Business Papers 2021

MID-WESTERN REGIONAL COUNCIL

ORDINARY MEETING
WEDNESDAY 17 MARCH 2021

SEPARATELY ATTACHED ATTACHMENTS

A prosperous and progressive community we proudly call home

Mid-Western Regional Council

ATTACHMENTS

PROPOSED SUBDIVISION

400 CASTLEREAGH HWY, MUDGEE, NSW, 2850

CIVIL DRAWINGS

LIST OF DRAWINGS

LOCALITY PLAN
SCALE 1:5000 AT A1

ARCHITECT

ISSUED FOR DEVELOPMENT APPLICATION	13/02/20	B
ISSUED FOR DEVELOPMENT APPLICATION	14/01/20	A
AMENDMENTS	DATE	ISSUE

STATUS
DEVELOPMENT APPLICATION

CLIENT
MR MICHAEL DE KANTZOW

PROJECT
CONCEPT SUBDIVISION
402 CASTLEREAGH HWY
MUDGEE, NSW, 2850

DESIGNED	DRAWN	DATE	SIZE	CAD REF
J.E.D.	J.A.M.	JAN '20	A1	MX-10356.01

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COMPLEX PROBLEMS RESOLVED SIMPLY

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PO BOX 1075, MUDGEE, NSW 2850
SYDNEY | ADELAIDE | BAROSSA | DARWIN | MUDGEE

DRAWING TITLE
COVER PAGE

DRAWING No. | ISSUE
MX-10356.01 -C1.0 B

GENERAL NOTES

CONSTRUCTION NOTES

1. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH MID-WESTERN REGIONAL COUNCIL AUS-SPEC STANDARD SPECIFICATION AND TO THE REQUIREMENTS OF THE SUPERVISING ENGINEERS.
2. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH THE APPROVED CONSTRUCTION CERTIFICATE PLANS.
3. CONTRACTOR SHALL CLEAR THE SITE BY REMOVING ALL RUBBISH, FENCES AND DEBRIS, ETC. TO THE EXTENT SPECIFIED. CLEARING AND GRUBBING - ATTENTION IS DRAWN TO COUNCIL'S TREE PRESERVATION ORDER.
4. ALL NEW WORKS SHALL MAKE SMOOTH JUNCTION WITH EXISTING WORKS.
5. THE CONTRACTOR SHALL CARRY OUT A SERVICES SEARCH AND SHALL LOCATE AND LEVEL ALL EXISTING SERVICES PRIOR TO COMMENCING CONSTRUCTION AND PROTECT AND MAKE ARRANGEMENT WITH THE RELEVANT AUTHORITY TO RELOCATE AND/OR ADJUST IF NECESSARY. INFORMATION GIVEN ON THE DRAWINGS IN RESPECT TO SERVICES IS FOR GUIDANCE ONLY AND IS NOT GUARANTEED COMPLETE NOR CORRECT.
6. SERVICE CONDUITS TO BE LAID AS DIRECTED BY THE RELEVANT AUTHORITY CLEAR OF ALL VEHICULAR CROSSINGS.
7. PROVISION TO BE MADE FOR SUITABLE PROTECTION OF ROAD PAVEMENT KERB AND GUTTER AND FOOTPATH FORMATION.
8. VEHICULAR ACCESS AND ALL SERVICES TO BE MAINTAINED AT ALL TIMES TO ADJOINING PROPERTIES AFFECTED BY CONSTRUCTION WORKS. THE CONTRACTOR IS NOT TO ENTER UPON NOR DO ANY WORK WITHIN ADJACENT LANDS WITHOUT THE PERMISSION OF THE OWNER AND SUPERINTENDENT.
9. WHERE KERB & GUTTER IS LAID BY USE OF A KERB & GUTTER MACHINE THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONCRETE QUALITY. THE REMOVAL OF ALL KERB & GUTTER AT HIS OWN EXPENSE WHERE THE MINIMUM STRENGTH IS NOT ACHIEVED AT 28 DAYS IN ACCORDANCE WITH COUNCIL'S STANDARD SPECIFICATIONS.
10. ALL TEMPORARY ROAD CONSTRUCTION TO BE REMOVED AND SURFACE TO BE REINSTATED TO NATURAL CONDITION WHERE PERMANENT ACCESS IS AVAILABLE.
11. TOPSOIL TO BE REMOVED AND STOCKPILED WHERE SHOWN.
12. EARTHWORKS TO BE CARRIED OUT TO THE SATISFACTION OF THE SUPERVISING ENGINEER. UNSOUND MATERIAL IS TO BE REMOVED FROM ROADS AND LOTS PRIOR TO FILLING. ALL SITE REGRADING AREAS SHALL BE FINALLY GRADED TO THE SATISFACTION OF THE SUPERINTENDENT.
13. WHERE LOT FILLING IN EXCESS OF 500mm IN DEPTH IS PROPOSED, LEVELS ARE TO BE TAKEN ON THE STRIPPED SURFACE PRIOR TO THE COMMENCEMENT OF FILLING AND ON THE FINISHED SURFACE. SUCH LEVELS ARE TO BE SHOWN ON THE WORK AS EXECUTED PLANS. FILLING TO BE CARRIED OUT TO COUNCIL'S STANDARDS.
14. PROVIDE 150mm TOPSOIL TO ALL FOOTPATHS AND FILLED AREAS.
15. DRAINAGE STUBS TO BE EXTENDED INTO EACH LOT.
16. CONDUIT TRENCHES AND STORMWATER DRAINAGE LINES TO BE BACKFILLED WITH APPROVED WASHED RIVER SAND AND VIBRATED. CONDUIT TRENCHES TO BE GRADED AT A MINIMUM OF 1% TO EITHER SUBSOIL OR STORMWATER DRAINAGE LINES.
17. SUBSOIL DRAINS TO BE CONSTRUCTED AS REQUIRED BY SUPERVISING ENGINEER.
18. SERVICE CONDUIT LOCATIONS TO BE PERMANENTLY MARKED ON KERB FACE.
19. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL PROVIDE A TRAFFIC MANAGEMENT PLAN PREPARED BY AN ACCREDITED PERSON IN ACCORDANCE WITH RTA REQUIREMENTS, FOR ANY WORK ON OR ADJACENT TO PUBLIC ROADS. PLAN TO BE SUBMITTED TO COUNCIL AND RTA.
20. LAND FILL MATERIALS MUST SATISFY THE FOLLOWING REQUIREMENTS:
    - BE NON-PUTRESCIBLE SOLID WASTE
    - BE FREE OF SLAG, HAZARDOUS, CONTAMINATED, TOXIC OR RADIO-ACTIVE MATTER
    - BE FREE OF INDUSTRIAL WASTE AND BUILDING DEBRIS
    - MUST NOT ORIGINATE FROM A SITE THAT HAS BEEN USED AT ANY TIME FOR ACTIVITIES LISTED IN APPENDIX 8 OF DIRCULAR NO.20 FROM NSW DEPARTMENT OF PLANNING, UNLESS THE MATERIALS HAVE BEEN CHEMICALLY TESTED AND THE MATERIALS APPROVED FOR DISPOSAL AS CLEAN FILL, OR THE SITE FROM WHICH THE MATERIAL ORIGINATES HAS BEEN DEMONSTRATED BY SUITABLE INVESTIGATION AND WHERE APPROPRIATE CHEMICAL TESTING, TO BE FREE OF CONTAMINATION TO THE SATISFACTION OF THE SUPERINTENDENT.
21. EACH INCOMING LOAD OF MATERIAL FOR DISPOSAL AT THE PROPERTY MUST BE INSPECTED ON ARRIVAL AT THE PROPERTY AND SORTED TO REMOVE ANY UNACCEPTABLE MATERIALS BEFORE PLACEMENT INTO THE EXCAVATION. ANY SUSPECT MATERIAL MUST EITHER BE REJECTED FOR DISPOSAL ELSEWHERE, OR BE CHEMICALLY TESTED TO CONFIRM THAT IT IS NOT CONTAMINATED. RECORDS OF THE SOURCE (INCLUDING THE ADDRESS AND OWNER OF SOURCE SITE), NATURE AND QUANTITY OF ALL INCOMING LOADS INCLUDING THE DATE, THE NAME OF CARRIER, AND VEHICLE REGISTRATION MUST BE MAINTAINED BY THE APPLICANT/OPERATOR AND SUPPLIED IF REQUESTED BY SUPERINTENDENT ALONG WITH ANY RESULTS OF CHEMICAL TESTING OF MATERIALS ACCEPTED FOR PLACEMENT IN THE EXCAVATION.
22. NO FIRES ARE TO BE LIT OR WASTE MATERIALS BURNT ON THE SITE.
23. ALL OUTBUILDINGS, RUBBISH & FENCES ARE TO BE DEMOLISHED AND THE MATERIALS DISPOSED OF WITHOUT NUISANCE . (N.B. INCINERATION OF THE MATERIALS IS STRICTLY PROHIBITED UNDER THE PROVISIONS OF THE CLEAN AIR ACT AND ANY BREACHES WILL RESULT IN LEGAL ACTION BEING RECOMMENDED.)
24. WHERE THE LAND IS TO BE FILLED, GRADED OR ROADWORKS CONSTRUCTED, IT WILL BE NECESSARY THAT REGULAR WATERING DOWN OF OPERATIONS BE CARRIED OUT WHERE THE CREATION OF DUST DURING EARTHWORKS IS A PROBLEM.
25. MATERIALS MUST NOT BE BURNT OR BURIED ON THE SITE ALL TRUCK TRANSPORTING DEBRIS FROM THE SITE MUST BE COVERED
26. ALL NOXIOUS PLANTS TO BE REMOVED FROM THE PROPERTY.
27. LAND FILLED IN EXCESS OF 500mm TO BE COMPACTED TO 95% STANDARD DRY DENSITY RATIO (AS1289 E4.1). EACH LOT, WHETHER FILLED OR NOT, TO BE CLASSIFIED IN TERMS OF THE AUSTRALIAN STANDARD FOR RESIDENTIAL SLABS AND FOOTINGS (AS2870) PREPARED BY A NATA REGISTERED SOIL TESTING CONSULTANT. WHERE THE LOT CLASSIFICATION IS H, A RESTRICTION WILL BE REQUIRED ON THE TITLE OF THAT LOT THAT SPECIAL FOOTINGS FOR ANY BUILDING MAY BE REQUIRED. A CLASSIFICATION OF E OR P IS UNACCEPTABLE.
28. THE FOLLOWING MEASURES ARE TO BE UNDERTAKEN TO TREES TO BE RETAINED.
    - AREA AROUND TREES TO BE TAPED OFF.
    - NO MACHINERY TO BE USED ADJACENT TO TREES.
    - ALL WORKS WITHIN 3m OF THE TREES TO BE CARRIED OUT BY MANUAL METHODS AND NOT COMPACTED BY MACHINERY.
    - STONE PITCHING TO BE USED AROUND TREES WHERE FILLING IS TO BE UNDERTAKEN THAT IS GREATER THAN 0.3m.
    - WHERE DESIGN LEVELS ARE LOWER THAN THE LEVELS OF A TREE, EXCAVATION WILL ONLY BE CARRIED OUT BY HAND AND THE TREES BEING LEFT ON A SUITABLE MOUND.
29. ALL MACHINERY TO BE LOADED/UNLOADED WITHIN WORKSITE.
30. ALL MATERIALS TO BE LOADED/UNLOADED WITHIN WORKSITE.
31. ALL CONSTRUCTION MATERIALS AND MACHINERY MUST BE KEPT WITHIN WORKSITE.
32. THE CONTRACTOR SHALL ENSURE THAT SOIL/EXCAVATED MATERIAL IS NOT DEPOSITED ON SURROUNDING ROADS. ANY SOIL DROPPED ON THE SURROUNDING ROADS SHALL BE IMMEDIATELY REMOVED.

EARTHWORKS NOTES

1. OVER FULL AREA OF EARTHWORKS, CLEAR VEGETATION, RUBBISH, SLABS ETC.. AND STRIP TOPSOIL, AVERAGE 150mm THICK. REMOVE FROM SITE, EXCEPT TOP SOIL FOR RE-USE.
2. CUT AND FILL OVER THE SITE TO LEVELS REQUIRED.
3. PRIOR TO ANY FILLING IN AREAS OF CUT OR IN EXISTING GROUND, PROOF ROLL THE EXPOSED SURFACE WITH A ROLLER OF MINIMUM WEIGHT OF 8 TONNES WITH A MINIMUM OF 6 PASSES.
4. EXCAVATE AND REMOVE ANY SOFT SPOTS ENCOUNTERED DURING PROOF ROLLING AND REPLACE WITH APPROVED FILL COMPACTED IN LAYERS. THE WHOLE OF THE EXPOSED SUBGRADE AND FILL SHALL BE COMPACTED TO 100% STANDARD MAXIMUM DRY DENSITY AT OPTIMUM MOISTURE CONTENT ± 2%. THE COST OF ANY RE-TESTING IS TO BE THE RESPONSIBILITY OF THE CONTRACTOR.
5. FOR ON SITE FILLING AREAS, THE PROJECT SURVEYOR SHALL BE NOTIFIED AND TAKE LEVELS OF EXISTING SURFACE AFTER STRIPPING TOPSOIL AND PRIOR TO COMMENCING FILL OPERATIONS.
6. ROCK: WHERE ROCK IS ENCOUNTERED AT SUBGRADE, IT SHALL BE OVER RIPPED A MINIMUM OF 300mm DEEP AND RECOMPACTED TO SPECIFICATION TO BREAK UP DRAINAGE PATHS.
7. FILL IN 150mm MAXIMUM (LOOSE THICKNESS) LAYERS TO UNDERSIDE OF BASECOURSE USING THE EXCAVATED MATERIAL AND COMPACTED TO 100% STANDARD (AS1289.5.1.1), MAXIMUM DRY DENSITY AT OPTIMUM MOISTURE CONTENT ± 2%. SHOULD THERE BE INSUFFICIENT MATERIAL FROM SITE EXCAVATIONS, IMPORT AS NECESSARY CLEAN GRANULAR FILL TO APPROVAL.
8. BATTERS TO BE AS SHOWN, OR MAXIMUM 1 VERT : 4 HORIZ.
9. ALL CONDUITS AND MAINS SHALL BE LAID PRIOR TO LAYING FINAL PAVEMENT.
10. ALL BATTERS AND FOOTPATHS ADJACENT TO ROADS SHALL BE TOPSOILED WITH 150mm APPROVED LOAM AND SEEDED UNLESS OTHERWISE SPECIFIED.

GEOTECHNICAL NOTES

1. ALL FILL SHALL BE COMPACTED TO NOT LESS THAN 95% OF STANDARD MAXIMUM DRY DENSITY. ALL AREAS WHICH HAVE TEST RESULTS LESS THAN 95 % STANDARD SHOULD BE REWORKED AND RETESTED TO ENSURE COMPLIANCE, IN ACCORDANCE WITH AS1289 TESTS 12 & 13.
2. ALL FILL AREAS TO BE SURVEYED AT STRIPPING AND FINAL STAGES AND LEVELS SHOWN ON PLAN SHADED. (TOGETHER WITH CROSS SECTIONS AT MAX. 20m C/C) AT WORK AS EXECUTED STAGE AND CONTROLLED BY REGISTERED SURVEYOR.
3. ALL TESTING WORKS SHALL BE CONTROLLED AND CERTIFIED BY A N.A.T.A. REGISTERED LABORATORY. A COLLATED COPY OF ALL TESTS CERTIFICATES, ACCOMPANIED BY AN OVERALL SITE PLAN, CLEARLY INDICATING THE LOCATION OF EACH TEST AND FILL AREAS ETC. AND THE LABORATORY CERTIFICATE COVERING THE WHOLE OF THE AREA TO BE FORWARDED TO THE SUPERINTENDENT UPON COMPLETION.
4. BACKFILL ADJACENT TO THE SIDE OF ALL UNDERGROUND TANKS SHALL BE SAND COMPACTED TO 100% STANDARD MAXIMUM DRY DENSITY AT OPTIMUM MOISTURE CONTENT. TESTING TO BE CARRIED OUT BY GEOTECHNICAL ENGINEER.

SURVEY NOTES

ALL SURVEY INFORMATION PROVIDED FOR THIS PROJECT IS OBTAINED FROM BLAXLANDS PTY LTD.

1. ALL LEVELS ARE TO A.H.D.
2. ALL CHAINAGES AND LEVELS ARE IN METRES, DIMENSIONS FOR DETAILS AS SHOWN.
3. CONTRACTORS SHALL ARRANGE FOR THE WORKS TO BE SET OUT BY A REGISTERED SURVEYOR.
4. EXISTING SERVICES SHOWN SHALL BE CONFIRMED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORK.
5. CO-ORDINATES ARE MGA ZONE 55 GROUND BASED ON SSM141515
   (EASTING 740788.339 NORTHING 6391151.325 RL 468.788
   COMBINED SCALE FACTOR 1.000229

INSPECTION HOLD POINTS

MID WESTERN REGIONAL COUNCIL (MWRC) IS TO BE NOTIFIED 24 HOURS PRIOR TO EACH INSPECTION. UPON SATISFACTORY COMPLETION OF THE WORK MWRC WILL RELEASE EACH HOLD POINT BY PROVIDING WRITTEN NOTICE TO THE SUPERINTENDENT. WORK SHALL ONLY RECOMMENCE AFTER THE HOLD POINT HAS BEEN RELEASED.

INSPECTION HOLD POINTS ARE TO BE AS FOLLOWS:

1. INSTALLATION OF ALL EROSION AND SEDEMENTATION CONTROL MEASURES
2. INSTALLATION OF TRAFFIC CONTROL PRIOR TO CONSTRUCTION WORKS COMMENCING.
3. INSTALLATION OF ALL WATER SUPPLY INFRASTRUCTURE PRIOR TO BACKFILLING
4. INSTALLATION OF ALL SEWERAGE INFRASTRUCTURE PRIOR TO BACKFILLING
5. INSTALLATION OF ALL DRAINAGE INFRASTRUCTURE PRIOR TO BACKFILLING
6. TEST RESULTS OF SUB-BASE AND BASE COURSE MATERIAL PROPOSED PRIOR TO PLACING
7. PROOF ROLLING WITH MINIMUM 15T ROLLER OF SUBGRADE WITH MAXIMUM DEFLECTION OF DRUM THICKNESS.
8. ESTABLISHMENT OF LINE AND LEVEL FOR KERB AND GUTTER PLACEMENT
9. ROAD PAVEMENT CONSTRUCTION INCLUDING SUBMISSION OF ALL SATISFACTORY COMPACTION TEST REPORTS IN ACCORDANCE WITH AUS-SPEC ACCEPTANCE OF COMPACTED LAYERS C242.17 AND C242.18 FOR SUB-BASE AND BASE LAYERS MAXIMUM 150mm DEPTH USING RANDOM TEST LOCATIONS AS PER RTA Q4
10. VISUAL INSPECTION OF ROAD PAVEMENT TO CONFIRM CONSISTENCY OF PAVEMENT PRIOR TO BITUMEN SEALING
11. VISUAL INSPECTION OF BITUMEN SEAL PRIOR TO ASPHALTING
12. ALL RECORDS FOLLOWING PAVEMENT SURFACING INCLUDING PRIMER SEAL AND ASPHALT DETAILS AS SPECIFIED IN AUS-SPEC
13. FINAL VISUAL INSPECTION OF ROAD PAVEMENT SURFACING ON COMPLETION
14. ACCEPTANCE TESTING OF WATER SUPPLY AND SEWERAGE INFRASTRUCTURE IN ACCORDANCE WITH WSA02-2002 V2.3 AND WSA03-2002 C2.3
15. INSTALLATION OF FORM WORK AND STEEL PRIOR TO POURING CONCRETE
16. PRACTICAL COMPLETION

ARCHITECT

ISSUED FOR DEVELOPMENT APPLICATION	13/02/20	B
ISSUED FOR DEVELOPMENT APPLICATION	16/01/20	A
AMENDMENTS	DATE	ISSUE

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J.D.	JA.M.	JAN '20	A1	MX-10356.01

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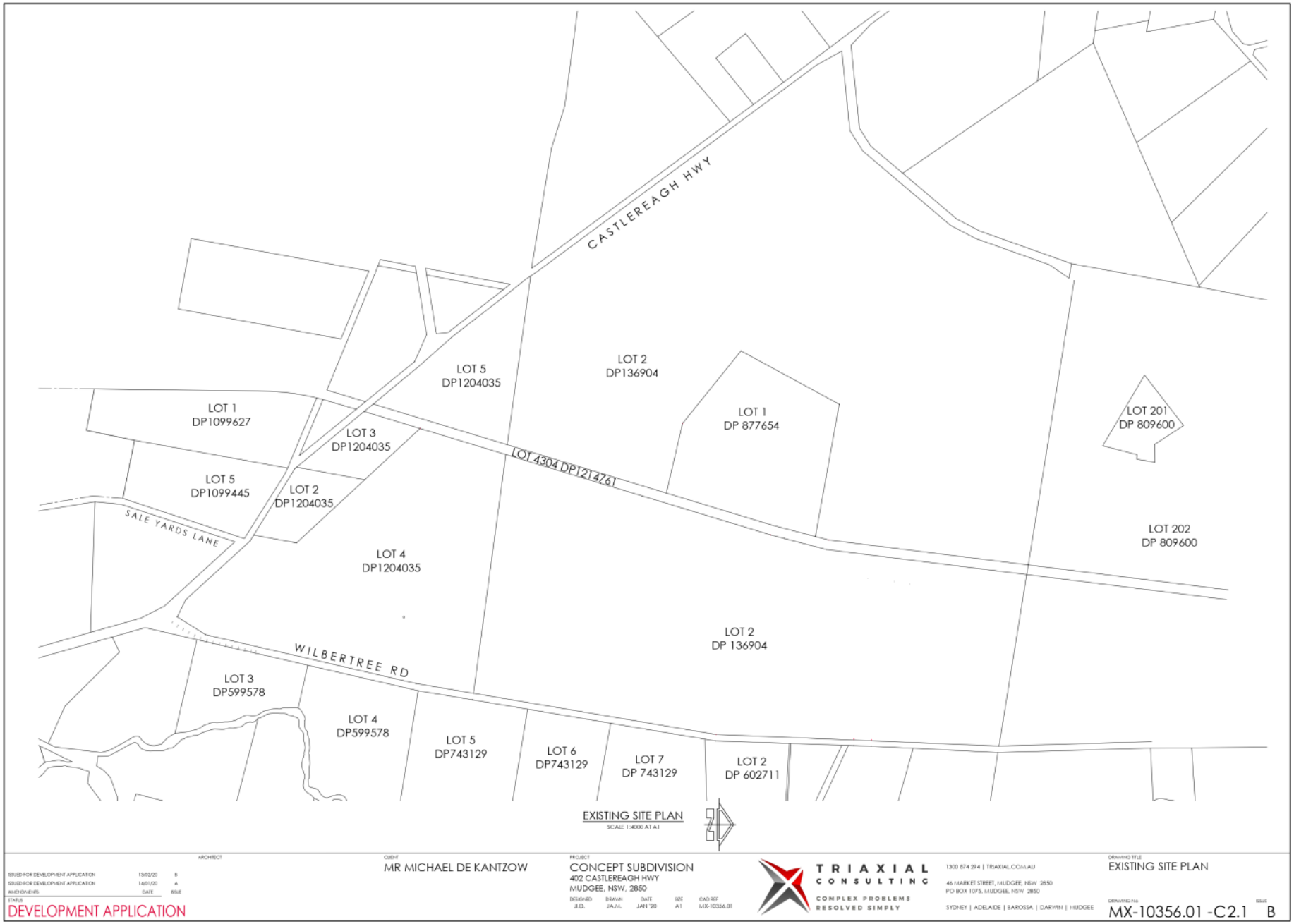
DRAWING TITLE
GENERAL NOTES

DRAWING No
MX-10356.01 -C1.1

ISSUE
B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LOT 5
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LOT 2
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LOT 202
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LOT 2
DP 136904
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DP743129
LOT 7
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LOT 2
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EXISTING SITE PLAN
SCALE 1:4000 AT A1
ISSUED FOR DEVELOPMENT APPLICATION 13/02/20 B
ISSUED FOR DEVELOPMENT APPLICATION 14/01/20 A
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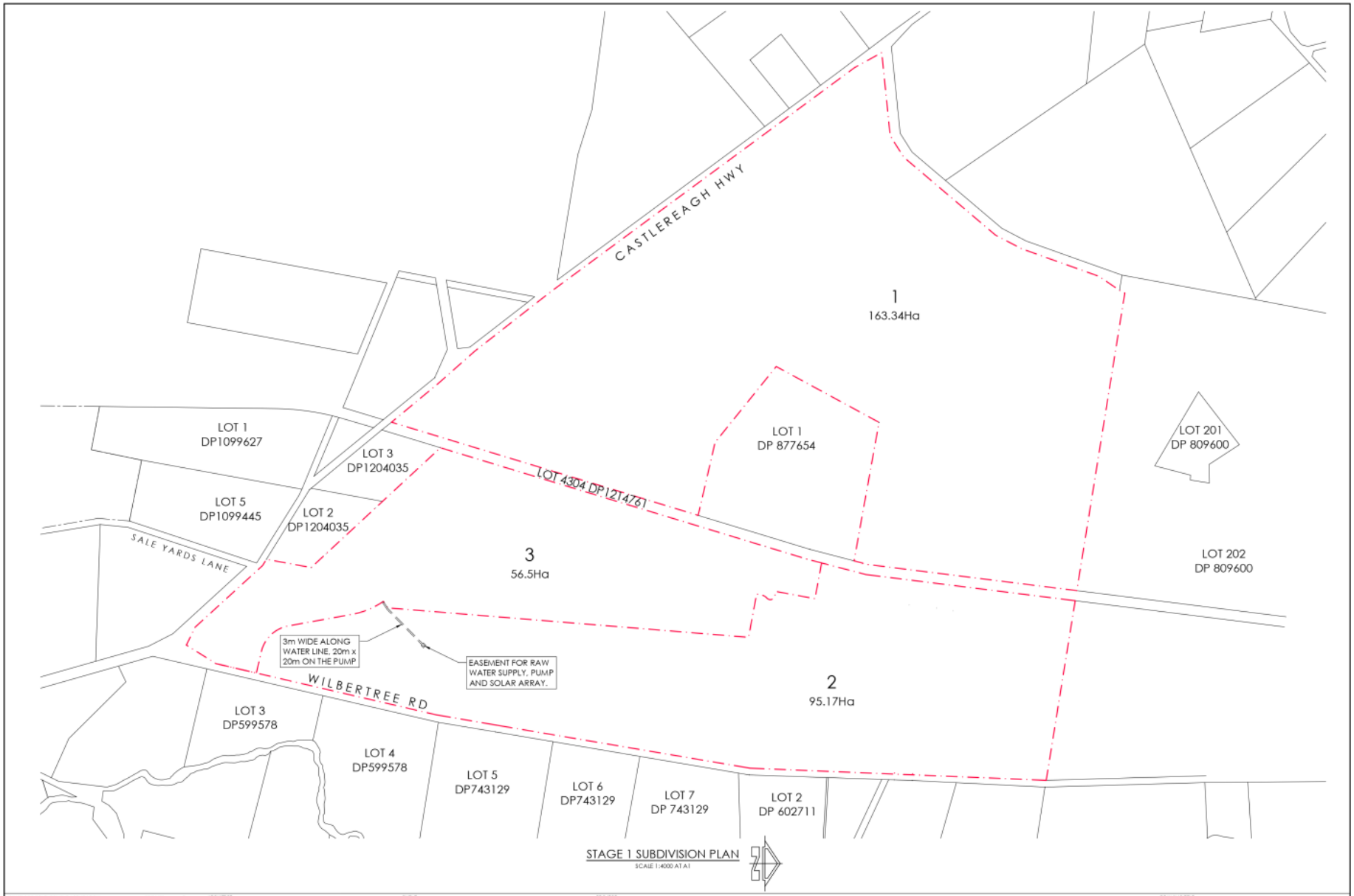
DRAWING TITLE
EXISTING SITE PLAN
DRAWING No
MX-10356.01 -C2.1
ISSUE
B



STAGE 1 SUBDIVISION PLAN

SCALE 1:4000 AT A1

ISSUED FOR DEVELOPMENT APPLICATION	27/01/21	D	ARCHITECT
ISSUED FOR DEVELOPMENT APPLICATION	2/03/20	C	
ISSUED FOR DEVELOPMENT APPLICATION	13/02/20	B	
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DRAWING TITLE
SUBDIVISION STAGE 1

DRAWING No
MX-10356.01 -C2.1

ISSUE
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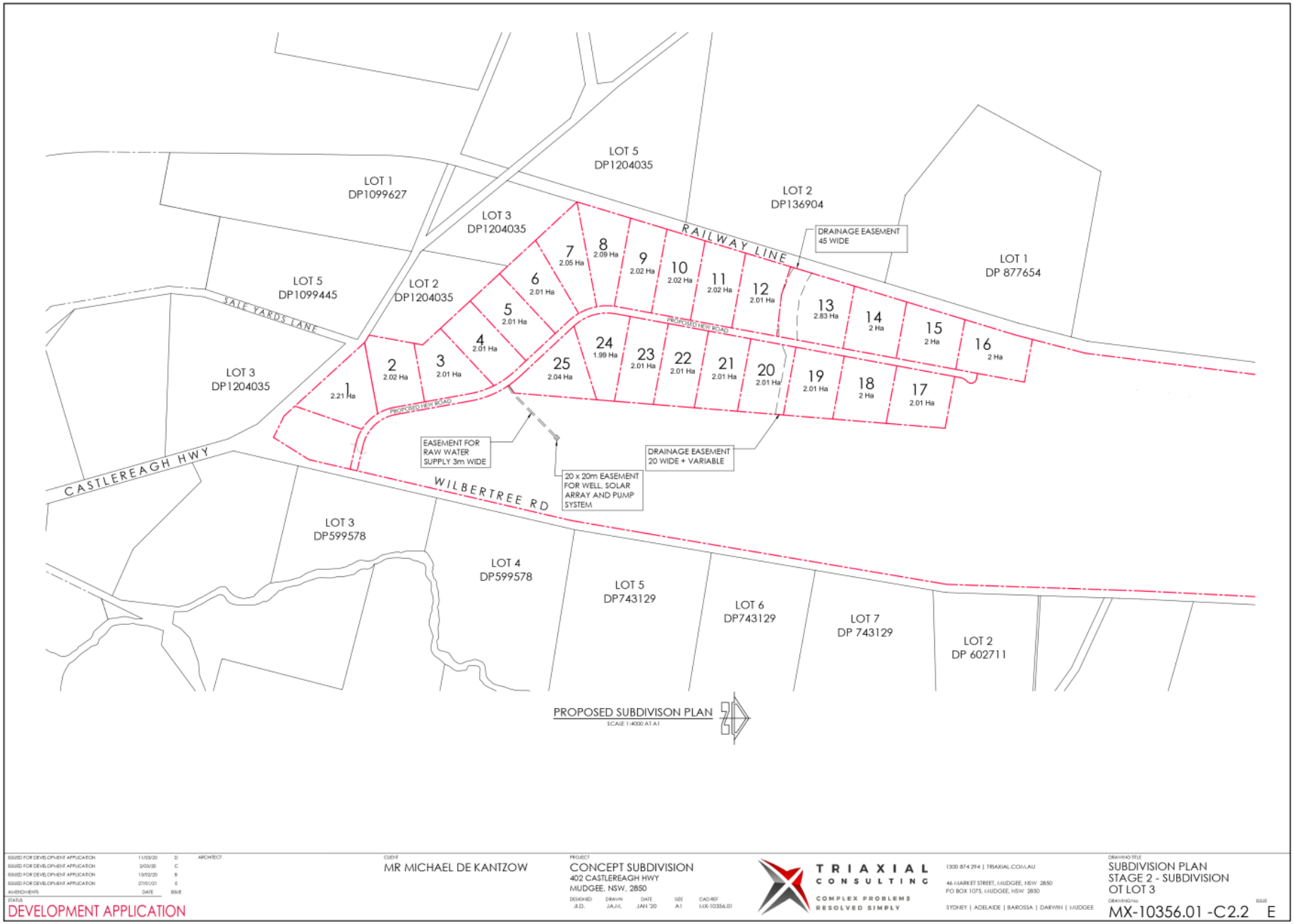
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SALE YARDS LANE
PROPOSED NEW ROAD
LOT 3
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CASTLEREAGH HWY
EASEMENT FOR
RAW WATER
SUPPLY 3m WIDE
20 x 20m EASEMENT
FOR WELL, SOLAR
ARRAY AND PUMP
SYSTEM
DRAINAGE EASEMENT
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PROPOSED SUBDIVISON PLAN
SCALE 1:4000 AT A1
ISSUED FOR DEVELOPMENT APPLICATION 11/03/20 D
ISSUED FOR DEVELOPMENT APPLICATION 2/03/20 C
ISSUED FOR DEVELOPMENT APPLICATION 13/02/20 B
ISSUED FOR DEVELOPMENT APPLICATION 27/01/21 E
AMENDMENTS DATE ISSUE
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SUBDIVISION PLAN
STAGE 2 - SUBDIVISION
OT LOT 3
DRAWING No.
MX-10356.01 -C2.2
ISSUE
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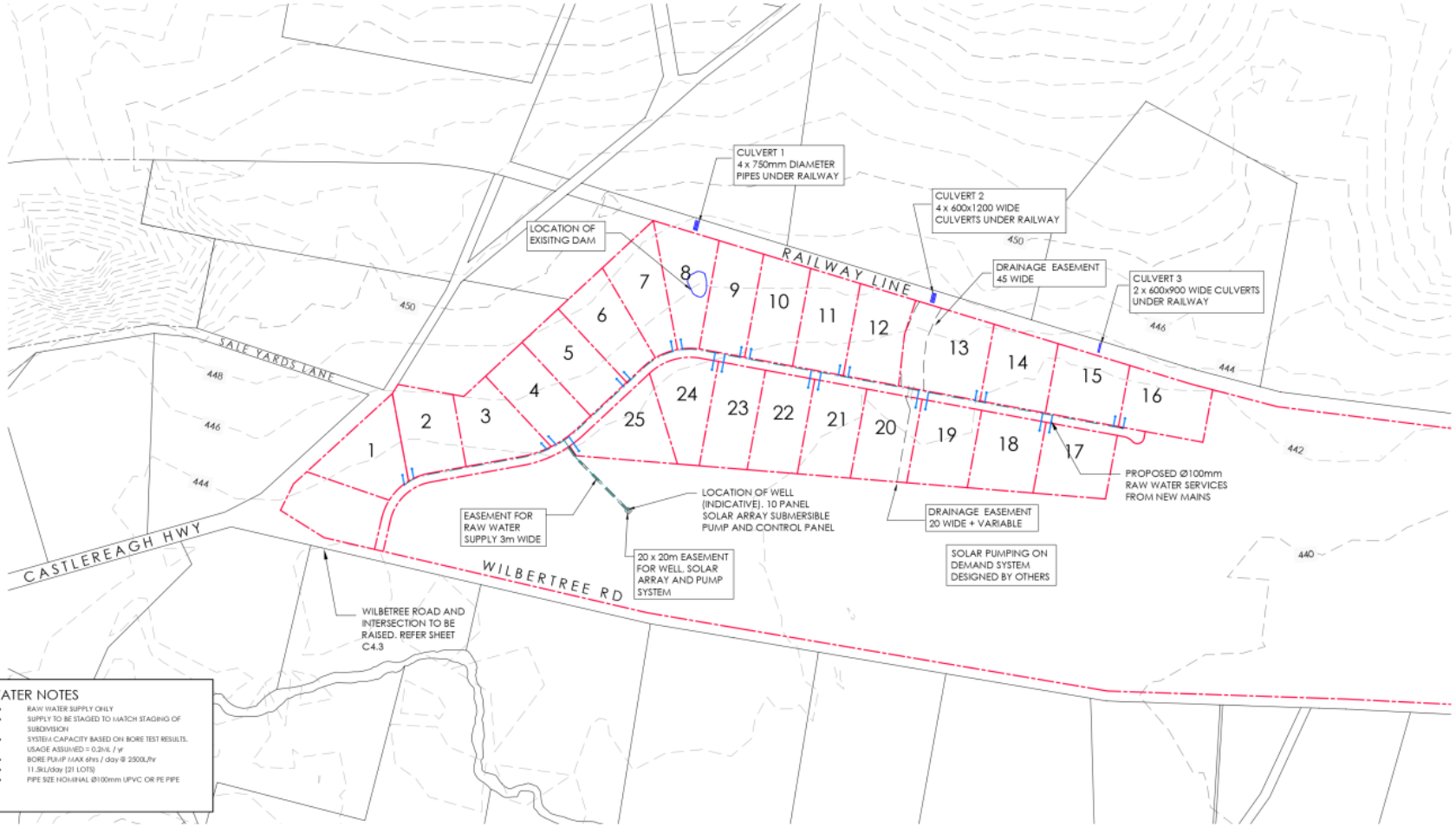

WATER NOTES

- RAW WATER SUPPLY ONLY
- SUPPLY TO BE STAGED TO MATCH STAGING OF SUBDIVISION
- SYSTEM CAPACITY BASED ON BORE TEST RESULTS. USAGE ASSUMED = 0.2ML / yr
- BORE PUMP MAX 6hrs / day @ 2500L/hr
- 11.9kL/day (21 LOTS)
- PIPE SIZE NOMINAL Ø100mm UPVC OR PE PIPE

LEGEND

- WATER MAIN (RAW WATER)
- WATER SERVICE
- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- DRAINAGE LINE

CULVERT DISCHARGE NOTES

CULVERT	MAX. DISCHARGE FLOWRATE	NOTES
1	4.4m³/s	ASSUME NO OVERTOPPING
2	8.2m³/s	ASSUME NO OVERTOPPING
3	3.0m³/s	ASSUME NO OVERTOPPING

CAPACITY OF CULVERTS CALCULATED USING HYDRAFLOW EXPRESS SOFTWARE WITH THE FOLLOWING INPUT:
* SURVEYED CULVERT DATA PROVIDED BY JM GEORGE SURVEYORS
* NO FLOW ASSUMED TO OVERTOP RAILWAY EMBANKMENT
* FLARED WINGWALLS, n = 0.012, MIN SLOPE 1%.

SERVICING PLAN
SCALE 1:4000 AT A1

AMENDMENTS	DATE	ISSUE
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ISSUED FOR DEVELOPMENT APPLICATION	26/02/21	F
ISSUED FOR DEVELOPMENT APPLICATION	27/01/21	E

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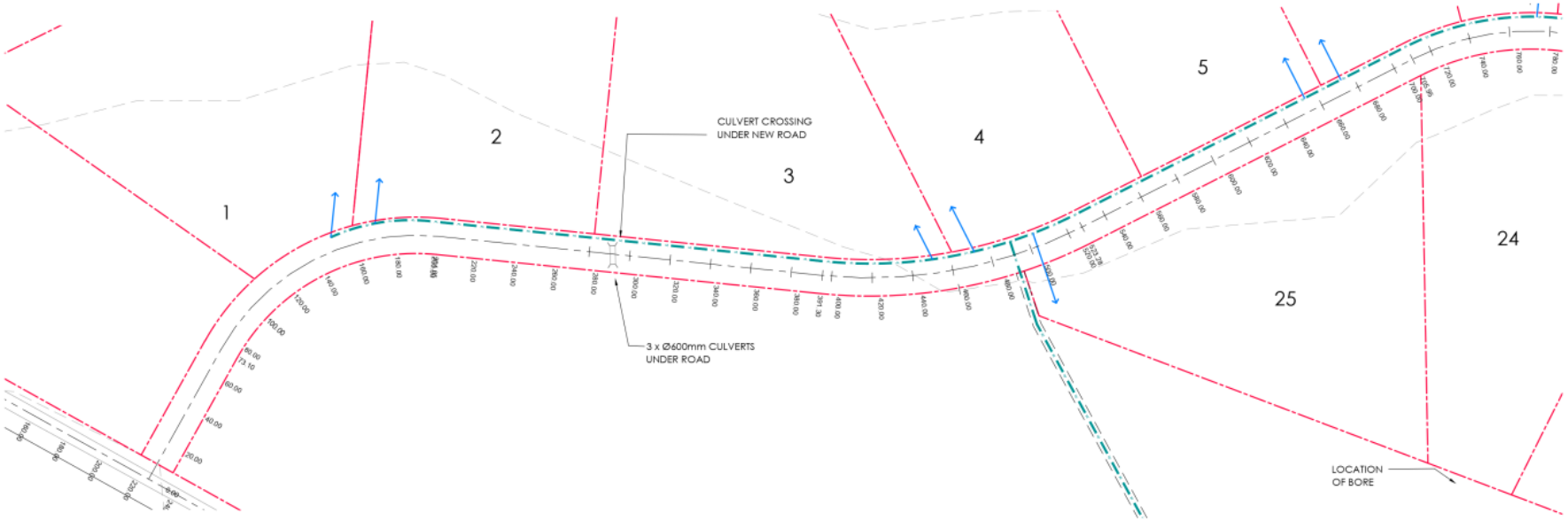
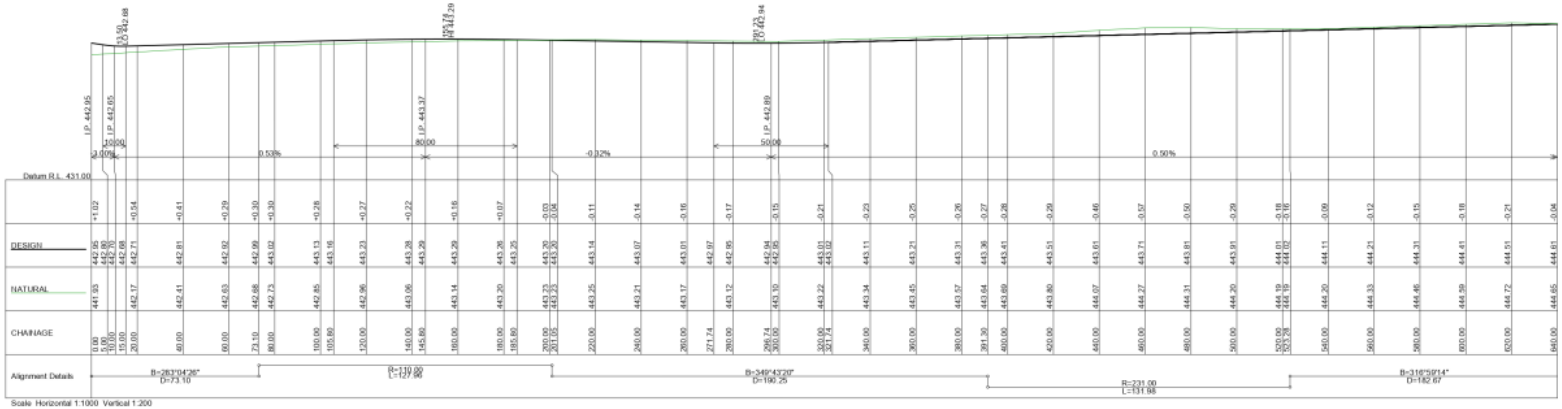
DRAWING TITLE: SERVICING PLAN

DRAWING No: MX-10356.01 -C3.0

ISSUE: F





PROPOSED ACCESS ROAD LONG SECTION - 1

SCALE 1:1000 H AT A1
SCALE 1:200 V AT A1

ISSUED FOR DEVELOPMENT APPLICATION	27/01/21	C
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PROJECT: CONCEPT SUBDIVISION
402 CASTLEREAGH HWY
MUDGEE, NSW, 2850

DESIGNED	DRAWN	DATE	SIZE	CAD REF
J.D.	J.A.M.	JAN '20	A1	MX-10356.01

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COMPLEX PROBLEMS RESOLVED SIMPLY

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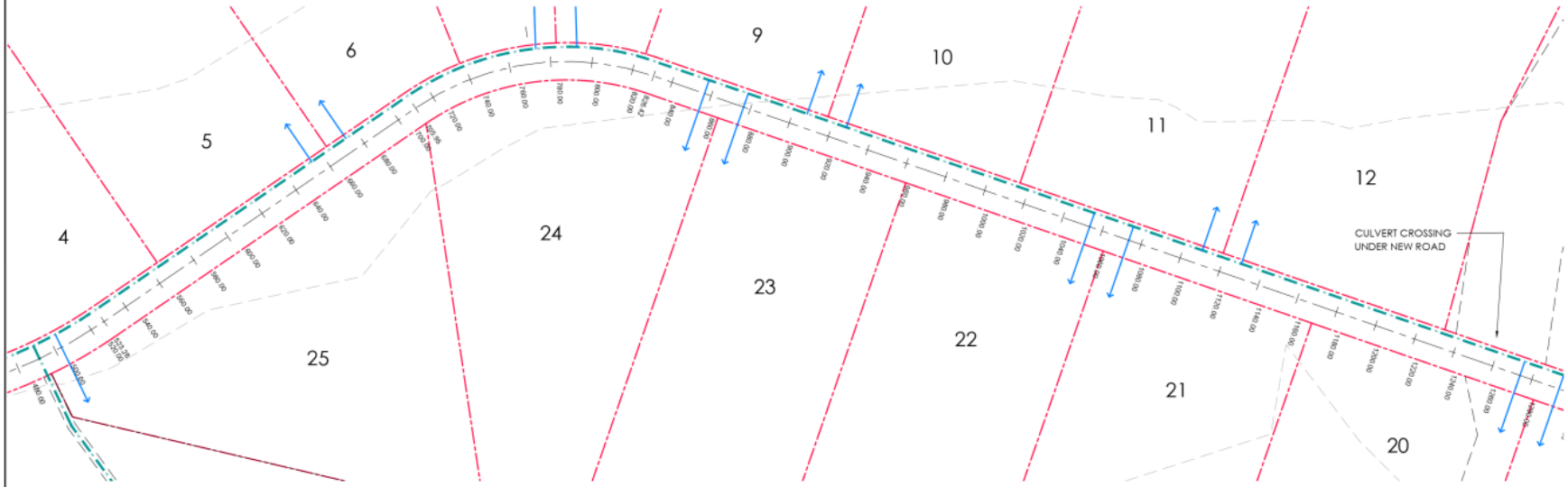
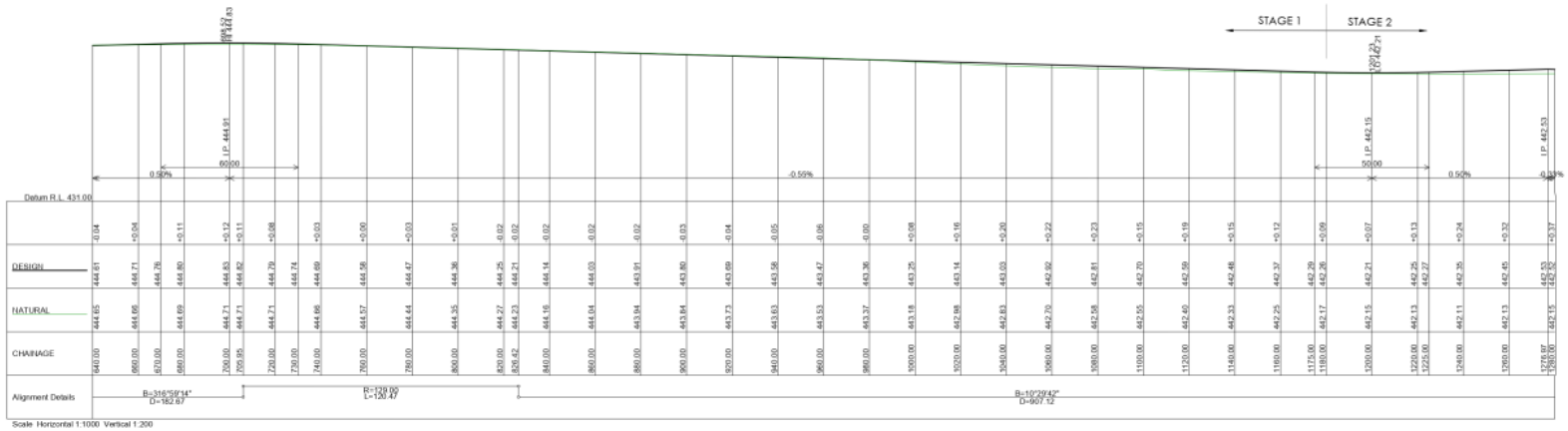
PO BOX 1075, MUDGEE, NSW 2850
SYDNEY | ADELAIDE | BAROSSA | DARWIN | MUDGEE

DRAWING TITLE: ROAD SECTIONS - SHEET 1

DRAWING No: MX-10356.01 -C4.0 ISSUE: C





PROPOSED ACCESS ROAD LONG SECTION - 2

SCALE 1:1000 H AT A1
SCALE 1:200 V AT A1

ARCHITECT

ISSUED FOR DEVELOPMENT APPLICATION	13/02/20	B
ISSUED FOR DEVELOPMENT APPLICATION	16/01/20	A
AMENDMENTS	DATE	ISSUE

STATUS
DEVELOPMENT APPLICATION

CLIENT
MR MICHAEL DE KANTZOW

PROJECT
CONCEPT SUBDIVISION
402 CASTLEREAGH HWY
MUDGEE, NSW, 2850

DESIGNED	DRAWN	DATE	SIZE	CAD REF
J.D.	J.A.M.	JAN '20	A1	MX-10356.01

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COMPLEX PROBLEMS RESOLVED SIMPLY

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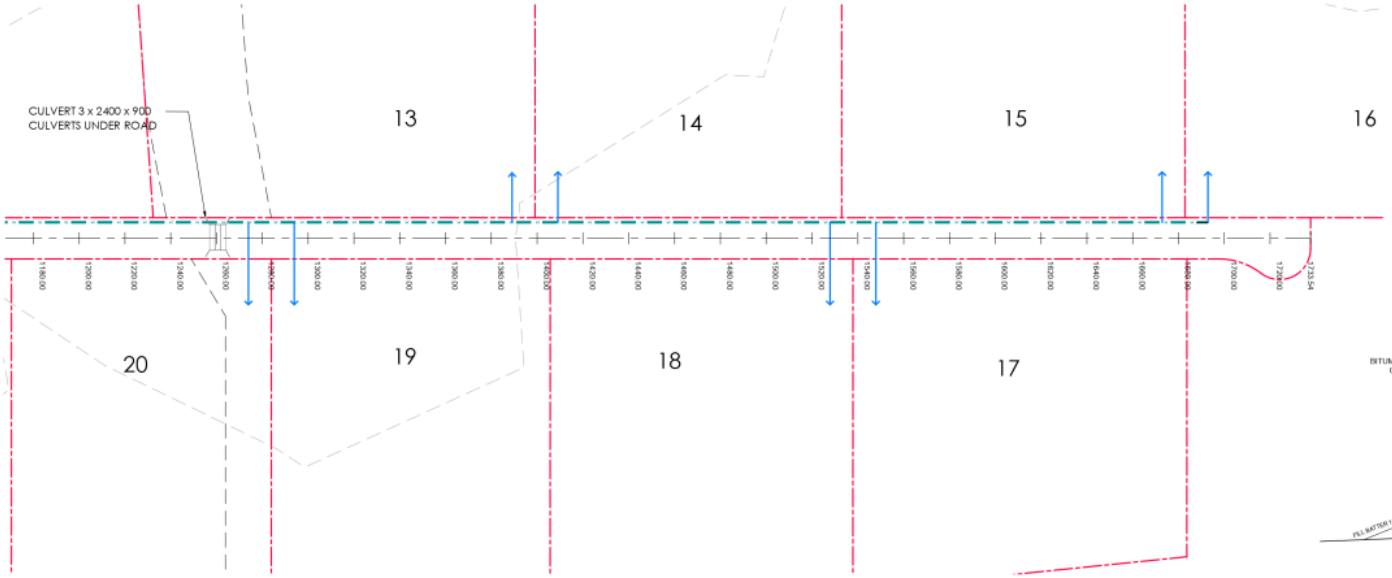
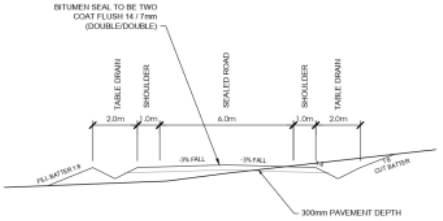
DRAWING TITLE
ROAD SECTIONS - SHEET 2

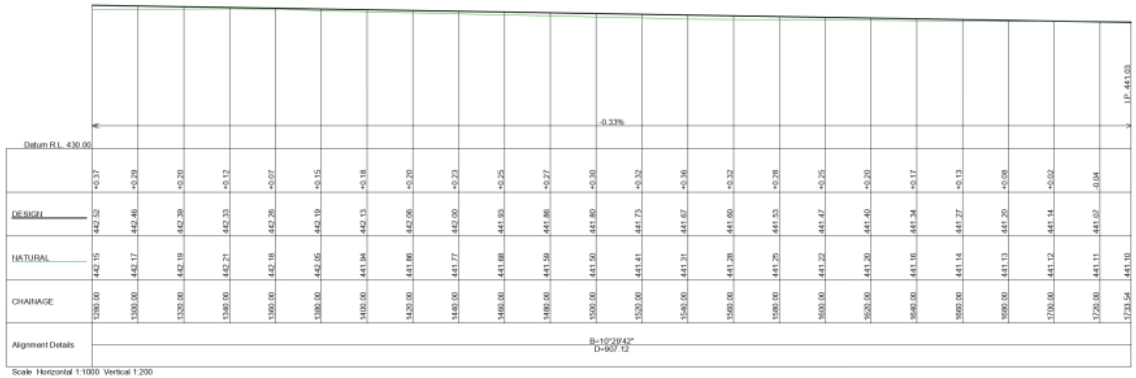
DRAWING No
MX-10356.01 -C4.1

ISSUE
B





TYPICAL ROAD CROSS SECTION
SCALE 1:1000 H AT A1
SCALE 1:200 V AT A1



PROPOSED ACCESS ROAD LONG SECTION - 3
SCALE 1:1000 H AT A1
SCALE 1:200 V AT A1

ARCHITECT

ISSUED FOR DEVELOPMENT APPLICATION	13/02/20	B
ISSUED FOR DEVELOPMENT APPLICATION	14/01/20	A
AMENDMENTS	DATE	ISSUE

STATUS
DEVELOPMENT APPLICATION

CLIENT
MR MICHAEL DE KANTZOW

PROJECT
CONCEPT SUBDIVISION
402 CASTLEREAGH HWY
MUDGEE, NSW, 2850

DESIGNED	DRAWN	DATE	SIZE	CAD REF
JLD.	JA.M.	JAN '20	A1	MX-10356.01

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COMPLEX PROBLEMS RESOLVED SIMPLY

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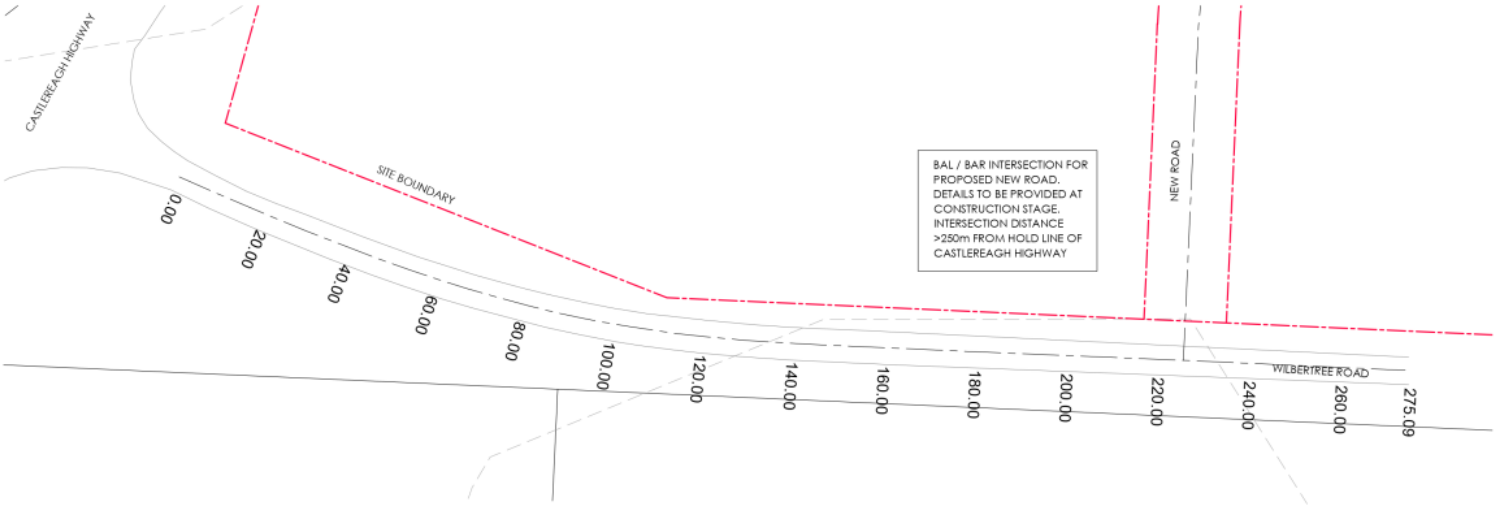
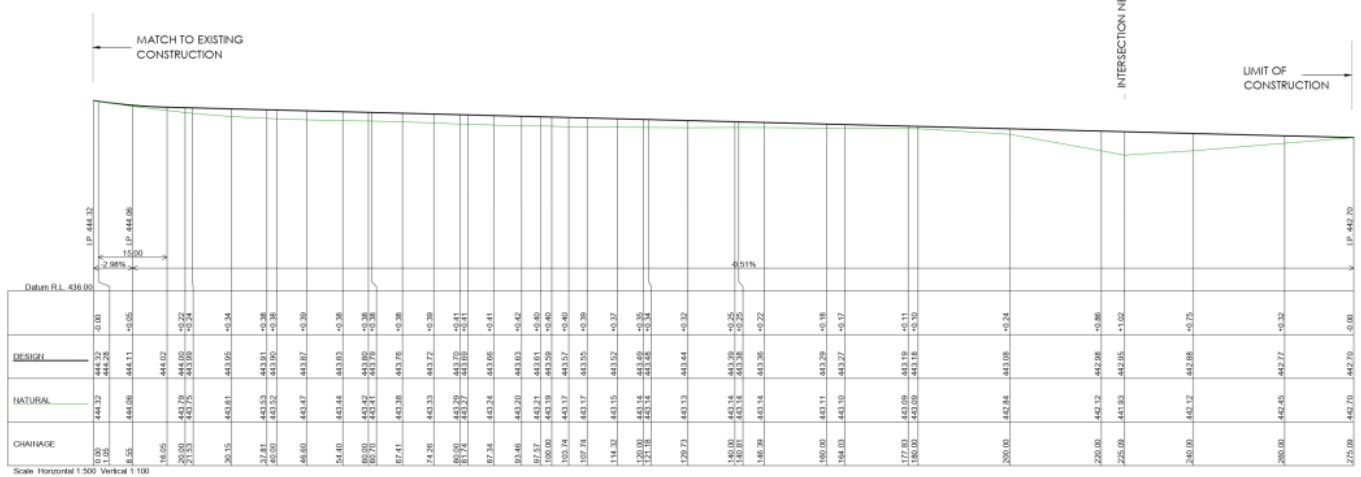
DRAWING TITLE
ROAD SECTIONS - SHEET 3

DRAWING No
MX-10356.01 -C4.2

ISSUE
B





PROPOSED ROAD LONG SECTION - WILBERTREE ROAD

SCALE 1:1000 H AT A1
SCALE 1:200 V AT A1

ISSUED FOR DEVELOPMENT APPLICATION	27/02/01	C
ISSUED FOR DEVELOPMENT APPLICATION	13/02/20	B
ISSUED FOR DEVELOPMENT APPLICATION	14/01/20	A
AMENDMENTS	DATE	ISSUE

STATUS
DEVELOPMENT APPLICATION

ARCHITECT

CLIENT
MR MICHAEL DE KANTZOW

PROJECT
CONCEPT SUBDIVISION
402 CASTLEREAGH HWY
MUDGEE, NSW, 2850

DESIGNED	DRAWN	DATE	SIZE	CAD REF
J.D.	J.A.M.	JAN '20	A1	MX-10356.01

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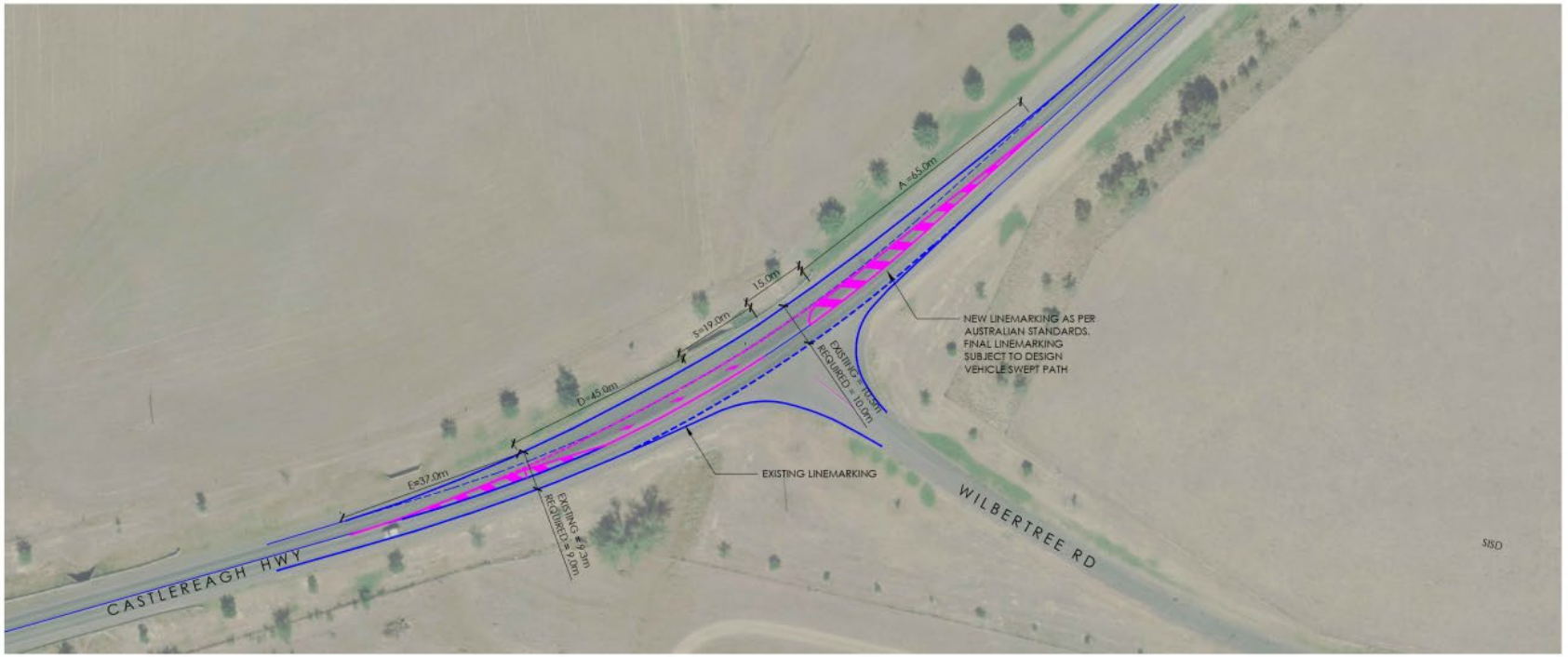
DRAWING TITLE
ROAD SECTIONS - WILBERTREE ROAD

DRAWING No
MX-10356.01 -C4.3

ISSUE
C



CONCEPT INTERSECTION PLAN
SCALE 1:500 AT A1

LEGEND
- EXISTING LINEMARKING
- PROPOSED NEW LINEMARKING

INTERSECTION DESIGN NOTATIONS:

1.) ALL WORKS TO AUSTROADS GUIDE TO ROAD DESIGN:
PART 3: GEOMETRIC DESIGN
PART 4: GUIDE TO ROAD DESIGN PART 4A UNSIGNALISED AND SIGNALISED INTERSECTIONS.

2.) HORIZONTAL ALIGNMENT CATERS FOR 19.0m PRIME MOVER AND SEMI-TRAILER. STORAGE LENGTH AT INTERSECTION INCLUDES 19.0m LENGTH FOR SEMI-TRAILER TURNING.

3.) VERTICAL ALIGNMENT DEEMED TO COMPLY FROM SITE INSPECTION

4.) SIGHT DISTANCES: SIGHT DISTANCES ARE WELL IN EXCESS OF THE REQUIRED SISD OF 182m REQUIRED.

5.) DESIGN DISTANCES FOR INTERSECTION BASED ON FIGURE 7.7 OF AUSTROADS GUIDE TO ROAD DESIGN PART 4A.

6.) EXISTING CARRIAGEWAY LANE WIDTH ON CASTLEREAGH HIGHWAY 3.5m WIDTH, 2.0m SEALED SHOULDER.

7.) WIDTHS SHOWN ON PLAN AT INTERSECTION GEOMETRY POINTS RELATE TO WIDTH OF SEALED PAVEMENT BETWEEN EXISTING LINEMARKING AND NEW MINIMUM REQUIRED WIDTH BASED ON AUSTROADS REQUIREMENTS.

ARCHITECT

ISSUED FOR DEVELOPMENT APPLICATION	10/07/20	A
AMENDMENTS	DATE	ISSUE

STATUS
DEVELOPMENT APPLICATION

CLIENT
MR MICHAEL DE KANTZOW

PROJECT
CONCEPT SUBDIVISION
402 CASTLEREAGH HWY
MUDGEE, NSW, 2850

DESIGNED	DRAWN	DATE	SIZE	CAD REF
J.E.D.	J.A.M.	JAN '20	A1	MX-10356.01

TRIAXIAL CONSULTING
COMPLEX PROBLEMS RESOLVED SIMPLY

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DRAWING TITLE
CONCEPT INTERSECTION PLAN
WILBERTREE ROAD AND
CASTLEREAGH HIGHWAY

DRAWING NO: MX-10356.01 -C5.1 ISSUE: A

Booth Brown
LEGAL

Our Ref: KO:BBA:17399

12 March 2020

Ms E Yule
Atlas Environment & Planning
PO Box 464
MUDGEE NSW 2850

Dear Emma,

RE: SUBDIVISION (the Subdivision)
400 CASTLEREAGH HIGHWAY, MUDGEE

I refer to previous correspondence in relation to the Subdivision.

Subdivision

We note that your client intends to seek development consent for the subdivision of lot 2 DP136904 (lot 2) and Lot 4 DP1204035 (Lot 4). The provisions of the Mid-Western Regional Local Environmental Plan 2012 (MWRLEP) apply to Lot 2 and Lot 4 and we note that upon subdivision, three (3) lots are to be created as follows:

Proposed Lot 1 – RU4 Primary Production Small Lots
Proposed Lot 2 – RU4 Primary Production Small Lots
Proposed Lot 3 – RU 5 Large Lot Residential

Proposed Lot 3 is to be further subdivided at a future date to create up to 25 Large Lot Residential Lots, each with a minimum size of 2 Ha. Clause 4.1 of the MWRLEP provides that a minimum subdivision lot size of 2 Ha is permitted if the Council is satisfied that each lot will be serviced by a water reticulation system.

The Development Control Plan (DCP) provides that for the purposes of clause 4.1 of the MWRLEP:

1. a water reticulation system is a reticulated community bore; and
2. the minimum non-potable water supply for each lot is to be 0.200 megalitres per year.

Further, to demonstrate compliance with this requirement Council requires:

1. the provision of a licence issued in accordance with the Water Industry Competition Act 2006 to demonstrate the ability to supply the minimum quantities of water referred to in the MWRLEP; or
2. If a licence is not required, a draft Community Statement and Community Title Subdivision plan including all infrastructure for the proposed water reticulation scheme.

Contact Details
3/65 Church Street, (PO Box 20), Dubbo NSW 2830
Telephone: 02 6882 1844 **Facsimile**: 02 6882 2633
Email: reception@boothbrown.com.au

Principals: **Kane Olney Charlotte Egan**
Licensed Conveyancer: **Colleen Iwikau**

Our advice is sought regarding the implementation of a private water supply scheme which will satisfy the requirements of the MWRLEP.

Licensing requirements for Community Bore

We note that a groundwater source (existing well) is located within proposed Lot 2 and water supply infrastructure is able to be constructed at this location.

Pursuant to the provisions of s52 of the Water Management Act 2000 (WMA), a landholder has a right to:

a. take any water from any aquifer underlying the land;
b. without an access licence, water supply work approval or water use approval;
c. for domestic consumption and stock watering.

The Water Industry Competition Act 2006 (WICA) (s 5) further provides that construction of water supply infrastructure is prohibited without the authority of a WICA licence. However, the 2008 regulations to the WICA (Water Industry Competition (General) Regulation) provide an exemption to the WICA licensing requirement for any water supply work that is to be undertaken pursuant to s52 of the WMA.

As the proposed source of the water supply to all Large Lot Residential lots is an aquifer located on the adjacent lot and the supply of water is limited to a domestic purpose, in our view the requirement to obtain a Water Industry Competition Act 2006 (WICA) licence as set out in the DCP is not applicable in the current circumstances.

Proposed Water Supply arrangements – Large Lot Residential subdivision

We note that it is proposed to include easements for water supply within the subdivision plan that will encompass the existing well and water supply infrastructure and the supply route for pipes and associated water supply infrastructure for the servicing of all lots within the Large Lot Residential subdivision.

