I hereby give notice that an Ordinary Meeting of Council will be held on:

Date:	**Monday, 24 April 2023**
Time:	**9.15am**
Location:	**Bourke Shire Council**
	29 Mitchell Street Bourke NSW

BUSINESS PAPER

Ordinary Council Meeting

24 April 2023

Leonie Brown

General Manager

Time	Event	Representative	Organisation
9.00am	Community Open Forum for members of the public to address Council		
10.30am	Monthly Update	Inspector Peter Walton	Central North Police District

BOURKE SHIRE COUNCIL

DECLARATION OF INTEREST FORM
COUNCIL OFFICIAL

FOR USE AT COUNCIL AND COMMITTEE MEETINGS

NAME OF COUNCIL OFFICIAL DECLARING INTEREST:

ACTION PROPOSED:

Tick one box only:

☐ In my opinion, **my interest is pecuniary,** and I am therefore required to take the action specified in Part 4 of Council's Code of Conduct.

☐ In my opinion, **my interest is non-pecuniary but significant**. I am unable to remove the source of conflict. I am therefore required to treat the interest as if it were pecuniary and take the action specified in clause 5.10 of Council's Code of Conduct.

☐ In my opinion, **my interest is non-pecuniary and less than significant.** I therefore make this declaration as I am required to do pursuant to clause 5.11 of Council's Code of Conduct. However, I intend to continue to be involved with the matter.

COUNCIL OFFICIAL

I, ____(name of COUNCIL OFFICIAL) disclose the above interest and acknowledge that I will take appropriate action as I have indicated above.

Signed: Date:

GENERAL MANAGER – required for all declarations:

I have noted the above declaration and I note your opinion and/or the action you have proposed.

Signed: Date:

DEFINE YOUR INTEREST:

Is your interest:

☐ Pecuniary (see dealing with pecuniary interests)?

☐ Non pecuniary (see dealing with non–pecuniary interests)

MATTER IN WHICH YOU HAVE AN INTEREST: (Please provide full details, including item number on Council agenda)

NAME OF THE INTEREST:

Be specific and include information such as:

- The names of any person or organisation with which you have a relationship;
- The nature of your relationship with the person or organisation:
- The reason(s) why you consider the situation may (or may be perceived to) give rise to a conflict between your personal interests and your public duty as a COUNCIL OFFICIAL .

MANAGING LESS THAN SIGNIFICANT NON-PECUNIARY INTERESTS:
Clause 5.11 of Council's Code of Conduct provides that if you determine that a non-pecuniary conflict of interest is less than significant and does not require further action, you must provide an explanation of why you consider that conflict does not require further action in the circumstances.
IS YOUR NON-PECUNIARY INTEREST LESS THAN SIGNIFICANT?
If you are of the view that your non-pecuniary interest is less than significant, please provide your explanation directly below (only complete if you are claiming that your non-pecuniary interest is less than significant).
DEFINITIONS:
A **PECUNIARY INTEREST** is an interest that a designated person has in a matter because of a reasonable likelihood or expectation of appreciable financial gain or loss to the person (see Part 4 of Council's Code of Conduct). A **NON-PECUNIARY INTEREST** is a private or personal interest that does not amount to pecuniary interest as defined by Part 5 of Council's Code of Conduct.
MANAGING PECUNIARY INTERESTS:
Part 4.10 of Council's Code of Conduct requires designated persons to declare in writing to the General Manager the nature of a pecuniary interest the person has in any Council matters, as soon as practicable after becoming aware of the interest.
MANAGING SIGNIFICANT NON-PECUNIARY INTERESTS:
Clause 5.10 of Council's Code of Conduct provides that you must manage a significant non-pecuniary interest by not participating in consideration of, or decision making in relation to, the matter in which you have the significant non-pecuniary conflict of interest and the matter being allocated to another person for consideration or determination, or if the significant non-pecuniary conflict of interest arises in relation to a matter under consideration at a council or committee meeting, by managing the conflict of interest as if you had a pecuniary interest in the matter by complying with clauses 4.28 and 4.29 of the Code.
MANAGING NON-PECUNIARY INTERESTS:
Clause 5.8 of Council's Code of Conduct states that how you manage a non-pecuniary interest will depend on whether or not it is significant. Clause 5.9 of Council's Code of Conduct states that, as a general rule, a non-pecuniary conflict of interests will be significant where a matter does not raise a pecuniary interest but involves:- a) a relationship between a council official and another person who is affected by a decision or a matter under consideration that is particularly close, such as a current or former spouse or de facto partner, a relative for the purposes of clause 4.4 of the Code or another person from the council official's extended family that the council official has a close personal relationship with, or another person living in the same household; b) other relationships with persons who are affected by a decision or a matter under consideration that are particularly close, such as friendships and business relationships. Closeness is defined by the nature of the friendship or business relationship, the frequency of contact and the duration of the friendship or relationship; c) an affiliation between the council official and an organisation (such as a sporting body, club, religious, cultural or charitable organisation, corporation or association) that is affected by a decision or a matter under consideration that is particularly strong. The strength of a council official's affiliation with an organisation is to be determined by the extent to which they actively participate in the management, administration or other activities of the organisation; d) membership, as the council's representative, of the board or management committee of an organisation that is affected by a decision or a matter under consideration, in circumstances where the interests of the council and the organisation are potentially in conflict in relation to the particular matter; e) a financial interest (other than an interest of a type referred to in clause 4.6 of the Code) that is not a pecuniary interest for the purposes of clause 4.1of the Code; f) the conferral or loss of a personal benefit other than one conferred or lost as a member of the community or a broader class of people affected by a decision.

Statement of ethical obligations

In accordance with Councils adopted Code of Meeting Practice (Clause 3.23), Councillors are reminded of their Oath or Affirmation of Office made under section 233A of the Local Government Act and their obligations under the Council's Code of Conduct to disclose and appropriately manage conflicts of interest.

Order Of Business

1 OPENING PRAYER

2 ACKNOWLEDGEMENT OF COUNTRY

3 REMEMBRANCE

4 APOLOGIES AND APPLICATIONS FOR LEAVE OF ABSENCE

5 ATTENDANCE BY AUDIO VISUAL LINK BY COUNCILLORS

6 DISCLOSURES OF INTEREST

7 MAYORAL MINUTE

7.1 MAYORAL MINUTE - MAYORAL ACTIVITIES

File Number: **M2.1**

Author: **Barry Hollman, Mayor**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

The Activites of the Mayor from 22 March 2023 to 18 April 2023 are as follows:

Date	Meeting	Location
24/03/2023	Meeting with Ken Harrison and Simon Davis – Resilience NSW	Council Chambers
27/03/2023	Bourke Shire Council Meeting	Council Chambers
31/03/2023	FNWJO Board Meeting	Conference Room via AV Link
09/04/2023	Bourke Picnic Races	Renshaw Complex
12/04/2023	Funeral Archie Harland	Bourke Cemetery

Recommendation

That the information in the Mayoral Minute – Mayoral Activities as presented to Council on Monday, 24 April 2023 be noted.

8 STARRING OF ITEMS

9 CONFIRMATION OF MINUTES

Ordinary Council Meeting - 27 March 2023

BOURKE
SHIRE
COUNCIL

MINUTES

Ordinary Council Meeting

27 March 2023

Order Of Business

MINUTES OF SHIRE OF BOURKE
ORDINARY COUNCIL MEETING
HELD AT THE BOURKE SHIRE COUNCIL, 29 MITCHELL STREET BOURKE NSW
ON MONDAY, 27 MARCH 2023 AT 9.15AM

PRESENT: Cr Barry Hollman (Mayor), Cr Victor Bartley, Cr Sarah Barton, Cr Lachlan Ford (Deputy Mayor), Cr Sally Davis, Cr Cec Dorrington, Cr Sam Rice, Cr Grace Ridge (via a-v Link), Cr Nathan Ryan, Cr Robert Stutsel

IN ATTENDANCE: Leonie Brown (General Manager), Paul Flanagan (Manager Roads Services), Melanie Milgate (Economic Development Manager), Mark Riley, (Manager Special Projects – via a-v Link), Dwayne Willoughby (Manager Environmental Services), Margo Anderson (Executive Assistant – Minutes)

1 OPENING PRAYER

The Mayor opened the meeting with a prayer

2 ACKNOWLEDGEMENT OF COUNTRY

The Mayor then provided an Acknowledgment of Country

3 REMEMBRANCE

Council stood in silence in the memory of the following recently deceased:

Joshua Browne Robert Campbell Jill McInerney Estelle West

4 APOLOGIES AND APPLICATIONS FOR LEAVE OF ABSENCE

Nil

5 ATTENDANCE BY AUDIO VISUAL LINK BY COUNCILLORS

A request to attend the meeting via Audio Visual Link was received from Councillor Grace Ridge who was unable to attend the meeting due to personal reasons.

Resolution 2023/30

Moved: Cr Cec Dorrington
Seconded: Cr Sarah Barton

That Cr Grace Ridge be permitted to attend the meeting via audio-visual link due to her inability to attend in person due to personal reasons.

Carried

6 DISCLOSURES OF INTEREST

Cr Sarah Barton declared a significant non pecuniary conflict of interest in Item 7.2 of the Agenda – Mayoral Minute – General Manager Annual Leave. The reason for such interest is that Cr Barton is the daughter of Councils General Manager, which the subject report relates to. In making this declaration, Cr Barton advised that she would leave the Chamber and be out of sight during Councils consideration of Item 7.2 of the Agenda.

Cr Sarah Barton declared a significant non pecuniary conflict of interest in Item 10.1 of the Agenda – Notice of Motion of Rescission North Bourke Water Supply and Item 10.2 Notice of Motion - North Bourke Water Supply. The reason for such interest is that Cr Barton is the niece of Mr Warren Hand, who Council is proposing that the filtered water supply in North Bourke be extended to his property. In making this declaration, Cr Barton advised that she would leave the Chamber and be out of sight during Councils consideration of Items 10.1 and 10.2 of the Agenda.

Cr Cec Dorrington declared a significant non pecuniary conflict of interest in Item 10.1 of the Agenda – Notice of Motion of Rescission North Bourke Water Supply and Item 10.2 Notice of Motion - North Bourke Water Supply. The reason for such interest is that Mrs Susanne Hand is Cr Dorrington’s daughter, with Mr Warren Hand being his son in law. In making this declaration, Cr Dorrington advised he would leave the Chamber and be out of sight during Councils consideration of Item 10.1 and 10.2 of the Agenda.

Councils General Manager, Mrs Leonie Brown, declared a significant non pecuniary conflict of interest in Item 10.1 of the Agenda – Notice of Motion of Rescission North Bourke Water Supply and Item 10.2 Notice of Motion - North Bourke Water Supply. The reason for such interest is that Mr Warren Hand, named in the rescission motion and who Council is proposing in the motion that the filtered water supply in North Bourke be extended to his property, is the brother of Mrs Brown. In making this declaration, Mrs Brown advised she would leave the Chamber and be out of sight during Councils consideration of Items 10.1 and 10.2 of the Agenda.

Cr Sally Davis declared a pecuniary conflict of interest in Item 12.1 of the Agenda – Business Arising, North Bourke Storm Water Drainage and Item 22.1 - North Bourke Storm Water Drainage. The reason for such interest is that Cr Davis and her husband own land adjacent to the land the subject of the reports and is in discussion with Council regarding a potential sale of a portion of such land. In addition, she has a friendship with the landowner (Mr G Seiler). In making these declarations, Cr Davis advised she would leave the Chamber and be out of sight should Council separately consider Item 12.1 of the Agenda and that she would leave the Chamber and be out of sight during Councils consideration of Item 22.1 of the Agenda.

Cr Grace Ridge declared a pecuniary conflict of interest in Item 12.1 of the Agenda – Business Arising, North Bourke Storm Water Drainage and Item 22.1 - North Bourke Storm Water Drainage. The reason for such interest is that Cr Ridge and her family have a business relationship with the owner of the land detailed within the report. In making this declaration Cr Ridge advised that she would turn off her a-v link, and be out of sight should Council separately consider Item 12.1 of the Agenda and that she would turn off her a-v link, and be out of sight during Councils consideration of Item 22.1 of the Agenda.

7 MAYORAL MINUTE

7.1 MAYORAL MINUTE - MAYORAL ACTIVITIES

File Number: M2.1

The Council had before it the report of the Mayor regarding the Mayoral Minute - Mayoral Activities.

Resolution 2023/31

Moved: Cr Barry Hollman

That the information in the Mayoral Minute – Mayoral Activities as presented to Council on Monday, 27 March 2023 be noted.

Carried

At this juncture, Cr Sarah Barton left the meeting, the time being 9:25 am.

7.2 *** MAYORAL MINUTE - GENERAL MANAGER ANNUAL LEAVE

File Number: A3.8, S6.24

The Council had before it the report of the Mayor regarding the Mayoral Minute - General Manager Annual Leave.

Resolution 2023/32

Moved: Cr Barry Hollman

1. **That Mr Ross David Earl be appointed as General Manager, Bourke Shire Council for the period 25 April 2023 to 24 May 2023, inclusive, in the absence of Councils General Manager, Mrs Leonie Brown, whilst on annual leave.**
2. **That the Instrument of Delegation as provided by Council to Mrs Leonie Catherine Brown effective 4 July 2022 be provided to Mr Ross David Earl during his term of General Manager for the period 25 April 2023 to 24 May 2023, inclusive.**
3. **That the Mayor and General Manager be authorised to finalise the relevant details of Mr Earl's short-term tenure.**

Carried

At this juncture, Cr Sarah Barton returned to the meeting, the time being 9:27 am.

8 STARRING OF ITEMS

Council's Code of Meeting Practice provides that Council may at any time, resolve to adopt multiple items of business on the agenda by way of a single resolution.

In this regard the Council had before it a list of reports, unstarred, with such items proposed to be adopted by Council in a single resolution.

Resolution 2023/33

Moved: **Cr Sally Davis**
Seconded: **Cr Sam Rice**

That the the recommendations as detailed in the un-starred items as contained in the agenda for the Ordinary Meeting of Council, held on Monday, 27 March 2023 be adopted.

Carried

9 CONFIRMATION OF MINUTES

Resolution 2023/34

Moved: **Cr Cec Dorrington**
Seconded: **Cr Lachlan Ford**

That the minutes of the Ordinary Council Meeting held on 27 February 2023 be taken as read, confirmed as correct minutes and signed by the Mayor and the General Manger.

Carried

At this juncture, Cr Sarah Barton, Cr Cec Dorrington and the General Manager left the meeting, the time being 9:30 am.

10 RESCISSION MOTIONS

10.1 *** NOTICE OF MOTION OF RESCISSION - NORTH BOURKE WATER SUPPLY

File Number: **W2.1**

The Council had before it the report of the General Manager regarding the Notice of Motion of Rescission - North Bourke Water Supply.

Resolution 2023/35

Moved: **Cr Robert Stutsel**
Seconded: **Cr Lachlan Ford**

That the following resolution, being Clause six (6) only of Item 5.1 - North Bourke Water Supply (Resolution 2023/2) of the meeting of the North Bourke Water Extension Request Committee held on 14 March 2023 be rescinded:

6. **That Mr Warren and Mrs Susanne Hand be permitted to access the filtered water supply running past their property in accordance with Bourke Shire Council Policy Number 3.7.10, provided that they have the written permission from the Bourke Abattoir owner / operators.**

Carried

11 NOTICES OF MOTION

11.1 *** NOTICE OF MOTION - NORTH BOURKE WATER SUPPLY

File Number: W2.1

The Council had before it the report of the General Manager regarding the Notice of Motion - North Bourke Water Supply.

Resolution 2023/36

Moved: Cr Sally Davis
Seconded: Cr Lachlan Ford

That Mr Warren and Mrs Susanne Hand be advised that Council concurs with the connection of a 20mm water supply service to their property , Virginia Farm, 985 Mitchell Highway, North Bourke, on the basis of such supply being sourced from Councils filtered water main that runs on the eastern side of the Mitchell Highway, North Bourke and on the basis of them making an application and accepting a quotation from Council to undertake the works to connect to such supply via a pipe under the Highway to a nominated point at their front boundary, as per Councils Rural Water Supply Policy (Policy No 3.7.10), which requires in part:

- **The capital works being undertaken at no cost to Council and the total cost of the scheme proposed is prepaid to Council prior to Council carrying out the work.**
- **All new owners agreeing to pay Water Headworks contributions to cover augmentation of major capital items such as treatment works, reservoirs, pumps and rising mains relatively remote from the Scheme area.**
- **The connection shall be for domestic purposes only.**
- **That all internal plumbing be carried out by a licensed plumber in accordance with the provisions of the Local Government (General) Regulation 2005 and that all such works be inspected and tested by officers of Council prior to the covering of the works.**
- **The design and construction of any water main to service properties complying with Council's current policies.**

Carried

At this juncture, Cr Sarah Barton, Cr Cec Dorrington and the General Manager returned to the meeting, the time being 9:36 am.

12 BUSINESS ARISING

12.1 CALENDAR OF EVENTS

File Number: C12.6

The Council had before it the report of the General Manager regarding the Calendar of Events.

Resolution 2023/37

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

That the information in the Calendar of Events Report as presented to Council on Monday, 27 March 2023 be noted.

Carried

12.2 INFORMATION TO COUNCILLORS

File Number: C12.1

The Council had before it the report of the General Manager regarding the Information to Councillors.

Resolution 2023/38

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

That the contents of the Information to Councillors Report as presented to Council on Monday, 27 March 2023 be noted.

Carried

12.3 *** BUSINESS ARISING

File Number: C12.1

The Council had before it the report of the General Manager regarding the Business Arising.

Resolution 2023/39

Moved: Cr Victor Bartley
Seconded: Cr Sam Rice

That the information in the Business Arising Report as presented to Council on Monday, 27 March 2023 be noted.

Carried

13 ENGINEERING SERVICES DEPARTMENT

13.1 *** REVISED STREET TREE POLICY

File Number: T6.2

The Council had before it the report of the Manager Works regarding the Revised Street Tree Policy.

Resolution 2023/40

Moved: Cr Robert Stutsel
Seconded: Cr Sarah Barton

That Councils revised Street Tree Policy (Policy No: 3.6.11(v4)) as submitted to Council on Monday, 27 March 2023 be adopted.

Carried

14 ENVIRONMENTAL SERVICES & DEVELOPMENT DEPARTMENT

14.1 LOCAL PROVISION DRAFT PLANNING PROPOSAL

File Number: T5.1

The Council had before it the report of the Manager Environmental Services regarding the Local Provision Draft Planning Proposal.

Resolution 2023/41

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

1. **That Council support the Planning Proposal attached as Appendix A to undertake an Amendment to the Bourke Local Environmental Plan 2012 as follows:**

    a. **Permit with consent, development for the purposes of business premises and office premises in the R1 General Residential zone.**
    b. **Restrict proposed development to the confines of an existing dwelling house or for new development, to a gross floor area of 250m2.**
    c. **Rezone land at Lot 62 DP 1027306, No. 68B Sid Coleman Drive, North Bourke from SP2 (Air Transport Facility) to IN1 General Industrial.**
2. **That Council exercise their delegation under Section 3.36 of the Environmental Planning and Assessment Act, 1979 and request that NSW Parliamentary Counsel's Office draft the new Plan.**
3. **That Council request that the NSW Department of Planning and Environment to prepare the mapping associated with the proposed Amendment to the Bourke Local Environmental Plan 2012.**
4. **That Council request the final Amendment be notified on the NSW Legislation website.**

Carried

15 GENERAL MANAGER

15.1 *** CAMPING & CARAVAN USAGE - MITCHELL HIGHWAY ROAD RESERVE AND NORTH BOURKE BOAT RAMP CROWN RESERVE

File Number: L1.9

The Council had before it the report of the General Manager regarding the Camping & Caravan Usage - Mitchell Highway Road Reserve and North Bourke Boat Ramp Crown Reserve.

Motion

Moved: Cr Cec Dorrington
Seconded: Cr Sam Rice

1. **That the information in respect of the potential usage of the Polygonum Swamp Road be noted.**
2. **That Council not pursue the development of a Rest Area to allow camping on the side of the Polygonum Swamp Road.**
3. **That the No Camping and No Caravans signs be maintained to encourage Caravan and Camping users to move on to a more suitable location, where there is no risk to pedestrians, road users and themselves.**

Amendment

Moved: Cr Robert Stutsel
Seconded: Cr Victor Bartley

1. That the information in respect of the potential usage of the Polygonum Swamp Road be noted.
2. That Council not pursue the development of a Rest Area to allow camping on the side of the Polygonum Swamp Road.
3. That the No Camping and No Caravans signs be maintained to encourage Caravan and Camping users to move on to a more suitable location, where there is no risk to pedestrians, road users and themselves.
4. That if funding is an issue, then allowances be made in future budgets for the construction to proceed and that, as it would be the only Non-Truck Rest Area in the vicinity of Bourke , that Transport for NSW be approached to fund the project.

In accordance with Clause 10.11 of Councils Code of Meeting Practice, the Mayor deemed the amendment to be a direct negative of the original motion and ruled the amendment out of order and as per Clause 10.8 of the Code, the amendment was taken to have been lost.

Resolution 2023/42

Moved: Cr Cec Dorrington
Seconded: Cr Sam Rice

1. **That the information in respect of the potential usage of the Polygonum Swamp Road be noted.**
2. **That Council not pursue the development of a Rest Area to allow camping on the side of the Polygonum Swamp Road.**
3. **That the No Camping and No Caravans signs be maintained to encourage Caravan and**

Camping users to move on to a more suitable location, where there is no risk to pedestrians, road users and themselves.

Carried

Councillor Robert Stutsel requested that his vote against the Motion be recorded.

15.2 *** SALE OF LAND FOR UNPAID RATES IN ACCORDANCE WITH SECTION 713 OF THE LOCAL GOVERNMENT ACT 1993

File Number: R2.21

The Council had before it the report of the General Manager regarding the Sale of Land for Unpaid Rates in accordance with Section 713 of the Local Government Act 1993.

Resolution 2023/43

Moved: Cr Sally Davis
Seconded: Cr Lachlan Ford

1. **That the report regarding the Sale of Land for unpaid rates and charges be received and information contained therein be noted.**
2. **That a further report be provided to Council once all costs are known and the sales finalised.**

Carried

15.3 *** PURCHASE AND CLASSIFICATION OF 54 MERTIN STREET, BOURKE

File Number: R2.10

The Council had before it the report of the General Manager regarding the Purchase and Classification of 54 Mertin Street, Bourke.

Resolution 2023/44

Moved: Cr Cec Dorrington
Seconded: Cr Sam Rice

1. **That Council endorse the acquisition of Lot 1 DP 910329, 54 Mertin St, Bourke at a purchase price of $5,000.00.**
2. **That in accordance with the provisions of the *Local Government Act 1993*, Council proceed to give 28 days' public notice of its proposed resolution to classify Lot 1 DP 910329, 54 Mertin St, Bourke as Operational Land.**
3. **That following such public notice, a further report be submitted to Council on the proposed land classification.**
4. **That any necessary documents be executed under the Common Seal of Council.**

Carried

16 CORPORATE SERVICES DEPARTMENT

16.1 *** BANK RECONCILIATION & STATEMENT OF BANK BALANCES - FEBRUARY 2023

File Number: **F1.1**

The Council had before it the report of the Manager Corporate Services regarding the Bank Reconciliation & Statement of Bank Balances - February 2023.

Resolution 2023/45

Moved: **Cr Victor Bartley**
Seconded: **Cr Sam Rice**

That the Certificate of Reconciliation of the Cash Book for all funds of the Council and the Statement of Bank Balances as at 28 February 2023 be noted.

Carried

16.2 *** INVESTMENT REPORT AS AT 28 FEBRUARY 2023

File Number: **F1.1**

The Council had before it the report of the Manager Corporate Services regarding the Investment Report as at 28 February 2023.

Resolution 2023/46

Moved: **Cr Cec Dorrington**
Seconded: **Cr Lachlan Ford**

1. **That the report regarding Council's Investment Portfolio 28 February 2023 be received and noted.**
2. **That the Certificate of the Responsible Accounting Officer be noted, and the report adopted.**

Carried

16.3 *** 2023/2024 DRAFT OPERATIONAL PLAN

File Number: P4.1

The Council had before it the report of the Manager Corporate Services regarding the 2023/2024 Draft Operational Plan.

Resolution 2023/47

Moved: Cr Cec Dorrington
Seconded: Cr Sam Rice

1. **That the report of the Manager of Corporate Services detailing an overview of the 2023/2024 Draft Operational Plan be noted.**
2. **That Councils 2023/2024 Draft Operational Plan be adopted for the purpose of public exhibition from Monday, 3 April 2023 until 5.00pm Monday, 1 May 2023 in accordance with *Section 405 (3) of the Local Government Act.***
3. **That all submissions received be tabled at the 22 May Ordinary Meeting of Council, for consideration prior to Councils Operational Plan for 2023/2024 being determined.**

Carried

16.4 *** 2023/2024 PLANT REPLACEMENT SCHEDULE

File Number: P3.1-P4.2

The Council had before it the report of the Manager Corporate Services regarding the 2023/2024 Plant Replacement Schedule.

Resolution 2023/48

Moved: Cr Victor Bartley
Seconded: Cr Lachlan Ford

That the Plant Replacement Schedule as detailed be included in the 2023/2024 Draft Operational Plan.

Carried

16.5 *** 2023/2024 FEES AND CHARGES

File Number: F1.2, P4.2

The Council had before it the report of the Manager Corporate Services regarding the 2023/2024 Fees and Charges.

Resolution 2023/49

Moved: Cr Lachlan Ford
Seconded: Cr Victor Bartley

That Council adopt the 2023/2024 Fees and Charges Report, as attached, for inclusion in the 2023/2024 Draft Operational Plan.

Carried

16.6 *** 2023/2024 LOAN SCHEDULE

File Number: P4.2

The Council had before it the report of the Manager Corporate Services regarding the 2023/2024 Loan Schedule.

Resolution 2023/50

Moved: Cr Cec Dorrington
Seconded: Cr Lachlan Ford

1. **That Council borrow up to $993,000.00 in the 2023/2024 financial year to fund the projects as listed.**
2. **That as per Section 230 of the Local Government (General) Regulation 2021, the General Manager take the necessary action, in due course, to notify the Executive Director of the Office of Local Government, Department of Planning and Environment of a borrowing under a loan contract within 7 days of the borrowing.**

Carried

16.7 *** SALE OF ASSETS TO BE CONDUCTED BY COUNCIL

File Number: A11.1.1

The Council had before it the report of the Manager Corporate Services regarding the Sale of Assets to be Conducted by Council.

Resolution 2023/51

Moved: Cr Sam Rice
Seconded: Cr Cec Dorrington

That the sale of listed plant for inclusion in the 2023/2024 Draft Operational Plan be approved.

Carried

16.8 *** STATEMENT OF REVENUE POLICY

File Number: P4.2

The Council had before it the report of the Manager Corporate Services regarding the Statement of Revenue Policy.

Resolution 2023/52

Moved: Cr Sally Davis
Seconded: Cr Sarah Barton

1. **That Council note the Draft Revenue Policy for 2023/2024.**
2. **That Council adopts a filtered water price of $2.40/KL for the 2023/2024 rating period while maintaining the set increase of 4% in all water access charges.**
3. **That Council adopts an increase of 4% in Sewerage Rates & Charges for the 2023/2024 rating period.**
4. **That Council adopt the maximum interest rate as provided by the Office of Local Government under section 566 (3) of the *Local Government Act*, once received.**
5. **That Council adopts the Domestic Waste Management Charges as detailed and include in the Draft Operational Plan 2023/2024.**
6. **That Council adopt the Schedule of Rates and Charges for inclusion in the Draft Operational Plan 2023/2024.**

Carried

17 ECONOMIC DEVELOPMENT DEPARTMENT

Nil

18 DELEGATES AND COUNCILLORS REPORTS

Nil

19 POLICIES

Nil

20 PRÉCIS OF CORRESPONDENCE

Nil

21 ACTIVITY REPORTS

21.1 ENGINEERING SERVICES - ROAD WORKS AND WORKSHOP - WORKS UNDERTAKEN

File Number: E7.1

The Council had before it the report of the Manager Roads regarding the Engineering Services - Road Works and Workshop - Works Undertaken.

Resolution 2023/53

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

That Council note the information in the Roads Department Road Works and Workshop Activity Report as presented to Council on Monday, 27 March 2023.

Carried

21.2 PARKS & GARDENS / TOWN SERVICES / WATER & WASTE WATER ENGINEERING SERVICES ACTIVITY REPORT

File Number: E7.1

The Council had before it the report of the Manager Works regarding the Parks & Gardens / Town Services / Water & Waste Water Engineering Services Activity Report.

Resolution 2023/54

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

That Council note the information in the Parks and Gardens, Town Services and Water and Wastewater Engineering Services Department Activity Reports as presented to Council on Monday, 27 March 2023.

Carried

21.3 PLANNING, REGULATORY & ENVIRONMENTAL SERVICES - ACTIVITY REPORT

File Number: D3.1-A11.1-A8.1-S10.1

The Council had before it the report of the Manager Environmental Services regarding the Planning, Regulatory & Environmental Services - Activity Report.

Resolution 2023/55

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

That the information in the Planning, Regulatory & Environmental Services Activity Report as presented to Council on Monday, 27th March 2023 be received and noted.

Carried

21.4 GENERAL MANAGER'S ACTIVITY REPORT

File Number: G2.1

The Council had before it the report of the General Manager regarding the General Manager's Activity Report.

Resolution 2023/56

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

That the information in the General Manager's Activity Report as presented to Council on Monday, 27 March 2023 be noted.

Carried

21.5 LIBRARY MANAGER'S ACTIVITY REPORT FOR FEBRUARY 2023

File Number: L4.1

The Council had before it the report of the Library Manager regarding the Library Manager's Activity Report for February 2023.

Resolution 2023/57

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

That the information in the Library Manager's Report for February 2023 as presented to Council on Monday, 27 March 2023 be noted.

Carried

21.6 TOURISM AND EVENTS REPORT

File Number: T4.3

The Council had before it the report of the Coordinator Tourism Operations regarding the Tourism and Events Report.

Resolution 2023/58

Moved: Cr Sally Davis
Seconded: Cr Sam Rice

That the information in the Tourism and Events Managers Report for February 2023 as presented to Council on Monday, 27 March 2023 be noted.

Carried

22 CLOSED SESSION

At this juncture, the Council gave consideration to moving into Closed Session of Council.

Resolution 2023/59

Moved: Cr Cec Dorrington
Seconded: Cr Victor Bartley

That Council considers the confidential report(s) listed below in a meeting closed to the public in accordance with Section 10A(2) of the Local Government Act 1993:

22.1 * North Bourke Stormwater Drainage**

This matter is considered to be confidential under Section 10A(2) - (g) of the Local Government Act, and the Council is satisfied that discussion of this matter in an open meeting would, on balance, be contrary to the public interest as it deals with advice concerning litigation, or advice as comprises a discussion of this matter, that would otherwise be privileged from production in legal proceedings on the ground of legal professional privilege.

22.2 Tender 04/23 - Bourke Memorial Swimming Pool Front of House Entry Building

This matter is considered to be confidential under Section 10A(2) - (d)(i) of the Local Government Act, and the Council is satisfied that discussion of this matter in an open meeting would, on balance, be contrary to the public interest as it deals with commercial information of a confidential nature that would, if disclosed prejudice the commercial position of the person who supplied it.

Carried

Council proceeded into closed session with the livestreaming of the meeting being paused at 11.06am.

At this juncture, Cr Sally Davis and Cr Grace Ridge left the meeting, the time being 11:07am.

22.1 *** NORTH BOURKE STORMWATER DRAINAGE

File Number: D6.1, D6.2, V1.6

The Council had before it the report of the Manager Special Projects regarding the North Bourke Stormwater Drainage.

Resolution 2023/60

Moved: Cr Cec Dorrington
Seconded: Cr Robert Stutsel

1. **That the Mayor and General Manager be requested to undertake final negotiations with Mr Rob and Mrs Sally Davis in respect of the acquisition of some 2.21ha of their land fronting Warrego St, North Bourke for the purpose of constructing a stormwater detention basin thereon, for a final report to Council.**
2. **That on the basis of Council resolving to formally acquire such land, the General Manager be requested to take the necessary action that would result in the construction of a stormwater detention basin and required infrastructure on such land, in general conformity with the concept plan developed by Premise dated 10 February 2023 designed to accommodate a 1:100 year rainfall event for this area.**
3. **That the opinion as expressed in the Expert Report prepared by Engineering Investigations and Solutions in regard to the residence of Mr G and Mrs C Seiler be noted.**
4. **That Council not pursue the purchase of the Seiler property located in Namoi St, North Bourke.**
5. **That Councils Solicitor, Insurer and Mr G Seiler be advised accordingly.**
6. **That any necessary documents be executed under the Common Seal of Council.**
7. **That the documents and considerations in respect of this matter remain confidential to Council.**

Carried

At this juncture, Cr Sally Davis and Cr Grace Ridge returned to the meeting, the time being 11:09 am.

22.2 *** TENDER 04/23 - BOURKE MEMORIAL SWIMMING POOL FRONT OF HOUSE ENTRY BUILDING

File Number: S10.1

The Council had before it the report of the Manager Environmental Services regarding the Tender 04/23 - Bourke Memorial Swimming Pool Front of House Entry Building.

Resolution 2023/61

Moved: Cr Lachlan Ford
Seconded: Cr Robert Stutsel

1. **That the tender of Lukas Building and Construction for the upgrade of the kiosk at the Bourke Swimming in the amount of $1,118,423.00 (Ex GST) be accepted.**
2. **That any necessary documents be executed under the Common Seal of Council.**
3. **That the documents and considerations in respect of this matter remain confidential to Council.**

Carried

Resolution 2023/62

Moved: Cr Sam Rice
Seconded: Cr Cec Dorrington

That Council moves out of Closed Council into Open Council.

Carried

Open council resumed at 11.15am.

RESOLUTIONS FROM CLOSED SESSION OF COUNCIL

At the request of the Mayor, the General Manager read to the meeting the Councils resolutions as determined in the Closed Session of Council.

The Meeting closed at 11.17am.

The minutes of this meeting were confirmed at the Ordinary Council Meeting held on 24 April 2023.

....

CHAIRPERSON

10 RESCISSION MOTIONS

Nil

11 NOTICES OF MOTION

11.1 *** NOTICE OF MOTION - WATER SECURITY FOR BOURKE ABATTOIR

File Number: **A1.1, W2.2.3**

Attachments: **1. Notice of Motion - Water Security for Bourke Abattoir ⇩**

I, Councillor Lachlan Ford, give notice that at the next Ordinary Meeting of Council to be held on 24 April 2023, I intend to move the following motion:

That it be Council Policy that no access be made available to either business or members of the public to the 50mm raw water supply line or the 150mm filtered water supply line that both extend from the Bourke Water Treatment Plant, via North Bourke , to the Bourke Abattoir North Bourke, other than to provide water supplies to the abattoir itself at the abattoir site.

Background

The Bourke Abattoir is a major economic development initiative for Bourke. Following the receipt of Federal Government Funding, Council undertook the installation of water infrastructure to supply the abattoir with both 1ML of filtered (potable) water and 0.25ML of raw water per working day (5 working days per week). This equates to a supply of some 250ML of filtered water per annum and a further 62.5ML of raw water per annum. The provision of any access to these water mains to users other than the abattoir could diminish Councils ability to supply the abattoir with its required water supplies via these Council owned water mains. Hence the purpose of the Motion is to clarify that the subject water mains are only to supply water to the Abattoir.

Motion

That it be Council Policy that no access be made available to either business or members of the public to the 50mm raw water supply line or the 150mm filtered water supply line that both extend from the Bourke Water Treatment Plant, via North Bourke , to the Bourke Abattoir North Bourke, other than to provide water supplies to the abattoir itself at the abattoir site.

11 April 2023

The General Manager
Bourke Shire Council
Mitchell St,
Bourke NSW 2840

Dear Leonie,

Notice of Motion

I would like to place the following Notice of Motion on the agenda for the 24 April 2023 Ordinary meeting of Council:

> *That it be Council Policy that no access be made available to either businesses or members of the public to the 50mm raw water supply line or the 150mm filtered water supply line that both extend from the Bourke Water Treatment Plant, via North Bourke, to the Bourke Abattoir North Bourke, other than to provide water supplies to the abattoir itself at the abattoir site.*

Background

The Bourke Abattoir is a major economic development initiative for Bourke. Following the receipt of Federal Government Grant Funding, Council undertook the installation of water infrastructure to supply the abattoir with both 1ML of filtered (potable) water and 0.25ML of raw water per working day (5 working days a week). This equates to a supply of some 250ML of filtered water per annum and a further 62.5ML of raw water per annum. The provision of any access to these water mains to users other than the abattoir could diminish Councils ability to supply the abattoir with its required water supplies via these Council owned water mains. Hence the purpose of the Motion is to clarify that the subject water mains are only to supply water to the Abattoir.

Your faithfully,

Councillor Lachlan Ford

11.2 *** NOTICE OF MOTION - AGE OF CRIMINAL RESPONSIBILITY

File Number: **C8.9.3, C8.9.13**

Attachments: **1. Notice of Motion - Age of Criminal Responsibility** ⇩

Councillor Victor Bartley and Councillor Robert Stutsel gave notice of their intention to move the following motion at the next Ordinary Meeting of Council to be held on 24 April 2023.

That Council write to the Prime Minister, the Hon Anthony Albanese MP, Federal Minister for Indigenous Australians, the Hon Linda Burney MP, the NSW Premier, the Hon Chris Minns MP, the NSW Attorney General – the Hon Michael Daley MP, the NSW Leader of the Opposition, the NSW Shadow Attorney-General and the Member for Barwon – Mr Roy Butler MP, expressing Council's absolute opposition to an increase in the age of criminal responsibility from ten years to fourteen year's.

Supporting Information

Circa 1970, the "age of criminal responsibility" was eight years of age. Since that time children generally have had the benefit of readily available television etc that ought to have overcome any lapses in parenting and social awareness.

One could make a case for changing the age back to eight years because when a child commits a crime at that age, there is a remote chance that they can be rehabilitated whereas if committing crime from age eight to age fourteen, there is virtually no chance whatsoever of redemption.

We should bear in mind that virtually each "offender", in the Bourke context, is a **victim** of a poor upbringing and court intervention might provide some hope for the child that has not been addressed by Youth and Community Services.

The Federal Minister for Indigenous Australians is pushing for an Australia wide "age of criminal responsibility" of fourteen (14) years.

Scuttlebutt or mischievous supporters of an increase say, "you don't want ten year old's thrown in gaol". The "age of criminal responsibility" does not automatically infer that offenders will be gaoled [detained] but is rather a process for children to be called to account for their actions.

Juvenile crime in Bourke is "managed" to a degree but in reality, it is definitely not controlled and millions of dollars are spent each year trying "Band-Aid" solutions. Likewise, juvenile crime is out of control in all of Australia and increasing the age will only exacerbate the existing problems.

Motion

That Council write to the Prime Minister, the Hon Anthony Albanese MP, Federal Minister for Indigenous Australians, the Hon Linda Burney MP, the NSW Premier, the Hon Chris Minns MP, the NSW Attorney General – the Hon Michael Daley MP, the NSW Leader of the Opposition, the NSW Shadow Attorney-General and the Member for Barwon – Mr Roy Butler MP, expressing Council's absolute opposition to an increase in the age of criminal responsibility from ten years to fourteen year's.

11 April 2023

The General Manager
Bourke Shire Council
Mitchell St,
Bourke NSW 2840

Dear Leonie,

Notice of Motion

We would like to place the following Notice of Motion on the agenda for the 24 April 2023 Ordinary meeting of Council:

> **That Council write to the Prime Minister, the Hon Anthony Albanese MP, Federal Minister for Indigenous Australians, the Hon Linda Burney MP, the NSW Premier, the Hon Chris Minns MP, the NSW Attorney General – the Hon Michael Daley MP, the NSW Leader of the Opposition, the NSW Shadow Attorney-General and the Member for Barwon – Mr Roy Butler MP, expressing Council's absolute opposition to an Increase in the age of criminal responsibility from ten years to fourteen year's.**

Supporting information

Circa 1970, the "age of criminal responsibility" was eight years of age. Since that time children generally have had the benefit of readily available television etc that ought to have overcome any lapses in parenting and social awareness.

One could make a case for changing the age back to eight years because when a child commits a crime at that age, there is a remote chance that they can be rehabilitated whereas if committing crime from age eight to age fourteen, there is virtually no chance whatsoever of redemption.

We should bear in mind that virtually each "offender", in the Bourke context, is a **victim** of a poor upbringing and court intervention might provide some hope for the child that has not been addressed by Youth and Community Services.

The Federal Minister for Indigenous Australians is pushing for an Australia wide "age of criminal responsibility" of fourteen (14) years.

Scuttlebutt or mischievous supporters of an increase say "you don't want ten year olds thrown in gaol". The "age of criminal responsibility" does not automatically infer that offenders will be gaoled [detained] but is rather a process for children to be called to account for their actions.

12 BUSINESS ARISING

12.1 CALENDAR OF EVENTS

File Number: **C12.6**

Author: **Leonie Brown, General Manager**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Background

Information is sent out monthly to advise when Council Meetings, meetings which Councillors are Delegates to and other meetings of which Council is a member of, or representatives of Council, are to be held.

Current Situation

Month	Date	Time	Meeting / Event	Location
2023				
April	24	9.15am	Council Meeting	Council Chamber
May	22	9.15am	Council Meeting	Council Chamber
June	26	9.15am	Council Meeting	Council Chamber
July	24	9.15am	Council Meeting	Council Chamber
August	28	9.15am	Council Meeting	Council Chamber
September	25	9.15am	Council Meeting	Council Chamber
October (*)	23	9.15am	Council Meeting	Council Chamber
November (*)	27	9.15am	Council Meeting	Council Chamber
December (*)	18	9.15am	Council Meeting	Council Chamber

(*) Indicative date only. Council meeting dates post September 2023 will be determined by Council as part of the September 2023 Agenda relating to the election of the Mayor and Deputy Mayor.

Recommendation

That the information in the Calendar of Events Report as presented to Council on Monday, 24 April 2023 be noted.

12.2 INFORMATION TO COUNCILLORS

File Number: **C12.1**

Author: **Leonie Brown, General Manager**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Background

Each month a list of correspondence is sent out in the Business Paper to Councillors to ensure that they have not missed any information since the last Business Paper was produced.

Current Situation

Information that has been provided to Councillors for the period 21 March 2023 to 14 April 2023 follows:

Date	Information Sent	Author	Email
22/03/2023	The Weekly Newsletter, 21 March 2023	Local Government NSW	✓
22/03/2023	GMs Column for publication - 23 March 2023	Leonie Brown	✓
23/03/2023	Business Papers for the March Ordinary Council Meeting Monday, 27 March 2023	Leonie Brown	✓
23/03/2023	Business Papers for the March Closed Session Council Meeting Monday, 27 March 2023	Leonie Brown	✓
24/03/2023	Website link to Business Papers for the March Ordinary Council Meeting Monday, 27 March 2023	Leonie Brown	✓
28/03/2023	Community update on the Menindee fish death event	Department Primary Industry and Environment	✓
28/03/2023	Minutes of the March 2023 Council Meeting	Leonie Brown	✓
29/03/2023	GMs Column for publication - 30 March 2023	Leonie Brown	✓
29/03/2023	Urgent need for inquiry as farmers lose billions	NSW Farmers Association	✓
29/03/2023	The Weekly Newsletter, 28 March 2023	Local Government NSW	✓
30/03/2023	Topical stories regarding Local Government issues	Inside Local Government	✓
04/04/2023	The Weekly Newsletter, 4 April 2023	Local Government NSW	
05/04/2023	GMs Column for publication - 6 April 2023	Leonie Brown	✓
05/04/2023	Calling for Tour de OROC committee members	Mathew Dickerson (OROC)	✓
11/04/2023	Coulton's Catch Up – Monday, 10 April	Mark Coulton MP	✓
12/04/2023	GMs Column for publication – 13 April 2023	Leonie Brown	✓

Recommendation
That the contents of the Information to Councillors Report as presented to Council on Monday, 24 April 2023 be noted.

12.3 *** BUSINESS ARISING

File Number: **C12.1**

Author: **Leonie Brown, General Manager**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Background

Business outstanding from previous meetings.

Current Situation

GM GENERAL MANAGER	MW MANAGER WORKS
MCS MANAGER CORPORATE SERVICES	MRS MANAGER ROAD SERVICES
MES MANAGER ENVIRONMENTAL SERVICES	EDM ECONOMIC DEVELOPMENT MANAGER

362/2018	BIODIVERSITY CONSERVATION ACT 2016 - UPDATE
RESPONSIBLE OFFICER	DWAYNE WILLOUGHBY - MANAGER ENVIRONMENTAL SERVICES
FILE NUMBER	E6.1-E6.4-L8.1
RESOLUTION	
1. That Council undertake a review of the potential impact on the sale of land held for industrial development including obtaining specialist advice as appropriate. 2. That on finalisation of that review a further report be brought back to Council	
ACTION TAKEN	
1. Continue to lobby Government – matter evolving. 2. Issue of impact of the Biodiversity Act recently discussed at meeting of the Alliance of Western councils. 3. Meeting held with Alliance of Western Councils and Paul Scully, Shadow Minister for Planning, 1 September to provide an update on the impact if the Biodiversity Act. 4. Matter continues to be pursued by Western Alliance on behalf of member Councils. 5. Matter further discussed at the Alliance of Western Council Meeting held on 09/12/2022. 6. Impact of Biodiversity Act, and specifically the issue of the North Bourke Industrial lots, raised on Sydney Radio (2GB Ray Hadley 14/03/2023) by Chair of Western Alliance, Cr Craig Davies. 7. GM and MES attended Biodiversity teleconference organised by LGNSW held on 4 April 2023 . Submission from Council will be forthcoming during the follow up process.	

427/2018	PROPOSED CHANGE OF MANAGEMENT OF THE PCYC
RESPONSIBLE OFFICER	LEONIE BROWN - GENERAL MANAGER
FILE NO	L1.17-Y1.7-LD-L11.14.3
RESOLUTION	
That the General Manager prepare a detailed report in relation to the matter, including the seeking	

of legal advice if necessary.
ACTION TAKEN
1. In progress. 2. Teleconference held 20/08/2020. 3. Correspondence sent to PCYC 25/8/20 and followed up for response 20/10/20 & 16/11/2020. 4. Matter further discussed with Crown Lands staff on 09/03/2021 for their contact with PCYC. 5. Further discussions held in July 2021 with Crown Lands in regard to their contact with PCYC with correspondence sent to PCYC as a follow up to discussions. 6. PCYC have advised that as a result of internal management changes they wish to defer discussions on land management till mid-2022. 7. No further approaches made by PCYC re land management matter.

274/2019	DROUGHT – WATER UPDATE
RESPONSIBLE OFFICER	LEONIE BROWN – GENERAL MANAGER
FILE NO	W2.2.9 – W2.2.9.1
RESOLUTION	
That the General Manager write to the State Government seeking their urgent consideration of the construction of a regulator or additional weir including a fish ladder upstream of Bourke at a location identified as BU8	
ACTION TAKEN	
1. Letter sent & meeting held. 2. State Government commits to preparation of Western Weirs Strategy. 3. Teleconference involving staff and Councillors held with State Water on 22/9/2020 re Strategy. 4. Meeting held with DPIE representatives on 10/11/2020 & 11/11/2020. 5. Further briefings on Strategy held 10/02/2021 and 24/05/2021. 6. Discussions held by GM with Jim Betts in July 2021 Secretary, DPIE, in regard to the Weir Strategy Project and its prolonged timeframes. 7. NSW Govt. in Oct 2021 announced the Better Baaka Program which includes Weir renewals on the Darling and specifically upgrading of the Bourke Weir. Meeting with DPIE to be held in Bourke on 23 November 2021. 8. Meeting held DPIE 23/11/2021 with Jim Bentley and his team via Video conference regarding Better Baaka Better Bidgee project. 9. Meeting held in December 2021 with Andrew Lavelle regarding the Weir upgrade at Bourke and connectivity strategy. 10. Contact made with Minister Pavey's Office re concerns regarding potential removal of downstream weirs. 11. GM and MCS met with DPIE officers undertaking Western Regional Water Strategy consultation in Bourke on 8 March 2022 raising concern at the potential loss of downstream weirs. 12. Contact made in March 2022 with Andrew Lavelle of DPIE re weir progress. Advised that Western Weirs project is progressing following completion of Strategic Business Case. Advised that he will be seeking to have further conversations re weirs downstream. 13. Meeting held with Graham Attenborough and Jason Gordon of DPIE on 15 March 2022 re all things water including weir. 14. Mayor, Mark Riley and Leonie Brown attended the DPIE Forum at Bourke Bowling Club on 30 June 2022 re Western Region Water Strategy and Barwon-Darling Water Sharing Plan and Floodplain Harvesting licencing.	

15. Submissions subsequently made re increasing Bourke Weir height and retention of downstream weirs.
16. Mayor/GM met with Hon. Tanya Plibersek, MP Federal Minister for the Environment and Water at Alliance of Western Councils Meeting at Narromine on 19/08/2022.
17. Ingrid Emery, Executive Director Project Interfaces and Program Management Water Infrastructure to provide update to Councillors on 22 August 2022 – No State or Federal Funding for Final Business Case Study.
18. Refer Council Resolution Clause 2022/176 herewith for further update.
19. Meeting held in February 2023 with Minister Anderson - see item 2022/176.

2020/111	DUAL NAMING OF THE DARLING RIVER – DARLING RIVER BAAKA
RESPONSIBLE OFFICER	LEONIE BROWN – GENERAL MANAGER
FILE NO	R6.5
RESOLUTION	
That Council seek further clarification from the GNB on which section of the Darling River will be dual named Baaka and will the name be Darling Baaka River / Baaka Darling River or Darling River Baaka.	
ACTION TAKEN	
1. Ongoing. Geographical Names Board GNB contacted. 2. Investigations are continuing by GNB. 3. GNB advised in July 2021 that it would be undertaking consultation in August 2021 in regard to dual name proposal. 4. GNB subsequently advised in August that due to COVID the consultations will now be undertaken in 2022. 5. Meeting was to be held with GNB on 22 June 2022 however was postponed by GNB till “next month” with a date yet to be suggested. 6. Meeting scheduled for 19 July 2022 postponed – new date yet to be confirmed. 7. New meeting date proposed for 11 October 2022. 8. Representatives of NSW GNB attended Council on 11 October 2022 and met with available Councillors and relevant staff re naming matter. 9. No further advice received from GNB, to date.	

2020/325 and 2020/326	REVIEW OF CAPITAL WORKS PROGRAM 2019/2020 AND REALLOCATION OF FUNDS – ITEM 15.5 - MOUNT OXLEY
RESPONSIBLE OFFICER	LEONIE BROWN – GENERAL MANAGER
FILE NO	R2.5
RESOLUTION	
1. That Council notes the report on the responsibility and current condition of the access road to the summit of Mount Oxley. 2. That Council notes the status of telecommunication infrastructure located atop Mount Oxley. 3. That following a Title Search discussion be held with the owners of the land and the various owners of the telecommunications infrastructure atop Mount Oxley with a view to sourcing funding for at least the $80,000 in maintenance work and potentially a further $110,000 for the guard rail installation, for a further report to Council including consideration to any contribution by Council. 4. That Council investigates its potential liability as a result of the public use of the access road to the	

top of Mount Oxley and a report be submitted back to Council.
ACTION TAKEN
1. Extensive title searches have been completed. 2. Liability issues being pursued by Booth Brown Legal for further report. 3. Meeting held with Mr & Mrs Stalley on 10 December 2020. 4. Risk review undertaken by Council's insurers on 16/03/21. Awaiting advice to allow instructions to be issued by Booth Brown Legal to prepare licence documentation. 5. Discussions held with NSW Telco Authority re potential for funding to assist with road upgrade. Costs advised. No funding available. 6. Further discussions to be held with owners of Mt Oxley site.

2020/236	BOURKE AIRPORT DEVELOPMENT PROPOSAL
RESPONSIBLE OFFICER	PETER BROWN – MANAGER WORKS
FILE NO	A6.1
RESOLUTION	
That Council seeks quotations for the preparation of a Master Plan at the Bourke Airport to determine the availability of land for the proposed development and future developments.	
ACTION TAKEN	
Brief prepared, quotations to be invited, when funding available.	

2019/439 and 2021/33	NORTH BOURKE BRIDGE REHABILITATION CONCEPT PLAN
RESPONSIBLE OFFICER	LEONIE BROWN – GENERAL MANAGER
FILE NO	B6.1
RESOLUTION	
1. Council continues to apply for funding to undertake the project. 2. Council commits additional funds of $269,922 from Councils Infrastructure Reserve Fund to ensure a total co-contribution from Council of $969,922 (25%) to the Building Better Regions Fund Round 5, for North Bourke Bridge Renewal, if a funding application is successful.	
ACTION TAKEN	
1. Ongoing. 2. Letter received from Minister Toole 11/11/2020 advising upcoming funding opportunities for bridge. 3. Funds as resolved reserved in Councils accounts. 4. Application under Building Better Regions Fund lodged 11/02/2021. Application unsuccessful. 5. Strategy prepared for investigation, assessment and restoration of bridge for input into Tourism Grant Application. 6. Application lodged in August 2021. No response to date. 7. Representations made to Member for Barwon, Roy Butler MP regarding funding for Bridge. 8. Further application under Building Better Regions Fund lodged February 2022. 9. Council resolved 25 February 2022 to allocate funding of $200,000 to engage a structural engineer to prepare documentation to allow Council to invite tenders for restoration of the bridge. 10. Draft brief prepared and with Public Works Advisory (PWA) for review.	

11. Quote obtained from PWA with further discussions to be held.
12. Further Grant funding application for design funding lodged with NSW Government in July 2022.
13. Councils Grant Funding application was successful. Deed executed.
14. Brief with PWA finalised and awaiting final quotation.
15. Meeting with PWA and Bridge Engineer held on site 5 April 2023 to progress brief development and consider restoration options. Report from Bridge Engineer to be provided.

2021/355	ROAD CLASSIFICATION REVIEW
RESPONSIBLE OFFICER	PAUL FLANAGAN – ROADS MANAGER
FILE NO	R7.1, R7.4.3

RESOLUTION

1. That Council provide a submission to the Independent Panel on Road Classification Review and Regional Road Transfer proposing that ownership of the Bourke – Milparinka Rd (Wanaaring Rd) be transferred to the NSW Government, as a minimum.
2. That the transfer of any Regional Roads to Government in the Bourke Shire being on the basis of Council entering into a contract with Government which would see Council continuing to undertake both improvement works, and the necessary programmed and emergency maintenance works on the transferred roadway(s).
3. That Council also provides a submission to the Independent Panel on Road Classification Review and Regional Road Transfer proposing the reclassification from local road to regional road status of the following roads:
    - RLR 5 – Caronga Peak to Wilga Downs (23km / no bridge);
    - RLR50 - Moleyarrah Road – Wanaaring to Hungerford (86.82km / no bridge);
    - RLR44 – Janina Road – Louth to Wanaaring (85.7km / no bridge);
    - RLR49 – West Culgoa Road – Bourke to Weilmoringle (82.82km / single lane bridge).

ACTION TAKEN

1. Submission to Review Panel prepared and submitted.
2. Additional information and financial data requested for consideration 23 August 2022. Information provided.
3. No Further information to date.

2022/96 and 2023/60	NORTH BOURKE STORMWATER DRAINAGE
RESPONSIBLE OFFICER	LEONIE BROWN - GENERAL MANAGER
FILE NO	D6.1, D6.2, V 1.6

RESOLUTION

1. That the information in the report of the General Manager from March 2022 be noted.
2. That the Mayor and General Manager be requested to take the necessary action in pursuit of Potentially acquiring land in respect of this drainage matter, for a further report to Council.
3. That the Mayor and General Manager be requested to brief Mr G Seiler on the progress of this matter.
4. That the documents and considerations in respect of this matter remain confidential to Council.

ACTION TAKEN

1. Investigations into land proceeding.
2. Mayor and GM have briefed Mr Seiler.

3. Land to west of subject site reviewed by environmental consultant and is considered to be an undesirable location for the construction of stormwater retention infrastructure due to the multitude of environmental, practical and physical constraints.
4. Further update meeting held in June 2022 with Mr Seiler involving Mayor, Deputy Mayor and Messrs Riley and Brown.
5. Monthly progress reports to be provided to Mr Seiler by Council.
6. Structural Engineer engaged by Insurers inspected property on 8 September 2022.
7. Meeting held with landowners to the north of Warrego Street with a view to a portion of this land being acquired and utilised for the construction of a detention pond. Further information being sought for a future meeting.
8. Further information received and provided to the landowners to the north of Warrego Street with subsequent discussions held.
9. Structural Engineers Report received. Comprehensive report being developed for Workshop of Councillors in March 2023.
10. Workshop held 20 March 2023. Workshop report including recommendation included in March 2023 Business Paper.
11. Council in March 2023 (2023/60) resolved:
    - to undertake final negotiations with Mr Rob and Mrs Sally Davis in respect of the acquisition of some 2.21ha of their land fronting Warrego St, North Bourke for the purpose of constructing a stormwater detention basin thereon, for a final report to Council.
    - on the basis of Council resolving to formally acquire such land, the General Manager be requested to take the necessary action that would result in the construction of a stormwater detention basin and required infrastructure on such land, in general conformity with the concept plan developed by Premise dated 10 February 2023 designed to accommodate a 1:100 year rainfall event for this area.
    - noted the opinion as expressed in the Expert Report prepared by Engineering Investigations and Solutions in regard to the residence of Mr G and Mrs C Seiler.
    - not pursue the purchase of the Seiler property located in Namoi St, North Bourke.
12. Meeting with Mr and Mrs Davis requested. Council's Solicitor, Insurer and Mr G Seiler advised of Councils resolution accordingly.

2022/115	RISK MANAGEMENT AND INTERNAL AUDIT FRAMEWORK FOR COUNCILS
RESPONSIBLE OFFICER	ANG PASANG RAI - MANAGER CORPORATE SERVICES
FILE NO	R5.1

RESOLUTION

1. That Council join with the Far North West Joint Organisation and its member Councils in establishing a Shared Audit Risk and Improvement Committee in accordance with section 428B of the Local Government Act 1993.
2. That Council delegate authority to the Far North West Joint Organisation to appoint the chair and two (2) independent members to form the shared Audit Risk And Improvement Committee to serve the Far North West Joint Organisation and all three member Councils.
3. That Council appoint a Councillor to serve as the non-voting board member on the ARIC for this Council only.
4. That Council adopt the Draft Terms of Reference developed for the operation of the Audit Risk and Improvement noting the initial revised term to cater for the shorter period to be served by the current Council and the fact that there is no current need for the Chair to be pre-qualified at

this stage. 5. That Council note the Expression of Interest document developed by the Far North West Joint Organisation for distribution to potential applicants for persons to serve as the Chair or one of the two (2) independent Committee Members including the fees payable to the Chair and Committee members. 6. That applications as detailed in the Expression of Interest document be called for by the placement of advertisements in the local papers circulating in each of the towns within the FNWJO area together with the websites of each of the member Councils to provide local residents the opportunity to apply to become a member of the Shared Committee if they are suitably qualified and wish to apply.
ACTION TAKEN
1. General Manager advised FNWJO of Council's resolution. 2. Manager Corporate Services take the necessary action to implement Council's resolution. 3. Expression of Interest received from another Council regarding joining the FNWJO. 4. FNWJO meeting held on 1 August 2022. 5. Expression of Interest for persons to serve as the Chair on one of the two (2) independent Committee members have been invited and subsequently closed. As at 23/03/2023 the submissions received are under review for report to the FNWJO in April 2023. 6. Report considered by FNWJO Board at its meeting of 31 March. Interview of short listed applicants to proceed.

2022/161 and 2023/42	CAMPING & CARAVAN USAGE - MITCHELL HIGHWAY ROAD RESERVE AND NORTH BOURKE BOAT RAMP CROWN RESERVE
RESPONSIBLE OFFICER	DWAYNE WILLOUGHBY – MANAGER ENVIRONMENTAL SERVICES
FILE NO	L1.9
RESOLUTION	
1. That the legislative information in respect of the potential usage of the North Bourke Boat Ramp Crown Reserve for the purposes of caravanning and camping be noted. 2. That Council not pursue the development of a primitive campground to allow camping at the North Bourke Boat Ramp Crown Reserve and having regard to this position, camping in this reserve not be permissible and appropriate signage be maintained. 3. That Council enter into discussions with TfNSW with a view to the sealed section of road reserve leading to the old North Bourke Bridge being designated for use by light and recreational travellers as a Rest Area, for a trial period ending 12 months after the opening of such road reserve as a rest area, should it be approved. 4. At the end of this period it would be proposed that a report on the trial be provided to Council to review usage and issues, including any impact on accommodation providers in Bourke. 5. That Council investigate further opportunities to promote Bourke as an RV friendly town.	
ACTION TAKEN	
1. Contact made with Transport for NSW (TfNSW). 2. Awaiting response from TfNSW. 3. Further follow up with TfNSW. Cobar Shire have advised they are having similar issues. 4. Further contact made with Transport for NSW. 5. Follow up report included in March 2023 Business Paper. 6. At the March 2023 Ordinary Meeting of Council the following resolution (2023/42) was carried. 1. That the information in respect of the potential usage of the Polygonum Swamp Road be	

noted.

2. That Council not pursue the development of a Rest Area to allow camping on the side of the Polygonum Swamp Road.
3. That the No Camping and No Caravans signs be maintained to encourage Caravan and Camping users to move on to a more suitable location, where there is no risk to pedestrians, road users and themselves.

2022/176	MAYORAL MINUTE – WESTERN WEIRS STRATEGY
RESPONSIBLE OFFICER	LEONIE BROWN – GENERAL MANAGER
FILE NO	W3.1

RESOLUTION

1. That the status upgrade in respect of the Western Weirs Strategy as presented to Council by Ms Ingrid Emery, Water Infrastructure NSW on Monday, 22 August 2022 be noted.
2. That Council write to the Hon. Tanya Plibersek, MP, Federal Minister for the Environment and Water, and the Hon. Kevin Anderson, MP, State Minister for Land and Water seeking support and funding to progress the next stage of the Western Weir Strategy being the Final Business Case for the proposed upgrading of the Bourke Weir to improve town water supply security.

ACTION TAKEN

1. Letter written by the Mayor to Hon. Tanya Plibersek, MP, seeking support and funding to progress to the next stage of the Western Weir Strategy being the Final Business Case for the proposed upgrading of the Bourke Weir to improve town water supply security.
2. Letter also written to the Hon. Kevin Anderson, State Minister for Land and Water seeking support and seeking a meeting to discuss same. Minister’s office advised that “the Minister will be unable to accept your request to meet.”
3. Response dated 5 October 2022 received from Minister Anderson. The Minister advised that:
   - Infrastructure NSW (INSW) completed its Gateway 1 Review in December 2021 in respect of the Western Weirs Program. INSW is working with the Australian Government re: funding arrangements for a final Business Case.
   - Western Weirs Program has been incorporated into the Better Baaka Program. Better Baaka aims to protect rivers and floodplains with towns having “a secure water source into the future, and sustainable local communities, agriculture and industries can be supported.”
4. Response dated 12 December 2022 received from Minister Plibersek advised that:
   - The NSW Government is responsible for water management in our region and is developing regional water strategies across the State.
   - The Western Weirs Strategy sits alongside these strategies.
   - The Australian Government’s role as a significant investor in water infrastructure through the National Water Grid Authority, State and Territory Governments are responsible for water planning and water infrastructure delivery. Applications for National Water Grid funding must have support of the State Government.
5. State Minister for Land and Water, the Hon Kevin Anderson attended Bourke on 6 February 2023 and met with the Mayor and Acting GM. The Minister advised the Western Weirs Strategy will be abandoned as it is not well supported. However, the issue of water security will be included in the Better Baaka Program. The State and Federal Ministers are to meet for discussion in late February. The proposal aims to meet the Federal objectives but will require more time to adopt measures to ensure water consumption is not restricted at the same time. There are implications

for a need for increased water storage capacity if weirs are not upgraded.

6. Correspondence sent to the Hon Tanya Plibersek, MP and the NSW Minister for Lands and Water, the Hon Kevin Anderson, MP in March 2023 seeking the status of weir proposals. In response, the acting CEO of the NSW Water Sector responded that "the strategic business case for the Western Weirs program was completed in November 2021" and further that "the NSW Government continues to work with the Australian Government on suitable funding arrangements to progress to a final business case." The Federal Government responded in April 2023 advising that "foe the raising of the Bourke Weir to be eligible for National Water Grid funding consideration, a proposal must be submitted to the National Water Grid Authority by the NSW Government. You may wish to continue your engagement with the NSW Government so that a proposal may be brought forward, should it be prioritised by the NSW Government.
7. In response, a further letter was sent to acting CEO of the NSW Water Sector, April 2023, requesting confirmation that funding to progress to a final business case is an eligible project under the investment principles of the National Water Grid Fund and if so, what is the specific time frame for the NSW Government to submit an application that covers funding for a final business case to raise the height of the Bourke Weir.

2022/222 and 2022/250	PROPOSED INTEGRATED PRIMARY HEALTH CARE CENTRE
RESPONSIBLE OFFICER	LEONIE BROWN – GENERAL MANAGER
FILE NO	A11.1, H1.1, H1.15

RESOLUTION

1. That the Mayor and General Manager be requested to further discuss with the Bourke Aboriginal Corporation Health Service (BACHS) the potential acquisition of the following land:
    a) Lot 8 DP 35739, Lot 9 DP 35739 and Lot 10 DP35739 in Mitchell Street, Bourke
    b) Three (3) x lots from Lot 6 DP 35797, Lot 7 DP 35797, Lot 8 DP 35797, Lot 9 DP 35797 and Lot 10 DP 35797.
2. That based on three (3) lots in one line being required, the land be available for sale at an indicative combined price of $45,000.
3. That Council provide the BACHS with the requested Evidence of Tenure and Letter of Support, as requested.
4. That the documents and considerations in respect of this matter remain confidential to Council.
5. That Council proceed to sell Lots 7,8,9 and 10 DP 35797 Mitchell St, Bourke at a combined price of $45,000 (ex GST) to the Bourke Aboriginal Corporation Health Service.
6. That any necessary documents be executed under the Common Seal of Council.
7. That the documents and considerations in respect of this matter remain confidential to Council.

ACTION TAKEN

1. Further discussions with BACHS as Resolved by Council.
2. Follow up report on matter to be considered by Council at its October 2022 meeting.
3. BACHS advised of Councils resolution.
4. Email received from BACHS advising that they were not able to proceed with the purchase without securing grant funding to construct the new clinic.
5. Correspondence sent to BACHS acknowledging the reliance on securing funding prior to progressing sale.
6. In December 2022, the Australian Government announced funding of $8.06m to BACHS for the construction of a new Primary Care Clinic for the Bourke region.
7. In January 2023, Council forwarded a letter to BACHS congratulating them on the funding

	success and requesting advice as to their intentions in respect of Council's land offer, such that Council can progress the contract of sale for such parcels of land, or not.
8.	No response as yet received from BACHS re land acquisition.

2022/235	DRAFT FAR WEST REGIONAL PLAN 2041
RESPONSIBLE OFFICER	DWAYNE WILLOUGHBY – MANAGER ENVIRONMENTAL SERVICES
FILE NO	T1.5
RESOLUTION	
That Council note the information contained within the Draft Far West Regional Plan 2041 Report.	
ACTION TAKEN	
1. Matter discussed regarding gaps in the plan relative to Bourke, linkages, tourism, health services, transport, small business and biodiversity. Hoping for changes to the draft. Opportunities to participate in workshops. 2. Continue to pursue amendments to the plan in respect of identified gaps. 3. Council's submission lodged, awaiting response.	

2022/238	GEOGRAPHICAL NAMES BOARD – THE POUND YARD
RESPONSIBLE OFFICER	LEONIE BROWN - GENERAL MANAGER
FILE NO	A2.1, A2.2.16, H3.3
RESOLUTION	
That Council advise the NSW Geographical Names Board that whilst it raises no objection to the name "Pound Yard", it is considered imperative that the Board consult with appropriate Aboriginal persons before any decision is ultimately made.	
ACTION TAKEN	
1. NSW Geographical Names Board advised of Council's Resolution. 2. Aboriginal people who have been identified as residents of the Pound Yard have been suggested as the appropriate people to be consulted by the GNB. 3. Work in progress. 4. List of names received, contact details yet to be received.	

2022/251 and 2023/43	SALE OF LAND FOR UNPAID RATES AND CHARGES
RESPONSIBLE OFFICER	ANG PASANG RAI – MANAGER CORPORATE SERVICES
FILE NO	R2.10
RESOLUTION	
1. That the land listed in Attachment 1 herewith be included in a sale of land for unpaid rates and charges by way of public auction, or by private treaty subsequent to such public auction, pursuant to Section 713 of the Local Government Act 1993. 2. That the General Manager be authorised to perform the necessary actions to facilitate the conduct of such public auction, including the authority to determine reserve prices for the various allotments, negotiate the terms of the sale of any land listed in Attachment 1, even if the reserve	

price is not reached. 3. That the General Manager be authorised to apply the proceeds of any such sales and to write off any rates, charges or costs incurred through the sale of land process which are not recovered by the sale. 4. That the General Manager be authorised, and Council reserves the right, to withdraw any property from sale for technical or legal reasons. 5. That the Centre for Sustainable Debt Recovery Pty Ltd, t/as Recoupa, be appointed to administer the sale on Council's behalf. 6. That the General Manager be requested to review the various properties as to them having any strategic benefit to Council, for a further report to Council, if required. 7. That the Mayor and General Manager be authorised to execute all relevant documentation to affect such sales. 8. That the documents and considerations in respect of this matter remain confidential to the Council.
ACTION TAKEN
1. Matter proceeding. Real Estate Agent engaged to manage sale confirmed for Friday, 17 March 2023. 2. Statutory advertising requirements proceeding. 3. Sale completed 17 March 2023. Summary included in March 2023 Business Paper. 4. Report on Auction Sale considered at the April 2023 Council Meeting (2023/43) with Council resolving that a further report be provided to Council once all costs are known and the sales finalised.

2022/285	ADMINISTRATION OF SEPTEMBER 2024 ORDINARY COUNCIL ELECTIONS
RESPONSIBLE OFFICER	LEONIE BROWN
FILE NO	C11.1, E2.3.7
RESOLUTION	
1. That pursuant to s. 296(2) and (3) of the Local Government Act 1993 (NSW) an election arrangement be entered into by contract for the Electoral Commissioner to administer all elections of the Council. 2. That pursuant to s.296(2) and (3) of the Act, as applied and modified by s.18, a council poll arrangement be entered into by contract for the Electoral Commissioner to administer all council polls of the Council. 3. That pursuant to s.296(2) and (3) of the Act, as applied and modified by s.18, a constitutional referendum arrangement be entered into by contract for the Electoral Commissioner to administer all constitutional referenda of the Council. 4. That the General Manager be requested to publish a copy of this resolution on Council's website and further advise the NSW Electoral Commission.	
ACTION TAKEN	
Correspondence advising of Councils resolution provided to the NSWEC. Resolution published on Councils website. Awaiting provision of contract to Council.	

2023/9, 2023/35, 2023/36	NORTH BOURKE WATER SUPPLY
RESPONSIBLE OFFICER	PETER BROWN
FILE NO	W2.1

RESOLUTION

1. At the December meeting of Council, having regard to the apology from Cr Hollman and the previously advised conflict of interest declarations from Crs Barton, Davis, Dorrington, Ford, and Rice, the Chairman adjourned consideration of this item to the February Ordinary Meeting of Council commencing at 9.15am on Monday, 27 February 2023 in the Council Chamber, due to the lack of a quorum to consider the matter, with Crs Bartley, Ridge (via Audio Visual Link), Ryan and Stutsel being the remaining councillors present.
2. That a North Bourke Water Extension Request Committee be formed to meet for the sole purpose of determining the report of the Manager Works titled North Bourke Water Supply, as initially included in the Council Agenda of December 2022.
3. That the membership of such Committee comprise the five (5) Councillors who were either absent from, or did not declare, a significant non-pecuniary conflict of interest in item 13.1, North Bourke Water Supply, of Councils December 2022 Meeting Agenda, being Councillors Bartley, Holman, Ridge, Ryan and Stutsel, with the Manager of Works and the Executive Assistant being non-voting attendees of the Committee.
4. That the quorum for the Committee be three (3) Councillors.
5. That once the Committee has made its determination, all Councillors be advised of the outcome.

ACTION TAKEN

1. Report on matter to be included in Agenda for February 2023 meeting.
2. Contact was made with the Governance Branch of the Office of Local Government seeking guidance on management of the issue.
3. Meeting held 14 March 2023. Details of Resolution circulated to Councillors.
4. Rescission Motion re accessing the abattoir water line lodged and to be considered at Councils March meeting.
5. At the March 2023 Council Meeting a Rescission Motion in respect of W and S Hand having access to filtered water via the abattoir line was carried. The following Motion (2023/36) was then carried:

   That Mr Warren and Mrs Susanne Hand be advised that Council concurs with the connection of a 20mm water supply service to their property , Virginia Farm, 985 Mitchell Highway, North Bourke, on the basis of such supply being sourced from Councils filtered water main that runs on the eastern side of the Mitchell Highway, North Bourke and on the basis of them making an application and accepting a quotation from Council to undertake the works to connect to such supply via a pipe under the Highway to a nominated point at their front boundary, as per Councils Rural Water Supply Policy (Policy No 3.7.10), which requires in part:

   - The capital works being undertaken at no cost to Council and the total cost of the scheme proposed is prepaid to Council prior to Council carrying out the work.
   - All new owners agreeing to pay Water Headworks contributions to cover augmentation of major capital items such as treatment works, reservoirs, pumps and rising mains relatively remote from the Scheme area.
   - The connection shall be for domestic purposes only.
   - That all internal plumbing be carried out by a licensed plumber in accordance with the provisions of the Local Government (General) Regulation 2005 and that all such works be inspected and tested by officers of Council prior to the covering of the

works.
- The design and construction of any water main to service properties complying with Council's current policies.

6. Landholders advised of Councils resolution.

2023/32	MAYORAL MINUTE – GENERAL MANAGER ANNUAL LEAVE
RESPONSIBLE OFFICER	LEONIE BROWN
FILE NO	A3.8, S6.24

RESOLUTION

1. That Mr Ross David Earl be appointed as General Manager, Bourke Shire Council for the period 25 April 2023 to 24 May 2023, inclusive, in the absence of Councils General Manager, Mrs Leonie Brown, whilst on annual leave.
2. That the Instrument of Delegation as provided by Council to Mrs Leonie Catherine Brown effective 4 July 2022 be provided to Mr Ross David Earl during his term of General Manager for the period 25 April 2023 to 24 May 2023, inclusive.
3. That the Mayor and General Manager be authorised to finalise the relevant details of Mr Earl's short-term tenure.

ACTION TAKEN

Confirmation of tenure and Delegations prepared and completed.

2023/41	LOCAL PROVISION DRAFT PLANNING PROPOSAL
RESPONSIBLE OFFICER	DWAYNE WILLOUGHBY
FILE NO	T5.1

RESOLUTION

1. That Council support the Planning Proposal attached as Appendix A to undertake an Amendment to the Bourke Local Environmental Plan 2012 as follows:
    a. Permit with consent, development for the purposes of business premises and office premises in the R1 General Residential zone.
    b. Restrict proposed development to the confines of an existing dwelling house or for new development, to a gross floor area of 250m2.
    c. Rezone land at Lot 62 DP 1027306, No. 68B Sid Coleman Drive, North Bourke from SP2 (Air Transport Facility) to IN1 General Industrial.
2. That Council exercise their delegation under Section 3.36 of the Environmental Planning and Assessment Act, 1979 and request that NSW Parliamentary Counsel's Office draft the new Plan.
3. That Council request that the NSW Department of Planning and Environment to prepare the mapping associated with the proposed Amendment to the Bourke Local Environmental Plan 2012.
4. That Council request the final Amendment be notified on the NSW Legislation website.

ACTION TAKEN

Letter sent to Department of Planning.

2023/44	PURCHASE AND CLASSIFICATION OF 54 MERTIN STREET, BOURKE
RESPONSIBLE OFFICER	LEONIE BROWN
FILE NO	R2.10
RESOLUTION	
1. That Council endorse the acquisition of Lot 1 DP 910329, 54 Mertin St, Bourke at a purchase price of $5,000.00. 2. That in accordance with the provisions of the *Local Government Act 1993*, Council proceed to give 28 days' public notice of its proposed resolution to classify Lot 1 DP 910329, 54 Mertin St, Bourke as Operational Land. 3. That following such public notice, a further report be submitted to Council on the proposed land classification. 4. That any necessary documents be executed under the Common Seal of Council.	
ACTION TAKEN	
Contract signed. Advertisement re classification placed in the Western Herald.	

2023/47	2023/2024 DRAFT OPERATIONAL PLAN
RESPONSIBLE OFFICER	ANG PASANG RAI
FILE NO	P4.1
RESOLUTION	
1. That the report of the Manager of Corporate Services detailing an overview of the 2023/2024 Draft Operational Plan be noted. 2. That Councils 2023/2024 Draft Operational Plan be adopted for the purpose of public exhibition from Monday, 3 April 2023 until 5.00pm Monday, 1 May 2023 in accordance with *Section 405 (3) of the Local Government Act.* 3. That all submissions received be tabled at the 22 May Ordinary Meeting of Council, for consideration prior to Councils Operational Plan for 2023/2024 being determined.	
ACTION TAKEN	
Operational Plan exhibited from 3 April 2023.	

2023/61	TENDER 04/23 - BOURKE MEMORIAL SWIMMING POOL FRONT OF HOUSE ENTRY BUILDING
RESPONSIBLE OFFICER	DWAYNE WILLOUGHBY
FILE NO	S10.1
RESOLUTION	
1. That the tender of Lukas Building and Construction for the upgrade of the kiosk at the Bourke Swimming in the amount of $1,118,423.00 (Ex GST) be accepted. 2. That any necessary documents be executed under the Common Seal of Council. 3. That the documents and considerations in respect of this matter remain confidential to Council.	
ACTION TAKEN	

Awaiting contract to be finalised.

Recommendation **That the information in the Business Arising Report as presented to Council on Monday, 24 April 2023 be noted.**

13 ENGINEERING SERVICES DEPARTMENT

13.1 BOURKE LOCAL TRAFFIC COMMITTEE MEETING MINUTES

File Number: C6.6

Author: Paul Flanagan, Manager Roads

Authoriser: Leonie Brown, General Manager

Attachments: 1. Traffic Committee Meeting Minutes 14 March 2023 ⇩

Background

The Local Traffic Committee (LTC) is primarily a technical review committee, which is required to advise Council on matters referred to it by Council. These matters must be related to prescribed traffic control devices and traffic control facilities for which Council has delegated authority by Transport for NSW.

The Local Traffic Committee has no decision-making powers. The Council must refer all traffic related matters to the Local Traffic Committee prior to exercising its delegated functions. Matters related to State Roads or functions that have not been delegated to Council must be referred directly to the RMS or relevant organisation.

The Committee provides recommendations to Council. Should Council wish to act contrary to the advice of the Committee or if that advice is not supported unanimously by the Committee members, then the Police or RMS have an opportunity to appeal to the Regional Traffic Committee. The Bourke Local Traffic Committee generally meets four (4) times per year.

Formal voting membership on the Committee comprises the following:

- one representative of Council as nominated by Council;
- one representative of the NSW Police from the Bourke Local Area Command (LAC)
- one representative from the RMS; and
- one representative from the State Members of Parliament (MP) for the electorates of Barwon

Current Situation

The Local Traffic Committee met on Tuesday, 14 March 2023. The Minutes are attached for Council's information.

Financial Implications

There are no financial implications.

Recommendation

That the Minutes of the Meeting of the Bourke Shire Council Traffic Committee held on 14 March 2023 as presented to Council on Monday, 22 April 2023 be noted.

MINUTES OF BOURKE SHIRE COUNCIL
TRAFFIC COMMITTEE MEETING
HELD AT THE BOURKE SHIRE COUNCIL, 29 MITCHELL STREET, BOURKE NSW
ON TUESDAY, 14 March 2023 AT 2.00PM

1. **PRESENT**
Cr Lachlan Ford, Deputy Mayor, Leonie Brown, General Manager (GM), Paul Flanagan, Manager of Roads (MR), Chris Morrall, Engineering Technical Officer (ETO), Kayla Cohen, Transport for NSW (TfNSW), Dave Vant, TfNSW, Snr Con Daniel Vituseck, NSW Police (Wanaaring), Lynette Gooch, Engineering Secretary Support Officer (Record)

2. **APOLOGIES**
Letiticia Tiffen, WHS Officer

3. **ADOPTION OF THE PREVIOUS MINUTES** of Meeting conducted 20 September 2022
Recommendation:
That the Minutes of the Meeting of the Bourke Shire Council Traffic Committee held on Tuesday, 20 September 2022, be confirmed as a true and accurate record of the meeting.
Moved: Kayla Cohen **Seconded:** Chris Morrall

4. **BUSINESS ARISING FROM THE PREVIOUS MEETING**

Item	Responsible Officer	Status Update
Signage	**TfNSW** **Manager Economic Development (MED)**	Bourke and Louth Entry signs have been erected. Discussion on where Enngonia and Wanaaring signs will go. Council to prepare a mud map in case there is a requirement for a (Section 138) regarding the location at Enngonia.
40 Zone in CBD	**MR**	Proposed 40km/h speed zones are for: Mitchel Street (Glen Street-Charles Street), Richard Street (Mitchell Street-Mertin Street), Sturt Street (Oxley Street-Mitchell Street) Community consultation required. GM suggested advertising through Radio, Facebook and local paper. Council to provide traffic counts: 85th percentile speed, AADT, ADT and Heavy vehicle split.
School Zones	**TfNSW**	Janene has looked at the school zones state wide. Funding for stages 1-3 underway, Bourke will be included.
Nutrien Corner	**TfNSW** **Council**	Council provided design and estimate of $69,300 to TfNSW. TfNSW to seek funding

Minutes of the Bourke Shire Council Traffic Committee Meeting 14/03/2023

		which would have to be expended by the end of financial year.
Speed of Road Trains through Enngonia	TfNSW	TfNSW seeking funding for Radar Speed information signs at Enngonia to reduce speeding through town. They still think they can find the funding. MR suggested that rumble strips be installed but D Vant said this would not be allowed. Neither would splitter islands. It is an OLOS route. Snr Con Daniel Vituseck Police Officer at Enngonia (Pete) concerned about the speed of road trains coming through town. Police will be conducting speed control measures.
60km/h speed signs on Wanaaring Road.	**TfNSW**	S/C Vituseck has pointed out that there are 60km/h speed signs on the Wanaaring Road with no advanced warning of the speed limit change from 100km/h. Action: TfNSW to advise on legality of the speed signs.

5. AGENDA ITEMS

- **General Manager, Leonie Brown left the room at 2.58pm**

Item	Status
St Ignatius Kiss and Drop Off	TfNSW advised that opening Mitchell Street to through traffic at St Ignatius School would be counterproductive as it would encourage speeding. It was suggested to utilise the unused Mercy Park, which is the property of the school, to create a one-way entrance to the school drop-off area. Police also mentioned that their assistance is limited due to the conflicting parking signs. MR to speak with School Principal. TfNSW to seek funding for the roadworks. MR to check parking signs.
Truck Wash for Bourke	TfNSW will gather information.
Truck Parking-Glen Street	Recommendation is not to place parking restrictions in Glen Street. MR to respond to Complainant and to approach the Manager of the Motel.
Speeding through Enngonia	Council to send letter to Alistair, regarding funding for the radar sign. TfNSW will respond.

6. GENERAL BUSINESS

Item	Discussion
Blisters Spar Corner	Blister can be removed.
Eureka Plains	Manager of Roads to respond with letter to Eureka Plains Property owner requiring removal of traffic hazards.
60km/h speed signs on Wanaaring Road.	This and the item below were raised by Snr Const. Daniel Vituseck and discussed together.

2

Cuttaburra Bridge. Curve on Wanaaring Road at Gumbalie	TfNSW will check their database that will confirm if the speed zones are correct. TfNSW will check if speed limits are a legacy of speed control from road work sites. If any signage missing inform Council /MR so a work order can be generated. People fishing off the bridges, could advisory signs and NO fishing signs be erected. Could a sign be erected to slow traffic down on the hairpin bend. Discussion held TfNSW suggested a curve sign be erected. Dave Vant - TfNSW have marked roads with spots for signage, additional and ancillary to those already in place.
Boat Ramp	Parking Bay, not for heavy vehicles. Council needs a response from TfNSW regarding ownership and management of the boat ramp access area. Can Council create a rest area here?
Bus Stop Lighting	Solar lights to be erected

7. NEXT MEETING

The next Traffic Committee Meeting will be conducted at 2.00pm 20 June 2023 in the Council Chamber.

There being no further business the meeting closed at 3.51pm

13.2 *** BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

File Number: **W2.1**

Author: **Peter Brown, Manager Works**

Authoriser: **Leonie Brown, General Manager**

Attachments:
1. **Bourke Floodplain Risk Management Study and Plan - Volume 1 (Rev 1.3) Dated December 2022** ⇩
2. **Bourke Floodplain Risk Management Study and Plan - Volume 2 Figures. Dated December 2022** ⇩

Background

Council received grant funding from the NSW Government through the Governments Floodplain Management Program to undertake the preparation of the Bourke Flood Study and the Bourke Floodplain Risk Management Study and Plan for the town of Bourke. The overall objectives of the Bourke Floodplain Risk Management Study were to assess the impacts of flooding, review existing Council policies as they relate to development of land in flood liable areas, consider options for the management of flood affected land and to develop the Bourke Floodplain Risk Management Plan which:

i) Proposes modifications to existing Council policies to ensure that the development of flood affected land is undertaken so as to be compatible with the flood hazard and risk.

ii) Proposes Flood Planning Levels for the various land uses in the floodplain.

iii) Sets out the recommended program of works and measures aimed at reducing over time, the social, environmental and economic impacts of flooding.

iv) Provides a program for implementation of the proposed works and measures.

The first steps in the process of preparing the Bourke Floodplain Risk Management Plan were the collection of flood data and the undertaking of a flood study for Bourke (Bourke Flood Study). The Bourke Flood Study formed the formal starting process of defining management measures for flood liable land and represented a detailed technical investigation of flood behaviour for the township.

The Bourke Floodplain Risk Management Study focuses on flooding that originates from the Darling River (Darling River flooding), as well as flooding that occurs as a result of heavy and/or prolonged rain that falls directly over Bourke (local catchment flooding).

A copy of the Bourke Floodplain Risk Management Study and Plan, Volumes 1 and 2 (Figures) are attached herewith.

The activities undertaken in preparing the Bourke Floodplain Risk Management Study, and references to such activities in the Study, included:

1. Undertaking a consultation program over the course of the study to ensure that the Bourke community was informed of the objectives, progress and outcomes over the course of the study (Chapter 1 and 3, as well as Appendix A).

2. Analysis of historic stream flow data to generate the flood frequency relationships for the Darling River at Bourke (Chapter 2 and Appendix B).

3. Development of hydraulic models and the definition of Darling River and local catchment flooding for flood events up to the Extreme Flood (Chapter2 and Appendix B).

4. Assessment of the economic impacts of flooding, including the numbers of affected properties and estimation of flood damages (Chapter 2 and Appendix C).

5. Review of current flood related planning controls for Bourke and their compatibility with flooding conditions (Chapter 2).

6. Strategic review of potential floodplain management works and measures aimed at reducing flood damages, including an economic assessment of the most promising measures and the preparation of suggested wording for inclusion in the Bourke Shire Council Development Control Plan which are aimed at guiding future development in flood prone areas (Chapter 3 and Appendices D and E).

7. Ranking of works and measures using a multi-objective scoring system which took into account economic, financial, environmental and planning considerations (Chapter 4).

8. Preparation of the Bourke Floodplain Risk Management Plan (Chapter 5).

Current Situation

Pages S1 to S4, being the Summary as contained in Volume 1 of Attachment 1 provides a good overview of the Study Objectives; Study Activities; the Existing Flood Mitigation Measures at Bourke; Summary of Flood Impacts; the Bourke Floodplain Risk Management Plan; Timing and Funding of the Bourke Floodplain Risk Management Plan; Measures and the Council Action Plan. It is not proposed to repeat this information except in respect of the ten (10) various measures identified for Council to undertake in adopting the Bourke Floodplain Risk Management Plan.

In this regard it is noted that the Floodplain Risk Management Plan includes four management measures which could be implemented by Council with the assistance of NSW SES (Measures 3-4), all of which would not require State Government funding. The four measures are as follows:

- Measure 1 – Council to consider the inclusion of a new special flood considerations clause which would apply to land which lies between the FPA and the Extreme Flood.

- Measure 2 - The application of a graded set of planning controls for future development that recognise the location of the development within the floodplain; to be applied through an update of the wording in Bourke Shire Development Control Plan 2012. Recommended wording for inclusion in Bourke Shire Development Control Plan 2012 is set out in Appendix E of this report.

- Measures 3 - Improvements in the NSW SES's emergency response planning, including use of the flood related information contained in this report to update the Bourke Shire Local Flood Plan.

- Measure 4 - Council should take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplain of the flood risk. This could be achieved through the preparation of a Flood Information Brochure which could be prepared by Council with the assistance of NSW SES containing both general and site-specific data and distributed with rate notices.

In addition, the FRMP includes the following six "structural" measures which would require Government funding:

- Measure 5 – The investigation and concept design of the upgrade of the Bourke Levee to a 1% AEP design standard (Estimated Cost - $150,000).

- Measure 6 – The detailed design and construction of the Bourke Levee upgrade works (Estimated Cost - $1.25 Million).

- Measure 7 – The investigation and concept design of the upgrade of the Alice Edwards Village Levee to a 1% AEP design standard (Estimated Cost - $40,000).

- Measure 8 – The detailed design and construction of the Alice Edwards Village Levee upgrade works (Estimated Cost - $200,000).

- Measure 9 – Investigation and development of a flood evacuation pump strategy for Bourke (Estimated Cost - $100,000).

- Measure 10 – Detailed design and implementation of the flood evacuation pump strategy for Bourke (Estimated Cost - $1 Million).

It is advised that as part of the Bourke Floodplain Risk Management Study, a Community Newsletter and a Community Questionnaire, were distributed by Council to residents and business owners in Bourke to allow input to the study by responding to the Community Questionnaire. 15 responses were subsequently received. Following the drafting of the Bourke Floodplain Risk Management Study and Plan, the document was placed on Public Exhibition during the period 18 August 2022 until Friday, 9 September 2022. As a result of this exhibition, no responses were received.

The Bourke Floodplain Risk Management Study and Plan was considered by Councils MANEX Committee who were in agreement with its adoption and with progressing the proposed measures. In this regard, further reports to progress Measures 1 and 2, being revised planning controls, will be forthcoming to Council.

Financial Implications

The total estimated cost to implement the measures set out in the Bourke Floodplain Risk Management Plan is estimated to be $2.74 Million, exclusive of Council and NSW SES Staff Costs.

The timing of the measures will depend on Council's overall budgetary commitments and the availability of Government funding.

Assistance for funding qualifying projects included in the Bourke Floodplain Risk Management Plan may be available upon application under the Commonwealth and State funded floodplain management programs, currently administered by the Office of Environment and Heritage.

Recommendation

1. **That the Bourke Floodplain Risk Management Study and Plan (Volumes 1 and 2) dated December 2022, be adopted.**

2. **That the General Manager be requested to take the necessary action in respect of implementing Measures 1-4 as identified in the Plan, being the measures "that could be implemented by Council with the assistance, where required, of the NSW SES".**

3. **That in implementing Measures 1-2, being proposed revised planning controls, a further report on such measures be forthcoming to Council.**

4. **That the General Manager be requested to take the necessary action in respect of implementing Measures 5-10, as identified in the Plan, being the measures "that require the sourcing of Government funding" to progress such measures.**

BOURKE SHIRE COUNCIL

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

DECEMBER 2022

VOLUME 1 – REPORT

Job No: EL507 File: BFRMS_V1_Report_[Rev 1.3]	Date: December 2022 Rev No: 1.3	Principals: SAB Authors: SAB/TDR

FOREWORD

NSW Government's Flood Policy

The NSW Government's Flood Policy is directed at providing solutions to existing flooding problems in developed areas and to ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas.

Under the Policy, the management of flood liable land remains the responsibility of local government. The State subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist councils in the discharge of their floodplain risk management responsibilities. The Policy provides for technical and financial support by the State through the following four sequential stages:

1.	Data Collection and Flood Study	Collects flood related data and undertakes an investigation to determine the nature and extent of flooding.
2.	Floodplain Risk Management Study	Evaluates management options for the floodplain in respect of both existing and proposed development.
3.	Floodplain Risk Management Plan	Involves formal adoption by Council of a plan of management for the floodplain.
4.	Implementation of the Plan	Construction of flood mitigation works to protect existing development. Use of Local Environmental Plans to ensure new development is compatible with the flood hazard. Improvements to flood emergency management procedures.

Presentation of Study Results

The results of the *Bourke Flood Study* investigation commissioned by Bourke Shire Council are presented in **Appendix B** of this report. Both the *Bourke Flood Study* and *Bourke Floodplain Risk Management Study and Plan* have been prepared under the guidance of the Floodplain Risk Management Committee comprising representatives from Bourke Shire Council, the NSW Department of Planning and Environment, the NSW State Emergency Service and community representatives.

ACKNOWLEDGEMENT

Bourke Shire Council has prepared this document with financial assistance from the NSW Government through its Floodplain Management Program. This document does not necessarily represent the opinions of the NSW Government or the Department of Planning and Environment.

TABLE OF CONTENTS

Cont'd Over

TABLE OF CONTENTS (Cont'd)

APPENDICES

LIST OF FIGURES
(BOUND IN VOLUME 2)

ABBREVIATIONS

AEP	Annual Exceedance Probability (%)
AHD	Australian Height Datum
ARI	Average Recurrence Interval (years)
ARR	Australian Rainfall and Runoff (1987 Edition)
BoM	Bureau of Meteorology
Council	Bourke Shire Council
DCP	Development Control Plan
DECC	Department of Environment and Climate Change
FDM	Floodplain Development Manual, 2005
FPL	Flood Planning Level (1% AEP flood level + freeboard)
FPA	Flood Planning Area (area inundated at the FPL)
FRMS	Floodplain Risk Management Study
FRMP	Floodplain Risk Management Plan
FRMS&P	Floodplain Risk Management Study and Plan
GSDM	Generalised Short Duration Method
LEP	Local Environmental Plan
LiDAR	Light Detection and Ranging (form of aerial based survey)
MFL	Minimum Floor Level
NSW SES	New South Wales State Emergency Service
OEH	Office of Environment and Heritage
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PW	New South Wales Public Works
VP	Voluntary Purchase

SUMMARY

S1 Study Objectives

Bourke Shire Council (**Council**) commissioned the preparation of the *Bourke Flood Study* and the *Bourke Floodplain Risk Management Study and Plan* (***Bourke FRMS&P)*** for the town of Bourke. The overall objectives of the *Bourke Floodplain Risk Management Study (**Bourke FRMS)*** were to assess the impacts of flooding, review existing Council policies as they relate to development of land in flood liable areas, consider options for the management of flood affected land and to develop the *Bourke Floodplain Risk Management Plan (**Bourke FRMP)*** which:

i) Proposes modifications to existing Council policies to ensure that the development of flood affected land is undertaken so as to be compatible with the flood hazard and risk.

ii) Proposes *Flood Planning Levels* for the various land uses in the floodplain.

iii) Sets out the recommended program of works and measures aimed at reducing over time, the social, environmental and economic impacts of flooding.

iv) Provides a program for implementation of the proposed works and measures.

The first steps in the process of preparing the *Bourke FRMP* were the collection of flood data and the undertaking of a flood study for Bourke (***Bourke Flood Study***). The *Bourke Flood Study* formed the formal starting process of defining management measures for flood liable land and represented a detailed technical investigation of flood behaviour for the township.

The *Bourke FRMS* focuses on flooding that originates from the Darling River (**Darling River flooding**), as well as flooding that occurs as a result of heavy and/or prolonged rain that falls directly over Bourke (**local catchment flooding**).

S2 Study Activities

The activities undertaken in this *Bourke FRMS* included:

1. Undertaking a consultation program over the course of the study to ensure that the Bourke community was informed of the objectives, progress and outcomes over the course of the study (**Chapter 1** and **3**, as well as **Appendix A**).
2. Analysis of historic stream flow data to generate the flood frequency relationships for the Darling River at Bourke (**Chapter 2** and **Appendix B**).
3. Development of hydraulic models and the definition of Darling River and local catchment flooding for flood events up to the Extreme Flood (**Chapter 2** and **Appendix B**).
4. Assessment of the economic impacts of flooding, including the numbers of affected properties and estimation of flood damages (**Chapter 2** and **Appendix C**).
5. Review of current flood related planning controls for Bourke and their compatibility with flooding conditions (**Chapter 2**).
6. Strategic review of potential floodplain management works and measures aimed at reducing flood damages, including an economic assessment of the most promising measures and the preparation of suggested wording for inclusion in the *Bourke Shire Council Development Control Plan* which are aimed at guiding future development in flood prone areas (**Chapter 3** and **Appendices D** and **E**).

7. Ranking of works and measures using a multi-objective scoring system which took into account economic, financial, environmental and planning considerations (**Chapter 4**).

8. Preparation of the *Bourke FRMP* (**Chapter 5**).

S3 Existing Flood Mitigation Measures at Bourke

Bourke is protected from Darling River flooding by a 10.5 km long earthen ring levee (**Bourke Levee**) that has been highly modified over the past 70 years. **Figure 2.1**, sheet 3 shows the current alignment of the Bourke Levee, while **Figure 2.2** shows how its alignment and length has changed over the past 70+ years. **Figure 2.3** is a long section along the alignment of the Bourke Levee showing its crest relative to adjacent floodplain and design flood levels.

Local catchment runoff discharges to the river side of the Bourke Levee via eleven (11) individual pipes to which flood gates have been fitted to their outlets. **Figure 2.1**, sheet 3 shows the location of the pipes and their associated flood gates. A series of flood evacuation pumps comprising both permanent and portable fixtures are also used to discharge local catchment runoff to the river side of the Bourke Levee during periods when the flood gates are in their closed position (i.e. during periods of elevated water levels in the Darling River). The location of the flood evacuation pumps are also shown on **Figure 2.1**, sheet 3.

The adjacent Alice Edwards Village is protected from Darling River flooding by a 1.7 km long earthen ring levee (**Alice Edwards Village Levee**), the current alignment of which is shown on **Figure 2.1**, sheet 3. **Figure 2.4** is a long section along the alignment of the Bourke Levee showing its crest relative to adjacent floodplain and design flood levels. No details were available on the stormwater drainage system which controls local catchment runoff internal to the Alice Edwards Village Levee. For this reason, the nature of local catchment flooding internal to the Alice Edwards Village Levee has not been defined as part of the present study.

The Imminent Failure Flood (**IFF**)[1] for the Bourke and Alice Edwards Village levees has been assessed as being equivalent to the 10% and 5% AEP, respectively.

The *Bourke Shire Local Flood Plan* (NSW State Emergency Service (**NSW SES**), 2013) states that Bourke and Alice Edwards Village are protected from Darling River flooding up to 15.5 m and 14.5 m on the *Darling River at Bourke stream gauge* (GS 425003) (**Bourke stream gauge**), respectively. However, the present study found that absent the installation of any temporary flood protection measures, Bourke and Alice Edwards Village are protected from Darling River flooding only up to 14.35 m and 15.01 m on the Bourke stream gauge, respectively.[2]

S4 Summary of Flood Impacts

Figures 2.5 and **2.6** (3 sheets each) show the indicative extent and depths of inundation of both the 1% AEP and Extreme Flood events on the Darling River.

[1] The IFF is the flood which would compromise the freeboard provision in the levee design, which based on the findings of the *Preliminary Freeboard Analysis* undertaken as part of the present investigation (refer **Appendix D** of the *Bourke FRMS* report for details) is taken to be equal to 1.0 m. The prediction of a flood higher than the IFF would trigger the evacuation of the protected area, as NSW State Emergency Service would have deemed the levee to be at risk of failure.

[2] Council advised that these two low spots in the levees would be sandbagged should the need arise.

As mentioned above, major overtopping of the Bourke Levee does not occur for floods less than about 1% AEP in magnitude. As a result, depths of inundation resulting from local catchment flooding internal to the ring levee is generally of a low hazard nature, with depths of inundation generally not exceeding 0.3 m in a 1% AEP local catchment flood event. Depths of inundation in parts of North Bourke exceed 1 m during a 1% AEP flood on the Darling River, namely in a number of residential properties that are located on the eastern side of the Mitchell Highway.

While no existing development that is located internal to the Bourke Levee would experience above-floor flooding during a 1% AEP local catchment storm event, four existing dwellings and one commercial building that are located in North Bourke would experience above-floor flooding during a 1% AEP flood on the Darling River, resulting in total damages of about $0.47 Million.

The total damages that would be experienced internal to the Bourke Levee as a result of a 1% AEP local catchment storm is estimated to be about $0.94 Million, increasing to a maximum of $1.25 Million if such a storm was to occur when the flood gates are closed and the flood evacuation pumps are not operational.

The *Present Worth Value* of damages for all Darling River floods should the Bourke and Alice Edwards Village levees experience a partial failure is about $58.1 Million and $1.0 Million, respectively. These values are the maximum amount that could be spent upgrading the town levees to ensure that they are geotechnically stable, free of defects and incorporate the required freeboard to the 1% AEP flood and still be justified on economic grounds.

S5 Bourke Floodplain Risk Management Plan

The *Bourke FRMP* setting out recommended floodplain risk management measures is presented in **Chapter 5**, with the recommended works and measures summarised below. The recommended works and measures have been given a provisional priority ranking, confirmed by the Floodplain Risk Management Committee, according to a range of economic, social, environmental and other criteria set out in **Table 4.1** of this report.

The *Bourke FRMP* includes four management measures which could be implemented by Council with the assistance of NSW SES, all of which would not require State Government funding. The four measures are as follows:

- **Measure 1** – Council to consider the inclusion of a new special flood considerations clause which would apply to land which lies between the FPA and the Extreme Flood.
- **Measure 2** - The application of a graded set of planning controls for future development that recognise the location of the development within the floodplain; to be applied through an update of the wording in *Bourke Shire Development Control Plan 2012*. Recommended wording for inclusion in *Bourke Shire Development Control Plan 2012*is set out in **Appendix E** of this report.
- **Measures 3** - Improvements in the NSW SES's emergency response planning, including use of the flood related information contained in this report to update the *Bourke Shire Local Flood Plan*.
- **Measure 4** - Council should take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplain of the flood risk. This could be achieved through the preparation of a *Flood Information Brochure* which could be prepared by Council with the assistance of NSW SES containing both general and site specific data and distributed with rate notices.

In addition to the above measures, the *Bourke FRMP* includes the following six “structural” measures which would require Government funding:

- **Measure 5** – The investigation and concept design of the upgrade of the Bourke Levee to a 1% AEP design standard (Estimated Cost - $150,000).
- **Measure 6** – The detailed design and construction of the Bourke Levee upgrade works (Estimated Cost - $1.25 Million).
- **Measure 7** – The investigation and concept design of the upgrade of the Alice Edwards Village Levee to a 1% AEP design standard (Estimated Cost - $40,000).
- **Measure 8** – The detailed design and construction of the Alice Edwards Village Levee upgrade works (Estimated Cost - $200,000).
- **Measure 9** – Investigation and development of a flood evacuation pump strategy for Bourke (Estimated Cost - $100,000).
- **Measure 10** – Detailed design and implementation of the flood evacuation pump strategy for Bourke (Estimated Cost - $1 Million).

S6 Timing and Funding of the Bourke FRMP Measures

The total estimated cost to implement the measures set out in the *Bourke FRMP* is estimated to be **$2.74 Million**, exclusive of Council and NSW SES Staff Costs. The timing of the measures will depend on Council’s overall budgetary commitments and the availability of both Local and State Government funds.

Assistance for funding qualifying projects included in the *Bourke FRMP* may be available upon application under the Commonwealth and State funded floodplain management programs, currently administered by the Office of Environment and Heritage.

S7 Council Action Plan

1. Council adopted the *Bourke FRMP* according to the procedure recommended in **Section 5.13**.
2. Council and NSW SES commence work on the “non-structural” measures in the *Bourke FRMP* (**Measures 1**, **2**, **3** and **4**).
3. Council apply for Government Funding to undertake the investigation and concept design of the levee upgrades, as well as development of the flood evacuation pump strategy for Bourke (**Measures 5**, **7** and **9** of the *Bourke FRMP*).

Following the completion of the aforementioned investigations and concept designs, Council to apply for Government Funding to undertake the detailed design and construction of the works (**Measure 6**, **8** and **10** of the *Bourke FRMP*).

1 INTRODUCTION

1.1 Study Background

Bourke Shire Council (**Council**) commissioned the preparation of the *Bourke Flood Study* and the *Bourke Floodplain Risk Management Study and Plan* (***Bourke FRMS&P***) for the town of Bourke in accordance with the New South Wales Government's *Flood Prone Land* policy. This report sets out the findings of both the *Bourke Flood Study* and the *Bourke FRMS&P*. **Figure 1.1** shows the location of the town which lies on the Darling River about 80 km (by river) downstream of the confluence of the Barwon River and Culgoa River.

The *Flood Study* defined flood behaviour in the vicinity of Bourke for both historic and design flood events, while the *Bourke Floodplain Risk Management Study (**Bourke FRMS**)* reviewed baseline flooding conditions, including an assessment of economic impacts and the feasibility of potential measures aimed at reducing the impact of flooding on both existing and future development. This process allowed the formulation of the *Bourke Floodplain Risk Management Plan* (***Bourke FRMP***).

In this report, the inundation of land by floodwater which originates from the Darling River is referred to as '*Darling River flooding*", while the inundation of land resulting from runoff which occurs as a result of heavy and/or prolonged rain over Bourke is referred to as "*local catchment flooding*".

1.2 Background Information

The following documents were used in the preparation of this report.

- *Bourke Flood Levee Augmentation Study* (Sinclair Knight & Partners (**SKP**), 1986)
- *Bourke Shire Local Flood Plan* (NSW State Emergency Service (**NSW SES**), 2013)
- *Floodplain Development Manual* (New South Wales Government (**NSWG**), 2005)
- *Rural Flood Study Darling River Floodplain (Bogan River Confluence to Louth)* (URS et al., 2009)
- *Bourke Local Environmental Plan, 2012*
- *Bourke Levee – Investigation for Upgrade of the Levee* (NSW Public Works (**PW**), 2011)
- *Visual Audit of Bourke Levee* (PW, 2012)
- *Bourke Shire Development Control Plan 2012* (Bourke Shire Council, 2012)
- *Australian Rainfall and Runoff – A Guide to Flood Estimation* (Geoscience Australia (**GA**), 2019)
- *Floodplain Management Plan for the Barwon-Darling Valley Floodplain* (NSW Department of Primary Industries – Water (**DPIW**), 2017)
- *Draft Bourke Levee Owner's Manual* (PW, 2018)
- *425003 Darling River at Bourke – High Stage Rating Post the 2012 Floods* (WaterNSW, 2020)

Refer **Section B1.1** of **Appendix B** for a summary of the above reports.

1.3 Overview of FRMS Report

The results of the *Bourke FRMS* and the *Bourke FRMP* are set out in this report. The contents of each chapter of the report are briefly outlined below:

- **Chapter 2**, **Baseline Flooding Conditions**. This Chapter includes a description of the drainage system and a review of existing flood behaviour at Bourke as derived by the *Bourke Flood Study*. The Chapter also summarises the economic impacts of flooding on existing urban development, reviews Council's existing flood related planning controls and management measures and NSW SES's flood emergency planning. The Chapter concludes with an assessment of the impact the potential increases in rainfall intensities linked to future climate change would have on flooding behaviour.
- **Chapter 3**, **Potential Floodplain Risk Management Measures**. This Chapter reviews the feasibility of floodplain risk management measures for their possible inclusion in the *Bourke FRMP.* The list of measures considered is based on input from the Floodplain Risk Management Committee, as well as the Community Consultation process, which sought the views of residents and business owners at Bourke in regard to potential flood management measures which could be included in the *Bourke FRMP*. The measures are investigated at the strategic level of detail, including an indicative cost estimate of the most promising measure and benefit/cost analysis.
- **Chapter 4**, **Selection of Floodplain Risk Management Measures**. This Chapter assesses the feasibility of potential floodplain risk management strategies using a multi-objective scoring procedure which was developed in consultation with the Floodplain Risk Management Committee and outlines the preferred strategy.
- **Chapter 5** presents the **Bourke Floodplain Risk Management Plan**. The *Bourke FRMP* comprises a number of structural and non-structural measures which are aimed at increasing the flood awareness of the community and ensuring that future development is undertaken in accordance with the local flood risk.
- **Chapter 6** contains a glossary of terms used in the study.
- **Chapter 7** contains a list of References.

Four appendices provide further information on the study results:

Appendix A – Community Consultation summarises residents' and business owners' views on potential flood management measures which could be incorporated in the *Bourke FRMP*.

Appendix B – Bourke Flood Study contains a brief description of previous studies which have been undertaken to define the nature of flooding at Bourke, as well as an analysis of the available stream flow record. This Appendix also deals with the development and calibration of new hydraulic models, as well as their use to define the nature of both Darling River and local catchment flooding at Bourke for design flood events up to the Extreme Flood.

Appendix C – **Flood Damages** is an assessment of the economic impacts of flooding to existing residential, commercial and industrial development, as well as public buildings in Bourke. The damages have been assessed using the results of the *Bourke Flood Study,* an estimate of floor levels and characteristics of affected development derived from a combination of a "drive-by" property survey and use of Google Street View, as well as data from Light Detection and Ranging (**LiDAR**) survey.

Appendix D – **Preliminary Freeboard Analysis** sets out the results of an analysis which was undertaken to derive the freeboard allowance which has been incorporated in the strategic design of the upgraded levee.

Appendix E – **Suggested Wording for Inclusion in Bourke Shire Development Control Plan** presents guidelines for the control of future urban development in flood prone areas in the Bourke local government area.

1.4 Community Consultation

A *Community Newsletter and Questionnaire* was distributed by Council seeking details from residents and business owners regarding their attitudes toward potential floodplain management measures. Community responses are summarised in **Chapter 3** of this report, with supporting information in **Appendix A**. The views of the community on potential flood management measures to be considered in the study were also taken into account in the assessment presented in **Chapter 3** of this report.

The draft Bourke FRMS&P report was placed on public exhibition for a period of four weeks in late 2022, with no submissions received by the closing date.

1.5 Flood Frequency and Terminology

In this report, the frequency of floods is referred to in terms of their Annual Exceedance Probability (**AEP**). The frequency of floods may also be referred to in terms of their Average Recurrence Interval (**ARI**). The approximate correspondence between these two systems is:

Annual Exceedance Probability (AEP) – %	Average Recurrence Interval (ARI) – years
0.2	500
0.5	200
1	100
2	50
5	20
20	5
10	10

The AEP of a flood represents the percentage chance of it being equalled or exceeded in any one year. Thus a 1% AEP flood, which is equivalent to a 100 year ARI, has a 1% chance of being equalled or exceeded in any one year and would be experienced, on the average, once in 100 years; similarly, a 20 year ARI flood has a 5% chance of exceedance, and so on.

While a 1% AEP flood is a major flood event, it does not define the upper limit of possible flooding. Over the course of a human lifetime of, say 70 years, there is a 50 per cent chance that a flood at least as big as a 1% AEP event will be experienced. Accordingly, a knowledge of flooding patterns in the event of larger flood events up to the Extreme Flood, the largest flood that could reasonably be expected to occur, is required for floodplain and emergency management purposes. The hydrographs of the Extreme Flood were determined by applying a multiplication factor of five to the 1% AEP hydrographs. In the *Bourke Flood Study* (refer **Appendix B** for details) flooding patterns were assessed for design floods ranging between a 10% AEP event and the Extreme Flood.

2 BASELINE FLOODING CONDITIONS

2.1 Background

The township of Bourke, which was first established in 1835 and currently has a population of about 1,800 is located on the eastern bank of the Darling River about 780 km north-west of Sydney. The catchment area of the Darling River at Bourke is approximately 386,000 km^2 and includes the Culgoa, Moonie, Gwydir, Namoi, Macquarie and Castlereagh River basins.

The main channel of the Darling River at Bourke is about 80 m in width and between about 10-15 m in depth, while the floodplain is about 28 km in width. There is substantial warning time of an impending flood on the Darling River at Bourke, with the floodwave generally taking about seven days to travel the 200 km (by river) between Brewarrina and Bourke.[3]

Figure 2.1 (3 sheets) shows the location of the WaterNSW Operated *Darling River at Bourke stream gauge* (GS 425003) (**Bourke stream gauge**) on the southern bank of the river midway between to the extension of Richard and Sturt streets. The Bourke stream gauge was installed in February 1895 and later upgraded to a telemetered system in 1968.

There are three main urban centres at Bourke, two of which are located on the eastern bank of the Darling River (referred to herein as "**Bourke**" and "**Alice Edwards Village**", the latter which is an aboriginal community), while the third is located on the western bank of the river adjacent to Bourke Aerodrome (referred to herein as "**North Bourke**"). **Figure 2.1**, sheets 2 and 3 show the location of the three urban centres, while **Table 2.1** below sets out the number of residential, commercial/industrial and public properties in each.

Natural surface levels in Bourke and Alice Edwards Village generally vary between about RL 104 m AHD and RL 106 m AHD, which is equivalent to between about 12 m and 14 m on the Bourke stream gauge, while natural surface levels in North Bourke generally vary between about RL 106 m AHD and RL 108 m AHD, which is equivalent to between about 14 m and 16 m on the same stream gauge.

TABLE 2.1
EXISTING DEVELOPMENT AT BOURKE

Development Type	Urban Centre		
	Bourke	Alice Edwards Village	North Bourke
Residential	853	18	50
Commercial / Industrial	94	0	13
Public	34	0	1
Total	**981**	**18**	**64**

2.2 Existing Flood Mitigation Measures at Bourke

Steps have been taken over the years to protect parts of Bourke from Darling River flooding through the construction of two earthen ring levees (collectively referred to herein as the **"town levees**") in combination with the operation of a series of flood gates and flood evacuation pumps to control local catchment flooding.

[3] *Source: Bourke Shire Local Flood Plan*

Figure 2.2 shows the approximate alignment of an earthen ring levee which was constructed to protect parts of Bourke at the time of major floods that occurred in 1950, 1971, 1974 and 1976 (denoted herein as the "**Bourke Levee**"), while **Figure 2.3** is a long section along the current levee alignment showing its crest level relative to adjacent levels on the floodplain. Also shown on **Figure 2.3** are water surface profiles for design flood events ranging between 10% (1 in 10) AEP and the Extreme Flood.

While the crest of the Bourke Levee is relatively uniform in elevation, there are four existing low points which reduce its level of protection (refer **Figure 2.3** for location). While the existing low points at Kidman Way (Cobar Road), the Old Bourke Wharf and the Mitchell Highway (Cumamulla Road) can be easily accessed by emergency services during a flood event, the existing low point which is located adjacent to Rotary Park is located in private property.

Local catchment runoff generated internal to the Bourke Levee is controlled by a piped stormwater drainage system which is interconnected by a series of roadside table drains, drainage swales/channels and general depressions. **Figure 2.1**, sheet 3 shows the layout of the existing stormwater drainage system internal to the Bourke Levee. Local catchment runoff discharges to the river side of the earthen levee via eleven (11) individual pipes to which flood gates have been fitted to their outlets. **Figure 2.1**, sheet 3 shows the location of the eleven outlet pipes (as identified by their assigned flood gate numbers), while **Table 2.2** over lists their location by levee chainage, as well as their diameter and invert level.

A series of flood evacuation pumps comprising both permanent and portable fixtures are used to discharge local catchment runoff to the river side of the Bourke Levee during periods when the flood gates are in their closed position (i.e. during periods of elevated water levels in the Darling River). The adopted naming convention for each pump is shown on **Figure 2.1**, sheet 3 and in **Table 2.2**, noting that there are three permanent pumps which are used to evacuate trapped low points that are present on the northern side of the Kamilaroi Highway (FSP_01), on the eastern side of the Mitchell Highway (FSP_02) and on the western side of the Main Western Railway (FSP_03).

The NSW Department of Public Works (now Public Works Advisory) undertook a visual audit of the Bourke Levee in May 2013 and later published its findings in a report entitled *Visual Audit of Bourke Levee* (PW, 2014). While PW, 2014 found that the Bourke Levee was generally in an acceptable condition, there were a number of issues identified which were of a relative minor nature, details of which are set out in **Section B1.2.6** of **Appendix B**.

The second earthen levee protects Alice Edwards Village and was constructed after a flood that occurred in 1984 (denoted herein as the "**Alice Edwards Village Levee**").[4] **Figure 2.1**, sheets 2 and 3 show the alignment of the Alice Edwards Village Levee, while **Figure 2.4** is a long section along the current levee alignment showing its crest level relative to adjacent levels on the floodplain. Also shown on **Figure 2.4** are water surface profiles for design flood events ranging between 10% (1 in 10) AEP and the Extreme Flood. The crest level of the Alice Edwards Village Levee has been set at an elevation of about RL 107.1 m AHD, with a single low point located on its southern side where a local road provides access off Parkdale Road. No details were available on the stormwater drainage system which controls local catchment runoff internal to the Alice Edwards Village Levee. It is also understood that a visual audit of the existing levee has not been undertaken to date.

[4] *Source: Bourke Shire Local Flood Plan*

TABLE 2.2
EXISTING DRAINAGE STRUCTURES AROUND PERIMETER OF BOURKE LEVEE[1]

Levee Chainage (m)		Location	Flood Gates			Flood Evacuation Pump			
Present Study	PW, 2018		Flood Gate ID[2]	Culvert Diameter (mm)	Invert of Pipe[3] (m AHD)	Pump ID[2]	Type	Capacity (L/s)	Status
1,655	1,650	Brewarrina Road	-			FSP_01	ABS	130	Permanent
3,030	3,000	Common	-			FSP_02	ABS	130	Permanent
3,240	3,250	Nyngan Road	-			FSP_03	Sulzer	100	Permanent
5,635	5,655	Pistol Range	FG_01	525	101.62	FGP_01	Flygt	30	Portable
7,475	7,455	Adelaide Street	FG_02	525	103.73	FGP_02	Flygt	30	Portable
7,985	7,950	Meek Street	FG_03	525	101.76	FGP_03	Flygt	30	Portable
8,200	8,160	Charles Street	FG_04	525	103.81	FGP_04	Flygt	30	Portable
8,430	8,390	Sturt Street	FG_05	600	102.85	FGP_05	Flygt	30	Portable
8,665	8,635	Richard House	FG_06	1,050	102.11	FGP_06	Flygt	30	Permanent
8,800	8,785	Hudson House	FG_07	300	103.80	FGP_07	Portable	unknown	Portable
8,940	8,940	Glen Street	FG_08	525	103.26	FGP_08	Flygt	30	Portable
9,250	9,250	Wilson Street	FG_09	525	103.32	FGP_09	Flygt	30	Portable
9,675	9,645	Water Works	FG_10	1,050	101.07	FGP_10	Flygt	30	Portable
9,925	9,925	Back O Bourke	FG_11	525	102.33	FGP_11	Flygt	30	Portable

1. Source PW, 2018, unless otherwise stated.
2. Refer **Figure 2.1**, sheet 3 for location.
3. Taken from detailed ground survey.

2.3 Flood History at Bourke

Bourke has experienced several large floods since settlement occurred in 1835. While telemetered stream gauge records only extend back to 1968, annual maximum peak discharges are available dating back to 1885. While SKP, 1986 states that a major flood that occurred in the Darling River Valley in 1864 is considered the flood of record at Bourke, there is no information available regarding the severity of flooding that was experienced in the town during this event.

More recently, major flooding has been experienced in the Darling River Valley in August 1950, January 1974, March 1976, September 1998 and March 2012. **Table 2.3** over provides a comparison of the maximum water levels and peak flows that were recorded by the Bourke stream gauge for the ten (10) historic floods that were larger than 10% AEP in magnitude, noting that NSW SES's Major Flood Level is currently set at 12.7 m on the stream gauge.

The stage hydrographs over show that water levels in the river can remain elevated above NSW SES's Major Flood Level of 12.7 m on the Bourke stream gauge for weeks and in the case of the September 1998 flood, for a period of almost two months.

TABLE 2.3
FLOOD HISTORY AND DESIGN FLOOD LEVELS(1,2)
BOURKE STREAM GAUGE

Flood Event	Gauge Height (m)	Elevation(3) (m AHD)	Peak Flow (m^3/s)
Extreme	15.96	107.81	19,500
0.2% AEP	14.70	106.55	10,700
March 1864	14.52	106.37	-
0.5% AEP	14.50	106.35	8,100
April 1890	14.39	106.24	6,629
1% AEP	14.38	106.23	6,500
2% AEP	14.26	106.11	5,000
March 1976	14.18	106.03	5,841
January 1974	14.10	105.95	5,198
5% AEP	14.04	105.89	3,050
August 1950(4)	13.93	105.78	4,346
March 2012	13.83	105.68	2,092
September 1998	13.78	105.63	2,701
March 1956(5)	13.75	105.60	3,459
July 1893	13.68	105.53	3,220
March 1971	13.64	105.49	2,563
10% AEP	13.51	105.36	1,700
Major(6)	12.70	104.55	-
Moderate(6)	11.40	103.25	-
Minor(6)	9.50	92.35	-

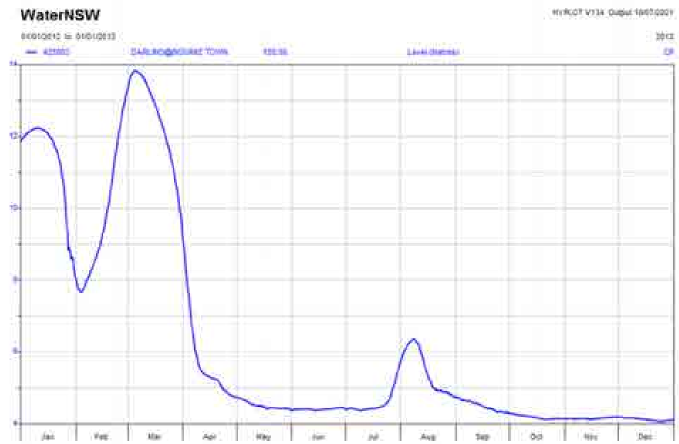
1. Design flood levels relate to those derived as part of the present study.
2. Refer **Table B1.6** of **Appendix B** for source of historic flood data.
3. Gauge zero on the Bourke stream gauge = RL 91.85 m AHD.
4. A second flood peak occurred in December 1950 when the flood level peaked at RL 13.56 m (i.e. 105.41 m AHD) on the Bourke stream gauge.
5. A second flood peak occurred in July 1956 when the flood level peaked at RL 13.61 m (i.e. 105.46 m AHD) at the Bourke stream gauge.
6. Source: NSW SES Flood Intelligence Card "*Bourke 425003 (425 Darling River)*" dated 19 June 2017

Annexure B1 in **Appendix B** of this report contains a series of plates showing the major flooding that was experienced at Bourke during the August 1950, March 1971, January 1974, March 1976, May 1988 and March 2012 floods. Also contained in **Annexure B1** are several photos showing the minor flooding that occurred internal to the Bourke Levee as a result of very intense rain which fell directly over the town in February 2009.

January 1974 flood

March 1976 flood

September 1998 flood



March 2012 flood

2.4 Design Flood Behaviour

2.4.1 General

The *Bourke Flood Study* contained in **Appendix B** defines the nature of the following two types of flood behaviour that are experienced at Bourke:

- **Darling River flooding**, which results from flows that surcharge the main channel of the Darling River. These flows may be greater than 15 m deep in the main channel and moving at a velocity of about 1 m/s.
- **Local catchment flooding**, which results from runoff that is generated from internal to the town levees. Local catchment flooding is generally of a ponding nature reaching up to about 0.5 m in depth in a 1% AEP storm event.

The study involved computer modelling of the local catchment and Darling River floodplain to assess flow patterns and indicative extents of inundation for a range of design floods ranging from 10% AEP up to the Extreme Flood.

Two hydraulic models were developed using the TUFLOW software to define the nature of Darling River (**Darling River TUFLOW Model**) and local catchment (**Bourke TUFLOW Model**) flooding.

The hydraulic analysis comprised a two-dimensional geometric model of the floodplain which was based on grid points of natural surface levels sampled from the available LiDAR and field survey data. A 20 m grid spacing was adopted for the Darling River TUFLOW Model with a smaller 10 m grid spacing embedded internal to the model in the Darling River and Little Bogan River riparian zones, while the Bourke TUFLOW Model comprised a 5 m grid.

Four historic floods (January 1974, March 1976, September 1998 and March 2012) were used to test the Darling River TUFLOW Model, the structure of which was modified to reflect conditions on the floodplain that were present at the time of each flood. The discharge hydrographs that were recorded by the Bourke stream gauge at the time of each flood were used as input to the Darling River TUFLOW Model. The peak flood levels derived by the Darling River TUFLOW Model were found to be in good agreement with available historic flood data.

Steady-state design discharge hydrographs were also used as input to the Darling River TUFLOW Model, the peak flows for which were based on the results of a flood frequency analysis that was undertaken as part of the *Bourke Flood Study* (refer **Section B1.3.2** of **Appendix B** for discussion).

The design storms input to the Bourke TUFLOW Model were derived using the procedures set out in the 2019 edition of *Australian Rainfall and Runoff* (Geoscience Australia (**GA**), 2019) (**ARR 2019**). They assumed that rainfall intensities were uniform over the areal extent of the local catchment, although intensities varied over the duration of the storm event.

2.4.2 Design Flooding Patterns

Figures 2.3 and **2.4** show water surface profiles and the available freeboard along the alignment of the Bourke Levee and Alice Edwards Village Levee for the full range of design flood events, respectively, while **Figures 2.5** and **2.6** (2 sheets each) show the indicative extent and depths of inundation for the 1% AEP and Extreme Flood events at Bourke, respectively. **Figures B5.1** to **B5.5** of **Appendix B** show similar information for the 10, 5, 2, 0.5 and 0.2% AEP flood events.

The extents and depths of inundation shown on the abovementioned figures are a combination of Darling River flooding on the river side, and local catchment flooding on the protected side of the Bourke Levee. For presentation purposes, in the case of Darling River flooding it has been assumed that the flood gates are in their closed position and floodwater cannot backwater into town. Conversely, in the case of local catchment flooding internal to the Bourke Levee, it has been assumed that river levels are not elevated and the flood gates are in their open position.

Table 2.3 sets out the design flood levels at the Bourke stream gauge and provides a comparison with historic flood levels, while **Table 2.4** below sets out the minimum freeboard which is available to the crest of the town levees at the location of the existing low points for the design flood events that were assessed as part of the present study.

TABLE 2.4
MINIMUM AVAILABLE FREEBOARD TO CREST OF TOWN LEVEES(1,2)

AEP (%)	Bourke Levee				Alice Edwards Village Levee	
	Mitchell Highway [0 m]	Kidman Way [4,800 m]	Bourke Wharf [8,400 m]	Rotary Park [8,750 m]	Local Access Road [260 m]	Low Point [1,440 m]
10	1.30	-	0.83	1.46	-	-
5	0.70	1.12	0.31	0.94	0.95	1.18
2	0.46	0.65	0.08	0.70	0.73	0.95
1	0.34	0.45	-0.04	0.60	0.63	0.84
0.5	0.21	0.29	-0.16	0.48	0.51	0.72
0.2	-0.02	0.07	-0.35	0.28	0.33	0.53
Extreme	-1.16	-1.37	-1.55	-0.92	-1.00	-0.68

1. Values in [ ] represent the levee chainage.
2. A negative value represents the maximum depth to which the crest of the existing levee would be overtopped in the absence of any wind or wave action.

The key features of Darling River flooding along the alignment of the Bourke Levee are as follows:

- Flood levels exceed the Imminent Failure Flood (**IFF**)[5] level of the Bourke Levee in the vicinity of the Old Bourke Wharf in a flood event more frequent than 10% AEP.
- Floodwater will surcharge the Bourke Levee at the Old Bourke Wharf in a 1% AEP flood.
- In the absence of any wind or wave action and assuming that the low points at the Mitchell Highway, Kidman Way and the Old Bourke Wharf are temporarily raised as recommended in the *Levee Owner's Manual* (PW, 2018), then the Bourke Levee will not be overtopped for floods up to 0.2% AEP in magnitude.
- The available freeboard to the crest of the Bourke Levee (assuming the low points in the Bourke Levee have been temporarily raised) is 0.6 m at the 1% AEP level of flooding, reducing to 0.28 m at the 0.2% AEP level of flooding.

[5] The IFF is the flood which would compromise the freeboard provision in the levee design, which based on the findings of the *Preliminary Freeboard Analysis* undertaken as part of the present investigation (refer **Appendix D** of the *Bourke FRMS* report for details) is taken to be equal to 1.0 m. The prediction of a flood higher than the IFF would trigger the evacuation of the protected area, as NSW SES would have deemed the levee to be at risk of failure.

- **Table 2.5** over sets out the location of the low points in the Bourke Levee and the peak gauge height at which each will be first overtopped. The Bourke Levee will commence to overtop in the vicinity of the Old Bourke Wharf when flood levels reach 14.35 m on the Bourke stream gauge, or the low point in the vicinity of Rotary Park when levels reach 14.98 m on the gauge.
- If the low points in the vicinity of the Mitchell Highway, Kidman Way and Old Bourke Wharf are temporarily raised to the elevation of the adjacent levee, floodwater will commence to exceed the IFF level of the Bourke Levee in the private property that is located adjacent to Rotary Park in a 5% AEP flood event.
- The town would be inundated to depths of between 1.8-3.2 m in an Extreme Flood.

TABLE 2.5
PEAK HEIGHTS ON BOURKE STREAM GAUGE CORRESPONDING WITH LOW POINTS ALONG TOWN LEVEES

Levee	Location	Chainage (m)	Peak Height on Bourke stream gauge when Low Point First Overtopped (m)
Bourke Levee	Mitchell Highway	0	14.73
	-	4,400	15.23
	Kidman Way	4,800	14.85
	-	8,260	15.27
	Bourke Wharf	8,400	14.35
	Private Property[(1)]	8,750	14.98
Alice Edwards Village Levee	Local Access Road	260	15.01

1. The low point is located in a private property that is located immediately to the east of Rotary Park.

The key features of Darling River flooding along the alignment of the Alice Edwards Village Levee are as follows:

- Flood levels exceed the IFF level of the Alice Edwards Village Levee in the vicinity of the local access road in a 5% AEP flood.
- In the absence of any wind or wave action, the Alice Edwards Village Levee would not be overtopped for floods up to 0.2% AEP in magnitude.
- The available freeboard to the crest of the Alice Edwards Village Levee is 0.63 m at the 1% AEP level of flooding, reducing to 0.33 m at the 0.2% AEP level of flooding.
- The existing development internal to the Alice Edwards Village would be inundated to depths of between 1.8-2.2 m in an Extreme Flood.

The key features of Darling River flooding on the floodplain in the vicinity of Bourke are as follows:

- Floodwater surcharges the banks of the Darling River in flood events more frequent than 10% AEP in magnitude.
- Parkdale Road (Alice Edwards Road) and the Mitchell Highway (Nyngan Road) will be inundated in flood events more frequent than 10% AEP.

- The Kamilaroi Highway (Brewarrina Road) and Kidman Way (Cobar Road) will commence to become inundated in a 5% AEP flood.
- Bourke commences to become isolated in a 2% AEP flood when the Mitchell Highway (Cullamulla Road) is inundated to depths of up to 250 mm where it runs between the Bourke Levee and the Swamp Bridge.
- Existing residential development that is located on the eastern side of the Mitchell Highway at North Bourke would experience above-floor flooding during floods as frequent as 5% (1 in 20) AEP.
- **Table 2.6** gives the distribution of flow across the Darling River floodplain at Bourke for the seven design flood events that were assessed as part of the present study. The total flow on the Darling River floodplain at Bourke is also given for each event
- Floodwater originating from the Darling River backwaters into the Bourke Aerodrome via a set of culverts beneath Hungerford Road and commences to inundate the runway in a 2% AEP flood event. The runway will be inundated to a depth of about 200 mm at the 1% AEP level of flooding, increasing to about 600 mm at the 0.2% AEP level of flooding.
- Floodwater surcharges the right bank of the Darling River upstream of the Old Bourke Bridge in a 0.5% AEP flood and discharges to the Bourke Aerodrome via a set of culverts beneath the Mitchell Highway in the vicinity of its intersection with Warrego Street. Floodwater commences to overtop the Mitchell Highway at this location in a 0.2% AEP flood.

TABLE 2.6
DISTRIBUTION OF FLOW ON THE DARLING RIVER FLOODPLAIN AT BOURKE
DESIGN FLOOD EVENTS
(m^3/s)

Location	Design Flood Event						
	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP	Extreme Flood
Bourke Aerodrome	-	-	-	-	1	55	2,246
Mitchell Highway (Main Channel)	841	1,255	1,511	1,646	1,772	1,941	2,574
Mitchell Highway (Billabong)	135	226	276	309	341	393	837
Mitchell Highway (Swamp)	691	1,114	1,380	1,515	1,642	1,817	2,439
Mitchell Highway (Railway)	30	452	1,882	3,114	4,394	6,423	20,200
Total Flow Across Darling River Floodplain	1,697	3,047	5,049	6,584	8,150	10,629	28,296

The key features of local catchment flooding internal to the Bourke Levee are as follows:

- Depths of flow/ponding generally doesn't exceed 300 mm in the vicinity of existing development in a 1% AEP storm event.
- Runoff generated by the catchment that is generally bounded by Warraweena Street to the west, Darling Street to the north, Monomeeth Street to the east and the Mitchell Highway to the south ponds on the northern side of the highway before being conveyed in a southerly direction via a table drain towards pump station FSP_03 in the vicinity of levee chainage 3,240 m.

