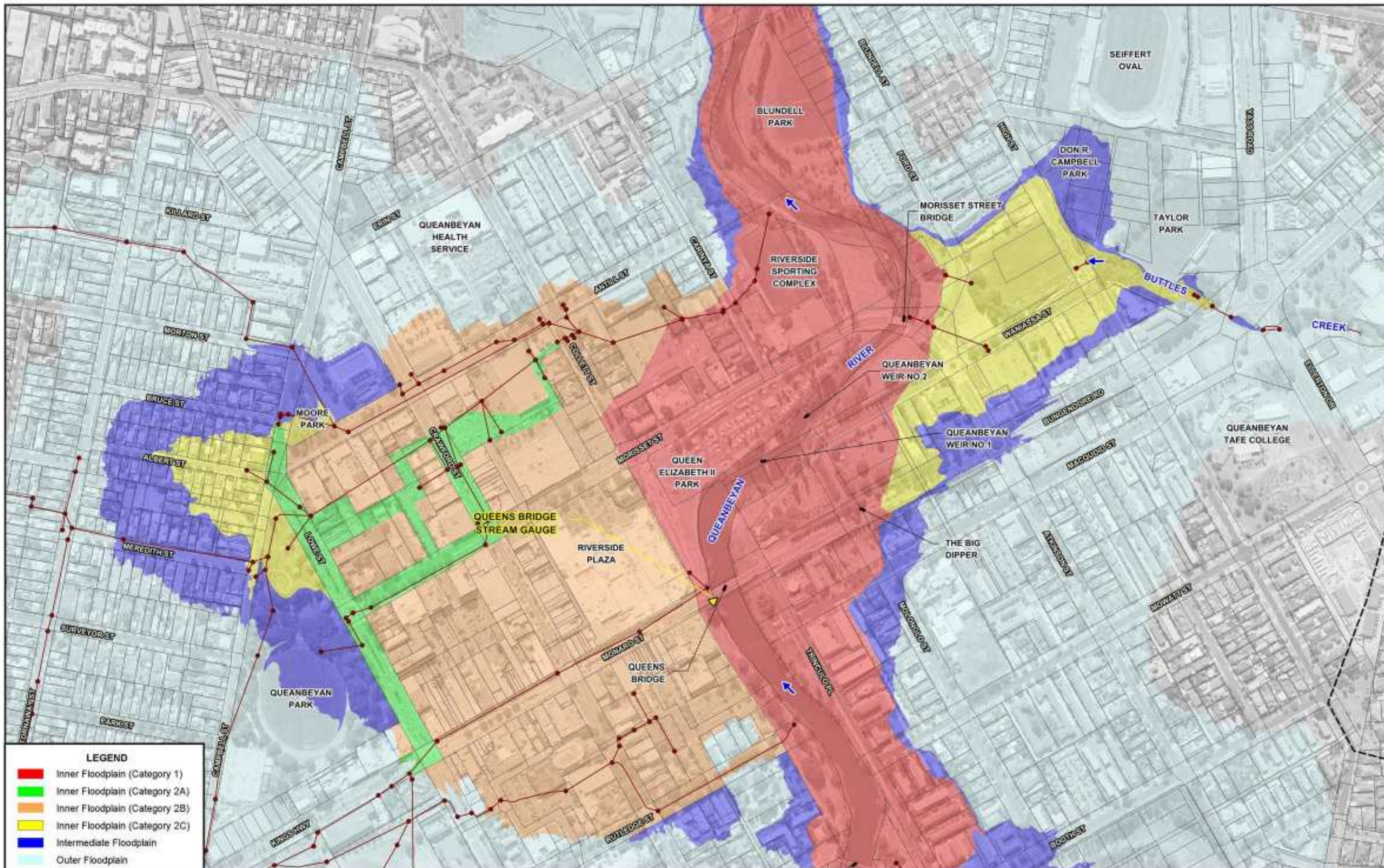
EXTRACT OF FLOOD PLANNING MAP AT QUEANBEYAN



**QUEANBEYAN FLOODPLAIN RISK
MANAGEMENT STUDY AND PLAN**

Figure E1.2
(Sheet 1 of 2)

QUEANBEYAN FLOOD HAZARD MAP



LEGEND

- Inner Floodplain (Category 1)
- Inner Floodplain (Category 2A)
- Inner Floodplain (Category 2B)
- Inner Floodplain (Category 2C)
- Intermediate Floodplain
- Outer Floodplain

Scale: 1:5,000

0 50 100 150 m

Lyll & Associates

NOTE

The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 4 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

LEGEND

- Two-Dimensional Model Boundary
- Modelled Stormwater Drainage System
- Stream Gauge

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure E1.2
(Sheet 2 of 2)

QUEANBEYAN FLOOD HAZARD MAP