It is intended to make a water supply available for all lots to the boundary of each lot within the water supply easement and each lot owner will bear the responsibility of connecting any improvements on the lot to the water supply located within the easement site.

We recommend that the supply and distribution of water for domestic purposes in quantities required by the MWRLEP is undertaken by the establishment of a private water scheme (the Scheme).

It is proposed that the Scheme is to be created upon the establishment of an Incorporated Association, formed for the specific purpose of supply of water to the various lots in the subdivision. The Incorporated Association is established with Fair Trading NSW.

The Incorporated Association must prepare and file its constitution which contains all relevant provisions regarding the operation of the private water scheme for the benefit of lot owners. A committee must be formed upon establishment of the Incorporated Association and a minimum

of 3 persons must be appointed as committee members when the Incorporated Association is established.

Upon the sale of each lot in the subdivision, each Purchaser must become a member of the Scheme in order to acquire the relevant lot and to receive a water supply. Further, the Contract for Sale for each individual lot will include a condition (together with a Deed) which requires any subsequent Purchaser of a lot to become a member of the Scheme as a condition of the subsequent sale of the lot.

The constitution of the Scheme will contain all relevant rules associated with the supply of water including maximum volumes, metering requirements and charges for the operation of the Scheme.

In due course, we are able to assist with preparation of an appropriate constitution for the Scheme and associated documents (including the Contract for Sale of Land).

We consider that establishment of the Scheme outlined above will satisfy the requirements for a reticulated water system within the Large Lot Residential subdivision, without the need to create a community title subdivision plan.

We look forward to discussing this matter with you further in due course.

Yours faithfully,
BOOTH BROWN LEGAL

Kane Olney
Principal

NSW GOVERNMENT | Natural Resources Access Regulator

Contact: Christopher Binks
Phone: 02-67631465
Email: Chris.Binks@dpi.nsw.gov.au

Our ref: IDAS1124181
Our file: CNR-6496 A-7117
Your ref: DA0225/2020

General Manager
Mid-Western Regional Council
PO Box 156
MUDGEE NSW 2850

Attention: Kayla Robson

19 May 2020

Dear Sir/Madam

Re: Integrated Development Referral – General Terms of Approval
Dev Ref: DA0225/2020
Description: Staged Subdivision
Location: 402 CASTLEREAGH HIGHWAY MENAH 2850

I refer to your recent letter regarding an integrated Development Application (DA) proposed for the above location. Attached, please find Natural Resources Access Regulator's General Terms of Approval (GTA) for part of the proposed development requiring a Controlled Activity approval under the *Water Management Act 2000* (WM Act), as detailed in the subject DA.

Please note Council's statutory obligations under section 4.47 of the *Environmental Planning and Assessment Act 1979* (EPA Act) which requires a consent, granted by a consent authority, to be consistent with the general terms of any approval proposed to be granted by the approval body.

If the proposed development is approved by Council, NRAR requests these GTA be included (in their entirety) in Council's development consent. Please also note NRAR requests notification:

- if any plans or documents are amended and these amendments significantly change the proposed development or result in additional works or activities (i) in the bed of any river, lake or estuary; (ii) on the banks of any river lake or estuary, (iii) on land within 40 metres of the highest bank of a river lake or estuary; or (iv) any excavation which interferes with an aquifer.

  NRAR will ascertain from the notification if the amended plans require review of or variation/s to the GTA. This requirement applies even if the amendment is part of Council's proposed consent conditions and do not appear in the original documentation.

- if Council receives an application under s96 of the EPA Act to modify the development consent and the modifications change the proposed work or activities described in the original DA.
- of any legal challenge to the consent.

As the proposed work or activity cannot commence before the applicant applies for and obtains an approval, NRAR recommends the following condition be included in the development consent:

The attached GTA issued by NRAR do not constitute an approval under the *Water Management Act 2000*. The development consent holder must apply to NRAR for a Controlled Activity approval **after consent** has been issued by Council **and before** the commencement of any work or activity.

A completed application form must be submitted to NRAR together with any required plans, documents, application fee, security deposit or bank guarantee (if required) and proof of Council's development consent. Finalisation of an approval can take up to eight (8) weeks from the date the application and all required supporting documentation is received.

Application forms are available from the NRAR website at:

www.industry.nsw.gov.au › Water › Licensing & Trade › Approvals.

NRAR requests that Council provide a copy of this letter to the development consent holder.

NRAR also requests a copy of the determination for this development application be provided by Council as required under section 91A (6) of the EPA Act.

Yours Sincerely

for

Rachel Daly
Water Regulation Officer
Water Regulatory Operations
Natural Resources Access Regulator

NSW GOVERNMENT | Natural Resources Access Regulator

General Terms of Approval

for proposed development requiring approval under s89, 90 or 91 of the Water Management Act 2000

Reference Number:	IDAS1124181
Issue date of GTA:	19 May 2020
Type of Approval:	Controlled Activity
Description:	Staged Subdivision
Location of work/activity:	402 CASTLEREAGH HIGHWAY MENAH 2850
DA Number:	DA0225/2020
LGA:	Mid-Western Regional Council
Water Sharing Plan Area:	Macquarie Bogan Unregulated and Alluvial Water Sources

The GTA issued by NRAR do not constitute an approval under the *Water Management Act 2000.* The development consent holder must apply to NRAR for the relevant approval **after development consent** has been issued by Council **and before** the commencement of any work or activity.

Condition Number	Details
	Design of works and structures
GT0018-00006	Before constructing or carrying out any proposed controlled activity, an application must be submitted to Natural Resources Access Regulator, and obtained, for a controlled activity approval under the Water Management Act 2000.
	Erosion and sediment controls
GT0006-00001	The following plan(s): - Erosion and Sediment Controls Plan must be: A. prepared in accordance with Managing Urban Stormwater: Soils and Construction, Volume 1 (Landcom, 2004), as amended or replaced from time to time, and B. submitted with an application for a controlled activity approval.
GT0014-00007	A. The consent holder must ensure that any proposed materials or cleared vegetation, which may: i. obstruct water flow, or ii. wash into the water body, or iii. cause damage to river banks, are not stored on waterfront land, unless in accordance with a plan held by Natural Resources Access Regulator as part of a controlled activity approval. B. When the carrying out of the controlled activity has been completed, surplus materials must be removed from waterfront land.
	Plans, standards and guidelines
GT0003-00022	The application for a controlled activity approval must include the following document(s): - structural design and specifications; Erosion and Sediment Control Plan; Vegetation Management Plan.
GT0012-00004	Any proposed controlled activity must be carried out in accordance with plans submitted as part of a controlled activity approval application, and approved by Natural Resources Access Regulator.
	Rehabilitation and maintenance
GT0011-00001	A rehabilitation plan for the waterfront land must be provided as part of a controlled activity approval application.
	Reporting requirements
GT0016-00003	The consent holder must inform Natural Resources Access Regulator in writing when any proposed controlled activity carried out under a controlled activity approval has been completed.

SCHEDULE 1

The plans and associated documentation listed in this schedule are referred to in general terms of approval (GTA) issued by NRAR for integrated development associated with DA0225/2020 as provided by Council:

- DA documents and plans.

Contact: Rob Kardell
Phone: 0408 923 596
Email: Robert.kardell@waternsw.com.au
File ref: CNR-6496
Your ref: DA0225/2020

Mid-Western Regional Council
Attn: Kayla Robson
Po Box 156
MUDGEE NSW 2850

21 September 2020

Dear Ms Robson

RE: Integrated Development Referral

Dev Ref: DA0225/2020

Description: Staged Subdivision

Location: 402 CASTLEREAGH HIGHWAY MENAH 2850

I refer to your correspondence seeking WaterNSW consideration in respect to requirements under section 89 and 90(2) of the *Water Management Act 2000* (WM Act).

WaterNSW has reviewed the information submitted with the application for the purposes of the WM Act, and can advise that no water use approval under section 89 of the WM Act is required to be administered by WaterNSW. Consideration in respect to 'water use' is only assessed by WaterNSW in relation to irrigation use. Any purpose outside of irrigation should be addressed by the relevant consenting authority, such as Council via local government development consent.

Further, no requirement for WaterNSW consideration in respect to section 90(2) of the WM Act - water management work approval, is necessary under this request. The proposed shared water supply arrangement to each of the resultant land portions post subdivision can be facilitated by the works (Wells / bores) currently authorised under approval 80CA718669 and the associated Water Access Licence (WAL) 34156.

It is however noted that the removal of defunct works may be required during, or prior to the subdivision construction phase. WaterNSW advise that the proponent be aware of decommissioning conditions pertinent to 80CA718669.

WaterNSW requests that Council provide a copy of this letter to the development consent holder.

Please feel free to contact me should you require any further information.

Yours Sincerely

Rob Kardell
Water Regulation Officer
Assessments and Approvals

Transport for NSW

25 September 2020

SF2020/081488; WST20/00108/03

General Manager
Mid-Western Regional Council
86 Market St
MUDGEE NSW 2850

Attn: Kayla Robson

Dear Ms Robson,

DA 0225/2020: Lot 2 DP 136904 & Lot 4 DP 1204035; 402 Castlereagh Highway (HW18), Menah
Proposed rural residential subdivision

Thank you for referring DA 0225/2020 to Transport for NSW (**TfNSW**) for comment. TfNSW encompasses both road and rail infrastructure and as such this response provides comments on both. This response relates to both the original DA referral and additional information received on 7 September 2020.

From a review of the documentation submitted in support of the proposal it is understood to include:

- Subdivision with staged release of land for primary production and residential purposes, with the applicable minimum lot size met for all lots, being to create lots of minimum 2ha.

- The overall development results in the creation of twenty-five (25) large residential lots and one (1) 96.1ha lot comprising of the remaining RU4 zoned land south of the Railway, and a 163.34ha rural lot comprising the land north of the railway corridor.

- The land has frontage to a new road for access to all residential lots. Proposed Lot 26 will have access off Wilbetree Road and the new road. Proposed Lot 1 in Stage 1, has existing access off Castlereagh Highway (to homestead) that is proposed to continue to be utilised.

The site is bound to the north by the non-operational rail corridor from Kandos to Gulgong. This rail corridor is currently subject to a feasibility study for re-opening. The site is bound to the west by the Castlereagh Highway (HW18), which is a state Classified Road. The DA has been referred to TfNSW pursuant to clauses 85, 86 and 104 of *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) and Section 138(2) of the Roads Act 1993.

Transport for NSW
51-55 Currajong Street PARKES NSW 2870 | PO Box 334 PARKES NSW 2870 DX20256
P 6861 1449 | **W** development.western@rms.nsw.gov.au | ABN 18 804 239 602

TfNSW does not object to the proposal, and grants its concurrence pursuant to section 138(2) of the *Roads Act 1993*, subject to the following being included in any development consent:

- The intersection of the Castlereagh Highway and Wilbetree Road is to be upgraded prior to issuance of subdivision certificate, in accordance with *Austroads Guide to Road Design Part 4A (2017):*

    - Figure 7.5 'Type CHR' (Channelised Right Turn); and
    - Figure 8.3 'Type AUL (Auxiliary Left Turn) and any relevant TfNSW Supplements.

- Safe Intersection Sight Distance (SISD) requirements outlined in the *Austroads Guide to Road Design Part 4A* and relevant TfNSW Supplements shall be provided in both directions at the intersection of the Castlereagh Highway and Wilbetree Road. For an 80 km/h speed zone the minimum SISD is 181 metres.

- A copy of construction plans for the proposed road work associated with the intersection is to be submitted to TfNSW for approval. As road work is required on a state road, the developer will be required to enter into a Works Authorisation Deed (WAD) with TfNSW. TfNSW will exercise its powers under Section 87 of the *Roads Act, 1993* (the Act) and/or the functions of the roads authority, to undertake roadwork in accordance with Sections 64 and 71 and/or Sections 72 and/or 73 of the Act, as applicable, for all works under the WAD.

- Prior to the commencement of construction works, the proponent is to contact TfNSW's Traffic Operations Coordinator on 1300 656 371 to determine if a Road Occupancy Licence (ROL) is required. In the event that an ROL is required, the proponent will obtain the ROL prior to works commencing within three (3) metres of the travel lanes in the Castlereagh Highway.

Pursuant to clauses 85 and 86 of *State Environmental Planning Policy (Infrastructure) 2007*, TfNSW requests the following recommendations be applied to any consent issued by Council:

- Prior to issue of the Subdivision Certificate, evidence is to be provided to Council that the private level crossing to Lot 2 DP 136904 at the rail corridor has been formally closed.

    Reason for condition

    It is NSW Government policy to close level crossings if a closure of level crossings is assessed to have no adverse impacts on affected parties where alternative access exists due to the safety risk associated with level crossings. JHR's record indicates that there is a private level crossing located at the rail corridor which appears to be exclusively provided to Lot 2 DP 136904 to accommodate its access. The development of Stage 1 proposes to provide access to proposed Lot 1 via Castlereagh Highway and to proposed Lot 2 via Wilbertree Road. In addition, the development contains a proposal to develop a new cul-de-sac road off Wilbetree Road to provide access to 25 lots in Stage 2. In light of the above, it is considered that provision of the private level crossing to Lot 2 DP 136904 will no longer be required following subdivision.

Transport for NSW
51-55 Currajong Street PARKES NSW 2870 | PO Box 334 PARKES NSW 2870 DX20256
P 6861 1449 | **W** development.western@rms.nsw.gov.au | ABN 18 804 239 602

- Prior to issue of the relevant Subdivision Works Certificate, evidence is to be provided to Council to demonstrate that the applicant has obtained an approval from RailCorp to install boundary fences along the boundary with the railway line. Prior to the issue of the relevant Subdivision Certificate, evidence shall be provided to demonstrate that the approved fencing has been installed to the satisfaction of RailCorp.

Note: The applicant is required to submit an application to install the boundary fences to John Holland Rail, who manages the Country Regional Network, for its endorsement and for RailCorp's approval. A survey, prepared by a registered surveyor, to define the common boundary along the rail corridor, is to be submitted to JHR and to obtain RailCorp's approval to the definition of the common boundary.

Reason for condition

The security of fencing along the rail corridor is essential to prevent unauthorised entry and ensure safety. It is noted that proposed Lots 1, 2 and 3 are immediately adjacent to the rail corridor. The applicant is advised to contact JHR's Third party works team via CRN.3rdpartyworks@jhg.com.au for more information.

- Prior to issue of the Subdivision Certificate, the applicant is required to enter into an easement for noise and vibration to burden on the subdivided lots and to benefit RailCorp in accordance with terms and conditions as stipulated in a Section 88B Instrument in light of the rail corridor adjoining the site is currently in operation.

Reason for condition

The feasibility of reopening the railway line is currently under investigation.

- Prior to the issue of any Subdivision Works Certificate for the subdivision, evidence is to be provided to demonstrate that post development stormwater generation does not exceed pre-development stormwater generation at the point of discharge to the railway corridor. The evidence shall be in the form of a detailed stormwater management plan prepared by a suitably qualified and experience engineering consultant and to the satisfaction of RailCorp.

Note: If the above assessment determines that works are required on site to retard stormwater prior to discharge to the railway corridor, a 4.55 modification application would be required to enable consideration of the impacts of the additional works required to adequately address stormwater management.

Reason for condition

To ensure stormwater generation does not adversely impact on the rail corridor.

The applicant should also be made aware, by way of an advisory note on the consent of the following items:

- Noting that the current application does not include works, the applicant should be advised that in any subsequent applications whereby such equipment is required to be used in the air space over the rail corridor, the applicant must submit an application to JHR for RailCorp's approval in advance. The applicant is welcome to contact JHR's Third party works team via CRN.3rdpartyworks@jhg.com.au for more information in this regards.

Transport for NSW
51-55 Currajong Street PARKES NSW 2870 | PO Box 334 PARKES NSW 2870 DX20256
P 6861 1449 | **W** development.western@rms.nsw.gov.au | ABN 18 804 239 602

- Noting that the current application does not include works or design, the applicant should be advised that in any subsequent applications that the development lighting and external finishes of building do not temporarily blind or cause distraction to railway operation. In addition, the use of red and green lights must be avoided in all signs, lighting and building colour schemes on any part of a building which faces the rail corridor.

Pursuant to clauses 101 and 104 of *State Environmental Planning Policy (Infrastructure) 2007*, TfNSW provides the following recommendations to assist Council in its assessment and determination of the DA:

- Austroads *Guide to Road Design Part 4: Intersections and Crossings – General* identifies that the location and spacing of intersections and property access can affect the safety and operation of a road, and as such that Intersections must be located so that required driver and pedestrian sight distances are met.

- In this regard, the proposed new road should be located to ensure that all the sight distance requirements of Section 3.2 of Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* are achieved. For an 80km/h speed limit, an Approach Site Distance (ASD) of 114m is required and a Safe Intersection Sight Distance (SISD) of 181m is required.

- Prior to the issue of any Subdivision Certificate, a restriction as to user is to be registered under the *Conveyancing Act 1919* on each of the lots that have frontage to the Castlereagh Highway (classified State road HW18), prohibiting vehicular access between HW18 and each lot burdened.

  Reason: To comply with Section 101 of SEPP (Infrastructure) 2007.

Please forward a copy of Council's determination of the DA to TfNSW at the same time it is sent to the applicant. If you have any queries or wish to discuss this matter further, please contact Ainsley Bruem, A/Manager Land Use Assessments on 02 6861 1449.

Yours faithfully

Holly Davies
A/Senior Manager Regional Customer Services
Western Region

Transport for NSW
51-55 Currajong Street PARKES NSW 2870 | PO Box 334 PARKES NSW 2870 DX20256
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Subject: Re: NSW Government concurrence and referral request CNR-6496 / DA0225/2020 - 402 Castlereagh Highway, Menah (Lot 2 DP136904, Lots 4 & 5 DP1204035) - Staged subdivision

Attachments: Plans Subdivision Stage 1 and 2.docx

Dear Sir/Madam,

We refer to the above matter and to your correspondence via the NSW Planning Portal seeking comment from Essential Energy in relation to the proposed development.

Strictly based on the documents submitted, Essential Energy has no comments to make as to potential safety risks arising from the proposed development.

Essential Energy makes the following general comments:

1. If the proposed development changes, there may be potential safety risks and it is recommended that Essential Energy is consulted for further comment.

2. As part of the subdivision/s, easement/s are to be created for any existing or new electrical infrastructure, using Essential Energy's standard easement terms current at the time of registration of the plan/s of subdivision.

3. Any existing encumbrances in favour of Essential Energy (or its predecessors) noted on the title of the above properties should be complied with.

4. Council should ensure that a Notification of Arrangement (confirming satisfactory arrangements have been made for the provision of power) is issued by Essential Energy with respect to all proposed lots which will form part of the subdivision, prior to Council releasing the Subdivision Certificate. It is the Applicant's responsibility to make the appropriate application with Essential Energy for the supply of electricity to the subdivision, which may include the payment of fees and contributions. Despite Essential Energy not having any safety concerns, there may be issues with respect to the subdivision layout, which will require Essential Energy's approval.

5. In addition, Essential Energy's records indicate there is electricity infrastructure located within the properties and within close proximity to the properties. Any activities within these locations must be undertaken in accordance with the latest industry guideline currently known as *ISSC 20 Guideline for the Management of Activities within Electricity Easements and Close to Infrastructure*. Approval may be required from Essential Energy should activities within the property encroach on the electricity infrastructure.

6. Prior to carrying out any works, a "Dial Before You Dig" enquiry should be undertaken in accordance with the requirements of Part 5E (Protection of Underground Electricity Power Lines) of the *Electricity Supply Act 1995 (NSW)*.

7. Given there is electricity infrastructure in the area, it is the responsibility of the person/s completing any works around powerlines to understand their safety responsibilities. SafeWork NSW (www.safework.nsw.gov.au) has publications that provide guidance when working close to electricity infrastructure. These include the *Code of Practice – Work near Overhead Power Lines* and *Code of Practice – Work near Underground Assets*.

Should you require any clarification, please do not hesitate to contact us.

Regards

Fiona Duncan
Conveyancing Officer
Legal & Conveyancing
Governance & Corporate Services

NSW GOVERNMENT

NSW RURAL FIRE SERVICE

Mid-Western Regional Council
PO Box 156
MUDGEE NSW 2850

Your reference: DA0225/2020 (CNR-6496)
Our reference: DA20200409001287-Original-1

ATTENTION: Kayla Robson

Date: Monday 25 May 2020

Dear Sir/Madam,

Development Application
s4.15 – Other –
402 Castlereagh Highway Menah NSW 2850, 2//DP136904

I refer to your correspondence dated 07/04/2020 seeking advice regarding bush fire protection for the above Development Application in accordance with section 4.15 of the *Environmental Planning and Assessment Act 1979*.

The New South Wales Rural Fire Service (NSW RFS) has considered the information submitted and provides the following recommended conditions:

Asset Protection Zones
The intent of measures is to provide sufficient space and maintain reduced fuel loads so as to ensure radiant heat levels of buildings are below critical limits and to prevent direct flame contact with a building. To achieve this, the following conditions shall apply:

[1.]

At the issue of a subdivision certificate, the entire site must be managed as an inner protection area (IPA). The IPA must comprise:

- Minimal fine fuel at ground level;
- Grass mowed or grazed;
- Trees and shrubs retained as clumps or islands and do not take up more than 20% of the area;
- Trees and shrubs located far enough from buildings so that they will not ignite the building;
- Garden beds with flammable shrubs not located under trees or within 10 metres of any windows or doors;
- Minimal plant species that keep dead material or drop large quantities of ground fuel;
- Tree canopy cover not more than 15%;
- Tree canopies not located within 2 metres of the building;
- Trees separated by 2-5 metres and do not provide a continuous canopy from the hazard to the building; and,

Postal address
NSW Rural Fire Service
Locked Bag 17
GRANVILLE NSW 2142

Street address
NSW Rural Fire Service
4 Murray Rose Ave
SYDNEY OLYMPIC PARK NSW 2127

T (02) 8741 5555
F (02) 8741 5550
www.rfs.nsw.gov.au

- Lower limbs of trees removed up to a height of 2 metres above the ground.

General Advice – Consent Authority to Note
Any further development application for class 1,2 & 3 buildings as identified by the National Construction Code must be subject to separate application under section 4.14 of the Environmental Planning and Assessment Act 1979 and address as may be applicable, the requirements of Planning for Bush Fire Protection 2019.

For any queries regarding this correspondence, please contact Marc Ellwood on 1300 NSW RFS.

Yours sincerely,

Nika Fomin
Manager Planning & Environment Services
Planning and Environment Services

Edward Knox DeLong II & Susan Brav DeLong

24 April 2020

Mr Brad Cam
General Manager
Mid-Western Regional Council
86 Market St
Mudgee 2850 NSW

Re: Development Application DA0225/2020 – PROPOSED TORRENS TITLE SUBDIVISION OF LAND IN (2) TWO STAGES (STAGE 1 – 2 INTO 3 LOTS & STAGE 2-1 INTO 25 LOTS) @ MENAH 400 – 402 CASTLEREAGH HIGHWAY MENAH NSW 2850 – LOT 2 DP 136904 & LOT 4 DP12 1204035

CONCENT AUTHORITY: MID-WESTERN REGIONAL COUNCIL

APPLICANT: MR MICHAEL R DE KANTZOW

Dear ~~General Manager~~ Brad:

My wife and I have the following concerns regarding the Development Application (DA) referenced above.

WATER
An adequate and sustainable supply of water is essential for life, both for humans and for the land. We view the potential inability of the land and the sky to provide an adequate amount of water as the most significant issue related to this DA.

The DA places great reliance on rainwater to supply potable water year round, citing an average annual rainfall for Mudgee of 684.5mm (page 33), saying rainwater alone will not meet the requirements of a home and projecting that water from a shared well can make up the difference. Reliance on the average annual rainfall amount, however, is risky. The Bureau of Meteorology (BoM) says Mudgee received only 367.1mm last year and that for this Century annual rainfall was less than the annual amount cited in the DA in 5 of the past 7 years.

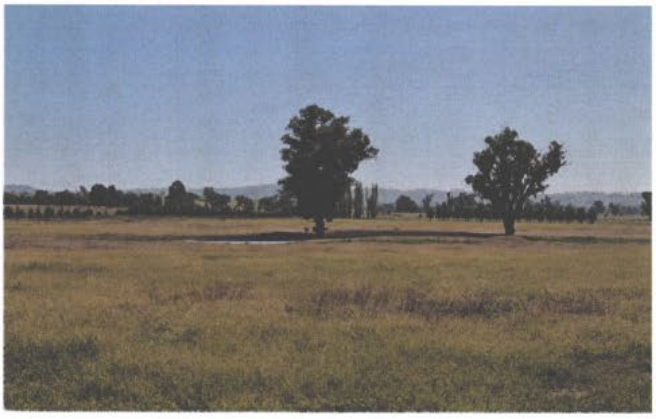
Without entering the argument of whether we are in an era of long-term climate change, it appears to us that the DA's projected reliance on rainwater is optimistic.

ENVIRONMENTAL IMPACT
Two aspects of environmental impact are of concern.

The first is the way the DA absolutely ignores the presence of a dam that has not run dry during our 19 years here and that must be preserved for both its esthetic attraction and its presence as part of a water system that appears to be made up of both a stream on the surface and infill from springs at the bottom of the dam.

We estimate that this dam would be in proposed Lot 7. A formal survey, which should have been included in the DA from the outset, will determine the exact location of the dam, its supply stream and its overflow stream. The supply stream lies just below the red line in the photo on the next page (taken from Google Maps), while the dam itself and the two mature gum trees on its northern edge are within the blue line on the same photo.

Also plainly visible in the aerial photo are a number of mature trees within what is probably Lots 5, 6 and 7 as well as a triangular stand of young trees, planted relatively recently, just to the right of the dam.



This second photograph shows the dam as seen from our property, looking across Lot 6 and Lot 7.

Edward Knox DeLong II & Susan Bray DeLong

The other area of environmental concern is the impact on existing properties posed by Lots 2 through 7. The DA pays lip service to the establishment of a healthy relationship between the proposed new lots, which would be carved out of grazing land, and the existing properties. It sums up its view of this by saying: "The additional dwelling opportunities are not likely to adversely impact on the neighbouring residential land or their amenity." This is not true.

The property bounded by proposed Lots 2 - 6 was purchased for its rural agricultural outlook (see submission by Tony and Elizabeth Roberts) and is currently running sheep, while the property bounded by Lots 6 – 7 is our working farm raising Damara sheep.

Our farm, while admittedly small compared to many of the properties around Mudgee, will subject its proposed new neighbours to the noise of animals and farm equipment, to potential spray drift of agricultural chemicals, to the occasional sound of putting down a sick animal or dispatching an intruding animal that poses a threat to our stock.

As for amenity, we and the Roberts family (again see their submission) are seriously concerned about the threatened loss of view, privacy, serenity and lifestyle that in large measure prompted us to purchase at this location in the first place. It might be noted that we were told by a Council planning officer in 2001 that the land to our north (the land now the subject of this DA) would never be built out because it as flood plain. The truth of this flood risk was dramatically demonstrated a few years later when a particularly heavy rain coupled with an already full Cudgegong River produced a flood that came up to the back of the dam mentioned earlier in this submission – far beyond the bounds of the 100 year flood line relied upon in this DA.

We seek to have a buffer between our properties and the proposed new encroaching properties. We submit the way in which Wellington Council dealt with this conflict between existing and new uses as an example of what this Council could do. See Attachment 1 for details of the problem and solutions taken at the state level by Western Australia and Queensland, and at the local level by Wellington Council and others.

Whether or not Council agrees to require an adequate spray drift buffer, we are concerned with the potential for the proposed new properties to disrupt the amenity of our lives both visually and audibly. This is no small issue and we are dismayed at the way the DA treated it as if it were of little significance.

We ask Council to impose a visual buffer of substantially more than 20 meters between our boundary and buildings erected on the proposed new properties. It seems to us that somewhere between 50 and 100 meters would be an appropriate construction setback and that a screen of mature trees

Minor issues to be dealt with but not addressed in the DA include such items renewal of the boundary fence between us and the proposed new lots and the type of fencing to be erected on the proposed new properties.

SUMMATION
We have raised questions about the way the DA at hand addresses:

- Adequacy of water supplies;
- A major environmental feature in the form of a dam that is never dry, even when most dams across the region are bone dry;
- A spray drift buffer between our property and those proposed in the DA;
- Provision of an adequate visual buffer whether or not a spray drift buffer is required;
- Minor issues such as fencing.

While we would like to see the land to our immediate north remain undeveloped, we recognize that this horse has bolted. That being the case, we have no objection to the proposed development so long as the above issues are dealt with adequately.

Sincerely,

Ed and Susan DeLong

Attachment 1

Spray Drift

Protecting new residential development from the negative impact of existing normal farming activity such as agricultural spraying is a duty of care issue of potential public health and safety significance for councils.

This issue has been addressed at the state level by Queensland and Western Australia, both of which have prepared guidelines for their councils to follow, and at the local government level in the DCPs of a number of councils in New South Wales, Victoria and South Australia.

The risks associated with agricultural spray drifting into off-target areas – particularly where residential properties share a boundary with agricultural activities – have been identified by CSIRO and other scientific organisations. These risks include potential harm to human health as well as injury or damage to plants, animals, the environment and property. Spray drift is the most common cause of off-target movement of agricultural chemicals and can exist despite the application by sprayers of best practice measures to minimise it.

Mid-Western Regional Council presently addresses spraying primarily as part of its roadside management program. There are no provisions in the DCP designed to protect new residential development from the potentially dangerous or unwelcome impacts of normal activities on adjoining agricultural land and to ensure those normal agricultural activities can continue. The absence of such provisions needs to be addressed expeditiously so the DCP can more completely provide certainty to residents and developers in locations where development may conflict with or be

constrained by adjoining land uses. My requested addition to Draft DCP Amendment 3 offers the ideal opportunity to rectify this situation.

Land use across most of this Council is agricultural in nature. There is little or no conflict between adjoining properties that both spray for weeds. Unless Council adopts proactive control measures such as buffer zones, however, conflict can result from increased expansion of residential developments into what had been exclusively agricultural areas.

State and local governments have most often chosen buffer zones to protect new residential development while allowing existing agricultural practices to continue on adjoining properties.

Here how the Lismore City Council describes the use of these zones:

> Conflicts in land use may occur where residential development encroaches into non-residential areas, and established land use practices associated with a particular land use or activity are likely to lead to a real or perceived loss of amenity for residents. Typical external effects which may be generated by certain land uses and which could be considered to be incompatible with residential development include noise, odours, chemical sprays dust etc. If these effects are not taken into account at the development control stage, pressures can be exerted on land owners to modify existing land use practices. This could affect the economic viability of an established land use or industry and in some cases could result in the sterilisation of a resource.
>
> The most appropriate means for reducing potential land use conflicts is to provide for a physical separation between incompatible land uses in the form of a buffer area. ... Where an application is received for a development which is likely to result in a conflict with existing or likely future adjoining land uses, it will be the responsibility of the "encroaching development" to provide the required buffer areas.
>
> *– Lismore City Council DCP for LEP 2000 Lands (underscoring mine)*

Most councils adopt buffers of varying widths depending on why the buffer is needed and the type of buffer used. Councils have generally modelled their DCPs on Queensland's *Planning Guidelines: Separating Agricultural and Residential Land Uses – August 1997*.

The Wellington Council Development Control Plan 2013 is one such plan in the Central West. It incorporates the following buffer requirements:

Buffer design for various situations

	Duration threshold	Min default distance (m) without vegetative buffer	Min design distance (m) with suitable vegetative buffer
Chemical spray drift	None	300	40
Intermittent odour	>88 hrs/yr	500	500*
Intermittent noise such as a tractor	>10 hrs/yr <50 hrs/yr	60 (day) 1000 (night)	15 (day) 250 (night)
Long term noise such as a continuously running motor	>50 hrs/yr	500 (day) 1000 (night)	120 (day) 1000 (night)
Dust, smoke and ash	None	150	40

* Minimum design distance for an odour buffer may reduced based on site factors and nature of the odour

** Day = noise occurring 6am-10pm
Night = noise ocurring 10pm-6am

Suitable Vegetative Screen:
Research into the behaviour of pesticide spray drift has shown that Buffer Elements in the form of vegetation screens can prove effective barriers to spray drift where they meet the following criteria:

- Are a minimum total width of 40m;
- Contain random plantings of a variety of tree and shrub species of differing growth habits, at spacings of 5m for a minimum width of 40m;
- Include species with long, thin and rough foliage which facilitates the more efficient capture of spray droplets;
- Provide a permeable barrier which allows air to pass through the buffer.
- Foliage is from the base to the crown;
- Include species which are fast growing and hardy;
- Have a mature tree height 1.5 times the spray release height or target vegetation height, whichever is higher;
- Have mature height and width dimensions which do not detrimentally impact upon adjacent cropped land;
- Include an area of at least 10m clear of vegetation or other flammable material to either side of the vegetated area.

The complete Queensland Department of Natural Resources Document *Planning Guidelines: Separating Agricultural and Residential Land Uses – August 1997* is provided as Attachment 1 (page ??).

I urge this Council to add a section to DCP Amendment 3 reflecting the following concepts. The language and structure I have used is derived from the Queensland Department of National Resources *Planning Guidelines: Separating Agricultural and Residential Land Uses – August 1997* supported by CSIRO (2002) and from the West Australia Department of Health *Guidelines for Separation of Agricultural and Residential Land Uses*. Other jurisdictions have used a similar process.

Introduction
Conflict between residential development and agricultural land uses is likely to occur where residential land use directly abuts, or is sufficiently close to, farmland such that the residential land use is likely to be affected by agricultural activities.

The need for a formal policy arises as an increasing number of residential developments encroach on land previously occupied for agricultural use. Conflict between these distinctly different uses can arise from the use of agricultural chemicals, and noise, dust and odour generating activities. Adverse impacts of residential development on farmland include sediment and stormwater run-off.

Edward Knox DeLong II & Susan Bray DeLong

These planning guidelines outline planning measures to reduce such land use conflict.

Definitions

Agricultural land – Land to produce food, fibre and timber including grazing, breeding, cropping, horticulture and forestry.
Buffer area/zone – An area of separation between differing land uses.
Buffer element – A natural or artificial feature that mitigates an adverse impact, including open ground, vegetation or constructed/acoustic barrier.
Rural residential development – Rural allotments created primarily for residential purposes and other places of human accommodation, excluding dwellings associated with bona fide agricultural holdings.
Sensitive land use – Land uses considered to be potentially sensitive to emissions from industry and infrastructure including residential developments, hospitals, hotels, motels, hostels, caravan parks, schools, hospitals, nursing homes, child care facilities, shopping centres, playgrounds, and some public buildings.
Separation distances – The total linear distance between a source and a sensitive receptor.

Principles
The following principles should govern the application of these planning guidelines:

- Provided agricultural activities conform to existing codes of practice, it is unreasonable for new adjacent uses to demand a modification of these activities to an extent which threatens efficient agricultural operations.

- Local governments should avoid, as far as practicable, locating residential development in close proximity to agricultural land. Where this is not possible, mechanisms such as buffer areas should be used to minimise conflicts.

- Buffer areas are to be located within the encroaching residential development and are to be provided/funded by the proponent of that development. This principle protects the prior rights of agricultural producers to practice agriculture on rural land.

- Where conflicts already exist between agricultural and residential land uses, mechanisms including mediation, source controls and public education should be encouraged.

Limitations
It has been found impractical for buffer distances to be based on the chemical being applied. It is therefore important for various buffer distances to be conservatively based on the nature specific agricultural activities.
Vegetative buffers may not be suitable where the chemicals in use may result in vapour drift (for example soil fumigants) or where herbicide spray drift would impact on the vegetative buffer. In these circumstances a 300m buffer distance would apply.
Safe application of chemicals, design and use of spray technology/equipment and requirements under existing legislation are not specifically covered by this document.
Buffers are not a substitute for good spray management practices.

Establishment and maintenance of buffer areas
New residential developments should protect the rights of the existing agricultural producers to continue to perform farming activities on their land.

The following measures should be implemented at the earliest possible planning stage to minimise impacts on public health:

- Where land is approved for subdivision or residential development the prospective proponent must be advised by the local government of the requirement for buffer areas to be included.
- Applications for development are to consider and describe the existence and location of surrounding land uses, including viticultural and agricultural activities, and site the development in a position which will not result in the potential for land use conflict between neighbouring land uses.
- Applications for a site being developed for residential purposes are to include buffer areas that are planned and funded by the proponent of that development, unless otherwise determined by mutual agreement with existing land owners (including land owned by State and local authorities).
- Buffer areas should apply from the boundary to boundary of the conflicting land uses.

- Persons intending to live in or adjacent to an agricultural land use area need to be fully informed of the agricultural practices and their potential impact on health or amenity before they settle into the area.

- Where a vegetative buffer is planned, the proposals must state who is responsible for planting and maintaining the buffer area vegetation. The vegetative buffer needs to be planted and established before building approval is granted. A legal agreement must be established that specifies the legal and ongoing obligations on the developers, local government and landowners.

Separation Distances

Agricultural Spray Drift

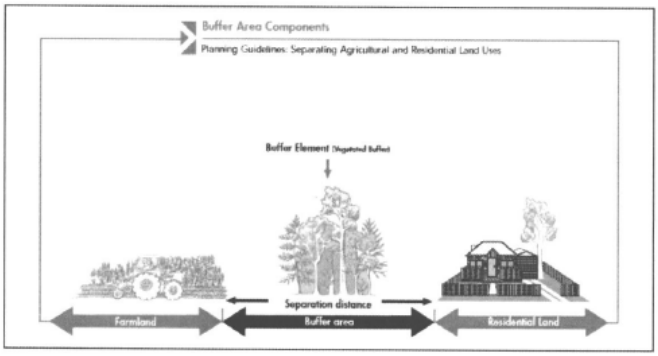
The off-target movement of agricultural chemicals can be a cause for concern to residents in proximity to farming areas. These concerns are largely based on fears of exposure to agricultural chemicals which have the potential to harm human health, damage plants and injure animals on adjoining residential property. These concerns can be triggered by the detection of odours associated with the chemical.

Based on the available research on chemical spray drift, the planning guidelines have adopted a minimum width of 300m where open ground conditions apply between the agricultural activity and the residential property and a minimum width of 40m where a suitable vegetative buffer can be satisfactorily implemented and maintained.

Summary of spray drift buffer requirements:

Element:	***Agricultural Chemical Spray Drift***
Objective:	To locate new residential areas so that the impact of agricultural chemical spray drift on amenity and health is avoided and complaints from residents regarding the use of agricultural chemicals is unlikely.

Performance Criteria	***Acceptable Solutions***
Residential development to be located or incorporate measures such that chemical spray drift does not adversely affect community public health and safety.	(i) The separation distance between a sensitive receptor and agricultural land is a minimum of 300 m. or: (ii) A vegetated buffer designed by a consultant acceptable to council and incorporating the criteria shown in Appendix 2 is located between the sensitive receptor and adjacent agricultural land. The vegetated buffer should: • be provided with a suitable watering system; • include access strips on either side which are kept clear of vegetation and other flammable materials; • be of a height, density and width (40 m min) acceptable to council prior to the development of residential areas within 300 m of the agricultural land. or (iii) Other measures which meet the performance criteria and which are acceptable to council.



Odour

Odour in rural areas can arise from use of agricultural chemical sprays, fertilisers, effluent disposal and intensive livestock (e.g. feedlots, piggeries and poultry farms) and composting plants. Such detrimental odours can impact on residential amenity and have the potential to affect public health. Odour is can also be a major factor in complaints about off-site chemical spray drift where there may be no objective evidence of toxic exposure. This can result from the placement of strong "marker" odours as in a chemical to allow easy identification.

Edward Knox DeLong II & Susan Bray DeLong

To minimise the impact of odour generated by agricultural activities a separation distance between residential land and agricultural land producing the odour is a minimum of 500m unless a buffer area is designed based on a report from a qualified consultant acceptable to council detailing relevant factors and verifying that odour design goals will be met at within the development or other measures are adopted which meet the performance criteria and which are acceptable to council.

Summary of odour control solutions:

Element:	***Odour from agricultural activities***	
Objective:	To locate new residential areas so that the impact of odour generated by agricultural activities on residential areas is minimised.	
Performance Criteria		***Acceptable Solutions***
Residential development to be located or incorporate measures to minimise the impact of odour in excess of the duration threshold generated by intermittent agricultural activities at dwellings within the development.		(i) The separation distance between a sensitive receptor and agricultural land is a minimum of 500 m. or: (ii) A buffer area design based on a report consistent with the draft EPP (Air) from a qualified consultant acceptable to council detailing relevant factors and verifying that odour design goals in the EPP (Air) will be met at sensitive receptors within the development. or: (iii) Other measures which meet the performance criteria and which are acceptable to council.

Noise

Four types of noise associated with agricultural activity may lead to land use conflict. These are the noises associated with intensive livestock facilities, aircraft activities, constant or long-term noise (e.g. pumps or refrigeration plants), and intermittent noise from tractors and other machinery.

The following noise levels and cumulative time thresholds have been adopted to determine whether noise is likely to be excessive and require a buffer. The noise source is classed as intermittent if the noise level specified in the following table is exceeded for a cumulative total of more than 10 hours per year. If this cumulative time is not exceeded, there is no requirement for a buffer area. The noise is considered long term if it exceeds the level given in the table for a cumulative total of more than 50 hours per year. Stricter standards are applied to noise from night time operations between 10pm and 6am.

Noise level classifications

	Intermittent Noise >10 hrs/yr	**Long Term Noise >50 hrs/yr**
Day-time 6am-10pm	75 dB(A) (LAmax,T)	60 dB(A) (LAmax,T)
Night-time 10pm-6am	55 dB(A) (LAmax,T)	45 dB(A) (LAmax,T)

Edward Knox DeLong II & Susan Bray DeLong
"Ardrossan"
PO Box 1192, Mudgee, NSW 2850 Australia
286 Castlereagh Highway, Menah NSW 2850 Australia

Minimum separation distances between an agricultural noise source and residential property are based on a noise attenuation rate of 5 dB(A) for each doubling of distance from the noise source across open ground. The existence of natural barriers, broken topography or other features would increase attenuation and affect the separation distance required.

A standard noise source of 90 dB(A)(LAmax,T), measured at 7.5m from the source has been used. For example a daytime noise level is attenuated to 75 dB(A) (LAmax,T) at a distance of 60m from the source. A night-time noise level is attenuated to 55 dB(A) (LAmax,T) at a distance of 1000m from the source. These distances have been adopted in the planning guidelines as the minimum buffer width for intermittent day and night-time activities that occur more than 10 hrs/yr but less than 50 hrs/yr.

Factors affecting noise from agricultural activities which should be considered in designing buffer areas include:

- type of engine (diesel or petrol; 2- or 4-stroke);
- number of cylinders;
- cooling system (air or liquid);
- load;
- timing, frequency and duration of operations;
- geographical conditions and barriers e.g.
- topography and inversions;
- weather conditions e.g. wind speed and
- direction;
- typical industry machinery and practices.

In circumstances where there are existing long term noise sources close to a proposed residential development, the proponent may consider funding measures such as machinery enclosures, mufflers, noise barriers and /or house design elements such as double glazing to complement subdivision layout and design measures to meet the performance criteria.

Applicants who wish to propose alternative noise reduction measures should determine noise levels at specific representative sites and demonstrate that the noise design goals for residential areas are not excessive.

Edward Knox DeLong II & Susan Bray DeLong

Element:	***Noise from agricultural activities***
Objective:	To locate new residential areas so that noise from agricultural activities is attenuated to safeguard amenity in noise sensitive places.

Performance Criteria	***Acceptable Solutions***
a) Residential development to be located or incorporate designs to minimise the impact of noise in excess of the duration threshold from **day-time** agricultural activities at dwelling within the development.	a) (i) The separation distance between the sensitive receptor and agricultural land is a minimum of 60 m for intermittent noise and 500 m for long-term noise. or: (ii) A buffer width and design based on a report from a qualified acoustic consultant acceptable to council detailing relevant factors and verifying that noise design goals consistent with the draft EPP (Noise) will be met at sensitive receptors within the development. or: (iii) Other measures which meet the performance criteria and which are acceptable to council.
b) Residential development to be located or incorporate designs to minimise the impact of noise in excess of the duration threshold from **night-time** agricultural activities at dwellings within the development.	b) (i) The separation distance between the sensitive receptor and agricultural land is a minimum of 1000 m. or: (ii) A buffer width and design based on a report from a qualified acoustic consultant acceptable to council detailing relevant factors and verifying that noise design goals consistent with the draft EPP (Noise) will be met at sensitive receptors within the development. or: (iii) Other measures which meet the performance criteria and which are acceptable to council.
c) In areas of **aerial** agricultural activity, development should be located to minimise noise from aircraft.	c) The separation distance between the sensitive receptor and agricultural land to be a minimum of 100 m to comply with Air Navigation Order 20.21 which prohibits air craft flying closer than 100 m to a private dwelling.

Aircraft noise is governed by factors outside the scope of a council's DCP. In areas of aerial spraying, the separation distance between residential development and agricultural land must be a minimum of 100m to comply with Australia's Civil Aviation Safety Regulations 1998. This distance is based on operational safety as well as noise considerations and applies to both fixed wing and rotary wing aircraft.

Dust, Smoke and Ash

Some agricultural activities including soil cultivation, tractor movements, controlled burning and harvesting can generate dust, smoke and ash. Local conditions, including wind strength and direction, rainfall, humidity and ambient temperatures, soil type, vegetative cover and type of on-site activity determine the extent of the problem.

In the absence of quantitative research data, a separation distance of 150m is recommended where dust, smoke or ash from agricultural activities have been identified as a potential source of conflict between farming activities and residential development. In most cases, a vegetated buffer designed to capture chemical spray drift will also be effective in reducing conflict resulting from dust, smoke and ash.

Summary of solutions to problems of dust, smoke and ash

Element: ***Dust, smoke and ash from agricultural activities***

Objective: To locate new residential areas so that the impact of dust, smoke and ash generated by agricultural activities on residential areas is minimised.

Performance Criteria	***Acceptable Solutions***
Residential development to be located or incorporate measures to minimise the impact of dust, smoke and ash generated by agricultural activities.	(i) The separation distance between the sensitive receptor and agricultural land is a minimum of 150 m. or: (ii) A vegetated buffer designed by a consultant acceptable to council is located between the sensitive receptor and adjacent agricultural land. The vegetated buffer should: • be provided with a suitable watering system; • include access strips on either side which are kept clear of vegetation and other flammable materials; • be of a height, density and width (40 metres min) acceptable to council prior to the development of residential areas within 150 m of the agricultural land. or: (iii) • Other measures which meet the performance criteria and which are acceptable to council.

April 21st 2020

General Manager,
Midwestern Regional Council
86 Market Street,
Mudgee 2850

Tony & Elizabeth Roberts

Dear General Manager,

RE; Development Application DA0225/2020 – PROPOSED TORRENS TITLE SUBDIVISION OF LAND IN (2) STAGES (STAGE 1-2 INTO 3 LOTS & STAGE2-1 INTO 25 LOTS) @ MENAH 400-402 CASTLEREAGH HIGHWAY MENAH NSW2850- LOT 2 DP 136904 & DP 1204035
CONSENT AUTHORITY : MID-WESTERN REGIONAL COUNCIL
APPLICANT: MR MICHAEL R DE KANTZOW

We have many concerns and apprehensions about the above mentioned Development Application;

- loss of view & serenity
- loss of privacy
- loss of lifestyle
- water – that the proposed communal bore will greatly affect our well/bore supply levels and quality
- what compensation will be in place should this affect our ground water
- waste water management systems on each block possibly having an effect on ground water quality
- Dust
- Noise
- Disruption during the development

Further consultation is required in regard to;

- set backs of buildings from all boundaries
- MATURE vegetation / screening & plant types along our boundaries BEFORE RELEASE
- fencing – renewal of boundary fence
- building heights / restrictions
- type of fencing erected on proposed blocks
- more accurate measurement and placement of blocks

We are strongly against the development because of **all** of the above mentioned points.

Yours Faithfully

Tony and Elizabeth Roberts

10 August 2020

'Menah'

400 Castlereagh Highway

Menah NSW 2850

General Manager

Mid-Western Regional Council

86 Market Street

Mudgee NSW 2850

Dear General Manager,

Re: Development Application DA 0225/2020

I write in response to submissions received by Council relating to the above development application. They were received from the DeLong and Roberts families, both of whom own 4 hectare lots adjacent to the land subject to the above DA.

Many of the points raised in these submissions were dealt with at the rezoning stage in 2018, and others such as building setback are addressed in Councils' existing planning controls which will apply to the new blocks. Other main points are addressed below.

Other issues raised in the submissions can be generally categorised as follows:

- **Water:** Concern has been raised that the proposed community bore reticulation system for supplementary supply may impact the underlying aquifer. The system requires approximately 5 megalitres per annum across 25 lots if fully utilised. For perspective the average annual flow noted in the Water NSW Macquarie-Cudgegong Water sharing plan is 1,448,000 megalitres. Five megalitres is a daily average requirement of 13,700 litres. The bore test attached to this application shows a 24 hour flow rate of 23,000 litres per hour from a single bore, or approximately 40 times the required flow rate with a recharge time of only 5 minutes.

- **Dam:** the DeLong submission notes concern over an existing dam (likely to remain in proposed lot 8). This not a natural landscape feature, but it is likely that this lot will attract a buyer who appreciates its amenity and is both keen to preserve it and seeking to avoid the cost of removing it.

- **Agricultural spray drift:** It is noted that both neighbouring properties on occasion carry some sheep, but the extent of spray activity in an enterprise of 4 Hectares is unlikely to cause environmental or health issues if carried out in accordance with existing farm chemical regulations, as it should be.

- **Dust, noise and disruption during development:** DA conditions customarily include controls to reasonably alleviate such issues including limiting times for permitted construction activities.

- **Setback, building heights, restrictions etc.:** Councils' existing Development Control Plan anticipates these issues and will presumably apply to this development.

- **Fencing and vegetation:** Common fencing between lots in NSW falls under the Dividing Fences Act (1991). Vegetation and screening plantings can be planted by landholders so inclined at any time as has always been the case. Presumably future adjacent landholders would also be motivated to screen where appropriate for reasonable privacy.

- **Loss of view, privacy, lifestyle:** Councillors would be aware that any land use change can compromise the amenity of neighbouring blocks to some extent but Council planning staff and development controls work to balance such issues in supporting sound planning outcomes. While conscious of neighbours' concerns, to state the obvious clearly the only way to guarantee the amenity of several hundred acres of land around your house in perpetuity is to buy several hundred acres of land. Note also that the current proposal is essentially the same as that submitted for the Gateway Determination granted in June 2015, with this public information having been available prior to the Roberts' purchase of their adjacent 4 hectare lot.

Yours Faithfully

Michael de Kantzow

PLANNING PROPOSAL
CASTLEREAGH HIGHWAY
GULGONG

705 Springfield Lane

October 2020

ATLAS
ENVIRONMENT & PLANNING

Emma Yule t/a Atlas Environment and Planning (Atlas), responsible for the preparation and contents and information provided within this report declare that there is no current benefit nor expect to have a beneficial interest in the study area of this project and will not benefit from any of the recommendations outlined in this report.
The preparation of this report has been in accordance with the project brief provided by the client and has relied upon the information, data and results provided or collected from the sources and under the conditions outlined in the report.
Atlas accepts no liability for the accuracy or completeness of the data and information provided to it by, or obtained by it, from any third parties, even if that data has been incorporated into or relied upon for generating this report.
This report has been produced by Atlas using information that is available to the client as at the date stated within this report and cannot be relied upon in any way if situations at the subject site changes. Atlas is under no obligation to update the information contained within the report at any time.
This report has been prepared on behalf of and for the exclusive use of the Atlas client and is subject to and issued in connection with the provisions of the agreement between Atlas and its client. All information contained within this report are prepared for the exclusive use of the client to accompany this report for the land described herein and are not to be used for any other purpose or by any other person or entity. No reliance should be placed on the information contained in this report for any purposes apart from those stated therein. Atlas accepts no responsibility for any loss, damage suffered or inconveniences arising from, any person or entity using the plans or information in this study for purposes other than those stated above.

VERSION AND AMENDMENT CONTROL HISTORY

VERSION	DATE	DESCRIPTION	QA/QC
001	OCT 2020	DRAFT FOR CLIENT REVIEW	CLIENT
002	OCT 2020	FINAL	EY

1 OBJECTIVES AND INTENDED OUTCOMES OF THE PROPOSAL

1.1 STATEMENT OF INTENDED OUTCOMES

This planning proposal is intended to:

- Enable the land (approximately 82.3ha) to be developed into a rural lifestyle opportunity, with a minimum lot size of 12ha.

This is consistent with the Mid-Western Regional Comprehensive Land Use Strategy, which outlines suitable areas for rural residential expansion around Gulgong – Short term area - Sector E.

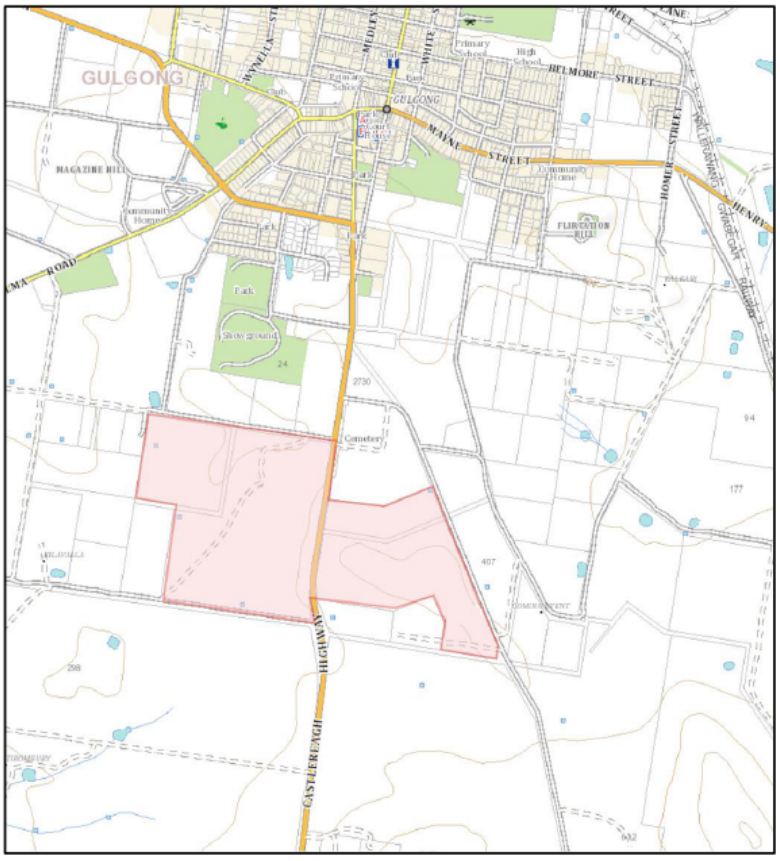


Figure 1: Location plan showing proximity of subject site to Gulgong

(Source: SIX Maps)

1.2 DETAILS OF THE PROPOSED DEVELOPMENT AND CONCEPT PLAN

The central purpose of this planning proposal is to make the necessary amendments to the Mid-Western Regional Local Environmental Plan 2012 (MWRLEP 2012) to enable the creation of dwelling entitlements as opportunity for future rural lifestyle living opportunity in close vicinity to Gulgong, with minor subdivision requirement (i.e. utilise existing land titles where possible). The site is gently undulating, creating an opportunity for a high quality rural/residential environment with limited constraints to be considered.

It is envisaged that the min. 12ha lots to be created; either through consolidation or subdivision; will not rely on reticulated services. The lots are of a size sufficient to be able to incorporate an on-site sewage management system (OSSM) and have individual bores for a domestic water source and rely upon rainwater as the source of primary potable water. A concept plan has been prepared, which details the likely development outcome for the site taking into consideration existing lot patterns, road access, servicing, and amenity to be afforded to each lot. The land has several public road frontages (and will not rely on Castlereagh Highway for access).

Summary:

Concept - Min lot size - 12 ha		
Potential for 6 dwelling entitlements ***No new road***		
LOT	**AREA**	**DESCRIPTION**
Proposed Lot 1	13.2ha	Consolidation of Lot 70 and 71 in DP755434. Access - Adams Lead Road.
Proposed Lot 2	16.2ha	Consolidation of Lot 17 in DP1172228 and Lot 138 in DP755434. Access - Adams Lead Road.
Proposed Lot 3	12.5ha	Subdivision of Lot 64 in DP755434 and Lots 15 & 16 in DP11722228 Access – Bergalin Road.
Proposed Lot 4	12.5ha	Subdivision of Lot 64 in DP755434 and Lots 15 & 16 in DP11722228 Access – Bergalin Road.
Proposed Lot 5	14.9ha	Consolidation of Lots 277, 278, 285 & 286 in DP755433. Access - Springfield Lane.
Proposed Lot 6	14.6ha	Consolidation of Lots 279, 280, 281 & 282 in DP755433. Access - Springfield Lane.

1.2.1 Concept 1 – 12ha min lot size

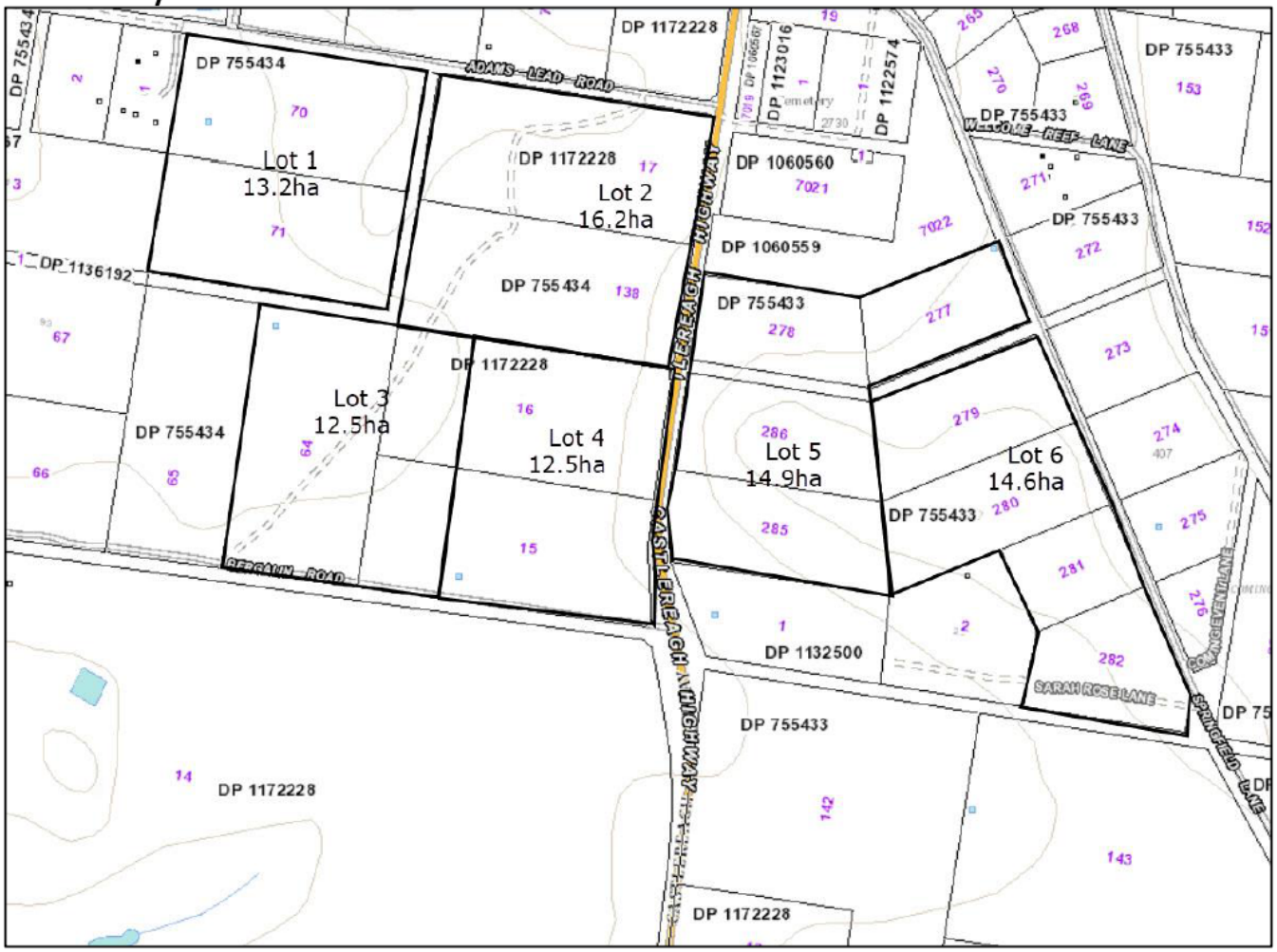


Figure 2: Concept Plan – min 12ha lot size

2 EXPLANATION OF PROVISIONS

The following formal amendments to the MWRLEP 2012 are proposed to facilitate the intended outcomes of the proposal discussed in Part 1:

- Amend LZN_005C and LZN_005 to show the subject land as R5 Large Lot Residential (currently RU1 Primary Production); and
- Amend LSZ_005C and LSZ_005 to show the minimum lot size as 12ha (currently 100ha).

3 JUSTIFICATION

This section sets out the reasoning and justification for the proposed changes to the MWRLEP 2012, which ultimately will lead to further development of the site in line with the stated intended outcomes outlined in Part 1.

The following questions are in line with the requirements set out by the NSW Department of Planning and Environment through their document *A Guide to Preparing Planning Proposals (August 2016)*.

SECTION A - Need for the planning proposal

Q1: Is the planning proposal the result of any strategic study or report?

Answer: YES

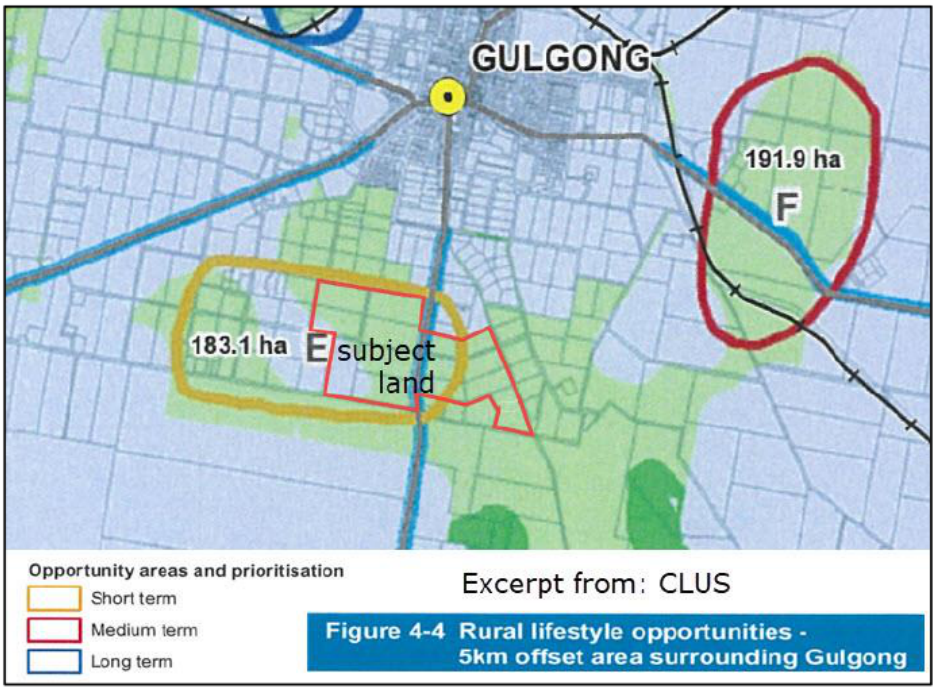


Figure 3: Excerpt from CLUS showing subject land in Precinct E – SHORT TERM RELEASE AREA

The *Mid-Western Regional Comprehensive Land Use Strategy* (CLUS) prepared by Parsons Brinckerhoff and originally endorsed by Council in 2010 was developed to guide future land use planning in the Mid-Western Region and identify opportunities for growth.

The CLUS identifies the subject site (described as the precinct E) as a short-term opportunity to develop rural lifestyle lots with a minimum lot size of 12ha. This is further reflected in **Figure 4-4 of the CLUS**, which details the map indicating the area as a future large lot residential opportunity.

Page 69 of the CLUS refers to the subject land.
"Two contiguous opportunity areas have been identified as short-term rural lifestyle, namely sectors C and E, to the west and south of Gulgong respectively." The CLUS goes on to indicate "*These opportunity areas should be prioritised for rural lifestyle development and investigated under the Rural Land Release Strategy. The minimum lot size for these opportunity areas should generally be 12 hectares. Council may consider 2-6 hectare lots within section E if reticulated water is available, as this sector borders the existing settlement area and would provide an alternative lot size for the Mudgee/Gulgong market* (i.e. the subject land).

The CLUS clarifies that this would cater to the residential market rather than a rural one. This planning proposal seeks to keep a rural setting and provide a supply of rural lifestyle lots. The CLUS identified that an estimated demand of 5 lots per annum, can be assumed for Gulgong. This demand has not been met in recent years in line with the CLUS.

Q2: Is the planning proposal the best means of achieving the objectives or intended outcomes, or is there a better way?

Answer: YES

Both the RU1 (current zone) and R5 (proposed zone) zones are 'open zones' for the purposes of permitted land uses. A review of the land use table for the R5 Large Lot Residential zone has not revealed any potential land uses that would be rendered '*permitted with consent*' as a result of the proposal that would be envisaged to cause any conflict with adjoining rural and residential uses.

It is considered that the planning proposal with LEP map amendments, is the necessary avenue to achieve the intended outcomes. A review of the current MWRLEP 2012 has revealed that there is no other option to currently achieve the provision of rural lifestyle lots and meet the CLUS target for land south of Gulgong. In this case both a zoning and lot size map amendment is considered appropriate and necessary to achieve the outcomes sought.

SECTION B - Relationship to the strategic planning framework

Q3: Is the planning proposal consistent with the objectives and actions of the applicable regional or sub-regional strategy?

Answer: YES

Mid-Western Regional Council falls within the 'Central West and Orana Region' and has therefore been included in the *Central West and Orana Regional Plan 2036*.

The plan broadly identifies areas for more economical expansion and associated housing opportunities throughout the region, including the Mid-Western Regional LGA.
In particular, Goal 4 - Dynamic, vibrant and healthy communities, discusses various actions for more housing variety including Direction 28 'Manage rural residential development'.

Direction 28 aims to promote a consistent approach to identifying new areas for rural residential development. Whilst the site has already been identified within the CLUS as potential future rural lifestyle lots, the actions detailed in Direction 28 below are still considered relevant in supporting this planning proposal.

The actions are as follows:

ACTION 28.1 Locate new rural residential areas:

- *close to existing urban settlements to maximise the efficient use of existing infrastructure and services, including roads, water, sewer and waste services, and social and community infrastructure.*
- *to avoid and minimise the potential for land use conflicts with productive, zoned agricultural land and natural resources; and*
- *to avoid areas of high environmental, cultural or heritage significance, regionally important agricultural land or areas affected by natural hazards.*

Comment: The site is in very close proximity to Gulgong and therefore benefits from good connections and access to all the necessary services on offer and required for rural setting for housing envisaged.

As detailed throughout this proposal there are no significant conflicts with the land and other surrounding uses and minimal constraints with regards to natural hazards or environmental considerations.

ACTION 28.2 Enable new rural residential development only where it has been identified in a local housing strategy prepared by Council and approved by the Department of Planning and Environment.

Comment: The CLUS has identified this particular site as suitable for future rural lifestyle development and will support a variety of housing lot types in association with Gulgong.

ACTION 28.3 Manage land use conflict that can result from cumulative impacts of successive development decisions.

Comment: No significant compatibility issues have been identified with the proposal with the additional rural lifestyle opportunity. The further development of the land into 2ha lots was also identified in the CLUS and this proposal can be seen as a logical development decision for implementation of the adopted Strategy for the Gulgong surrounds.

Q4: Is the planning proposal consistent with a council's local strategy or other local strategic plan?

Answer: YES

At Council's 20 May 2020 meeting, Council adopted the Local Strategic Planning Statement. The Mid-Western Regional Local Strategic Planning Statement (LSPS) outlines the vision for land use planning in the Mid-Western Region and details Planning Priorities along with Land Use Actions to achieve the Planning Priorities. The Land Use Actions outline where Council will focus its strategic land use planning project work in the future.
The subject land falls within the area identified in the Gulgong Structure Plan as the southern 'main entrance corridor' to Gulgong. Supporting the aesthetic appeal of the town is planning priority identified in the LSPS.
However, planning priority 2 is most relevant to this proposal – i.e.
Make available diverse, sustainable, adaptable and affordable housing options through effective land use planning.
The LSPS supports maintenance of a variety of housing options across the Region. The proposed rural housing opportunities will keep the entrance to Gulgong a rural setting, and support the variety in housing options close to the town. The planning proposal supports the implementation of the *Mid-Western Regional LSPS* and *Central West and Orana Regional Plan 2036*.