- Runoff generated by the portion of the abovementioned catchment that is north of Green Street flows in a southerly direction on the eastern side of Monomeeth Street, but is diverted and is prevented from discharging to the storage area that drains to pump station FSP_02 by an access track that has been built across the table drain adjacent to the pump. Runoff is therefore diverted to pump station FSP_03.
- Runoff that drains the storage area in the vicinity of FSP_03 backs up to the culvert beneath the Mitchell Highway in the vicinity of the intersection of Bloxham Street and Meadows Road in storm events as frequency as 20% AEP.
- Runoff ponds at the natural low points that are present on the eastern and western sides of the Kidman Way crossing of the Bourke Levee in the vicinity of levee chainage 4,820 m as there are no pipes through the levee or permanent flood evacuation pumps at these two locations. That said, runoff ponding at these two locations does not impact existing development.
- The pipes extending through the Bourke Levee along the Darling River frontage generally have sufficient capacity to prevent major flooding from occurring, except in the vicinity of flood gate FG_10 where runoff backs up and inundates Wortumertie Street to a depth of about 300 mm in a 1% AEP design storm event.

2.5 Economic Impacts of Flooding

The economic consequences of floods are discussed in **Appendix C**, which assesses flood damages to residential and commercial property, as well as public buildings that are located in Bourke. There are no quantitative data available on historic flood damages in Bourke. Accordingly it was necessary to use data on damages experienced as a result of historic flooding in other urban centres. The residential flood damages were based on the publication *Floodplain Risk Management Guideline No. 4, 2007* (**Guideline No. 4**) published by the Department of Environment and Climate Change (**DECC**) (now Department of Planning and Environment (**DPE**)). Damages to commercial development, as well as public buildings were evaluated using data from previous floodplain management investigations in NSW.

It is to be noted that the principle objectives of the damages assessment were to gauge the severity of urban flooding likely to be experienced at Bourke and also to provide data to allow the comparative economic benefits of upgrading the existing levee. As explained in **Appendix C**, it is not the intention to determine the depths of inundation or the damages accruing to *individual properties*, but rather to obtain a reasonable estimate of damages experienced over the extent of the urban area at Bourke for the various design flood events. The estimation of damages using *Guideline No. 4* (in lieu of site specific data determined by a loss adjustor) also allows a uniform approach to be adopted by Government when assessing the relative merits of measures competing for financial assistance in flood prone centres in NSW.

Damages were estimated for the design flood levels determined from the hydraulic modelling that was undertaken as part of the *Bourke Flood Study*, while the elevations of the floors of affected properties were estimated by a “drive-by” survey which assessed the height of the floor above local natural surface elevations. These natural surface elevations were derived from the LiDAR survey used to construct the Darling River and Bourke TUFLOW models. Flood damages in Bourke resulting from the following five scenarios were assessed as part of the present study:

<u>Damage due to Darling River flooding</u>

- No coincident rainfall over Bourke during river flooding (**Darling River Flood Damage Scenario 1**).

- No coincident rainfall over Bourke during river flooding that causes a partial failure of the existing levee (**Darling River Flood Damage Scenario 2**). Note that partial failure has been assumed to occur at the low point that is located in the private property adjacent to Rotary Park.

<u>Damage due to local catchment flooding</u>

- No river flooding and gravity drainage of the protected area via the eleven (11) gated stormwater drainage pipes that control ponding levels behind the Bourke Levee (**Local Catchment Damage Scenario 1**).
- Pumping of stormwater runoff to the river side of the Bourke Levee via the fourteen (14) pumps and assuming the eleven (11) flood gates are in their closed position and the town levees are not overtopped (**Local Catchment Damage Scenario 2**).
- Failure of the fourteen (14) pumps to operate during a storm event and assuming the eleven (11) flood gates are in their closed position and the town levees are not overtopped (**Local Catchment Damage Scenario 3**).

The number of flood affected and flood damaged properties, as well as the estimated damages which would occur for Darling River and local catchment flooding are summarised over in **Tables 2.7** and **2.8**, respectively.

Provided the town levees do not fail prior to them being overtopped, no existing development within the Bourke and Alice Edwards Village damage centres would experience above-floor inundation for Darling River floods up to 0.2% (1 in 500) AEP in magnitude. At North Bourke, one commercial property would experience above-floor inundation during a 10% AEP (1 in 10) flood, while two dwellings would experience above-floor inundation during a 5% (1 in 20) flood. At the 1% (1 in 100) AEP level of flooding, four dwellings and one commercial property would experience above-floor inundation at North Bourke as a result of Darling River flooding.

Failure of the town levees during a Darling River flood would result in significant flood damages being experienced at Bourke, with an estimated 867 dwellings, 90 commercial and 31 public buildings expected to experience above-floor inundation at the 1% AEP level of flooding. The total damages that would be experienced at Bourke should the town levees fail during a 1% AEP flood on the Darling River is estimate to be about $98 Million.

While local catchment runoff would affect a large number of properties that are protected from Darling River flooding by the Bourke Levee, no buildings would experience above-floor inundation for all storms up to 1% (1 in 100) AEP in intensity, even should intense rain fall over Bourke coincident with elevated water levels in the river. The total damages that would be experienced as a result of a 1% AEP storm over Bourke is estimated to be about $0.94 Million, increasing to a maximum of $1.25 Million if such a storm was to occur when the flood gates are closed and the flood evacuation pumps are not operational.

The *Present Worth Value* of damages for all Darling River floods between the IFF and the 1% AEP event assuming a partial failure of the town levees is about $58.1 Million and $1.0 Million in Bourke and Alice Edwards Village, respectively. These values are the maximum amount that could be spent upgrading the town levees to ensure that they are geotechnically stable, free of defects and incorporate the required freeboard to the 1% AEP flood and still be justified on economic grounds.

TABLE 2.7
FLOOD DAMAGES AT BOURKE RESULTING FROM DARLING RIVER FLOODING

Damage Centre	Design Flood Event (% AEP)	Number of Properties Flood Affected						Number of Properties Flood Damaged						Total Damages ($ Million)	
		Residential		Commercial		Public		Residential		Commercial		Public			
		DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2
Bourke	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	798	0	60	0	20	0	617	0	29	0	8	0	55.0
	2	0	848	0	86	0	34	0	813	0	70	0	22	0	76.7
	1	0	852	0	94	0	34	0	850	0	90	0	31	0	96.7
	0.5	0	853	0	94	0	34	0	852	0	94	0	32	0	110.3
	0.2	0	853	0	94	0	34	0	853	0	94	0	32	0	134.2
	Extreme	853	853	94	94	34	34	853	853	94	94	34	34	205.6	205.4
Alice Edwards Village	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	17	0	0	0	0	0	12	0	0	0	0	0	0.93
	2	0	18	0	0	0	0	0	17	0	0	0	0	0	1.36
	1	0	18	0	0	0	0	0	18	0	0	0	0	0	1.49
	0.5	0	18	0	0	0	0	0	18	0	0	0	0	0	1.58
	0.2	0	18	0	0	0	0	0	18	0	0	0	0	0	1.79
	Extreme	18	18	0	0	0	0	18	18	0	0	0	0	3.11	3.16

DRFS1 = Darling River Flood Damage Scenario 1 **DRFS2** = Darling River Flood Damage Scenario 2

Cont'd Over

TABLE 2.7 (Cont'd)
FLOOD DAMAGES AT BOURKE RESULTING FROM DARLING RIVER FLOODING

Damage Centre	Design Flood Event (% AEP)	Number of Properties Flood Affected						Number of Properties Flood Damaged						Total Damages ($Million)	
		Residential		Commercial		Public		Residential		Commercial		Public			
		DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2	DRFS1	DRFS2
North Bourke	10	0	Not Applicable	0	Not Applicable	0	Not Applicable	0	Not Applicable	1	Not Applicable	0	Not Applicable	0	Not Applicable
	5	2		1		0		2		1		0		0.21	
	2	3		1		0		3		1		0		0.32	
	1	6		1		0		4		1		0		0.47	
	0.5	9		1		0		5		1		0		0.64	
	0.2	19		1		1		9		1		0		1.15	
	Extreme	42		7		1		40		5		1		8.57	

DRFS1 = Darling River Flood Damage Scenario 1 **DRFS2** = Darling River Flood Damage Scenario 2

TABLE 2.8
FLOOD DAMAGES AT BOURKE RESULTING FROM LOCAL CATCHMENT FLOODING[(1)]

Design Flood Event (% AEP)	Number of Properties Flood Affected									Number of Properties Flood Damaged									Total Damages ($ Million)		
	Residential			Commercial			Public			Residential			Commercial			Public					
	LCFS1	LCFS2	LCFS3	LCFS1	LCFS2	LCFS3	LCFS1	LCFS2	LCFS3	LCFS1	LCFS2	LCFS3	LCFS1	LCFS2	LCFS3	LCFS1	LCFS2	LCFS3	LCFS1	LCFS2	LCFS3
10	5	9	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0.15	0.19
20	16	24	25	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0.29	0.41	0.43
5	32	42	44	3	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0.57	0.76	0.79
1	53	69	72	5	5	5	1	1	1	0	0	0	0	0	0	0	0	0	0.94	1.2	1.25
0.5	75	98	104	5	5	5	2	2	3	2	2	2	0	0	0	0	0	0	1.38	1.75	1.85
0.2	117	138	140	6	7	7	2	3	3	2	3	3	0	0	0	0	0	0	2.12	2.51	2.55
Extreme	803	805	805	89	89	89	30	30	30	625	630	630	62	63	63	21	21	21	65.15	65.69	65.69

1. Flood damages only computed for the urban centre of Bourke

LCFS1 = Local Catchment Flood Damage Scenario 1 **LCFS2** = Local Catchment Flood Damage Scenario 2 **LCFS3** = Local Catchment Flood Damage Scenario 3

2.6 Impact of Flooding on Vulnerable Development and Critical Infrastructure

Figure 2.7 shows the location of vulnerable development and critical infrastructure relative to the extent of inundation resulting from floods with AEP's of between 10 and 0.2 per cent, as well as the Extreme Flood, while **Table 2.9** summarises the impact that flooding has on these types of development at Bourke.

While community assets such as the electricity substation and telephone exchange are protected by the Bourke Levee and therefore only impacted by floods larger than about 0.2% AEP, the main runway in Bourke Aerodrome would be impacted by a 2% AEP flood on the Darling River.

Both the Mitchell Highway (Nyngan Road) and Parkdale Road (Alice Edwards Road) are impacted by floods as frequent as 10% AEP, with the latter preventing vehicular access to Alice Edwards Village. Both the Kamilaroi Highway (Brewarrina Road) and Kidman Way (Cobar Road) would be impacted by a 5% AEP flood, the Mitchell Highway (Cunnamulla Road) would generally remain flood free for all floods up to 1% AEP in magnitude where it runs between Bourke and North Bourke.

While most emergency service facilities are located on land that is only affected by an Extreme Flood, the Bourke NSW SES local unit headquarters is located on land which is affected by a 0.2% AEP Darling River flood event. It is also noted that the road leading to the local unit headquarters would be inundated by a 2% AEP flood on the Darling River.

Vulnerable development is principally located in the urban centre of Bourke and is therefore not affected by Darling River floods up to about 0.2% AEP in magnitude. The exception is Kidmans Camp Caravan Park which is located in North Bourke given it is impacted by floods larger than 1% AEP in magnitude.

2.7 Flood Hazard and Hydraulic Categorisation of the Floodplain

2.7.1 General

According to Appendix L of NSWG, 2005, in order to achieve effective and responsible floodplain risk management, it is necessary to divide the floodplain into areas that reflect:

1. The impact of flooding on existing and future development and people. To examine this impact it is necessary to divide the floodplain into *"flood hazard vulnerability"* categories, which are assessed on the basis of the velocity and depth of flow. The results of the *Bourke Flood Study* (refer **Appendix B**) were used to divide the floodplain into six flood hazard vulnerability zones. **Section 2.7.2** below provides details of the adopted procedure.
2. The impact of future development activity on flood behaviour. Development in active flow paths (i.e. *"floodways"*) has the potential to adversely re-direct flows towards adjacent properties. Examination of this impact requires the division of flood prone land into various *"hydraulic categories"* to assess those parts which are effective for the conveyance of flow, where development may affect local flooding patterns. Hydraulic categorisation of the floodplain was also undertaken using the results of the TUFLOW model that was developed as part of the *Bourke Flood Study*. **Section 2.7.3** below summarises the procedure adopted.

TABLE 2.9
IMPACT OF FLOODING ON VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE AT BOURKE

Type	Development/Structure	Location Identifier[1]	Location Name	Design Flood Event						
				10% AEP	5%AEP	2% AEP	1% AEP	0.5%	0.2%	Extreme Flood / PMF
Community Asset	Airport	-	Bourke Aerodrome	NF	NF	F	F	F	F	F
	Electricity Substation	-	Substation	NF	NF	NF	NF	NF	NF	F
	Telephone Exchange	-	Telephone Exchange	NF	NF	NF	NF	NF	NF	F
	Major Road Crossing	RC1	Mitchell Highway (Cunnamulla Road)	NF	NF	NF	F	F	F	F
		RC2	Kamilaroi Highway (Brewarrina Road)	NF	F	F	F	F	F	F
		RC3	Mitchell Highway (Nyngan Road)	F	F	F	F	F	F	F
		RC4	Kidman Way (Cobar Road)	NF	F	F	F	F	F	F
		RC5	Parkdale Road (Alice Edwards Road)	F	F	F	F	F	F	F
	Sewerage Treatment Plant	-	Bourke Sewerage Treatment Plant	NF	NF	NF	NF	NF	NF	F
	Water Supply	-	Water Supply	NF	NF	NF	NF	NF	NF	F
Emergency Services	Ambulance Facility	AF	Bourke Ambulance Service	NF	NF	NF	NF	NF	NF	F
	Evacuation Centre	EC1	Bourke Multipurpose Centre	NF	NF	NF	NF	NF	NF	F
		EC2	J.B. Renshaw Complex	NF	NF	NF	NF	NF	NF	F
		EC3	Bourke Tourist Information Centre	NF	NF	NF	NF	NF	NF	F
		EC4	Bourke High School	NF	NF	NF	NF	NF	NF	F
		EC5	Bourke District Hospital	NF	NF	NF	NF	NF	NF	F
	Hospital	-	Bourke District Hospital	NF	NF	NF	NF	NF	NF	F
	Police Station	-	Bourke Police Station	NF	NF	NF	NF	NF	NF	F
	F&R NSW Station	-	Bourke Fire Station	NF	NF	NF	NF	NF	NF	F
	RFS Station	-	Bourke Headquarters RFB	NF	NF	NF	NF	NF	NF	F
	NSW SES Station	-	Bourke NSW SES	NF	NF	NF	NF	NF	F	F
Vulnerable Development	Aged Care Facility	AC1	Bourke Multi-Purpose Service	NF	NF	NF	NF	NF	NF	F
		AC2	River Gum Lodge	NF	NF	NF	NF	NF	NF	F
	Child Care Facility	CC1	Bourke Child Care Centre	NF	NF	NF	NF	NF	NF	F
		CC2	Bourke and District Child Care	NF	NF	NF	NF	NF	NF	F
	Caravan Park	CP1	Kidmans Camp	NF	NF	NF	NF	F	F	F
		CP2	Mitchell Caravan Park	NF	NF	NF	NF	NF	NF	F
	Educational Facility	EF1	Koinonia Christian Academy	NF	NF	NF	NF	NF	NF	F
		EF2	St Ignatius' Primary School	NF	NF	NF	NF	NF	NF	F
		EF3	Bourke TAFE College	NF	NF	NF	NF	NF	NF	F
		EF4	Bourke Public School	NF	NF	NF	NF	NF	NF	F
		EF5	Bourke High School	NF	NF	NF	NF	NF	NF	F

1. Refer **Figure 2.7** (3 sheets) for location of vulnerable development and critical infrastructure.
"NF" = Infrastructure not impacted by flooding.
"F" = Infrastructure impacted by flooding.

2.7.2 Flood Hazard Categorisation

Flood hazard categories may be assigned to flood affected areas in accordance with the definitions contained in ARR 2019. Flood prone areas may be classified into six hazard categories based on the depth of inundation and velocity of flow that relate to the vulnerability of the community when interacting with floodwater, as shown in the illustration which has been taken from ARR 2019.

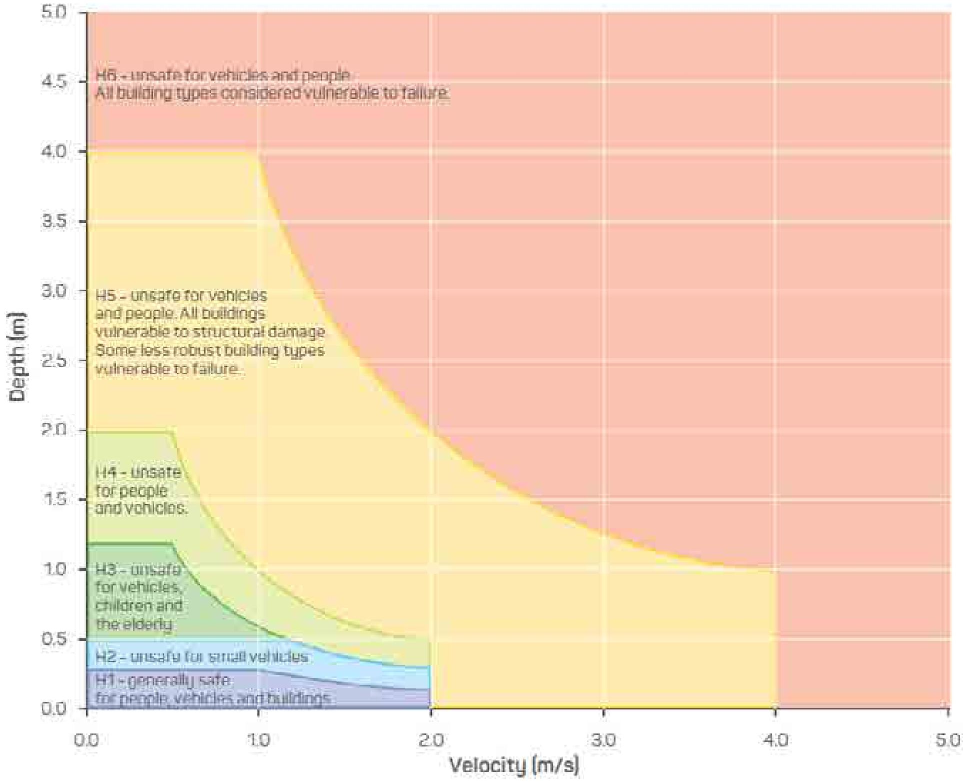


Figure 2.8 (3 sheets) shows the *Flood Hazard Vulnerability Classification* based on the procedures set out in ARR 2019 for the 1% AEP flood event. While areas that are subject to H5 and H6 type conditions are generally confined to areas external to the town levees (the exception being the inbank area of Horsefalls Billabong internal to the Bourke Levee where ponding depths in a 1% AEP local catchment flood event are classified as H5), there is a single dwelling in North Bourke that is located on land which is classified as H5. There are also several dwellings located in North Bourke that are located on land which would be subject to H3 and H4 type flooding conditions during a 1% AEP flood on the Darling River.

2.7.3 Hydraulic Categorisation of the Floodplain

According to the NSWG, 2005, the floodplain may be subdivided into the following three hydraulic categories:

- Floodways;
- Flood storage; and
- Flood fringe.

Floodways are those areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that, even if partially blocked, would cause a significant increase in flood level and/or a significant re-distribution of flow, which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.

Flood Storage areas are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. If the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. Substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows.

Flood Fringe is the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.

Floodplain Risk Management Guideline - Floodway Definition (DECC, 2007d) offers guidance in relation to two alternative procedures for identifying floodways. They are:

- **Approach A**. Using a *qualitative approach* which is based on the judgement of an experienced hydraulic engineer. In assessing whether or not the area under consideration was a floodway, the qualitative approach would need to consider; whether obstruction would divert water to other existing flow paths; or would have a significant impact on upstream flood levels during major flood events; or would adversely re-direct flows towards existing development.
- **Approach B**. Using the hydraulic model, in this case TUFLOW, to define the floodway based on *quantitative experiments* where flows are restricted or the conveyance capacity of the flow path reduced, until there was a significant effect on upstream flood levels and/or a diversion of flows to existing or new flow paths.

One quantitative experimental procedure commonly used is to progressively encroach across either floodplain towards the channel until the designated flood level has increased by a significant amount (for example 0.1 m) above the existing (un-encroached) flood levels. This indicates the limits of the hydraulic floodway since any further encroachment will intrude into that part of the floodplain necessary for the free flow of flood waters – that is, into the floodway.

The *quantitative assessment* associated with **Approach B** is technically difficult to implement. Restricting the flow to achieve the 0.1 m increase in flood levels can result in contradictory results, especially in unsteady flow modelling, with the restriction actually causing reductions in computed levels in some areas due to changes in the distribution of flows along the main drainage line.

Accordingly the *qualitative approach* associated with **Approach A** was adopted, together with consideration of the portion of the floodplain which conveys approximately 80% of the total flow and also the findings of *Howells et al., 2004* who defined the floodway based on velocity of flow and depth. Through an iterative process the following criteria for defining those areas which operate as a "floodway" in a 1% AEP event were adopted as part of the present study:

Darling River Flooding

- Velocity x Depth greater than 0.25 m^2/s **and** Velocity greater than 0.25 m/s; or
- Velocity greater than 1 m/s.

Local Catchment Flooding

- Velocity x Depth greater than 0.15 m^2/s **and** Velocity greater than 0.25 m/s; or
- Velocity greater than 1 m/s.

Flood storage areas are identified as those areas which do not operate as floodways in a 1% AEP event but where the depth of inundation exceeds 1 m on the Darling River floodplain and 0.3 m as a result of local catchment flooding. The remainder of the flood affected area was classified as flood fringe.

Figure 2.9 (3 sheets) shows the division of the floodplain into floodway, flood storage and flood fringe areas for a 1% AEP Darling River flood. The hydraulic capacity of the Darling River is not large enough to convey the 1% AEP flows, therefore a significant portion of the flood flow is conveyed on the floodplain. As a result, areas which lie on the overbank area of the river also function as a floodway during the 1% AEP flood event. Due to the relative steep sided nature of the floodplain, the remainder of the floodplain outside the floodway areas is generally classified as flood storage.

Figure 2.9, sheet 3 shows the division of the floodplain into floodway, flood storage and flood fringe areas for a 1% AEP local catchment flood internal to the Bourke Levee. Floodway areas are generally confined to the inbank area of well-defined drainage channels which link with the existing piped stormwater drainage system. The remainder of the flood affected land is generally classified as flood fringe, with isolated pockets of flood storage present throughout the protected area.

2.8 Potential Impacts of Future Urbanisation

Future urbanisation has the potential to increase the rate and volume of runoff discharging to the Darling River via the relatively small diameter pipes which control local catchment flooding behind the town levees.

The upgrade of the town levees will need to take into consideration the potential for the rate and volume of runoff to be increased over time as a result of an increase in impervious area. For example, it would be prudent to incorporate larger diameter pipes in the design of any future levee upgrade to accommodate changes in the nature of local catchment runoff.

2.9 Potential Impacts of Climate Change

Consideration was given to the impacts on design flood levels of future climate change when estimating freeboard requirements on minimum floor levels of future development.

DPEs guideline titled *Practical Consideration of Climate Change* (DECC, 2007b) was used as the basis for examining climate change at Bourke. The guideline recommends that until more work is completed in relation to the climate change impacts on rainfall intensities, sensitivity analyses should be undertaken based on increases in rainfall intensities ranging between 10 and 30 per cent.

On current projections, the increase in rainfalls within the service life of developments or flood management measures is likely to be around 10%, with the higher value of 30% representing an upper limit which may apply near the end of the century. Under present day climatic conditions, increasing the 1% AEP design rainfall intensities by 10% would generally produce about a flood with an AEP of about 0.5%, while increasing those rainfalls by 30% would generally produce a flood with an AEP of about 0.2%. However, it is noted that based on the findings of the flood frequency analysis, the peak 0.5% AEP flow is about 50% higher than the peak 1% AEP flow, which is considered to be an overestimate of the impact a 10% increase in the intensity of 1% AEP rainfalls.

Figure 2.10 (3 sheets) shows the impact that a 10% increase in rainfall intensities could potentially have on peak 1% AEP flood levels at Bourke. While under this scenario peak 1% AEP flood levels bordering the town levees would generally be increased in the range 0.1-0.2 m, they would be increased by almost 1 m in the off-river flood storage area that is located to the north of Hungerford Road on the western overbank of the Darling River. Peak flood levels internal to the Bourke Levee would generally be increased in the range 20-100 mm, with slightly larger increases shown to occur east of Monomeeth Street and south of Anson Street.

Figure 2.11 (3 sheets) shows the impact that a 30% increase in rainfall intensities could potentially have on peak 1% AEP flood levels at Bourke. Under this scenario peak 1% AEP flood levels bordering the town levees would generally be increased in the range 0.3-0.5 m. Peak flood levels internal to the Bourke Levee would generally be increased in the range 10-50 mm, with slightly larger increases shown to occur east of Monomeeth Street and south of Anson Street.

Figure 2.12 (3 sheets) shows that increases in peak flood levels attributable to future climate change would not result in a significant increase in the extent of land which would be affected by a 1% AEP flood, with the exception of land that is located on the western overbank of the river and includes the Bourke Aerodrome.

Given the current uncertainties in the estimation of increased rainfalls resulting from climate change and its timeframe, it is considered that its impacts on peak flood levels in areas subject to flooding could reasonably be catered for within the currently adopted freeboard of 0.5 m. That said, provision for the potential impacts of future climate change on peak flood levels should be incorporated in the derivation of the design freeboard for any future upgrade to the town levees (refer **Appendix D** for details).

2.10 Environmental Considerations

The Darling River system is generally in its natural state at Bourke. Given the relatively wide floodplain at Bourke and the fact that there are a limited number of properties affected by Darling River flooding, modifications to the main arm of the river would not result in a significant reduction in flood damages. As a result, channel modifications and vegetation management do not form part of the recommended set of flood mitigation measures at Bourke.

2.11 Council's Existing Planning Instruments and Policies

2.11.1 General

The *Bourke Local Environmental Plan, 2012* (***Bourke LEP 2012***) is the principal statutory planning document used by Council for controlling development by defining zoning provisions, establishing permissibility of land use and regulating the extent of development at Bourke.

The *Bourke Shire Development Control Plan 2012* (***Bourke Shire DCP 2012***) supplements *Bourke LEP 2012* by providing general information and detailed guidelines and controls which relate to the decision making process.

2.11.2 Land Use Zoning – Bourke LEP 2012

Figure 2.12 shows the extent of the urban areas of Bourke which comprises land which is zoned *R1 General Residential*, *B2 Local Centre*, *IN1 General Industry*, *RE1 Public Recreation*, *R5 Large Lot Residential*, *SP2 Infrastructure* and *SP3 Tourist*. The land bordering the urbanised areas of Bourke are zoned *RU1 Primary Production*, with the exception of the inbank area of the Darling River which is zoned *W1 Natural Waterways*.

2.11.3 Flood Provisions – Bourke LEP 2012

Clause 5.21 of *Bourke LEP 2012* entitled "Flood planning" outlines its objectives in regard to development of land that lies within the Flood Planning Area (**FPA**). The FPA is the area of land which lies below the Flood Planning Level (**FPL**), where the FPL is a combination of flood levels and freeboards selected for floodplain risk management purposes.

Clause 5.22 of *Bourke LEP 2012* entitled "Special flood considerations" has not been adopted by Council.

2.11.4 Flooding and Stormwater Controls – Bourke Shire DCP 2012

Section 3.2 of *Bourke Shire DCP 2012* titled "Flooding" sets out the following flood related controls that apply to development that is proposed in the shire:

"3.2. Flooding

3.2.1. Flood Affected Land

- *A significant amount of land along the Darling River and its tributaries is floodprone.*
- *The Bourke Shire LEP states that land at or below the flood planning level the flooding provisions of the LEP apply. Council's adopted 1:100 ARI flood is the level of the 1974 flood.*
- *As a general rule, flood affected land within the Shire is that land that is grey soil adjacent to the Darling River and its tributaries. Red soil is generally considered not to be floodprone.*
- *If a development is proposed for land on the grey soil or is, in the opinion of a senior officer of the Council, likely to be flood affected, it is deemed to be flood affected land for the purposes of this DCP.*

3.2.2. Access

- *Flood free vehicle access is required for all lots created by subdivision.*
- *For development of existing lots, where flood free vehicle access is not possible, the development must be able to achieve safe wading criteria as specified in Figure L1 of the Floodplain Development Manual.*

3.2.3. On-site Sewer Management

Onsite sewer management facilities must be sited and designed to withstand flooding conditions (including consideration of structural adequacy, avoidance of inundation, and flushing/leaking into flowing flood waters). Tank and trench style of systems are not permitted on land affected by the Flood Planning Level.

All sewer fixtures must be located above the 1% Flood.

3.2.4. General Development Requirements

- *No building or work (including land filling, fencing, excavation) shall be permitted on flood affected land where in the opinion of Council, such building or work will obstruct the movement of floodwater or cause concentration or diversion of floodwaters.*
- *DA must demonstrate the building or structure can withstand the force of flowing floodwaters, including debris and buoyancy forces as appropriate.*
- *A survey plan prepared by a registered surveyor showing existing ground levels, finished ground levels, finished floor levels, flood levels and location of existing/proposed buildings and safe evacuation path on the site relative to AHD. This survey plan is to have regard to the flood planning level of the 1:100 ARI flood.*
- *ll materials used in construction shall be flood compatible.*
- *Development must be designed in accordance with the Flood Proofing Guidelines (refer Discretionary Development Standards).*

3.2.5. Residential Development

- *Floor levels of all habitable rooms, or rooms with connection to sewer infrastructure shall not be less than the flood planning level which is 500mm (freeboard) above the level of the highest known flood.*
- *Upon completion and prior to the occupation (where relevant), a certificate by a registered surveyor showing the finished ground and floor levels conform to approved design levels shall be submitted to Council.*
- *Additions to existing buildings will be only be permitted, with limitations, as follows:*
  - *where the floor level of the proposed addition is located below the flood standard the maximum increase in floor area is not to exceed 10% of the floor area of the existing dwelling; or*
  - *where the floor level of the proposed addition is located above the flood standards the maximum increase in habitable floor space shall not exceed 100m^2.*
- *Where additions are below the 500mm "freeboard" (the flood planning level) Council must be satisfied that the addition will not increase risk to inhabitant in the event of a flood.*
- *Rebuilding part of a dwelling may be permitted provided the building maintains the same dimensions which result in the same impact on flood behaviour.*

3.2.6. Commercial / Retail / Industrial Development

- *Development shall incorporate measures to seal or flood proof buildings, to avoid activities or fittings susceptible to flood damage, or to store the contents of buildings above the flood planning level.*

3.2.7. Subdivision

- *Residential subdivision will not be permitted where any lot to be created will be fully inundated by flood higher than the flood planning level event and the creation of such lot will create the potential for increased intensity of development on flood liable land.*

3.2.8. Landfilling

- *Survey plan prepared by a registered surveyor is required, showing the contour levels of natural surface, any existing fill and the designed contour levels for the finished work.*
- *A report certified by a consulting engineer is required to detail the impact of the proposed fill on adjoining properties and, where levee banks are proposed, and the methods of internal drainage.*
- *Applications shall be accompanied by a construction management plan to show*
  - *source of fill, including contamination assessment*
  - *an assessment of the impact of haulage vehicles on roads*
  - *precondition report of all haulage routes*
  - *details of method of compaction of fill and associated impacts: control of dust, sedimentation, water quality impacts, noise and vibration*
  - *contingency for containment of fill in the event of a flood during placement*

3.2.9. Non-residential rural buildings

- *Not permitted in "floodways".*
- *Floor areas shall be located above the flood planning level.*

Definitions are as per the Floodplain Development Manual (NSW Government)"

2.12 Flood Warning and Flood Preparedness

The NSW SES is nominated as the principal combat and response agency for flood emergencies in NSW. NSW SES is responsible for the issuing of relevant warnings (in collaboration with BoM), as well as ensuring that the community is aware of the flood threat and how to mitigate its impact.

The *Bourke Shire Local Flood Plan* (NSW SES, 2013) covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures for all levels of flooding within the Bourke Shire area. The *Bourke Shire Local Flood Plan* is administered by the NSW SES Bourke Local Controller who controls flood operations within the Bourke Shire area and is based in Bourke.

The main body of the *Bourke Shire Local Flood Plan* is divided into the following sections:

- ***Introduction****;* this section identifies the responsibilities of the NSW SES Local Controller, Unit Controllers and NSW SES members, as well as supporting services such as the Police, Bourke Shire Council, BoM, NSW Fire Brigade, Rural Fire Service, etc.
- ***Preparedness****;* this section deals with activities required to ensure the *Bourke Shire Local Flood Plan* functions during the occurrence of the flood emergency. The Plan will devote considerable attention to flood warning and emergency response.

- ***Response***. The NSW SES maintains an Operations Centre at Bourke Airport. Response operations will commence: on receipt of a NSW SES Livestock and Equipment Warnings, BoM Flood Alerts and Flood Warnings, Local Flood Advices, Evacuation Warnings and Standard Emergency Warning Signal.
- ***Recovery,*** involving measures to ensure the long term welfare for people who have been evacuated, recovery operations to restore services and clean up and de-briefing of emergency management personnel to review the effectiveness of the *Bourke Local Flood Plan.*

Annexes A and B of the *Bourke Shire Local Flood Plan* describe the flood threat and impact that flooding has on the community in the Bourke Shire area, respectively.

Annex A of the *Bourke Shire Local Flood Plan* notes that the flood wave takes seven (7) days to travel the 200 km (by river) from Brewarrina to Bourke. It also gives peak heights that have been recorded at the Bourke stream gauge dating back to 1890.
Annex B of the *Bourke Shire Local Flood Plan* states that Bourke and Alice Edwards Village are protected from Darling River flooding up to 15.5 m and 14.5 m on the Bourke stream gauge, respectively.[6]

Annex B of the *Bourke Shire Local Flood Plan* states that Moderate levels of flooding (10.7 m to 12.2 m on the Bourke stream gauge) will cut access to rural properties that are located on the western overbank of the Darling River, while Major levels (12.2 m and above) can result in most roads in the Bourke area being cut, with homesteads along the river isolated for six to eight weeks. Roads in the Bourke area that may be affected by flooding are given as follows:

Gauge Height (m)	Road	Designation	Location of Closure
8.70	Bourke to Weilmoringle	RLR 49	1 km north of Bourke
9.00	Parkdale Road	RLR 22	3 km west of Bourke
9.77	Bourke to Brewarrina	MR 68	
10.50	Bourke to Brewarrina	MR 68	Bogan River Bridge (47 km from Bourke)
10.97	The River Road	RLR 16	The Big Billabong
11.15	Bourke to Louth	MR 68	Jandra Creek
11.35		RLR 10	“Dicks Dam”
11.95	Bourke to Brewarrina	MR 68	28 km east of Bourke
13.00	Bourke to Alice Edwards Village	RLR 22	Billabong Causeway
	Bourke to Cobar	MR 421	
13015	Mitchell Highway	SH 7	4 km south of Bourke

[6] As set out in **Table 2.5** of this report, the present study found that absent the installation of any temporary flood protection measures, Bourke and Alice Edwards Village are protected from Darling River flooding up to 14.35 m and 15.01 m on the Bourke stream gauge, respectively.

Annex C of the *Bourke Local Flood Plan* gives the Minor, Moderate and Major flood levels on the Bourke stream gauge as 9.0 m, 10.7 m and 12 m, respectively. This differs from NSW SES's *Flood Intelligence Card* for the Bourke stream gauge which gives the Minor, Moderate and Major flood levels as 9.5 m, 11.4 m and 12.7 m, respectively. It is noted that the *Flood Intelligence Card* is dated 19 June 2017, and therefore post-dates the *Bourke Local Flood Plan*.

3 POTENTIAL FLOODPLAIN RISK MANAGEMENT MEASURES

3.1 Range of Available Measures

A variety of floodplain risk management measures can be implemented to reduce flood risk and damages. They may be divided into three categories, as follows:

Flood modification measures change the behaviour of floods in regard to discharges and water surface levels to reduce flood risk and damages. This can be done by the construction of levees, detention basins, channel improvements and upgrades of piped drainage systems in urban areas. Such measures are also known as "structural" options as they involve the construction of engineering works. Vegetation management is also classified as a flood modification measure.

Property modification measures reduce risk to properties through appropriate land use zoning, specifying minimum floor levels for new developments, voluntary purchase of residential property in high hazard areas, or raising existing residences in the less hazardous areas. Such options are largely planning (i.e. "non-structural") measures, as they are aimed at ensuring that the use of floodplains and the design of buildings are consistent with flood risk. Property modification measures could comprise a mix of structural and non-structural methods of damage minimisation to individual properties.

Response modification measures change the response of flood affected communities to the flood risk by increasing flood awareness, implementation of a flood warning system and the development of an emergency response plan for property evacuation.

3.2 Community Views

Comments on potential flood management measures were sought from the Bourke community by way of the *Community Questionnaire*, which was distributed at the commencement of the study. A copy of the *Community Questionnaire* is contained in **Appendix A**. Question 11 in the *Community Questionnaire* outlined a range of potential flood management measures. The responses are shown on **Table 3.1** over the page.

The most popular structural measures were the improvement to the stormwater drainage system internal to the existing levee and the raising of the existing earthen levee, by either permanent or temporary methods.

Of the non-structural measures, improvement of flood warning and evacuation procedures, provision of a Planning Certificate to purchasers in flood prone areas, specifying controls on future development in flood-prone areas and community flood-awareness programs all received strong support.

A mostly negative response was given to providing subsidies for raising the floor level of properties, the implementation of a residential Voluntary Purchase scheme and flood proofing individual properties.

Several of the measures set out in **Table 3.1** were examined at the strategic level of detail in **Chapter 3** and then tested for feasibility on a range of assessment criteria in **Chapter 4**. Following consideration of the results by the Floodplain Risk Management Committee, selected measures were included in the *FRMP* in **Chapter 5**.

TABLE 3.1
COMMUNITY VIEWS ON POTENTIAL FLOOD MANAGEMENT MEASURES

Flood Management Measure		Classification[(1)]	Respondent's Views		
			Yes	No	Don't Know
a)	Raising of the existing earthen levee using the same construction methodology	FM	12	1	2
b)	Raising of the existing earthen levee during times of flood using temporary/relocatable flood barriers	FM	6	5	4
c)	Improvements to the internal drainage system (e.g. upgrade of the existing piped drainage system around the perimeter of the existing levee)	FM	14	0	1
d)	Voluntary purchase of the most severely affected flood-liable properties	PM	3	11	1
e)	Provide funding or subsidies to raise houses above major flood level in low hazard areas.	PM	3	10	2
f)	Flood proofing of individual properties by waterproofing walls, putting shutters across doors, etc.	PM	1	9	5
g)	Improve flood warning and evacuation procedures both before and during a flood.	RM	14	0	1
h)	Community education, participation and flood awareness programs.	RM	13	1	1
i)	Ensuring all residents and business owners have Flood Action Plans - these outline WHAT people should do, WHERE they should go and WHO they should contact in a flood	RM	11	1	3
j)	Specify controls on future development in flood-liable areas (e.g. controls on extent of filling, minimum floor levels, etc.)	PM	12	2	1
k)	Provide a Planning Certificate to purchasers in flood prone areas, stating that the property is flood affected.	PM	13	2	0
l)	Ensuring all information about the potential risks of flooding is available to all residents and business owners	PM	15	0	0

1. FM = Flood Modification Measure
   PM = Property Modification Measure
   RM = Response Modification Measure

3.3 Potential Flood Modification Measures

3.3.1 Bourke Levee Upgrade

The freeboard analysis set out in **Appendix D** of this report determined that for strategic design purposes the adoption of a 1 m freeboard for setting the level of protection on the Bourke Levee would be appropriate. As shown on **Figure 3.2**, the existing Bourke Levee generally incorporates 1 m freeboard to peak 1% AEP Darling River flood levels, with the exception of a 3 km length of levee which runs between Chainage 0 and 3,000, as well as six defined low points, the locations of which are listed in **Table 2.5** of this report.

While the existing earthen levee will only need to be raised by a maximum of about 0.2 m between Chainages 0 and 3,000, and locally at Chainages 4,400 and 8,260 in order to achieve the required 1 m freeboard to peak 1% AEP Darling River flood levels, it will be necessary to include provisions for the installation of removable barrier type arrangements at the location of the two road crossings, and also at Bourke Wharf. It would also be necessary for Council to arrange access to the private property that spans the crest of the levee at Chainage 8,750 in order to raise the low point that is present at this location. It is also recommended that Council create an easement over the levee where it runs through the private property so as to facilitate future maintenance.

As part of any future upgrade works, it is recommended that a detailed visual audit be undertaken by Public Works Advisory of the Bourke Levee in order to identify any deficiencies or defects in the existing earthen embankment and to incorporate any remediation works into the package of works. For example, Council advised that there are a number outlet headwalls on the pipes that discharge directly to the Darling River which are in need of repair. It will therefore be necessary to rectify these deficiencies as part of the broader levee upgrade works.[7]

The upgrade of the Bourke Levee is estimated to cost about $1.4 Million, which would prevent its premature overtopping and also reduce the risk of it failing during major flood events on the Darling River, noting that up to $97 Million in flood damages would be saved if the levee prevented flooding in Bourke during a 1% AEP Darling River flood.

3.3.2 Alice Edwards Village Levee Upgrade

While vehicular access to Alice Edwards Village from Bourke would be cut during floods larger than about 10% AEP, thereby requiring all residents to be evacuated by this time, there is merit in including provisions for the installation of a removable barrier type arrangement at the location of the low point at Chainage 260. This would increase the hydrologic standard of the levee to close to 1% AEP based on a 1 m freeboard provision and also prevent its premature overtopping, thereby reducing the damage that would be experienced in the 18 existing dwellings that are present within the village.

3.3.3 Stormwater Drainage Upgrades

Due to the flat nature of the topography internal to the Bourke Levee, there are a number of locations where runoff ponds in private property and across roads for an extended period of time during periods of intense or prolonged heavy rainfall. While no existing buildings would experience above-floor flooding during storms up to 1% AEP in intensity, the ponding of stormwater runoff for an extended period of time causes frequent nuisance flooding in existing residential development, with Council called upon to install temporary pumps in order to dewater certain areas.

Based on advice provided by Council, the two worst affected areas are located along the northern side of Anson Street, the first near its intersection with Wilson Street and the second in the immediate vicinity of Meadows Road and Bloxham Street. Council's observations are supported by the results of the flood modelling that has been undertaken as part of the present study.

While a stormwater drainage system controls runoff ponding along Anson Street west of about Wilson Street, its very flat nature coupled with the long distance to its outlet means that surface runoff takes an extended period of time to drain the area. Historically Council has installed a

[7] PW, 2014 noted two existing flood gates and six culvert outlets are in need of repair.

temporary pump arrangement at the road intersection which is used to pump surface water to the adjacent rail corridor. It is noted that a study that was commissioned by Council in 2015 (Geolyse, 2015) recommended the installation of a permanent pumping station on Anson Street between its intersection with Wilson and Glen Streets in combination with the regrading of an existing channel in the rail corridor so as to drain the water in an easterly direction to a second pump station which was recommended at the location of flood storage pump FSP_03.[8] Geolyse 2015 also recommended the upgrade of the existing stormwater drainage system along Anson Street west of about Church Street, as well as the upgrade of the existing flood gate pump FGP_01 at the southern end of Horsfalls Billabong.

In regards the local catchment flooding that is experienced in the immediate vicinity of Meadows Road and Bloxham Street, Geolyse, 2015 recommended the removal of a blockage that was present at the time in the existing channel which runs along the rear of the residential properties that are located on the southern side of Meadows Road. As the flood modelling that was undertaken as part of the present study does not include the blockage identified in Geolyse, 2015, flooding in this area is of a broader nature requiring additional mitigation measures.

It is noted that there is no gravity drainage through the Bourke Levee on either side of the Mitchell Highway and that flood storage pumps FSP_02 and FSP_03, while permanent, are relatively small in terms of their lifting capacity.

In addition to the abovementioned measures, Geolyse, 2015 recommended the installation of a new piped stormwater drainage system along the full length of Wilson Street, as well as the upgrade of flood gated pumps FGP_05, FGP_06, FGP_08 and FGP_09.

Based on the findings of the present investigation, it was found that there would be limited benefit from a flood mitigation point of view in Council implementing the measures set out in Geolyse, 2015.[9] That said, the flood mitigation benefits associated with the upgrade of the existing flood evacuation pumps that are located around the perimeter of the Bourke Levee was assessed as part of the present study. **Table 3.2** sets out the combination of pump capacities that were assessed as part of the present study, while **Figures 3.4** and **3.5** show the reduction in peak 1% AEP flood levels that would occur as a result of their implementation. The key findings of the assessment were as follows:

- The upgrade of flood evacuation pump FSP_01 would reduce the depth of ponding that is experienced along Monomeeth Street, north of Mitchell Street.
- The upgrade of flood evacuation pump FSP_02 in combination with the removal of an adjacent existing 375 mm diameter pipe and its associated embankment would reduce the flooding that is experienced in existing residential development that is bounded by Green Street to the north, Monomeeth Street to the east, Anson Street to the south and Tarcoon Street to the west.[10]

---

[8] Geolyse, 2015 does not acknowledge the existence of flood storage pump FSP_03, so it is not clear whether this pump was present at the time of the investigation or was installed based on the recommendations contained in the report.

[9] While the measures recommended in Geolyse, 2015 may reduce the frequency of nuisance flooding in parts of Bourke, they would not have a significant impact on the depth and extent of inundation during more intense rainfall events and hence would not be eligible for funding through the NSW Government's Floodplain Management Program.

[10] Initial runs of the TUFLOW model found that the adjacent 375 mm diameter pipe and associated embankment acts as a major constraint on the ability of flow to reach the flood evacuation pump, hence its removal as part of the present study.

TABLE 3.2
ASSESSED FLOOD EVACUATION PUMP CAPACITIES

Levee Chainage (m)		Location	Existing Flood Evacuation Pump				Assessed Flood Evacuation Pump Capacity (L/s)	
Present Study	PW, 2018		Pump ID[2]	Type	Capacity (L/s)	Status	Option 1	Option 2
1,655	1,650	Brewarrina Road	FSP_01	ABS	130	Permanent	1000	1000
3,030	3,000	Common	FSP_02	ABS	130	Permanent	-	500
3,240	3,250	Nyngan Road	FSP_03	Sulzer	100	Permanent	-	500
5,635	5,655	Pistol Range	FGP_01	Flygt	30	Portable	150	500
7,475	7,455	Adelaide Street	FGP_02	Flygt	30	Portable	150	150
7,985	7,950	Meek Street	FGP_03	Flygt	30	Portable	150	150
8,200	8,160	Charles Street	FGP_04	Flygt	30	Portable	150	150
8,430	8,390	Sturt Street	FGP_05	Flygt	30	Portable	150	150
8,665	8,635	Richard House	FGP_06	Flygt	30	Permanent	150	150
8,800	8,785	Hudson House	FGP_07	Portable	unknown	Portable	150	150
8,940	8,940	Glen Street	FGP_08	Flygt	30	Portable	150	150
9,250	9,250	Wilson Street	FGP_09	Flygt	30	Portable	150	150
9,675	9,645	Water Works	FGP_10	Flygt	30	Portable	150	150
9,925	9,925	Back O Bourke	FGP_11	Flygt	30	Portable	150	150

1. Refer **Figures 3.4** and **3.5** for location.

- While the upgrade of flood evacuation pump FSP_03 would have a limited impact in terms of reducing the extent and depth of inundation during a 1% AEP flood event, it would reduce the frequency and duration stormwater runoff ponds in areas south of Anson Street.
- While the upgrade of flood evacuation pump FGP_01 has the potential to lower water levels in Horsfalls Billabong, the benefits reduce in an easterly direction along Anson Street.
- While the upgrade of flood evacuation pumps FGP_02, FGP_03, FGP_04, FGP_05, FGP_06, FGP_07, FGP_08, FGP_09 would have a limited impact in terms of reducing the extent and depth of inundation during a 1% AEP flood event, it would reduce the frequency and duration stormwater runoff ponds in the urbanised areas of Bourke.
- The upgrade of flood evacuation pump FGP_10 would reduce the depth of ponding that is experienced existing residential development that is bounded by Cullie Street to the north, Moculta Street to the east, Short Street to the south and Wortumerte Street to the west.

- The upgrade of flood evacuation pump FGP_11 would reduce the depth of ponding that is experienced in the information and exhibition centre that is located on the western side of Moculta Street, north of Cullie Street.

Based on the above findings, there is merit in upgrading a number of the existing flood evacuation pumps that are located around the perimeter of the Bourke Levee. The *Bourke FRMP* therefore includes a recommendation to undertake a feasibility study to refine the flood evacuation pump strategy for Bourke, prior to its implementation.

3.3.4 Vegetation Management

Management programs in creeks and rivers typically involve maintenance of batters and the removal of sediment and dense vegetation, as well as the clearance of flood debris after significant flow events. Clearance of debris within the stream corridor reduces the potential for future capture by the flow and blockage of bridges and culverts.

While there is merit in removing flood debris from the banks of the Darling River after significant flow events, this would only have a relatively minor impact in terms of reducing peak flood levels in the river given its already large conveyance capacity. As such, the development and implementation of a *Vegetation Management Plan* for the Darling River at Bourke is not recommended for inclusion in the *Bourke FRMP*.

3.4 Potential Property Modification Measures

3.4.1 Controls over Future Development

3.4.1.1 Current Government Policy

The NSW Government has recently finalised reforms of the *NSW Flood Prone Land Package*. As part of the reform, the wording in the flood planning clause of all NSW Councils was updated on 14 July 2021. As part of the reform, Council needs to nominate the FPL or levels that it wishes to adopt for defining the FPA and make alternative arrangements for making flood planning maps publicly available where previously solely reliant on LEP flood overlay maps. The reforms also include an optional clause titled *special flood considerations* which applies to land which lies between the FPA and the extent of the Extreme Flood. The adopted form of wording for the flood planning and special flood considerations clauses, the former which came into effect on the 14 July 2021 and the latter which is recommended for inclusion in *Bourke LEP 2012* is set out in **Section 3.4.1.4** of this report.

3.4.1.2 Considerations for Setting Freeboard Requirements at Bourke

General

Selection of the FPL for an area is an important and fundamental decision as the standard is the reference point for the preparation of floodplain risk management plans. It is based on the adoption of the peak level reached by a particular flood plus an appropriate allowance for freeboard. It involves balancing social, economic and ecological considerations against the consequences of flooding, with a view to minimising the potential for property damage and the risk to life and limb. If the adopted FPL is too low, new development in areas outside the FPA (particularly where the difference in level is not great) may be inundated relatively frequently and damage to associated public services will be greater. Alternatively, adoption of an excessively high FPL will subject land that is rarely flooded to unwarranted controls.

Freeboard provides reasonable certainty that the risk exposure selected in deciding on a particular flood is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. As set out in **Appendix D** of this report, design variables that are typically incorporated in the derivation of freeboard typically comprise the following:

- increases in peak flood levels due to wind and wave action;
- increases in peak flood levels due to local water surge;
- uncertainties in the design flood level estimates due to the confidence limits associated with the design peak flow estimate, inaccuracies in the LiDAR survey data and possible variations in key parameters such as hydraulic roughness; and
- increases in peak flood levels due to future climate change.

Areas External to the Town Levees that are Impacted by Darling River Flooding

Table 3.3 provides a summary of a joint probability analysis similar to that presented in **Appendix D** of this report that was undertaken to assess the freeboard allowance which should be incorporated in the FPL for areas that are affected by Darling River flooding.

TABLE 3.3
SUMMARY OF FREEBOARD ANALYSIS
AREAS AFFECTED BY DARLING RIVER FLOODING AT BOURKE

Design Variable [A]	Probability of Occurrence [B]	Maximum Allowance (m) [C]	Joint Probability Allowance (m) [D]
Wave Action	50%	0.30	0.15
Inaccuracies in Peak 1% AEP Flood Level Estimate			
- LiDAR survey data	50%	0.30	0.15
- Peak flow estimate	50%	0.08	0.04
- Hydraulic roughness	50%	0.14	0.07
Future Climate Change	50%	0.20	0.10
TOTAL			**0.51**

The maximum allowance for uncertainties in the peak 1% AEP flood level estimate is comprised of the following

- inaccuracies in the LiDAR survey data (+0.3 m);
- provision for a 10% increase in the best-estimate peak 1% (1 in 100) AEP flow derived by the flood frequency analysis (+0.08 m)
- increase in peak flood levels associated with a possible 20% increase in the best-estimate hydraulic roughness values (generally a maximum of +0.14 m based on the information shown on **Figure 2.19**).

In regards the potential impacts of future climate change on flood behaviour at Bourke, the *ARR Data Hub* gives the following interim climate change factors for Representative Concentration Pathways (**RCPs**) of 4.5 and 8.5 in the years 2050 and 2090:

Year	**RCP 4.5**	**RCP 8.5**
2050	7.7%	10.3%
2090	10.6%	23.5%

A flood with an AEP of 0.5% is commonly considered to be analogous to a flood that would result from a 10% increase in 1% AEP rainfall intensities. By comparison with the interim climate change factors, the adoption of the 0.5% AEP would provide a reasonable indicator of the potential for future climate change to impact peak 1% AEP flood levels at Bourke (generally in the range +0.1-0.2 m based on the information shown on **Figure 2.10**).

Based on the above findings, it is considered reasonable to adopt a freeboard of 0.5 m for setting the FPL in areas external to the town levees (for example, in North Bourke).

<u>Areas Internal to the Bourke Levee that are Impacted by Local Catchment Flooding</u>

While local catchment flooding internal to the Bourke Levee is typically of a ponding nature and generally no deeper than 0.3 m in a 1% AEP storm event, there is merit in adopting the current freeboard provision of 0.5 m for defining the FPL, noting that this would more than compensate for uncertainties in the peak flood level estimate.

Figure E1.1 in **Appendix E** of this report is an extract from the *Flood Planning Map* at Bourke. The extent of the FPA is shown in a solid red colour and has been defined as the area that lies at or below by the 1% AEP plus 0.5 m freeboard. Also shown in **Figure E1.1** is the extent of the Outer Floodplain, which is the area of land which lies between the extent of the FPA and the Extreme Flood.

While further investigations would need to be undertaken to define the nature of local catchment flooding internal to the Alice Edwards Village Levee, the area has been identified as lying within the extent of the FPA.

3.4.1.3 Proposed Planning Controls for Bourke

While *Bourke Shire DCP 2012* contains a set of flood related development controls, these are linked to flood levels that were reached in the 1974 flood, which the *Bourke Flood Study* found has an AEP of slightly less than 5% at Bourke. It is also not clear how Council apply the minimum floor levels controls internal to the Bourke Levee given floodwater did not enter the town during this event.

An updated set of planning controls have therefore been recommended for adoption in *Bourke Shire DCP 2012*, the suggested wording of which is set out in **Appendix E** of this report.

It is proposed that properties intersected by the extent of the FPA would be subject to S10.7 flood affectation notification and planning controls graded according to flood hazard and evacuation constraints. NSWG, 2005 suggests wording on S10.7 (2) Planning Certificates along the following lines:

"Council considers the land in question to be within the Flood Planning Area and therefore subject to flood related development controls. Information relating to this flood risk may be obtained from Council. Restrictions on development in relation to flooding apply to this land as set out in Council's Flood Policy which is available for inspection at Council offices or website."

Annexure 2 in **Appendix E** sets out the graded set of flood related planning controls which have been developed for areas that are subject to both Darling River and local catchment flooding.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development in properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figure E1.1**. The MHFLs for the different land use types are as follows:

- at or above the 2% (1 in 50) AEP plus 0.5 m freeboard in the case of recreational and non-urban type development
- at or above the 1% (1 in 100) AEP plus 0.5 m freeboard in the case of residential type development;
- as close as practical to the 1% (1 in 100) AEP plus 0.5 m but no lower than the 2% (1 in 50) AEP plus 0.5 m freeboard in the case of commercial/industrial type development; and
- at or above the 0.5% (1 in 200) AEP plus 0.5 m freeboard in the case of flood vulnerable residential type development, essential community facilities and critical utilities.

Figure E1.2 in **Appendix E** is an extract of the *Flood Planning Constraint Category Map* for the Bourke Shire which shows the subdivision of the floodplain into the following four categories which have been used as the basis for developing the graded set of planning controls:

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the FPA where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the FPA but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this document.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises the area which lies between the extent of the FPA and the PMF. Flood related controls in areas designated FPCC4 are typically limited to flood evacuation and emergency response, although additional controls apply to "critical uses and facilities" which are critical for response and recovery.

The derivation of the four FPCCs firstly involved the derivation of a number of sub-regions which were based on the nature of flooding at Bourke, the sub-categories of which are set out in **Table 3.4** over the page. These sub-regions were then combined, with the resulting extents further refined in order to improve the area over which each FPCC applied.

TABLE 3.4
KEY ELEMENTS COMPRISING FLOOD PLANNING CONSTRAINT CATEGORIES FOR BOURKE

Flooding	FPCC	Sub-category	Constraint
Darling River Flooding	1	a	1% AEP Darling River Flooding Floodway
		b	1% AEP Darling River Flooding Flood Hazard Vulnerability Classification H6
	2	a	1% AEP Darling River Flooding Flood Storage
		b	1% AEP Darling River Flooding Flood Hazard Vulnerability Classification H5
		c	1% AEP Flood Emergency Response Classification (Flooded - Isolated - Submerged)
		d	1% AEP Flood Emergency Response Classification (Flooded - Isolated - Elevated)
	3	-	Flood Planning Area
	4	-	Extent of Extreme Flood
Local Catchment Flooding(1)	1	a	1% AEP Floodway
		b	Flood Hazard Vulnerability Classification H4 - H6
	2		1% AEP Flood Storage Area
	3	-	Flood Planning Area
	4	-	Extent of PMF

1. Limited to areas internal to the Bourke Levee

3.4.1.4 Revision of Bourke LEP 2012 by Council

The *Bourke FRMS&P* has been developed giving consideration to the following amended form of wording which came into effect on 14 July 2021:

"5.21 Flood planning

(1) The objectives of this clause are as follows—

(a) to minimise the flood risk to life and property associated with the use of land,

(b) to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change,

(c) to avoid adverse or cumulative impacts on flood behaviour and the environment,

(d) to enable the safe occupation and efficient evacuation of people in the event of a flood.

(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development—

(a) is compatible with the flood function and behaviour on the land, and

(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and

(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and

(d) incorporates appropriate measures to manage risk to life in the event of a flood, and

(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.

(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters—

(a) the impact of the development on projected changes to flood behaviour as a result of climate change,

(b) the intended design and scale of buildings resulting from the development,

(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,

(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.

(4) A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.

(5) In this clause—

Considering Flooding in Land Use Planning Guideline means the *Considering Flooding in Land Use Planning Guideline* published on the Department's website on 14 July 2021.

flood planning area has the same meaning as it has in the Floodplain Development Manual.

Floodplain Development Manual means the *Floodplain Development Manual* (ISBN 0 7347 5476 0) published by the NSW Government in April 2005.

It is also recommended that the optional new *special flood considerations* clause be added to *Bourke LEP 2012* as follows:

Special flood considerations

(1) The objectives of this clause are as follows—

(a) to enable the safe occupation and evacuation of people subject to flooding,

(b) to ensure development on land is compatible with the land's flood behaviour in the event of a flood,

(c) to avoid adverse or cumulative impacts on flood behaviour,

(d) to protect the operational capacity of emergency response facilities and critical infrastructure during flood events,

(e) to avoid adverse effects of hazardous development on the environment during flood events.

(2) This clause applies to—

(a) for sensitive and hazardous development—land between the flood planning area and the probable maximum flood, and

(b) for development that is not sensitive and hazardous development—land the consent authority considers to be land that, in the event of a flood, may—

(i) cause a particular risk to life, and

(ii) require the evacuation of people or other safety considerations.

(3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development—

(a) will not affect the safe occupation and efficient evacuation of people in the event of a flood, and

(b) incorporates appropriate measures to manage risk to life in the event of a flood, and

(c) will not adversely affect the environment in the event of a flood.

(4) A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.

(5) In this clause—

***Considering Flooding in Land Use Planning Guideline**—see clause 5.21(5).*

***flood planning area**—see clause 5.21(5).*

***Floodplain Development Manual**—see clause 5.21(5).*

***probable maximum flood** has the same meaning as it has in the Floodplain Development Manual.*

***sensitive and hazardous development** means development for the following purposes—*

[list land uses]

Direction— Only the following land uses are permitted to be included in the list—

(a) boarding houses,

(b) caravan parks,

(c) correctional centres,

(d) early education and care facilities,

(e) eco-tourist facilities,

(f) educational establishments,

(g) emergency services facilities,

(h) group homes,

(i) hazardous industries,

(j) hazardous storage establishments,

(k) hospitals,

(l) hostels,

(m) information and education facilities,

(n) respite day care centres,

(o) seniors housing,

(p) sewerage systems,

(q) tourist and visitor accommodation,

(r) water supply systems

The steps involved in Council amending *Bourke LEP 2012* following the finalisation and adoption of the *Bourke FRMS&P* are:

1. Council Planning Staff consider the conclusions of the *Bourke FRMS&P* and suggested amendments to *Bourke LEP 2012*.
2. Council resolves to amend *Bourke LEP 2012* in accordance with the *Bourke FRMS&P*.
3. Council prepares a Planning Proposal in accordance with NSW Planning and Environment Guidelines. Planning Proposal submitted to NSW Planning and Environment in accordance with section 3.33 of the EP&A Act, 1979.
4. Planning Proposal considered by DPE and determination made in accordance with section 3.34(2) of the EP&A Act, 1979 as follows:

   (a) whether the matter should proceed (with or without variation),

   (b) whether the matter should be resubmitted for any reason (including for further studies or other information, or for the revision of the planning proposal),

   (c) community consultation required before consideration is given to the making of the proposed instrument (the community consultation requirements),

   (d) any consultation required with State or Commonwealth public authorities that will or may be adversely affected by the proposed instrument,

   (e) whether a public hearing is to be held into the matter by the Planning Assessment Commission or other specified person or body,

   (f) the times within which the various stages of the procedure for the making of the proposed instrument are to be completed.
5. Planning Proposal exhibited for public comment.
6. Planning Proposal reviewed following public submissions and submissions from relevant State and Commonwealth authorities.
7. Final Local Environmental Plan with proposed amendments drafted.
8. Amending Local Environmental Plan made by the Minister and gazetted.

3.4.2 Voluntary Purchase of Residential Properties

Removal of housing from high hazard floodway areas in the floodplain is generally accepted as a cost effective means of correcting previous decisions to build in such areas. The Voluntary Purchase of residential property in hazardous areas has been part of subsidised floodplain risk management programs in NSW for over 20 years.[11] After purchase, land is subsequently cleared and the site re-developed and re-zoned for public open space or some other flood compatible use. A further criterion applied by State Government agencies in assessing eligibility for funding is that the property must be in a high hazard floodway area, that is, in the path of flowing floodwaters where the depth and velocity at the peak of the flood are such that life could be threatened, damage of property is likely and evacuation difficult.

Under a Voluntary Purchase scheme the owner is notified that the body controlling the scheme, Council in the present case, is prepared to purchase the property when the owner is ready to sell. There is no compulsion whatsoever to sell at any time. The price is determined by independent valuers and the Valuer General, and by negotiation between Council and the owners. Valuations are not reduced due to the flood affected nature of the site.

Prior to progressing to the purchase of a property, it would first be necessary to hold discussions with each eligible and agreeable property owner, as well as a detailed assessment of each property to determine a priority order and costing for each.

As there are no existing dwellings that are located in a high hazard floodway area, the inclusion of a VP Scheme in Bourke FRMP cannot be justified.

3.4.3 Raising Floor Levels of Residential Properties

The term “house raising” refers to procedures undertaken, usually on a property by property basis, to protect structures from damage by floodwaters. The most common process is to raise the affected house by a convenient amount so that the floor level is at or above the MHFL. For weatherboard and similar buildings this can be achieved by jacking up the house, constructing new supports, stairways and balconies and reconnecting services. Alternatively, where the house contains high ceilings, floor levels can be raised within rooms without actually raising the house. It is usually not practical to raise brick or masonry houses. Most of the costs associated with this measure relate to the disconnection and reconnection of services. Accordingly, houses may be raised a considerable elevation without incurring large incremental costs.

State and Federal Governments have agreed that flood mitigation funds will be available for house raising, subject to the same economic evaluation and subsidy arrangements that apply to other structural and non-structural flood mitigation measures. In accepting schemes for eligibility, the Government has set out the following conditions:

- House raising should be part of the adopted Floodplain Risk Management Plan.
- The scheme should be administered by the local authority.

State government funding is only available for properties where the buildings were approved and constructed prior to 1986 when the original Floodplain Development Manual was gazetted. Properties built after this date should have been constructed in accordance with the principles in

[11] State government funding is only available for properties where the buildings were approved and constructed prior to 1986 when the original Floodplain Development Manual was gazetted. Properties built after this date should have been constructed in accordance with the principles in the manual.

the manual. The Government also requires that councils carry out ongoing monitoring in areas where subsidised voluntary house raising has occurred to ensure that redevelopment does not occur to re-establish habitable areas below the design floor level. In addition, it is expected that councils will provide documentation during the conveyancing process so that subsequent owners are made aware of restrictions on development below the design floor level.

Council's principal role in subsidised voluntary house raising would be to:

- Define a habitable floor level, which it will have already done in exercising controls over new house building in the area.
- Guarantee a payment to the builder after satisfactory completion of the agreed work.
- Monitor the area of voluntary house raising to ensure that redevelopment does not occur to re-establish habitable areas below the design floor level.

Prior to progressing to the raising of a dwelling, it would be necessary to hold discussions with each eligible and agreeable property owner, as well as a detailed assessment of each property to determine a priority order and costing for each.

The current cost to raise a medium sized (150 m^2) house is about $100,000 based on recent experience in other centres.

While there are four existing dwellings that are subject to above-floor flooding in a 1% AEP flood event at North Bourke (refer **Figure C4.1** in **Appendix C** for location), they are located on the boundary between flood fringe and flood storage areas and therefore are unlikely to qualify for inclusion in the NSW Government's Voluntary House Raising Scheme.

3.5 Response Modification Measures

3.5.1 Improvements to Flood Warning System

As mentioned in **Section 2.12**, BoM currently operates a well-established and proven flood warning system which provides predictions of gauge heights along the Darling River, including at Bourke. BoM's system is based on water levels that are recorded by the network of telemetered gauges to predicted peak flood levels along the river, which are updated and conveyed to NSW SES Local Units during a flood emergency.

While the community did not feel that it is necessary to improve flood warning and evacuation procedures, it is recommended that the information contained in this study be used by NSW SES to update its flood intelligence database, and that this information be used to improve emergency planning and response at Bourke.

3.5.2 Improved Emergency Planning and Response

As mentioned in **Section 2.12**, the *Bourke Shire Local Flood Plan* provides detailed information regarding preparedness measures, conduct of response operations and coordination of immediate recovery measures for all levels of flooding.

NSW SES should ensure information contained in this report on the impacts of flooding on urban development, as well as recommendations regarding flood warning and community education are used to update the *Bourke Local Flood Plan*:

Annex A – The Flood Threat includes the following sub-sections:

Land Forms and River Systems – ref. **Sections 2.1** and **2.2** of the report for information on these topics.

Characteristics of Flooding – The elevation to which peak flood levels reach relative to the crest height of the town levees for floods ranging between 10% and 0.2% AEP, as well as the Extreme Flood is shows on **Figures 2.3** and **2.4**, while the indicative extent and depth of inundation both internal and external to the town levees for a 1% AEP and Extreme Flood on the Darling River are shown on **Figures 2.5** and **2.6**, respectively **Appendix B** of the report contains figures showing the nature of Darling River and local catchment flooding for design flood events ranging between 10% and 0.2% AEP, as well as the local catchment PMF event internal to the Bourke Levee. **Table 2.3** provides a comparison between historic and design peak heights on the Bourke stream gauge. **Table 2.9** summarises the impact Darling River and local catchment flooding has on vulnerable development and critical infrastructure at Bourke. The location of vulnerable development and critical infrastructure relative to the flood extents is shown on **Figure 2.7**.

Annex B – Effects of Flooding on the Community

The depth and extent of inundation in individual properties resulting from a 1% AEP flood on the Darling River are shown on **Figure 2.5**. Similar information for the Extreme Flood is shown on **Figure 2.5** and in **Appendix B** for Darling River and local catchment dominant floods of varying AEP.

The approximate depth of above-floor inundation that would occur in existing development that is located at North Bourke for a range of design flood events is shown on **Figure C4.1** in **Appendix C**.

Figure 2.7 shows the location of vulnerable development and critical infrastructure at Bourke relative to the extent of inundation for floods ranging between 10% and 0.2% AEP, as well as the Extreme Flood. Refer **Section 2.6** and **Table 2.9** for details of affected development/infrastructure.

Figures 3.6, **3.7** and **3.8** show the flood emergency response planning classifications for the 5% AEP, 1% AEP and Extreme Flood events, respectively, based on the definitions set out in the *Floodplain Risk Management Guideline – Flood Emergency Response Classification of Communities* (DECC, 2007a).

At the 1% AEP level of flooding (refer **Figure 3.4**), areas internal to the existing levee are generally classified as *Low Hazard Hydraulic Flooding*, with a small area classified as a Low Flood Island between Bloxham Street and Hughes Street. Two small areas in the north-eastern corner of the village are classified as *Areas on the Floodplain with Rising Road Access* and *Areas on the Floodplain with Overland Escape Routes*.

As mentioned in **Section 2.12** of the *Bourke FRMS* report, the Bourke Shire Local Flood Plan states that Bourke and Alice Edwards Village are protected from Darling River flooding up to 15.5 m and 14.5 m on the Bourke stream gauge, respectively. However, as set out in **Table 2.5** of the *Bourke FRMS* report, the present study found that absent the installation of any temporary flood protection measures, Bourke and Alice Edwards Village are protected from Darling River flooding only up to 14.35 m and 15.01 m on the Bourke stream gauge, respectively.

3.5.3 Public Awareness Programs

Community awareness and appreciation of the existing flood hazards in the floodplain would promote proper land use and development in flood affected areas. A well informed community would be more receptive to requirements for flood proofing of buildings and general building and development controls imposed by Council. Council should also take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplains of the flood risk.

One aspect of a community's preparedness for flooding is the "flood awareness" of individuals. This includes awareness of the flood threat in their area and how to protect themselves against it. The overall level of flood awareness within the community tends to reduce with time, as memories fade and as residents move into and out of the floodplain. The improvements to flood warning arrangements described above, as well as the process of disseminating this information to the community, would represent a major opportunity for increasing flood awareness at Bourke.

Means by which community awareness of flood risks can be maintained or may be increased include:

- displays in Bourke using the information contained in the present study; and
- talks by NSW SES officers with participation by Council and longstanding residents with first-hand experience of flooding in the area.
- preparation of a *Flood Information Brochure* which could be prepared by Council with the assistance of NSW SES containing both general and site specific data and distributed with rate notices.

The community should also be made aware that a flood greater than historic levels or the planning level can, and will, occur at some time in the future.

4 SELECTION OF FLOODPLAIN RISK MANAGEMENT MEASURES

4.1 Background

NSWG, 2005 requires a Council to develop a Floodplain Risk Management Plan based on balancing the merits of social, environmental and economic considerations which are relevant to the community. This chapter sets out a range of factors which need to be taken into consideration when selecting the mix of works and measures that should be included in the *Bourke FRMP*.

The community will have different priorities and, therefore, each needs to establish its own set of considerations used to assess the merits of different measures. The considerations adopted by a community must, however, recognise the State Government's requirements for floodplain management as set out in NSWG, 2005 and other relevant policies. A further consideration is that some elements of the *Bourke FRMP* may be eligible for subsidy from State and Federal Government sources and the requirements for such funding must, therefore, be taken into account.

Typically, State and Federal Government funding is given on the basis of merit, as judged by a range of criteria:

- The magnitude of damage to property caused by flooding and the effectiveness of the measure in mitigating damage and reducing the flood risk to the community.
- Community involvement in the preparation of the *Bourke FRMP* and acceptance of the measure.
- The technical feasibility of the measure (relevant to structural works).
- Conformance of the measure with Council's planning objectives.
- Impacts of the measure on the environment.
- The economic justification, as measured by the benefit/cost ratio of the measure.
- The financial feasibility as gauged by Council's ability to meet its commitment to fund its part of the cost.
- The performance of the measure in the event of a flood greater than the design event.
- Conformance of the measure with Government Policies (e.g. NSWG, 2005 and Catchment Management objectives).

4.2 Ranking of Measures

A suggested approach to assessing the merits of various measures is to use a subjective scoring system. The chief merits of such a system are that it allows comparisons to be made between alternatives using a common "currency". In addition, it makes the assessment of alternatives "transparent" (i.e. all important factors are included in the analysis). The system does not, however, provide an absolute "right" answer as to what should be included in the *Bourke FRMP* and what should be left out. Rather, it provides a method by which Council can re-examine the measures and if necessary, debate the relative scoring given to aspects of the *Bourke FRMP*.

Each measure is given a score according to how well the measure meets the considerations discussed above. In order to keep the scoring simple, the following system is proposed:

+2	Measure rates very highly
+1	Measure rates well
0	Measure is neutral
- 1	Measure rates poorly
- 2	Measure rates very poorly

The scores are added to get a total for each measure.

Based on considerations outlined in this chapter, **Table 4.1** presents a suggested scoring matrix for the measures reviewed in **Chapter 3** at Bourke. This scoring has been used as the basis for prioritising the components of the *Bourke FRMP*.

4.3 Summary

Table 4.1 indicates that there are good reasons to consider including the following elements into the *Bourke FRMP*:

- An update of the *Bourke LEP 2012* to allow better management of the floodplain.
- Improved planning controls through the updating of *Bourke Shire DCP 2012* based on the recommended approach set out in this report.
- Incorporation of the location specific information on flooding impacts contained in this study in the *Bourke Local Flood Plan*.
- Improved public awareness of flood risk in the community.
- Upgrade of the Bourke Levee to 1% AEP standard.
- Upgrade of the Alice Edward Village Levee to 1% AEP standard.
- Upgrade of a select number of the existing flood evacuation pumps at Bourke, including any associated drainage infrastructure.

TABLE 4.1
ASSESSMENT OF POTENTIAL FLOODPLAIN MANAGEMENT MEASURES FOR INCLUSION IN THE BOURKE FLOODPLAIN RISK MANAGEMENT PLAN

Measure	Impact on Flooding/ Reduction in Flood Risk	Community Acceptance	Technical Feasibility	Planning Objectives	Environ. Impacts	Economic Justification	Financial Feasibility	Extreme Flood	Government Policies and TCM Objectives	Score
Flood Modification										
Upgrade of Bourke Levee to a 1% AEP design standard(1)	+2	+2	+1	+2	0	+2	+1	0	+2	+12
Upgrade of Alice Edward Village Levee to a 1% AEP design standard	+1	-1	+2	+2	0	+1	+1	0	+2	+9
Upgrade of select number of existing flood evacuation pumps at Bourke	+1	+2	+2	+1	0	+1	+1	0	+1	+9
Voluntary House Raising Scheme	+1	-2	+1	0	0	+1	0	+1	0	+2
Property Modification										
Update of wording in *Bourke LEP 2012*	+2	+2	+2	+2	0	0	0	+1	+2	+11
Update of wording in *Bourke Shire DCP 2012*	+2	+2	+2	+2	0	0	0	0	+2	+10
Response Modification										
Improved Emergency Planning and Response	+2	+2	+2	+1	0	0	0	+2	+2	+11
Public Awareness Programs	+2	+2	+2	+1	0	0	0	+1	+2	+10

1. Includes the upgrade of the outlet headwall arrangements of the existing stormwater drainage system at select locations along the length of the levee.

5 BOURKE FLOODPLAIN RISK MANAGEMENT PLAN

5.1 The Floodplain Risk Management Process

The *Bourke Floodplain Risk Management Study (**Bourke FRMS**)* and draft *Bourke Floodplain Risk Management Plan* (***Bourke FRMP***) have been prepared as part of a Government program to mitigate the impacts of major floods and reduce the hazards in the floodplain. The *Bourke FRMP* which is set out in this Chapter has been prepared as part of the Floodplain Risk Management Process in accordance with NSW Government's Flood Prone Land Policy.

The first steps in the process of preparing the *Bourke FRMP* were the collection of flood data, the review of previous studies and the development of a set of flood models which were used to more accurately define the nature of flooding on the Darling River floodplain at Bourke (***Bourke Flood Study***). The preparation of the *Bourke Flood Study* formed the formal starting process of defining management measures for flood liable land and represented a detailed technical investigation of flood behaviour for Bourke.

5.2 Purpose of the Plan

The overall objectives of the *Bourke FRMS* were to assess the impacts of flooding, review policies and measures for management of flood affected land and to develop a *Bourke FRMP* which:

- Sets out the recommended program of works and measures aimed at reducing over time, the social, environmental and economic impacts of flooding and establishes a program and funding mechanism for the *Bourke FRMP*.
- Proposes amendments to Bourke Shire Council's (**Council's**) existing policies to ensure that the future development of flood affected land at Bourke is undertaken so as to be compatible with the flood hazard and risk.
- Ensures that the *Bourke FRMP* is consistent with NSW State Emergency Service's (**NSW SES's**) local emergency response planning procedures.
- Ensures that the *Bourke FRMP* has the support of the community.

In this Plan, the inundation of land by floodwater which originates from the Darling River is referred to as '*Darling River flooding*", while the inundation of land resulting from runoff that occurs as a result of heavy and/or prolonged rain directly over Bourke is referred to as "*local catchment flooding*".

5.3 The Study Area

The study area for this *Bourke FRMP* principally comprises the urbanised parts of Bourke and North Bourke, as well as their immediate environs. **Figures 1.1** and **2.1** (3 sheets) show the location of Bourke and North Bourke on the opposing banks of the Darling River, a distance of about 200 km (by river) downstream of Brewarrina.

Also shown on **Figure 2.1** is the extent of two earthen ring levees which protect existing development at Bourke (**Bourke Levee**) and the adjacent Alice Edwards Village (**Alice Edwards Village**) (collectively referred to herein as "the town levees"). Further background to the history of the Bourke Levee and also the current design standard of the town levees is provided in **Section 5.5** of the *Bourke FRMP*.

5.4 Community Consultation

The Community Consultation process provided valuable direction over the course of the investigations, bringing together views from key Council staff, other departments and agencies, and importantly, the views of the community gained through the delivery of a *Community Newsletter and Community Questionnaire* to property occupiers located on the floodplain which allowed the Bourke community to gain an understanding of the issues being addressed as part of the study.

The views of the community on potential flood risk management measures to be considered in the study were also taken into account in the assessment presented in **Chapter 3**, with supporting information provided in **Section 1.2** of the report.

The draft *Bourke FRMS&P* report was placed on public exhibition for a period of a four weeks in late 2022, with no submissions received by the closing date.

5.5 Existing Flood Mitigation Measures at Bourke

5.5.1 Bourke Levee

Figure 2.2 shows the approximate alignment of Bourke Levee around the time of major floods that occurred in 1950, 1971, 1974 and 1976, while **Figure 2.3** is a long section along the current levee alignment showing its crest level relative to adjacent levels on the floodplain. Also shown on **Figure 2.3** are water surface profiles for design flood events ranging between 10% Annual Exceedance Probability (**AEP**) and the Extreme Flood.

While the crest of the Bourke Levee is relatively uniform in elevation, there are four existing low points which reduce its level of protection (refer **Figure 2.3** for location). While the existing low points at Kidman Way (Cobar Road), the Old Bourke Wharf and the Mitchell Highway (Cumamulla Road) can be easily accessed by emergency services during a flood event, the existing low point which is located adjacent to Rotary Park is located in private property.

The NSW Department of Public Works (now Public Works Advisory) undertook a visual audit of the Bourke Levee in May 2013 and later published its findings in a report entitled *Visual Audit of Bourke Levee* (PW, 2014). While PW, 2014 found that the Bourke Levee was generally in an acceptable condition, there were a number of issues identified which were of a relative minor nature.

The present study identified that the Imminent Failure Flood (**IFF**) level[12] for the Bourke Levee would be exceeded during a Darling River flood with an AEP of 10%, while floodwater would first surcharge the existing earthen embankment at the location of the Old Bourke Wharf during a 1% AEP flood event.

---

[12] The IFF is the flood which would compromise the freeboard provision in the levee design, which based on the findings of the *Preliminary Freeboard Analysis* undertaken as part of the present investigation (refer **Appendix D** of the *Bourke FRMS* report for details) is taken to be equal to 1.0 m. The prediction of a flood higher than the IFF would trigger the evacuation of the protected area, as NSW SES would have deemed the levee to be at risk of failure.

Local catchment runoff discharges to the river side of the Bourke Levee via eleven (11) individual pipes to which flood gates have been fitted to their outlets. **Figure 2.1**, sheet 3 shows the location of the pipes and their associated flood gates. A series of flood evacuation pumps comprising both permanent and portable fixtures are also used to discharge local catchment runoff to the river side of the Bourke Levee during periods when the flood gates are in their closed position (i.e. during periods of elevated water levels in the Darling River). The location of the flood evacuation pumps are also shown on **Figure 2.1**, sheet 3.

5.5.2 Alice Edwards Village Levee

Figure 2.4 is a long section along the alignment of the Alice Edwards Village Levee showing its crest level relative to adjacent levels on the floodplain. Also shown on **Figure 2.4** are water surface profiles for design flood events ranging between 10% AEP and the Extreme Flood.

Similar to the Bourke Levee, the crest level of the Alice Edwards Village Levee is relatively uniform, with a single low point located on its southern side where a local road provides access off Parkdale Road. No details were available on the stormwater drainage system which controls local catchment runoff internal to the Alice Edwards Village Levee. For this reason, the nature of local catchment flooding internal to the Alice Edwards Village Levee has not been defined as part of the present study. It is also understood that a visual audit of the existing levee has not been undertaken to date.

The present study identified that the IFF level for the Alice Edwards Village Levee would be exceeded during a Darling River flood with an AEP of 5%, while floods up to 0.2% AEP would not surcharge the existing earthen embankment in the absence of any wind or wave action.

5.6 Flood History at Bourke

Bourke has experienced several large floods since settlement occurred in 1835. While telemetered stream gauge records only extend back to 1968, annual maximum peak discharges are available dating back to 1885. While the *Bourke Flood Levee Augmentation Study* (Sinclair Knight & Partners (**SKP**), 1986) states that a major flood that occurred in the Darling River Valley in 1864 is considered the flood of record at Bourke, there is no information available regarding the severity of flooding that was experienced in the town during this event. More recently, major flooding has been experienced in the Darling River Valley in August 1950, January 1974, March 1976, September 1998 and March 2012.

Annexure B1 in **Appendix B** of the *Bourke FRMS* report contains a series of plates showing the major flooding that was experienced at Bourke during the August 1950, March 1971, January 1974, March 1976, May 1988 and March 2012 floods. Also contained in **Annexure B1** are several photos showing the minor flooding that occurred internal to the Bourke Levee as a result of very intense rain which fell directly over the town in February 2009.

Stage hydrographs which are available on WaterNSW's web site show that water levels in the Darling River generally remain elevated above NSW SES's Major Flood Level of 12.7 m on the *Darling River at Bourke stream gauge* (GS 425003) (**Bourke stream gauge**) for weeks and in the case of the September 1998 flood, for a period of almost two months.

Figures B3.3 to **B3.6** in **Appendix B** of the *Bourke FRMS* report show the indicative extent and depth of inundation that was experienced on the broader Darling River floodplain at Bourke for the floods that occurred in 1974, 1976, 1998 and 2012, while **Figure B3.7** shows the indicative extent and depth of inundation internal to the Bourke Levee that resulted from intense rainfall that was experienced over the town in February 2009 (as defined by the flood models that were developed as part of the *Bourke Flood Study*).

5.7 Design Flood Behaviour

The *Bourke Flood Study* defined the nature of both Darling River and local catchment flooding at Bourke under present day conditions. **Figures 2.5** and **2.6** (3 sheets each) show the indicative extent and depth of inundation on the Darling River floodplain at Bourke for the 1% AEP flood and Extreme Flood, respectively, while similar information is shown on **Figures B5.1** to **B5.5** for floods with AEPs of 10, 5, 2, 0.5 and 0.2 per cent. **Figure B5.6** shows the indicative extent and depth of inundation internal to the Bourke Levee that would result from a localised PMF event.

The design peak flood levels on the Bourke stream gauge as defined by the *Bourke Flood Study* are as follows:

- 10% AEP 13.51 m
- 5% AEP 14.04 m
- 2% AEP 14.26 m
- 1% AEP 14.38 m
- 0.5% AEP 14.50 m
- 0.2% AEP 14.70 m
- Extreme Flood 15.96 m

The key features of Darling River flooding on the floodplain in the vicinity of Bourke are as follows:

- Floodwater surcharges the banks of the Darling River in flood events more frequent than 10% AEP in magnitude.
- Parkdale Road (Alice Edwards Road) and the Mitchell Highway (Nyngan Road) will be inundated in flood events more frequent than 10% AEP.
- The Kamilaroi Highway (Brewarrina Road) and Kidman Way (Cobar Road) will commence to become inundated in a 5% AEP flood.
- Bourke commences to become isolated in a 2% AEP flood when the Mitchell Highway (Cullamulla Road) is inundated to depths of up to 250 mm where it runs between the Bourke Levee and the Swamp Bridge.
- Existing residential development that is located on the eastern side of the Mitchell Highway at North Bourke would experience above-floor flooding during floods as frequent as 5% (1 in 20) AEP.
- Floodwater originating from the Darling River backwaters into the Bourke Aerodrome via a set of culverts beneath Hungerford Road and commences to inundate the runway in a 2% AEP flood event. The runway will be inundated to a depth of about 200 mm at the 1% AEP level of flooding, increasing to about 600 mm at the 0.2% AEP level of flooding.

- Floodwater surcharges the right bank of the Darling River upstream of the Old Bourke Bridge in a 0.5% AEP flood and discharges to the Bourke Aerodrome via a set of culverts beneath the Mitchell Highway in the vicinity of its intersection with Warrego Street. Floodwater commences to overtop the Mitchell Highway at this location in a 0.2% AEP flood.

As overtopping of the Bourke Levee commences at about the 1% AEP, flooding internal to the levee during local catchment storm events up to 1% AEP in intensity is generally of a low hazard nature, with depths of inundation in developed areas generally not exceeding 0.3 m.

5.8 Economic Impacts of Flooding

Flood damages in Bourke and North Bourke were assessed as part of the present study for both Darling River and local catchment flooding.

While no above-floor inundation would be experienced in existing development that is located internal to the Bourke Levee for storm events up to 1% AEP in intensity, it is estimated that four existing dwellings and one commercial property would experience above-floor inundation at North Bourke during a 1% AEP flood on the Darling River, resulting in total damages of about $0.47 Million.

The total damages that would be experienced internal to the Bourke Levee as a result of a 1% AEP local catchment storm is estimated to be about $0.94 Million, increasing to a maximum of $1.25 Million if such a storm was to occur when the flood gates are closed and the flood evacuation pumps are not operational.

The *Present Worth Value* of damages for all Darling River floods between the IFF and the 1% AEP event assuming a partial failure of the town levees is about $58.1 Million and $1.0 Million in Bourke and Alice Edwards Village, respectively. These values are the maximum amount that could be spent upgrading the town levees to ensure that they are geotechnically stable, free of defects and incorporate the required freeboard to the 1% AEP flood and still be justified on economic grounds.

5.9 Structure of Floodplain Risk Management Study and Plan

The *Bourke FRMS* and *Bourke FRMP* are supported by Appendices which provide additional details of the investigations. A summary of the *Bourke FRMP* proposed for the study area along with broad funding requirements for the recommended measures are shown in **Table 5.1** over. The measures will over time achieve the objectives of reducing the flood risk to existing and future development for the full range of floods.

The *Bourke FRMP* is based on a mix of measures which have been given a provisional priority ranking according to a range of economic, social, environmental and other criteria set out in **Table 4.1** of the *Bourke FRMS* report.

5.10 Planning and Development Controls

The results of *Bourke FRMS* indicate that an important measure for Council to adopt is the update of both *Bourke LEP 2012* and *Bourke Shire DCP 2012* to reflect more contemporaneous best-floodplain risk management practices.

TABLE 5.1
MEASURES COMPRISING THE BOURKE FLOODPLAIN RISK MANAGEMENT PLAN

Measure	Required Funding	Priority
Measure 1 – Update wording in *Bourke Local Environmental Plan 2012*	Council's staff costs	1
Measure 2 – Update wording in *Bourke Development Control Plan 2012*	Council staff costs	1
Measure 3 – Improvements to emergency response planning	NSW SES costs	1
Measure 4 – Increase public awareness of the risks of flooding in the community	Council staff costs	1
Measure 5 – Investigation and concept design of Bourke Levee upgrade works	$150,000	1
Measure 6 – Detailed design and construction of levee upgrade works	$1.25 Million	2(1)
Measure 7 – Investigation and concept design of Bourke Levee upgrade works	$40,000	2(2)
Measure 8 – Detailed design and construction of levee upgrade works	$200,000	3(3)
Measure 9 – Investigation and development of flood evacuation pump strategy for Bourke	$100,000	1
Measure 10 – Detailed design and implementation of flood evacuation pump strategy for Bourke	$1.0 Million	2(1)

1. Because of its medium to long term nature, this measure has been given a **Priority 2** ranking.
2. Assigned a lower priority ranking due to the existing levee having a higher standard than the Bourke Levee

5.10.1 Revision of Bourke Local Environmental Plan 2012

Clause 5.21 of *Bourke LEP 2012* entitled "Flood planning" outlines its objectives in regard to development of land that lies within the Flood Planning Area (**FPA**). The FPA is the area of land which lies below the Flood Planning Level (**FPL**), where the FPL is a combination of flood levels and freeboards selected for floodplain risk management purposes.

The NSW Government recently finalised reforms of the Flood Prone Land Package which included an update of the flood planning clause in all NSW Council Local Environmental Plans which came into effect on 14 July 2021. While the wording of the flood planning clause in the Bourke LEP 2012 was automatically updated on this date, it is recommended that the new *special flood considerations* clause set out in the Flood Prone Land Package also be incorporated in *Bourke LEP 2012* (**Measure 1**). The objectives of the new clause are as follows:

- in relation to development with particular evacuation or emergency response issues (e.g. group homes, residential care facilities, etc.) to enable evacuation of land subject to flooding in events exceeding the flood planning level; and
- to protect the operational capacity of emergency response facilities and critical infrastructure during extreme flood events.

The new clause would apply to land identified as Outer Floodplain (i.e. land which lies between the FPA and the extent of the Extreme Flood). Wording in relation to this new clause is given in **Section 3.4.1.4**.

5.10.2 Bourke Shire Development Control Plan 2012

The recommended approach to managing future development in the study area uses contemporaneous concepts of *flood hazard* and *hydraulic categorisation* to develop controls for future development on flood prone land (**Measure 2**). **Figure E1.1** in **Appendix E** of the *Bourke FRMS* report is an extract from the *Flood Planning Map* relating to the study area. The extent of the FPA has been defined as the 1% (1 in 100) AEP plus 0.5 m freeboard.

It is proposed that properties intersected by the extent of the FPA would be subject to S10.7 flood affectation notification and planning controls graded according to flood hazard and hydraulic categorisation. **Annexure 2** in **Appendix E** sets out the graded set of flood related planning controls which should be applied to development in the Bourke Shire area.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development on properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figure E1.1**. The MHFLs for residential land use types is the level of the 1% AEP flood event plus 0.5 m freeboard, whereas for commercial and industrial land use types the MHFL is to be as close to the 1% AEP flood level plus 0.5 m freeboard as practical, but no lower than the 2% AEP flood level plus 0.5 m freeboard. In situations where the MHFL for commercial and industrial land used types is below the 1% AEP flood level plus 0.5 m freeboard, a mezzanine area equal to 20% of the total habitable floor area or 20 m^2 (whichever is the larger) is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus 0.5 m freeboard. The MHFLs for flood vulnerable residential development, critical utilities and uses, and essential community facilities located on the floodplain is the 0.5% AEP flood event plus 0.5 m freeboard.

Figure E1.2 in **Appendix E** is an extract of the *Flood Planning Constraint Category Map* for Bourke. The figure shows the subdivision of the floodplain into the following four categories which have been used as the basis for developing the graded set of planning controls:

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the FPA where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the FPA but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this document.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises the area which lies between the extent of the FPA and the PMF. Flood related controls in areas designated FPCC4 are typically limited to flood evacuation and emergency response, although additional controls apply to “critical uses and facilities” which are critical for response and recovery.

5.11 Improvements to Emergency Response Planning and Community Awareness

Two measures are proposed in the *Bourke FRMP* to improve emergency response planning and community awareness to the threat posed by flooding.

Measure 3 involves the update by NSW SES of the *Bourke Shire Local Flood Plan* using information on design peak flood levels on the Bourke stream gauge, flooding patterns and flood prone areas identified in this report. The level on the Bourke stream gauge at which the existing town levees will be overtopped should also be amended. Figures have been prepared showing indicative extents of flooding and high hazard areas. **Section 3.5.2** of the *Bourke FRMS* report references the locations of key data within this report.

Council should also take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplain of the flood risk (included as **Measure 4** of the *Bourke FRMP*). This information could be included in a *Flood Information Brochure* to be prepared by Council with the assistance of NSW SES containing both general and site specific data and distributed with the rate notices. The community should also be made aware that a flood greater than historic levels or the planning level can, and will, occur at some time in the future. The *Bourke FRMP* should be publicised and exhibited at community gathering places to make residents aware of the measures being proposed.

5.12 Flood Modification Works

While the present study found that the Bourke and Alice Edwards Village levees would not be overtopped by floods smaller than about 1% AEP and 0.2% AEP in magnitude, respectively, both levees do not incorporate the required 1 m freeboard to peak 1% AEP flood levels.

In the case of the Bourke Levee, it would be necessary to raise a 3 km long section of the earthen embankment by a maximum of about 0.2 m, as well as at two other locations in order to achieve the required 1 m freeboard to peak 1% AEP Darling River flood levels. It would also be necessary to include provisions for the installation of removable barrier type arrangements at the location of the Kidman Way (Cobar Road) and Mitchell Highway (Cumamulla Road) road crossings, as well as at Bourke Wharf. It would also be necessary for Council to arrange access to the private property that spans the crest of the levee immediately adjacent to Rotary Park in order to raise the low point that is present at this location. It is also recommended that Council create an easement over the levee where it runs through the private property so as to facilitate future maintenance. It is estimated that the investigation, design and construction of the levee upgrade works (**Measures 5** and **6**) would cost about $1.4 Million.

In the case of the Alice Edwards Village Levee, the upgrade works would be limited to the installation of removable barrier type arrangements at the location of the local access road crossing. It is estimated that the investigation, design and construction of the levee upgrade works (**Measures 7** and **8**) would cost about $240,000.

The present investigation found that there is merit in upgrading the existing flood evacuation pumps that are used to pump stormwater runoff over the Bourke Levee during periods of intense rainfall, as well as any associated drainage infrastructure. It is therefore recommended that an investigation be undertaken to develop and implement a flood evacuation pump strategy for Bourke (**Measures 9** and **10**), the cost of which is estimated at about $1.1 Million.

5.13 Implementation Program

The steps in progressing the floodplain management process from this point onwards are:

1. Council adopts the *Bourke FRMP* and submits an application for funding assistance.
2. Assistance for funding qualifying projects included in the *Bourke FRMP* may be available upon application under the Commonwealth and State funded floodplain management programs, currently administered by the Department of Planning, Industry and Environment.
3. As funds become available from Government agencies and/or Council's own resources, implement the measures in accordance with the established priorities.

The *Bourke FRMP* should be regarded as a dynamic instrument requiring review and modification over time. The catalysts for change could include new flood events and experiences, legislative change, alterations in the availability of funding, reviews of Council's planning strategies and importantly, the outcome of some of the studies proposed in this report as part of the *Bourke FRMP*. In any event, a thorough review every five years is warranted to ensure the ongoing relevance of the *Bourke FRMP*.

6 GLOSSARY OF TERMS

Note: For expanded list of definitions, refer to Glossary contained within the NSW Government Floodplain Development Manual, 2005.

TERM	DEFINITION
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, for a flood magnitude having five per cent AEP, there is a five per cent probability that there would be floods of greater magnitude each year.
Australian Height Datum (AHD)	A common national surface level datum corresponding approximately to mean sea level.
Darling River Flooding	Inundation of normally dry land occurring when water overflows the natural banks of the Darling River.
Flood Affected Properties	Properties that are either encompassed or intersected by the **Flood Planning Area (FPA)**.
Flood Fringe Areas	The remaining area of flood prone land after floodway and flood storage areas have been defined.
Floodplain	Area of land which is subject to inundation by floods up to and including the Probable Maximum Flood (**PMF**) event, that is, flood prone land.
Flood Planning Area	The area of land that is shown to be in the Flood Planning Area on the *Flood Planning Map*.
Flood Planning Map	The *Flood Planning Map* shows the extent of land on which flood related development controls apply.
Flood Planning Level (FPL)	The combinations of flood levels and freeboards selected for planning purposes, as determined in floodplain risk management studies and incorporated in floodplain risk management plans. For land within the Flood Planning Area subject to Darling River flooding, the Flood Planning Level (FPL) is the level of the 1% Annual Exceedance Probability (AEP) flood event plus 500 mm freeboard. For areas outside the Flood Planning Area shown on the *Flood Planning Map*, the FPL is the level of the 1% AEP flood event plus 500 mm freeboard.
Flood Prone/Flood Liable Land	Land susceptible to flooding by the PMF. Flood Prone land is synonymous with Flood Liable land.
Floodway Areas	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Flood Storage Areas	Those parts of the floodplain that may be important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.

TERM	DEFINITION
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding a particular flood chosen as the basis for the FPL and MFL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the FPL and MFL.
Habitable Room	In a residential situation: a living or working area, such as a lounge room, dining room, kitchen, bedroom or workroom. In an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Local Drainage	Land on an overland flow path where the depth of inundation during the 1% AEP storm event is less than 150 mm.
Local Catchment Flooding	Inundation of normally dry land occurring when heavy and/or prolonged rain occurs over Bourke
Probable Maximum Flood (PMF)	The largest flood that could conceivably occur at a particular location. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain.

7 REFERENCES

BoM (Bureau of Meteorology), 2003. ***"The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method"***.

Bourke Shire Council, 2012. ***"Bourke Local Environmental Plan, 2012"***

Bourke Shire Council, 2016. ***"Bourke Shire Development Control Plan"***

DECC (Department of Environment and Climate Change, NSW), 2007a. ***"Floodplain Risk Management Guideline – Flood Emergency Response Classification of Communities"***.

DECC (Department of Environment and Climate Change, NSW), 2007b. ***"Floodplain Risk Management Guideline – Practical Considerations of Climate Change"***.

DECC (Department of Environment and Climate Change, NSW), 2007c. ***"Floodplain Risk Management Guideline No 4. Residential Flood Damage Calculation"***.

DECC (Department of Environment and Climate Change, NSW), 2007d. ***"Floodplain Risk Management Guideline – Floodway Definition"***.

DPIW (NSW Department of Primary Industries – Water), 2017. ***"Floodplain Management Plan for the Barwon-Darling Valley Floodplain"***

DWR (Department of Water Resources), 1992. ***"Estimation of Potential Flood Damages at Bourke"***

Geolyse, 2015. **"Bourke Stormwater Upgrade Strategy"**

GA (Geoscience Australia), 2016. ***"Australian Rainfall and Runoff – A Guide to Flood Estimation"***

Howells et al., 2004. ***"Defining the Floodway - Can One Size Fit All?"*** FMA NSW Annual Conference, Coffs Harbour, February 2004.

IEAust (The Institution of Engineers Australia), 1987. ***"Australian Rainfall and Runoff – A Guide to Flood Estimation"***, Volumes 1 and 2.

NSWG (New South Wales Government), 2005. ***"Floodplain Development Manual"***

NSW SES (NSW State Emergency Service), 2000. ***"Bourke Local Flood Plan"***

PW (NSW Department of Public Works), 2011. ***"Bourke Levee – Investigation for Upgrade of the Levee"***

PW (NSW Department of Public Works), 2012. ***"Visual Audit of Bourke Levee"***

PW (NSW Department of Public Works), 2018. ***"Draft Bourke Levee Owners Manual"***

SKP (Sinclair Knight & Partners), 1986. ***"Bourke Flood Levee Augmentation Study"***

URS et al., 2009. ***"Rural Flood Study Darling River Floodplain (Bogan River Confluence to Louth)"***

WaterNSW, 2020. ***"425003 Darling River at Bourke – High Stage Rating Post the 2012 Floods"***

APPENDIX A

COMMUNITY CONSULTATION

TABLE OF CONTENTS

Page No.

ANNEXURES

A1. INTRODUCTION

At the commencement of the *Bourke FRMS,* the Consultants prepared a *Community Newsletter* and a *Community Questionnaire*, both of which were distributed by Council to residents and business owners in Bourke (refer to **Annexure A1** in this Appendix). A media release was also prepared that introduced the project and encouraged the community to provide input to the study by responding to the Community Questionnaire. The media release was placed on Council's website and advertised in the local newspaper and radio station.

The purpose of the *Community Newsletter* was to introduce the objectives of the study and set the scene on flooding conditions so that the community would be better able to respond to the *Community Questionnair*e and contribute to the study process.

The *Newsletter* contained the following information:

- A plan showing the extent of the study area.
- A statement of the objectives of the *Bourke FRMS&P*; namely the development of a strategy for reducing the flood risk and minimising the long-term impact of flooding on the community.

The *Community Questionnaire* was structured with the objectives of:

- Determining residents' and business owners' attitudes to controls over future development in flood liable areas.
- Inviting community views on possible flood management options which could be considered for further investigation in the *Bourke FRMS* and possible inclusion in the resulting *Bourke FRMP*.
- Obtaining feedback on any other flood related issues and concerns which the residents and business owners cared to raise.

This **Appendix** to the *Bourke FRMS&P* report discusses the responses to the twelve questions that were included in the *Community Questionnaire* and comments made by respondents.

Chapter A2 deals with the residents' and business owners' views on the relative importance of classes of development over which flood-related controls should be imposed by Council.

Chapter A3 identifies residents' and business owners' views on the suitability of the various options which could be considered in more detail in the *Bourke FRMS.*

Chapter A4 discusses the best methods by which the community could provide feedback to the consultants over the course of the study.

Chapter A5 summarises the findings of the community consultation process.

A2 RESIDENT PROFILE AND FLOOD EXPERIENCE

A2.1 General

Residents were requested to complete the *Community Questionnaire* and return it to the Consultants by 19 March 2021. The deadline was extended to include any submissions that were received after this date. The Consultants received 15 responses in total out of the 800 that had been distributed.

The Consultants have collated the responses, which are shown in graphical format in **Annexure A2** in this Appendix.

A2.2 Respondent Profile

The first three questions of the *Community Questionnaire* canvassed resident information such as whether the respondent was a resident or business owner, length of time at the property, the type of property (e.g. house, unit/flat).

Fourteen respondents were residents and two were business owners, noting that one respondent indicated that they were both a resident and a business owner (**Question 1**). Eight respondents are the owner of the property and two rent the property, while five did not indicate whether they own or rent the property (**Question 1**).

The length of time respondents had been at the address was found to be varied, with seven responses for ‘5 to 20 years’ and seven for ‘more than 20 years’, while one respondent had resided at the nominated address for ‘1 to 5 years’ (**Question 2**).

The majority of respondents occupied residential type property (**Question 3**), which included houses (13 respondents) and semi-rural farms (1). One respondent was concerned with public property.

A2.3 Experiences of Flooding

In Questions 4 to 7, respondents were asked about their experiences of flooding at Bourke. In response to **Question 4**, one respondent had been affected by Darling River flooding in January 1974, March 1976, September 1998 and March 2012, while an additional two respondents had also been affected by Darling River flooding in March 2012. Seven respondents were affected by flooding during the storm event that occurred in February 2009.

In response to **Question 5** regarding records of flood levels at Bourke, one respondent referenced the peak flood levels that were recorded at the Bourke stream gauge during the 2012 and 2016 flood events, while one respondent indicated that floodwater inundated the back steps of their house during the February 2009 storm event.

When asked if their property has been damages by floodwater (**Question 6**), respondents identified the following impacts:

- House movement (one respondent)
- Water damage (one)
- Damaged fencing (two)
- Sewerage problems (one)
- Backyard inundated (one)

A2.4 Controls over Development in Flood Prone Areas

The respondents were asked to rank from 1 to 4 the classes of development which they consider should receive protection from flooding (**Question 8**). Rank 1 was the most important and rank 4 the least.

The classes in decreasing order of importance to respondents ranged from:

- residential property;
- essential community facilities (e.g. schools, evacuation centres); and
- critical utilities;
- commercial/business type development;
- new residential subdivisions; and
- minor development.

Respondents were also asked in **Question 9** about the level of control Council should place on new development to minimise flood-related risks. The most popular responses were to place restrictions on development to reduce the potential for flood damage (e.g. minimum floor level controls or the use of compatible building materials) and prohibit all development on land with any potential to flood. The next most favoured response was to advise of the flood risks, but allow the individual the choice as to whether they develop or not provided they take steps to minimise the potential flood risks and prohibit new development only in those locations that would be extremely hazardous to persons or property during floods.

In **Question 10**, respondents were asked what notifications Council should give about the flood affectation of individual properties. The community was strongly in favour of advising existing residents (nine) and prospective purchasers (four) of the known potential flood.

A3 POTENTIAL FLOOD MANAGEMENT MEASURES

The respondents were asked for their opinion on potential flood management measures which could be evaluated in the *Bourke FRMS* (and if found to be feasible included in the *Bourke FRMP*), by ticking a "yes" or "no" to the eleven potential options identified in **Question 11**.

The options comprised a range of *structural flood management measures* (e.g. raising the existing levee; improving the stormwater system) as well as various *non-structural management measures* (e.g. voluntary purchase of residential properties in high hazard areas; raising floor levels of houses in low hazard areas; flood related controls over new developments; improvements to flood warning and evacuation procedures; community education on flooding; flood advice certificates). The options were not mutually exclusive, as the adopted *Bourke FRMP* could, in theory, include all of the options set out in the *Community Questionnaire*, or indeed, other measures nominated by the respondents or the FRMC.

The most popular structural measures were the improvement to the stormwater drainage system internal to the existing levee and the raising of the existing earthen levee, by either permanent or temporary methods.

Of the non-structural measures, improvement of flood warning and evacuation procedures, provision of a Planning Certificate to purchasers in flood prone areas, specifying controls on future development in flood-prone areas and community flood-awareness programs all received strong support.

A mostly negative response was given to providing subsidies for raising the floor level of properties, the implementation of a residential Voluntary Purchase scheme and flood proofing individual properties.

A4 INPUT TO THE STUDY AND FEEDBACK FROM THE COMMUNITY

In **Question 12,** residents and business owners were asked for their view on the best methods of their providing input to the Study and feedback to the Consultants over the course of the investigation. Articles in the local newspaper and Council's website were the most popular methods, followed by public meetings and through the FRMC. Other suggestions raised by respondents include using Council's social media pages.

A5 SUMMARY

Fifteen responses were received to the *Community Questionnaire* which was distributed by Council to residents and business owners in Bourke. The responses amounted to about 2 per cent of the total number of questionnaires that were distributed to the community.

The issues identified by the responses to the *Community Questionnaire* support the objectives of the study as nominated in the attached *Community Newsletter,* and the activities nominated in the Study Brief. Of interest is that the majority of respondents supported raising the existing earthen levee to protect the town from riverine type flooding and improving the stormwater drainage system internal to the existing levee to minimise the impacts of localised rainfall events on existing development at Bourke.

Improvements of flood warning and evacuation procedures, provision of a Planning Certificate to purchasers in flood prone areas, specifying controls on future development in flood-prone areas and community flood-awareness programs were the most popular of the potential *non-structural measures* set out in the *Community Questionnaire*.

There were no new measures identified by the respondents to the questionnaire.

ANNEXURE A1

COMMUNITY NEWSLETTER AND QUESTIONNAIRE

Planning, Industry & Environment

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Community Information

To the Residents and Business Owners of Bourke:

Bourke Shire Council has received a grant from the NSW Government's Floodplain Management Program to prepare a *Flood Study* and *Floodplain Risk Management Study and Plan* (*FRMS&P*) for the town of Bourke. The attached figure shows the extent of the study area, as well as the alignment of the existing earthen ring levees which protects the town and the Alice Edwards Village from riverine type flooding. Council's main objective in undertaking the study is to assess the requirements for the upgrade of the existing town levee in order to ensure that it will protect the town from riverine flooding up to the 1 in 100 year event.

The study is a joint project between Council and the NSW Department of Planning, Industry and Environment which aims to build community resilience towards flooding through informing better planning of development, emergency management and community awareness. Council has established a Floodplain Risk Management Committee which is comprised of relevant council members, state government agencies and community representatives.

As part of the study the consultants will:

- Prepare a computer based hydraulic model of the Darling River and its floodplain to determine flooding and drainage patterns, flood levels, flow velocities and depths of inundation in the vicinity of the town.
- Assess damages to the community resulting from floods that overtop the existing levees.
- Assess the upgrade requirements for the existing levees, including improvements to the interval drainage system.
- Assist Council in the preparation of policies which ensure that future development in flood prone areas is carried out in recognition of the existing flood risk.
- Assist the NSW State Emergency Service in developing appropriate emergency response planning for flood events.
- Develop a comprehensive Floodplain Risk Management Plan for Bourke.

Have Your Say on Floodplain Management

An important first step in the preparation of a *Flood Study* and *FRMS&P* is to identify the availability of existing data on historic floods and to determine the flood issues that are important to the community. The attached **questionnaire** has been provided to residents and business owners to assist the Consultants in gathering this important information. All information provided will remain confidential and for use in this study only. Please return the completed questionnaire in the reply paid envelope provided by **Friday 19 March 2021**.

Contact: Bourke Shire Council

Peter Brown – Manager Works
Phone: (02) 6830 8000
Email: pbrown@bourke.nsw.gov.au

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

COMMUNITY QUESTIONNAIRE

This Questionnaire is part of the *Bourke Flood Study* and *Floodplain Risk Management Study and Plan*, which are currently being prepared by Bourke Shire Council with the financial assistance and technical support of the NSW Department of Planning, Industry and Environment. Your responses to the questionnaire will help us identify the availability of historic flood data and to determine the flood issues that are important to you.

Please return your completed Questionnaire in the reply paid envelope provided by **Friday 19 March 2021**. No postage stamp is required. If you have misplaced the supplied envelope or wish to send an additional submission the address is:

Lyall & Associates
Reply Paid 85163
NORTH SYDNEY NSW 2060

Name (Optional): ______________________________

Address: ______________________________

About your property

1. Please tick as appropriate:

- ☐ I am a resident
- ☐ I am a business owner
- ☐ I own the property
- ☐ I rent the property
- ☐ Other (please specify__________________)

2. How long have you been at this address?

- ☐ Less than a year
- ☐ 1 year to 5 years
- ☐ 5 years to 20 years
- ☐ More than 20 years (____ years)

3. What is your property?

- ☐ House
- ☐ Vacant land
- ☐ Shop/Retail
- ☐ Community building
- ☐ Other: ____________________________

4. Have you experienced flooding at your property?

- ☐ January 1974 (river flood)
- ☐ March 1976 (river flood)
- ☐ September 1998 (river flood)
- ☐ February 2009 (localised storm)
- ☐ March 2012 (river flood)
- ☐ Other: ____________________________

5. For the floods you have listed, do you have any records of the height the floodwaters reached? For example, a flood mark on a building, shed, fence, light pole? (please provide brief description)

____
____
____
____
____
____

6. If flooding affected your property in the past, what damages occurred as a result?

____
____
____
____
____
____
____

7. If you have any photographs of historic flooding at Bourke you are welcome to drop into Council's office in Bourke to have them photocopied or email them to pbrown@bourke.nsw.gov.au. Council will then forward the photographs onto the Consultant on your behalf.

Your attitudes to Council's development controls

8. Please rank the following development types according to which you think are the most important to protect from floods (1=highest priority to 6=least priority)

- ☐ Commercial
- ☐ Residential
- ☐ Essential community facilities
- ☐ Critical Utilities
- ☐ Minor developments and additions
- ☐ New residential subdivisions

9. What level of control do you consider Council should place on new development to minimise flood-related risks? (Tick only one box)
(In addition to being favoured by the Community, these options would also need to comply with legislation)

- ☐ Prohibit all new development on land with any potential to flood
- ☐ Prohibit all new development only in those locations that would be extremely hazardous to persons or property due to the depth and/or velocity of floodwaters, or evacuation difficulties.
- ☐ Place restrictions on developments which reduce the potential for flood damage (e.g. minimum floor level controls or the use of flood compatible building materials)
- ☐ Advise of the flood risks, but allow the individual a choice as to whether they develop or not, provided steps are taken to minimise potential flood risks
- ☐ Provide no advice regarding the potential flood risks or measures that could minimise those risks
- ☐ Don't know

10. What notifications do you consider Council should give about the potential flood affectation of individual properties? (Tick only one boxes)

- ☐ Advise every resident and property owner on a regular basis of the known potential flood threat
- ☐ Advise only those who enquire to Council about the known potential flood threat
- ☐ Advise prospective purchasers of property of the known potential flood threat.
- ☐ Provide no notifications
- ☐ Other (____________________________)

Your opinions on floodplain risk management measures and controls

11. Below is a list of possible options that may be looked at to try to minimise the effects of flooding in the Study Area (see plan at back of questionnaire).

This list is not in any order of importance and there may be other options that you think should be considered. For each of the options listed, please indicate "yes", or "no" to indicate if you favour the option or "don't know" if undecided. (In addition to being favoured by the Community, management options would also need to comply with legislation and be capable of being funded).

Option	Yes	No	Don't Know
Raising of the existing earthen levee using the same construction methodology			
Raising of the existing earthen levee during times of flood using temporary/relocatable flood barriers			
Improvements to the internal drainage system (e.g. upgrade of the existing piped drainage system around the perimeter of the existing levee)			
Voluntary purchase of the most severely affected flood-liable properties			
Provide funding or subsidies to raise houses above major flood level in low hazard areas.			
Flood proofing of individual properties by waterproofing walls, putting shutters across doors, etc.			
Improve flood warning and evacuation procedures both before and during a flood.			
Community education, participation and flood awareness programs.			
Ensuring all residents and business owners have Flood Action Plans - these outline WHAT people should do, WHERE they should go and WHO they should contact in a flood			
Specify controls on future development in flood-liable areas (e.g. controls on extent of filling, minimum floor levels, etc.)			
Provide a Planning Certificate to purchasers in flood prone areas, stating that the property is flood affected.			
Ensuring all information about the potential risks of flooding is available to all residents and business owners			

12. What do you think is the best way for us to get input and feedback from the local community about the results and proposals from this study? (Tick one or more boxes)

- ☐ Council's website
- ☐ Articles in local newspaper
- ☐ Open days or drop-in days
- ☐ Community workshops
- ☐ Public Meetings
- ☐ Through Council's Floodplain Management Committee
- ☐ Other (please specify ________________)

13. If you wish us to contact you so you can provide further information, please provide your details below:

Name: ______________________________

Address: ______________________________

____

Phone: ______________________________

Best time to call is ______________________________

Email: ______________________________

Who can I contact for further information?

Bourke Shire Council
Peter Brown – Manager Works
Phone: (02) 6830 8000
Email: pbrown@bourke.nsw.gov.au

COMMENTS

Please write your comments here:

____

____

____

____

____

____

____

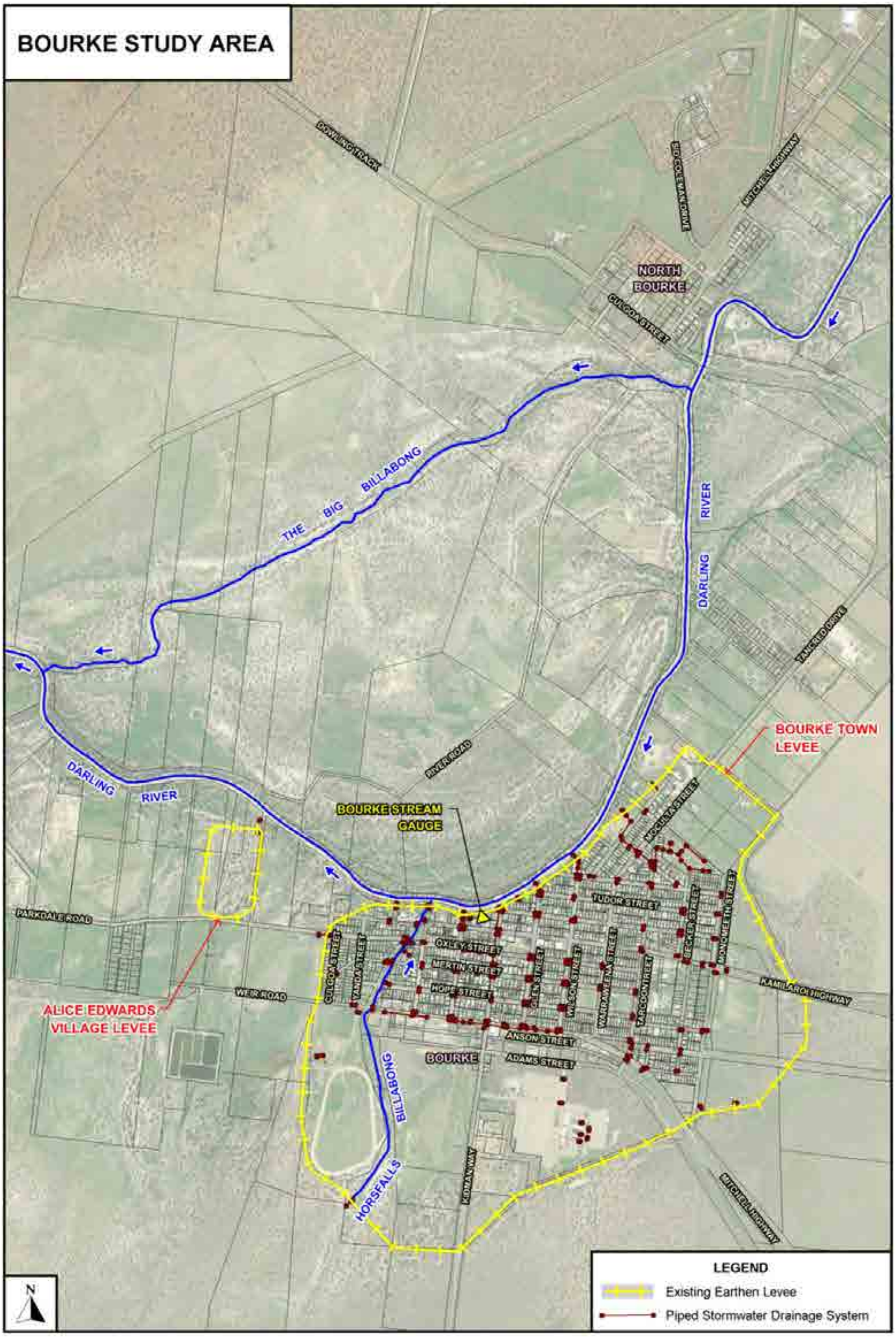
____

____

____

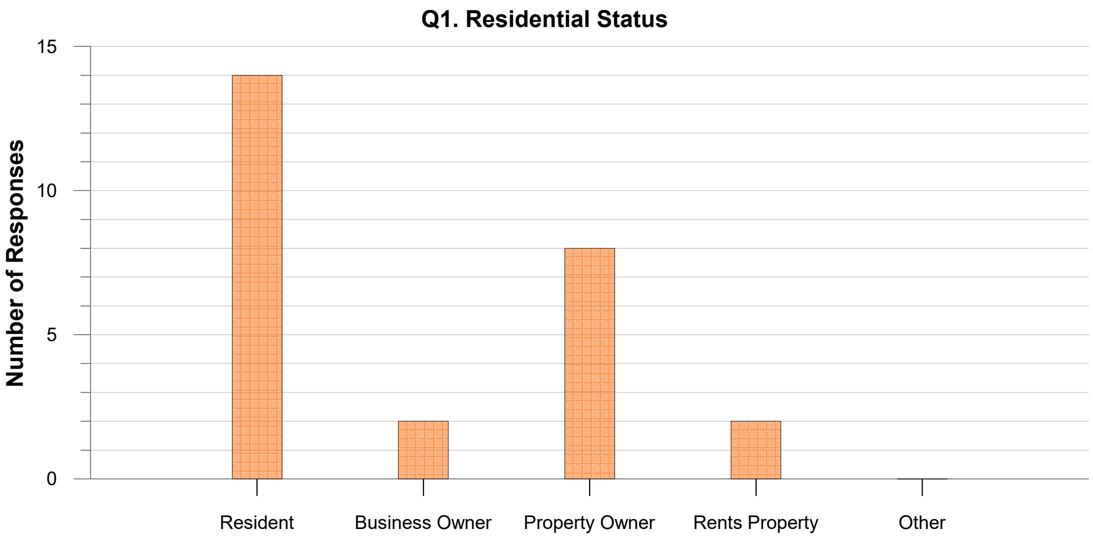
____

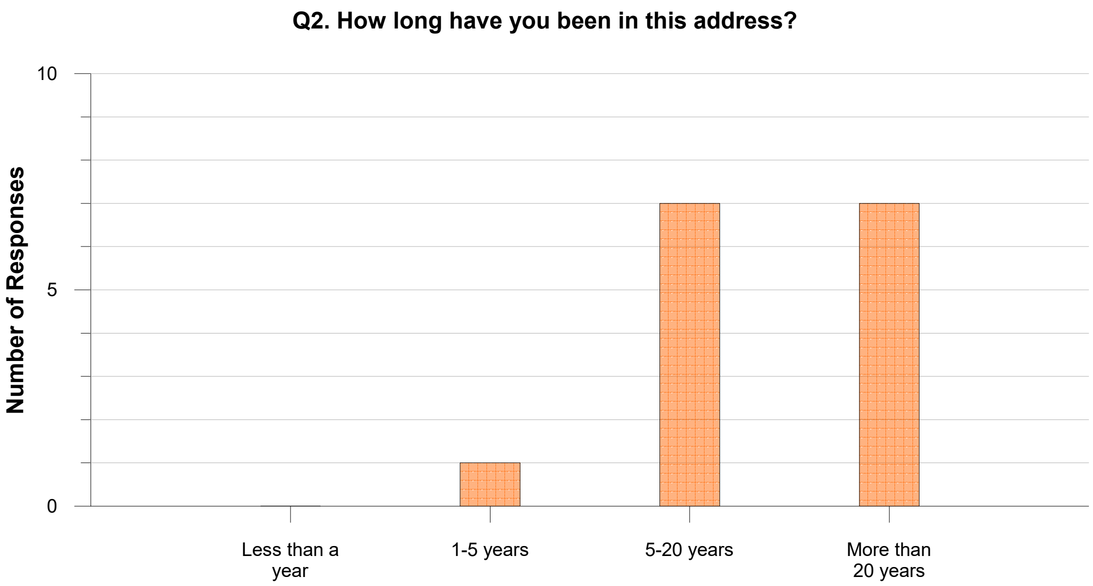
____

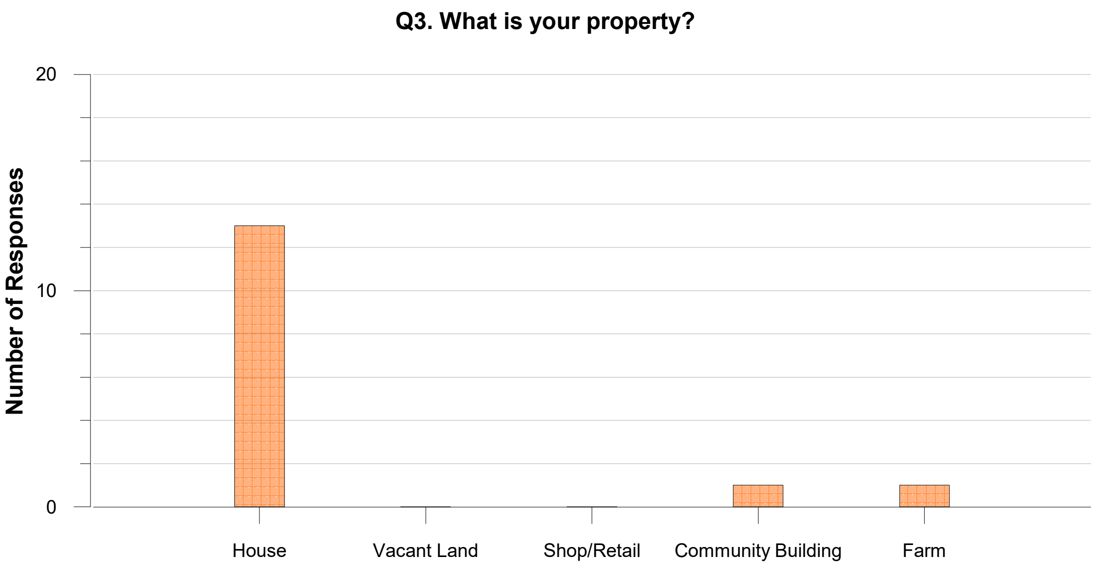

BOURKE STUDY AREA
DOWLING TRACK
MITCHELL HIGHWAY
NORTH BOURKE
CULGOA STREET
THE BIG BILLABONG
DARLING RIVER
BOURKE TOWN LEVEE
RIVER ROAD
DARLING RIVER
BOURKE STREAM GAUGE
TUDOR STREET
OXLEY STREET
MERTIN STREET
HOPE STREET
PARKDALE ROAD
WEIR ROAD
ALICE EDWARDS VILLAGE LEVEE
CULGOA STREET
YANDA STREET
ANSON STREET
ADAMS STREET
BOURKE
BILLABONG
HORSFALLS
KIDMAN WAY
KAMILAROI HIGHWAY
MITCHELL HIGHWAY
LEGEND
Existing Earthen Levee
Piped Stormwater Drainage System
N

ANNEXURE A2

RESPONSES TO COMMUNITY QUESTIONNAIRE

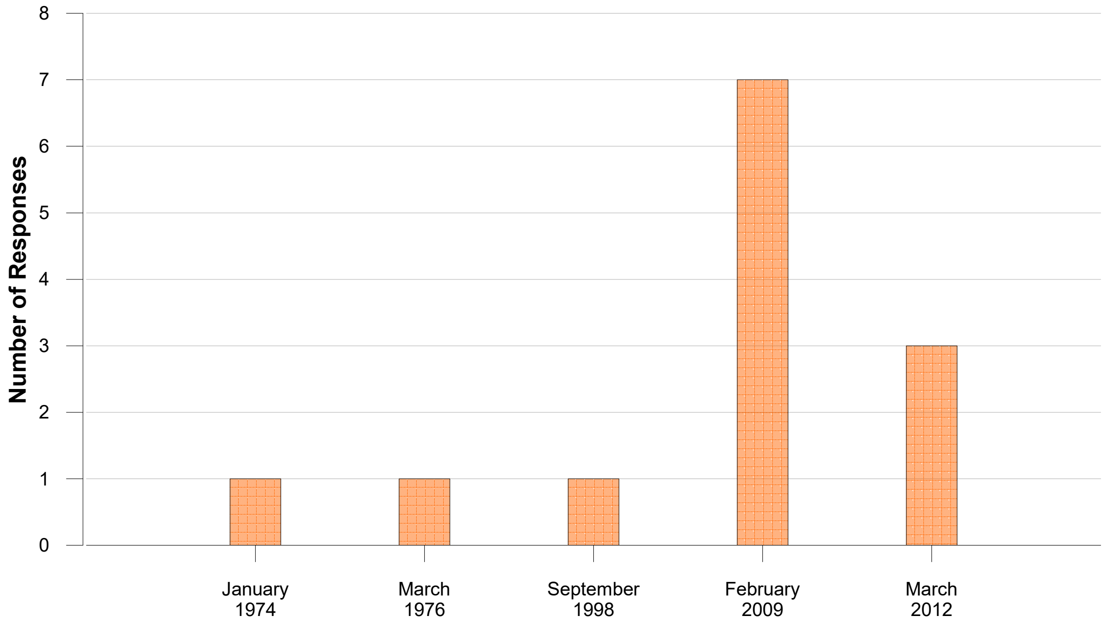




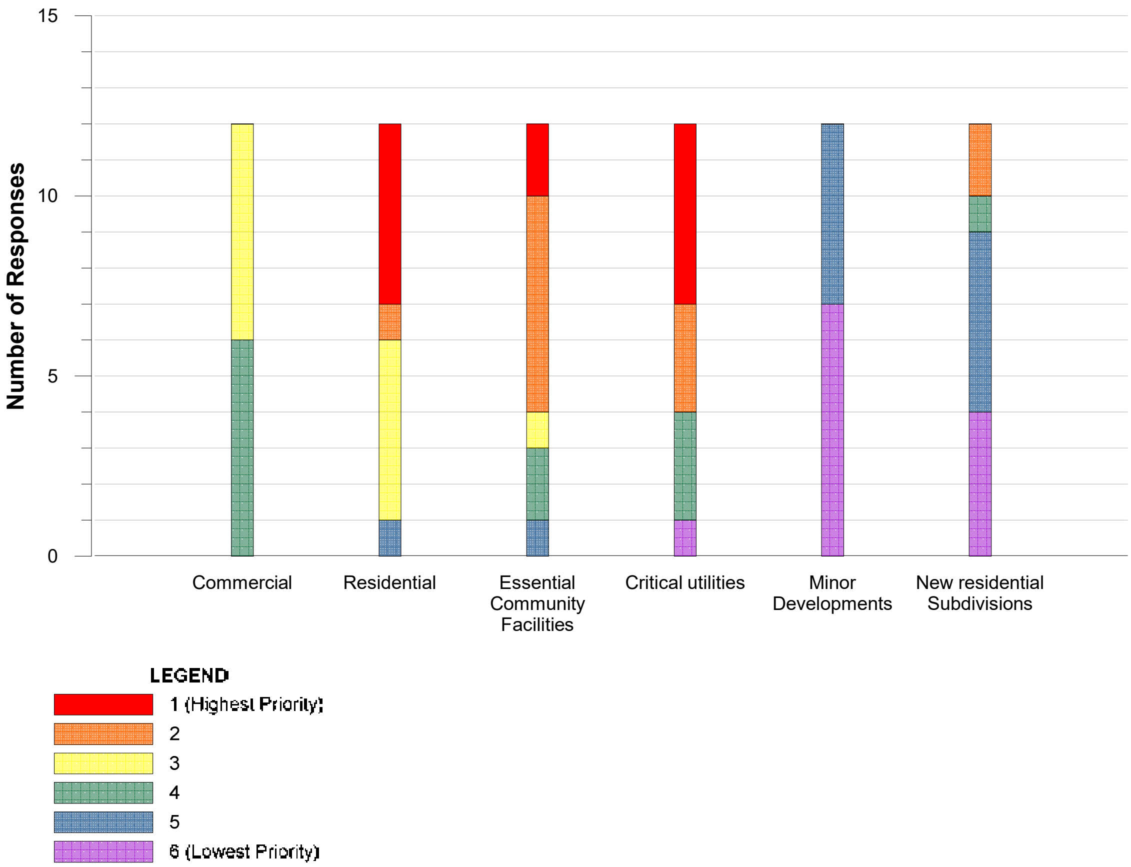


RESPONSE TO COMMUNITY QUESTIONNAIRE

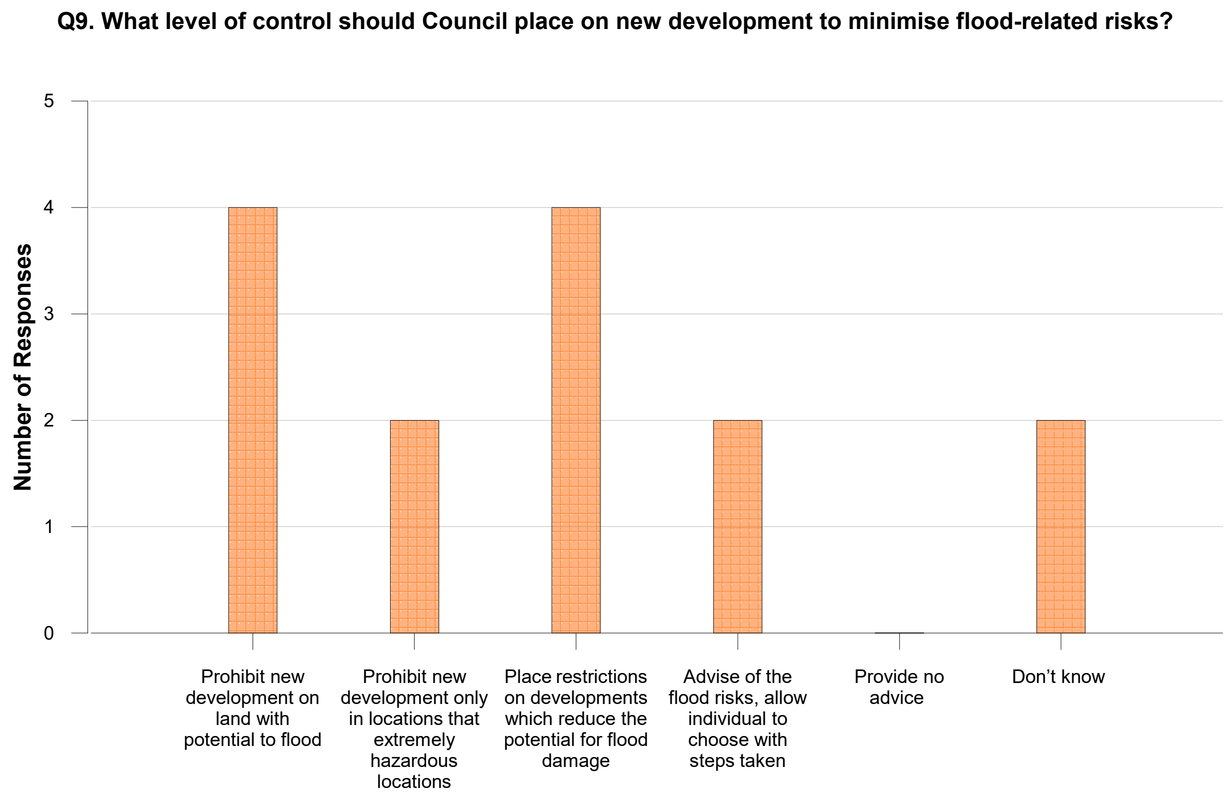
Q4. On what dates did you experience flooding?

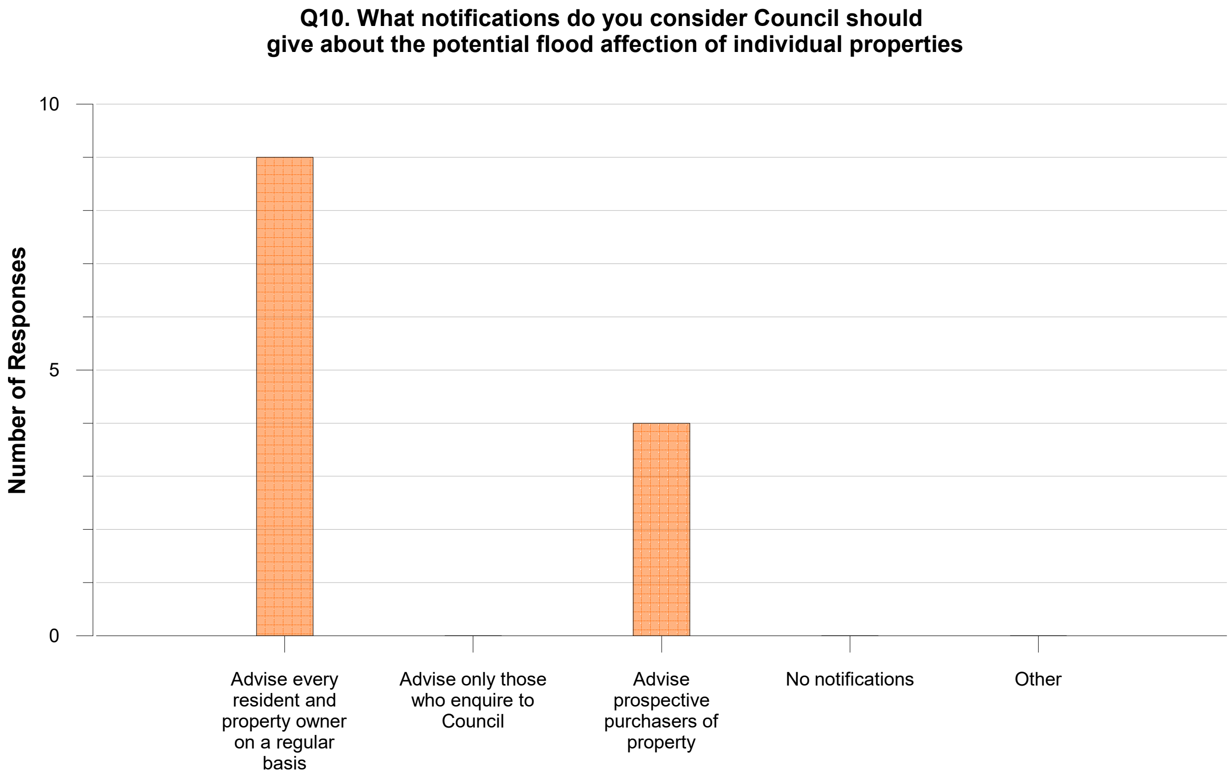


Q8. Ranking of development types by importance to protect from floods



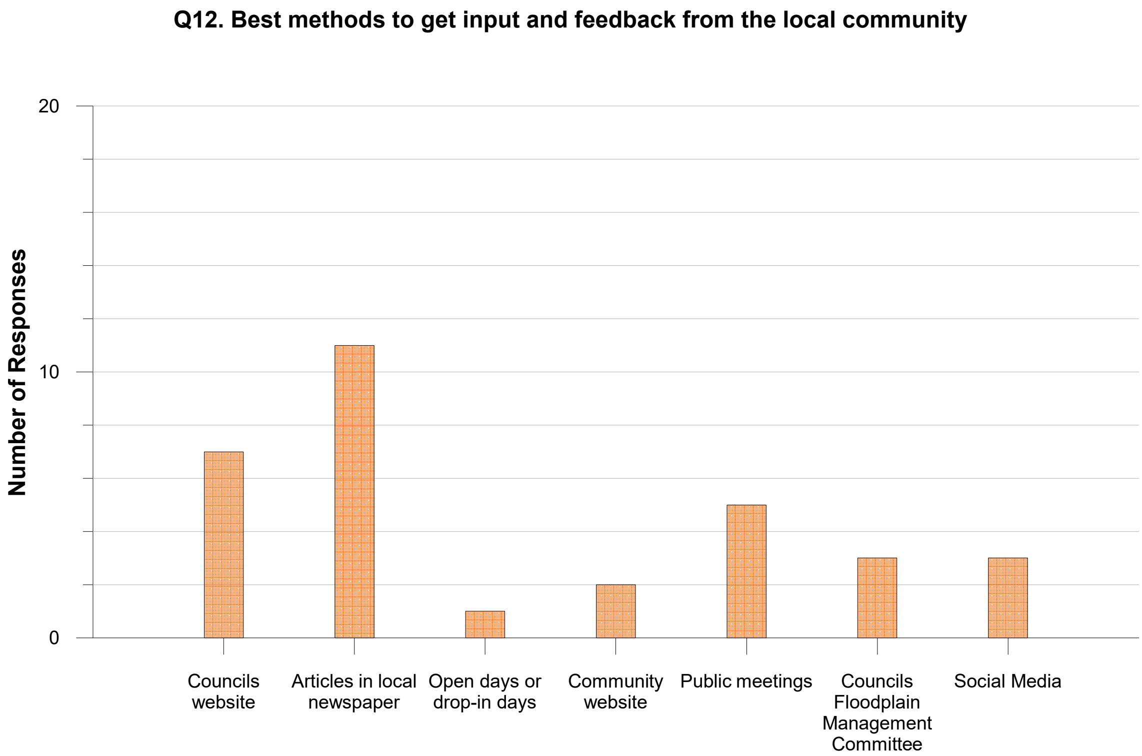
RESPONSE TO COMMUNITY QUESTIONNAIRE





RESPONSE TO COMMUNITY QUESTIONNAIRE

RESPONSE TO COMMUNITY QUESTIONNAIRE



RESPONSE TO COMMUNITY QUESTIONNAIRE

APPENDIX B

BOURKE FLOOD STUDY

TABLE OF CONTENTS

Cont'd Over

TABLE OF CONTENTS (Cont'd)

Page No.

ANNEXURES

FIGURES
(BOUND IN VOLUME 2)

B1. BACKGROUND INFORMATION

B1.1. Summary of Available Data

Data collected for the purpose of the present investigation included:

- Photographs obtained from Council at the commencement of the study showing localised flooding internal to the Bourke Levee that occurred on 14 February 2009, as well as riverine type flooding on the Darling River floodplain in the vicinity of Bourke that occurred in August 1950, March 1971, January 1974, March 1976, May 1988, September 1998 and March 2012 (copies of which are contained in **Annexure B1** of this Appendix).
- Stream flow data recorded at five telemetered stream gauges that are operated by WaterNSW. The location of the five stream gauges is shown on **Figure 1.1** of the Main Report, while their commencement dates are set out in **Table B1.1** below. **Annexure B2** of this Appendix contains annual maximum peak height and flow data for the *Darling River at Bourke Town* stream gauge (GS 425003) (**Bourke stream gauge**).

TABLE B1.1
DETAILS OF AVAILABLE STREAM FLOW GAUGES

Gauge Number	Gauge Name	Commencement Date
421023	Bogan River at Gongolgon	November 1945
422002	Barwon River at Brewarrina	April 1892
422005	Bokhara River at Bokhara	September 1944
422006	Culgoa River at Collerina	September 1944
425003	Darling River at Bourke Town	February 1895(1)

1. Annual maximum peak discharges dating back to 1885 are available from URS et. al., 2009).

- Rainfall data recorded at the Bourke Airport AWS rain gauge (GS 048245) that is operated by BoM (refer **Figure B1.1** for location).
- Newspaper articles from *The Western Herald* dating back to the August 1950 flood obtained from Council.
- Two sets of Light Detecting and Ranging (**LiDAR**) survey data, the extents of the which are shown on **Figure 1.1** of the Main Report and the capture dates of which are set out in **Table B1.2** below. The data comprising each set were captured to the *International Committee on Surveying and Mapping Level 3* standard with a 95% confidence interval on horizontal accuracy of ±800 mm and a 95% confidence interval on vertical accuracy of ±300 mm.

TABLE B1.2
LiDAR SURVEY DATA SPECIFICATIONS

Gauge Name	Commencement Date
DarlingBourke2009	2009(1)
Bourke201501	January 2015

1. Exact date of capture not specified in the metadata.

- Photogrammetry derived Digital Elevation Models (**DEMs**) covering the full extent of the Darling River floodplain obtained from Geoscience Australia's online database. The photogrammetry data were captured in July-August 2015 and has horizontal accuracy of ±1.25 m and a vertical accuracy of ±0.9 m.
- **Figure B1.1** shows the extent of aerial photography that was captured of the Darling River floodplain in the vicinity of Bourke during the March 2012 flood event. The exact time and date of capture is not known.
- GIS based data sets including cadastre and watercourse information that were extracted from the NSW Government's *Spatial Information Exchange* website.
- A GIS and excel database of the existing piped stormwater drainage system at Bourke that was provided at the commencement of the study (refer **Figure B1.1** for layout).
- Work-as-Executed drawings from Transport for NSW showing the dimensions of the Billabong and Swamp Bridges that were constructed in 1984 and the Bourke Bridge which was constructed in 1995. The drawings also show the dimensions of the timber bridge crossings of the billabong and swamp that were once located approximately 100 m downstream of the existing bridges. **Table B1.3** sets out the dimensions of the abovementioned bridges.

TABLE B1.3
DETAILS OF BRIDGE ARRANGEMENTS IN BOURKE

Bridge(1)	Deck Level (m AHD)	Bridge Opening (m)
Bourke Bridge	109.2	240
Old Bourke Bridge(2)	108.3 (left bank) 106.8 (right bank)	220
Billabong Bridge(3)	109.2 [107.3]	78 [48]
Swamp Bridge(3)	109.2 [107.5]	270 [200]

1. Refer **Figure B1.1** (sheet 2) for location.
2. Bridge dimensions estimated using aerial photography, LiDAR survey data and visual inspection.
3. Values in square brackets represent pre-1984 bridge details.

- Historic flood data taken from URS et. al., 2009 comprising four surveyed peak flood levels on the Darling River floodplain in the vicinity of Bourke for the flood that occurred in 1976.
- Surveyed cross sections of the Darling River in the vicinity of the Bourke stream gauge and Old Bourke Bridge taken from URS et. al., 2009 (refer **Figure B1.1** for location).
- A number of previous studies which contain flood related information at Bourke (refer **Section B1.2** for further details).

B1.2. Previous Investigations

B1.2.1. Bourke Flood Levee Augmentation Study (SKP, 1986)

The *Bourke Flood Levee Augmentation Study* (SKP, 1986) assessed the condition of the existing flood protection levee at Bourke and set out a range of upgrade requirements. SKP, 1986 provides a description of historic flooding at Bourke, which includes the flood of record in the Darling River Valley that occurred in March 1864, which was equivalent to a flood that reached 14.5 m (i.e. RL 106.35 m AHD) on the Bourke stream gauge.

Columns B of **Table B1.4** sets out the findings of a flood frequency analysis that was undertaken as part of SKP, 1986 using 71 years of annual maximum stage data for the period 1885 to 1956 at the Bourke stream gauge. The flood frequency derived peak 1% AEP flood level of 14.55 m (i.e. RL 106.40 m AHD) is 0.05 m higher than the March 1864 flood level at the Bourke stream gauge.

TABLE B1.4
DESIGN PEAK FLOOD LEVELS AND FLOWS AT BOURKE STREAM GAUGE DERIVED AS PART OF PREVIOUS INVESTIGATIONS

Design Flood Event	SKP, 1986		DWR, 1992		URS et. al., 2009	
	Gauge Height (m)	Corresponding Elevation (m AHD)	Gauge Height (m)	Corresponding Elevation (m AHD)	Peak Flow (ML/day)	Peak Flow (m^3/s)
[A]	[B]	[C]	[D]	[E]	[F]	[G]
0.2% AEP	-	-	14.75	106.60	-	-
0.5% AEP	-	-	14.60	106.45	655,522	7,590
1% AEP	14.55	106.40	14.45	106.30	466,760	5,400
2% AEP	14.35	106.20	14.30	106.15	324,895	3,760
5% AEP	14.25	106.10	13.95	105.80	191,912	2,220
10% AEP	13.65	105.50	-	-	122,267	1,420
20% AEP	12.75	104.60	-	-	73,336	850
50% AEP	-	-	-	-	28,225	330
1 EY	7.95	99.80	-	-	-	-

SKP, 1986 found that a freeboard of 1 m was applicable at Bourke resulting in a proposed crest elevation of RL 107.4 m AHD. SKP, 1986 recommended a crest width of 3 m, with side slopes of 3H:1V on the river side, and 2H:1V on the town side of the levee.

While a geotechnical investigation undertaken by Coffey and Partners as part of SKP, 1986 recommended that the existing levee be totally reconstructed, it also found that a partial reconstruction could be considered as an alternative, but that this would pose a greater risk of damage and consequent failure of the embankment."

An internal drainage investigation was also undertaken as part of SKP, 1986 to determine the location and size of drainage structures through the earthen embankment, as well as the size of excavated storage areas internal to the levee.

B1.2.2. Estimation of Potential Flood Damages at Bourke (DWR, 1992)

The *Estimation of Potential Flood Damages at Bourke* (Department of Water Resources (**DWR**), 1992) utilised the FLDAMAGE computer model to estimate flood damages at Bourke for a range of design flood events should the levee that was present at the time fail. **Column D** of **Table B1.4** sets out the design peak flood levels at the Bourke stream gauge that were derived using a flood frequency analysis as part of DWR, 1992.[1] The peak 1% AEP flood level at the Bourke stream gauge is 0.1 m lower than that derived as part of SKP, 1986.

DWR, 1992 found that more that 966 of the 1000 properties at Bourke would be flooded above-floor level if the levee were to fail during a 1% AEP flood, which would result in flood damages of approximate $32.4 Million in 1992 dollars.

B1.2.3. Rural Flood Study Darling River Floodplain (Bogan River Confluence to Louth) (URS et al., 2009)

The *Rural Flood Study Darling River Floodplain (Bogan River Confluence to Louth)* (URS et al., 2009) comprises two reports; the *Compendium of Data* (dated June 2009) and the *Flood Study Report* (dated December 2009). URS et al., 2009 constituted the first step in the development of the *Rural Floodplain Management Plan* for the Darling River.

URS et al., 2009 contains an environmental and archaeological review of the study area, as well as a summary of the available survey and historic flood data (which includes four flood marks that were surveyed on the Darling River floodplain in the vicinity of Bourke following the March 1976 flood).

Annual peak flows for the period 1885 to 1956 were derived by converting the peak gauge heights reported in SKP, 1986 to peak flows using the rating curve that was current at the time of the study (which was not defined), while peak flows for the period 1956 to 2005 were taken from WaterNSW's *PINNEENA* database. The annual peak flows set out in URS et. al., 2009 for the period 1885 to 1971 have been relied upon for the present study.

Columns F and **G** of **Table B1.4** set out the design peak flow estimates that were derived from the flood frequency analysis that was undertaken as part of URS et al., 2009 for the Bourke stream gauge using the 121 years of annual peak flows for the period 1885 to 2005.[2] The peak 1% AEP flow derived as part of URS et. al., 2009 at Bourke was 5,400 m^3/s.

URS et. al., 2009 also found that the floods that occurred in 1974 and 1976 were equivalent to design flood events with AEPs of 0.95% (1 in 105 years) and 1.1% (1 in 90 years), respectively, while SKP, 1986 found these events were equivalent to design flood events with AEPs of about 2.5% (1 in 40 years) and 5% (1 in 20 years), respectively.

Hydraulic modelling that covers a 170 km reach of the Darling River between its confluence with the Bogan River and Louth was undertaken using the MIKE Flood software. The MIKE Flood model was calibrated to the 1974, 1976 and 1998 flood events. A Manning's n roughness value of 0.04 was assigned to the floodplain for all three historic events in order to achieve a good match between observed and modelled flood behaviour.

---

[1] DWR, 1992 does not provide any information on the adopted period of record incorporated in the flood frequency analysis.

[2] The flood frequency analysis undertaken as part of URS et al., 2009 did not take into account the flood that occurred in March 1864 which is considered to be the flood of record in the Darling River Valley.

Cross-sectional survey of the Bourke stream gauge and the Old Bourke Bridge that were contained in URS et. al., 2009 were used to define the invert of the river as part of the present study.

B1.2.4. Bourke Levee – Investigation for Upgrade of the Levee (PW, 2011)

The *Bourke Levee – Investigation for Upgrade of the Levee* (PW, 2011) was commissioned following extensive flooding that occurred internal to the Bourke Levee as a result of heavy rainfall that fell between 16:20 hours on 13 February 2009 and 08:00 hours on 14 February 2009. BoM advised that the rainfall that fell over this period was equivalent to a design storm event with an AEP of about 0.825% (1 in 120 year).

A detailed inspection of the levee was undertaken on 30 November – 1 December 2010 to determine the general condition of the levee crest, batters, material, vegetation cover and accessible drainage structures. PW, 2011 recommended the following remediation works:

Repair Works

- Outlet in the vicinity of drainage outlet in the vicinity of flood gate FG_03 at levee chainage 7,950 m has been undercut and needs repair.
- Repair scour damages that occurred on river side of the Bourke Levee at the point at which pumped discharge from pump station FSP_03 that is located on the western side of the Mitchell Highway at levee chainage 3,240 m.
- Install "tidal flap gates" on drainage outlets in the vicinity of levee chainage 8,430 m and 8,665 m (in the vicinity of FG_05 and FG_06, respectively).

Investigation Activities

- Undertake a levee centreline survey along the full length of the existing Bourke Levee.
- Undertake geomorphology survey to determine the predicted long term migration of the Darling River at Bourke.
- Engage specialist agronomist to advise where effective vegetation protection is required on the levee.
- Undertake internal drainage investigation to identify potential restrictions in the drainage system internal to the Bourke Levee and provide recommendations on the improvements to the drainage system including the optimal size/distribution of flood evacuation pumps.

Maintenance Activities

- Replenish topsoil layer following significant rainfall events.
- Regrade the crest of the Bourke Levee so that it falls towards the unprotected (river) side.
- Eradicate ants' nests and backfill with compacted, gypsum stabilised clay fill.
- Plant small shrubby type native vegetation on sections of levee that are subject to wave action.

Maintenance Responsibilities

- Designate responsibility for levee maintenance to a suitable officer who will be responsible for planning, maintenance and operation of the levee.

Appendix B of PW, 2011 shows the plan location of the flood gates and pumps along the alignment of the Bourke Levee, but does not provide details of each. It is noted that while Appendix B of PW, 2011 shows flood gates at levee chainages 7,950 m, 8,400 m and 8,650 m (refer FG_03, FG_05 and FG_06, respectively), PW found that no flood gates were installed at these locations.

B1.2.5. Bourke Local Flood Plan (NSW SES, 2013)

The *Bourke Local Flood Plan* (NSW SES, 2013) covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures for all levels of flooding. NSW SES, 2013 provides a description of the historic flooding patterns in the vicinity of Bourke and the effects of flooding on the community.

The heights on the Bourke stream gauge corresponding with Minor, Moderate and Major Floods, as defined in NSW SES, 2000 are 9.0 m, 10.7 m and 12.2 m, respectively.

Figure 1 of NSW SES, 2013 sets out the heights that have been recorded for the 18 floods that have exceeded 12.3 m on the Bourke stream gauge between April 1890 and September 1998. NSW SES, 2013 does not include reference to the March 1864 flood and incorrectly lists the peak flood level for the April 1890 and March 1893 flood events as 13.0 m and 12.4 m, respectively. As a result NSW SES, 2013 incorrectly identifies the March 1976 flood as the flood of record at Bourke.

NSW SES, 2013 identified that while flooding in the area around Bourke is mainly caused by over-bank flows from the Darling River, however high levels in the Darling River can also cause the Bogan River to backup causing floodwaters to approach Bourke from the east along the “Dry Bogan” and Little Bogan River systems. NSW, 2013 also indicates that during extreme flood events, floodwaters also break out from the Culgoa River and approach Bourke from the north of the Darling River.

B1.2.6. Visual Audit of Bourke Levee (PW, 2014)

The NSW Department of Public Works undertook a visual audit of the Bourke Levee in May 2013 and later published its findings in a report entitled *Visual Audit of Bourke Levee* (PW, 2014). The aim of the inspection was to identify potential problems with the existing levee and to provide recommendations for suitable remedial works.

While PW, 2014 found that the Bourke Levee was generally in an acceptable condition, issues were given an **unacceptable** rating at the following levee chainages:

- 1,100 m – Erosion of levee batter from unauthorised motorcycle traffic.
- 3,030 m – Blockage of inlet and outlet to pump station FSP_02.
- 5,635 m – Blockage of outlet from pump station FGP_01.
- 7,475 m – Blockage of outlet from pump station FGP_02.
- 8,665 m – Flood gate FG_06 is inoperable as gate seal is faulty.
- 8,740 m to 8,760 m – Access to levee is blocked by private fencing.
- 9,675 m - Flood gate FG_010 is inoperable due to corrosion.

PW, 2014 also identified the general issues to be addressed as soon as possible:

- Locate and review existing levee operation and maintenance manual, specifically the procedures for flood gates, pumps and sandbagging of the Old Bourke Wharf.
- Clarify and document flood emergency procedures with NSW SES.
- Council to re-examine development policy to ensure levee system is free of future development.
- Council to locate and conveniently store all existing critical levee documents.

PW, 2014 assigned a **marginal** rating to issues at the following levee chainages:

- 500 m – Ant nest to be removed and repaired.
- 1,100 m to 6,000 m – Fill and re-batter crab holes.
- 8,200 m – Headwall outlet in the vicinity of flood gate FG_04 has been dislodged.
- 8,430 m – Headwall outlet in the vicinity of flood gate FG_05 has deteriorated and needs repair.
- 8,850 m to 9,980 m – Remove existing trees and vegetation.

B1.2.7. Floodplain Management Plan for the Barwon-Darling Valley Floodplain (DPIW, 2017)

The *Floodplain Management Plan for the Barwon-Darling Valley* (DPIW, 2017) was undertaken to inform local landholders and the wider community about how the rural floodplain management planning approach presented in the *Rural Floodplain Management Plans: Technical manual for plans developed under the Water Management Act 2000* has been applied on the Barwon-Darling Valley floodplain.

The MIKE Flood model developed as part of URS et al., 2009 was updated in the MIKE 21 software and extended approximately 350 km along the Barwon River to Mungindi. DPIE provided the MIKE 21 results for the February 1976 flood, as well as a flood that occurred in November 2011 which was equivalent to about a 17% AEP flood at Bourke for use in the present study. The MIKE 21 results were used to determine the downstream boundary condition (i.e. flood slope) in the Darling River TUFLOW Model that was developed as part of the present study.

B1.2.8. Bourke Levee Owner's Manual (PW, 2018) [Draft Rev 1.0]

The draft *Bourke Levee Owner's Manual* prepared by PW in 2018 sets out the roles and responsibilities relating to levee ownership and provides guidelines on the operation and maintenance of the Bourke Levee.

PW, 2018 indicates that the gauge heights corresponding with the BoM defined Minor, Moderate and Major Flood Levels are 9.5 m, 11.4 m and 12.7 m, respectively, which differ from those set out in NSW SES, 2013.

PW, 2018 provides guidance for annual inspections that are to be undertaken by Council every 12 months and recommends a formal visual audit be undertaken by an external party every five years.

PW, 2018 contains details of the eleven flood gates that are located around the perimeter of the Bourke Levee (refer **Table 2.1** of Main Report for details and **Figure 2.1**, sheet 3 for their plan location), but does not set out the "Activation Levels" (i.e. the flood level at the Bourke stream gauge which should trigger the closure of the flood gates). Details of the fourteen flood evacuation pumps are also contained in PW, 2018 (refer **Table 2.1** of Main Report for details and **Figure 2.1**, sheet 3 for their plan location).

PW, 2018 identifies the location of seven low points in the Bourke Levee where temporary flood protection structures would need to be installed to achieve the designated design standard of the levee. The Appendix of PW, 2014 that provides guidance on the flood level at the Bourke stream gauge which should trigger the installation of the temporary structures has not been completed.

B1.2.9. 425003 Darling River at Bourke – High Stage Rating Post the 2012 Floods (WaterNSW, 2020)

425003 Darling River at Bourke – High Stage Rating Post the 2012 Floods present the findings of a review of the rating curve at the Bourke stream gauge that was undertaken by WaterNSW following the March 2012 flood. A copy of WaterNSW, 2020 is contained in **Annexure B3** of this Appendix.

During significant flood events, WaterNSW gauges discharge at the following locations on the Darling River floodplain (refer **Figure B1.1** for location of gaugings):

- “Main Channel” – Bourke Bridge (it has been assumed that gaugings taken prior to the upgrade of the Mitchell Highway in 1995 were taken at the Old Bourke Bridge)
- “Billabong” – Billabong Bridge (it has been assumed that gaugings taken prior to the upgrade of the Mitchell Highway in 1984 were taken at the Old Billabong Bridge)
- “Swamp” – Swamp Bridge (it has been assumed that gaugings taken prior to the upgrade of the Mitchell Highway in 1984 were taken at the Old Swamp Bridge)
- “Railway” – Flow across Mitchell Highway to the south of Bourke Levee

Table B1.5 over shows a comparison of the gauged discharge, flow area and mean flow velocity at the four gauge locations for four historic flood when the recorded gauge height was between 13.74 and 13.83 m on the Bourke stream gauge.

Table B1.5 shows that there has been a reduction in gauge discharge and mean flow velocity at the four gauge locations between the floods in the 1970s and the more recent events, except to the south of Bourke (refer “Railway”) where the March 2012 mean flow velocity was the same as that in January 1974. **Table B1.5** also shows that there has been a significant reduction in the flow area to the south of Bourke (refer “Railway”) during high flow events in the more recent flood events when compared with the events from the 1970s.

The key findings of WaterNSW, 2020 are as follows:

- The cross-sectional area of the three main channels at Bourke (refer “Main Channel”, Swamp” and “Billabong”) and floodplain vegetation has not changed significantly between the 1970s and present day;[3]
- The Little Bogan River contributed significant flows to the Darling River in the 1974 and 1976 floods, but not in the 1998 and 2012 floods.

[3] It is noted that three Mitchell Highway bridge crossings of the Darling River floodplain on the northern side of Bourke have been upgraded since the 1970s.

TABLE B1.5
COMPARISON OF GAUGED DATA AT BOURKE STREAM GAUGE
HISTORIC FLOOD EVENTS(1,2)

Flood Event	Date of Gauging	Gauge Height (m)	Main Channel(3)			Billabong(3)			Swamp(3)			Railway(3)			Total Gauged Discharge (m^3/s)
			Gauged Discharge (m^3/s)	Flow Area (m^3)	Gauged Mean Flow Velocity (m/s)	Gauged Discharge (m^3/s)	Flow Area (m^3)	Gauged Mean Flow Velocity (m/s)	Gauged Discharge (m^3/s)	Flow Area (m^3)	Gauged Mean Flow Velocity (m/s)	Gauged Discharge (m^3/s)	Flow Area (m^3)	Gauged Mean Flow Velocity (m/s)	
January 1974	04/02/1974	13.83	1,401	1,340	1.08	226	188	1.20	1,242	1,090	1.14	665	1,251	0.53	3,534
March 1976	19/03/1976	13.74	1,362	1,374	0.99	226	217	0.95	1,069	1,070	1.00	257	1,253	0.35	2,894
September 1998	30/09/1998	13.77	1,161	1,408	0.82	217	204	1.06	1,113	1,135	0.98	46	731	0.22	2,538
March 2012	05/03/2012	13.79	934	1,359	0.69	173	186	0.93	931	1,100	0.85	75	204	0.53	2,114

1. Source: WaterNSW, 2020
2. Refer **Figure B1.2** for comparison of gaugings and WaterNSW derived rating curves.
3. Refer **Figure B1.1** for location of gaugings.

- During large flood events, floodwater may surcharge the Little Bogan River upstream of its confluence with the Darling River and flow to the south of Bourke (i.e. refer WaterNSW gauged location "Railway"). Therefore, the gauge height at the Bourke stream gauge may not give a true representation of the flow across the southern portion of the Darling River floodplain at Bourke during Little Bogan River dominant flood events.
- The hydraulic nature of the southern portion of the Darling River floodplain has completely altered since the 1970s due to civil infrastructure.

A new rating curve was derived as part of the present study based on the findings of WaterNSW, 2020 (Refer *WaterNSW No. 301.00* on **Figure B1.2**) and was retrospectively applied to the Bourke stream gauge dating back to 3 December 2011.

B1.2.10. Other Reports

The following reports have been undertaken in the vicinity of Bourke, but were not available for review as part of the present study:

- *Audit of Flood Levees for New South Wales – Town of Bourke* (PW, 1991)
- *Bourke Levee Reconstruction Stages 2 and 3 – Typical Details* (Kinhill, 1997)

B1.3. Analysis of Available Stream Gauge Data

B1.3.1. General

A manually-read stream gauge was first installed on the Darling River at Bourke in 1885[4], while WaterNSW installed a telemetered stream gauge at the same location in August 1968. While there are no records of river levels at Bourke for a 14 year period between 1957 and 1970, annual maximum flow data for this period were taken from URS et. al., 2009, which also contains peak flood level data for the March 1864 flood which is considered the flood of record in the Darling Valley.

The highest recorded stream gauging at the site was taken on 29 January 1974 when the water level reached 14.091 m on the Bourke stream gauge, which is about 5 mm below the peak of the flood that occurred on the following day. The gauged flow in the river at the time was 5,182 m^3/s.

The historic rating tables for the stream gauge were extracted from PINEENA at the commencement of the present study, while the then current rating table was downloaded from WaterNSW's website. **Figure B1.2** shows the difference between the historic rating tables that were current at the time of the major historic floods, as well as the historic gaugings that have been taken at the gauge site dating back to 1885.

As discussed in **Section B1.2.9**, the stage-discharge relationship changed in December 2011 based on the findings of WaterNSW, 2020 (refer "*WaterNSW No. 301.01*" on **Figure B1.2**) and has remained unchanged since.

[4] The exact date that the stream gauge was installed is not known.

Table B1.6 lists the ten largest floods by gauge height that have been recorded at the Bourke stream gauge dating back to 1864. Included in the table are the corresponding peak flows based on the rating curve that was current at the time of the flood, as well as an approximate AEP of the flood event based on the flood frequency analysis that was undertaken as part of the present study (refer **Section B1.3.2** for details).

From the available data, the January 1974, March 1976, September 1998 and March 2012 floods were identified as the four largest floods to have occurred at Bourke since the construction of the levee. **Figure B1.3** (2 sheets) shows the stage and discharge hydrographs recorded at the Bourke stream gauge for the abovementioned historic flood events which have been used for calibration purposes as part of the present study.

TABLE B1.6
HISTORIC PEAK STAGE AND FLOW DATA
BOURKE STREAM GAUGE(1,2)

Flood Event	Gauge Height (m)	Elevation (m AHD)	Peak Flow (m^3/s)	Approximate Frequency(3) (AEP)
March 1864(4)	14.52(5)	106.37	-	-
April 1890	14.39	106.24	6,629	1.01
March 1976	14.18	106.03	5,841	1.3
January 1974	14.10	105.95	5,198	1.8
August 1950(6)	13.93	105.78	4,346	2.6
March 2012	13.83	105.68	2,092	7.9
September 1998	13.78	105.63	2,701	5.8
March 1956(7)	13.75	105.60	3,459	3.9
July 1893	13.68	105.53	3,220	4.6
March 1971	13.64	105.49	2,563	6.3
June 1983	13.27	105.12	1,862	9

1. Only the ten largest flood events to have been recorded by the gauge are listed. Refer **Table B1** and **B2** in **Annexure B2** for the full record of annual maximums.
2. Flood events have been ranked based on recorded gauge height, noting that there have been significant changes to the floodplain that have resulted in higher peak flood levels experienced at the Bourke stream gauge for lower flows.
3. Approximate frequency based on the findings of the flood frequency analysis which incorporated the annual peak flows for the period 1885-2019 but omitted low flows and the historic flood of 1864 (refer **Section B2.3.2** for discussion).
4. No rating curve available for flood event.
5. Peak gauge height taken from URS et. al., 2009, which is 20 mm higher than the peak flood level which is set out in SKP, 1986.
6. Note that a flood occurred in December 1950 when the water level in the Darling River peaked at 13.56 m (i.e. RL 105.41 m AHD) on the Bourke stream gauge.
7. Note that a flood occurred in July 1956 when the water level in the Darling River peaked at 13.61 m (i.e. RL 105.46 m AHD) on the Bourke stream gauge.

B1.3.2. Annual Flood Frequency Analysis

A log-Pearson Type 3 (**LP3**) distribution was fitted to the annual series of flood peaks for the 135 year period of record ending in the year 2019 using the FLIKE software.[5] The resulting frequency curves, along with 5% and 95% confidence limits are shown on **Figure B1.4** (refer left hand side (**LHS**) of sheet 1).

As the recorded flood peaks are only a small sample of peaks actually occurring over a longer period, an expected probability adjustment was made using the procedure set out in GA, 2019. GA, 2019 recommends implementing the expected probability adjustment to remove bias from the estimate. **Column C** in **Table B1.7** over the page gives the peak flow estimates for a range of AEPs as derived from the above analysis, which are similar to those derived as part of URS et. al., 2009 (refer **Column B**) which was based on a shorter period of record (i.e. 121 years) and did not incorporate the flood of record from March 1864.

The flood of record that occurred in March 1864 ,which for the purpose of the present study has been assumed to have been larger than the 1890 flood at Bourke was incorporated in the flood frequency analysis. Inclusion of this flood increased the estimate of the 1% AEP flood from 5,300 m^3/s to 6,050 m^3/s (refer right hand side (**RHS**) of **Figure B1.4**, sheet 1 and **Column D** of **Table B1.7**).

Values at the low end of the observed range of flood peaks can distort the fitted probability distribution and affect the estimates of large floods. Deletion of these low values may improve the fit to the remaining data. The LHS of **Figure B1.4**, sheet 2 shows the results of omitting the 107 annual flows less than 700 m^3/s from the analysis and applying the expected probability adjustment to the remaining data. **Column E** in **Table B1.4** gives the peak flow estimates after removing the low flows from the data set, while the RHS of **Figure B1.4**, sheet 2 and **Column E** of **Table B1.4** show the result of omitting flows less than 700 m^3/s from the data set that includes the historic flood event.

The results of the LP3 analysis show that the inclusion of low flows leads to line-of-best fit without any skew in the fitted distribution which doesn't fit the recorded annual peak flows for the larger, less frequent floods. By comparison, the fitted probability distribution for the case where low flows were omitted provides the best fit to the historic data.

An analysis was also carried out by fitting the annual series of flood peaks to the General Extreme Value (**GEV**) distribution using LH moments. **Figure B1.5** shows the results for both the full period of record plus two historic floods (sheet 1) and after the 107 annual flows less than 700 m^3/s are omitted from the analysis (sheet 2).

The GEV distribution with the inclusion of low flows was found to have a positive skew which resulted in an overestimate for the larger, less frequent floods. The estimated peak discharge when low flows are omitted (refer **Columns I** and **J** of **Table B1.7**) are comparable to those derived using the LP3 distribution.

[5] Refer **Table B1** of **Annexure B2** of this Appendix which contains a list of the adopted annual series of flood peaks.

Based on the above findings, the peak flow estimates derived by fitting a LP3 distribution to the 135 years of record ending in 2019 but omitting flows less than 700 m^3/s gave the best fit with the historic data. Therefore, the design peak flow estimates set out in **Column E** of **Table B1.7**, as well as the relationship shown on the LHS of **Figure B1.4**, sheet 1 have been given greatest weight when deriving design discharge hydrographs for input to the hydraulic model.

Table B1.7 over shows that the peak flow estimate derived as part of the present study are about 10-30% higher than that derived as part of URS et al., 2009. The peak flow estimates derived as part of the present study are considered a more accurate assessment of the design peak flows in the Darling River at Bourke as they incorporate an additional 14 years of continuous data and also take into consideration the flood of record at Bourke.

B1.4. Analysis of Available Rain Gauge Data

Council identified two notably intense storm events that have been experienced at Bourke on 13-14 February 2009 and 3 November 2019. Council provided photographic evidence (refer **Annexure B1**) of the patterns of overland flow at Bourke for the February 2009 storm event. Council also anecdotally advised that while the November 2019 storm event was very intense at Bourke, no flooding was experienced as the storm event occurred after a long dry period and the majority of the rainfall was absorbed into the earth.

The LHS of **Figure B1.6** shows the cumulative rainfall that was recorded at the BoM operated Bourke Airport AWS rain gauge during the February 2009 and March 2019 storm events, while the RHS shows design versus historic intensity-frequency-duration (**IFD**) curves for the two events. **Table B1.8** over gives the approximate AEP of the recorded rainfall by the rain gauge for storm durations ranging between 1 and 24 hours.

Figure B1.6 and **Table B1.8** show the storm event that occurred February 2009 was equivalent to a 0.2% AEP design event for a storm duration of 12 hours, while the November 2019 event was equivalent to a 20% design storm event.

TABLE B1.7
ESTIMATES OF DESIGN PEAK FLOWS AT BOURKE STREAM GAUGE
VALUES IN m^3/s

Annual Exceedance Probability % AEP	URS et. al., 2009	LP3 Distribution				GEV Distribution			
		Full Period of Record	Full Period of Record Including Historic Flood [1]	Low Flows Omitted[2]	Low Flows Omitted but Including Historic Flood[1,2]	Full Period of Record	Full Period of Record Including Historic Flood[1]	Low Flows Omitted[2]	Low Flows Omitted but Including Historic Flood[1,2]
[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]
0.2	-	10,550	12,700	10,700	15,800	22,600	27,600	18,300	20,500
0.5	7,587	7,200	8,450	8,100	10,550	11,800	13,900	10,000	10,900
1	5,402	5,300	6,050	6,500	7,650	7,200	8,250	6,300	7,250
2	3,760	3,800	4,300	5,000	5,350	4,400	4,950	4,000	5,000
5	2,221	2,325	2,550	3,050	2,950	2,300	2,500	2,150	2,800
10	1,415	1,500	1,600	1,700	1,625	1,360	1,450	1,340	1,600
20	849	880	910	710	730	785	820	785	690

1. Peak discharge of 1864 flood assumed to be greater than 6,630 m^3/s.
2. Peak flows lower than 700 m^3/s omitted.

TABLE B1.8
APPROXIMATE AEPs OF RECORDED RAINFALL FOR HISTORIC STORM EVENTS
BOURKE AIRPORT AWS RAIN GAUGE

Storm Duration	February 2009	November 2019
1	10%	20%
2	20%	20%
3	5-10%	20%
6	2%	20%
9	0.5%	20-50%
12	0.2%	50%
24	0.5%	20%

B2. HYDROLOGIC MODEL DEVELOPMENT AND CALIBRATION

B2.1. Hydrologic Modelling Approach

The present study required the use of a hydrologic model that is capable of representing the rainfall-runoff processes that occur within the 6 km^2 catchment internal to the Bourke Levee. The hydrologic response of the catchment was simulated using the direct-rainfall-on-grid approach which is built into the TUFLOW software.

B2.2. Hydrologic Model Testing

B2.2.1. General

Historic flood data suitable for use in the model calibration process is limited to photographic and anecdotal evidence of flooding patterns for the storms that occurred in February 2009, which as discussed in **Section B1.4**, was equivalent to a 0.2% AEP design storm event.

As there was no historic data on storm flows anywhere in the town, the procedure adopted for the calibration of the hydrologic models involved an iterative process sometimes referred to as "tuning". This process involved inputting the continuous rainfall data that were recorded at the Bourke Airport AWS rain gauge to the TUFLOW model and comparing the resulting flooding patterns with the photographic and anecdotal evidence. Several iterations of this process were required, whereby changes were made to the rainfall hydrologic model parameters until a good fit with recorded data was achieved (refer **Section B3.4** for further details).

B2.2.2. Hydrologic Model Parameters

The *ARR Data Hub* is generally used to derive the initial and continuing loss values to be applied in flood hydrograph estimation. **Table B2.1** sets out the initial and continuing loss values that were found to achieve a good match between the modelled and observed flood behaviour for the February 2009 storm event (refer **Section B3.4** for further discussion). It is noted that the *ARR Data Hub* does not presently provide recommendations for continuing loss values in "Arid" regions due to the lack of catchments that are suitable for use in tuning the predicted loss equations that have been developed as part of GA, 2019. As a result, the continuing loss value of 2.5 mm/hr was adopted.

TABLE B2.1
ADOPTED LOSS VALUES
HISTORIC STORM EVENTS

Model Parameter	Initial Loss (mm)	Continuing Loss (mm/hr)
Impervious Areas	2	0
Pervious Areas	40	2.5

B3. HYDRAULIC MODEL DEVELOPMENT AND CALIBRATION

B3.1. General

The present study required the use of a hydraulic model that is capable of analysing the time varying effects of flow in the Darling River and the local stormwater drainage system and the two-dimensional nature of flow on both the floodplain and in the area behind the Bourke Levee. The TUFLOW modelling software was adopted as it is one of only a few commercially available hydraulic models which contain all the required features.

This chapter deals with the development of the Darling River and Bourke TUFLOW Models. It also deals with the calibration of the Darling River TUFLOW Model using the available flood data from the January 1974, March 1976, September 1998 and March 2012, and the Bourke TUFLOW Model using photographic evidence of local catchment flooding in February 2009.

B3.2. Brief Review of TUFLOW Modelling Approach

TUFLOW is a true two-dimensional hydraulic model which does not rely on a prior knowledge of the pattern of flood flows in order to set up the various fluvial and weir type linkages which describe the passage of a flood wave through the system.

The basic equations of TUFLOW involve all of the terms of the St Venant equations of unsteady flow. Consequently the model is "fully dynamic" and once tuned will provide an accurate representation of the passage of the flood wave through the drainage system (both surface and piped) in terms of extent, depth, velocity and distribution of flow.

TUFLOW solves the equations of flow at each point of a rectangular grid system which represent overland flow on the floodplain. The choice of grid point spacing depends on the need to accurately represent features on the floodplain which influence hydraulic behaviour and flow patterns (e.g. buildings, streets, changes in channel and floodplain dimensions, hydraulic structures which influence flow patterns, etc.).

Pipe drainage and channel systems can be modelled as one-dimensional elements embedded in the larger two-dimensional domain which typically represents the wider floodplain. Flows are able to move between the one and two-dimensional elements of the model depending on the capacity characteristics of the drainage system being modelled.

The Darling River and Bourke TUFLOW Models also allow for the assessment of potential flood management measures.

B3.3. TUFLOW Model Setup

The layout of the Darling River TUFLOW Model is shown on **Figure B3.1**. The model comprises a 90 km reach of the Darling River within the two-dimensional (in plan) model domain using a grid based approach. A 20 m grid spacing was adopted for the Darling River TUFLOW Model with a smaller 10 m grid spacing embedded internal to the model in the Darling River and Little Bogan River riparian zones (refer **Figure B3.1** for extent).

The layout of the Bourke TUFLOW Model is shown on **Figure B3.2**. The model comprises the 6 km^2 catchment which lies internal to the Bourke Levee. A 3 m grid spacing was adopted for the Bourke TUFLOW Model in order to more accurately define the passage of overland flow through the town.

Ground surface elevations for model grid points were initially assigned using a Digital Terrain Model (**DTM**) derived from the LiDAR survey data. Ridge lines were added to the TUFLOW model where the grid spacing was considered too coarse to accurately represent important topographic features such as the railway and road embankments and the existing levees which influence the passage of overland flow. The elevations for these ridge and gully lines were determined from inspection of the LiDAR survey data.

Gully lines were used to represent the creeks and watercourses. The use of gully lines ensured that positive drainage was achieved along the full length of these watercourses, and thus avoided creation of artificial ponding areas as artefacts of the 'bumpy' nature of the underlying LiDAR survey data.

Figure B3.2 shows the piped elements incorporated in the Bourke TUFLOW Model. Pipe inverts were taken from the detailed ground survey data provided by Council and pipe dimensions were based on a stormwater asset database that was provided by Council.

Model Parameters

The main physical parameter for TUFLOW is hydraulic roughness. Hydraulic roughness is required for each of the various types of surfaces comprising the overland flow paths. In addition to the energy lost by bed friction, obstructions to flow also dissipate energy by forcing water to change direction and velocity and by forming eddies. Hydraulic modelling traditionally represents all of these effects via the surface roughness parameter known as "Manning's n". **Table B3.1** sets out the Manning's n values that were found to achieve a reasonable match between the modelled and recorded flood levels for the historic flood events (refer **Section B3.4** for further discussion).

TABLE B3.1
BEST ESTIMATE HYDRAULIC ROUGHNESS VALUES

Surface Treatment	Manning's n Value	
	Parameter Set No. 1	Parameter Set No. 2
Asphalt or concrete road surface	0.02	
River bed	0.025	0.035
Floodplain	0.04	0.045
Trees / Shrubs	0.04	0.055
Riparian Vegetation	0.055	0.09
Allotments	0.1	
Buildings	10	

Model Boundary Conditions

The location where discharge hydrographs were applied at the upstream limit of the Darling River TUFLOW Model is shown on **Figure B3.1**.

Figure B3.2 shows the extent over which rainfall was directly applied to the model grid of the Bourke TUFLOW Model. TUFLOW converted the rainfall to runoff and routed the flow to the drainage outlets beneath the Bourke Levee. Direct application of rainfall to the natural surface is a recent development and is part of the TUFLOW modelling system. While direct application should be used with caution as it has the potential to over-attenuate overland flows, it has considerable advantages in situations where the flow paths are relatively indistinct and are difficult to "map" by eye. In effect, the grid of the TUFLOW geometric model of the floodplain defines the flow paths automatically.

The downstream boundaries of the two models comprised a "free discharge" outlet, where a TUFLOW derived normal depth calculation was used to define hydraulic conditions at the outlet of both models.

B3.4. Model Calibration

B3.4.1. Darling River TUFLOW Model

Following a review of the available data, the floods that occurred in January 1974, March 1976, September 1998 and March 2012 were selected for calibrating the Darling River TUFLOW Model.

The following changes were made to the structure of the Darling River TUFLOW Model in order to represent contemporaneous floodplain conditions at the time of the January 1974 and March 1976 floods:

- the topography of the model was adjusted to reflect the alignment of the levee that was present at the time of the flood (refer **Figure 2.2** of Main Report for alignments);
- adjustment of the topography to represent the pre-1984 alignment of the Mitchell Highway crossing of the Darling River floodplain to the north of the town, including the removal of the Bourke Bridge, Billabong Bridge and Swamp Bridge;
- details of the Old Billabong Bridge and Old Swamp Bridge were incorporated in the model; and
- removal of the Alice Edwards Village levee (which was constructed in post-1984 based on information contained in NSW SES, 2013).

It is noted that WaterNSW, 2020 indicated that the nature of the southern portion of the Darling River floodplain at Bourke has altered since the 1970s due to civil infrastructure such as "off stream storage infrastructure" and a "sealed highway". It was not possible to remove the abovementioned infrastructure from the Darling River TUFLOW Model as WaterNSW, 2020 does not describe the location and extent of these works. Therefore, the Darling River TUFLOW Model may underestimate the flow on the southern portion of the floodplain at Bourke for the 1974 and 1976 floods.

The discharge hydrographs that were recorded at the Bourke stream gauge were used as input to the Darling River TUFLOW Model at its upstream boundary.

The Darling River TUFLOW Model was calibrated to recorded stream gauge data taken from WaterNSW's website for the four historic flood events, as well as the historic flood level data presented in URS et al., 2009 for the March 1976 flood. The Manning's n hydraulic roughness Parameter Set No. 1 set out in **Table B3.1** was adopted in order to match the recorded flood data for the January 1974, March 1976 and September 1998, while Parameter Set No. 2 was required to achieve a good match with the recorded flood data for the March 2012 flood.

Figures B3.3, **B3.4**, **B3.5** and **B3.6** show the Darling River TUFLOW Model results for the January 1974, March 1976, September 1998 and March 2012 floods, respectively, while **Table B3.2** over provides a comparison of modelled versus recorded peak flood levels for the four historic floods.

TABLE B3.2
COMPARISON OF RECORDED VERSUS MODELLED PEAK FLOOD LEVELS

Event	ID(1,2)	Location	Peak Flood Level (m AHD)		Difference(3) (m)	Discussion
			Recorded	Modelled		
January 1974	-	Bourke stream gauge	105.95	106.05	+0.10	Good match
March 1976	A14	35 km north-east of Bourke	111.19(4)	109.64	-1.55	While the recorded flood level is considered unreliable, the modelled flood level is within 0.4 m of the flood level derived by the MIKE Flood model that was developed as part of URS et. al., 2009.
	A15		110.6(5)	109.99	-0.61	While the recorded flood level is considered unreliable, the modelled flood level is within 0.1 m of the flood level derived by the MIKE Flood model that was developed as part of URS et. al., 2009.
	A13	15 km north-east of Bourke	107.89	107.51	-0.38	Difference may be a result of change in landform between the time of the flood event and the date that the LiDAR survey data was capture (i.e. 2009).
	-	Bourke stream gauge	106.03	106.11	+0.08	Good match
	A16	15 km south-west of Bourke	103.49	104	+0.51	Difference may be a result of change in landform between the time of the flood event and the date that the LiDAR survey data was capture (i.e. 2009).
March 2012(4)	-	Bourke stream gauge	105.63	105.61	-0.02	Good match
November 2016	-		105.68	105.59	-0.09	Good match

1. Source of recorded peak flood levels and descriptors: URS et al., 2009.
2. Refer **Figure B3.4**, sheet 1 for location of available flood marks.
3. Note that a positive value indicates that the modelled flood level is higher, and conversely a negative value indicates that the modelled flood level is lower than the recorded flood level.
4. URS et. al., 2009 deemed the flood mark unreliable as it was based on an approximate flood extent on a cattle grid, the location of which may have changed.
5. URS et. al., 2009 deemed the flood mark unreliable as it was based on an anecdotal description that the peak flood level reached "halfway" up a door but was not clearly marked.

Figure B1.3 (2 sheets) shows a comparison of recorded and modelled stage and discharge hydrographs at the Bourke stream gauge. **Figure B1.3** also shows the recorded and modelled flow at the four WaterNSW gauging locations across the Darling River floodplain at Bourke, while **Table B3.3** sets out the total modelled flow at the four WaterNSW gauging locations.

TABLE B3.3
DISTRIBUTION OF FLOW ON THE DARLING RIVER FLOODPLAIN AT BOURKE
HISTORIC FLOOD EVENTS(1)
(m^3/s)

WaterNSW Gauging Location(2)	Historic Flood			
	January 1974	March 1976	September 1998	March 2012
Main Channel	1,746	2,007	1,308	988
Billabong	259	371	212	168
Swamp	1,506	1,630	1,076	840
Railway	1,554	1,882	100	83
Total(3)	**5,065**	**5,883**	**2,692**	**2,074**

1. Derived by running the Darling River TUFLOW Model for each individual historic flood.
2. Refer **Figure B1.1** for location.
3. The total flow on the Darling River floodplain at Bourke does not equal the sum of the peak flows in the four flow paths due to differences in the timing of the flood peaks.

The key findings as they related to the calibration of the Darling River TUFLOW Model are as follows:

- **Table B3.2** shows that the Darling River TUFLOW Model generated peak flood levels that are within 100 mm of the recorded flood levels at the Bourke stream gauge for the four historic flood events.
- The Darling River TUFLOW Model does not achieve a good match with the recorded flood levels that are located 15 km upstream and downstream of Bourke (refer Point IDs *A13* and *A16*). The LiDAR survey data that has been used to derive the natural surface levels in the Darling River TUFLOW Model was captured more than forty (40) years after the 1976 flood and may not represent floodplain conditions that were present at the time of the event, particularly the civil infrastructure mentioned in WaterNSW, 2020. It also has a stated vertical accuracy of ±300 mm which may also affect the ability of the model to closely match recorded flood levels. It was not possible to determine the reason for the differences in recorded and modelled levels as part of the present study.
- **Figure B1.3**, sheet 1 shows that the Darling River TUFLOW Model underestimates the flow on the southern portion of the floodplain (refer "Railway") for the January 1974 and March 1976, this may be a function of the model not reflecting floodplain conditions that were present at the time.
- The RHS of **Figure B1.3**, sheet 1 shows that the receding limb of the modelled discharge hydrographs for the March 1976 flood do not match the gauged discharges at the four WaterNSW gauging locations. It was not possible to achieve a match as the recorded flow at the Bourke stream gauge, which was used as input to the TUFLOW model, doesn't match the total gauged flow on the receding limb.
- **Figure B1.3**, sheet 2 shows that the Darling River TUFLOW Model achieved a good match with the flow distribution across the floodplain for the September 1998 and March 2012 floods.

As the aim of the present study was to determine the design flood behaviour in the vicinity of the town under present day conditions, the Darling River TUFLOW Model is considered suitable for defining flood levels as it achieves a good match with recorded levels at the Bourke stream gauge and the distribution of flow across the floodplain for the more recent flood events.

B3.4.2. Bourke TUFLOW Model

Following a review of the available data, the storm that occurred in February 2009 was selected for calibrating the Bourke TUFLOW Model. **Figure B3.7** shows the Bourke TUFLOW Model results for the February 2009 storm event and the plan location of observed flood behaviour taken from the photographs that were provided by Council at the commencement of the present study (a copy of which are contained in **Annexure B1** of this Appendix). **Table B3.4** at the end of this chapter sets out a comparison of the observed and modelled flood behaviour at Bourke during the February 2009 storm event.

In general, the Bourke TUFLOW Model was able to reproduce the observed flood behaviour.

B3.4.3. Concluding Remarks

Based on the findings of the model calibration process, the Darling River TUFLOW Model and Bourke TUFLOW Model are considered to provide a good match with the available flood data. As such, the hydraulic model parameters set out in **Section B3.3**, and in particular the hydraulic roughness values set out in **Table B3.1,** were considered appropriate for use in defining flood behaviour at Bourke over the full range of design flood events. Further discussion and presentation of hydrologic model parameters that were adopted for design flood estimation purposes is provided in **Section B4**.

TABLE B3.4
COMPARISON OF OBSERVED VERSUS MODELLED FLOOD BEAHVIOUR AT BOURKE

Observed Flood Behaviour ID(1)	Observed Flood Behaviour	Model Verification Comments
FM01	Tudor Street inundated to the west of its intersection with Warraweena Street (refer **Plate 52** of **Annexure B1**).	TUFLOW Model shows Tudor Street inundated to a maximum depth of 150 mm.
FM02	Mitchell Street inundated to the west of its intersection of Tarcoon Street (refer **Plate 88** of **Annexure B1**).	TUFLOW Model shows Mitchell Street inundated to a maximum depth of 80 mm.
FM03	Vacant lots located to the south-west corner of the intersection of Tarcoon and Mitchell Streets inundated (refer **Plate 89** in **Annexure B1**).	TUFLOW Model shows vacant lot inundated to a maximum depth of about 250 mm.
FM04	Shallow inundation of Tarcoon Street between Oxley Street and Mitchell Street (refer **Plate 67** in Annexure B1).	TUFLOW Model shows the Tarcoon Street inundated to a maximum depth of 150 mm.
FM05	Shallow inundation of Dr R. E. Coolican Field (refer **Plate 65** of **Annexure B1**).	TUFLOW Model shows the field is inundated to depths greater than 100 mm.
FM06	Denman Street inundated to the south of its intersection with Green Street (refer **Plate 92** of **Annexure B1**).	TUFLOW model shows Denman Street inundated to a depth of about 150 mm.
FM07	Floodwater at the point of encroaching on the Mitchell Highway (refer **Plate 61** of **Annexure B1**).	TUFLOW model results show shallow inundation (<100 mm) of the shoulder Mitchell Highway.
FM08	Inundation of the intersection of Bloxham Street and Meadows Road. The pipes beneath Mitchell Highway are completely submerged (the obvert set and an elevation of about RL 104.22 m AHD) (refer **Plates 59**, **60**, **62** and **63** of **Annexure B1**).	TUFLOW model shows floodwater ponding to an elevation of RL 104.80 m AHD.
FM09	Shallow inundation of Anson Street west of its intersection with Glen Street (refer **Plate 56** of **Annexure B1**).	TUFLOW model shows Anson Street inundated to a depth of about 100 mm.
FM10	Floodwater just below "bank-full" level (i.e. RL 105.25 m AHD) in open channel on southern side of Anson Street (refer **Plate 84** of **Annexure B1**).	Peak flood level in channel is 105.25 m AHD in TUFLOW model.

Refer over for footnotes to table.

TABLE B3.4 (Cont'd)
COMPARISON OF MODELLED VERSUS OBSERVED FLOOD BEAHVIOUR AT BOURKE

Observed Flood Behaviour ID[(1)]	Observed Flood Behaviour	Model Verification Comments
FM11	Floodwater overtopping the western kerb of Sturt Street immediately north of its intersection with Mertin Street (refer **Plate 81** of **Annexure B1**).	TUFLOW model shows top of kerb inundated by about 50 mm.
FM12	Shallow inundation of Anson Street where it cross Horsfalls Billabong (refer **Plate 85** of **Annexure B1**).	TUFLOW model shows Anson Street inundated to a depth of about 100 mm.
FM13	Culgoa Street inundated to the north of its intersection with Anson Street (refer **Plate 86** of **Annexure B1**).	TUFLOW model shows Culgoa Street inundated to a depth of about 200 mm.

1. Refer **Figure B3.7** for location of Observed Flood Behaviour Identifier.

B4. DERIVATION OF DESIGN DISCHARGE HYDROGRAPHS

B4.1. Design Storms

B4.1.1. Rainfall Intensity

The procedures used to obtain temporally and spatially accurate and consistent Intensity-Frequency-Duration (**IFD**) design rainfall curves for the assessment of local catchment flooding at Bourke are presented in GA, 2019. Design storms for frequencies of 20, 10, 5, 2, 1, 0.5 and 0.2% AEP were derived for storm durations ranging between 30 minutes and seven days. The IFD dataset was downloaded from the Bureau of Meteorology's (**BoM's**) *2016 Rainfall IFD Data System*.

B4.1.2. Areal Reduction Factors

The rainfalls derived using the processes outlined in GA, 2019 are applicable strictly to a point. In the case of a catchment of over tens of square kilometres area, it is not realistic to assume that the same rainfall intensity can be maintained. An Areal Reduction Factor (**ARF**) is typically applied to obtain an intensity that is applicable over the entire catchment.

However, as the local catchment at Bourke is relatively small (6 km^2), the reduction in rainfall intensity would be quite small. Accordingly, no reduction in design point rainfalls was made for this present study (i.e. an ARF of 1.0 was adopted).

B4.1.3. Temporal Patterns

GA, 2019 prescribes the analysis of 10 temporal patterns per storm duration for various zones in Australia. These patterns are used in the conversion of a design rainfall depth with a specific AEP into a design flood of the same frequency. The patterns may be used for AEP's down to 0.2 per cent where the design rainfall data is extrapolated for storm events with an AEP less than 1 per cent.

The temporal patterns ensembles for Frequent (more frequent than 14.4% AEP), Intermediate (between 3.2 and 14.4% AEP) and Rare (rarer than 3.2% AEP) storm events were obtained from the *ARR Data Hub*[6], while those for the very rare events were taken from the BoM's update of *Bulletin 53* (BoM, 2003). A copy of the data extracted from the *ARR Data Hub* for Bourke is contained in **Annexure B4** of this Appendix.

B4.1.4. Probable Maximum Precipitation

Estimates of PMP were made using the Generalised Short Duration Method (**GSDM**) as described in BoM, 2003. This method is appropriate for estimating extreme rainfall depths for catchments up to 1,000 km^2 in area and storm durations up to six hours.

The steps involved in assessing PMP for each study catchment are briefly as follows:

- Calculate PMP for a given duration and catchment area using depth-duration-area envelope curves derived from the highest recorded US and Australian rainfalls.

[6] It is noted that the temporal pattern data set for the *Rangelands* region is suitable for use at Bourke.

- Adjust the PMP estimate according to the percentages of the catchment which are meteorologically rough and smooth, and also according to elevation adjustment and moisture adjustment factors.
- Assess the design spatial distribution of rainfall using the distribution for convective storms based on US and world data but modified in the light of Australian experience.
- Derive storm hyetographs using the temporal distribution contained in BoM, 2003, which is based on pluviographic traces recorded in major Australian storms.

B4.2. Design Rainfall Losses

The initial and continuing loss values to be applied in flood hydrograph estimation were derived using the NSW jurisdictional specific procedures set out in the *ARR Data Hub*.

The raw Probability Neutral Burst Initial Loss values obtained from the *ARR Data Hub* were reviewed and adjusted to remove inconsistencies in values with varying storm probability and durations. **Figure B4.1** shows the original Probability Neutral Burst Initial Loss curves derived from the tables obtained from the *ARR Data Hub*, together with the adopted probability neutral burst initial loss curves following the adjustments that were made as part of the present study.

As discussed in **Section B2.2.2**, the *ARR Data Hub* does not presently provide recommendations for continuing loss values in "Arid" regions due to the lack of catchments that are suitable for use in tuning the predicted loss equations that have been developed as part of GA, 2019. As a result, the continuing loss value of 2.5 mm/hr was adopted.

B4.3. Derivation of Design Discharges

In order to reduce model run time for design flood modelling, steady-state discharge hydrographs were used to model the flow in the Darling River whereby the flow increased over a 24 hour period, and then continued at a constant rate based on the design peak flow estimates set out in **Column E** of **Table B1.**7 for a period of a further 400 hours.

As required by the Study Brief, the Extreme Flood was assumed to have a peak flow five (5) times that of the 1% AEP flood at the Bourke stream gauge.

B5. HYDRAULIC MODELLING OF DESIGN STORMS

B5.1. Presentation and Discussion of Results

B5.1.1. General

The following Chapter sets out the design flooding patterns at Bourke for both Darling River and local catchment flooding.

In order to create realistic results which remove most of the anomalies caused by inaccuracies in the LiDAR survey data (which as noted in **Section B1.1** has a design accuracy such that 95 per cent of the points have an accuracy in level of +/- 300 mm), a filter was applied to remove depths of inundation over the natural surface less than 100 mm. This has the effect of removing the very shallow depths which are more prone to be artefacts of the model, but at the same time giving a reasonable representation of the various overland flow paths.

B5.1.2. Accuracy of Hydraulic Modelling

The accuracy of results depends on the precision of the numerical finite difference procedure used to solve the partial differential equations of flow, which is also influenced by the time step used for routing the floodwave through the system and the grid spacing adopted for describing the natural surface levels on the floodplain. The results are also heavily dependent on the size of the two-dimensional grid, as well as the accuracy of the LiDAR survey data.

Given the uncertainties in the LiDAR survey data and the definition of features affecting the passage of flow, maintenance of a depth of flow of at least 200 mm is required for the definition of a "continuous" flow path in the areas subject to shallow overland flow. Lesser modelled depths of inundation may be influenced by the above factors and therefore may be spurious, especially where that inundation occurs at isolated locations and is not part of a continuous flow path. In areas where the depth of inundation is greater than the 200 mm threshold and the flow path is continuous, the likely accuracy of the hydraulic modelling in deriving peak flood levels is considered to be between 100 and 150 mm.

Use of the results from the present study when applying flood related controls to development proposals should be undertaken with the above limitations in mind. Proposals should be assessed with the benefit of a site survey to be supplied by applicants in order to allow any inconsistencies in results to be identified and given consideration. This comment is especially appropriate in the areas subject to shallow flow, where the errors in the LiDAR survey data or obstructions to flow would have a proportionally greater influence on the computed water surface levels than in the deeper flooded main stream areas.

Minimum floor levels for residential, commercial and industrial developments should be based on the 1% AEP flood level plus appropriate freeboard (i.e. the *FPL*), to cater for uncertainties such as wave action, effects of flood debris conveyed in the flow stream and precision of modelling. Note that a freeboard of 500 mm has been adopted for defining the *FPL's* <To be confirmed>.

The sensitivity studies and discussion presented in **Section B5.2** provide guidance on the suitability of the recommended allowance for freeboard under present day climatic conditions.

In accordance with DPIE recommendations (DECC, 2007b), sensitivity studies have also been carried out to assess the impacts of future climate change (refer **Section B5.3**). Increases in flood levels due to future increases in rainfall intensities may influence the selection of *FPL's*.

B5.1.3. Design Flooding and Drainage Patterns

Figures 2.3 and **2.4** of the Main Report shows water surface profiles and the available freeboard along the alignment of the Bourke Levee and Alice Edwards Village Levee, respectively for the full range of design flood events, while **Figures 2.5** and **2.6** of the Main Report show the nature of both Darling River flooding and local catchment flooding at Bourke for the 1% AEP and Extreme Flood events, respectively. **Figures B5.1** to **B5.5** show similar information for the 10, 5, 2, 0.5 and 0.2% AEP flood events.

Section 2.4.2 of the Main Report provides a description of the key features of both Darling River and local catchment flooding at Bourke.

B5.1.4. Potential Impact of Partial Levee Failure

While the present study found that in the absence of any wind or wave action the Bourke Levee would only be overtopped during very rare and extreme flood events, its design freeboard of 1 m is compromised by floods that are larger than about a 5% AEP event at the low point that is located in private property adjacent to Rotary Park. While investigations have shown that the embankment is in good condition, there is still the potential for it to fail prior to it being overtopped.

The Darling River TUFLOW Model was used to assess the impact a partial failure of the Bourke Levee would have on depths of inundation in the town for a 1% AEP Darling River flood event. Peak flood levels in Bourke should the Bourke Levee partially fail are controlled by the peak flood level on the floodplain during the designated flood event as this level is lower than the absolute low point in the levee.

Figure B5.7 shows the town would be inundated to depths of up to 0.5-1.6 m in a 1% AEP flood should the Bourke Levee partially fail.

B5.1.5. Potential Impact of Coincident Darling River and Local Catchment Flooding

During periods when water levels in the Darling River are elevated, Council closes the eleven flood gates which are fitted to the stormwater drainage pipes which are located around the perimeter of the Bourke Levee. If a rainfall event coincides with the closure of the flood gates, then stormwater runoff is forced to pond behind the Bourke Levee until water levels in the river recede, or alternatively the fourteen stormwater evacuation pumps are used to pump water to the river side of the Bourke Levee.

Figure B5.8 shows the depth of inundation that would occur internal to the Bourke Levee should a 1% AEP storm occur over Bourke while the flood gates are in their closed position and the stormwater evacuation pumps are operating at full capacity, while **Figure B5.9** shows the impact that the closure of the flood gates would have on flood behaviour for the case where the stormwater evacuation pumps are operating at full capacity when compared to the 'flood gates open' case. **Figure B5.9** shows that the stormwater evacuation pumps do not have the capacity to offset the impact that the closure of the flood gates has on flood behaviour as the rate at which the pumps evacuate water ponding behind the levee is slower than it can drain to the river side of the Bourke Levee under gravity.

An assessment was also made of the impact not operating the stormwater evacuation pumps during a 1% AEP storm event for the case when the flood gates are in their closed position would have on flood behaviour. **Figure B5.10** shows the resulting depth and extent of inundation that would occur under these conditions, while **Figure B5.11** shows the impact that not operating the stormwater evacuation pumps will have on flood behaviour compared to the 'stormwater evacuation pumps operating' case. **Figure B5.11** shows that depths of ponding would be increased by up to about 10 mm to the north of pump station FSP_02 in existing development in Anson Street and Meadows Road, while they would be increased by about 50 mm on the inside of the Bourke Levee adjacent to the Darling River between chainages 7,970 m and 10,150 mm.

B5.2. Sensitivity Studies

B5.2.1. General

The sensitivity of the hydraulic model was tested to variations in model parameters such as hydraulic roughness and the partial blockage of major hydraulic structures across the Darling River. The main purpose of these studies was to give some guidance on the freeboard to be adopted when setting floor levels of development in flood prone areas as part of the *Bourke FRMS*. The results are summarised in the following sections.

B5.2.2. Sensitivity to Hydraulic Roughness

Figure B5.12 shows the difference in peak flood levels (i.e. the "afflux") for the 1% AEP Darling River flood event resulting from an assumed 20% increase in hydraulic roughness values set out in **Table B3.1**. The typical increase in peak flood level along the Darling River in the vicinity of Bourke was found to be in the range 90 to 150 mm.

B5.2.3. Sensitivity to Partial Blockage of Hydraulic Structures

The mechanism and geometrical characteristics of blockages in hydraulic structures and piped drainage systems are difficult to quantify due to a lack of recorded data and would no doubt be different for each system and also vary with flood events. Realistic scenarios would be limited to waterway openings becoming partially blocked during a flood event (no quantitative data are available on instances of blockage of the drainage systems which may have occurred during historic flood events).

GA, 2019 provides guidance on the derivation of blockage factors which should be applied to hydraulic structures to account for large woody debris becoming lodged in the clear opening of either a culvert or a bridge. **Table B5.1** over the page sets out the classifications which were adopted in the derivation of the blockage factor that was applied to the two bridges and one culvert that were incorporated in the Darling River TUFLOW Model.

GA, 2019 states that in the absence of a record of past debris accumulated at the structure, the L_{10} value should be determined from an inspection of debris on the floor of the source area.[7] Based on a visual inspection of the type of vegetation on the banks of the Darling River from historic photographs contained in **Annexure B1** of this Appendix, an L_{10} value of 5 m was adopted for the present investigation. GA, 2019 also states that the blockage mechanism creating the worst impact on flood behaviour should be used in design. As such, a blockage factor of 15% was applied to the bridge crossings in the Darling River TUFLOW Model.

Figure B5.12 shows that a partial blockage of the four bridges would result have a negligible impact on peak 1% AEP flood levels. In regards the potential blockage of the local stormwater drainage system would have on local catchment flooding, reference is made to the discussion in **Section B5.1.5**.

[7] L_{10} is the average length of the longest 10% of the debris that could arrive at the site.

TABLE B5.1
SUMMARY OF BLOCKAGE ASSESSMENT

Mode of Blockage	Criterion	Classification[1]	Descriptor	GA, 2019 Reference Table[5]
Inlet Blockage	Debris Availability	L	➢ Streams with moderate to flat slopes and stable bed and banks. ➢ Arid areas where vegetation is deep rooted.	6.6.1
	Debris Mobility	H	➢ Receiving streams that frequently overtop their banks. ➢ Main debris source areas close to streams.	6.6.2
	Debris Transportability	H	➢ Deep stream relative to vertical debris dimension ($D > 0.5L_{10}$) ➢ Wide stream relative to horizontal debris dimension.($W > L_{10}$) ➢ High temporal variability in maximum stream flows.	6.6.3
	1% AEP Debris Potential	M	HHL (Combination of the above three classifications)	6.6.4
	AEP Adjusted Debris Potential	H	AEP > 5% - Low AEP ≤ 5% - High	6.6.5
	Most Likely Inlet Blockage Levels[2]	**10% (Old Bourke Bridge)**	$L_{10} \leq W \leq 3xL_{10}$ – Medium[3]	6.6.6
		0% (Bourke Bridge, Swamp Bridge, Billabong Bridge)	$W > 3xL_{10}$ – Medium[4]	
Barrel Blockage	Likelihood of Sediment Being Deposited in Barrel/Waterway	L	Based on a peak velocity through the bridge structures of about 1.5 m/s and clay/silt being the mean sediment size present at the site	6.6.7
	AEP Adjusted Debris Potential	M	AEP > 5% - Low AEP ≤ 5% - High	6.6.5
	Most Likely Depositional Blockage Levels	**15%**	L – M (Based on the above two classifications)	6.6.8

1. L = Low M = Medium H = High
2. L_{10} value set equal to 5 m based on site inspection.
3. Clear span (W) of Old Bourke Bridge is about 9 m.
4. Clear span (W) of Bourke Bridge, Swamp Bridge and Billabong Bridge are about 34 m, 24 m and 24 m, respectively.
5. Table numbers relate to those presented in Chapter 6 of Book 6 of GA, 2019.

B5.3. Climate Change Sensitivity Analysis

B5.3.1. General

At the flood study stage, the principal issue regarding climate change is the potential increase in flood levels and extents of inundation throughout the study area. In addition it is necessary to assess whether the patterns of flow will be altered by new floodways being developed for key design events, or whether the provisional flood hazard will be increased.

DPIE recommends that its guideline *Practical Considerations of Climate Change* (DECC, 2007b) be used as the basis for examining climate change induced increases in rainfall intensities in projects undertaken under the State Floodplain Management Program and NSWG, 2005. The guideline recommends that until more work is completed in relation to the climate change impacts on rainfall intensities, sensitivity analyses should be undertaken based on increases in rainfall intensities ranging between 10 and 30 per cent. On current projections the increase in rainfalls within the service life of developments or flood management measures is likely to be around 10 per cent, with the higher value of 30 per cent representing an upper limit. Under present day climatic conditions, increasing the 1% AEP design rainfall intensities by 10 per cent would produce a 0.5% AEP flood; and increasing those rainfalls by 30 per cent would produce a 0.2% AEP event.

The impacts of climate change and associated effects on the viability of floodplain risk management options and development decisions may be significant and will need to be taken into account in the *Bourke FRMS* using site specific data.

In the *Bourke FRMS* it will be necessary to consider the impact of climate change on flood damages to existing development. Consideration will also be given both to setting floor levels for future development and in the formulation of works and measures aimed at mitigating adverse effects expected within the service life of development.

B5.3.2. Sensitivity to Increased Rainfall Intensities

As mentioned, the investigations undertaken at the flood study stage are mainly seen as sensitivity studies pending more detailed consideration in the *FRMS*. For the purposes of the present investigation, the design peak flows for 0.5 and 0.2% AEP flood events were adopted as being analogous to flooding which could be expected should present day 1% AEP rainfall intensities increase by 10 and 30 per cent, respectively.

The design peak flows at the Bourke stream gauge for the 0.5 and 0.2% AEP flood events are about 1.24 and 1.65 times the 1% AEP peak flow, respectively. Based on this finding, the comparisons between the 0.5 and 0.2% AEP events with the 1% AEP event may provide an over-estimate of the future effects of climate change on flood behaviour at Bourke. None the less, they do provide a good indication of the changes which will occur due to flooding behaviour for floods that are slightly larger than the 1% AEP event, which unless there are exceptional circumstances is adopted by local councils for setting flood related controls on future development.

Figures 2.10 and **2.11** of the Main Report show the impact a 10 and 30 per cent increase in 1% AEP rainfall intensities, respectively would have on flooding behaviour at Bourke. In general terms, peak 1% AEP flood levels on the Darling River floodplain in the vicinity of Bourke would be increased in the range 120 to 180 mm as a result of a 10 per cent increase in rainfall intensities and in the range 300 to 450 mm as a result of a 30 per cent increase in rainfall intensities. As shown in **Figure 2.12**, these increases in peak 1% AEP flood levels do not translate into a significant increase in the extent of flooding principally due to the relatively steep sided nature of the Darling River floodplain in the vicinity of Bourke.

B6. REFERENCES

BoM (Bureau of Meteorology), 2003. ***"The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method"***.

Bourke Shire Council, 2012. ***"Bourke Local Environmental Plan, 2012"***

Bourke Shire Council, 2016. ***"Bourke Shire Development Control Plan"***

DECC (Department of Environment and Climate Change, NSW), 2007b. ***"Floodplain Risk Management Guideline – Practical Considerations of Climate Change"***.

DPIW (NSW Department of Primary Industries – Water), 2017. ***"Floodplain Management Plan for the Barwon-Darling Valley Floodplain"***

DWR (Department of Water Resources), 1992. ***"Estimation of Potential Flood Damages at Bourke"***

GA (Geoscience Australia), 2019. ***"Australian Rainfall and Runoff – A Guide to Flood Estimation"***

Howells et al., 2004. ***"Defining the Floodway - Can One Size Fit All?"*** FMA NSW Annual Conference, Coffs Harbour, February 2004.

IEAust (The Institution of Engineers Australia), 1987. ***"Australian Rainfall and Runoff – A Guide to Flood Estimation"***, Volumes 1 and 2.

NSWG (New South Wales Government), 2005. ***"Floodplain Development Manual"***

NSW SES (NSW State Emergency Service), 2000. ***"Bourke Local Flood Plan"***

PW (NSW Department of Public Works), 2011. ***"Bourke Levee – Investigation for Upgrade of the Levee"***

PW (NSW Department of Public Works), 2012. ***"Visual Audit of Bourke Levee"***

PW (NSW Department of Public Works), 2018. ***"Draft Bourke Levee Owners Manual"***

SKP (Sinclair Knight & Partners), 1986. ***"Bourke Flood Levee Augmentation Study"***

URS et al., 2009. ***"Rural Flood Study Darling River Floodplain (Bogan River Confluence to Louth)"***

WaterNSW, 2020. ***"425003 Darling River at Bourke – High Stage Rating Post the 2012 Floods"***

ANNEXURE B1

PLATES SHOWING HISTORIC FLOODING AT BOURKE

AUGUST 1950 FLOOD EVENT

Plate 1 – Looking south-west across the town of Bourke with Braeburn Orchard in foreground. (*Source: Council*)

Plate 2 – Looking north towards the Convent (St Ignatius Parish School today) from Anson Street. (*Source: Council*)

Plate 3 – Looking south-west along Darling River (Wilson Street running right to left in foreground). (*Source: Council*)

Plate 4 – Looking north-west across Horsfalls Billabong towards the Convent (St Ignatius Parish School today) from corner of Charles Street and Mitchell Street. (*Source: Council*)

Plate 5 – Looking east across Horsfalls Billabong. (*Source: Council*)

Plate 6 – Looking north-east across the town of Bourke with train station in foreground. (*Source: Council*)

AUGUST 1950 FLOOD EVENT

Plate 7 – Construction of levee bank. (*Source: Council*)

Plate 8 – Construction of levee bank. (*Source: Council*)

Plate 9 – Looking north towards Braeburn Orchard in background. (*Source: Council*)

MARCH 1971 FLOOD EVENT

Plate 10 – Looking south-west towards Old Bourke Bridge and North Bourke. (*Source: Council*)

Plate 11 – Looking south across Old Bourke Bridge (Darling Street/Mitchell Highway in foreground). (*Source: Council*)

Plate 12 – Looking south-east along upstream side of the Swamp Bridge. (*Source: Council*)

Plate 13 – Looking south-west towards Waterworks tank. (*Source: Council*)

Plate 14 – Looking south-east across Mitchell Highway and disused Main Western Railway (approximately 1.5 km from town). (*Source: Council*)

Plate 15 – Looking south-east across the town of Bourke. (*Source: Council*)

MARCH 1971 FLOOD EVENT

Plate 15 – Looking south-east across the town of Bourke. (*Source: Council*)

Plate 17 – Looking west across the town of Bourke (*Source: Council*)

JANUARY 1974 FLOOD EVENT

Plate 18 –Looking south across Darling River immediately upstream of Old Bourke Bridge. (*Source: Council*)

Plate 19 – Looking south-west across the town of Bourke with Braeburn Orchard in foreground. (*Source: Council*)

Plate 20 – Looking south across Pitches Orchard from North Bourke (Mitchell Highway in foreground). (*Source: Council*)

Plate 21 – Looking north-west along Mitchell Highway towards Bourke. (*Source: Council*)

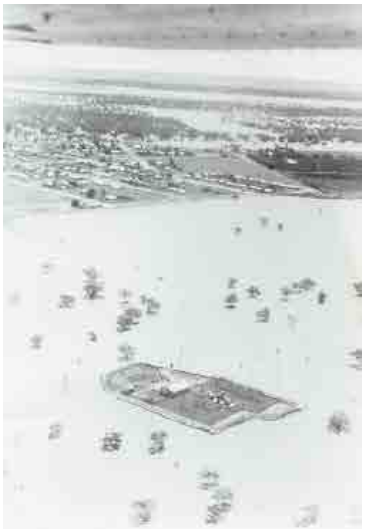


Plate 22 – Looking north-west across Bourke showing electrical sub-station isolated in the foreground. (*Source: Council*)

Plate 23 – Looking north-west towards Parkdale Orchard. (*Source: Council*)

JANUARY 1974 FLOOD EVENT	
	
Plate 24 – Looking north-east along Tancred Drive. (*Source: Council*)	**Plate 25** – Overlooking Bourke Meatworks. (*Source: Council*)
	
Plate 26 – Looking south-west from North Bourke towards The Swamp bridge crossing. (*Source: Council*)	**Plate 27** – Looking north along old levee from Kamilaroi Highway (Bunyan's house to left). (*Source: Council*)
	
Plate 28 – Community sandbag filling at Railway Goods Yard. (*Source: Council*)	**Plate 29** – Looking north towards Braeburn Orchard. (*Source: Council*)

JANUARY 1974 FLOOD EVENT	

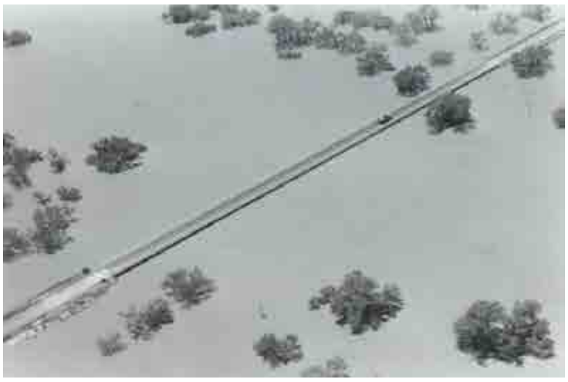
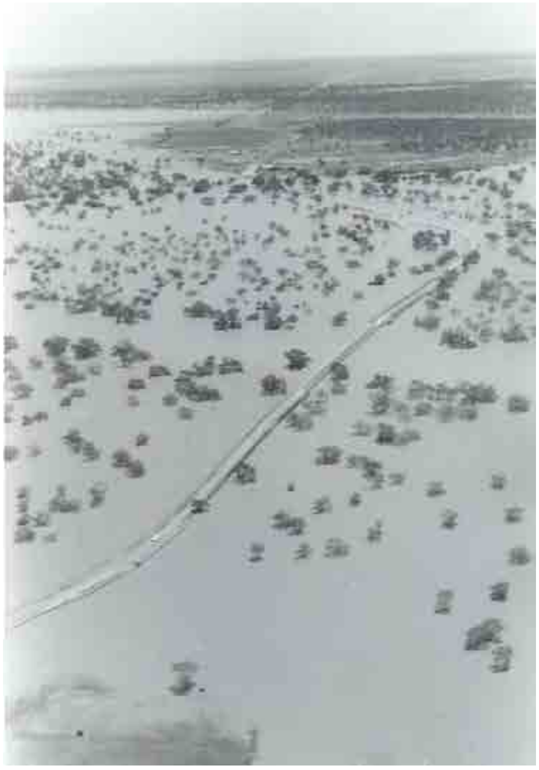

	

Plate 30 – Overlooking bridge crossing at Polygonums Swamp. (*Source: Council*)	**Plate 31** – Looking north-east towards North Bourke from the bend in Tancred Drive. (*Source: Council*)

MARCH 1976 FLOOD EVENT

Plate 32 – Looking north-east across Kamilaroi Highway near the town of Bourke. (*Source: Council*)

Plate 33 – Looking south-east towards Mt Oxley from the intersection of the Main Western Railway and levee (Mitchell Highway can be seen just beyond the levee). (*Source: Council*)

Plate 34 – Looking south-east from Kidman Highway approximately 230m south of levee. (*Source: Council*)

Plate 35 – Rail cart travelling along Main Western Railway with the town of Bourke in background. (*Source: Council*)

Plate 36 – Main Western Railway near the town of Bourke. (*Source: Council*)

MARCH 1976 FLOOD EVENT	
	
Plate 37 – Looking south-east across the town of Bourke. (*Source: The Western Herald*)	**Plate 38** – Levee seen to be ineffective for property that lies half-way between Bourke and North Bourke. (*Source: The Western Herald*)
	
Plate 39 – Looking east across Darling River immediately downstream of Old Bourke Bridge. (*Source: The Western Herald*)	**Plate 40** – Newspaper truck driving through floodwaters on Mitchell Highway to deliver crucial newspapers to the town of Bourke (image captured 07/03/1976). (*Source: The Western Herald*)
	
Plate 41 – Two children seen floating in floodwater over Mitchell Highway (image captured 07/03/1976). (*Source: The Western Herald*)	**Plate 42** – Meat supplies being transported to town via boat adjacent to the Main Western Railway (image captured 08/03/1976). (*Source: The Western Herald*)

MARCH 1976 FLOOD EVENT

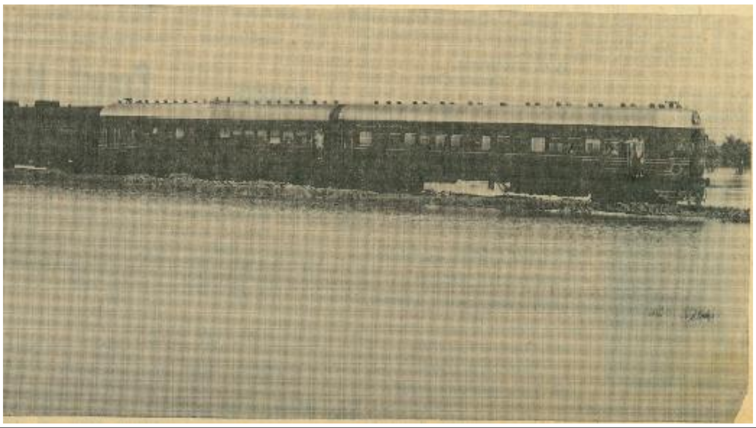


Plate 43 – Train travelling into the town of Bourke, floodwaters seen almost overtopping the tracks (image captured 08/03/1976). (*Source: The Western Herald*)

MAY 1988 FLOOD EVENT

Plate 44 – Looking south-east across floodplain with Bourke weir in foreground. (*Source: Council*)

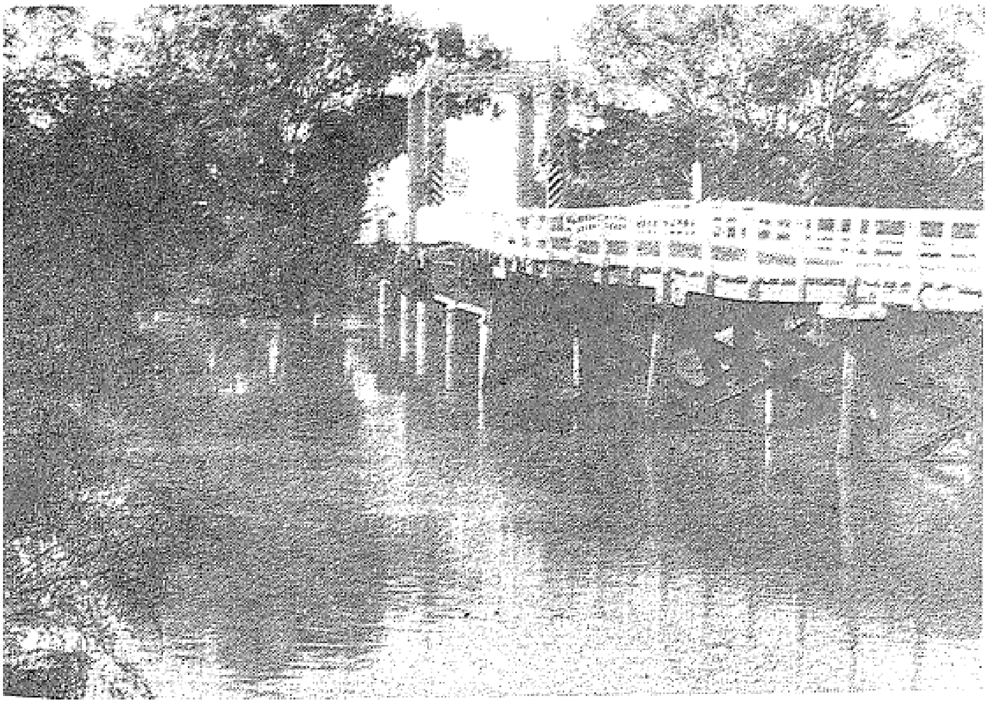


Plate 45 – Looking south-east across Darling River from immediately upstream of Old Bourke Bridge (image captured 17/05/1988). (*Source: The Western Herald*)

SEPTEMBER 1998 FLOOD EVENT	

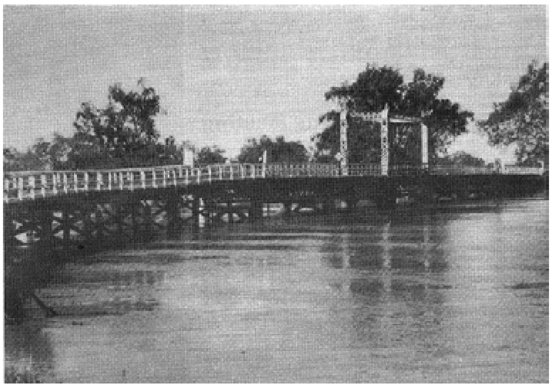



Plate 46 – Looking east across Darling River immediately downstream of Old Bourke Bridge. (*Source: The Western Herald*)	**Plate 47** – Property more than half underwater on northern floodplain. (*Source: The Western Herald*)
	
Plate 48 – Looking south along Darling River from North Bourke. (*Source: The Western Herald*)	**Plate 49** – Car driving through floodwaters looking north-west along Mitchell Highway (image captured 29/09/2012). (*Source: The Western Herald*)

FEBRUARY 2009 STORM EVENT

	
Plate 50 – Looking east from intersection of Short Street and Monomeeth Street. (*Source: Council*)	**Plate 51** – Looking west along Short Street from its intersection with Monomeeth Street. (*Source: Council*)
	
Plate 52 – Warraweena Street inundated to the west of its intersection with Tudor Street. (*Source: Council*)	**Plate 53 –** Floodwater ponding on the eastern side of Wilson Street north of its intersection with Tudor Street. (*Source: Council*)
	
Plate 54 – Glen Street inundated on the southern side of its intersection with Mitchell Street. (*Source: Council*)	**Plate 55 –** Floodwater ponding in Central Park in the vicinity of the intersection of Oxley Street and Glenn Street. (*Source: Council*)

FEBRUARY 2009 STORM EVENT

Plate 56 – Anson Street inundated on the southern side of its intersection with Glen Street. (*Source: Council*)

Plate 57 – Floodwater ponding on the north-east corner of the intersection of Anson Street and Wilson Street. (*Source: Council*)

Plate 58 – Looking south-east from the intersection of Anson Street and Wilson Street. (*Source: Council*)

Plate 59 – Looking east along Meadows Road from the Mitchell Highway. (*Source: Council*)

Plate 60 – Looking north along Bloxham Street from the Mitchell Highway. (*Source: Council*)

Plate 61 –Floodwater at point of surcharging the Mitchel Highway to the east of the intersection of Bloxham Street and Meadows Road. (*Source: Council*)

FEBRUARY 2009 STORM EVENT	
	
Plate 62 – Looking east along Meadows Road from the Mitchell Highway. (*Source: Council*)	**Plate 63** – Looking north along Bloxham Street from the Mitchell Highway. (*Source: Council*)
	
Plate 64 – Shallow inundation of Dr R.E Coolican Field. (*Source: Council*)	**Plate 65 –** Shallow inundation of Dr R.E Coolican Field. (*Source: Council*)
	
Plate 66 – Tarcoon Street inundated to the north of its intersection with Hope Street. (*Source: Council*)	**Plate 67 –** Tarcoon Street inundated to the north of its intersection with Oxley Street. (*Source: Council*)

FEBRUARY 2009 STORM EVENT

Plate 68 – Floodwater ponding on cricket field that is isolated to the north of the intersection of Culgoa Street and River Road. (*Source: Council*)

Plate 69 – Flooding at Bourke Airport. (*Source: Council*)

Plate 70 – Flooding at Bourke Airport. (*Source: Council*)

Plate 71 – Flooding at Bourke Airport. (*Source: Council*)

Plate 72 – Flooding at Bourke Airport. (*Source: Council*)

Plate 73 – Flooding at Bourke Airport. (*Source: Council*)

FEBRUARY 2009 STORM EVENT	
	
Plate 74 – Flooding at Bourke Airport. (*Source: Council*)	**Plate 75** – Flooding at Bourke Airport. (*Source: Council*)
	
Plate 76 – Flooding at Bourke Airport. (*Source: Council*)	**Plate 77 –** Flooding at Bourke Airport. (*Source: Council*)
	
Plate 78 – Flooding at Bourke Airport. (*Source: Council*)	**Plate 79 –** Flooding at Bourke Airport. (*Source: Council*)

FEBRUARY 2009 STORM EVENT

Plate 80 – Shallow inundation of footpath areas in Bourke Memorial Swimming Pool. (*Source: Council*)

Plate 81 – Looking north along Sturt Street from its intersection of Mertin Street. (*Source: Council*)

Plate 82 – Floodwater ponding on northern side of Mertin Street north of its intersection with Sturt Street. (*Source: Council*)

Plate 83 – Looking north along Sturt Street from its intersection with Hope Street. (*Source: Council*)

Plate 84 – 'Bank full' condition in concrete lined channel that is located on the southern side of Anson Street. (*Source: Council*)

Plate 85 – Looking north-west from the intersection of Anson Street and Church Street. (*Source: Council*)

FEBRUARY 2009 STORM EVENT	
	
Plate 86 – Culgoa Street inundated to the north of its intersection with Anson Street. (*Source: Council*)	**Plate 87 –** Looking west across Horsfalls Billabong Hope Street. (*Source: Council*)
	
Plate 88 – Mitchell Street inundated to the west of its intersection with Tarcoon Street. (*Source: Council*)	**Plate 89 –** Vacant lots on the south-western side of the intersection of Hope Street and Sturt Street. (*Source: Council*)
	
Plate 90 – Looking west along Oxley Street from its intersection with Tarcoon Street. (*Source: Council*)	**Plate 91** – Looking east along Green Street from its intersection with Denman Street. (*Source: Council*)

FEBRUARY 2009 STORM EVENT

Plate 92 – Looking south along Denman Street from its intersection with Green Street. (*Source: Council*)

Plate 93 – Ponding on eastern side of Wilson Street north of its intersection with Anson Street. (*Source: Council*)

Plate 94 – Floodwater ponding in the south-eastern corner of Bourke Golf Course. (*Source: Council*)

Plate 95 – Floodwater ponding in south-eastern corner of Bourke Gold Course. (*Source: Council*)

Plate 96 – Looking north from western side of Caltex petrol station (Wilsons Street in background). (*Source: Council*)

Plate 97 – Looking north along Mitchell Highway immediately south of Fred Hollows Vision Way Memorial Walls. (*Source: Council*)

<table>
<tr><th colspan="2">FEBRUARY 2009 STORM EVENT</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Plate 98 – Looking north-east on Mitchell Highway approximately 200m north of Fred Hollows Vision Way Memorial Walls. (Source: Council)</td><td>Plate 99 – Looking west from Mitchell Highway crossing of Bourke Town Levee. (Source: Council)</td></tr>
</table>

MARCH 2012 FLOOD EVENT

Plate 100 – Looking north along Darling River toward Old Bourke Bridge (image captured 29/02/2012 at river height 13.18m). (*Source: The Western Herald*)

Plate 101 – The Jandra Paddleboat marooned in floodwater (image captured 29/02/2012 at river height 13.18m). (*Source: The Western Herald*)

Plate 102 – Looking south toward Back O'Bourke Information & Exhibition Centre (image captured 29/02/2012 at river height 13.18m). (*Source: The Western Herald*)

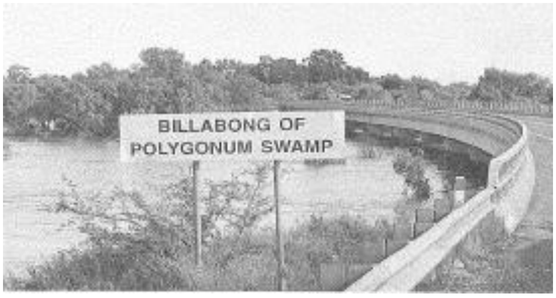


Plate 103 – Looking north-west across The Swamp bridge crossing (image captured 29/02/2012 at river height 13.18m). (*Source: The Western Herald*)

Plate 104 – Residence on Darling Street, North Bourke (image captured 29/02/2012 at river height 13.18m). (*Source: The Western Herald*)

Plate 105 – Looking south-west from The Swamp bridge crossing (image captured 29/02/2012 at river height 13.18m). (*Source: The Western Herald*)

<table>
<tr><th colspan="2">MARCH 2012 FLOOD EVENT</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Plate 106 – Looking north along Darling River toward Old Bourke Bridge (image captured 29/02/2012 at river height 13.18m). (Source: The Western Herald)</td><td>Plate 107 – Looking north from Tancred Drive approximately 1.5 km from the Bourke Town Levee (image captured 29/02/2012 at river height 13.18m). (Source: The Western Herald)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Plate 108 – Looking south-west toward Water Works tanks from rear end of 1 Tancred Drive property (image captured 29/02/2012 at river height 13.18m). (Source: The Western Herald)</td><td>Plate 109 – Looking north across Darling River at the Bourke Wharf (image captured 29/02/2012 at river height 13.18m). (Source: The Western Herald)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Plate 110 – Looking east from western end of town. Edge of Alice Edwards Village Levee can be seen on the left edge of photograph (image captured 02/03/2012).
(Source: Matthew McCorkle)</td><td>Plate 111 – Looking south across Darling River and Alice Edwards Village (image captured 02/03/2012).
(Source: The Western Herald)</td></tr>
</table>

<table>
<tr><th colspan="2">MARCH 2012 FLOOD EVENT</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Plate 112 – Looking north along Darling River immediately downstream of both bridges at North Bourke (image captured 02/03/2012). (Source: Matthew McCorkle)</td><td>Plate 113 – Looking south across the town of Bourke. Darling River and Waterworks can be seen in foreground (image captured 02/03/2012). (Source: Matthew McCorkle)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Plate 114 – Looking east across 167 Tancred Drive property. The Swamp runs from left to right on the near side of the property in the photograph (image captured 02/03/2012). (Source: Matthew McCorkle)</td><td>Plate 115 – Looking north across Darling Street and Mitchell Highway. Back O’Bourke Gallery in bottom left corner (blue roof) (image captured 02/03/2012). (Source: Matthew McCorkle)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Plate 116 – Looking south-east across Darling River from Kidman’s Camp (image captured 02/03/2012). (Source: Matthew McCorkle)</td><td>Plate 117 – Looking south-east across the town of Bourke (image captured 02/03/2012). (Source: Matthew McCorkle)</td></tr>
</table>

MARCH 2012 FLOOD EVENT	

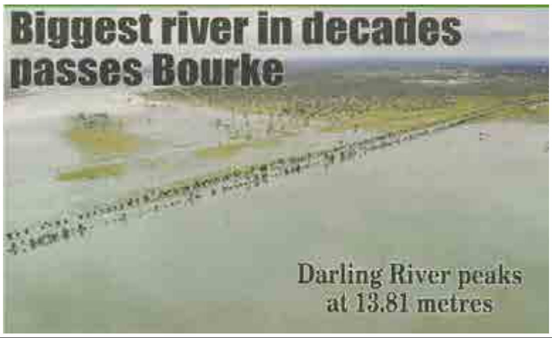



Plate 118 – Looking north-west across Mitchell Highway toward the town of Bourke (image captured 04/03/2012). (*Source: The Western Herald*)	**Plate 119** – Looking north-west along High Street from its intersection with Tancred Drive (image captured 04/03/2012). (*Source: The Western Herald*)
	
Plate 120 – Looking south over Jandra Station homestead (image captured 04/03/2012). (*Source: The Western Herald*)	**Plate 121** – Looking south-east along Mitchell Highway (image captured 04/03/2012). (*Source: The Western Herald*)
	
Plate 122 – Looking south over 141 Polygonum Swamp Road, North Bourke property (image captured 04/03/2012). (*Source: The Western Herald*)	**Plate 123** – Looking west over 13 and 49 Polygonum Swamp Road, North Bourke properties (image captured 04/03/2012). (*Source: The Western Herald*)

MARCH 2012 FLOOD EVENT

Plate 124 – Looking east from Kidman Way approximately 1 km south of the town of Bourke Levee (image captured 04/03/2012). (*Source: The Western Herald*)

Plate 125 – Looking north-west across 167 Tancred Drive property. The Swamp runs from right to left in the background of the photograph (image captured 04/03/2012). (*Source: The Western Herald*)

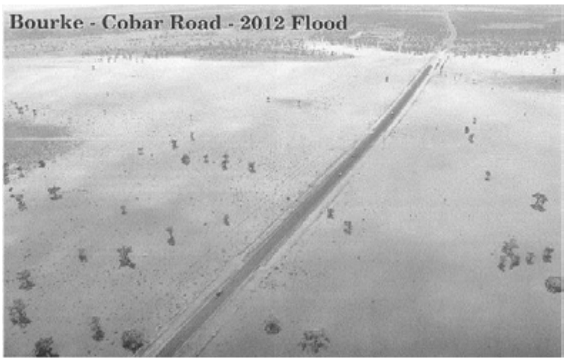


Plate 126 – Looking south along Kidman Way from above the town of Bourke (image captured 04/03/2012). (*Source: The Western Herald*)

Plate 127 – Owners of 109 Tancred Drive working on a levee to protect their property (image captured 04/03/2012). (*Source: The Western Herald*)

Plate 128 – Car driving through floodwaters on Mitchell Highway (image captured 04/03/2012). (*Source: The Western Herald*)

Plate 129 – Looking along Kamilaroi Highway (image captured 04/03/2012). (*Source: The Western Herald*)

MARCH 2012 FLOOD EVENT	

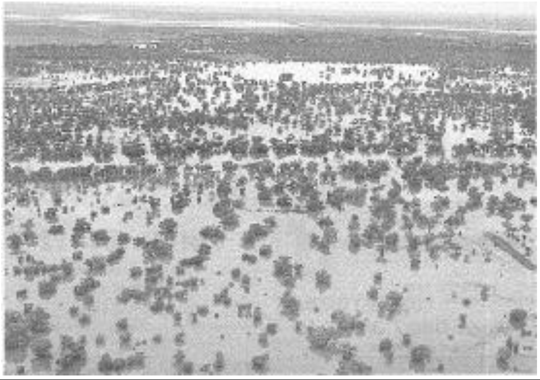



Plate 130 – Car driving through floodwaters on Mitchell Highway (image captured 04/03/2012). (*Source: The Western Herald*)	**Plate 131** – Looking south-west along Darling River from upstream of both bridges at North Bourke. (*Source: The Western Herald*)
	
Plate 132 – Looking across Kamilaroi Highway near Gordons (image captured 05/03/2012). (*Source: The Western Herald*)	**Plate 133** – Looking south-west over 49 Polygonum Swamp Road, North Bourke property (image captured 05/03/2012). (*Source: The Western Herald*)
	
Plate 134 – Looking north-east along Kamilaroi Highway with Beemery Bridge in foreground (image captured 05/03/2012). (*Source: The Western Herald*)	**Plate 135** – Looking north-east across Mitchell Highway approximately 1.5 km from the Bourke Town Levee (image captured 05/03/2012). (*Source: The Western Herald*)

ANNEXURE B2

DARLING RIVER AT BOURKE TOWN
STREAM GAUGE DATA (GS 425003)

TABLE B1
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN DATE ORDER
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Source of Gauge Height Data	Discharge (m^3/s)	Source of Discharge Data
1864	14.52	106.37	URS, 2009	-	
1885	3.94	95.79		86	URS, 2009
1886	13.06	104.91		1,804	
1887	12.52	104.37		1,194	
1888	9.27	101.12		341	
1889	10.41	102.26		504	
1890	14.39	106.24		6,629	
1891	12.42	104.27		1,122	
1892	11.20	103.05		642	
1893	13.68	105.53		3,220	
1894	11.86	103.71		835	
1895	9.02	100.87		323	
1896	8.00	99.85		283	
1897	9.19	101.04		330	
1898	9.21	101.06		330	
1899	6.60	98.45		228	
1900	8.33	100.18		296	
1901	7.19	99.04		251	
1902	1.75	93.60		9	
1903	10.83	102.68		574	
1904	6.99	98.84		243	
1905	7.11	98.96		248	
1906	7.75	99.60		273	
1907	7.42	99.27		260	
1908	10.59	102.44		534	
1909	6.60	98.45		228	
1910	11.94	103.79		860	
1911	11.79	103.64		809	
1912	7.98	99.83		282	

TABLE B1 (Cont'd)
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN DATE ORDER
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Source of Gauge Height Data	Discharge (m^3/s)	Source of Discharge Data
1913	9.25	101.10	URS, 2009	335	URS, 2009
1914	4.95	96.80		155	
1915	3.53	95.38		65	
1916	9.75	101.60		410	
1917	11.20	103.05		642	
1918	5.05	96.90		161	
1919	2.84	94.69		36	
1920	12.75	104.60		1,425	
1921	13.00	104.85		1,733	
1922	8.53	100.38		304	
1923	4.34	96.19		111	
1924	10.62	102.47		538	
1925	4.04	95.89		93	
1926	6.58	98.43		227	
1927	5.89	97.74		200	
1928	9.35	101.20		355	
1929	7.49	99.34		263	
1930	5.56	97.41		187	
1931	12.22	104.07		976	
1932	8.61	100.46		307	
1933	9.09	100.94		326	
1934	7.16	99.01		250	
1935	8.10	99.95		287	
1936	5.49	97.34		184	
1937	9.50	101.35		375	
1938	6.50	98.35		224	
1939	7.21	99.06		252	
1940	4.95	96.80		155	
1941	9.83	101.68		420	

TABLE B1 Cont'd)
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN DATE ORDER
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Source of Gauge Height Data	Discharge (m^3/s)	Source of Discharge Data
1942	9.14	100.99	URS, 2009	328	URS, 2009
1943	7.19	99.04		251	
1944	5.41	97.26		181	
1945	7.32	99.17		256	
1946	5.49	97.34		184	
1947	9.35	101.20		355	
1948	7.95	99.80		281	
1949	9.70	101.55		403	
1950	13.93	105.78		4,346	
1951	9.25	101.10		335	
1952	11.43	103.28		699	
1953	11.84	103.69		826	
1954	10.74	102.59		560	
1955	12.42	104.27		1,122	
1956	13.75	105.60		3,459	
1957				111	
1958				137	
1959				592	
1960				165	
1961				251	
1962				531	
1963				346	
1964				249	
1965				133	
1966				249	
1967				110	
1968				253	
1969				313	
1970				209	

TABLE B1 (Cont'd)
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN DATE ORDER
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Source of Gauge Height Data	Discharge (m^3/s)	Source of Discharge Data
1971	13.64	105.49	SKP, 1986	2,563	URS, 2009
1972	7.40	99.25	WaterNSW	246	WaterNSW
1973	8.33	100.18		310	
1974	14.10	105.95		5,198	
1975	8.14	99.99		294	
1976	14.18	106.03		5,841	
1977	11.71	103.56		755	
1978	10.88	102.73		533	
1979	4.74	96.59		64	
1980	4.44	96.29		31	
1981	5.95	97.80		162	
1982	9.31	101.16		370	
1983	13.27	105.12		1,862	
1984	12.56	104.41		1,175	
1985	4.80	96.65		67	
1986	5.34	97.19		122	
1987	4.63	96.48		49	
1988	12.57	104.42		1,208	
1989	10.49	102.34		508	
1990	12.99	104.84		1,591	
1991	6.05	97.90		171	
1992	6.80	98.65		210	
1993	4.80	96.65		71	
1994	4.78	96.63		69	
1995	9.43	101.28		346	
1996	12.40	104.25		934	
1997	9.80	101.65		389	
1998	13.78	105.63		2,701	
1999	7.72	99.57		252	

TABLE B1 (Cont'd)
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN DATE ORDER
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Source of Gauge Height Data	Discharge (m^3/s)	Source of Discharge Data
2000	12.29	104.14	WaterNSW	885	WaterNSW
2001	10.20	102.05		439	
2002	4.25	96.10		14	
2003	4.69	96.54		57	
2004	7.70	99.55		251	
2005	8.66	100.51		297	
2006	4.25	96.10		13	
2007	4.32	96.17		19	
2008	8.80	100.65		305	
2009	5.99	97.84		160	
2010	10.79	102.64		523	
2011	12.57	104.42		1,024	
2012	13.83	105.68		2,092	
2013	8.29	100.14		292	
2014	4.47	96.32		34	
2015	4.47	96.32		34	
2016	10.32	102.17		428	
2017	4.67	96.52		55	
2018	4.34	96.19		21	
2019	4.29	96.14		17	

TABLE B2
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN ORDER OF MAGNITUDE[1,2]
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Discharge[1] (m^3/s)
Extreme	15.96	107.81	19,500
0.2% AEP	14.7	106.55	10,700
1864	14.52	106.37	-
0.5% AEP	14.50	106.35	8,100
1890	14.39	106.24	6,629
1% AEP	14.38	106.23	6,500
2% AEP	14.26	106.11	5,000
1976	14.18	106.03	5,841
1974	14.10	105.95	5,198
5% AEP	14.04	105.89	3,050
1950	13.93	105.78	4,346
2012	13.83	105.68	2,092
1998	13.78	105.63	2,701
1956	13.75	105.60	3,459
1893	13.68	105.53	3,220
1971	13.64	105.49	2,563
10% AEP	13.51	105.36	1,700
1983	13.27	105.12	1,862
1886	13.06	104.91	1,804
1921	13.00	104.85	1,733
1990	12.99	104.84	1,591
1920	12.75	104.60	1,425
1988	12.57	104.42	1,208
2011	12.57	104.42	1,024
1984	12.56	104.41	1,175
1887	12.52	104.37	1,194
1891	12.42	104.27	1,122
1955	12.42	104.27	1,122
1996	12.40	104.25	934
2000	12.29	104.14	885

Refer over for footnotes to table.

TABLE B2 (Cont'd)
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN ORDER OF MAGNITUDE[1,2]
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Discharge[1] (m^3/s)
1931	12.22	104.07	976
MAJOR	12.2	104.05	825
1910	11.94	103.79	860
1894	11.86	103.71	835
1953	11.84	103.69	826
1911	11.79	103.64	809
1977	11.71	103.56	755
1952	11.43	103.28	699
1892	11.20	103.05	642
1917	11.20	103.05	642
1978	10.88	102.73	533
1903	10.83	102.68	574
2010	10.79	102.64	523
1954	10.74	102.59	560
MODERATE	10.7	102.55	466
1924	10.62	102.47	538
1908	10.59	102.44	534
1989	10.49	102.34	508
1889	10.41	102.26	504
2016	10.32	102.17	428
2001	10.20	102.05	439
1941	9.83	101.68	420
1997	9.80	101.65	389
1916	9.75	101.60	410
1949	9.70	101.55	403
1937	9.50	101.35	375
1995	9.43	101.28	346
1928	9.35	101.20	355
1947	9.35	101.20	355

Refer over for footnotes to table.

TABLE B2 (Cont'd)
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN ORDER OF MAGNITUDE[1,2]
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Discharge[1] (m^3/s)
1982	9.31	101.16	370
1888	9.27	101.12	341
1913	9.25	101.10	335
1951	9.25	101.10	335
1898	9.21	101.06	330
1897	9.19	101.04	330
1942	9.14	100.99	328
1933	9.09	100.94	326
1895	9.02	100.87	323
MINOR	9	100.85	323
2008	8.80	100.65	305
2005	8.66	100.51	297
1932	8.61	100.46	307
1922	8.53	100.38	304
1900	8.33	100.18	296
1973	8.33	100.18	310
2013	8.29	100.14	292
1975	8.14	99.99	294
1935	8.10	99.95	287
1896	8.00	99.85	283
1912	7.98	99.83	282
1948	7.95	99.80	281
1906	7.75	99.60	273
1999	7.72	99.57	252
2004	7.70	99.55	251
1929	7.49	99.34	263
1907	7.42	99.27	260
1972	7.40	99.25	246
1945	7.32	99.17	256

Refer over for footnotes to table.

TABLE B2 (Cont'd)
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN ORDER OF MAGNITUDE(1,2)
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Discharge(1) (m^3/s)
1939	7.21	99.06	252
1901	7.19	99.04	251
1943	7.19	99.04	251
1934	7.16	99.01	250
1905	7.11	98.96	248
1904	6.99	98.84	243
1992	6.80	98.65	210
1899	6.60	98.45	228
1909	6.60	98.45	228
1926	6.58	98.43	227
1938	6.50	98.35	224
1991	6.05	97.90	171
2009	5.99	97.84	160
1981	5.95	97.80	162
1927	5.89	97.74	200
1930	5.56	97.41	187
1936	5.49	97.34	184
1946	5.49	97.34	184
1944	5.41	97.26	181
1986	5.34	97.19	122
1918	5.05	96.90	161
1914	4.95	96.80	155
1940	4.95	96.80	155
1985	4.80	96.65	67
1993	4.80	96.65	71
1994	4.78	96.63	69
1979	4.74	96.59	64
2003	4.69	96.54	57
2017	4.67	96.52	55

Refer over for footnotes to table.

TABLE B2 (Cont'd)
RECORDED PEAK HEIGHT AND DISCHARGE DATA IN ORDER OF MAGNITUDE[1,2]
DARLING RIVER AT BOURKE TOWN STREAM GAUGE

Year	Gauge Height (m)	Elevation (m AHD)	Discharge[1] (m^3/s)
1987	4.63	96.48	49
2014	4.47	96.32	34
2015	4.47	96.32	34
1980	4.44	96.29	31
1923	4.34	96.19	111
2018	4.34	96.19	21
2007	4.32	96.17	19
2019	4.29	96.14	17
2002	4.25	96.10	14
2006	4.25	96.10	13
1925	4.04	95.89	93
1885	3.94	95.79	86
1915	3.53	95.38	65
1919	2.84	94.69	36
1902	1.75	93.60	9

1. Only years where gauge height was recorded are shown.
2. Refer **Table B1** of **Annexure B** for source of gauge height and discharge data.

ANNEXURE B3

COPY OF WATERNSW, 2020

425003 Darling River @ Bourke

The High Stage Rating post the 2012 Floods

Compiled and Modelled by Ted Cutler

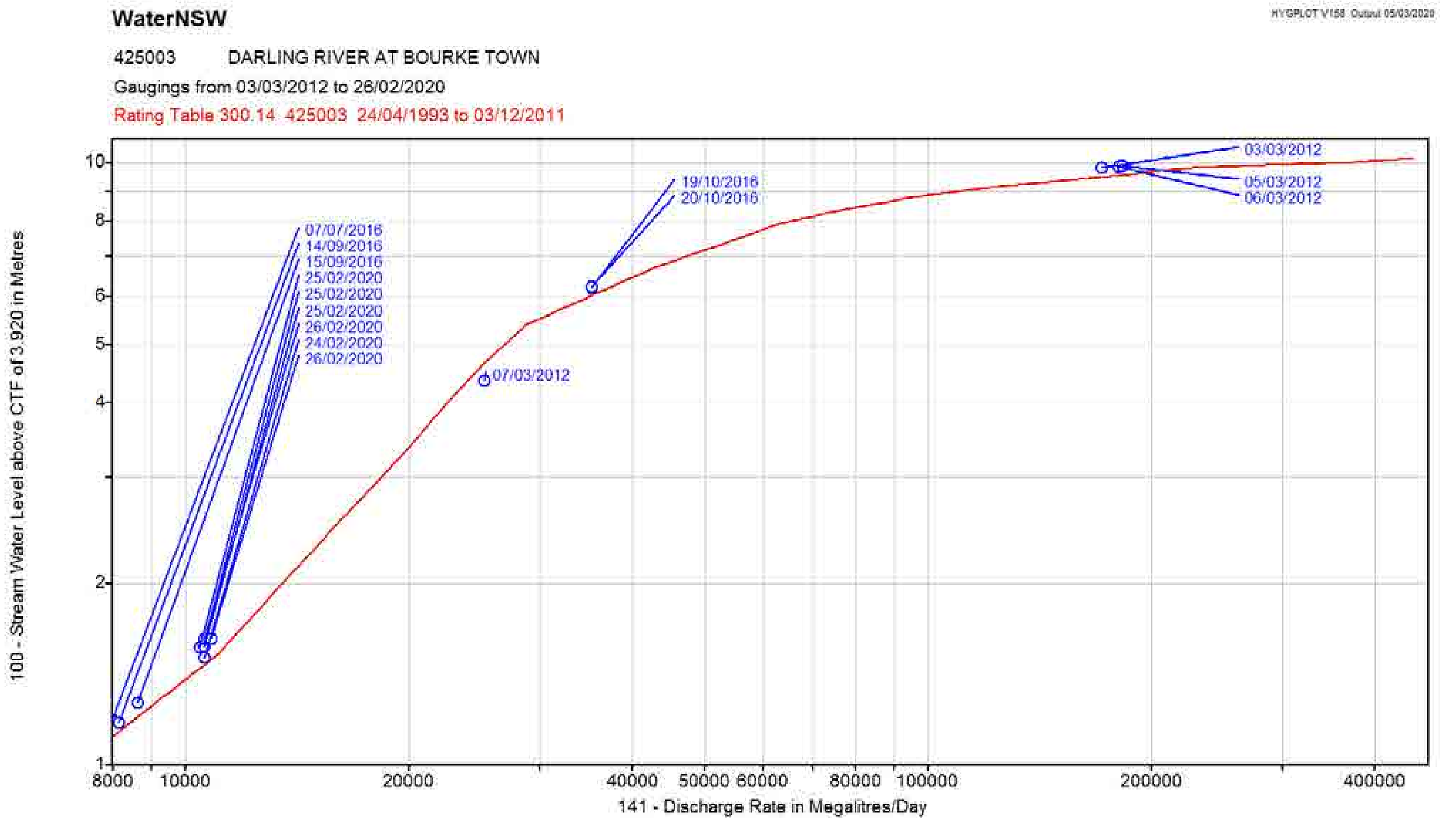
Data Assurance Manager Water Monitoring

06/03/2020

WaterNSW

425003 Darling River @ Bourke – Rating Change (as of 03/03/2020)

Gaugings analysed since the March 2012 floods have been assessed for their fit with long standing rating RT300.14. Below is immediate visual that a new rating is required as the gaugings are not portraying RT300.14 as a line of mean fit. Of particular note are the high stage gaugings collected 03-06 March 2012 which are plotting some -20%.



The following are summaries of the flood events since the 1970's which display that over time the Mean Velocity has decreased, further justifying the change to the high stage rating. It must also be noted that the Little Bogan may have had significant influence on the historic rating via the Southern floodplain which is now more consolidated with off stream storage infrastructure and a sealed highway.

Bourke peak gauging 29/01/1974			
GHT 14.091m		Q= 5065 cumecs	
A	B	C	D
Channel	Q cumecs	Area sq m	MV m/s
Main River	1746	1394	1.25
Billabong	259	177	1.46
Swamp	1506	1176	1.28
Railway	1554	1251	1.24

Bourke Gauging 4/2/1974			
GHT 13.83		Q= 3534	
A	B	C	D
Channel	Q cumecs	Area sq m	MV m/s
Main River	1401	1340	1.05
Billabong	226	188	1.20
Swamp	1242	1090	1.14
Railway	665	1253	0.53

Bourke peak gauging 19/03/1976			
GHT 13.74m		Q= 2894 cumecs	
A	B	C	D
Channel	Q cumecs	Area sq m	MV m/s
Main River	1362	1374	0.99
Billabong	206	217	0.95
Swamp	1069	1070	1.00
Railway	257	731.72	0.35

Bourke peak gauging 30/09/1998			
GHT 13.766		Q= 2538 cumecs	
A	B	C	D
Channel	Q cumecs	Area sq m	MV m/s
Main River	1161	1408	0.82
Billabong	217	204	1.06
Swamp	1113	1135	0.98
Railway	46	204	0.22

Bourke Peak Gauging 05/03/2012			
GHT 13.79m		Q= 2114 cumecs	
A	B	C	D
Channel	Q cumecs	Area sq m	MV m/s
Main River	934	1359	0.69
Billabong	173	186	0.93
Swamp	931	1100	0.847
Railway	75	141	0.53

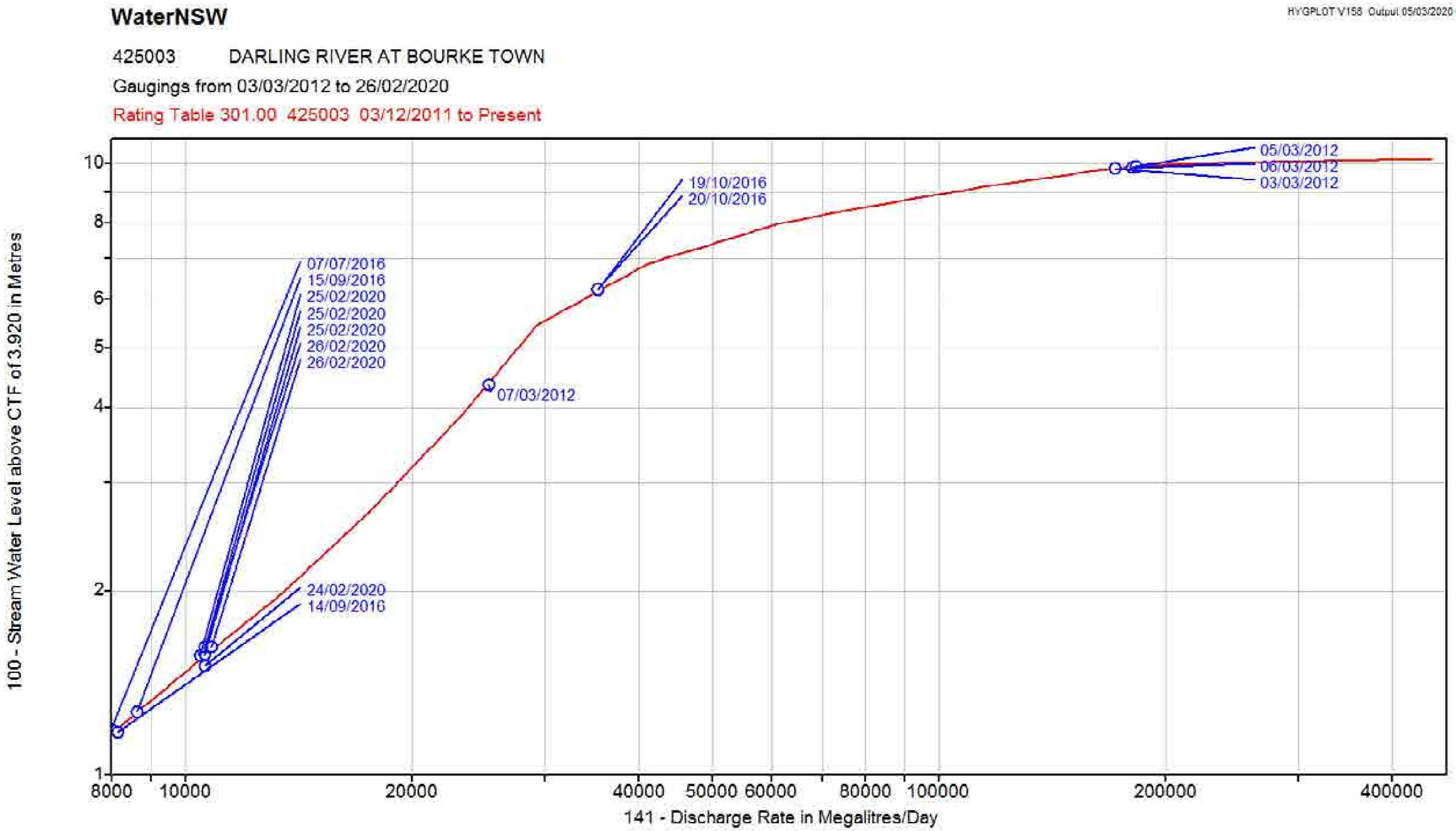
Notes

Recent gaugings are little different in area, width or depth and fit the pattern reasonably well in these areas,
with some inconsistencies
However velocities in 2012 are consistently lower at River, Billabong and Swamp, leading to less flow of 1970's.
due to vegetation? Or use of Doppler? It does not seem that the River has changed shape or vegetation much.

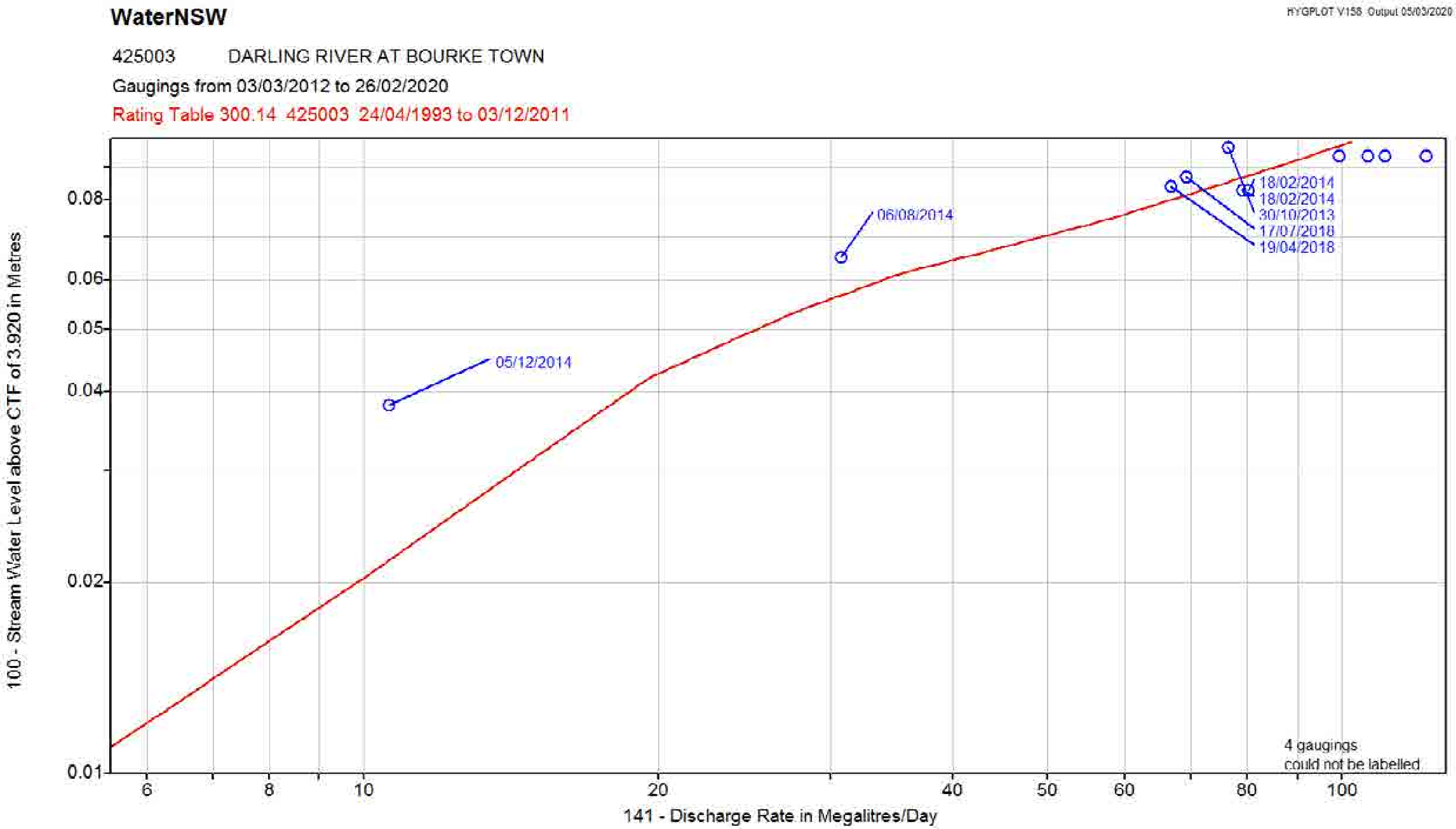
Railway - in recent floods there is just less water of 1970's floods, when the Little Bogan River contributed large flows to this area.

So could expect changes in flow (reduced flow) at River, Billabong and Swamp now of before
care with rating including the Railway flows as these are influenced by Little Bogan flows which may not relate to
the river height at the gauge.

RT 301 rel 00 has now been drawn (03/03/2020) to assist WaterNSW RiverOps with flow management around the 10000ML/D threshold and is seen as being a better line of mean fit up to the peak gaugings of March 2012. The high stage above the peak gaugings of March 2012 is blended higher to the same peak coding point of RT300.14 which is believed to cater for the 1971 & 1976 floods to a GHT of 14.10m.

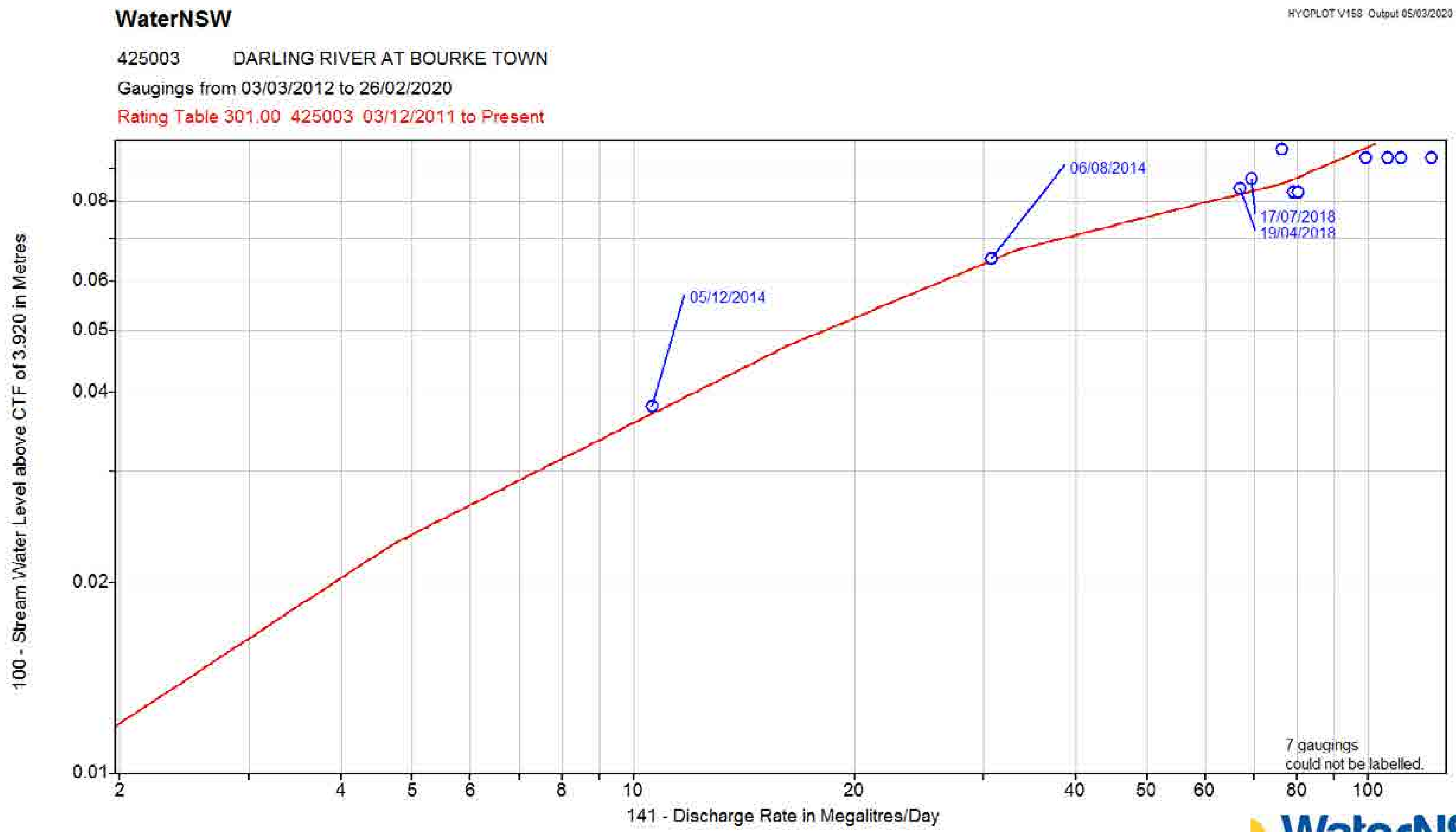


The low stage rating viewed via RT300.14 also appeared as not being a line of best fit for the stage vs height relationship since the March 2012 flood. The extreme low stage was therefore assessed for a more justifiable relationship bearing in mind the rating in the past at this level is quite insensitive and tricky due to such things as scum on the weir sill and wave action.