Comprehensive Land Use Strategy (CLUS)
The CLUS prepared on behalf of MWRC provides the most relevant guidance. The Strategy provides a basis for identifying options for MWRC to meet long term urban and rural growth needs. The CLUS also identifies the need for residential opportunities in a rural setting. As identified at Q1 - the CLUS identifies the subject site (described as the precinct E) as a short-term opportunity to develop rural lifestyle lots with a minimum lot size of 12ha. This proposal aligns with the CLUS.

In addition, the CLUS identifies some areas for large lot residential expansion within the Gulgong Town Structure Plan (see below). A second concept below is provided to demonstrate the consistency. Where the land is developed for 12ha lots, this is not to the detriment of the potential for future development of 2ha lots in accordance with the structure plan (& subject to meeting service levels).

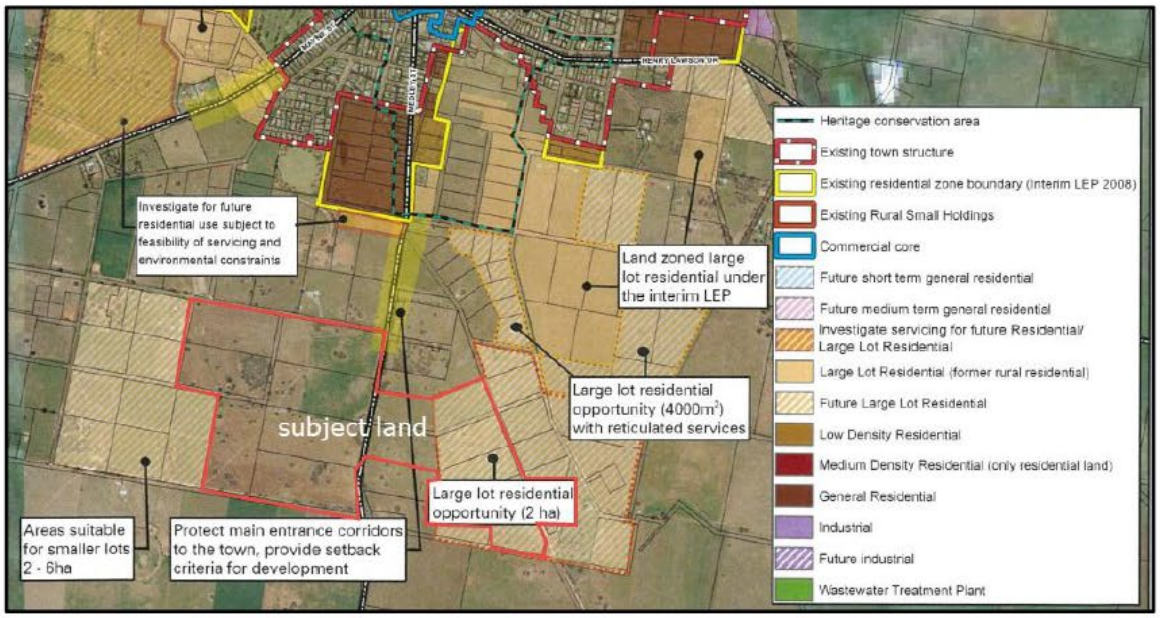


Figure 3: Extract from the CLUS indicating the opportunity for the subject site

(MWR CLUS: Parsons Brinckerhoff)

3.1.1 Concept 2 – Incorporate future 2ha min lot size as per CLUS

This second concept demonstrates that the land has potential for further development subject to a separate proposal (i.e. concept 2 demonstrates that a reduced minimum lot size of 12ha does not hinder the further development potential in line with the Gulgong Town Structure Map (opportunity for 2ha lots on available frontage to Springfield Lane)).

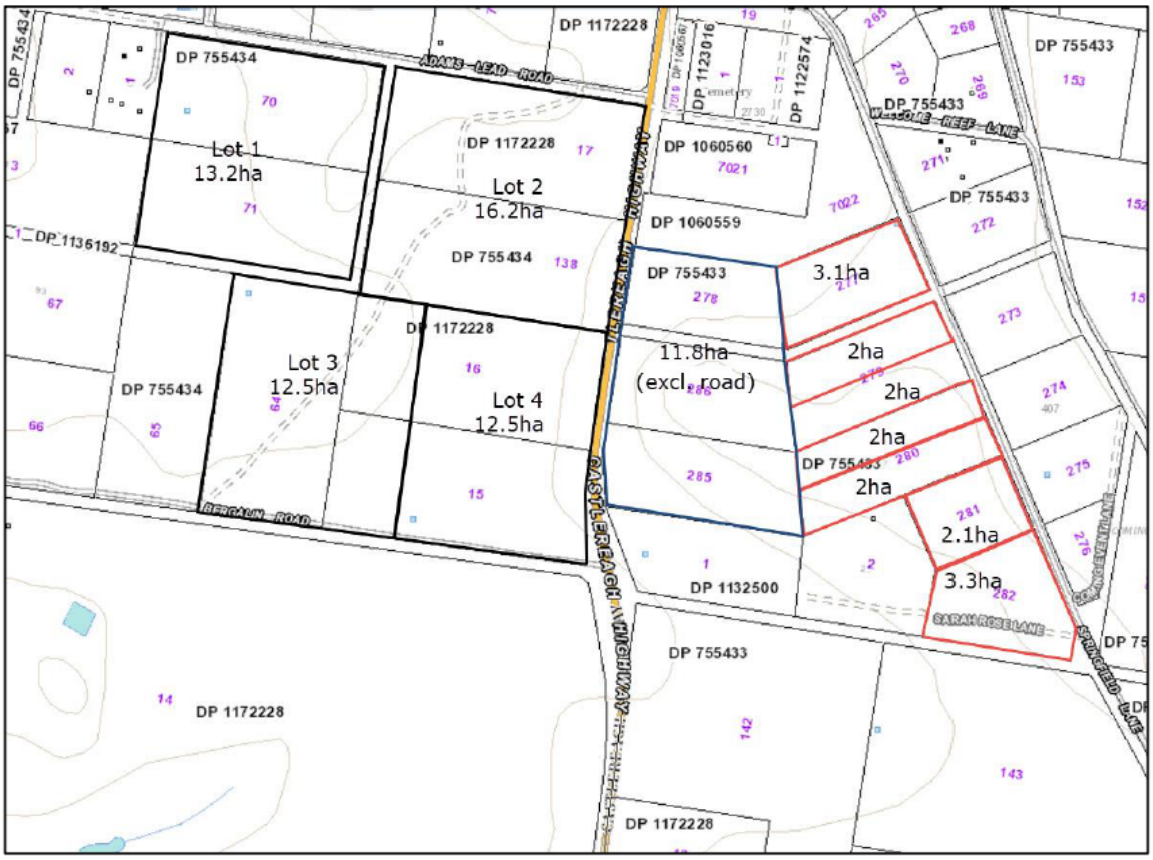


Figure 4: Concept Plan – additional opportunity for 2ha lots

Q5: Is the planning proposal consistent with applicable State Environmental Planning Policies?

Answer: YES

SEPP	Applicable/Consistency
State Environmental Planning Policy (Affordable Rental Housing) 2009: Land Application (pub. 31-7-2009)	Not applicable to the proposal.
State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004: Land Application (pub. 25-6-2004)	Not applicable to the proposal.
State Environmental Planning Policy (Concurrences) 2018: Land Application (pub. 21-12- 2018)	Not applicable to the proposal.
State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017: Land Application (pub. 1-9-2017)	Not applicable to the proposal.
State Environmental Planning Policy (Exempt and Complying Development Codes) 2008: Land Application (pub. 12-12-2008)	Not applicable to the proposal.
State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004: Land Application (pub. 31-3-2004)	Not applicable to the proposal.
State Environmental Planning Policy (Infrastructure) 2007: Land Application (pub. 21-12- 2007)	Classified Road Adjacent – Castlereagh Highway – No new accesses are proposed onto the Highway for future housing opportunities. The property is located near electrical infrastructure and future development will need to consider any interaction and location of easements.
State Environmental Planning Policy (Koala Habitat Protection) 2019: Land Application (pub. 20-12-2019)	Not applicable at Proposal stage. At development application consideration of any land clearing to consider potential for feed tree species. Land is mostly cleared.
State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007: Land Application (pub. 16-2-2007)	Not applicable to the proposal.
State Environmental Planning Policy (Miscellaneous Consent Provisions) 2007: Land Application (pub. 28-9-2007)	Not applicable to the proposal.
State Environmental Planning Policy (Primary Production and Rural Development) 2019: Land Application (pub. 28-2-2019)	See below.
State Environmental Planning Policy No 1—Development Standards: Land Application (pub. 17-10-1980)	Not applicable to the proposal.
State Environmental Planning Policy No 21—Caravan Parks: Land Application (pub. 24-4- 1992)	Not applicable to the proposal.
State Environmental Planning Policy No 33—Hazardous and Offensive Development: Land Application (pub. 13-3-1992)	Not applicable to the proposal.
State Environmental Planning Policy No 36—Manufactured Home Estates: Land Application (pub. 16-7-1993)	Not applicable to the proposal.
State Environmental Planning Policy No 50—Canal Estate Development: Land Application (pub. 10-11-1997)	Not applicable to the proposal.
State Environmental Planning Policy No 55—Remediation of Land: Land Application (pub. 28- 8-1998)	See below.
State Environmental Planning Policy No 64—Advertising and Signage: Land Application (pub. 16-3-2001)	Not applicable to the proposal.
State Environmental Planning Policy No 65—Design Quality of Residential Apartment Development: Land Application (pub. 26-7-2002)	Not applicable to the proposal.

The following SEPP's are considered most relevant to the planning proposal.

State Environmental Planning Policy (Primary Production and Rural Development) 2019

The land is not identified as state significant agricultural land. No aquaculture developments are likely to be affected by the planning proposal. Schedule 4 does not apply as MWRLEP 2012 is a standard instrument. The use of the land for rural lifestyle lots is appropriate considering vicinity of other residential land use and rural large lot areas close to Gulgong.

State Environmental Planning Policy No 55 - Remediation of Land

SEPP 55 sets out requirements and procedures for the remediation of contaminated land during the development process. The SEPP would need to be considered by MWRC whilst assessing a development application for the site, which would likely be a development application for subdivision/future dwelling applications.

At present there does not appear to be any potentially contaminating activities occurring on site or any evidence of past activities. Whilst further consideration of the SEPP is not warranted until the lodgement of a development application, there does not appear to be any initial concerns that would arise from the site and further rural lifestyle development.

State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017

As the planning proposal is aiming to amend the zoning of the land from RU1 Primary Production to R5 Large Lot Residential, any future development and associated tree removal may require consideration under the Vegetation SEPP.

The concept plan that has been prepared for the site. This demonstrates that existing lot boundaries are primarily able to be utilised. Further subdivision and development on the site can be undertaken with limited vegetation clearing and no clearing of the mapped Biodiversity Sensitive area would be required. Hence it is not likely to trigger any further consideration at subdivision stage under the SEPP or the *Biodiversity Conservation Act 2016*.

Q6: Is the proposal consistent with applicable Ministerial Directions (9.1 Directions)?

Answer: YES

The following Ministerial Directions are considered of relevance to the proposal.

1.2 Rural Zones

The Ministerial Direction essentially directs Council not to undertake a planning proposal to rezone land from a rural zone to a residential zone unless they are justified by a relevant study or strategy applicable to the site and circumstances.

As discussed elsewhere the site has already been included in the CLUS as suitable for future rural lifestyle development and is therefore considered to satisfy section (5) of this direction.

1.5 Rural Lands

The Ministerial Direction aims to protect the agricultural production value of rural lands, ensure land use conflicts are minimised to facilitate ongoing agricultural uses and ensure several other broad planning principles are addressed during the planning proposal process.

The closest productive agricultural land to the site lies further south of Gulgong and the subject land, which is currently being utilised for the purpose of pasture and intensive agriculture. No significant impact should occur with large lot residential land uses already occurring in vicinity and existing road reserves forming a hard barrier to separate the land uses. No new buffers would be required to be implemented that will hinder any rural land use.

2.3 Heritage Conservation

The Ministerial Direction aims to protect places or Aboriginal and European heritage during the planning proposal process. No items of environmental heritage have been identified and a AHIMS has been undertaken (**Appendix B**) as a preliminary measure.

Appropriate mechanisms will be available through any future subdivision/development approval processes to protect any items that are discovered during construction.

4.4 Planning for Bushfire Protection

The Ministerial Direction aims to ensure the relevant bushfire protection measures identified in the document *Planning for Bushfire Protection 2006* are applied to the proposal. The site is not identified on bushfire prone land mapping as being bushfire prone. There is no impediment to complying with the more recent provisions of *Planning for Bushfire Protection 2019*, which are expected to be adequately addressed through the development application stage for subdivision in the future.

5.10 Implementation of Regional Plans

The Ministerial Direction aims to ensure any planning proposal is consistent with the relevant regional plan. This issue has been addressed in this report and the planning proposal is considered consistent with the *Central West and Orana Regional Plan 2036*.

6.1 Approval and Referral Requirements

The Ministerial Direction aims to ensure that LEP provisions encourage the appropriate and efficient assessment of development. The planning proposal does not include LEP provisions that require further consultation or concurrence with other Departments.

No other Ministerial Directions are considered of relevance to the proposal.

Q7: Is there any likelihood that Critical Habitat or threatened species, populations or ecological communities, or their habitats, will be adversely affected as a result of the proposal?

Answer: UNLIKELY.

The property has one minor stand of vegetation identified on Council's LEP mapping of being of high biodiversity significance (refer to figure below).

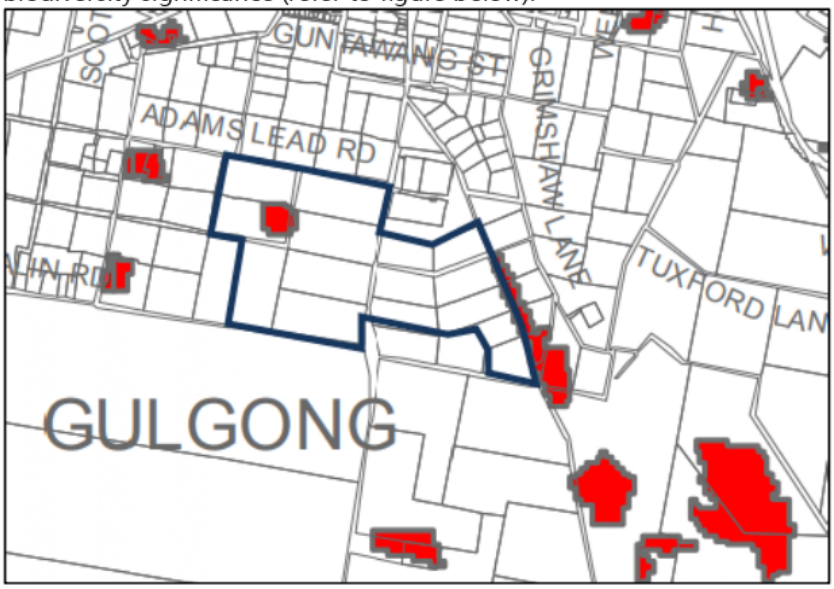


Figure 5: Biodiversity mapping

(Excerpt Sensitivity Biodiversity Map - Sheet BIO_005 MWRLEP 2012)

The concept plan has been carefully prepared to show that the vegetation on site can readily be retained taking into consideration future boundary and dwelling sites.

The majority of the site has been historically cleared with only a scattering of individual trees present across the site. It is expected that these trees can generally remain on site without being impacted by future lot boundaries and dwelling sites. Additional plantings are likely to result with increase land management. Further specific assessment can be undertaken at subdivision stage in accordance with the various relevant legislation.

Q8: Are there any other likely environmental effects as a result of the planning proposal and how are they proposed to be managed?

An initial assessment of the site and expected future development as a result of the intended outcomes has not revealed any significant environmental constraints or predicted effects. Vegetation on site is expected to be retained and other constraints including environmental heritage, groundwater vulnerability and noise/air quality issues are expected to have negligible impact.

There are no issues expected, such as effluent disposal and the like, that cannot be addressed and mitigated at the subdivision stage for the proposal. Lot size of 12ha will provide ample area for a dwelling with an OSSM and small farm rural activities.

Q9: How has the planning proposal adequately addressed any social and economic effects?

The proposal will contribute to additional housing choice in close vicinity to Gulgong and assist in promoting the historic rural setting of Gulgong. Future residents seeking the rural lifestyle of housing will enjoy the benefits of close vicinity of a town and facilities. The proposal will contribute positively to social and economic outcomes in Gulgong and address the demand for lifestyle housing opportunities in the Mid-Western Regional LGA.

Q10: Is there adequate public infrastructure for the planning proposal?

Answer: YES

The site currently has electricity and telecommunications infrastructure that will be assessed for further extension at subdivision/DA for dwelling stage. The necessary consultation with those authorities will be undertaken, however this is not considered to be a hindrance to further development of the site.

Water

The proposal for 12ha lots will not result in the need to connect to a reticulated water supply with rainwater harvesting considered the most effective means of supplying water to each future dwelling.

Roads

Minor increases in traffic will be expected from the proposal. The existing road infrastructure and access driveways can be upgraded in accordance with the requirements of the *Mid-Western Regional Development Control Plan 2013* and further considered at subdivision stage. An initial review of the MWRDCP 2013 has not revealed any significant limitations or requirements for a subdivision in the proposed R5 Large Lot Residential zone.

Sewer

The MWRDCP 2013 does not require this level of servicing for lots in the R5 Large Lot Residential zone on min. 12ha lots. The lots are expected to be of a sufficient size to cater for any on-site effluent disposal systems that would be required for each new dwelling.

Q11: What are the views of State and Commonwealth Public Authorities consulted in accordance with the gateway determination, and have they resulted in any variations to the planning proposal?

It is expected that MWRC will consult with the relevant Public Authorities and consideration of their views will be included.

4 MAPPING

MWRC has a Standard Instrument LEP in force and new mapping should be carried out consistent with the requirements of the standard technical requirements for LEP maps. The land subject of the planning proposal is included within Land Zoning Map LZN_005 and LZN 005C as shown below. The mapping will be required to be amended to reflect the new R5 Large Lot Residential zoning for the site.

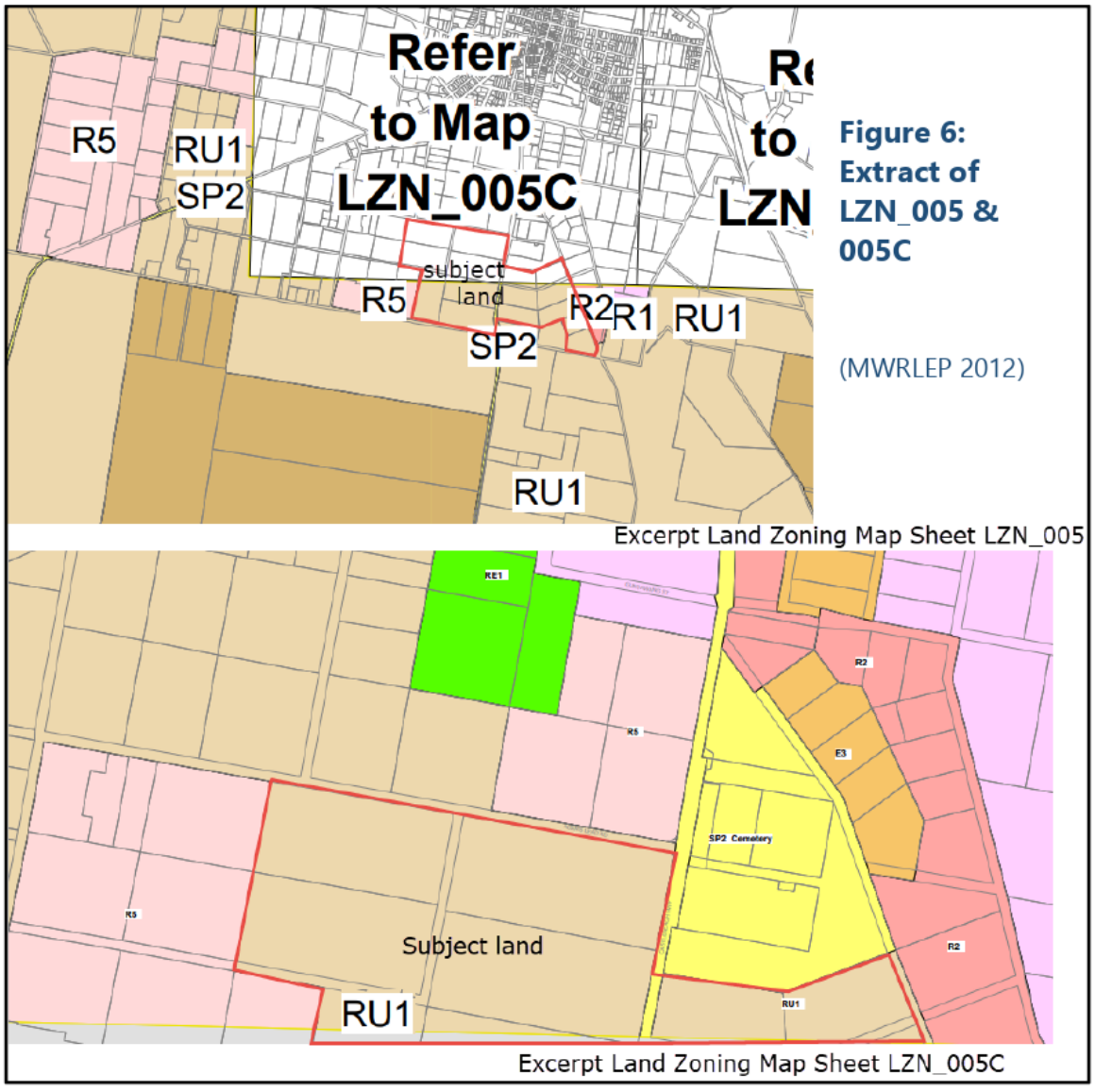


Figure 6: Extract of LZN_005 & 005C

(MWRLEP 2012)

The corresponding lot size map will also require amending to reflect the new minimum lot size of 12ha. The site is located within Lot Size Map LSZ_005C and LSZ_005 as shown below.

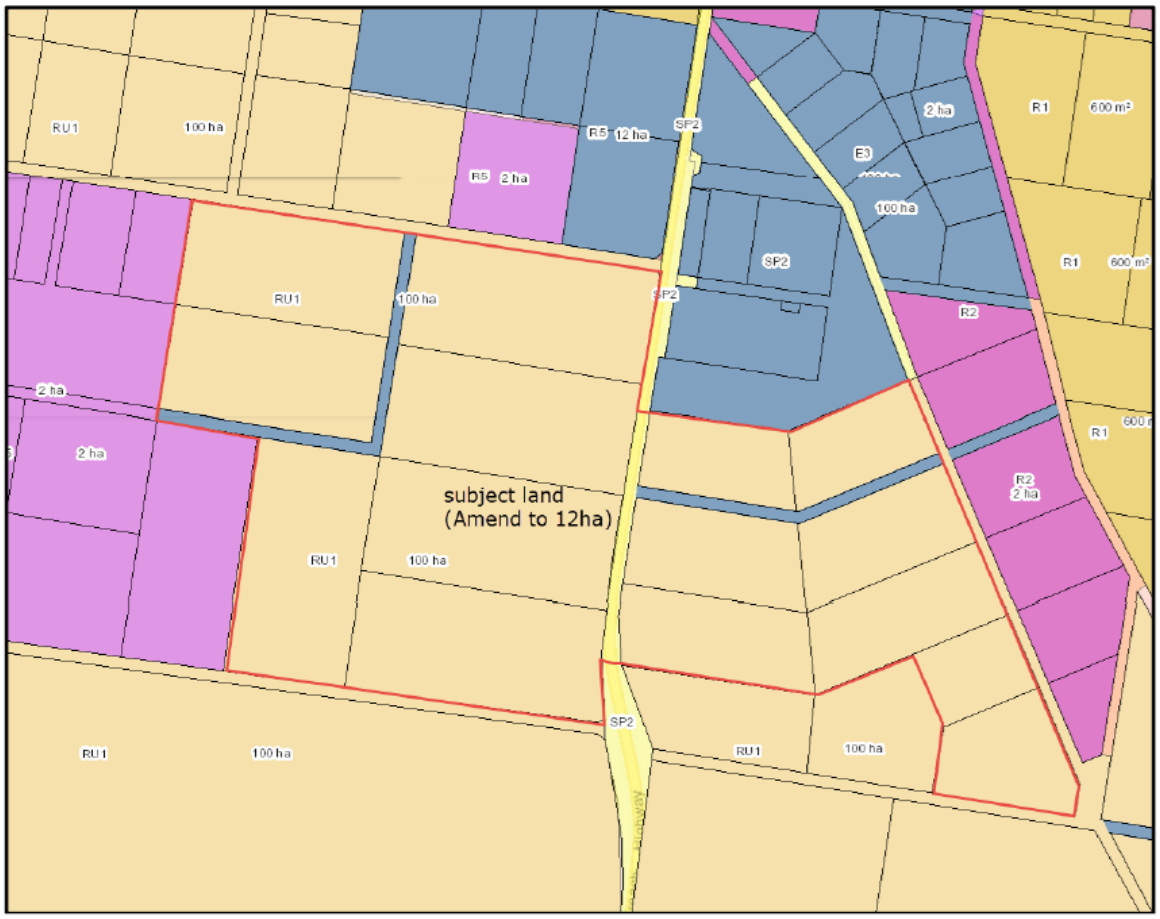


Figure 7: Extract of LSZ_005 & 005C

(MWRLEP 2012 – NSW Planning Portal Mapping)

5 COMMUNITY CONSULTATION

Community consultation for the planning proposal is expected be undertaken in accordance with the requirements set out in *A guide to Preparing Planning Proposals* (DoPE 2018).

It is expected MWRC will undertake the necessary consultations with the NSW Government as directed throughout the planning proposal process.

6 PROJECT TIMELINE

This will be prepared with MWRC, however there appears to be limited requirements moving forward to enact on the planning proposal outcomes.

Appendix A

Table of Areas

Lot	Deposited Plan	acres	roods	perches	m2	hectares	
277	**755433**	7	2	14	30705.55	**3.070555**	
278	**755433**	8	1	34	34246.55	**3.424655**	
279	**755433**	8	3	25	36042.35	**3.604235**	
280	**755433**	10	0	0	40468.6	**4.04686**	
281	**755433**	5	0	16	20638.99	**2.063899**	
285	**755433**	10	3	20	44009.6	**4.40096**	
286	**755433**	9	3	5	39583.35	**3.958335**	
15	**1172228**				0	**8.645**	
16	**1172228**				0	**8.023**	
17	**1172228**				0	**8.091**	
64	**755434**	20	2	23	83542.37	**8.354237**	
70	**755434**	16	1	10	66014.4	**6.60144**	
71	**755434**	16	1	10	66014.4	**6.60144**	
138	**755434**	20	0	0	80937.2	**8.09372**	
282	**755433**	8	1	1	33411.89	**3.341189**	
					TOTAL	**82.32053**	**hectares**

Appendix B

AHIMS SEARCH RESULTS

Office of Environment & Heritage

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : A163
Client Service ID : 543293

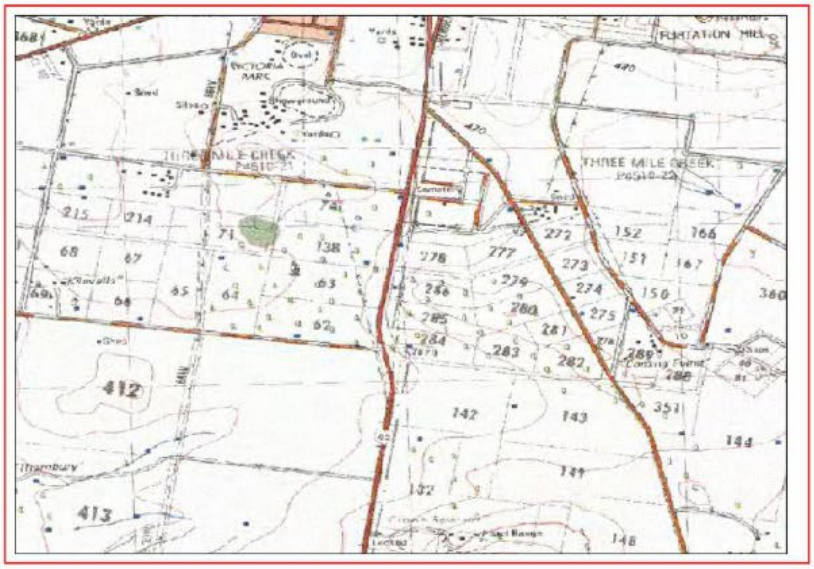
Atlas Environment & Planning
46 Market Street
Mudgee New South Wales 2850
Attention: Emma Yule
Email: yule.atlas@gmail.com

Date: 17 October 2020

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -32.3886, 149.5166 - Lat, Long To : -32.3705, 149.5452 with a Buffer of 50 meters, conducted by Emma Yule on 17 October 2020.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

MID-WESTERN REGIONAL COUNCIL

MUDGEE FLOOD STUDY

FINAL REPORT

wma water

FEBRUARY 2021

Level 2, 160 Clarence Street
Sydney, NSW, 2000

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Web: www.wmawater.com.au

MUDGEE FLOOD STUDY

FINAL REPORT

FEBRUARY 2021

Project Mudgee Flood Study	**Project Number** 118033
Client Mid-Western Regional Council	**Client's Representative** David Webster
Authors Mahshid Shahrban	**Prepared** by Daniel Wood Mahshid Shahrban
Date 13/02/2020	**Verified by**

Revision	Description	Distribution	Date
1	Stage 1 Report	MWRC	
2	Draft Flood Study Report	MWRC	25/11/2019
3	Draft Flood Study Report	MWRC	13/02/2020
4	Final Flood Study Report	MWRC	22/02/2021

Front Page image source: http://www.lueactiongroup.org/news/articles/news.php?nid=KSmy8TwUD4J4qQ56q8

MUDGEE FLOOD STUDY

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LIST OF ACRONYMS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AR&R	Australian Rainfall and Runoff
BoM	Bureau of Meteorology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EY	Exceedances per Year
GSAM	General Southeast Australia Method
GSDM	Generalised Short Duration Method
IFD	Intensity, Frequency and Duration of Rainfall
IPCC	Intergovernmental Panel on Climate Change
LGA	Local Government Area
LiDAR	Light Detection and Ranging (also known as ALS)
LPI	Land and Property Information
LP3	Log Pearson III probability distribution
m	metre
m^3/s	cubic metres per second (flow measurement)
m/s	metres per second (velocity measurement)
MWRC	Mid-Western Regional Council
NOW	NSW Office of Water
OEH	Office of Environment and Heritage
PINNEENA	Database of water resources information
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
TUFLOW	one-dimensional (1D) and two-dimensional (2D) flood and tide simulation software program (hydraulic computer model)
WBNM	Watershed Bounded Network Model (hydrologic computer model)
1D	One dimensional hydraulic computer model
2D	Two dimensional hydraulic computer model

TERMINOLOGY USED IN REPORT

Australian Rainfall and Runoff have produced a set of draft guidelines for appropriate terminology when referring to the probability of floods. In the past, AEP has generally been used for those events with greater than 10% probability of occurring in any one year, and ARI used for events more frequent than this. However, the ARI terminology is to be replaced with a new term, EY.

Annual Exceedance Probability (AEP) is expressed using percentage probability. It expresses the probability that an event of a certain size or larger will occur in any one year, thus a 1% AEP event has a 1% chance of being equalled or exceeded in any one year. For events smaller than the 10% AEP event however, an annualised exceedance probability can be misleading, especially where strong seasonality is experienced. Consequently, events more frequent than the 10% AEP event are expressed as X Exceedances per Year (EY). Statistically a 0.5 EY event is not the same as a 50% AEP event, and likewise an event with a 20% AEP is not the same as a 0.2 EY event. For example an event of 0.5 EY is an event which would, on average, occur every two years. A 2 EY event is equivalent to a design event with a 6 month average recurrence interval where there is no seasonality, or an event that is likely to occur twice in one year.

While AEP has long been used for larger events, the use of EY is to replace the use of ARI, which has previously been used in smaller magnitude events. The use of ARI, the Average Recurrence Interval, which indicates the long term average number of years between events, is now discouraged. It can incorrectly lead people to believe that because a 100-year ARI (1% AEP) event occurred last year it will not happen for another 99 years. For example there are several instances of 1% AEP events occurring within a short period, for example the 1949 and 1950 events at Kempsey.

The PMF is a term also used in describing floods. This is the Probable Maximum Flood that is likely to occur. It is related to the PMP, the Probable Maximum Precipitation.

This report has adopted the approach of the ARR draft terminology guidelines and uses % AEP for all events greater than the 10% AEP and EY for all events smaller and more frequent than this.

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very Frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.5
	1	63.21	1.58	1
Frequent	0.69	50	2	1.44
	0.5	39.35	2.54	2
	0.22	20	5	4.48
	0.2	18.13	5.52	5
	0.11	10	10	9.49
Rare	0.05	5	20	20
	0.02	2	50	50
	0.01	1	100	100
Very Rare	0.005	0.5	200	200
	0.002	0.2	500	500
	0.001	0.1	1000	1000
	0.0005	0.05	2000	2000
Extreme	0.0002	0.02	5000	5000
			↓	
			PMP/ PMPDF	

FOREWORD

The NSW State Government's Flood Prone Land Policy provides a framework to ensure the sustainable use of floodplain environments. The Policy is specifically structured to provide solutions to existing flooding problems in rural and urban areas. In addition, the Policy provides a means of ensuring that any 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 Government subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist Councils in the discharge of their floodplain management responsibilities.

The Policy provides for technical and financial support by the Government through five sequential stages:

1. ***Data Collection***
   - Compilation of existing data and collection of additional data.
2. ***Flood Study***
   - Determine the nature and extent of the flood problem.
3. ***Floodplain Risk Management Study***
   - Evaluates management options for the floodplain in respect of both existing and proposed development.
4. ***Floodplain Risk Management Plan***
   - Involves formal adoption by Council of a plan of management for the floodplain.
5. ***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.

EXECUTIVE SUMMARY

WMAwater has been engaged by Mid-Western Regional Council (MWRC) to undertake an investigation on flood behaviour in Mudgee and provide an improved understanding of flood behaviour and impacts in the area, in order to better inform the management of flood risk for the community. Mudgee is located in the Macquarie River Basin on the banks of the Cudgegong River. The Cudgegong River has a wide floodplain at Mudgee with the majority of the town built on higher ground on the southern bank of the river.

The town is subject to flooding from the following sources:

- riverine flooding from Cudgegong River and Lawsons Creek, with their confluence on the north western edge of town;
- flash flooding from multiple smaller creeks that originate on the south western edge of Mudgee and traverse the town until their confluence with the Cudgegong River, and
- local urban stormwater flooding.

Major flood events over the last 70 years have occurred in 1955, 1969, 1971, 1974 and 1990. The town also experienced major flooding in February 2003 and December 2010. Recent flood events of lesser magnitude have occurred in 2016 and 2017.

MWRC has previously completed a number of studies to investigate floodplain management in Mudgee. The 1998, 2002 and 2008 studies separately consider flooding in Cudgegong River, Lawsons Creek and the local creeks that traverse Mudgee. As development pressure in the town continues, MWRC wishes to develop a single flood study that provides an improved understanding of flood behaviour and flood consequences in Mudgee. This study will focus on the February 2003, December 2010 and September 2016 events for model calibration as these events were recent and provide the best opportunity to obtain information from the community.

The primary objectives of this study are to:

- prepare a suitable hydrologic and hydraulic modelling system that defines flood behaviour for the 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2% AEP and the Probable Maximum Flood (PMF) design events for the town of Mudgee and the surrounding floodplain.
- provide results for flood behaviour in terms of flood risk, peak flood levels and inundation extents within the study area.
- Prepare maps of flood behaviour results in order to provide MWRC with the planning tools necessary to mitigate flood risk for current and future development.

Based on the analysis undertaken the following has been identified:

- In a1% AEP riverine flood event there is significant flood impacts present both within the township and on the roadways connecting the town to the surrounding region. During a riverine flood only the Castlereagh Highway running south is flood free. In this event all other routes out of the town have the potential to be closed in excess of 24 hours;
- During a local (flash flood) 1% AEP storm event at Mudgee there is a high likelihood that property flooding and damage will occur. With the exception of Redbank Creek most other overland flow paths through the township do not have sufficient capacity to safely contain

flow through the township;

- Sensitivity analysis shows that in general the floodplain is not sensitive to changes in hydrologic or hydraulic modelling parameters which would still be in accordance with best practice. The catchment is sensitive to increases in rainfall intensity due to climate change however, with level increases in the 1% AEP event in excess of 0.50 m in the 1% AEP event within the Cudgegong River. These increased levels increases the risk of flooding on property and further reduces the evacuation capacity of the township.

1. INTRODUCTION

1.1. Background

Mudgee is situated in the Macquarie River Basin on the banks of the Cudgegong River, approximately 261 kilometres north-west of Sydney and is located within the Mid-Western Regional Council (MWRC) Local Government Area (LGA) as shown on Figure 1. The town is subject to flooding from the following sources:

- riverine flooding from Cudgegong River and Lawsons Creek with their confluence on the north western edge of town;
- flash flooding from multiple smaller creeks that originate on the south western edge of Mudgee and traverse the town until their confluence with the Cudgegong River, and
- local urban stormwater flooding.

MWRC has previously completed a number of investigations to determine flood behaviour and investigate floodplain management in Mudgee. The 1998, 2002 and 2008 studies separately consider flooding in Cudgegong River, Lawsons Creek and the local creeks that traverse Mudgee. As development pressure in the town continues and development begins to occur at the fringe of the available flood information, MWRC wishes to develop a single flood study that provides an improved understanding of flood behaviour and flood consequences in Mudgee. This study covers all urban areas of Mudgee and the surrounding floodplain, considering flooding from all sources and mechanisms.

1.2. Objectives

The primary objective of this Flood Study is to develop a robust hydrologic and hydraulic modelling system that defines flood behaviour for the 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2% AEP and the Probable Maximum Flood (PMF) design events for the town of Mudgee and the surrounding floodplain. This will be used to assist MWRC in determining existing flood risk, peak flood levels and inundation extents within the study area. Given a history of flooding and recent development within the catchment, there is a strong need to define and map flood behaviour in the catchment in order to provide MWRC with the planning tools necessary to mitigate flood risk for current and future development. The tools developed may subsequently be used within a Floodplain Risk Management Study and Plan to assess the effectiveness and suitability of potential flood risk mitigation measures.

2. BACKGROUND

2.1. Study Area

Mudgee is located in the Macquarie River Basin on the banks of the Cudgegong River. The Cudgegong River rises in the Great Dividing Range within Wollemi National Park and follows a generally north westerly direction as it bypasses the town of Mudgee until its confluence with the Macquarie River at Burrendong Dam approximately 80 km downstream of Mudgee. The Cudgegong River has a wide floodplain at Mudgee with the majority of the town built on higher ground on the southern bank of the river. At Mudgee, the catchment area of the Cudgegong River and Lawsons Creek is approximately 1820 km². There are several water storage features in the catchment including the Windemere Dam, Kandos Weir and Rylstone Dam. Windamere Dam is located approximately 25 km upstream of Mudgee and has a contributing catchment area of 1,070 km^2 and a storage capacity of 368,120 ML. Windamere Dam operates in conjunction with Burrendong Dam to supply water for irrigation, stock and household needs in the Cudgegong and Macquarie Valleys, as well as providing environmental flows.

Lawsons Creek with a catchment area of 543 km² is the main tributary of the Cudgegong River rising 30 km east of Mudgee with their confluence on the north western edge of town. The other main tributaries of Cudgegong River in the vicinity of Mudgee are Oaky Creek, Sawpit Gully and Redbank Creek which originate south west of Mudgee as shown on Figure 2, with their confluence with Cudgegong River adjacent to Mulgoa Way. The urban area is drained by a series of smaller creeks which rise in the lower hills south of Mudgee and traverse the town itself until they meet the Cudgegong River on the northern edge of town. Their catchments are generally small and steep with bed slopes ranging between 4% in the upper reaches and 1% closer to the Cudgegong River floodplain.

The land uses in the catchment range from agriculture including grazing and vineyards to forested slopes in the Wollemi National Park and Avisford Nature Reserve as well as urban and industrial areas in the town of Mudgee.

2.2. Historical Flooding

2.2.1. Flood Mechanisms

Flooding at Mudgee is influenced by the following flood mechanisms:

1. **Cudgegong River and Lawsons Creek** - The floodplain adjacent to the town of Mudgee is subject to flooding from Cudgegong River and Lawsons Creek. Most of the urban area is built on higher ground and is largely unaffected by flooding from this source, although there are a number of residences, sporting facilities, commercial and agricultural businesses located on the floodplain that are directly affected by flooding from this mechanism. The coincidence of peak flood levels from the Cudgegong River and Lawsons Creek is usually responsible for major flood events. Flooding on Cudgegong River and Lawsons Creek can occur independently of one another or concurrently depending on the distribution and intensity of rainfall across the catchment. This will have significant effect on peak flood levels in Cudgegong River and Lawsons Creek and on the floodplains

adjacent to Mudgee.

2. **Local Creeks and Stormwater Flooding** - Due to their steep catchments the smaller creeks respond quickly to intense bursts of rainfall, rising quickly after the commencement of heavy rainfall and often resulting in "flash flooding" through the urban areas of Mudgee. At their outlets, the creeks discharge to the Cudgegong River, with river levels only influencing peak flood levels in the lower reaches of the creeks. As in any urban environment intense rainfall will exceed the capacity of the local drainage network resulting in overland flow paths traversing the town of Mudgee until they discharge into the Cudgegong River.

2.2.2. Historical Events

Records of historical flood events in and around Mudgee date back to 1870. Major flood events over the last 70 years occurred in 1955, 1969, 1971, 1974, 1990, 2003 and 2010. Recent flood events of lesser magnitude have occurred in 2016 and 2017. This study will calibrate to three events focusing on the February 2003, December 2010 and September 2016 events. As these events were recent, they provide the best opportunity to obtain information from the community.

The February 1955 storm was the largest recorded flood event since 1870 and has been reported to have approached the 1% AEP flood event for Cudgegong River at Mudgee. Since the 1955 event however, Windamere Dam has been incorporated which has significantly altered the hydrologic and hydraulic characteristics of the catchment. While the incorporation of the Dam has the potential to reduce flood levels, as the system is uncontrolled there is no specific flood mitigation capacity.

The February 2003 event recorded a 24 hour rainfall total of 178 mm at the Mudgee gauge which exceeds the 1% AEP 24 hour duration of 144 mm. The December 2010 flood event while not as intense as the 2003 event recorded 175 mm over three days at the Mudgee gauge and was significant enough for Mudgee to be declared a Natural Disaster Zone, with damage costs exceeding $10 million. A historical image of the 1955 flood event is shown in Plate 1.

Image Source: http://www.frankavis.com/blog/238/mudgee-floods/

Plate 1 – Flooding in Mudgee during 1955 flood event

2.3. Changes to Catchment and Flood Behaviour

2.3.1. Windamere Dam

The most significant change in catchment conditions was the construction of Windamere Dam with construction commencing in 1974 and completing in 1984. The dam has a total storage capacity of 386,120 ML with the main function to provide regulated flows along the Cudgegong River. It is not designed to include reserve storage capacity for flood mitigation and since the dam has an ungated spillway, there is no means of controlling the release of major flood flows. Historical records indicate that dam storage will be below full supply level for extended periods of time, therefore there is the potential for the dam to provide flood mitigation in flood events, but it is not its primary purpose nor can it be managed. The magnitude of this potential mitigation will depend on dam level prior to a flood event.

It is important to note that upstream of the town of Mudgee that 44% of the catchment which includes Lawson's Creek is not controlled by Windamere Dam. Major flooding can occur from this area independently of the catchment upstream of the dam.

2.3.2. Development in Catchment

As development in the catchment increases so does the percentage of impervious land, which will increase runoff and overland flow. The additional volume of water will exacerbate the pressure on the existing drainage network especially in the urban areas of the catchment. This has the potential to increase peak flood levels in the urban areas and drainage channels especially downstream of any new development.

With the explosion of residential development in the catchment and the region at large the issue of flooding and additional runoff from these areas will need to be managed on a small development scale. Retention basins and wetlands are an example of mitigation measures that can capture additional runoff from development and provide controlled release into the existing rivers, creeks or drainage line. There is also the opportunity to create parklands and open space for the community around the basins or wetlands. There are already several basins in the area however the ad hoc nature of development and implementation means that there potential to improve the capability of the current systems utilising information generated from this study.

3. AVAILABLE DATA

3.1. Overview

Data collection is the first stage in the floodplain risk management process and is essential to gain an understanding of the flooding characteristics within the catchment, including the nature, size and frequency of the flood problem. The type of data that is collected for a flood study is as follows:

- Topographic – LiDAR, river bathymetry and site specific survey;
- Stream Level and Flow – permanent water level gauges and historical flood level survey;
- Rainfall – permanent rain gauges;
- Council – cadastre, zoning layers, pipes pits and hydraulic structures;
- Design Rainfall – design rainfall data from Bureau of Meteorology (BOM) and Australian Rainfall and Runoff (ARR2016) data hub; and
- Historical Catchment Conditions – previous reports, flood levels, flood behaviour.

3.2. Data Sources

The available data sets for this study are summarised in the following sections. Table 1 provides a summary of the type of data sources, the supplier, and its application in the study.

Table 1 - Data Sources

Type of Data	Format Provided (Source)	Application
LIDAR data (2017)	MWRC	To construct a Digital Elevation Model (DEM) of the study area
Pits, Pipes, Hydraulic Structures	DRAINS model (Reference 1), AutoCAD cross-sections (Reference 2)	To build drainage network and hydraulic structures in TUFLOW model
River channel cross-section data	AutoCAD cross-sections (Reference 2)	To redefine the river and creek channel bathymetry
GIS Information (Cadastre, Zoning)	MWRC	To assist with hydraulic and hydrologic model build
Intensity Frequency Duration (IFD)	BOM	Design Flood Estimation
Temporal Patterns, Rainfall Losses, Areal Reduction Factors	ARR 2106 Data Hub	Design Flood Estimation
Historical Flood Levels and Behaviour	MWRC / Community	Calibration of Modelling Package
Rainfall Gauge (Daily)	BOM	Calibration of Modelling Package
Rainfall Grids (Daily)	BOM	Calibration of Modelling Package
Pluviometer (Continuous)	BOM	Calibration of Modelling Package
Stream Gauge (Continuous)	Water NSW	Calibration of Modelling Package
Previous Reports	Council	Historical Catchment Conditions and Historical Flood Data.

3.3. Topographic Data

Light Detection and Ranging (LiDAR) survey of the study area and its immediate surroundings was obtained for the study with a Digital Elevation Model (DEM) developed to be used in the hydraulic model as shown on Figure 3. LiDAR is aerial survey data that provides a detailed topographic representation of the ground with a survey mark between 1 m and 5 m depending on the survey. The data has been obtained from NSW spatial services, with the location, resolution, date of survey and accuracy displayed in Table 2. The accuracy of the ground information obtained from LiDAR survey can be adversely affected by the nature and density of vegetation, the presence of steeply varying terrain, the vicinity of buildings and/or the presence of water.

Table 2 – LiDAR Data

Region	Resolution	Survey End	Spatial Accuracy Horizontal (+/- m)	Spatial Accuracy Vertical (+/- m)
Euchareena	2 m	09/02/2017	0.8	0.3
	5 m	29/09/2014	1.25	0.9
Gulgong	2 m	30/11/2015	0.8	0.3
Mudgee	2 m	22/01/2017	0.8	0.3
Orange	2 m	09/02/2017	0.8	0.3

Surveyed river and creek cross sections for the Cudgegong River and Lawson Creek floodplain were obtained for a previous study to define the river and creek channel bathymetry. The cross sections were surveyed in June 1995 by a local surveyor, Land & Engineering Surveyors, and have been partially updated in 2002 and 2004.

3.4. Stream Gauges

The presence of water level recorders (stream gauges) in a catchment will assist in the calibration of the hydrologic and hydraulic modelling package. For this study five gauges are located in or adjacent to the study area and are listed in Table 3 with their locations shown on Figure 4.

Table 3 – Stream Gauges

Station ID	Station Name	Opened	Closed	Gauge Zero (AHD)
421019	Cudgegong River at Yamble Bridge	Aug-39	Current	379.071
421079	Cudgegong River at D/S Windamere Dam	Feb-70	Current	490.424
421149	Cudgegong River at Rocky Water Hole	Oct-94	Current	458.371
421150	Cudgegong River at Wilbertree Road	Aug-87	Current	427.134
421184	Cudgegong River at Upstream Rylstone	Jun-09	Current	580.817

The flow corresponding to a given water level is estimated from a rating curve which provides a relationship between the water level and flow at each gauge. This relationship is derived from velocity measurements (using a current meter) at a known water level and cross-sectional water

area (obtained by survey). Many of these velocity readings are taken over a period of years at different water levels (termed gaugings) and in this way a rating curve is developed as a "line of best fit" between the gaugings. It is relatively easy to obtain "low flow" gaugings as small rises in water levels occur frequently and the gauging party has therefore ample opportunity to undertake them. It is much harder to obtain "high flow" gaugings as they can only be obtained during large floods (which occur infrequently) and it may be that the gauging party cannot get access to the site or are otherwise engaged. Safe access to the site can also be an issue. Thus, all rating curves generally have few "high flow" gaugings and the rating curve must be extrapolated. A review of the gaugings indicates how many "high flow" gaugings were undertaken and the height at which they were taken, this in comparison to peak recorded flood levels can provide an estimate of the accuracy of the rating curve for high flows. Generally, there are few gaugings taken at the peak of a flood and thus the highest gaugings may be several metres below the highest recorded flood levels.

All five gauges used for this study are controlled by Water NSW and have available rating curves. The rating curves are shown on Figure 5 to Figure 9. A review of the gauges within the study area indicates that Cudgegong River at D/S Windamere Dam has some high flow ratings present (approximately a 10% AEP event) but no other gauges have recorded flows above a 20% AEP level. At these locations the flows are derived using an extrapolated rating curve which must be used with caution.

3.4.1. Analysis of Stream Gauge Records

The gauge with the longest record is the Yamble Bridge gauge at Cudgegong River. The top ten annual maximums recorded at the gauge are shown in Table 4 with the 1956 event recording the largest stage height. It should be noted that the stage height at the gauge was not available for the 1955 event.

Table 4 – Top Ten Annual Maximum at Yamble Bridge Gauge (Gauge zero - 379.071 mAHD)

421019 Cudgegong River at Yamble Bridge	
Year	Annual Max Level (m)
1956	8.36
2010	7.61
1979	7.33
2000	7.04
1971	6.88
1990	6.58
1998	5.99
2012	5.85
2003	5.19
1996	4.86

The stream gauge records were analysed for two significant historical events mentioned in Section 2.2. The recorded peak stage heights for the Cudgegong River for the 2003 and 2010 events are shown in Table 5 and the stage hydrographs are shown on Figure 10 and Figure 11.

Table 5 – Peak Stage Heights (m)

Event	Station Name	Cudgegong River Stage Height (m)
Feb 2003	Cudgegong River at Yamble Bridge	5.19
	Cudgegong River at D/S Windamere Dam	1.48
	Cudgegong River at Rocky Water Hole	4.52
	Cudgegong River at Wilbertree Road	5.80
Dec 2010	Cudgegong River at Yamble Bridge	7.61
	Cudgegong River at D/S Windamere Dam	2.16
	Cudgegong River at Rocky Water Hole	5.32
	Cudgegong River at Wilbertree Road	5.76
	Cudgegong River at Upstream Rylstone	2.39

3.5. Rainfall Stations

3.5.1. General

There are a number of rainfall stations within a 100 km radius of the study area. These include daily read stations and continuous pluviometer stations.

The daily read stations record total rainfall for the 24 hours to 9:00 am of the day being recorded. For example, the rainfall received for the period between 9:00 am on 3 February 2008 until 9:00 am on 4 February 2008 would be recorded on the 4 February 2008.

The continuous pluviometer stations record rainfall in sub-daily increments (with output typically reported every 5 or 6 minutes). These records were used to create detailed rainfall hyetographs. A rainfall hyetograph is a graphical representation of how rainfall intensity or rainfall depth is distributed over time. The rainfall hyetographs are a model input for historical events against which the model can be calibrated. Table 6 and Table 7 present a summary of the continuous pluviometer and daily rainfall gauges available for use in this study. The locations of these gauges are shown on Figure 12 and Figure 13. These gauges are operated by the BOM and Water NSW.

Table 6 - Continuous read rainfall stations

Station Name	Agency	Station ID	Opened	Closed
Glen Alice	BOM	61334	07/1970	04/2014
Bylong (Montoro)	BOM	62020	02/1965	03/1991
Wellington Research Centre	BOM	65035	02/1961	02/2005
Bylong (Bylong Rd)	BOM	62102	05/1991	10/2016
Glen Alice (Eurella)	BOM	61149	01/1966	10/1967
Ben Bullen	BOM	563034	07/2005	Current
Rylstone (Marloo)	Water NSW	562101	22/6/1990	28/11/2011
Glenn Alice (Yandarra)	Water NSW	562102	22/6/1990	28/11/2011

Table 7 - Daily read rainfall stations

Station Name	Station ID	Opened	Closed
Rylstone (Kelgoola)	61215	30/10/1962	Current
Brogans Ck Cement Quarry	62001	29/09/1950	29/12/1978
Charbon Standard Portland Ceme	62006	29/06/1929	29/12/1978
Kandos	62016	30/07/1938	29/12/1967
Kandos Cement Works	62017	01/01/1951	Current
Springdale	62023	30-01-1898	29/12/1967
Ilford (Tara)	62029	01/01/1928	Current
Ilford (Warrangunyah)	62031	30-01-1896	Current
Leadville (Moreton Bay)	62035	01/01/1936	Current
Ulan Post Office	62036	27/02/1906	Current
Marsden Forest	62055	01/01/1948	01/01/1984
Wollar (Maree)	62056	29/09/1962	Current
Lue (Bayly St)	62062	30/10/1902	Current
Mudgee (Kemshall)	62075	01/01/1959	Current
Budgee Budgee (Botobolar Vineyard)	62084	29/04/1971	Current
Windamere Dam	62093	28/02/1976	Current
Mudgee Airport AWS	62101	30/10/1988	Current
Mudgee (Wandu-Too)	62104	08/09/1997	Current
Tallawang (Talinga)	62105	01/01/2003	Current
Tyar	63110	01/01/1935	01/01/1964
Goolma (Brooklyn)	62028	01/01/1919	Current
Wollar (Barrigan St)	62032	01/01/1901	Current
Weeroona	62033	01/01/1897	01/01/1971
Leadville (Daymar)	62068	01/01/2002	Current
Bylong (Heatherbrae)	62080	30/08/1968	Current
Geurie (Kurrabri)	65099	03/02/2003	Current
Hargraves (Edge Hill)	62089	01/01/1971	Current
Muronbung (Youralla)	65107	01/01/1948	01/01/1995
Muronbung (Youralla)	65107	29/09/2003	Current
Yarrabin (Osory)	62095	29/06/2002	25/08/2003
Bylong (Bylong Rd)	62102	30/05/1991	Current
The Gullies	63031	01/01/1940	01/01/1969
Hill end Post Office	63035	29/04/1880	Current
Dunedoo Post Office	64009	01/01/1912	Current
Elong Elong (Bendeela St)	64010	01/01/1926	Current
Sofala Old Post Office	63076	30/01/1892	Current
Paling Yards (Ulabri)	63085	01/01/1921	Current
Cobbora (Ellismayne)	64026	01/01/1887	Current
Wattle Flat General Store	63089	29/09/1889	Current
Wellington Research Centre	65035	01/01/1946	22/02/2005
Eurella	61149	30/01/1914	29/12/1969
Bodangora Post Office	65003	30/10/1899	29/12/1968
Geurie Post Office	65018	30/05/1910	Current
Hargraves (The Elders)	62014	30/05/1913	Current
Dunedoo Post Office	64009	01/01/1912	Current

3.5.2. Analysis of Daily Read Data

The selected daily rainfall gauges were analysed for the three significant events specified in Section 2.2.2. Each event was analysed for the maximum 1-day, 2-day, 3-day and entire event totals. The 2010 event was also analysed for the maximum 4-day entire event totals. The results of the analysis are shown in Table 8

The pluviometer gauges were also analysed for the historical events that had corresponding rainfall data. The rainfall hyetographs for the historical events are shown on Figure 14 to Figure 15.

The rainfall totals for each event at each available rain gauge were used to create rainfall isohyets for the entire catchment using the natural neighbour interpolation technique, whereby the recorded rainfall depth at each gauge is used to create a rainfall depth grid of the entire catchment, which are shown on Figure 16. They fundamentally show the variability in rainfall depth across the catchment which can then be used to determine rainfall depths for each individual sub catchment in the historical events in the hydrological model.

Table 8 – Highest Daily Read Rainfall Readings (mm) for 1955, 2003 and 2010 events

Event	Duration	Station ID	Station Name	Total Rainfall (mm)
1955	1-day	64009	Dunedoo Post Office	261.1
	2-day			326.1
	3-day			334.2
	entire event			334.2
2003	1-day	62014	Geurie (Kurrabri)	27
	2-day	62084	Budgee Budgee	213.2
	3-day			217.2
	entire event			217.2
2010	1-day	62102	Bylong (Bylong Rd)	53.4
	2-day	62032	Wollar (Barrigan St)	90.2
	3-day	62014	Hargraves (The Elders)	152
	4-day	64026	Cobbora (Ellismayne)	185.8
	entire event			185.8

3.6. Design Rainfall

The design rainfall intensities for the town of Mudgee obtained from the BOM website are shown in Table 9. Note the IFD values utilised in the study may vary as the IFDs are calculated at the centroid of each subcatchment.

Table 9 - IFD Table for Mudgee (location -32.597S, 149.5875E)

Storm Duration	1 EY	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
1 min	1.79	2	2.66	3.13	3.6	4.25	4.76
2 min	2.97	3.31	4.39	5.15	5.92	6.92	7.7
3 min	4.13	4.6	6.11	7.16	8.23	9.63	10.7
4 min	5.18	5.77	7.67	9	10.3	12.1	13.5
5 min	6.12	6.82	9.07	10.7	12.2	14.4	16.1
10 min	9.62	10.7	14.3	16.8	19.4	22.9	25.7
15 min	11.9	13.3	17.7	20.9	24	28.4	31.9
30 min	16	17.8	23.7	27.9	32.1	38	42.6
1 hour	20.1	22.3	29.7	34.9	40.1	47.2	52.8
2 hour	24.6	27.4	36.2	42.4	48.6	56.9	63.4
3 hour	27.7	30.8	40.7	47.6	54.5	63.7	70.9
6 hour	34.3	38.2	50.4	58.8	67.2	78.5	87.4
12 hour	43	47.9	63.3	74	84.5	99.5	111
24 hour	53.6	59.8	79.5	93.2	107	127	144
48 hour	64.9	72.4	97.1	115	132	159	182
72 hour	71	79.3	107	126	146	177	203
96 hour	74.9	83.8	113	134	155	188	216
120 hour	77.8	87	117	139	161	195	223
144 hour	80.1	89.5	120	142	165	199	228
168 hour	82	91.7	123	145	167	202	231

3.7. Pits, Pipes and Hydraulic Structures

The 2008 Mudgee Local Creeks Floodplain Risk Management Study and Plan Volume 2 Flood Behaviour Studies (Reference 1) and the 2002 Mudgee Floodplain Management Study and Plan (Reference 2) established one dimensional (1D) flood models to define flood behaviour.

These models were developed from cross section survey and information on hydraulic structures. Pits, pipes and hydraulic structure data from these studies were reviewed and the suitability for use in the current study determined. Missing data was identified and site visits undertaken by WMAwater on 23rd to 24th May 2018 and 20th to 22nd June 2018 to verify pit and pipe locations and obtain a more accurate understanding of the drainage network within the catchment. The site visits also included the inspection of other hydraulic controls within the catchment, such as detention basins, swales, bridges and open channels. The location of the hydraulic structures reviewed for inclusion in the hydraulic model to date are shown on Figure 17. A data gap analysis was undertaken for the hydraulic structures in the study area with details of this analysis provided to Council.

Due to limited availability of data some crossing structure details have been omitted. It is considered these omissions are unlikely to significantly affect the outcomes of the modelling however as better data becomes available this should be reviewed against the model setup to

confirm reasonable correlation. Table 10 shows the locations of key structures where information is missing. Note that at Fairy Dale Lane the model DEM is out of date, once revised topographic information is present for this area the model setup should be reviewed to incorporate the data.

Table 10 – Key structures missing information

Location	X Coordinate	Y Coordinate	Assumed Dimensions
Sawpit Gully downstream of industrial area (under railway)	744626.008	6389176.200	4 x 1.2 m RCP
12 Castlereagh Hwy	743785.062	6389788.062	Assumed open bridge
63 Fairy Dale Lane	740661.658	6391515.777	Omitted (DEM outdated)

3.8. Previous Studies

3.8.1. Mudgee Reconnaissance Flood Study Report; Water Resource Commission 1985 (Reference 4)

The report has not been obtained by WMAwater but the following summary was taken from Reference 6. A reconnaissance flood study was undertaken in 1985 which documents flood data recorded during the February 1955 flood and produced a flood inundation map for Mudgee based on this event. Although a flood frequency analysis on the historical flood data was not carried out. The 1955 flood is reported as being a major event approaching the 1% AEP event the Cudgegong River at Mudgee. A preliminary assessment of the flood problem noted that flood damage to urban development at Mudgee was limited to about six dwellings on the floodplain and the local radio station.

3.8.2. Advice Concerning Flooding of the Cudgegong River and Lawsons Creek at Mudgee; Sinclair Knight & Partners 1983 (Reference 3)

The report has not been obtained by WMAwater but the following summary was taken from Reference 6. This advice is contained in a brief report that provides a flood assessment for land located between the Cudgegong River and Lawsons Creek, upstream of the confluence of both rivers.

Reported food conditions were based on flood heights that were observed in the vicinity of the site in 1969 and 1955. These floods were assessed to be equivalent to a 5% and 1% AEP event respectively, based on flood frequency analysis of available flood records at Yamble Bridge and the Windamere Dam site.

3.8.3. Redbank Creek Dam – Dambreak Study; Public Works Department 1992 (Reference 5)

The report has not been obtained by WMAwater but the following summary was taken from Reference 6. The study investigated the risk of flooding due to the possible failure of the Redbank Creek Dam wall. Various dambreak scenarios were investigated, with computer modelling simulating flood conditions in Redbank Creek, between the dam and the railway line.

Eleven cross sections of Redbank Creek, surveyed by Council of Redbank Creek were used in the analysis. Floor levels of low lying properties were also surveyed to help quantify the number of homes affected by flooding.

The report concludes that about fourteen dwellings would be at risk from a sunny day dam failure, upstream of the railway line. Dam failure during a PMF was estimated to result in additional inundation depths, but no increase to the number of dwellings affected by flooding. The dam was assessed as having a high flood hazard rating.

3.8.4. Mudgee Flood Study; Department of Land and Water Conservation 1998 (Reference 2)

The flood study was undertaken to define flood behaviour in the town of Mudgee and the rural surrounds. In this study, flood behaviour for Cudgegong River and Lawsons Creek was assessed using the hydrologic model (RORB) and hydraulic model (MIKE-11) software. Surveyed cross sections from the 1995 study were used to define the river system bathymetry. Flood levels and velocities were determined for the 5%, 2%, 1% AEP and PMF design events, with these results to be used to assess development applications. The models developed for this study were used in the subsequent Floodplain Risk Management Study and Plan.

3.8.5. Mudgee Floodplain Management Study and Plan – Redbank Creek Flood Investigations; Bewsher Consulting 2000 (Reference 7)

After considering the flooding issue on Redbank Creek the Floodplain Management Committee (FMC) decided to expand the Mudgee floodplain management study to include the Redbank Creek catchment. The objective of the study was to define flood behaviour for Redbank Creek so that management options could be considered in the subsequent management study. Flood behaviour of Redbank Creek was investigated using the hydrologic model RORB and the hydraulic model HECRAS. Flood levels and velocities were determined for the 5%, 2% and 1% AEP design events. The following issues were identified:

- potential for dam failure;
- houses subject to flooding;
- issues at Waterworks Road;
- culverts with inadequate capacity;
- high velocities, scour potential and potential infrastructure damage;
- Redbank Creek Dam operation options;
- recommended freeboard of 1.0 m, and
- suggested mitigation options.

3.8.6. Mudgee Floodplain Management Study and Plan; Bewsher Consulting 2002 (Reference 6)

The FRMS&P used the modelling package developed in the 1998 Flood Study (Reference 2). The objectives of the study included:

- a review of the existing flood study model and results;
- additional flood modelling of Redbank Creek (Reference 5);
- quantification of the flood problem in Mudgee and rural surrounds;
- assessment of potential flood mitigation options, and
- development of recommended floodplain management plan.

A review and investigation of potential planning instruments and measures was undertaken as well as the investigation of potential floodplain mitigation measures. Following this investigation the following measures were recommended in the Draft Floodplain Management Plan:

- High Priority Measures
  - planning and development controls – graded set of planning controls that recognises type of development and flood risk of that area;
  - improved public awareness – update Council's GIS with current flood information, issue of flood certificates, construction of flood markers;
  - improved emergency management plans – update SES local flood plan for Mudgee in conjunction with improvement to flood warning system;
  - flood action plan for the Short Street Caravan Park, and
  - remedial measures for Redbank Creek Dam (in 2008 1.6 m diameter outlet pipe was installed. In 2013 the upper section of the dam wall was demolished to create an 80 m wide spillway at a crest level of 531.1 mAHD and the 1.6 m diameter outflow pipe was reduce to 0.75 m in dimeter to convert the dam into a retarding basin).
- Medium Priority Measures
  - vegetation management study and plan – recommended for Cudgegong River and Lawsons Creek;
  - flood warning proposal and implementation, and
  - small landscaped levee in Mulgoa Robertson Street.
- Low Priority Measures
  - culvert amplifications under Waterworks Road;
  - channel works upstream of Waterworks Road;
  - voluntary house raising, and
  - flood proofing measures.

3.8.7. Redbank Creek Dam Flood Study, Department of Commerce 2006 (Reference 8)

The Hydrology Group of the NSW Department of Commerce (DOC) were engaged to provide specific flood estimates to assist with the concept work relating to the upgrading of the Redbank Creek Dam. The report summarizes the hydrologic investigations undertaken to provide estimates of 1 in 100000 AEP inflow hydrographs. The estimates were requested to be based on:

- using the RORB hydrological model for the Dam catchment;
- using suitable model parameter values based on the work of Dyer et al (1996) and the

regional relations in ARR87;
- determining design rainfall frequency curves, and
- using the RORB model to transfer the 1 in 100,000 AEP design rainfalls to provide 1 in 100,000 AEP flood inflow hydrographs.

The study recommended that flood estimates should be reviewed for future design purposes and consideration should be given to reviewing the flood frequency estimates when CRC Forge rare rainfall estimates becomes available for NSW.

3.8.8. Mudgee Local Creeks Floodplain Risk Management Study and Plan Volume 1&2; Lyall and Associates 2008 (Reference 1)

The Floodplain Risk Management Study and Plan consisted of two volumes:
- Volume 1 – Draft Floodplain Management Study and Plan
- Volume 2 – Flood Behaviour Studies

The overall objectives of the study were to define and assess the impacts of flooding in the local creeks catchments, review policies and options for management of flood affected land and to develop a draft Floodplain Risk Management Plan which:
- proposes modifications to existing Council policies to ensure that the development of flood affected land adjacent to the creeks in undertaken so as to be compatible with the flood risk;
- proposes flood planning levels for various land uses in the floodplains;
- sets out the recommended program of works and measures aimed at reducing over time, the social, environmental and economic impacts of flooding, and
- provides a program for implementation of the proposed works and measure.

Volume 1 – Study and Plan

The proposed measures in Volume 2 were refined and an investigation undertaken into planning, policy, emergency response and a flash flood early warning system. The recommended measures for the draft floodplain risk management plan are:
- investigation/concept design study to confirm the feasibility of structural drainage works;
- depending on results of above undertake detailed design and construction of drainage works program;
- application of existing policy document “Managing Our Flood Risks” to control development in the floodplains of the Mudgee Local Creeks;
- undertake investigation of feasibility of a flash flood warning system;
- implementation of flash flood warning system;
- ensure flood data in this FRMS&P are available to SES for inclusion in flood emergency response procedures, and
- implement flood awareness and education program for residents bordering the creek system and owners industrial developments adjacent to Sawpit Gully.

Volume 2 – Flood Behaviour Studies

Volume 2 of the study defines flood behaviour for seven of the eight drainage lines running through the town of Mudgee excluding Redbank Creek which was investigated in Reference 6. The

drainage lines were given the following names:

- Catchment A, also known as Saleyards Creek
- Catchment B
- Catchment C
- Catchment D
- Catchment E
- Catchment F
- Sawpit Gully

The study used a hydrological model (DRAINS) and a one-dimensional hydraulic model (HEC-RAS, Reference 5) to estimate design flood behaviour in the study area for the 20%, 5%, 1% AEP and PMF events. A broad scale investigation of structural measures was undertaken to mitigate flooding in residential areas bordering the Mudgee Creek system and is summarised below:

- Catchment A
  - channel enlargement from Wallerang – Gwabegar Railway embankment to Lang Street;
  - channel enlargement from on Southern side of Galdstone Street from Fairy Dale Lane to Bell Street;
  - improve capacity of Rifle Range Road culvert;
  - detention basin d/s Bellevue Road (constructed in 2013), and
  - reconstruct Farm Dam (as a dual purpose flood mitigation/water conservation dam).
- Catchment B
  - detention basin u/s Railway (constructed in 2017), and
  - improve hydraulics of intake pit to relief pipeline in Cox Street.
- Catchment C
  - improve capacity of Mortimer Street culvert;
  - detention basin Victoria Park area and improve inlet to Perry Street culvert, and
  - remove brick wall across channel south side Gladstone Street
- Catchment D
  - no improvements proposed
- Catchment E
  - increase culvert capacity and/or lower road level at Mortimer Street crossing
- Catchment F
  - improve capacity of George Street culvert;
  - convert golf course dam to dual purpose storage basin;
  - improve capacity of Inglis Street culvert, and
  - improve capacity of Mortimer Street culvert
- Sawpit Gully
  - reduce capacity of detention basin low level outlets (short-term measure);
  - raise level of embankment and spillway of detention basin (long term measure), and
  - improve capacity of Industrial Avenue culverts, plus channel improvements.

3.8.9. Stormwater and Flood Investigation – Byron Place/Church Street Mudgee Town

Centre; Wallis and Moore Insites 2009 (Reference 10)

Stormwater and flood behaviour were investigated in the Mudgee town centre to provide options and advice to Council on works in the catchment to reduce potential flooding in Byron Place car park through to Market Street, Mortimer Street in front of Woolworths and the corner of Gladstone and Church Streets. The hydrologic and hydraulic modelling package XP storm was used to model the 20%, 5% and 1% AEP events. The following options were investigated with specific recommendations provided in the report:

- Church Street drainage extension;
- Mortimer Street drainage upgrade and extension;
- Perry Street;
- Intersection of Perry Street and Gladstone Street; and
- Mortimer Street Low Point.

3.8.10. Spring Flat Drainage Study Report, Mudgee – Wallis and Moore Insites 2010 (Reference 11)

WMAwater has not obtained this report, with this brief description provided in the project brief document. The study assesses flooding/drainage problems within the Spring Flat catchment of Mudgee.

3.8.11. Glen Willow Master Plan – Glen Willow Regional Sporting Complex – Mid-Western Council 2016 - Amended in 2018 (Reference 12)

The master plan outlines MWRC proposal to establish a sporting complex around the main one thousand seat stadium located at Pitts Lane Mudgee. The objective is to establish a number of multi-use fields for both summer and winter competitions including soccer, AFL, rugby league, rugby union, touch football, cricket, junior league, hockey, softball, baseball and netball.

The proposed site is Council owned land that is bounded by Lawson Creek to the north, Pitts Lane to the south and farm land to the east and west. The site area is approximately 40 hectares. The site level is below the 1% AEP flood level and is located in an area designated as a high hazard flood zone. Significant vegetation exists along Lawsons Creek and there are a few native trees along the southern boundary. The remaining site is grassed and generally flat with a gentle fall to the west.

The overall vision is for the following:

- three major fields
- nine other fields
- one cricket oval
- two artificial fields
- up to 24 netball hardcourts
- 9 netball grass courts
- associated grandstands, amenities, club rooms and storage sheds
- extended off leash dog park
- cycleways and walkways

- lighting, signage, fencing and irrigation

As the site is located within a floodplain it is proposed to raise all buildings onto berms. The report states that the intention of the plan is to not raise the entire site as this would have detrimental effects on adjoining properties due to floodwaters and that flood analysis work is being carried out to ensure that pre-development and post-development flood levels both upstream and downstream are maintained.

Council's vision has already commenced with the development of the six existing fields, 12 netball courts and development of main field and stadium. Council proposes to develop the Glen Willow Regional Sporting Complex over a number of stages in the coming years.

3.8.12. Mudgee and Gulgong Urban Release Strategy – Hill PDA Consulting 2014 (Reference 13)

Council and the NSW Department of Planning and Environment identified the need to prepare an Urban Release Strategy for the towns of Mudgee and Gulgong. This is due to strong population growth driven by the expansion of the local coal mining industry and the sustained pressure for residential development. To date the majority of housing growth has occurred in Mudgee however nearby Gulgong has also been impacted in recent years by shifts in the housing market.

The Urban Release Strategy addresses the following:

- Strategy timeframe and review
- Land Supply Monitor
- Planning Framework and Strategy
- Mid-Western Local Environment Plan 2012
- Development Servicing Plans
- Urban Release Strategy
- Demographic Trends
    - Population Projections
    - Resident and Dwelling Characteristics
- Residential Market Snapshot
- Supply and Demand Analysis
    - Supply Factors
    - Demand Factors
    - Mudgee – Supply and Demand
- Land Release Strategy
- Recommendations
    - Mudgee Land Release Recommendations
    - Gulgong Land Release Recommendations

4. COMMUNITY CONSULTATION

4.1. Information Brochure and Survey

In collaboration with MWRC an information brochure with community survey was distributed to residents within the study area. The function of this was to describe the role of the Flood Study in the floodplain risk management process and to request records of historical flooding. Coupled with updates on Council's social media and online survey eighteen responses were received from the survey. From the survey 94% of respondents are aware of flooding issues in the catchment, with eleven respondents having had their properties affected by flooding.

4.2. Community Responses

The responses are summarised in graphs on Figure 18 and the properties identified as flood affected are shown on Figure 19. The following issues were raised by the respondents:

- the majority of respondents are acutely aware of flooding risks. Most respondents remember the flood events in February 2010, September 2016 and March 2017 causing limited access to or isolation in their properties. For most of the affected properties flood water took longer than 1 day to drain away or had to be pumped out;
- some residents are concerned about the impact of flooding on local tourism for caravan parks or hotels;
- some respondents feel that new residential buildings and unit development and changes to the drainage system in their local area have significantly changed the overland flow path in recent years, making their properties more vulnerable to flooding;
- some respondents observed that the general watercourse from the airport and Henry Lawson Drive through to Putta Bucca Road has been significantly changed, making parts of Putta Bucca Road completely unusable and inaccessible;
- according to some respondents, improvements in the management of Windamere Dam could reduce the risk of flooding downstream of the dam;
- some respondents feel that the current flood situation causes a threat to children, animals and more vulnerable people that rely on medical care and assistance;
- a respondent feels that the flood problem is being neglected by the Council with regard to the redirection of a watercourse through their property, and
- some respondents are concerned about future development in areas that are isolated during flood events. They are concerned that the development will be dangerous to new residents and stretch the resources of community and emergency services during flood events.

A selection of flood images provided by MWRC and the community is shown in Plate 2 to Plate 15.

Plate 2– Lawsons Park 2003

Plate 3 – Lawsons Park 2003

Plate 4 - Lawsons Park 2003

Plate 5 – Wilbertree Road 2003

Plate 6 – Ulan Road 2003

Plate 7 – Jubilee Park after 2003 flood

Plate 8 – Mudgee, 2010 flood

Plate 9 – Mudgee, 2010 flood

Plate 10 – Mudgee, 2010 flood

Plate 11 – Mudgee, 2010 flood

Plate 12 – 17 Mortimer Street Mudgee

Plate 13 - 17 Mortimer Street Mudgee

Plate 14 – Glen Willow Sports Complex

Plate 15 – Glen Willow Sports Complex

5. STUDY METHODOLOGY

The approach adopted in flood studies to determine design flood levels largely depends upon the objectives of the study and the quantity and quality of the data (survey, flood, rainfall, flow etc.). There is a thorough record of daily rainfall data for the catchment and some sub-hourly rainfall data from pluviometer gauges and stream gauges with sufficient record length, which can be used for event-based model calibration. For this study, a rainfall-runoff approach was adopted, using a hydrologic model to estimate the runoff flows from rainfall, and a detailed hydraulic model to determine the flood levels, depths, velocities and extents produced by the runoff flows throughout the study area. A diagrammatic representation of the flood study process undertaken in this manner is shown below.

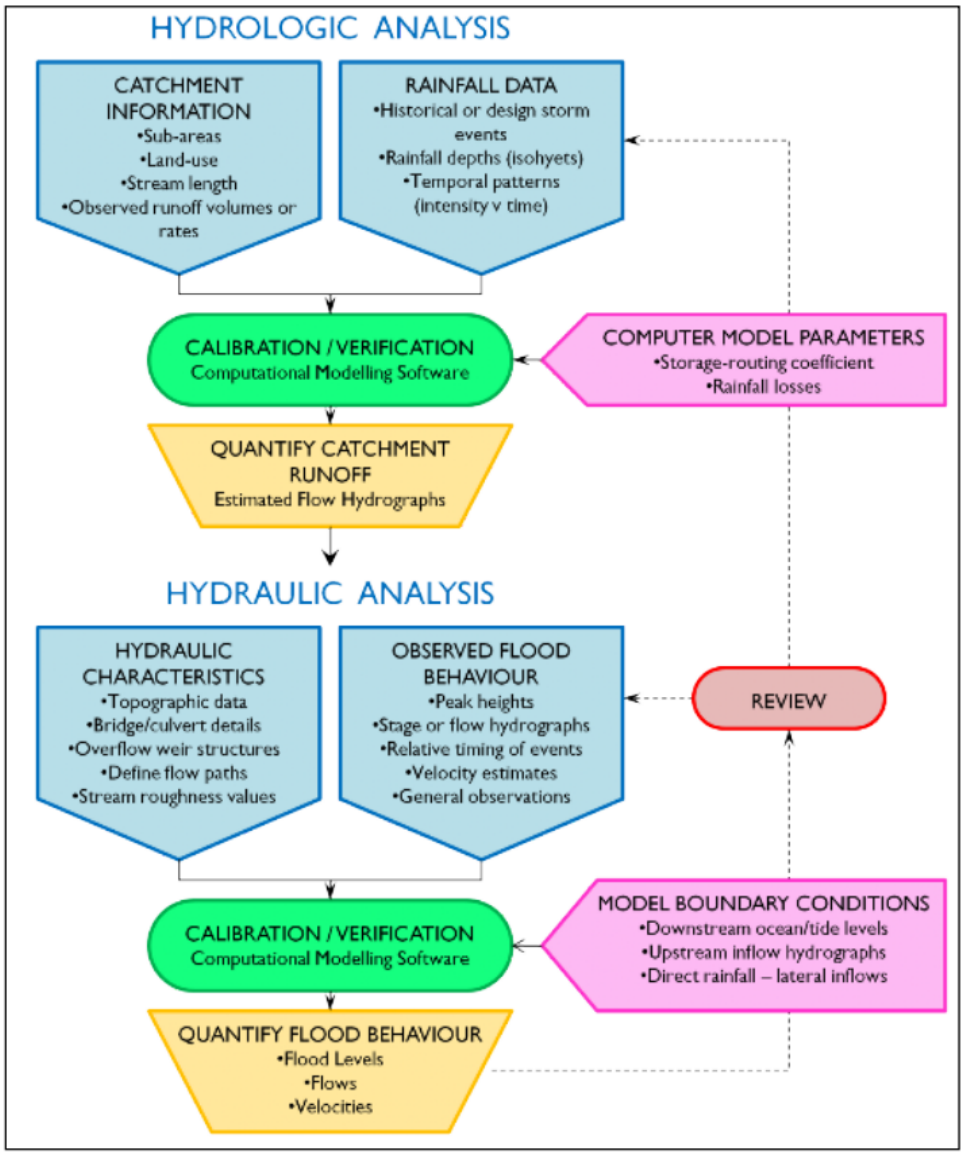

Diagram 1: Flood Study Process

6. HYDROLOGIC MODEL

6.1. Introduction

Inflow hydrographs serve as inputs at the boundaries of the hydraulic model. In a flood study where long-term gauged streamflow records are not available at the point of interest, or other flood mechanisms exist, a rainfall-runoff hydrologic model (converts rainfall to runoff) is generally used to provide these inflows. A range of runoff routing hydrologic models are available as described in Australian Rainfall and Runoff (ARR2019) 2019. These models allow the rainfall depth to vary both spatially and temporarily over the catchment and readily lend themselves to calibration against recorded data. While there is long term data available for

The WBNM hydrologic run-off routing model was used to determine flows from each sub-catchment. The WBNM model has a relatively simple but well supported method, where the routing behaviour of the catchment is primarily assumed to be correlated with the catchment area. If flow data is available at a stream gauge, then the WBNM model can be calibrated to this data through adjustment of various model parameters including the stream lag factor, storage lag factor, and/or rainfall losses.

A hydrological model for Cudgegong River and Lawsons Creek catchment was created and used to calculate the flows for each individual sub-catchment and tributary creek for inclusion in the TUFLOW hydraulic model. A detailed hydrological model which covers the Mudgee Township has also been developed to assess the local runoff characteristics of the area.

6.2. Sub-catchment delineation

The catchment boundary was determined by the ridges that create the natural drainage division. Precipitation falling on the other side of these boundaries would flow into other catchments and so was not modelled within this study area. Lawson creek catchment has been combined with the adjacent Cudgegong river catchment, both adding up to a total catchment size of approximately 1800 km^2 to the downstream of Mudgee Township. Within these catchments, smaller sub catchment areas were derived from LiDAR topographic data and consideration of hydraulic controls such as bridge crossings and rail/road embankments. Figure 20 shows the sub catchment delineation for the study area.

The catchment in general has been considered to be pervious in the majority of areas. The township of Mudgee and surrounding suburbs have been assessed on a land use scale for the application of effective fraction impervious parameters.

The catchment model extends significantly further downstream than the study boundary to allow for the inclusion of the Wilbertree Road flow gauge. This is to enable two calibration points within the hydrology and hydraulic models.

6.3. Adopted Hydrologic Model Parameters

The model input parameters for each sub catchment are:

- A lag factor (termed C), which can be used to accelerate or delay the runoff response to rainfall (Section 6.4);
- A stream flow routing factor, which can accelerate or decelerate in-channel flows occurring through each sub catchment (Section 6.4);
- An impervious area lag factor (Section 6.5);
- An areal reduction factor (Section 6.7);
- The percentage of catchment area with a pervious/impervious surface (Section 6.5); and
- Rainfall losses calculated by initial and continuing losses to represent infiltration (Section 6.6).

6.4. Lag and Routing Factors

A typical regional value of 1.8 for the lag factor 'C' hydrologic model parameter which is in range rec by WBNM was found to be appropriate which is within the range of values recommended by WBNM. This was based on the calibration of the flood models, discussed in Section 8. A value of 1.45 was used for the stream flow routing which is based on the calibration undertaken (Refer Section 8). The C value was modified from the default to account for the flat nature of the floodplain in the Mudgee region. This characteristic alters the response of the catchment lag. The value is still close to the default and is well within the bounds of the variation identified within WBNM runoff routing parameters for south and eastern Australia (Reference 24). The impervious area lag factor is set to 0.1, which is the default set by WBNM.

6.5. Impervious Surface Area

Runoff from connected impervious surfaces such as roads, gutters, roofs or concrete surfaces occurs significantly faster than from vegetated surfaces. This results in a faster concentration of flow within the downstream area of the catchment and increased peak flow in some situations. This is less important in rural studies as they consist of relatively few impervious areas, and those areas are typically not hydraulically connected to the waterway (i.e. the water flows across pervious areas on the route between the impervious surface and the receiving waterway). Mudgee, on the other hand has a number of commercial impervious areas such as the CBD and the industrial precinct south east of the township.

Land use information and aerial photography was utilised to estimate the effective impervious surface area for each sub-catchment. For each of the land use types, an impervious percentage was assigned. The assumed effective imperviousness of each sub-catchment varied from 0 to 90%, depending on the land use. A large majority of the catchment is undeveloped and has an imperviousness of 0% to 5%. Slightly higher values were applied where there was low-density development, whilst higher imperviousness percentages were applied in the urban area of Mudgee. Table 11 provides a summary of the fraction impervious and the effective fraction impervious utilised for each associated land use. Effective fraction impervious differs from fraction impervious as it aims to estimate the proportion of the total impervious area that results in runoff.

Based on aerial photography the medium density and general residential have been deemed to have the same effective fraction impervious as both still contain significant regions of green space.

Table 11 - Summary of the Effective Fraction Impervious Utilised

Land Use	Fraction Impervious (%)	Effective Fraction Impervious (%)
Rural / Primary Production	0	0
Commercial	90-100	90
Medium Density Residential	40-50	30
General Residential	30-40	30
Recreation	0-10	0

6.6. Rainfall Losses

Methods for modelling the proportion of rainfall that is "lost" to infiltration are outlined in ARR2019 (Reference 15). The intent of the approaches is to provide a reasonable estimate of loss in the catchment based on the best available information. The methods are of varying degrees of complexity, with the more complex options only suitable if sufficient data is available. The method most typically used for design flood estimation is to apply an initial and continuing loss to the rainfall. The initial loss represents the wetting of the catchment prior to runoff starting to occur and the filling of localised depressions, and the continuing loss represents the ongoing infiltration of water into the saturated soils while rainfall continues. The rainfall losses adopted as a result of the calibration process are discussed in Section 8 and the loss values used in design flood estimation are discussed in Section 9.

6.7. Areal Reduction Factor

Areal reduction factors (ARF) convert design point rainfall intensities (IFD) into areal-averaged rainfall estimates. The ARF provides a correction factor between the catchment rainfall depth (for a given combination of AEP and duration) and the mean of the point rainfall depths across a catchment. The ARF applied to design rainfall is a function of the total area of the catchment, the design rainfall duration and the AEP. Applying an ARF is a necessary input to computation of design flood estimates from a catchment model that preserves a probability neutral transition between the design rainfall and the design flood characteristics. The ARF merely influences the average depth of rainfall across the catchment, it does not account for variability in the spatial and/or space-time patterns of its occurrence over the catchment.

The method adopted for the derivation of areal reduction factors is based on ARR 2019 (Reference 16). Local rainfall areal reduction factors were applied to short duration burst events that may affect the town centre rather than the regional areal reduction factor. This ensures the correct volume of rainfall is considered for events in the area of interest.

7. HYDRAULIC MODEL

7.1. Introduction

The availability of high quality LiDAR as well as detailed aerial photographic data enables the use of 2D hydraulic modelling for the study. Various 2D software packages are available (SOBEK, TUFLOW, RMA-2) and the TUFLOW package was adopted as it is the most widely used model of this type in Australia for riverine and property scale flood modelling.

Recent developments to the TUFLOW engine have enabled the utilisation of high powered graphics cards to improve the run times associated with large model domains. Given the large area present in this study area, it was deemed necessary to utilise this technology, known as TUFLOW HPC GPU.

The TUFLOW model version used in this study was 2018-03-AE-iSP and further details regarding TUFLOW software can be found in the User Manual (Reference 20)

In TUFLOW the ground topography is represented as a uniform grid with a ground elevation and Manning's 'n' roughness value assigned to each grid cell. The size of grid is determined as a balance between the catchment features, model result definition required, and the computer processing time needed to run the simulations. The greater the definition i.e. the smaller the grid size the greater the processing time needed to run the simulation. A cell size of 3 m by 3 m was adopted as it provided an appropriate balance between providing sufficient detail for the river channels and bridges, while still resulting in workable computational run times.

7.2. TUFLOW Hydraulic Model

The Digital Elevation Model (DEM) for use in TUFLOW was generated from a triangulation of filtered ground points from the LiDAR dataset and surveyed cross sections as discussed in Section 3.3. The DEM is shown on Figure 3. The model extent for the catchment was determined in conjunction with MWRC based on where development is occurring and flood information is required. The upstream boundaries are Cudgegong River upstream of Rocky Water Hole gauge and Lawsons Creek upstream of Mudgee. The downstream boundaries are located on the Cudgegong River downstream of the Wilbertree Road gauge. The model extent is shown Figure 21.

7.3. Boundary Locations

7.3.1. Inflows

Figure 22 shows the locations of the flow and downstream boundaries of the flood model. For sub-catchments within the TUFLOW model domain, local runoff hydrographs were extracted from the WBNM model (see Section 6). These were applied to the downstream end of the sub-catchments within the 2D domain of the Mudgee Flood Study hydraulic model. The hydraulic model also has several inflows which utilise hydrologic routing in upstream catchments to reduce the overall footprint of the hydraulic model.

The inflow hydrographs for the design events were taken from the calibrated WBNM model utilising information from the ARR data hub (refer Section 9). The inflow hydrographs for the calibration events were also taken from the WBNM model, based on the parameters selected for each event (refer Section 8).

7.3.2. Downstream Boundary

The hydraulic model has one downstream boundary condition which is located downstream of Wilbertree Road gauge on Cudgegong River. This has been set as a constant slope boundary of 0.1% consistent with the gradient of the River at this location. The location is set sufficiently far downstream of the gauge to allow calibration of the model to occur at the gauge.

7.4. Mannings ‘n’ Roughness

Roughness, represented by the Manning’s ‘n’ coefficient, is an influential parameter in hydraulic modelling. The hydraulic reference book Chow provides the definitive reference work in regard to the setting of roughness values for hydraulic calculations. A range of standard hydraulic roughness examples are provided within the text book which allow the selection of parameters. These parameters form the initial basis of the assessment, with further refinement of the values undertaken during the calibration component of the study to ensure good replication of known events. As part of the calibration process roughness values are adjusted within ranges defined in industry guidance so that the model may match observed peak flood levels at a variety of locations. The calibration process is discussed in Section 8.

Henderson (Reference 14) also provides roughness values for various land use and flow conditions. Table 4-2 of Henderson (Reference 14) states that for a natural channel, roughness may vary between 0.025 to 0.03 for a clean and straight channel, from 0.033 to 0.04 for a winding channel with pools and shoals, and from 0.075 to 0.15 for a very winding and overgrown channel.

The main channel of Cudgegong River and Lawsons Creek are earth channels with several meanders. There are some riparian sections of dense weeds and shrubs on each channel which require consideration of vegetation in the hydraulic roughness selected. In some locations the banks of the channels are heavily treed, which is vastly different compared to the in-bank channel. Separate values were chosen for the river channels and the riparian edge.

The in-bank section of each river was modelled using a Manning's 'n' value of 0.04 and the dense riparian vegetation was modelled using a Manning's 'n' value of 0.08, recognising that some of the vegetation on the banks will be knocked flat in a major flood event. Figure 23 shows the roughness values within the model.

The Manning's 'n' values adopted are shown in Table 12.

Table 12 – Adopted Manning's *n* values – TUFLOW model

Surface	Manning's *n*
Road	0.02
Farmland	0.04
Township (Excluding Buildings)	0.04
River	0.04
Riparian Vegetation	0.08
Forest	0.10

7.5. Rivers

The river channels were defined in the 2D grid domain. The channels represent the key conveyance system in the study area and thus appropriate representation is required. The DEM was modified to provide a continuous flow path with gradient determined from available data. The LiDAR was able to provide topographic information of the river channels above the water level on the day of the survey. The low water level channel information for Cudgegong River was based on the available cross section survey (Refer section 3.3) for the River. This was incorporated through the use of a z shape layer within TUFLOW which enables the interpolation of the information along the channel alignment.

7.6. Roads and Railway

The roads and railway were all modelled using break lines which alter the topography of the DEM. The elevations of the road and railway system were determined using the LiDAR survey. It is noted that in several locations the top of the Cudgegong River channel is above the surrounding flood plain, acting as a form of levee to the system. The use of a 3 m grid resolution ensures that, where present, these features, along with all other local hydraulic features, are picked up.

7.7. Hydraulic Structures

7.7.1. Bridges and Large Culverts

Throughout the study area there are several bridges that cross Cudgegong River and Lawsons Creek (Reference 2). These include:

- Rocky Water Hole Road over Cudgegong River. This is a bank of 7 culverts that has limited hydraulic capacity. The causeway serves as a hydraulic control for the upstream river gauge;
- Railway Crossing upstream of Mudgee Township over Cudgegong River;
- Ulan Road over Cudgegong River (Holyoake Bridge). A 60 m long bridge with 3 piers in

the waterway has a concrete railing approx. 1 m high on both sides. An additional pedestrian lane is present upstream of the original bridge which has an open metal handrail approx. 1.4 m high;

- Ulan Road over Lawsons Creek (Neville H Paine Bridge). A short span bridge with full concrete barriers on each side. An additional pedestrian lane is present upstream of the original bridge which has an open metal handrail approx. 1.2 m high;
- Putta Bucca Road over Cudgegong River. Short span bridge (approx. 21 m) with a single concrete buttress in the waterway. Metal posts and rails approx. 0.7 m high on both sides of the road;
- Railway Crossing downstream of Mudgee Township over Cudgegong River; and
- Wilbertree Road over Cudgegong River.

It is noted that there are also several structures also along Redbank Creek. Where information is available these structures have been incorporated. Where no data is present structural information has been estimated from photography.

The hydraulic model has utilised 1D elements and 2D layered flow constrictions to represent the structures as appropriate. Figure 17 shows the locations of the structures present in the model.

7.7.2. Detention Storage and Dams

The Mudgee Flood Study hydraulic investigation area has several detention basins and dams present. The largest system is the Redbank Creek Dam. Within the hydraulic model the dam crest, based on the information present in the Redbank Creek Dam Stabilisation Works Design Report and on Mid Western Regional Council's website (http://www.midwestern.nsw.gov.au/resident-services/Water-Services/stormwater/Redbank-Creek-Dam/) will be modelled in the 2D domain. The information provides detail on the Dam crest levels and the initial water level (assumed empty).

7.7.3. Buildings

All buildings within the Mudgee Township were digitised as separate elements for consideration within the hydraulic model. The buildings have been considered as full blockages to flow within the model.

7.7.4. Pit and Pipe Network

The stormwater drainage network within Mudgee has been incorporated into the model as 1d elements. The pipe and pipe network information is based upon the data that council supplied (Refer Section 3.7) and infilled where information was missing. Visual inspection of the alignment was also undertaken to inform appropriate network connectivity where data was missing.

8. CALIBRATION

8.1. Objectives

The objective of the calibration process is to build a robust hydrologic and hydraulic modelling system that can replicate historical flood behaviour in the catchment being investigated. If the modelling system can replicate historical flood behaviour then it can more confidently be used to estimate design flood behaviour. The resulting outputs from design flood modelling are used for planning purposes and for infrastructure design. For this study, due to limited historical data for the area the historical events chosen for calibration were:

- February 2003;
- December 2010; and
- September 2016.

The events were selected based on the magnitude of the event and the availability of data. It is noted that the largest event on record, the 1955 event has not been modelled. This is due to no information with regards to flow or river being present at any stream flow, rainfall gauge within the study area available and Windamere Dam not being present in the catchment during the event. It is difficult to replicate conditions prior to the construction of Windamere Dam with the available information.

The 1998 Flood Study provides some advice with regards to the magnitude of the 1955 event and some limited flood level information. The report notes the event was in the order of a 1% AEP event when Windamere Dam is present. It should be noted during the 1998 Flood Study that validation of the model to recorded levels alongside Mudgee was unsuccessful (Reference 2, pg. 28). This was generally attributed to the passing of time and the limited data available of earlier conditions. The three events selected have information that is relevant to current catchment conditions and have sufficient information to inform at least a partial calibration.

8.2. Stream Gauge information

Within the study area downstream of Windamere Dam there are three flow gauges present. Due to the hydraulic control of Windamere Dam, which will attenuate all upstream flow from that portion of the catchment into the dam and in many cases result in no downstream flow, no calibration of gauges upstream of the dam has been undertaken. Table 13 provides a summary of the gauges selected for review within the calibration. Figure 4 shows the locations of these gauges within the study area.

Table 13 – Stream Gauges

Station ID	Station Name	Opened	Closed
421079	Cudgegong River at D/S Windamere Dam	Feb-70	Current
421149	Cudgegong River at Rocky Water Hole	Jul-85	Current
421150	Cudgegong River at Wilbertree Road	May-85	Current

8.3. Methodology

A joint calibration of the hydrologic and hydraulic model was chosen as the best approach for the study area for the following reasons:

- While there are two flow gauges present within the hydraulic study area, there is limited confidence on the flow rating curves present. More emphasis will therefore be placed on the recorded levels than the recorded flows during the assessment.
- There is very sparse rainfall pluviograph information for the region which results in large data gaps for historical events. A review of level and extent rather than flow in most cases will be the only available data to verify the system is responding appropriately to lived experience.

The approach to model calibration was to adjust the rainfall loss parameters and the stream routing parameter in the WBNM (hydrologic) model and adjust the Manning's 'n' roughness values in the TUFLOW hydraulic model. Multiple combinations of these parameters were investigated until the best fit to the recorded water levels and description of flood behaviour in the study area could be achieved across the whole range of calibration events.

For the three events, the adopted rainfall depths (obtained from AWAP, Reference 23) and temporal patterns (obtained from local pluviography information) were found to have the most influence on the calibration results. The levels obtained at the three gauges in the study area were more sensitive to the rainfall assumptions than to the other model parameters available for tuning the model calibration. Since the available rainfall data is inherently unable to reflect the true spatial and temporal rainfall distribution across the catchment for the floods investigated due to limited availability, it is unreasonable to try and obtain a perfect fit in the model calibration results. It was however identified that due to the very flat nature of the catchment through the floodplain area (approximately 0.2% gradient through the floodplain) the stream routing parameter was required to be increased to develop a reasonable response.

8.3.1. Rainfall Losses (WBNM)

The initial loss / continuing loss model was used to estimate rainfall losses over the catchment. Due to the irrigated nature of the catchment and the presence of a dam which releases environmental flows, the initial losses estimated within catchment varied significantly event to event. Additionally, the antecedent conditions of the catchment, given the different times of year the events occurred were likely varied. The continuing losses however were generally consistent which indicates a generally homogenous infiltration rate once the soil is saturated. Table 14 provides a summary of the losses used in each calibration event.

Table 14 – Calibration Event Rainfall Losses

Event	Initial Loss	Continuing Loss
February 2003	130 mm	2.5 mm/h
December 2010	55 mm	3 mm/h
September 2016	10 mm	3 mm/h

As the three events modelled are relatively recent, it is likely that current catchment conditions are relatively consistent with the calibration findings.

8.3.2. Windamere Dam

Since the completion of construction of Windamere Dam in 1974 there has been only one event in which the full supply level was exceeded. This was in August 1990. Unfortunately, data is not present at any downstream gauges within the catchment for this event and thus calibration to the event could not be undertaken. In the calibration events modelled, no flows were present over the dam spillway and thus flows from the upstream catchment have not been considered. Some low flow releases are present during the calibration events however these have been considered to be negligible relative to the flood flows present.

8.3.3. Stream Routing Parameter (WBNM)

The typical stream routing value in WBNM is 1.0 for natural channels. An increase to this parameter will reduce stream velocity and a decrease will increase stream velocity. A stream routing value of 1.45 was applied to provide the best fit to historical events. This value can be justified by the very flat terrain of the floodplain and the meanders present. Preliminary hydraulic model runs indicate an average velocity of less than 0.7 m/s through the floodplain, consistent with this assumption.

8.3.4. Manning's 'n' Roughness

Multiple combinations of Manning's 'n' parameters were modelled in order to determine the values that provided the best fit to recorded water levels. The values modelled were justified in the literature discussed previously in Section 7.4. The Manning's 'n' values that provided the best fit are shown in Table 15 and were used in all three modelled events. These values are in line with standard industry guidance and are considered reasonable.

Table 15 – Adopted Manning's *n* values – TUFLOW model

Surface	Manning's *'n'*
Road	0.02
Rural farmland	0.04
Township (buildings Excluded)	0.04
River	0.04
Riparian Vegetation	0.08
Dense Vegetation	0.10

8.4. Calibration Results

8.4.1. Hydrologic Flow Comparison

The flow hydrographs for D/S Windamere Dam (421079), Rocky Water Hole (421149) and Wilbertree (421150) gauges from the modelled historical events are shown Figure 24 to Figure 26. The same rainfall loss and stream routing parameters that were used as part of the joint calibration were adopted.

A review of the rating curves provided indicates that there is little confidence in the rating curves generated due to limited to no gauging of major flood events.

As such the hydrologic validation primarily focussed on matching the event shape and timing. In general, the response of the model with regards to rate of rise is good however due to limited temporal rainfall information the distribution of flow was not able to be replicated. Similarly, in several instances the peak flow rate in the model is significantly different to the recorded flows. A review of the water levels generated within the hydraulic model is required to provide more confidence in the modelling systems developed. The peak flow summary is presented in Table 16.

Table 16 – Peak Flows Summary

Parameter	D/S Windamere Dam (421079)	Rocky Water Hole (421149)	Wilbertree (421150)
February 2003			
Recorded Flow (m^3/s)	20.6	97.4	430.8
Modelled Flow (m^3/s)	29.6	93.0	375.9
Difference (m^3/s)	9.0	-4.4	-54.9
Difference (%)	44	-5	13
December 2010			
Recorded Flow (m^3/s)	45.7	232.2*	391.8
Modelled Flow (m^3/s)	55.7	116.0	410.8
Difference (m^3/s)	10	-116.2	19
Difference (%)	22	-50	14
September 2016			
Recorded Flow (m^3/s)	30.9	34.9	192.5
Modelled Flow (m^3/s)	16.5	45.1	161.1
Difference (m^3/s)	14.4	10.2	-31.4
Difference (%)	-47	29	-16

* note – this flow greatly exceeds even the estimated flow rating curve and is likely to be highly erroneous.

8.4.2. Hydraulic Calibration

The hydraulic model was setup utilising the approach discussed in Section 7. The hydrologic inflows were incorporated into the model for each calibration event. Due to the long durations associated with the calibration events the model has been run on a 5 m x 5 m grid for the purposes of calibration.

8.4.2.1. FEBRUARY 2003

The February 2003 event was modelled over 4 days. BoM daily rainfall grids (http://www.bom.gov.au/climate/how/newproducts/IDCdrgrids.shtml) for the 4 days were developed and a variable rainfall depth for each subcatchment applied. A maximum rainfall total of 213 mm was applied to some subcatchments however there some subcatchments that were estimated to receive less than 120 mm. The temporal pattern from the Glen Alice pluviometer was utilised as best available temporal information. This pluviometer is located 70 km away from the Mudgee Township.

The results are shown Figure 24 and in Table 17. Due to the large variance in rainfall depth (and likely temporal variance) experienced over the catchment, a poor shape representation is present in the hydraulic model. Several variations of the model setup were utilised however the rainfall temporal shapes recorded at surrounding gauges do not match the shape of the recorded hydrographs. The closest pluviograph information recorded a multiple burst event with the highest intensity occurring in the second burst. Additionally, while the Windamere Dam did not overtop it is noted that in the recorded hydrographs a baseflow in the channel is present which may slightly affect the results. A review of the results and discussion is provided below.

During the event, Rocky Creek gauge recorded a single event peak (Chart 1) while Wilbertree Road gauge recorded a double peak event (Chart 2). This may be due to the timing of the rainfall event resulting in offset peaks between Pipeclay Creek and Cudgegong River. The pluviograph information available is too sparse to confirm however. It may also be due to the initial peak at Rocky Creek gauge being absorbed by the initial loss in the model. This is the assumption that was utilised in the calibration approach.

This assumption results in an offset of the peak flow recorded at Rocky Creek gauge but results in a very similar response shape and magnitude. It also results in a reasonably well timed double peak at Wilbertree Road gauge however the highest peak is predicted to be on the second burst event, while the gauge recorded the peak during the first event.

Due to the data limitations the calibration of stream flow records undertaken is deemed to be adequate however it is likely that improvements could be made if additional information on the rainfall event was avialable. At Wilbertree Road Gauge an over estimation of the volume is recorded.

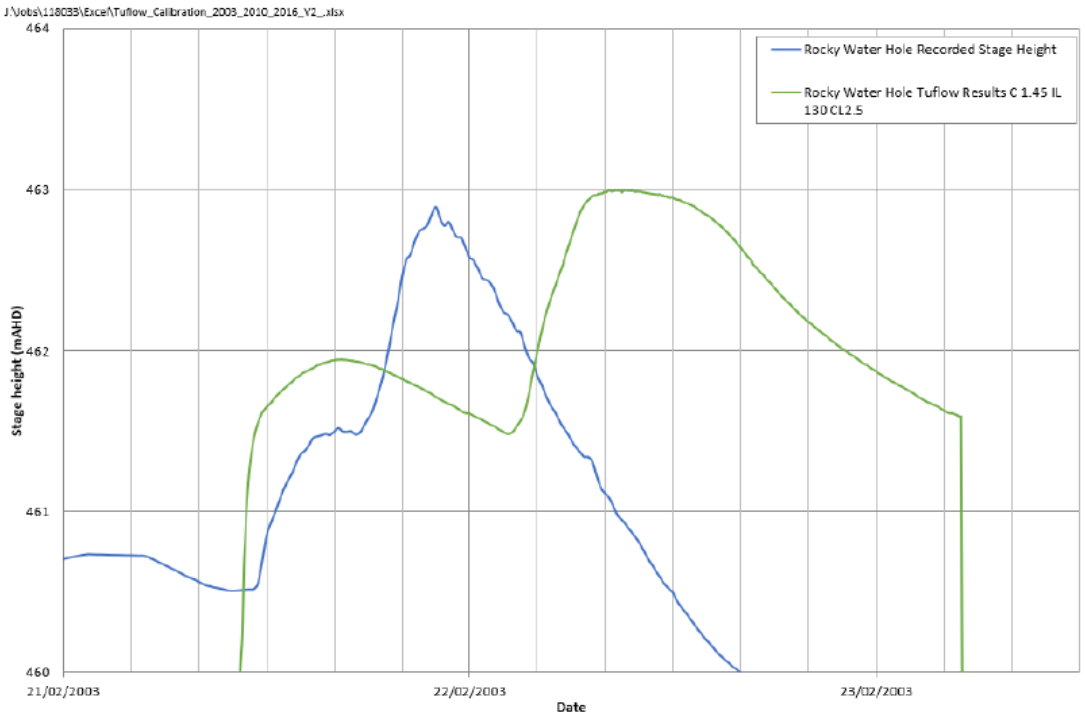

Chart 1: February 2003 Event – Rocky Creek Water Hole Results Comparison

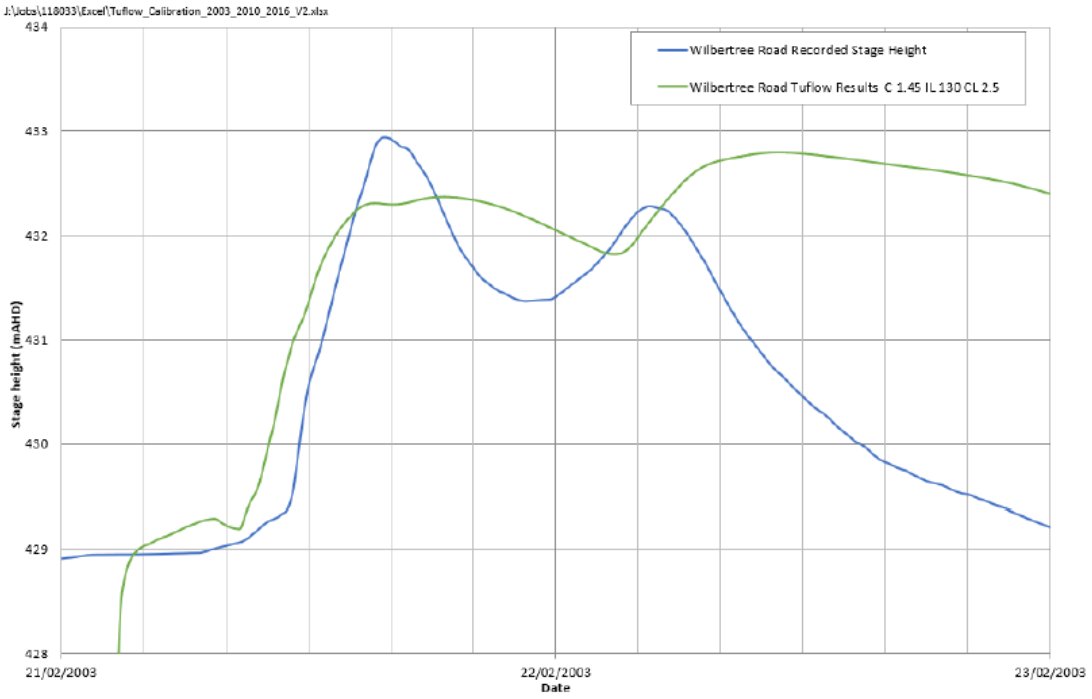

Chart 2: February 2003 Event –Wilbertree Road Gauge Results Comparison

While some difficulty was experienced in the development of hydrologic parameters, the developed flows utilised within the hydraulic model results in well matched peak flood levels at the two gauges present in the hydraulic model.

Table 17 – Peak Flood Levels January 2003

Gauge	Recorded (mAHD)	Modelled (mAHD)	Difference (m)	Calibration
Rocky Water Hole (421149)	462.9	463.0	0.1	Good
Wilbertree (421150)	432.9	432.8	-0.1	Good

To further validate the model, visual comparison of flood photography taken during the event to the modelled outputs has also been undertaken. Note that a significant amount of flood photography was provided however in general there was limited information available to georeference the photographs. The following locations were selected based on the ability to confidently locate the photograph to allow for a direct comparison with model results. The red "X" on each flood map indicates the estimated location the photograph was taken.

Jubilee Oval – The model results indicate depths in the range of 0.05 – 0.40 m present with the majority of the oval and surrounds inundated. Debris marks on the fence near the netball courts of similar depth (between 0.15 – 0.2 m).

Plate 16 –Inundated Jubilee Oval during February 2003 flood event

Plate 17 - Model result depth map around Jubilee Oval area

Lawson Park – Modelled depths of less than 0.1 m present at the location of the memorial, extent of flooding very similar to the photography supplied.

Plate 18 – Extent of February 2003 flood event at Lawson Park

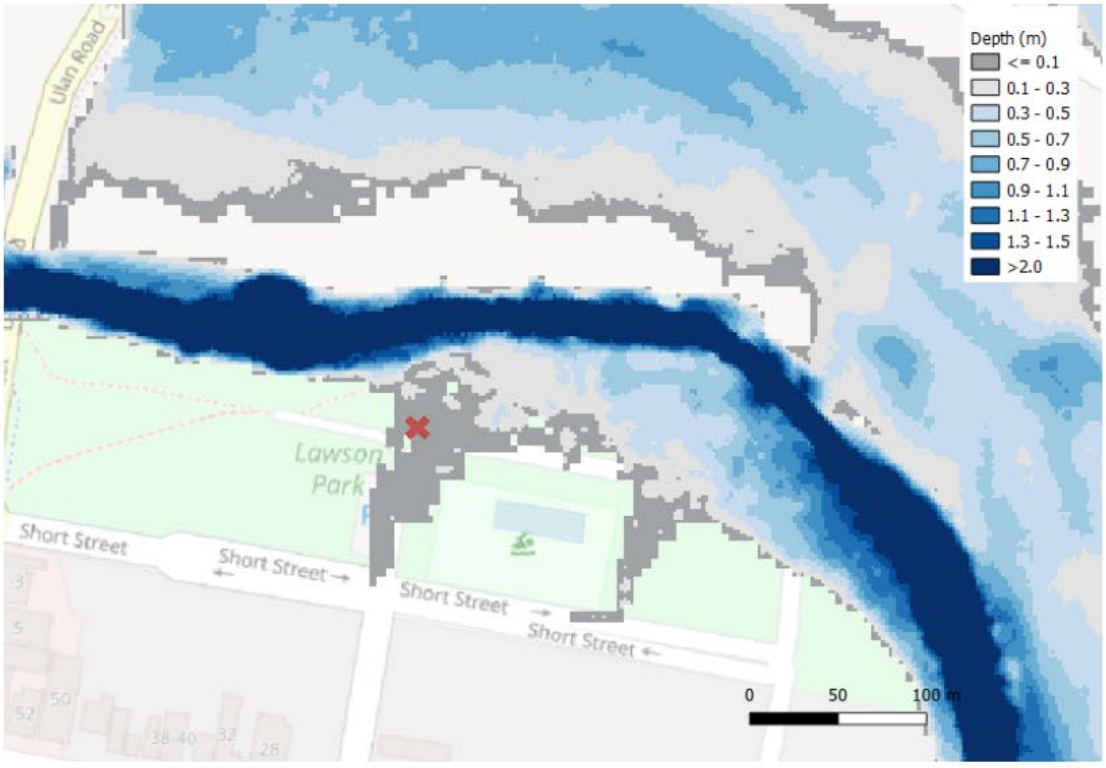

Plate 19 - Modelled result depth map at Lawson Park

32 Cox Street Mudgee – Modelled flood depths in the order of 0.15 – 0.30 m present on the roadway. Results look to be consistent with photography of debris marks.

Plate 20 –Debris marks of February 2003 flood event at 32 Cox Street Mudgee

Plate 21 - Modelled result depth map at 32 Cox Street Mudgee

Ulan Road Opposite the Racecourse – during the flood event Ulan Road was overtopped with fast flowing water from the racecourse passing over the road. The hydraulic model replicates a similar extent and depth of flooding as presented in the photography.

Plate 22 –Inundated Ulan Road Opposite the Racecourse during February 2003 flood event

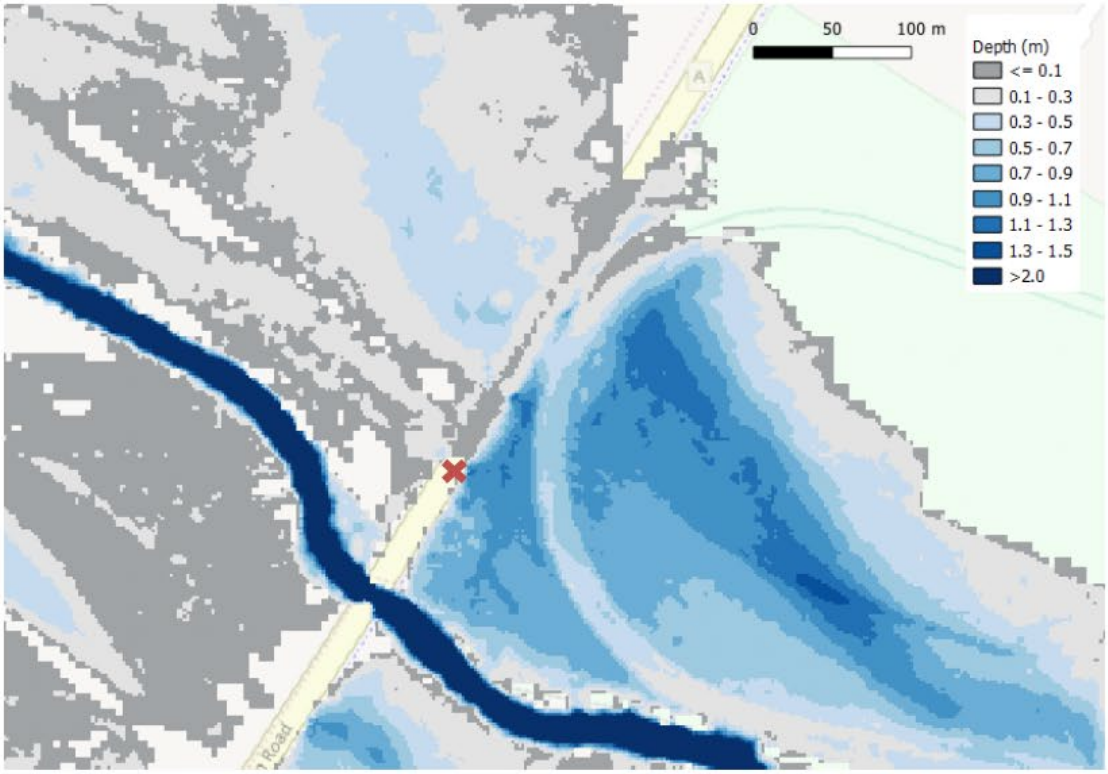

Plate 23 Modelled result depth map at Ulan Road Opposite the Racecourse

8.4.2.2. DECEMBER 2010

The December 2010 event was modelled over 9 days. BoM daily rainfall grids (http://www.bom.gov.au/climate/how/newproducts/IDCdrgrids.shtml) for the 9 days were developed and rainfall for each subcatchment applied a maximum rainfall total of 202 mm was present, consistent with local rainfall station recordings. Rainfall looked to be generally consistent across the catchment with a minimum in the order of 180 mm recorded in the grids. The temporal pattern from the Glen Alice pluviometer was utilised as best available temporal information. The results are shown in Figure 25 and Table 17.

For the primary peak in the rainfall events a good match of rise and fall is present however at the Rocky Water Hole gauge there looks to be a burst rainfall period which was not captured in the temporal pattern applied, this has resulted in a slightly lower peak. This is not present at Wilbertree which shows a good match between rising limbs, falling limbs and the peak water level achieved.

Table 18 – Peak Flood Levels December 2010

Gauge	Recorded (mAHD)	Modelled (mAHD)	Difference (m)	Calibration
Rocky Water Hole (421149)	463.7	463.1	-0.6	Average
Wilbertree (421150)	432.9	432.9	0.0	Good

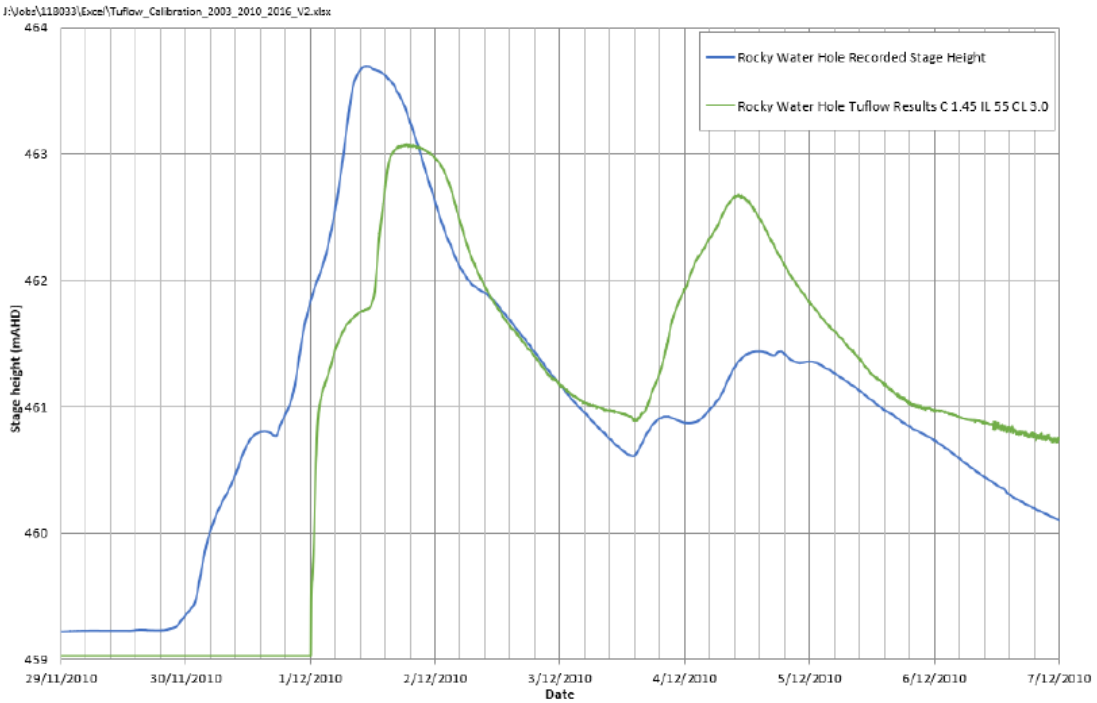

Chart 3: December 2010 Event – Rocky Creek Water Hole Results Comparison

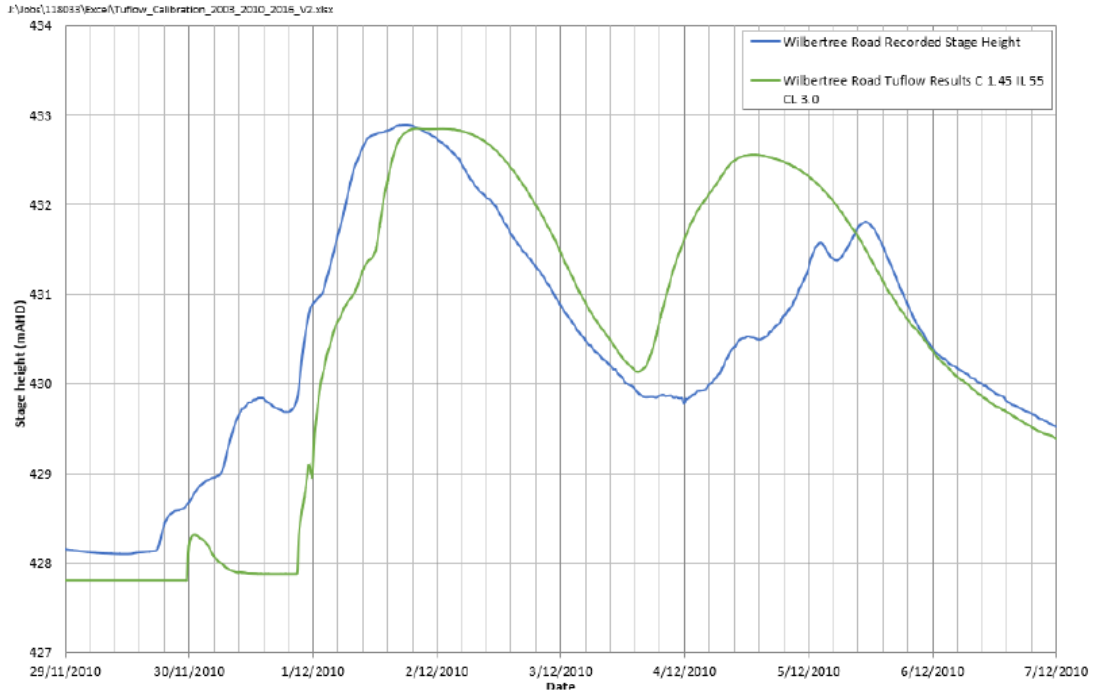

Chart 4: December 2010 Event –Wilbertree Road Gauge Results Comparison

While some photography was provided for the 2010 event, there was no indicator of location and thus limited information could be inferred. An aerial photo of the flood however is available. Comparison of the extents shows a good correlation, with very similar levels present on the racecourse. Additionally, at Glen Willow Sports

Plate 24 – Aerial Image of Flooding December 2010

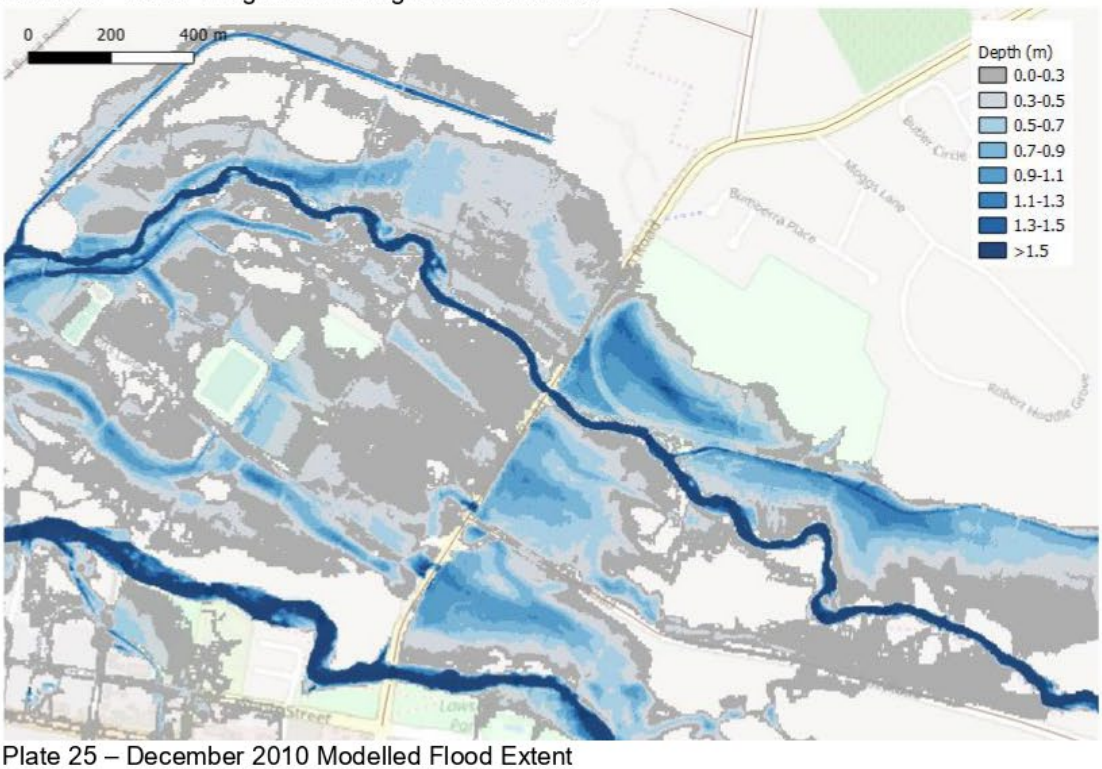

Plate 25 – December 2010 Modelled Flood Extent

Plate 26 – Glen Willow Sports Field Netball Court Flooding December 2010

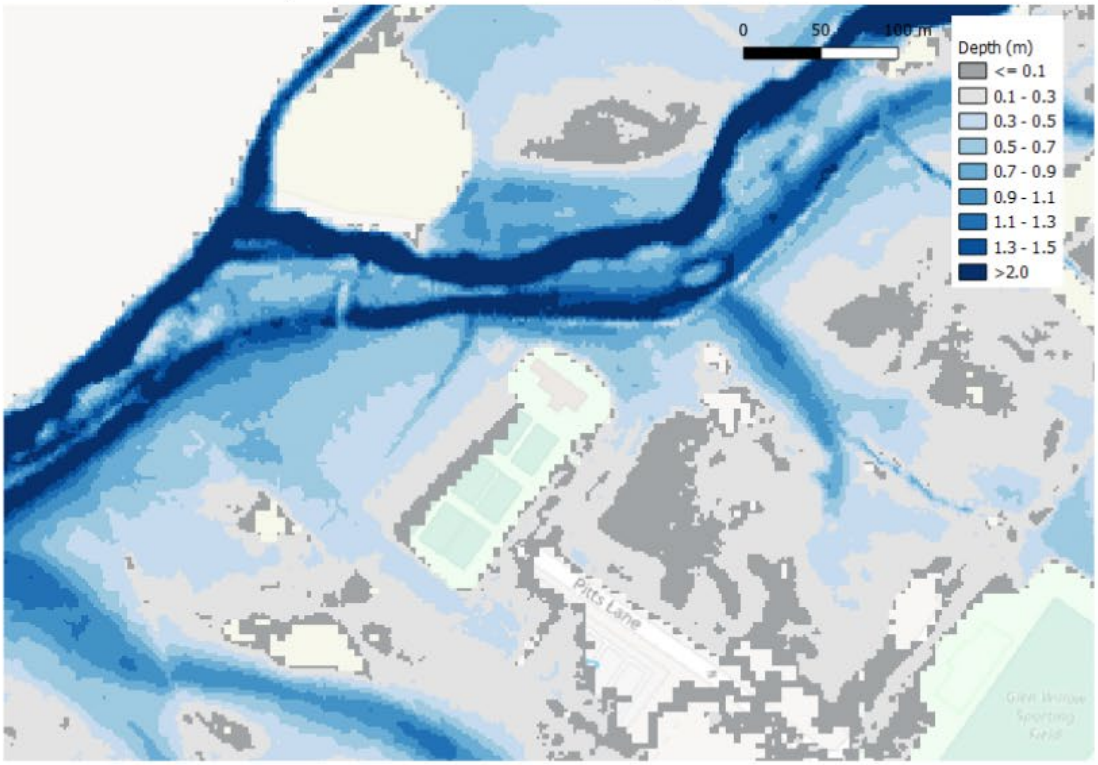

Plate 27 – December 2010 Modelled Flood Extent

8.4.2.3. SEPTEMBER 2016

The September event was modelled over 4 days. BoM daily rainfall grids (http://www.bom.gov.au/climate/how/newproducts/IDCdrgrids.shtml) for the 4 days were developed and rainfall for each subcatchment applied a maximum rainfall total of 91 mm was present, consistent with local rainfall station recordings. Rainfall looked to be generally consistent across the catchment with a minimum in the order of 72 mm recorded in the grids. The temporal pattern from the Windamere Dam pluviometer was utilised as best available temporal information. The results are shown in Figure 26 and Table 19.

The calibration for this event is based on a best fit outcome for both gauges. As Wilbertree Road was indicating higher levels and Rocky Water Hole lower, a compromise between the two locations within the hydrology model was required. Independent calibration at each gauge would result in a more accurate calibration at one gauge at the expense of accuracy at the other.

For the rainfall events a good match of rise and fall is present however the event in the model starts earlier. At Rocky Water Hole the tail of the modelled event falls more sharply than the recorded event in the hydrology model while a slower fall is recorded in the flood model . No flood photography was present to further verify this event.

Table 19 – Peak Flood Levels September 2016

Gauge	Recorded (mAHD)	Modelled (mAHD)	Difference (m)	Calibration
Rocky Water Hole (421149)	462.7	462.3	-0.4	Good
Wilbertree (421150)	431.9	432.2	0.3	Good

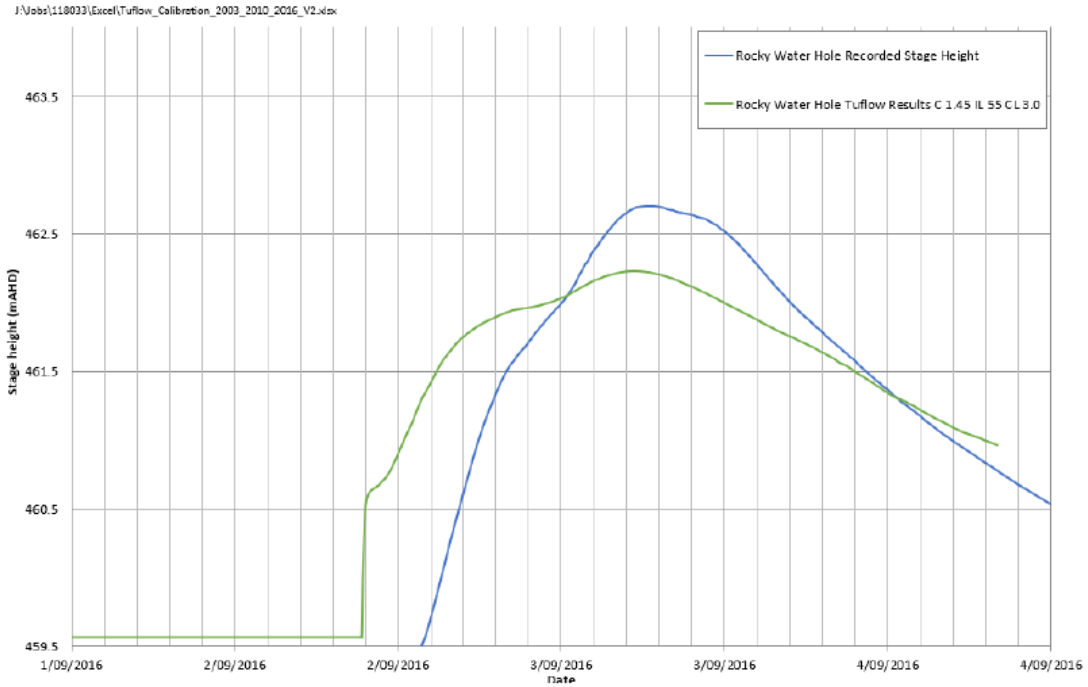

Chart 5: September 2016 Event – Rocky Creek Water Hole Results Comparison

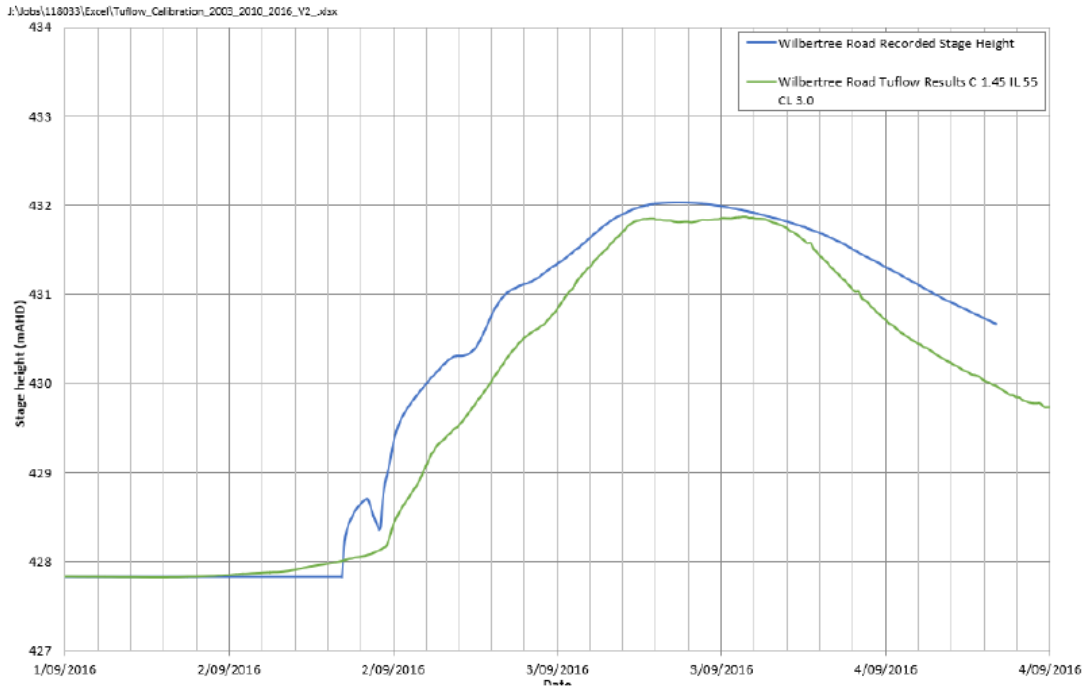

Chart 6: September 2016 Event –Wilbertree Road Gauge Results Comparison

8.5. Discussion

A calibration of the flood model has been undertaken to determine the validity of the model setup for both the hydrologic and hydraulic models. Due to limited recorded data in the area the development of good calibration was difficult. Through a mix of gauge readings and visual inspection of flood photography however a good correlation between recorded events and the model outputs has been achieved.

Due to the limited data, it is recommended that during future rainfall events flood levels through the township are recorded to enable the verification of the flood model. The installation of a pluviograph and flow gauge in closer proximity to the township would also enable a review of levels in critical locations during flood events.

9. DESIGN EVENT SETUP

9.1. Design Losses

NSW Office of Environment and Heritage has developed a guide to assist councils and consultants undertaking studies under the NSW Floodplain Management Program to transition to Australian Rainfall and Runoff 2019.

As part of this transition a study (Review of ARR Design Inputs for NSW report) was undertaken to review and advise on addressing under-estimation bias being experienced when using standard ARR2019 design event methods with default data available from the ARR data hub.

The outcomes of this study indicated that there is significant bias in the standard ARR2019 design event method with default ARR data hub losses and pre-burst.

It identified that default continuing losses available from the ARR data hub over-estimated losses and therefore were not fit for purpose and should only be used where better information was not available. If default continuing losses from the ARR datahub are to be used these should only be used with a multiplier of 0.4 applied.

9.1.1. Initial Loss Rate

The calibration undertaken for the study area utilised a range of initial losses from 130 – 10 mm. Due to the large variance, it is deemed unreasonable to utilise an average of the losses as the design loss. Instead it is proposed to utilise losses based on the ARR2019 Data hub. This provides an initial burst loss of 10 mm. This value is consistent with the lowest calibrated design loss and thus conservative.

9.1.2. Continuing Loss Rate

Based on the calibration undertaken, a continuing loss of between 2.5-3 mm/hr provides a good correlation to the events modelled. As such it is reasonable to utilise a loss rate of 2.8 mm/hr for the purposes of design modelling. This is consistent with ARR2019 advice which suggests the average of the calibrated losses should be utilised where possible. This is slightly lower than the ARR2019 Data hub estimate of 3.6 mm/hr.

9.2. Flood Frequency Analysis

Flood Frequency Analysis (FFA) estimates the magnitudes of flood peaks based on the statistical analysis of recorded data at specific locations. In order to develop confidence design flows produced using the calibrated hydrology model and the ARR2019 design flood approach.

Some advantages of FFA are:

- No assumptions are required regarding the relationship between probabilities of rainfall and runoff;
- All factors affecting flood magnitude are already integrated into the data;
- Estimation of rainfall losses is not required;
- Confidence limits can be estimated; and
- Historical rainfall data is not required.

The FFA approach also has several limitations:

- The data cannot be easily adjusted to account for catchment modifications or the change in climatic conditions;
- The data available is relatively short (compared to the correspondent design event) for which there is considerable uncertainty; and
- Gauges generally present issues with the accuracy of rating curves, especially at high flows.

As per the ARR2019 recommendation, a Bayesian approach in the software Tuflow Flike was applied to perform the current FFA. It must be highlighted that the results of the FFA are estimates only, and therefore, they must be used accordingly to guide engineering design.

9.2.1. Stream gauges

Three gauges are present downstream of Windamere Dam within close proximity to the study area. Table 20 lists the gauges and their locations.