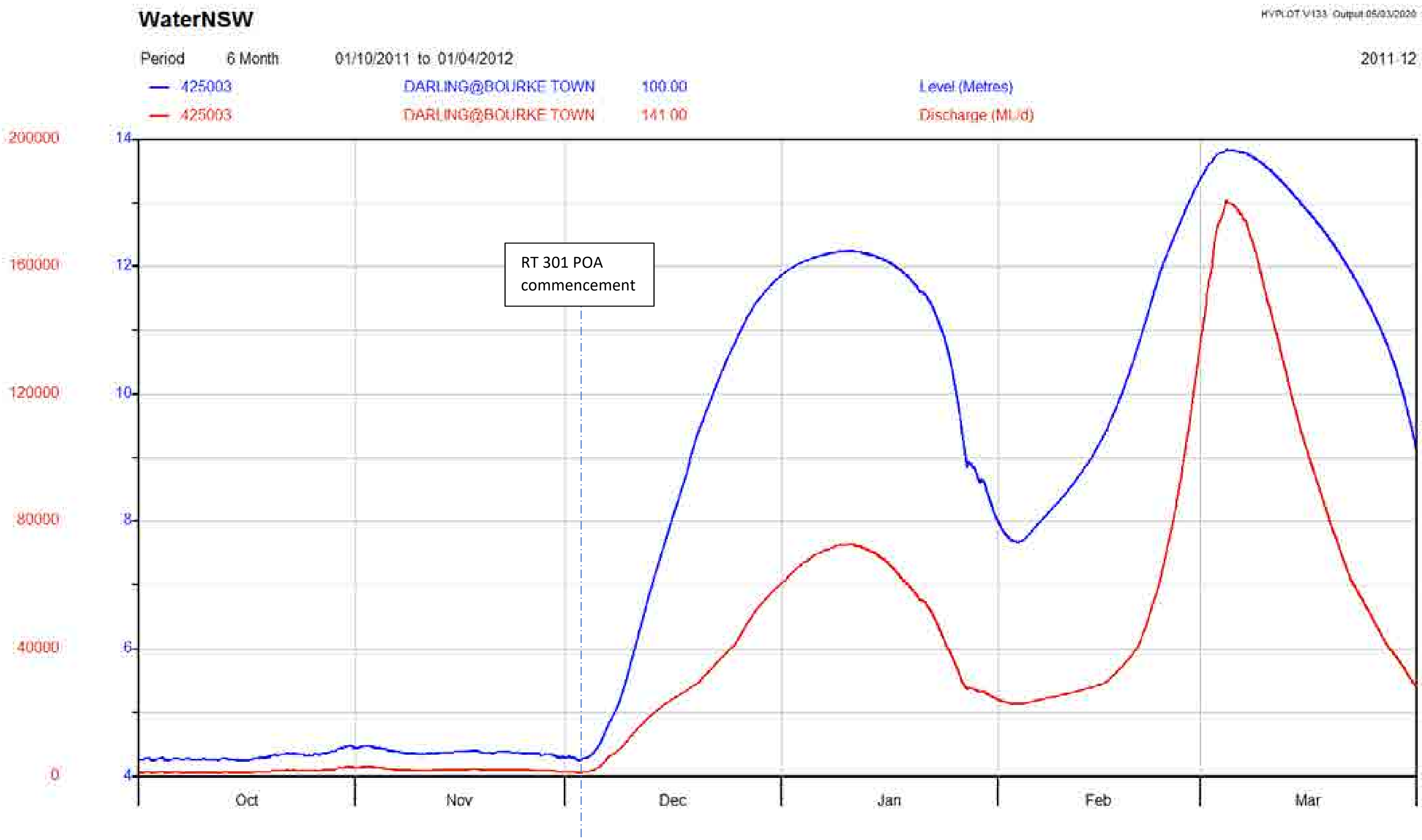
The low stage rating now appears as below in RT 301.00.

NB: It is well known by experienced hydrometric staff that the rating below 150 ML/D can deviate quite substantially due to factors like wind and wave action. Therefore (as previously indicated) there is potential the low stage rating of RT 301 may well be varied to a better line of mean fit to accommodate further gaugings.



RT 301 Period of Applicability (POA)

Choosing a commencement of POA for RT 301 is done by selecting a segment of rating 300.14 which remains unchanged for new RT301.00 and is prior to the peak of March 2012. Analysing the height and flow hydrographs of Bourke, it is seen the months prior to the March 2012 peak were active with flows above 20000ML/D which is now an altered flow rate from RT 300.14 to RT 301.00. Therefore to choose a commencement of the new POA, the low flow prior to the 2011/2012 summer events was identified as this segment of the rating remains unchanged.



POA RT 301 is deemed to have commenced at 01:00_03/12/2011 GHT 4.25m & 1146 ML/D. This GHT & Flow is common to both RT 300.14 & RT 301.00

RT 300.14 and RT 301.00 are identical for the rating segment GHT 4.006m & 77 ML/D to GHT 4.598m & 4064 ML/D

Modelling the new High Stage Rating for RT 301

The flow summaries of previous floods identify that the cross sectional areas of the three main channels being main river, swamp & billabong have hardly changed over time. Therefore, the maximum gaugings of 29/01/1974 and their respective area components will be utilised with a 'new aged' modelled mean velocity to determine a flow for a GHT of 14.09m. The gauging of 04/02/1974 is similar in GHT (13.83m) to that of March 2012 (13.79m)

Bourke peak gauging 29/01/1974			
GHT 14.091m		Q= 5065 cumecs	
A	B	C	D
Channel	Q cumecs	Area sq m	MV m/s
Main River	1746	1394	1.25
Billabong	259	177	1.46
Swamp	1506	1176	1.28
Railway	1554	1251	1.24

Bourke Gauging 4/2/1974			
GHT 13.83		Q= 3534	
A	B	C	D
Channel	Q cumecs	Area sq m	MV m/s
Main River	1401	1340	1.05
Billabong	226	188	1.20
Swamp	1242	1090	1.14
Railway	665	1253	0.53

Assessing Mean Vel increase with Peak GHTs			
	MV 4/2/1974 GHT 13.83m	MV 29/01/1974 GHT 14.091m	MV % increase from GHT 13.83 to 14.091m
Main	1.05m/s	1.25m/s	19%
Billabong	1.20m/s	1.46m/s	22%
Swamp	1.14m/s	1.28m/s	12%

Using Channel Areas of Peak Gauging 29/01/1974 GHT 14.091m multiplied with MV% applied to March 2012 Mean vels

A	B	C	D	E	F
Channel	Area sqm (1974)	MV m/s (2012)	MV % Increase	MV for GHT 14.09 (C*D)	Modelled flow column B*E
Main River	1394	0.69	19%	0.82	1143
Billabong	177	0.93	22%	1.13	200
Swamp	1176	0.847	12%	0.95	1117
					FLOW = 2460 cumecs

Resolve Railway overflow channels for GHT 14.09m post 2012 floods.

Modelling the Area

Bourke Peak Gauging 05/03/2012					
GHT 13.79m		Q= 2114 cumecs			
A	B	C	D	E	F
Channel	Q cumecs	Area sq m	MV m/s	Width m	Max Depth m
Main River	934	1359	0.69		
Billabong	173	186	0.93		
Swamp	931	1100	0.847		
Railway	75	141	0.53	1560	0.13

As per the peak gauging conducted 05/03/2012, the railway channel has an area of 141sqm and a width of 1560m. This equates to a mean depth of 0.09m and further equates to being 0.7 x Maximum depth 0.13m. For a GHT rise of 0.30m to 14.09m, it is assumed a rise of 0.30m applies to the maximum depth. Therefore the maximum depth of the Railway Channel for a GHT of 14.09m is 0.43m. Applying 0.7 x 0.43m to acquire a mean depth gives this as 0.30m. It is estimated that with a rise of 0.3m in GHT compared to the 2012 flood, the railway channel will spread another 500m making this channel width to be 2060m. Equating the width and mean depth 0.3m x 2060m gives an area of 618 sqm.

Modelling the Mean Velocity

Bourke peak gauging 29/01/1974					
GHT 14.091m		Q= 5065 cumecs			
A	B	C	D	E	F
Channel	Q cumecs	Area sq m	MV m/s	Width m	Max Depth m
Main River	1746	1394	1.25	213.4	14.8
Billabong	259	177	1.46	45.7	4.8
Swamp	1506	1176	1.28	201	8.2
Railway	1554	1251	1.24		

Bourke Gauging 4/2/1974					
GHT 13.83		Q= 3534			
A	B	C	D	E	F
Channel	Q cumecs	Area sq m	MV m/s	Width m	Max Depth m
Main River	1401	1340	1.05	208	15.2
Billabong	226	188	1.20	45	5.7
Swamp	1242	1090	1.14	201	8.16
Railway	665	1253	0.53		

When comparing the Mean Velocity of March 2012 with the Mean Velocity of gauging 04/02/1974 of similar GHT to 2012, it is seen they are the same at 0.53m/s. In 1974 the MV increased by a factor of 2.33 with no change in stream width. It is therefore concluded that the hydraulic nature of the southern floodplain has completely altered since 1974 due to civil infrastructure. It is also concluded that in 1974 the flow was able to spread further with ease hence the channel width of 1.25 klms. It is therefore envisaged the Mean Velocity does not increase by a factor of 2.33 in the modern era as it did in 1974 for a rise in GHT of 0.30m. Therefore an estimate of this mean velocity is put at 0.75m/s to equate to a Railway Channel flow for GHT 14.09m post 2012.

Modelled Flow Figure for Railway Overflow

Q= Area x MV = 618sqm x 0.75m/s

= 463.5 cumecs

Resolving Total Flow for a GHT of 14.09m

A	B	C	D	E	F
Channel	Area sqm (1974)	MV m/s (2012)	MV % Increase	MV for GHT 14.09 (C*D)	Modelled flow column B*E
Main River	1394	0.69	19%	0.82	1143
Billabong	177	0.93	22%	1.13	200
Swamp	1176	0.847	12%	0.95	1117
					FLOW = 2460 cumecs

+

Modelled Flow Figure for Railway Overflow

Q= Area x MV = 618sqm x 0.75m/s

= 463.5 cumecs

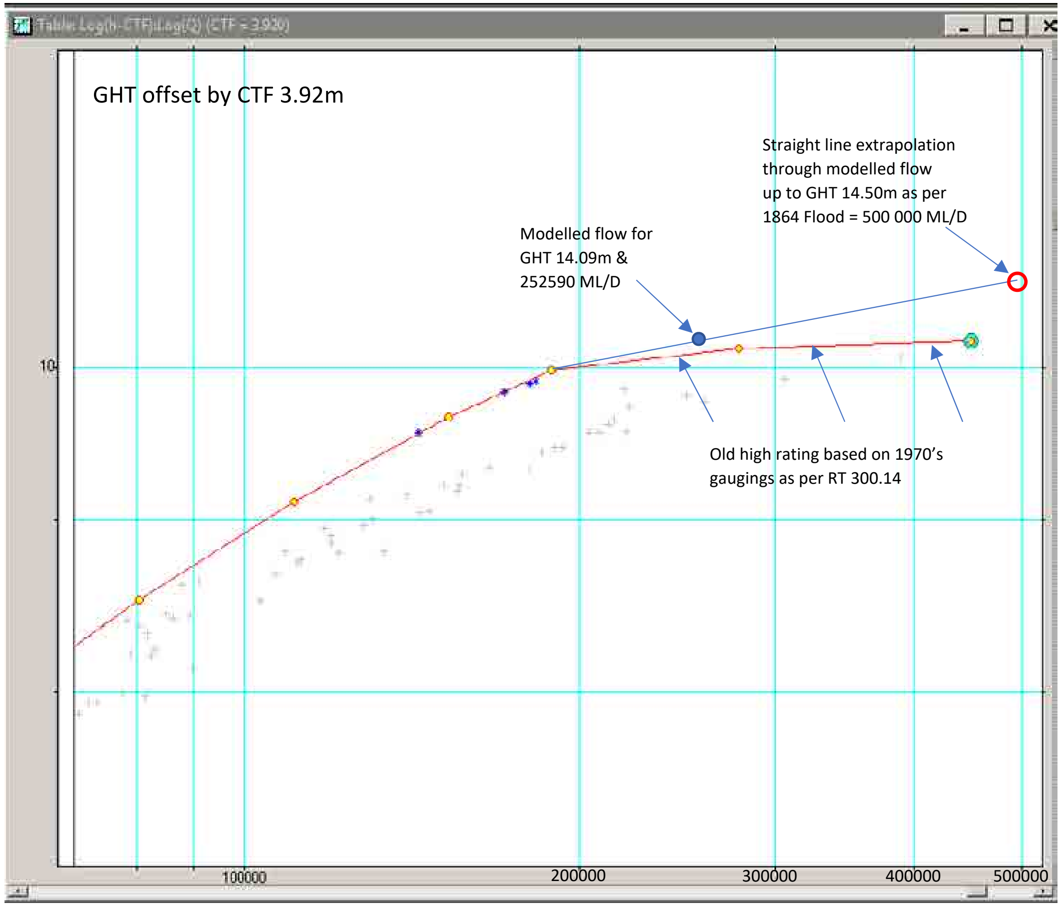
=

2923.5 cumecs

Or

252590 ML/D

Implementing the new era High Stage Rating – post 2012



With flow modelled for a GHT of 14.09m in the new era, inflection points can be assigned up to the 1864 peak GHT of 14.50m. This is simply achieved by a straight line extrapolation from RT301.00 coding point 13.90m & 188901 ML/D, through the modelled flow 14.09m & 252590 ML/D and onwards to GHT 14.50m & 500000 ML/D.

The implementation of this new era high stage rating above coding point 13.90m & 188901 ML/D, creates RT 301.01

ANNEXURE B4

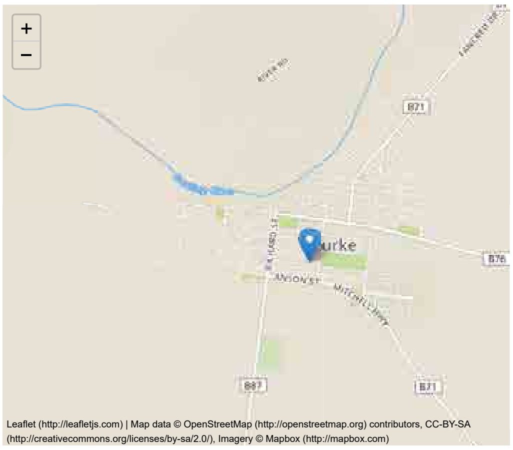
DESIGN INPUT DATA FROM ARR DATA HUB

ATTENTION: This site was updated recently, changing some of the functionality. Please see the changelog (./changelog) for further information

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	145.941
Latitude	-30.093
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show
Probability Neutral Burst Initial Loss (./nsw_specific)	show



Data

River Region

Division	Murray-Darling Basin
River Number	26
River Name	Darling River

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^b - c\log_{10}Duration\right)Duration^{-d} + eArea^f Duration^g\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i
Semi-arid Inland QLD	0.159	0.283	0.25	0.308	7.3e-07	1.0	0.039	0.0	0.0

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2016_v1

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26\text{ x }10^{-3}\text{ x }Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141\text{ x }Area^{0.213}\text{ x }10^{-0.021\frac{(Duration-180)^2}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Note: As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub (./nsw_specific) is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. The continuing storm loss information from the ARR Datahub provided below should only be used where relevant under the loss hierarchy (level 5) and where used is to be multiplied by the factor of 0.4.

ID	18388.0
Storm Initial Losses (mm)	-50.0
Storm Continuing Losses (mm/h)	-50.0

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/R.zip)

code	R
Label	Rangelands

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_R.zip)

code	R
arealabel	Rangelands

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-30.093&longitude=145.941&sdmin=true&sdh to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	10 September 2020 11:22AM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	1.4 (0.061)	2.0 (0.055)	2.3 (0.052)	2.7 (0.050)	4.5 (0.067)	5.9 (0.076)
90 (1.5)	1.0 (0.037)	1.5 (0.037)	1.8 (0.037)	2.2 (0.036)	2.3 (0.031)	2.3 (0.027)
120 (2.0)	1.2 (0.042)	1.7 (0.039)	2.0 (0.037)	2.3 (0.036)	2.1 (0.026)	1.9 (0.021)
180 (3.0)	0.3 (0.010)	1.6 (0.034)	2.4 (0.042)	3.3 (0.046)	2.6 (0.030)	2.1 (0.021)
360 (6.0)	0.4 (0.012)	1.1 (0.020)	1.5 (0.022)	1.9 (0.024)	2.9 (0.029)	3.7 (0.032)
720 (12.0)	0.0 (0.000)	0.3 (0.005)	0.5 (0.007)	0.7 (0.008)	0.9 (0.008)	1.0 (0.008)
1080 (18.0)	0.0 (0.000)	0.1 (0.001)	0.1 (0.001)	0.2 (0.002)	0.5 (0.004)	0.7 (0.005)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.6 (0.005)	1.1 (0.007)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.2 (0.004)	0.3 (0.006)	0.4 (0.007)	0.6 (0.010)	0.8 (0.011)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.001)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	13.9 (0.591)	14.4 (0.398)	14.7 (0.325)	15.0 (0.277)	19.2 (0.287)	22.3 (0.290)
90 (1.5)	14.7 (0.562)	15.0 (0.373)	15.3 (0.303)	15.5 (0.256)	14.4 (0.193)	13.5 (0.158)
120 (2.0)	10.2 (0.364)	13.7 (0.317)	16.0 (0.296)	18.2 (0.281)	14.2 (0.179)	11.3 (0.123)
180 (3.0)	8.7 (0.281)	13.8 (0.291)	17.2 (0.291)	20.4 (0.289)	23.8 (0.273)	26.2 (0.263)
360 (6.0)	9.1 (0.249)	13.0 (0.236)	15.6 (0.228)	18.1 (0.222)	19.7 (0.197)	20.9 (0.183)
720 (12.0)	3.1 (0.070)	7.8 (0.121)	10.9 (0.138)	13.9 (0.148)	15.4 (0.134)	16.5 (0.125)
1080 (18.0)	0.3 (0.006)	3.3 (0.047)	5.3 (0.061)	7.2 (0.070)	11.2 (0.089)	14.1 (0.098)
1440 (24.0)	0.1 (0.002)	1.4 (0.018)	2.2 (0.024)	3.0 (0.027)	9.0 (0.067)	13.6 (0.088)
2160 (36.0)	0.0 (0.000)	0.9 (0.012)	1.6 (0.016)	2.2 (0.018)	3.6 (0.025)	4.7 (0.028)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.000)	1.3 (0.008)	2.2 (0.012)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.000)

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	25.7 (1.095)	32.1 (0.887)	36.3 (0.803)	40.3 (0.742)	43.8 (0.655)	46.4 (0.604)
90 (1.5)	26.0 (0.996)	33.5 (0.832)	38.5 (0.764)	43.2 (0.715)	44.7 (0.601)	45.8 (0.535)
120 (2.0)	24.3 (0.869)	36.2 (0.838)	44.0 (0.817)	51.6 (0.796)	40.7 (0.511)	32.5 (0.355)
180 (3.0)	25.2 (0.815)	34.5 (0.728)	40.7 (0.689)	46.6 (0.659)	52.1 (0.599)	56.1 (0.563)
360 (6.0)	22.3 (0.610)	32.7 (0.592)	39.5 (0.580)	46.1 (0.566)	45.9 (0.461)	45.8 (0.401)
720 (12.0)	20.7 (0.476)	31.1 (0.483)	37.9 (0.479)	44.5 (0.471)	50.6 (0.439)	55.1 (0.419)
1080 (18.0)	16.7 (0.349)	21.9 (0.311)	25.3 (0.292)	28.5 (0.276)	33.5 (0.266)	37.3 (0.260)
1440 (24.0)	11.4 (0.222)	14.1 (0.188)	15.9 (0.172)	17.6 (0.159)	26.1 (0.193)	32.4 (0.211)
2160 (36.0)	5.8 (0.105)	15.3 (0.187)	21.6 (0.213)	27.6 (0.226)	29.9 (0.202)	31.7 (0.187)
2880 (48.0)	2.6 (0.044)	5.5 (0.063)	7.4 (0.068)	9.2 (0.071)	14.5 (0.091)	18.4 (0.102)
4320 (72.0)	0.0 (0.000)	2.9 (0.031)	4.8 (0.041)	6.6 (0.046)	7.3 (0.042)	7.9 (0.040)

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	**RCP 8.5**
2030	**1.010 (5.1%)**	0.854 (4.3%)	**1.022 (5.1%)**
2040	**1.262 (6.3%)**	1.185 (6.0%)	**1.524 (7.7%)**
2050	**1.519 (7.7%)**	1.490 (7.5%)	**2.009 (10.3%)**
2060	**1.755 (8.9%)**	1.787 (9.1%)	**2.504 (13.0%)**
2070	**1.943 (9.9%)**	2.094 (10.8%)	**3.036 (16.0%)**
2080	**2.056 (10.6%)**	2.428 (12.6%)	**3.632 (19.4%)**
2090	**2.067 (10.6%)**	2.808 (14.7%)	**4.318 (23.5%)**

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Probability Neutral Burst Initial Loss

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	24.2	36.8	31.7	31.5	29.6	26.8
90 (1.5)	26.9	38.0	33.4	33.2	31.6	29.9
120 (2.0)	28.9	38.6	34.3	33.8	31.7	30.7
180 (3.0)	32.0	40.4	36.7	35.8	31.8	30.3
360 (6.0)	38.2	43.6	40.1	39.9	36.2	33.9
720 (12.0)	46.0	46.6	43.9	43.6	39.2	38.5
1080 (18.0)	51.2	47.7	46.2	46.9	43.4	40.5
1440 (24.0)	55.0	51.1	50.4	52.6	48.9	47.1
2160 (36.0)	60.2	50.8	51.4	52.3	47.7	47.1
2880 (48.0)	63.7	56.5	57.6	60.5	55.4	54.2
4320 (72.0)	67.9	59.0	59.8	64.0	60.0	56.9

Layer Info

Time Accessed	10 September 2020 11:22AM
Version	2018_v1
Note	As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub (./nsw_specific) is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.

Download TXT (downloads/0e4c4f73-885e-432a-bac9-0f269eef31fa.txt)

Download JSON (downloads/8a7147ac-bbb0-48af-8e25-3d7f2418b6e8.json)

Generating PDF... (downloads/3917ce00-c6c9-4c43-9b67-553c77f271c5.pdf)

APPENDIX C

FLOOD DAMAGES

TABLE OF CONTENTS

Page No.

FIGURES
(BOUND IN VOLUME 2)

C1 INTRODUCTION AND SCOPE

C1.1 Introduction

Damages from flooding belong to two categories:

- **Tangible Damages**
- **Intangible Damages**

Tangible damages are defined as those to which monetary values may be assigned, and may be subdivided into direct and indirect damages. Direct damages are those caused by physical contact of floodwater with damageable property. They include damages to commercial/industrial and residential building structures and contents, as well as damages to infrastructure services such as electricity and water supply. Indirect damages result from the interruption of community activities, including traffic flows, trade, industrial production, costs to relief agencies, evacuation of people and contents and clean up after the flood.

Generally, tangible damages are estimated in dollar values using survey procedures, interpretation of data from actual floods and research of government files.

The various factors included in the **intangible damage** category may be significant. However, these effects are difficult to quantify due to lack of data and the absence of an accepted method. Such factors may include:

- inconvenience
- isolation
- disruption of family and social activities
- anxiety, pain and suffering, trauma
- physical ill-health
- psychological ill-health.

C1.2 Scope of Investigation

In the following sections, tangible damages to residential, commercial / industrial and public properties have been estimated resulting from flooding at Bourke. Intangible damages have not been quantified. The threshold floods at which damages may commence to infrastructure and community assets have also been estimated, mainly from site inspection and interpretation of flood level data. However, there is no data available to allow a quantitative assessment of damages to be made to this category.

C1.3 Terminology

Definitions of the terms used in this Appendix are presented in **Chapter C8** which also summarises the value of Tangible Flood Damages.

C2 DESCRIPTION OF APPROACH

The damage caused by a flood to a particular property is a function of the depth of inundation above floor level and the value of the property and its contents. The warning time available for residents to take action to lift property above floor level also influences damages actually experienced. A spreadsheet model which has been developed by DPIE for estimating residential damages and an in house spreadsheet model which has been developed for previous investigations of this nature for estimating commercial, industrial and public building damages were used to estimate damages on a property by property basis according to the type of development, the location of the property and the depth of inundation.

Using the results of the hydraulic model, a peak flood elevation for each event was interpolated at each property. The interpolated property flood levels were input to the spreadsheet models which also contained property characteristics and depth-damage relationships. The depth of above-floor inundation was computed as the difference between the interpolated flood level and the floor elevation at each property. The elevations of building floors were assessed by adding the height of floor above a representative natural surface within the allotment (as estimated by visual inspection) to the natural surface elevation determined from LiDAR survey data. The type of structure and potential for property damage were also assessed during the visual inspection.

The depth-damage curves for residential damages were determined using procedures described in *Guideline No. 4*. Damage curves for other categories of development (commercial and industrial, public buildings) were derived from previous floodplain management investigations.

Damages to the non-residential sector depend on the nature of the enterprise, the depth of inundation over the floor area and the time available for owners to take action to mitigate losses to contents. A spreadsheet model was used which was similar to the residential model in terms of estimated floor level and estimation of depths of inundation, but used typical unit damage data which had been adopted in similar studies in NSW in recent years.

It should be understood that this approach is not intended to identify individual properties liable to flood damages and the value of damages in individual properties, even though it appears to be capable of doing so. The reason for this caveat lies in the various assumptions used in the procedure, the main ones being:

- the assumption that computed water levels and topographic data used to define flood extents are exact and without any error;
- the assumption that the water levels as computed by the hydraulic model are not subject to localised influences;
- the estimation of property floor levels by visual inspection rather than by formal field survey;
- the use of "average" stage-damage relationships, rather than a unique relationship for each property;
- the uncertainties associated with assessing appropriate factors to convert *potential damages* to *actual flood damages* experienced for each property after residents have taken action to mitigate damages to contents.

The consequence of these assumptions is that some individual properties may be inappropriately classified as flood liable, while others may be excluded. Nevertheless, when applied over a broad area these effects would tend to cancel, and the resulting estimates of overall damages, would be expected to be reasonably accurate.

For the above reasons, the information contained in the spreadsheets used to prepare the estimates of flood damages for the catchments should not be used to provide information on the depths of above-floor inundation of individual properties.

C3 SOURCES OF DATA

C3.1 General

To estimate A*verage Annual Flood Damages* for a specific area it is necessary to estimate the damages for several floods of different magnitudes, i.e. of different frequencies, and then to integrate the area beneath the damage – frequency curve computed over the whole range of frequencies up to the Extreme Flood/PMF. To do this, it is necessary to have data on the damages sustained by all types of property over the likely range of inundation. There are several ways of doing this:

- The ideal way would be to conduct specific damage surveys in the aftermath of a range of floods, preferably immediately after each. An example approaching this ideal is the case of Nyngan where surveys were conducted in May 1990 following the disastrous flood of a month earlier (DWR, 1990). This approach is not possible at Bourke, as specific damage surveys were not conducted following the 1956, 1974, 1976 and 2012 floods.
- The second best way is for experienced loss adjusters to conduct a survey to estimate likely losses that would arise due to various depths of inundation. This approach is used from time to time, but it can add significantly to the cost of a floodplain management study (LMJ, 1985). It was not used for the present investigation.
- The third way is to use generalised data such as that published by CRES (Centre for Resource & Economic Studies, Canberra) and used in the Floodplain Management Study for Forbes (SKM, 1994). These kinds of data are considered to be suitable for generalised studies, such as broad regional studies. They are not considered to be suitable for use in specific areas, unless none of the other approaches can be satisfactorily applied.
- The fourth way is to adapt or transpose data from other flood liable areas. This was the approach used for the present study. As mentioned, the *Guideline No 4* procedure was adopted for the assessment of residential damages. The approach was based on data collected following major flooding in Katherine in 1998, with adjustments to account for changes in values due to inflation, and after taking into account the nature of development and flooding patterns in the study area. The data collected during site inspection in the flood liable areas assisted in providing the necessary adjustments. Commercial and industrial damages were assessed via reference to recent floodplain management investigations undertaken by Lyall & Associates of a similar nature to the present study.

C3.2 Property Data

The properties were divided into three categories: residential, commercial/industrial and public buildings.

For residential properties, the data used in the damages estimation included:

- the location/address of each property
- an assessment of the type of structure
- natural surface level
- floor level

For commercial/industrial and public properties, the required data included:

- the location of each property
- the nature of each enterprise
- an estimation of the floor area
- natural surface level
- floor level

The property information was used to classify the commercial and public developments into categories (i.e. high, medium or low value properties) which relate to the magnitude of likely flood damages.

The study area was split into the following three damages centres:

- **Bourke** - properties that are located internal to the Bourke Levee
- **Alice Edwards Village** - properties that are located internal to the Alice Edwards Village Levee
- **North Bourke** - properties that are located on the right (northern) bank of the Darling River upstream of the Bourke Bridge

The total number of residential, commercial, industrial and public properties are shown in **Table C3.1**.

TABLE C3.1
NUMBER OF PROPERTIES INCLUDED IN DAMAGES DATABASE

Development Type	Urban Centre		
	Bourke	Alice Edwards Village	North Bourke
Residential	853	18	50
Commercial / Industrial	94	0	13
Public	34	0	1
Total	**981**	**18**	**64**

Note: the number and location of the properties incorporated in the flood damages databases were based on aerial photography taken in June 2009.

C3.3 Flood Levels Used in the Analysis

Damages were computed for the design flood levels determined from the hydraulic model that was set up as part of the present study (refer **Appendix B** for details). Damages resulting from both local catchment and Darling River flooding were computed for Bourke.

For the purposes of assessing damages, the 50% AEP was adopted as the "threshold" flood at which damages commence in Bourke. The Bourke and Alice Edwards Village Levees will be overtopped by an Extreme Darling River Flood, but the IFF level has an AEP of about 5%. In the case of partial failure, damages were calculated assuming floodwater internal to the levee would pond to the elevation set out in **Table C3.2** over which was based on the flood level on the Darling River side of the levee in the vicinity of the levee failure.

TABLE C3.2
PONDING LEVELS INTERNAL TO LEVEES AS A RESULT OF PARTIAL FAILURE

AEP	Bourke	Alice Edwards Village
10%	-[(1)]	-[(2)]
5%	105.90[(3)]	105.79[(5)]
2%	106.13[(3)]	106.02[(5)]
1%	106.45[(5)]	106.13[(5)]
0.5%	106.60[(5)]	106.24[(5)]
0.2%	106.84[(5)]	106.44[(5)]

1. While the IFF of the Bourke Levee is exceeded in a 10% AEP Darling River flood in the vicinity of Old Bourke Wharf, the levee is not deemed to have failed in an event of this magnitude as the "top of levee" at this location is the top of the existing left bank of the Darling River (i.e. there is no earth embankment).
2. The 10% AEP Darling River flood does not exceed the IFF of the Alice Edwards Village Levee.
3. Based on partial failure in the vicinity of Rotary Park (refer levee chainage 8,750 m).
4. Based on partial failure in the vicinity of the Mitchell Highway (refer levee chainage 10,400 m).
5. Based on partial failure in the vicinity of the local access road in the vicinity of levee chainage 270 m.

In the case of the damages arising from Darling River flooding, the following scenarios were assessed:

- No coincident rainfall over Bourke during river flooding (**Darling River Flood Damage Scenario 1**).
- No coincident rainfall over Bourke during river flooding that causes a partial failure of the existing levee (**Darling River Flood Damage Scenario 2**). Note that partial failure has been assumed to occur at the low point that is located in private property adjacent to Rotary Park.

In the case of the damages arising from local stormwater runoff, the following three scenarios were assessed:

- No river flooding and gravity drainage of the protected area via the eleven (11) penstock gated stormwater drainage pipes that control ponding levels behind the Bourke Levee (**Local Catchment Damage Scenario 1**).
- Pumping of stormwater runoff to the river side of the Bourke Levee via the fourteen (14) pumps and assuming the eleven (11) penstock gates are in their closed position and the town levees are not overtopped (**Local Catchment Damage Scenario 2**).
- Failure of the fourteen (14) pumps to operate during a storm event and assuming the eleven (11) penstock gates are in their closed position and the town levees are not overtopped (**Local Catchment Damage Scenario 3**).

Table C3.3 over sets out which damage scenarios were assessed for the three damages centres at Bourke.

TABLE C3.3
SUMMARY OF DAMAGE SCENARIOS ASSESSED AS PART OF FLOOD DAMAGES ASSESSMENT

<table>
<tr><th rowspan="2">Damage Scenario</th><th colspan="3">Urban Centre</th></tr>
<tr><th>Bourke</th><th>North Bourke</th><th>Alice Edwards Village</th></tr>
<tr><td>Darling River Damage Scenario 1</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Darling River Damage Scenario 2</td><td>✓</td><td>Not Applicable</td><td>✓</td></tr>
<tr><td>Local Catchment Damage Scenario 1</td><td>✓</td><td colspan="2" rowspan="3">Not Assessed</td></tr>
<tr><td>Local Catchment Damage Scenario 2</td><td>✓</td></tr>
<tr><td>Local Catchment Damage Scenario 3</td><td>✓</td></tr>
</table>

C4 RESIDENTIAL DAMAGES

C4.1 Damage Functions

The procedures identified in *Guideline No 4* allow for the preparation of a depth versus damage relationship which incorporates structural damage to the building, damage to internals and contents, external damages and clean-up costs. In addition, there is the facility for including allowance for accommodation costs and loss of rent. Separate curves are computed for three residential categories:

- Single storey slab on ground construction
- Single storey elevated floor
- Two storey residence

The level of flood awareness and available warning time are taken into account by factors which are used to reduce "potential" damages to contents to "actual" damages. "Potential" damages represent losses likely to be experienced if no action were taken by residents to mitigate impacts. A reduction in the potential damages to "actual" damages is usually made to allow for property evacuation and raising valuables above floor level, which would reduce the damages actually experienced. The ability of residents to take action to reduce flood losses is mainly limited to reductions in damages to contents, as damages to the structure and clean-up costs are not usually capable of significant mitigation.

The reduction in damages to contents is site specific, being dependent on a number of factors related to the time of rise of floodwaters, the recent flood history and flood awareness of residents and emergency planning by the various Government Agencies (BoM and NSW SES).

While there is a well developed and tested flood warning system for the Darling River that is operated by BoM, as well as detailed response procedures incorporated in the *Bourke Local Flood Plan* which are implemented during flood alerts, actions taken by residents and business owners are unlikely to significantly reduce flood damages resulting from an overtopping event (i.e. because depths of inundation would be too great and they are unlikely to relocate contents to another town or remote evacuation centre during a flood event).

Local catchment flooding is "flash flooding" in nature with a time of rise generally limited to less than one hour. The duration of peak flooding is similarly quite short. There is no "flash flooding" flood warning system in operation at Bourke. Furthermore, no specific response procedures have been developed by NSW SES for flooding along the major overland flow paths. Consequently, there would be very limited time in advance of a flood event in which to warn residents and for them to take action to mitigate flood losses.

Table C4.1 over sets out the parameters and resulting factors that were adopted for converting potential to actual damages after taking into account the differences between the rate of rise and duration of inundation of Darling River and local catchment flooding.

Table C4.2 over shows total flood damages estimated for the three classes of residential property using the procedures identified in *Guideline No. 4*, for typical depths of above-floor inundation of 0.1 m and 0.3 m. A typical ground floor area of 160 m^2 was adopted for the assessment. The values in **Table C4.2** allow for damages to buildings and contents, as well as external damages and provision for alternative accommodation.

TABLE C4.1
DAMAGE ADJUSTMENT FACTORS/PARAMETERS FOR RESIDENTIAL DEVELOPMENT SUBJECT TO LOCAL CATCHMENT AND DARLING RIVER FLOODING

Property Damage	Parameter/Factor	Darling River Flooding	Local Catchment Flooding
Building	Typical Duration of Immersion (hours)	168	24
	Building Damage Repair Limitation Factor	1.0	1.0
	Total Building Adjustment Factor	2.38	2.38
Contents	Contents Damage Repair Limitation Factor	0.9	0.9
	Level of Flood Awareness	High	Low
	Effective Warning Time	24[(1)]	0
	Typical Table/Bench Height (TTBH) (m)	0.9	0.9
	Total Contents Adjustment Factor (Above-Floor Depth <= TTBH)	0.74	1.67
	Total Contents Adjustment Factor (Above-Floor Depth > TTBH)	1.67	1.67

1. Maximum value permitted in damages spreadsheet.

TABLE C4.2
DAMAGES TO RESIDENTIAL PROPERTIES

Type of Residential Construction	0.1 m Depth of Inundation Above Floor Level		0.3 m Depth of Inundation Above Floor Level	
	Darling River Flooding	Local Catchment Flooding	Darling River Flooding	Local Catchment Flooding
Single Storey Slab on Ground	$31,340	$78,405	$63,240	$87,420
Single Storey High Set	$82,044	$87,167	$97,412	$97,412
Double Storey	$21,938	$54,883	$44,268	$61,194

Note: These values allow for damages to buildings and contents, as well as external damages and provision for alternative accommodation.

C4.2 Total Residential Damages

Tables C4.3 and **C4.4** at the end of this chapter summarise residential damages resulting from Darling River and local catchment flooding, respectively.

The key findings as they related to residential flood damages are as follows:

- All dwellings internal to the Bourke and Alice Edwards Village Levees will remain flood free for flood events up to 0.2% AEP in magnitude (**Darling River Flood Damage Scenario 1**).
- **Figure C4.1** shows the plan location of the dwellings in North Bourke that would experience above-floor inundation during Darling River floods with AEPs of 5%, 2%, 1%, 0.5% and 0.2% AEP, as well as the Extreme Flood. **Figure C4.1** also shows that floodwater from the Darling River commences to inundate dwellings in North Bourke at the 5% AEP level when two dwellings would be inundated to depths of up to 0.6 m.

- Four dwellings in North Bourke would experience above-floor inundation in a 1% AEP Darling River flood, resulting in residential damages amounting to about $0.4 Million (**Darling River Flood Damage Scenario 1**).
- A partial failure of the existing levees may potentially occur in a 5% AEP flood event, which would result in total residential damages of $50.19 Million and $0.93 Million in Bourke and Alice Edwards Village, respectively (**Darling River Flood Damage Scenario 2**).
- The upper limit of residential flood damages in Bourke, Alice Edwards Village and North Bourke resulting from an Extreme Flood on the Darling River are about $151.8 Million, $3.16 Million and $4.9 Million, respectively (**Darling River Flood Damage Scenarios 1 and 2**).
- No dwellings internal to the Bourke Levee would experience above-floor inundation during local catchment storms up to 1% AEP in intensity for all three assessed damage scenarios (**Local Catchment Flood Damages Scenarios 1**, **2** and **3**).
- In the absence of riverine type flooding, two dwellings would experience above-floor inundation during a 0.2% AEP storm event (**Local Catchment Flood Damages Scenario 1**), which increases to three dwellings if the flood gates were in their closed position and the flood evacuation pumps were operational (**Local Catchment Flood Damages Scenario 2**). Failure or non-operation of the stormwater evacuation pumps would not increase the number of dwellings that would experience above-floor inundation (**Local Catchment Flood Damages Scenario 3**)
- A total of 625 dwellings would experience above-floor inundation in a PMF local catchment storm event, with the estimated flood damages amounting to around $60.5 Million.

TABLE C4.3
RESIDENTIAL FLOOD DAMAGES – DARLING RIVER FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Darling River Flood Damage Scenario 1			Darling River Flood Damage Scenario 2		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
Bourke	10	0	0	0	0	0	0
	5(1)	0	0	0	798	617	50.2
	2	0	0	0	848	813	68.6
	1	0	0	0	852	850	81.9
	0.5	0	0	0	853	852	91.8
	0.2	0	0	0	853	853	110.5
	Extreme	853	853	151.75	853	853	151.8
Alice Edwards Village	10	0	0	0	0	0	0
	5(1)	0	0	0	17	12	0.93
	2	0	0	0	18	17	1.36
	1	0	0	0	18	18	1.49
	0.5	0	0	0	18	18	1.58
	0.2	0	0	0	18	18	1.79
	Extreme	18	18	3.11	18	18	3.16

TABLE C4.3 (Cont'd)
RESIDENTIAL FLOOD DAMAGES – DARLING RIVER FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Darling River Flood Damage Scenario 1			Darling River Flood Damage Scenario 2		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
North Bourke	10	0	0	0	Not Applicable		
	5	2	2	0.17			
	2	3	3	0.26			
	1	6	4	0.40			
	0.5	9	5	0.56			
	0.2	19	9	1.04			
	Extreme	42	40	4.90			

1. Approximate AEP when partial levee failure first occurs.

TABLE C4.4
RESIDENTIAL FLOOD DAMAGES – LOCAL CATCHMENT FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Local Catchment Flood Damage Scenario 1			Local Catchment Flood Damage Scenario 2			Local Catchment Flood Damage Scenario 3		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
Bourke	10	5	0	0.08	9	0	0.15	12	0	0.19
	5	16	0	0.26	24	0	0.39	25	0	0.41
	2	32	0	0.52	42	0	0.68	44	0	0.71
	1	53	0	0.86	69	0	1.12	72	0	1.17
	0.5	75	2	1.28	98	2	1.65	104	2	1.75
	0.2	117	2	2.00	138	3	2.37	140	3	2.41
	PMF	803	625	60.5	805	630	61.1	805	630	61.1

C5 COMMERCIAL / INDUSTRIAL DAMAGES

C5.1 Direct Commercial / Industrial Damages

The method used to calculate damages requires each property to be categorised in terms of the following:

- damage category
- floor area
- floor elevation

The damage category assigned to each enterprise may vary between "low", "medium" or "high", depending on the nature of the enterprise and the likely effects of flooding. Damages also depend on the floor area.

It has recently been recognised following the 1998 flood in Katherine that previous investigations using stage-damage curves contained in proprietary software tends to seriously underestimate true damage costs. OEH are currently researching appropriate damage functions which could be adopted in the estimation of commercial and industrial categories as they have already done with residential damages. However, these data were not available for the present study.

On the basis of previous investigations, the following typical damage rates are considered appropriate for potential external and internal damages and clean-up costs for both commercial and industrial properties. They are indexed to a depth of inundation of 2 metres. At floor level and 1.2 m inundation, zero and 70% of these values respectively were assumed to occur:

Low value enterprise	$280/m^2	(e.g. Commercial: small shops, cafes, joinery, public halls. Industrial: auto workshop with concrete floor and minimal goods at floor level, Council or Government Depots, storage areas.)
Medium value enterprise	$420/m^2	(e.g. Commercial: food shops, hardware, banks, professional offices, retail enterprises, with furniture/fixtures at floor level which would suffer damage if inundated. Industrial: warehouses, equipment hire.)
High value enterprise	$650/m^2	(e.g. Commercial: electrical shops, clothing stores, bookshops, newsagents, restaurants, schools, showrooms and retailers with goods and furniture, or other high value items at ground or lower floor level. Industrial: service stations, vehicle showrooms, smash repairs.)

The factor for converting potential to actual damages depends on a range of variables such as the available warning time, flood awareness and the depth of inundation. Given sufficient warning time, a well prepared business will be able to temporarily lift property above floor level. However, unless property is actually moved to flood free areas, floods which result in a large depth of inundation, will cause considerable damage to stock and contents.

For the present study, the above-floor potential damages were converted to actual damages using a multiplier which ranged between 0.5 and 0.8 depending on the depth of inundation above the floor. The multiplier of 0.5 was adopted to convert potential to actual damages for depths of inundation up to 1.2 m, increasing to 0.8 for greater depths.

C5.2 Indirect Commercial and Industrial Damages

Indirect commercial and industrial damages comprise costs of removal of goods and storage, loss of trading profit and loss of business confidence.

Disruption to trade takes the following forms:

- The loss through isolation at the time of the flood when water is in the business premises or separating clients and customers. The total loss of trade is influenced by the opportunity for trade to divert to an alternative source. There may be significant local loss but due to the trade transfer this may be considerably reduced at the regional or state level.
- In the case of major flooding, a downturn in business can occur within the flood affected region due to the cancellation of contracts and loss of business confidence. This is in addition to the actual loss of trading caused by closure of the business by flooding.

Loss of trading profit is a difficult value to assess and the magnitude of damages can vary depending on whether the assessment is made at the local, regional or national level. Differences between regional and national economic effects arise because of transfers between the sectors, such as taxes, and subsidies such as flood relief returned to the region.

Some investigations have lumped this loss with indirect damages and have adopted total damage as a percentage of the direct damage. In other cases, loss of profit has been related to the gross margin of the business, i.e. turnover less average wages. The former approach has been adopted in this present study. Indirect damages have been taken as 50% of direct actual damages. A clean-up cost of \$15/metre^2 of floor area of each flooded property was also included.

C5.3 Total Commercial and Industrial Damages

Tables C5.1 and **C5.2** at the end of this chapter summarise commercial and industrial damages in Bourke resulting from Darling River and local catchment flooding, respectively.

The key findings as they related to commercial/industrial flood damages are as follows:

- All commercial/industrial buildings that are located internal to the Bourke Levee will remain flood free for Darling River floods up to 0.2% AEP in magnitude (**Darling River Flood Damage Scenario 1**).
- **Figure C4.1** shows that one commercial building in North Bourke would experience above-floor inundation in a 5% AEP Darling River flood (**Darling River Flood Damage Scenario 1**).
- A total damages of \$10.6 Million would be incurred in commercial/industrial buildings in Bourke if the existing Bourke Levee was to partially fail in a 1% AEP Darling River Flood (**Darling River Flood Damage Scenario 2**).
- The upper limit of residential flood damages in Bourke and North Bourke resulting from an Extreme Flood on the Darling River are about \$33.3 Million and \$1.44 Million, respectively

(**Darling River Flood Damage Scenarios 1 and 2**), noting that there are no commercial buildings located internal to the Alice Edwards Village Levee.

- No commercial/industrial buildings in Bourke would experience above-floor inundation during local catchment storms up to 0.2% AEP in intensity for all three assessed damage scenarios (**Local Catchment Flood Damages Scenarios 1**, **2** and **3**).
- A total of 63 commercial/industrial buildings in Bourke would experience above-floor inundation in a PMF local catchment storm event, with the estimated upper limit of flood damages amounting to around $3.65 Million.

TABLE C5.1
COMMERCIAL/INDUSTRIAL FLOOD DAMAGES – DARLING RIVER FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Darling River Flood Damage Scenario 1			Darling River Flood Damage Scenario 2		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
Bourke	10	0	0	0	0	0	0
	5(1)	0	0	0	60	29	3.82
	2	0	0	0	86	70	5.96
	1	0	0	0	94	90	10.6
	0.5	0	0	0	94	94	13.0
	0.2	0	0	0	94	94	16.3
	Extreme	94	94	33.3	94	94	33.3
Alice Edwards Village	10	0	0	0	0	0	0
	5(1)	0	0	0	0	0	0
	2	0	0	0	0	0	0
	1	0	0	0	0	0	0
	0.5	0	0	0	0	0	0
	0.2	0	0	0	0	0	0
	Extreme	0	0	0	0	0	0

TABLE C5.1 (Cont'd)
COMMERCIAL/INDUSTRIAL FLOOD DAMAGES – DARLING RIVER FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Darling River Flood Damage Scenario 1			Darling River Flood Damage Scenario 2		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
North Bourke	10	0	0	0	Not Applicable		
	5	1	1	0.04			
	2	1	1	0.06			
	1	1	1	0.07			
	0.5	1	1	0.08			
	0.2	1	1	0.09			
	Extreme	7	5	1.44			

1. Approximate AEP when partial levee failure first occurs.

TABLE C5.2
COMMERCIAL/INDUSTRIAL FLOOD DAMAGES – LOCAL CATCHMENT FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Local Catchment Flood Damage Scenario 1			Local Catchment Flood Damage Scenario 2			Local Catchment Flood Damage Scenario 3		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
Bourke	10	0	0	0	0	0	0	0	0	0
	5	2	0	0.03	1	0	0.02	1	0	0.02
	2	3	0	0.05	5	0	0.08	5	0	0.08
	1	5	0	0.08	5	0	0.08	5	0	0.08
	0.5	5	0	0.08	5	0	0.08	5	0	0.08
	0.2	6	0	0.10	7	0	0.11	7	0	0.11
	PMF	89	62	3.64	89	63	3.65	89	63	3.65

C6 DAMAGES TO PUBLIC BUILDINGS

C6.1 Direct Damages – Public Buildings

Included under this heading are government buildings, churches, swimming pools and parks. Damages were estimated individually on an area basis according to the perceived value of the property. Potential internal damages were indexed to a depth of above-floor inundation of 2 metres as shown below. At floor level and 1.2 metres depth of inundation, zero and 70% of these values respectively were assumed to occur.

Low value	$280/m^2	
Medium value	$420/m^2	(e.g. council buildings, NSW SES HQ, fire station)
High value	$650/m^2	(e.g. schools)

These values were obtained from the Nyngan Study (DWR, 1990), as well as commercial data presented in the Forbes Water Studies report (WS, 1992). External and structural damages were taken as 4 and 10% of internal damages respectively.

C6.2 Indirect Damages – Public Buildings

A value of $15/metre^2 was adopted for the clean-up of each property. This value is based on results presented in the Nyngan Study and adjusted for inflation. Total "welfare and disaster" relief costs were assessed as 50% of the actual direct costs.

C6.3 Total Damages – Public Buildings

Tables C6.1 and **C6.2** at the end of this chapter summarise public damages in Bourke resulting from Darling River and local catchment flooding, respectively.

The key findings as they related to commercial/industrial flood damages are as follows:

- All public buildings that are located internal to the Bourke Levee will remain flood free for Darling River floods up to 0.2% AEP in magnitude (**Darling River Flood Damage Scenario 1**).
- A total damages of $4.26 Million would be incurred in public buildings in Bourke if the existing Bourke Levee was to partially fail in a 1% AEP Darling River Flood (**Darling River Flood Damage Scenario 2**).
- The upper limit of public building flood damages in Bourke and North Bourke resulting from the Extreme Darling River Flood are $20.5 Million and $2.33 Million, respectively (**Darling River Flood Damage Scenarios 1 and 2**), noting that there are no public buildings located internal to the Alice Edwards Village Levee.
- No public buildings in Bourke would experience above-floor inundation during local catchment storms up to 0.2% AEP in intensity for all three assessed damages scenarios (**Local Catchment Flood Damages Scenarios 1**, **2** and **3**).
- A total of 21 commercial/industrial buildings in Bourke would experience above-floor inundation in a PMF local catchment storm event, with the estimated upper limit of flood damages amounting to around $0.99 Million.

TABLE C6.1
PUBLIC FLOOD DAMAGES – DARLING RIVER FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Darling River Flood Damage Scenario 1			Darling River Flood Damage Scenario 2		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
Bourke	10	0	0	0	0	0	0
	5(1)	0	0	0	20	8	0.98
	2	0	0	0	34	22	2.14
	1	0	0	0	34	31	4.26
	0.5	0	0	0	34	32	5.56
	0.2	0	0	0	34	32	7.36
	Extreme	34	34	20.5	34	34	20.5
Alice Edwards Village	10	0	0	0	0	0	0
	5(1)	0	0	0	0	0	0
	2	0	0	0	0	0	0
	1	0	0	0	0	0	0
	0.5	0	0	0	0	0	0
	0.2	0	0	0	0	0	0
	Extreme	0	0	0	0	0	0

TABLE C6.1 (Cont'd)
PUBLIC FLOOD DAMAGES – DARLING RIVER FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Darling River Flood Damage Scenario 1			Darling River Flood Damage Scenario 2		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
North Bourke	10	0	0	0	Not Applicable		
	5	0	0	0			
	2	0	0	0			
	1	0	0	0			
	0.5	0	0	0			
	0.2	1	0	0.02			
	Extreme	1	1	2.23			

1. Approximate AEP when partial levee failure first occurs.

TABLE C6.2
PUBLIC FLOOD DAMAGES – LOCAL CATCHMENT FLOODING ONLY

Urban Centre	Design Flood Event (% AEP)	Local Catchment Flood Damage Scenario 1			Local Catchment Flood Damage Scenario 2			Local Catchment Flood Damage Scenario 3		
		Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)	Number of Properties		Total Damages ($ Million)
		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged		Flood Affected	Flood Damaged	
Bourke	10	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	1	1	0	0	1	0	0	1	0	0
	0.5	2	0	0.02	2	0	0.02	3	0	0.02
	0.2	2	0	0.02	3	0	0.03	3	0	0.03
	PMF	30	21	0.99	30	21	0.99	30	21	0.99

C7 DAMAGES TO INFRASTUCTURE AND COMMUNITY ASSETS

No data were available regarding damage of community infrastructure during historic flood events. However, a qualitative matrix of the effects of flooding on important assets in Bourke is presented in **Table C7.1**.

TABLE C7.1
QUALITATIVE EFFECTS OF FLOODING ON INFRASTRUCTURE AND COMMUNITY ASSETS(1)

Damage Sector	Design Flood Event (% AEP)						
	10	**5**	**2**	**1**	**0.5**	**0.2**	**PMF**
Roads	X	X	X	X	X	X	X
Telephone Exchange	O	O	O	O	O	O	X
Sewerage	O	O	O	O	O	O	X
Water-Supply	O	O	O	X	X	X	X
Parks and Gardens	X	X	X	X	X	X	X

1. Darling River flooding only

Notes: O = No significant damages likely to be incurred.
X = Some damages likely to be incurred.

C8 SUMMARY OF TANGIBLE DAMAGES

C8.1 Tangible Damages

From **Tables C8.1** to **C8.2** at the end of this chapter, considerable flood damages would only be expected in Bourke as a result of a partial failure of the existing levees. The relatively large increase in flood damages is due to the rapid inundation during a partial failure event, whereby existing buildings would generally be inundated to depths ranging from a maximum of 1.8 m during a 1% AEP flood up to 3.0 m during an extreme event.

C8.2 Definition of Terms

Average Annual Damages (also termed "expected damages") are determined by integrating the area under the damage-frequency curve. They represent the time stream of annual damages, which would be expected to occur on a year by year basis over a long duration.

Using an appropriate discount rate, average annual damages may be expressed as an equivalent "*Present Worth Value"* of damages and used in the economic analysis of potential flood management measures.

A flood management scheme which has a design 1% AEP level of protection, by definition, will eliminate damages up to this level of flooding. If the scheme has no mitigating effect on larger floods, then these damages represent the benefits of the scheme expressed on an average annual basis and converted to the *Present Worth Value* via the discount rate.

Under current NSW Treasury guidelines, economic analyses are carried out assuming a 50 year economic life for projects and discount rates of 7% pa. (best estimate) and 11% and 4% pa. (sensitivity analyses).

C8.3 Average Annual Damages

The *Average Annual Damages* in Bourke for all flood events up to the PMF in the case of local catchment flooding and the Extreme Flood in the case of Darling River flooding are shown in **Tables C8.3** and **C8.4**, respectively. Note that values have been quoted to two decimal places to highlight the relatively small recurring damages in Bourke.

C8.4 Present Worth of Damages

The *Present Worth Value* of damages likely to be experienced in Bourke as a result of Darling River and local catchment flooding for events up to 1% AEP, as well as the PMF/Extreme Flood, a 50 year economic life and discount rates of 4, 7 and 11 per cent are shown in **Tables C8.5** and **C8.6**.

The *Present Worth Value* of damages for all Darling River floods between the IFF and the 1% AEP event assuming a partial failure of the existing town levees is about $58.1 Million and $1.0 Million in Bourke and Alice Edwards Village, respectively. These values are the maximum amount that could be spent upgrading the existing levees to ensure that they are geotechnically stable, free of defects and incorporates the required freeboard to the 1% AEP flood and still be justified on economic grounds.

For a discount rate of 7% pa and an economic life of 50 years, the *Present Worth Value* of damages is negligible, since no properties would experience above-floor inundation for all local catchment storm events up to 0.2% AEP in intensity. As a result, stormwater drainage upgrade schemes cannot be economically justified.

TABLE C8.1
TOTAL FLOOD DAMAGES - DARLING RIVER FLOODING ONLY
$ MILLION

Urban Centre	Design Flood Event (%AEP)	Darling River Flood Damage Scenario 1				Darling River Flood Damage Scenario 2			
		Residential	Commercial	Public	Total	Residential	Commercial	Public	Total
Bourke	10	0	0	0	0	0	0	0	0
	5(1)	0	0	0	0	50.2	3.82	0.98	55.0
	2	0	0	0	0	68.6	5.96	2.14	76.7
	1	0	0	0	0	81.9	10.6	4.26	96.7
	0.5	0	0	0	0	91.8	13.0	5.56	110.3
	0.2	0	0	0	0	110.5	16.3	7.36	134.2
	Extreme	151.8	33.3	20.5	205.6	151.8	33.1	20.5	205.4
Alice Edwards Village	10	0	0	0	0	0	0	0	0
	5(1)	0	0	0	0	0.93	0	0	0.93
	2	0	0	0	0	1.36	0	0	1.36
	1	0	0	0	0	1.49	0	0	1.49
	0.5	0	0	0	0	1.58	0	0	1.58
	0.2	0	0	0	0	1.79	0	0	1.79
	Extreme	3.11	0	0	3.11	3.16	0	0	3.16

Refer over for footnotes to table.

TABLE C8.1 (Cont'd)
TOTAL FLOOD DAMAGES - DARLING RIVER FLOODING ONLY
$ MILLION

Urban Centre	Design Flood Event (%AEP)	Darling River Flood Damage Scenario 1				Darling River Flood Damage Scenario 2			
		Residential	Commercial	Public	Total	Residential	Commercial	Public	Total
North Bourke	10	0	0	0	0	Not Applicable			
	5(1)	0.17	0.04	0	0.21				
	2	0.26	0.06	0	0.32				
	1	0.4	0.07	0	0.47				
	0.5	0.56	0.08	0	0.64				
	0.2	1.04	0.09	0.02	1.15				
	Extreme	4.90	1.44	2.23	8.57				

1. Approximate AEP when overtopping of the existing levee first occurs.

TABLE C8.2
TOTAL FLOOD DAMAGES – LOCAL CATCHMENT FLOODING ONLY
$ MILLION

Urban Centre	Design Flood Event (%AEP)	Local Catchment Flooding Damage Scenario 1				Local Catchment Flooding Damage Scenario 2				Local Catchment Flooding Damage Scenario 3			
		Residential	Commercial	Public	Total	Residential	Commercial	Public	Total	Residential	Commercial	Public	Total
Bourke	10	0.08	0	0	0.08	0.15	0	0	0.15	0.19	0	0	0.19
	5	0.26	0.03	0	0.29	0.39	0.02	0	0.41	0.41	0.02	0	0.43
	2	0.52	0.05	0	0.57	0.68	0.08	0	0.76	0.71	0.08	0	0.79
	1	0.86	0.08	0	0.94	1.12	0.08	0	1.2	1.17	0.08	0	1.25
	0.5	1.28	0.08	0.02	1.38	1.65	0.08	0.02	1.75	1.75	0.08	0.02	1.85
	0.2	2.00	0.10	0.02	2.12	2.37	0.11	0.03	2.51	2.41	0.11	0.03	2.55
	PMF	60.52	3.64	0.99	65.15	61.05	3.65	0.99	65.69	61.05	3.65	0.99	65.69

TABLE C8.3
AVERAGE ANNUAL DAMAGES - DARLING RIVER FLOODING ONLY
$ MILLION

Urban Centre	Design Flood Event (%AEP)	Darling River Flood Damage Scenario 1				Darling River Flood Damage Scenario 2			
		Residential	Commercial	Public	Total	Residential	Commercial	Public	Total
Bourke	10	0	0	0	0	0	0	0	0
	5(1)	0	0	0	0	1.25	0.10	0.02	1.37
	2	0	0	0	0	3.04	0.24	0.07	3.35
	1	0	0	0	0	3.79	0.32	0.10	4.21
	0.5	0	0	0	0	4.22	0.38	0.13	4.73
	0.2	0	0	0	0	4.53	0.43	0.15	5.11
	Extreme	0.15	0.03	0.02	0.2	4.79	0.48	0.18	5.45
Alice Edwards Village	10	0	0	0	0	0	0	0	0
	5(1)	0	0	0	0	0.02	0	0	0.02
	2	0	0	0	0	0.06	0	0	0.06
	1	0	0	0	0	0.07	0	0	0.07
	0.5	0	0	0	0	0.08	0	0	0.08
	0.2	0	0	0	0	0.08	0	0	0.08
	Extreme	0	0	0	0	0.09	0	0	0.09

Refer over or footnotes to table

TABLE C8.3 (Cont'd)
AVERAGE ANNUAL DAMAGES - DARLING RIVER FLOODING ONLY
$ MILLION

Urban Centre	Design Flood Event (%AEP)	Darling River Flood Damage Scenario 1				Darling River Flood Damage Scenario 2			
		Residential	Commercial	Public	Total	Residential	Commercial	Public	Total
North Bourke	10	0	0	0	0	Not Applicable			
	5(1)	0	0	0	0				
	2	0.01	0	0	0.01				
	1	0.01	0	0	0.01				
	0.5	0.02	0	0	0.02				
	0.2	0.02	0	0	0.02				
	Extreme	0.02	0.01	0	0.03				

1. Approximate AEP when overtopping of the existing levee first occurs.

TABLE C8.4
AVERAGE ANNUAL DAMAGES – LOCAL CATCHMENT FLOODING ONLY
$ MILLION

Urban Centre	Design Flood Event (%AEP)	Local Catchment Flooding Damage Scenario 1				Local Catchment Flooding Damage Scenario 2				Local Catchment Flooding Damage Scenario 3			
		Residential	Commercial	Public	Total	Residential	Commercial	Public	Total	Residential	Commercial	Public	Total
Bourke	10	0.01	0	0	0.01	0.01	0	0	0.01	0.01	0	0	0.01
	5	0.02	0	0	0.02	0.02	0	0	0.02	0.03	0	0	0.03
	2	0.03	0	0	0.03	0.04	0	0	0.04	0.04	0	0	0.04
	1	0.03	0	0	0.03	0.05	0	0	0.05	0.05	0	0	0.05
	0.5	0.04	0	0	0.04	0.06	0	0	0.06	0.06	0	0	0.06
	0.2	0.04	0	0	0.04	0.06	0	0	0.06	0.07	0	0	0.07
	PMF	0.11	0.01	0	0.12	0.13	0.01	0	0.14	0.13	0.01	0	0.14

TABLE C8.5
PRESENT WORTH VALUE OF DAMAGES - DARLING RIVER FLOODING ONLY
$ MILLION

Urban Centre	Discount Rate (%)	Darling River Flood Damage Scenario 1		Darling River Flood Damage Scenario 2	
		All Floods up to 0.2% AEP	All Floods up to Extreme Flood	All Floods up to 0.2% AEP	All Floods up to Extreme Flood
Bourke	4	0	4.3	90.5	117.2
	7	0	2.8	58.1	75.2
	11	0	1.8	37.9	49.1
Alice Edwards Village	4	0	0	1.5	1.9
	7	0	0	1.0	1.2
	11	0	0	0.6	0.8
North Bourke	4	0.2	0.6	Not Applicable	
	7	0.1	0.4		
	11	0.1	0.3		

TABLE C8.6
PRESENT WORTH VALUE OF DAMAGES – LOCAL CATCHMENT FLOODING ONLY
$ MILLION

Urban Centre	Discount Rate (%)	Local Catchment Flood Damage Scenario 1		Local Catchment Flood Damage Scenario 2		Local Catchment Flood Damage Scenario 3	
		All Floods up to 0.2% AEP	All Floods up to PMF	All Floods up to 0.2% AEP	All Floods up to PMF	All Floods up to 0.2% AEP	All Floods up to PMF
Bourke	4	0.6	2.6	1.1	3.0	1.1	3.0
	7	0.4	1.7	0.7	1.9	0.7	1.9
	11	0.3	1.1	0.5	1.3	0.5	1.3

C9 REFERENCES

DECC (Department of Environment and Climate Change, NSW), 2007c. ***"Floodplain Management Guideline No 4. Residential Flood Damages"***.

DWR (Department of Water Resources, NSW), 1990. ***"Nyngan April 1990 Flood Investigation"***.

LMJ (Lyall, Macoun and Joy, Willing and Partners Pty Ltd), 1985. ***"Camden Floodplain Management Study"***.

NSW SES (NSW State Emergency Service), 2000. ***"Bourke Local Flood Plan"***

SKM (Sinclair Knight Merz), 1994. ***"Forbes Floodplain Management Report and Draft Floodplain Management Plan, Volume 1"***.

WS (Water Studies), 1986. ***"The Sydney Floods of August 1986"***, Volume I Residential Flood Damage Survey, Report prepared for CRCE Water Studies Pty Ltd for the NSW PWD.

WS (Water Studies), 1992. ***"Forbes Flood Damage Survey, August 1990 Flood"***.

APPENDIX D

PRELIMINARY LEVEE FREEBOARD ANALYSIS

TABLE OF CONTENTS

Page No.

FIGURES
(BOUND IN VOLUME 2)

SYNOPSIS

This Appendix deals with the derivation of the freeboard allowance which has been incorporated into the strategic design of the upgraded levee at Bourke. As there are presently no formal freeboard standards in Australia, the freeboard requirements for the levee have been based on a joint probability analysis that consisted of an assessment of the possible increase in peak flood levels associated with a range of design variables and their associated probabilities of occurrence.

Design variables that have been incorporated in the derivation of the freeboard for the Bourke Levee comprised the following:

- increases in peak flood levels due to wind action;
- increases in peak flood levels due to wave action;
- increases in peak flood levels due to local water surge;
- uncertainties in the design flood level estimates due to inaccuracies in the LiDAR survey data and possible variations in key parameters such as hydraulic roughness;
- post-construction settlement of the levee;
- reduction in the crest level due to defects; and
- inaccuracies in peak flood levels as a result of future climate change.

The total freeboard allowance was assessed at four locations along the existing levee as shown on **Figure D1.1**. **Table DS1** over gives a breakdown of the freeboard allowance which has been derived for each of the design variables and their associated probabilities of occurrence. Based on the findings of the assessment, a freeboard allowance of 1 m has been adopted in the strategic design of the upgraded levee (refer **Section D2.1** of this Appendix for reasoning supporting the adoption of a reduced freeboard).

TABLE DS1
FREEBOARD ALLOWANCE AT BOURKE[1]

Design Variable	Probability of Occurrence (%)	Location A		Location B		Location C		Location D	
		Maximum Allowance (m)	Joint Probability Allowance (m)	Maximum Allowance (m)	Joint Probability Allowance (m)	Maximum Allowance (m)	Joint Probability Allowance (m)	Maximum Allowance (m)	Joint Probability Allowance (m)
Wave Action (Run-up)	50	0.43	0.21	0.51	0.26	0.66	0.33	0.50	0.25
Wave Action (Set-up)	50	0.30	0.15	0.34	0.17	0.43	0.22	0.03	0.02
Local Water Surge	50	0.00	0.00	0.01	0.01	0.01	0.01	0.05	0.03
Uncertainties in Peak Flood Level Estimates	50	0.53	0.27	0.52	0.26	0.48	0.24	0.44	0.22
Levee Settlement	100	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Levee Defects	50	0.10	0.05	0.10	0.05	0.10	0.05	0.10	0.05
Future Climate Change	50	0.19	0.10	0.18	0.09	0.15	0.08	0.12	0.06
Total			**0.80**		**0.86**		**0.95**		**0.65**

1. Refer **Figure D1.1** for location where assessment relates.

D1. FREEBOARD COMPONENTS

D1.1 Wave Action

Where the levee face is exposed to a large expanse of flood water, windy conditions can generate significant waves. When superimposed on the design flood level, these waves may cause the levee to be overtopped.

There are two types of wave action to be considered when assessing this component of the freeboard allowance;

- *Wave Run-up* - When a wave generated over a certain fetch reaches an earth levee, it will run up the embankment based on its slope and surface roughness.
- *Wind Setup* – Wind blowing over a water surface exerts a horizontal shear force driving it in the direction of the wind, which results in a higher water level at the downwind end of the fetch.

The freeboard allowance for wave action is based on the Australian Wind Loading Standard – *AS/NSZ1170.2 (2002)* and guidelines for the estimation of wave run-up in *NSWPW (2010)* and *USDIBR (2012)*. The freeboard allowance for four locations with different approach winds and fetch length are shown below in **Table D1.1**.

TABLE D1.1
WAVE ACTION FREEBOARD ALLOWANCE

Location(1)	Effective Fetch Length (km)	Wind Direction	Design Wind Speed(2) (m/s)	Significant Wave Height (m)	Wave Run-up(3) (m)	Wind Setup (m)
A	3.9	North-East	22	0.78	0.43	0.98
B	5.2	South-East	22	0.9	0.51	1.13
C	5.7	West	27	1.22	0.66	1.42
D	4	North	25	0.93	0.5	0.11

1. Refer **Figure D1.1** for location where assessment relates.
2. Design wind speed taken from *AS/NZS1170.2, 2002*
3. Embankment slope ranged from 1V:3H to 1V:4H assuming “rubble-mound slopes” (NSWPW, 2010)

D1.2 Local Water Surge

When the velocity and direction of flow changes abruptly, such as alongside a levee bank, local water levels can become elevated when compared to the broader water surface (commonly referred to as “water surge”). Flow velocities of between 0.2-1.0 m/s adjacent to the existing levee were extracted from the TUFLOW model results and used to estimate local water surge. The local water surge at each location can be seen in **Table DS1**.

D1.3 Inaccuracies in Design Flood Level Estimates

Uncertainties in the determination of peak flood levels occur if there is doubt about any of the parameters used in the computation process. Confidence in the computed flood levels may be compromised by the following:

- *Model calibration* – The Darling River TUFLOW Model was calibrated to the 1974, 1976, 1998 and 2012 flood events which had equivalent AEP's of between about 1.3 and 7.9 per cent so estimates of peak flood levels reached by rarer events could be considered to have a greater error band.
- *Availability of detailed survey data* – LiDAR survey data was captured to a vertical accuracy of ±0.3 m and horizontal accuracy of ±0.8 m.
- *How accurately flood slope can be calculated given the available data* - The design flood levels were modelled in TUFLOW using LiDAR based elevations sampled on a 5 m grid spacing along the alignment of the Bourke Levee. The two-dimensional nature of the modelling coupled with the high level of detail used for the underlying topography means that the flood slope can be assessed with a high degree of certainty.
- *Degree of uncertainty in model parameters* – The model parameters adopted for design flood estimation may not reflect contemporaneous conditions at the time of an actual flood (e.g. rainfall losses and hydraulic roughness).

The above factors may result in the underestimation of either design flows or levels. Sensitivity analyses were undertaken to determine the increase in peak flood levels associated with a 20% increase in the 'best estimate' hydraulic roughness and a 10% increase in the peak 1% AEP flow. The computed vertical inaccuracies in the design flood level estimates based on the findings of the sensitivity analyses are given in **Table D1.2**, along with the stated vertical accuracy of the LiDAR survey data.

TABLE D1.2
INACCURACIES IN DESIGN FLOOD LEVEL ESTIMATES
1% AEP

Location(1)	Vertical Error in LiDAR (m)	Impact of 20% Increase in Hydraulic Roughness (m)	Impact of 10% Increase in Peak Flow Estimates (m)	Total (m)
A	0.30	0.15	0.08	0.53
B	0.30	0.14	0.08	0.52
C	0.30	0.12	0.06	0.48
D	0.30	0.09	0.05	0.44

1. Refer **Figure D1.1** for location where assessment relates.

D1.4 Levee Settlement

The existing earthen levee will be raised using material sourced from a local borrow pit, the location of which has yet to be determined. In most cases settlement of an earth embankment occurs post construction as a result of drying, shrinkage and cracking. In previous studies undertaken by Lyall & Associates it has been found that a levee of up to 2.5 m height which is constructed of the clayey material sourced from a local borrow pit can be expected to have a maximum settlement of about 0.02 m.

D1.5 Defects in Levee

The structural integrity of a levee depends on its age, design, construction methodology, fill material and maintenance history. If any of these components are compromised then defects in the levee may cause it to fail. The following will mitigate the likelihood of defects occurring.

- *Design and Construction* – It is envisaged that the raised sections of levee will be designed with a 150 mm thick topsoil layer to allow vegetation to establish which reduces the risk of erosion by direct rainfall.
- *Maintenance* - A levee maintenance program will need to be developed and implemented by Council in order to identify and repair any defects that may cause a progressive failure of the levee.

The risk of defects occurring in an earthen levee is reduced through the design and construction of a vegetated layer of topsoil and regular inspection and maintenance. Levees that are neglected should allow for an additional 0.5 m freeboard to cater for defects. For the purpose of the freeboard assessment, it has been assumed that the Bourke Levee will be well maintained. Based on this assumption, a freeboard allowance for possible defects in the levee of only 0.1 m has been adopted.

D1.6 Climate Change

DPIE recommends that its guideline *Practical Considerations of Climate Change, 2007* be used as the basis for examining climate change induced increases in rainfall intensities in projects undertaken under the State Floodplain Management Program and the Floodplain Development Manual (NSWG, 2005). The guideline recommends that until more work is completed in relation to the climate change impacts on rainfall intensities, sensitivity analyses should be undertaken based on increases in rainfall intensities ranging between 10 and 30 per cent. On current projections the increase in rainfalls within the service life of developments or flood management measures is likely to be around 10 per cent, with the higher value of 30 per cent representing an upper limit. Under present day climatic conditions, increasing the 1% AEP design rainfall intensities by 10 per cent would produce a 0.5% AEP flood; and increasing those rainfalls by 30 per cent would produce a 0.2% AEP event.

Along the alignment of the Bourke Levee, 1% AEP flood levels would be increased by a maximum of 0.20 m and 0.46 m as a result of a 10% and 30% increase in rainfall intensity, respectively. **Table DS1** shows the freeboard allowance which has been adopted for uncertainties in the peak flood level estimates due to potential increases in rainfall intensities linked to future climate change, noting that it is based on the lower bound estimate of climate change related impacts.

D2. FREEBOARD ALLOWANCE

D2.1 Joint Probability Analysis

The freeboard allowances set out in **Chapter D1** represent the maximum increases possible for each design variable. It is highly unlikely that these will compound along the existing levee during a flood event, therefore each design variable is assigned a probability of occurrence in order to determine a factored freeboard allowance. As shown in **Table DS1**, the factored values are added together at each location to determine the total freeboard allowance along the existing levee. The total freeboard allowance along the route of the Bourke Levee which accounts for all of the design variables is between 0.65 m to 0.95 m.

Based on the above finding, a freeboard of 1 m has been adopted for assessing the upgrade requirements for the Bourke Levee.

D3. REFERENCES

NSWG (New South Wales Government), 2005. ***"Floodplain Development Manual"***

USDIBR (U.S. Department of the Interior Bureau of Reclamation), 2012. ***"Design Standard No. 13 – Embankment Dams, Chapter 6: Freeboard"***

Standards Australia,2002. ***"Australia/New Zealand standard 1170.2:2002, Structural design action, Part 2 Wind Actions"***

NSW Public Works (NSWPW), 2010. ***"Wagga Wagga Levee Upgrade – Flood Freeboard"***

PJ Hawkes, Department of Environment, Food and Rural Affairs (UK), 2005. ***"Use of Joint Probability Methods in Flood Management – A Guide to Best Practice"***

Chris Stanton, Stanton Associates, date unknown. ***"Flood Levee Design based on Progressive Failure Probability"***

APPENDIX E

SUGGESTED WORDING FOR INCLUSION IN BOURKE SHIRE DEVELOPMENT CONTROL PLAN

TABLE OF CONTENTS

Page No.

FIGURES
(BOUND IN VOLUME 2)

E1.1 Introduction

This section of the DCP sets out specific controls to guide development of flood liable land. The approach to managing future development that is subject to flooding supports the findings of a series of location specific floodplain risk management studies and plans that have been prepared as part of the NSW Government's program to mitigate the impact of major floods and reduce the associated hazards in the floodplain.

E1.2 Objectives in Relation to Flood Risk Management

a) To minimise the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors.

b) To increase public awareness of the hazard and extent of land affected by all potential floods, including floods greater than the 1% Annual Exceedance Probability (AEP) flood and to ensure essential services and land uses are planned in recognition of all potential floods.

c) To inform the community of Council's controls and policy for the use and development of flood prone land.

d) To reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods.

e) To provide detailed controls for the assessment of applications lodged in accordance with the *Environmental Planning and Assessment Act 1979* on land affected by potential floods.

f) To provide different guidelines, for the use and development of land subject to all potential floods in the floodplain, which reflect the probability of the flood occurring and the potential hazard within different areas.

g) To apply a "merit-based approach" to all development decisions which takes account of social, economic and ecological considerations.

h) To control development and other activity within each of the individual floodplains within the LGA having regard to the characteristics and level of information available for each of the floodplains, in particular the availability of floodplain risk management studies and plans prepared in accordance with the *Floodplain Development Manual*, issued by the NSW Government.

i) To deal equitably and consistently with applications for development on land affected by potential floods, in accordance with the principles contained in the *Floodplain Development Manual*.

E1.3 Procedure for Determining What Controls Apply to Proposed Development

The procedure Council will apply for determining the specific controls applying to proposed development in flood liable areas is set out below. Upon enquiry by a prospective applicant, Council will make an initial assessment of the flood affectation and flood levels at the site using the following procedure:

- Assess whether the development is located on flood liable land from the **Flood Planning Map**.

- Determine which set of prescriptive flood related planning controls apply to the development from the **Flood Planning Map**.
- Identify the category of the development from **Schedule1: Land Use Categories.**
- Determine the appropriate flood level at the site from the results of the location specific flood or floodplain risk management study.
- Determine which part of the floodplain the development is located in from the **Flood Planning Constraint Category Map**.
- Confirm that the development conforms with the relevant performance criteria, as well as the prescriptive controls set out in **Schedule 2**.

With the benefit of this initial information from Council, the applicant will:

- Prepare the documentation to support the Development Application according to the requirements of **Section E1.11**.

A survey plan showing natural surface levels over the site will be required as part of the Development Application documentation. Provision of this plan by the applicant at the initial enquiry stage will assist Council in providing flood related information.

E1.4 Land Use Categories

The policy recognises seven different types of land use for which a graded set of flood related controls apply. They are included in **Schedule 1: Land Use Categories**.

E1.5 Flood Planning Constraint Categories

For those floodplains where Council has adopted a flood or floodplain risk management study, the identified flood liable land has been divided into the following four *Flood Planning Constraint Categories* (**FPCCs**):

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the FPA where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the FPA but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this DCP.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises the area which lies between the extent of the FPA and the PMF. Flood related controls in areas designated FPCC4 are typically limited to flood evacuation and emergency response, although additional controls apply to "critical uses and facilities" which are critical for response and recovery.

E1.6 Development Controls

The development controls have been graded relative to the severity and frequency of potential floods, having regard to the FPCCs determined by the relevant Floodplain Risk Management Study and Plan or, if no such study or plan exists, Council's interim considerations.

The objectives of the development controls are:

a) To require developments with high sensitivity to flood risk to be designed so that they are subject to minimal risk.

b) To allow development with a lower sensitivity to the flood hazard to be located within the floodplain, provided the risk of harm and damage to property is minimised.

c) To minimise the intensification of the high flood risk areas, and if possible, allow for their conversion to natural waterway corridors.

d) To ensure design and siting controls required to address the flood hazard do not result in unreasonable social, economic or environmental impacts.

e) To minimise the risk to life by ensuring the provision of reliable access from areas affected by flooding.

f) To minimise the damage to property arising from flooding.

g) To ensure the proposed development does not expose existing development to increased risks associated with flooding.

The performance criteria which are to be applied when assessing a proposed development are:

a) The proposed development should not result in any significant increase in risk to human life, or in a significant increase in economic or social costs as a result of flooding.

b) The proposal should only be permitted where effective warning time and reliable access is available to an area free of risk from flooding, consistent with any relevant Flood Plan or flood evacuation strategy.

c) Development should not significantly increase the potential for damage or risk to other properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain.

d) Procedures would be in place, if necessary, (such as warning systems, signage or evacuation drills) so that people are aware of the need to evacuate and are capable of identifying the appropriate evacuation route.

e) Development should not result in significant impacts upon the amenity of an area by way of unacceptable overshadowing of adjoining properties, privacy impacts (e.g. by unsympathetic house–raising) or by being incompatible with the streetscape or character of the locality.

The prescriptive controls which apply to development that is proposed on flood liable land are set out in **Schedule 2**.

E1.7 Proposals to Modify Flood Planning Constraint Categories

In certain situations it may be feasible to modify existing flood behaviour through engineering works which in turn would enable the extent of the FPCCs to be modified at a particular location. Proposals to modify an FPCC at a particular location would need to be supported by a detailed flooding investigation, further details of which are set out in **Section E1.11** below. Proposals would also need to demonstrate consistency with the flood related objectives and performance criteria of both the *Bourke Local Environmental Plan 2012* and the *Bourke Shire Development Control Plan 2012*.

E1.8 Development Requiring a Higher Level of Protection

Developments including nursing homes, aged care facilities and the like are usually recommended to be built at levels higher than the residential FPL, noting the limited mobility of occupants. However, in the case of Bourke, flood warning times are such that adequate notification of the need to evacuate in times of extreme flooding is typically available.

The *Bourke Shire Development Control Plan* 2012 nominates the 1% AEP flood level plus 0.5 m as the FPL for Flood Vulnerable Residential Development (which includes nursing homes, aged care facilities and the like). The applicant is to ensure that valuable equipment necessary for the operation of the facility is located at or above the nominated FPL, either permanently or via relocation to a temporary storage area suitable for this purpose. Additionally, these types of developments are to contain flood compatible building materials up to the PMF/Extreme Flood level to ensure that damage suffered by these important buildings is lessened in a more severe flood and inhabitants can move back into their residences faster after flood waters have subsided.

E1.9 Additions to Existing Dwellings and Ancillary Developments

For all new developments, it is recognised that the residential FPL is the minimum benchmark for floor levels. Additions are separately categorised in **Annexure 2** for instances where building up to the residential FPL is impractical or unreasonable. Appendix I 6.3.2 of the *Floodplain Development Manual 2005* states that additions can be built below the FPL *'where, in the opinion of Council, the floor level requirement is impractical or unreasonable'*.

Criteria have been included below to clarify instances where Council may be of the opinion that building up to the residential FPL would be impractical or unreasonable for various types of developments, as outlined below:

Dwelling Additions

- The addition is not to exceed 50% of the habitable floor area of the existing dwelling, and
- The addition is to be designed to withstand the force of floodwater including debris and buoyancy forces. A detailed report from a practising structural engineer certifying that the addition can achieve this is required. NOTE: For calculation of debris forces, assume a solid object of mass 250 kg travelling at a velocity of 2.0 metres/second, and
- The addition is proposed to be built from flood compatible materials (as included in **Annexures 3A** and **3B**) up to the 1% AEP flood level plus 0.5 m, and
- The addition is proposed in a precinct which allows such additions, as shown in **Annexure 2** and on **Figure E1.2**.

If an addition to a dwelling meets all of the above criteria, it may be built at the same floor level as the existing building. To ensure cumulative impacts are minimised/controlled, multiple applications for additions to dwellings are not permitted.

Outbuildings

- The outbuilding is proposed in a precinct which allows such development, as shown in **Annexure 2** and on **Figure E1.2**, and
- The outbuilding is proposed to be built from flood compatible building materials (as specified in **Annexures 3A** and **3B**) up to the 1% AEP flood level plus 0.5 m, and
- The outbuilding is to be designed to withstand the force of floodwater including debris and buoyancy forces. A detailed report from a practising structural engineer certifying that the addition can achieve this is required. NOTE: For calculation of debris forces, assume a solid object of mass 250 kg travelling at a velocity of 2.0 metres/second, and
- A location for the storage of goods during a flood event is to be provided inside the outbuilding with a minimum floor area of 10% of the gross floor area of the outbuilding proposed. This area is to be built to at least the residential FPL, being the 1% flood level plus 0.5 m.

E1.10 Special Requirements for Fencing

The objectives are:

a) To ensure that fencing does not result in the obstruction of the free flow of floodwater.

b) To ensure that fencing does not become unsafe during floods so as to threaten the integrity of structures or the safety of people.

c) To ensure fencing is constructed in a manner which does not significantly increase flood damage or risk to surrounding land.

The performance criteria which are to be applied when assessing proposed fencing are:

a) Fencing is to be constructed in a manner that does not affect the flow of floodwater so as to detrimentally increase flood affection on surrounding land.

b) Fencing must be certified by an engineer specialising in hydraulic engineering stating that the proposed fencing would be constructed so as to withstand the force of floodwater, or collapse in a controlled manner to prevent the impediment of floodwater.

The prescriptive controls which apply to any proposed fencing on land designated FPCC 1, FPCC 2 and FPCC 3 are:

a) An applicant will need to demonstrate that the fence (new or replacement fence) would create no impediment to the flow of floodwater. Fences must satisfy the following:

   - an open collapsible hinged fence structure or pool type fence, or louvre fencing;
   - must not be constructed of non-permeable materials; and
   - must allow floodwater to equalise on both sides of the fence and minimise entrapment of flood debris.

E1.11 Explanatory Notes on Lodging Applications

The following steps must be followed in the lodgement of a development application:

a) Check the proposal is permissible in the zoning of the land by reference to any applicable environmental planning instruments.

b) Consider any other relevant planning controls of Council (e.g. controls in any other relevant part of the DCP).

c) Check whether your property is located either partially or wholly within the Flood Planning Area or Outer Floodplain, as defined on the **Flood Planning Map**.

d) Determine which set of prescriptive flood related planning controls apply to the development from the **Flood Planning Map**.

e) Determine which Flood Planning Constraint Category (FPCC) applies to the developable portion of your property by reference to the **Flood Planning Constraint Category Map**. Enquire with Council regarding existing flood risk mapping or whether a site–specific assessment may be warranted. A property may be located in more than one FPCC and the assessment must consider the controls that apply in each.

f) Determine the land use category relevant to the development proposal, by firstly confirming how it is defined by the relevant environmental planning instrument and secondly by ascertaining the land use category from **Schedule 1: Land Use Categories**.

g) Assess and document how the proposal will achieve the performance criteria for proposed development and associated fencing set out in **Sections E1.6** and **E1.8**.

h) Check if the proposal will satisfy the prescriptive controls for different land use categories in different FPCCs, as specified in either **Schedule 2**.

i) If the proposal does not comply with the prescriptive controls, determine whether the performance criteria are nonetheless achieved.

j) Illustrations provided in this plan to demonstrate the intent of development controls are diagrammatic only. Proposals must satisfy all relevant controls contained in this plan and associated legislation.

k) The assistance of Council staff or an experienced engineer or planner may be required at various steps in the process to ensure that the flood risk management related requirements of this Plan are fully and satisfactorily addressed.

Note that compliance with all the requirements of this DCP does not guarantee that an application will be approved.

Information required with an application to address this DCP is as follows:

a) Applications must include information which addresses all relevant controls listed above, and the following matters as applicable.

b) Applications for alterations and additions (see **Schedule 2**) to an existing dwelling on flood liable land must be accompanied by documentation from a registered surveyor confirming existing floor levels.

c) Development applications affected by this DCP must be accompanied by a survey plan showing:

  i. The position of the existing building/s or proposed building/s;
  ii. The existing ground levels to Australian Height Datum around the perimeter of the building and contours of the site; and
  iii. The existing or proposed floor levels to Australian Height Datum.

d) Applications for earthworks, filling of land and subdivision shall be accompanied by a survey plan (with a contour interval of 0.25 m) showing relative levels to Australian Height Datum.

e) Where an existing catchment based flood study is not available, a flood study using a fully dynamic one or two dimensional computer model may be required. For smaller developments an existing suitable flood study may be used if available (e.g. it contains sufficient local detail), or otherwise a flood study prepared in a manner consistent with the latest edition of *Australian Rainfall and Runoff* and the *Floodplain Development Manual*, will be required and the following information must be submitted in plan form:
  i. water surface contours;
  ii. velocity vectors;
  iii. velocity and depth product contours;
  iv. delineation of flood risk precincts relevant to individual floodplains; and
  v. both existing and proposed flood profiles for the full range of events for total development including all structures and works (such as revegetation/ enhancements).

  This information is required for both pre–developed and post–developed scenarios.

f) Where the controls for a particular development proposal require an assessment of structural soundness during potential floods, the following impacts must be addressed:
  i. hydrostatic pressure;
  ii. hydrodynamic pressure;
  iii. impact of debris; and
  iv. buoyancy forces.

  Foundations need to be included in the structural analysis.

E1.12 Glossary of Terms

Note: For an expanded list of definitions, refer to the Glossary contained within the NSW Government Floodplain Development Manual, 2005.

TERM	DEFINITION
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, for a flood magnitude having five per cent AEP, there is a five per cent probability that there would be floods of greater magnitude each year.
Australian Height Datum (AHD)	A common national surface level datum corresponding approximately to mean sea level.
Floodplain	Area of land which is subject to inundation by floods up to and including the Probable Maximum Flood or Extreme Flood event, that is, flood prone land.
Flood Planning Area	The area of land that is shown to be in the Flood Planning Area on the *Flood Planning Map*.
Flood Planning Map	The *Flood Planning Map* shows the extent of land on which flood related development controls apply in a given area, noting that other areas may exist which are not mapped but where flood related development controls apply.
Flood Planning Constraint Category 1 (FPCC 1)	Comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
Flood Planning Constraint Category 2 (FPCC 2)	Comprises areas which lie within the extent of the *Flood Planning Area* where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
Flood Planning Constraint Category 3 (FPCC 3)	Comprises areas which lie within the extent of the *Flood Planning Area* but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this document.
Flood Planning Constraint Category 4 (FPCC 4)	Comprises the area which lies between the extent of the *Flood Planning Area* and the Probable Maximum Flood or Extreme Flood. Flood related controls in areas designated FPCC4 are typically limited to flood evacuation and emergency response, although additional controls apply to "critical uses and facilities" which are critical for response and recovery.
Flood Planning Level (FPL)	Flood levels selected for planning purposes, as determined by the relevant adopted floodplain risk management study and plan, or as part of a site specific study In the absence of an adopted floodplain risk management study and plan for a particular location, the FPL is defined as the peak 1% AEP flood level plus the addition of a 0.5 m freeboard.

TERM	DEFINITION
Flood Prone/Flood Liable Land	Land susceptible to flooding by the Probable Maximum Flood or Extreme Flood. Flood Prone land is synonymous with Flood Liable land.
Floodway	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Flood Storage Area	Those parts of the floodplain that may be important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding a particular flood chosen as the basis for the *Flood Planning Level* is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the *Flood Planning Level*.
Habitable Room	In a residential situation: a living or working area, such as a lounge room, dining room, kitchen, bedroom or workroom. In an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Local Drainage	Land on an overland flow path where the depth of inundation during the 1% AEP storm event is less than 0.1 m.
Probable Maximum Flood (PMF) or Extreme Flood	The largest flood that could conceivably occur at a particular location. Generally, it is not physically or economically possible to provide complete protection against this event. The Probable Maximum Flood or Extreme Flood defines the extent of flood prone land, that is, the floodplain.

SCHEDULE 1
LAND USE CATEGORIES

Essential Community Facilities and Critical Utilities and land uses	Flood Vulnerable Residential	Subdivision and Filling	Residential	Commercial/ Industrial	Recreation or Non-Urban	Additions to Dwellings and Ancillary Developments
Place of Assembly or Public building that may provide an important contribution to the notification and evacuation of the community during flood events; Hospitals; Telecommunication facilities; Public Utility Installation that may cause pollution of waterways during flooding, or if affected during flood events would significantly affect the ability of the community to return to normal activities after the flood events. Hazardous industry; Hazardous storage establishments.	Group home; Housing for aged or disabled persons; and Units for aged persons; Child care centre, Institutions, Educational establishments.	Subdivision of land involving the creation of new allotments for residential purposes; Earthworks or filling operations covering 100 m^2 or more than 0.3 m deep.	Dwelling; Residential flat building; Home industry; Boarding house; Professional consulting rooms; Public utility undertakings (other than critical utilities); Utility installation (other than critical utilities); Caravan Park (vans do not have to be built up, only permanent structures with footings and/or tie-downs).	Bulk Store; Bus depot; Bus station; Car repair stations; Club; Commercial premises; General store; Health care professional; Hotel; Intensive livestock keeping; Junkyard; Liquid fuel depot; Motel; Motor showroom; Place of Assembly (other than essential community facilities; Place of public worship; Public building (other than essential community facilities); Recreation facility; Refreshment room; Road transport terminal; Rural industry; Service station; Shop; Tourist facilities; Warehouse, car repair station, church, light industry, industry, plant nursery, roadside stall, sawmill.	Agriculture; Extractive industry; Forestry; Mine; Plantation forest; Retail nursery; Recreation area; Roadside stall; Stock and saleyard, hangar.	Dwelling Additions* Outbuildings* Change of Use* Private Swimming Pools* *For specific criteria on these, refer **Section E1.9**.

SCHEDULE 2
PRESCRIPTIVE FLOOD RELATED DEVELOPMENT CONTROLS

Planning considerations	Flood Planning Constraint Category 1 (FPCC 1)							Flood Planning Constraint Category 2 (FPCC 2)							Flood Planning Constraint Category 3 (FPCC 3)							Flood Planning Constraint Category 4 (FPCC 4)						
	Essential Community Facilities and Critical Utilities and land uses	Flood Vulnerable Residential	Subdivision and Filling	Residential	Commercial / Industrial	Recreational and Non-Urban	Additions to Dwellings and Ancillary Developments	Essential Community Facilities and Critical Utilities and land uses	Flood Vulnerable Residential	Subdivision and Filling	Residential	Commercial / Industrial	Recreational and Non-Urban	Additions to Dwellings and Ancillary Developments	Essential Community Facilities and Critical Utilities and land uses	Flood Vulnerable Residential	Subdivision and Filling	Residential	Commercial / Industrial	Recreational and Non-Urban	Additions to Dwellings and Ancillary Developments	Essential Community Facilities and Critical Utilities and land uses	Flood Vulnerable Residential	Subdivision and Filling	Residential	Commercial / Industrial	Recreational and Non-Urban	Additions to Dwellings and Ancillary Developments
Minimum Habitable Floor Level						A1	A2 A3				A2	A4	A1	A2 A3	A5	A5		A2	A4	A1	A2 A3	A5	A5					
Building Components						B1	B1				B1	B1	B1	B1	B2	B2		B1	B1	B1	B1	B2	B21					
Structural Soundness						C2	C1				C1	C1	C1	C1	C2	C2		C1	C1	C1	C1	C2	C2					
Flood Affectation						D1	D1			D1	D1	D1	D1	D2	D1	D1	D1	D1	D1	D1	D2							
Emergency Response						E4	E2 or E3			E4 E5	E3 E4	E3 E4	E4	E2 or E3	E2 E4	E2 E4	E4 E5	E2 E4	E2 E4	E4	E2 or E3	E2 or E3	E2 E4					
Management and Design						F2 F3	F2 F3			F1	F2	F2 F3 F4	F2 F3	F2 F3	F2 F3 F4	F2 F3 F4	F1		F4			F2 F3	F2 F3 F4					
Stormwater							G2			G1 G2	G1 G2	G1 G2		G2	G1 G2	G1 G2	G1 G2	G1 G2	G1 G2		G2	G1	G1					

	Not Relevant		Unsuitable Land Use

Prescriptive controls for associated planning considerations under each FPCC		
Minimum Habitable Floor Level **A1** Habitable floor levels to be set no lower than the 2% AEP flood level plus freeboard(1) unless justified by site specific assessment. **A2** Habitable floor levels to be set no lower than the 1% AEP flood level plus freeboard(1). **A3** Habitable floor levels to be as close to the Minimum Habitable Floor Level as practical and no lower than the existing floor level when undertaking concessional development. **A4** Habitable floor levels to be as close to the 1% AEP flood level plus freeboard(1) as practical, but no lower than the 2% AEP flood level plus freeboard(1). In situations where the habitable floor level is set below the 1% AEP flood level plus freeboard(1), a mezzanine area equal to 20% of the total habitable floor area or 20 m^2 (whichever is the largest) is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard(1). **A5** Habitable floor levels to be set no lower than the 0.5% AEP flood level plus freeboard(1).	**Building Components & Method** **B1** All structures to have flood compatible building components below the 1% AEP flood level plus freeboard(1) (refer **Schedules 3A** and **3B**). **B2** All structures to have flood compatible building components below the 0.5% AEP flood level plus freeboard(1) (refer **Schedules 3A** and **3B**).	**Structural Soundness** **C1** Engineers report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard(1). **C2** Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard(1) or a PMF/Extreme, whichever is the greatest.
Flood Affectation **D1** Engineers report required to certify that the development will not increase flood affectation elsewhere. **D2** The impact of the development on flooding elsewhere to be considered. **Note:** When assessing flood affectation the following must be considered: **1**. Loss of storage in the floodplain. **2.** Changes in flood levels and flow velocities caused by alteration of conveyance of flood waters. **3.** Impacts of urbanisation on peak flood flows and volumes.	**Emergency Response** **E1** Reliable egress for pedestrians and vehicles required during a 1% AEP flood. **E2** Reliable egress for pedestrians and vehicles required during a PMF/Extreme Flood. **E3** Reliable egress for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest habitable floor level to an area of refuge above the PMF/Extreme Flood level, or a minimum of 20 m^2 of the dwelling to be above the PMF/Extreme Flood level. **E4** The development is to be consistent with any relevant flood evacuation strategy or similar plan. **E5** Applicant to demonstrate that there is rising road egress/access from all allotments internal to the subdivision to land which lies above the PMF/Extreme Flood.	**Management and Design** **F1** Applicant to demonstrate that potential development as a consequence of a subdivision or development proposal can be undertaken in accord with this Plan. **F2** Flood Safe Plan (home or business or farm houses) to address safety and property damage issues (including goods storage and stock management) considering the full range of flood risk. **F3** Site Emergency Response Flood Plan required considering the full range of flood risk **F4** No external storage of materials below the Minimum Habitable Floor Level which may cause pollution or be potentially hazardous during any flood.
Stormwater **G1** Engineers report required to certify that the development will not affect stormwater drainage. **G2** The impact of the development on local overland flooding to be considered.		

Unless stated otherwise in an adopted location specific Floodplain Risk Management Study and Plan, freeboard is equal to 0.5 m.

SCHEDULE 3A
GENERAL BUILDING MATTERS

Electrical and Mechanical Equipment

For dwellings constructed on land to which this policy applies, the electrical and mechanical materials, equipment and installation should conform to the following requirements.

Main Power Supply

Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant elevation referred to in control B1 or B2 of **Schedule 2**. Means shall be available to easily isolate the dwelling from the main power supply.

Wiring

All wiring, power outlets, switches, etc, should be, to the maximum extent possible, located above the relevant elevation referred to in control B1 or B2 of **Schedule 2**. All electrical wiring installed below this level should be suitable for continuous underwater immersion and should contain no fibrous components. Earth leakage circuit breakers (core balance relays) must be installed. Only submersible type splices should be used below the relevant elevation referred to in control B1 or B2 of **Schedule 2**. All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding.

Equipment

All equipment installed below or partially below the relevant elevation referred to in control B1 or B2 of **Schedule 2** should be capable of disconnection by a single plug and socket assembly.

Reconnection

Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.

Heating and Air Conditioning Systems

Where viable, heating and air conditioning systems should be installed in areas and spaces of the house above the relevant elevation referred to in control B1 or B2 of **Schedule 2**. When this is not feasible, every precaution should be taken to minimise the damage caused by submersion according to the following guidelines:

i) Fuel

Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.

ii) Installation

The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to the relevant elevation referred to in control B1 or B2 of **Schedule 2**.

iii) Ducting

All ductwork located below the relevant elevation referred to in control B1 or B2 of **Schedule 2** should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a watertight wall or floor below the relevant flood level, a closure assembly operated from above the relevant elevation set out under B1 or B2 of **Schedule 2** should protect the ductwork.

Sewer

All sewer connections to properties in flood prone areas are to be fitted with reflux valves.

SCHEDULE 3B
FLOOD COMPATIBLE MATERIALS

Building Component	Flood Compatible Material	Building Component	Flood Compatible Material
Flooring and Sub Floor Structure	• Concrete slab-on-ground monolith construction. Note: clay filling is not permitted beneath slab-on-ground construction which could be inundated. • Pier and beam construction or • Suspended reinforced concrete slab	**Doors**	• Solid panel with waterproof adhesives • Flush door with marine ply filled with closed cell foam • Painted material construction • Aluminium or galvanised steel frame
Floor Covering	• Clay tiles • Concrete, precast or in situ • Concrete tiles • Epoxy formed-in-place • Mastic flooring, formed-in-place • Rubber sheets or tiles with chemical set adhesive • Silicone floors formed-in-place • Vinyl sheets or tiles with chemical-set adhesive • Ceramic tiles, fixed with mortar or chemical set adhesive • Asphalt tiles, fixed with water resistant adhesive • Removable rubber-backed carpet	**Wall and Ceiling Linings**	• Brick, face or glazed • Clay tile glazed in waterproof mortar • Concrete • Concrete block • Steel with waterproof applications • Stone natural solid or veneer, waterproof grout • Glass blocks • Glass • Plastic sheeting or wall with waterproof adhesive
Wall Structure	Solid brickwork, blockwork, reinforced, concrete or mass concrete	**Insulation**	• Foam or closed cell types
Windows	Aluminium frame with stainless steel or brass rollers	**Nails, Bolts, Hinges and Fittings**	• Galvanised • Removable pin hinges

BOURKE SHIRE COUNCIL

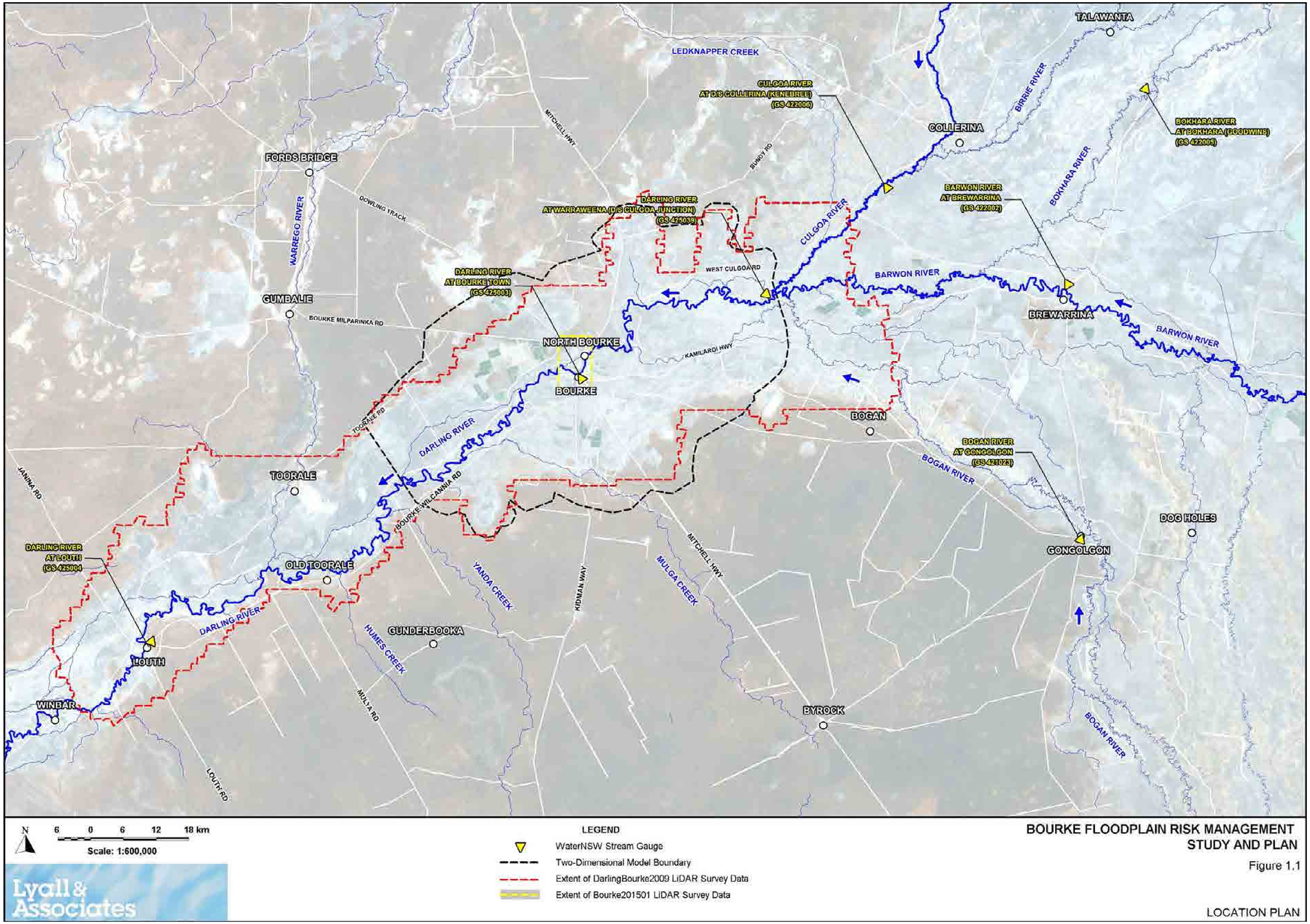
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

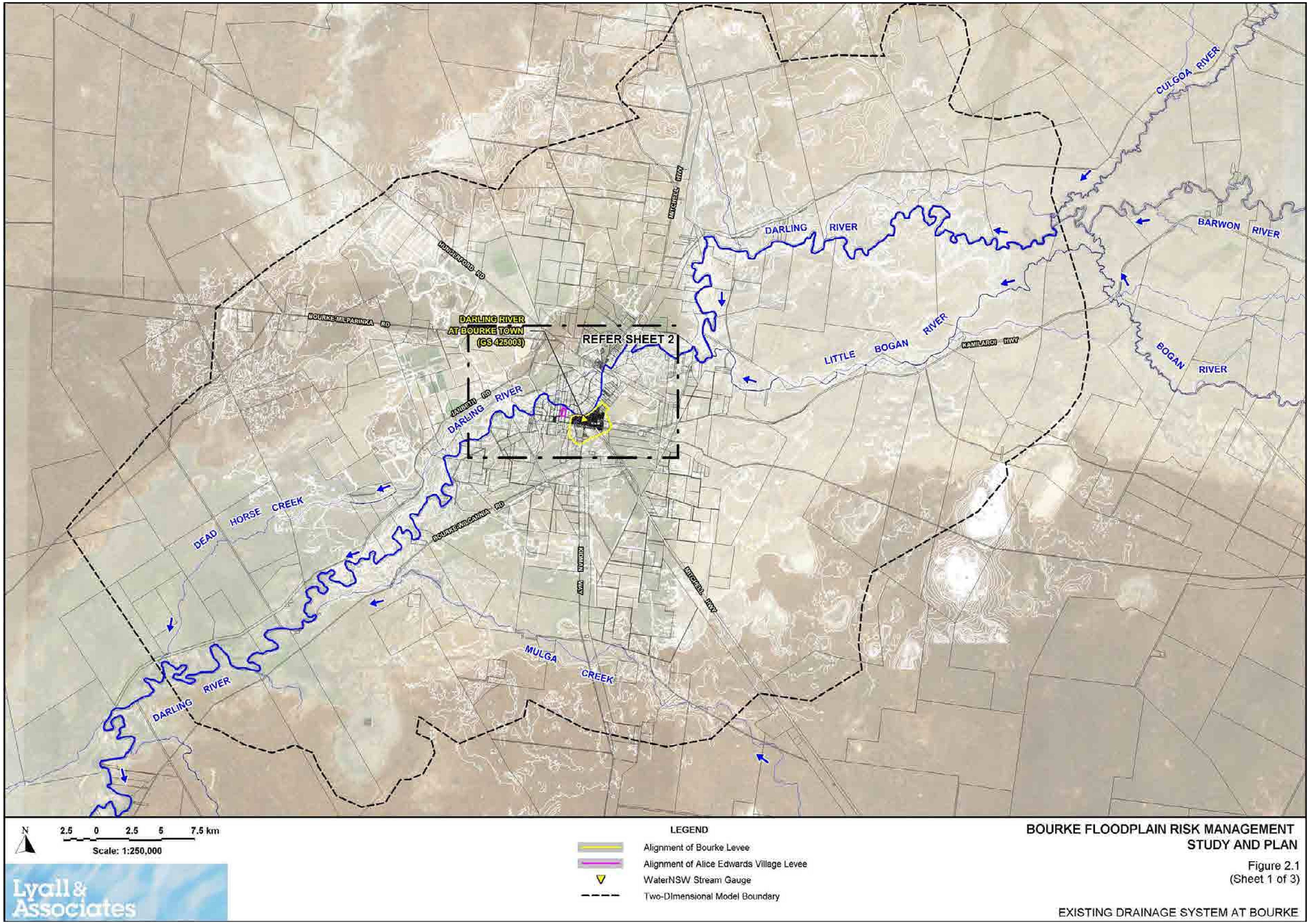
DECEMBER 2022

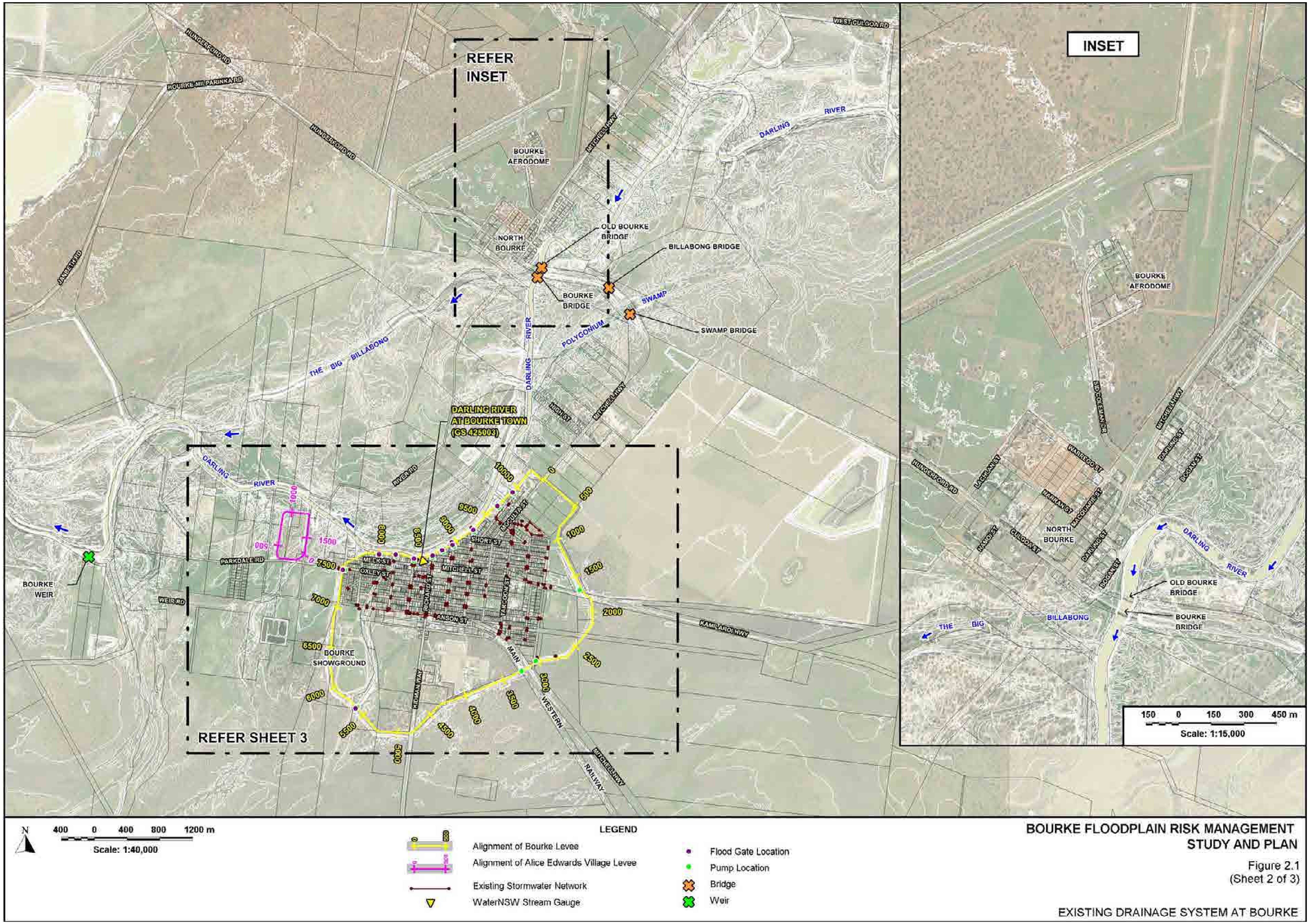
VOLUME 2 – FIGURES

Job No: EL507 File: BFRMS_V2_Figures_[Rev 1.3]	Date: December 2022 Rev No: 1.3	Principal: SAB Author: SAB/TDR

LIST OF FIGURES


TALAWANTA
LEDKNAPPER CREEK
CULGOA RIVER AT D/S COLLERINA (KENEBREE) (GS 422006)
BIRRIE RIVER
BOKHARA RIVER AT BOKHARA (GOODWINS) (GS 422005)
COLLERINA
FORDS BRIDGE
MITCHELL HWY
BUNDY RD
BOKHARA RIVER
DOWLING TRACK
DARLING RIVER AT WARRAWEENA (D/S CULGOA JUNCTION) (GS 425039)
BARWON RIVER AT BREWARRINA (GS 422002)
WARREGO RIVER
CULGOA RIVER
WEST CULGOA RD
BARWON RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
GUMBALIE
BOURKE MILPARINKA RD
BREWARRINA
BARWON RIVER
NORTH BOURKE
KAMILAROI HWY
BOURKE
TOORALE RD
BOGAN
DARLING RIVER
BOGAN RIVER AT GONGOLGON (GS 421023)
BOGAN RIVER
JANINA RD
TOORALE
BOURKE-WILCANNIA RD
DOG HOLES
GONGOLGON
DARLING RIVER AT LOUTH (GS 425004)
OLD TOORALE
YANDA CREEK
MITCHELL HWY
MULGA CREEK
KIDMAN WAY
DARLING RIVER
GUNDERBOOKA
HUMES CREEK
LOUTH
MULYA RD
WINBAR
BYROCK
BOGAN RIVER
LOUTH RD
N
6 0 6 12 18 km
Scale: 1:600,000
Lyall & Associates
LEGEND
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
Extent of DarlingBourke2009 LiDAR Survey Data
Extent of Bourke201501 LiDAR Survey Data
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 1.1
LOCATION PLAN

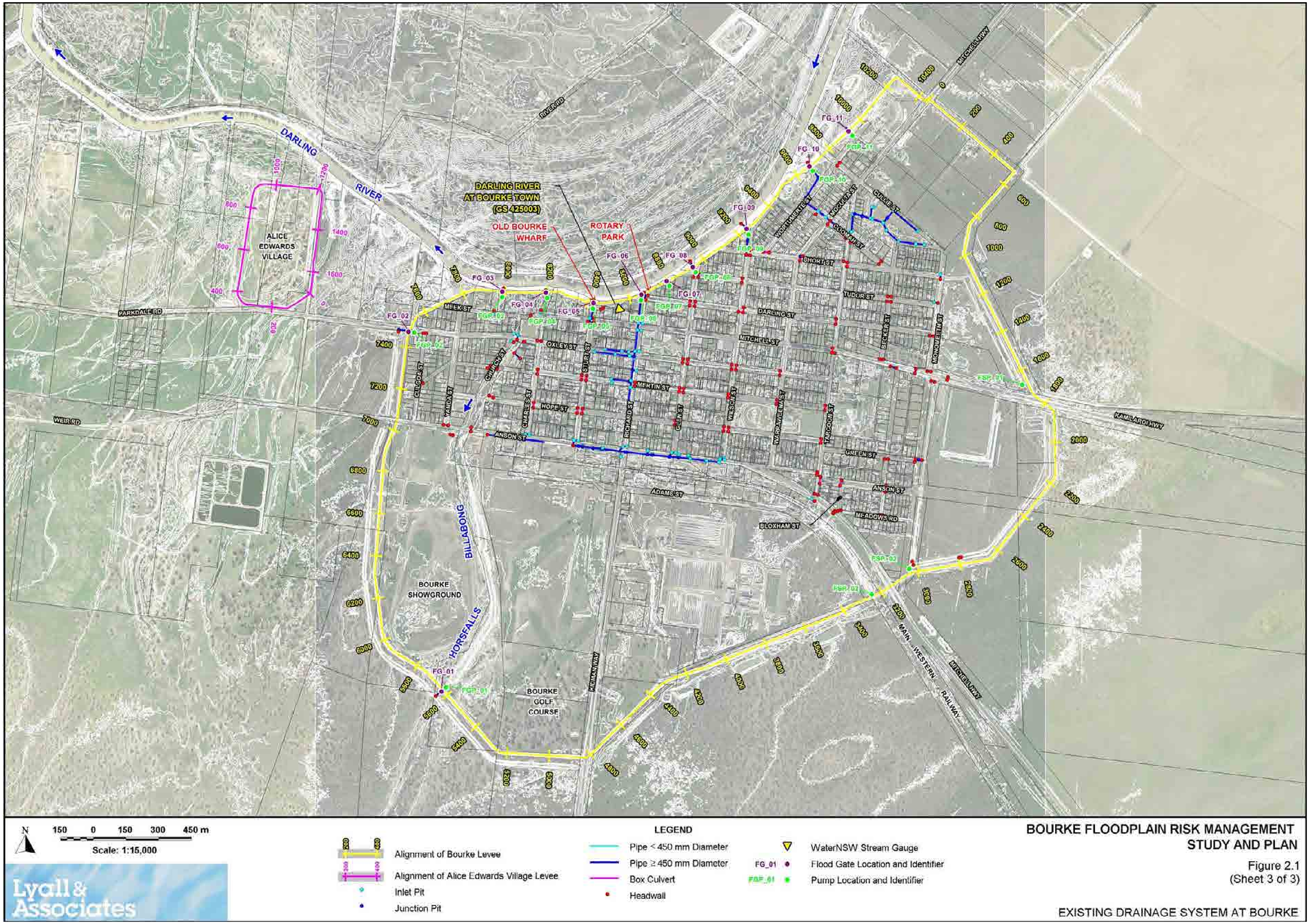

CULGOA RIVER
DARLING RIVER
BARWON RIVER
LITTLE BOGAN RIVER
BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
DARLING RIVER
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MULGA CREEK
DARLING RIVER
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.1
(Sheet 1 of 3)
EXISTING DRAINAGE SYSTEM AT BOURKE



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.1
(Sheet 2 of 3)

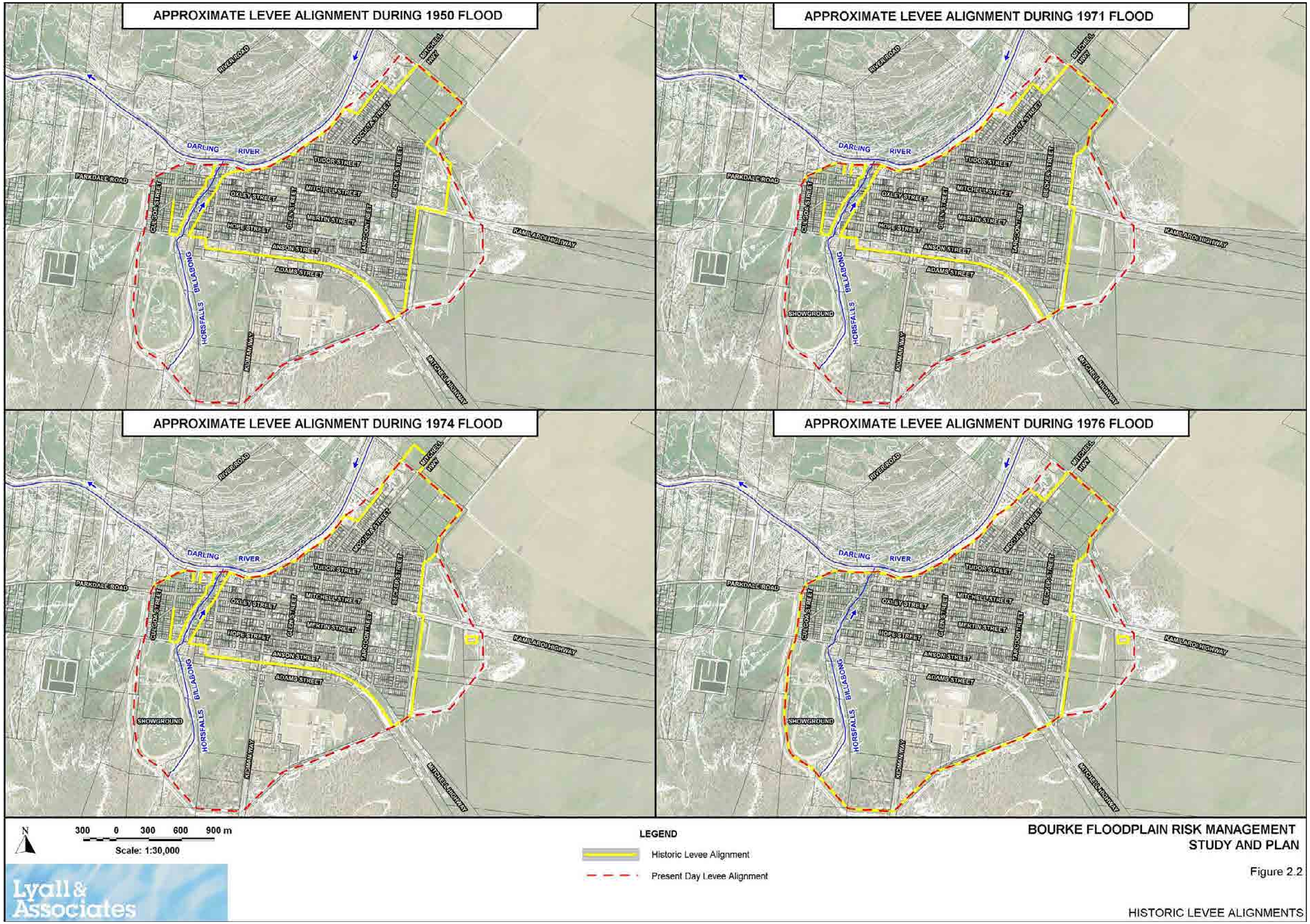
EXISTING DRAINAGE SYSTEM AT BOURKE



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.1 (Sheet 3 of 3)

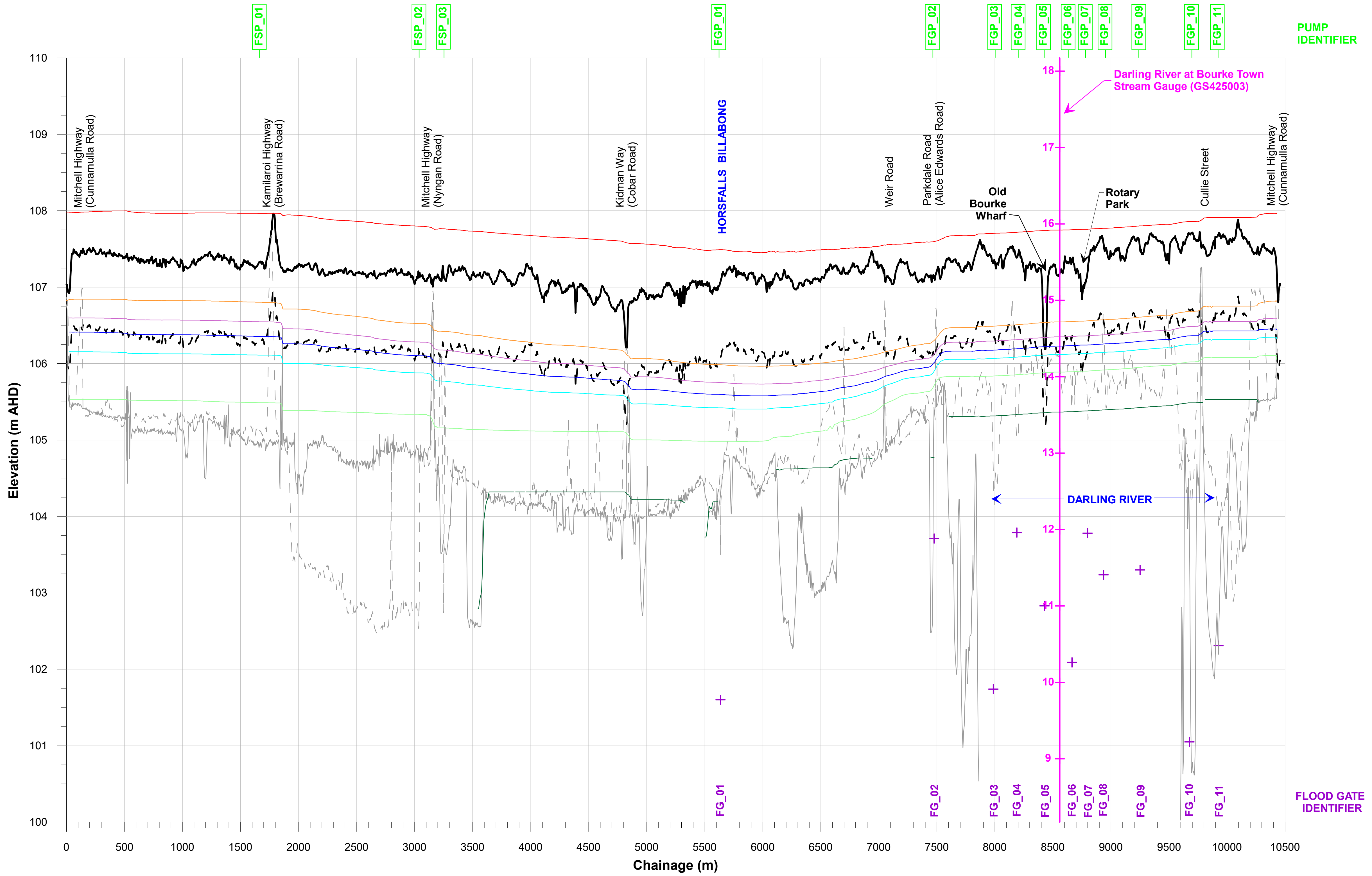
EXISTING DRAINAGE SYSTEM AT BOURKE



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.2

HISTORIC LEVEE ALIGNMENTS



Lyall & Associates

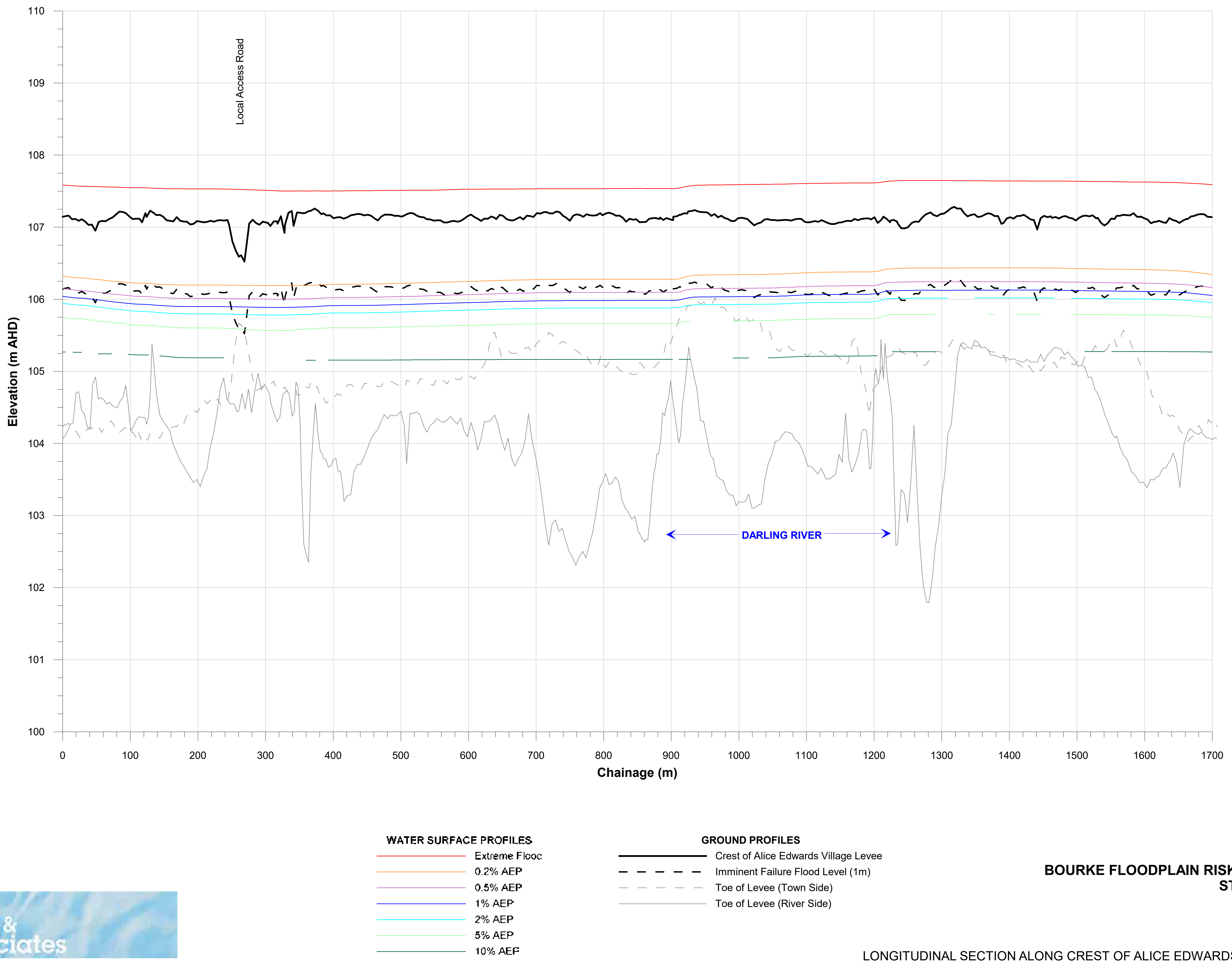
NOTE:

1. Imminent failure flood level assumes that the low-points at the Mitchell Highway, Kidman Way and Old Bourke Wharf are temporarily filled to the elevation of the existing levee crest adjacent to the lowpoint.