Table 20 - Stream Gauges

Station ID	Station Name	Opened	Closed
421079	Cudgegong River at D/S Windamere Dam	Feb-70	Current
421149	Cudgegong River at Rocky Water Hole	Oct-94	Current
421150	Cudgegong River at Wilbertree Road	Aug-87	Current

Station 421079 is located immediately downstream of Windamere Dam. It has 50 years of records in total from 1970 until 2019. As Windamere Dam is a major hydraulic control however, it is necessary to omit the record of data that occurred prior to the completion of the dam, which was 1984. This reduces the relevant, useful data size to 35 years. Stations 421149 and 421150 have less than 30 years of records. This limited dataset present at all sites results in limited confidence in the estimated peak flows for major flood events however provides a reasonable estimation of peak flows for more frequent flow events.

Table 21 shows the results of the FFA completed at all stations, the confidence limits are presented to highlight the uncertainty present in the outcomes. As a consequence of this uncertainty, the results of the FFA must be used very carefully and interpreted as guide estimations only.

Table 21 - Peak flows determined by FFA for gauges within or adjacent to the Study Area

Station	Event	FFA (m^3/s)	90% Quantile Probability Limits (m^3/s)	
421149	20% AEP	**49**	31	85
	10% AEP	**87**	51	178
	5% AEP	**140**	76	352
	2% AEP	**237**	114	826
	1% AEP	**338**	144	1510
	0.5% AEP	**465**	175	2699
421150	20% AEP	**142**	65	326
	10% AEP	**333**	139	1142
	5% AEP	**687**	242	3910
	2% AEP	**1577**	396	19805
	1% AEP	**2774**	493	65824
	0.5% AEP	**4685**	600	212461
421079 (1985-current)	20% AEP	**31**	22	46
	10% AEP	**51**	34	87
	5% AEP	**77**	48	156
	2% AEP	**123**	68	317
	1% AEP	**166**	84	528
	0.5% AEP	**220**	100	859

9.3. Windamere Dam Design Water Level

Windamere Dam is the largest hydraulic control present upstream of Mudgee and has the potential to greatly influence the design peak flow rate estimates for Mudgee. The full supply level (FSL) of the Windamere Dam is 552 mAHD. Once this level is reached the spillway which passes flow to Cudgegong River is activated. During these events the Dam acts as a large hydraulic control with the spillway capacity limiting the flow into the Cudgegong River.

The historical records at the site show that this level has been exceeded once, in August 1990. A flood on the Cudgegong River was recorded in August 1990, preceded by significant rainfalls in April and July of that year.

Based on this information alone it may be reasonable to suggest that a level lower than full supply level is appropriate to incorporate into design event analysis. This information however does not consider peak levels in the dam over the known historical period, just the time it has overtopped. In order to determine the appropriate level to set the initial water level in Windamere Dam for design runs a review of the historical levels present in the dam has been undertaken.

The development of a Water Level Frequency Assessment is difficult as it takes into account the maximum water level achieved in any year. In years that had a major rainfall event, this would be at the end of the event rather than the beginning. As the purpose of this assessment is to determine design levels however it is considered that a conservative approach to the dam level, noting there is no controls in place to release water in advance of a large rainfall event, is appropriate. Table 22 presents the results of the Water Level Frequency Assessment.

Based on the analysis undertaken, in events greater than a 10% AEP the analysis indicates a dam level of FSL or greater. A review of the analysis undertaken within the 1998 Mudgee Flood Study confirms a similar outcome. For conservatism and consistency with the previous flood study it is proposed to utilise the FSL as the initial level for all design events.

Table 22 - Water Levels determined by the Frequency Assessment

Event	WLFA (mAHD)	90% Quantile Probability Limits (mAHD)	
20% AEP	548	546	550
10% AEP	551	548	>552
5% AEP	>552	551	>552
2% AEP	>552	>552	>552
1% AEP	>552	>552	>552
0.5% AEP	>552	>552	>552

9.4. Design Event Temporal Pattern Selection

Temporal patterns for this study were obtained from ARR2016 (Reference 1615). ARR 1987 provided a single temporal pattern for events more and less frequent than a 30 year ARI for each storm duration. The ARR 2016 attempts to provide several temporal patterns and recommends an approach where an ensemble of different temporal patterns are investigated. This addresses the potential inaccuracies with adopting a single pattern in ARR 1987. It is widely accepted that there are a wide variety of temporal patterns possible for rainfall events of similar magnitude. This variation in temporal pattern can result in significant effects on the estimated peak flow.

To determine the critical storm duration for various parts of the catchment, modelling of the 0.2%, 0.5%, 1%, 2%, 5%, 10%, 20% AEP events from separate temporal pattern bins was undertaken for a range of design storm durations from 15 minutes to 24 hours for local catchments and from 24 hours to 168 hours for local catchments. Ensembles of 10 temporal patterns were run for each storm duration as per recommendations in ARR 2016. Temporal patterns for each duration are analysed for one regional subcatchment at Mudgee, downstream of the confluence of Cudgegong River and Lawsons Creek (M7). In addition to the regional analysis, this study will also assess flood impacts on Mudgee Town Centre based on overland flooding from the local subcatchment upstream of the Township. This area will likely be subject to flash flooding from short duration storm events. Three local catchments within the Mudgee town (J6, C10 and B14) have be selected for this purpose. The subcatchment outlet locations for C10, B14 and M7 are shown in Figure 4.

Due to the nature of Mudgee and the presence of a large hydraulic control on the primary creek running through the Township validation of flows from the hydrology model will provide little value.

Instead during the hydraulic modelling phase WMAwater will liaise with Council to confirm the flooding extent predicted is consistent with historical issues present in the township.

The temporal pattern selected to represent the ensemble is the pattern just above the mean peak flood level within the ensemble. Critical durations of 1.5 to 6 hours have been selected for the local catchments while critical durations in order of 36 to 72 hours have been used for the catchments in regional area. The selected critical events are presented in Table 23. For each AEP, the critical event that creates the higher flow has been selected for each critical duration among C10 and B14. The model has been also run for 7 more events for M7, and 4 more events for C10 which have similar mean flow values to the critical events presented in Table 23 to ensure the appropriate event is modelled.

Table 23 - Critical Events for Design Flow estimation

Catchment	Event	Critical Duration (hours)	Temporal Pattern
M7	0.2% AEP	36	ATP3879
	0.5% AEP	36	ATP3875
	1% AEP	72	ATP4057
	2% AEP	72	ATP4057
	5% AEP	72	ATP4057
	10% AEP	36	ATP3875
	20% AEP	36	ATP3878
C10	0.2% AEP	1.5	TP2220
	0.5% AEP	1.5	TP2220
	1% AEP	1.5	TP2220
	2% AEP	1.5	TP2220
	5% AEP	2	TP2266
	10% AEP	2	TP2234
	20% AEP	2	TP2277
B14	0.2% AEP	1.5	TP2220
	0.5% AEP	1.5	TP2220
	1% AEP	1.5	TP2220
	2% AEP	1.5	TP2220
	5% AEP	2	TP2266
	10% AEP	2	TP2234
	20% AEP	2	TP2277
J6	0.2% AEP	3	TP2283
	0.5% AEP	3	TP2283
	1% AEP	3	TP2282
	2% AEP	3	TP2282
	5% AEP	3	TP2282
	10% AEP	6	TP2367
	20% AEP	3	TP2300

9.4.1. Design Events

Chart A1 shows a boxplot of the design flow results for the 1% AEP for M7, C10, B14 and J6. The mean flow rates for the 36 and 72 hours events are approximately the same. These 2 durations have been run during the hydraulic analysis to ensure the appropriate event is modelled.

9.5. PMF Analysis

The probable maximum flood (PMF) is the largest flood that could reasonably be expected to occur for a catchment. For the purposes of floodplain management, and consistent with the NSW Government's Floodplain Development Manual, the PMF is estimated using the probable maximum precipitation (PMP) and a single temporal pattern. Due to the conservativeness applied to other factors influencing flooding, a PMP does not translate to a PMF of the same probability. But for the purposes of floodplain management, the probability of the PMP may be assigned to the PMF.

For Mudgee, two PMF analysis have been undertaken – a regional, taking into consideration the entire riverine catchment upstream of Mudgee, including Windamere Dam and a local assessment which considers only the area upstream of Mudgee Township. Similar to the design event process, this has been undertaken to ensure the correct rainfall depths have been assumed for each different flood scenario.

9.6. Review of Design Flow Estimates

9.6.1. Comparison to FFA Flows

Following the completion of the FFA analysis and the development of design model parameters, the WBNM model was run for a range of AEP and durations. Design events were then taken from a number of time varying flow hydrographs obtained from the WBNM model for 20, 10, 5, 2, 1, 0.5, 0.2 % AEP and Probable Maximum Flood (PMF). These inflow hydrographs were then applied to the calibrated TUFLOW hydraulic model to produce design flood levels.

Table 24 presents comparison between design flow estimates and FFA for three key locations in the regional area. At Rocky Creek Water Hole (421149) gauge the peak flow rates estimated from the hydraulic model are much greater than the FFA estimates however are still within the confidence intervals for the FFA. At Wilbertree Road gauge (421150) the estimates are closer to the flows produced by the FFA. At both locations however, in more frequent rainfall events the design flows are greater than those predicted in the FFA. This is primarily due to the catchment upstream of Windamere Dam providing runoff in the design events as the dam is assumed to be at full supply level. This outcome is consistent with the estimates of flow downstream of the Dam (421079) which are markedly higher in the design events.

Table 24 – Design flow estimate and critical durations

Station	Event	FFA (m^3/s)	Design Flow Estimate, (m^3/s)	Critical Duration (hours)
421149	20% AEP	**49**	**225**	**36**
	10% AEP	**87**	**281**	**72**

Station	Event	FFA (m^3/s)	Design Flow Estimate, (m^3/s)	Critical Duration (hours)
	5% AEP	**140**	**403**	**72**
	2% AEP	**237**	**590**	**72**
	1% AEP	**338**	**777**	**72**
	0.5% AEP	**465**	**975**	**36**
	0.2% AEP	**-**	**1258**	**72**
	PMF	**NA**	**7771**	**24**
421150	20% AEP	**142**	**364**	**36**
	10% AEP	**333**	**427**	**72**
	5% AEP	**687**	**615**	**72**
	2% AEP	**1577**	**913**	**72**
	1% AEP	**2774**	**1201**	**72**
	0.5% AEP	**4685**	**1514**	**36**
	0.2% AEP	**-**	**2033**	**36**
	PMF	**NA**	**12550**	**24**
421079 (1985-current)	20% AEP	**31**	**225**	**36**
	10% AEP	**51**	**280**	**72**
	5% AEP	**77**	**400**	**72**
	2% AEP	**123**	**589**	**72**
	1% AEP	**166**	**762**	**72**
	0.5% AEP	**220**	**965**	**36**
	0.2% AEP	**-**	**1234**	**36**
	PMF	**NA**	**7217**	**24**

9.6.2. Comparison to 1998 Flood Study

To further confirm the flow rates are within the order of reasonable representation, a review of the peak flows from the 1998 Flood Study (Post Dam scenario) has been undertaken. This is presented in Table 13. The peak flow rates at Mudgee, downstream of the confluence of Cudgegong River and Lawsons Creek, are within 10% for the 2% and 1% AEP events. In the 5% AEP the flow is 39% higher. A review of losses used in the 1998 flood study indicates an initial loss of 35 mm was utilised. To determine the sensitivity of the model to this parameter, the calibrated model was run with this initial loss assumption.

The current model utilising 35 mm initial loss resulted in a flow rate of 450 m^3/s in the 5% AEP. This flow rate is generally consistent with the 1998 flood study flow rate. The 2% and 1% AEP flow rates dropped slightly however the changes are minor due to the greater storm volumes present. This review confirms the analysis is consistent with previous studies, with the 5% AEP predicted to be higher than the previous assessment.

Table 25 - Comparison to previous flood study

AEP (%)	1998 Flood Study Peak Flow (m^3/s)	ARR2019 Selected Losses - Peak flow rate (m^3/s)	Difference (m^3/s)	ARR2019 35 mm IL - mean flow rate (m^3/s)	Difference (m^3/s)
5	425	**591**	166	450	25
2	800	**873**	73	765	-35
1	1120	**1146**	26	995	-125

10. DESIGN FLOOD MODELLING RESULTS

10.1. Design Flood Results

The Peak flood depths and levels for the 0.2%, 0.5%,1%, 5%, 10% and 20% AEP and Probable Maximum Flood (PMF) design events are presented in Figure 27 to Figure 34. As a summary, peak flood depths and levels at key locations are detailed in Table 26. The results shown are the combined results of the range of critical durations that impact the study area.

The following sections provides and overview of observed flood impacts in the 1% AEP design event.

10.1.1. Cudgegong River and Lawsons Creek

In a 1% AEP event the Cudgegong River and Lawsons Creek floodplain through Mudgee exceeds 1 km in width. All roads to the township from the north are cut with Putta Bucca Road over the river experiencing depths in excess of 2 m. Ulan Road is also completely inundated with depths exceeding 0.5 m. The Castlereagh Highway north west of the township towards Gulgong is also cut with depths of approximately 0.5 m experienced. Road closures have the potential to exceed 24 hours.

The area to the north of Mudgee is also impacted in the 1% AEP event, specifically the caravan park and surrounding area. It is noted that there is recent development on the land adjacent to the caravan park, it is unclear if the topography in the flood model is accurately reflecting the levels of the development.

In a major riverine flood event, the township would be reliant on the Castlereagh Highway running south for evacuation and supplies. This route may be impacted by local overland flooding however and thus there is a risk that during a major flood event the township is isolated.

10.1.2. Local Creeks and Stormwater Flooding

In a 1% AEP event the Mudgee township suffers from significant overland flooding. The area around Third Street and Gladstone Street has significant areas where property inundation is present. The area north of Mudgee Showgrounds also experiences significant flooding with a large flow path, impacting several properties.

The Castlereagh Highway is also inundated in the 1% AEP east of the township. The levels are generally lower than 0.2 m but this would likely result in a closure of the road.

In general, the majority of stormwater channels and creeks are unable to manage a 1% AEP storm event. Redbank Creek flooding however is well contained along the length of the creek with breakout flow only occurring once downstream of Castlereagh Highway.

Table 26 – Peak Flood Depths (m) and Levels (mAHD) at key Locations for all Design Events and PMF

ID	Location	0.2% AEP		0.5% AEP		1% AEP		2% AEP		5% AEP		10% AEP		20% AEP		PMF	
		Depth	Level	Depth	Level	Depth	Level	Depth	Level	Depth	Level	Depth	Level	Depth	Level	Depth	Level
1	Ulan Road at Lue Road	0.59	449.7	0.47	449.6	0.37	449.5	0.26	449.4	0.09	449.2	-	-	-	-	3.5	452.4
2	Denison Street at Perry Street	0.02	462.7	0.01	462.7	0.01	462.7	0.01	462.7	0.01	462.7	0.01	462.7	0.01	462.7	0.6	463.2
3	Charles Lester Place	0.94	470.7	0.88	470.6	0.83	470.5	0.83	470.6	0.73	470.4	0.55	470.3	0.43	470.2	2.0	471.6
4	Robertson Street at Trefusis Avenue	0.28	481.6	0.17	481.4	0.11	481.4	0.10	481.4	-	-	-	-	-	-	2.5	483.3
5	Madeira Road at Mudgee Showground	0.05	477.8	0.04	477.8	0.03	477.8	0.04	477.8	0.04	477.8	0.02	477.8	0.02	477.8	0.3	478.1
6	Nicholson Street at Atkinson Street	0.40	469.6	0.37	469.6	0.32	469.5	0.27	469.5	0.25	469.4	0.22	469.4	0.21	469.4	0.9	470.1
7	Industrial Avenue	0.30	465.6	0.24	465.5	0.21	465.5	0.20	465.5	0.14	465.4	0.08	465.3	0.02	465.3	1.3	466.5
8	Castlereagh Hwy at Bunnings Mudgee	0.08	470.5	0.06	470.4	0.05	470.4	0.05	470.4	0.04	470.4	0.03	470.4	0.02	470.4	0.5	470.9
9	Waterworks Road at Redbank creek	0.28	510.4	0.25	510.4	0.23	510.3	0.23	510.3	0.20	510.3	0.17	510.3	0.14	510.3	1.3	511.4
10	Putta Bucca Road over Cudgegong River	3.15	446.2	2.88	446.0	2.66	445.8	2.42	445.5	2.09	445.2	1.81	444.9	1.68	444.8	6.1	449.2
11	Lawsons Creek near Lue Road	2.71	454.2	2.70	454.2	2.67	454.1	2.64	454.1	2.59	454.1	2.52	454.0	2.49	454.0	5.9	456.2
12	Oaky Creek near Cudgegong River	6.09	451.9	5.82	451.6	5.61	451.4	5.36	451.2	5.03	450.8	4.72	450.5	4.55	450.4	9.0	454.8

10.2. Sensitivity Analysis

Sensitivity analyses are typically used to evaluate the effect of variations in the assumptions and boundary conditions on the modelling results. The following sensitivity analyses were undertaken for the 0.2%, 1%, 5% AEP design events to obtain an understanding of the variability of design flood levels that may occur if different conditions or parameters were adopted. The variability presented would still fall within what would be deemed good modelling practice and thus acts as a mechanism to ensure the model in itself is not suspectable to large changes with only minor input changes.

Table 27 – Overview of Sensitivity Analyses

Scenario	Description
Initial Loss (IL and CL)	The catchment initial and continues losses were reduced by 20%.
Catchment Lag Factor (C)	The catchment lag factor value was increased and decreased by 20%.
Manning's (n)	The hydraulic roughness value was increased and decreased by 20%.
Culvert, Pipes, Pits and Bridges Blockage	Sensitivity to blockage of all structures was assessed for 100% blockage.

Tables C1, C2 and C3 (APPENDIX C) present the impacts of the change in the flood levels at key locations due to change in initial and continuous losses, catchment lag factor (C), Manning's (n) and blockage.

The peak flood levels are shown to be relatively insensitive to variation. Some local locations, such as Olan Road are sensitive to blockage assumptions however these impacts are localised to around where these structures are present. The Cudgegong River was also sensitive to the change in C factor with level variances in the order of 200 mm. This result is unsurprising as the variation of this parameter alters the peak flow rates generated by the hydrology model. In general however, the model is not considered sensitive to the parameters reviewed.

10.3. Climate Change

The 2005 Flood Development Manual (Reference 17) recommends that Flood management studies consider the impact of climate change on flood behaviour. Based on recommendations outlined in Floodplain Risk Management Guideline (Reference 18), rainfall intensity has been increased by 20%. This value is slightly lower than the 22.8% presented in the interim climate change factors on ARR datahub for RCP 8.5 but generally consistent. For information purposes, the 1% AEP average rainfall depth increases have been compared to other AEPs for critical duration of 1.5, 36, and 72 hours in Table 28.

Table 28 – Rainfall Depth Comparison

Duration	1% AEP	1%AEP plus 10%	1%AEP plus 20%	1% AEP plus 30%	0.5% AEP	0.2% AEP
1.5	58	64	70	76	66	77
36	173	190	207	224	198	231
72	217	239	261	283	245	284

Table 28 indicates that for the 1% AEP:

- A 10% increase in rainfall is approximately equivalent to a 0.5% AEP event
- A 30% increase in rainfall is approximately equivalent to a 0.2% AEP event.

Comparison of these flood levels would provide further insight (presented in Table 26) into the implications of various rainfall intensity increases.

The hydrologic and hydraulic model have been run for 1% AEP considering a 20% rainfall increase. Table 29 presents the changes in flood level after 20% rainfall increase for 1% AEP design event at key locations. The results show that a 20% increase in rainfall intensity has increased flood levels by over 0.5 m within the Cudgegong River floodplain. In the urban areas the increased levels are less dramatic. This is to be expected as these areas are generally impacted by short duration rainfall events. In these events there is less total volume and thus the increase in total runoff is not as great as within the floodplain.

Table 29 – Results of Climate Change for 1% AEP (20% Rainfall increase)

ID	Location	1% AEP Peak Flood Level (mAHD)	Change in Peak Flood level (m)
1	Ulan Road at Lue Road	449.5	0.25
2	Denison Street at Perry Street	462.7	0.00
3	Charles Lester Place	470.5	0.06
4	Robertson Street	481.4	0.06
5	Madeira Road at Mudgee Showground	477.8	0.01
6	Nicholson Street at Atkinson Street	469.5	0.05
7	Industrial Avenue	465.5	0.03
8	Castlereagh Hwy at Bunnings Mudgee	470.4	0.01
9	Waterworks Road at Redbank creek	510.3	0.02
10	Putta Bucca Road near Cudgegong River	445.8	0.57
11	Lawsons Creek near Lue Road	454.1	0.05
12	Oaky Creek near Cudgegong River	451.4	0.56

10.4. Glen Willow Sporting Fields

As part of the study, a review of potential upgrades to the Glen Willlow Sporting Field was undertaken. The base hydraulic model was updated with a revised sports field topography for the site based on preliminary concept sketches for stage 2. The revised surface included the following features:

- A bund up to the 1% AEP Flood Level for a new sporting field west of the existing stadium;
- A bund to allow for an elevated playing shed area in the north of the site;
- Some earthworks and drainage in the north of the site to manage flows from the site back to Lawsons Creek.

The design was run within the flood model to determine the impact the development would have on the floodplain. The analysis undertaken is concept only to review the potential impacts that an upgrade would pose.

Plate 1 shows the results of this assessment. The mitigation design modelled have resulted in impacts less than 50 mm offset to the west of the development and a reduction in levels on the property located on the corner of Pitts Road and Pitts Lane.

What is apparent is the inclusion of an additional bunded sports field in the south of the site has a marked impact on the floodplain, the location and ultimate design of this field, should it occur, should be undertaken with appropriate consideration of the potential impacts. The location is sensitive to changes and may result in adverse impacts if these risks are not appropriately managed.

Plate 1 – Glen Willow Stage 2 – Concept Level Impact Assessment 1% AEP Event.

10.5. Flood Hazard

Hazard classification plays an important role in managing floodplain risk in an area. The flood hazard has been defined using the Australian Disaster Resilience Handbook Collection (Reference 19). The supporting guideline 7-3 provides hazard categorisation based on velocity and depth of floodwater and its hazard to people, vehicles and buildings. The velocity/depth relationship for each of these categories is depicted in Diagram 2.

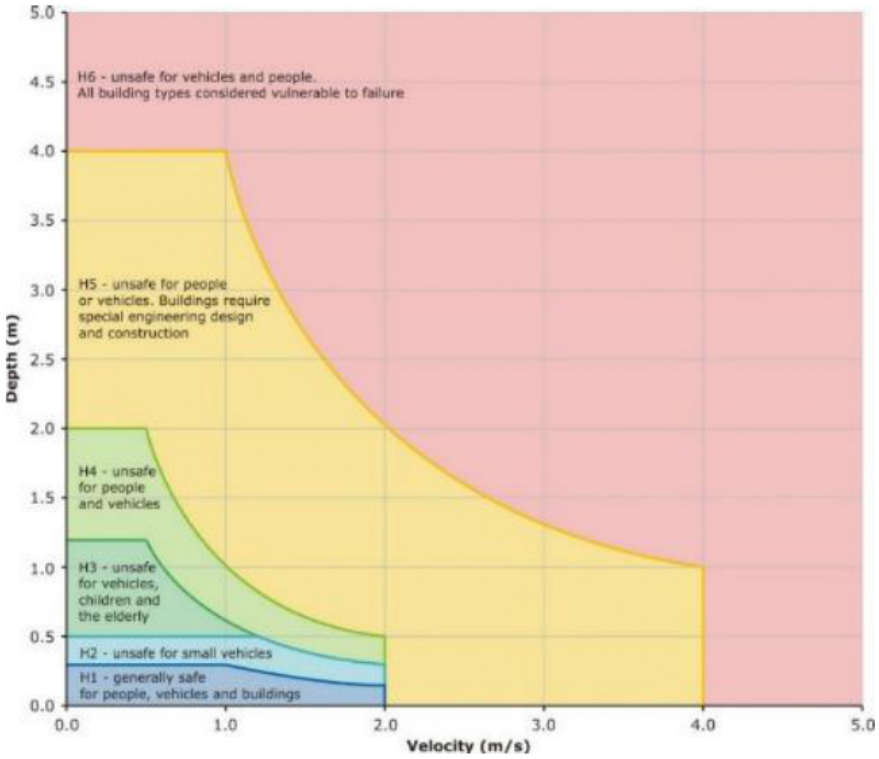

Diagram 2: Hazard Categorisation

The provisional hydraulic hazard categorisation based on Diagram 2 is shown in Figure 35 to Figure 37. The hazards are provisional because they only consider the hydraulic aspects of flood hazard and does not reflect other factors that influence hazard (such as warning time, flood readiness, rate of rise, duration of flooding, evacuation problems, effective flood access and the type of development). A review of the results indicates that a large proportion of Mudgee is classified as low hazard area while the high hazard areas are primarily located around the Cudgegong River on the northern edge of the town. Along the stormwater channels running through town there is areas where due to the channels having insufficient capacity, areas of moderate to high hazard are present.

11. INFORMATION TO SUPPORT DECISIONS ON ACTIVITIES IN THE FLOODPLAIN AND MANAGING FLOOD RISK

The following section of the report is provided as interim guidance in advance of a future flood risk management study (FRMS). An FRMS is a study in which the floodplain management issues confronting the study areas are assessed, management options investigated, and recommendations made. Specific objectives for this study include:

- Identifying innovative solutions to the management of flood hazards within the study area under current and future conditions,
- Emergency management planning for existing and future development,
- Strategic and development scale land-use planning to manage growth in flood risk,
- Review and discuss strategies for raising the awareness of flood risk and the level of flood preparedness in the catchment,
- Selection of practical, feasible and economic measures for treatment of risk.

A FRMS is a significant body of work and requires the development of a large amount of information to inform its decision making process.

The information provided in the following sections is based on the limited dataset of information that this flood study has developed. All information should be considered as high level guidance at this stage and will require review and revision as part of the future FRMS before the information is utilised to inform decision making processes.

11.1. Flood Function

Defining the floodway is a critical component of the flood risk management work carried out under the NSW Floodplain risk management program. This relates to the fact that the defined floodway extent will typically not be available for further residential development. As such it is imperative that the floodway definition is appropriate and not conservative.

Floodways are areas of the floodplain where a significant discharge of water occurs during floods and by definition if blocked would have a significant effect on flood flows, velocities or depths. Flood storage are areas of importance for the temporary storage of floodwaters and if filled would significantly increase flood levels due to the loss of flood attenuation. The remainder of the floodplain is defined as flood fringe.

The 2012 paper by Thomas et al. (Reference 21) presented an investigation which observed that "the 'corridor' required to convey approximately 80% of the peak 1% AEP flow correlated well with most of the other parameters that are relied upon to estimate the floodway extent" (e.g. the 0.1 m afflux approach described above).

Based on this approach a flood function map has been developed utilising the parameters presented in Table 30. The parameters were selected by reviewing cross sections through the

floodplain to confirm the extent of the floodway carried approximately 80% of the total peak 1% AEP flow. Figure 38 presents the flood function map developed using these parameters.

Table 30 – Floodway Parameters

Waterway	Floodway Definition Parameters
Cudgegong River and Lawsons Creek	D > 0.65 m^2/s and V > 0.65 m/s; or V > 0.65 m/s
Local Creeks and Stormwater	VD > 0.15 m^2/s and V > 0.15 m/s; or V > 1.0 m/s

11.2. Flood Emergency Response Classifications for Communities

The Manual (Reference 17) requires flood studies to address the management of continuing flood risk to both existing and future development areas. As continuing flood risk varies across the floodplain so does the type and scale of the emergency response problem and therefore the information necessary for effective Emergency Response Planning (ERP). Classification provides an indication of the vulnerability of the community in flood emergency response and identifies the type and scale of information needed by the State Emergency Services (SES) to assist in ERP.

Criteria for determining flood ERP classifications and an indication of the emergency response required for these classifications are provided in the Australian Disaster Resilience Handbook Collection, 2017 (Flood Emergency Response Planning: Classification of Communities). Reference 22 summarises the response required for areas of different classification. However, these may vary depending on local flood characteristics and resultant flood behaviour, i.e. in flash flooding or overland flood areas.

The ERP classifications within the hydraulic model extent have been defined for Mudgee and surrounds, as represented by the PMF flood extent and is shown in Figure 40. The classification has been undertaken on a precinct basis rather than lot-by-lot and is targeted at those areas which may require evacuation or assistance during a flood event. Classification of the floodplain is done by considering all design flood events and more importantly how each precinct of the floodplain floods.

11.3. Consequences of Flooding to the Community

Based on the findings of the flood study a preliminary consequences assessment has been undertaken. Given the limited information of impact to the community at this stage this is available, the consequence assessment has been based upon the potential consequences of flooding based on property flooding and the isolation of the community.

Figure 40 shows the properties flooded in the study area and the event in which the depths exceed 50 mm. In a 20% AEP event as expected significant areas of rural land is flood impacted. There are however still several areas in the township that are also subject to flooding. There is a large increase in the number of properties impacted in the 5% AEP and then again in the 0.2% AEP. Table 31 summarises the number of properties impacted.

Table 31 – Flood Affected Properties

AEP	Properties Affected
20% AEP	1341
10% AEP	1373
5% AEP	1567
2% AEP	1655
1% AEP	1659
0.2% AEP	1860
PMF	3046

The property figures above do not consider the amount of property flooded or the location on the property flooding occurs. The numbers are not representative of the likely number of dwellings that are subject to flooding. During the flood risk management study floor level survey of all potentially flood affected dwellings in the area should be undertaken to ensure accurate identification of at risk properties.

Figure 41 to Figure 43 show the road inundation at key locations within the study area for the 5%, 1% AEP and PMF flood events. Of note is that Ulan Road, Putta Bucca Road and Castlereagh Highway (north of Mudgee) are inundated in a 5% AEP Cudgegong River event. This means that the only means of evacuation may be via Castlereagh Highway south. The highway south is also subject to flooding however this flooding is due to local creek flooding and not a regional flood event. The reduced evacuation and supply capacity of the road network in a major regional flood is considered to be a key flooding issue that may have significant consequences to the Mudgee township economy and surrounds. In a PMF event the Highway is cut in all directions and thus presents a significant risk to the community.

Based on the preliminary information the following risk matrix has been developed. Note the economy consequences have been inferred from the closure of major routes and have not been quantified.

Likelihood of consequences	AEP range (%)	Level of Consequences				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likely	>10		People	Economy		
Unlikely	1 to 10			People	Economy	
Rare to very rare	0.01 to 1			People	Economy	
Extremely rare	<0.01				People, Economy	

Risk Very Low Low Medium High Extreme

11.4. Flood Planning Area

The Flood Planning Area (FPA) is an area to which flood planning controls are applied. An FPA map is a required outcome of the FRMS.

The NSW Standard Instrument LEP does not include a specific land use zone classification for flood prone land, rather it permits a Flood Planning Area map to be included as a layer imposed across all land use zones.

A preliminary flood planning area has been developed for this study which has been based on the 1% AEP in areas where depths exceed 100 mm. Figure 44 presents the area developed. This flood planning area should be reviewed in the following FRMS to ensure appropriate freeboard considerations are applied where relevant.

11.5. Flood Risk Precincts

Based on the revised flood information that is now available for Mudgee and surrounds it is recommended that an investigation into the appropriate method of implementation of the data into the Council development control plans be undertaken.

A key component of the flood planning controls utilised by Council is the flood risk precincts, which define what development is allowable in various locations throughout the floodplain. The development and control plan currently relies on two matrixes (One for Urban Floodplains and one for Non Urban Floodplains) which use a 3 flood risk precinct (High, Medium and Low) system to inform development controls.

The revised flood study has developed a revised provisional flood hazard categorisation map (Section 10.5) which is based on the hazard categorisation presented in Australian Disaster Resilience Handbook Collection. Previous flood studies in the area have relied upon a three criteria system focussing on hazard criteria of the 1% AEP and the extent of the PMF event.

Table 32 – Flood Planning Zone Potential Revision

Flood Planning Zone	Previous Zone Definition (from Mudgee FRMS&P, 2002)	Potential Zone Definition
High Flood Risk	Land that is below the 100 year ARI flood that is subject to a high hydraulic hazard (ie provisional high hazard in accordance with the criteria outlined in the Floodplain Management Manual) or areas that are isolated in a 100 year ARI flood due to evacuation difficulties.	Land that is below the 100 year ARI flood that is subject to a high hydraulic hazard (ie hazard categories 4,5 and 6 in accordance with the criteria outlined in the AIDR guideline 7-3) or areas that are isolated in a 100 year ARI flood due to evacuation difficulties.
Medium Flood Risk	Land below the 100 year ARI flood level that is not subject to high hydraulic hazard and where there are no significant evacuation difficulties.	Land below the 100 year ARI flood level that is not subject to high hydraulic hazard and where there are no significant evacuation difficulties.
Low Flood Risk	All other land within the floodplain (i.e. within the PMF extent) but not identified as either in a high flood risk or medium flood risk precinct.	All other land within the floodplain (i.e. within the PMF extent) but not identified as either in a high flood risk or medium flood risk precinct.

12. CONCLUSION

WMA water has undertaken a flood study for the Mudgee Township and surrounds, assessing both regional river flood impacts and local creek and stormwater impacts. The analysis undertaken has reviewed a range of design events and also tested the sensitivity of the area to various hydrologic and hydraulic parameters.

Based on the analysis undertaken the following has been identified:

- In a 1% AEP regional flood event there is significant flood impacts present both within the township and on the roadways connecting the town to the surrounding region. During a regional flood only the Castlereagh Highway running south is not inundated. In this event all other routes out of the town have the potential to be closed in excess of 24 hours;
- During a local 1% AEP storm event at Mudgee there is a high likelihood that property flooding and damage will occur. With the exception of Redbank Creek most other overland flow paths through the township do not have sufficient capacity to safely transfer flow through the township;
- Sensitivity analysis shows that in general the floodplain is not sensitive to changes in hydrologic or hydraulic modelling parameters which would still be in accordance with best practice. The catchment is sensitive to increases in rainfall intensity however, with level increases in the 1% AEP event in excess of 0.50 m in the 1% AEP event within the Cudgegong River.

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Appendix A

A1

Appendix A- GLOSSARY of TERMS

Taken from the Floodplain Development Manual (April 2005 edition)

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, if a peak flood discharge of 500 m^3/s has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 m^3/s or larger event occurring in any one year (see ARI).
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average Annual Damage (AAD)	Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.
Average Recurrence Interval (ARI)	The long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
consent authority	The Council, Government agency or person having the function to determine a development application for land use under the EP&A Act. The consent authority is most often the Council, however legislation or an EPI may specify a Minister or public authority (other than a Council), or the Director General of DIPNR, as having the function to determine an application.
development	Is defined in Part 4 of the Environmental Planning and Assessment Act (EP&A Act). **infill development:** refers to the development of vacant blocks of land that are generally surrounded by developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development. **new development:** refers to development of a completely different nature to that associated with the former land use. For example, the urban subdivision of an area previously used for rural purposes. New developments involve rezoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. **redevelopment:** refers to rebuilding in an area. For example, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either rezoning or major extensions to urban services.
disaster plan (DISPLAN)	A step by step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations, with the object of ensuring the coordinated response by all agencies having responsibilities and functions in emergencies.
discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
effective warning time	The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The

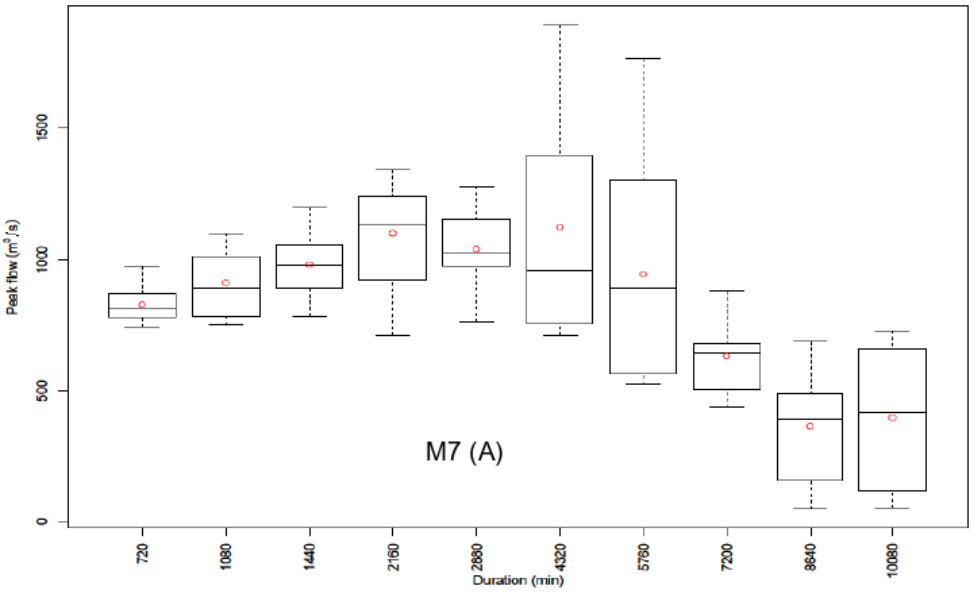
	effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.
emergency management	A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.
flash flooding	Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain.
flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
flood awareness	Flood awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures.
flood education	Flood education seeks to provide information to raise awareness of the flood problem so as to enable individuals to understand how to manage themselves an their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.
flood fringe areas	The remaining area of flood prone land after floodway and flood storage areas have been defined.
flood liable land	Is synonymous with flood prone land (i.e. land susceptible to flooding by the probable maximum flood (PMF) event). Note that the term flood liable land covers the whole of the floodplain, not just that part below the flood planning level (see flood planning area).
flood mitigation standard	The average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding.
floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
floodplain risk management options	The measures that might be feasible for the management of a particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options.
floodplain risk management plan	A management plan developed in accordance with the principles and guidelines in this manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.
flood plan (local)	A sub-plan of a disaster plan that deals specifically with flooding. They can exist at State, Division and local levels. Local flood plans are prepared under the leadership of the State Emergency Service.
flood planning area	The area of land below the flood planning level and thus subject to flood related development controls. The concept of flood planning area generally supersedes the "flood liable land" concept in the 1986 Manual.
Flood Planning Levels (FPLs)	FPL's are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. FPLs supersede the "standard flood event" in the 1986 manual.
flood proofing	A combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages.

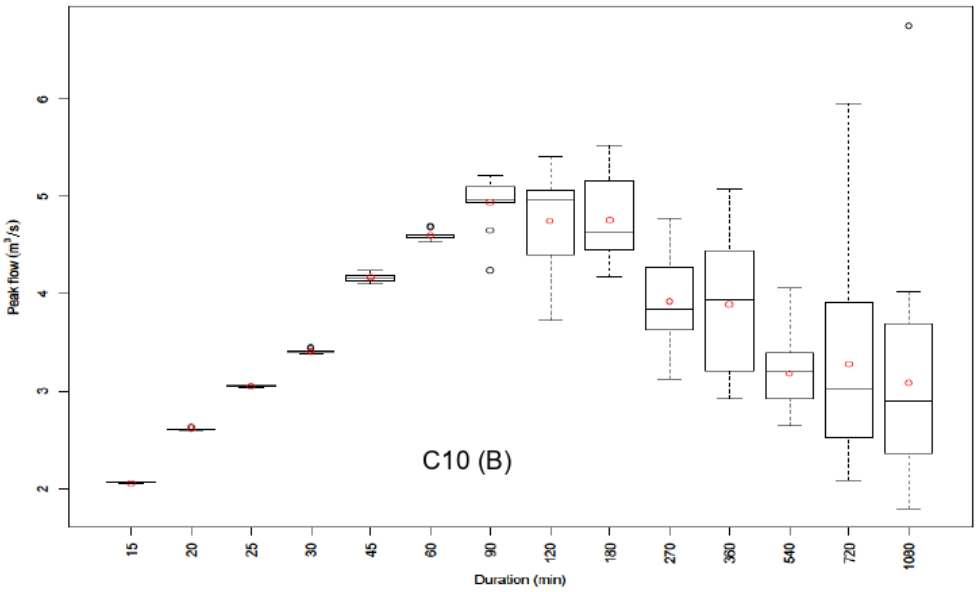
flood prone land	Is land susceptible to flooding by the Probable Maximum Flood (PMF) event. Flood prone land is synonymous with flood liable land.
flood readiness	Flood readiness is an ability to react within the effective warning time.
flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below. **existing flood risk:** the risk a community is exposed to as a result of its location on the floodplain. **future flood risk:** the risk a community may be exposed to as a result of new development on the floodplain. **continuing flood risk:** the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.
flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
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 flows, or a significant increase in flood levels.
freeboard	Freeboard provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL 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, rumpus 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.
hazard	A source of potential harm or a situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community. Definitions of high and low hazard categories are provided in the Manual.
hydraulics	Term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.
hydrograph	A graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood.
hydrology	Term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
local overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
local drainage	Are smaller scale problems in urban areas. They are outside the definition of major drainage in this glossary.

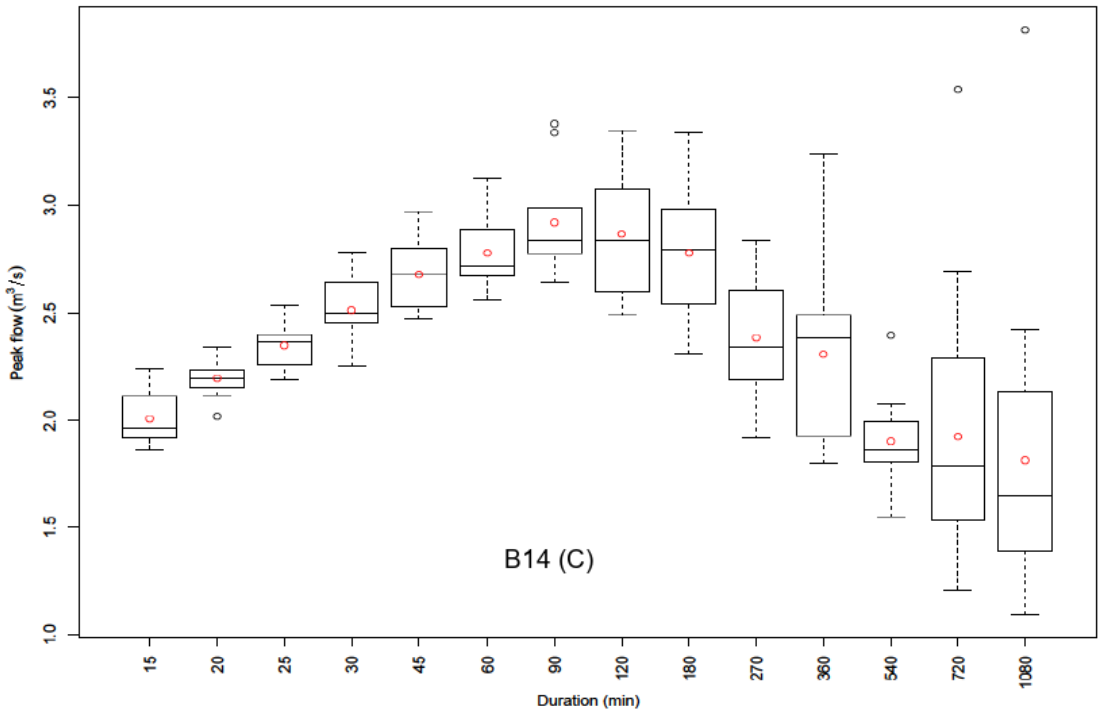
mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
mathematical/computer models	The mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.
minor, moderate and major flooding	Both the State Emergency Service and the Bureau of Meteorology use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood: **minor flooding:** causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding on the reference gauge is the initial flood level at which landholders and townspeople begin to be flooded. **moderate flooding:** low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered. **major flooding:** appreciable urban areas are flooded and/or extensive rural areas are flooded. Properties, villages and towns can be isolated.
modification measures	Measures that modify either the flood, the property or the response to flooding. Examples are indicated in Table 2.1 with further discussion in the Manual.
peak discharge	The maximum discharge occurring during a flood event.
Probable Maximum Flood (PMF)	The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. 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. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be addressed in a floodplain risk management study.
Probable Maximum Precipitation (PMP)	The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation.
probability	A statistical measure of the expected chance of flooding (see AEP).
risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
stage	Equivalent to "water level". Both are measured with reference to a specified datum.
stage hydrograph	A graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum.
survey plan	A plan prepared by a registered surveyor.
water surface profile	A graph showing the flood stage at any given location along a watercourse at a particular time.

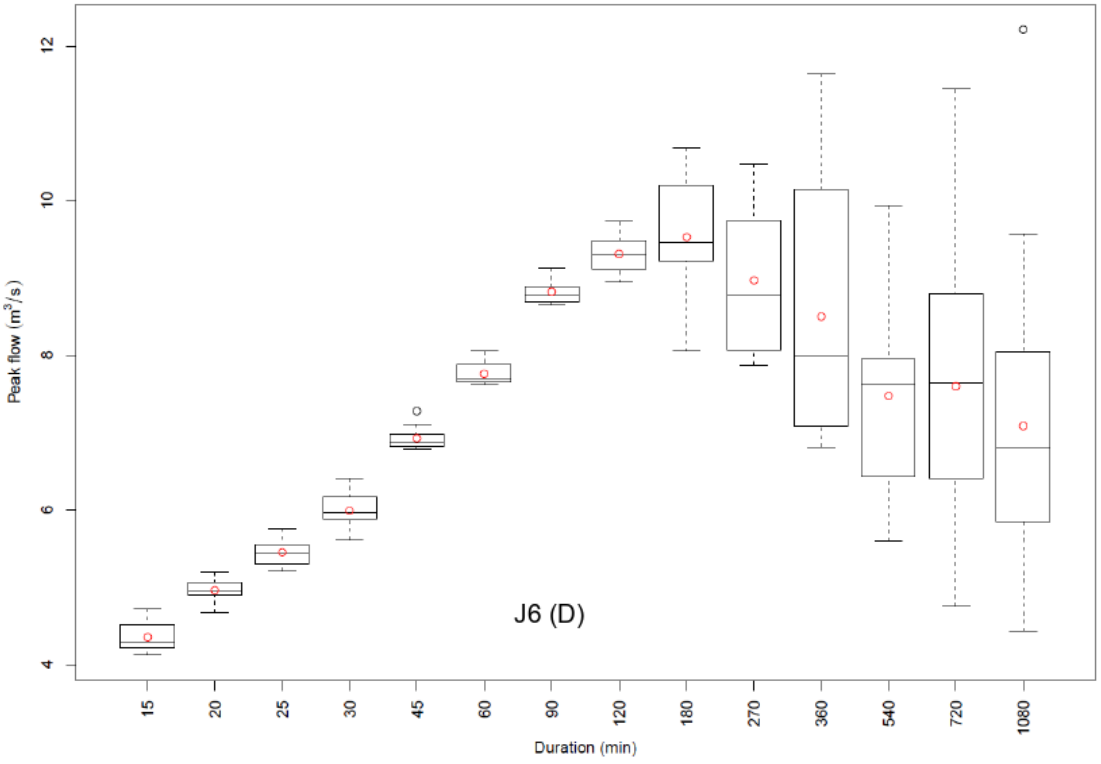
Appendix B

Appendix B - Chart B - 1% AEP Boxplot at M7 (A), C10 (B), B14 (C) and J6 (D) Subcatchments






Peak flow (m³/s)
1.0
1.5
2.0
2.5
3.0
3.5
B14 (C)
15
20
25
30
45
60
90
120
180
270
360
540
720
1080
Duration (min)


Peak flow (m³/s)
4
6
8
10
12
J6 (D)
15
20
25
30
45
60
90
120
180
270
360
540
720
1080
Duration (min)

Appendix C

Appendix C - Sensitivity Analysis Results

Table C 1 – Results of Sensitivity Analysis for 0.2% AEP

ID	Location	0.2% AEP Peak Flood Level (mAHD)	Change in Flood level (m)					
			Loss -20%	C -20%	C +20%	Manning's -20%	Manning's +20%	Blockage 100%
1	Ulan Road at Lue Road	449.7	0.00	0.08	-0.06	-0.02	0.06	0.13
2	Denison Street at Perry Street	462.7	0.00	0.00	0.00	0.02	-0.01	0.01
3	Charles Lester Place	470.7	0.00	0.04	-0.04	-0.04	0.04	-0.01
4	Robertson Street at Trefusis Avenue	481.6	0.00	0.03	-0.03	0.00	0.00	0.04
5	Madeira Road at Mudgee Showground	477.8	0.00	0.01	0.00	-0.01	0.01	0.01
6	Nicholson Street at Atkinson Street	469.6	0.00	0.01	-0.01	-0.01	0.01	0.01
7	Industrial Avenue	465.6	0.00	0.03	-0.03	-0.01	0.01	0.06
8	Castlereagh Hwy at Bunnings Mudgee	470.5	0.00	0.01	-0.01	-0.01	0.00	0.08
9	Waterworks Road at Redbank creek	510.4	0.00	0.01	-0.01	-0.02	0.00	0.00
10	Putta Bucca Road near Cudgegong River	446.2	0.00	0.16	-0.13	-0.12	0.12	0.01
11	Lawsons Creek near Lue Road	454.2	0.00	0.01	0.00	0.05	-0.03	0.00
12	Oaky Creek near Cudgegong River	451.9	-0.01	0.16	-0.13	-0.16	0.15	0.01

Table C 2 – Results of Sensitivity Analysis for 1% AEP

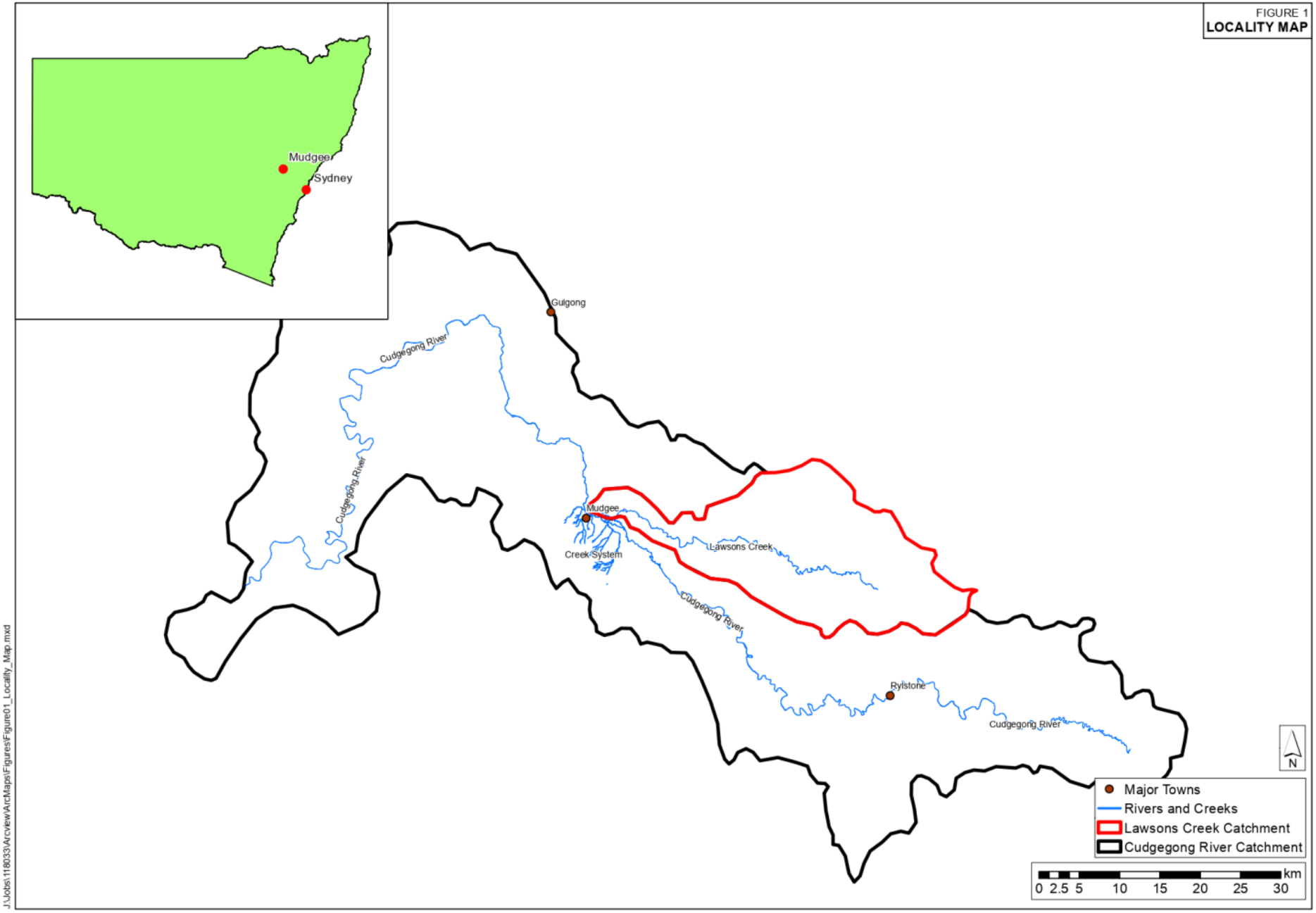
ID	Location	1% AEP Peak Flood Level (mAHD)	Change in Peak Flood level (m)					
			Loss -20%	C -20%	C +20%	Manning's -20%	Manning's +20%	Blockage 100%
1	Ulan Road at Lue Road	449.5	-0.01	0.08	-0.09	-0.03	0.01	0.15
2	Denison Street at Perry Street	462.7	0.00	0.00	0.00	0.01	-0.01	0.00
3	Charles Lester Place	470.5	0.00	0.04	-0.05	-0.05	0.04	0.00
4	Robertson Street at Trefusis Avenue	481.4	0.00	0.06	-0.05	0.00	0.00	0.08
5	Madeira Road at Mudgee Showground	477.8	0.00	0.01	0.00	0.00	0.01	0.01
6	Nicholson Street at Atkinson Street	469.5	0.00	0.01	-0.01	-0.01	0.01	0.03
7	Industrial Avenue	465.5	0.00	0.02	-0.01	-0.02	0.01	0.08
8	Castlereagh Hwy at Bunnings Mudgee	470.4	0.00	0.01	-0.01	0.00	0.00	0.08
9	Waterworks Road at Redbank creek	510.3	0.00	0.02	-0.02	-0.02	0.01	0.00
10	Putta Bucca Road near Cudgegong River	445.8	-0.03	0.18	-0.21	-0.14	0.07	-0.03
11	Lawsons Creek near Lue Road	454.1	0.00	0.03	-0.02	0.04	-0.03	0.00
12	Oaky Creek near Cudgegong River	451.4	-0.03	0.17	-0.21	-0.17	0.09	-0.02

Table C 3 – Results of Sensitivity Analysis for 5% AEP

ID	Location	5% AEP Peak Flood Level (mAHD)	Change in Peak Flood level (m)					
			Loss -20%	C -20%	C +20%	Manning's -20%	Manning's +20%	Blockage 100%
1	Ulan Road at Lue Road	449.2	-0.02	0.10	-0.09	-0.04	0.01	0.23
2	Denison Street at Perry Street	462.7	0.00	0.00	0.00	0.01	-0.02	0.00
3	Charles Lester Place	470.4	0.00	0.07	-0.06	-0.06	0.04	0.00
4	Robertson Street at Trefusis Avenue							
5	Madeira Road at Mudgee Showground	477.8	0.00	0.00	-0.01	-0.01	0.00	0.01
6	Nicholson Street at Atkinson Street	469.4	0.00	0.01	-0.01	-0.01	0.01	0.03
7	Industrial Avenue	465.4	0.00	0.03	-0.03	-0.01	0.01	0.06
8	Castlereagh Hwy at Bunnings Mudgee	470.4	0.00	0.01	-0.01	0.00	0.00	0.07
9	Waterworks Road at Redbank creek	510.3	0.00	0.02	-0.02	-0.02	0.01	0.00
10	Putta Bucca Road near Cudgegong River	445.2	-0.03	0.18	-0.20	-0.13	0.06	-0.02
11	Lawsons Creek near Lue Road	454.1	0.00	0.03	-0.05	0.01	0.00	0.00
12	Oaky Creek near Cudgegong River	450.8	-0.04	0.18	-0.22	-0.18	0.08	-0.03

C5

FIGURE 1
LOCALITY MAP



J:\Jobs\118033\ArcviewArcMaps\Figures\Figure01_Locality_Map.mxd

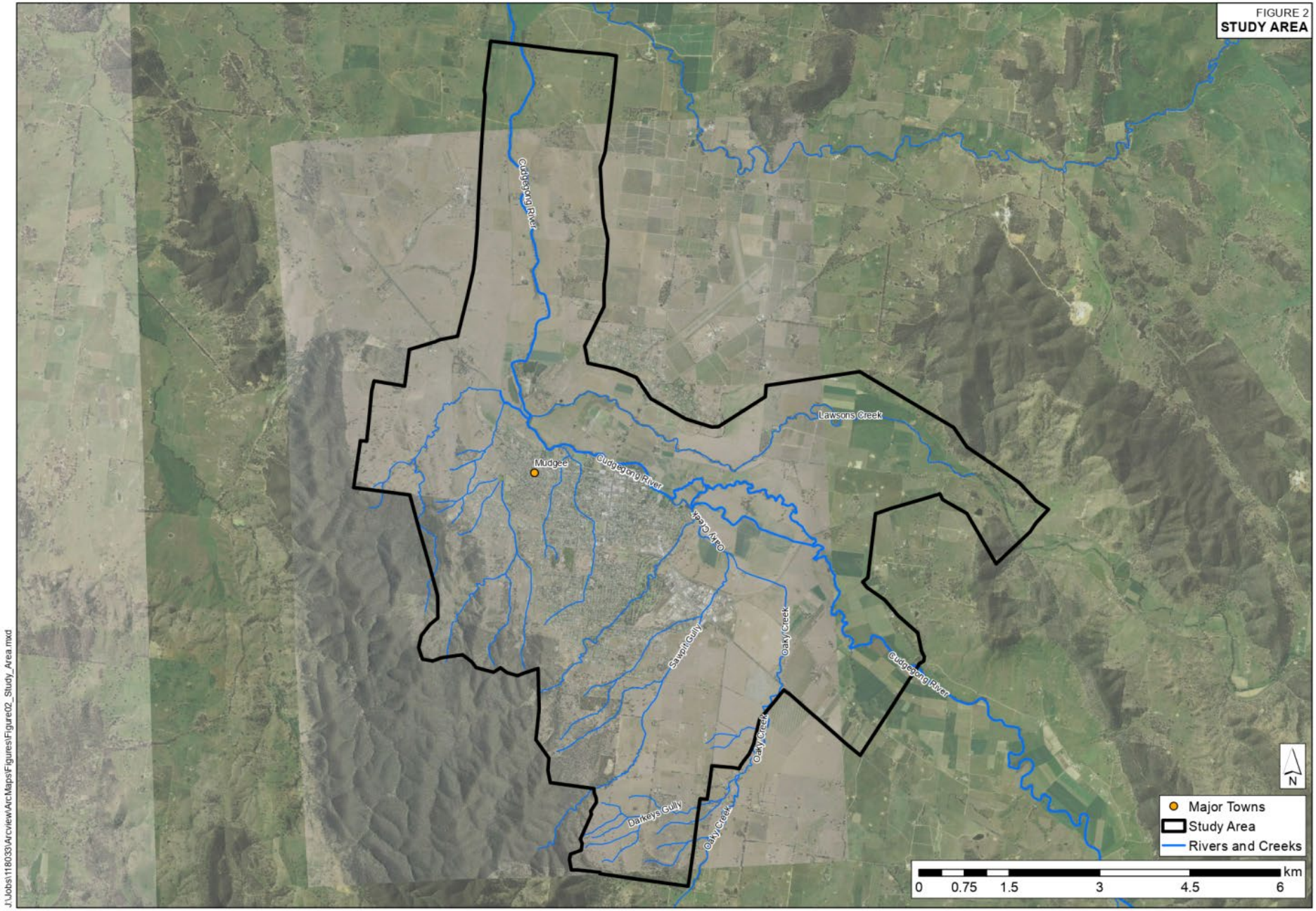


FIGURE 2
STUDY AREA
Cudgegong River
Lawsons Creek
Mudgee
Cudgegong River
Oaky Creek
Sawcut Gully
Oaky Creek
Cudgegong River
Oaky Creek
Oaky Creek
Darkeys Gully
N
Major Towns
Study Area
Rivers and Creeks
km
0
0.75
1.5
3
4.5
6
J:\Jobs\118033\Arcview\ArcMaps\Figures\Figure02_Study_Area.mxd

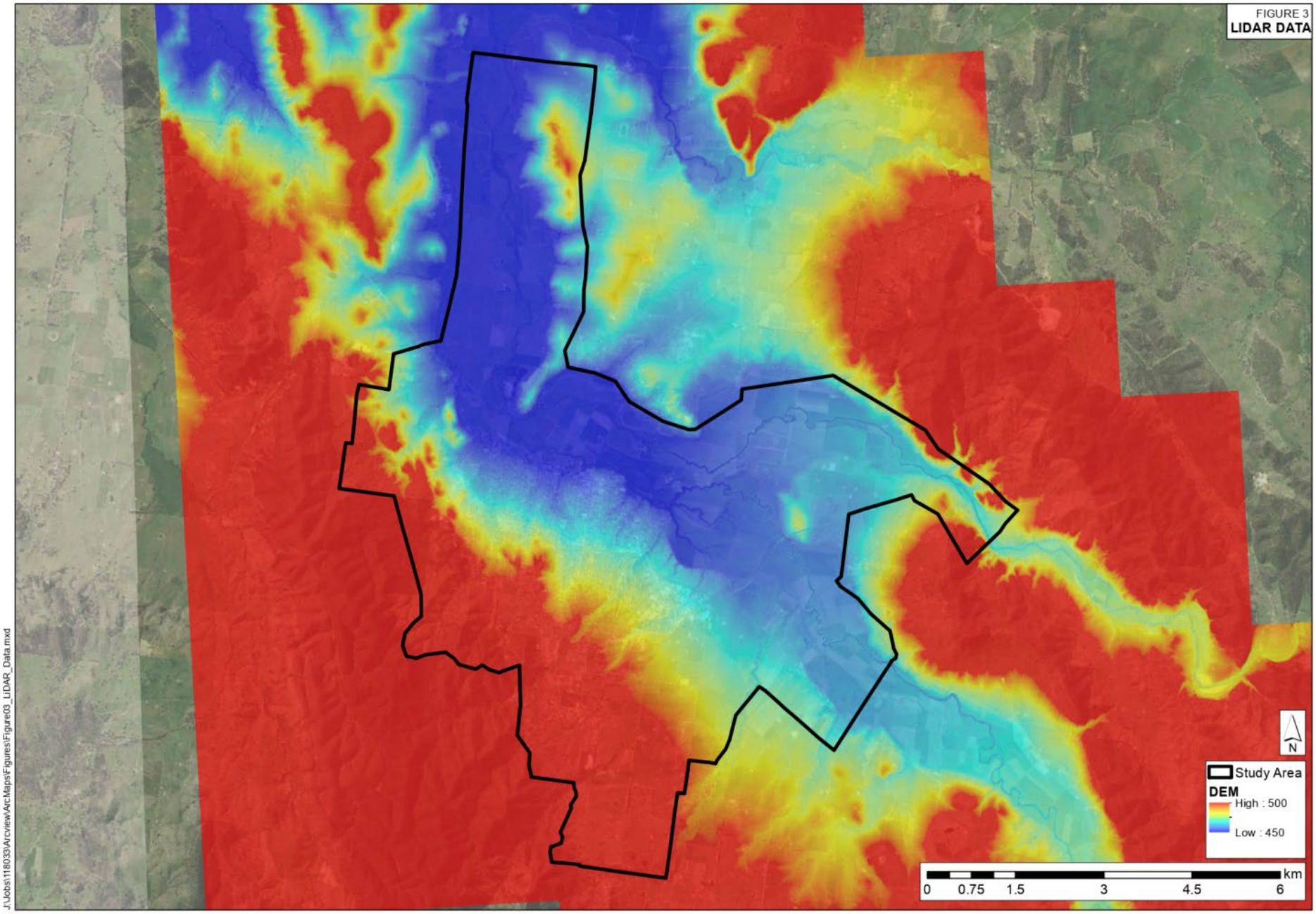


FIGURE 3
LIDAR DATA
N
Study Area
DEM
High : 500
Low : 450
km
0 0.75 1.5 3 4.5 6
J:\Jobs\118033\Arcview\ArcMaps\Figures\Figure03_LIDAR_Data.mxd

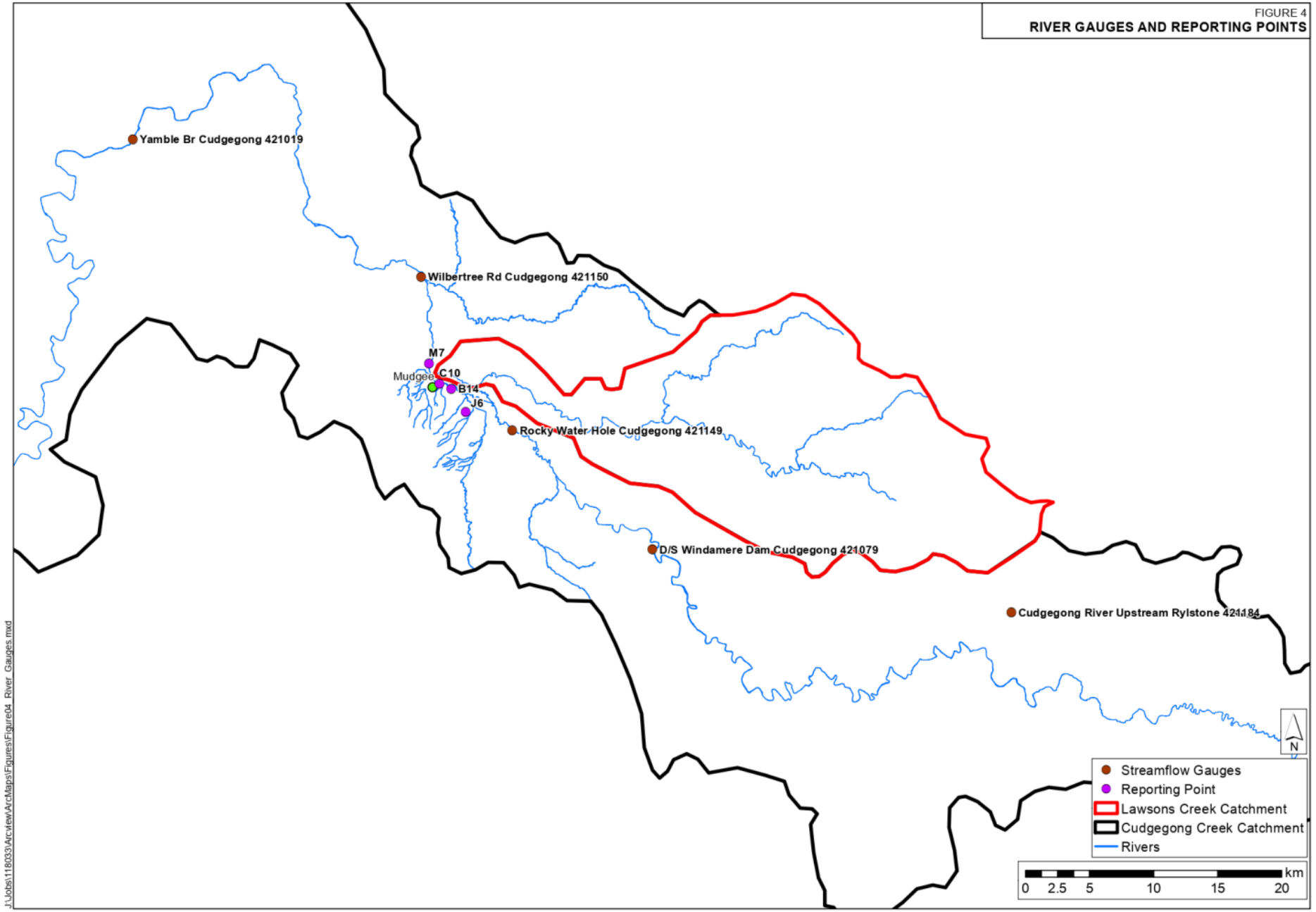


FIGURE 4
RIVER GAUGES AND REPORTING POINTS
Yamble Br Cudgegong 421019
Wilbertree Rd Cudgegong 421150
M7
C10
Mudgee
B14
J6
Rocky Water Hole Cudgegong 421149
D/S Windamere Dam Cudgegong 421079
Cudgegong River Upstream Rylstone 421184
N
Streamflow Gauges
Reporting Point
Lawsons Creek Catchment
Cudgegong Creek Catchment
Rivers
km
0 2.5 5 10 15 20
J:\Jobs\118033\ArcView\ArcMaps\Figures\Figure04_River_Gauges.mxd

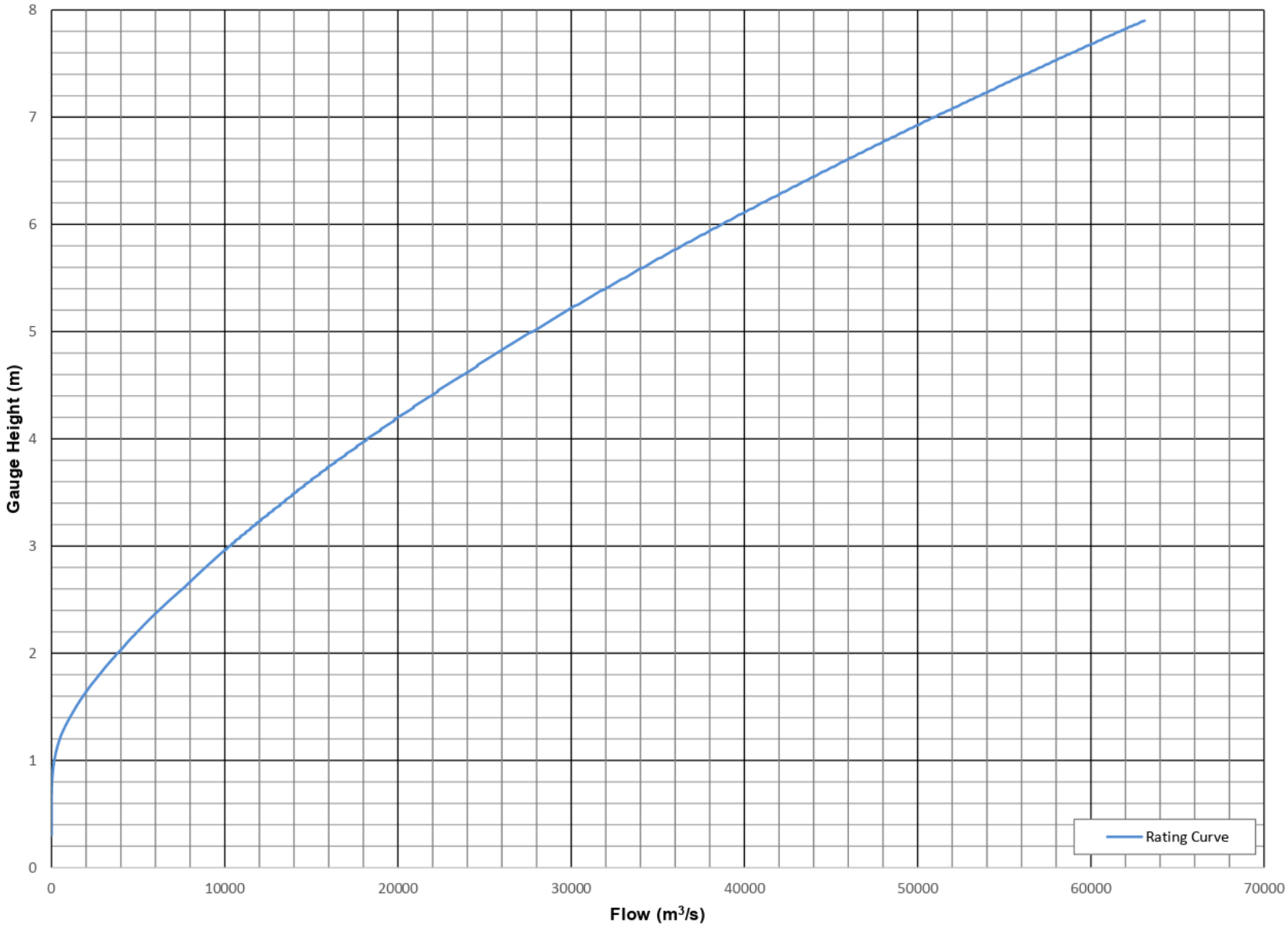
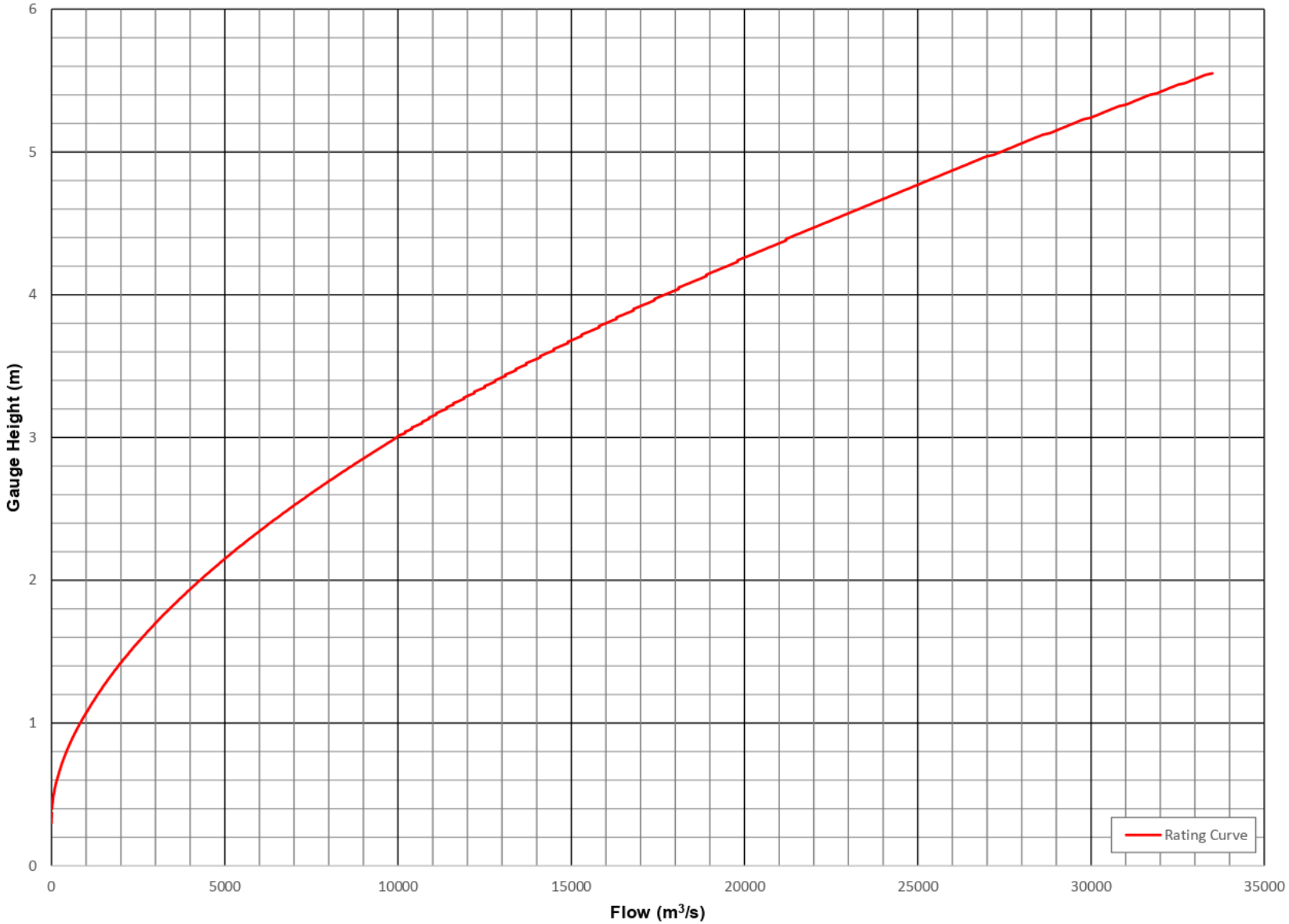


FIGURE 5
CUDGEGONG RIVER AT YAMBLE BRIDGE - 421019
RATING CURVE

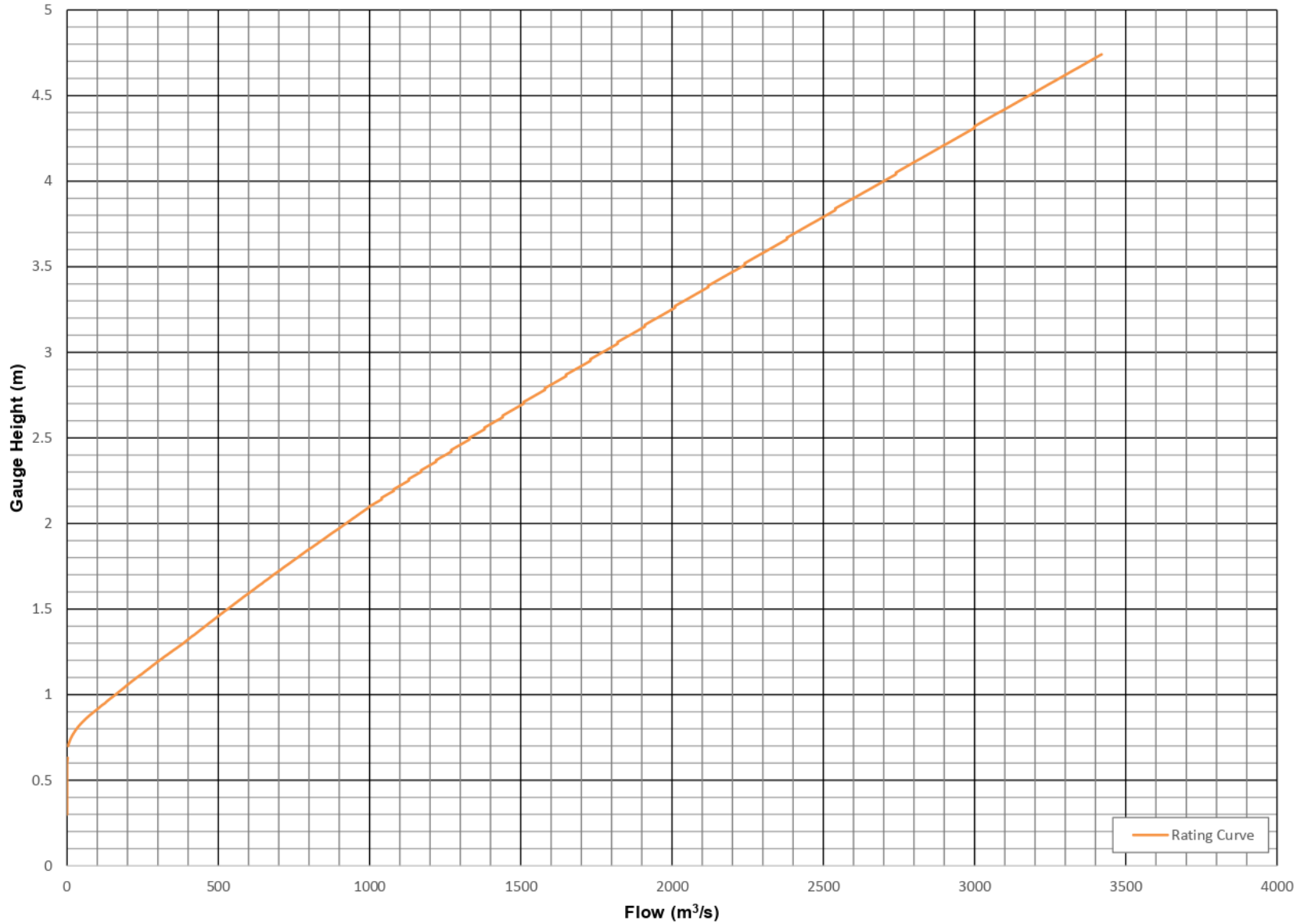
J:\Jobs\118033\Excel\RiverGauges_01_Mudgee.xlsx



CUDGEGONG RIVER AT D/S WINDAMERE DAM - 421079
RATING CURVE

FIGURE 6

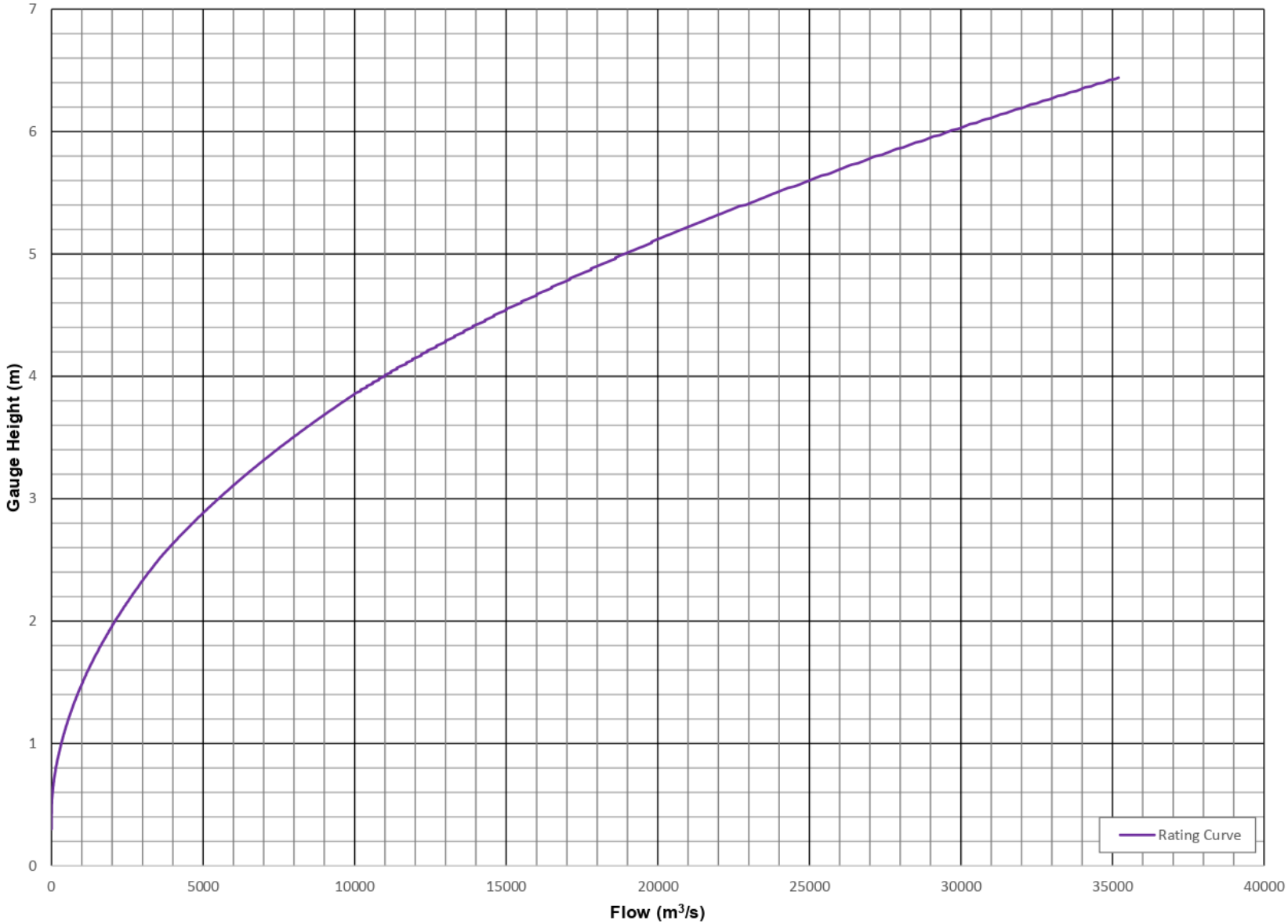
J:\Jobs\118033\Excel\RiverGauges_01_Mudgee.xlsx



CUDGEGONG RIVER AT ROCKY WATER HOLE - 421149
RATING CURVE AND GAUGINGS

FIGURE 7

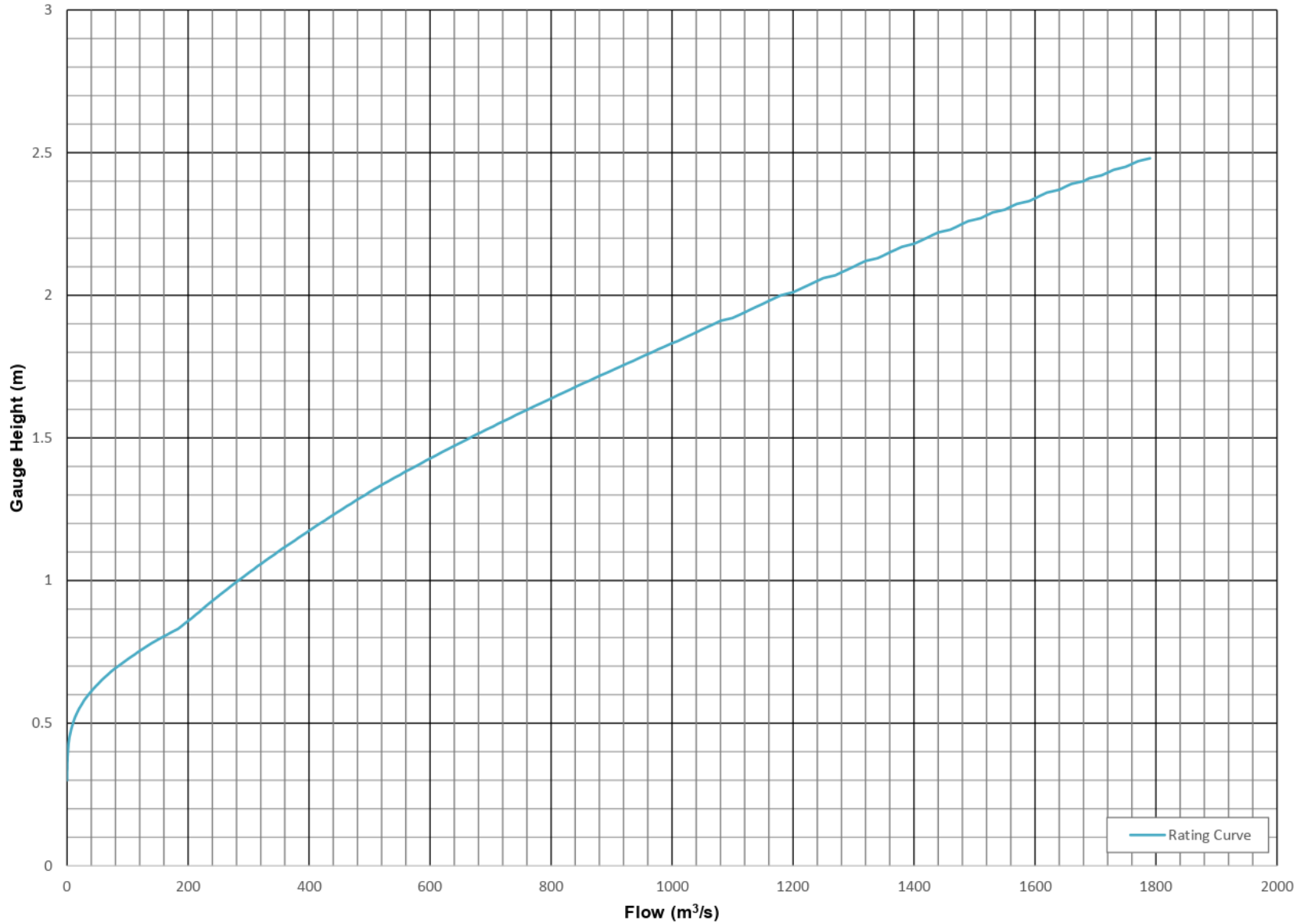
J:\Jobs\118033\Excel\RiverGauges_01_Mudgee.xlsx



CUDGEGONG RIVER AT WILBERTREE ROAD - 421150
RATING CURVE

FIGURE 8

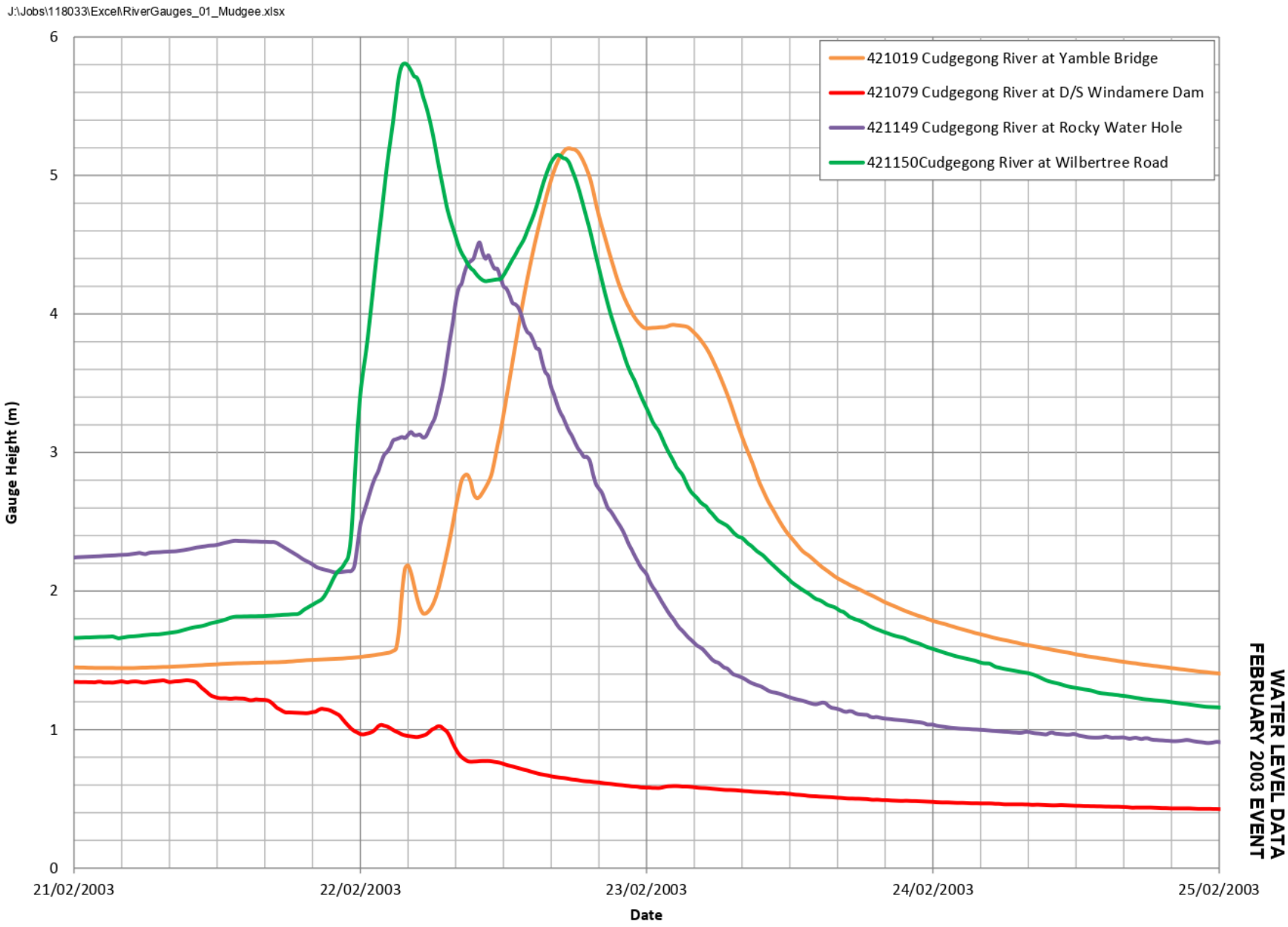
J:\Jobs\118033\Excel\RiverGauges_01_Mudgee.xlsx



CUDGEGONG RIVER AT UPSTREAM RYLSTONE - 421184
RATING CURVE

FIGURE 9

J:\Jobs\118033\Excel\RiverGauges_01_Mudgee.xlsx



WATER LEVEL DATA FEBRUARY 2003 EVENT

FIGURE 10

J:\Jobs\118033\Excel\RiverGauges_01_Mudgee.xlsx

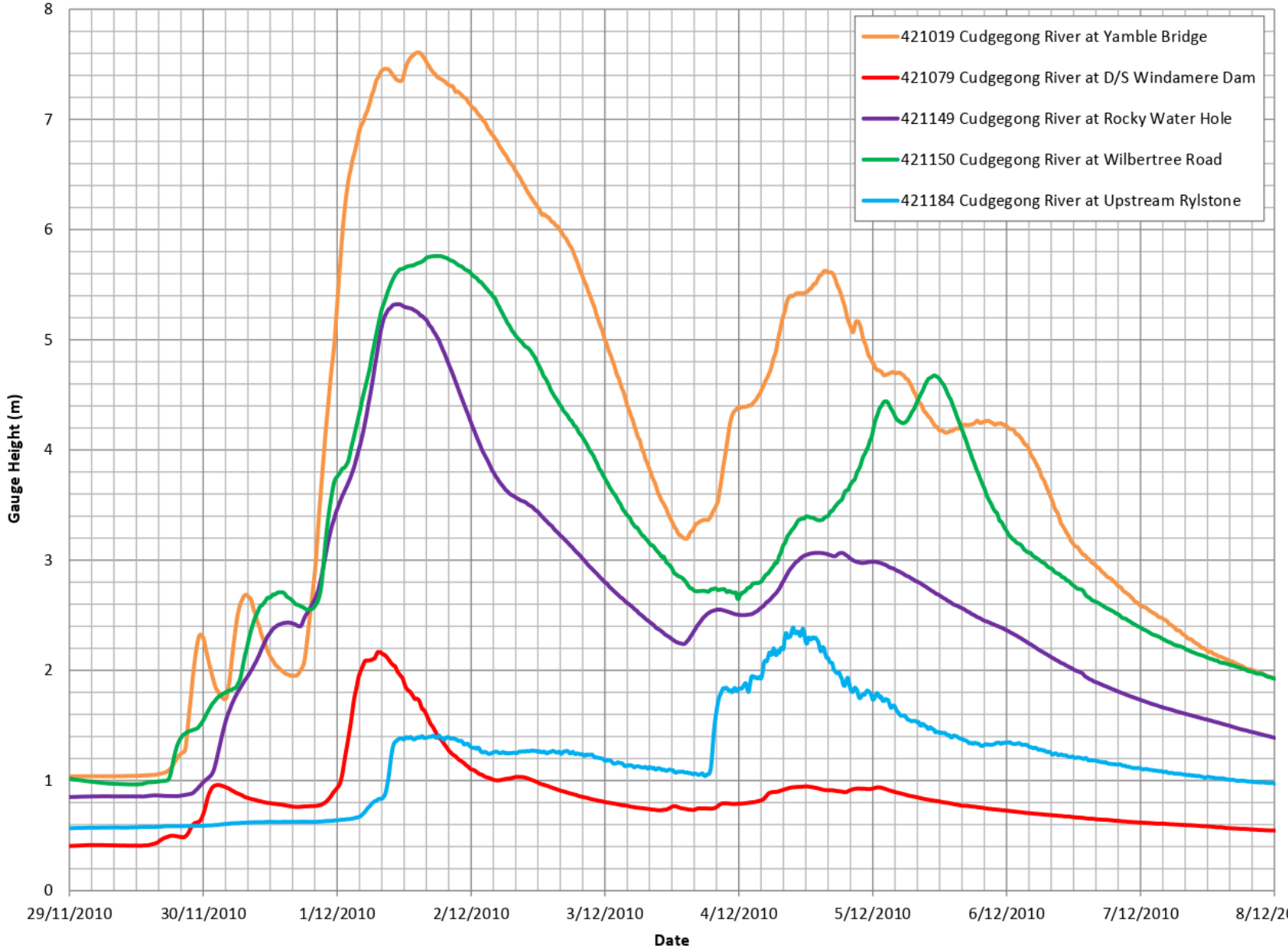


FIGURE 11
WATER LEVEL DATA
NOVEMBER / DECEMBER 2010 EVENT

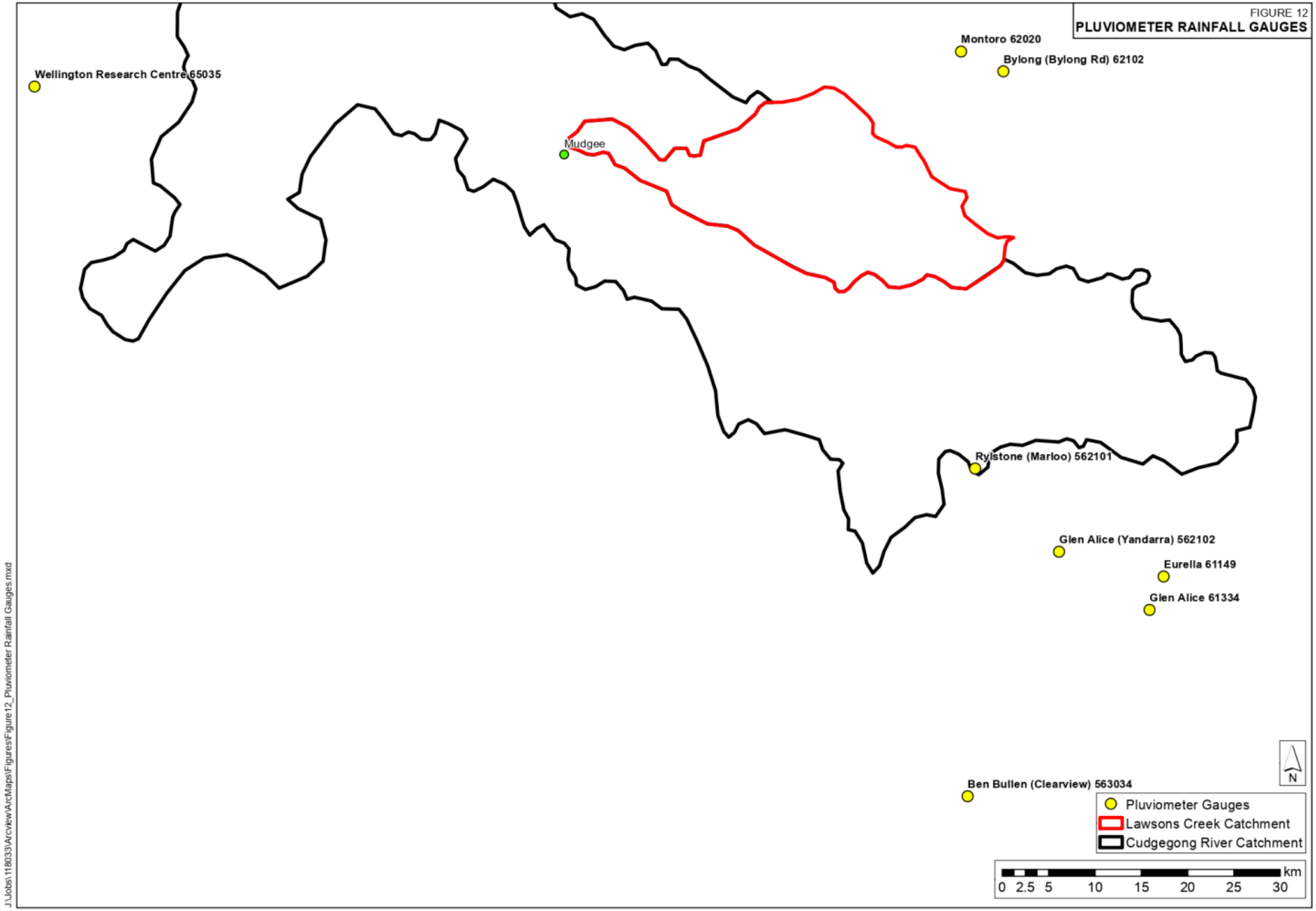
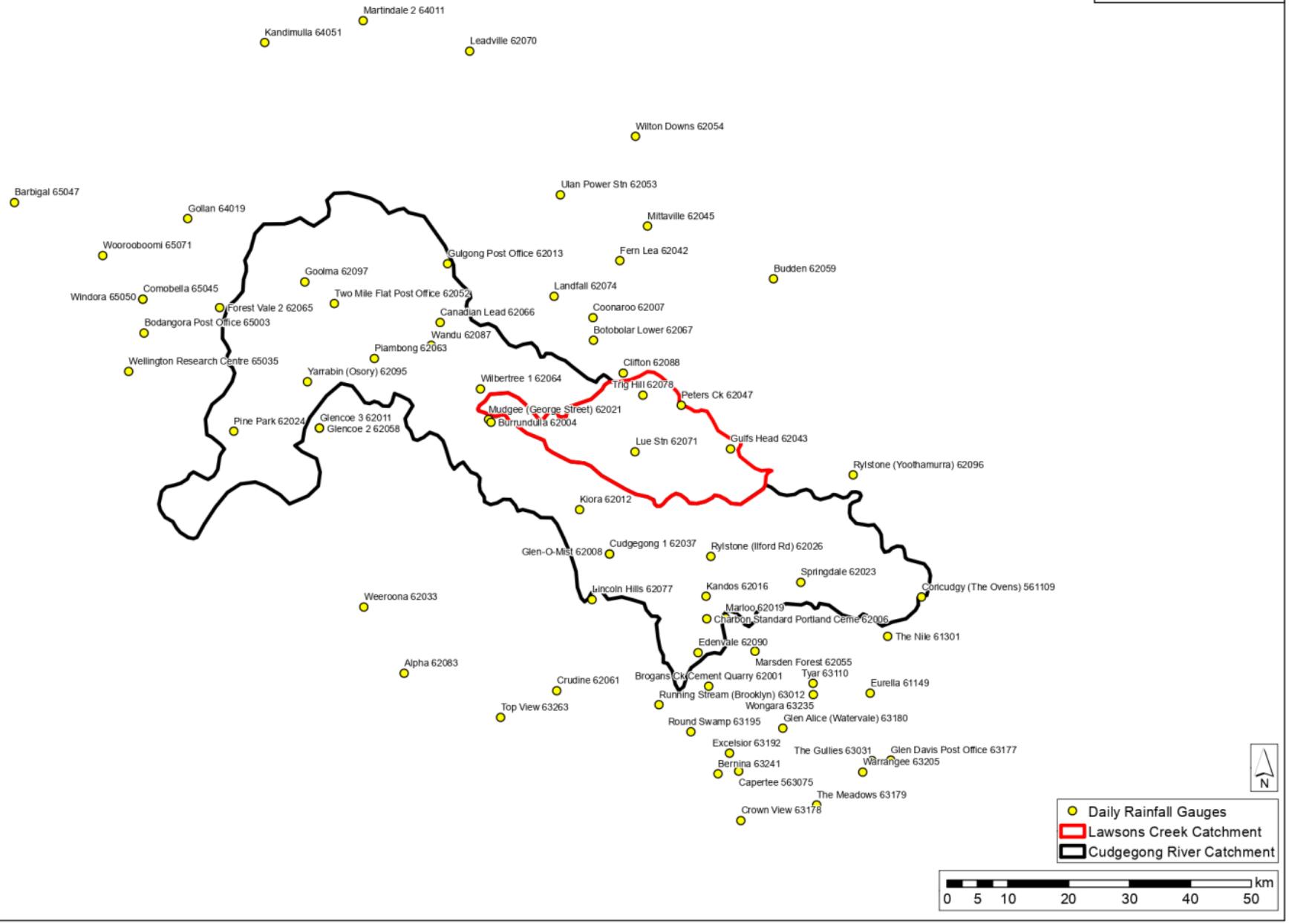


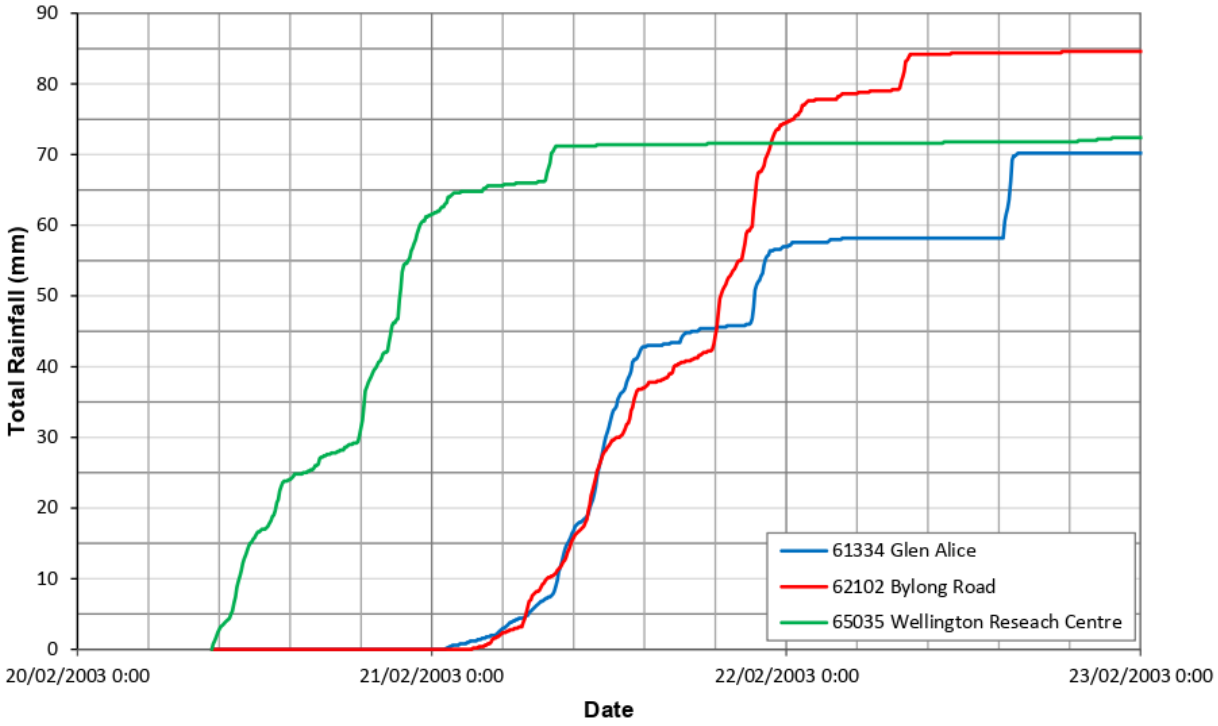
FIGURE 12
PLUVIOMETER RAINFALL GAUGES
Wellington Research Centre 65035
Mudgee
Montoro 62020
Bylong (Bylong Rd) 62102
Rylstone (Marloo) 562101
Glen Alice (Yandarra) 562102
Eurella 61149
Glen Alice 61334
Ben Bullen (Clearview) 563034
N
Pluviometer Gauges
Lawsons Creek Catchment
Cudgegong River Catchment
km
0 2.5 5 10 15 20 25 30
J:\Jobs\118033\Arcview\ArcMaps\Figures\Figure12_Pluviometer Rainfall Gauges.mxd

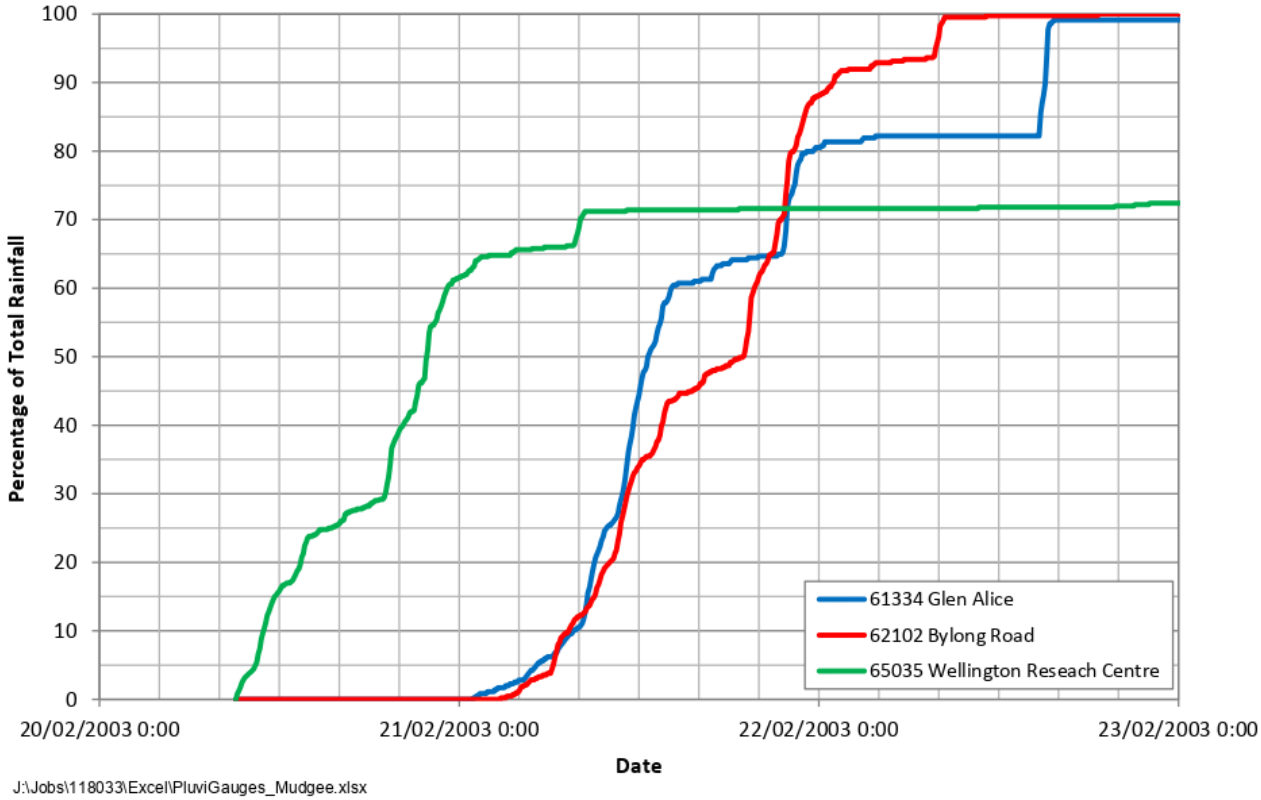
FIGURE 13
DAILY RAINFALL GAUGES



J:\Jobs\118033\ArcviewArcMaps\Figures\Figure13_Daily_Rainfall_Gauges.mxd

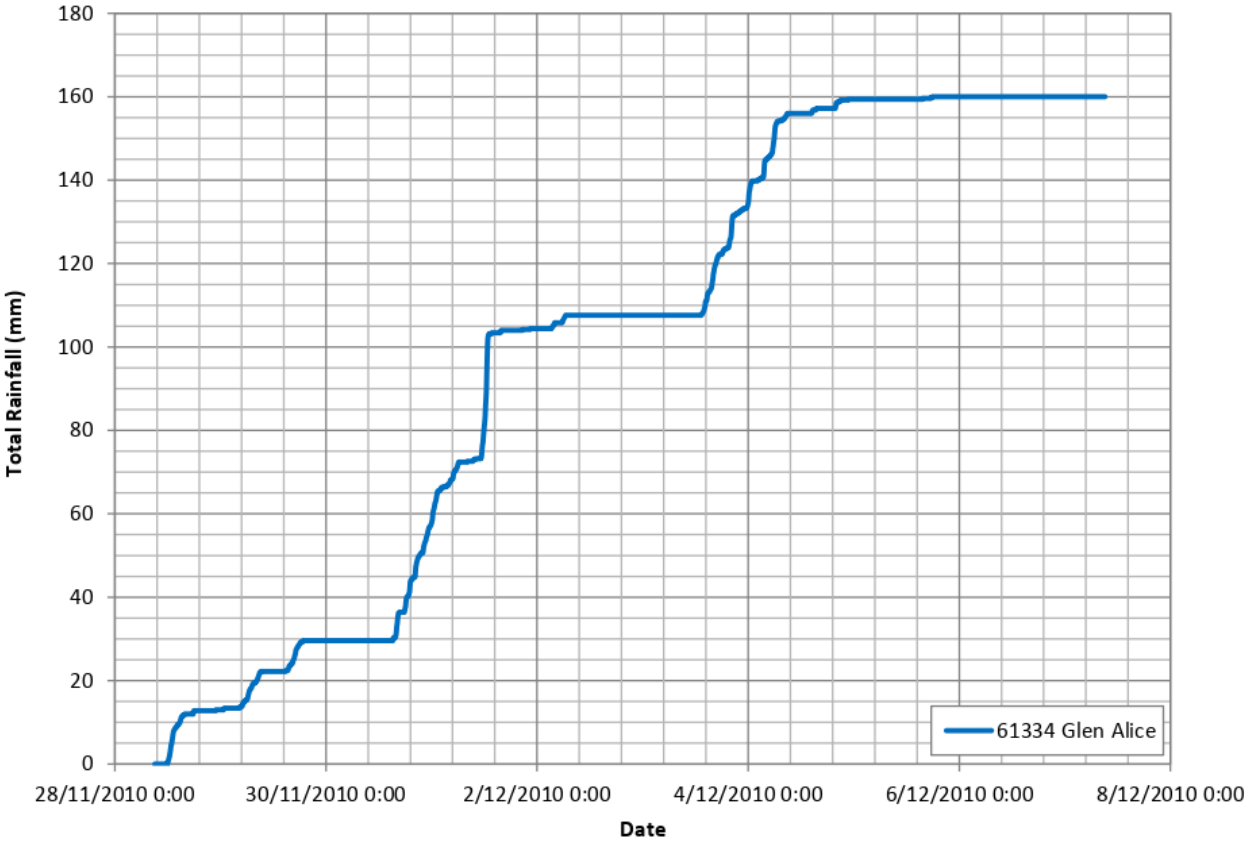
FIGURE 14
RAINFALL DATA
FEBRUARY 2003 EVENT

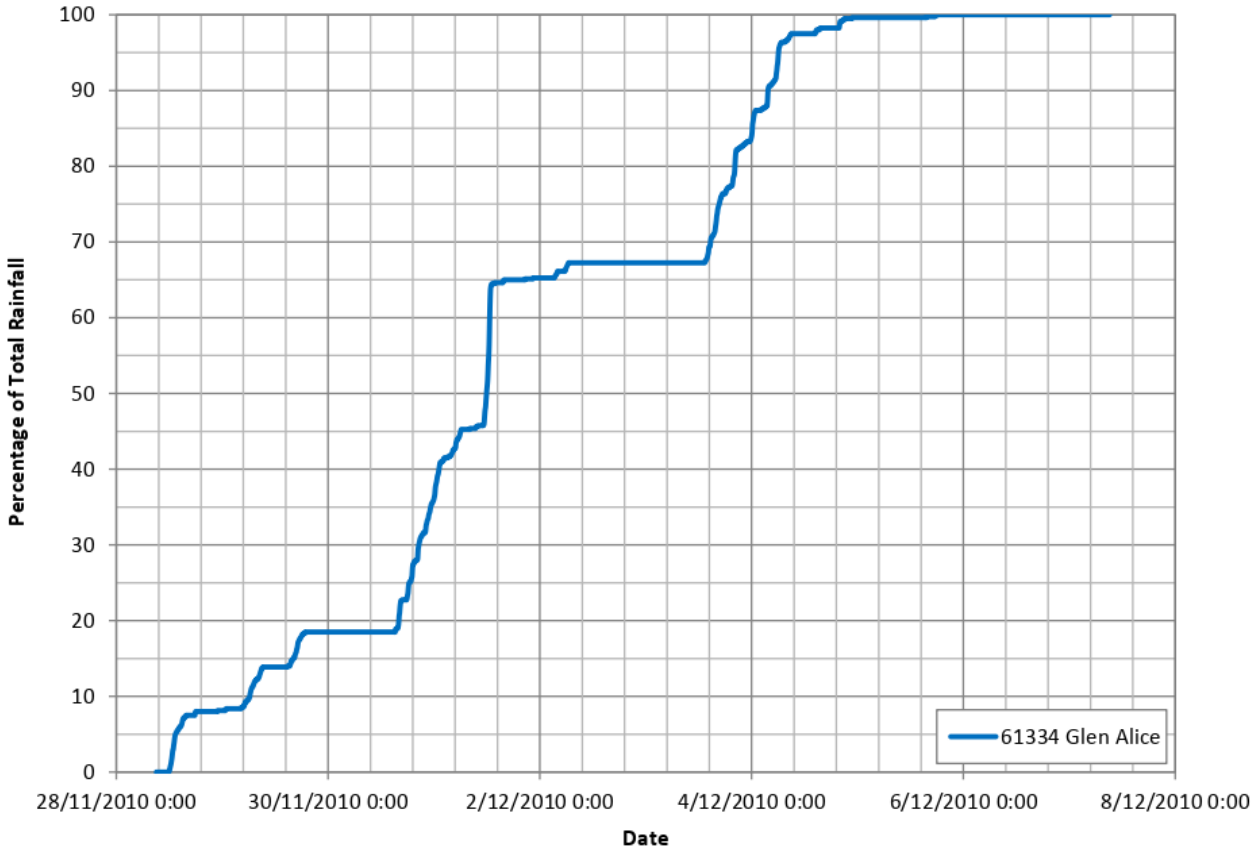




J:\Jobs\118033\Excel\PluviGauges_Mudgee.xlsx

FIGURE 15
RAINFALL DATA
DECEMBER 2010 EVENT





J:\Jobs\118033\Excel\PluviGauges_Mudgee.xlsx

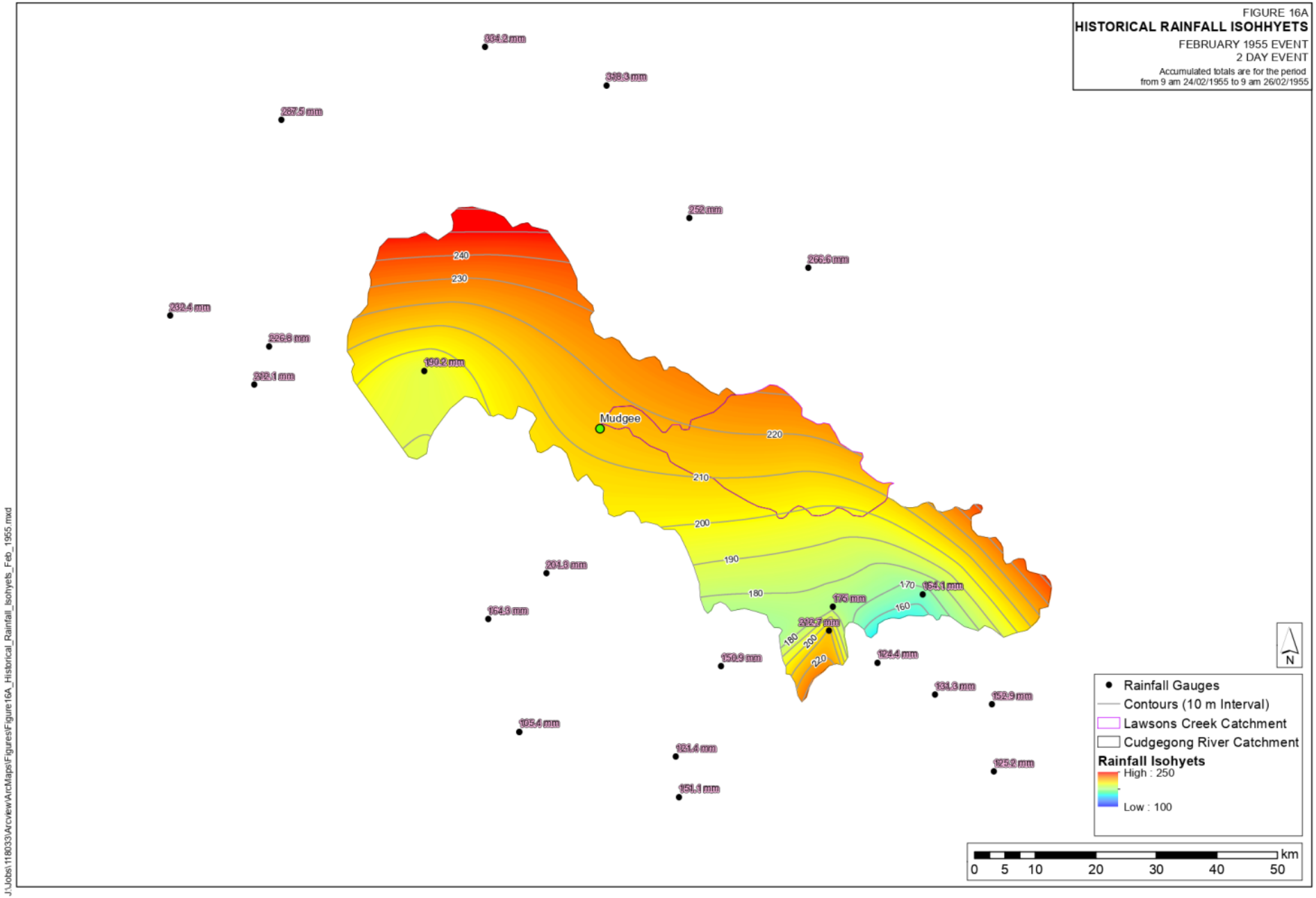


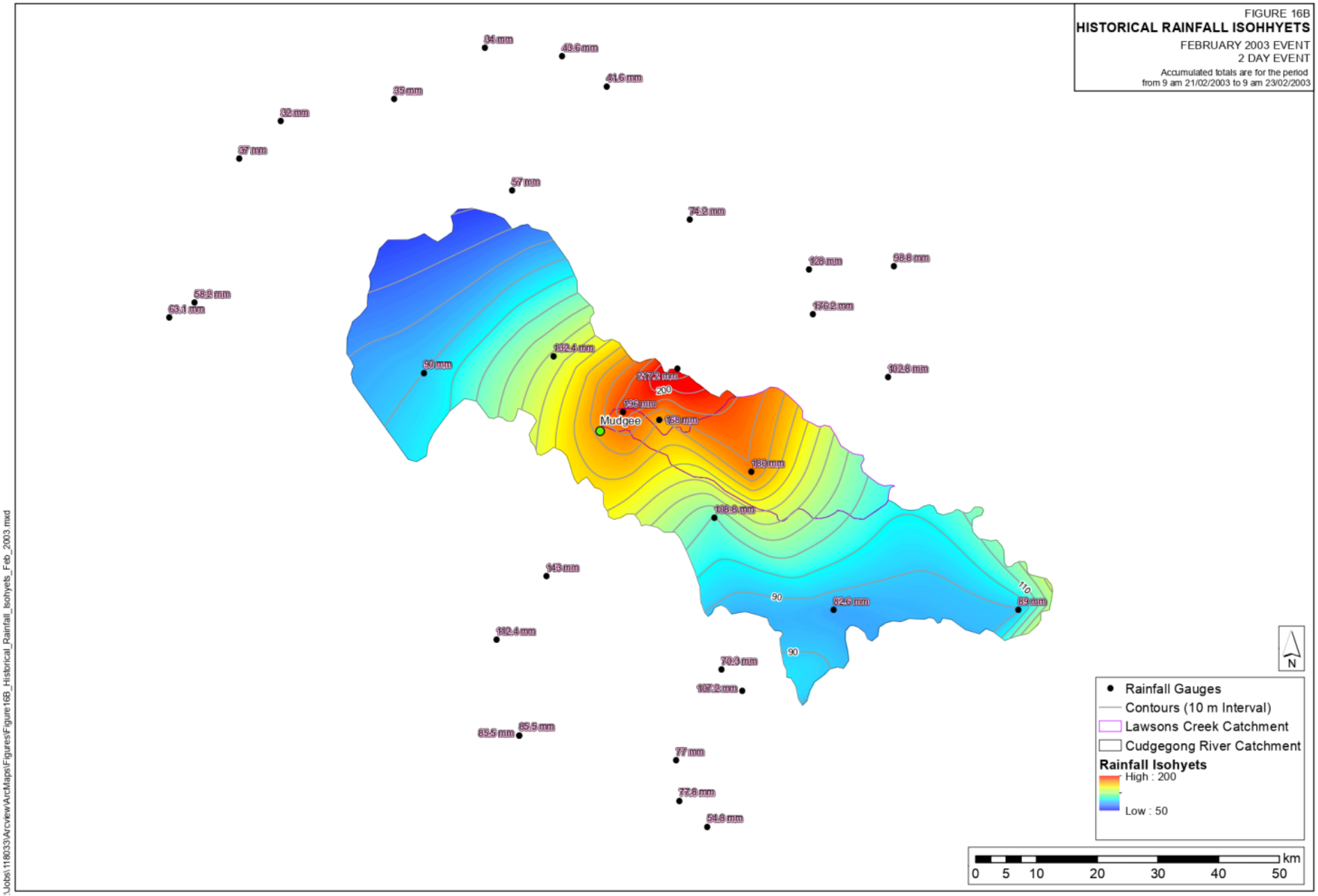
FIGURE 16A
HISTORICAL RAINFALL ISOHHYETS
FEBRUARY 1955 EVENT
2 DAY EVENT
Accumulated totals are for the period
from 9 am 24/02/1955 to 9 am 26/02/1955
334.2 mm
318.3 mm
287.5 mm
252 mm
266.6 mm
232.4 mm
226.8 mm
212.1 mm
190.2 mm
Mudgee
240
230
220
210
200
190
180
170
160
201.8 mm
164.3 mm
175 mm
164.1 mm
212.7 mm
150.9 mm
124.4 mm
131.3 mm
152.9 mm
105.4 mm
121.4 mm
125.2 mm
151.1 mm
N
Rainfall Gauges
Contours (10 m Interval)
Lawsons Creek Catchment
Cudgegong River Catchment
Rainfall Isohyets
High : 250
Low : 100
km
0 5 10 20 30 40 50
J:\Jobs\118033\ArcView\ArcMaps\Figures\Figure16A_Historical_Rainfall_Isohyets_Feb_1955.mxd

FIGURE 16B

HISTORICAL RAINFALL ISOHHYETS

FEBRUARY 2003 EVENT
2 DAY EVENT

Accumulated totals are for the period
from 9 am 21/02/2003 to 9 am 23/02/2003



J:\Jobs\118033\ArcviewArcMaps\Figures\Figure16B_Historical_Rainfall_Isohyets_Feb_2003.mxd

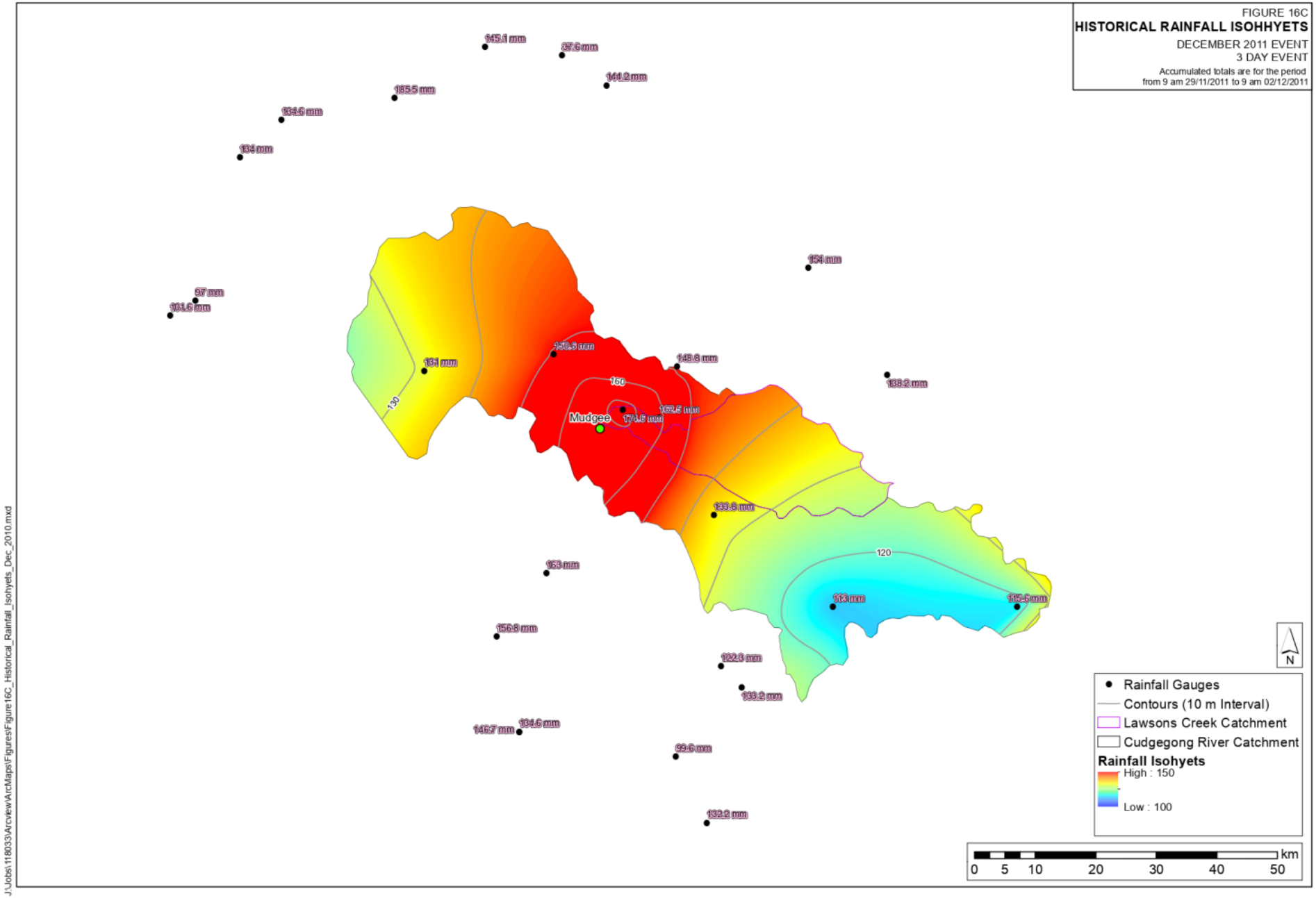


FIGURE 16C
HISTORICAL RAINFALL ISOHHYETS
DECEMBER 2011 EVENT
3 DAY EVENT
Accumulated totals are for the period
from 9 am 29/11/2011 to 9 am 02/12/2011
145.4 mm
147.6 mm
144.2 mm
185.5 mm
134.6 mm
134 mm
97 mm
101.6 mm
154 mm
150.6 mm
148.8 mm
138.2 mm
131 mm
160
130
Mudgee
174.6 mm
162.5 mm
133.8 mm
120
153 mm
114 mm
112.6 mm
156.8 mm
122.8 mm
133.2 mm
146.7 mm
134.6 mm
99.6 mm
132.2 mm
N
Rainfall Gauges
Contours (10 m Interval)
Lawsons Creek Catchment
Cudgegong River Catchment
Rainfall Isohyets
High : 150
Low : 100
km
0 5 10 20 30 40 50
J:\Jobs\118033\ArcView\ArcMaps\Figures\Figure16C_Historical_Rainfall_Isohyets_Dec_2010.mxd

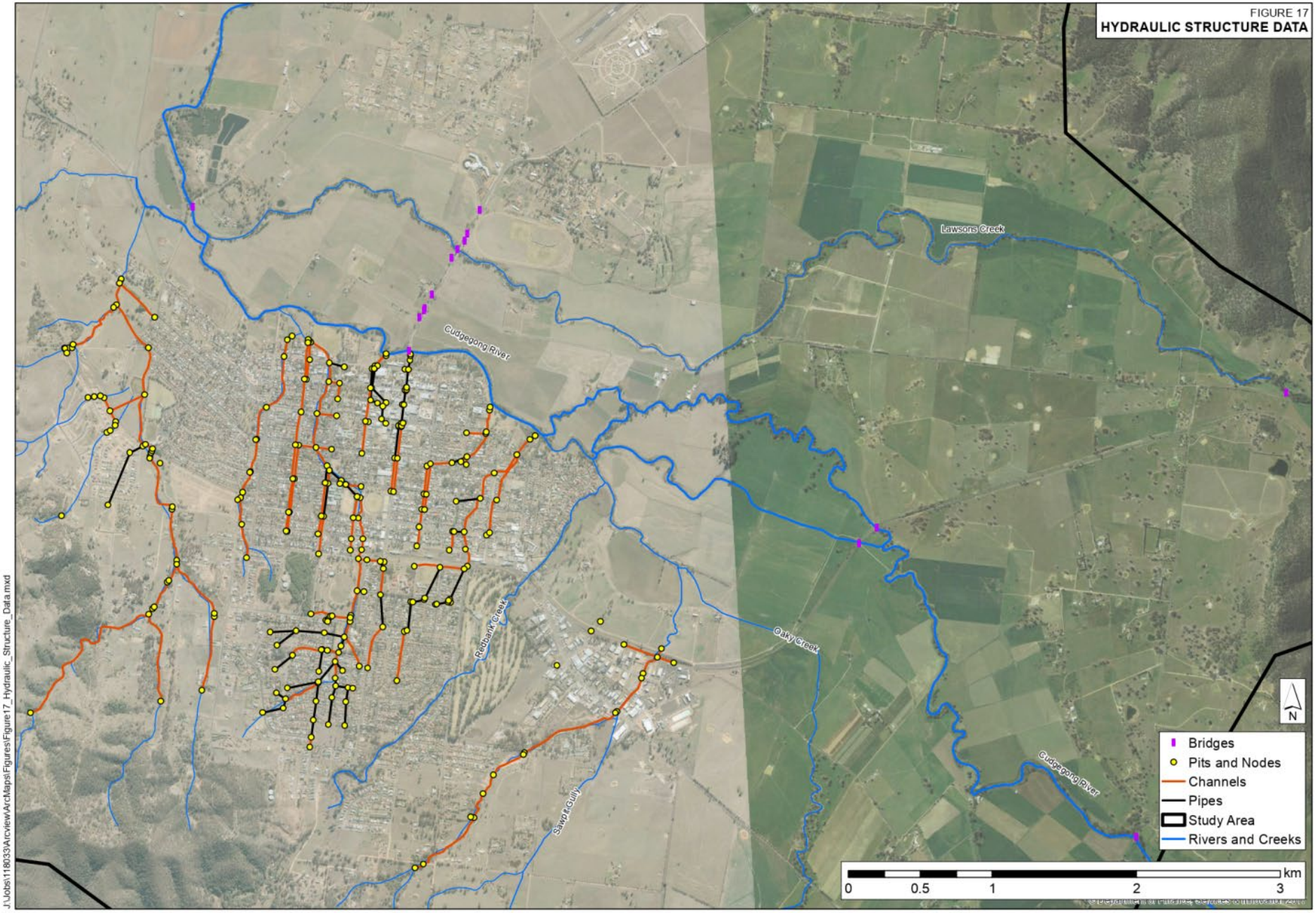
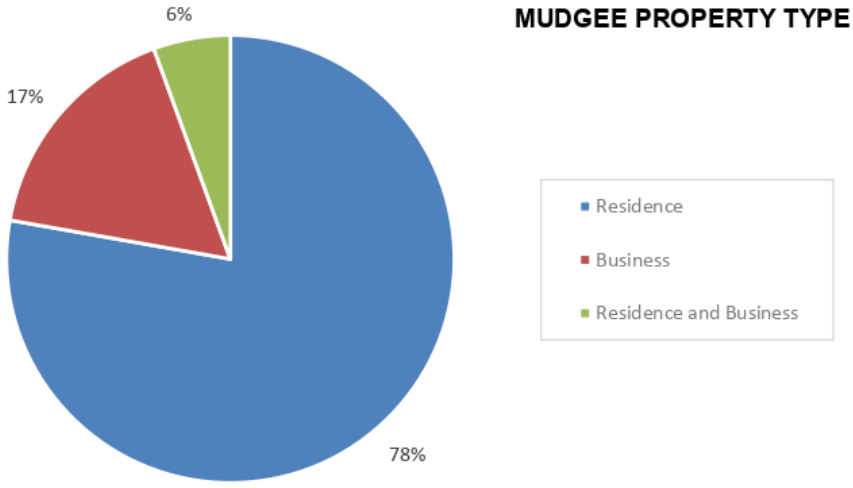
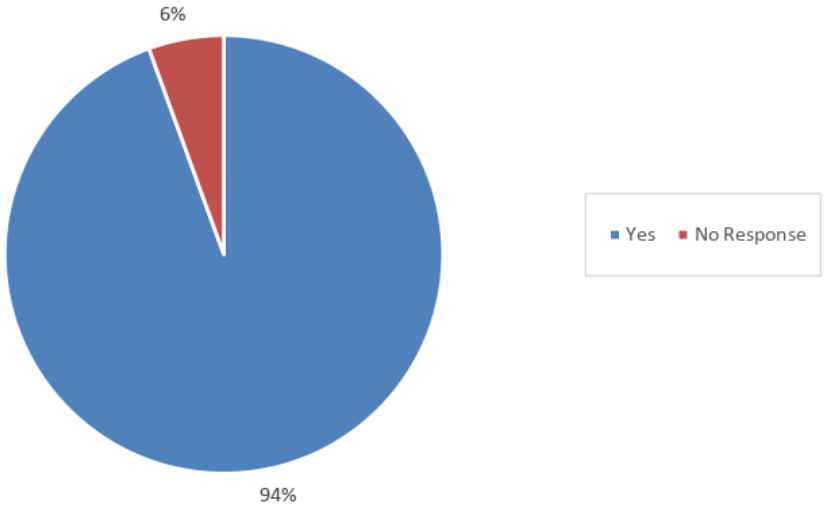


FIGURE 17
HYDRAULIC STRUCTURE DATA
Lawsons Creek
Cudgegong River
Redbank Creek
Oaky Creek
Sawpit Gully
Cudgegong River
N
Bridges
Pits and Nodes
Channels
Pipes
Study Area
Rivers and Creeks
km
0
0.5
1
2
3
J:\Jobs\118033\ArcviewArcMaps\Figures\Figure17_Hydraulic_Structure_Data.mxd