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.3

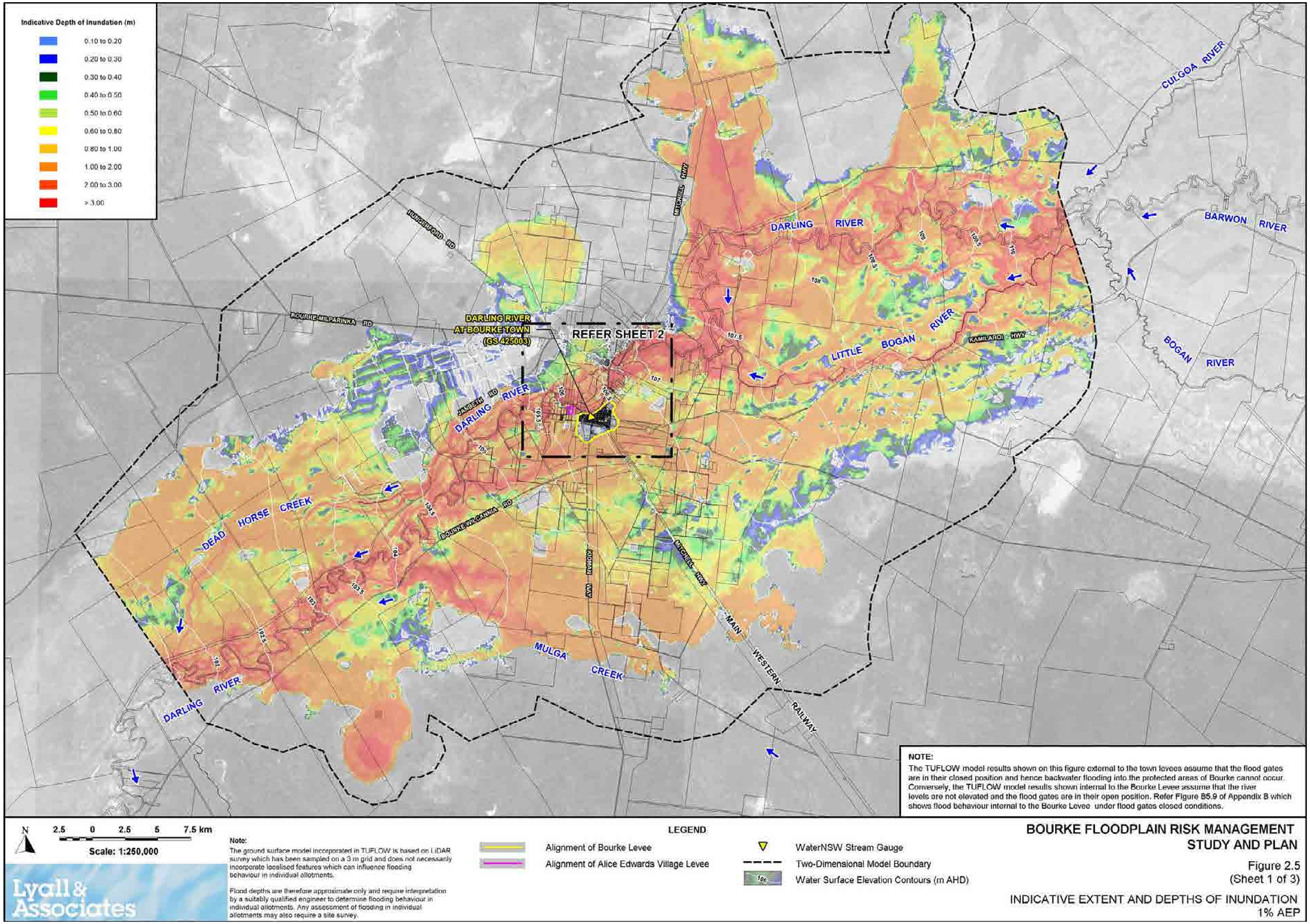
LONGITUDINAL SECTION ALONG CREST OF BOURKE LEVEE



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.4

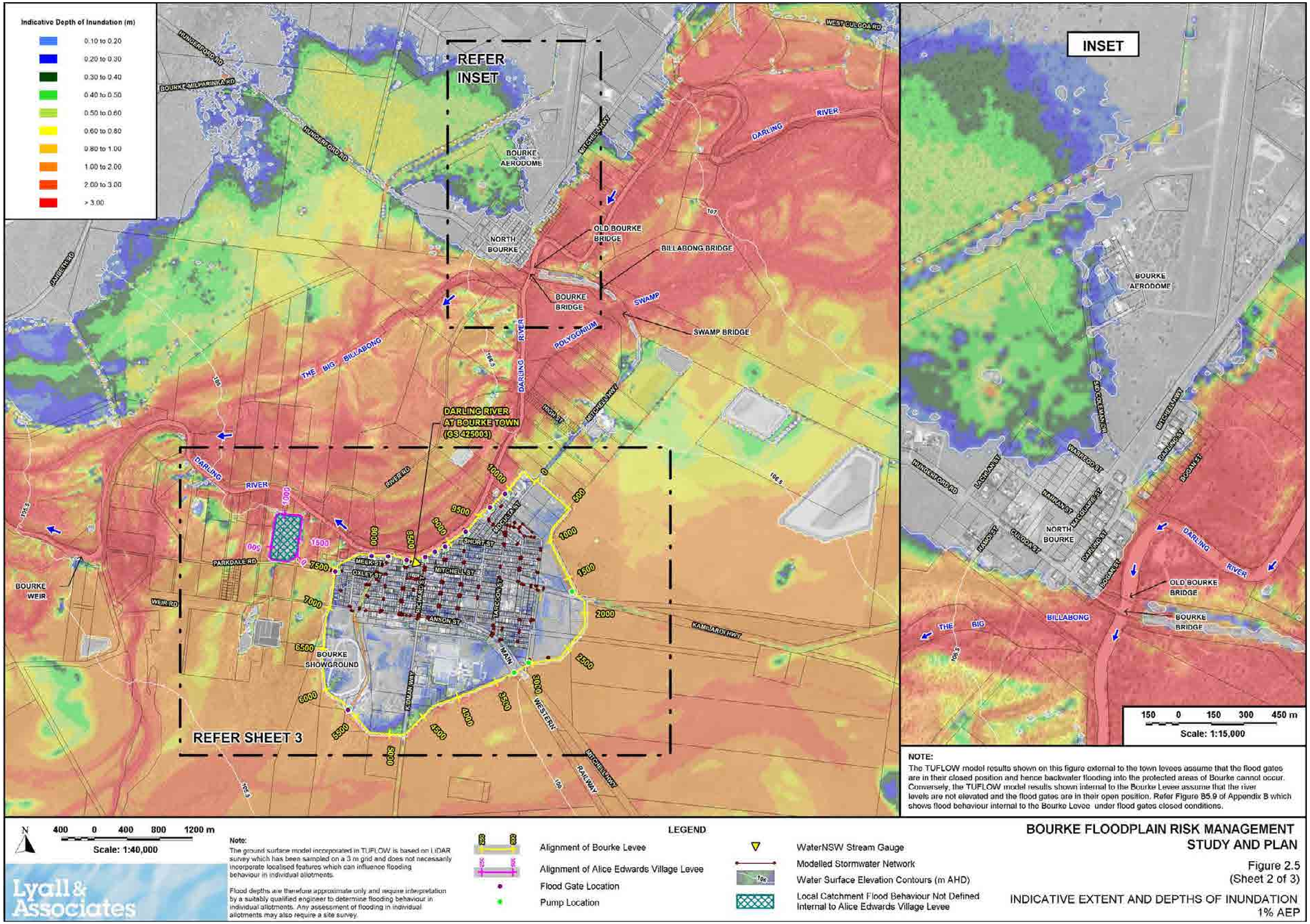
LONGITUDINAL SECTION ALONG CREST OF ALICE EDWARDS VILLAGE LEVEE

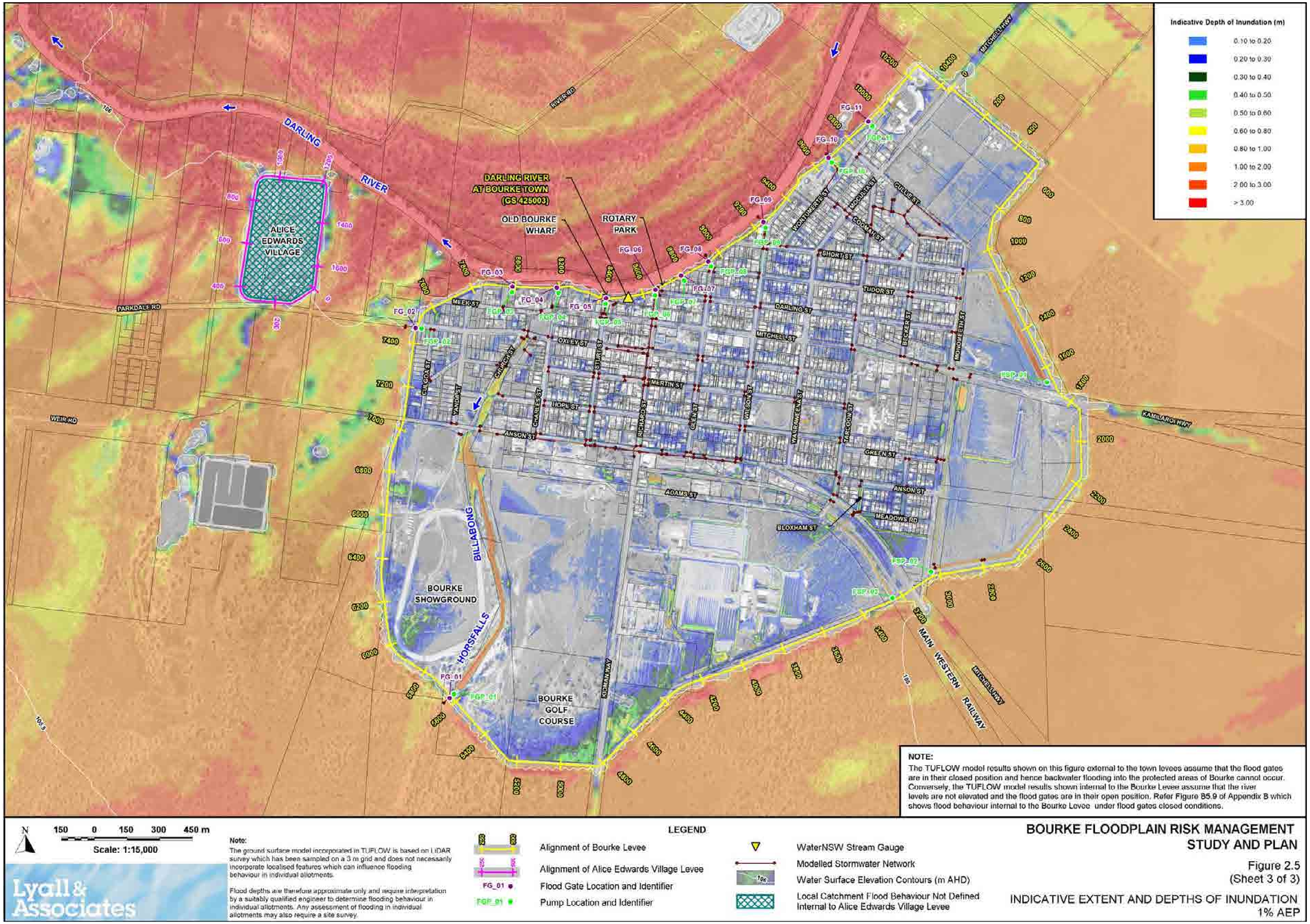


BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

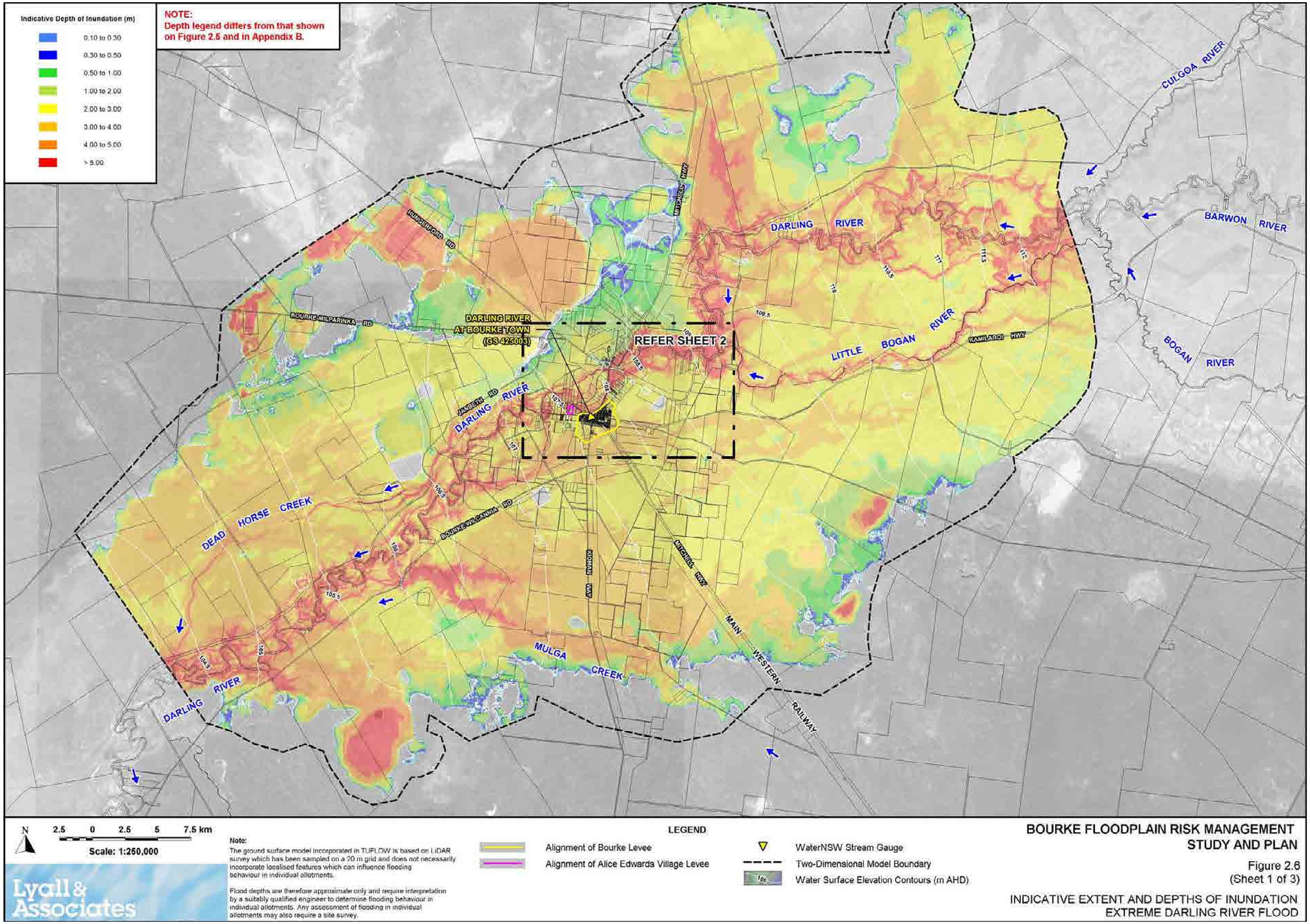
Figure 2.5 (Sheet 1 of 3)

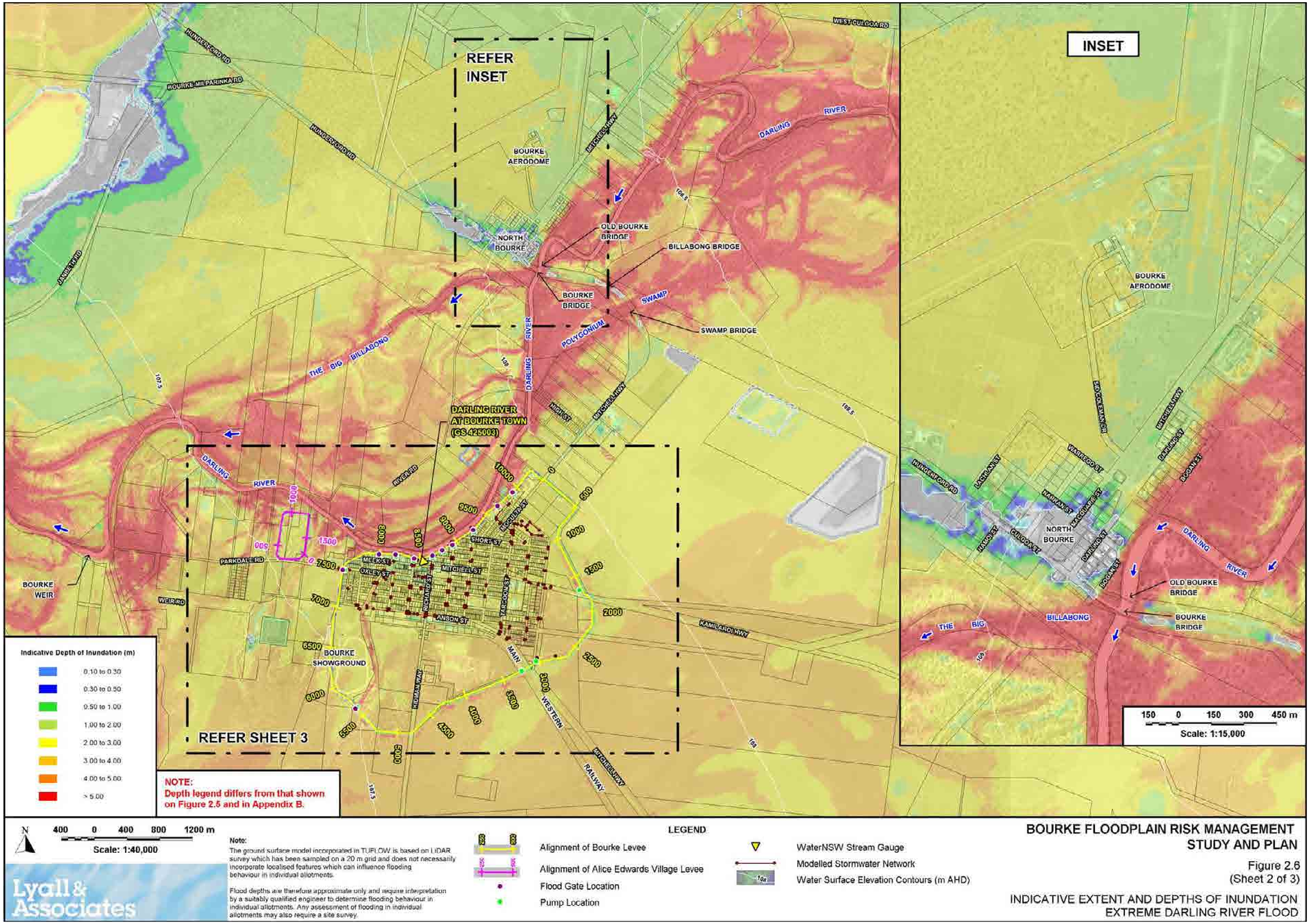
INDICATIVE EXTENT AND DEPTHS OF INUNDATION 1% AEP


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
REFER INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
DARLING RIVER
THE BIG BILLABONG
POLYGONIUM SWAMP
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
REFER SHEET 3
KAMILAROI HWY
MITCHELL HWY
INSET
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position. Refer Figure B5.9 of Appendix B which shows flood behaviour internal to the Bourke Levee under flood gates closed conditions.
Scale: 1:15,000
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.5
(Sheet 2 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
1% AEP



Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
BOURKE SHOWGROUND
BOURKE GOLF COURSE
BILLABONG
HORSFALLS
MITCHELL HWY
KAMILAROI HWY
MAIN WESTERN RAILWAY
KIDMAN WAY
RIVER RD
PARKDALE RD
WEIR RD
MEEK ST
OXLEY ST
MERTIN ST
HOPE ST
ANSON ST
ADAMS ST
DARLING ST
MITCHELL ST
SHORT ST
TUDOR ST
GREEN ST
MEADOWS RD
BLOXHAM ST
RICHARD ST
STURT ST
CHARLES ST
CHURCH ST
YANDA ST
CULGOA ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
BECKER ST
MONO MEETH ST
COOBAH ST
CULLIE ST
MOCULTA ST
WONTURRERE ST
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position. Refer Figure B5.9 of Appendix B which shows flood behaviour internal to the Bourke Levee under flood gates closed conditions.
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.5
(Sheet 3 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
1% AEP


Indicative Depth of Inundation (m)
0.10 to 0.30
0.30 to 0.50
0.50 to 1.00
1.00 to 2.00
2.00 to 3.00
3.00 to 4.00
4.00 to 5.00
> 5.00
NOTE:
Depth legend differs from that shown on Figure 2.5 and in Appendix B.
CULGOA RIVER
BARWON RIVER
DARLING RIVER
BOGAN RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
JANDRA RD
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MAIN WESTERN RAILWAY
MULGA CREEK
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
Water Surface Elevation Contours (m AHD)
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.6
(Sheet 1 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
EXTREME DARLING RIVER FLOOD



REFER INSET
INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
POLYGONUM SWAMP
DARLING RIVER
THE BIG BILLABONG
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
REFER SHEET 3
Indicative Depth of Inundation (m)
0.10 to 0.30
0.30 to 0.50
0.50 to 1.00
1.00 to 2.00
2.00 to 3.00
3.00 to 4.00
4.00 to 5.00
> 5.00
NOTE:
Depth legend differs from that shown on Figure 2.5 and in Appendix B.
Scale: 1:15,000
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.6 (Sheet 2 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION EXTREME DARLING RIVER FLOOD

N

150 0 150 300 450 m

Scale: 1:15,000

Lyall & Associates

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

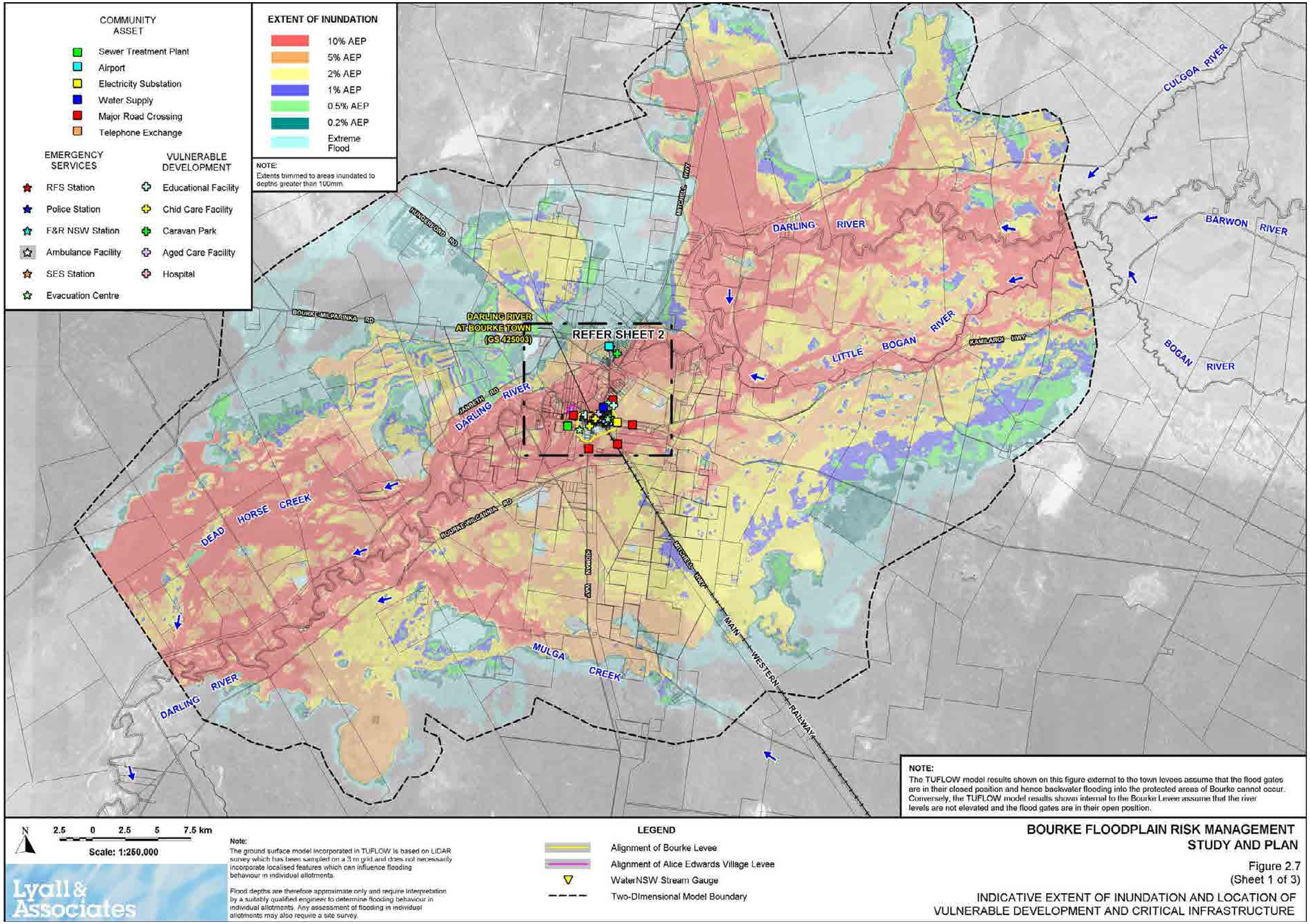
LEGEND

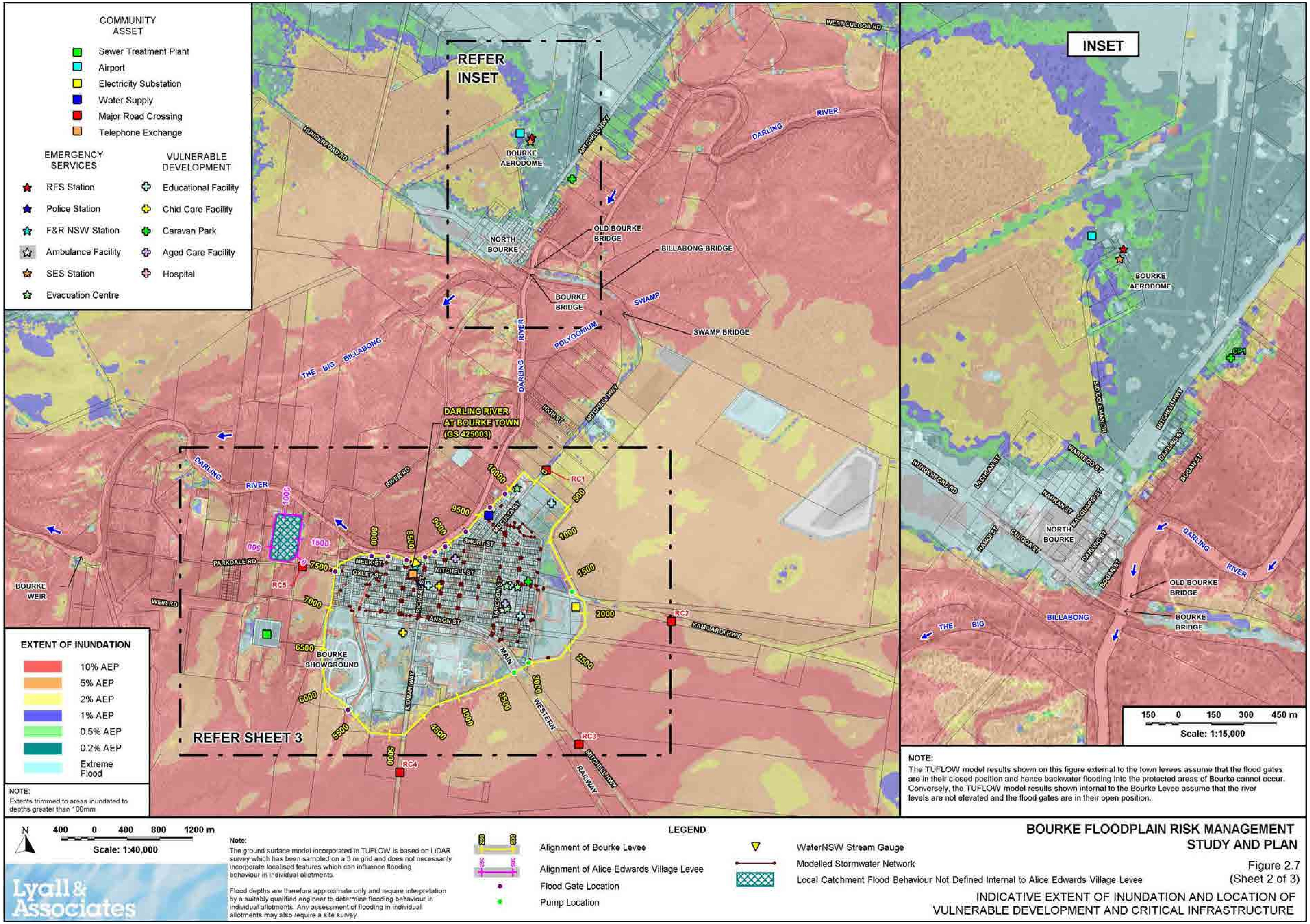
- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- FG_01 Flood Gate Location and Identifier
- FGP_01 Pump Location and Identifier
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Water Surface Elevation Contours (m AHD)

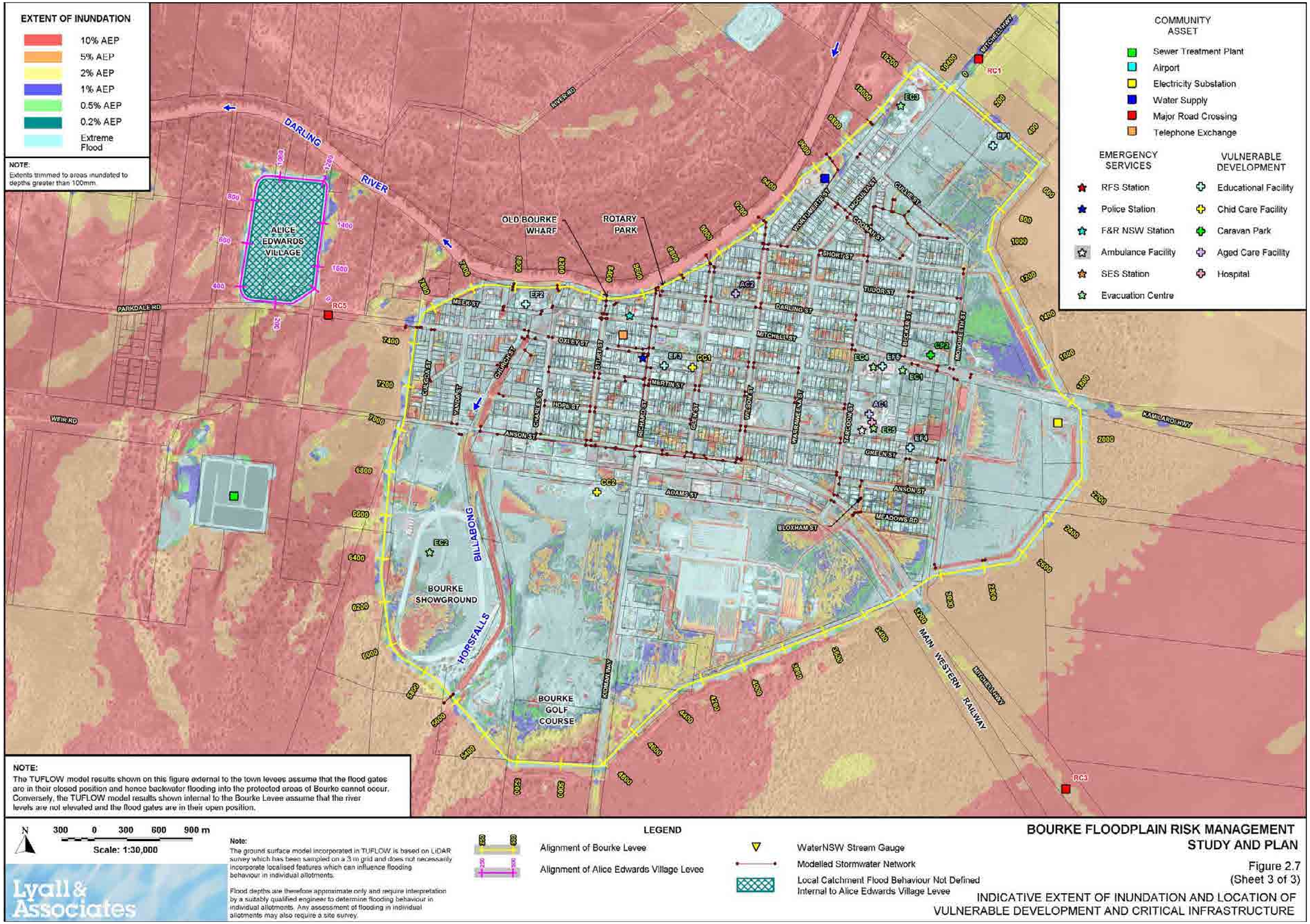
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

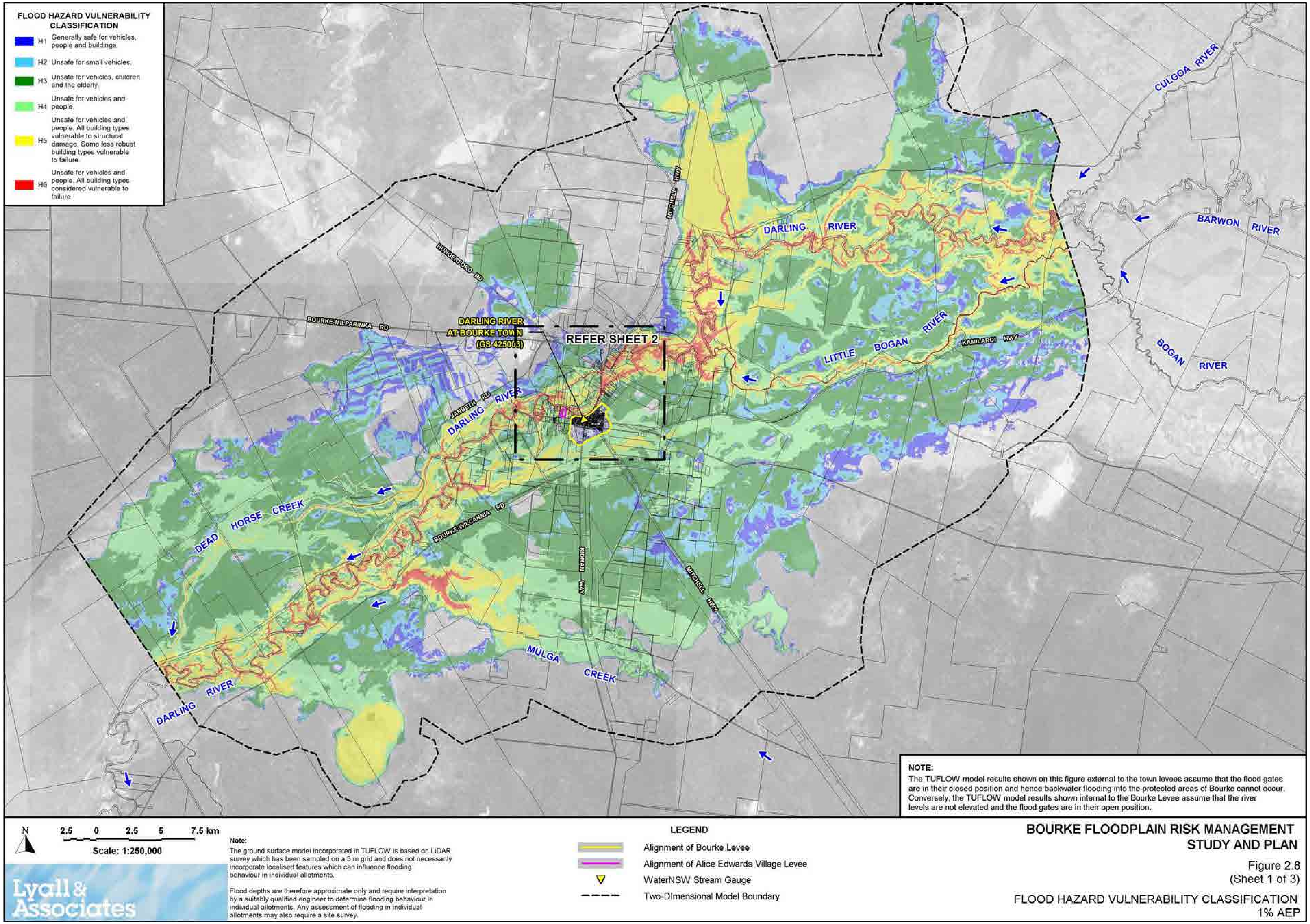
Figure 2.6
(Sheet 3 of 3)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
EXTREME DARLING RIVER FLOOD

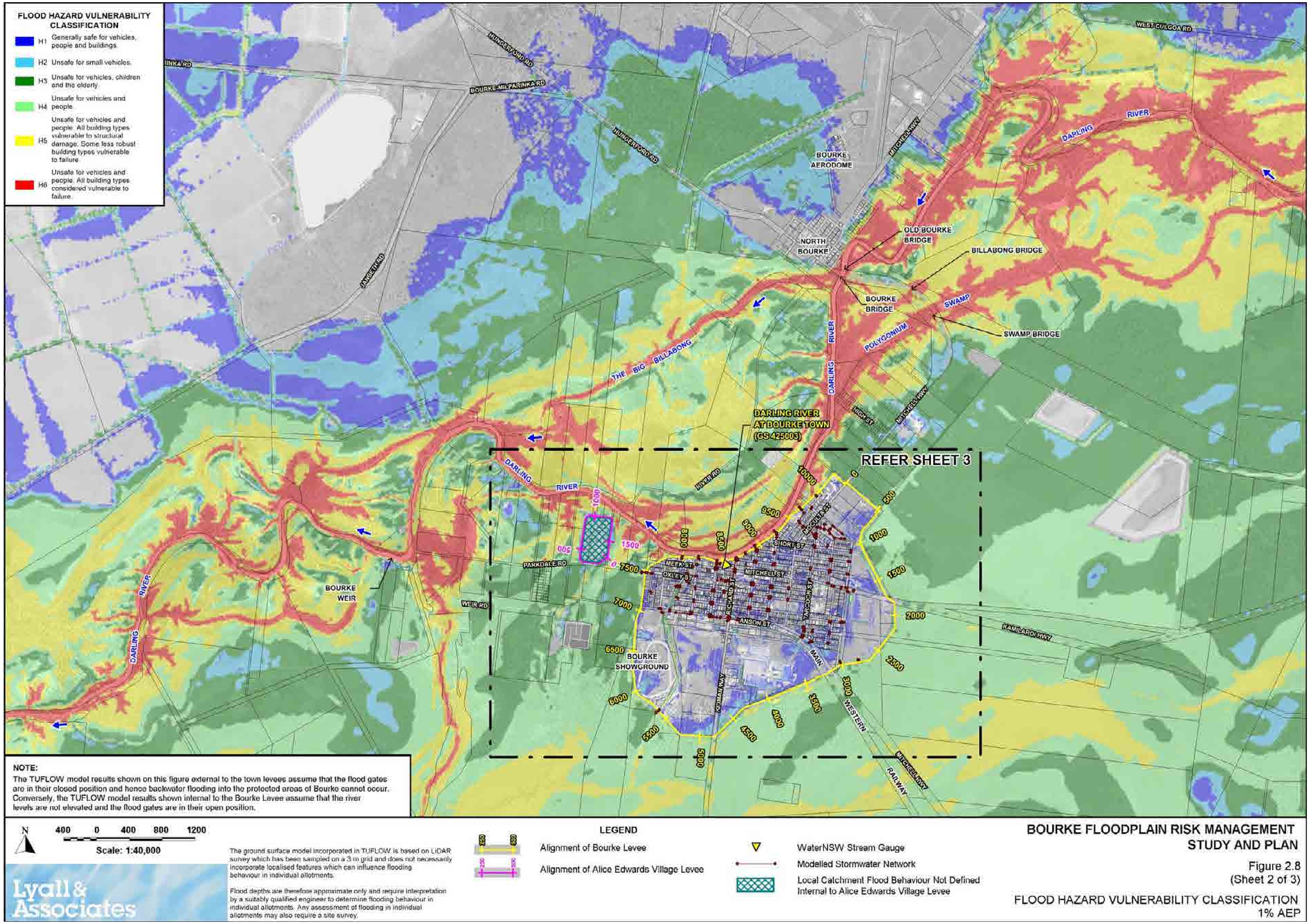

COMMUNITY ASSET
Sewer Treatment Plant
Airport
Electricity Substation
Water Supply
Major Road Crossing
Telephone Exchange
EMERGENCY SERVICES
RFS Station
Police Station
F&R NSW Station
Ambulance Facility
SES Station
Evacuation Centre
VULNERABLE DEVELOPMENT
Educational Facility
Chid Care Facility
Caravan Park
Aged Care Facility
Hospital
EXTENT OF INUNDATION
10% AEP
5% AEP
2% AEP
1% AEP
0.5% AEP
0.2% AEP
Extreme Flood
NOTE:
Extents trimmed to areas inundated to depths greater than 100mm.
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
DARLING RIVER
BARWON RIVER
CULGOA RIVER
BOGAN RIVER
LITTLE BOGAN RIVER
DEAD HORSE CREEK
MULGA CREEK
MITCHELL HWY
KAMILAROI HWY
KIDMAN WAY
HUNGERFORD RD
BOURKE-MILPARINKA RD
BOURKE-WILCANNIA RD
JANBETH RD
MAIN WESTERN RAILWAY
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.7
(Sheet 1 of 3)
INDICATIVE EXTENT OF INUNDATION AND LOCATION OF VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE

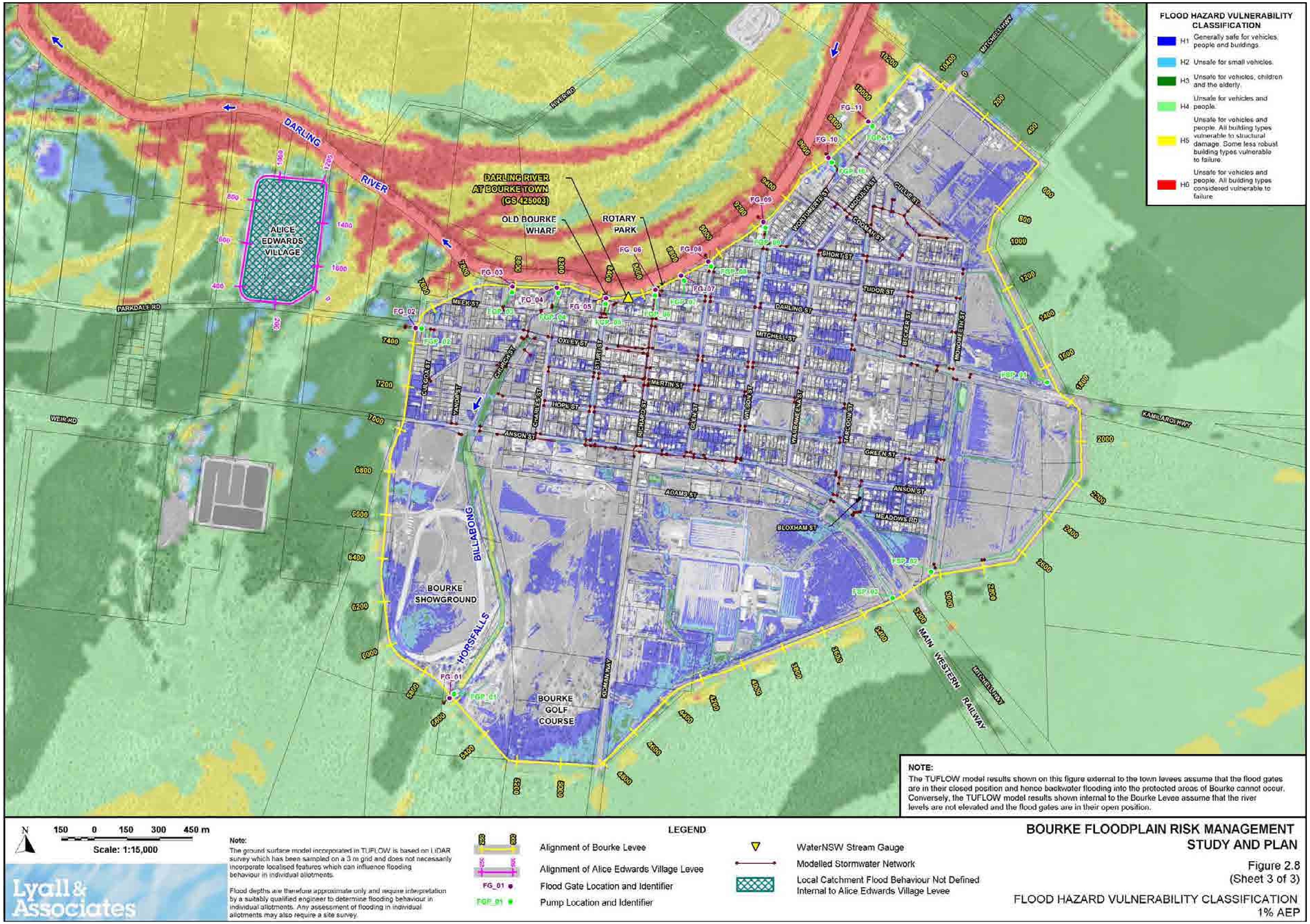

COMMUNITY ASSET
Sewer Treatment Plant
Airport
Electricity Substation
Water Supply
Major Road Crossing
Telephone Exchange
EMERGENCY SERVICES
RFS Station
Police Station
F&R NSW Station
Ambulance Facility
SES Station
Evacuation Centre
VULNERABLE DEVELOPMENT
Educational Facility
Chid Care Facility
Caravan Park
Aged Care Facility
Hospital
REFER INSET
REFER SHEET 3
INSET
EXTENT OF INUNDATION
10% AEP
5% AEP
2% AEP
1% AEP
0.5% AEP
0.2% AEP
Extreme Flood
NOTE:
Extents trimmed to areas inundated to depths greater than 100mm
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
THE BIG BILLABONG
DARLING RIVER
POLYGONIUM SWAMP
HUNGERFORD RD
MITCHELL HWY
KAMILAROI HWY
WEIR RD
PARKDALE RD
RC1
RC2
RC3
RC4
RC5
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
150 0 150 300 450 m
Scale: 1:15,000
400 0 400 800 1200 m
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.7 (Sheet 2 of 3)
INDICATIVE EXTENT OF INUNDATION AND LOCATION OF VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE

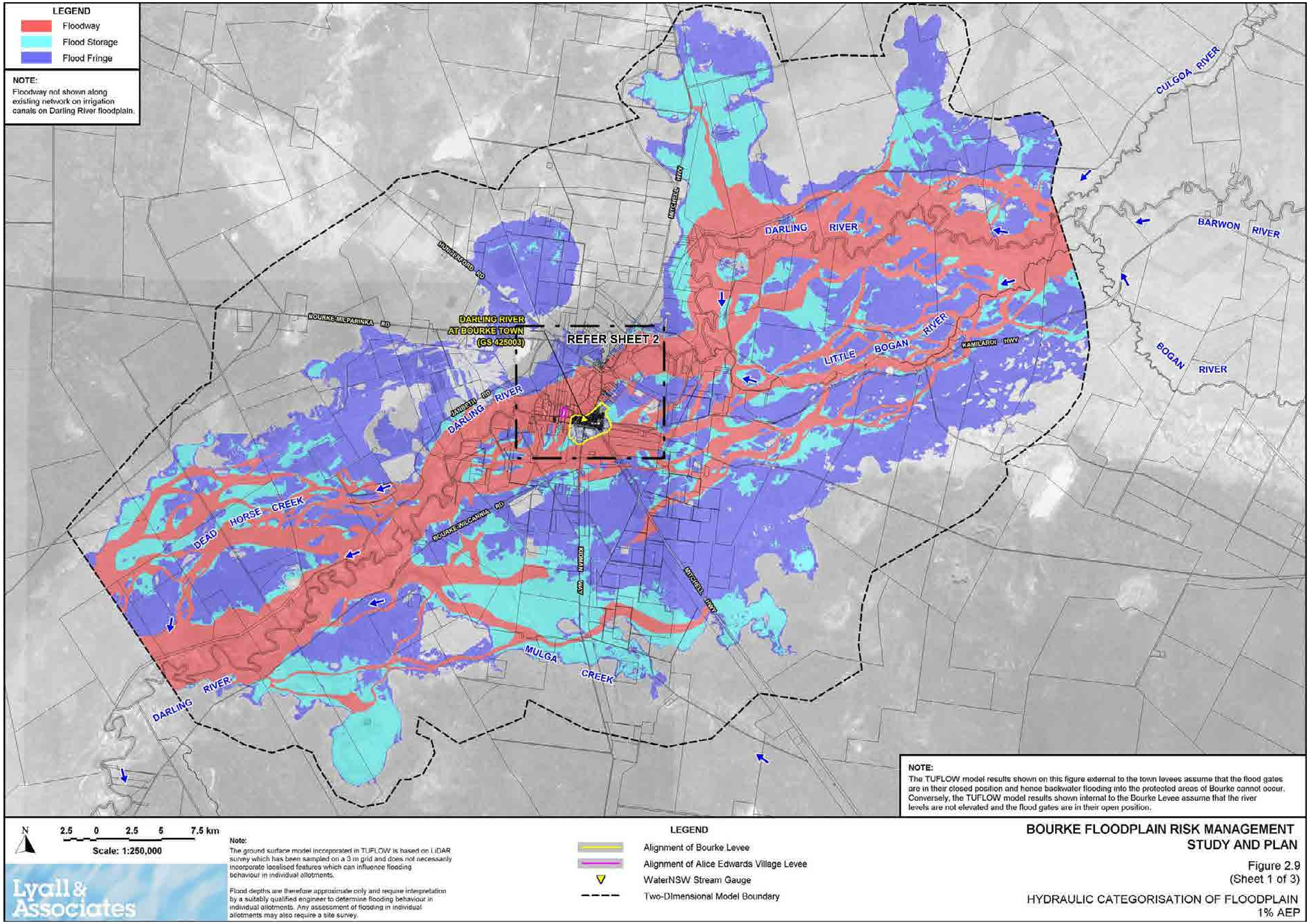

EXTENT OF INUNDATION
10% AEP
5% AEP
2% AEP
1% AEP
0.5% AEP
0.2% AEP
Extreme Flood
NOTE:
Extents trimmed to areas inundated to depths greater than 100mm.
COMMUNITY ASSET
Sewer Treatment Plant
Airport
Electricity Substation
Water Supply
Major Road Crossing
Telephone Exchange
EMERGENCY SERVICES
RFS Station
Police Station
F&R NSW Station
Ambulance Facility
SES Station
Evacuation Centre
VULNERABLE DEVELOPMENT
Educational Facility
Chid Care Facility
Caravan Park
Aged Care Facility
Hospital
DARLING RIVER
ALICE EDWARDS VILLAGE
OLD BOURKE WHARF
ROTARY PARK
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
KIDMAN WAY
MEEK ST
OXLEY ST
HOPE ST
ANSON ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
GREEN ST
MERTIN ST
MITCHELL ST
DARLING ST
TUDOR ST
SHORT ST
CULGOA ST
YANDA ST
CHURCH ST
CHARLES ST
STURT ST
RICHARD ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
BECKER ST
MONO MEETH ST
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
300 0 300 600 900 m
Scale: 1:30,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.7
(Sheet 3 of 3)
INDICATIVE EXTENT OF INUNDATION AND LOCATION OF VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE

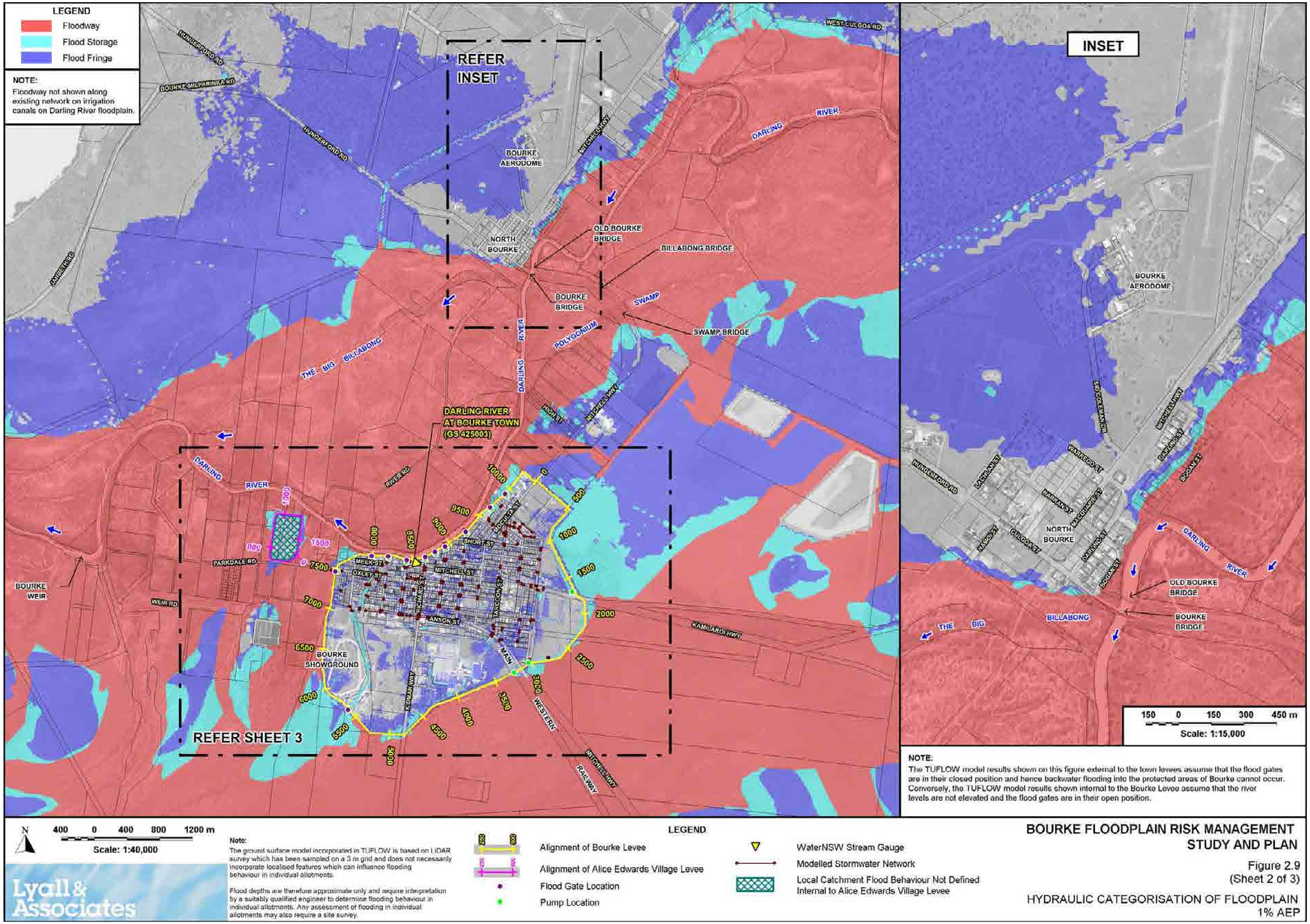


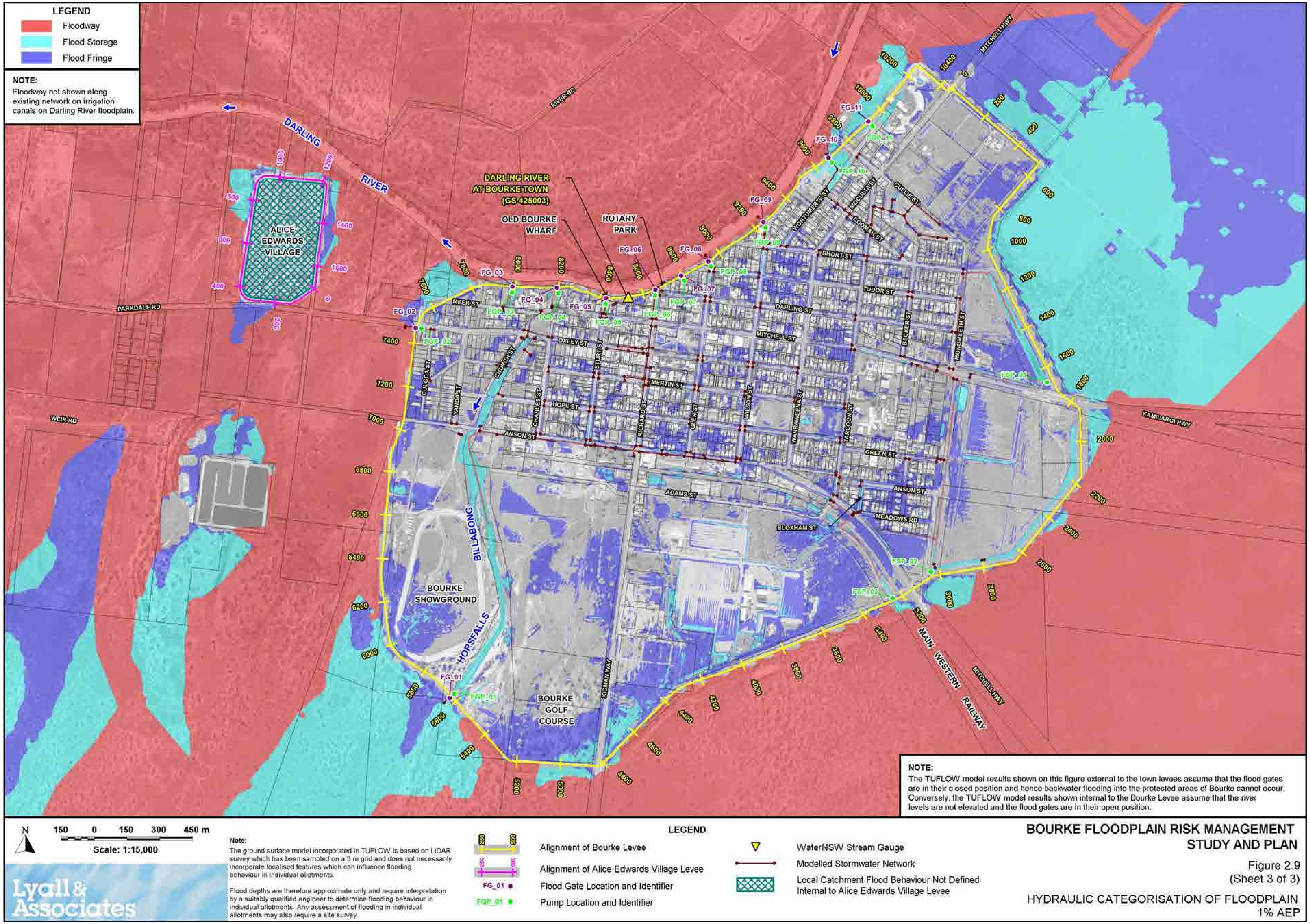
FLOOD HAZARD VULNERABILITY CLASSIFICATION
H1 Generally safe for vehicles, people and buildings.
H2 Unsafe for small vehicles.
H3 Unsafe for vehicles, children and the elderly.
H4 Unsafe for vehicles and people.
H5 Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6 Unsafe for vehicles and people. All building types considered vulnerable to failure.
CULGOA RIVER
BARWON RIVER
DARLING RIVER
BOGAN RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
JANDRA RD
BOURKE-WILCANNIA RD
DEAD HORSE CREEK
KIDMAN WAY
MULGA CREEK
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.8
(Sheet 1 of 3)
FLOOD HAZARD VULNERABILITY CLASSIFICATION
1% AEP

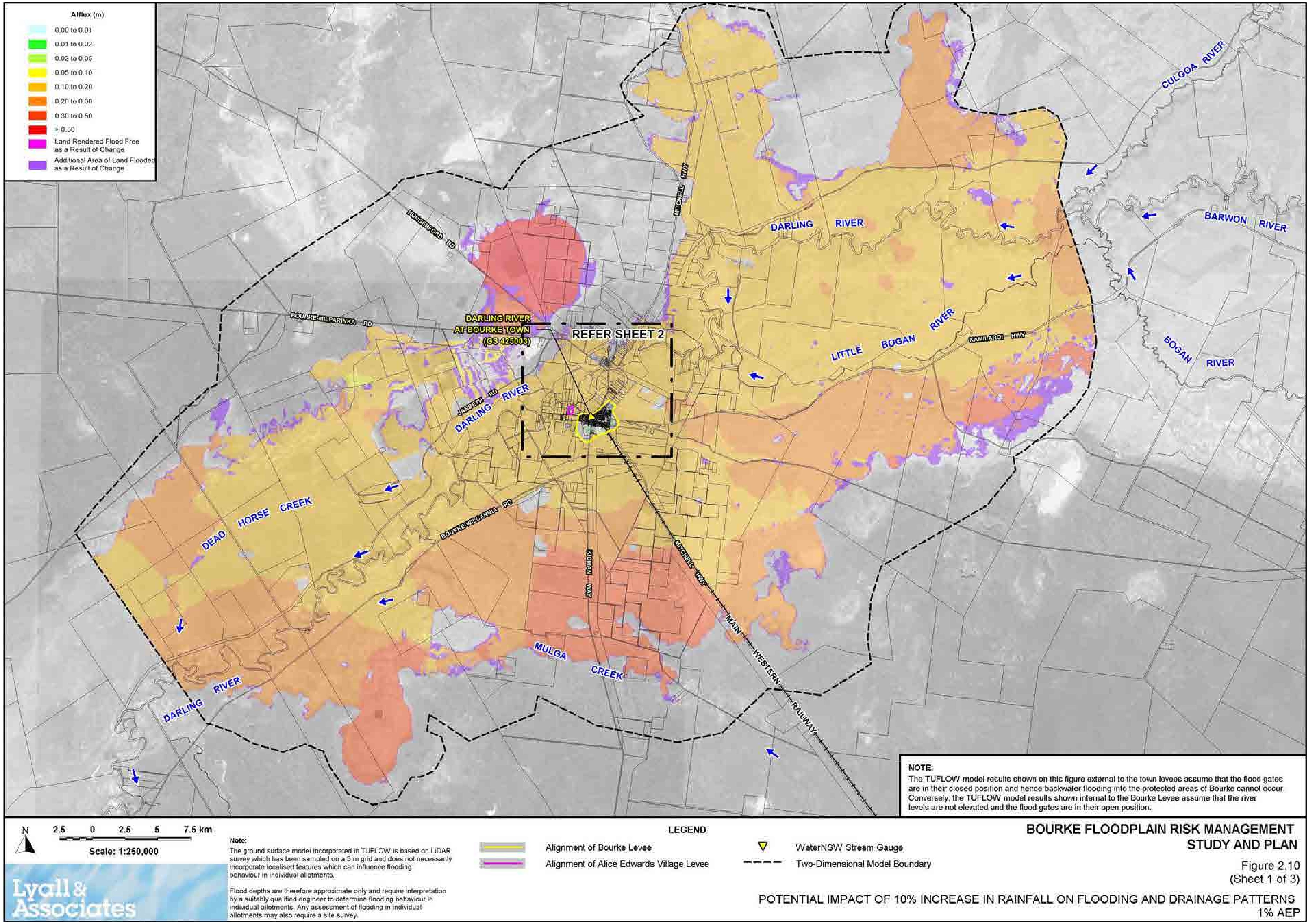

FLOOD HAZARD VULNERABILITY CLASSIFICATION
H1 Generally safe for vehicles, people and buildings.
H2 Unsafe for small vehicles.
H3 Unsafe for vehicles, children and the elderly.
H4 Unsafe for vehicles and people.
H5 Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6 Unsafe for vehicles and people. All building types considered vulnerable to failure.
HUNGERFORD RD
BOURKE MILPARINKA RD
WEST CULGOA RD
BOURKE AERODOME
MITCHELL HWY
DARLING RIVER
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
POLYGONUM SWAMP
THE BIG BILLABONG
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 3
HIGH ST
RIVER RD
PARKDALE RD
MEEK ST
OXLEY ST
SHORT ST
MITCHELL ST
RICHARD ST
ANSON ST
MAIN
BOURKE WEIR
WEIR RD
BOURKE SHOWGROUND
KIDMAN WAY
KAMILAROI HWY
WESTERN RAILWAY
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
400 0 400 800 1200
Scale: 1:40,000
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.8
(Sheet 2 of 3)
FLOOD HAZARD VULNERABILITY CLASSIFICATION
1% AEP

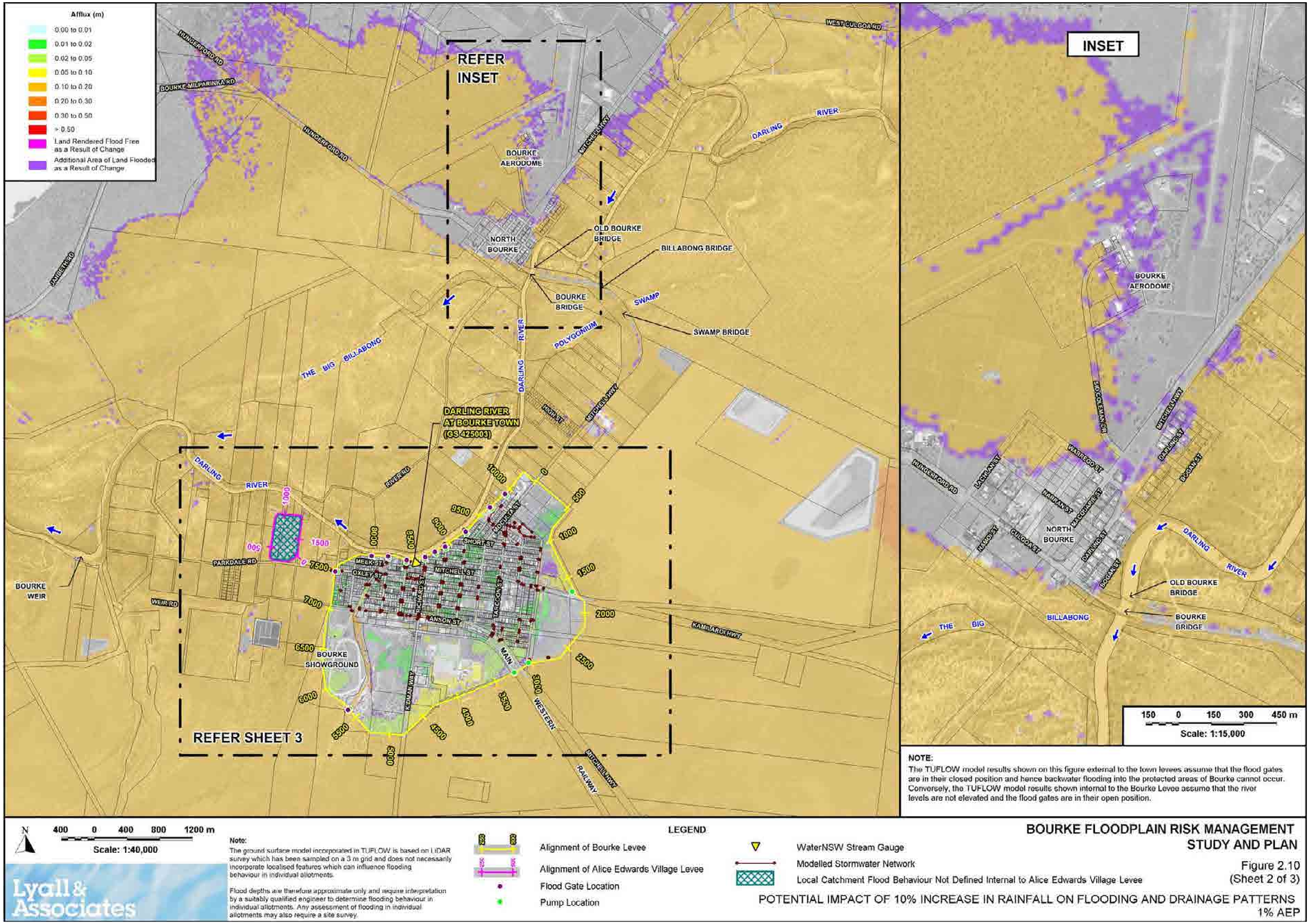

FLOOD HAZARD VULNERABILITY CLASSIFICATION
H1 Generally safe for vehicles, people and buildings.
H2 Unsafe for small vehicles.
H3 Unsafe for vehicles, children and the elderly.
H4 Unsafe for vehicles and people.
H5 Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6 Unsafe for vehicles and people. All building types considered vulnerable to failure.
DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
BOURKE SHOWGROUND
BOURKE GOLF COURSE
BILLABONG
HORSFALLS
MAIN WESTERN RAILWAY
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
MEEK ST
OXLEY ST
MERTIN ST
HOPE ST
ANSON ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
GREEN ST
DARLING ST
MITCHELL ST
TUDOR ST
SHORT ST
RICHARD ST
STURT ST
GLEN ST
WILSON ST
CULGOA ST
YANDA ST
CHURCH ST
CHARLES ST
BECKER ST
MONONEETH ST
KIDMAN WAY
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
150 0 150 300 450 m
Scale: 1:15,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
FG_01 Flood Gate Location and Identifier
FGP_01 Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.8
(Sheet 3 of 3)
FLOOD HAZARD VULNERABILITY CLASSIFICATION
1% AEP

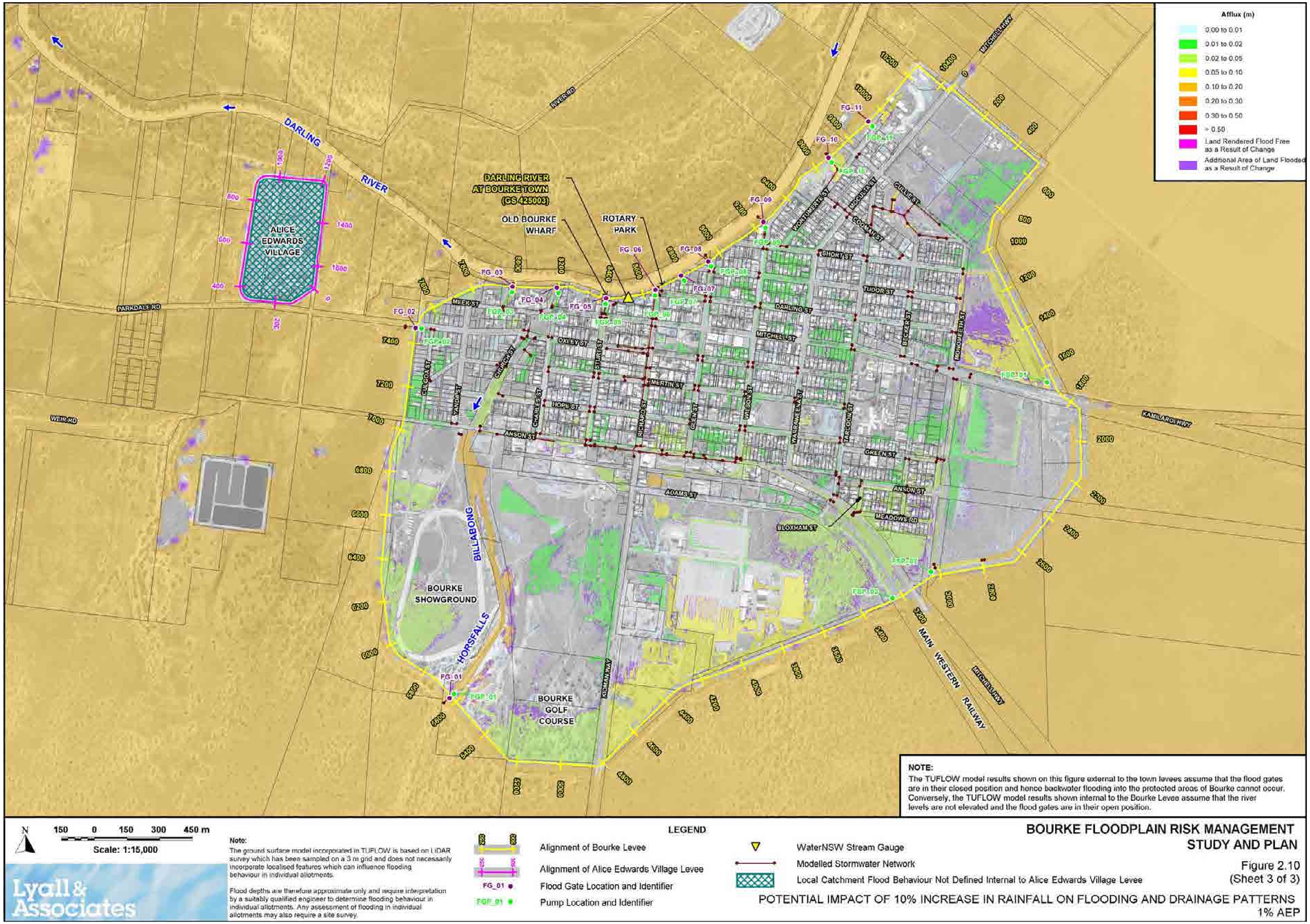

LEGEND
Floodway
Flood Storage
Flood Fringe
NOTE:
Floodway not shown along existing network on irrigation canals on Darling River floodplain.
CULGOA RIVER
BARWON RIVER
DARLING RIVER
BOGAN RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
JANDRA RD
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MULGA CREEK
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.9
(Sheet 1 of 3)
HYDRAULIC CATEGORISATION OF FLOODPLAIN
1% AEP


LEGEND
Floodway
Flood Storage
Flood Fringe
NOTE:
Floodway not shown along existing network on irrigation canals on Darling River floodplain.
REFER INSET
INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
THE BIG BILLABONG
DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
REFER SHEET 3
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
Scale: 1:15,000
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.9
(Sheet 2 of 3)
HYDRAULIC CATEGORISATION OF FLOODPLAIN
1% AEP

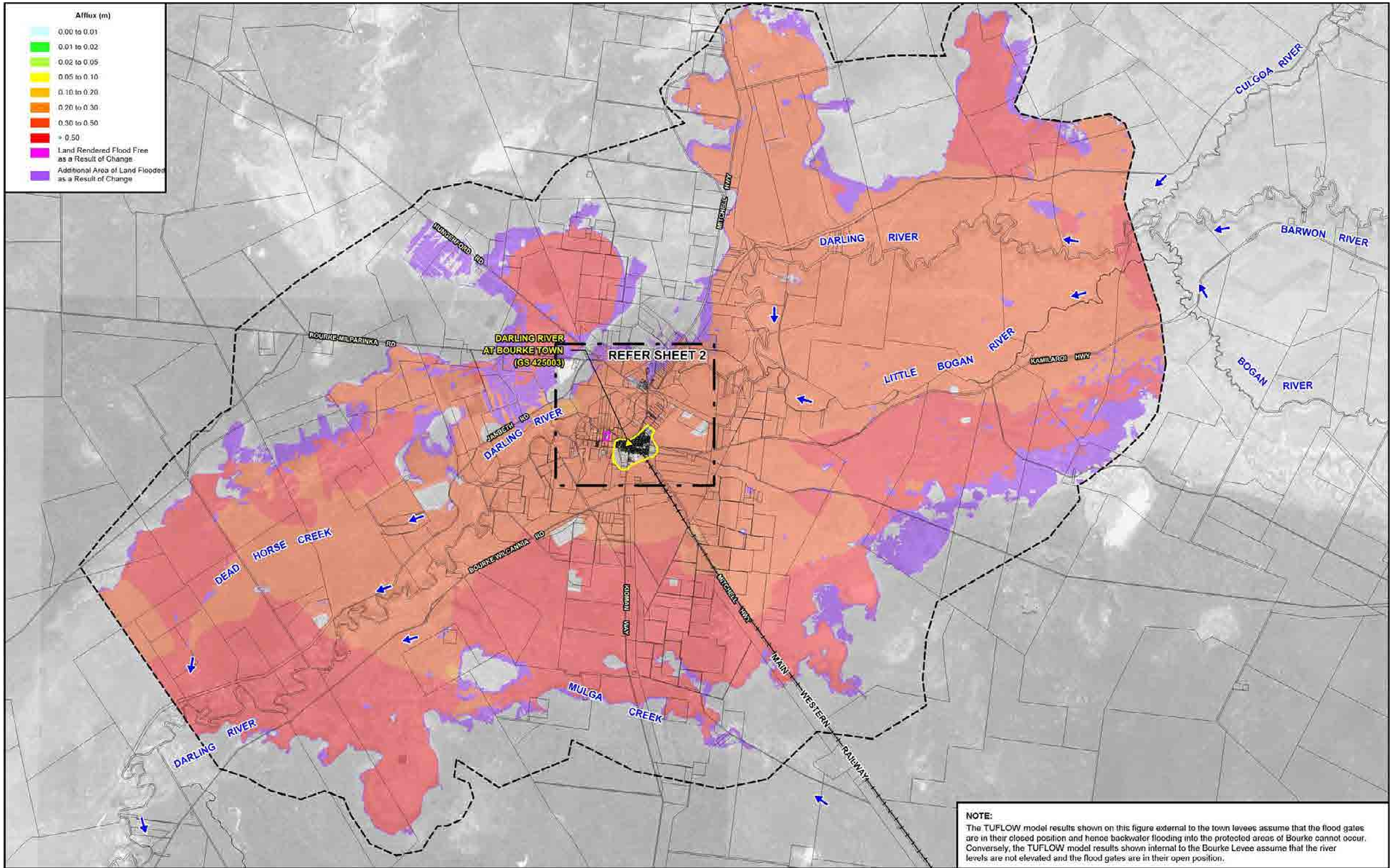

LEGEND
Floodway
Flood Storage
Flood Fringe
NOTE:
Floodway not shown along existing network on irrigation canals on Darling River floodplain.
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
MEEK ST
OXLEY ST
MERTIN ST
HOPE ST
ANSON ST
DARLING ST
MITCHELL ST
SHORT ST
TUDOR ST
GREEN ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
FG_01 Flood Gate Location and Identifier
FGP_01 Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.9
(Sheet 3 of 3)
HYDRAULIC CATEGORISATION OF FLOODPLAIN
1% AEP


Afflux (m)
0.00 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.50
> 0.50
Land Rendered Flood Free as a Result of Change
Additional Area of Land Flooded as a Result of Change
CULGOA RIVER
BARWON RIVER
DARLING RIVER
BOGAN RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MULGA CREEK
MAIN WESTERN RAILWAY
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.10
(Sheet 1 of 3)
POTENTIAL IMPACT OF 10% INCREASE IN RAINFALL ON FLOODING AND DRAINAGE PATTERNS
1% AEP


Afflux (m)
0.00 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.50
> 0.50
Land Rendered Flood Free as a Result of Change
Additional Area of Land Flooded as a Result of Change
REFER INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
DARLING RIVER
THE BIG BILLABONG
POLYGONUM SWAMP
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
REFER SHEET 3
INSET
150 0 150 300 450 m
Scale: 1:15,000
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
400 0 400 800 1200 m
Scale: 1:40,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.10
(Sheet 2 of 3)
POTENTIAL IMPACT OF 10% INCREASE IN RAINFALL ON FLOODING AND DRAINAGE PATTERNS
1% AEP



Afflux (m)
0.00 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.50
> 0.50
Land Rendered Flood Free as a Result of Change
Additional Area of Land Flooded as a Result of Change
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
BOURKE SHOWGROUND
BILLABONG
HORSFALLS
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
KAMILAROI HWY
MITCHELL HWY
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.10 (Sheet 3 of 3)
POTENTIAL IMPACT OF 10% INCREASE IN RAINFALL ON FLOODING AND DRAINAGE PATTERNS
1% AEP



N

2.5 0 2.5 5 7.5 km

Scale: 1:250,000

Lyall & Associates

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.

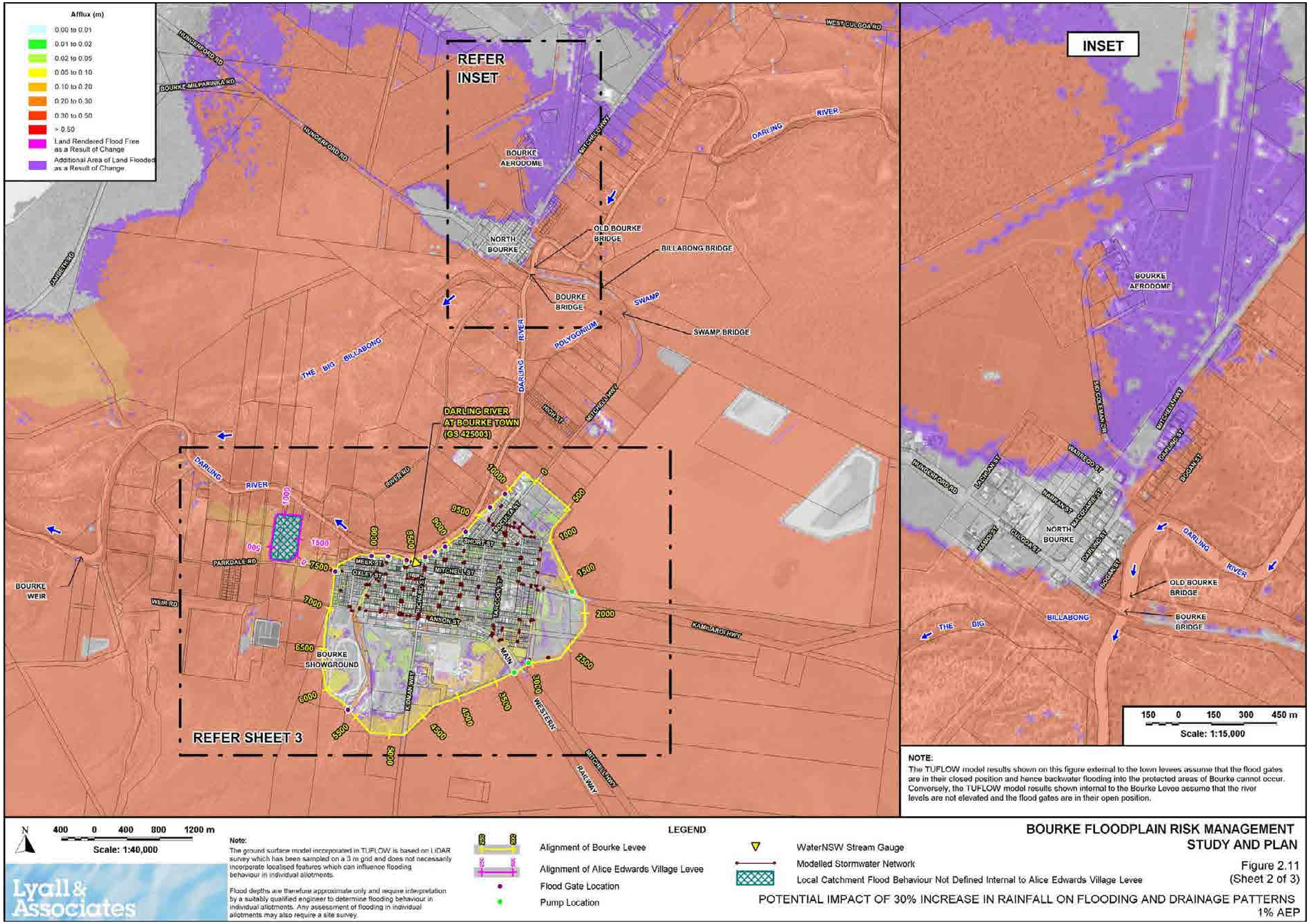
LEGEND

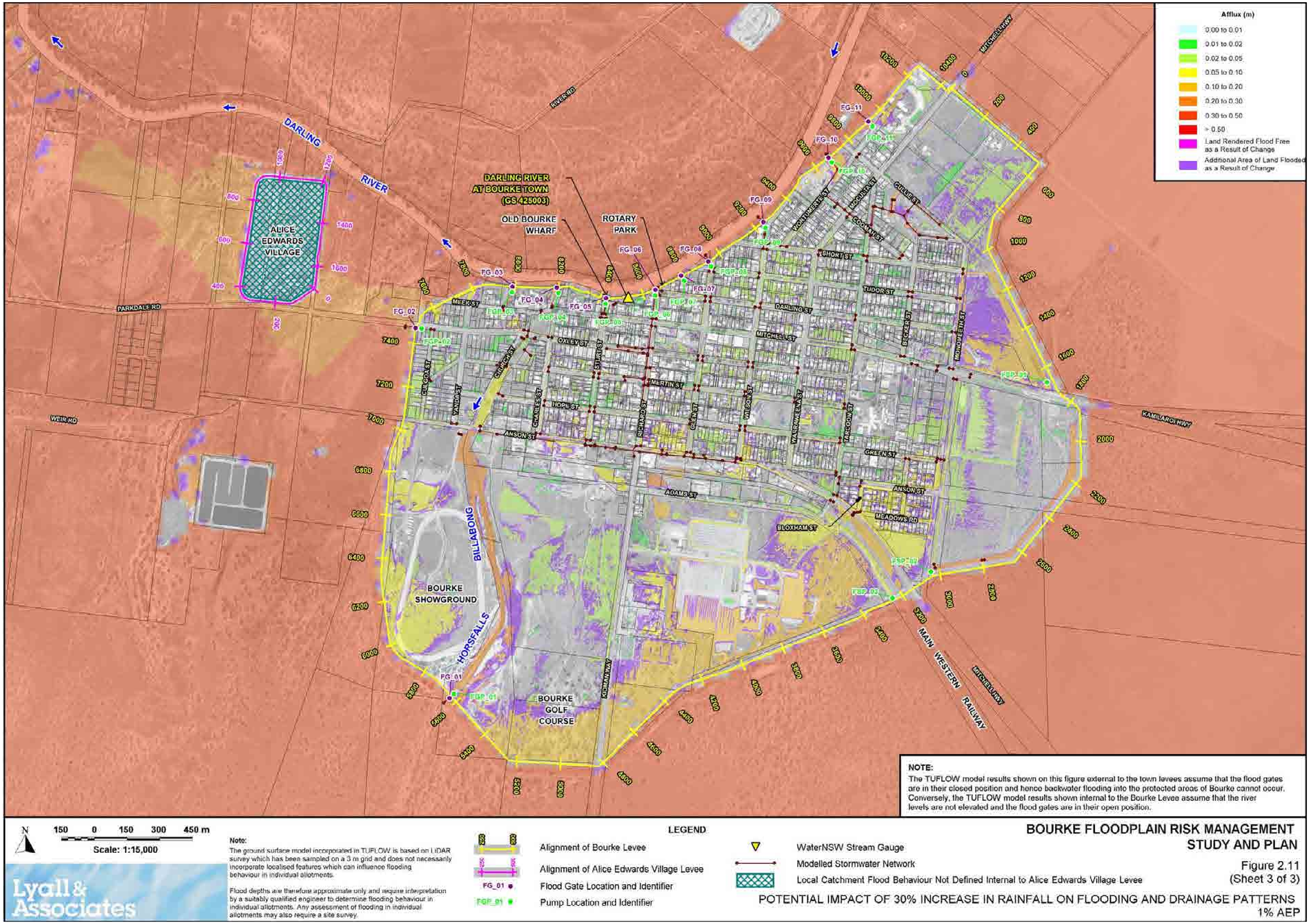
- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- WaterNSW Stream Gauge
- Two-Dimensional Model Boundary

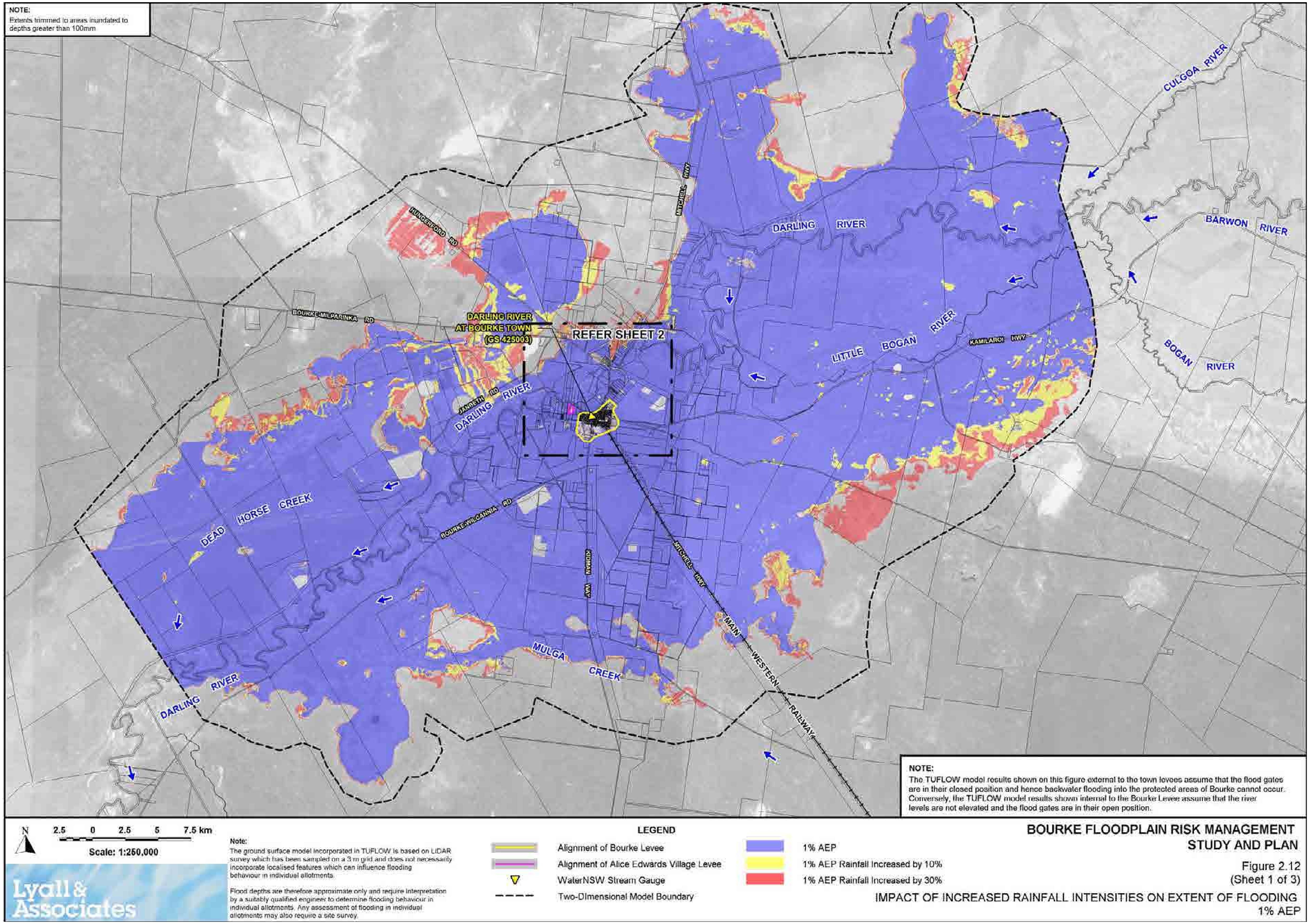
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.11
(Sheet 1 of 3)

POTENTIAL IMPACT OF 30% INCREASE IN RAINFALL ON FLOODING AND DRAINAGE PATTERNS
1% AEP


Afflux (m)
0.00 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.50
> 0.50
Land Rendered Flood Free as a Result of Change
Additional Area of Land Flooded as a Result of Change
REFER INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
THE BIG BILLABONG
POLYGONUM SWAMP
DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
REFER SHEET 3
HUNGERFORD RD
BOURKE-MILPARINKA RD
WEST CULGOA RD
MITCHELL HWY
KAMILAROI HWY
PARKDALE RD
WEIR RD
RIVER RD
RAILWAY
INSET
150 0 150 300 450 m
Scale: 1:15,000
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
400 0 400 800 1200 m
Scale: 1:40,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.11 (Sheet 2 of 3)
POTENTIAL IMPACT OF 30% INCREASE IN RAINFALL ON FLOODING AND DRAINAGE PATTERNS
1% AEP


Afflux (m)
0.00 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.50
> 0.50
Land Rendered Flood Free as a Result of Change
Additional Area of Land Flooded as a Result of Change
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
MAIN WESTERN RAILWAY
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
150 0 150 300 450 m
Scale: 1:15,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
FG_01 Flood Gate Location and Identifier
FGP_01 Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.11 (Sheet 3 of 3)
POTENTIAL IMPACT OF 30% INCREASE IN RAINFALL ON FLOODING AND DRAINAGE PATTERNS
1% AEP



Note:
The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 3 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.

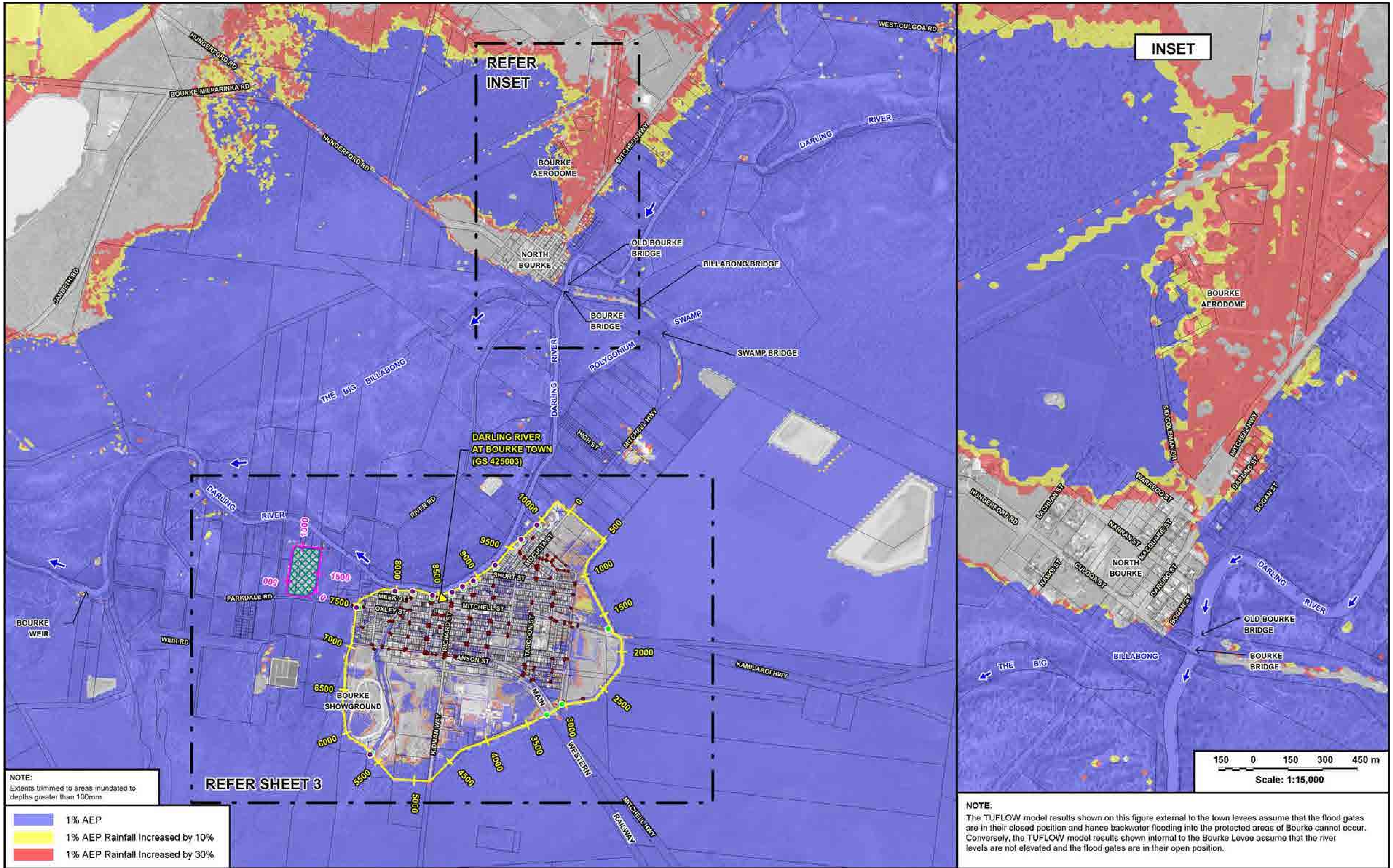
LEGEND

- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- WaterNSW Stream Gauge
- Two-Dimensional Model Boundary
- 1% AEP
- 1% AEP Rainfall Increased by 10%
- 1% AEP Rainfall Increased by 30%

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.12
(Sheet 1 of 3)

IMPACT OF INCREASED RAINFALL INTENSITIES ON EXTENT OF FLOODING
1% AEP



N 400 0 400 800 1200 m
Scale: 1:40,000

Lyall & Associates

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.

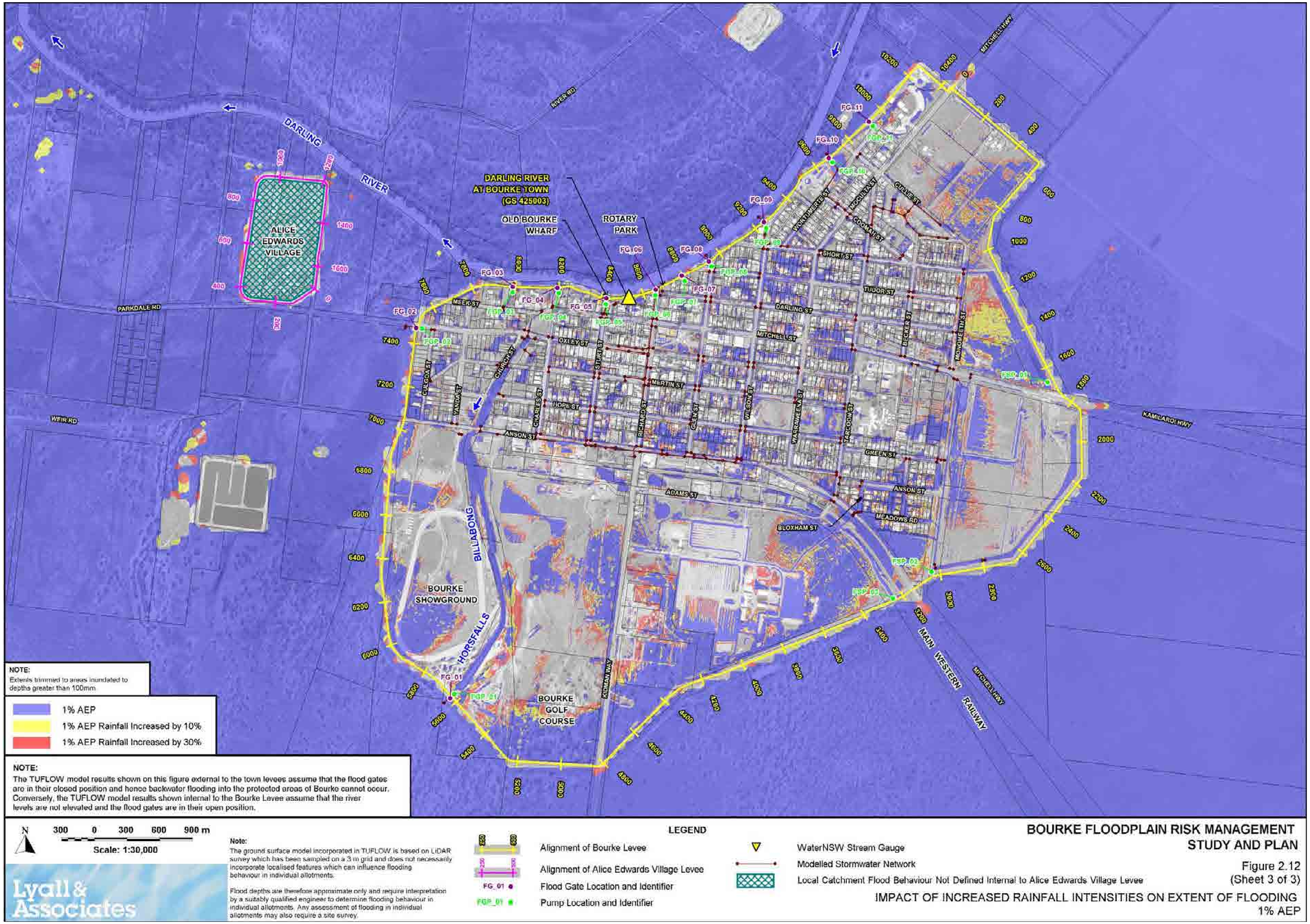
LEGEND

- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- Flood Gate Location
- Pump Location
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.12
(Sheet 2 of 3)

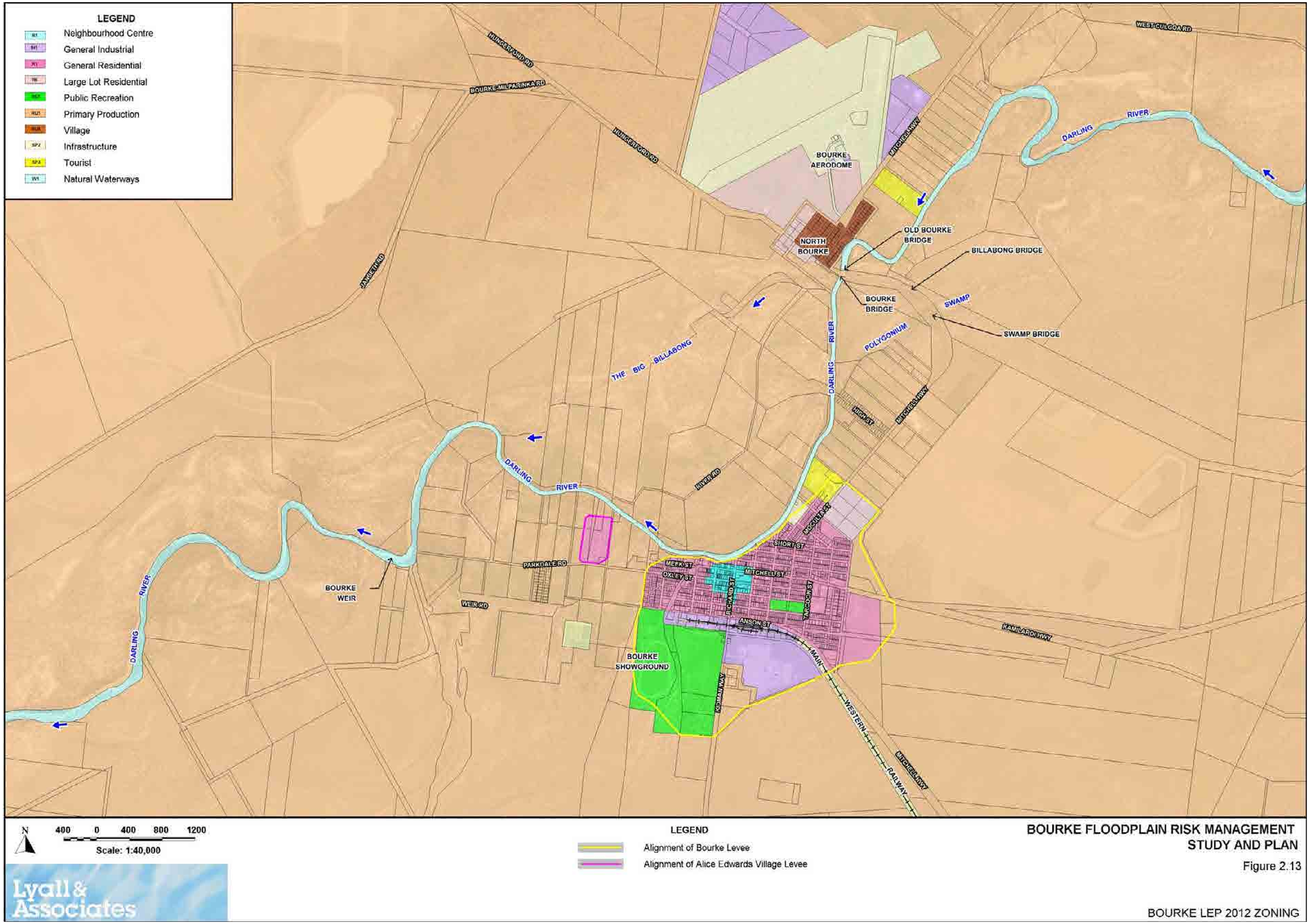
IMPACT OF INCREASED RAINFALL INTENSITIES ON EXTENT OF FLOODING
1% AEP



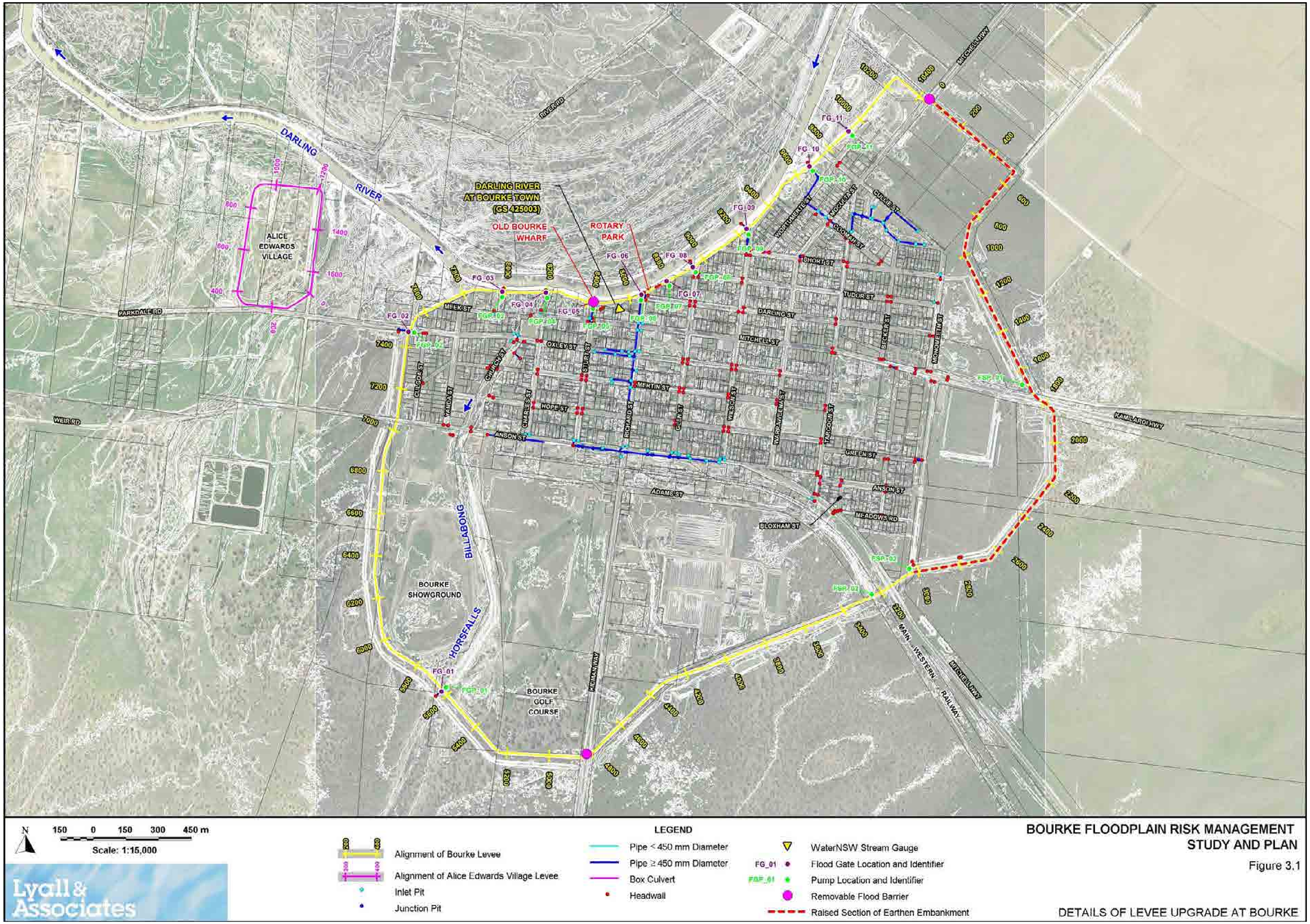
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

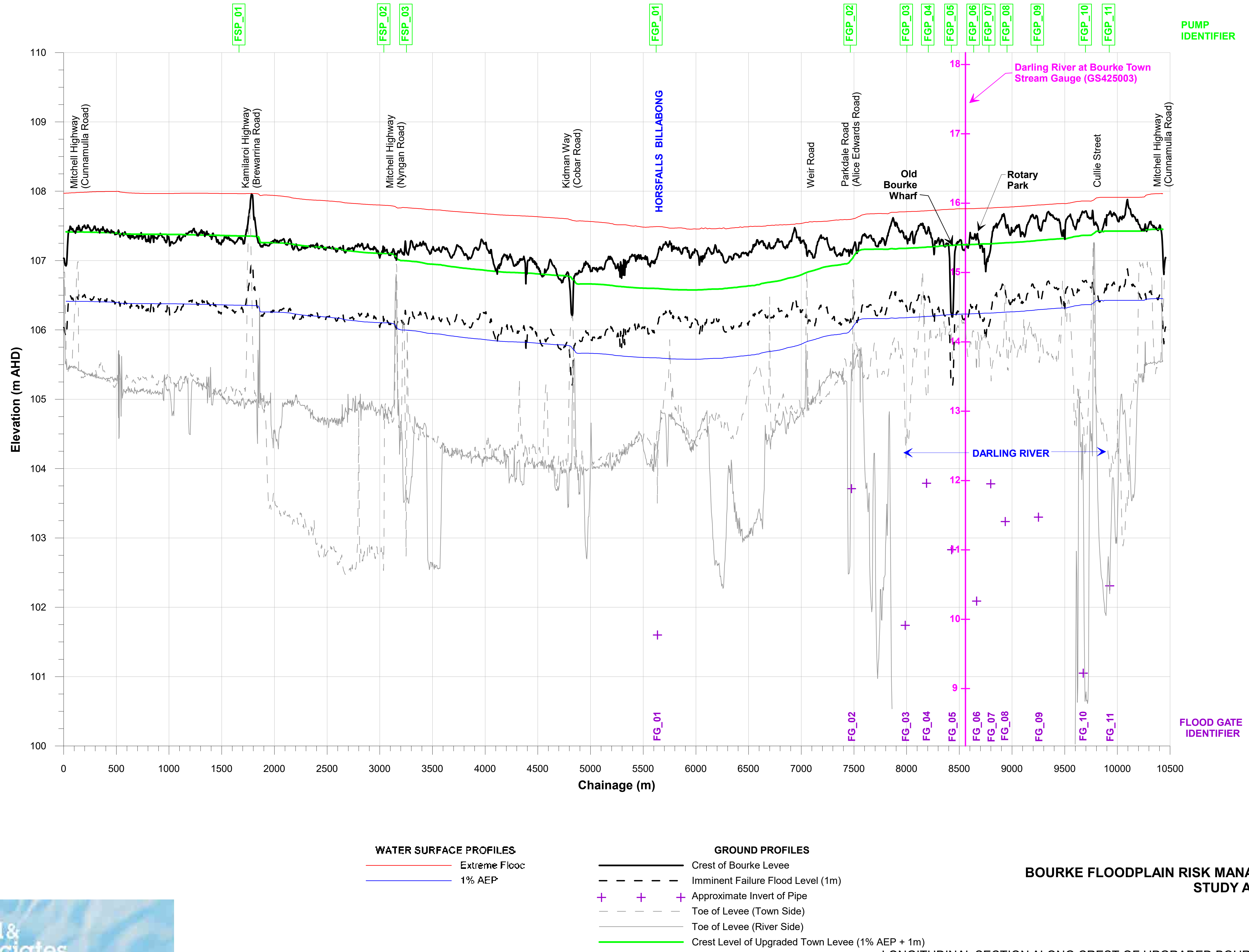
Figure 2.12 (Sheet 3 of 3)

IMPACT OF INCREASED RAINFALL INTENSITIES ON EXTENT OF FLOODING 1% AEP



LEGEND
Neighbourhood Centre
General Industrial
General Residential
Large Lot Residential
Public Recreation
Primary Production
Village
Infrastructure
Tourist
Natural Waterways
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
POLYGONUM SWAMP
THE BIG BILLABONG
DARLING RIVER
BOURKE WEIR
BOURKE SHOWGROUND
MAIN WESTERN RAILWAY
MITCHELL HWY
KAMILAROI HWY
HUNGERFORD RD
BOURKE MILPARINKA RD
WEST CULGOA RD
PARKDALE RD
WEIR RD
RIVER RD
MEEK ST
OXLEY ST
MITCHELL ST
SHORT ST
RICHARD ST
ANSON ST
TARCOON ST
HIGH ST
KIDMAN WAY
400 0 400 800 1200
Scale: 1:40,000
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 2.13
BOURKE LEP 2012 ZONING
Lyall & Associates


DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
MAIN WESTERN RAILWAY
MEEK ST
OXLEY ST
STURT ST
MERTIN ST
HOPE ST
ANSON ST
ADAMS ST
BLOXHAM ST
DARLING ST
MITCHELL ST
TUDOR ST
SHORT ST
GREEN ST
MEADOWS RD
BECKER ST
CULGOA ST
YANDA ST
CHURCH ST
CHARLES ST
RICHARD ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
WORTUMERTIE ST
MONCRIEFF ST
CULLIE ST
HERMAN WAY
N
150 0 150 300 450 m
Scale: 1:15,000
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Inlet Pit
Junction Pit
Pipe < 450 mm Diameter
Pipe ≥ 450 mm Diameter
Box Culvert
Headwall
WaterNSW Stream Gauge
Flood Gate Location and Identifier
Pump Location and Identifier
Removable Flood Barrier
Raised Section of Earthen Embankment
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 3.1
DETAILS OF LEVEE UPGRADE AT BOURKE

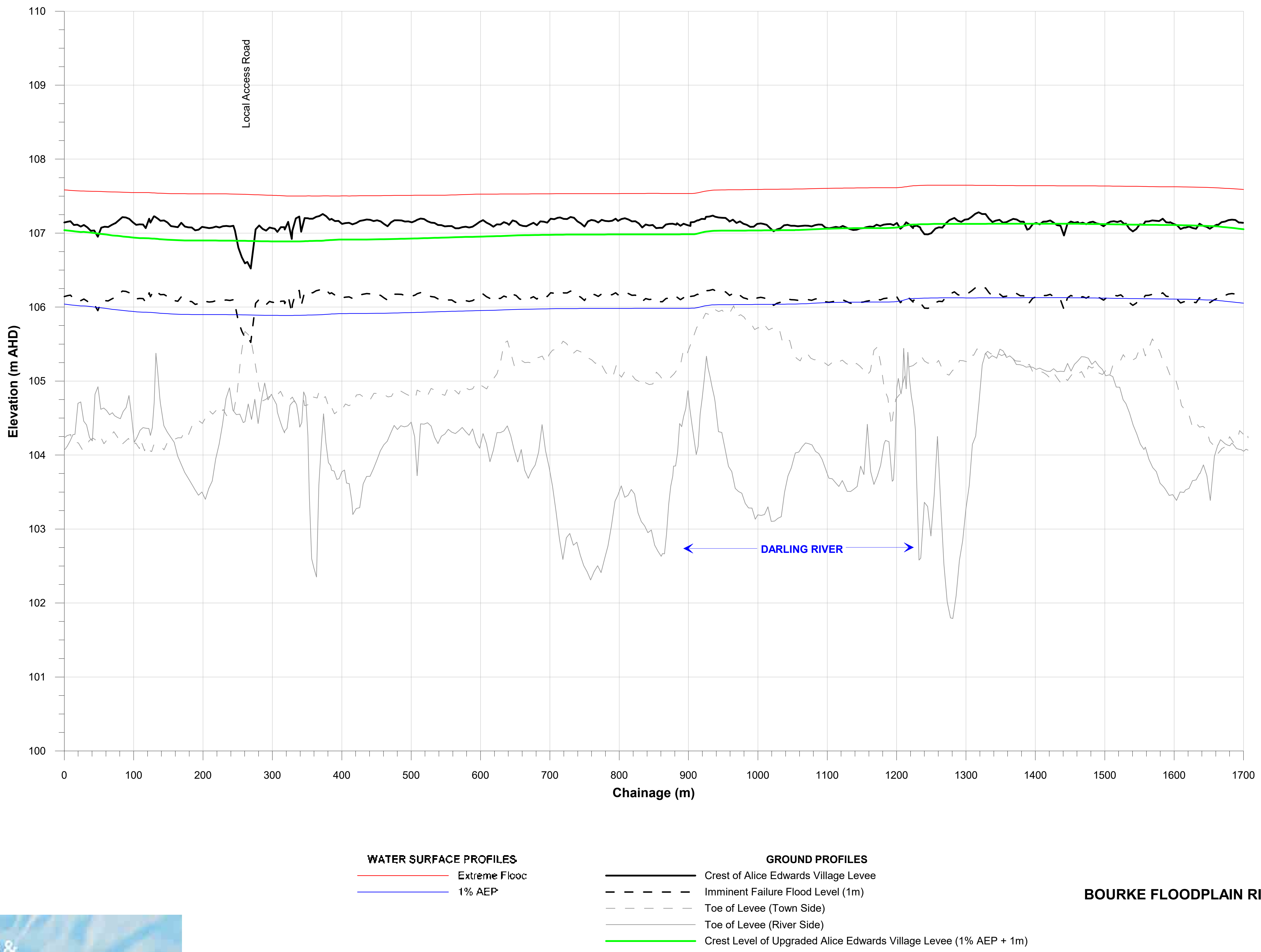


Lyall & Associates

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 3.2

LONGITUDINAL SECTION ALONG CREST OF UPGRADED BOURKE LEVEE

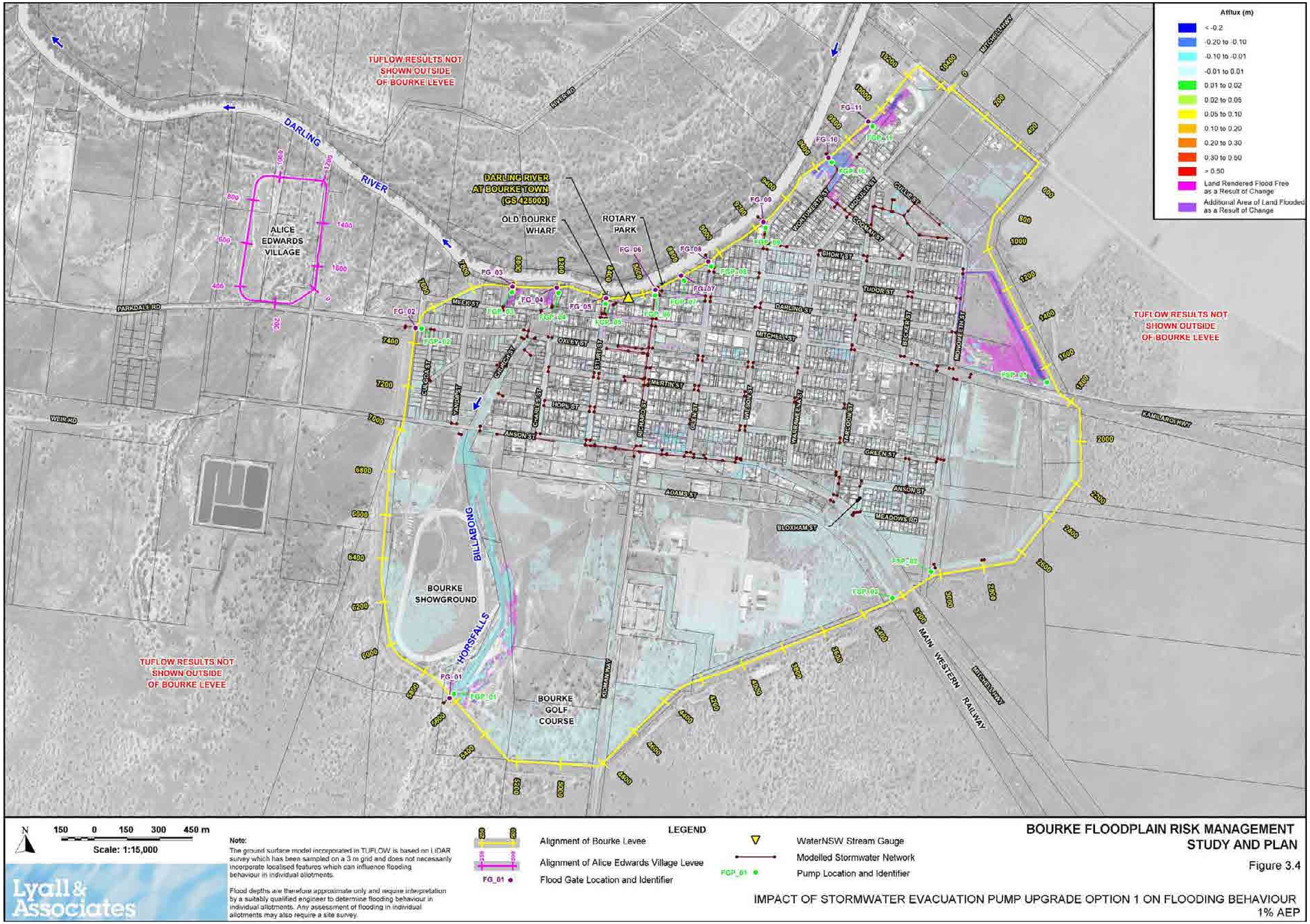


Lyall & Associates

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 3.3

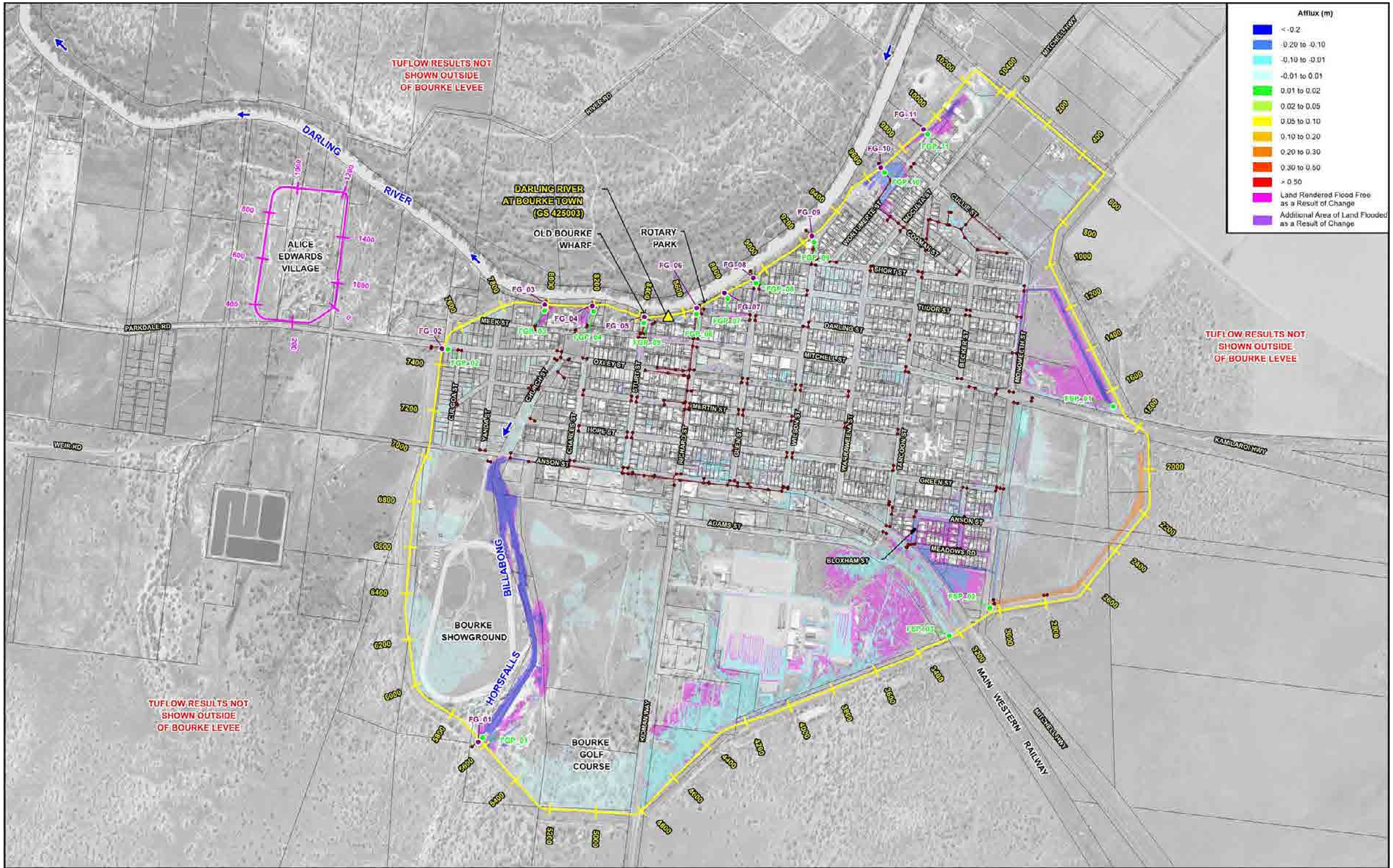
LONGITUDINAL SECTION ALONG CREST OF UPGRADED ALICE EDWARDS VILLAGE LEVEE



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 3.4

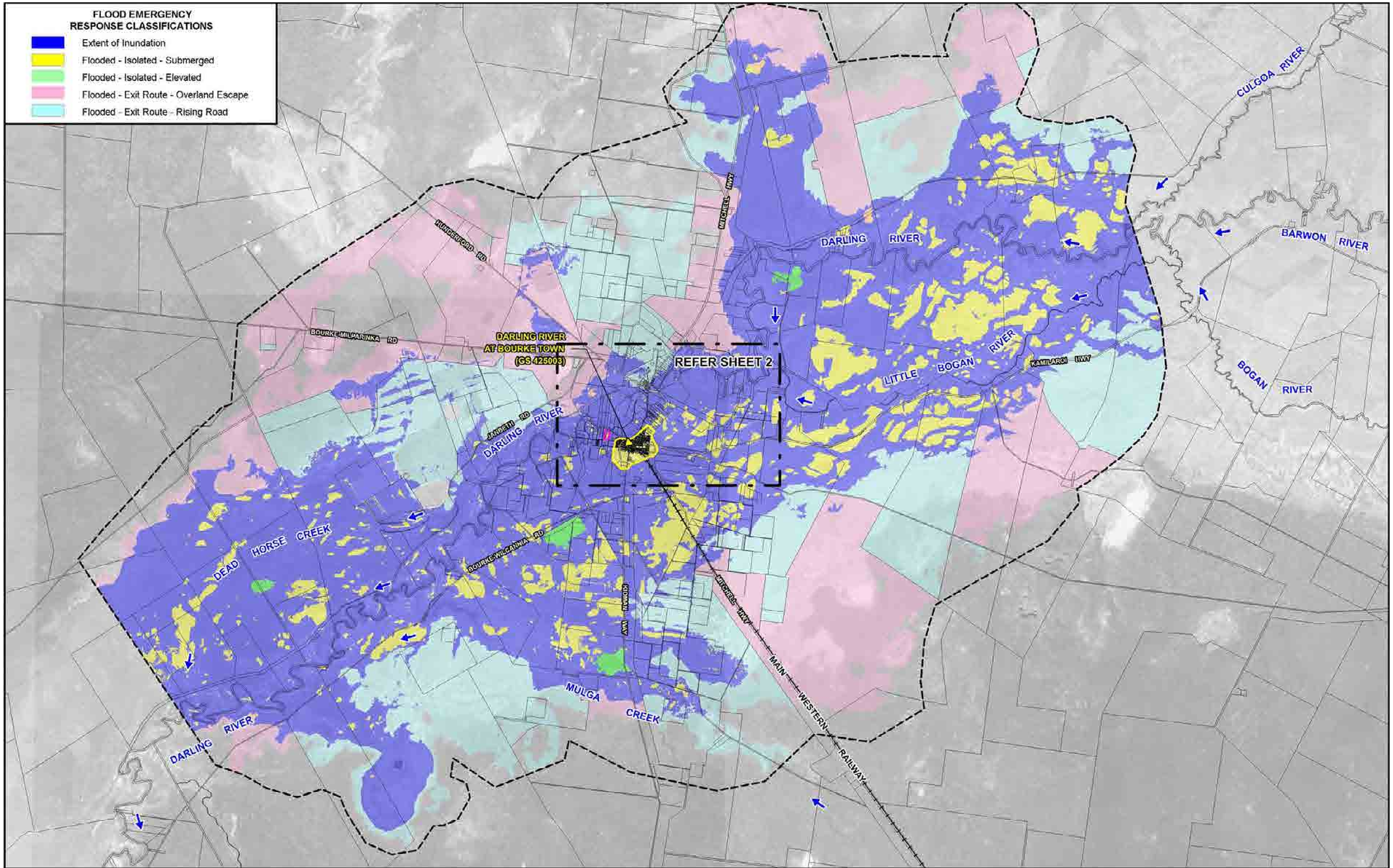
IMPACT OF STORMWATER EVACUATION PUMP UPGRADE OPTION 1 ON FLOODING BEHAVIOUR 1% AEP



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 3.5

IMPACT OF FLOOD EVACUATION PUMP UPGRADE OPTION 2 ON FLOODING BEHAVIOUR 1% AEP



N 2.5 0 2.5 5 7.5 km
Scale: 1:250,000

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

Lyall & Associates

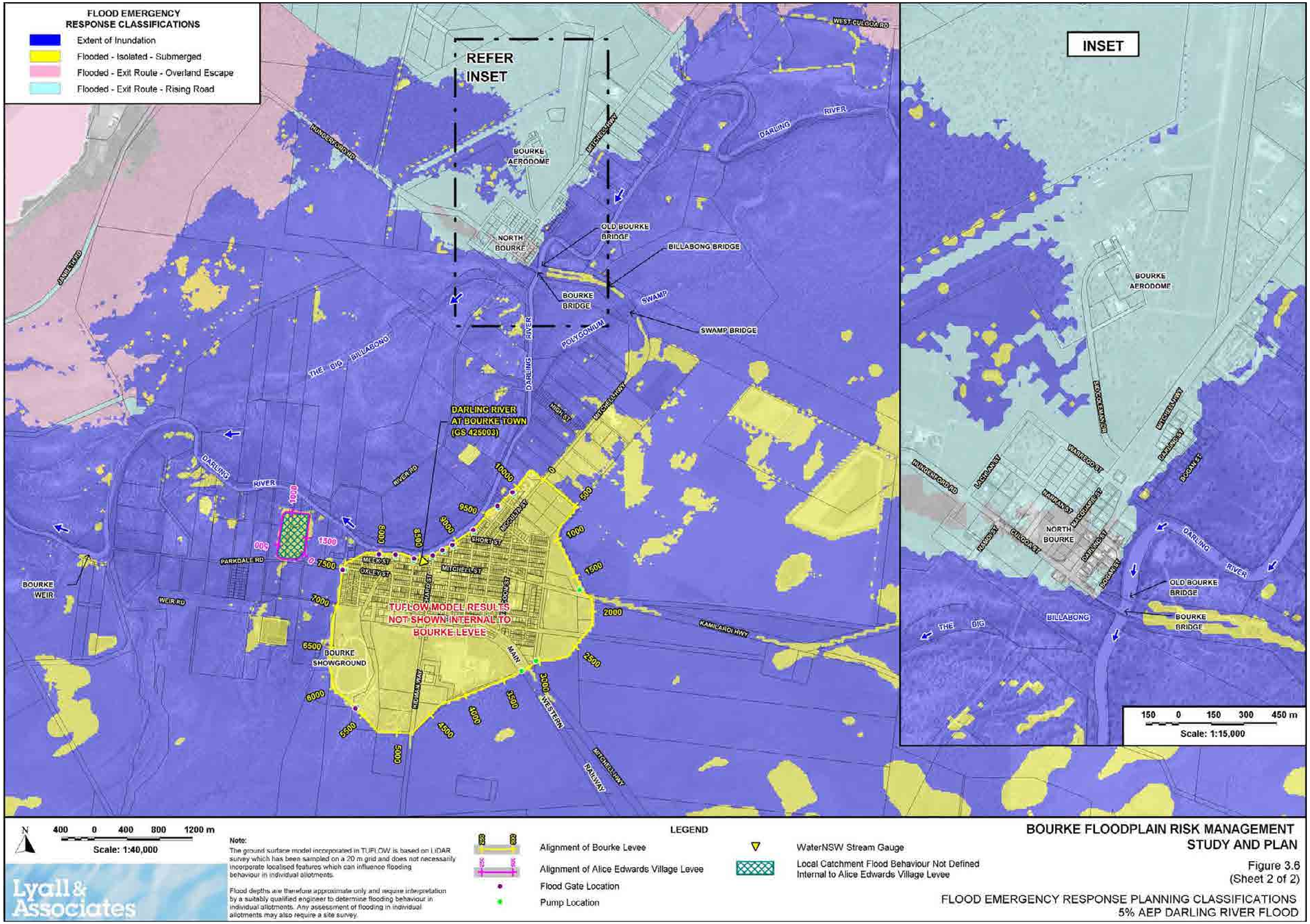
LEGEND

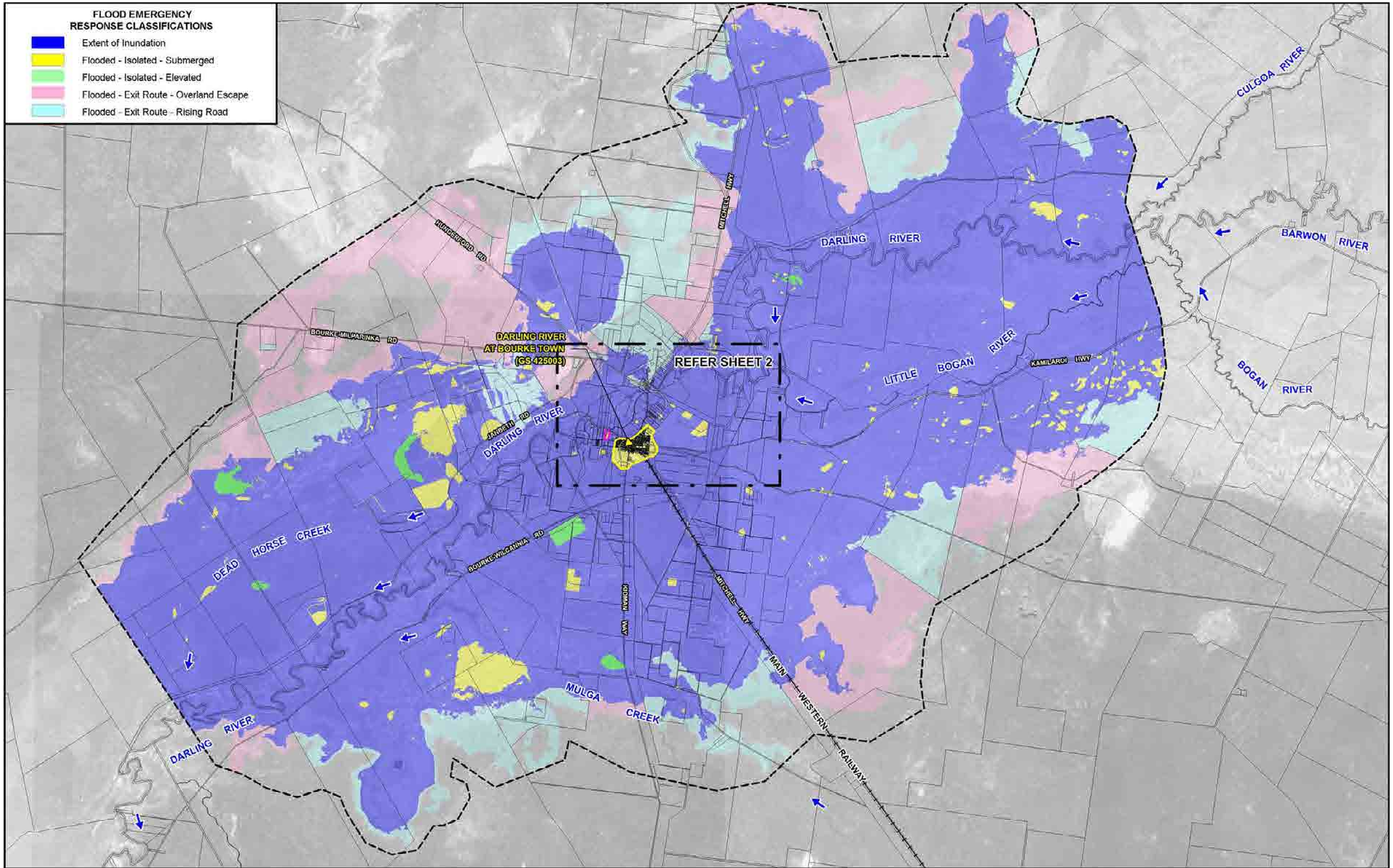
- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- WaterNSW Stream Gauge
- Two-Dimensional Model Boundary

BOURKE FLOODPLAIN RISK MANAGEMENT
STUDY AND PLAN

Figure 3.6
(Sheet 1 of 2)

FLOOD EMERGENCY RESPONSE PLANNING CLASSIFICATIONS
5% AEP DARLING RIVER FLOOD


FLOOD EMERGENCY RESPONSE CLASSIFICATIONS
Extent of Inundation
Flooded - Isolated - Submerged
Flooded - Exit Route - Overland Escape
Flooded - Exit Route - Rising Road
REFER INSET
INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
SWAMP
POLYGONUM
DARLING RIVER
THE BIG BILLABONG
HUNGERFORD RD
MITCHELL HWY
WEST CULGOA RD
JANBETH RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
TUFLOW MODEL RESULTS NOT SHOWN INTERNAL TO BOURKE LEVEE
BOURKE WEIR
PARKDALE RD
WEIR RD
BOURKE SHOWGROUND
KAMILAROI HWY
WESTERN
RAILWAY
MITCHELL ST
SHORT ST
OXLEY ST
MECK ST
HIGH ST
RIVER RD
HOBAN WAY
MAIN
OLD COLEMAN RD
WARREGO ST
LACHLAN ST
NAMOI ST
CULGOA ST
DARLING ST
BOGAN ST
MACQUARIE ST
BILLABONG
150 0 150 300 450 m
Scale: 1:15,000
400 0 400 800 1200 m
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 3.6
(Sheet 2 of 2)
FLOOD EMERGENCY RESPONSE PLANNING CLASSIFICATIONS
5% AEP DARLING RIVER FLOOD



Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

Lyall & Associates

LEGEND

Alignment of Bourke Levee

Alignment of Alice Edwards Village Levee

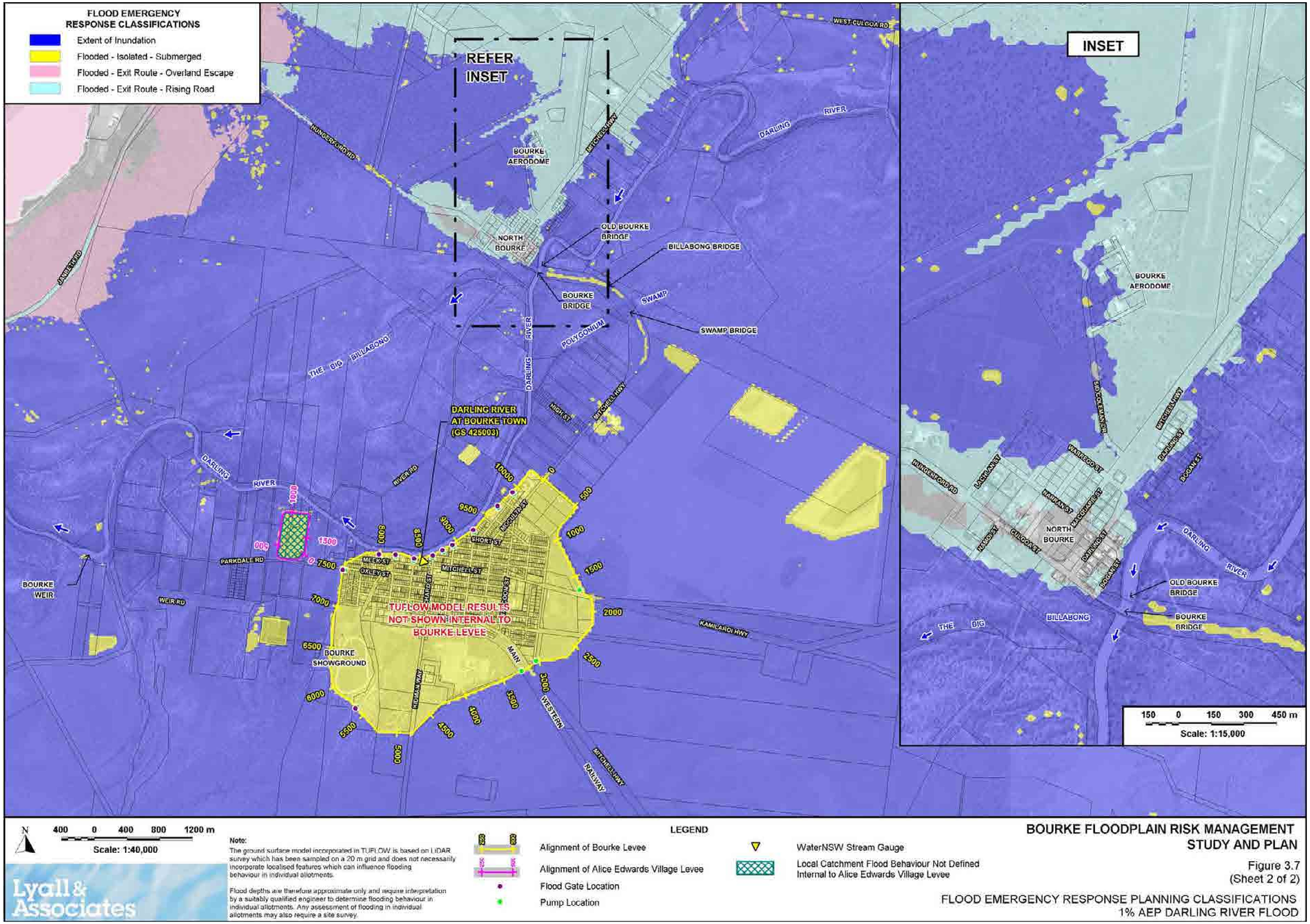
WaterNSW Stream Gauge

Two-Dimensional Model Boundary

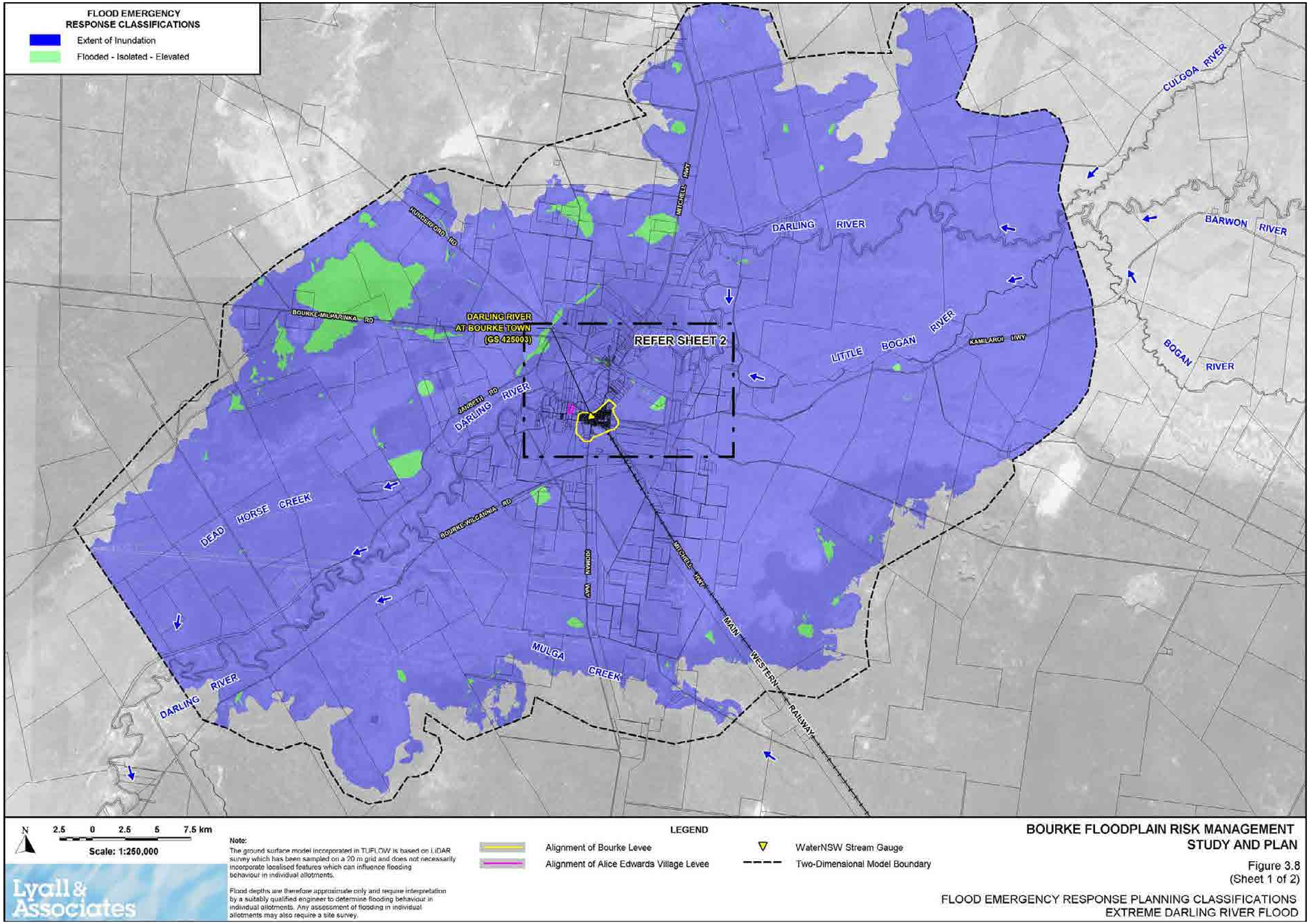
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

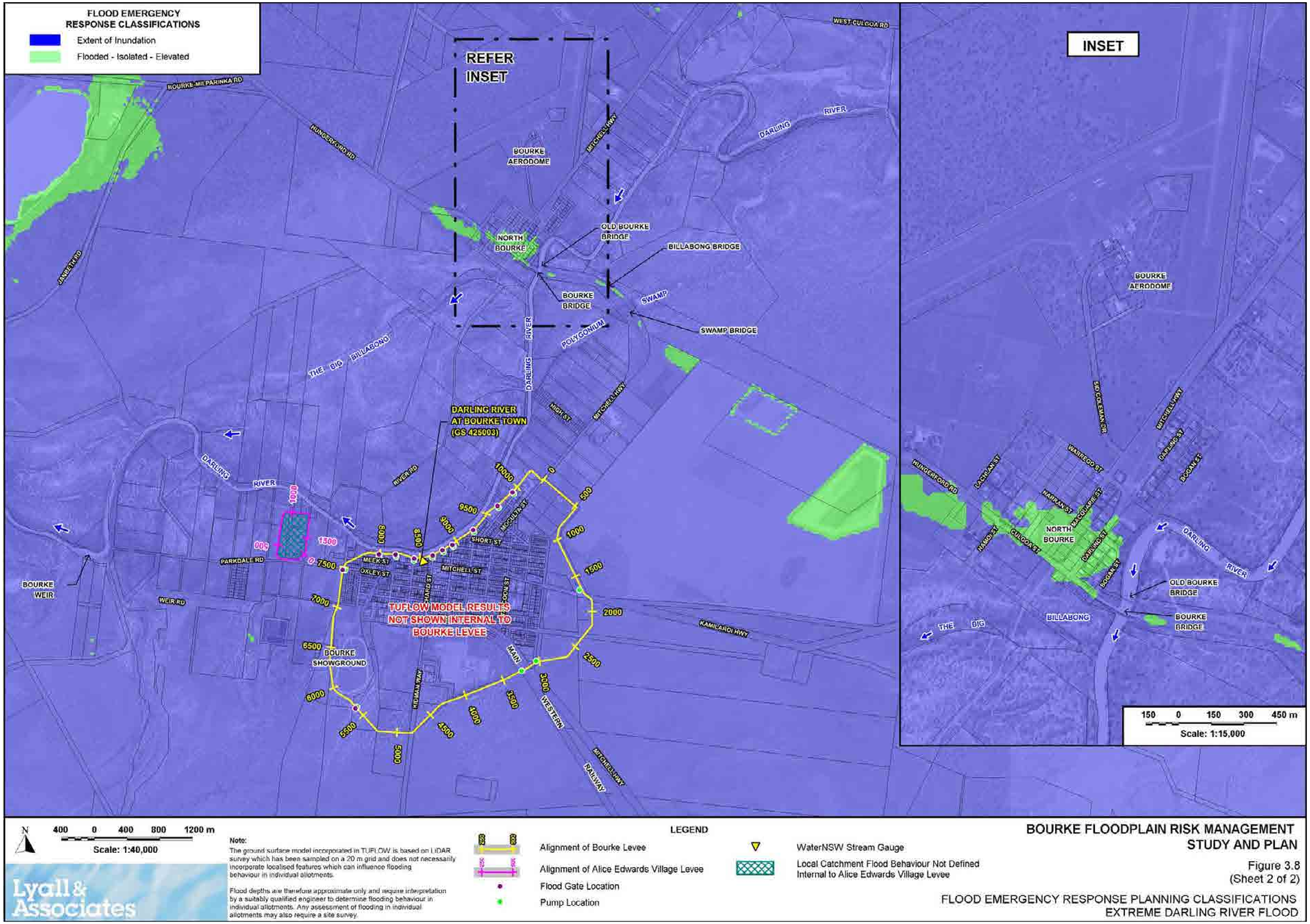
Figure 3.7
(Sheet 1 of 2)

FLOOD EMERGENCY RESPONSE PLANNING CLASSIFICATIONS
1% AEP DARLING RIVER FLOOD



FLOOD EMERGENCY RESPONSE CLASSIFICATIONS
Extent of Inundation
Flooded - Isolated - Submerged
Flooded - Exit Route - Overland Escape
Flooded - Exit Route - Rising Road
REFER INSET
INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
DARLING RIVER
THE BIG BILLABONG
POLYGONUM SWAMP
HUNGERFORD RD
MITCHELL HWY
WEST CULGOA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
TUFLOW MODEL RESULTS NOT SHOWN INTERNAL TO BOURKE LEVEE
BOURKE WEIR
WEIR RD
PARKDALE RD
BOURKE SHOWGROUND
KAMILAROI HWY
MITCHELL HWY
RAILWAY
WESTERN
150 0 150 300 450 m
Scale: 1:15,000
400 0 400 800 1200 m
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 3.7 (Sheet 2 of 2)
FLOOD EMERGENCY RESPONSE PLANNING CLASSIFICATIONS 1% AEP DARLING RIVER FLOOD

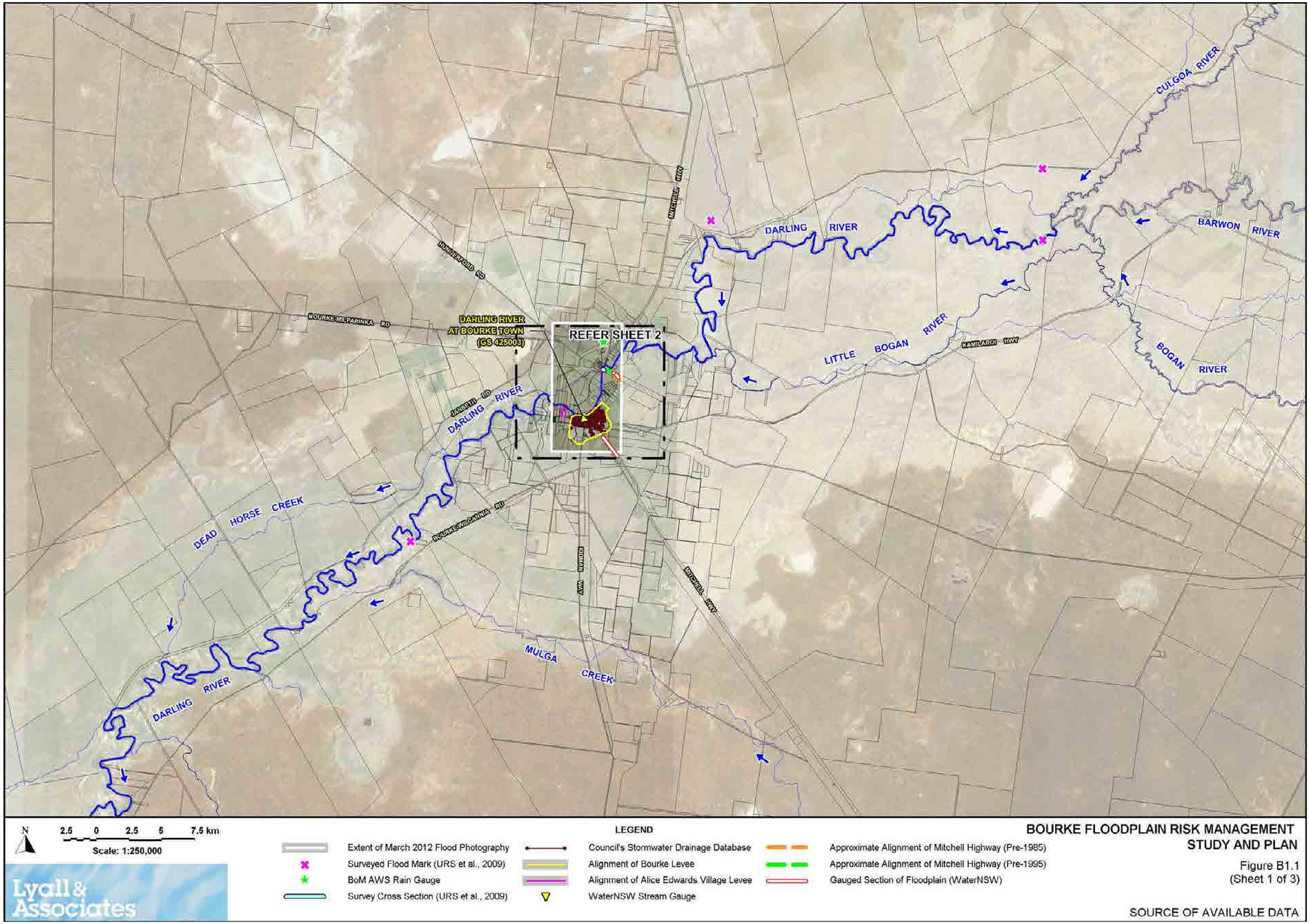

FLOOD EMERGENCY
RESPONSE CLASSIFICATIONS
Extent of Inundation
Flooded - Isolated - Elevated
CULGOA RIVER
BARWON RIVER
DARLING RIVER
BOGAN RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER
AT BOURKE TOWN
(GS 425003)
REFER SHEET 2
JANBEITH RD
DARLING RIVER
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MITCHELL HWY
MAIN WESTERN RAILWAY
MULGA CREEK
DARLING RIVER
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Note:
The ground surface model incorporated in TUFLOW is based on LIDAR survey which has been sampled on a 20 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT
STUDY AND PLAN
Figure 3.8
(Sheet 1 of 2)
FLOOD EMERGENCY RESPONSE PLANNING CLASSIFICATIONS
EXTREME DARLING RIVER FLOOD

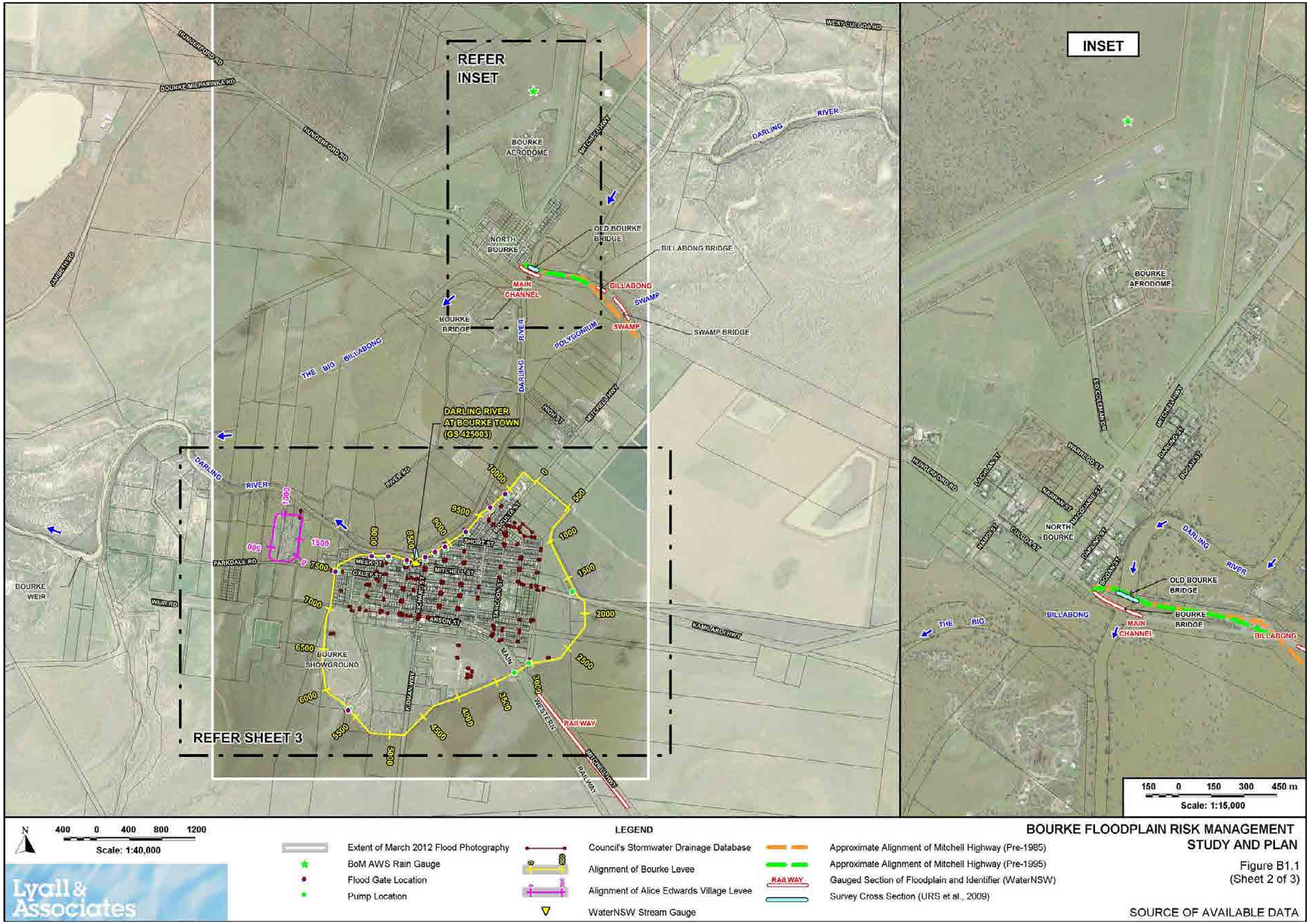

FLOOD EMERGENCY RESPONSE CLASSIFICATIONS
Extent of Inundation
Flooded - Isolated - Elevated
REFER INSET
INSET
BOURKE-MILPARINKA RD
HUNGERFORD RD
WEST CULGOA RD
DARLING RIVER
MITCHELL HWY
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP
SWAMP BRIDGE
POLYGONUM
THE BIG BILLABONG
DARLING RIVER AT BOURKE TOWN (GS 425003)
RIVER RD
PARKDALE RD
WEIR RD
BOURKE WEIR
MEEK ST
OXLEY ST
SHORT ST
MITCHELL ST
RICHARD ST
MCCULTA ST
MAIN ST
TUFLOW MODEL RESULTS NOT SHOWN INTERNAL TO BOURKE LEVEE
BOURKE SHOWGROUND
KIDMAN WAY
KAMILAROI HWY
WESTERN
RAILWAY
ANSON ST
HIGH ST
JANDRA RD
SID COLEMAN DR
WARREGO ST
LACHLAN ST
HARRAN ST
MACQUARIE ST
NAMOI ST
CULGOA ST
DARLING ST
BOGAN ST
BILLABONG
THE BIG
150 0 150 300 450 m
Scale: 1:15,000
400 0 400 800 1200 m
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure 3.8 (Sheet 2 of 2)
FLOOD EMERGENCY RESPONSE PLANNING CLASSIFICATIONS
EXTREME DARLING RIVER FLOOD

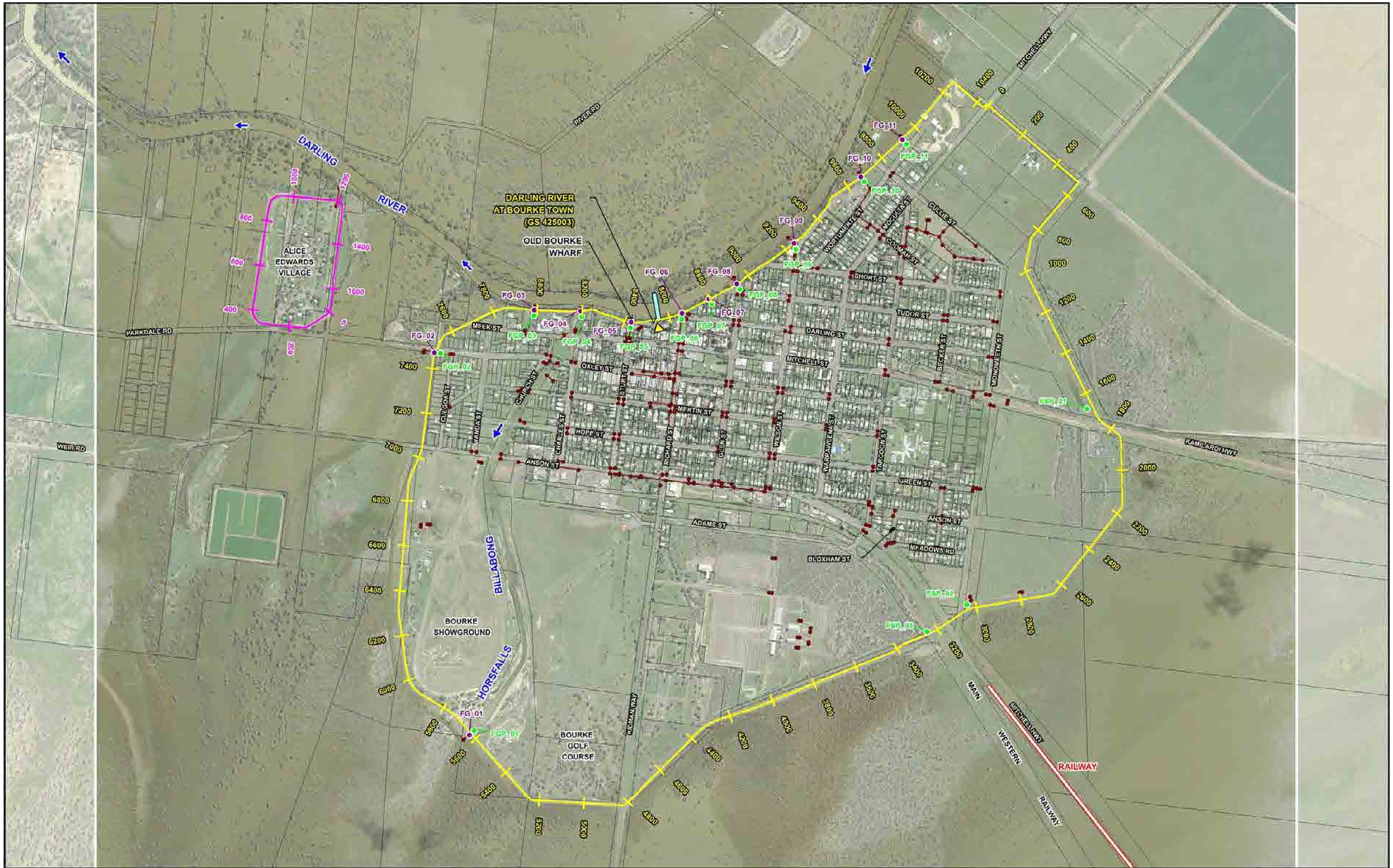
APPENDIX B

BOURKE FLOOD STUDY

LIST OF FIGURES (APPENDIX B)


CULGOA RIVER
DARLING RIVER
BARWON RIVER
LITTLE BOGAN RIVER
BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
JANDRA RD
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MULGA CREEK
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
LEGEND
Extent of March 2012 Flood Photography
Surveyed Flood Mark (URS et al., 2009)
BoM AWS Rain Gauge
Survey Cross Section (URS et al., 2009)
Council's Stormwater Drainage Database
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Approximate Alignment of Mitchell Highway (Pre-1985)
Approximate Alignment of Mitchell Highway (Pre-1995)
Gauged Section of Floodplain (WaterNSW)
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B1.1
(Sheet 1 of 3)
SOURCE OF AVAILABLE DATA


REFER INSET
INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
MAIN CHANNEL
BILLABONG
SWAMP
SWAMP BRIDGE
BOURKE BRIDGE
POLYGONUM
DARLING RIVER
THE BIG BILLABONG
DARLING RIVER AT BOURKE TOWN (GS 425003)
HUNGERFORD RD
BOURKE-MILPARINKA RD
WEST CULGOA RD
MITCHELL HWY
KAMILAROI HWY
PARKDALE RD
WEIR RD
BOURKE WEIR
BOURKE SHOWGROUND
RAILWAY
REFER SHEET 3
Scale: 1:40,000
Scale: 1:15,000
LEGEND
Extent of March 2012 Flood Photography
BoM AWS Rain Gauge
Flood Gate Location
Pump Location
Council's Stormwater Drainage Database
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Approximate Alignment of Mitchell Highway (Pre-1985)
Approximate Alignment of Mitchell Highway (Pre-1995)
Gauged Section of Floodplain and Identifier (WaterNSW)
Survey Cross Section (URS et al., 2009)
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B1.1
(Sheet 2 of 3)
SOURCE OF AVAILABLE DATA



N

150 0 150 300 450 m

Scale: 1:15,000

Lyall & Associates

LEGEND

Extent of March 2012 Flood Photography

Survey Cross Section (URS et al., 2009)

RAILWAY Gauged Section of Floodplain and Identifier (WaterNSW)

FG_01 Flood Gate Location and Identifier

FGP_01 Pump Location and Identifier

Council's Stormwater Drainage Database

Alignment of Bourke Levee

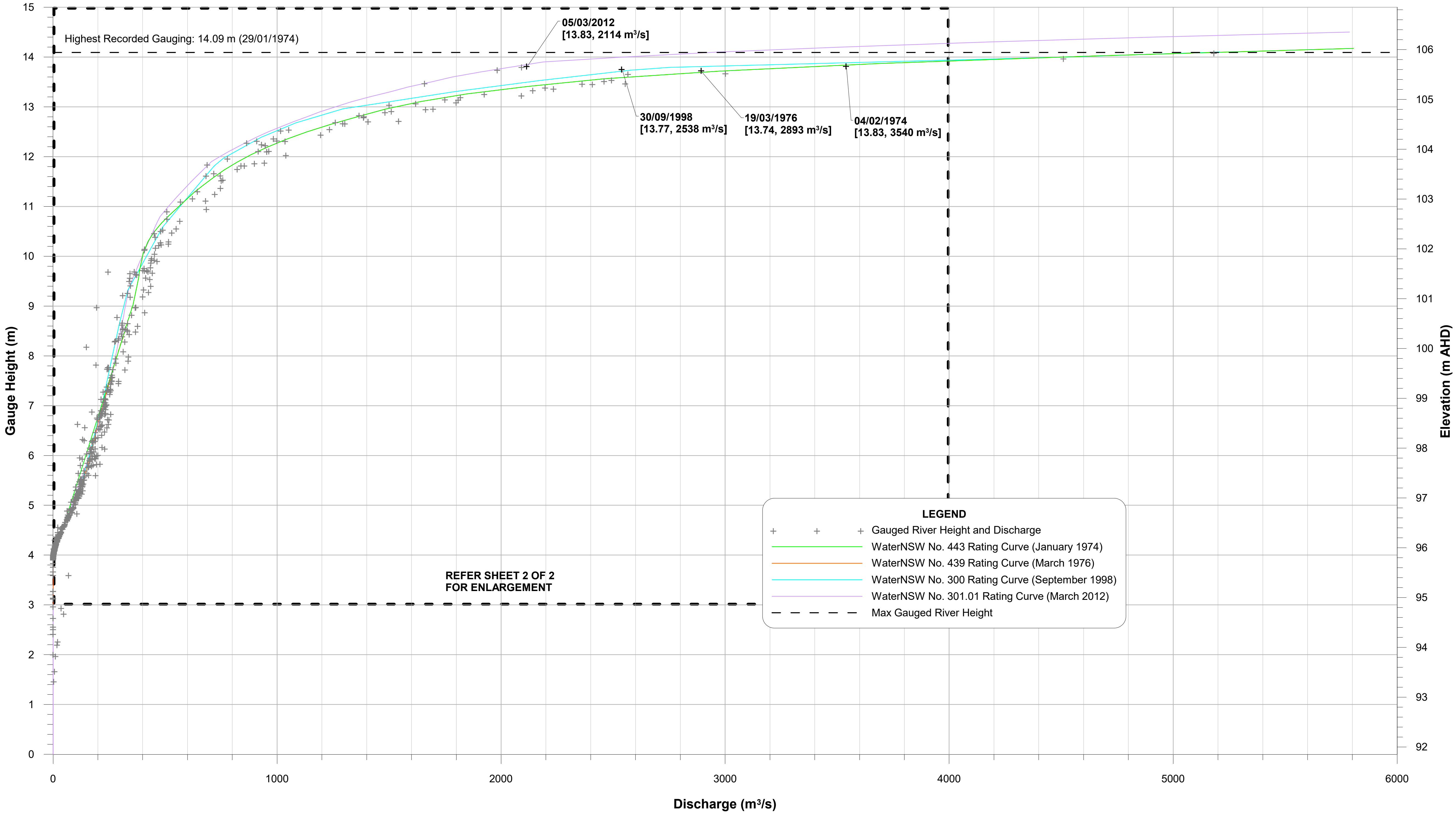
Alignment of Alice Edwards Village Levee

WaterNSW Stream Gauge

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.1
(Sheet 3 of 3)

SOURCE OF AVAILABLE DATA



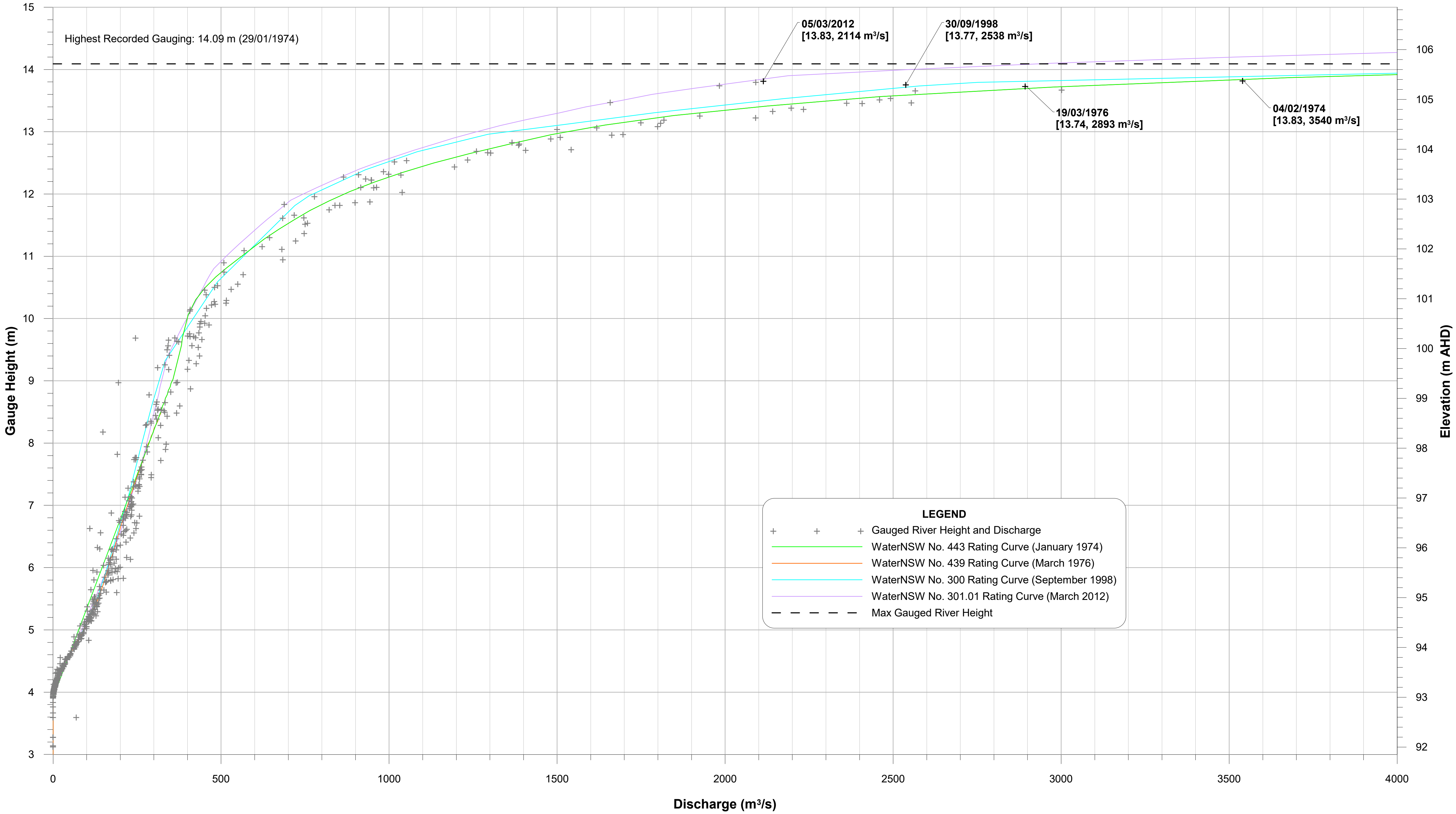
Lyall & Associates

NOTE:
Gauge zero on stream gauge is 91.85 m AHD.

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.2
(Sheet 1 of 2)

RATING CURVES
DARLING RIVER AT BOURKE TOWN STREAM GAUGE (GS 425003)



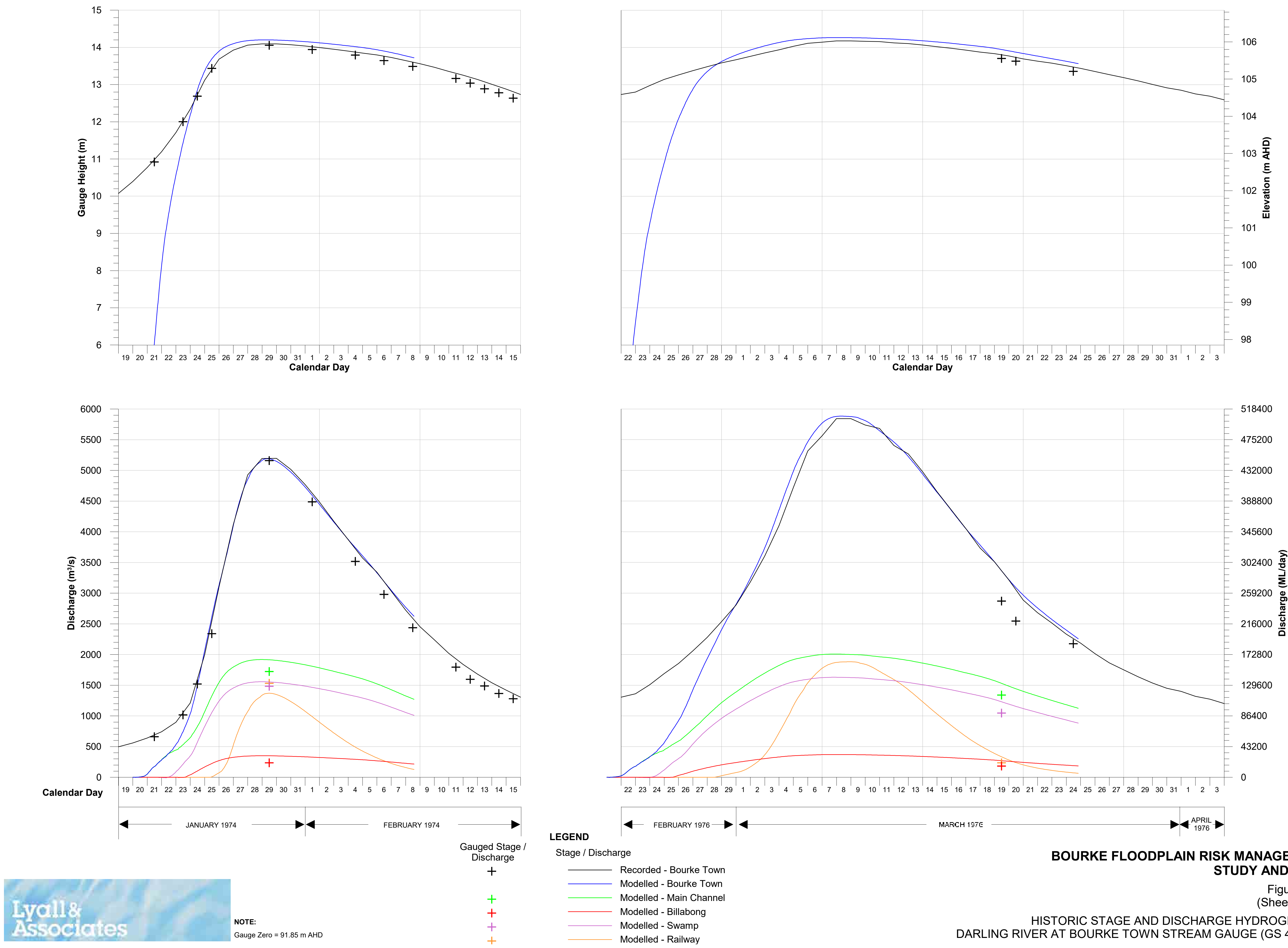
Lyall & Associates

NOTE:
Gauge zero on stream gauge is 91.85 m AHD.

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.2
(Sheet 2 of 2)

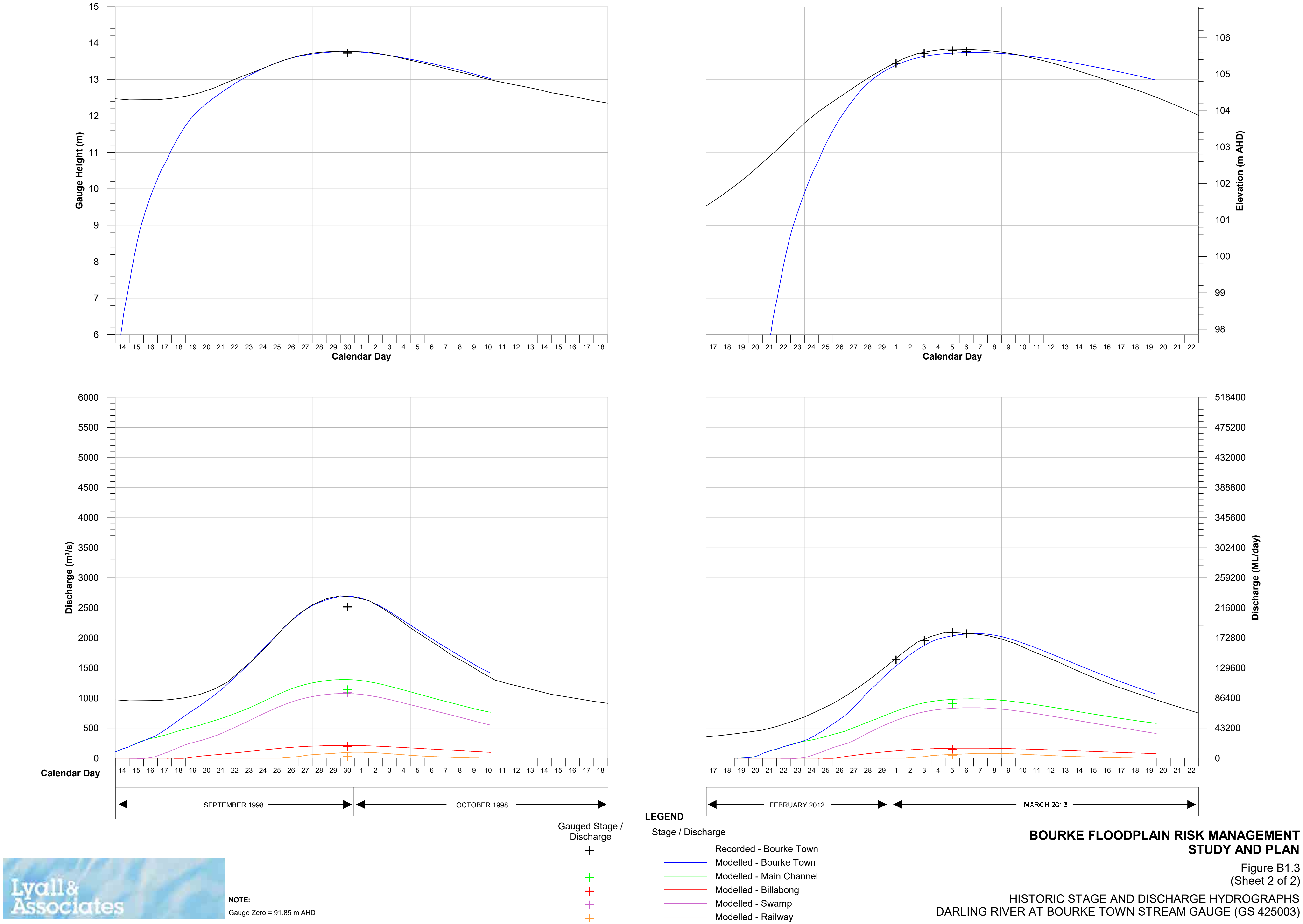
RATING CURVES
DARLING RIVER AT BOURKE TOWN STREAM GAUGE (GS 425003)



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.3
(Sheet 1 of 2)

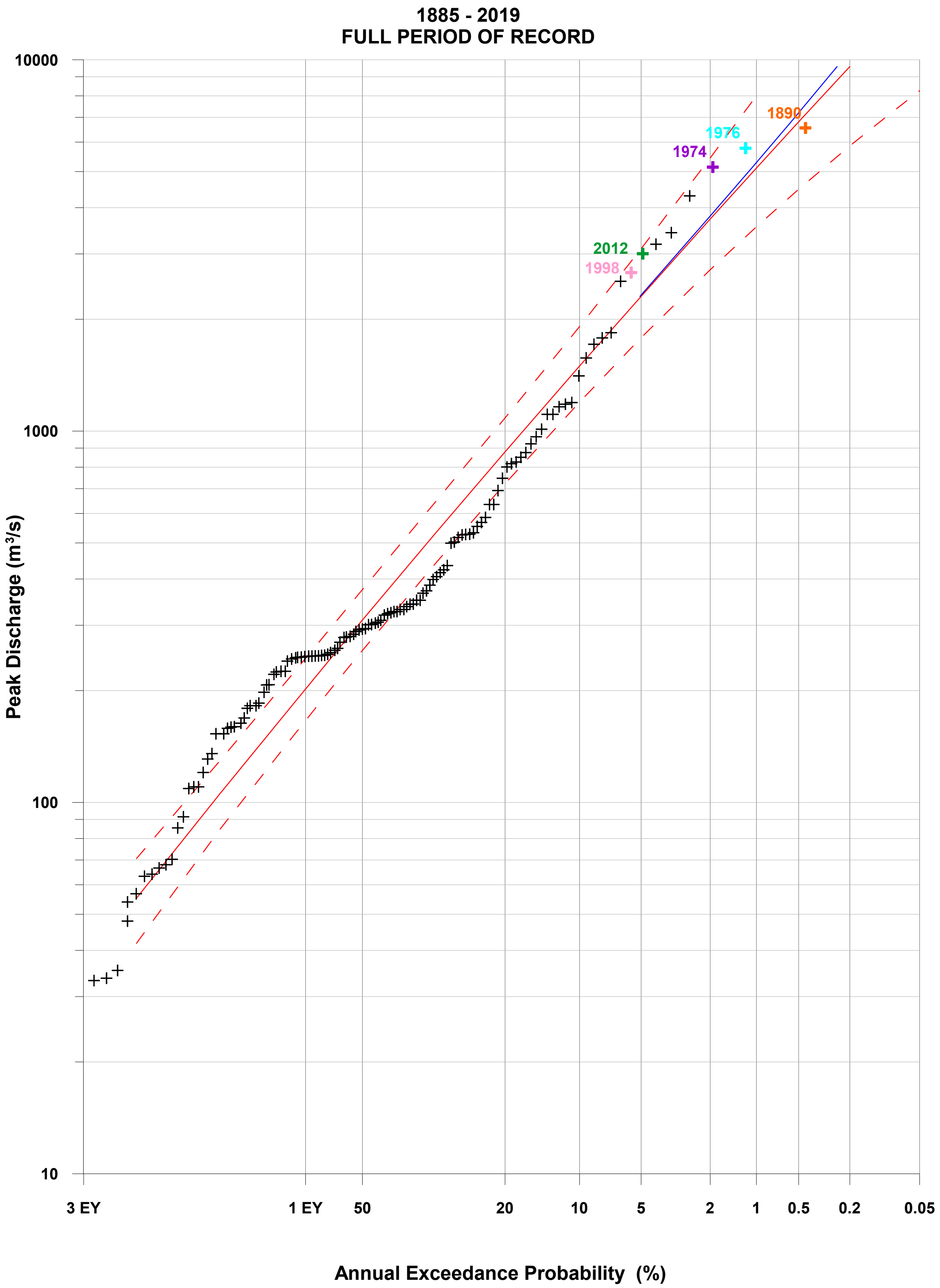
HISTORIC STAGE AND DISCHARGE HYDROGRAPHS
DARLING RIVER AT BOURKE TOWN STREAM GAUGE (GS 425003)

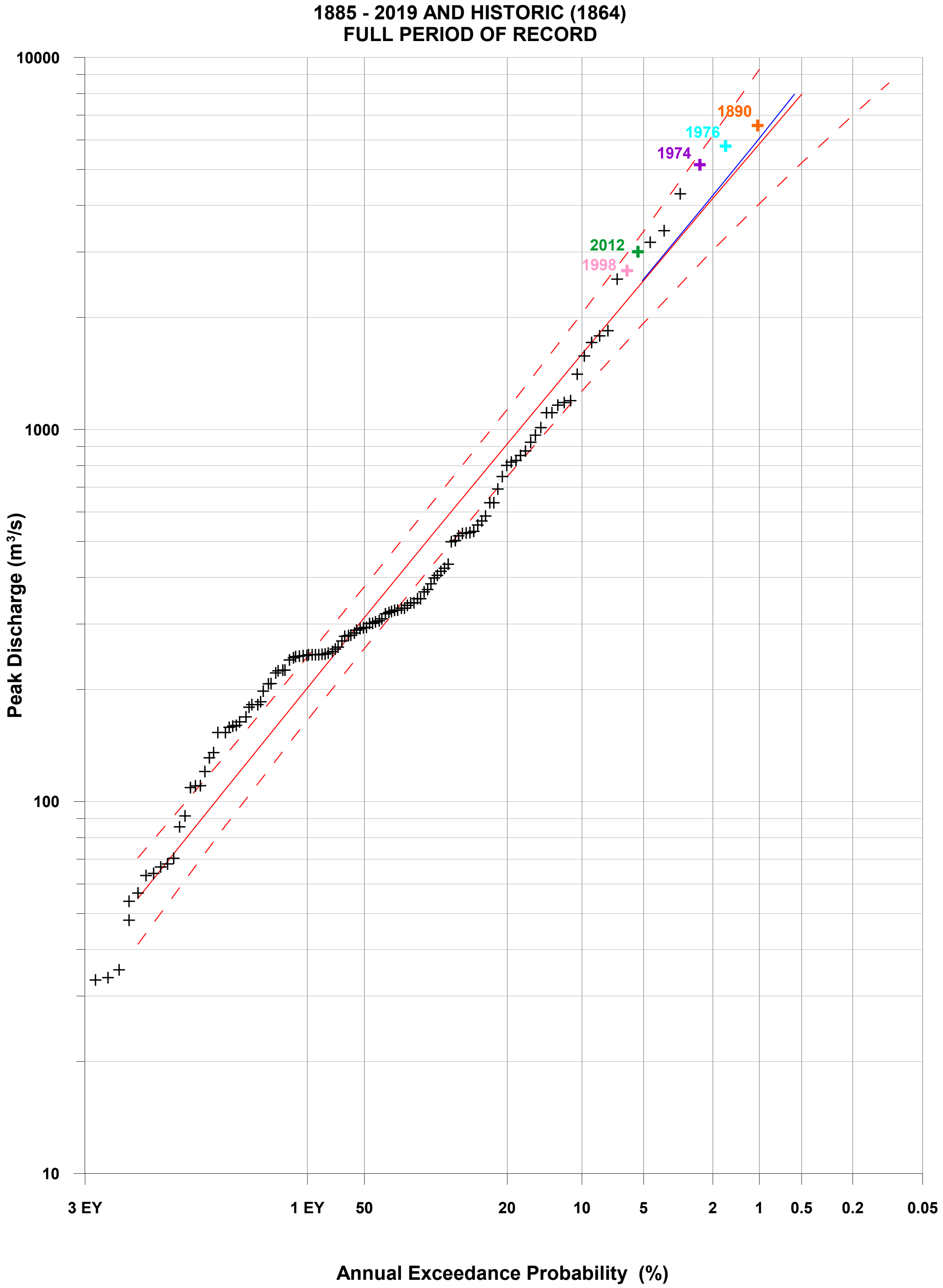


BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.3
(Sheet 2 of 2)

HISTORIC STAGE AND DISCHARGE HYDROGRAPHS
DARLING RIVER AT BOURKE TOWN STREAM GAUGE (GS 425003)





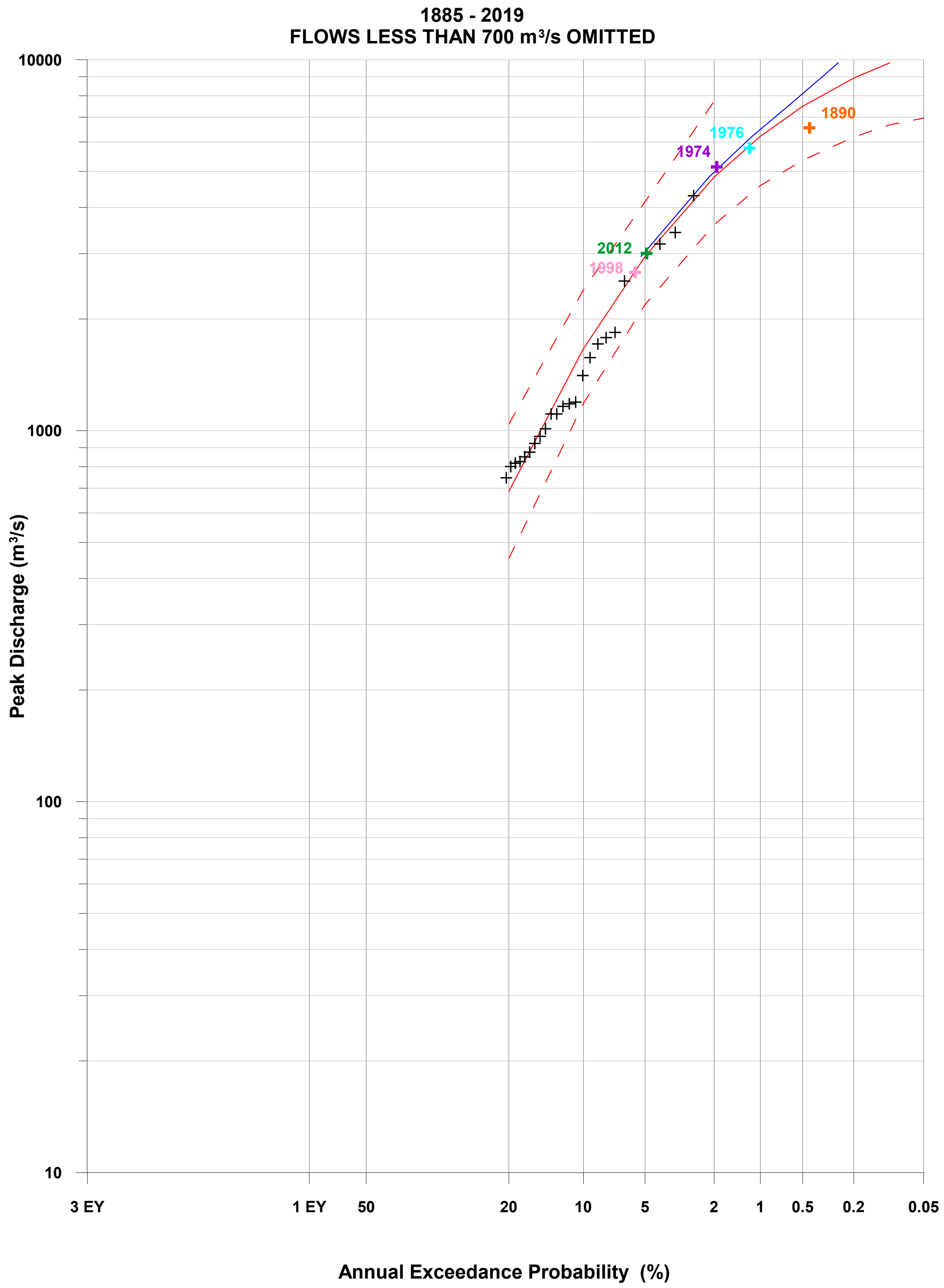
LEGEND

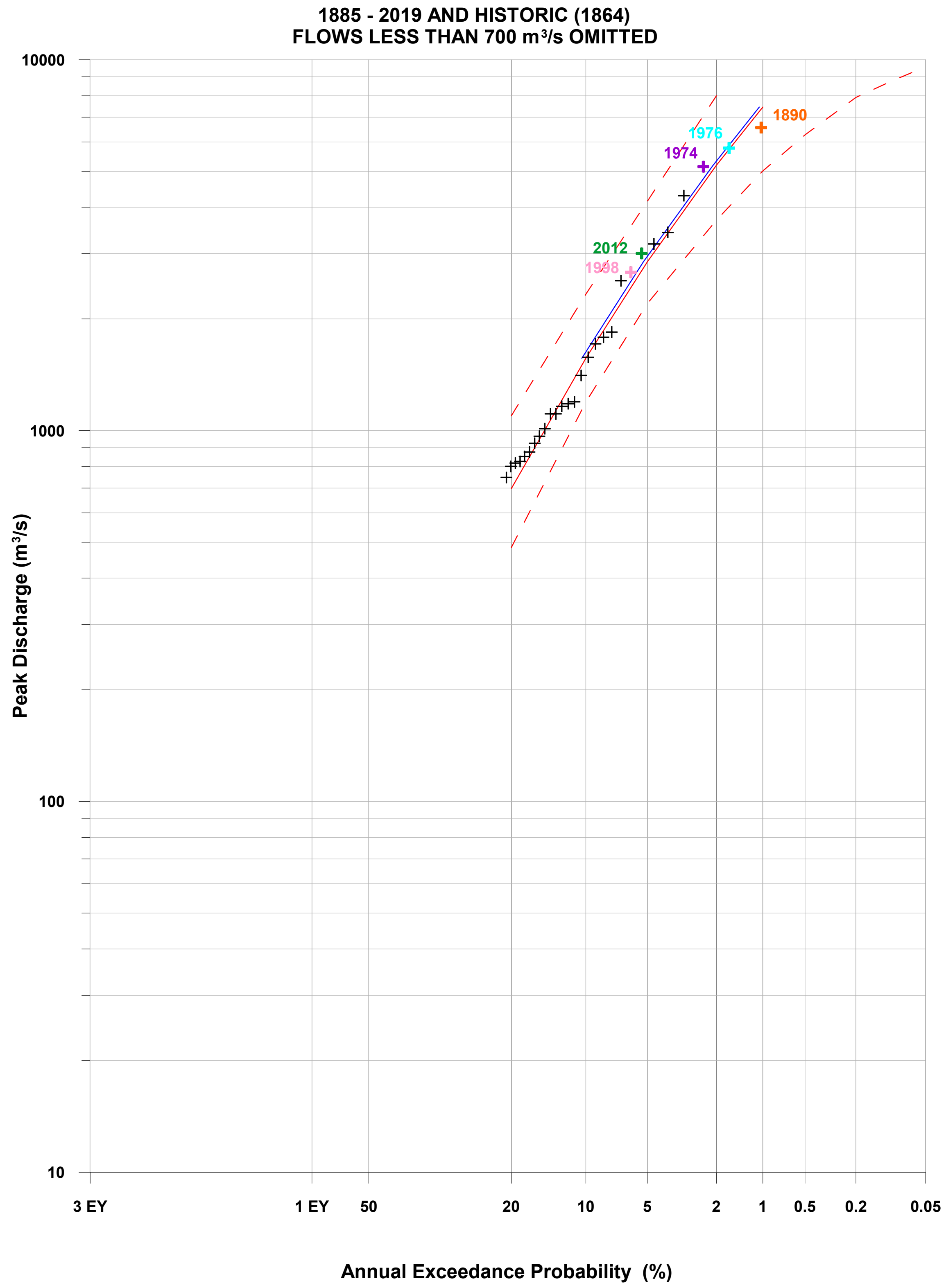
- Expected Probability Adjustment
- Log-Pearson III 5% Confidence Limits
- Log-Pearson III Fit
- + Recorded Annual Maximum Discharge

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.4
(Sheet 1 of 2)

FLOOD FREQUENCY RELATIONSHIP
LOG-PEARSON 3 ANNUAL SERIES 1885-2019
DARLING RIVER AT BOURKE TOWN STREAM GAUGE (GS 425003)





LEGEND

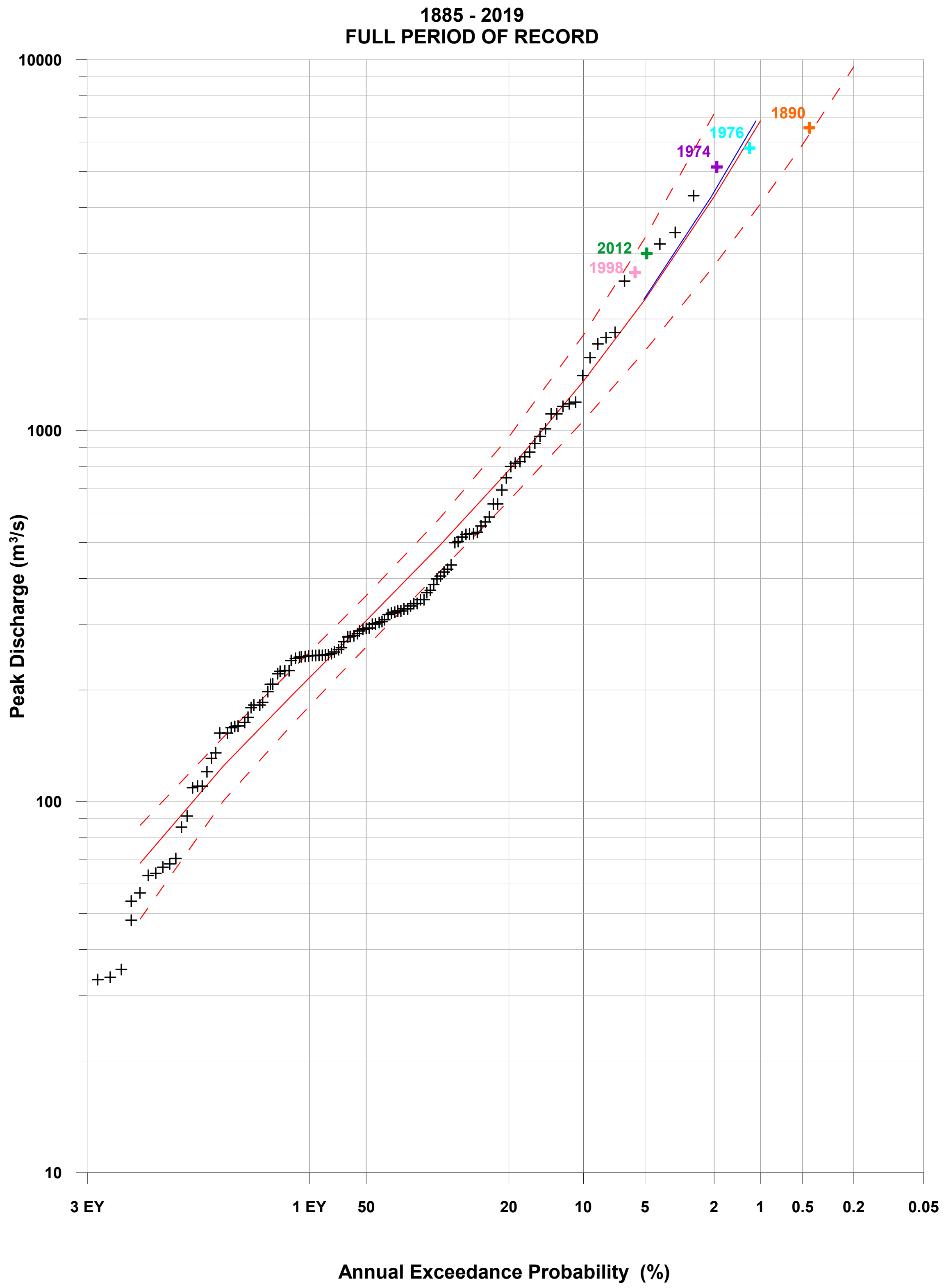
- Expected Probability Adjustment
- Log-Pearson III 5% Confidence Limits
- Log-Pearson III Fit
- + Recorded Annual Maximum Discharge

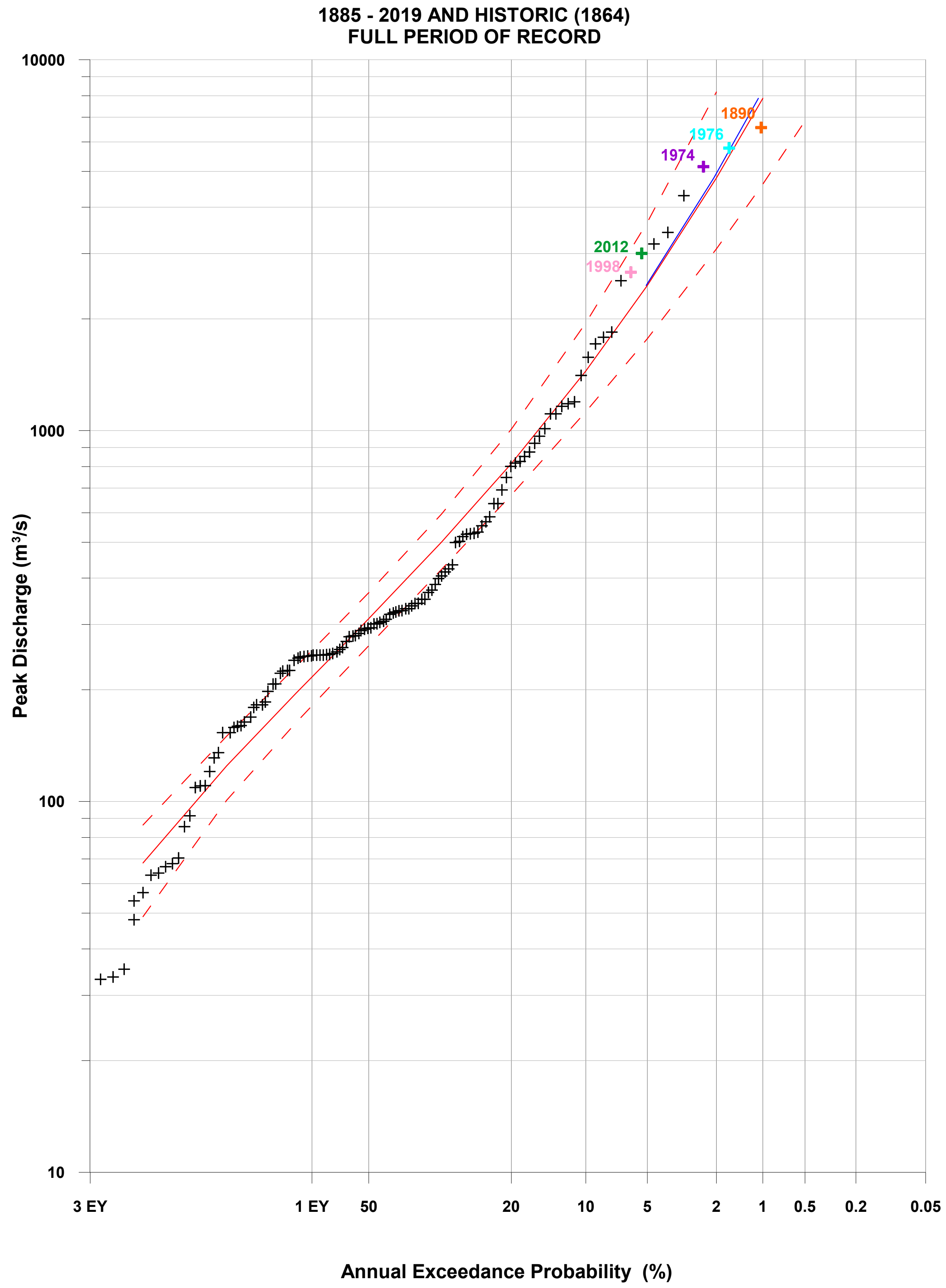
Lyall & Associates

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.4
(Sheet 2 of 2)

FLOOD FREQUENCY RELATIONSHIP
LOG-PEARSON 3 ANNUAL SERIES 1885-2019
DARLING RIVER AT BOURKE TOWN STREAM GAUGE (GS 425003)





LEGEND

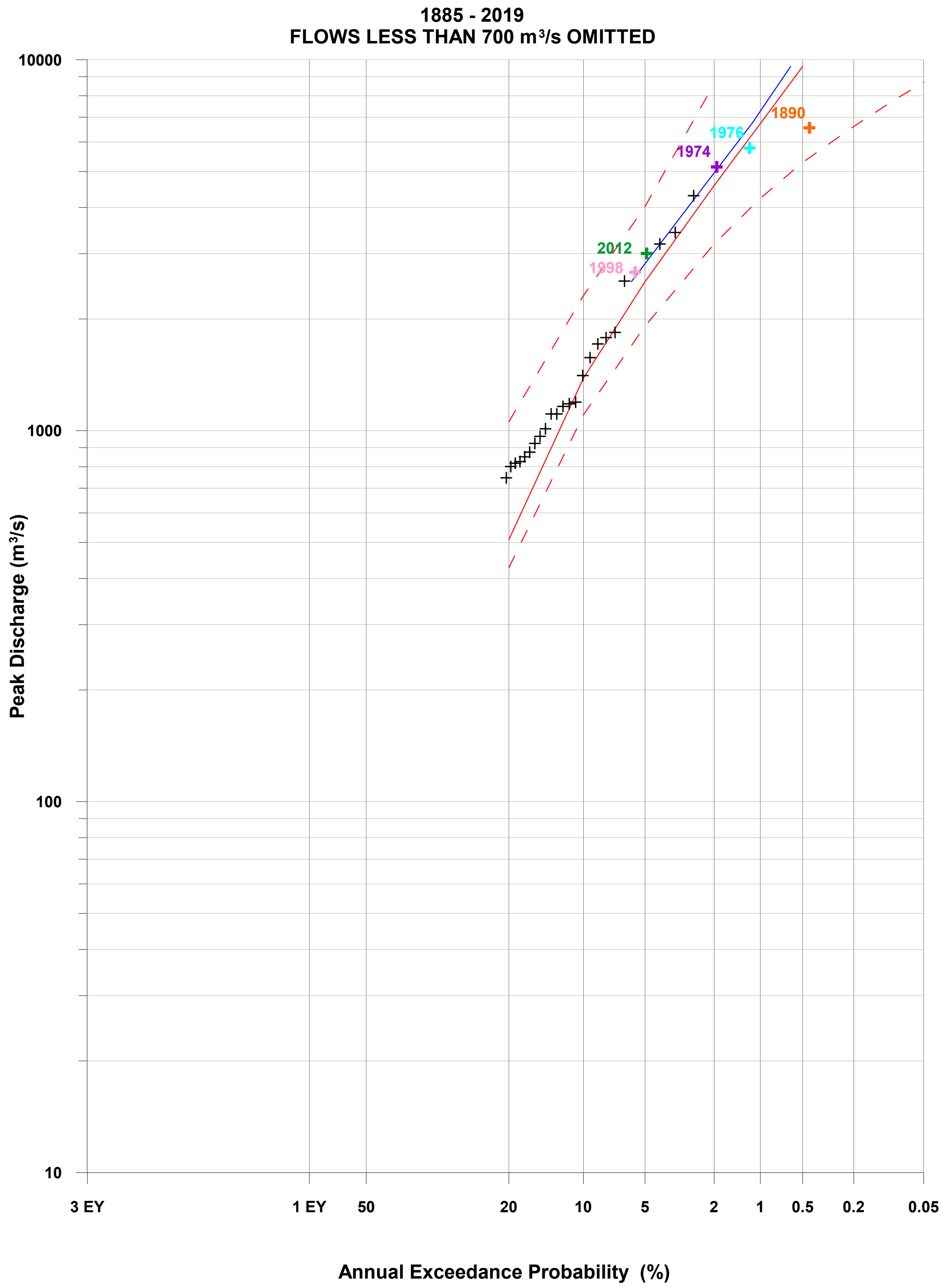
- Expected Probability Adjustment
- Generalised Extreme Value 5% Confidence Limits
- Generalised Extreme Value Fit
- + Recorded Annual Maximum Discharge

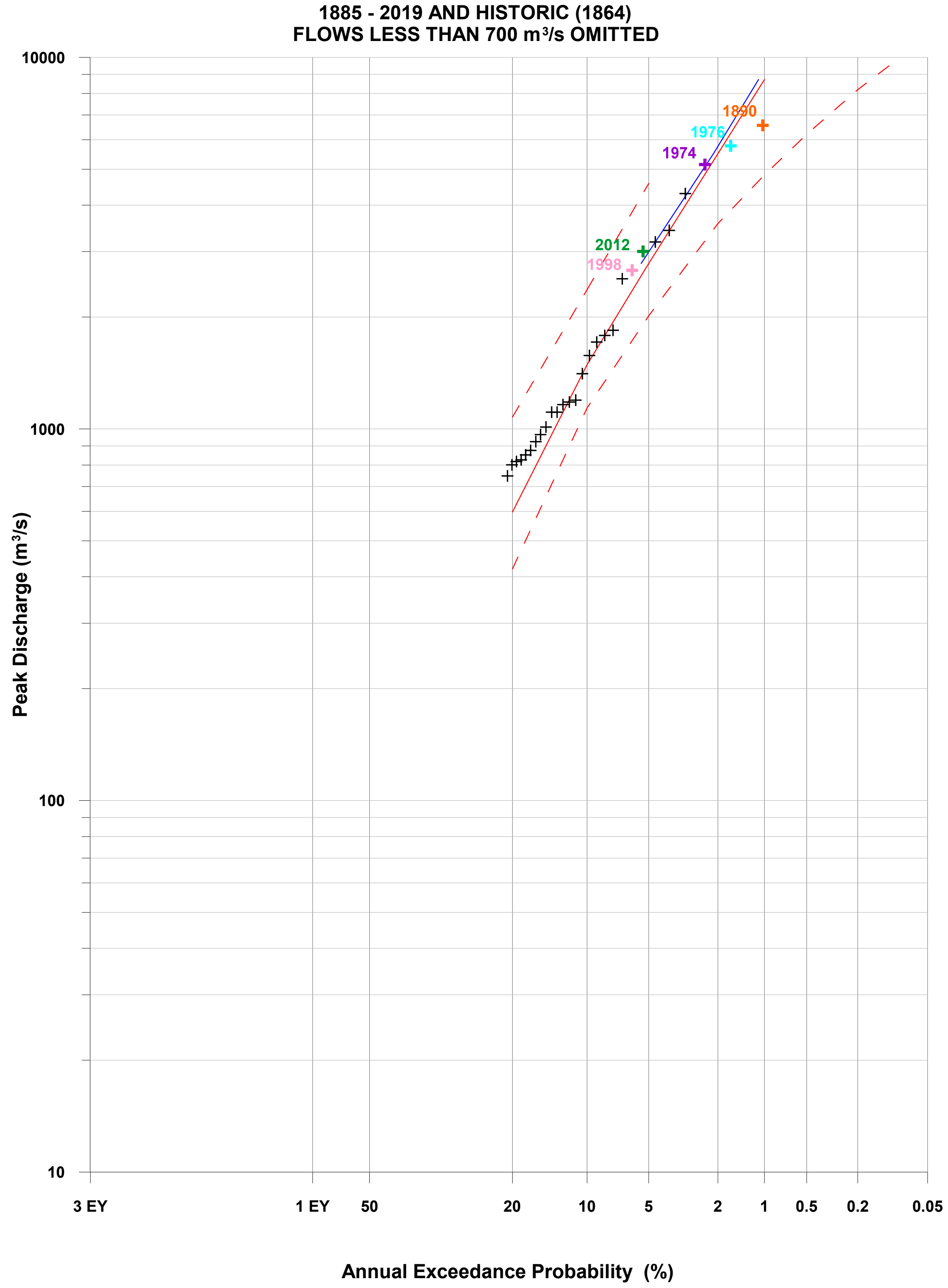
Lyall & Associates

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.5
(Sheet 1 of 2)

FLOOD FREQUENCY RELATIONSHIP
GENERALISED EXTREME VALUE ANNUAL SERIES 1885-2019
DARLING RIVER AT BOURKE TOWN STREAM GAUGE (GS 425003)





LEGEND

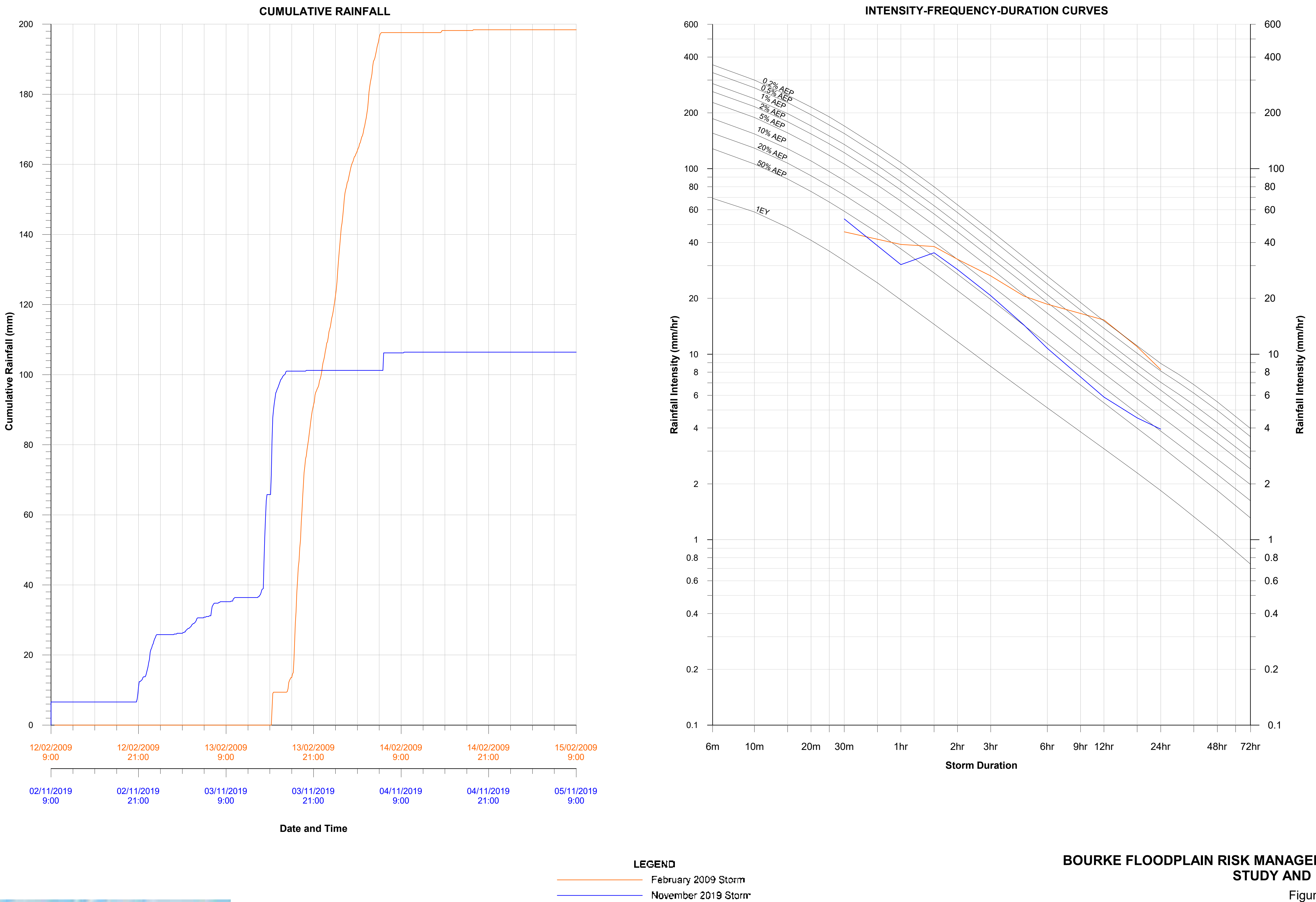
- Expected Probability Adjustment
- Generalised Extreme Value 5% Confidence Limits
- Generalised Extreme Value Fit
- + Recorded Annual Maximum Discharge

Lyall & Associates

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.5
(Sheet 2 of 2)

FLOOD FREQUENCY RELATIONSHIP
GENERALISED EXTREME VALUE ANNUAL SERIES 1885-2019
DARLING RIVER AT BOURKE TOWN STREAM GAUGE (GS 425003)

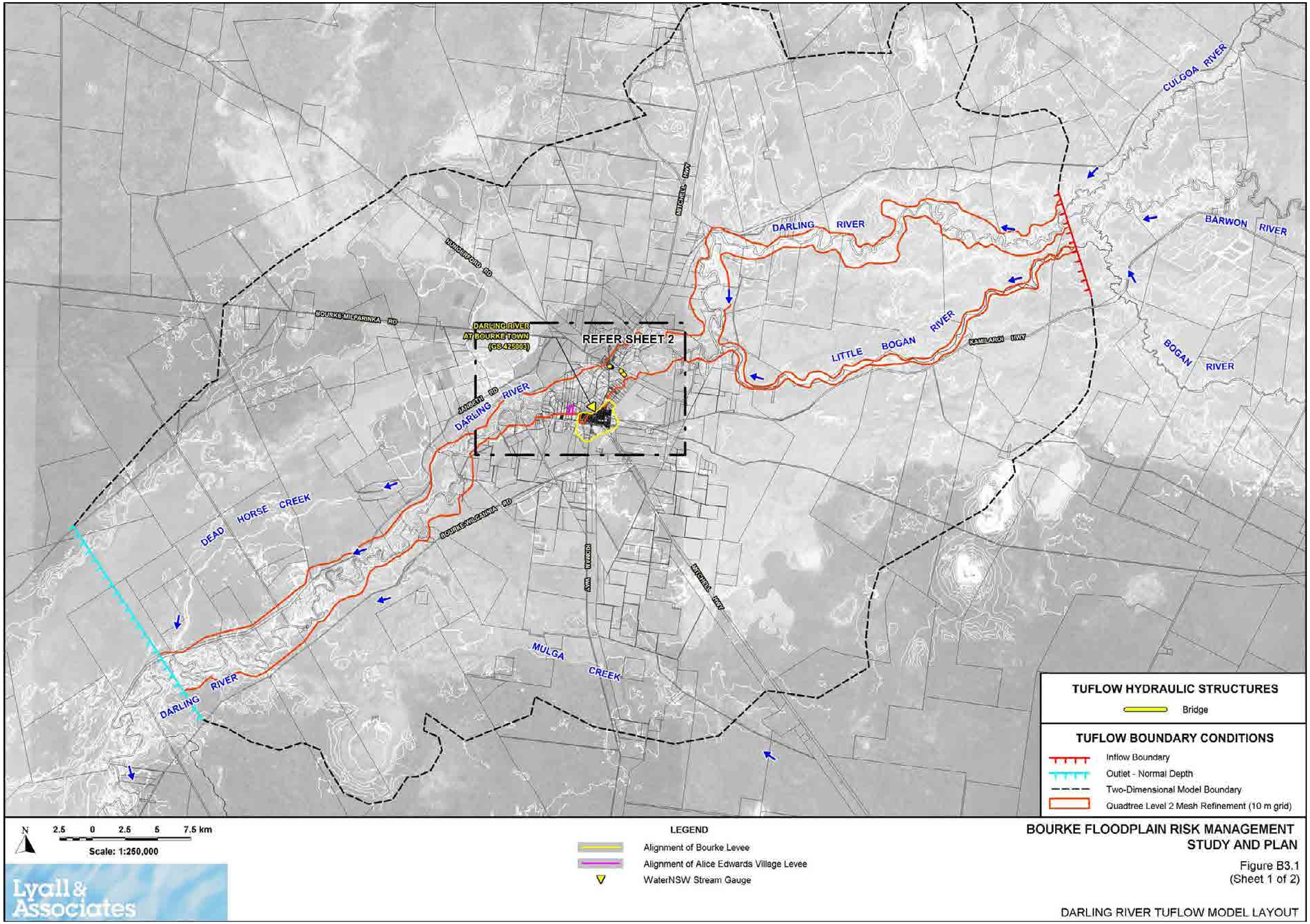


BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B1.6

CUMULATIVE RAINFALL AND INTENSITY-FREQUENCY-DURATION CURVES - HISTORIC STORM EVENTS
BOURKE AIRPORT AWS RAIN GAUGE (GS 048245)

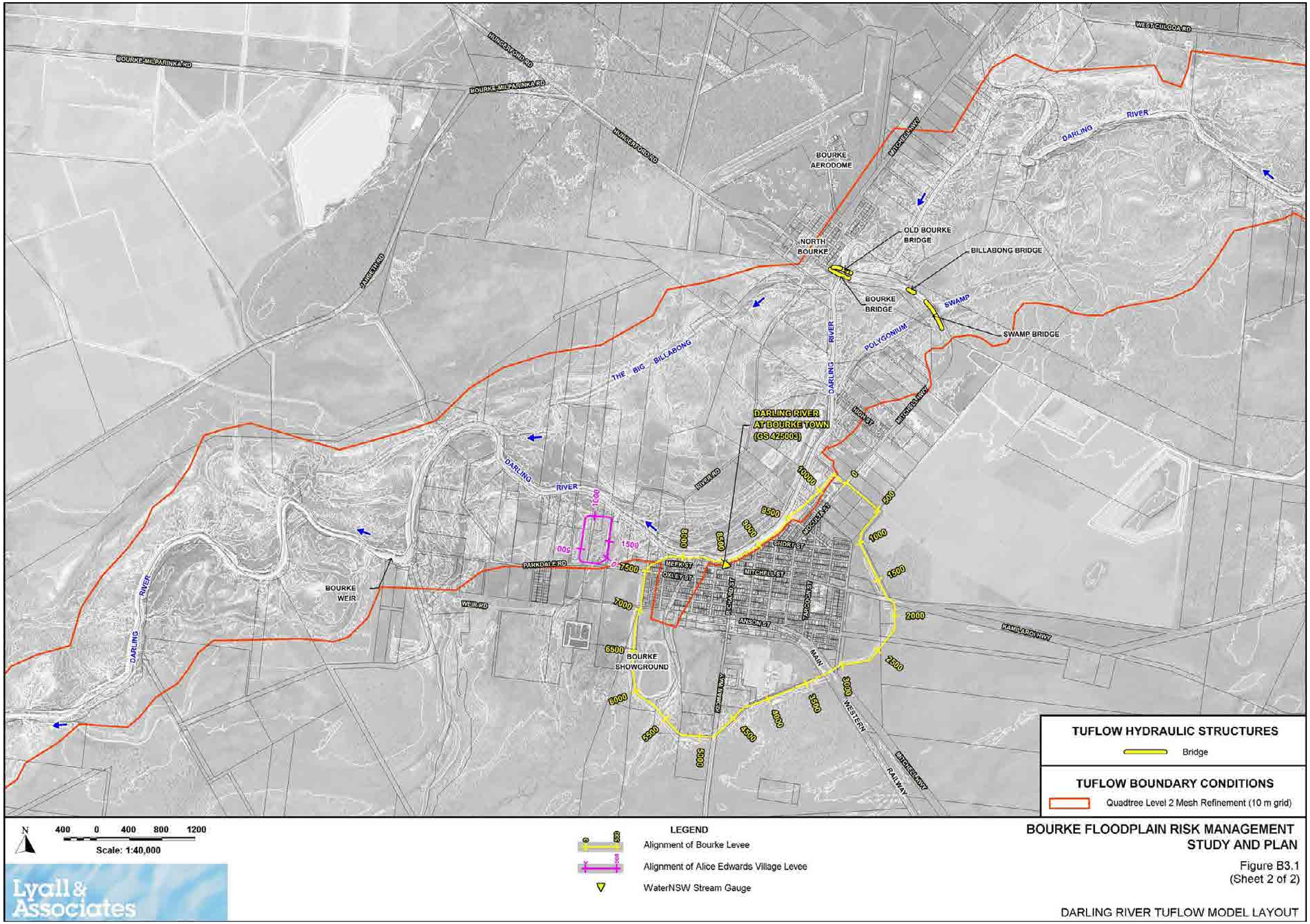
Lyall & Associates



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B3.1
(Sheet 1 of 2)

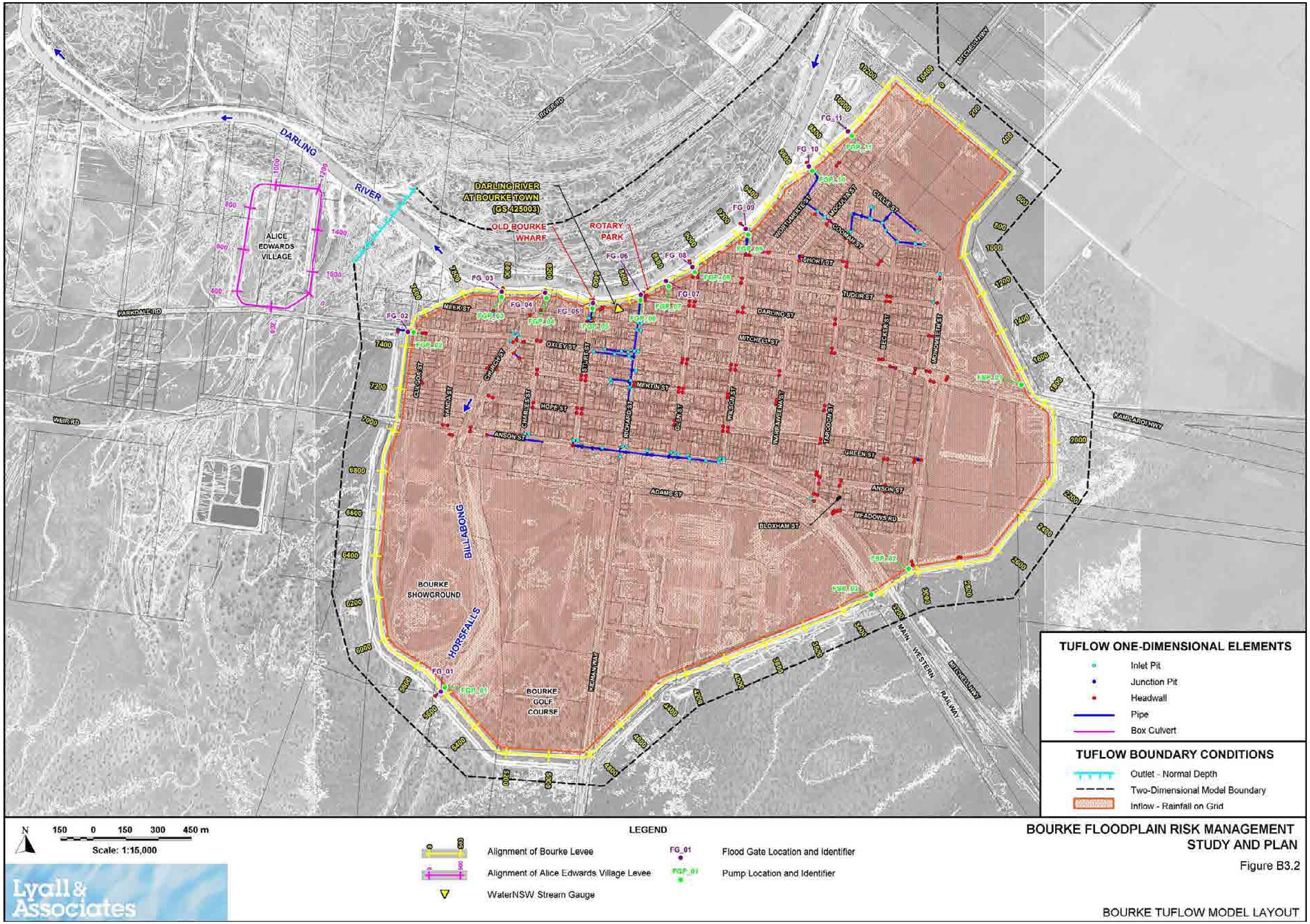
DARLING RIVER TUFLOW MODEL LAYOUT

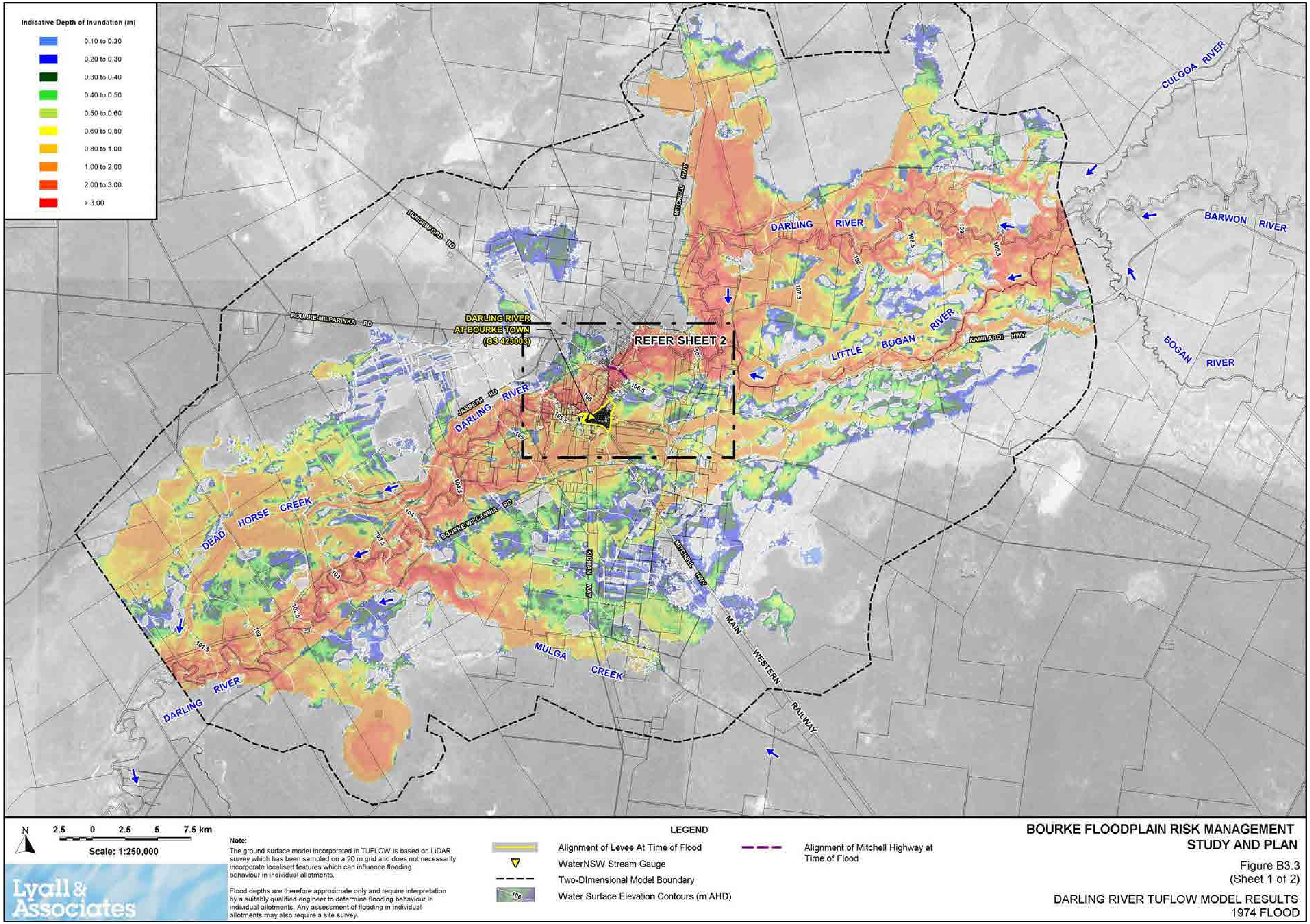


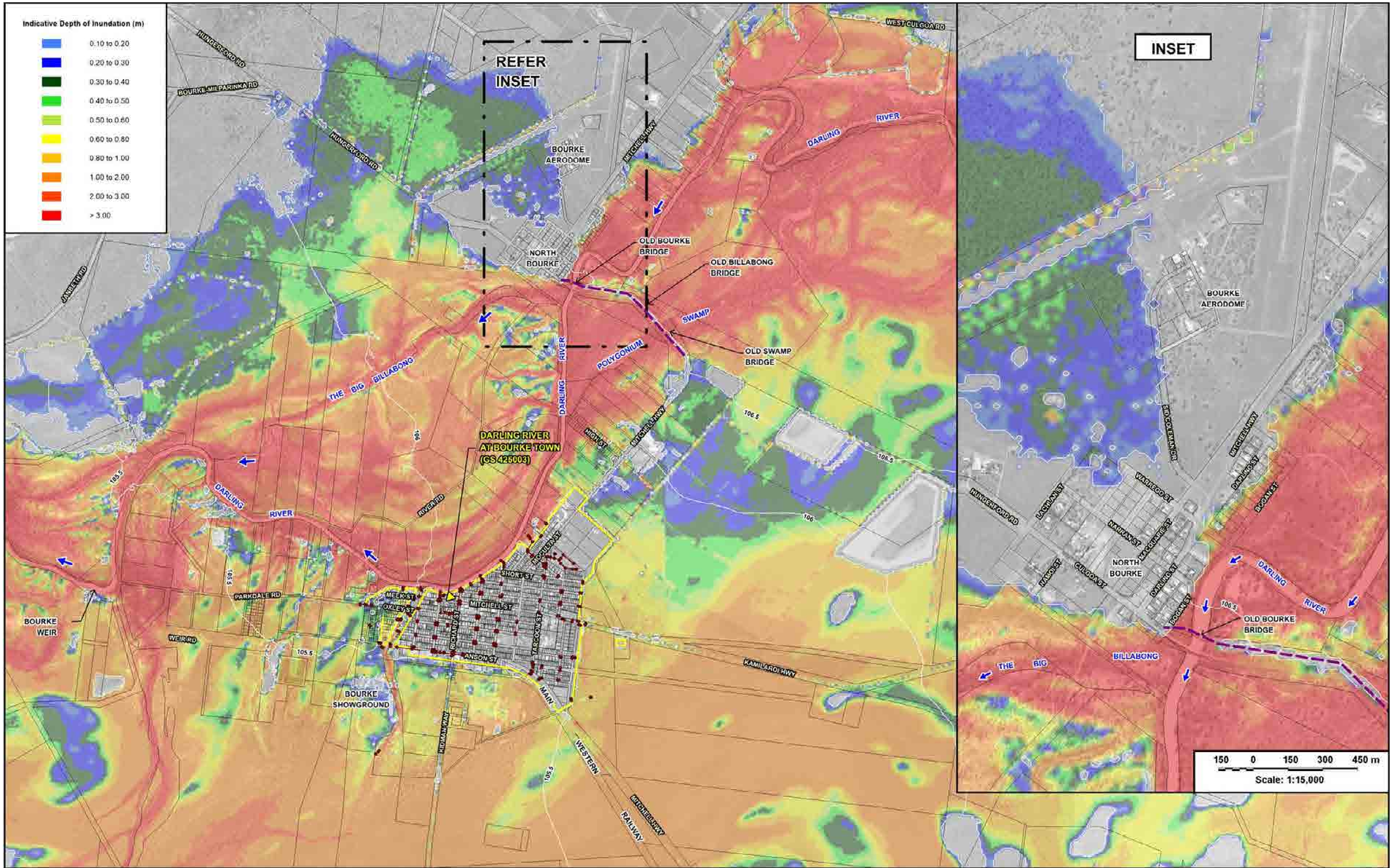
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B3.1 (Sheet 2 of 2)

DARLING RIVER TUFLOW MODEL LAYOUT


DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
MITCHELL HWY
KAMILAROI HWY
PARKDALE RD
WEIR RD
RIVER RD
MEEK ST
OXLEY ST
MERTIN ST
HOPE ST
ANSON ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
GREEN ST
DARLING ST
MITCHELL ST
TUDOR ST
SHORT ST
RICHARD ST
STURT ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
BECKER ST
MONCRIEFF ST
CULGOA ST
YANDA ST
CHURCH ST
CHARLES ST
HOEMAN WAY
TUFLOW ONE-DIMENSIONAL ELEMENTS
Inlet Pit
Junction Pit
Headwall
Pipe
Box Culvert
TUFLOW BOUNDARY CONDITIONS
Outlet - Normal Depth
Two-Dimensional Model Boundary
Inflow - Rainfall on Grid
150 0 150 300 450 m
Scale: 1:15,000
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
FG_01 Flood Gate Location and Identifier
FGP_01 Pump Location and Identifier
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B3.2
BOURKE TUFLOW MODEL LAYOUT
Lyall & Associates


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
CULGOA RIVER
BARWON RIVER
BOGAN RIVER
DARLING RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
WANAARING RD
BOURKE-WILCANNIA RD
DEAD HORSE CREEK
KIDMAN WAY
MULGA CREEK
MAIN WESTERN RAILWAY
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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
Alignment of Levee At Time of Flood
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
Water Surface Elevation Contours (m AHD)
Alignment of Mitchell Highway at Time of Flood
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B3.3
(Sheet 1 of 2)
DARLING RIVER TUFLOW MODEL RESULTS
1974 FLOOD



Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

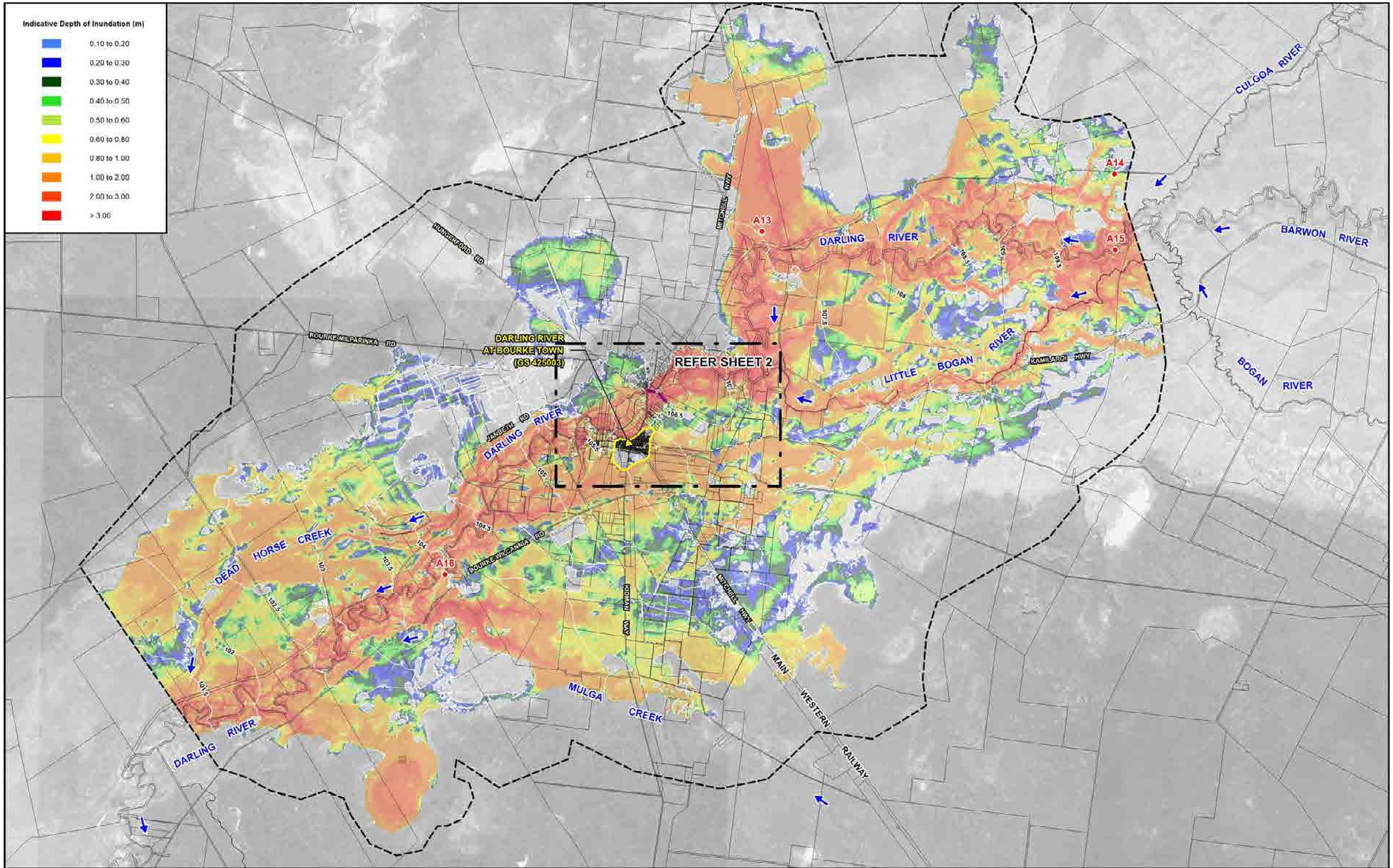
LEGEND
- Alignment of Levee At Time of Flood
- WaterNSW Stream Gauge
- Two-Dimensional Model Boundary
- Water Surface Elevation Contours (m AHD)
- Alignment of Mitchell Highway at Time of Flood

Lyall & Associates

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B3.3
(Sheet 2 of 2)

DARLING RIVER TUFLOW MODEL RESULTS
1974 FLOOD



N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000

Lyall & Associates

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

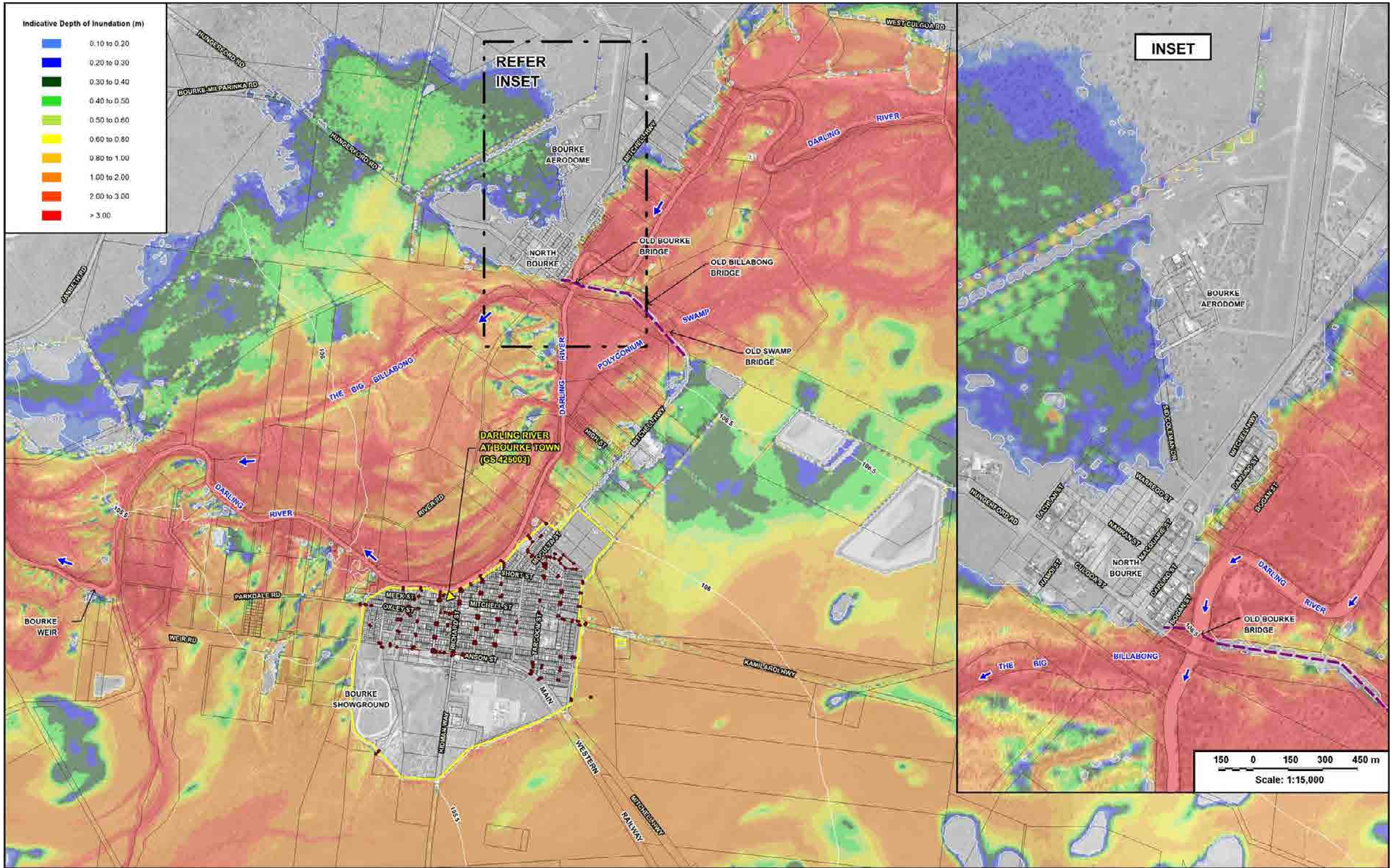
LEGEND

- Alignment of Levee At Time of Flood
- WaterNSW Stream Gauge
- Two-Dimensional Model Boundary
- Water Surface Elevation Contours (m AHD)
- Alignment of Mitchell Highway at Time of Flood
- A14 Surveyed Flood Mark and Identifier (Source: URS et al., 2009)

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B3.4
(Sheet 1 of 2)

DARLING RIVER TUFLOW MODEL RESULTS
1976 FLOOD



400 0 400 800 1200 m
Scale: 1:40,000

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

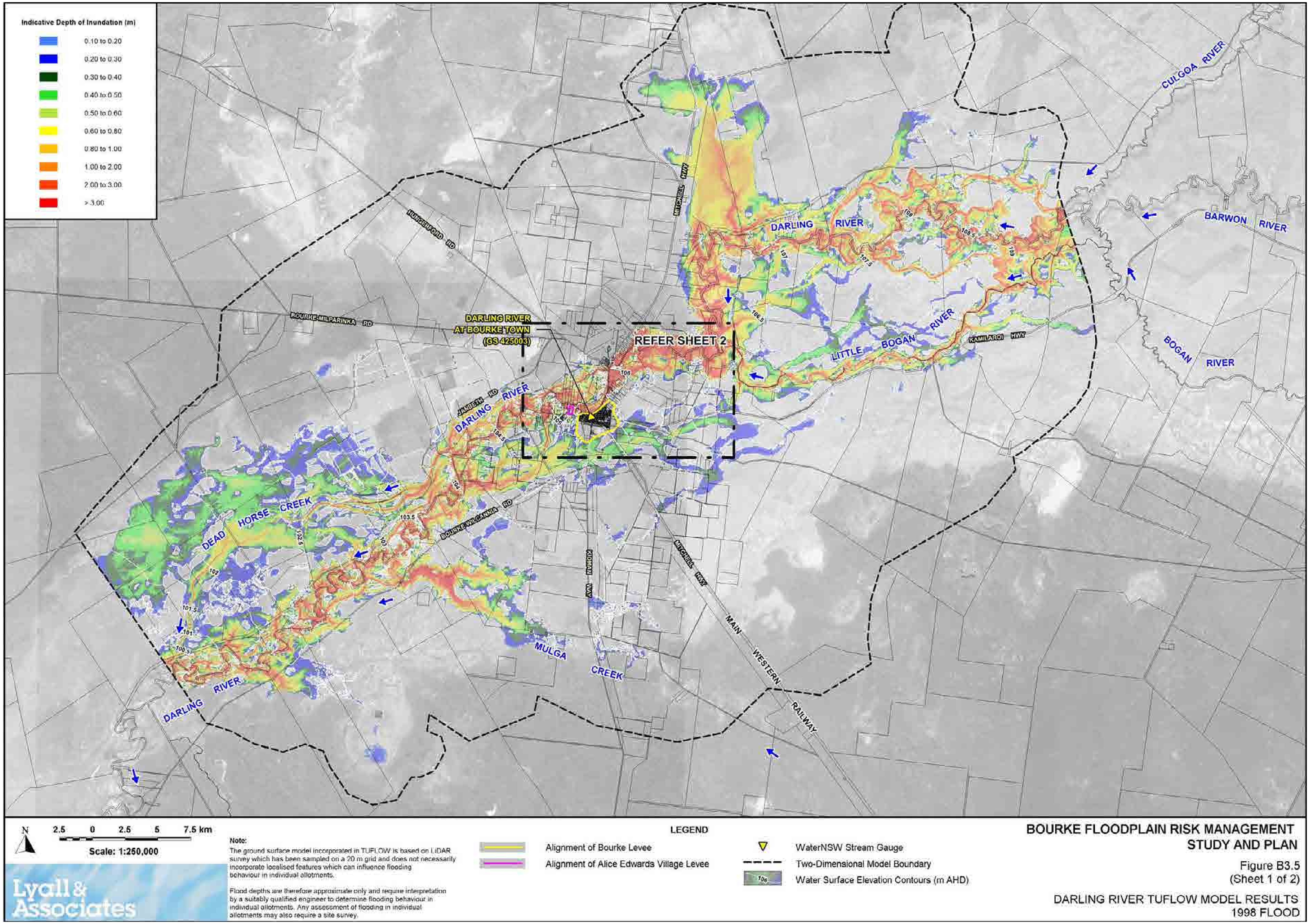
LEGEND
- Alignment of Levee At Time of Flood
- WaterNSW Stream Gauge
- Two-Dimensional Model Boundary
- Water Surface Elevation Contours (m AHD)
- Alignment of Mitchell Highway at Time of Flood

Lyall & Associates

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B3.4 (Sheet 2 of 2)

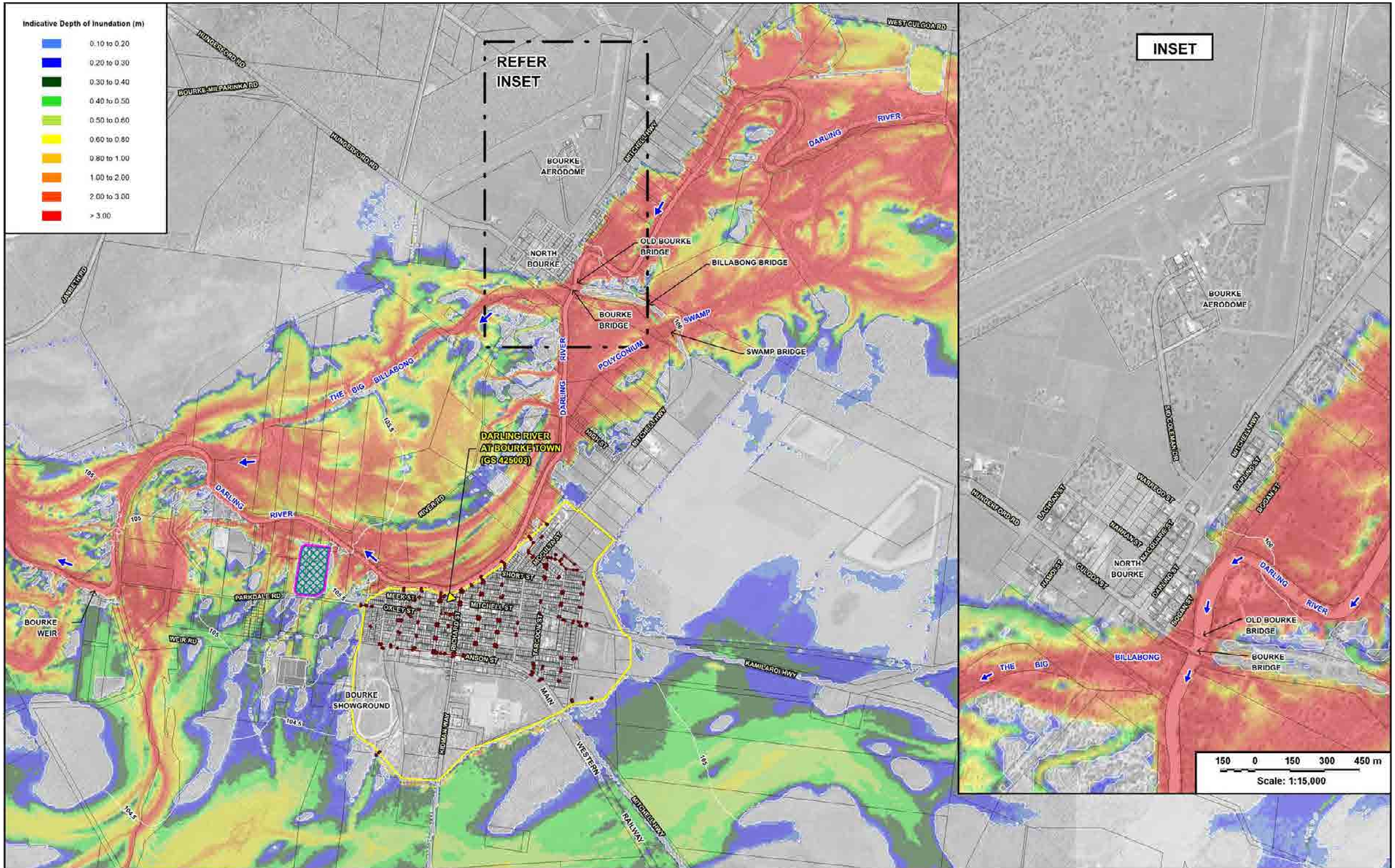
DARLING RIVER TUFLOW MODEL RESULTS 1976 FLOOD



BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B3.5
(Sheet 1 of 2)

DARLING RIVER TUFLOW MODEL RESULTS
1998 FLOOD



Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

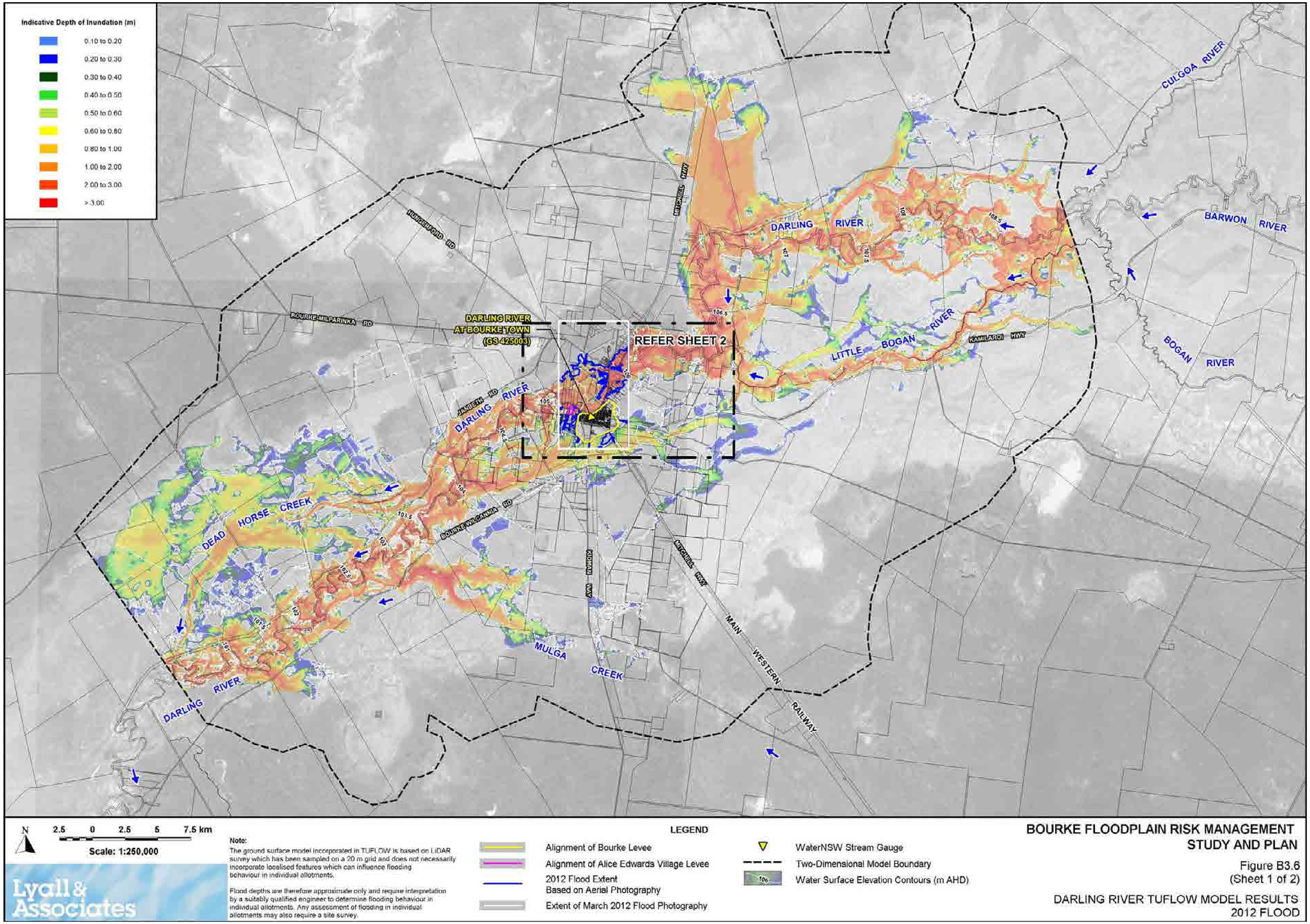
Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

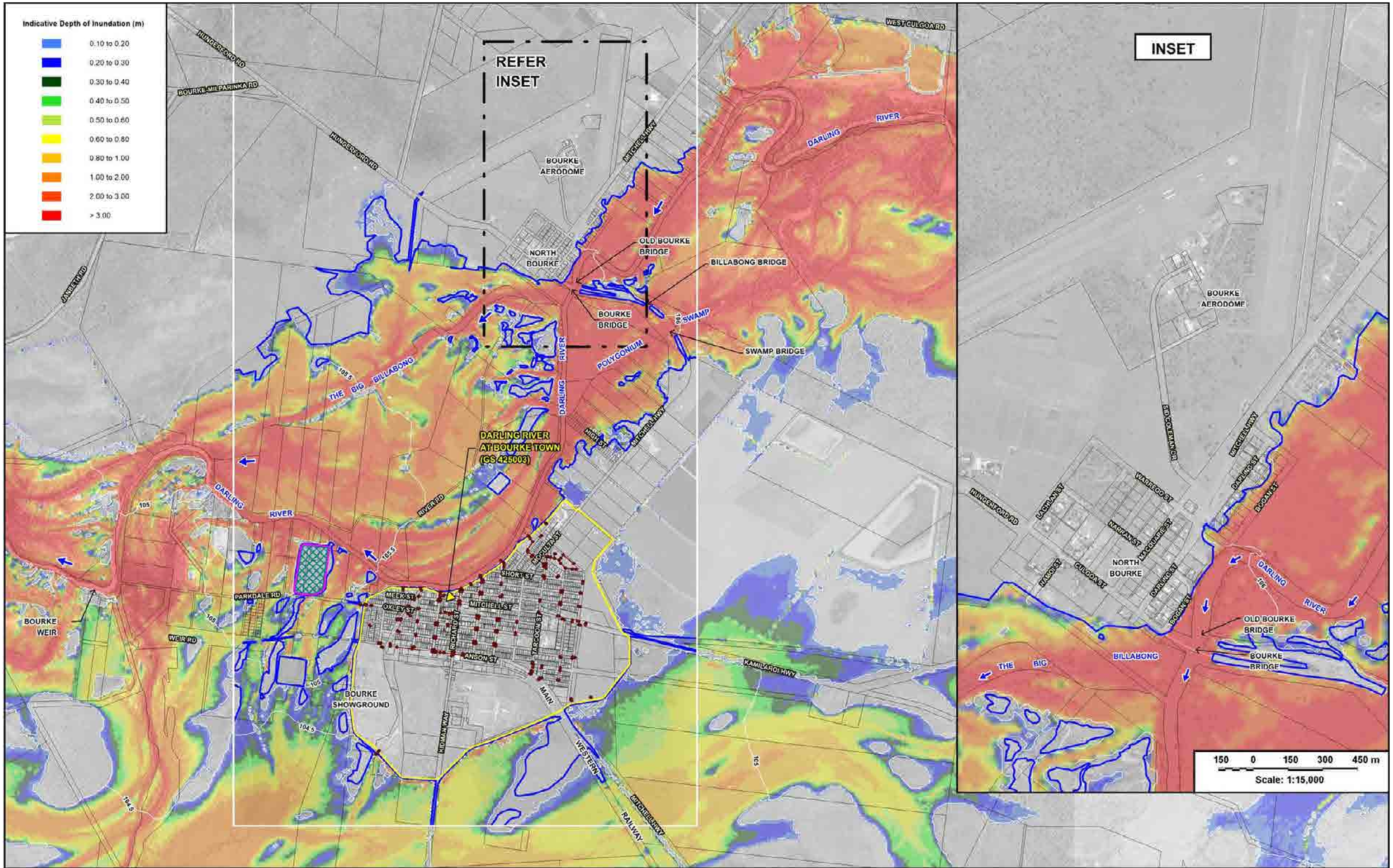
LEGEND
- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Water Surface Elevation Contours (m AHD)
- Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B3.5 (Sheet 2 of 2)

DARLING RIVER TUFLOW MODEL RESULTS 1998 FLOOD


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
CULGOA RIVER
BARWON RIVER
DARLING RIVER
BOGAN RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
MULGA CREEK
MAIN WESTERN RAILWAY
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
2012 Flood Extent Based on Aerial Photography
Extent of March 2012 Flood Photography
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
Water Surface Elevation Contours (m AHD)
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B3.6
(Sheet 1 of 2)
DARLING RIVER TUFLOW MODEL RESULTS
2012 FLOOD



400 0 400 800 1200 m
Scale: 1:40,000

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

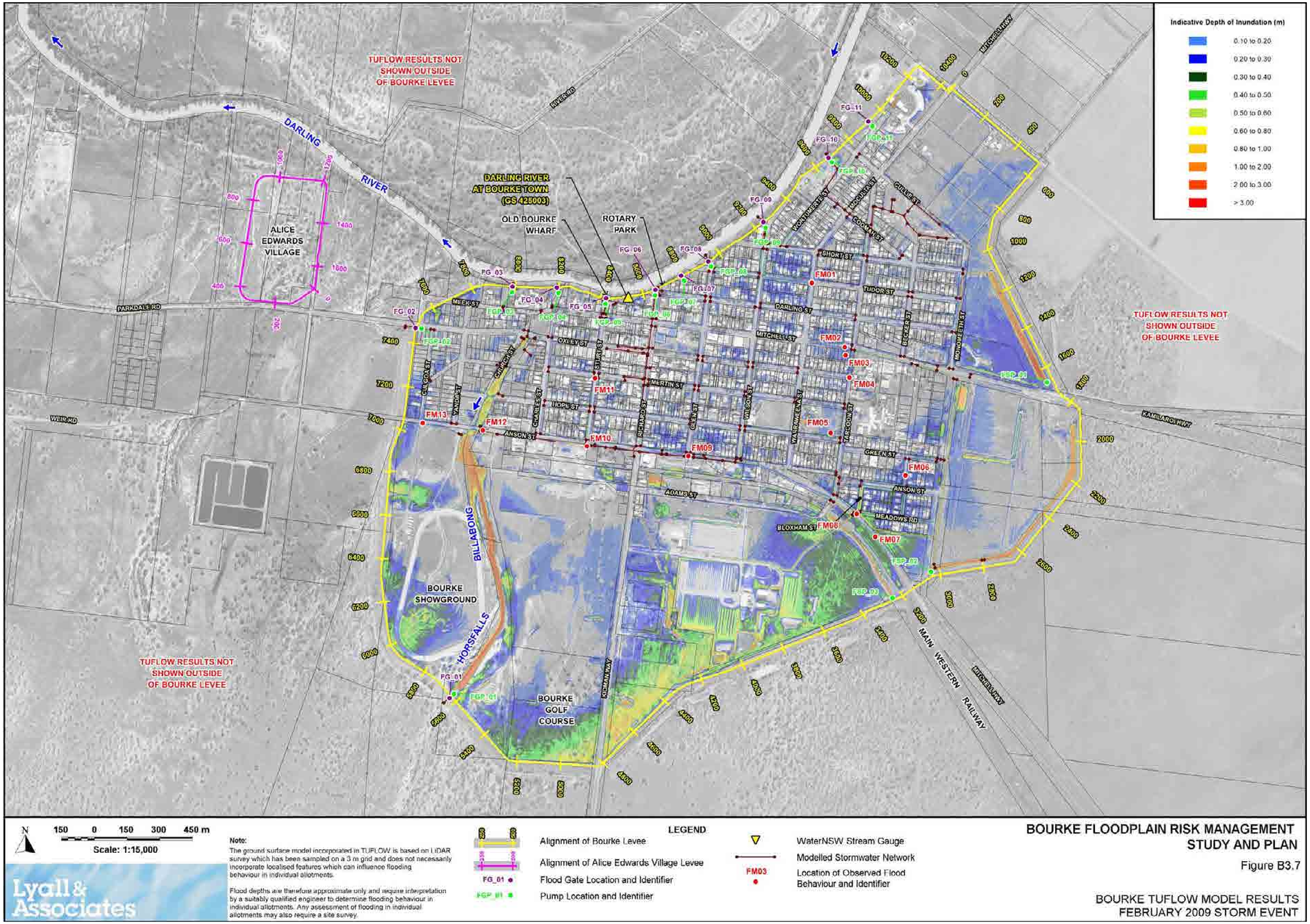
LEGEND

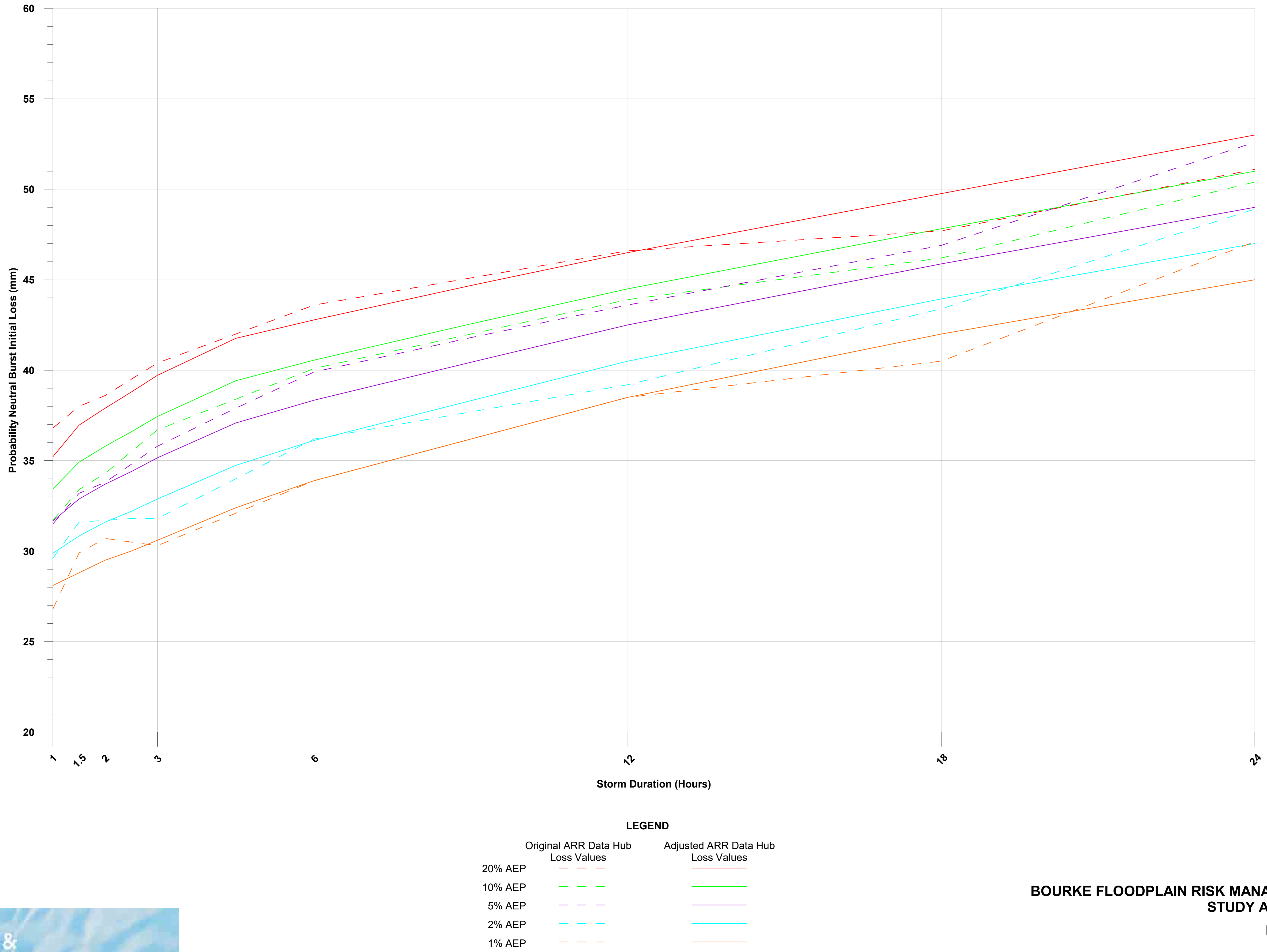
- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- 2012 Flood Extent Based on Aerial Photography
- Extent of March 2012 Flood Photography
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Water Surface Elevation Contours (m AHD)
- Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B3.6
(Sheet 2 of 2)

DARLING RIVER TUFLOW MODEL RESULTS
2012 FLOOD

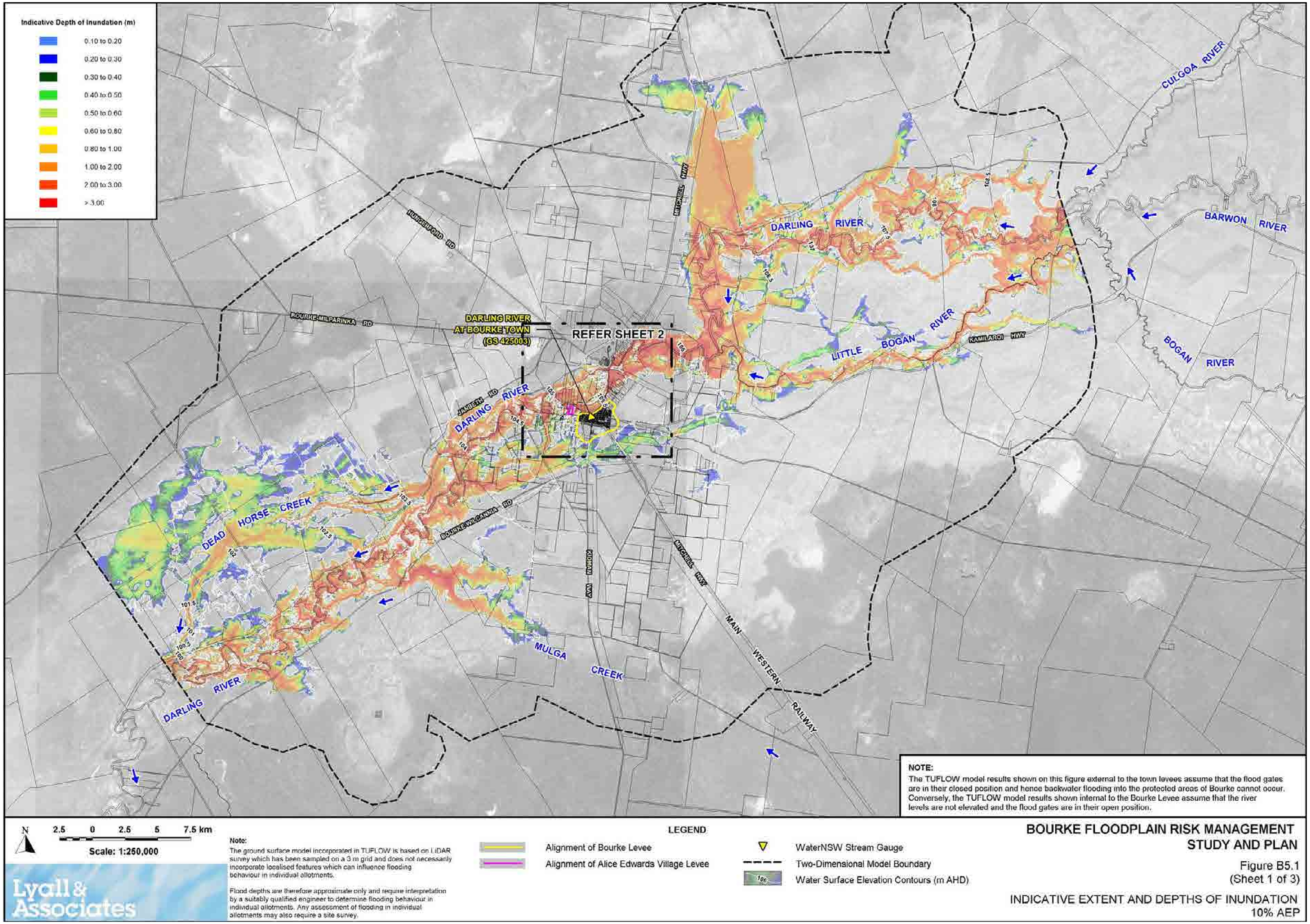

Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
TUFLOW RESULTS NOT SHOWN OUTSIDE OF BOURKE LEVEE
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
MITCHELL HWY
KAMILAROI HWY
KIDMAN WAY
PARKDALE RD
WEIR RD
RIVER RD
FM01
FM02
FM03
FM04
FM05
FM06
FM07
FM08
FM09
FM10
FM11
FM12
FM13
N
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Location of Observed Flood Behaviour and Identifier
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B3.7
BOURKE TUFLOW MODEL RESULTS FEBRUARY 2009 STORM EVENT

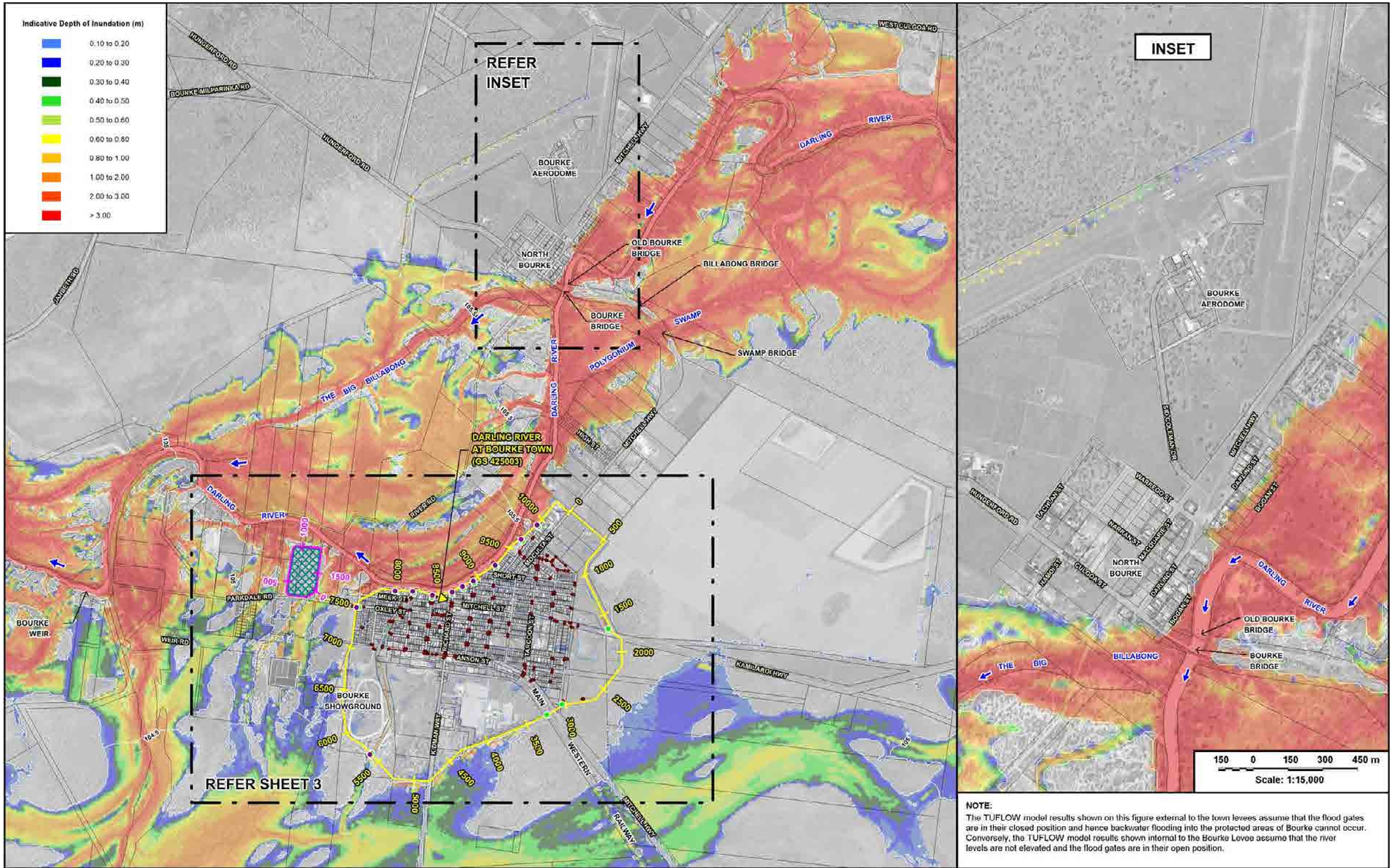


BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B4.1

ADJUSTED PROBABILITY NEUTRAL BURST INITIAL LOSS VALUES


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
CULGOA RIVER
BARWON RIVER
DARLING RIVER
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
LITTLE BOGAN RIVER
KAMILAROI HWY
BOGAN RIVER
JANDRA RD
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MAIN WESTERN RAILWAY
MULGA CREEK
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
Water Surface Elevation Contours (m AHD)
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.1 (Sheet 1 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION 10% AEP



400 0 400 800 1200 m
Scale: 1:40,000

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.