FIGURE 18A
MUDGEE PROPERTY TYPE



COMMUNITY AWARENESS OF FLOOD PRONE AREA



PERIOD OF TIME COMMUNITY HAS LIVED IN MUDGEE

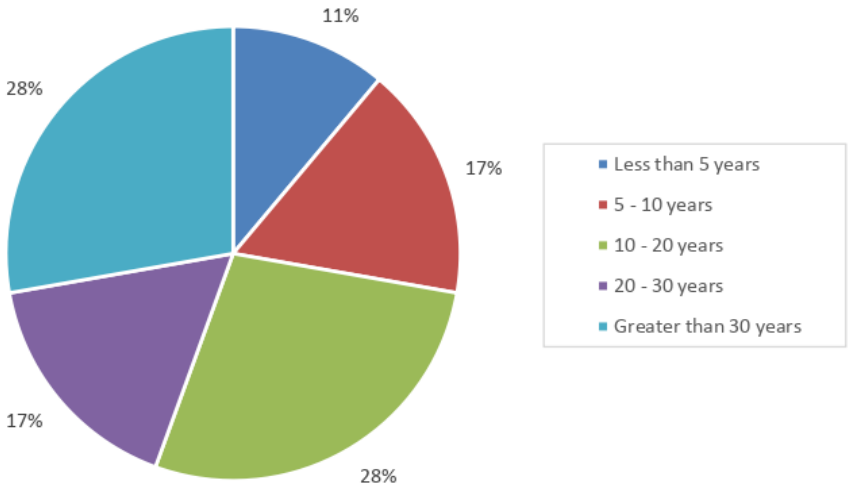
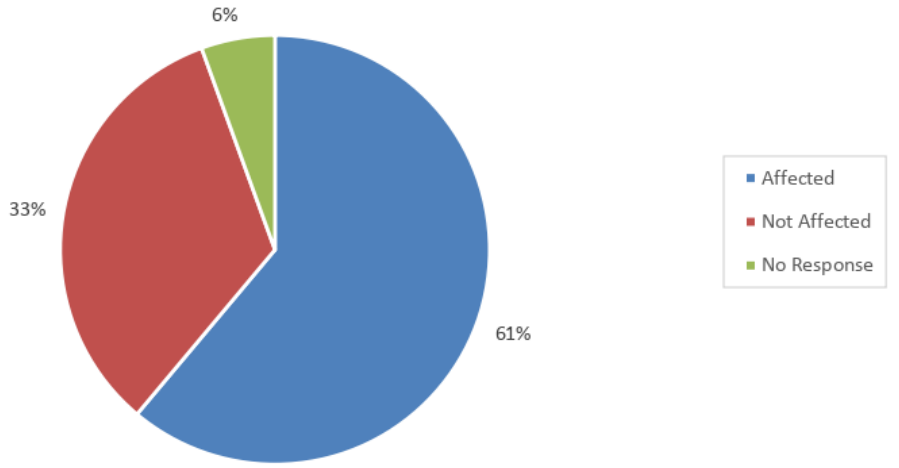
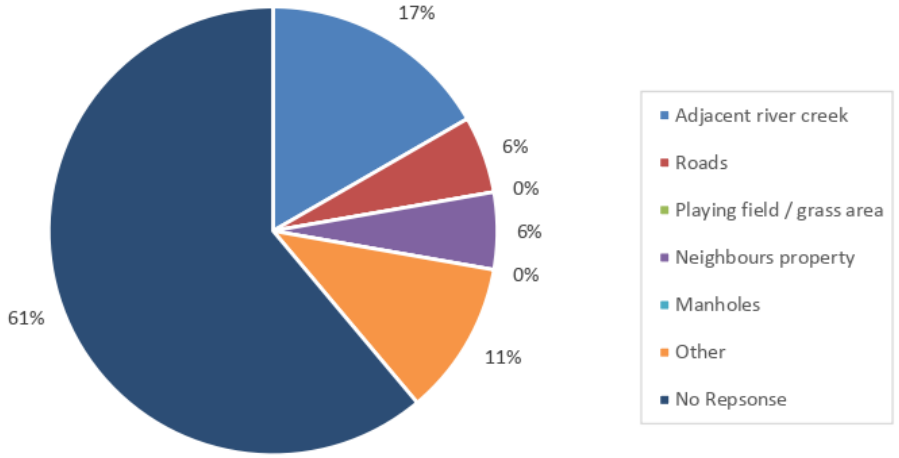


FIGURE 18B

PROPERTIES AFFECTED BY FLOODING FROM LOCAL RIVERS AND CREEKS



PERCIEVED SOURCE OF FLOODING



CONSEQUENCES OF FLOODING

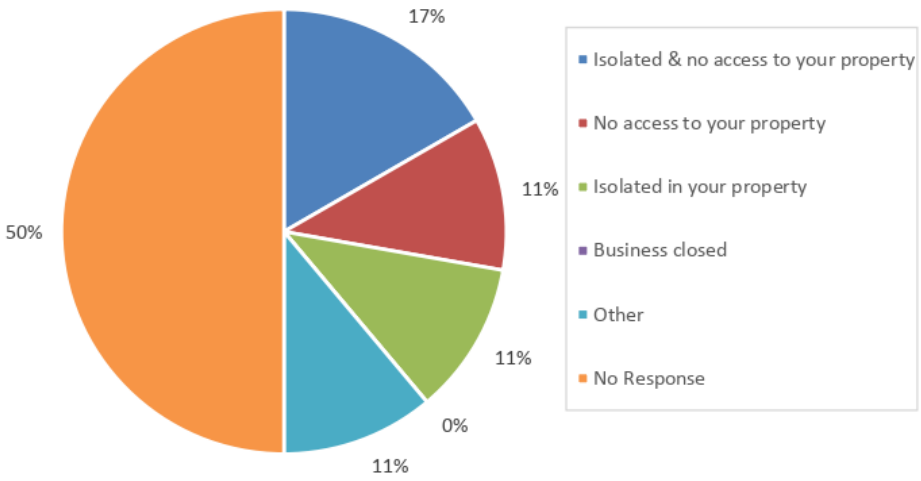
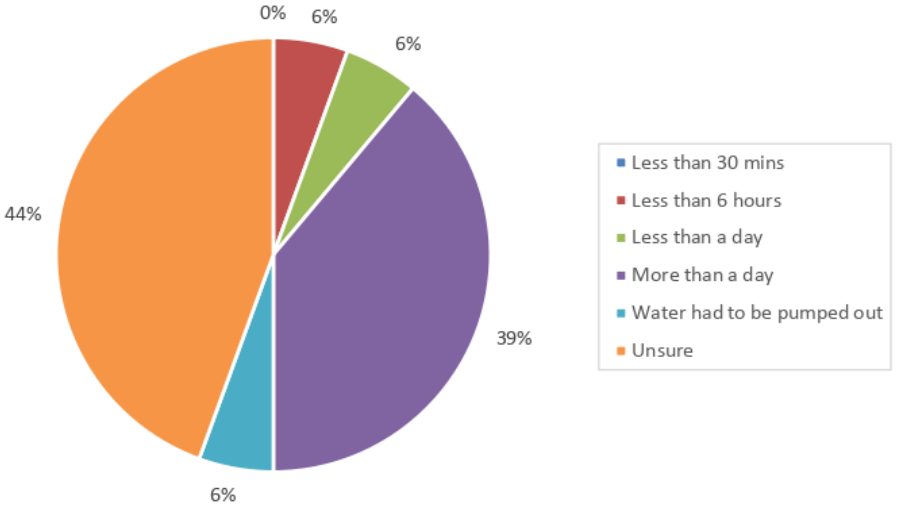
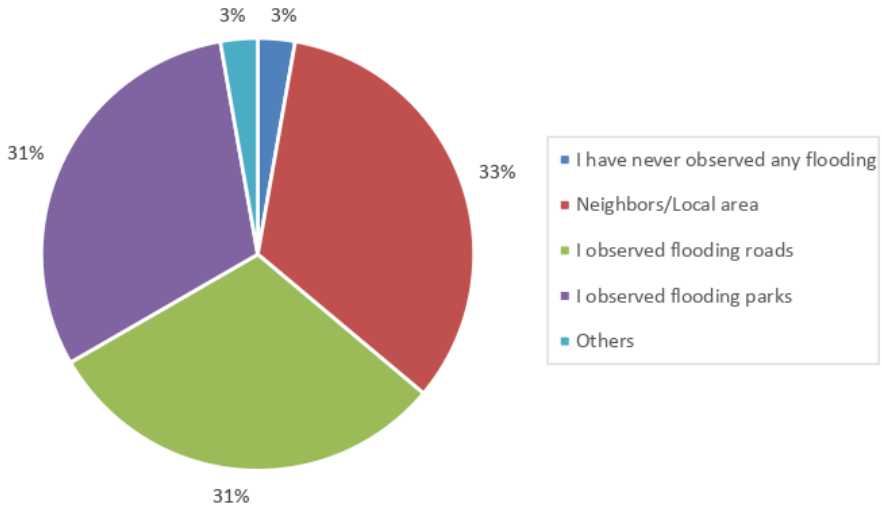


FIGURE 18C

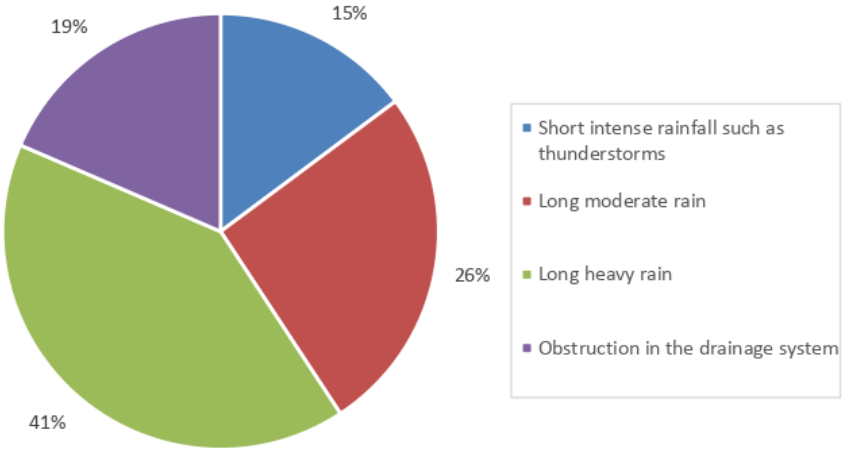
TIME FOR FLOOD WATER TO DRAIN AWAY AFTER FLOODING



NEIGHBORING PROPERTIES FLOODING EXTENT



CAUSES OF FLOODING



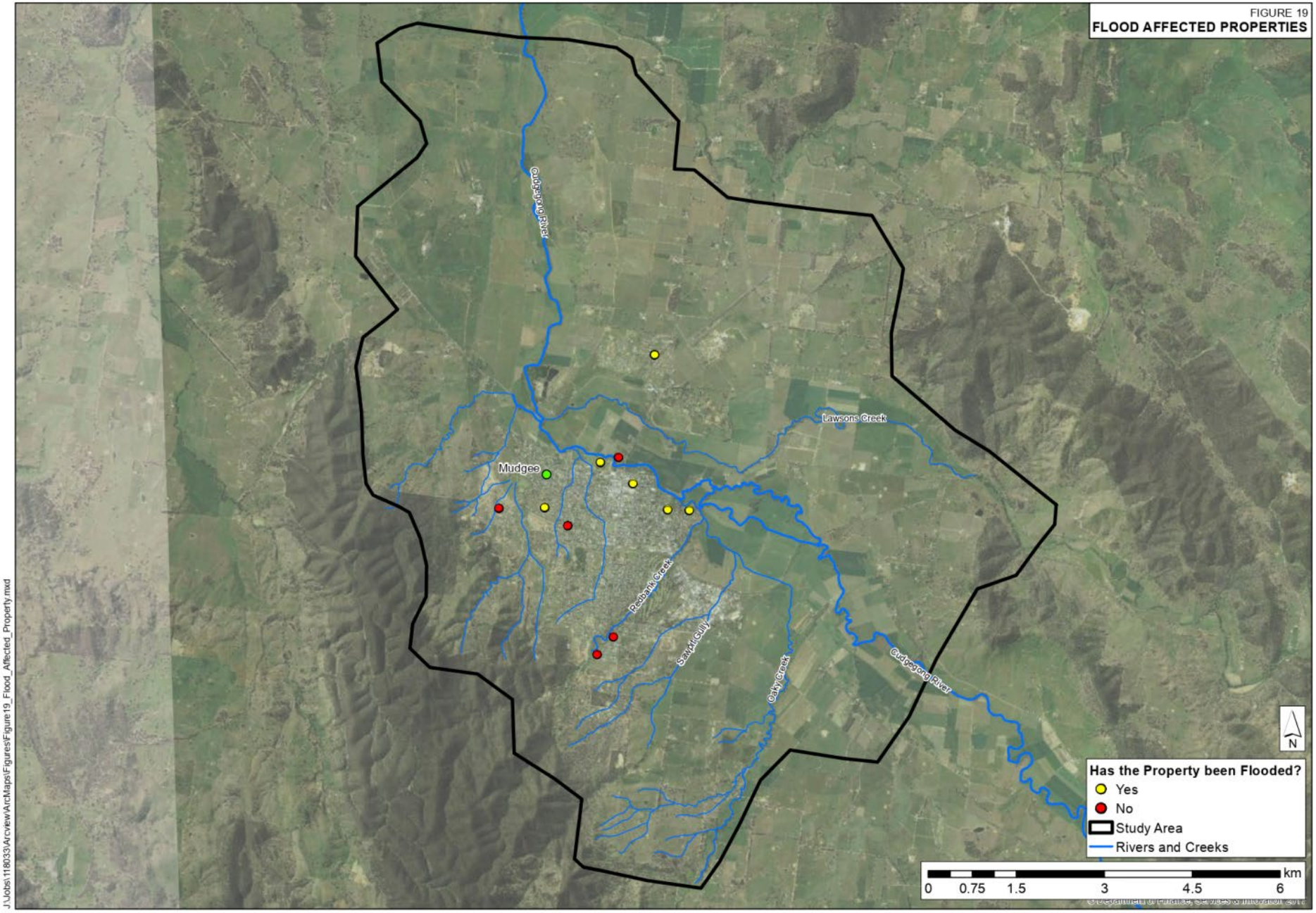


FIGURE 19
FLOOD AFFECTED PROPERTIES
Mudgee
Lawsons Creek
Redbank Creek
Stanhope Gully
Oakey Creek
Has the Property been Flooded?
Yes
No
Study Area
Rivers and Creeks
N
km
0
0.75
1.5
3
4.5
6
J:\Jobs\118033\ArcviewArcMaps\Figures\Figure19_Flood_Affected_Property.mxd

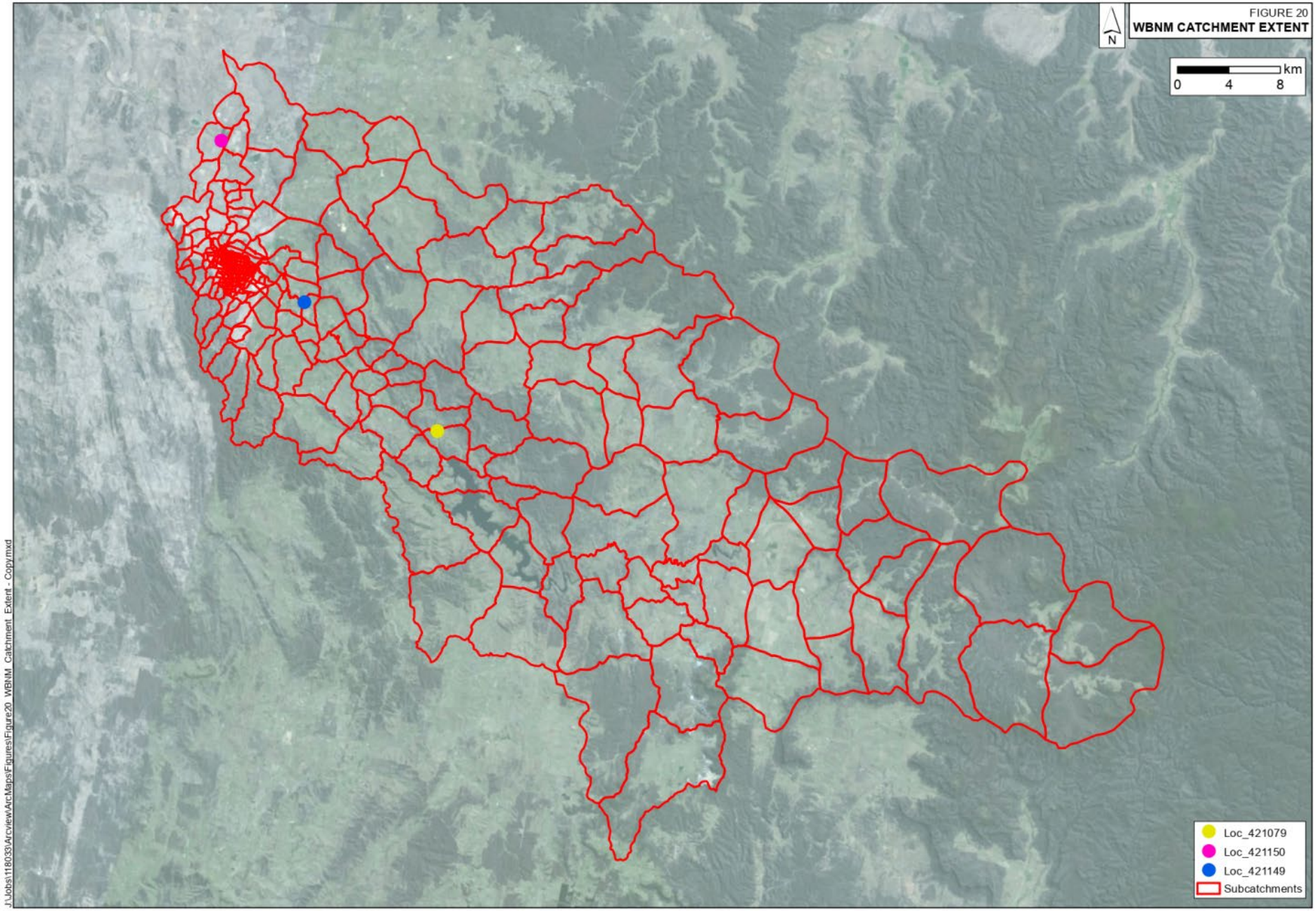


FIGURE 20
WBNM CATCHMENT EXTENT
N
km
0
4
8
Loc_421079
Loc_421150
Loc_421149
Subcatchments
J:\Jobs\118033\ArcView\ArcMaps\Figures\Figure20_WBNM_Catchment_Extent - Copy.mxd

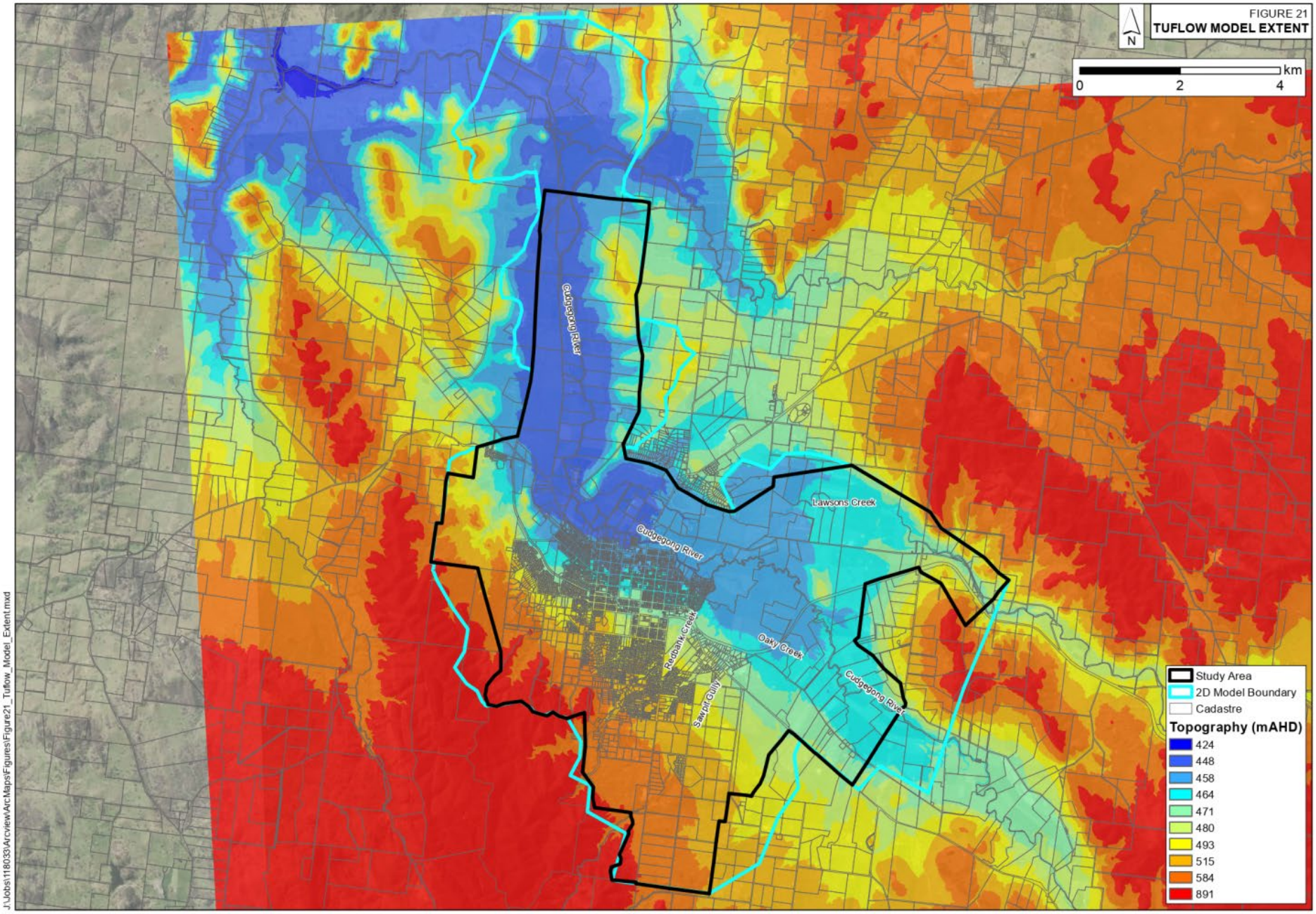


FIGURE 21
TUFLOW MODEL EXTENT
N
km
0
2
4
Study Area
2D Model Boundary
Cadastre
Topography (mAHD)
424
448
458
464
471
480
493
515
584
891
Cudgegong River
Lawsons Creek
Cudgegong River
Redbank Creek
Oaky Creek
Sawpit Gully
Cudgegong River
J:\Jobs\118033\ArcView\ArcMaps\Figures\Figure21_Tuflow_Model_Extent.mxd

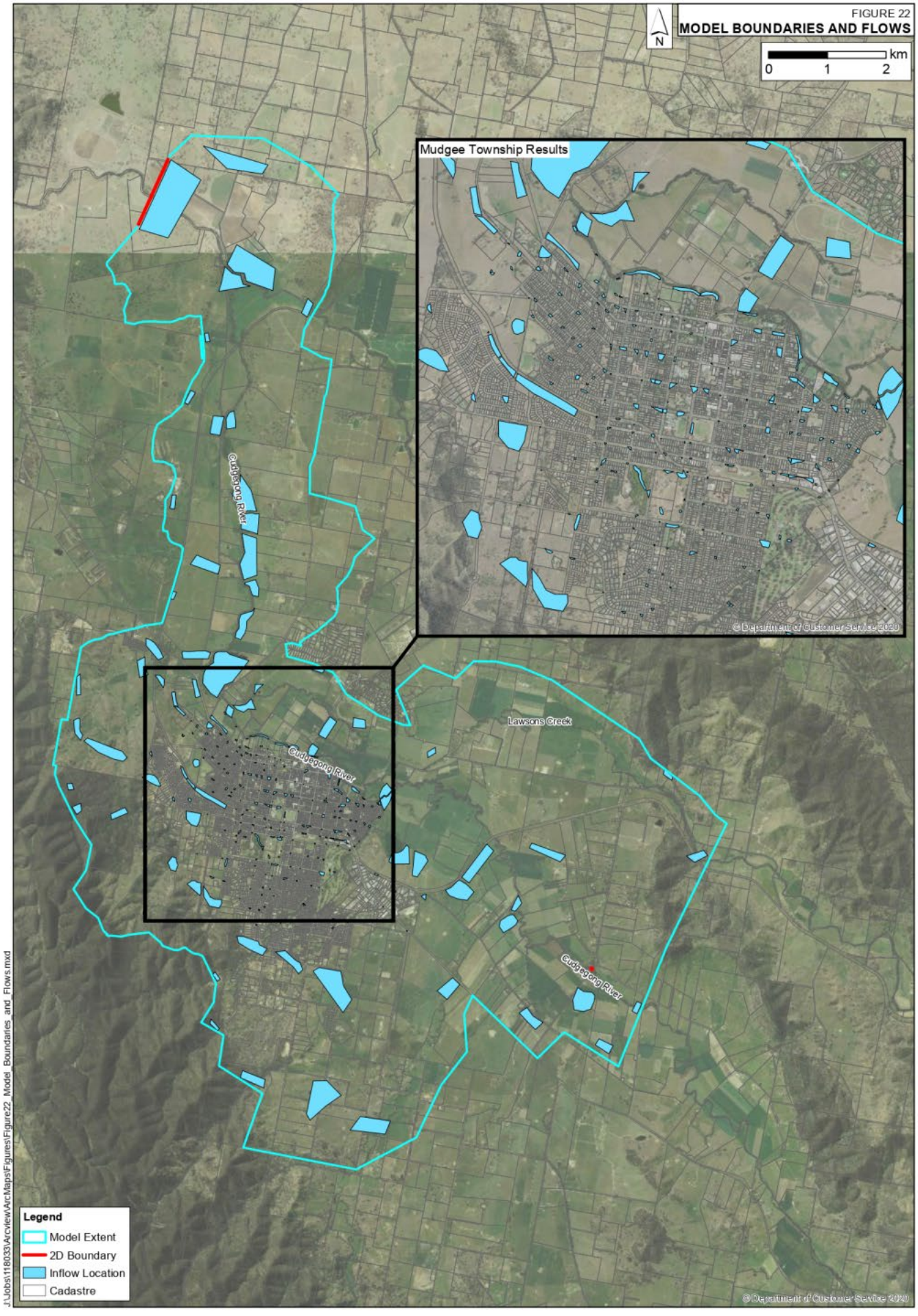


FIGURE 22
MODEL BOUNDARIES AND FLOWS
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Cudgegong River
Cudgegong River
© Department of Customer Service 2020
© Department of Customer Service 2020
Legend
Model Extent
2D Boundary
Inflow Location
Cadastre
J:\Jobs\118033\Arcview\ArcMaps\Figures\Figure22_Model_Boundaries_and_Flows.mxd

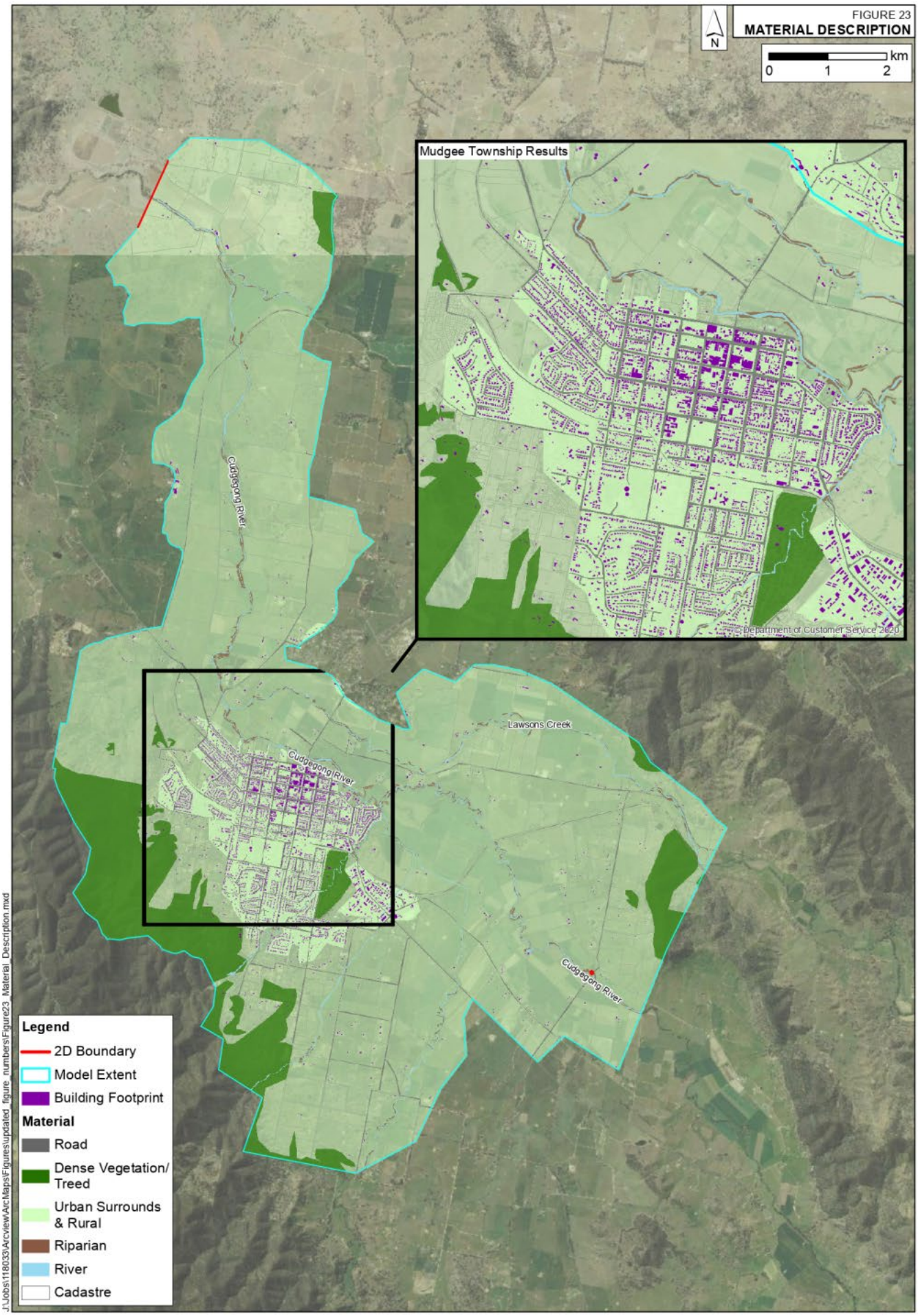


FIGURE 23
MATERIAL DESCRIPTION
N
km
0
1
2
Mudgee Township Results
Department of Customer Service 2020
Cudgegong River
Lawsons Creek
Cudgegong River
Cudgegong River
Legend
2D Boundary
Model Extent
Building Footprint
Material
Road
Dense Vegetation/ Treed
Urban Surrounds & Rural
Riparian
River
Cadastre
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure23_Material_Description.mxd

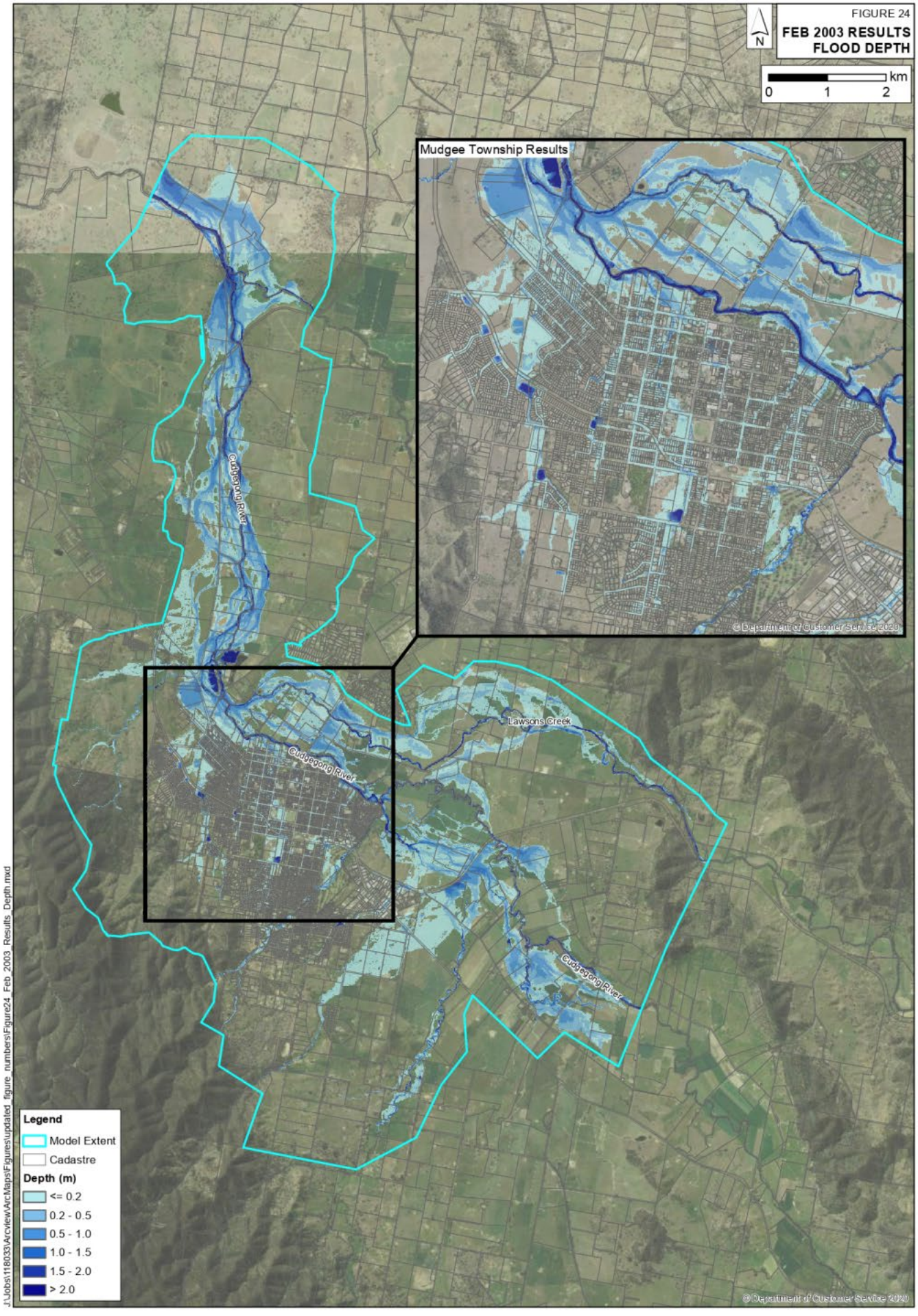


FIGURE 24
FEB 2003 RESULTS
FLOOD DEPTH
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Cudgegong River
Cudgegong River
© Department of Customer Service 2020
Legend
Model Extent
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcView\ArcMaps\Figures\updated_figure_numbers\Figure24_Feb_2003_Results_Depth.mxd

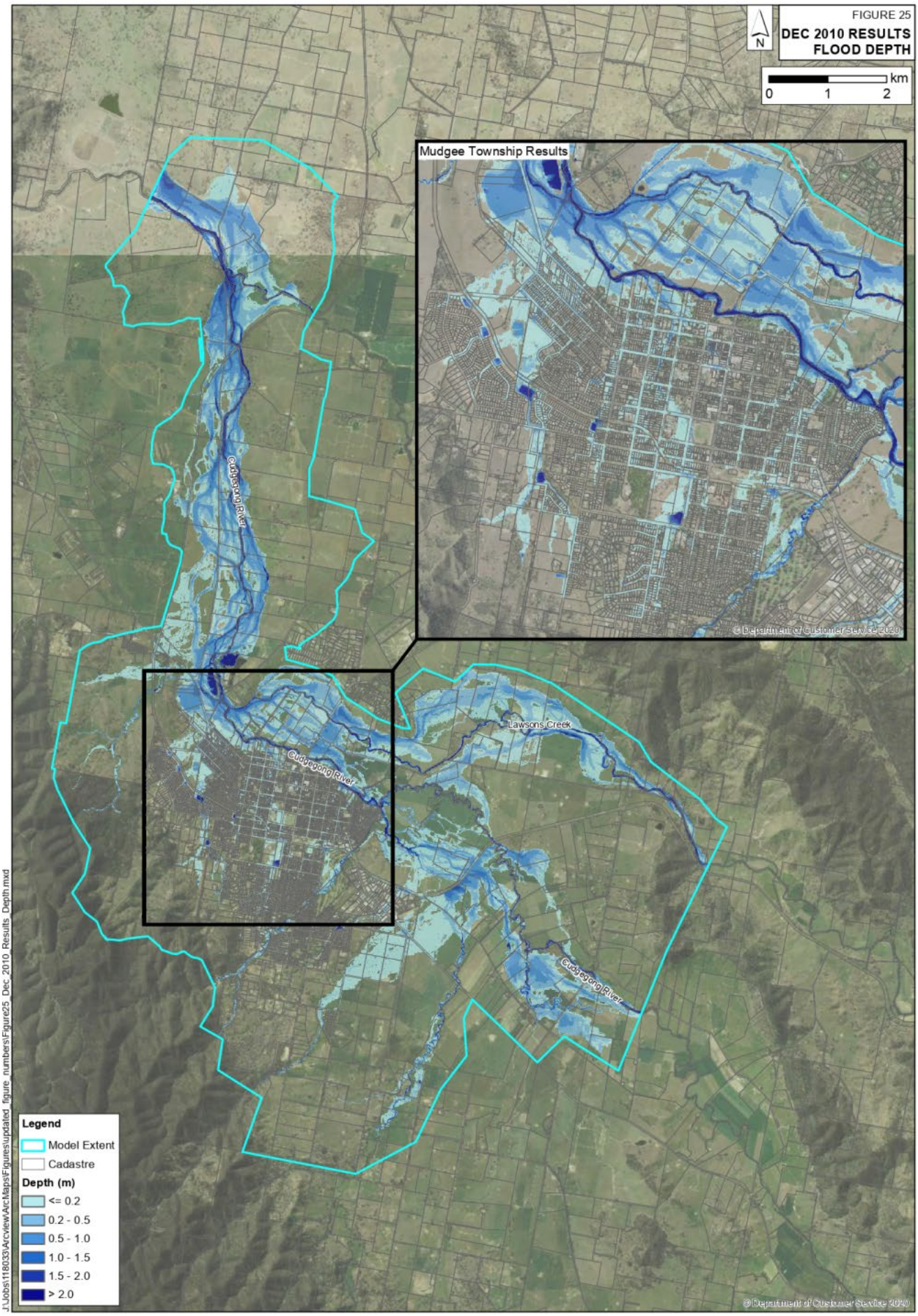


FIGURE 25
DEC 2010 RESULTS
FLOOD DEPTH
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Cudgegong River
Lawsons Creek
Cudgegong River
© Department of Customer Service 2020
© Department of Customer Service 2020
Legend
Model Extent
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure25_Dec_2010_Results_Depth.mxd

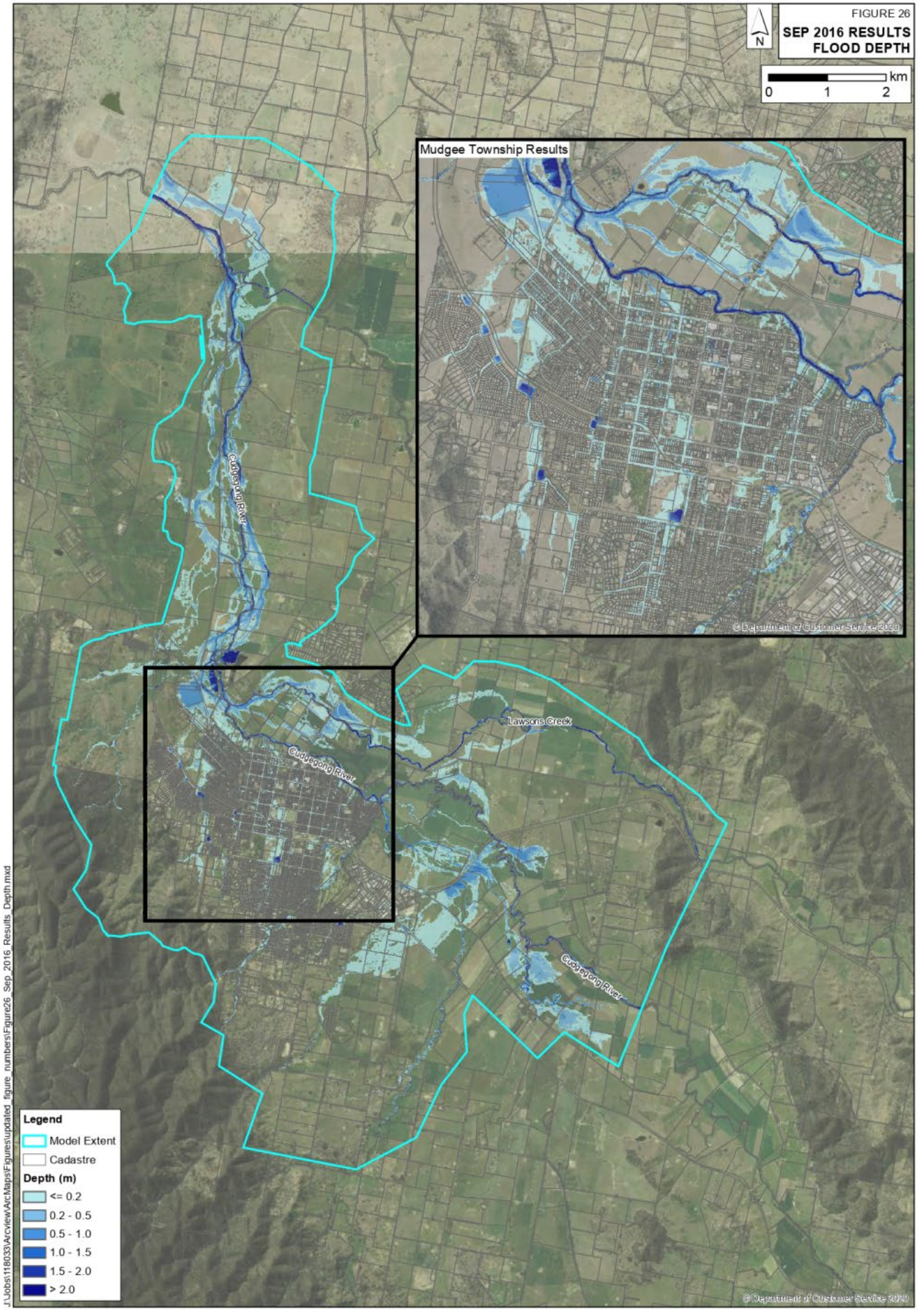


FIGURE 26
SEP 2016 RESULTS
FLOOD DEPTH
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Cudgegong River
Cudgegong River
© Department of Customer Service 2020
© Department of Customer Service 2020
Legend
Model Extent
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcView\ArcMaps\Figures\updated_figure_numbers\Figure26_Sep_2016_Results_Depth.mxd

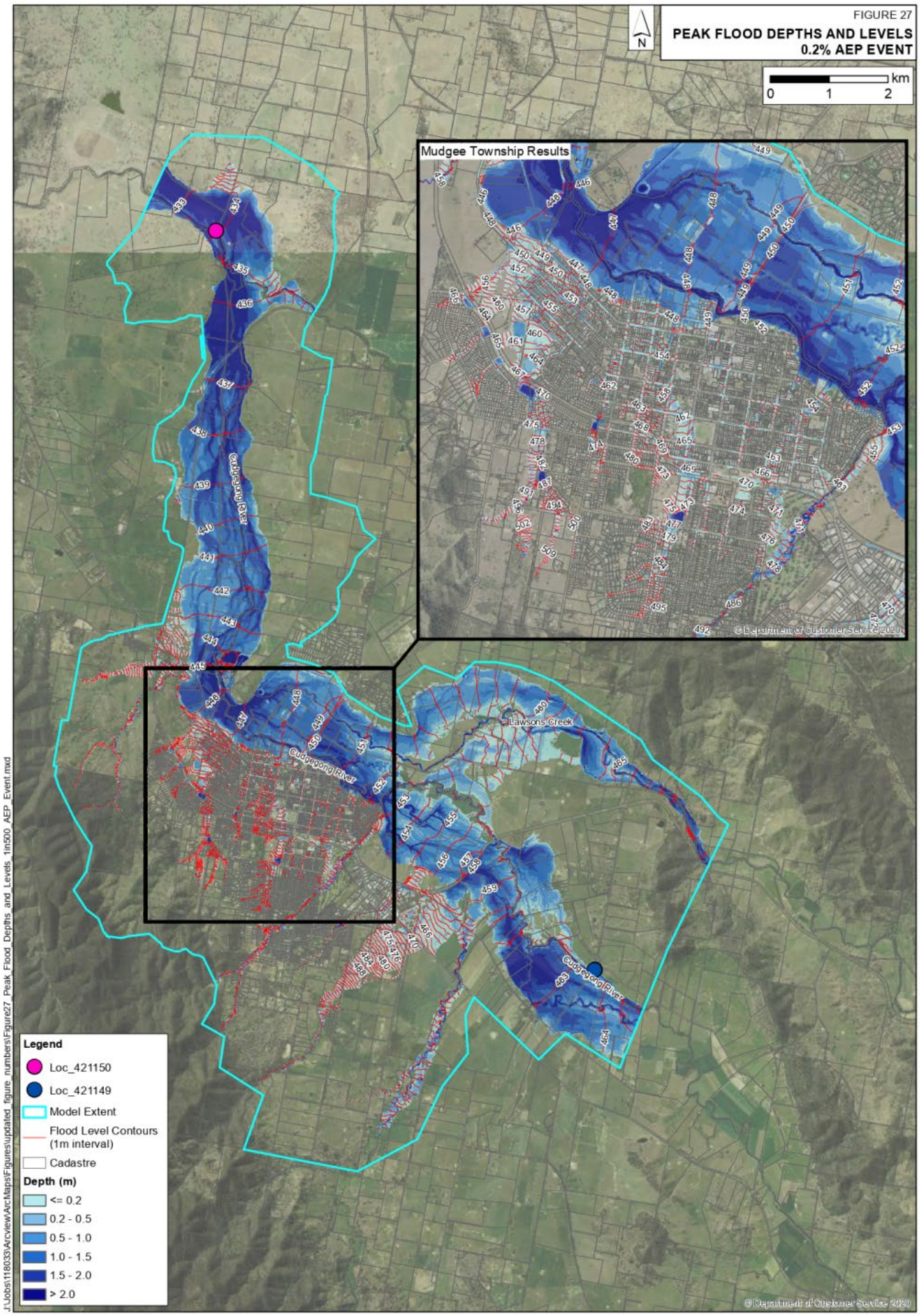


FIGURE 27
PEAK FLOOD DEPTHS AND LEVELS
0.2% AEP EVENT
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Legend
Loc_421150
Loc_421149
Model Extent
Flood Level Contours (1m interval)
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
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J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure27_Peak_Flood_Depths_and_Levels_1in500_AEP_Event.mxd

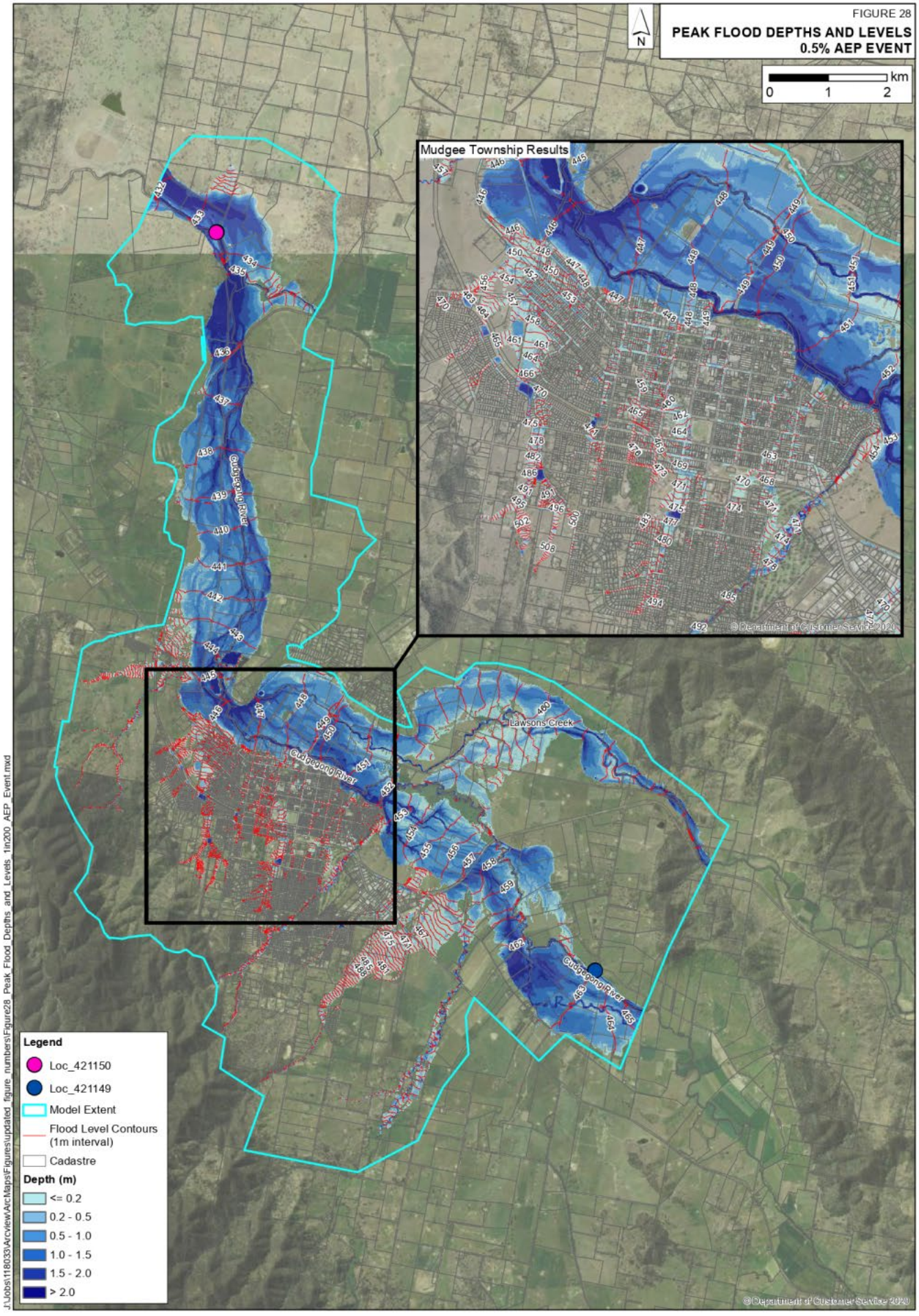
FIGURE 28
PEAK FLOOD DEPTHS AND LEVELS
0.5% AEP EVENT
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Legend
Loc_421150
Loc_421149
Model Extent
Flood Level Contours (1m interval)
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure28_Peak_Flood_Depths_and_Levels_1in200_AEP_Event.mxd
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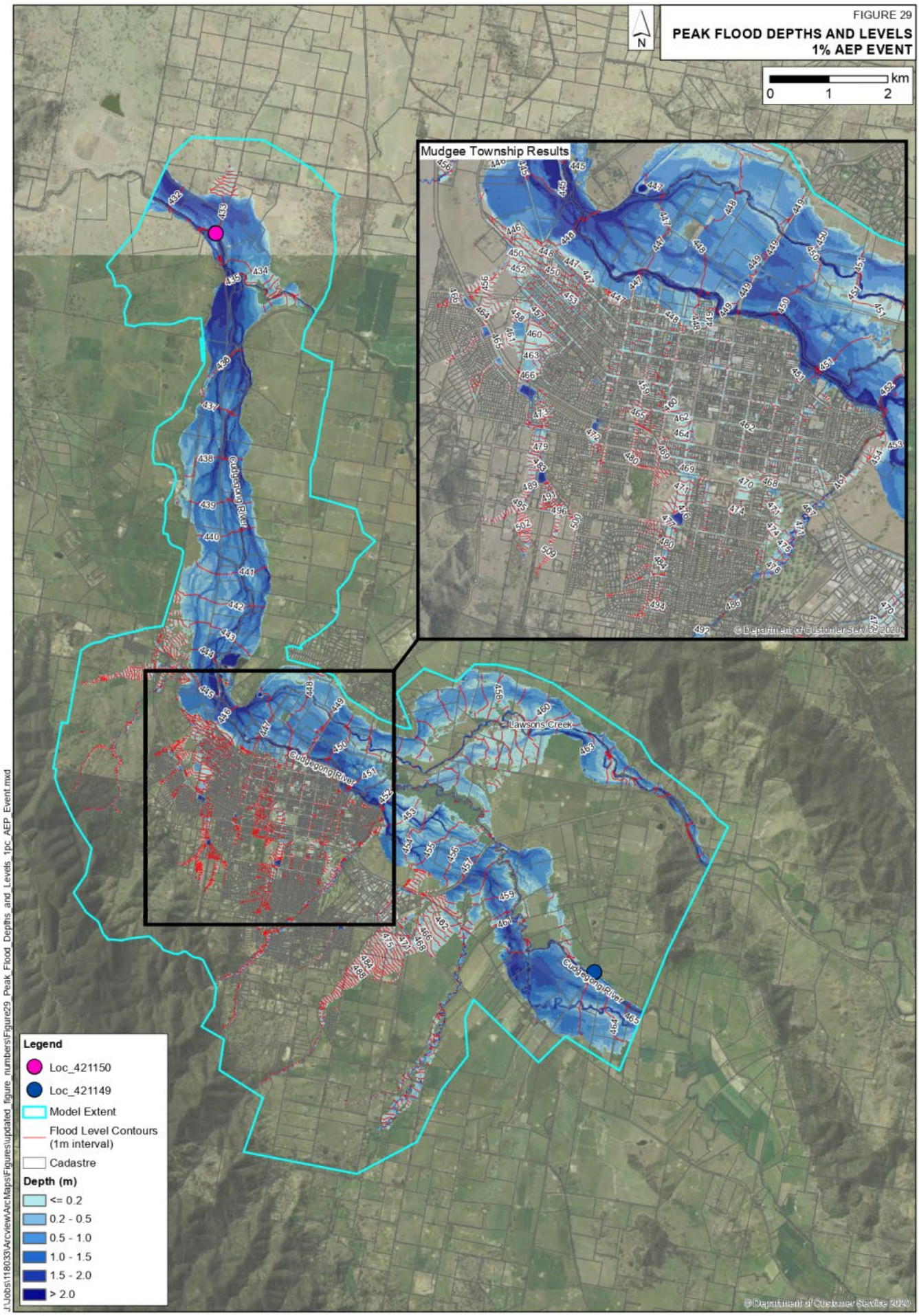
FIGURE 29
PEAK FLOOD DEPTHS AND LEVELS
1% AEP EVENT
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Legend
Loc_421150
Loc_421149
Model Extent
Flood Level Contours (1m interval)
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure29_Peak_Flood_Depths_and_Levels_1pc_AEP_Event.mxd
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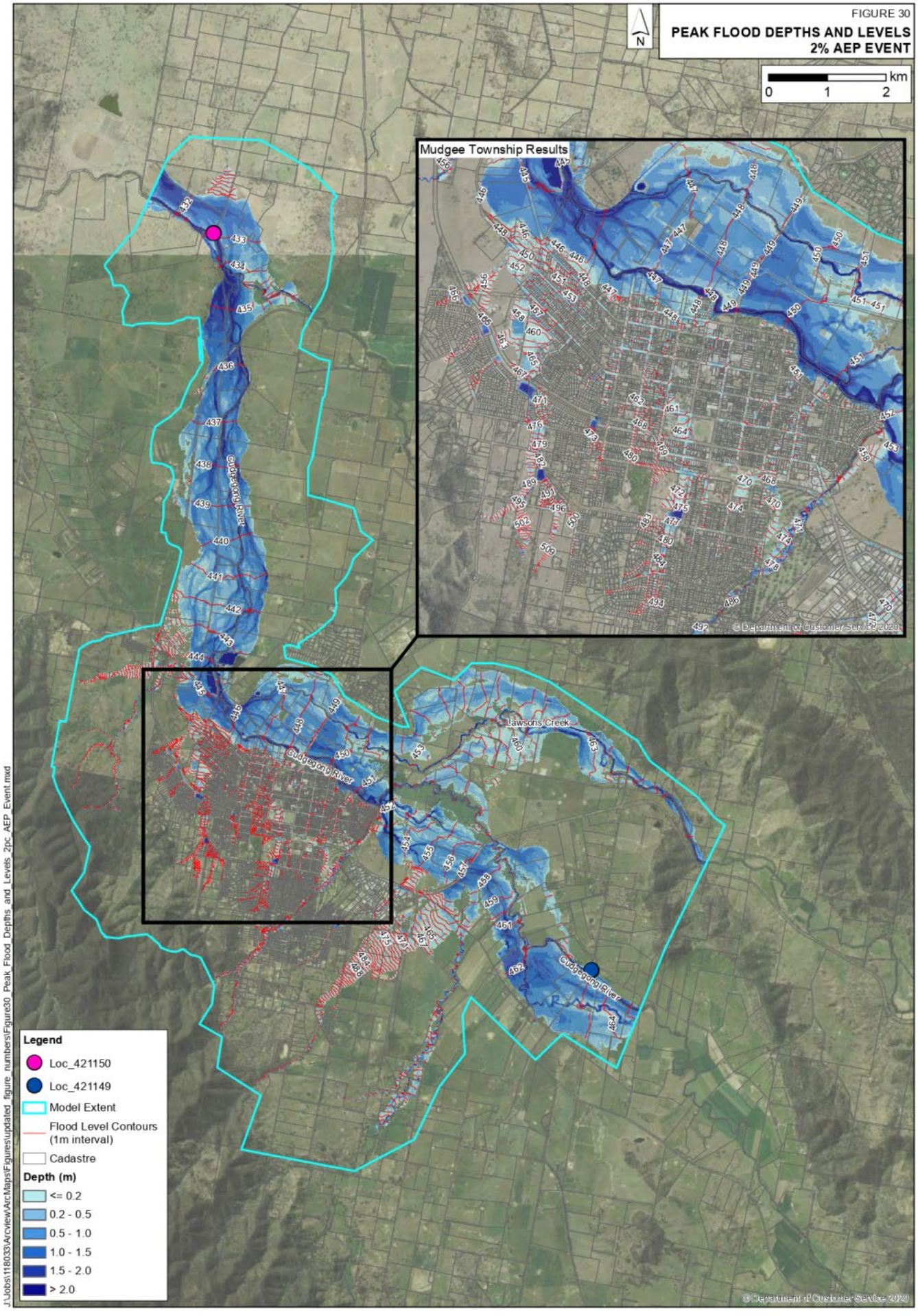
FIGURE 30
PEAK FLOOD DEPTHS AND LEVELS
2% AEP EVENT
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Legend
Loc_421150
Loc_421149
Model Extent
Flood Level Contours (1m interval)
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure30_Peak_Flood_Depths_and_Levels_2pc_AEP_Event.mxd
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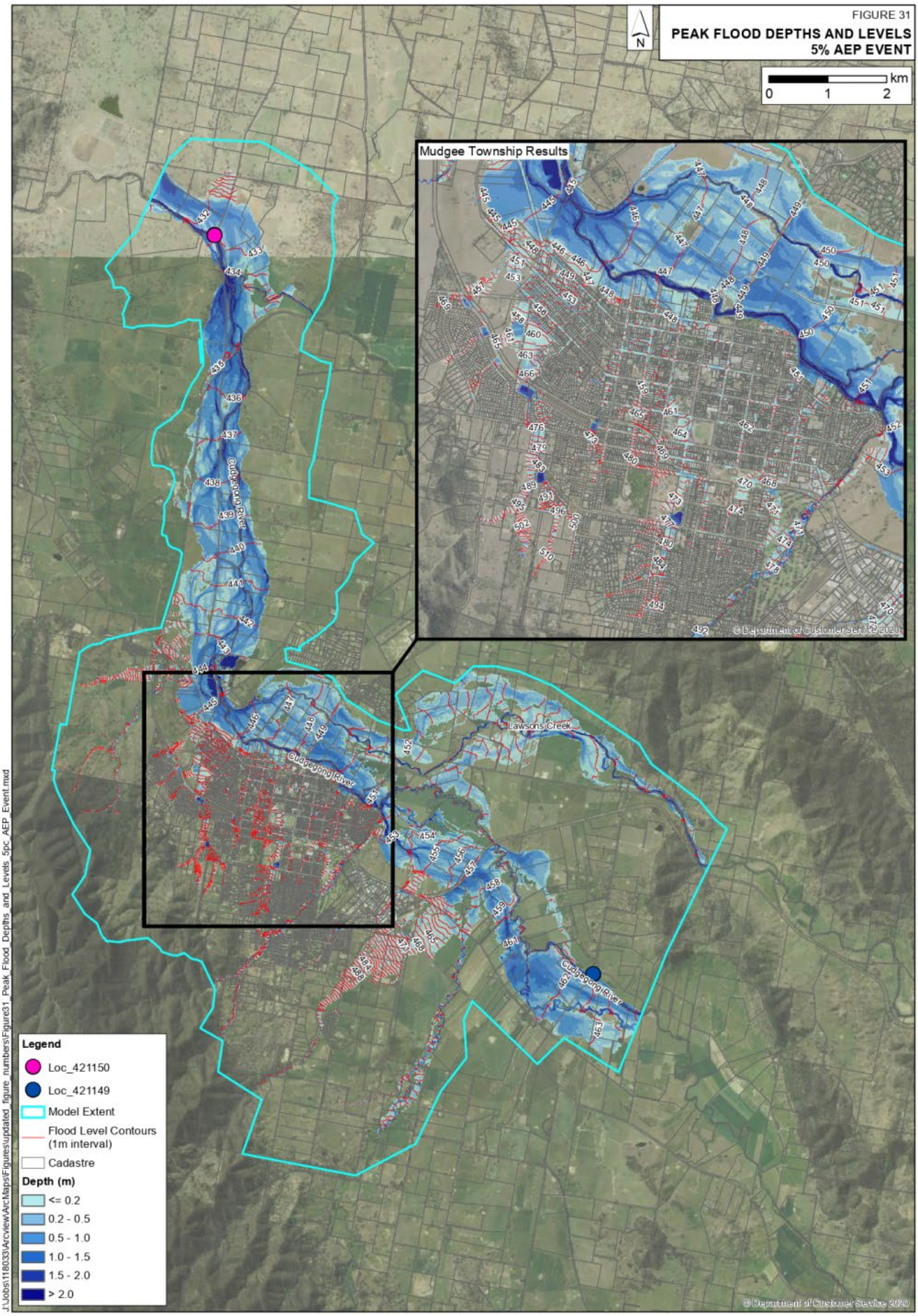
FIGURE 31
PEAK FLOOD DEPTHS AND LEVELS
5% AEP EVENT
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Legend
Loc_421150
Loc_421149
Model Extent
Flood Level Contours (1m interval)
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure31_Peak_Flood_Depths_and_Levels_5pc_AEP_Event.mxd
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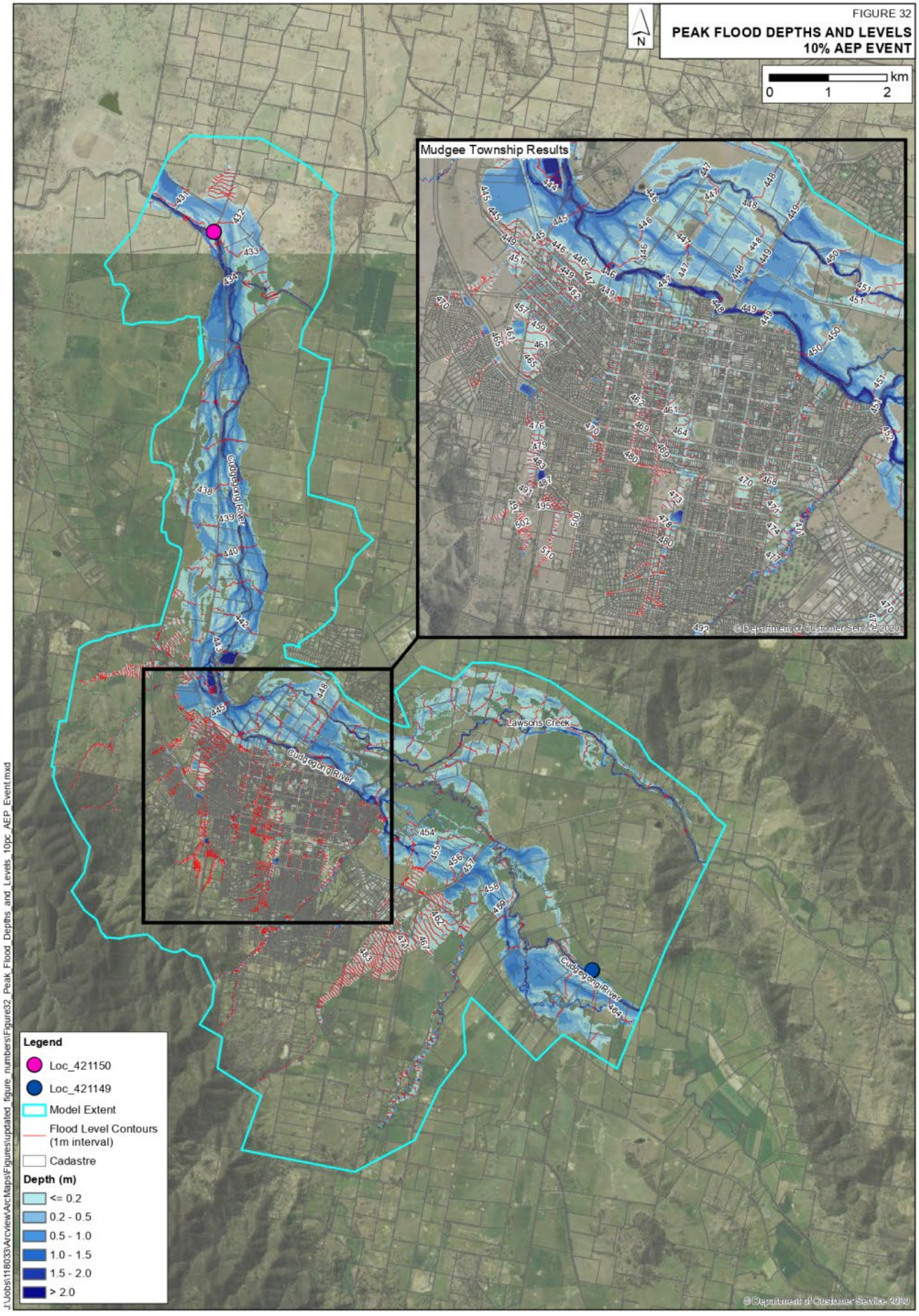
FIGURE 32
PEAK FLOOD DEPTHS AND LEVELS
10% AEP EVENT
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Legend
Loc_421150
Loc_421149
Model Extent
Flood Level Contours (1m interval)
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure32_Peak_Flood_Depths_and_Levels_10pc_AEP_Event.mxd
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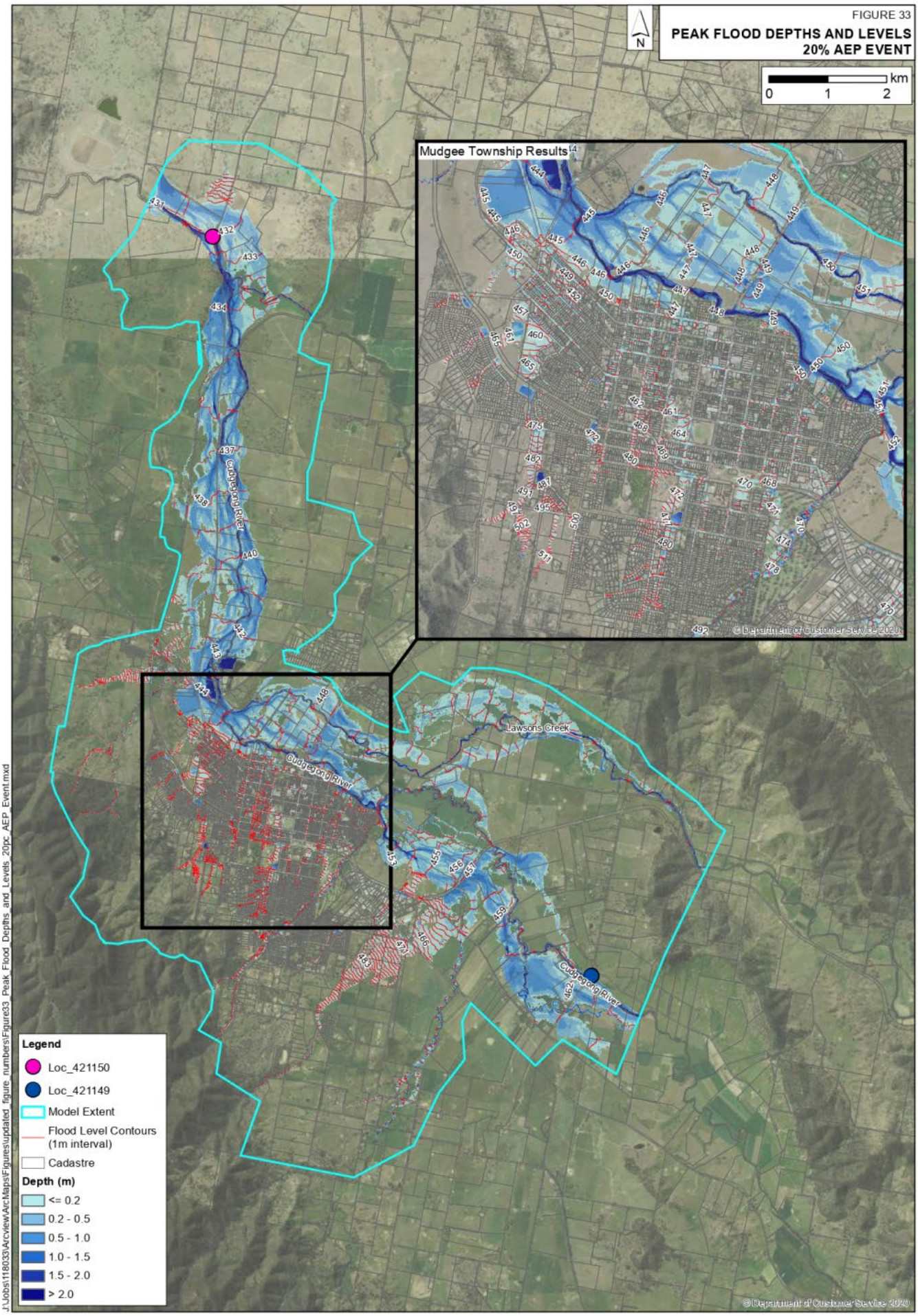
FIGURE 33
PEAK FLOOD DEPTHS AND LEVELS
20% AEP EVENT
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Legend
Loc_421150
Loc_421149
Model Extent
Flood Level Contours (1m interval)
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
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J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure33_Peak_Flood_Depths_and_Levels_20pc_AEP_Event.mxd