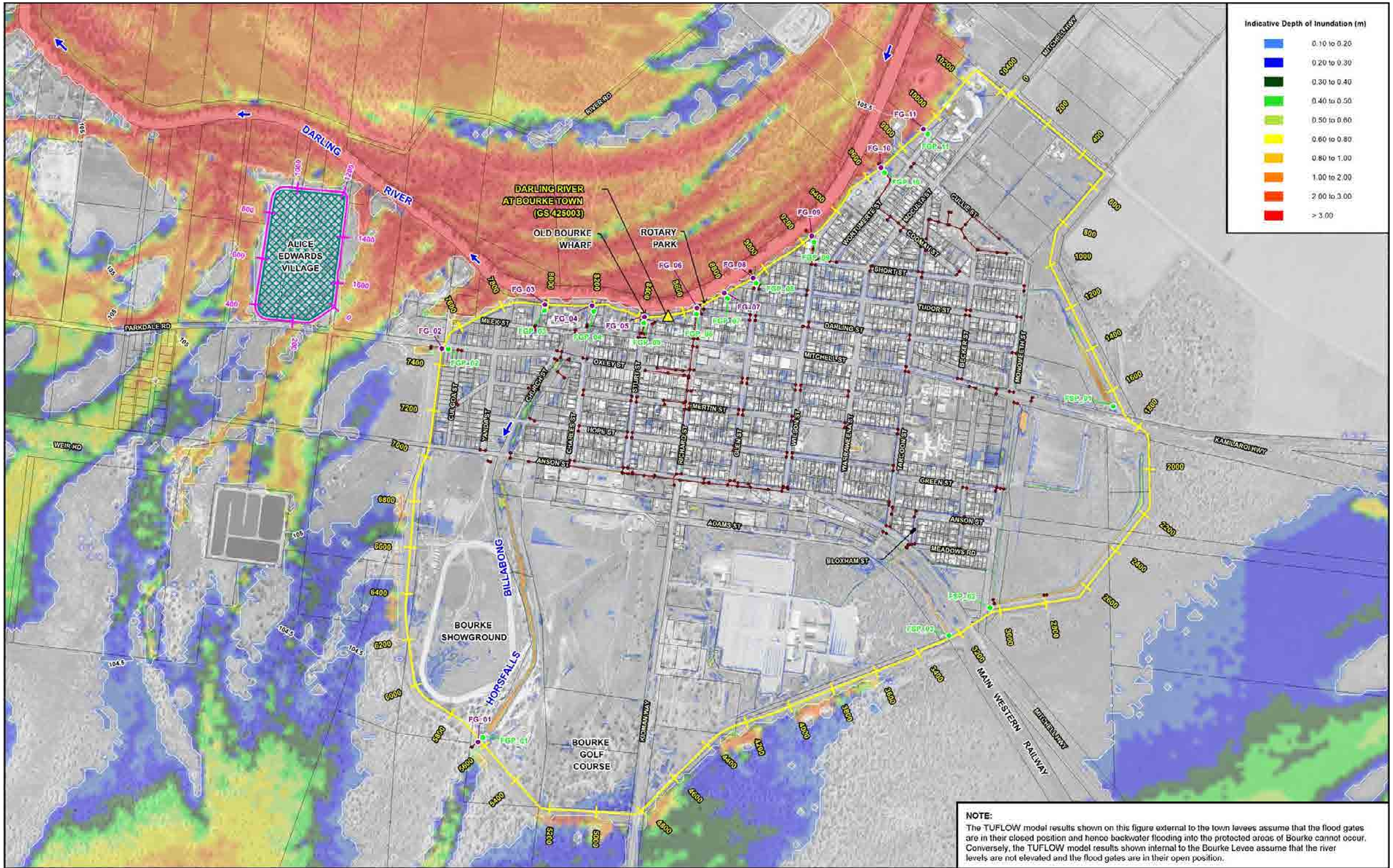
Lyall & Associates

LEGEND
- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- Flood Gate Location
- Pump Location
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Water Surface Elevation Contours (m AHD)
- Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B5.1 (Sheet 2 of 3)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION 10% AEP



NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.

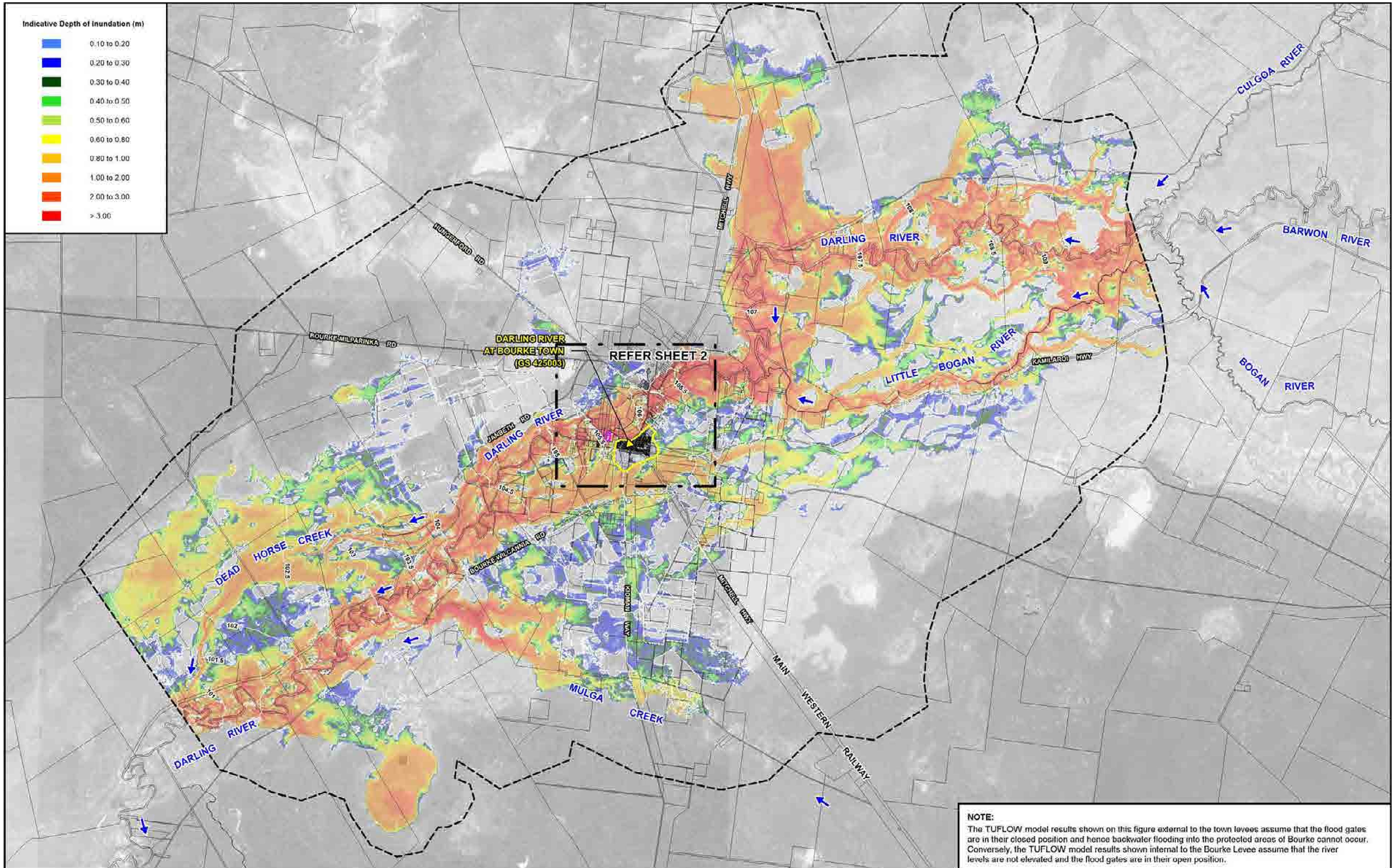
LEGEND

- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- FG_01 Flood Gate Location and Identifier
- FGP_01 Pump Location and Identifier
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Water Surface Elevation Contours (m AHD)
- Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B5.1
(Sheet 3 of 3)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
10% AEP



N 2.5 0 2.5 5 7.5 km

Scale: 1:250,000

Lyall & Associates

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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

Alignment of Bourke Levee

Alignment of Alice Edwards Village Levee

WaterNSW Stream Gauge

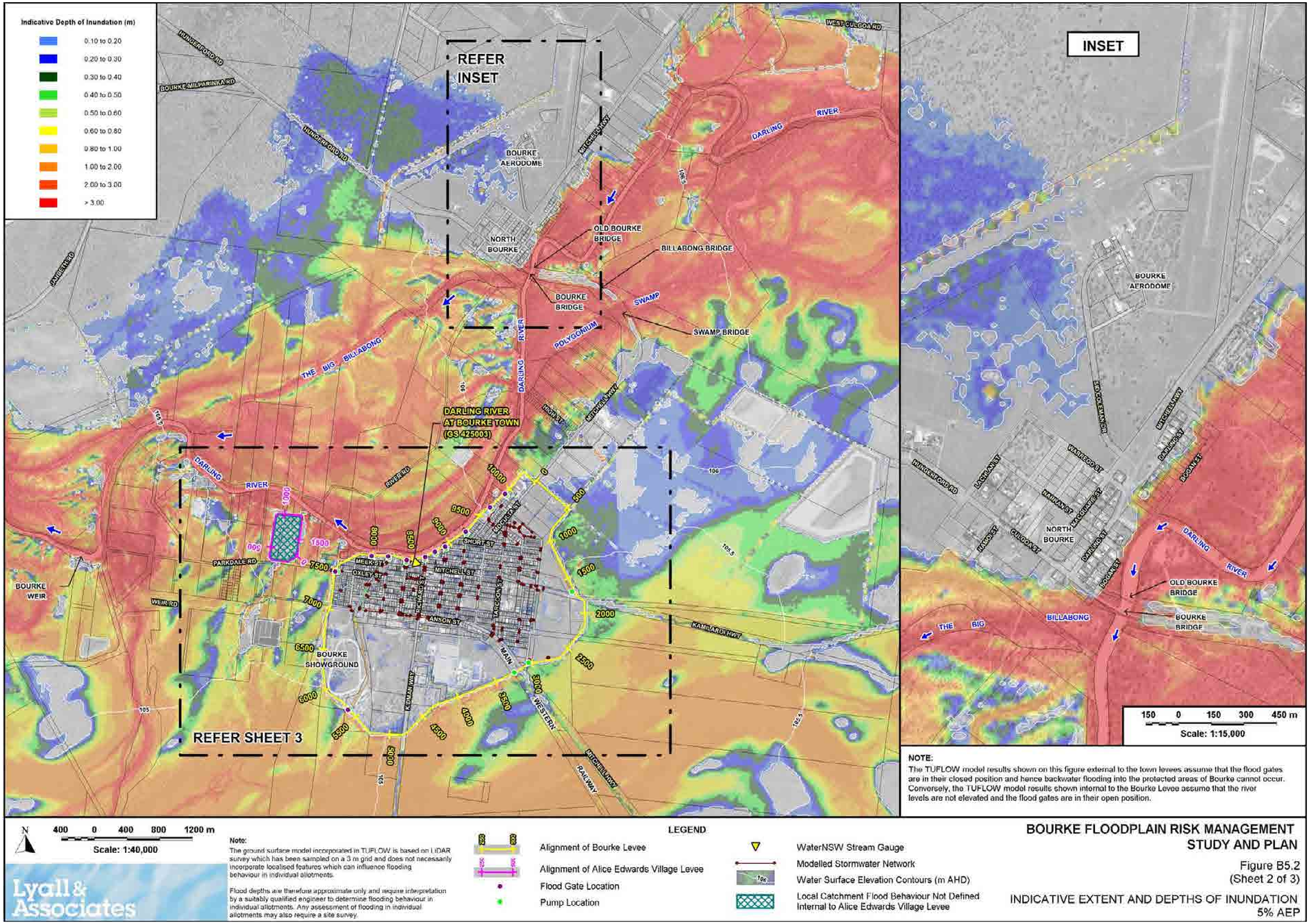
Two-Dimensional Model Boundary

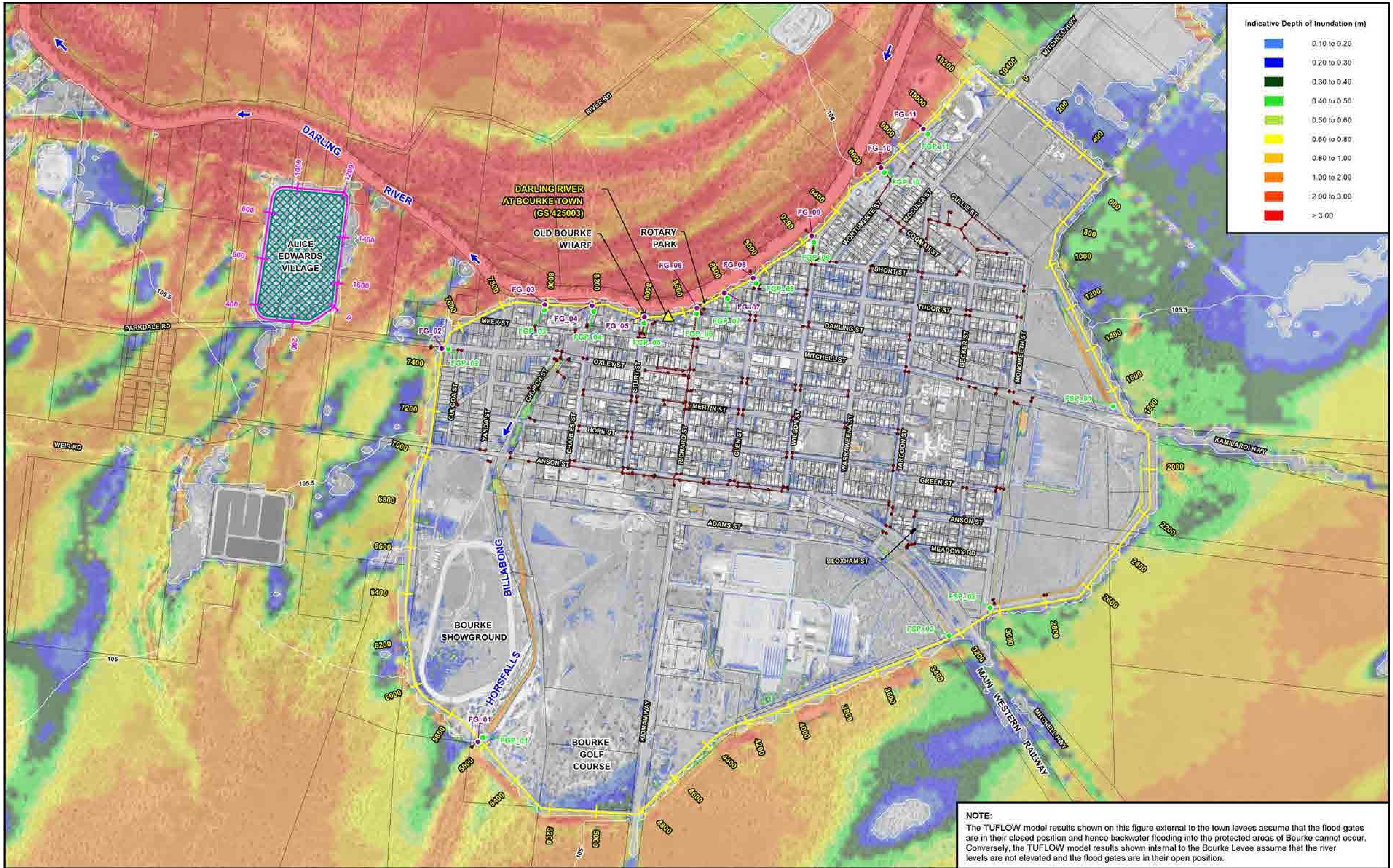
Water Surface Elevation Contours (m AHD)

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B5.2
(Sheet 1 of 3)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
5% AEP


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
REFER INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
THE BIG BILLABONG
DARLING RIVER
POLYGONUM SWAMP
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
REFER SHEET 3
INSET
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
150 0 150 300 450 m
Scale: 1:15,000
400 0 400 800 1200 m
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.2 (Sheet 2 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION 5% AEP



Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.

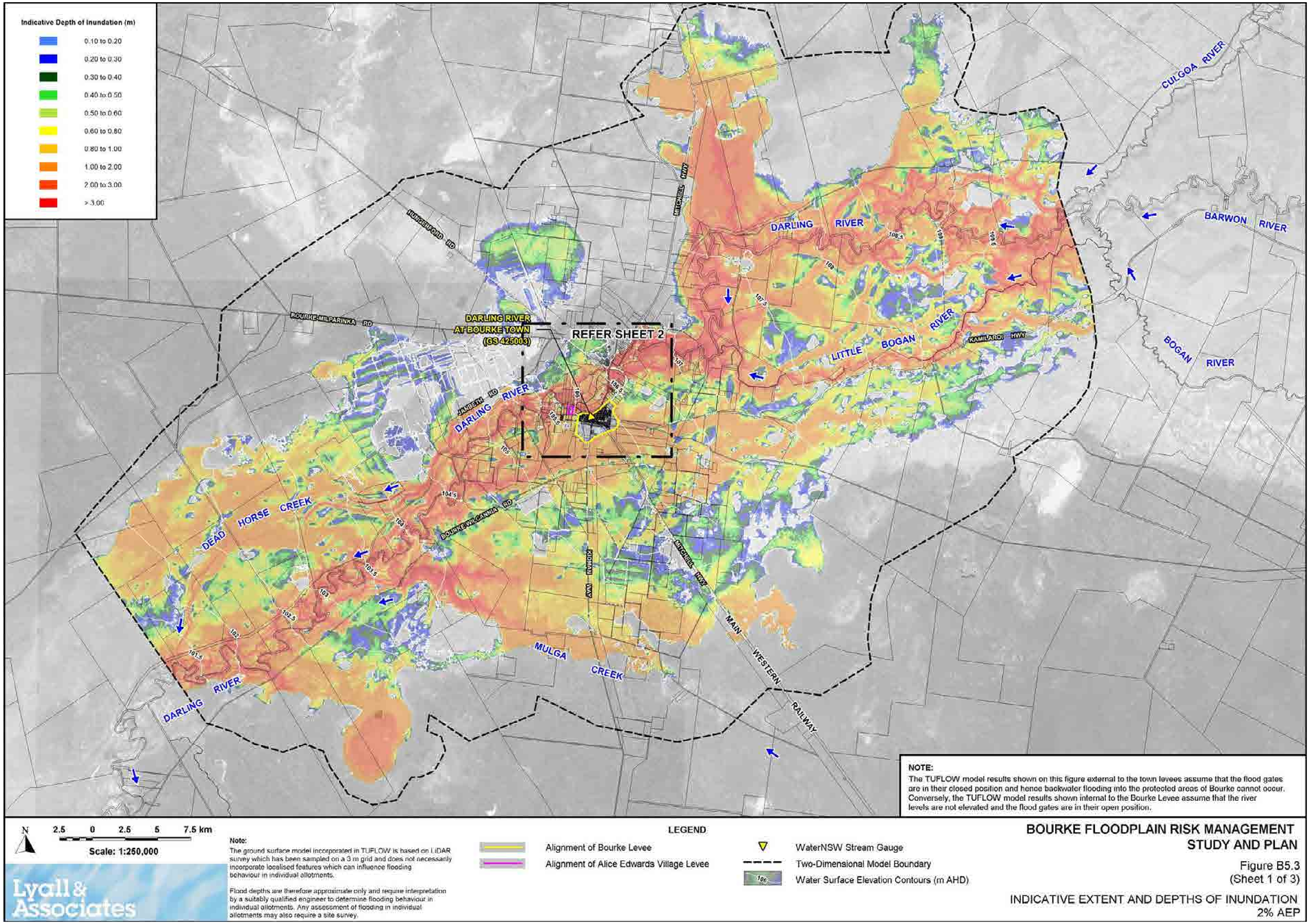
LEGEND

- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- FG_01 Flood Gate Location and Identifier
- FGP_01 Pump Location and Identifier
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Water Surface Elevation Contours (m AHD)
- Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee

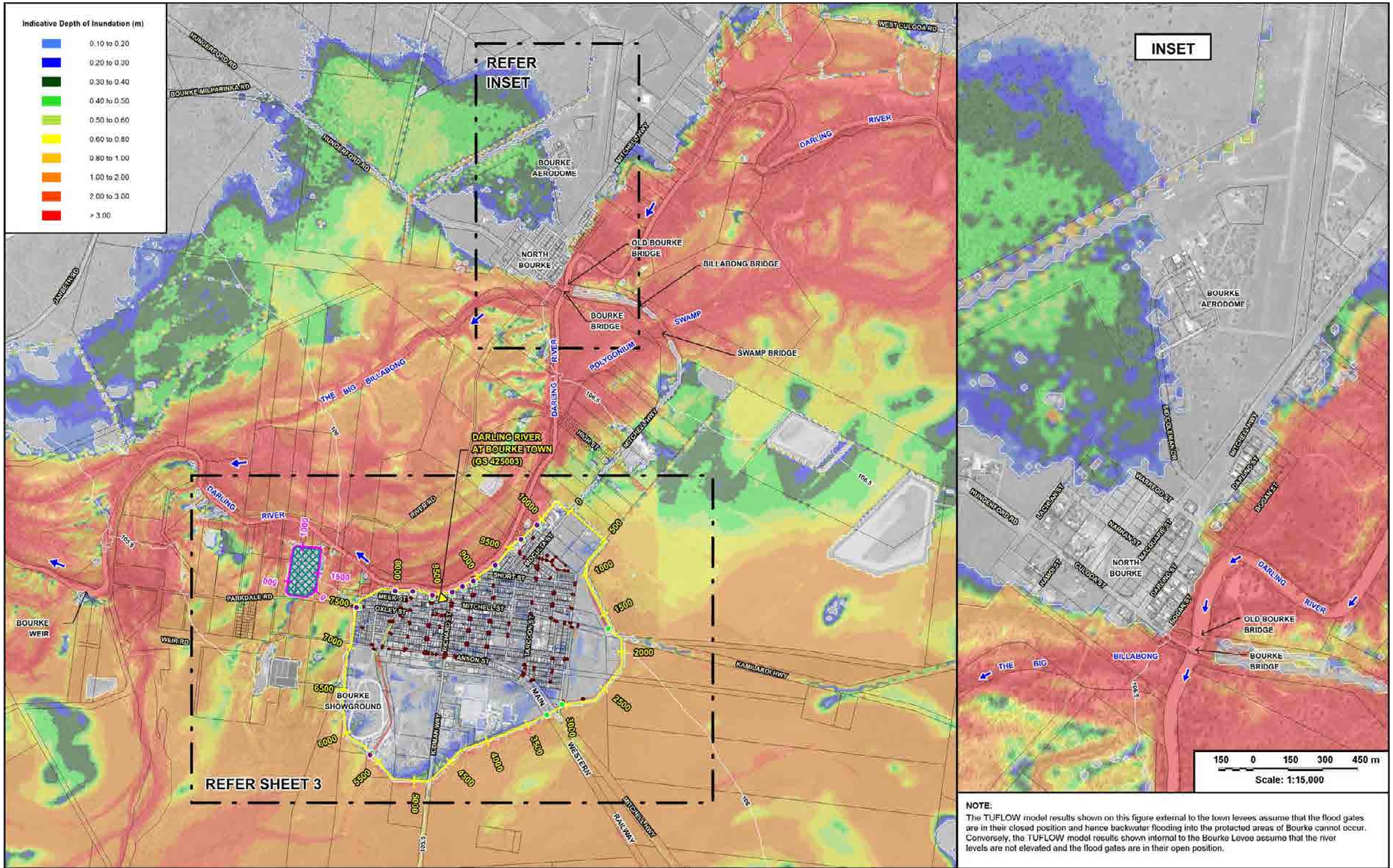
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B5.2
(Sheet 3 of 3)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
5% AEP



Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
CULGOA RIVER
BARWON RIVER
BOGAN RIVER
DARLING RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
JANDRA RD
DARLING RIVER
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MITCHELL HWY
MAIN WESTERN RAILWAY
MULGA CREEK
DARLING RIVER
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
Water Surface Elevation Contours (m AHD)
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.3
(Sheet 1 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
2% AEP



NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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

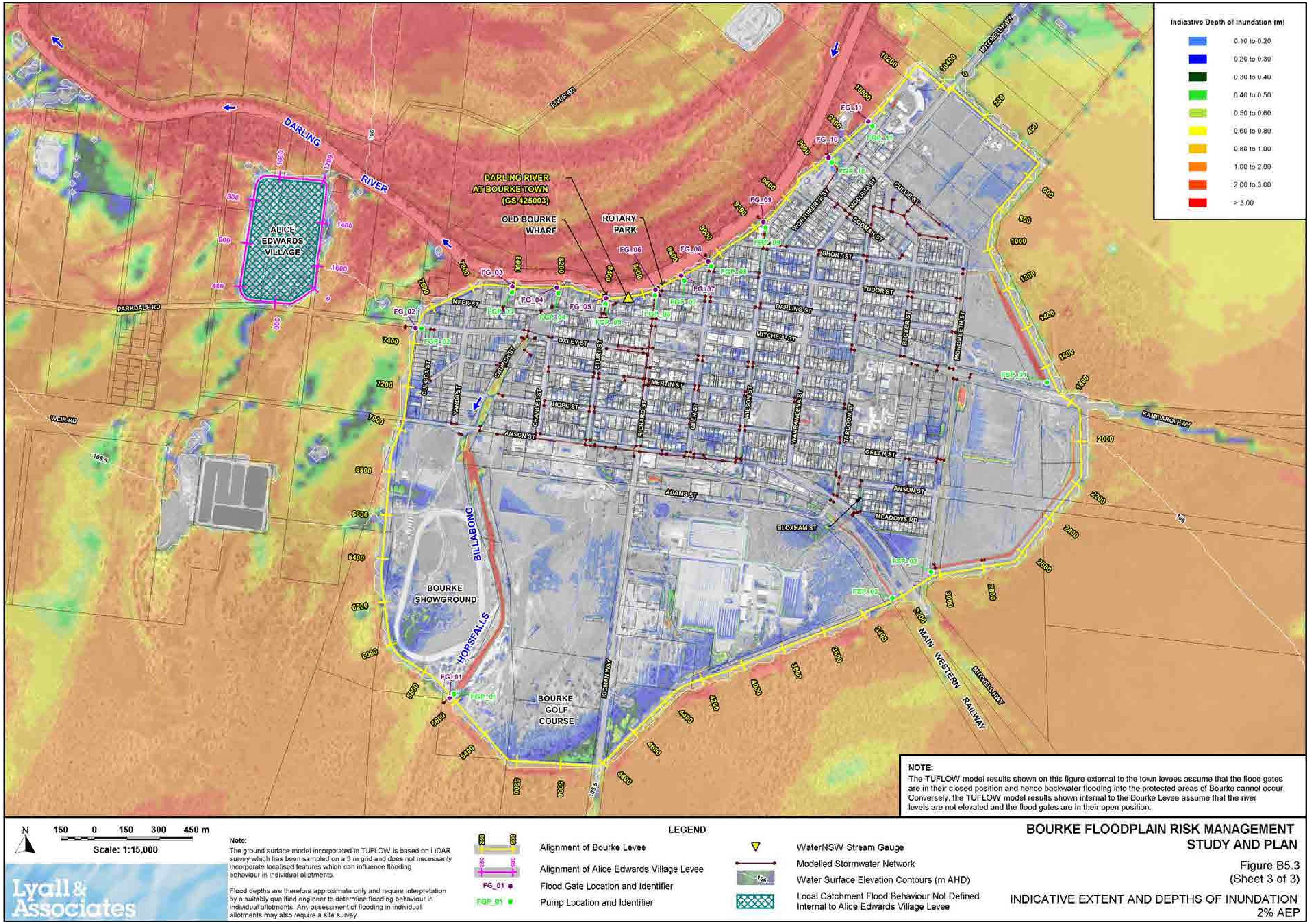
- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- Flood Gate Location
- Pump Location
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Water Surface Elevation Contours (m AHD)
- Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee

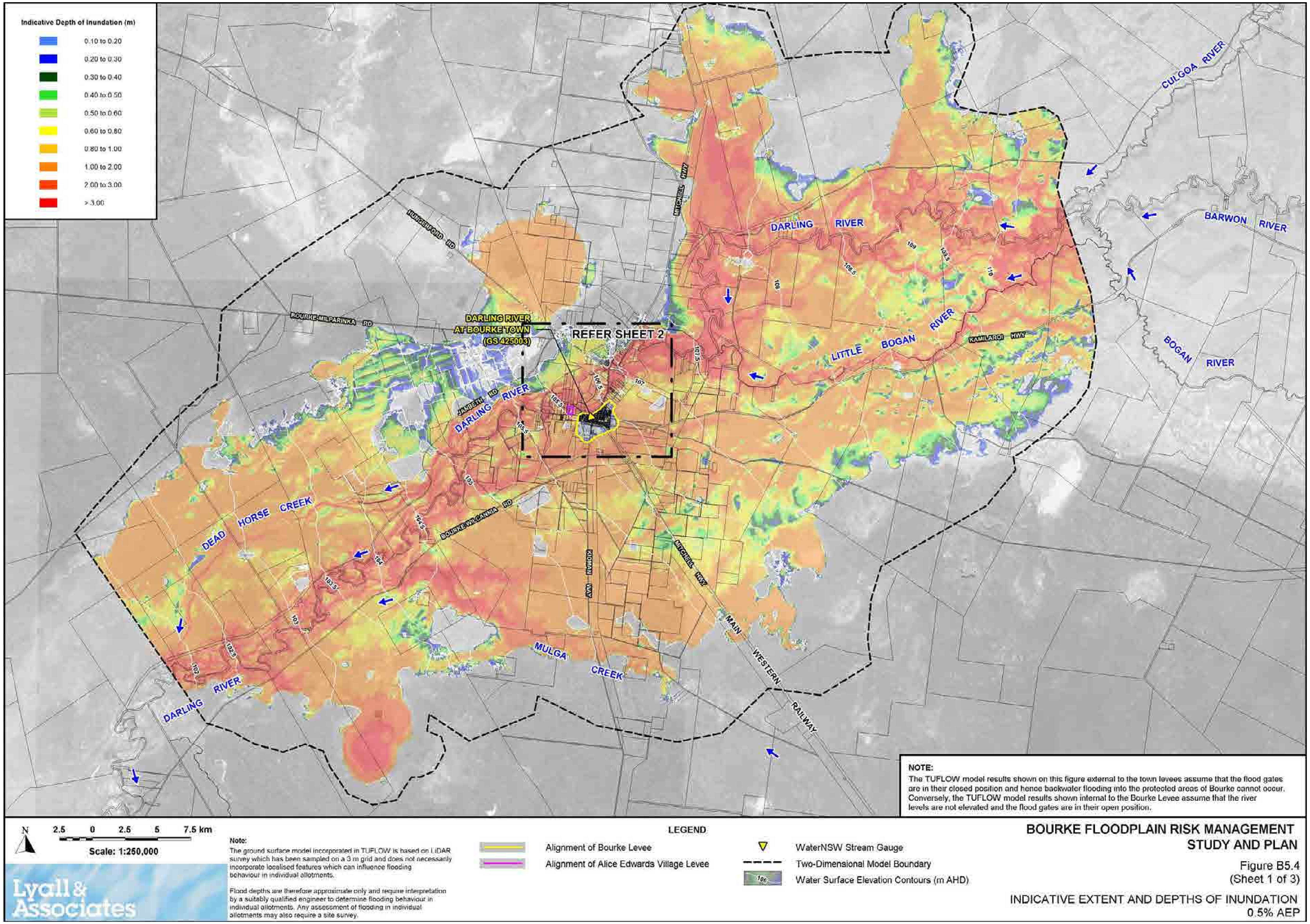
Lyall & Associates

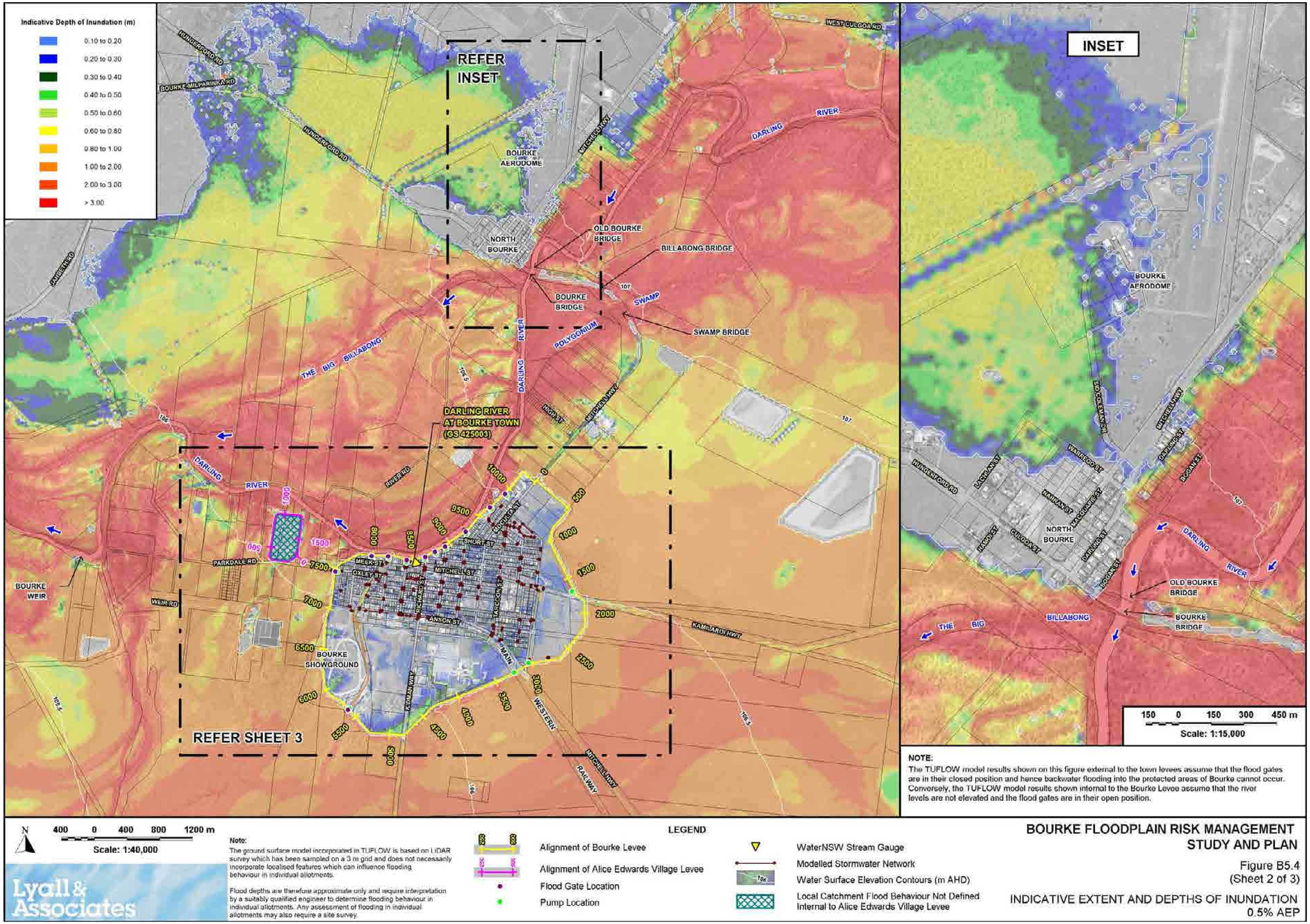
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

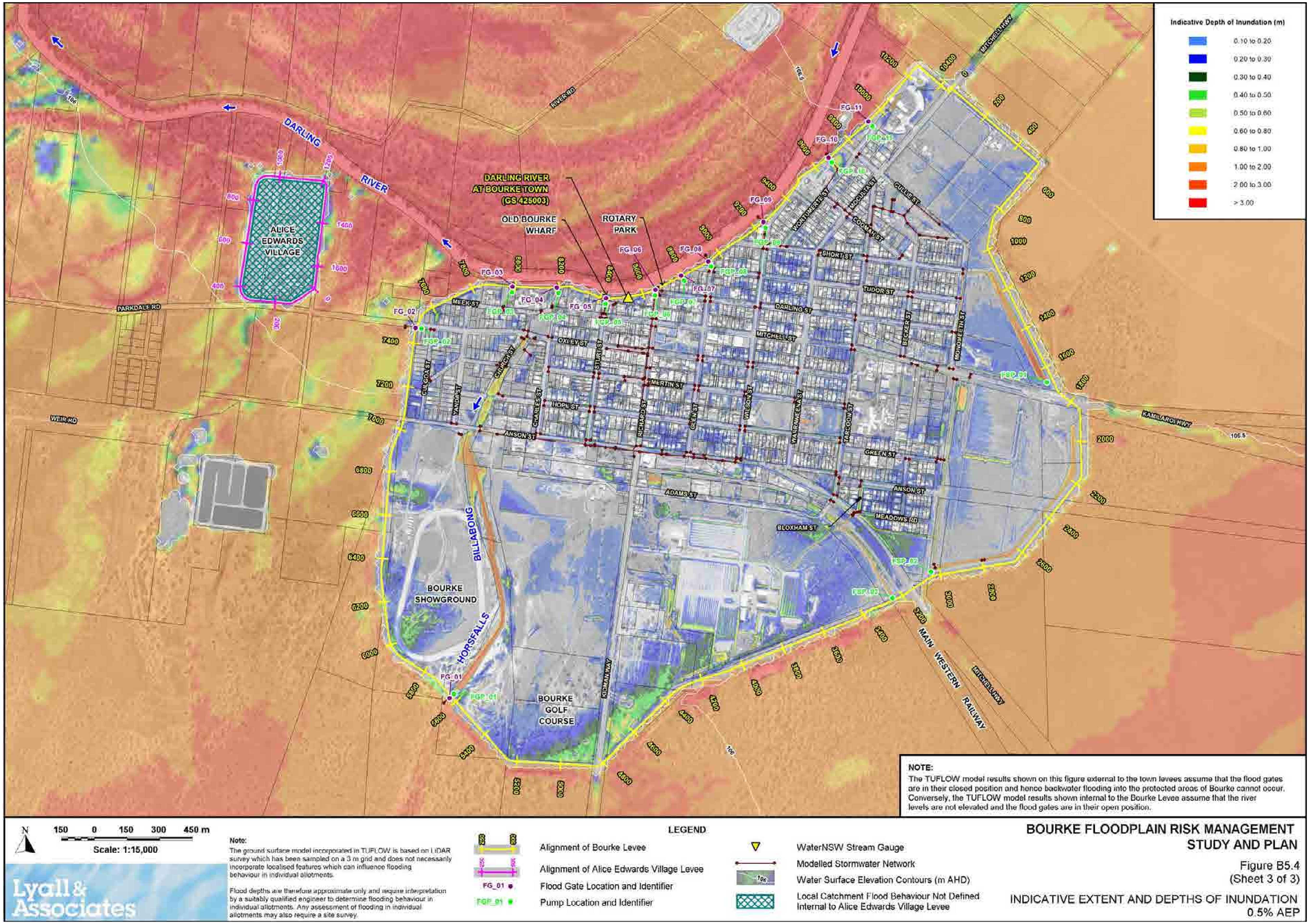
Figure B5.3
(Sheet 2 of 3)

INDICATIVE EXTENT AND DEPTHS OF INUNDATION
2% AEP

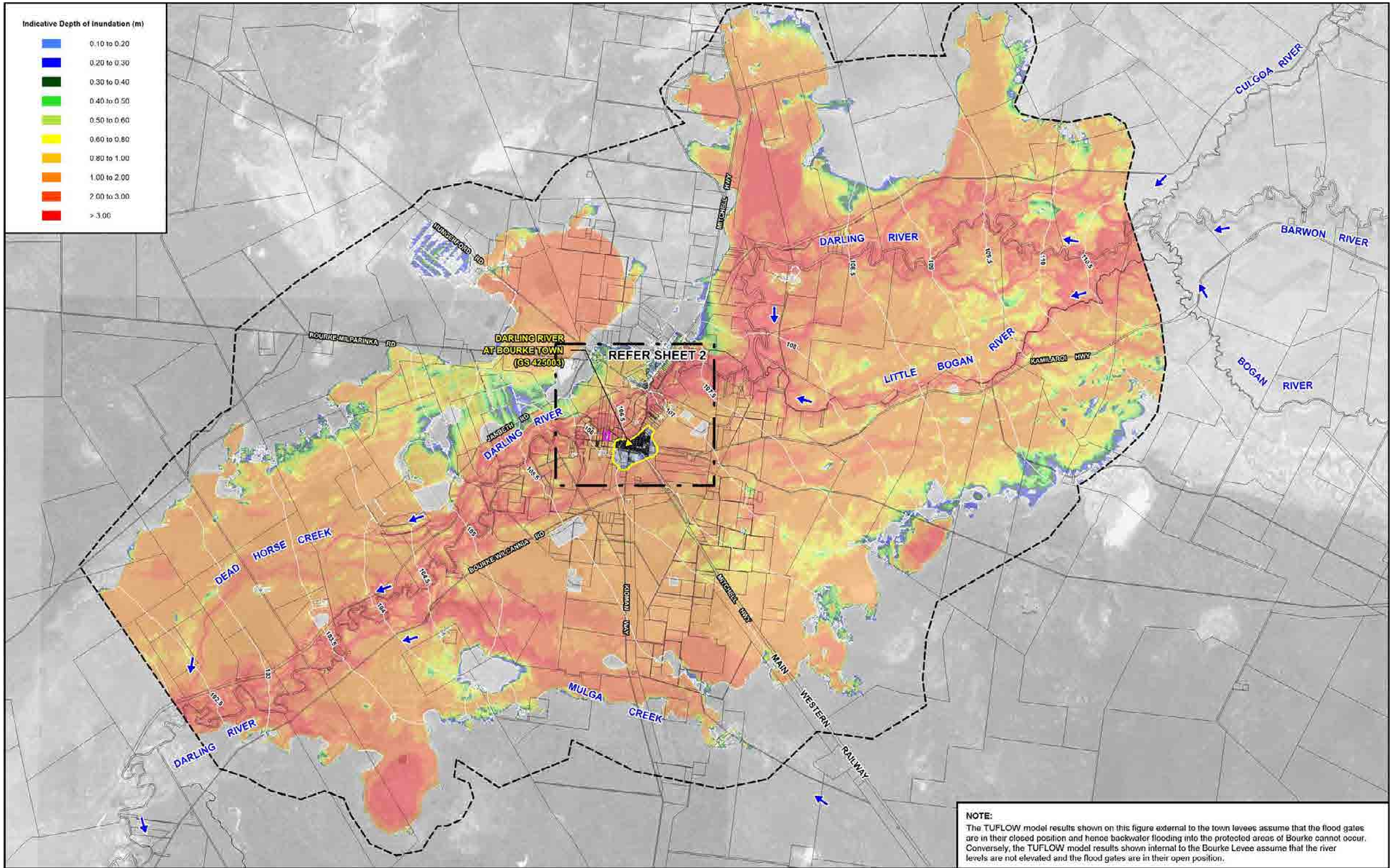

Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
MEEK ST
OXLEY ST
STURT ST
MERTIN ST
HOPE ST
ANSON ST
CHARLES ST
RICHARD ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
DARLING ST
MITCHELL ST
SHORT ST
TUDOR ST
GREEN ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
BECKER ST
MONOMEETH ST
CULGOA ST
YANDA ST
CHURCH ST
CULLIE ST
COOMAH ST
KOONDOWERIE ST
MOCULTA ST
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
150 0 150 300 450 m
Scale: 1:15,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
FG_01 Flood Gate Location and Identifier
FGP_01 Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.3
(Sheet 3 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
2% AEP


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
CULGOA RIVER
BARWON RIVER
DARLING RIVER
BOGAN RIVER
LITTLE BOGAN RIVER
KAMILAROI HWY
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
REFER SHEET 2
JANDRA RD
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MAIN WESTERN RAILWAY
MULGA CREEK
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
Water Surface Elevation Contours (m AHD)
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.4
(Sheet 1 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
0.5% AEP


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
REFER INSET
INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
DARLING RIVER
THE BIG BILLABONG
POLYGONIUM SWAMP
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
REFER SHEET 3
HUNGERFORD RD
BOURKE-MILPARINKA RD
WEST CULGOA RD
MITCHELL HWY
KAMILAROI HWY
PARKDALE RD
WEIR RD
RIVER RD
MEEK ST
OXLEY ST
SHORT ST
MITCHELL ST
ANSON ST
RICHARD ST
TARCOON ST
MAIN
KIDMAN WAY
WESTERN
RAILWAY
HIGH ST
150 0 150 300 450 m
Scale: 1:15,000
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
400 0 400 800 1200 m
Scale: 1:40,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.4
(Sheet 2 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
0.5% AEP



Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
BOURKE SHOWGROUND
BOURKE GOLF COURSE
HORSFALLS BILLABONG
MAIN WESTERN RAILWAY
KAMILAROI HWY
MITCHELL HWY
PARKDALE RD
WEIR RD
RIVER RD
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.4
(Sheet 3 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
0.5% AEP



N

2.5 0 2.5 5 7.5 km

Scale: 1:250,000

Lyall & Associates

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.

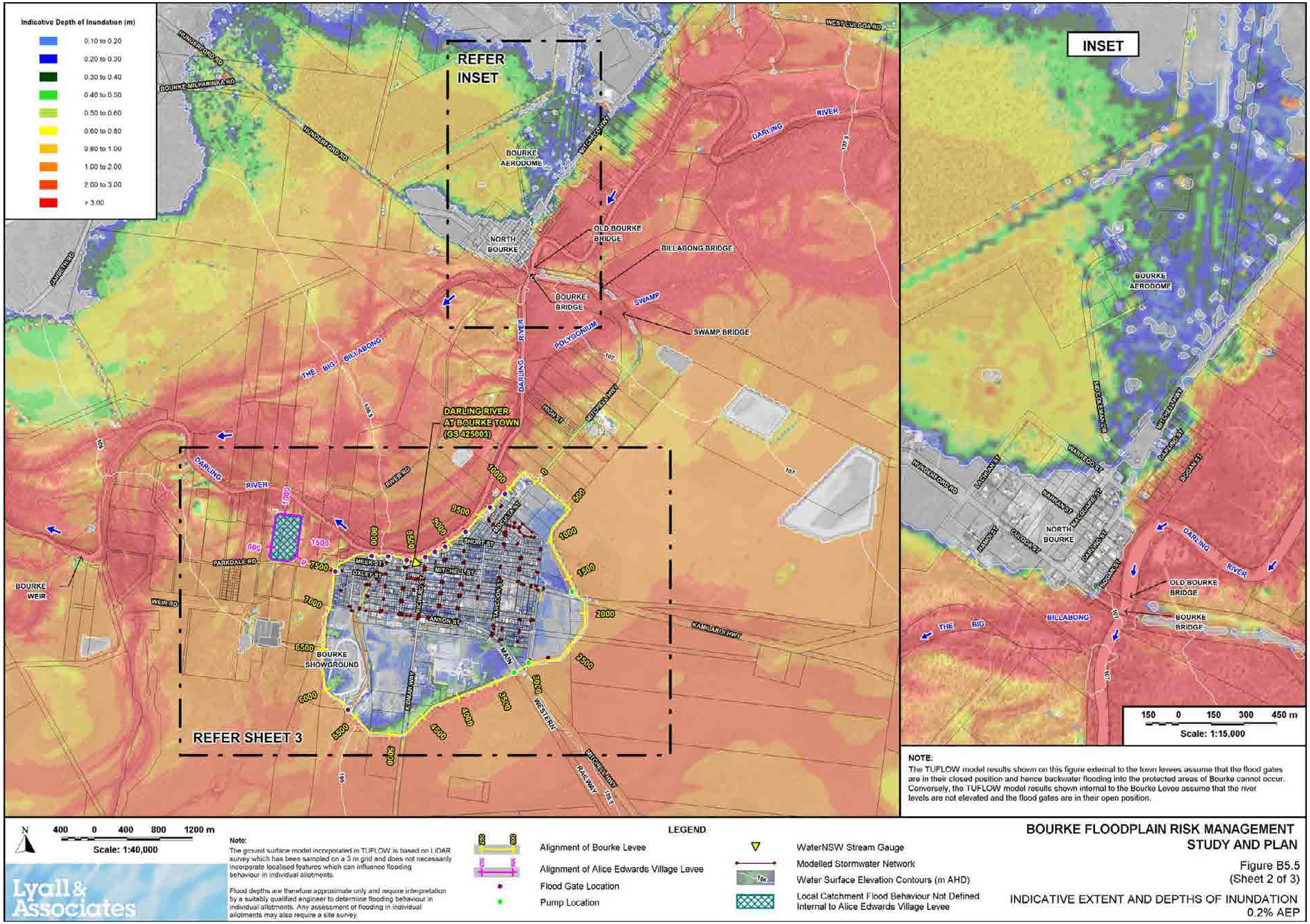
LEGEND

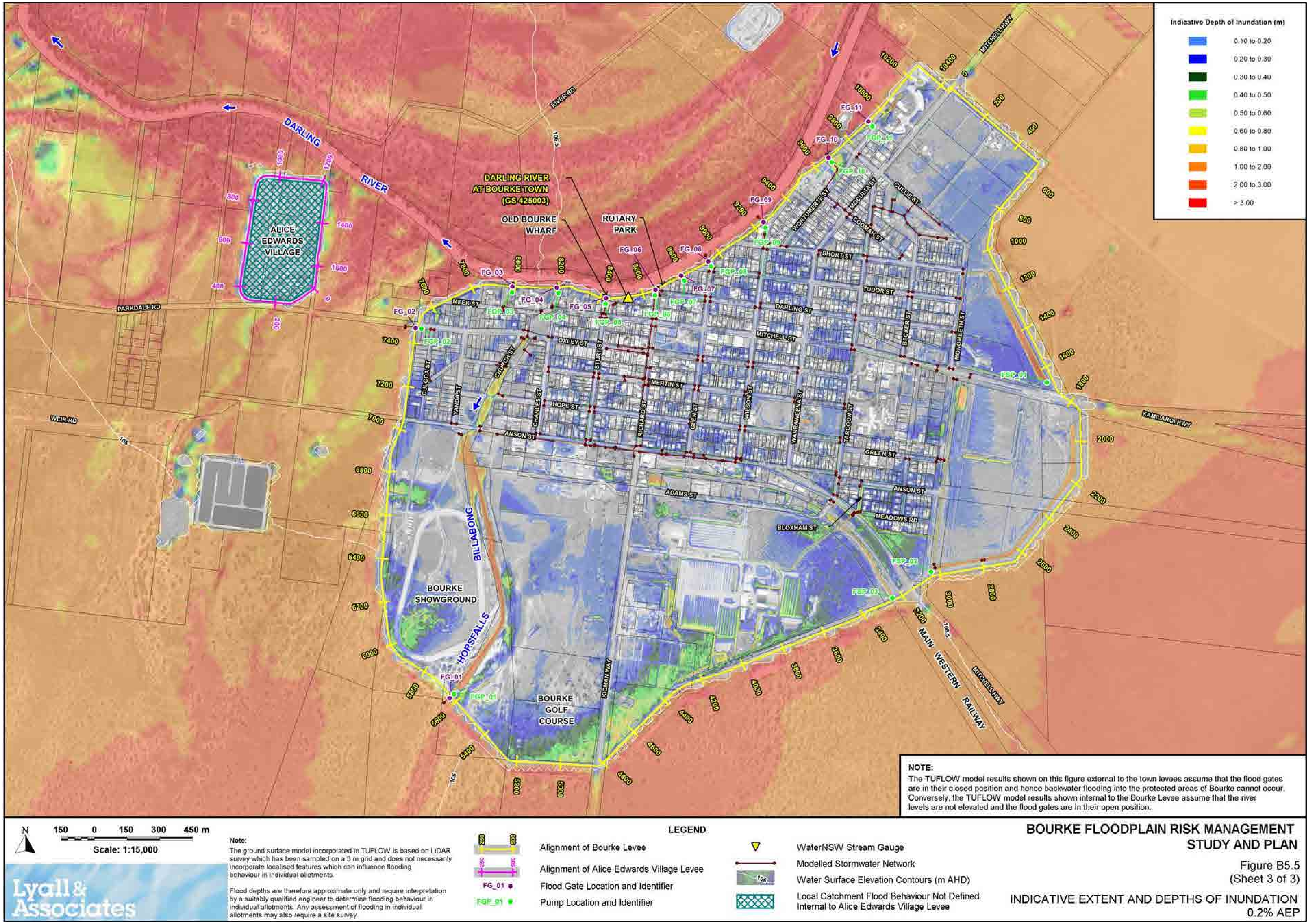
- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- WaterNSW Stream Gauge
- Two-Dimensional Model Boundary
- 106 Water Surface Elevation Contours (m AHD)

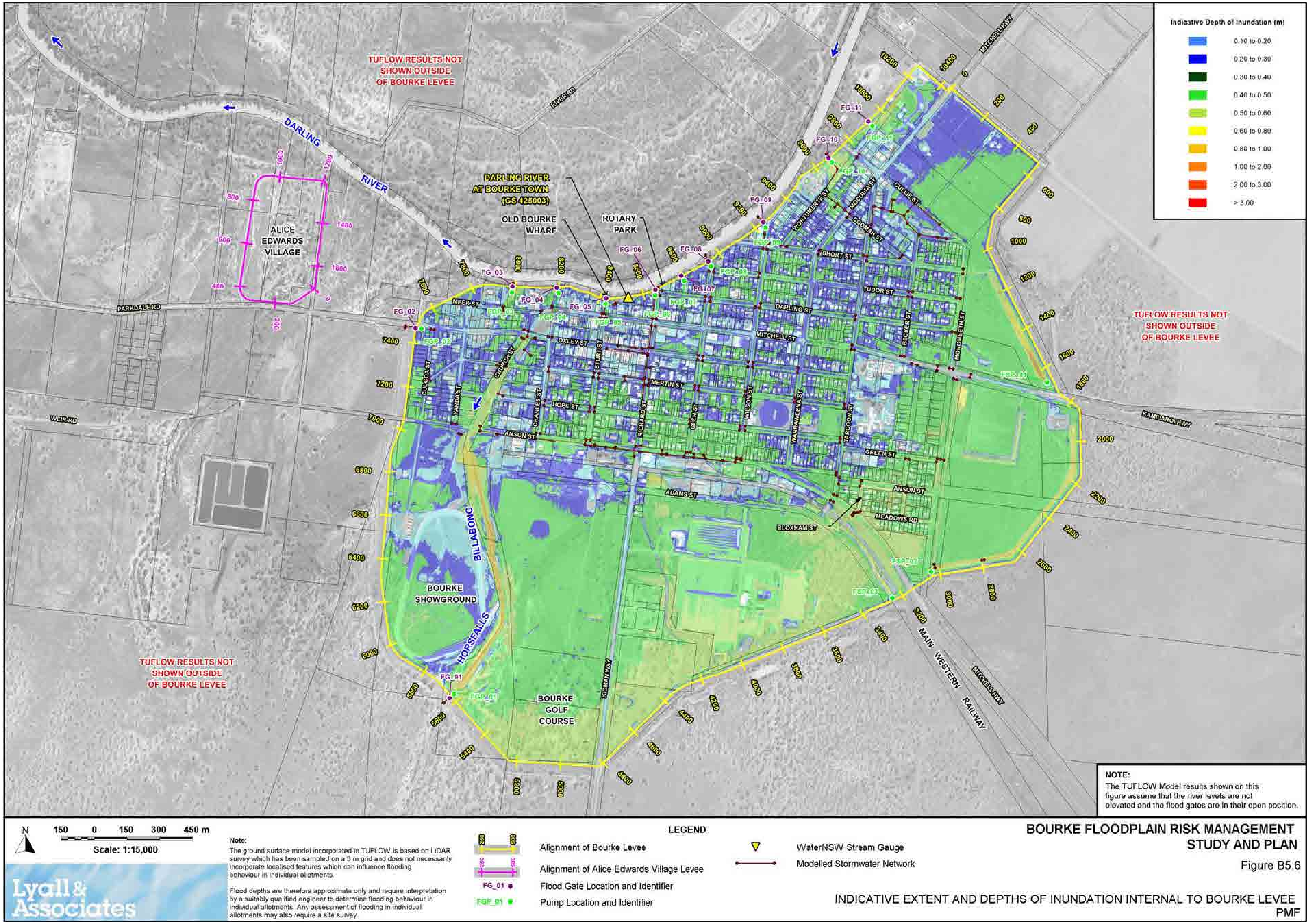
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

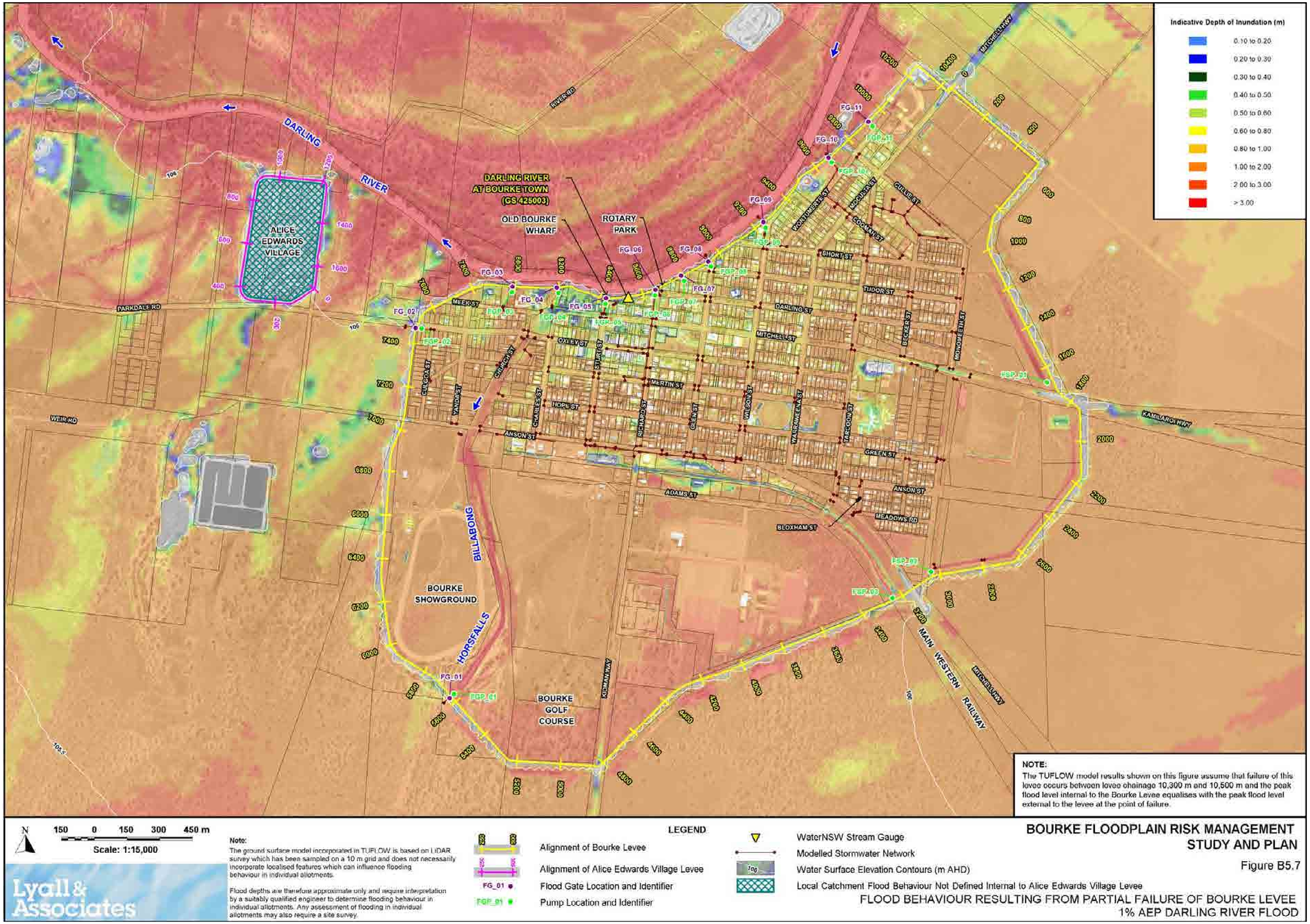
Figure B5.5
(Sheet 1 of 3)

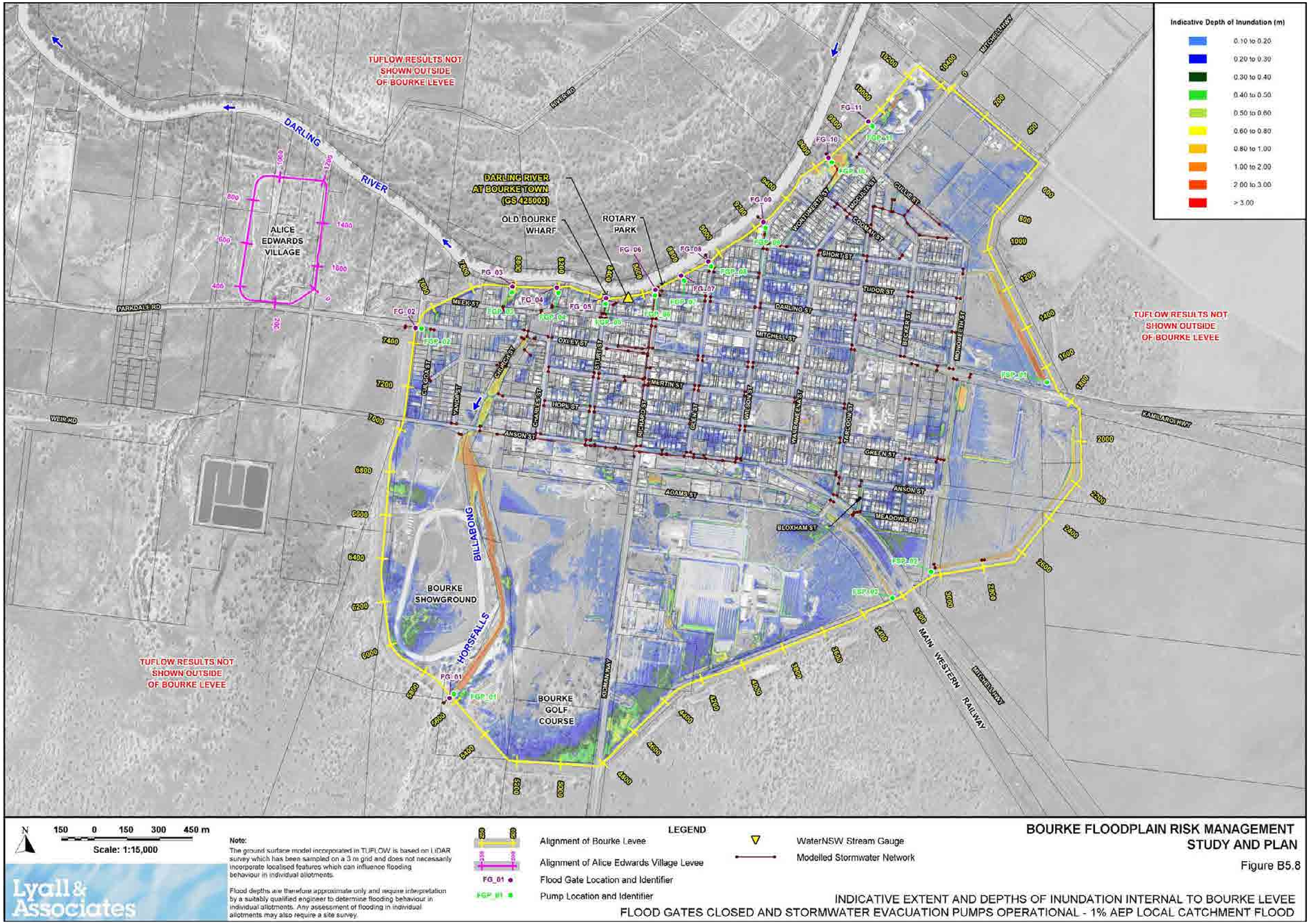
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
0.2% AEP

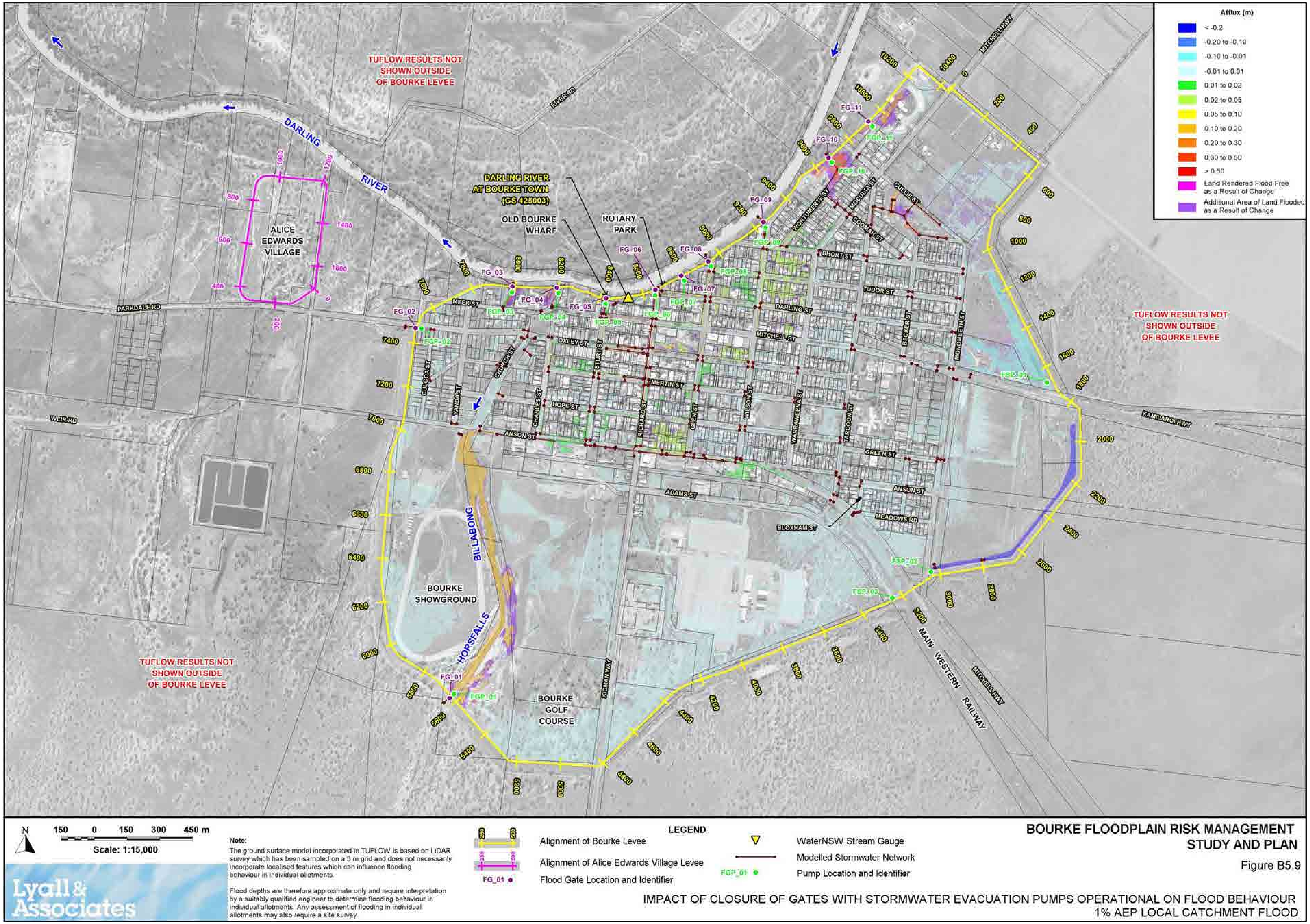

Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
REFER INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
POLYGONIUM SWAMP
DARLING RIVER
THE BIG BILLABONG
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
HUNGERFORD RD
BOURKE-MILPARINKA RD
MITCHELL HWY
KAMILAROI HWY
WEIR RD
PARKDALE RD
RIVER RD
WEST CULGOA RD
MEEK ST
OXLEY ST
SHORT ST
MITCHELL ST
ANSON ST
RICHARD ST
TARCOON ST
MAIN
WESTERN
RAILWAY
HIGH ST
REFER SHEET 3
INSET
150 0 150 300 450 m
Scale: 1:15,000
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
400 0 400 800 1200 m
Scale: 1:40,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.5
(Sheet 2 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION
0.2% AEP


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
BOURKE SHOWGROUND
HORSFALLS BILLABONG
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
MITCHELL HWY
KAMILAROI HWY
PARKDALE RD
WEIR RD
RIVER RD
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.5 (Sheet 3 of 3)
INDICATIVE EXTENT AND DEPTHS OF INUNDATION 0.2% AEP

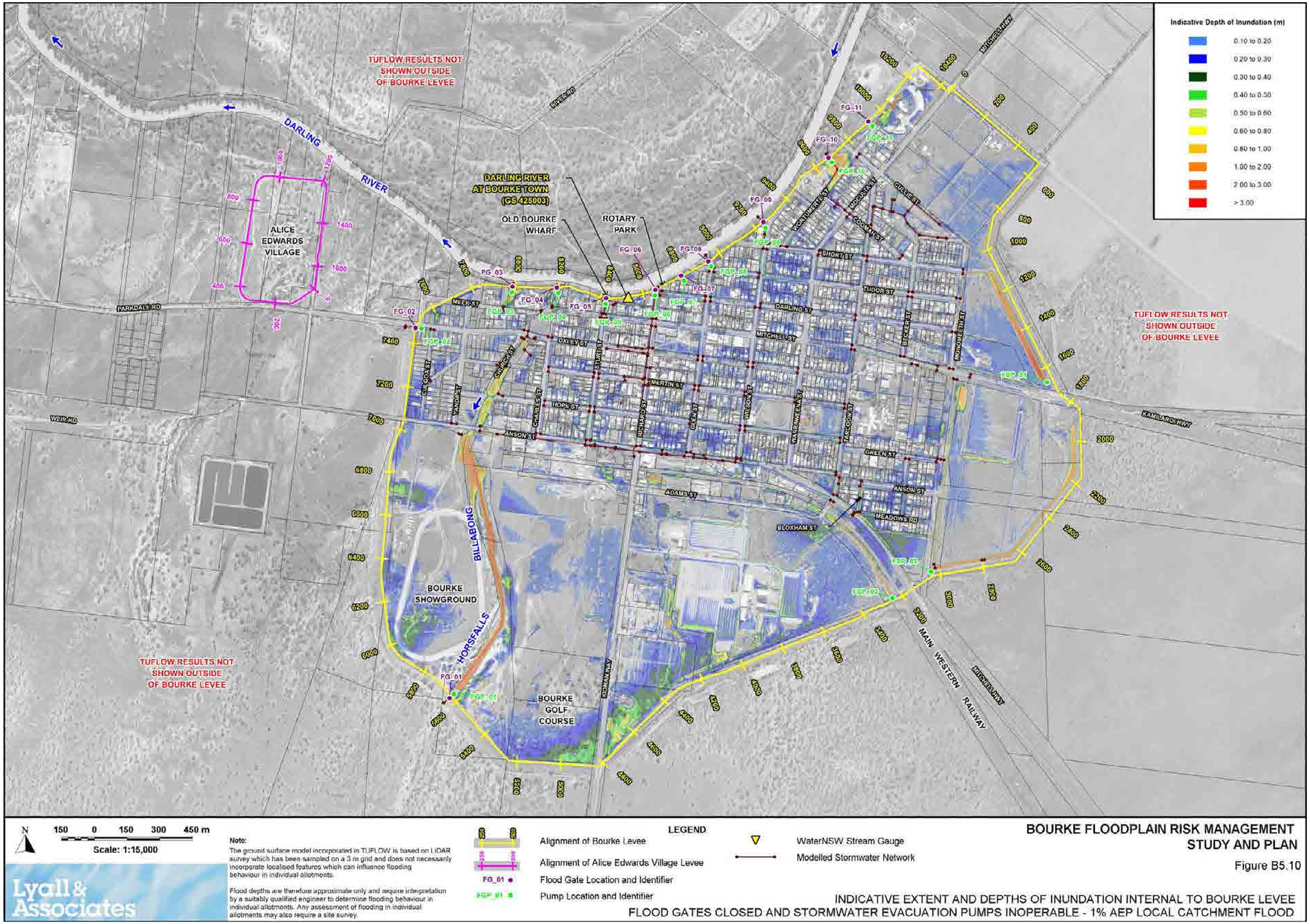

Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
TUFLOW RESULTS NOT SHOWN OUTSIDE OF BOURKE LEVEE
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
KIDMAN WAY
MAIN WESTERN RAILWAY
MEEK ST
OXLEY ST
MITCHELL ST
DARLING ST
TUDOR ST
SHORT ST
MERTIN ST
HOPE ST
ANSON ST
GREEN ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
CULGOA ST
YANDA ST
CHURCH ST
CHARLES ST
STURT ST
RICHARD ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
BECKER ST
MONOKEETH ST
NOTE:
The TUFLOW Model results shown on this figure assume that the river levels are not elevated and the flood gates are in their open position.
N
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.6
INDICATIVE EXTENT AND DEPTHS OF INUNDATION INTERNAL TO BOURKE LEVEE
PMF

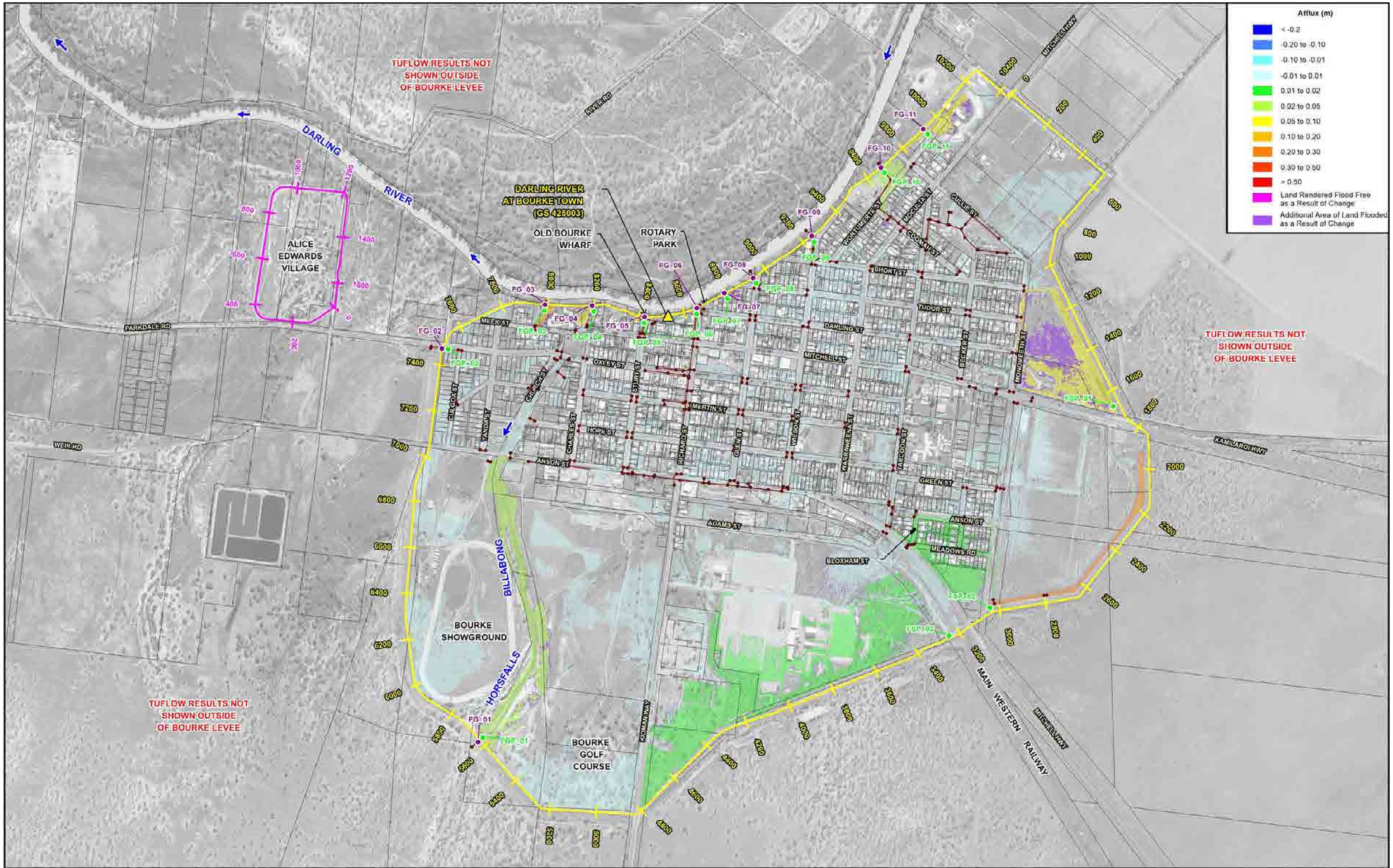

Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
BOURKE SHOWGROUND
BOURKE GOLF COURSE
BILLABONG
HORSFALLS
MAIN WESTERN RAILWAY
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
KIDMAN WAY
MEEK ST
OXLEY ST
MITCHELL ST
DARLING ST
TUDOR ST
SHORT ST
MERTIN ST
HOPE ST
ANSON ST
GREEN ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
NOTE:
The TUFLOW model results shown on this figure assume that failure of this levee occurs between levee chainage 10,300 m and 10,500 m and the peak flood level internal to the Bourke Levee equalises with the peak flood level external to the levee at the point of failure.
150 0 150 300 450 m
Scale: 1:15,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 10 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Water Surface Elevation Contours (m AHD)
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.7
FLOOD BEHAVIOUR RESULTING FROM PARTIAL FAILURE OF BOURKE LEVEE
1% AEP DARLING RIVER FLOOD


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
TUFLOW RESULTS NOT SHOWN OUTSIDE OF BOURKE LEVEE
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
BOURKE SHOWGROUND
BILLABONG
HORSFALLS
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
KAMILAROI HWY
MITCHELL HWY
PARKDALE RD
WEIR RD
KIDMAN WAY
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.8
INDICATIVE EXTENT AND DEPTHS OF INUNDATION INTERNAL TO BOURKE LEVEE
FLOOD GATES CLOSED AND STORMWATER EVACUATION PUMPS OPERATIONAL - 1% AEP LOCAL CATCHMENT FLOOD



Afflux (m)
< -0.2
-0.20 to -0.10
-0.10 to -0.01
-0.01 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.50
> 0.50
Land Rendered Flood Free as a Result of Change
Additional Area of Land Flooded as a Result of Change
TUFLOW RESULTS NOT SHOWN OUTSIDE OF BOURKE LEVEE
DARLING RIVER
ALICE EDWARDS VILLAGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
MAIN WESTERN RAILWAY
KAMILAROI HWY
MITCHELL HWY
PARKDALE RD
WEIR RD
RIVER RD
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
Pump Location and Identifier
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.9
IMPACT OF CLOSURE OF GATES WITH STORMWATER EVACUATION PUMPS OPERATIONAL ON FLOOD BEHAVIOUR
1% AEP LOCAL CATCHMENT FLOOD


Indicative Depth of Inundation (m)
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.60
0.60 to 0.80
0.80 to 1.00
1.00 to 2.00
2.00 to 3.00
> 3.00
TUFLOW RESULTS NOT SHOWN OUTSIDE OF BOURKE LEVEE
DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
BOURKE SHOWGROUND
BILLABONG
HORSFALLS
BOURKE GOLF COURSE
PARKDALE RD
WEIR RD
RIVER RD
KAMILAROI HWY
MITCHELL HWY
MAIN WESTERN RAILWAY
KIDMAN WAY
MEEK ST
OXLEY ST
STURT ST
MERTIN ST
HOPE ST
ANSON ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
GREEN ST
DARLING ST
MITCHELL ST
TUDOR ST
SHORT ST
RICHARD ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
BECKER ST
MONOMEETH ST
CULGOA ST
YANDA ST
CHURCH ST
CHARLES ST
CULLIE ST
COOMAH ST
MOCULTA ST
WORTUMERTIE ST
FG_01
FG_02
FG_03
FG_04
FG_05
FG_06
FG_07
FG_08
FG_09
FG_10
FG_11
FGP_01
FGP_02
FGP_03
FGP_04
FGP_05
FGP_06
FGP_07
FGP_08
FGP_09
FGP_10
FGP_11
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location and Identifier
Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.10
INDICATIVE EXTENT AND DEPTHS OF INUNDATION INTERNAL TO BOURKE LEVEE
FLOOD GATES CLOSED AND STORMWATER EVACUATION PUMPS INOPERABLE - 1% AEP LOCAL CATCHMENT FLOOD



150 0 150 300 450 m

Scale: 1:15,000

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.

Lyall & Associates

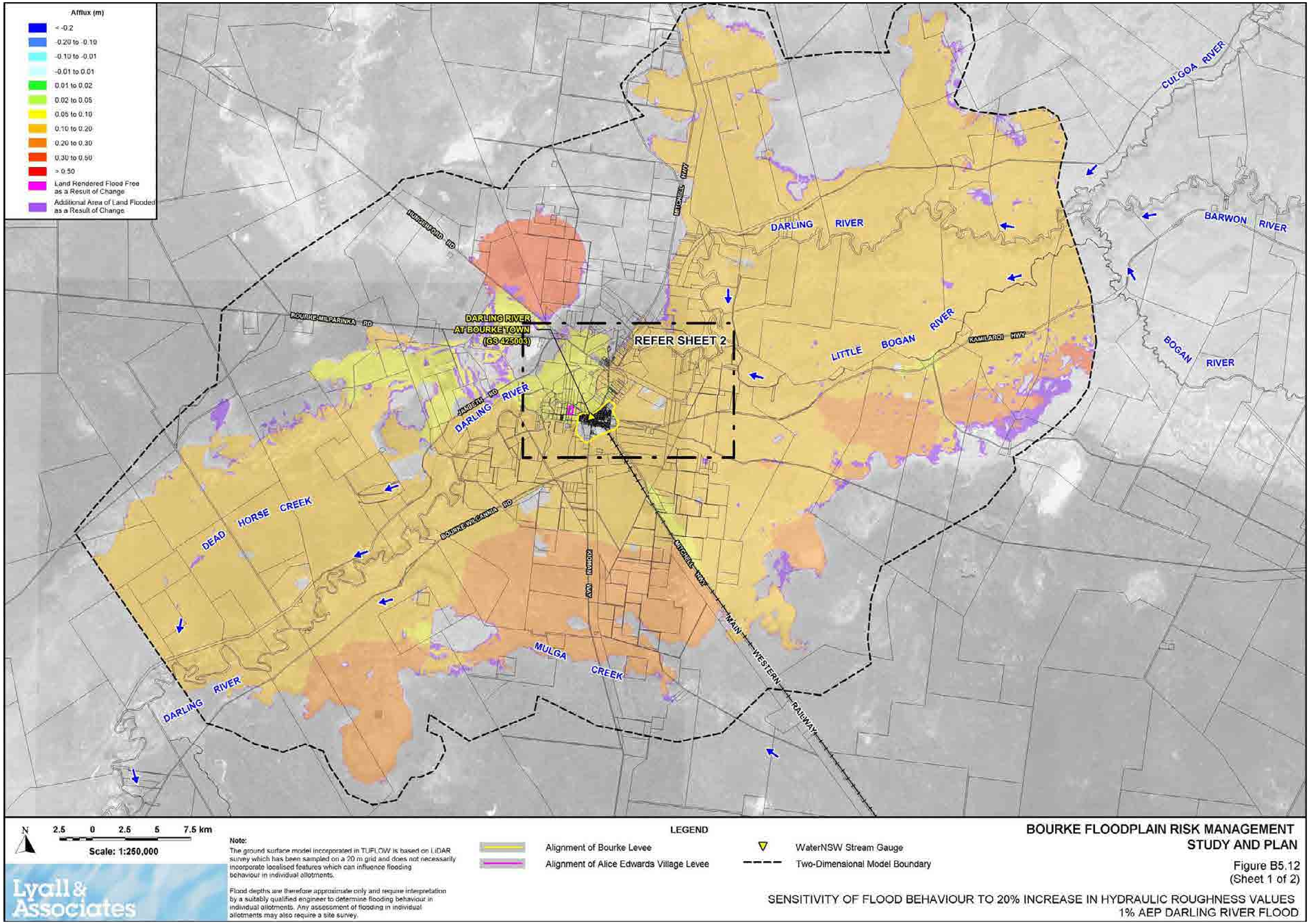
LEGEND

- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- FG_01 Flood Gate Location and Identifier
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- FGP_01 Pump Location and Identifier

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B5.11

IMPACT OF CLOSURE OF GATES WITH STORMWATER EVACUATION PUMPS INOPERABLE ON FLOOD BEHAVIOUR
1% AEP LOCAL CATCHMENT FLOOD



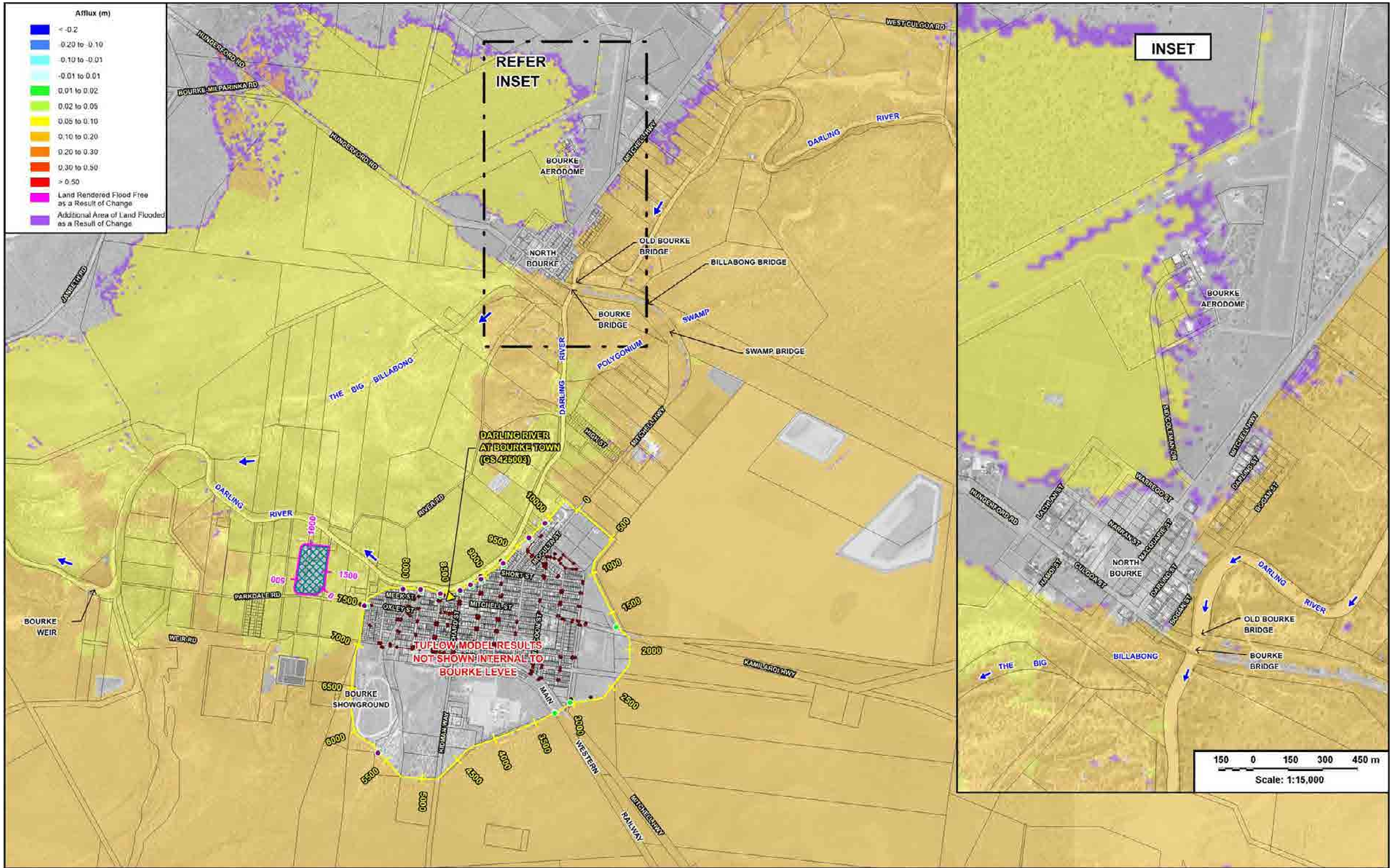
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.

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.

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B5.12
(Sheet 1 of 2)

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



Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

Lyall & Associates

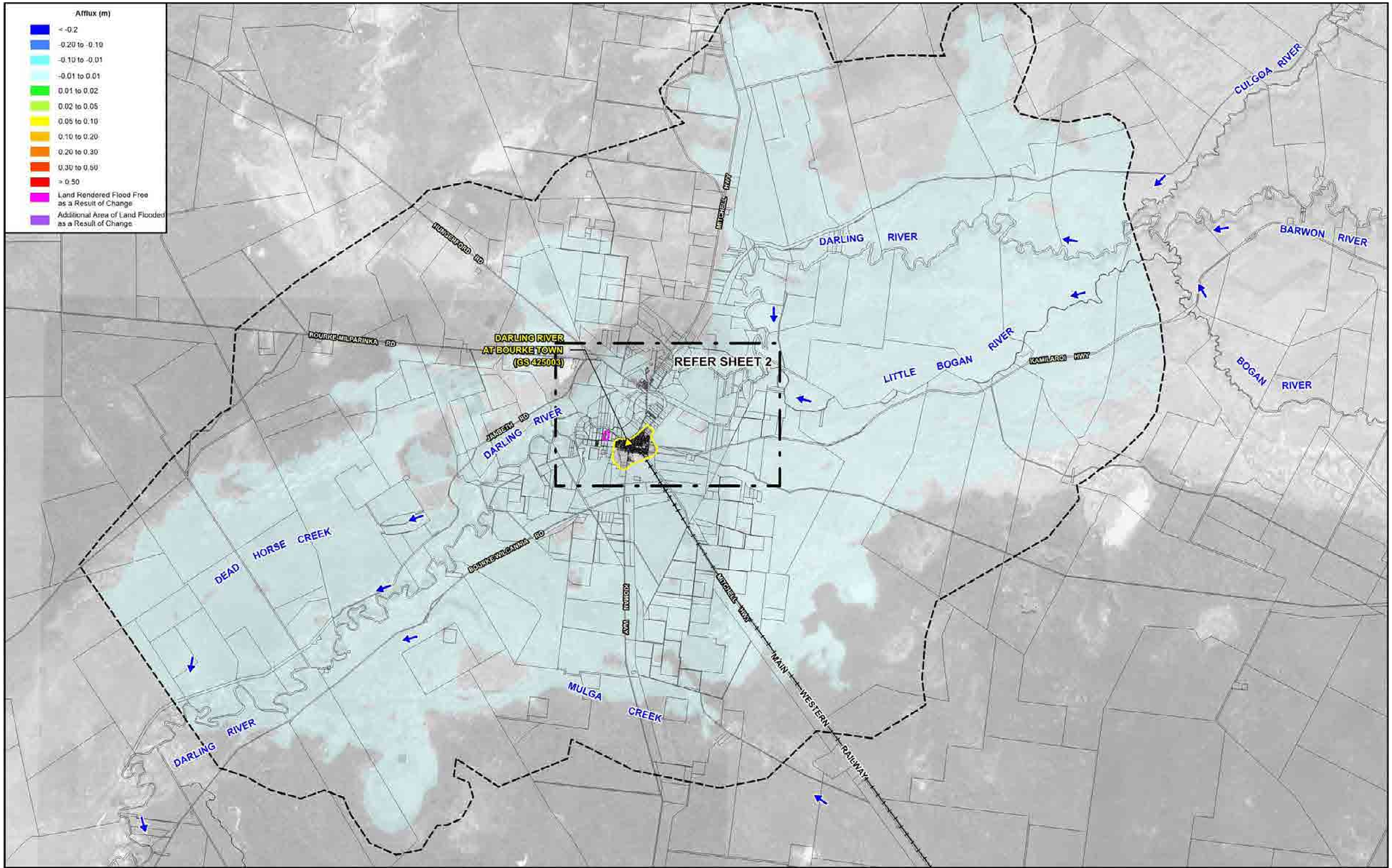
LEGEND

- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- Flood Gate Location
- Pump Location
- WaterNSW Stream Gauge
- Modelled Stormwater Network
- Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B5.12
(Sheet 2 of 2)

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



Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

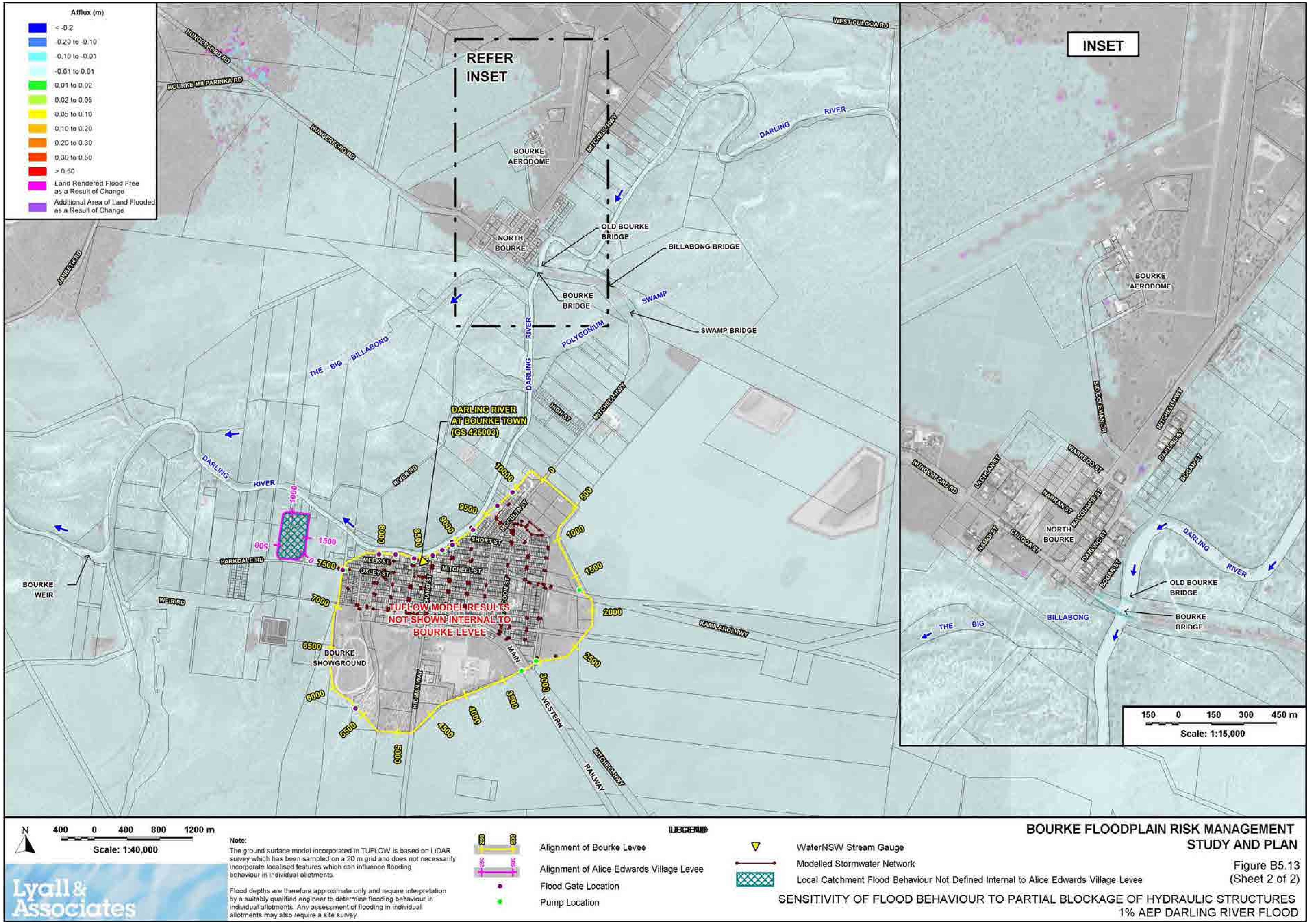
LEGEND

- Alignment of Bourke Levee
- Alignment of Alice Edwards Village Levee
- WaterNSW Stream Gauge
- Two-Dimensional Model Boundary

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure B5.13
(Sheet 1 of 2)

SENSITIVITY OF FLOOD BEHAVIOUR TO PARTIAL BLOCKAGE OF HYDRAULIC STRUCTURES
1% AEP DARLING RIVER FLOOD

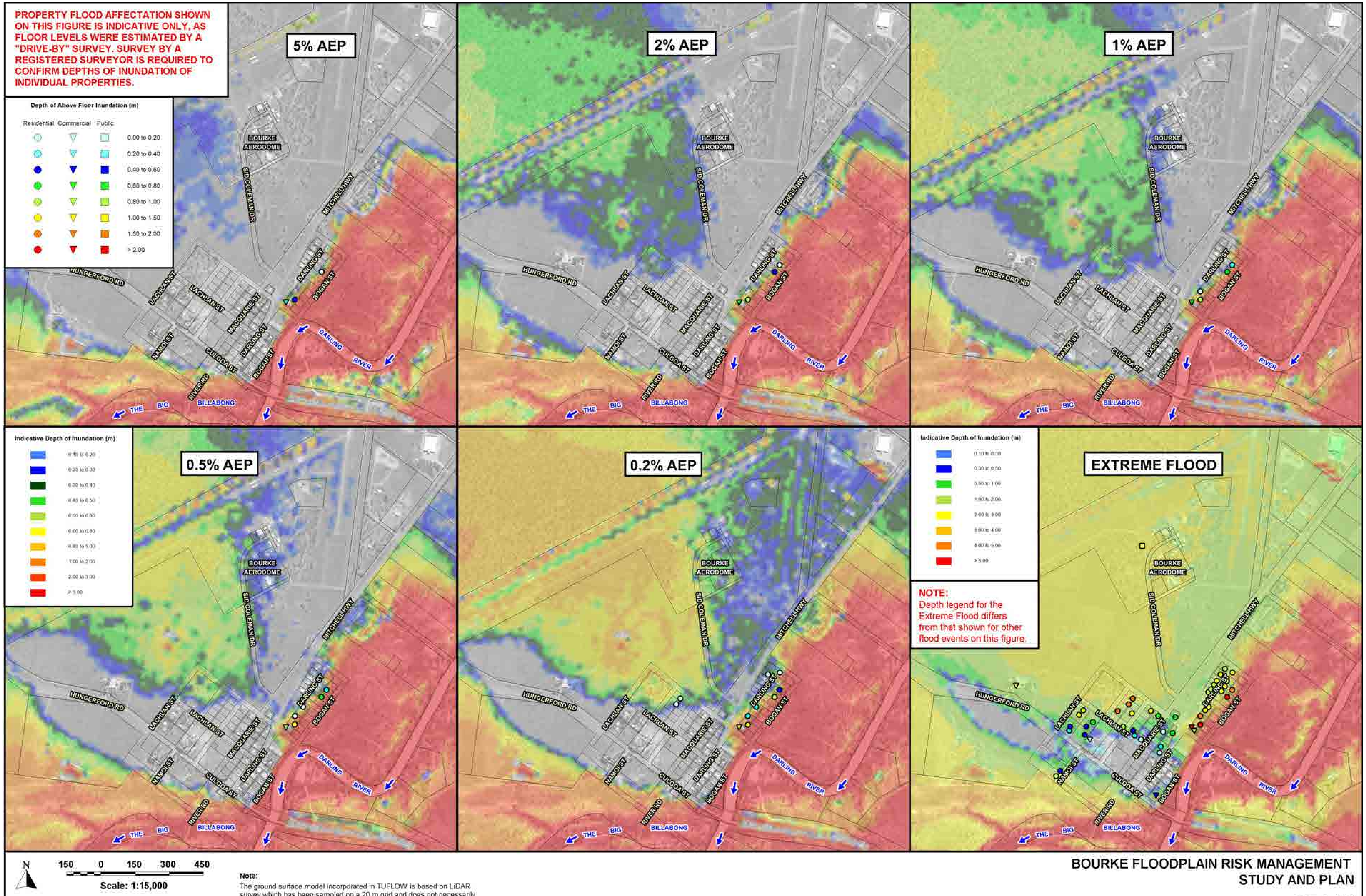


Afflux (m)
< -0.2
-0.20 to -0.10
-0.10 to -0.01
-0.01 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.50
> 0.50
Land Rendered Flood Free as a Result of Change
Additional Area of Land Flooded as a Result of Change
REFER INSET
INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
POLYGONUM SWAMP
DARLING RIVER
THE BIG BILLABONG
DARLING RIVER AT BOURKE TOWN (GS 425003)
TUFLOW MODEL RESULTS NOT SHOWN INTERNAL TO BOURKE LEVEE
BOURKE WEIR
BOURKE SHOWGROUND
WEST CULGOA RD
HUNGERFORD RD
BOURKE-MILPARINKA RD
MITCHELL HWY
KAMILAROI HWY
PARKDALE RD
WEIR RD
WESTERN RAILWAY
HIGH ST
SHORT ST
MITCHELL ST
OXLEY ST
MEEK ST
HOPE ST
ANSON ST
HOOD ST
MAIN
RIVER RD
N
400 0 400 800 1200 m
Scale: 1:40,000
150 0 150 300 450 m
Scale: 1:15,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Local Catchment Flood Behaviour Not Defined Internal to Alice Edwards Village Levee
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure B5.13 (Sheet 2 of 2)
SENSITIVITY OF FLOOD BEHAVIOUR TO PARTIAL BLOCKAGE OF HYDRAULIC STRUCTURES
1% AEP DARLING RIVER FLOOD

APPENDIX C

FLOOD DAMAGES

LIST OF FIGURES (APPENDIX C)



Lyall & Associates

Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 20 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.

BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

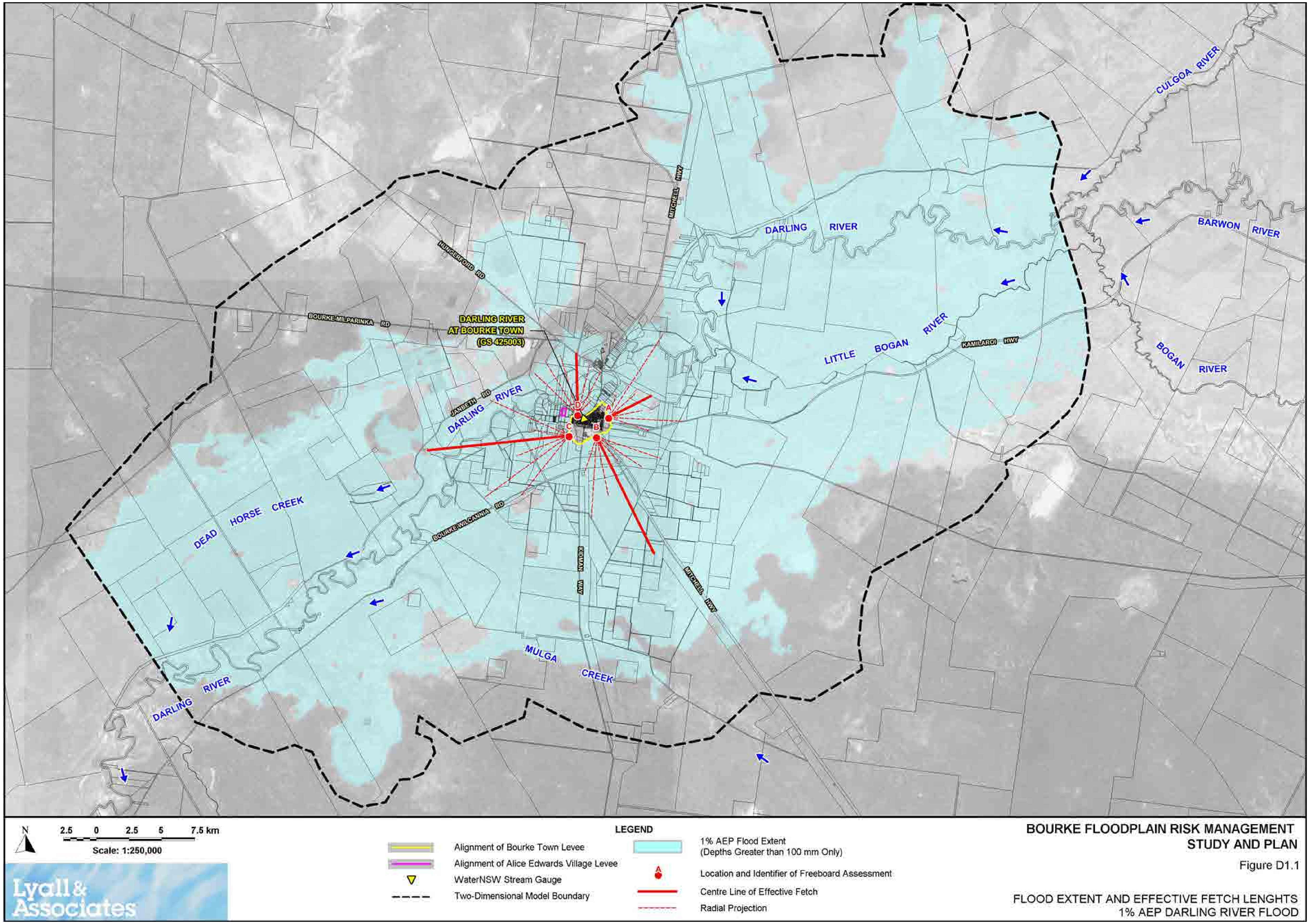
Figure C4.1

LOCATION AND DEPTH OF ABOVE-FLOOR INUNDATION AT NORTH BOURKE
DARLING RIVER FLOODING

APPENDIX D

PRELIMINARY LEVEE FREEBOARD ANALYSIS

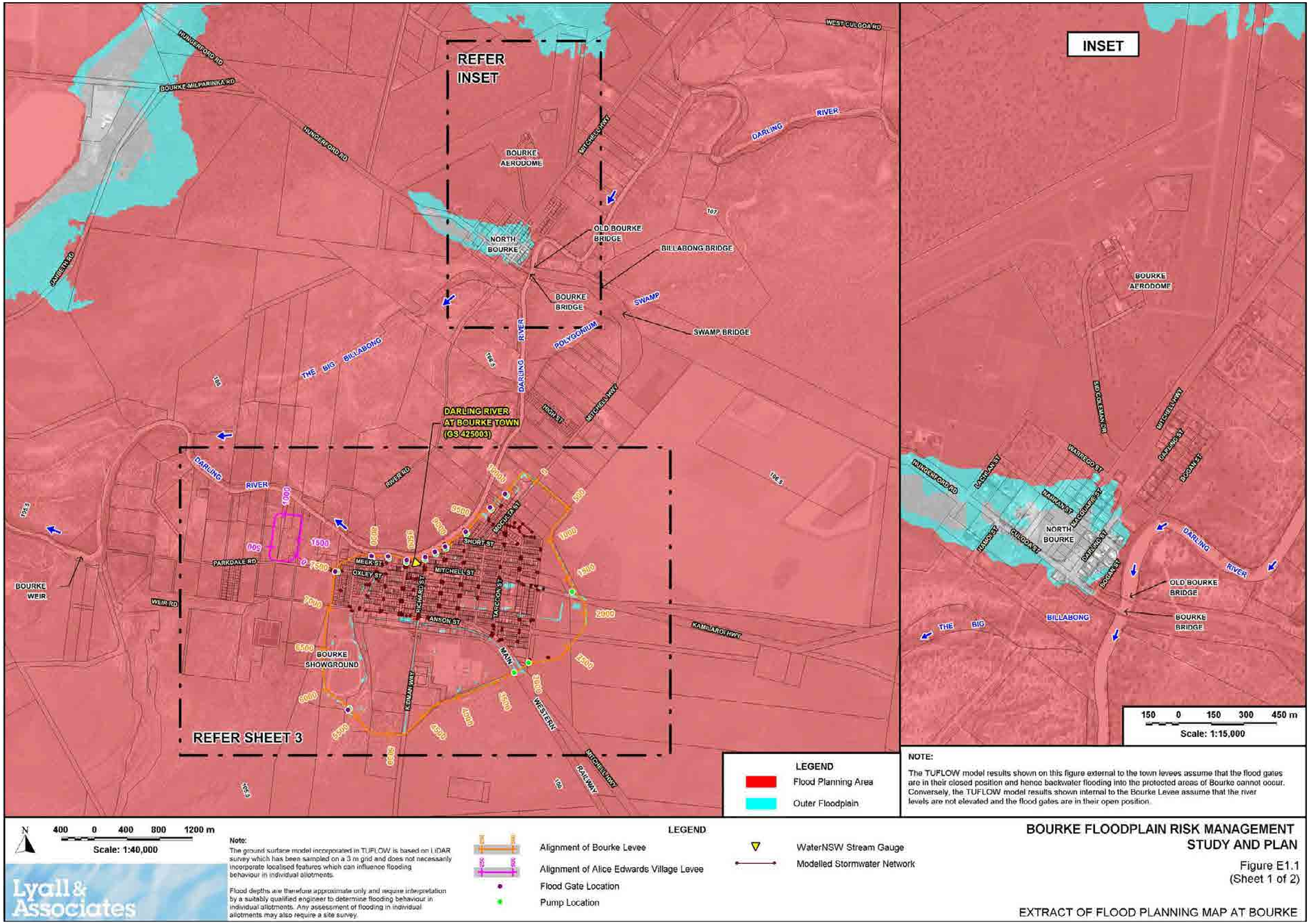
LIST OF FIGURES (APPENDIX D)

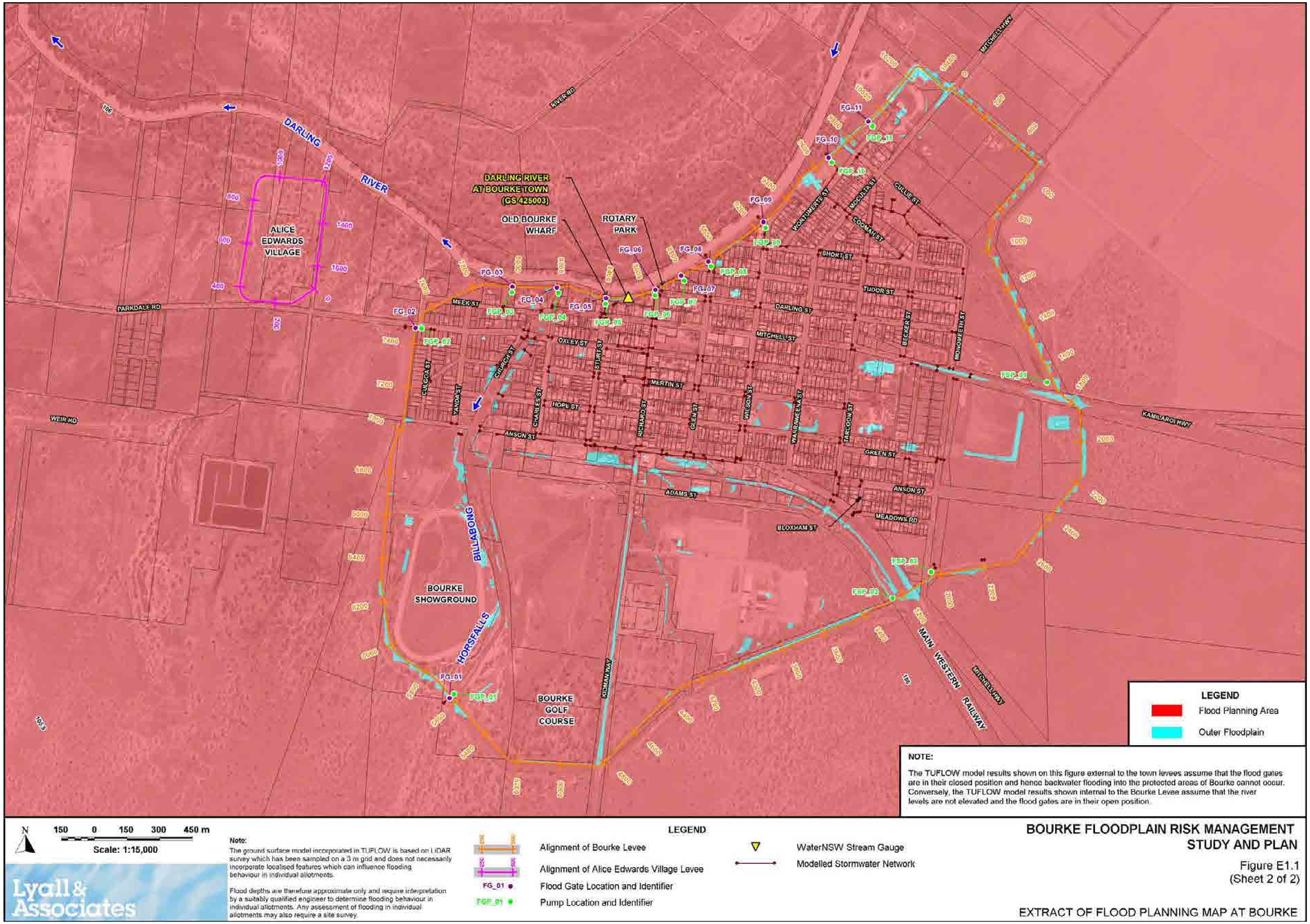

CULGOA RIVER
BARWON RIVER
DARLING RIVER
MITCHELL HWY
HUNGERFORD RD
BOURKE-MILPARINKA RD
DARLING RIVER AT BOURKE TOWN (GS 425003)
LITTLE BOGAN RIVER
KAMILAROI HWY
BOGAN RIVER
JANBETH RD
DARLING RIVER
A
B
C
D
DEAD HORSE CREEK
BOURKE-WILCANNIA RD
KIDMAN WAY
MITCHELL HWY
MULGA CREEK
DARLING RIVER
N
2.5 0 2.5 5 7.5 km
Scale: 1:250,000
Lyall & Associates
LEGEND
Alignment of Bourke Town Levee
Alignment of Alice Edwards Village Levee
WaterNSW Stream Gauge
Two-Dimensional Model Boundary
1% AEP Flood Extent (Depths Greater than 100 mm Only)
Location and Identifier of Freeboard Assessment
Centre Line of Effective Fetch
Radial Projection
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure D1.1
FLOOD EXTENT AND EFFECTIVE FETCH LENGHTS
1% AEP DARLING RIVER FLOOD

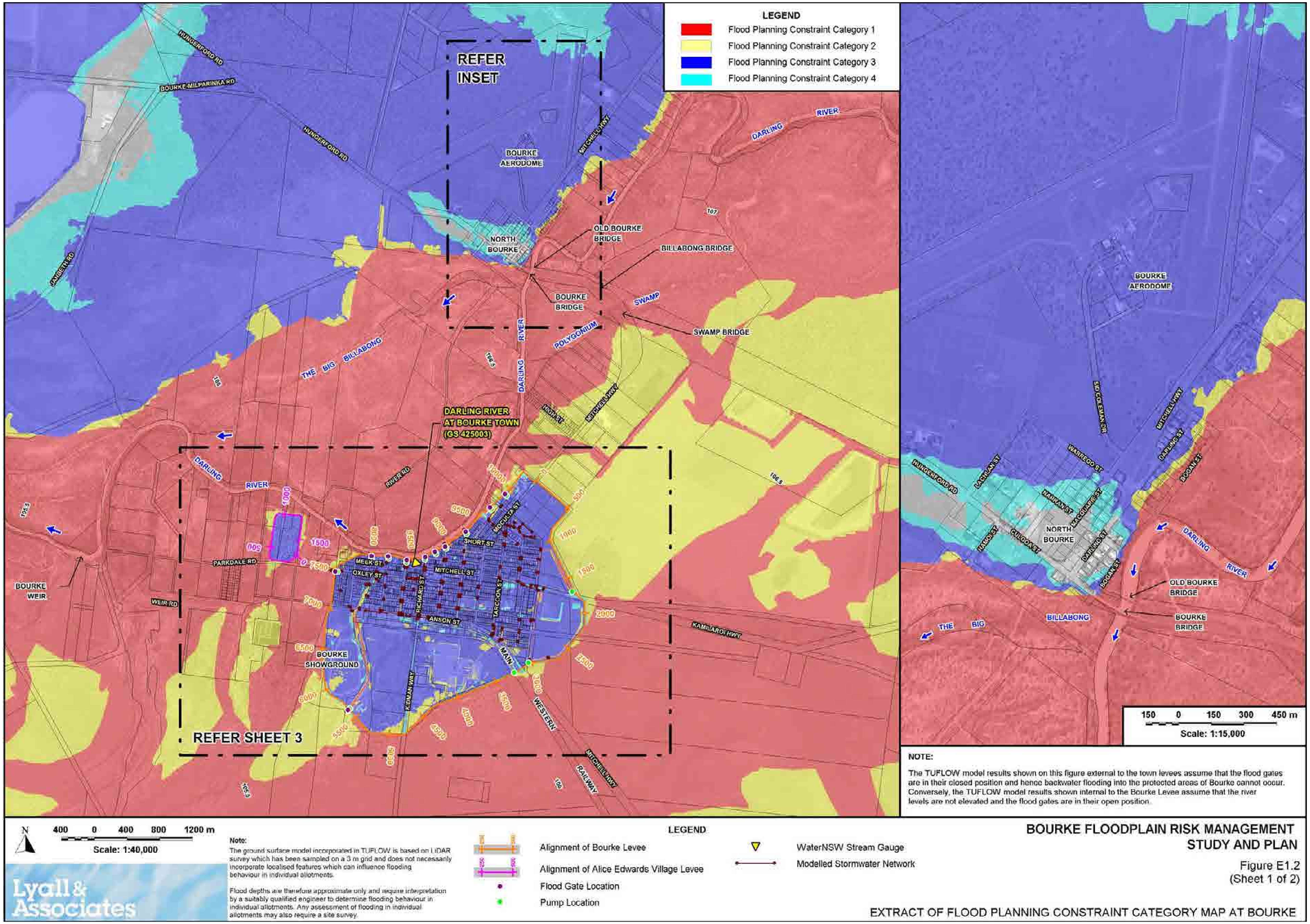
APPENDIX E

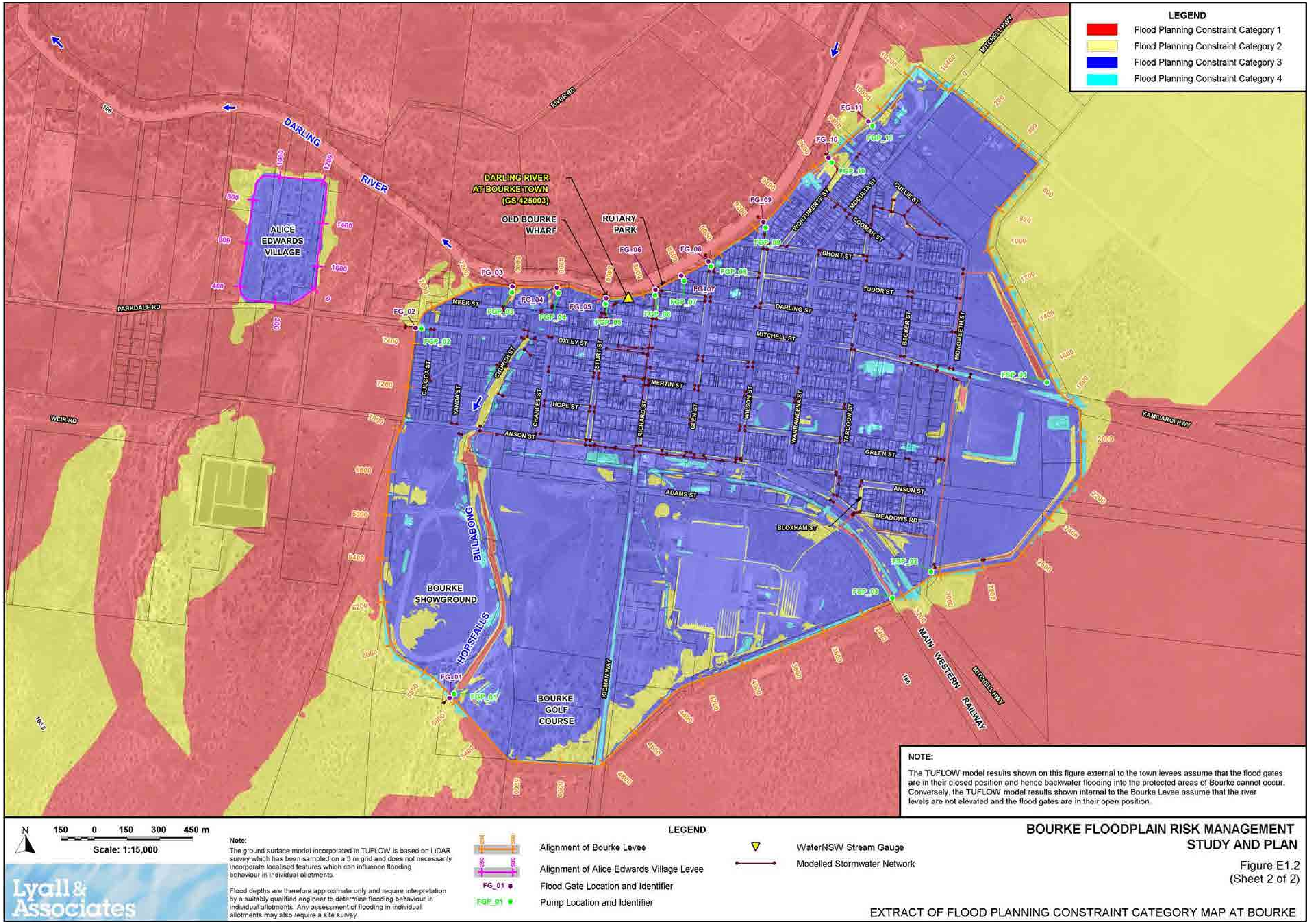
SUGGESTED WORDING FOR INCLUSION IN BOURKE SHIRE DEVELOPMENT CONTROL PLAN

LIST OF FIGURES (APPENDIX E)


REFER INSET
INSET
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
BOURKE WEIR
BOURKE SHOWGROUND
REFER SHEET 3
LEGEND
Flood Planning Area
Outer Floodplain
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
Scale: 1:15,000
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
Lyall & Associates
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure E1.1
(Sheet 1 of 2)
EXTRACT OF FLOOD PLANNING MAP AT BOURKE


DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
MAIN WESTERN RAILWAY
BILLABONG
HORSFALLS
BOURKE SHOWGROUND
BOURKE GOLF COURSE
KIDMAN WAY
MEEK ST
OXLEY ST
MERTIN ST
HOPE ST
ANSON ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
GREEN ST
DARLING ST
MITCHELL ST
SHORT ST
TUDOR ST
CULGOA ST
YANDA ST
CHURCH ST
CHARLES ST
STURT ST
RICHARD ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
BECKER ST
MONOMEETH ST
CULLIE ST
COOMAN ST
MOCULTA ST
WORTUMERTIE ST
LEGEND
Flood Planning Area
Outer Floodplain
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
150 0 150 300 450 m
Scale: 1:15,000
Lyall & Associates
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
FG_01 Flood Gate Location and Identifier
FGP_01 Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure E1.1
(Sheet 2 of 2)
EXTRACT OF FLOOD PLANNING MAP AT BOURKE


LEGEND
Flood Planning Constraint Category 1
Flood Planning Constraint Category 2
Flood Planning Constraint Category 3
Flood Planning Constraint Category 4
REFER INSET
REFER SHEET 3
BOURKE AERODOME
NORTH BOURKE
OLD BOURKE BRIDGE
BILLABONG BRIDGE
BOURKE BRIDGE
SWAMP BRIDGE
DARLING RIVER AT BOURKE TOWN (GS 425003)
THE BIG BILLABONG
POLYGONUM SWAMP
DARLING RIVER
BOURKE WEIR
BOURKE SHOWGROUND
HUNGERFORD RD
BOURKE-MILPARINKA RD
MITCHELL HWY
KAMILAROI HWY
PARKDALE RD
WEIR RD
RIVER RD
MEEK ST
OXLEY ST
SHORT ST
MITCHELL ST
ANSON ST
RICHARD ST
TARCOON ST
MAIN
WESTERN RAILWAY
KIDMAN WAY
SID COLEMAN DR
WARREGO ST
NARRAN ST
CULGOA ST
NAMOI ST
LACHLAN ST
DARLING ST
BOGAN ST
150 0 150 300 450 m
Scale: 1:15,000
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
N
400 0 400 800 1200 m
Scale: 1:40,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
Flood Gate Location
Pump Location
WaterNSW Stream Gauge
Modelled Stormwater Network
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure E1.2
(Sheet 1 of 2)
EXTRACT OF FLOOD PLANNING CONSTRAINT CATEGORY MAP AT BOURKE


LEGEND
Flood Planning Constraint Category 1
Flood Planning Constraint Category 2
Flood Planning Constraint Category 3
Flood Planning Constraint Category 4
DARLING RIVER
DARLING RIVER AT BOURKE TOWN (GS 425003)
OLD BOURKE WHARF
ROTARY PARK
ALICE EDWARDS VILLAGE
BOURKE SHOWGROUND
BOURKE GOLF COURSE
BILLABONG
HORSFALLS
PARKDALE RD
WEIR RD
RIVER RD
MITCHELL HWY
KAMILAROI HWY
MAIN WESTERN RAILWAY
MEEK ST
OXLEY ST
DARLING ST
MITCHELL ST
MERTIN ST
HOPE ST
ANSON ST
GREEN ST
ADAMS ST
BLOXHAM ST
MEADOWS RD
SHORT ST
TUDOR ST
CULGOA ST
YANDA ST
CHURCH ST
CHARLES ST
STURT ST
RICHARD ST
GLEN ST
WILSON ST
WARRAWEENA ST
TARCOON ST
BECKER ST
MONOMEETH ST
MOCULTA ST
CULLIE ST
COONAMBLE ST
KIDMAN WAY
NOTE:
The TUFLOW model results shown on this figure external to the town levees assume that the flood gates are in their closed position and hence backwater flooding into the protected areas of Bourke cannot occur. Conversely, the TUFLOW model results shown internal to the Bourke Levee assume that the river levels are not elevated and the flood gates are in their open position.
150 0 150 300 450 m
Scale: 1:15,000
Note:
The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3 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.
Lyall & Associates
LEGEND
Alignment of Bourke Levee
Alignment of Alice Edwards Village Levee
FG_01 Flood Gate Location and Identifier
FGP_01 Pump Location and Identifier
WaterNSW Stream Gauge
Modelled Stormwater Network
BOURKE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN
Figure E1.2
(Sheet 2 of 2)
EXTRACT OF FLOOD PLANNING CONSTRAINT CATEGORY MAP AT BOURKE

14 ENVIRONMENTAL SERVICES & DEVELOPMENT DEPARTMENT

Nil

15 GENERAL MANAGER

Nil

16 CORPORATE SERVICES DEPARTMENT

16.1 *** BANK RECONCILIATION AND STATEMENT OF BANK BALANCES - MARCH 2023

File Number: F1.1

Author: Ang Pasang Rai, Manager Corporate Services

Authoriser: Leonie Brown, General Manager

Attachments: Nil

Bank Reconciliation for the period ending 31 March 2023

Balances as per Bank Statement	$114,499.52
Plus: Deposit not shown	$1,251.06
Less: Unpresented Cheques	$5,038.21
Balance as per Cash Book	**$110,712.37**

Reconciled Ledger Accounts as at 31 March 2023

Fund or Account	Current Balance	Overdraft Statutory Limit
General	$26,970,034.34	$200,000.00
Water	$2,846,652.27	
Sewer	$7,770,921.45	
Trust	$99,019.38	
	$37,686,627.44	

Reconciliation as at 31 March 2023

Balance as per cash book	$110,712.37
Investments	$37,575,915.07
Total, equalling Reconciled Ledger	$37,686,627.44

* *In accordance with Council policy and legislative obligations, a complete breakdown of investments will be provided in the investment report for the month.*

Statement of Bank Balances as at 31 March 2023

	Balance	Transaction	Balance
	28 February 2023		31 March 2023
General Fund	$32,943,168.20	-$5,973,133.86	$26,970,034.34
Water Fund	$2,804,711.32	$41,940.95	$2,846,652.27
Sewer Fund	$2,774,835.45	$4,996,086.00	$7,770,921.45
Trust Fund	$99,109.38	-$90.00	$99,019.38
Investments	-$36,768,190.55	-$807,724.52	-$37,575,915.07
Totals	$1,853,633.80	**-$1,742,921.43**	$110,712.37

Balance of all Funds as at 31 March 2023

Balance as at 28 February 2023	$1,853,633.80
Add Receipts for	
(a) Rates	$209,662.31
(b) Other Cash	$2,239,869.52
Deduct payments for	
(a) Payments	$3,384,728.74
(b) New Investment	$807,724.52
Balance as at 31 March 2023	**$110,712.37**

Recommendation

That the Certificate of Reconciliation of the Cash Book for all funds of the Council and the Statement of Bank Balances as at 31 March 2023 be noted.

16.2 *** INVESTMENT REPORT AS AT 31 MARCH 2023

File Number: **F1.1**

Author: **Ang Pasang Rai, Manager Corporate Services**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Background

The investment report is submitted monthly to Council.

Issues

- Investments are in accordance with Division of Local Government Guidelines and Council's Investment Policy
- Statutory obligations are being met
- Councillors' roles as resource allocators and policy directors are satisfied

Assessment

Legal Implications Including Directives and Guidelines

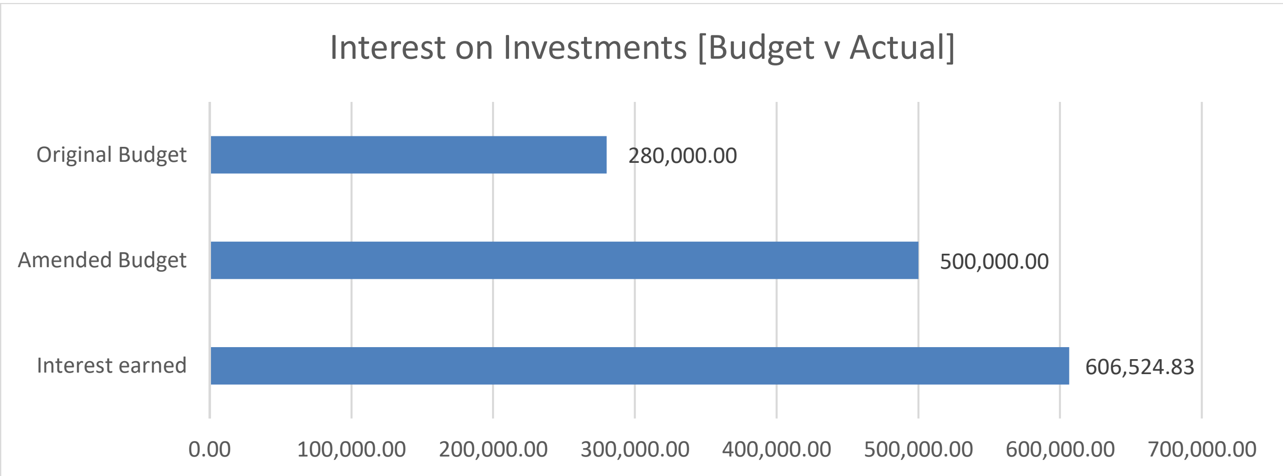
Local Government Act 1993
Local Government (General) Regulation 2021
The management, of Council's investments is delegated by the General Manager to the Manager Corporate Services.

Financial Implications/Consideration

The 2022/2023 Budget estimated the total investment revenue as $280,000 which represents an estimated return of 1.475%. This revenue was split proportionally across General, Water and Sewer Funds and changes on a monthly basis in accordance with cash flow requirements.

The market value of Council's investments held as at 31st March 2023 is $ 37,575,915.07

Investment income earned as at 31 March 2023 is $606,524.83



Due to a considerable increase in interest rates by the Reserve Bank of Australia and increased grants, which were unanticipated at the time the budget was prepared, interest earned on investments has surpassed the original and amended December quarter budget. Therefore, a favourable variation for Interest earned on Investment has been reported in the budget review for the March 2023 quarter.

Policy Provisions – Council Policy and Procedure
Policy 1.8.10(v7) – Investment Policy adopted 19 December 2022.
Ministerial Investment Order – 12 January 2011

Strategic Implications – Implications for Long Term Plans/Targets
Funds are invested in accordance with identified cash flow requirements.

Investment Portfolio as at 31 March 2023

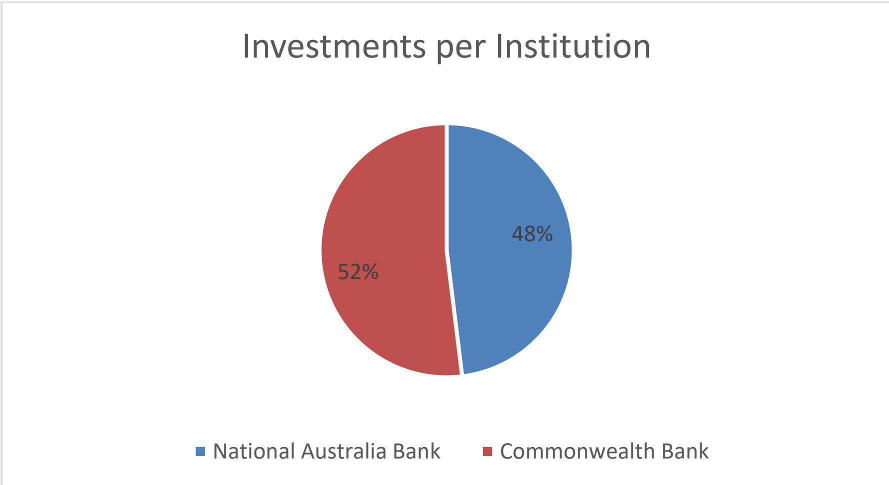
Institution	Investment No.	Maturity Date	Amount	Rate	Days	S&P Rating
National Australia Bank	16	24/05/2023	678,210.58	2.80%	365	A-1+
National Australia Bank	17	6/06/2023	2,014,665.26	3.05%	365	A-1+
Commonwealth Bank	4	6/04/2023	3,036,222.84	3.73%	239	A-1+
National Australia Bank	5	1/08/2023	1,088,291.01	4.02%	330	A-1+
National Australia Bank	6	21/09/2023	1,106,825.39	4.30%	365	A-1+
National Australia Bank	9	9/08/2023	707,486.48	4.00%	300	A-1+
Commonwealth Bank	10	3/11/2023	458,508.37	4.41%	361	A-1+
Commonwealth Bank	11	4/09/2023	1,162,900.41	4.35%	301	A-1+
Commonwealth Bank	12	5/07/2023	1,739,578.58	4.20%	240	A-1+
National Australia Bank	14	8/05/2023	1,519,411.37	4.10%	180	A-1+
Commonwealth Bank	15	17/05/2023	2,043,265.75	4.17%	90	A-1+
Commonwealth Bank	16	03/04/2023	2,000,000.00	3.59%	32	A-1+
Commonwealth Bank	17	03/04/2023	2,000,000.00	3.59%	32	A-1+
Commonwealth Bank	18	01/05/2023	2,000,000.00	3.65%	60	A-1+
National Australia Bank	19	31/05/2023	3,000,000.00	4.25%	90	A-1+
National Australia Bank	20	31/05/2023	3,000,000.00	4.25%	90	A-1+
Commonwealth Bank	21	08/05/2023	3,079,426.10	3.95%	62	A-1+
Commonwealth Bank	22	16/05/2023	2,000,000.00	4.00%	60	A-1+
National Australia Bank	23	27/07/2023	2,000,000.00	4.40%	120	A-1+
National Australia Bank			2,941,122.90			
		Total Investments	**37,575,915.07**			

Term Deposits

Discussions/Comments

The Investment portfolio increased by $807,724.52 during the period.

The investment portfolio is invested in term deposits with the National Australia Bank and the Commonwealth Bank. The investment portfolio is regularly reviewed in order to maximise investment performance and minimise risk.



The Government Guarantee on Investments up to $1 million dollars has now expired and the new cap of $250,000 has replaced the scheme.

Certification – Responsible Accounting Officer

I hereby certify that the investments listed in the attached report have been made in accordance with Section 625 of the Local Government Act 1993, clause 212 of the Local Government (General) Regulation 2005 and Council's Investment Policy.

Recommendation

1. **That the report regarding Council's Investment Portfolio 31 March 2023 be received and noted.**

2. **That the Certificate of the Responsible Accounting Officer be noted, and the report adopted.**

16.3 *** BUDGET REVIEW TO 31 MARCH 2023

File Number: **F1.6**

Author: **Ang Pasang Rai, Manager Corporate Services**

Authoriser: **Leonie Brown, General Manager**

Attachments: **1. Quarterly Budget Review Statement 31 March 2023** ⇩

Introduction

Clause 203 (1) of the *Local Government (General) Regulation 2005* (the Regulations) requires a Council's Responsible Accounting Officer to prepare and submit a Quarterly Budget Review Statement (QBRS) to the governing body of Council within two (2) months of the end of the quarter. Submitted hereunder is that report for the quarter ending 31 March 2023.

Background

The Office of Local Government released guidelines on the preparation of QBRS to Council in December 2010 with mandatory reporting in line with the guidelines commencing in July 2011.

The QBRS must show, by reference to the estimated income and expenditure that is set out in the operational plan adopted by Council for the relevant year, a revised estimate of income and expenditure for that year.

The guidelines also require the budget review statement to include a report by the responsible accounting officer as to whether or not they consider the statement indicates Council to be in a satisfactory financial position (with regard to its original budget) and if not, to include recommendations for remedial action.

Current Situation

Issues

- The QBRS must be prepared by the Responsible Accounting Officer and presented to Council within two (2) months of the end of the quarter.
- The minimum format of the QBRS is governed by the Division of Local Government's Guidelines in December 2010.

Assessment

(a) <u>Legal Implications Including Directives and Guidelines</u>
Local Government (General) Regulation 2021 (the Regulations) clause 203 requires a Council's Responsible Accounting Officer to prepare and submit a quarterly budget review statement to the governing body of Council within two months of the end of the quarter
Division of Local Government – Quarterly Budget Review Guidelines issued December 2010.

(b) <u>Financial Implications/Considerations</u>
Council's original budget was adopted as part of the 2022/2023 Operational Plan on 27th June 2022 and reflected an overall cash based surplus of $563,713.

(c) Policy Provisions – Council Policy and Practice
Nil

(d) Strategic Implications – Implications for Long Term Plans/Targets
Community Strategic Plan
Delivery Program/Operational Plan

Discussion
The QBRS has been prepared for the March 2023 review period and is presented to Council for consideration.

This review has been undertaken in consultation with the General Manager, Managers and other officers where applicable.

Overall Financial Position

The revised consolidated budget result following the March QBRS is estimated to be a Surplus of $574,500

The break-up of the funds are detailed in the table below once depreciation has been added back:

Fund	Expenses	Revenues	Depreciation	Operating result
General	($96,574,380)	$91,406,774	$5,167,606	0
Water	($5,519,005)	$4,232,906	$1,565,199	$279,100
Sewer	($1,492,501)	$1,407,284	$380,617	$295,400
Total	**($103,585,886)**	**$97,046,964**	**$7,113,422**	**$574,500**

The adjustments which have been identified during the Review are summarised below:

Operating and Capital Works Budgets:

Adjustment Description	Budget Impact
Operational Income – increase	5,754,045
Operational Expenses – increase	(5,654,974)
Capital Income and Contributions - increase	1,675,921
Capital Expenditure - increase	(1,772,919)
Transfer to/from Reserves	
Net adjustment - Budget	**$(2,073)**

Summary	Budget Impact
Original Budget surplus	563,713
Adjustments from QBRS September 2021	64,945
Adjustments from QBRS December 2021	(52,085)
Adjustments from QBRS March 2022	(2,073)
Revised Budget	**$574,500**

Conclusion

The financial position of Bourke Shire Council as at 31 March 2023 is considered to be satisfactory and is confirmed by the Report from the Responsible Accounting Officer provided under separate cover to Council.

Recommendation

1. **That the document entitled "Quarterly Budget Review Statement – March 2023" be received and noted.**

2. **That the variations of income and expenditure as identified in the "Quarterly Budget Review Statement – March 2023" be adopted.**

BOURKE SHIRE COUNCIL

BOURKE SHIRE COUNCIL
BUDGET REVIEW
31 March 2023

Council Meeting 24 April 2023

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Table of contents

page

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Report by responsible accounting officer

The following statement is made in accordance with Clause 203(2) of the Local Government (General) Regulations 2005:

31 March 2023

It is my opinion that the Quarterly Budget Review Statement for Bourke Shire Council for the quarter ended 31/03/23 indicates that Council's projected financial position at 30/6/23 will be satisfactory at year end, having regard to the projected estimates of income and expenditure and the original budgeted income and expenditure.

Signed: ______________________ **date:** 20-Apr-23

Ang Pasang Rai
Responsible accounting officer

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Income & expenses budget review statement

Budget review for the quarter ended 31 March 2023
Income & expenses - Council Consolidated

($000's)	Original budget 2022/23	Approved changes: Carry forwards	Approved changes: Other than by QBRS	Approved changes: Sep QBRS	Approved changes: Dec QBRS	Approved changes: Mar QBRS	Revised budget 2022/23	Variations for this Mar Qtr	Notes	Projected year end result	Actual YTD figures
Income											
Administration	7,884,920			676,719	1,204,146		9,765,785	389,203	1	10,154,988	4,789,567
Public order & safety	203,600			13,215	16,135		232,950	25,000	2	257,950	144,347
Health	159,600			20,892	5,000		185,492	7,500	3	192,992	96,740
Community services & education	24,200			96,088	15,000		135,288	48,313	4	183,601	167,218
Hoousing & community amenities	956,969			194,898	268,030		1,419,897	122,785	5	1,542,682	1,134,472
Water supplies	2,238,844			242,609	778		2,482,231	(2,073)		2,480,158	1,786,255
Sewer services	1,075,683			1,264			1,076,947	-		1,076,947	1,045,586
Recreation & Culture	109,800			20,189	(9,213)		120,776	-		120,776	81,819
Building Control	11,500						11,500	-		11,500	6,963
Transport & communication	8,928,209			134,032	126,866		9,189,107	5,349,246	6	14,538,353	9,250,314
Economic affairs	892,500			84,612	39,105		1,016,217	(285,000)	7	731,217	455,332
Total income from continuing operations	**22,485,825**	**-**	**-**	**1,484,518**	**1,665,847**	**-**	**25,636,190**	**5,654,974**		**31,291,164**	**18,958,613**
Expenses											
Administration	2,750,409			701,644	1,148,457		4,600,510	180,268		4,780,778	1,090,824
Public order & safety	794,028			8,111	16,135		818,274	25,000		843,274	420,285
Health	804,975			13,135			818,110	6,500		824,610	429,316
Community services & education	76,265			96,314	19,600		192,179	49,313		241,492	81,240
Hoousing & community amenities	2,611,119			130,507	297,761		3,039,387	115,218		3,154,605	1,553,526
Water supplies	3,489,023			178,928	52,863		3,720,814	-		3,720,814	1,320,414
Sewer services	1,156,667						1,156,667	-		1,156,667	558,758
Recreation & Culture	1,780,754			21,827	25		1,802,606	20,000	8	1,822,606	966,391
Building Control	-						-	-		-	-
Transport & communication	11,425,844			134,032	(33,134)		11,526,742	5,374,246	9	16,900,988	5,128,551
Economic affairs	2,258,610			3,217	90,000		2,351,827	(16,500)	10	2,335,327	1,283,957
Total expenses from continuing operations	**27,147,694**	**-**	**-**	**1,287,715**	**1,591,707**	**-**	**30,027,116**	**5,754,045**		**35,781,161**	**12,833,262**
Net operating result from continuing operations	**(4,661,869)**	**-**	**-**	**196,803**	**74,140**	**-**	**(4,390,926)**	**(99,071)**		**(4,489,997)**	**6,125,351**
Discontinued operations - surplus/(deficit)							-			-	
Net operating result from all operations	**(4,661,869)**	**-**	**-**	**196,803**	**74,140**	**-**	**(4,390,926)**	**(99,071)**		**(4,489,997)**	**6,125,351**
Net operating result before capital items	**(4,661,869)**			**196,803**	**74,140**		(4,390,926)	**(99,071)**		(4,489,997)	**4,166,999**

This statement forms part of Council's Quarterly Budget Review Statement (QBRS) for the quarter ended 31/03/2023 and should be read in conjuction with the total QBRS report

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Income & expenses budget review statement
Recommended changes to revised budget

Budget Variations being recommended include the following material items:

Notes	Details
1	Sundr other income not now expected -$9,500 Expected increase in Diesel Fuel Rebate $45,000 Expected increase in Interest on Investments $218,000 Expected increase in Insurance Claims reimbursement $8,000 Increase in Private Works income offset by Expenditure $120,000
2	Increase in Fire Hazard Reduction income offset by expenditure $25,000
3	Mosquito Management Grant offset by expenditure $6,500
4	Increased School Holiday Grant offset by Expenditure $7,000 Gonna Youth Academy Grant offset by Expenditure $40,000
5	Expected increase in Trade Waste Charges $5,834 Transfer from Reserve for new Waste Depot Cell offset by expenditure $46,715 Increase in Emergency Flood Works grant offset by expenditure $31,841 Increase in Emergency Levee repair Grant offset by Expenditure $13,878
6	LG flood Recovery Grant offset by Expenditure $1,000,000 Reg & Local Roads Flood Damage Grant offset by expenditure $4,476,112
7	Expected decrease in BOB General Income -$85,000 Reduction in expected income fom Outback Shows offset by reduced expenditure -$85,000 Reduction in Merchandise sales -$60,000 Increase in BOB Café income $25,000 Decrease in expected Jandra Operations income -$75,000
8	Expected increase in Swimming Pool Electricity $20,000
9	Expected increase in Town & Village Streets M & R $25,000
10	Increase in BOB Repairs & Maintenance $20,000 Decrease in Jandra Salaries & Wages -$47,500 Increase in Crossley Engine M & R $10,000

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Capital budget review statement

Budget review for the quarter ended 31 March 2023
Capital budget - Council Consolidated

($000's)	Original budget 2022/23	Approved changes: Carry forwards	Approved changes: Other than by QBRS	Approved changes: Sep QBRS	Approved changes: Dec QBRS	Approved changes: Mar QBRS	Revised budget 2022/23	Variations for this Mar Qtr	Notes	Projected year end result	Actual YTD figures
Capital expenditure											
New assets											
- Land & buildings	7,500,000						7,500,000			7,500,000	-
Renewal assets (replacement)											
- Plant & equipment	1,759,100			910,447	58,434		2,727,981	16,768	1	2,744,749	1,252,310
- Land & buildings	19,966,000			897,149	694,390		21,557,539	1,587,019	2	23,144,558	2,514,605
- Roads, bridges, footpaths	25,821,900			4,340,121	844,072		31,006,093			31,006,093	5,476,626
Water & Sewerage	1,343,600			469,700	197,651		2,010,951	72,134	3	2,083,085	830,853
Loan repayments (principal)	1,326,240						1,326,240			1,326,240	871,902
Total capital expenditure	**57,716,840**	**-**	**-**	**6,617,417**	**1,794,547**	**-**	**66,128,804**	**1,675,921**		**67,804,725**	**10,946,296**
Capital funding											
Rates & other untied funding	1,887,840			111,858	156,225		2,155,923	(106,998)		2,048,925	1,177,264
Capital grants & contributions	41,782,400			5,106,185	(437,232)		46,451,353	1,834,566		48,285,919	8,381,455
Reserves:											
- External resrtictions/reserves	893,600			272,119	34,455		1,200,174	9,366		1,209,540	172,900
- Internal restrictions/reserves	4,913,000			1,127,255	2,041,099		8,081,354	(61,003)		8,020,351	734,458
New loans	8,240,000						8,240,000			8,240,000	480,219
Total capital funding	**57,716,840**	**-**	**-**	**6,617,417**	**1,794,547**	**-**	**66,128,804**	**1,675,931**		**67,804,735**	**10,946,296**
Net capital funding - surplus/(deficit)	-	-	-	-	-	-	-	10		10	-

This statement forms part of Council's Quarterly Budget Review Statement (QBRS) for the quarter ended 31/03/2023 and should be read in conjuction with the total QBRS report

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Capital budget review statement
Recommended changes to revised budget

Budget variations being recommended include the following material items:

Notes	Details
1	Increase in BOB Welcome & Promotional Signage offset by increased expenditure $16,768
2	Davidson Oval Community Infrastructure Grant offset by Expenditure $861,000 Cultural Centre & Art Hub Grant offset by Expenditure $81,000 BOB Viewing Deck & Arena Grant offset by Expenditure $506,000 Additional Percy Hobson Mural Grant works offset by Expenditure $62,391 BOB Function Centre Disabled Access Grant offset by Expenditure $56,736
3	Additional Charles Street Reservoir works Grant offset by Expenditure $ 62,768

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Cash & investments budget review statement

Budget review for the quarter ended 31 March 2023
Cash & investments - Council Consolidated

($000's)	Original budget 2022/23	Approved changes: Carry forwards	Approved changes: Other than by QBRS	Approved changes: Sep QBRS	Approved changes: Dec QBRS	Approved changes: Mar QBRS	Revised budget 2022/23	Variations for this Mar Qtr	Notes	Projected year end result	Actual YTD figures
Externally restricted [1]											
Specific Purpose Unexp Grants Gen Fund	5,247,000						5,247,000			5,247,000	5,247,000
Specific Purpose Unexp Grants Water Fund	591,000						591,000			591,000	591,000
Water Fund	2,558,000						2,558,000			2,558,000	2,558,000
Sewerage Fund	2,539,000						2,539,000			2,539,000	2,539,000
Domestic Waste Management	29,000						29,000			29,000	29,000
Total externally restricted	**10,964,000**	-	-	-	-	-	**10,964,000**	-		**10,964,000**	**10,964,000**
(1) Funds that must be spent for a specific purpose											
Internally restricted [2]											
Employee Leave Entitlement	600,000						600,000			600,000	600,000
Deposits Retentions & Bonds	5,000						5,000			5,000	5,000
Prepaid Financial Assistance Grant	5,496,000						5,496,000			5,496,000	5,496,000
Total internally restricted	**6,101,000**	-	-	-	-	-	**6,101,000**	-		**6,101,000**	**6,101,000**
(2) Funds that Council has earmarked for a specific purpose											
Unrestricted (ie. available after the above Restricti	18,570,000	-	-	-	-	-	18,570,000	-		18,570,000	20,621,628
Total Cash & investments	**35,635,000**						**35,635,000**			**35,635,000**	**37,686,628**

This statement forms part of Council's Quarterly Budget Review Statement (QBRS) for the quarter ended 30/09/22 and should be read in conjuction with the total QBRS report

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Cash & investments budget review statement

Comment on cash & investments position

Not applicable

Investments

Investments have been invested in accordance with Council's Investment Policy.

Cash

The Cash at Bank figure included in the Cash & Investment Statement totals $114,500

This Cash at Bank amount has been reconciled to Council's physical Bank Statements.
The date of completion of this bank reconciliation is 31st March 2023

Reconciliation status

The YTD cash & investment figure reconciles to the actual balances held as follows:		**$ 000's**
Cash at bank (as per bank statements)		114,500
Investments on hand		37,575,915
less: unpresented cheques	(Timing Difference)	(5,038)
add: undeposited funds	(Timing Difference)	1,251
Reconciled cash at bank & investments		37,686,628
Balance as per QBRS review statement:		37,686,628
Difference:		-

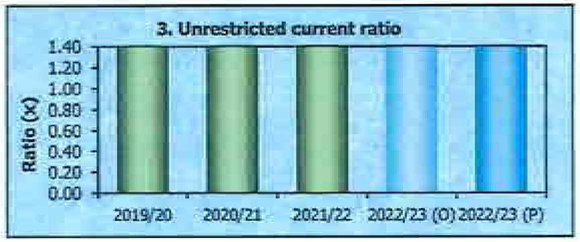
Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Key performance indicators budget review statement - Industry KPI's (OLG)

Budget review for the quarter ended 31 March 2023

($000's)	Current projection Amounts 22/23	Current projection Indicator 22/23	Original budget 22/23	Actuals prior periods 21/22	Actuals prior periods 20/21
NSW local government industry key performance indicators (OLG):					
1. Operating performance					
Operating revenue (excl. capital) - operating expenses	- 4,465,066	-18.6 %	1.9 %	-0.3 %	4.7 %
Operating revenue (excl. capital grants & contributions)	23,970,343				
This ratio measures Council's achievement of containing operating expenditure within operating revenue.					
2. Own source operating revenue					
Operating revenue (excl. ALL grants & contributions)	17,759,840	25.1 %	25.1 %	34.7 %	29.0 %
Total Operating revenue (incl. capital grants & cont)	70,858,928				
This ratio measures fiscal flexibility. It is the degree of reliance on external funding sources such as operating grants & contributions.					
3. Unrestricted current ratio					
Current assets less all external restrictions	29,952	4.79	4.79	4.79	4.74
Current liabilities less specific purpose liabilities	6,252				
To assess the adequacy of working capital and its ability to satisfy obligations in the short term for the unrestricted activities of Council.					



Bourke Shire Council

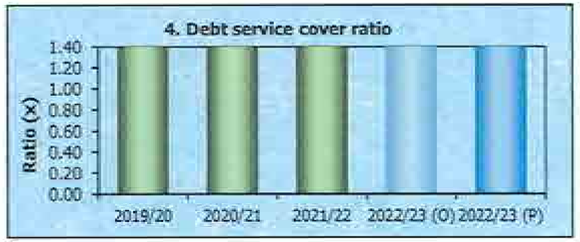
Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Key performance indicators budget review statement - Industry KPI's (OLG)

Budget review for the quarter ended 31 March 2023

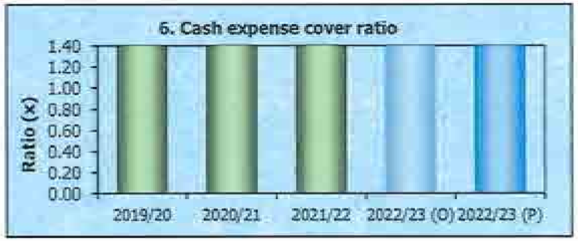
($000's)	Current projection Amounts 22/23	Current projection Indicator 22/23	Original budget 22/23	Actuals prior periods 21/22	Actuals prior periods 20/21
NSW local government industry key performance indicators (OLG):					
4. Debt service cover ratio					
Operating result before interest & dep. exp (EBITDA)	2,809,080	1.89	5.10	5.10	6.66
Principal repayments + borrowing interest costs	1,486,964				
5. Rates, annual charges, interest & extra charges outstanding					
Rates, annual & extra charges outstanding	772	14.7 %	14.7 %	14.7 %	16.7 %
Rates, annual & extra charges collectible	5,237				
6. Cash expense cover ratio					
Current year's cash & cash equivalents (incl.term deposits)	35,635	17.44	17.44	17.45	17.91
Operating & financing activities cash flow payments	2,043				

4. This ratio measures the availability of operating cash to service debt including interest, principal and lease payments.



5. To assess the impact of uncollected rates and annual charges on Council's liquidity and the adequacy of recovery efforts.

6. This liquidity ratio indicates the number of months a Council can continue paying for its immediate expenses without additional cash inflow.



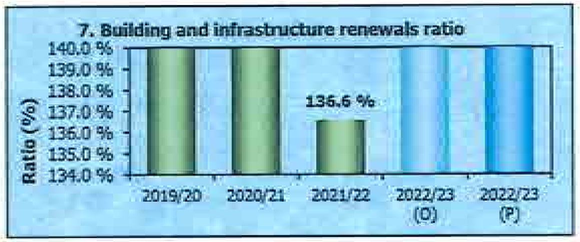
Bourke Shire Council

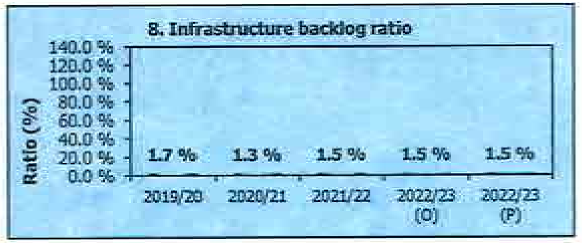
Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Key performance indicators budget review statement - Industry KPI's (OLG)

Budget review for the quarter ended 31 March 2023

($000's)	Current projection Amounts 22/23	Current projection Indicator 22/23	Original budget 22/23	Actuals prior periods 21/22	Actuals prior periods 20/21
NSW Local Government Infrastructure Asset Performance Indicators (OLG):					
7. Building and infrastructure renewals ratio					
Asset renewals (building, infrastructure & other structures)	43,130,298	606.3 %	606.3 %	136.6 %	247.5 %
Depreciation, amortisation & impairment	7,113,422				
To assess the rate at which these assets are being renewed relative to the rate at which they are depreciating.					
8. Infrastructure backlog ratio					
Estimated cost to bring assets to a satisfactory condition	4,950	1.5 %	1.5 %	1.5 %	1.3 %
Total value of infrastructure, building, other structures & depreciable land improvement assets	323,518				
This ratio shows what proportion the backlog is against the total value of a Council's infrastructure.					
9. Asset maintenance ratio					
Actual asset maintenance	6,371	140.1 %	140.1 %	140.1 %	84.1 %
Required asset maintenance	4,547				
Compares actual vs. required annual asset maintenance. A ratio above 1.0 indicates Council is investing enough funds to stop the Infrastructure Backlog growing.					





Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

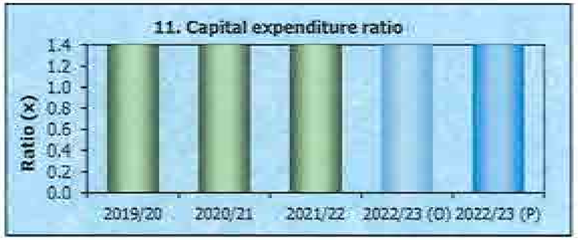
Key performance indicators budget review statement - Industry KPI's (OLG)

Budget review for the quarter ended 31 March 2023

($000's)	Current projection Amounts 22/23	Current projection Indicator 22/23	Original budget 22/23	Actuals prior periods 21/22	Actuals prior periods 20/21
NSW Local Government Infrastructure Asset Performance Indicators (OLG):					
10. Cost to bring assets to agreed service level					
Estimated cost to bring assets to an agreed service level set by council	4,950	1.0 %	1.0 %	1.0 %	1.2 %
Gross replacement cost	512,456				
11. Capital expenditure ratio					
Annual capital expenditure	63,008,017	8.9	8.9	8.9	8.8
Annual depreciation	7,113,422				

This ratio provides a snapshot of the proportion of outstanding renewal works compared to the total value of assets under Council's care and stewardship.

To assess the extent to which a Council is expanding its asset base thru capital expenditure on both new assets and the replacement and renewal of existing assets.



Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Contracts budget review statement

Budget review for the quarter ended 31 March 2023
Part A - Contracts listing - contracts entered into during the quarter

Contractor	Contract detail & purpose	Contract value	Start date	Duration of contract	Budgeted (Y/N)	Notes
BT Equipment	Supply 2 X Bomag BW216PD - 5 Padfoot Rollers	399,600	31/03/23	3 Months	Y	
BT Equipment	Supply 1 X Bomag BW28RH Multi Tyred Roller	138,000	31/03/23	3 Months	Y	
Westrac Pty Ltd	Supply 1 X Caterpillar 966GC Wheel Loader	439,845	31/03/23	3 Months	Y	
Lukas Building & Construction	Upgrade Kiosk at Bourke Swimming Pool	1,118,423	31/03/23	12 Months	Y	

Notes:

1. Minimum reporting level is 1% of estimated income from continuing operations of Council or $50,000 - whatever is the lesser.
2. Contracts listed are thoseentered into during the quarter being reported and exclude contractors on Council's Preferred Supplier list.
3. Contracts for employment are not required to be included.

This statement forms part of Council's Quarterly Budget Review Statement (QBRS) for the quarter ended xx/xx/xx and should be read in conjuction with the total QBRS report

Bourke Shire Council

Quarterly Budget Review Statement
for the period 01/01/23 to 31/03/23

Consultancy & legal expenses budget review statement

Consultancy & legal expenses overview

Expense	**YTD expenditure** (actual dollars)	**Bugeted** (Y/N)
Consultancies	322,080	Y
Legal Fees	117,713	Y

Definition of a consultant:

A consultant is a person or organisation engaged under contract on a temporary basis to provide recommendations or high level specialist or professional advice to assist decision making by management. Generally it is the advisory nature of the work that differentiates a concultant from other contractors.

17 ECONOMIC DEVELOPMENT DEPARTMENT

17.1 *** VISITOR ENHANCEMENTS AT BACK O' BOURKE EXHIBITION CENTRE

File Number: **T1.1**

Author: **Melanie Milgate, Manager Economic Development**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Background

The purpose of this report is to provide an update in regards to proposed visitor enhancements at the Back O' Bourke Exhibition Centre. These enhancements will involve the development of a fifth building at the Exhibition Centre to house local Aboriginal cultural displays and landscaping. The initial phase of this development will include the development of a business case and concept through to the preparation of a development application.

In 2022 Bourke Shire Council successfully applied to the NSW State Government for funding to enable this initial phase of development. The Creative Capital fund will contribute $250,000 towards the overall project.

Current Situation

The development of additional local Aboriginal stories and content for the Exhibition Centre has been a long term goal with visitor and local group feedback outlining a wish for additional cultural content. Over time, the level of content has increased within the bounds of available exhibition space and funding. Recent improvements have included enhanced gardens, visionaries display and most recently an updated display featuring Percy Hobson.

These improvements aside, Council now has an opportunity for further development and to plan for an Aboriginal Cultural Centre to sit within the overall precinct.

As outlined above, $250,000 has been granted to Council by the NSW State Government in order to facilitate the early phase development of the improved facility. The costs are budgeted to be $330,000 (Ex GST) and accordingly, a contribution from Council's Infrastructure Renewal Reserve is now sought.

Work in this initial phase will include:

- The development of a local Advisory Group to provide advice and feedback on display content and layout for the new facility;

- The development of a Business Case which will ultimately support an application for capital funding to construct the new building and displays;

- The concept development of the new building to development application stage, including access, energy efficiency, servicing and site layout;

- Concept development of the displays and landscape.

The new building is estimated to have an area of some 400m2, which is the size of existing building 3 at the Centre. The new building would be located to the south of the existing billabong and against the levee. The building would be integrated into the ticketing as part of the overall Exhibition Centre experience to take advantage of existing operational structures and marketing.

Council will continue to work with those involved with previous works at the Centre which will help to ensure that all aspects of the development are consistent with the development to date.

Financial Implications

The cost estimate for the work as outlined is $330,000 (Ex GST). The NSW Government’s Creative Capital Fund will contribute $250,000 towards the project with a contribution of $80,000 required from Council. It will be recommended that $80,000 be provided from the Infrastructure Renewal Reserve fund. Sufficient funds are available in the Infrastructure Renewal Reserve to fund this proposal.

Recommendation

1. **That Council note the report regarding the visitor enhancements at the Back O’ Bourke Exhibition Centre.**

2. **That Council make a co-contribution of $80,000 towards the business case and development application phase for the construction of a building that will house an Aboriginal Cultural Centre at the Back O’ Bourke Exhibition Centre from Councils Infrastructure Renewal Reserve fund.**

18 DELEGATES AND COUNCILLORS REPORTS

Nil

19 POLICIES

Nil

20 PRÉCIS OF CORRESPONDENCE

20.1 *** REQUEST FOR SUPPORT - NSW RURAL DOCTORS NETWORK BUSH BURSARY AND COUNTRY WOMEN'S ASSOCIATION OF NSW SCHOLARSHIP PROGRAM

File Number: **D5.2**

Author: **Leonie Brown, General Manager**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Background

The Bush Bursaries and Country Women's Association of NSW Scholarship program is designed to provide student health practitioners (medical, nursing and midwifery students) the opportunity to experience life and clinical practice in rural and remote areas. The aim is to encourage new graduates from the various disciplines to consider employment in the bush based on their experiences during their clinical placements.

Council has received an application from the Rural Doctors Network (RDN) requesting financial assistance in the amount of $3,000 excluding GST.

Current Situation

The $3,000 in scholarship funds donated by the Council goes directly to two (2) selected students. The scholarship is to be used to support their clinical studies and any expenses incurred during the placement (such as accommodation and travel).

Should Council choose to participate, the role of Council is summarised below;

- Investment of $3,000 (plus GST) to sponsor two students to undertake a placement within your LGA;
- Nomination of a contact person, often from within council, to develop a 12 day placement itinerary for the students and to be the main point of contact for students while they are on placement;
- Source accommodation for students for the duration of their placement;
- Liaise with RDN, students, and local media (where appropriate) to promote the placements in your community.

Previous experience has demonstrated Council does not have the capacity to fully meet the expectations of the role of Council as outlined above. In 2022 the Manager of Economic Development coordinated the placement by engaging health service providers and supporting them to fulfil the role, particularly in development of the placement itinerary.

Located within the grounds of the Bourke Multi-Purpose Centre (hospital) is the North West Academic Centre (NWAC) which is affiliated with the Broken Hill University Department of Rural Health. The NWAC have for several years been instrumental in supporting student placements. With a designated Project Officer, the NWAC are far better placed to fulfil the role assigned to Council, as student placements are their core business.

Financial Implications

The cost to Council would be $3,000 with the RDN advising that there is “no guarantee that the program will directly benefit the community of Bourke, however, will allow a student to experience a rural lifestyle practice”. In addition there is the hidden cost of staff wages in preparation, organisation and liaison relative to the placement.

Recommendation

1. **That Council accede to the request from the Rural Doctors Network regarding financial support in the amount of $3,000 to assist the Bush Bursary Scheme.**
2. **That Council advise the NSWRDN it is unable to fulfil the expected role of Council regarding the logistics of the student placement.**
3. **That Council suggest liaison with the NWAC regarding the student placement.**

21 ACTIVITY REPORTS

21.1 ENGINEERING SERVICES - ROAD WORKS AND WORKSHOP - WORKS UNDERTAKEN

File Number: **E7.1**

Author: **Paul Flanagan, Manager Roads**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Background

The following information outlines works undertaken from 13 March 2023 to 12 April 2023 inclusive.

ENGINEERING SERVICES – Road Works – Works Undertaken Michael Willoughby, Roads Supervisor		
NORTH TEAM – Denis Tiffen, Team Leader		
Location	**Work Type**	**Completed**
State Highways	Traffic Control for Flooding	Y
MR 405 Wanaaring Road	Construct and seal-132-136 km	N
SOUTH TEAM – John Reed, Team Leader		
Location	**Work Type**	**Completed**
State Highways	Heavy patching	N
MR 68 Bourke-Wilcannia Road	Construct and seal-43.7-46.7km	Y
TRANSPORT TEAM – Simon Wielinga, Team Leader		
Location	**Work Type**	**Completed**
MR 404 Hungerford Road	Construct and seal	N
MR 405 Wanaaring Road	Construct and seal-132-136km	N
BITUMEN TEAM – Phillip Harvey, Team Leader		
Location	**Work Type**	**Completed**
Bourke Township	Pothole patching	Y
Regional Roads	Pothole patching	Y
State Highways	Pothole patching	Y
SH 7 South of Bourke	Control vegetation (ongoing)	N
MR 421 Kidman Way	Control vegetation (ongoing)	N
CONTRACTORS		
Location	**Work Type**	**Completed**
MR 68 South	Maintenance grading (Sandford)	N
RLR 42-Dry Bogan	Maintenance grading (NAK)	N
RLR 10 Toorale Road	Repaired Flood Damage (Sandford)	Y
MR 68 Bourke-Wilcannia Road	Repaired Flood Damage (Sandford)	Y

WORKSHOP – Colin Kiley, Team Leader			
Plant No.	**Rego**	**Description**	**Work Carried Out**
46	BX92HR	2013 Hino FC 500	Removed and replaced window winder
50	CL16AC	Kenworth Primemover	Service carried out, repaired head light wiring, replaced relay, removed turn table, replaced mounting pads and reassemble, repaired coolant leak
59	Z-37484	2014	Repaired air leaks, removed and replaced hydraulic hoses, removed and replaced worn torque rod rubbers, replaced tyres, welded and repaired cracks in frame
64	UNREGD	2011 Gason	Removed wire from around shaft, removed and replaced blades
108	63723-D	Toro	Engine running rough, found dirty fuel, replaced fuel filter
132	XO71KD	John Deere	Service carried out, diagnosed electrical fault, found damage wiring
134	94196-D	2019 John Deere 770G	Service carried out
136	91045-D	Toro	Diagnosed noise found in deck, damage to bearings, removed and replaced spindle
141	XN84BW	John Deere Grader	Service carried out
157	UNREGD	Road Broom	Removed assemble and replaced hydraulic hose
172	XO67KD	Isuzu 1500 FXY	Service carried out, manufactured new brakes and repaired cross arm, repaired oil leak and replaced hydraulic hose
184	DF50KV	2023 Ford Ranger	Checked over, fitted accessory power to back of tube, fitted air vents to canopy
219	XO52KJ	2022 Isuzu	Service carried out, repaired wiring on bin lift arm
220	W87367	Boggie Trailer	Repaired leg stands and manufactured pins
243	64065-D	2020 Case Loader	Diagnosed fault, faulty code in sensor, removed, engineered and replaced damaged hydraulic hose on bucket
247	23013-E	2021 John Deere	Removed and repaired PTO shaft
271	DC65LK	202 Ford Ranger	Service carried out

WORKSHOP – Colin Kiley, Team Leader			
Plant No.	**Rego**	**Description**	**Work Carried Out**
506	XN65HG	Kenworth Primemover	Diagnosed clutch, problem found broken leakage, replaced and adjusted leakage
510	73228-D	Smooth Drum Roller	Repaired wiring and replaced lights
512	73235-D	Multi Tyre Roller	Checked transmission
		Renshaw Complex	Removed old sign frame, made and refitted new one, replaced damaged caps and cleaned gates
		Depot	Cleaned yard for auction, cleaned pit and repaired drain
		Crossley Engine	Helped rebuild both engines
		Jandra Paddle Boat	Replaced lift pump, diagnosed rpm fault with paddle, found faulty rpm counter, ordered parts

Recommendation

That Council note the information in the Roads Department Road Works and Workshop Activity Report as presented to Council on Monday, 24 April 2023.

21.2 PARKS & GARDENS / TOWN SERVICES / WATER & WASTE WATER ENGINEERING SERVICES ACTIVITY REPORT

File Number: **E7.1**

Author: **Peter Brown, Manager Works**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Background

The following information outlines works completed during the period 13 March 2023 to 12 April 2023 inclusive.

Current Situation

PARKS & GARDENS – Frank Hollman, Team Leader (13/3/2023 to 12/4/2023 inclusive)	
Location	**Work Carried Out**
General	All parks and sporting grounds and gardens - regular mowing and maintenance completed. Sporting grounds facilities cleaned and maintained. Public toilets cleaned and maintained. Facilities cleaned. General graffiti removal carried out on Council facilities.
Small Plant	Maintenance and service carried out on all ground plant.
Works Requests	Actioned and ongoing.
1 Tudor St	General maintenance carried out.
Wharf	General maintenance carried out.
Council Office	General maintenance carried out.
Renshaw Complex	General maintenance carried out.
Coolican Oval	Grounds, facilities cleaned and maintained. Prepared grounds for Bourke High School Soccer and Football Gala Day.
Davidson Oval	General maintenance carried out. Prepared grounds for NSW RL mid-week Competition. Prepared grounds for Rugby Union Training. Prepared grounds for Old Boys Rugby Union match Easter Weekend.
Central Park	Skate Park - regular mowing and maintenance carried out, including, graffiti removal. Prepared grounds for Anzac Day.
Villages	Mowed grounds, facilities cleaned and maintained.
Airport	Mowed airstrip.
Darling Park	General maintenance carried out.
Staff Training	Nil

TOWN SERVICES – Troy Hayman, Team Leader (13/3/2023 to 12/4/2023 inclusive)	
Location	**Work Carried Out**
Work Requests	Actioned and ongoing
	Weekly - sand footpaths

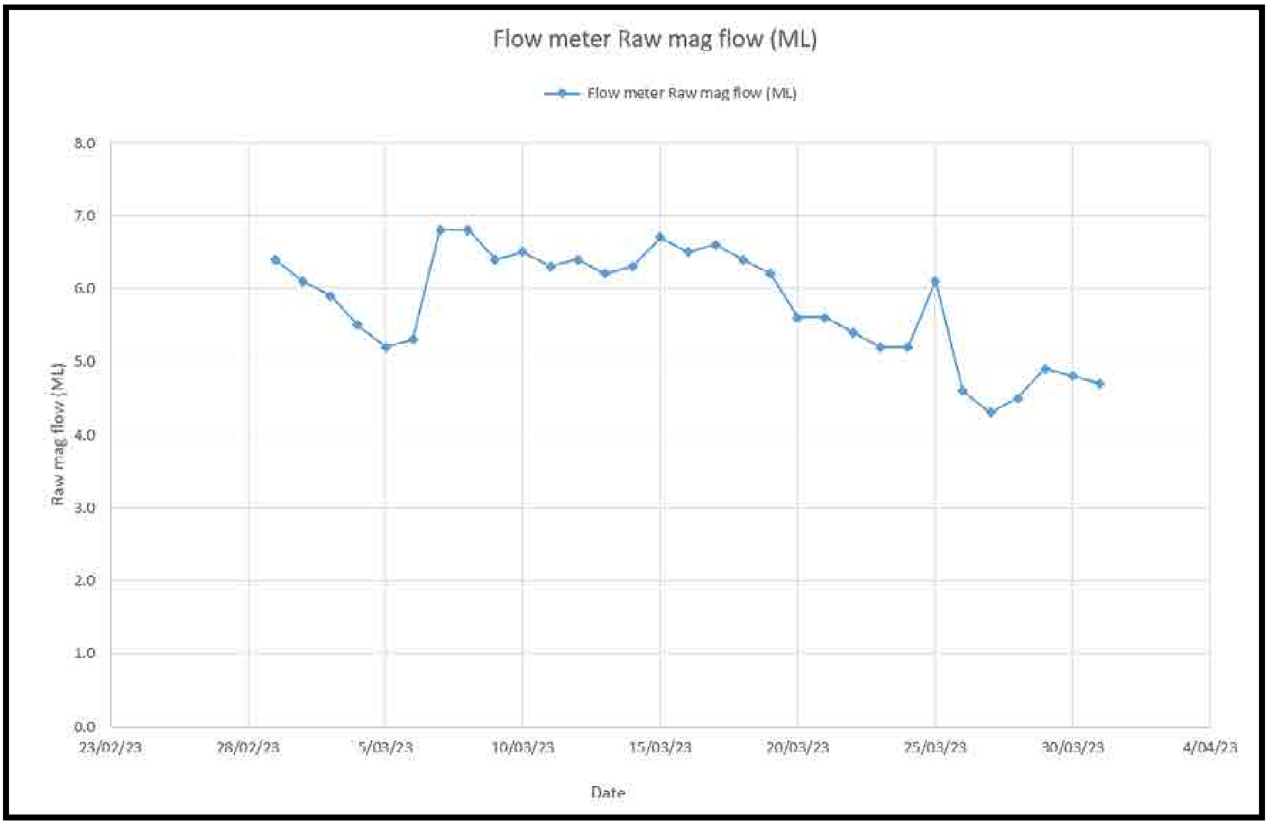
TOWN SERVICES – Troy Hayman, Team Leader (13/3/2023 to 12/4/2023 inclusive)	
Location	**Work Carried Out**
	Weekly - town mowing
	Daily - Main Street Program
	Airport slashing and mowing
	Mowed around Airport lights
	Town slashing and laneways
Cemetery	Graves Prepared: 0
Rest Areas	Picked up abandoned vehicle from Cobar Road
Staff Training	ChemCert
Works Request	Concrete footings for solar lights at central Park bus shelter
	Crane lift steel garden bed for front of Shire Office
	Crane lift shed onto slab for North Bourke Water Supply
	Spray wasps at wharf
	Pruned trees in Oxley Street along Central Park footpath
	Watering trees ongoing
	Delivered black dirt to Jandra site North Bourke
	Line marked 45 degree in Mitchell Street
	Aggregate Jandra site North Bourke
	Delivered mulch to Back O Bourke Exhibition Centre
	Racetrack jobs for Easter Weekend
	Line marked pedestrian crossing in Sturt Street
	Removed branches from 1-3 Short Street
	Removed rubbish for Contractor
	Levee flood gates replacement program
	Delivered softfall to Renshaw Complex
	Removed and replaced dead trees
	Mowed Enngonia Oval with Parks and Gardens
	Delivered stone to Wharf
	Delivered sand to Back O Bourke Exhibition Centre
	Mowed Renshaw Complex
	Delivered shed to cover generator at Enngonia
	Filled holes at Renshaw Complex
	Mowed Tancred Drive
	Cold Mix - Mitchell and Sturt Streets
	Erected new Weir signs
	Mowed Vision Way
	Erected signs for Easter Weekend
	Filled holes in laneway behind bakery
	Delivered chairs to Back O Bourke Exhibition Centre for Easter Weekend

WATER & WASTEWATER – Shane Hopley, Team Leader (13/3/2023 to 12/4/2023 inclusive)	
Water Supply Planned Maintenance	
Works Request	Daily
73 Anson Street	Sewer Choke
17 Tudor Street	Sewer Choke
18 Short Street	Sewer Choke

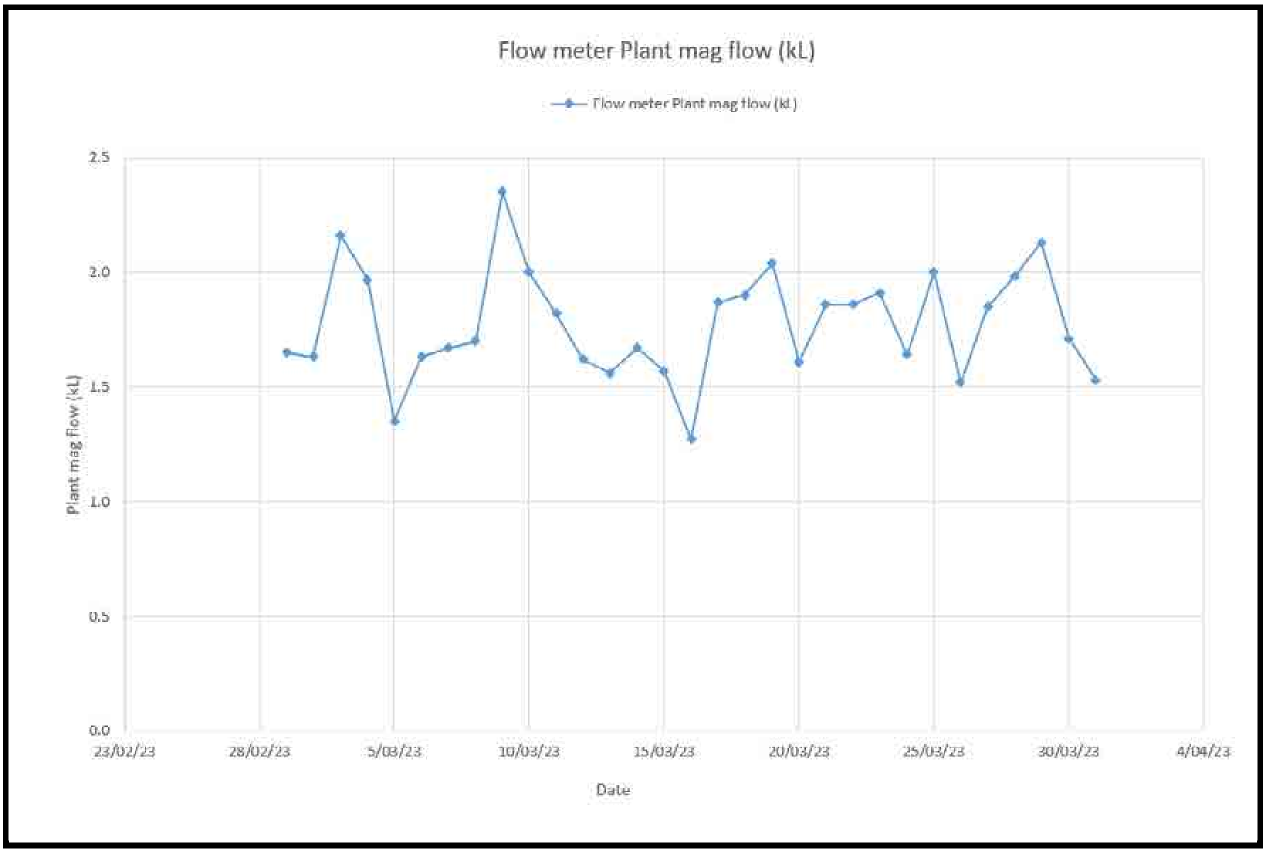
WATER & WASTEWATER – Shane Hopley, Team Leader (13/3/2023 to 12/4/2023 inclusive)	
Water Supply Planned Maintenance	
17 Sturt Street	Sewer Choke
78 Tudor Street	Sewer Choke
8 Becker Street	Sewer Choke
56 Darling Street	Sewer Choke
76 Darling Street	Sewer Choke
15 Adelaide Street	Sewer Choke
Cullie Street	Sewer Choke
150 Meadows Road	Sewer Choke, dug sewer boundary, cleared choke
1A Glen Stret	Repaired leaking 20mm filtered water service
33 Anson Street	Repaired leaking 20mm filtered water service
12 Glen Street	Repaired leaking 20mm filtered water service
54 Short Street	Repaired leaking 20mm filtered water service
13 Glen Street	Repaired leaking 20mm filtered water service
25 Oxley Street	Repaired leaking 20mm filtered water service
4 Culgoa Stret	Repaired leaking 20mm filtered water service
50 Mertin Street	Repaired leaking 20mm filtered water service
32 Oxley Street	Repaired leaking 20mm filtered water service
3 Yanda Street	Repaired leaking 20mm filtered water service
27 Adelaide Street	Repaired leaking 20mm filtered water service
103 Oxley Street	Repaired leaking 20mm filtered water service
54 Oxley Street	Repaired leaking 20mm filtered water service
17 Anson Street	Repaired leaking 20mm filtered water service
62 Darling Street	Repaired leaking 20mm filtered water service
Richard Street	Repaired leaking 20mm filtered water service
15 Adelaide Street	Installed new 20mm filtered water service
Enngonia Hall	Repaired leaking 20mm water service
4 Warraweena Street	Installed new 25mm filtered water service
High Street	Dug 50mm filtered water main and repaired main
77 Oxley Street	Dug 50mm filtered water main and repaired main
Crossroads Laneway	Dug 50mm filtered water main and repaired main
Macquarie Street, North Bourke	Dug 50mm filtered water main and repaired main
Fords Bridge	Dug 50mm filtered water main and repaired main
Alice Edwards Village	Dug 100mm filtered water main and replaced hydrant
Council Depot	Repaired leaking filtered water taps
20 Tudor Street	Repaired leaking 25mm raw water service
92 Hope Street	Repaired leaking 25mm raw water service
Tudor Street	Repaired leaking 25mm raw water service
14 Darling Street	Repaired leaking 25mm raw water service
Sale Yards	Dug 50mm raw water main and repaired main
33 Moculta Street	Dug 100mm raw water main and repaired main
Parkdale Road	Dug 100mm raw water main and repaired main
52 Mertin Street	Dug 100mm raw water main and repaired main
4 Warraweena Street	Installed new 100mm raw water service
Louth	Dug 100mm raw water main and repaired main, repaired leaking water service in the park

WATER & WASTEWATER – Shane Hopley, Team Leader (13/3/2023 to 12/4/2023 inclusive)	
Water Supply Planned Maintenance	
Cullie Street	Dug 100mm raw water main and replaced Hydrant
Yanda Street	Dug 100mm raw water main and replaced hydrant
1 Narran Street	Low water pressure
Charles Street	Dug up old drain to water tank
58 Oxley Street	Replaced pool pump
Warrego and Yanda	Located hydrants
Bourke Pool	Installed power and sprinklers, replaced chlorine dosing pump on the big pool
Power Outage	Set up generators at WTP and STP
Water Treatment Plant (WTP)	Routine maintenance, monitoring and reporting
Sewer Treatment Plant (STP)	Routine maintenance, monitoring and reporting
Alice Edwards Village	Routine maintenance and monitoring as per ACP management plan
Clara Hart Village	Routine maintenance and monitoring as per ACP management plan
Training	Nil

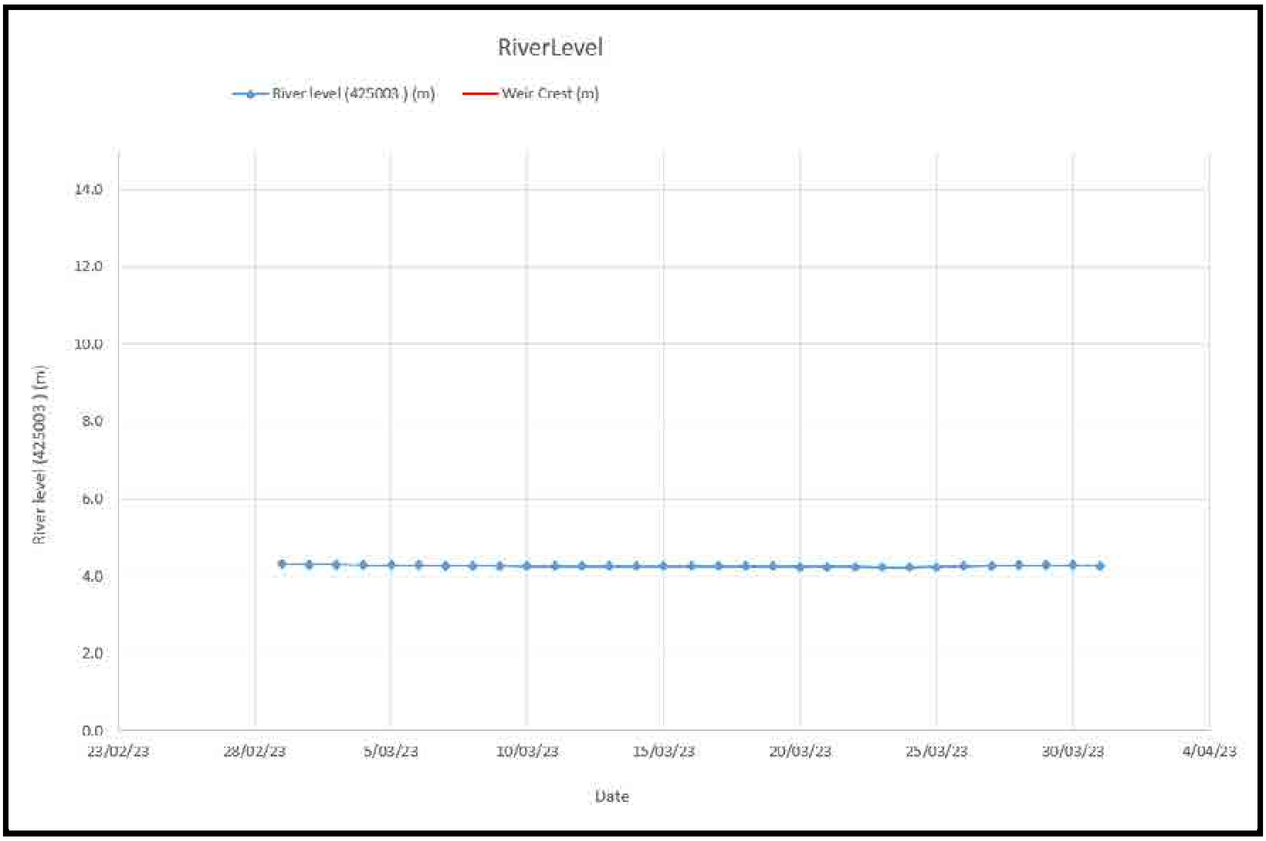
Raw Flow Meter



Plant Flow Meter



Current River Levels



Monthly Readings

Month	Raw water ML	Filter magflow pump 2 ML	Raw Water North Bourke KL	Filter Water North Bourke KL
July 2022	45	27	10,254	1,518
August 2022	49	25	15,321	1,622
September 2022	55	30	9,635	1,532
October 2022	52	27	7,862	1,544
November 2022	73	30	7,564	1,223
December 2022	138	41	23,264	1,325
January 2023	178	45	22,546	1,254
February 2023	170	43	32,365	1,534
March 2023	179	54	30,210	1,325

Council's Water Access Licences – WAL's

Process	Parameter	Minimum	Average	Maximum	Lower critical lim	Upper critical lim	No. of samples
River level	River level (425003)	4.22	4.25	4.30	3.9		31
Raw Water	pH	7.20	7.54	7.90			31
Raw Water	turbidity	57.00	76.39	111.00			31
Filtered water	pH	7.21	7.39	7.68	6.5	8.7	31
Tower	Free Cl2	1.72	3.25	4.50	0.2	5.0	31
Bourke High Schoo	Free chlorine	2.10	2.10	2.10	0.2	4.0	2
Bourke High Schoo	pH	7.40	7.45	7.50	6.5	8.5	2
Bourke High Schoo	Turbidity	0.15	0.17	0.18	0.0	0.5	2
WTP	Free chlorine	2.00	2.00	2.00	0.2	4.0	1
WTP	pH	7.40	7.40	7.40	6.5	8.5	1
WTP	Turbidity	0.20	0.20	0.20	0.0	0.5	1
Bourke Primary Sch	Free chlorine	1.50	1.50	1.50	0.2	4.0	1
Bourke Primary Sch	pH	7.30	7.30	7.30	6.5	8.5	1
Bourke Primary Sch	Turbidity	0.21	0.21	0.21	0.0	0.5	1
Meadows Rd	Free chlorine	2.20	2.20	2.20	0.2	4.0	1
Meadows Rd	pH	7.70	7.70	7.70	6.5	8.5	1
Meadows Rd	Turbidity	0.20	0.20	0.20	0.0	0.5	1
Mitchell St	Free chlorine	1.70	1.70	1.70	0.2	4.0	1
Mitchell St	pH	7.60	7.60	7.60	6.5	8.5	1
Mitchell St	Turbidity	0.20	0.20	0.20	0.0	0.5	1
Alice Edwards Villa	Free chlorine	0.40	0.40	0.40	0.2	4.0	1
Alice Edwards Villa	pH	7.50	7.50	7.50	6.5	8.5	1
Alice Edwards Villa	Turbidity	0.20	0.20	0.20	0.0	0.5	1

Health Guidelines

No	CCP	Monitoring Parameter	Location	Frequency	Target	Adjustment Level	Critical limit
CCP 1	Clarification	Turbidity	After clarifier	Daily grab sample	<1 NTU	4 NTU	>4 NTU
CCP 2 *	Filtration	Turbidity	After Filters	Daily grab sample	0.4 NTU	1 NTU	>1.2 NTU
CCP 3	Disinfection	Chlorine residual	Filtered Water	Daily grab sample	1.5-2 mg/L	<1.5 mg/L for more than 3 days	<0.5 mg/L or > 5 mg/L
CCP 4	Fluoridation	Fluoride concentration	After filters	Daily grab sample	1.0 mg/L	<0.95 mg/L or >1.0 mg/L	<0.9 mg/L for > 72 hours Or >1.5 mg/L
CCP 5	Reservoirs	Reservoir Integrity	Reservoirs	Weekly	Integrity maintained	Signs of integrity breach	Unable to rectify breaches

Water Monitoring Stations

Work Approval	Extraction Site	Site Name	Start meter read 01/07/2022	Old Meter read Mar-23	New meter Sep-22	Meter read Dec-22	usage Year to Date			Comment
85CA753414	ESID 121627	Water Plant TWS	14804.9	15742.5			937.6	ML	3200ML	
85CA753420	ESID 121630	North Bourke TWS	1732.447	1879.6			147.153	ML	300ML	
85CA753421	ESID 121630	North Bourke Abs	30.006	30.354			0.348	ML		
85CA751207	24634	Engonia Village TWS	181.64	184.017	0	27.923	30.3	ML	150ML	New meter installed Sep-22
85CA753599		Wanaaring Station	0	0	0	13.523	13.523	ML	25ML	New meter installed Oct-23
85CA753412	ESID 121626	(LWU Louth)	491.101	493	0	25.027	26.926	ML	25ML	New meter installed Sep-22
85CA751215	24639	Fords Bridge TWS	0	0	0	1.635	1.635	ML	2ML	New meter installed Sep-23
85CA751240	32585	Walken Bore No1	19.005	19.005			0	ML	100ML	
	148936	Walken Bore No2	128.567	128.567			0	ML		
	148937	Belvedere Bore	13.996	13.996			0	ML		
	209518	Stoney Rise Bore	24.603	24.603			0	ML		
	222419	Toll Bore					0	ML		No Meter Not Active
85WA753906		Gumbalie					0	ML		No Meter Required Road works Bore
90WA836011	208200	Rainbar or Tichaluka					0	ML		No Meter Required Road works Bore
90WA836179	211161	Rainbar or Tichaluka					0	ML		No Meter Required Road works Bore
85CA753031	ESID 12002	Golf Course					0	ML	320ML	No Meter Not Active
85CA752937	ESID 119950	Exhibition Centre					0	ML	29ML	No Meter Not Active

Treatment Plant EPA Licence Compliance

Record of Effluent Analysis

Pollutant	Unit Of Measure	Licence 100 Percentile Concentration Limit	Jan 2023 Test	Feb 2023 Test	Mar 2023 Test
Oil & Grease	*mg/L*		n/a-no flow	n/a-no flow	n/a-flood
pH			n/a-no flow	n/a-no flow	n/a-flood
Nitrogen (total)	*mg/L*		n/a-no flow	n/a-no flow	n/a-flood
Phosphorus (total)	*mg/L*		n/a-no	n/a-no	n/a-flood

			flow	flow	
Total suspended solids	*mg/L*		n/a-no flow	n/a-no flow	n/a-flood
Biochemical oxygen demand	*mg/L*		n/a-no flow	n/a-no flow	n/a-flood

Council notes the provisions of clause L2.5 (a) and (b) of its licence conditions of a chlorophyll exemption due algal growth, which also exempts the above exceedances.

- Rainfall in Bourke for March 2023 was 5.6 mm
- Hottest day for March 2023 was 35.9 degrees
- Coldest day for March 2023 was 19.5 degrees

Recommendation

That Council note the information in the Parks and Gardens, Town Services and Water and Wastewater Engineering Services Department Activity Reports as presented to Council on Monday, 24 April 2023.

21.3 PLANNING, REGULATORY AND ENVIRONMENTAL SERVICES ACTIVITY REPORT

File Number: **D3.1-A11.1-A8.1**

Author: **Dwayne Willoughby, Manager Environmental Services**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

Development Approvals			
Delegated Authority or Council	**Consent Type and Consent No.**	**Subject Land**	**Nature of Development**
Delegated	DA 2023/0012	Part Lot 9, DP 829041 72-76 Anson Street, Bourke	Demolition of Existing Amenities building
Delegated	DA 2023/0013	Lot 2, DP366346 19 Mertin Street, Bourke	Demolition of Existing Dwelling and Associated Structure
Delegated	DA 2023/0015	Lot 17, Section 97, DP758144 5 Yanda Street, Bourke	Demolition of Existing Dwelling
Delegated	DA 2023/0016	Lot 1, DP502912 2 Coomah Street, Bourke	Demolition of Existing Dwelling and Associated Structure
Delegated	DA 2023/0017	Lot 19, Section 97, DP 758144 1 Yanda Street, Bourke	Demolition of Existing Dwelling
Delegated	DA 2023/0018	Lot B, DP409909 6 Becker Street, Bourke	Demolition of Existing Dwelling and Associated Structure
Delegated	DA 2023/0019	Lot 2, DP355528 20 Tudor Street, Bourke	Demolition of Existing Dwelling and Associated Structure
Delegated	DA 2023/0021	Lot C, DP22638 39 Hope Street, Bourke	Construction of Residential Shed

Total value of Approved works for March 2023	= $239,000
No. of Development Application Approvals for March 2023	= 8
No. of Complying Development Application Approvals for March 2023	= 0

Building Services Report	
Location	**Work Carried Out**
Work Requests	Actioned and ongoing
Risk Assessments	Completed with every job
Training	As required
Contractors	Maintenance works completed as required Upgrade works completed as per Operational Plan
Buildings	Maintenance works completed as required
Airport	Maintenance works completed as required

Animal Control – March 2023		
Bourke Shire Council Holding Facility	**Dogs**	**Cats**
Animals in Pound beginning of Month	2	2
Seized	1	0
Surrendered	12	0
Handed in by members of the public	0	0
Dumped at pound	0	0
Total	**15**	**2**
Euthanised	3	0
Released to Owner	0	0
Adopted	0	2
Re-housed	2	0
Died in Pound	1	0
Escaped from Pound	0	0
Animals Remaining at End of Month	9	0
Total	**15**	**2**
Stock Rested in Stock Yards	24	

- Attended complaints regarding dogs causing trouble to the general public
- Ongoing patrols of the township enforcing the Companion Animal Act
- Water sampling for the township, villages and Darling river, as required
- Patrols of Councils Reserves

Swimming Pool Attendance for March 2023	
Adults	463
Children (2+)	633
Children (<2)	179
School Groups/Other	432
Total for Month	**1707**
Total for 22/23 Season	**13344**

Recommendation

That the information in the Planning, Regulatory and Environmental Services Activity Report as presented to Council on Monday, 24th April 2023 be received and noted.

21.4 GENERAL MANAGER'S ACTIVITY REPORT

File Number: **G2.1**

Author: **Leonie Brown, General Manager**

Authoriser: **Leonie Brown, General Manager**

Attachments: **Nil**

30 March 2023

Height of the Bourke Weir

One of the issues that Bourke Council has long advocated for is an increase to the height of the Bourke Weir in a bid to enlarge the capacity of the Bourke Weir Pool. As most residents would be aware, the capacity of the weir pool is currently such that once water ceases to flow over the weir, and there are no further inflows, the Bourke township has but 6 months of river water supply available to it. This limited availability of river water supply impacts significantly the economic development capability of our community. It is hard to fathom that despite the many hundreds of thousands of megalitres that flowed past Bourke during 2022, the water at the weir is now within 25 cm of water flow stopping with the community correspondingly close to going back onto water restrictions……all within 3 months of the community being cut off from localities to the south and east of Bourke due to flood waters.

Over the year's Council representatives have attended numerous consultation sessions, met with relevant Ministers and departmental officers, and whilst there have been verbal commitments to an increased weir height, Council has seen little actual progress in this most important issue for our town.

Council discussed this apparent lack of progress at its meeting back on 27 February 2023 and in doing so, resolved to write to the Federal Minister for the Environment and Water, the Hon Tanya Plibersek, MP and the NSW Minister for Lands and Water, the Hon Kevin Anderson, MP seeking formal clarification as to the status of the Western Weirs Strategy/Better Baaka Program and the resulting status of proposals to increase the height of the Bourke Weir.

With the NSW Government having been in caretaker mode since 3 March 2023 leading up to last week's state election, the NSW Minister requested the Acting CEO of the NSW Water Sector, Ms Amanda Jones, to respond to Council. In her response Ms Jones assured Council "that Bourke Weir is a high remediation priority for the NSW Government." She advised that "upgrades to the Bourke Weir, as part of the Western Weirs project, have been incorporated into the Better Baaka program, a holistic, system-wide approach to regional water infrastructure planning and operations to address the issues facing the Darling- Baaka River system. The program reflects a greater focus on environmental outcomes in the Darling Baaka."

Importantly she advised that "the strategic business case for the Western Weirs program was completed in November 2021" and further that "the NSW Government continues to work with the Australian Government on suitable funding arrangements to progress to a final business case."

Whilst Council has yet to receive a response to its letter to the Federal Minister for the Environment and Water, the Hon Tanya Plibersek, MP, its fair to say that this issue is not one that Council is going to easily let go of.

Fish Deaths

NSW Government agencies including the Department of Planning and Environment (DPE), the Department of Primary Industries (DPI) and WaterNSW continue to respond to major fish death events on the Lower Darling-Baaka in the Menindee Lakes region.

Since mid-February fish deaths have been recorded upstream of Pooncarie, both in the main channel of the river and in off-channel wetlands and depressions, where fish became stranded as water levels dropped. Most of the dead fish are native Bony herring and non-native Carp, although increasing numbers of large-bodied native fish such as Murray cod and Golden perch are being documented.

It is apparently unusual to see substantial numbers of Murray cod and Golden perch stranded due to flood water returning to rivers. This suggests that fish were avoiding the particularly poor water quality in the river channel during this period and were attracted to the higher quality water in the billabongs. Typically, it would be expected that Murray cod and Golden perch would return to the river before they are stranded in smaller channels.

The apparent cause of the fish kill is what’s known as hypoxic blackwater. This is a naturally occurring phenomenon when large quantities of fish, bacteria, algae and other organic matter deplete the oxygen levels especially throughout the night when photosynthetic generation of dissolved oxygen by water plants and algae ceases. While the forecast is for lower temperatures over coming weeks, the risk of hypoxia is still high, as warmer water holds less oxygen than cold water, and fish have higher oxygen needs at warmer temperatures.

The current task being addressed at Menindee is cleaning up the massive number of dead fish. One can only imagine the smell at the site.

Trivia

Talking of clean ups, Friday 18 March 2023, was the 20th anniversary of when two (2) protestors in the dead of night scaled one of the sails of the Sydney Opera House to paint the wording NO WAR in large red paint at the top point of the tallest sail on this iconic building. Sentenced to nine months periodic detention and fined $151,000, the malicious actions resulted in a new law which would see people who intentionally or recklessly damage the Opera House, face a jail term of up to seven (7) years. Where it gets interesting is that the removal of the red paint was undertaken by the Dubbo based company Techni-Clean. My understanding is that the exposure received from undertaking this onerous clean-up, certainly didn’t hurt Techni-Clean as they went about successfully expanding their operations.

National Asbestos Awareness Campaign

Asbestosis (as-bes-TOE-sis) is a debilitating chronic lung disease caused by inhaling asbestos fibres. In cases where people are exposed to high levels of asbestos dust over a long period of time, some of the airborne fibres can become lodged within their alveoli — the tiny sacs inside lungs where oxygen is exchanged for carbon dioxide in the blood. The asbestos fibres irritate and scar lung tissue, causing the lungs to become stiff. This makes it difficult to breathe. As asbestosis progresses, more and more lung tissue become scarred. Eventually, the lung tissue becomes so stiff that it can't contract and expand normally.

Asbestosis symptoms can range from mild to severe, and usually don't appear until many years after initial exposure. It is a debilitating disease with people who worked in mining, milling, manufacturing, and installation or removal of asbestos products before the late 1970s being at the highest risk of asbestosis. Whilst large steps have been taken in reducing the number of Australians exposed to asbestos, from 12 March 2023 till 10 April 2023 the Asbestos Safety and Eradication Agency is conducting a further phase of its successful National Asbestos Awareness Campaign. A major focus of the campaign is directed at homeowners who are undertaking renovations to their properties with the number of people undertaken home improvements ever increasing due to limited availability of tradies.

Before you start doing any home improvements yourself, always check if asbestos is present. You can do this by asking an asbestos professional for advice and have a sample tested, or assume the material contains asbestos & take the necessary precautions. If the asbestos material is in good condition do not disturb or damage it. If it is broken, weathered or if any renovation or maintenance work is likely to disturb or damage the asbestos, seek professional help to remove it. It could cost less than you think, on various levels.

Even if you’re just doing minor repairs or maintenance on your home, always take care to avoid disturbing or releasing asbestos fibres. Maintain asbestos materials in good condition by using paint or other sealants, enclosures and capping. Never use high-pressure water or any abrasive process (e.g. scrubbing, sanding or grinding) to clean asbestos cement roofs or any other asbestos material. This can result in widespread contamination and an expensive clean-up. If you plan to cut a small hole into an asbestos-cement sheet, for example to install a cable, only use a hand saw or hand drill (or low-speed battery drill) and contain or capture any asbestos dust as close to the source as possible. You must also wear suitable personal protective equipment.

With many of the houses in Bourke dating back to pre-1980, I encourage all to be careful when dealing with asbestos products. For more information have a look at the following link: https://www.asbestossafety.gov.au

Quote: “Members agreed to reconsider the case for a pause (in interest rate rises) at the following meeting, recognising that pausing would allow additional time to reassess the outlook for the economy,” Reserve Bank of Australia minutes of its March Meeting.
Time will tell!

6 April 2023

Easter Festival Visitors

Council is very excited to welcome Bourke residents, neighbouring towns, visitors and “ex-Bourkites” to the Back O' Bourke Easter Festival being held from tomorrow, Easter Friday through to and including next Monday 10 April 2023.

With so much for all ages to do, see and enjoy I trust that everyone has a most enjoyable weekend of activities. Don't forget the very popular Giant Easter Egg Hunt at the Back O' Bourke Exhibition Centre commencing at 8am on Easter Sunday morning. A few notes about the Hunt: Spaces are limited; children need to be registered to participate - visit or phone the Exhibition Centre on 6872 1321 to do so; children must be attended by an adult on the day.

If you are travelling away from Bourke for the weekend, please travel safely and remember to Stop, Revive and Survive.

Operational Plan Exhibition

The Council as elected in December 2021 has previously adopted its Community Strategic Plan, Delivery Program, Asset Management Policy, Strategy and Plan, Long Term Financial Plan and Workforce Plan. To deliver the objectives of these various documents, the Local Government Act provides that an Operational Plan must be adopted by the Council annually. The Operational Plan is local government speak for an annual budget.

Council at its 27 March 2023 meeting adopted its draft 2023/2024 Operational Plan for the purposes of it being exhibited for public comment prior to any adoption of a final document. Councils adoption of the draft comes after an earlier workshop with Councillors to allow staff to present and discuss the Plan with them. From the Council meeting, Council resolved that the Plan and associated documentation, such as the chart of fees and charges, be exhibited from Monday, 3 April 2023 until 5.00pm Monday, 1 May 2023. The Plan is available for viewing at Councils Website (www.bourke.nsw.gov.au) with a copy also available at the Council offices in Mitchell St, Bourke. Council is required to have considered any submissions received prior to adopting its annual Operational Plan. Such considerations will take place when a report on submissions is presented to Councils 22 May 2023 Ordinary Meeting.

NSW Election

Congratulations to Chris Minns on leading the Labor party to victory in the recent state government election. Congratulations are also extended to our local member, Roy Butler, on being re-elected to the NSW Parliament as the member for the state seat of Barwon. Mayor Barry has written to both Mr Minns and Mr Butler to congratulate them on their respective victories. Mayor Barry has also written to the outgoing Deputy Premier, the Hon Paul Toole to thank him and his government for their significant contribution to Bourke during their 12-year term in Government. I think it is fair to say that the amenity of Bourke has significantly improved during that time, largely as a result of considerable State Government funding made available to our community during this period through various regional funding programs. In writing to congratulate the new Premier, the Mayor has invited him to visit Bourke with a view to gaining a greater understanding of the numerous complexities and challenges facing a remote community, that Bourke is.

In terms of Mr Butlers state electorate, the seat of Barwon holds 54,093 voters and is the largest electoral seat in NSW in terms of area. It covers an area of 356,292 square kilometres (km2) which is, for those who like data, 44.47% of the area of the state of NSW. For comparative purposes, its area is basically the same area as the seventh-largest country in Europe, being Germany (357,022km^2), or just slightly smaller than the US state of Montana at 380,832 km^2. Whatever you compare it too, Barwon is a very large area. I read a recent article that said Mr Butlers car "was a year old and had carried him 60,000 kilometres, including 10,000 in the past two months", leading up to the election. At a Federal level, Bourke is in the seat of Parkes with this electorate covering an even larger area of 393,413km2 – which is 49% of NSW. The distance travelled by these two (2) parliamentary representatives is also large and I always feel privileged, during my relatively short time as GM, when our local members, Mr Butler and Mr Coulton, take the time and make the effort to visit us at Council for discussions on local matters that are relative to either of their respective State or Federal seats.

Election Logistics

Over my years of working at Council, I have been involved in undertaking the necessary arrangements in respect of the holding of local government elections. After I had voted in the recent State Elections, I got to thinking of the logistics involved in the NSW Electoral Commission organising a state-wide election. With a voting base of nearly 5.3 million voters, more than 2500 individual voting venues, 20,000 workers involved and something like 1,000 candidates, it would certainly be no small task in making it all happen. Detailed strategies and procedures are undoubtedly developed and enacted to ensure the election is delivered in a professional and seamless manner. The scale of the State Election certainly makes the one polling place that we utilise in Bourke for the Local Government Election very small scale!

A search of the logistics involved in the State election revealed that twenty-eight million ballot papers were printed for the 2023 March State election and along with the more than 2,500 individual voting centres, which included 200 early voting centres that were set up, Electoral staff also visited nearly 600 declared facilities such as nursing homes, aged care facilities and hospitals before election day to allow residents to vote in person on site.

In commissioning 93 election managers’ offices around the state, the Commission arranged the delivery of furniture, IT equipment and a broad range of voting materials to these offices. Each electoral district had between 17 to 50 voting centres that were then set up from the election managers' offices. Some of the numbers in terms of delivery’s made to election managers' offices included:

- 3,999 furniture items, including 279 desks, 1,395 chairs, 2,325 trestle tables and 837 cardboard tables;
- 2,500 computers, 82,995 pens with string and 335,340 bulldog clips:
- 987,000 forms and other materials including stationery kits and first aid kits;
- 930 canvas ballot boxes, 1,200 new plastic ballot boxes and 15,843 cardboard ballot boxes;
- 46,400 new cardboard items including signs, voting screens and recycle bins;
- 80,850 seals to secure ballot boxes and other electoral material; and importantly, 93 kettles!

The Electoral Commission also set up a call centre in Sydney for elector enquiries prior to the election. This call centre was staffed by up to 100 customer service officers by election day, responding to about 170,000 phone calls over a two (2) month period.

After the election, decommissioning the election venues is also a significant event and takes up to two weeks to complete. As I say, its big business that the NSW Electoral Commission does very well, especially when you consider some of the calamities that take place during elections at various other countries throughout the world.

Bourke Show

Its "full steam ahead" by the hard-working Committee who organise the annual Bourke Agricultural Show. This year, the Show will be held on Saturday 6 May 2023 at the very much improved Renshaw Grounds. I have felt for the Committee in recent years with the Show having to be cancelled in 2019 due to the drought and then again in 2020 due to COVID. A most successful show was back on in 2021 but then in 2022 was again cancelled, this time due to wet weather. As a cornerstone of Bourke's calendar since 1874, the work that goes into organising the annual Bourke Agricultural Show is significant. With the cancellation of the Show last year, the Committee determined that sponsorship from the cancelled Show in 2022 had been rolled over to this year's event. The Committee has recently written to its sponsors confirming this roll over and confirming sponsorship entitlements based on the 2022 level of sponsorship and seeking information in respect of trade space requirements. Events such as the Bourke Agricultural Show simply don't go ahead without their sponsors and I thank the various businesses who regularly step up to assist with not only the Show, but also so many community events. In a small community, it is invariably the same people or businesses that support these various events.

Quote: **"My message to people of this state is that we will govern for all of NSW. That's what people expect and deserve."** NSW Premier, Chris Minns after being sworn in as the 47th Premier of NSW.

13 April 2023

Easter Festival Visitors

Another successful Back O' Bourke Easter Festival has come and gone. With absolutely beautiful weather across the entire weekend, the 2023 Festival was another great success. Events such as the Festival, however, just don't happen. From the initial activity at 9.00am on Good Friday morning, being Paul Roe and his Cemetery Tour, followed closely by the ever-popular Easter Colour run, the ever-popular Rams v Barbarians Rugby Game on Saturday, through to the Back O' Bourke Race Club – Harry Hart Memorial Picnic Races on Sunday and then the last Jandra Paddleboat cruise on mid Easter Monday afternoon, and an absolute myriad of other events over the weekend, so many people just pitch in to make sure the weekend is a success. To the many volunteers who assist in great numbers, a wholesome thank you. To the Council staff who worked hard to ensure our town was extra "clean-n-tidy" for the weekend and for undertaking the important behind the scene jobs like delivering a caravan here, chairs there, installing a PA at an event, making sure road detour signs are in place, closing streets, picking up rubbish post events, driving water trucks to spray colour run participants, organising buses, cleaning toilets, attempting to maintain some sort of order at the Easter Egg Hunt, and so on and so on, thank you to everyone involved.

Operational Plan Exhibition

Don't forget that Councils draft 2023/2024 Operational Plan (the budget) and associated documentation is currently on exhibition until 5.00pm Monday, 1 May 2023. The Plan is available for viewing at Councils Website (www.bourke.nsw.gov.au) with a copy also available at the Council offices in Mitchell St, Bourke. Council is required to have considered any submissions received prior to adopting its annual Operational Plan. Such considerations will take place when a report on submissions is presented to Councils 22 May 2023 Ordinary Meeting. So, if you wish to have your say about where Council is proposing to spend funds for the upcoming new financial year, for consideration by Council, now is your opportunity.

Fire season extended

I note that the NSW Rural Fire Service (RFS) has announced that with an increased risk of grass fires continuing across large parts of the state, the bush fire danger period has been extended in 44 local government areas across NSW. In this regard the danger period in the Bourke LGA has been extended for a further month till the end of April 2023. The danger periods have also been extended in the adjoining LGA's of Brewarrina, Central Darling, Cobar and the Unincorporated Area to the west.

In announcing the extension, RFS Commissioner, Rob Rogers, made comment regarding the high fuel loads and warmer than average temperatures that currently exist across the State. He stated that "In March alone, firefighters have worked on more than 850 bush and grass fires burning over 66,000 hectares," noting further that "Fire activity in March accounted for almost 50% of the hectares burnt across the whole fire season".

Given the extension of the Bush Fire Danger Period in the Bourke Shire, fire permits are still required If you are planning to light a fire in the open during this extended time. In addition to a Permit being issued, you must notify neighbours and local fire authorities 24 hours before lighting up. With the prevailing dry conditions, it is vital when conducting a burn on your property it is safe to do so and make sure that you comply with the rules, even if you have conducted burns on your property for years. Please don't be a fire risk to our community, know your obligations if conducting burns and know the costs if you do the wrong thing, but most importantly, if a fire does get out of hand, make sure you report it immediately to Triple Zero (000).

A point made by Commissioner Rogers that I found most interesting related to people preparing their property in the event of bush and grass fires. In this regard, the Commissioner advised that RFS commissioned research shows that only one in two people in NSW had taken action to undertake the necessary preparations in response to the threat of bush and grass fire. I would urge all landholders and residents of the need to have a well-prepared property and importantly discuss their bush fire survival plan and know what they'll do if threatened by fire.

Roads to Recovery Funding

With Bourke Shire covering a large area of 41,679 km^2, roads are a significant areas of expenditure for Council. In 2018-19, councils across Australia spent $8.3 billion on transport, primarily on roads. Whilst some road maintenance funding in Bourke is provided from the council's limited rate base, Council is very much reliant upon road funding provided by the Commonwealth and NSW governments. Unlike these levels of government, councils have no direct mechanisms to raise funds for road construction and maintenance such as road user charges, registration charges, or any road- or transport-related fees or charges. To this end, the Commonwealth Governments major roads program is known as the Roads to Recovery (R2R) Program.

This program was introduced by the Commonwealth Government as part of its 2001/2002 Federal Budget. It was the result of an extended campaign by the Australian Local Government Association (ALGA) to seek funding from Federal Authorities to help councils address the maintenance backlog on local roads. In this regard councils had done a comprehensive body of work detailing what roads they had, there asset value, there life cycle and what funding was required to maintain them. The maintenance numbers were scary and well outside council's ability to fund them to achieve full asset maintenance. Faced with this data, some councils actually took the decision to return some of their potholed bitumen sealed local roads back to gravel to address the now identified funding shortfall. It was then Deputy Prime Minister, the Hon John Anderson who made the announcement as part of the Commonwealth Governments 2001/2002 Budget that all councils across the nation would receive R2R funding, with councils given the "discretion to determine their own road funding priorities."

I don't have total funding provided to councils since the inception of R2R in 2001. However, between the 2013/2014 financial year to the 2023/2024 financial years the Commonwealth Government will have provided $6.2 billion funding to local councils. I do know that in the initial year of the program (2001/2002), Bourke Shire received funding of $758,000. Councils allocation in 2023/2024 will be some $1.2m. In addition, in the past two (2) financial year's, Council has received additional funding totalling $1.2m as part of the Drought Communities Programme Extension.

As good as R2R continues to be, ALGA works hard with the Commonwealth Government for required levels of funding. From a study released in 2010 into local road funding, it was estimated that to simply maintain, rather than improve Australia's local roads, up to 2025, an additional $1.2 billion annually is required. As stated by ALGA, "without this additional funding, underinvestment in local roads will continue. This funding shortfall hinders local and regional social and economic development, and ultimately affects the development and productivity of the nation." ALGA has recently called for the Federal Government to increase R2R funding by $300 million per annum.

Bourke & District Cricket Association

Congratulations are extended to the Louth Cricket Club 1st XI, who recently took out the Bourke and District Cricket Association Competition 2022/2023 Season Grand Final against the Two Waterholes side. After batting first, Louth scored an impressive 152 runs with Will Mitchell top scoring with a solid, and ultimately, a match winning knock of 61. Louth then proceeded to bowl Two Waterholes out for 147 needing all their skills in the field to avoid Waterholes reaching the 153 runs required to win. Andrew Bell finished with figures of 4/7 off 7 overs. Played at the picturesque North Bourke Oval, it was a great day for Bourke Cricket with a big crowd, including many kids, on hand to witness a game played in the right spirit honouring the traditions of cricket. At the end of the game, both sides had a barbecue and drinks together. It was great to witness the comradery and a great way for the season to finish on. To Louth's credit, it was their first premiership since 2008, a spell of 15 year's. Congratulations to all concerned for a most successful day.

Quote: **"Effective from day one of term 4 this year, there will be a compulsory ban on phones in NSW high schools."** Recently elected NSW Premier, Chris Minns - insisting that young people would be at risk of declining educational results without such a mobile phone ban.

20 April 2023

Big Sky Country

Under the heading of "Big Sky Country", I was delighted to come across and subsequently read a two (2) page review by a Steve Madgwick of his stay at Trilby Station at Louth, in the Easter Sunday edition of the widely read Sunday Telegraph. With various forms of accommodation including self-contained cottages, campsites and powered caravan sites, the author, understandably, was full of praise for what Gary and Liz Murray do at their 130,000 ha Station. Apart from being most complimentary of Liz's home cooking and the quality of the accommodation, the author was in awe of the sheer size and openness of Trilby Station. As part of the article, the author recounts a story from Liz where a "German guest once asked her to drive him out to the middle of the property and just leave him there." Liz said to the visitor, "what do you want me to do that for? He said, 'in Germany, it's all people, mountains and light pollution – this is what I'm looking for'."

Well done to Liz and Gary on being part of such a widely distributed publication. In doing so, such articles promote our wider region as we continue to ensure tourists are aware of the beauty of outback NSW. Obviously, Gary and Liz aren't the only operators to provide farm stays in the region. In this regard, as we see the number of caravaners and campers already increasing for our 2023 season, I wish all involved in our tourism sector, the very best for a successful season. Whilst I know of numerous locals who regularly travel to the likes of Trilby Station just to get away for a weekend, as residents, we possibly often forget what we have in our own back yard. To assist, staff at the Back O' Bourke Exhibition Centre would be delighted to assist locals with information, the same as they do for our many tourists.

Operational Plan Exhibition

Time is running out if you wish to make a submission in respect of Councils draft 2023/2024 Operational Plan (the budget) and associated documentation which is currently on exhibition until 5.00pm Monday, 1 May 2023. The Plan is available for viewing at Councils Website (www.bourke.nsw.gov.au) with a copy also available at the Council offices in Mitchell St, Bourke. Council is required to have considered any submissions received prior to adopting its annual Operational Plan. Such considerations will take place when a report on submissions is presented to Councils 22 May 2023 Ordinary Meeting. So, if you wish to have your say about where Council is proposing to spend funds for the upcoming financial year, for consideration by Council, now is your opportunity.

Road Funding

Following the recent NSW State Election and the subsequent determination of Ministerial portfolios, Mayor Barry took the opportunity to write to the new Minister for Regional Transport and Roads, the Hon. Jenny Aitchison MP, on various road matters relating to the Bourke Shire. With Bourke's landscape being vast and beautiful, Mayor Barry advised that Councils vision was for our landscape to be witnessed by as many people as possible travelling on safe and accessible roads.

Barry recounted that funding assistance from successive State and Federal Governments had enabled Council to reconstruct and seal dirt roads that were once near undrivable at times. In this regard, the Bourke – Wanaaring Road, which was once a 190km bone jarring five (5) to six (6) hour journey will in coming months, with the completion of the current round of works, be sealed for all but 13 kilometres of this once horrendous road. Road works such as the Wanaaring Road have opened up areas of Far North West NSW to a wider visitor base. In addition, and importantly, the sealing of this, and other roads, have simply changed the life of many of our residents who live along these roads, in a most positive way. The Mayor sought from the Minister the continuation of programs that allow for the sealing of roads in remote areas. Naturally, Mayor Barry sought funding that would allow for the final 13 kilometres of the Wanaaring Road to be sealed.

As all locals would be aware, during the peak flows of the floods in November/December 2022, access to Bourke via the Mitchell Highway (south of Bourke), the Kamilaroi Highway (east of Bourke) and via the Kidman Way (south west of Bourke towards Cobar), were all cut and closed for an extended duration. Whilst not only significantly impacting travelling locals and the provision of products both into/out of our community, the closure of these roads impacted the freight task in terms of inland Melbourne to Darwin traffic. Light and heavy vehicles had to travel many extra hundreds of kilometres to achieve their required destinations. Council continues to undertake repair works to these Highways as part of its Road Maintenance Council Contract (RMCC) with Transport for NSW (TfNSW). In addition, Council officers have commenced discussions with TfNSW Officers regarding the potential raising of a portion of the Mitchell Highway, south of Bourke, such that the highway is not cut, except perhaps in the most extreme of floods greater than a 1:100 year event. Mayor Barry in writing to the Minister bought these important discussions to the attention of the Minister.

Speed Signage

I would advise motorists that where highways or local roads have been damaged and have yet to be repaired or are currently in the process of being repaired, the identified speed signage at the relevant location is enforceable and is enforced by NSW Police. If the roadworks speed sign says 40 km/h and it’s 7.00pm in the evening and there is not a worker in sight, the speed limit is still 40 km/h. I make this comment off the back of social media by the Traffic and Highway Patrol Command of the NSW Police Force over Easter after a Road Train travelling west on the Kamilaroi Highway near Bourke was detected travelling at 95 km/h in a signposted 40 km/h zone. The 51-year-old male driver from Perth was stopped and issued a $3966 penalty notice and instantly lost 12 demerit points, given double demerits being applicable over the Easter Weekend. His driving privileges in New South Wales were also immediately suspended for a period of six months. Not a good outcome, especially when you come from Perth. I again reiterate however, that speed signs are regulatory signs and under the current requirements of the NSW Traffic Act, drivers must not drive faster than the limit shown on the sign.

During the recent NSW Election campaign, now Premier, Chris Minns, advised that a Labor Government, will amend legislation such that roads subject to temporary speed limits due to construction work, will return to normal outside of construction hours, where safe to do so. At this point, this legislation has yet to be forthcoming, so nothing has as yet changed.

The Cut Line

Further west of Bourke, in the unincorporated area of NSW, is a currently unsealed road called the Cut Line. This road links Wanaaring with Tibooburra, all but 140 kilometres from Cameron’s Corner in the Sturt National Park. Council has previously provided letters of support to TfNSW as part of its endeavours to secure funding for the sealing of this 234km section of road. With the road from Broken Hill – Tibooburra now fully sealed and tourists making use of the road and experiencing corner country, the sealing of the Cut Line would allow an alternative route, via Bourke, for travellers wishing to experience the arid far north western corner of NSW. Travel to Tibooburra via Broken Hill and return via Bourke, or vice-versa. Whilst funding for this road has not as yet been forthcoming, Mayor Barry, in writing to the new Regional Roads Minister, also took the opportunity to confirm Councils position in respect of this potential project. With various and beautiful National Parks surrounding Bourke, a sealed Cut Line road would undoubtedly bring larger tourist numbers to the far west and far north west regions of NSW.

Quote: **"I can confirm that China has agreed to undertake an expedited review of the duties imposed on Australian barley over a three-month period, which may extend to a fourth if required."** Foreign Minister Penny Wong in response to China agreeing to fast-track a review of trade bans on Australian barley exports.

Recommendation

That the information in the General Manager's Activity Report as presented to Council on Monday, 24 April 2023 be noted.

21.5 LIBRARY MANAGER'S ACTIVITY REPORT FOR MARCH 2023

File Number: L4.1

Author: Jodi Hatch, Library Manager

Authoriser: Melanie Milgate, Manager Economic Development

Attachments: Nil

Current Situation

The following items for the March 2022 – March 2023 period are presented for information.

Item	March 2022	March 2023
Loans	569	864
New Members	10	13
Internet/Word Processing	26	52
Wireless Tickets	8	7
Number of Visitors	456	521
Scans	25	19
Information Requests	61	54
Technical Assistance / Printing	82	44
Faxes/ Laminating	5	4

- March was another busy month in the Library with various activities such as Code Club, LEGO Club, Kid's Craft and Online Trivia undertaken. Craft was celebrating St Patricks Day, and the children had a great time making leprechauns and rainbows with a pot of gold.

- Jodi and Bronwyn attended the Bourke High School and held information sessions with Year 7-12 students. The students particularly enjoyed the Kahoot trivia session to test their knowledge of the Library and its services. All the students received a bag with information about the Library.

- Library staff attended the Welcome to Bourke evening held on 16 March 2023 taking the opportunity to talk to many new community members about what the Library had to offer.

- The library had a visit from Geoscience Australia in March. There were 8 people who attended the session with the scientists very happy with the enthusiastic reception they received.

Recommendation

That the information in the Library Manager's Report for March 2023 as presented to Council on Monday, 24 April 2023 be noted.

21.6 TOURISM AND EVENTS REPORT

File Number: **T4.3**

Author: **Ben Nott, Coordinator Tourism Operations**

Authoriser: **Melanie Milgate, Manager Economic Development**

Attachments: **1. BOBEC Statistics March 2023 ⇩**
2. BOBEC Website Statistics March 2023 ⇩

Background

The Bourke Shire Councils Tourism and Events report provides Council with an updated status report for March 2023, relating to its tourism team's activities through visual data including graphs and statistics to allow for the measurement of the team's progress and performance.

Current Situation

Welcome to Bourke

On Wednesday, 15 March 2023, Bourke Shire Council hosted the Welcome to Bourke evening in the grounds of the Back O' Bourke Exhibition Centre. Mayor Hollman and Council staff welcomed more than 45 new residents to our community. The tourism staff greeted guests with cold drinks and sensational food. All new residents to Bourke received a welcome gift bag including a Back O' Bourke cap, a bottle of Bourke's local favourite soft drink Splashe Cola, along with information and flyers from community groups and sporting organisations. The evening also welcomed members of local clubs and groups along with the Historic Car Club of Bourke.

PV Jandra

After an extended period of hibernation due to flood waters, which resulted in both high water and strong currents, the PV Jandra returned to the Darling River, on 27 March 2023, just in time for our Easter visitors. Bourke Shire Council's tourism team welcomes Captain Stephen Coad aboard the vessel for the upcoming season. Captain Coad is from Murray Bridge in South Australia and was very much looking forward to returning to the beautiful Darling River. Council Staff and contractors worked together to get the vessel ready for its first voyage since Easter Monday 2022, when flood waters initially rose for 2022.

<u>Easter Festival – 7-10 April 2023</u>

Tourism and Events continue to plan and organise for what is hoped to be another successful Back O' Bourke Easter Festival. March update sees the;

The Good Friday, Back O' Bourke Billabong Sessions to be held at the Back O' Bourke Exhibition Centre in the Café gardens. Live performances featuring Kevin Sullivan – "The Sulli- Vans" as seen on The Voice and supporting act by Kora Naughton. The Back O' Bourke Cafe will be operating. Lowes Bus Company will provide a complimentary service to all wanting to attend. This event encourages families and friends to head out to the Centre for an afternoon of live music. BYO food and drinks are welcomed.

Saturday morning plans for 2023 will see the Easter Markets return to the Wally Mitchell Wharf Precinct on Easter Saturday morning.

The Bourke Historic Car Club Inc. will host a car display around the wharf gardens. Andrew Lewis will display his numerous vintage farm machinery throughout Mitchell Street from the Men's Shed to the Council Chambers. The markets commence from 9am, and it is anticipated that the markets will again be very popular with a lot of enquiries taken at the Exhibition Centre for an application form.

On Saturday morning the Bourke Rotary Club will conduct the Back O' Bourke Wool Bale Rolling Competition. The new location in Sturt Street will welcome Market Holders to Darling Park and the Wharf precinct. To date 17 stall holders have confirmed attendance for the Markets.

Businesses in Oxley Street will operate during the morning with visitors encouraged to shop local before the Wool bale rolling competition kicks off in Sturt Street at 10:30am.

On Easter Sunday the popular Giant Easter Egg Hunt will be held at the Back O' Bourke Exhibition Centre gardens again commencing from 8am. Following on from the success over the past four years, this year eggs and prizes are again valued at $5000 that will be available for a nominal fee of $5 per child. We anticipate numbers to increase this year as enquiries for registering children are beginning to occur. All children will need to be accompanied by an adult.

The feature event of the weekend is the Back O' Bourke Races on Easter Sunday and will kick off from 12pm. Always a popular event amongst the community and a major drawcard in attracting visitors to the region.

Over the weekend the Jandra Paddleboat is scheduled to operate Good Friday, Easter Saturday, Easter Sunday, and Easter Monday.

Back again this year is our local historian Paul Roe providing commentary on the Jandra and conducting Cemetery Tours. Operating over the weekend from 9am, the cemetery tours are a very personal experience that details the lives of some of the characters buried in the Bourke cemetery. Paul will also be conducting tours through the Back O' Bourke Exhibition Centre 3pm daily Friday, Saturday and Sunday.

Back O' Bourke Information and Exhibition Centre

Performance Indicator	February 2023	March 2023	% Difference
Vend Turnover	$26,090.00	$40,186.95	+ 35.0%
Visitor Numbers	557	1006	+ 80.6%
Email Enquiries	227	385	+ 69.6%
Incoming Calls	382	487	+ 27.5%
Website Enquiries	857	961	+ 12.1%
Exhibition Tickets	63	226	+72.0%
Café Turnover	$19,200.50	$24,864.50	+ 29.5%
Functions	6	5	+ 17.0%
My Oxley Tickets	0	0	
Tour Groups	0	3	+ 300%

- BOBEC continued operations 7 days per week in March 2023 in both the Café and Exhibition Centre with opening hours Monday to Friday being 9.00am to 5.00pm and 9.00am to 2.00pm on weekends;
- Vend turnover in March 2023 was $40,186.95 compared to $26,090.00 in February 2023, which is an increase of 35%.
- Visitor numbers for March 2023 were 1006 compared to 557 in February 2023 which is an increase of 80.6%;
- Email enquiries for March 2023 were 385 compared to 227 in February 2023 which is an increase of 69.6%;
- Incoming calls for March 2023 were 487 compared to 382 in February 2023 which is an increase of 27.5%;
- Statistics are attached for Website enquiries in March 2023;
- The PV Jandra commenced the 2023 season on 30 March 2023 under Captain, Steve Coad. There were 27 people booked on the Jandra in the first two (2) days of operation. The Jandra will provide 13 scheduled cruises per week.
- Exhibition Centre tickets sold in March 2023 were 226 compared to 63 tickets sold in February 2023, an increase of 72%;
- There were no tickets sold to Mt Oxley in March 2023 with the attraction remaining closed to the public;
- Café turn over in March 2023 was $24,864.50 compared to $19,200.50 in February 2023, an increase of 29.5%. Compared to March 2022 turnover increased by 78% in March 2023.

Maintenance on the Crossley Engine is almost completed with one (1) engine pulled down, serviced and reassembled. The Crossley Engine is expected to be operational at Easter. This year is the engines 100th Birthday.

The Back O' Bourke Information Centre garden staff were kept busy in March 2023 maintaining the gardens and preparing for the Easter weekend activities.

The Café and Information Centre had another good month thanks to the support of local people, with Sundays proving to be the busiest day of the week. Staff have enjoyed the additional catering for events and community groups. Thanks to staff for their hard work around the Centre.

The Centre had seven (7) function bookings during March 2023, three (3) of which were catered for by BOBEC staff. There were three (3) tour group bookings during March 2023.

Financial Year to date turnover to end of March 2023 was $415,137.54 (ex GST), the café contributed $209,351.49 of the total amount. This is an increase of 122% when compared to March 2022.

Visitor Numbers to the Back O' Bourke Tourist and Information Centre

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Jan	448	560	325	326	302	348	386	782	1109	816	603	609
Feb	157	397	271	373	391	220	282	1043	386	630	725	557
Mar	570	1500	1051	1342	1612	1245	1274	1021	412	1389	1100	1006
April	2144	3103	3146	3849	3118	3114	4024	3166	0	2387	2323	
May	2891	3758	3988	4602	4073	3983	4770	3693	0	2564	2016	
June	3216	4492	4275	5437	5199	4754	5634	4490	993	2366	2227	
July	4643	5173	6241	6002	5941	5982	7614	6834	2570	1068	2998	
Aug	4162	4410	4793	5078	4951	5051	5548	4052	1898	255	2557	
Sep	5074	4275	4764	4489	4532	4246	4676	3601	3325	0	2203	
Oct	3967	2383	2486	2370	2475	2463	3574	2222	5246	409	1094	
Nov	930	789	671	610	1031	876	1014	1220	1989	866	710	
Dec	347	207	242	272	281	255	630	860	1194	897	586	
Total	27649	31044	32253	34750	33906	32537	39454	32984	19122	13647	19142	

Financial Implications

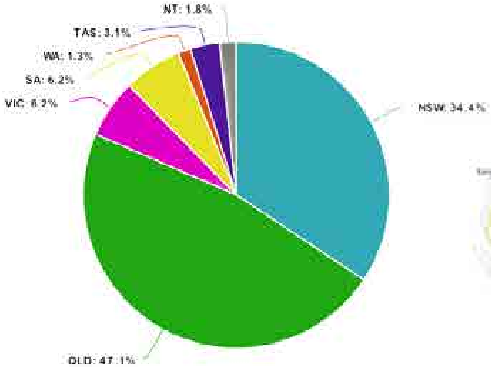
There are no financial implications.

Recommendation

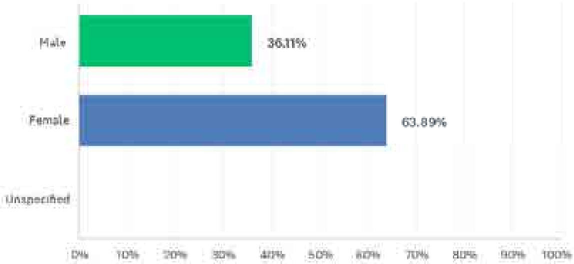
That the information in the Tourism and Events Managers Report for March 2023 as presented to Council on Monday, 24 April 2023 be noted.

MARCH STATISTICS 2023

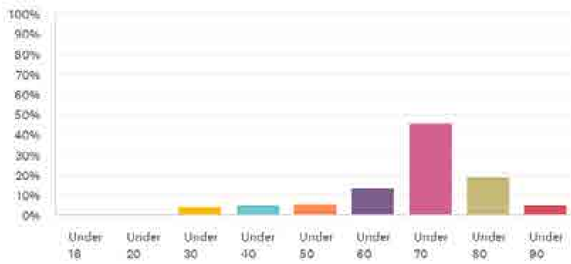
WHAT IS YOUR HOME POSTCODE?



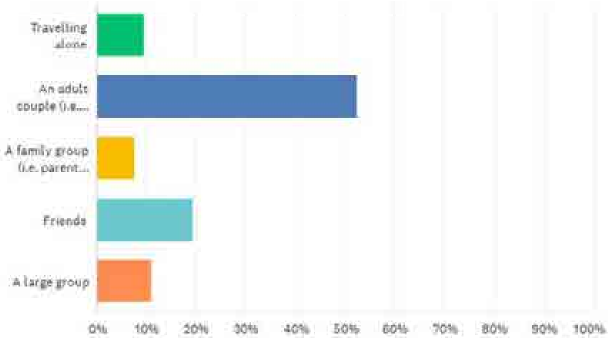
ARE YOU MALE OR FEMALE?



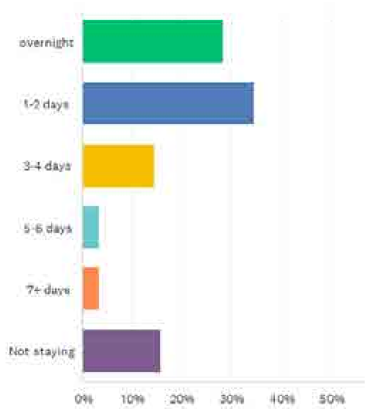
WHAT IS YOUR AGE?



HOW WOULD YOU DESCRIBE YOUR IMMEDIATE TRAVEL PARTY?

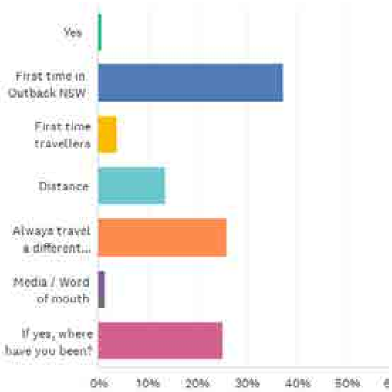


HOW LONG ARE YOU STAYING FOR?

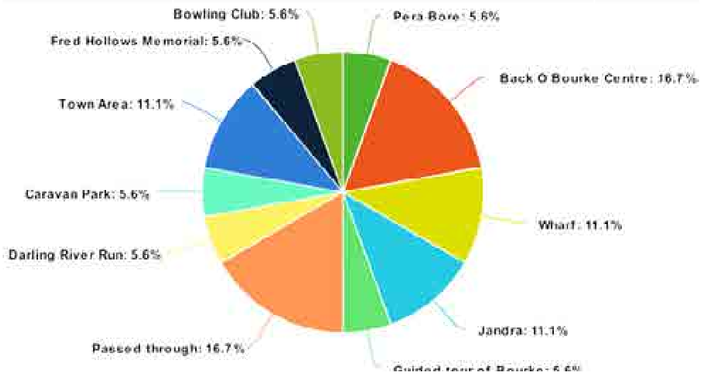


MARCH STATISTICS 2023

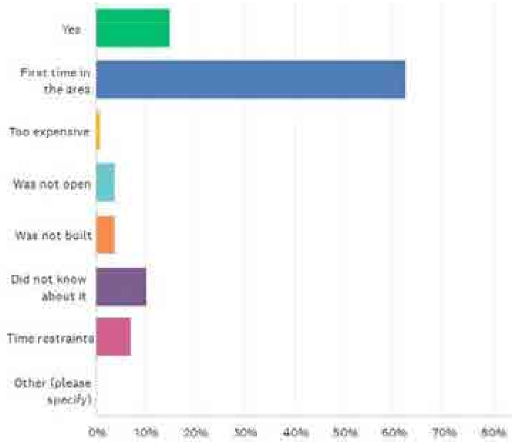
HAVE YOU BEEN TO BOURKE BEFORE?



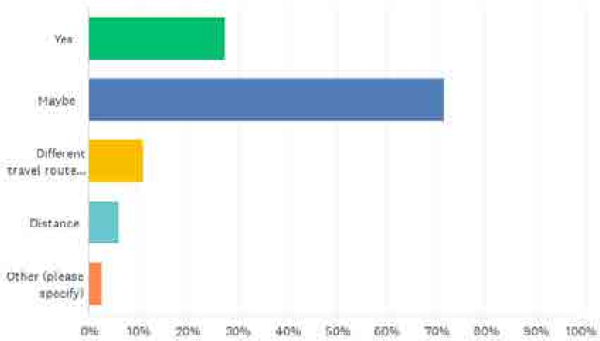
IF YES, WHERE HAVE YOU BEEN?



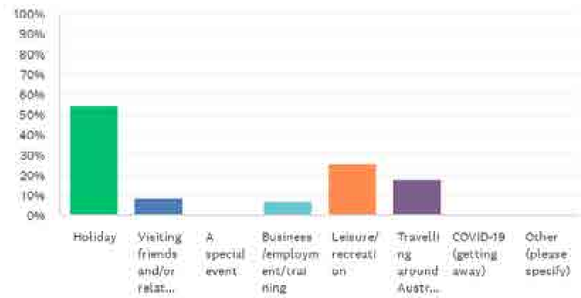
HAVE YOU BEEN THROUGH BACK O BOURKE CENTRE?



WILL YOU BE RETURNING TO BOURKE?



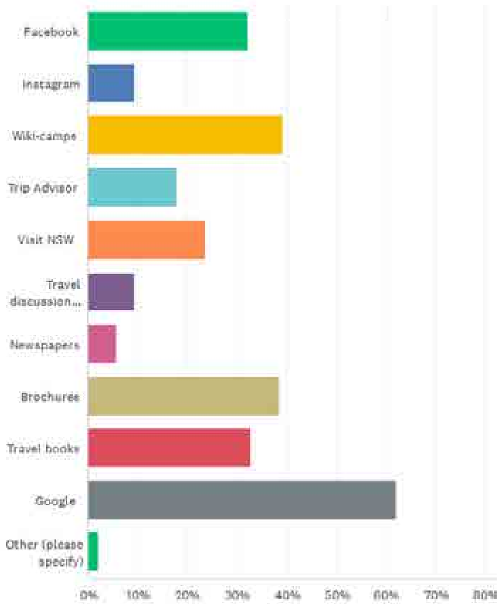
WHAT IS THE PURPOSE OF YOUR TRIP?



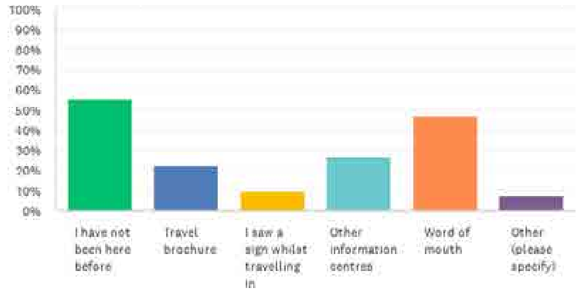
HOW LONG AGO DID YOU PLAN FOR THIS TRIP?

MARCH STATISTICS 2023

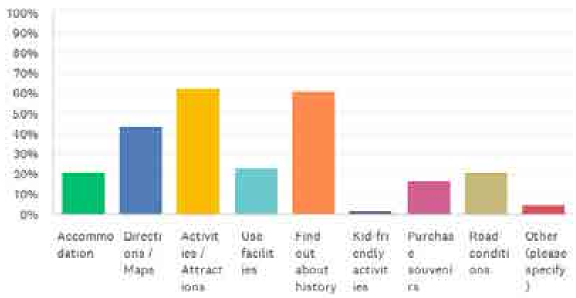
WHAT FORMS OF MEDIA DO YOU USE TO FIND INFORMATION?



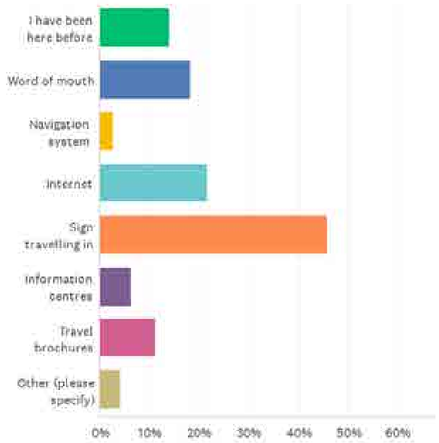
WHAT DETERMINES YOUR DECISION AS TO WHERE TO GO?



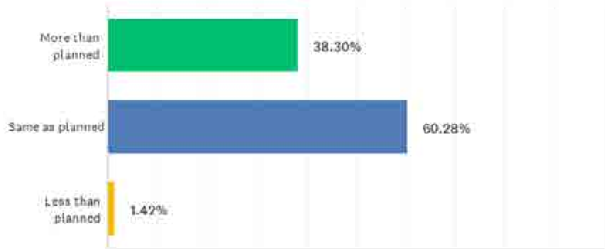
WHAT INFORMATION ARE YOU LOOKING FOR AT THE INFORMATION CENTRE?



HOW DID YOU FIND OUT ABOUT THIS INFORMATION CENTRE?

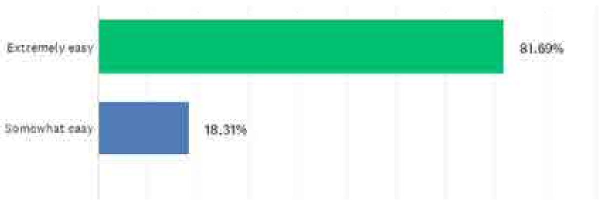


HOW DO YOU THINK THE INFORMATION THAT YOU GAINED FROM THE CENTRE MIGHT INFLUENCE HOW LONG YOU STAY AND THE ACTIVITIES YOU DO?

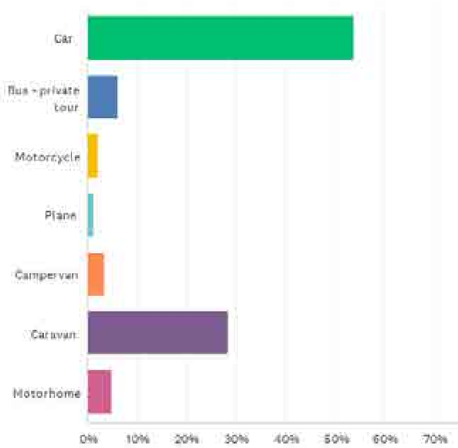


MARCH STATISTICS 2023

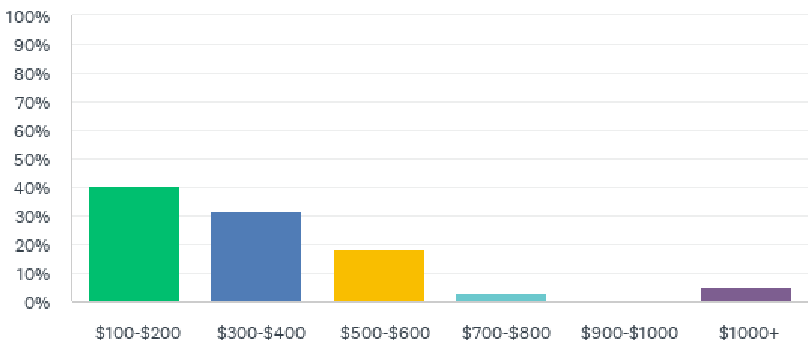
IN YOUR OPINION, HOW EASY WAS IT TO FIND OUR LOCATION?



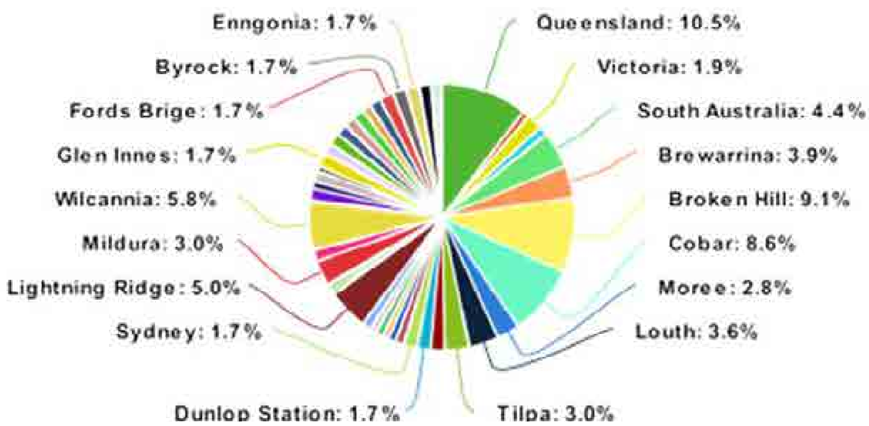
HOW DID YOU TRAVEL TO BOURKE?



OVER THE ENTIRE STAY IN BOURKE, HOW MUCH IN TOTAL, INCLUDING ACCOMMODATION, DO YOU ESTIMATE YOU HAVE/WILL SPEND IN AUSTRALIAN DOLLARS?

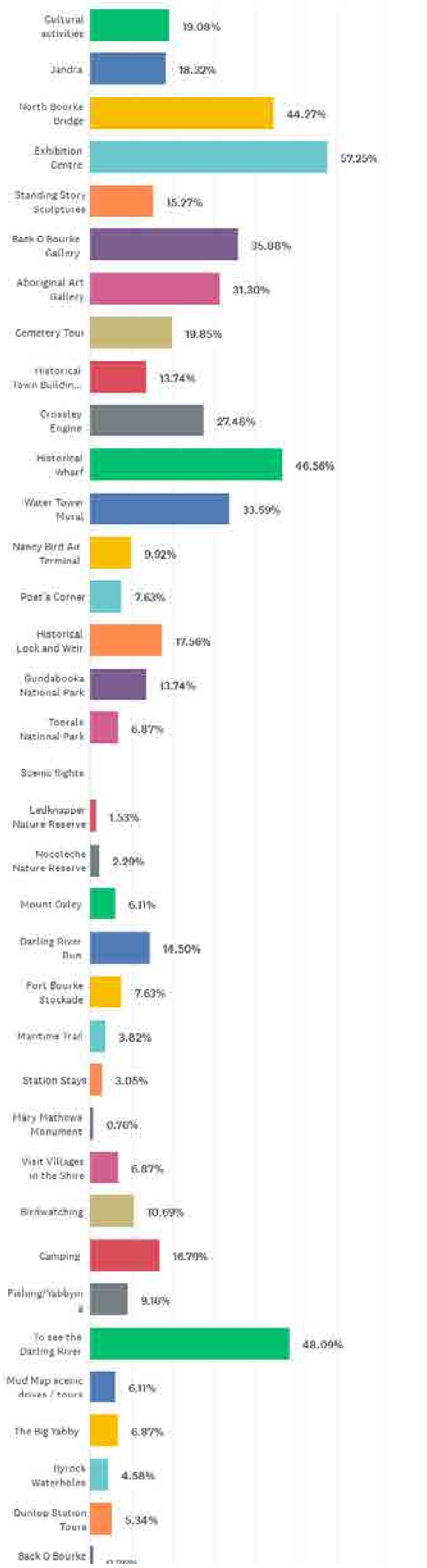


?



MARCH STATISTICS 2023

WHAT ACTIVITIES HAVE YOU DONE OR PLAN TO DO DURING YOUR STAY?



MARCH STATISTICS 2023

PLEASE LET US KNOW ABOUT ANY FEEDBACK YOU MAY HAVE REGARDING YOUR STAY

- “such friendly staff. So appreciated”
- “ok”
- “nice info centre, friendly staff”
- “nice and hot, pleasant quiet town”
- “I really enjoy visiting the visitors centre”
- “amongst our research we had heard Bourke was less safe than some other surrounding towns. This has us reduce our stay, as we have small children and wanted to be careful. We had no negative experiences here though”
- “helpful staff at info centre”
- “spray the weeds & burrs at attractions and stops”
- “all good”
- “all good”
- “lovely friendly town with great facilities! Thank you ☺”
- “staff very helpful & very friendly”
- “paddle steamer not running ☹”
- “centre was listed to be open till 4pm but closed before 2:25pm Saturday. Telephone message bank was full”
- “very friendly staff”
- “no complaints. Enjoying the experience”
- “love the country. Wonderful to see after the drought has ended”
- “air-condition the town”
- “lovely staff”
- “very friendly staff”
- “handcrafts not necessarily Aboriginal op shops”
- “all great”
- “very pleasant + friendly + helpful reception. Frances is exceptional”
- “lovely welcome + information”
- “love it here – we met Glenn McGrath!!!”
- “love Bourke and its people”
- “good and safe”
- “the coffee and cake was excellent. Staff friendly and helpful. The information centre was excellent. Local products as souvenirs – Very good!”
- “we went to the historic maritime port of Bourke on the other side of the river signs were faded and just a track it would have been nice to be able to read about it”
- “great service at info centre. Friendly staff, great ice coffee – lactose free and toasted sandwich were very nice. Great information!!”
- “staff at info centre were good and polite and knowledgeable”
- “I think the initiative to promote the “baaka Bourke” theme works extremely well. Love the Kidmans camp caravan and camping park”
- “fabulous time in the outback. Very friendly people”
- “lots of things closed – art gallery. Or not running – river trip. Or unable to do because we are travelling in 2 large motorhomes with 2 dogs. Alex, girl in info centre was very nice and helpful”

MARCH STATISTICS 2023

- “more info on re-open times/seasons of activities and if they are dog friendly. Lovely coffee @cooee for coffee and lunch, very friendly staff! Great friendly lady called Alex at info centre was very helpful thank you”
- “information staff excellent”
- “lovely lunch and café ☺. Great people in the café and behind the desk”
- “the staff (reception & café) were very welcoming. The coffee was amazing! Many thanks for such a wonderful family experience”
- “loved the place. Girls @ reception very friendly and informative. Great coffee and service from café”
- “not staying. Alex was terrific, very knowledgeable and great personality”
- “having passed through 6 or 7 times this is the first time I’ve stopped for a look. It’s really a lovely clean oasis, with very lovely locals. I stopped here for the Darling history”
- “The lovely girl on reception Briana is so helpful, friendly and has great knowledge of the area. Keep her she is an asset”
- “really enjoyed our visit to the back o Bourke information centre and gallery. Very helpful and knowledgeable staff. Thank you”
- “excellent information centre and staff”
- “great kiosk and helpful information staff. Pleasant staff”
- “all good”
- “great staff very welcoming and very informative”
- “only just got here” x2
- “friendly staff”
- “beautiful town, looking healthy and green”
- “there are limited eateries. The town seems almost deserted a lot of the time. Some terrific facilities, e.g. swimming pool, local radio station/newspaper. Can sense the town is struggling but working to keep its head up!”
- “Loved it – will be back!”
- “excellent info and staff”
- “great kiosk and helpful information staff. Pleasant staff”
- “great staff very welcoming and very informative”
- “beautiful town, looking healthy and green”
- “friendly staff”
- “really friendly & helpful staff, knowledgeable BOB centre. Very good plantings and landscape generally. Good coffee at BOB centre”
- “clean town”
- “hard to find info on good accommodation and station stays”
- “the centre is going to be wonderful when finished. We enjoyed our visit and can see the possible outcome of the reno”
- “no back o bourke centre signage on the highway”

BOBEC Website Statistics March 2023

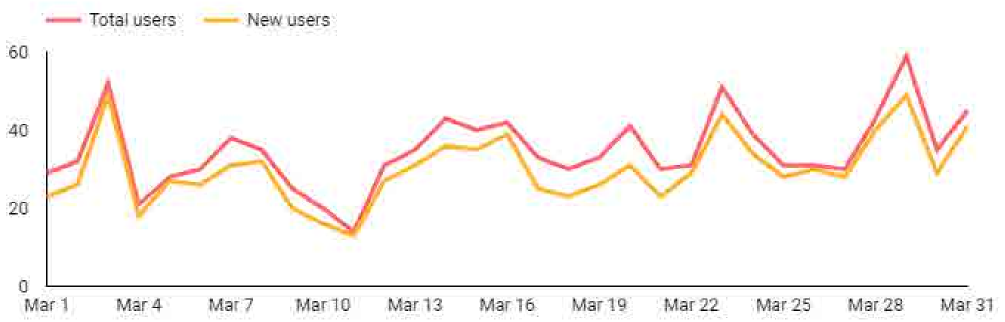
Total users	New users	Sessions per user	Page views	Conversions
961.0	929.0	1.3	4K	188
↑ 12.1%	↑ 9.0%	↑ 4.9%	↓ -0.2%	↑ 67.9%

Device category

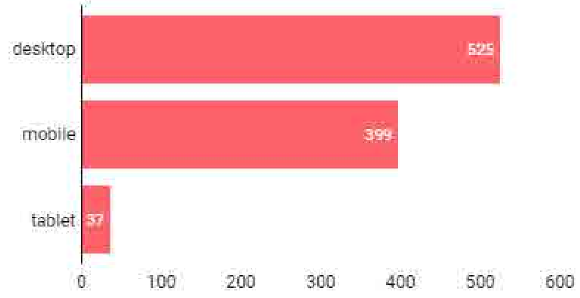
Country

User source / medium

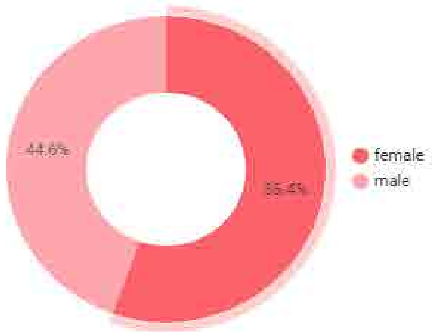
Total users



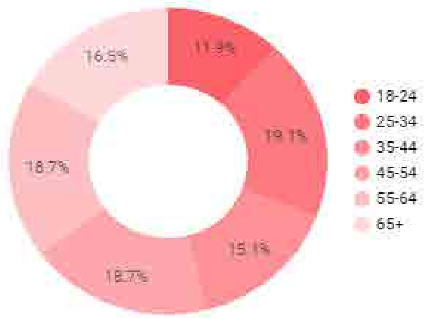
Users by Device category



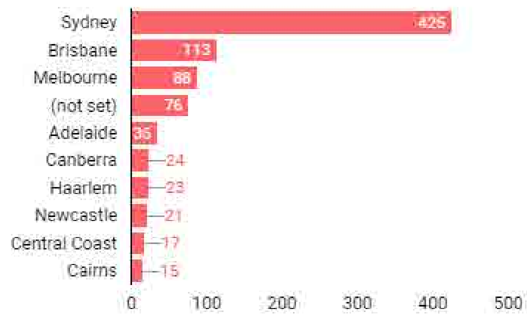
Users by Gender



Users by Age



Users by City



22 CLOSED SESSION

Recommendation

That Council considers the confidential report(s) listed below in a meeting closed to the public in accordance with Section 10A(2) of the Local Government Act 1993:

22.1 * Tender (05/23) - Management of the Bourke War Memorial Olympic Swimming Pool**

This matter is considered to be confidential under Section 10A(2) - (d)(i) of the Local Government Act, and the Council is satisfied that discussion of this matter in an open meeting would, on balance, be contrary to the public interest as it deals with commercial information of a confidential nature that would, if disclosed prejudice the commercial position of the person who supplied it.