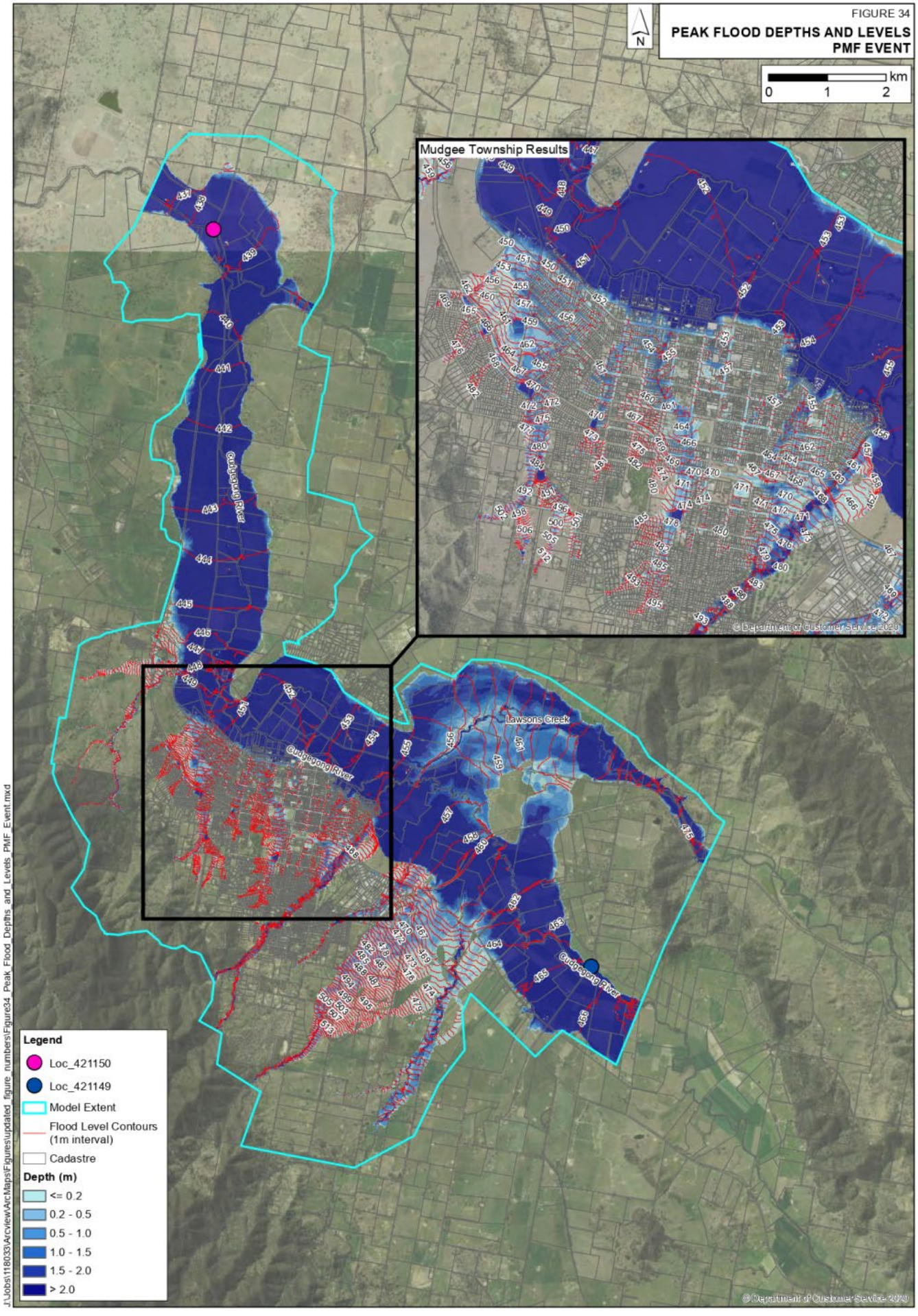
FIGURE 34
PEAK FLOOD DEPTHS AND LEVELS
PMF EVENT
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Lawsons Creek
Legend
Loc_421150
Loc_421149
Model Extent
Flood Level Contours (1m interval)
Cadastre
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure34_Peak_Flood_Depths_and_Levels_PMF_Event.mxd
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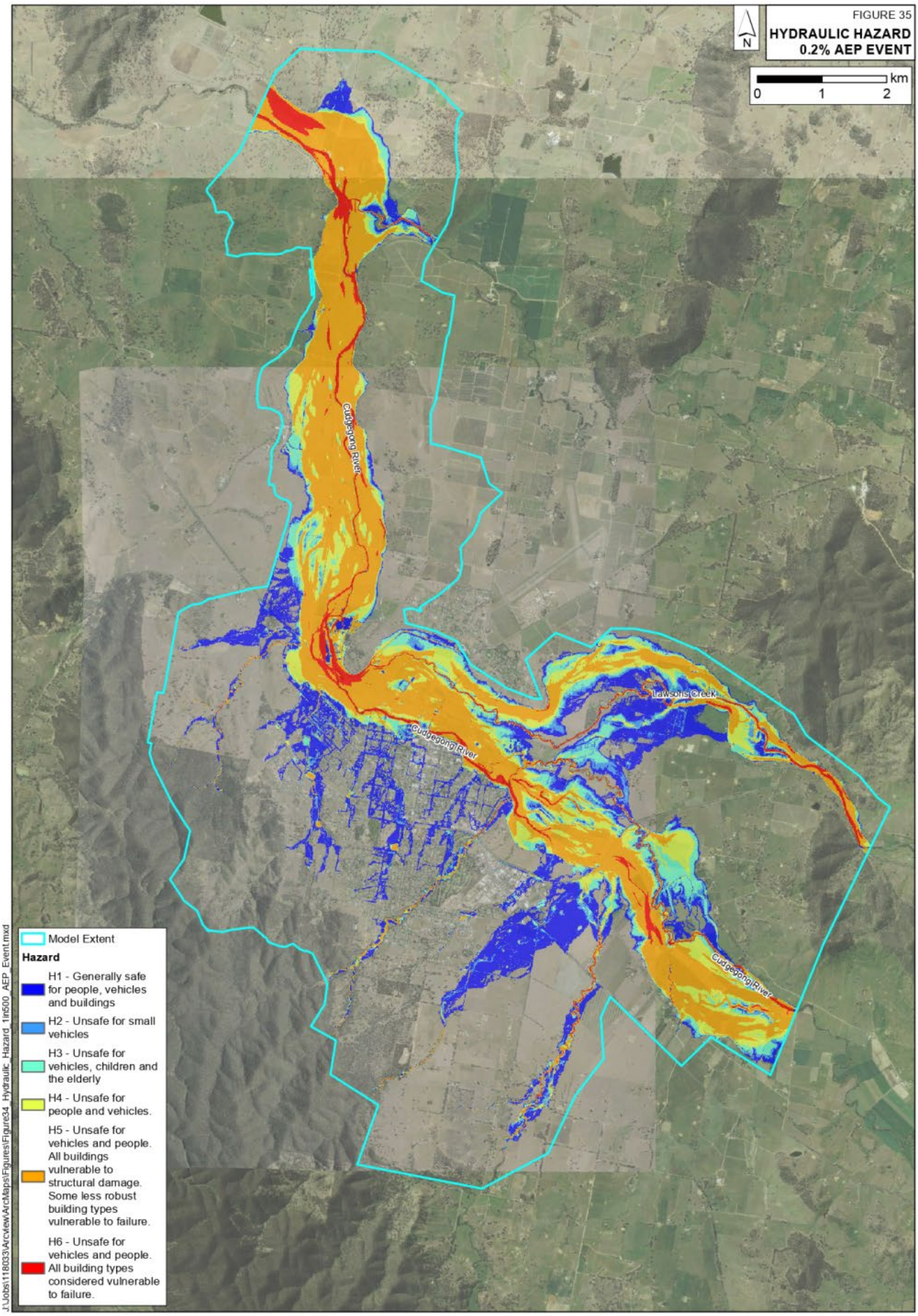


FIGURE 35
HYDRAULIC HAZARD
0.2% AEP EVENT
N
km
0
1
2
Cudgegong River
Lawsons Creek
Cudgegong River
Cudgegong River
Model Extent
Hazard
H1 - Generally safe for people, vehicles and buildings
H2 - Unsafe for small vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles.
H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.
J:\Jobs\118033\ArcViewArcMaps\Figures\Figure34_Hydraulic_Hazard_1in500_AEP_Event.mxd

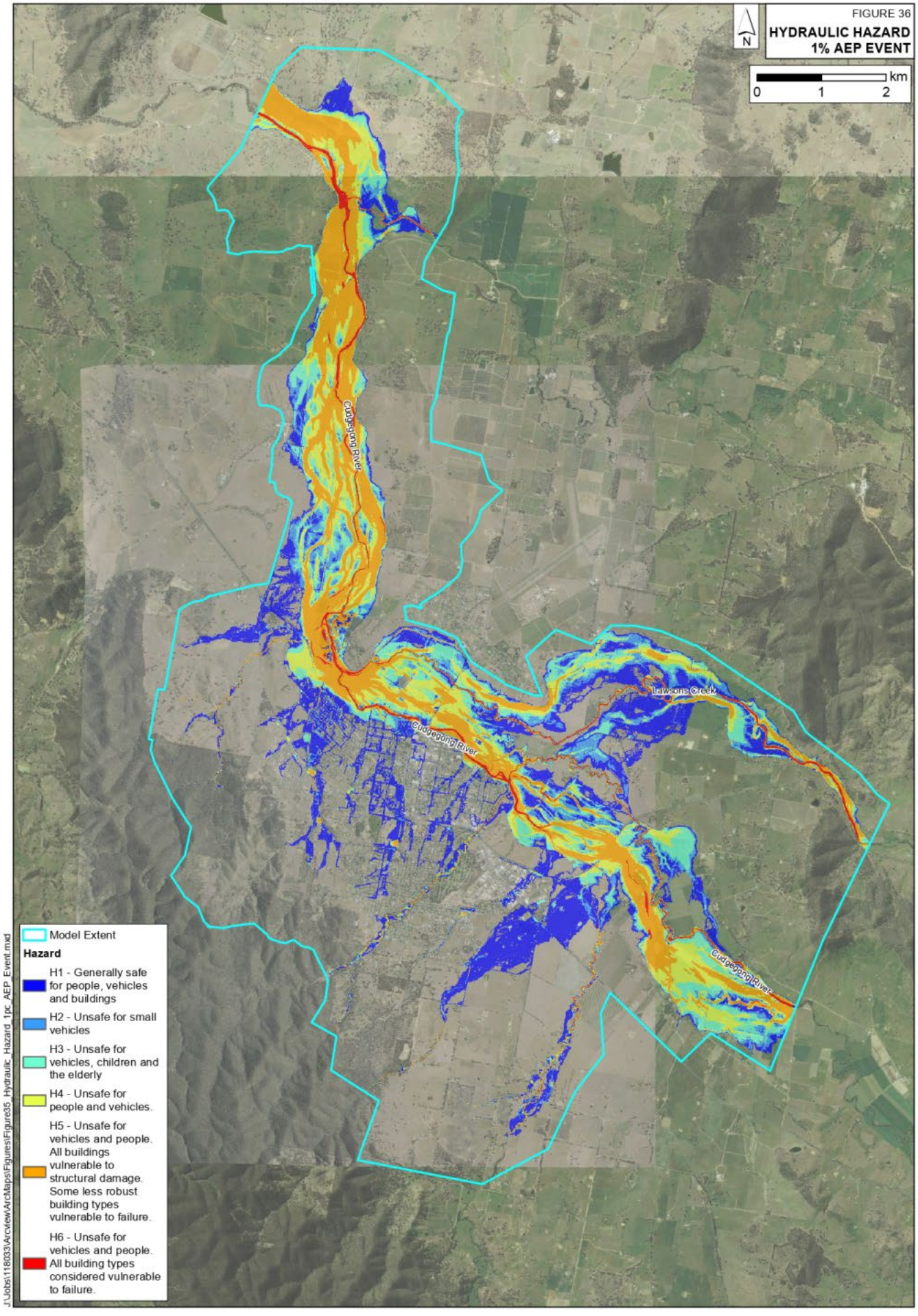


FIGURE 36
HYDRAULIC HAZARD
1% AEP EVENT
N
km
0
1
2
Cudgegong River
Lawsons Creek
Cudgegong River
Cudgegong River
Model Extent
Hazard
H1 - Generally safe for people, vehicles and buildings
H2 - Unsafe for small vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles.
H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.
J:\Jobs\118033\ArcView\ArcMaps\Figures\Figure35_Hydraulic_Hazard_1pc_AEP_Event.mxd

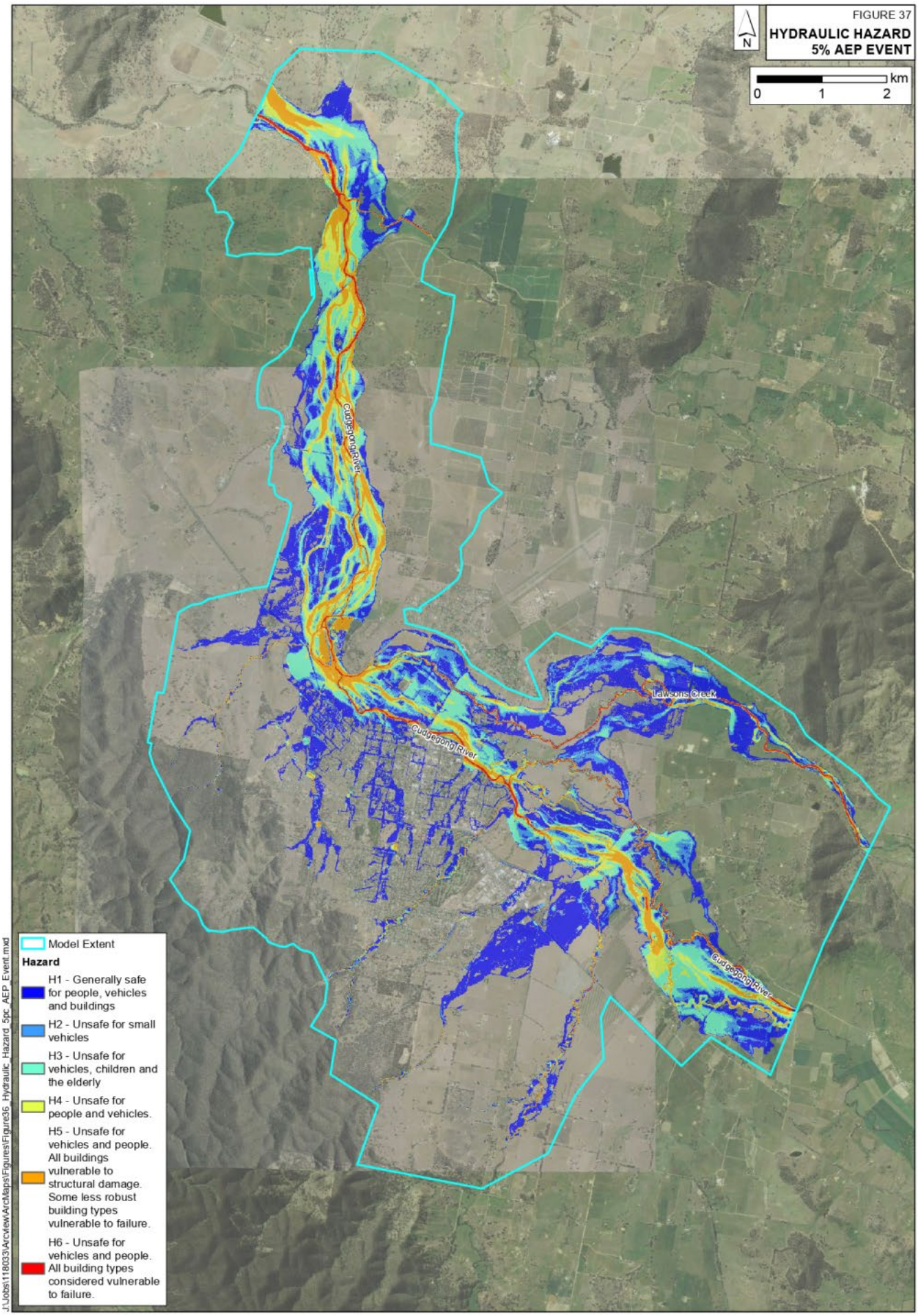


FIGURE 37
HYDRAULIC HAZARD
5% AEP EVENT
N
km
0
1
2
Cudgegong River
Lawsons Creek
Cudgegong River
Cudgegong River
Model Extent
Hazard
H1 - Generally safe for people, vehicles and buildings
H2 - Unsafe for small vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles.
H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.
J:\Jobs\118033\ArcViewArcMaps\Figures\Figure36_Hydraulic_Hazard_5pc_AEP_Event.mxd

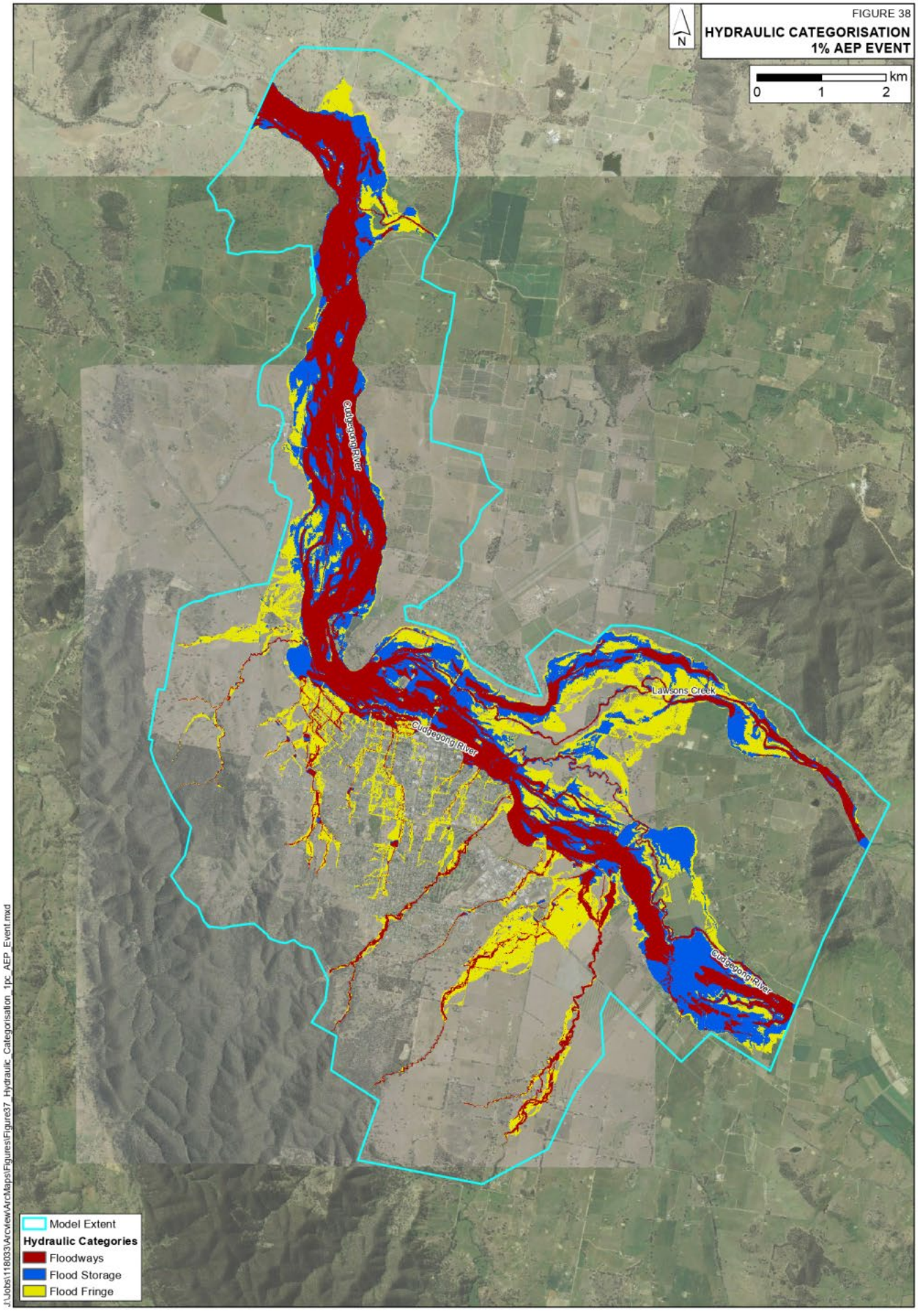


FIGURE 38
HYDRAULIC CATEGORISATION
1% AEP EVENT
N
km
0
1
2
Cudgegong River
Lawsons Creek
Cudgegong River
Cudgegong River
Model Extent
Hydraulic Categories
Floodways
Flood Storage
Flood Fringe
J:\Jobs\118033\ArcView\ArcMaps\Figures\Figure37_Hydraulic_Categorisation_1pc_AEP_Event.mxd

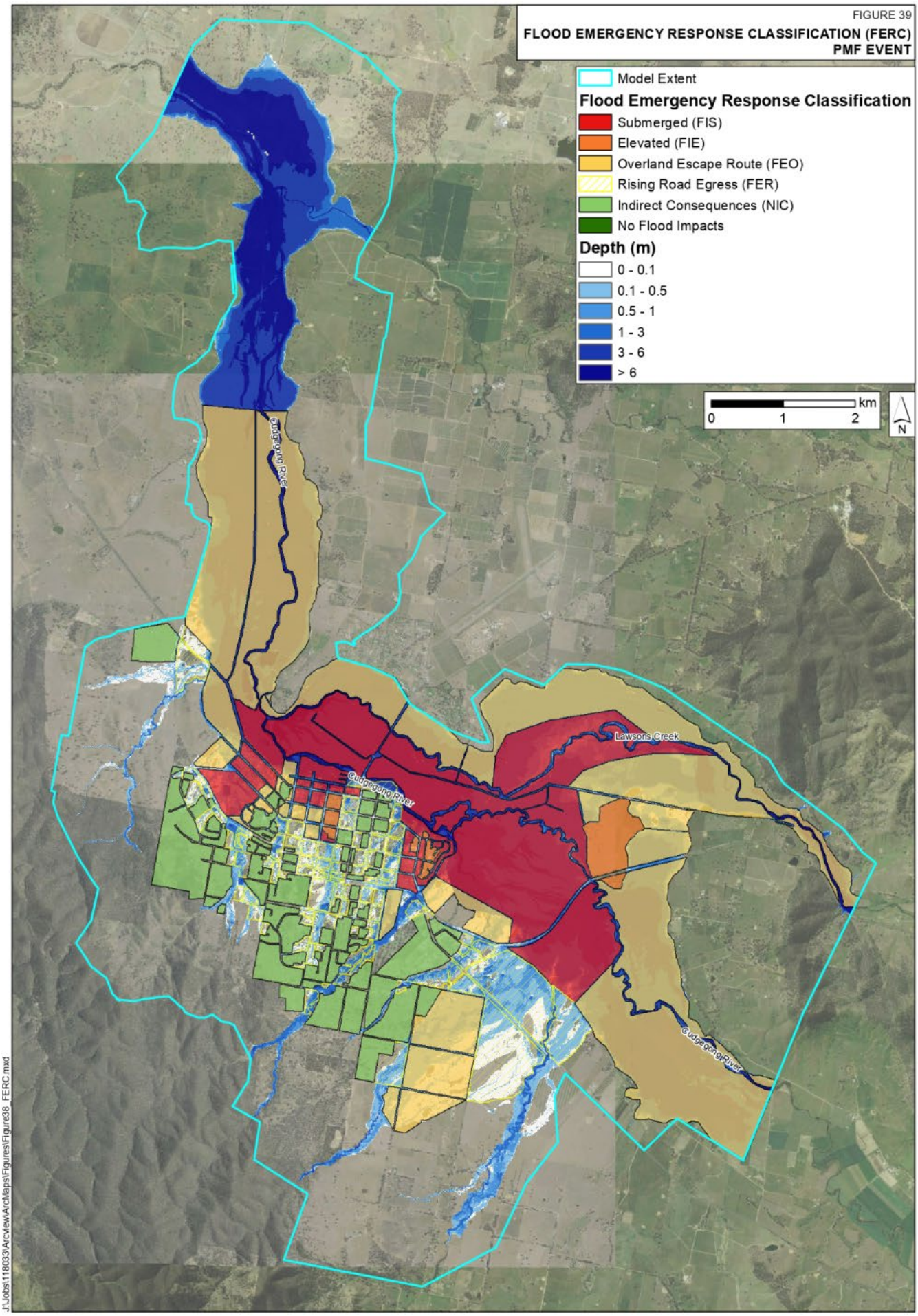


FIGURE 39
FLOOD EMERGENCY RESPONSE CLASSIFICATION (FERC)
PMF EVENT
Model Extent
Flood Emergency Response Classification
Submerged (FIS)
Elevated (FIE)
Overland Escape Route (FEO)
Rising Road Egress (FER)
Indirect Consequences (NIC)
No Flood Impacts
Depth (m)
0 - 0.1
0.1 - 0.5
0.5 - 1
1 - 3
3 - 6
> 6
km
0
1
2
N
Gudgegong River
Lawsons Creek
Gudgegong River
Gudgegong River
J:\Jobs\118033\ArcView\ArcMaps\Figures\Figure38_FERC.mxd

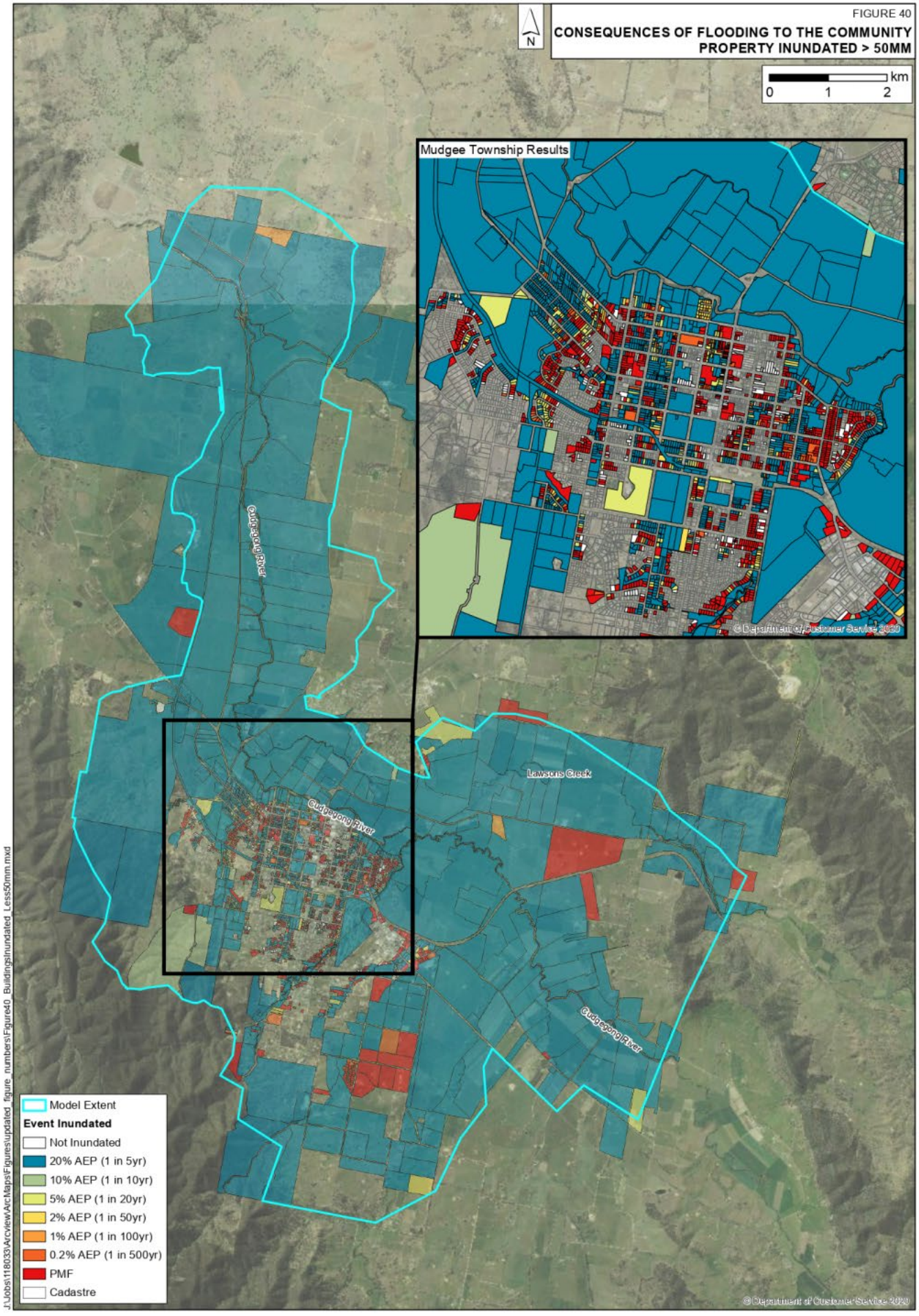
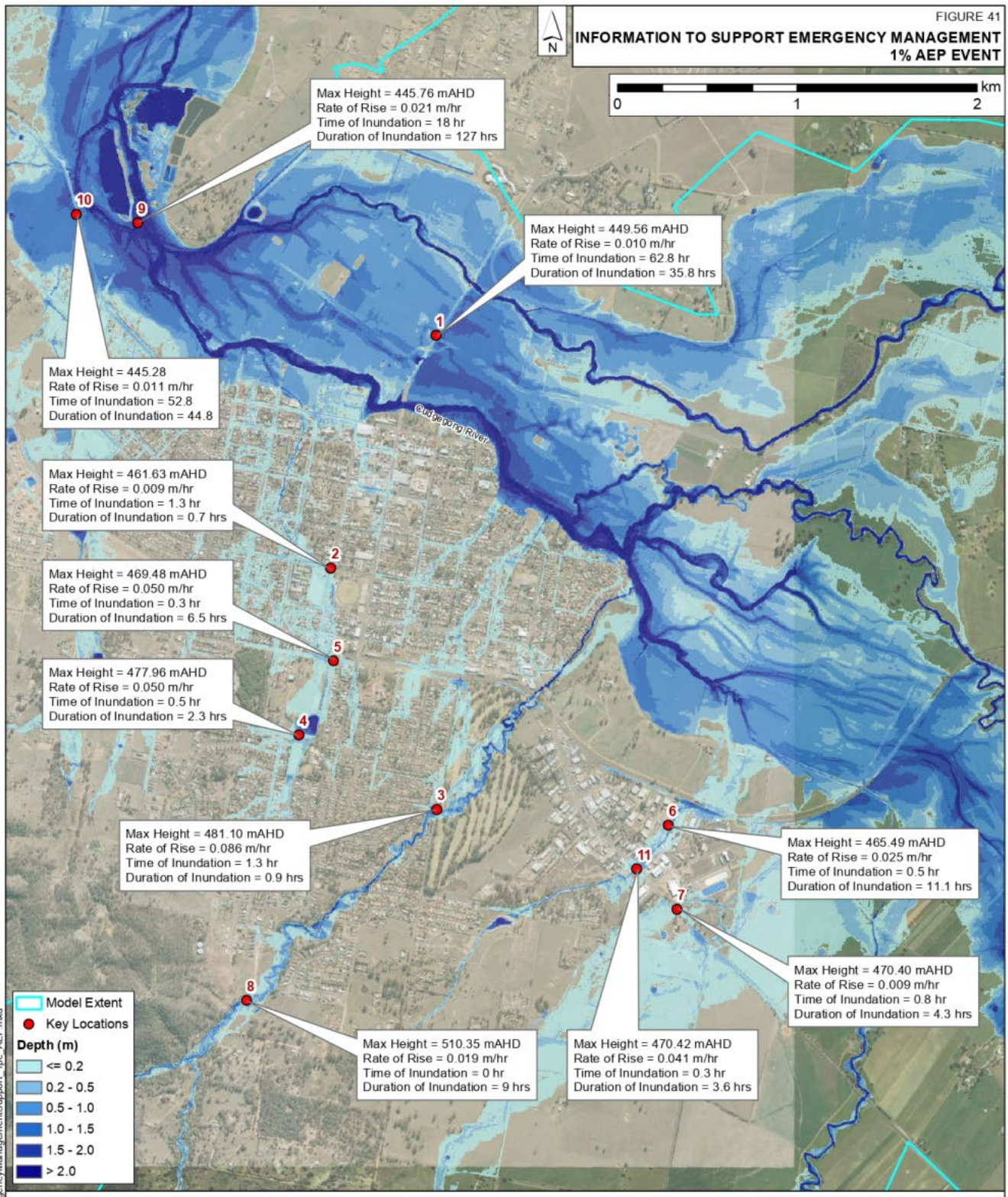


FIGURE 40
CONSEQUENCES OF FLOODING TO THE COMMUNITY
PROPERTY INUNDATED > 50MM
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Cudgegong River
Lawsons Creek
Cudgegong River
© Department of Customer Service 2020
Model Extent
Event Inundated
Not Inundated
20% AEP (1 in 5yr)
10% AEP (1 in 10yr)
5% AEP (1 in 20yr)
2% AEP (1 in 50yr)
1% AEP (1 in 100yr)
0.2% AEP (1 in 500yr)
PMF
Cadastre
J:\Jobs\118033\ArcviewArcMaps\Figures\updated_figure_numbers\Figure40_BuildingsInundated_Less50mm.mxd

FIGURE 41

INFORMATION TO SUPPORT EMERGENCY MANAGEMENT 1% AEP EVENT



INFORMATION TO SUPPORT EMERGENCY MANAGEMENT AT KEY LOCATIONS

1. Ulan Rd at Lue Rd
2. Denison Street at Perry Street
3. Robertson Street
4. Madeira Road at Mudgee Showground
5. Nicholson Street at Atkinson Street
6. Inudstrial Avenue
7. Castlereagh Highway at Bunnings Mudgee
8. Waterworks Road at Redbank Creek
9. Putta Bucca Road at Cudgegon River
10. Castlereagh Highway South of Wilbetree Road
11. Castlereagh Highway South at Sawpit Gully

J:\Jobs\118033\arcview\ArcMaps\Figures\0_EmergencyManagementSupport_1pc_AEP.mxd

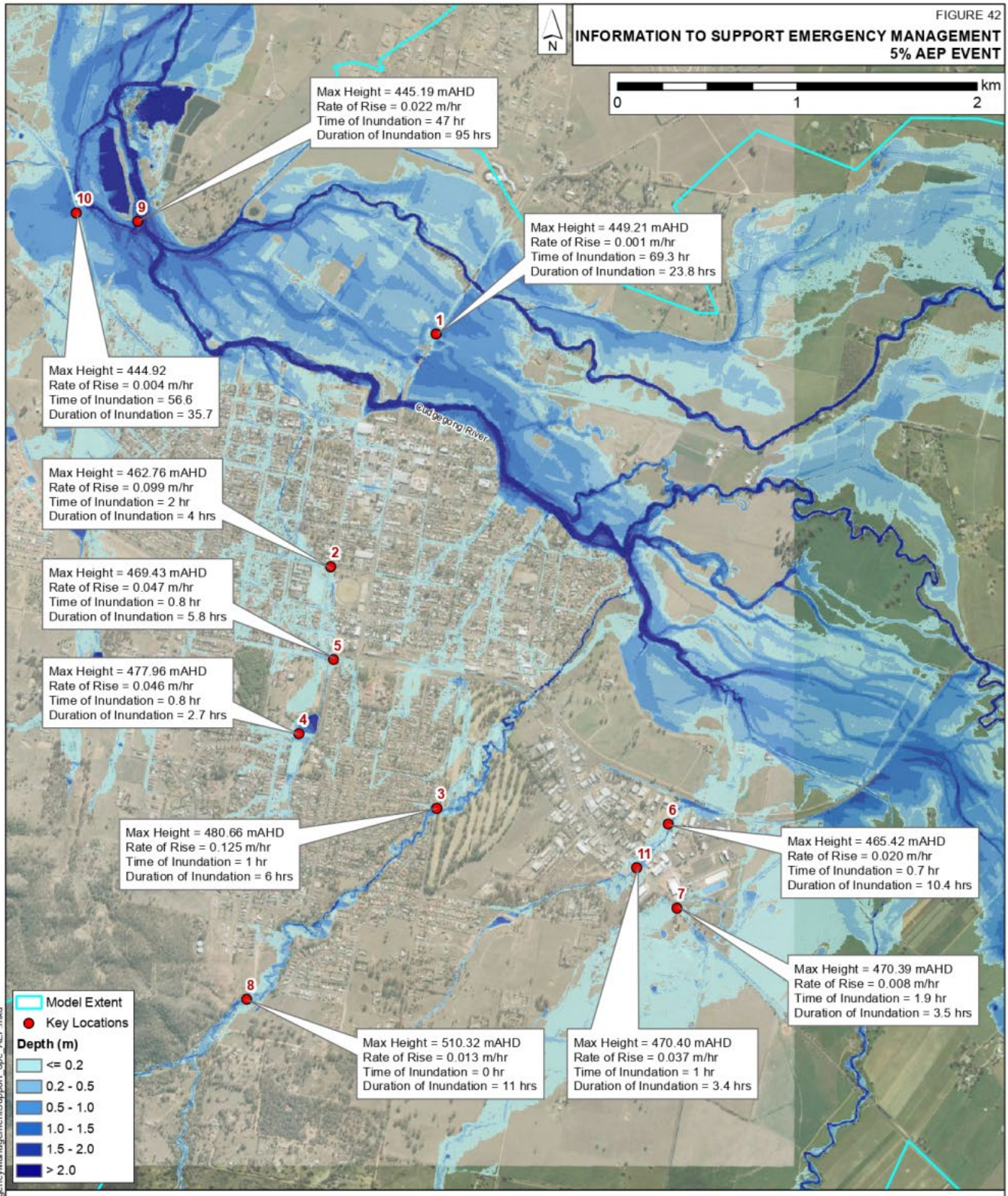
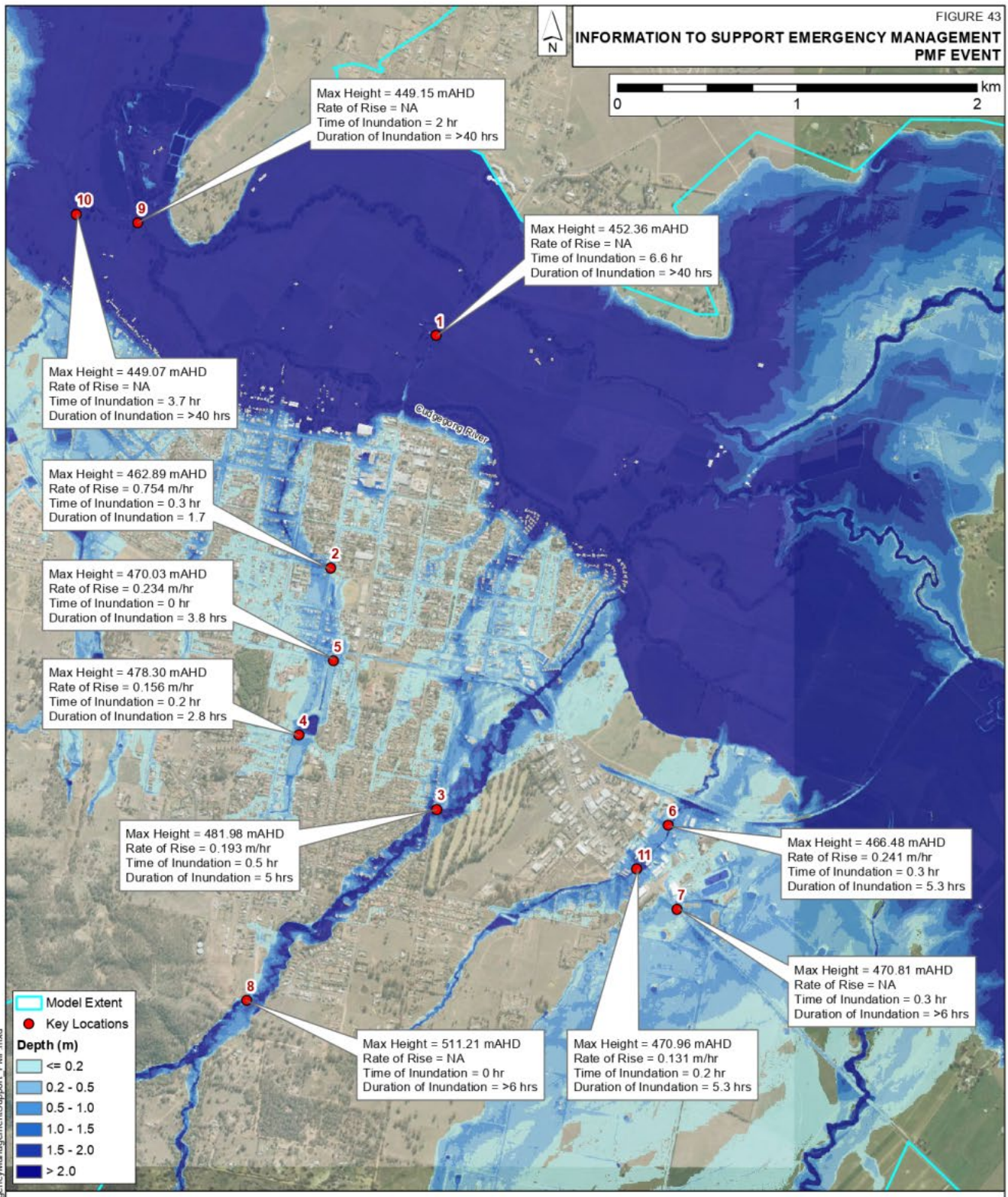


FIGURE 42
INFORMATION TO SUPPORT EMERGENCY MANAGEMENT
5% AEP EVENT
N
km
0
1
2
Max Height = 445.19 mAHD
Rate of Rise = 0.022 m/hr
Time of Inundation = 47 hr
Duration of Inundation = 95 hrs
Max Height = 449.21 mAHD
Rate of Rise = 0.001 m/hr
Time of Inundation = 69.3 hr
Duration of Inundation = 23.8 hrs
Max Height = 444.92
Rate of Rise = 0.004 m/hr
Time of Inundation = 56.6
Duration of Inundation = 35.7
Cudgegong River
Max Height = 462.76 mAHD
Rate of Rise = 0.099 m/hr
Time of Inundation = 2 hr
Duration of Inundation = 4 hrs
Max Height = 469.43 mAHD
Rate of Rise = 0.047 m/hr
Time of Inundation = 0.8 hr
Duration of Inundation = 5.8 hrs
Max Height = 477.96 mAHD
Rate of Rise = 0.046 m/hr
Time of Inundation = 0.8 hr
Duration of Inundation = 2.7 hrs
Max Height = 480.66 mAHD
Rate of Rise = 0.125 m/hr
Time of Inundation = 1 hr
Duration of Inundation = 6 hrs
Max Height = 465.42 mAHD
Rate of Rise = 0.020 m/hr
Time of Inundation = 0.7 hr
Duration of Inundation = 10.4 hrs
Max Height = 470.39 mAHD
Rate of Rise = 0.008 m/hr
Time of Inundation = 1.9 hr
Duration of Inundation = 3.5 hrs
Max Height = 510.32 mAHD
Rate of Rise = 0.013 m/hr
Time of Inundation = 0 hr
Duration of Inundation = 11 hrs
Max Height = 470.40 mAHD
Rate of Rise = 0.037 m/hr
Time of Inundation = 1 hr
Duration of Inundation = 3.4 hrs
Model Extent
Key Locations
Depth (m)
<= 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
INFORMATION TO SUPPORT EMERGENCY MANAGEMENT AT KEY LOCATIONS
1 Ulan Rd at Lue Rd
2 Denison Street at Perry Street
3 Robertson Street
4 Madeira Road at Mudgee Showground
5 Nicholson Street at Atkinson Street
6 Inudstrial Avenue
7 Castlereagh Highway at Bunnings Mudgee
8 Waterworks Road at Redbank Creek
9 Putta Bucca Road at Cudgegon River
10 Castlereagh Highway South of Wilbetree Road
11 Castlereagh Highway South at Sawpit Gully

FIGURE 43

INFORMATION TO SUPPORT EMERGENCY MANAGEMENT PMF EVENT



INFORMATION TO SUPPORT EMERGENCY MANAGEMENT AT KEY LOCATIONS

1. Ulan Rd at Lue Rd
2. Denison Street at Perry Street
3. Robertson Street
4. Madeira Road at Mudgee Showground
5. Nicholson Street at Atkinson Street
6. Inudstrial Avenue
7. Castlereagh Highway at Bunnings Mudgee
8. Waterworks Road at Redbank Creek
9. Putta Bucca Road at Cudgegon River
10. Castlereagh Highway South of Wilbetree Road
11. Castlereagh Highway South at Sawpit Gully

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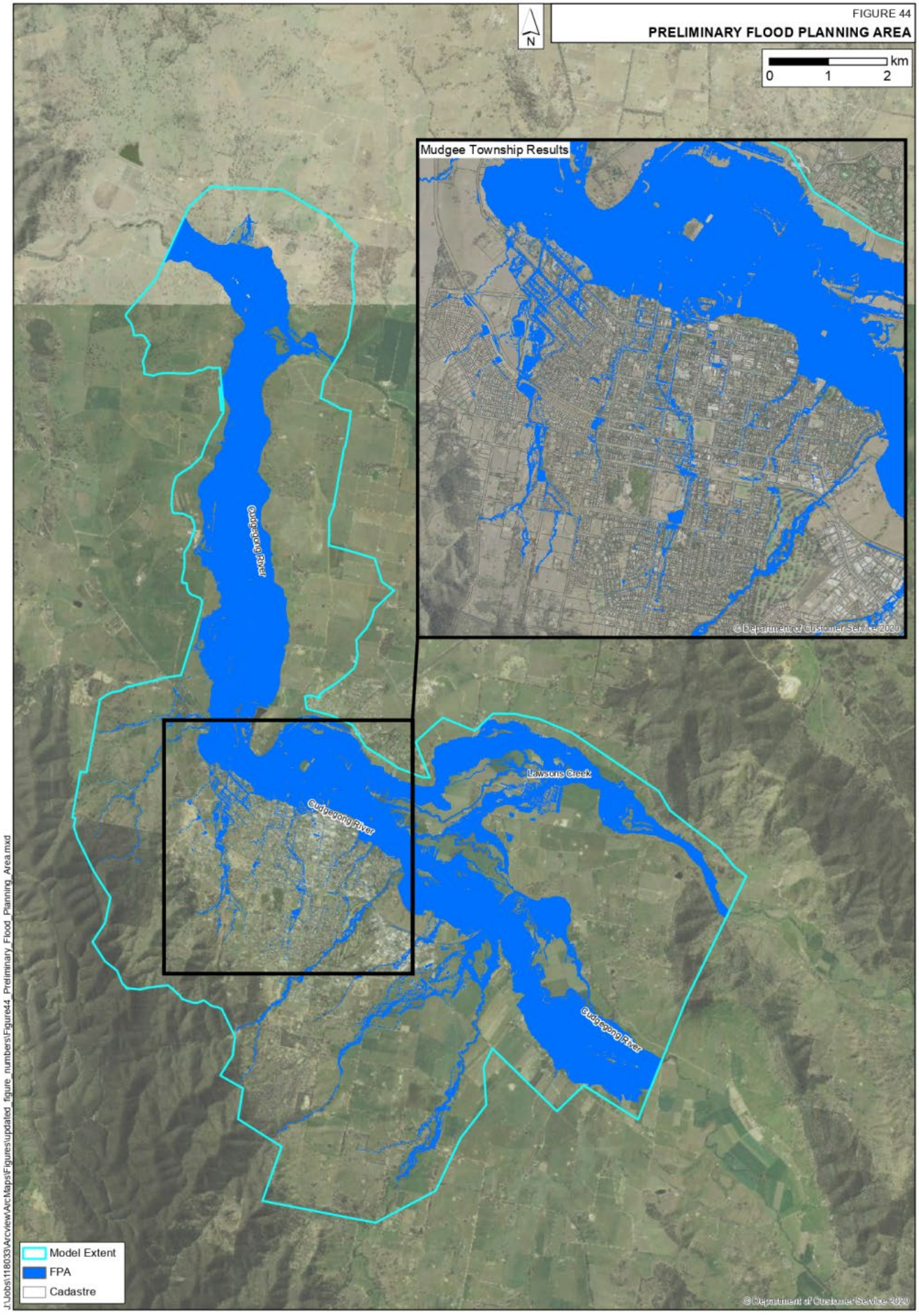
FIGURE 44
PRELIMINARY FLOOD PLANNING AREA
N
km
0
1
2
Mudgee Township Results
Cudgegong River
Cudgegong River
Lawsons Creek
Cudgegong River
Model Extent
FPA
Cadastre
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arts
OUTWEST
STRATEGIC
PLAN
2021-24

Arts OutWest acknowledges the traditional custodians of the country on which we work, the Wiradjuri/Wiradyuri people, and recognise their continuing connection to land, waters and culture.

We pay our respects to their Elders past, present and emerging.

Arts OutWest recognises the great value of Aboriginal culture to our region.

We will work with our communities and with the guidance of Elders to help strengthen the role that this culture plays in the lives of all of those in the Arts OutWest region on the NSW Central West.

EXECUTIVE summary

Arts OutWest's strategic plan will continue a history of arts and cultural development by an organisation that, in the final year of this plan, will be celebrating 50 years of delivery across the NSW Central West.

Mission: To promote, facilitate, educate and advocate for arts and cultural development for the communities of the NSW Central West.

Vision: A region with an active and exciting arts and culture sector featuring high-quality work contributing to the sense of regional identity, a strong creative economy and socially cohesive communities who are able to access arts and culture to interpret, express and explore.

Values: Professional; Inclusive; Innovative and inspiring; sustainable and good value.

The plan works on a model that values the cultural capital, social value and economic impact.

AOW has identified 6 goals. These are derived from our mission statement (to promote, facilitate, educate and advocate) plus strength in leadership and management.

1. **Leadership:** AOW is a leader in arts and cultural development, acting as the peak body in the region to provide advice and assistance in the area
2. **Promotion:** AOW conducts a media and promotions program that encourages participation in arts and cultural activity and which celebrates the success and diversity of the sector in our region.
3. **Facilitation:** AOW actively facilitates projects that demonstrate good or best practice, builds networks and creates links with other sectors.
4. **Education:** AOW provides opportunities for arts education across different levels including professional development, industry knowledge, and hobyist participation.
5. **Advocacy:** AOW is an effective advocate for the region's arts and cultural sector providing a voice at regional, state and national levels.
6. **Management:** AOW is run as an efficient and sustainable organisation, accountable to our members our supporters and our stakeholders.

A set of KPIs is attached to each of these goals.

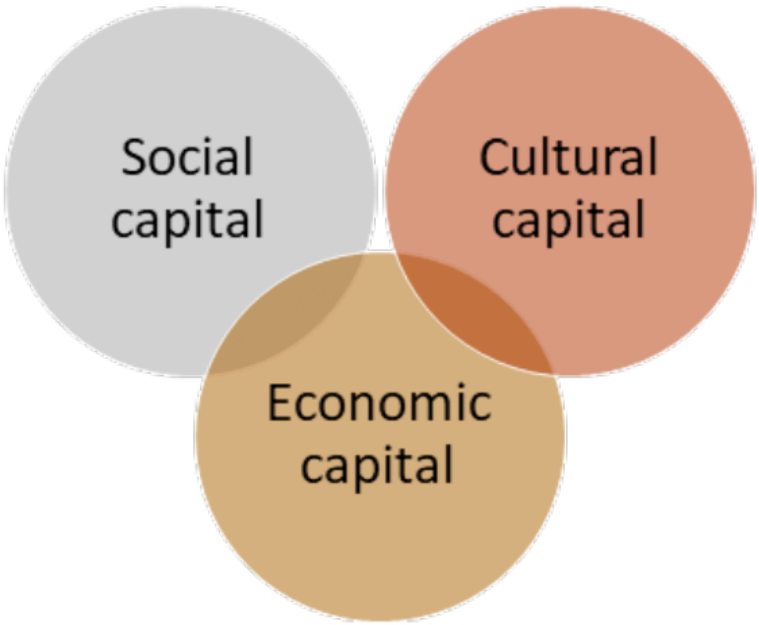
Finance: AOW receives core funding from the three levels of government through council contributions, program funding from Create NSW and from the Federal Government who support our Aboriginal program through their IVAIS funding program. AOW also works to receive additional project funds.

Governance: AOW has a skills-based board with positions that are appointed through an open application process. There is also an Advisory Council made up of members appointed by the contributing councils and Charles Sturt University.

AOW has a policy and procedures manual and has policies covering all areas of operations including risk management, work health safety, fair employment practices and succession planning.

A FEW FACTS

- Established in 1974, the first of the NSW Regional Arts Development Organisations
- Arts OutWest is the peak arts development body covering 11 council areas in Central West New South Wales
- In 2020 the organisation employed 10 staff members
- Arts OutWest contracts creative practitioners to work on projects – numbers are often over 100 artists each year
- Arts OutWest is one of 14 Regional Arts Development Organisations, funded to deliver services in regional NSW
- Arts OutWest has a skills-based Board overseeing the management of the organisation plus an Advisory Council made up of representatives who inform policy decisions.



PROCESS OF CONSULTATION FOR THIS STRATEGIC PLAN

- Online survey sent to Arts OutWest subscribers
- Meetings held in locations throughout the region
- Presentations to councils
- Strategic planning sessions with Arts OutWest's Advisory Council

OUR MISSION

To promote, facilitate, educate and advocate for arts and cultural development in the communities of the NSW Central West.

OUR VISION

Arts OutWest's vision for the region is of an active and exciting arts and culture sector with high-quality work contributing to a sense or regional identity, a strong creative economy and socially cohesive and liveable communities able to access arts and culture to interpret, express and explore.

VALUES arts outwest

WHO WE ARE

Arts OutWest is the regional arts and cultural development service for the Central West of New South Wales, covering the council areas of Bathurst Region, Blayney, Cabonne, Cowra, Forbes, Lachlan, Lithgow City, Oberon, Orange City, Parkes and Weddin.

These 11 Council areas cover an area of almost 70,000km2, with a population in 2019 of approximately 186,000.

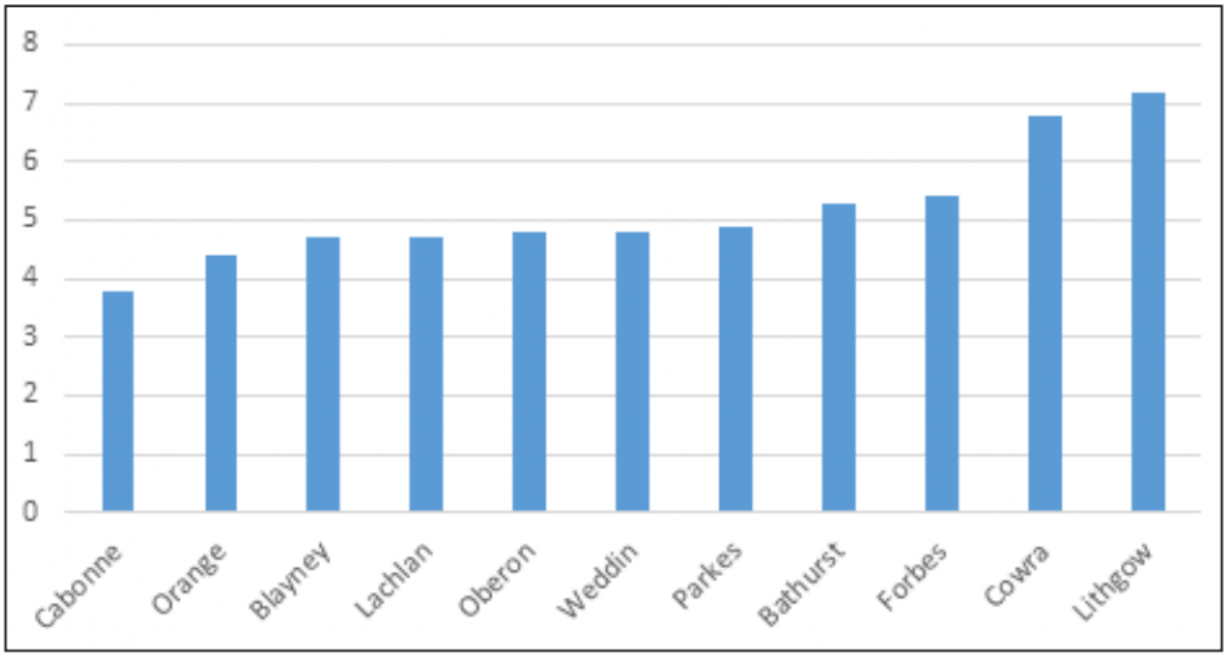
MAIN EMPLOYMENT SECTORS IN THE REGION

LGA Statistics	Population 2016 (census)	Distance to Sydney (km)	Main Industry	% Main Industry
Bathurst	42,389	200	Education and Training	12.1
Blayney	7,418	237	Agriculture, Fishing and Forestry	12.7
Cabonne	13,625	292	Agriculture, Fishing and Forestry	19.4
Cowra	12,673	308	Agriculture, Fishing and Forestry	15.4
Forbes	9,808	375	Agriculture, Fishing and Forestry	19.2
Lachlan	6,352	459	Agriculture, Fishing and Forestry	32.1
Lithgow	21,524	138	Mining	12.4
Oberon	5,399	179	Manufacturing	18.9
Orange	41,384	256	Health care and social assistance	16.2
Parkes	14,946	358	Retail	11.6
Weddin	3,692	362	Agriculture, Fishing and Forestry	36.7

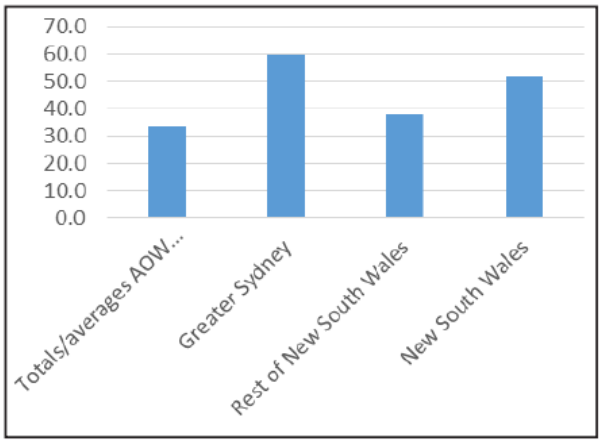
FACTS AND FIGURES ABOUT THE ARTS OUTWEST REGION (2016 CENSUS)

LGA UNEMPLOYMENT RATE

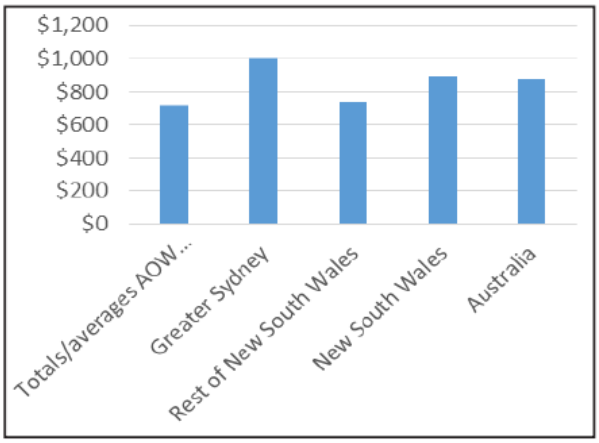
UNEMPLOYMENT BY LGA



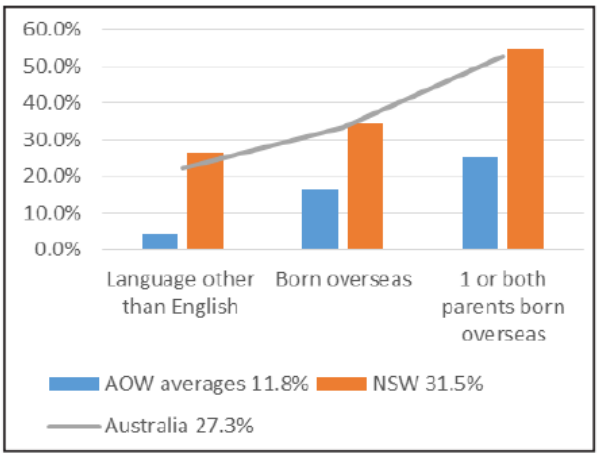
Yr 12 COMPLETION RATE



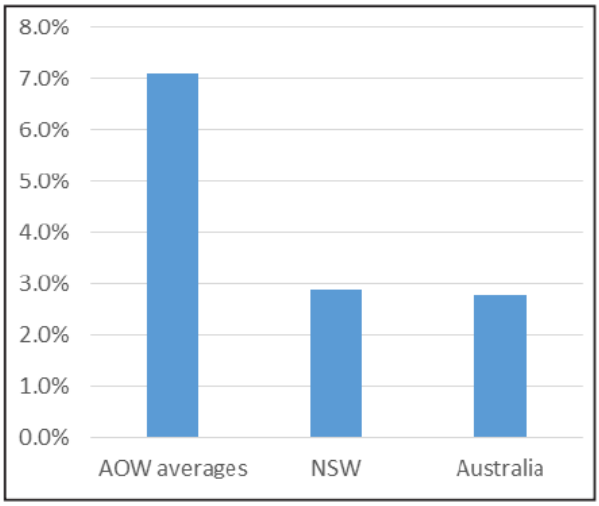
WEEKLY MEDIAN INCOME



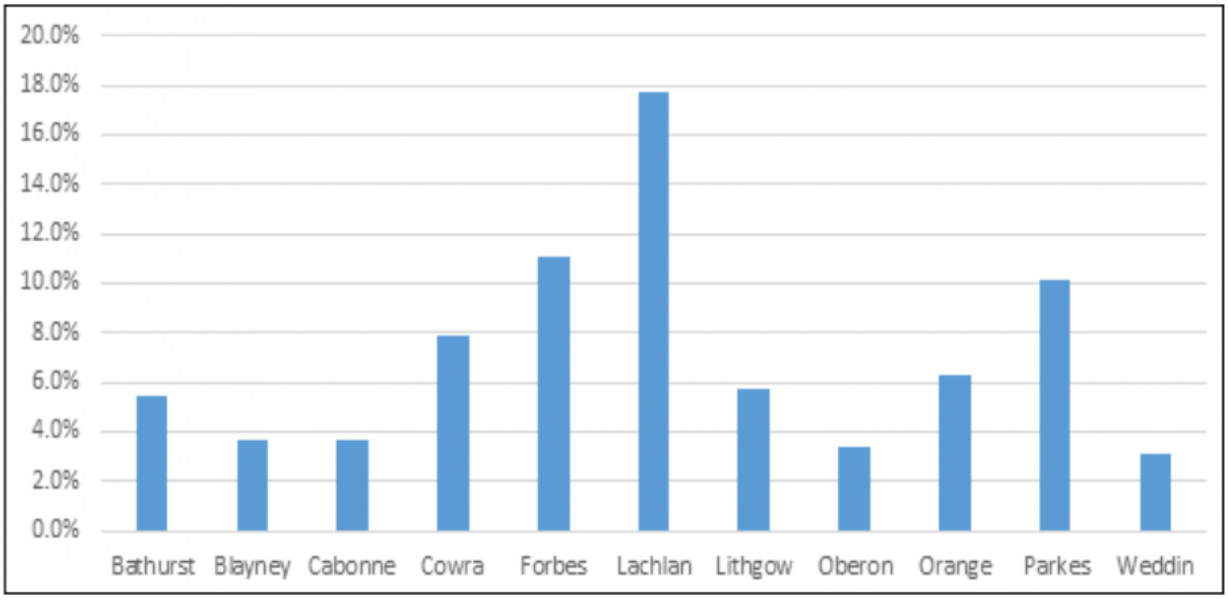
CALD RATE



ABORIGINAL POPULATION RATE

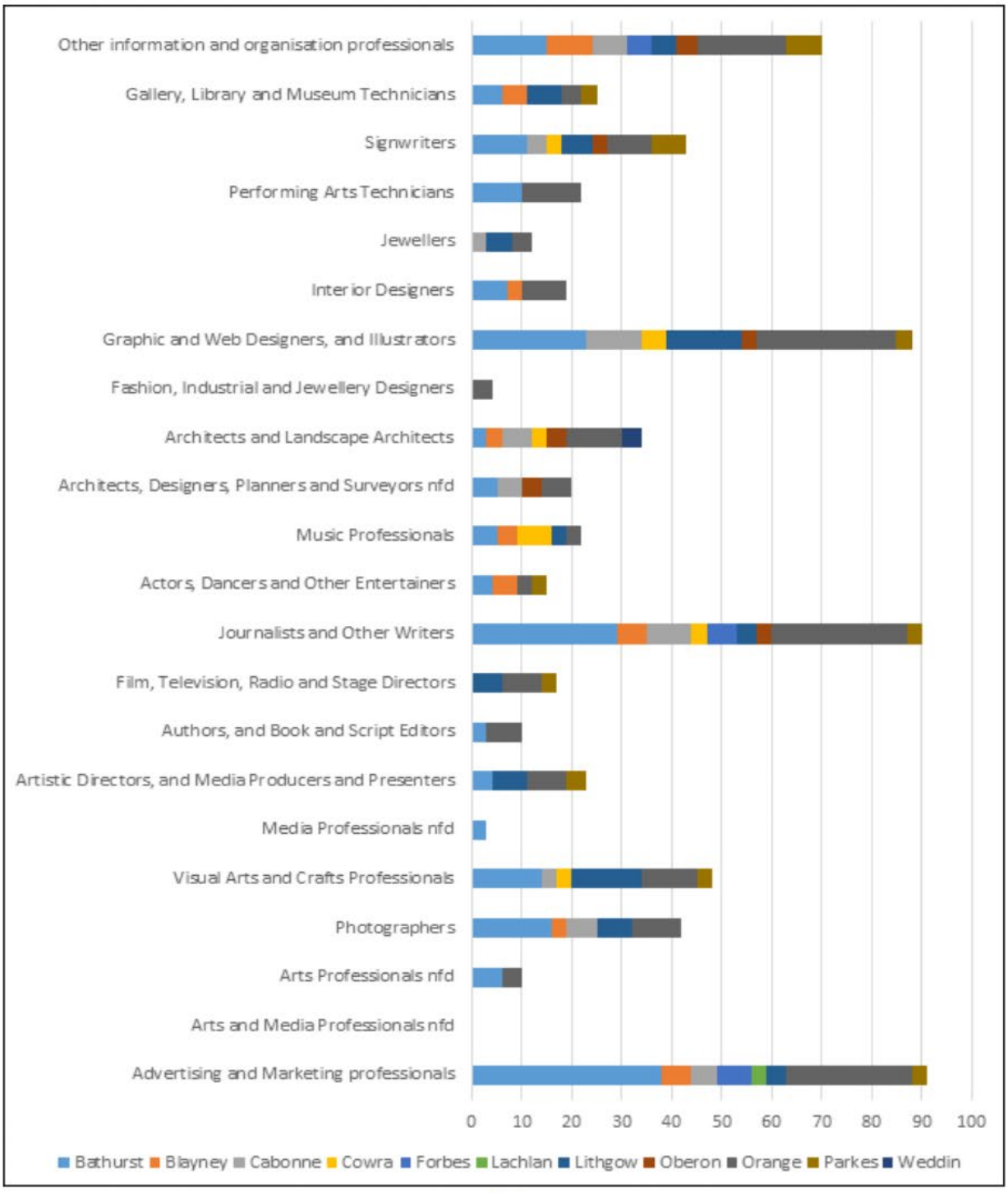


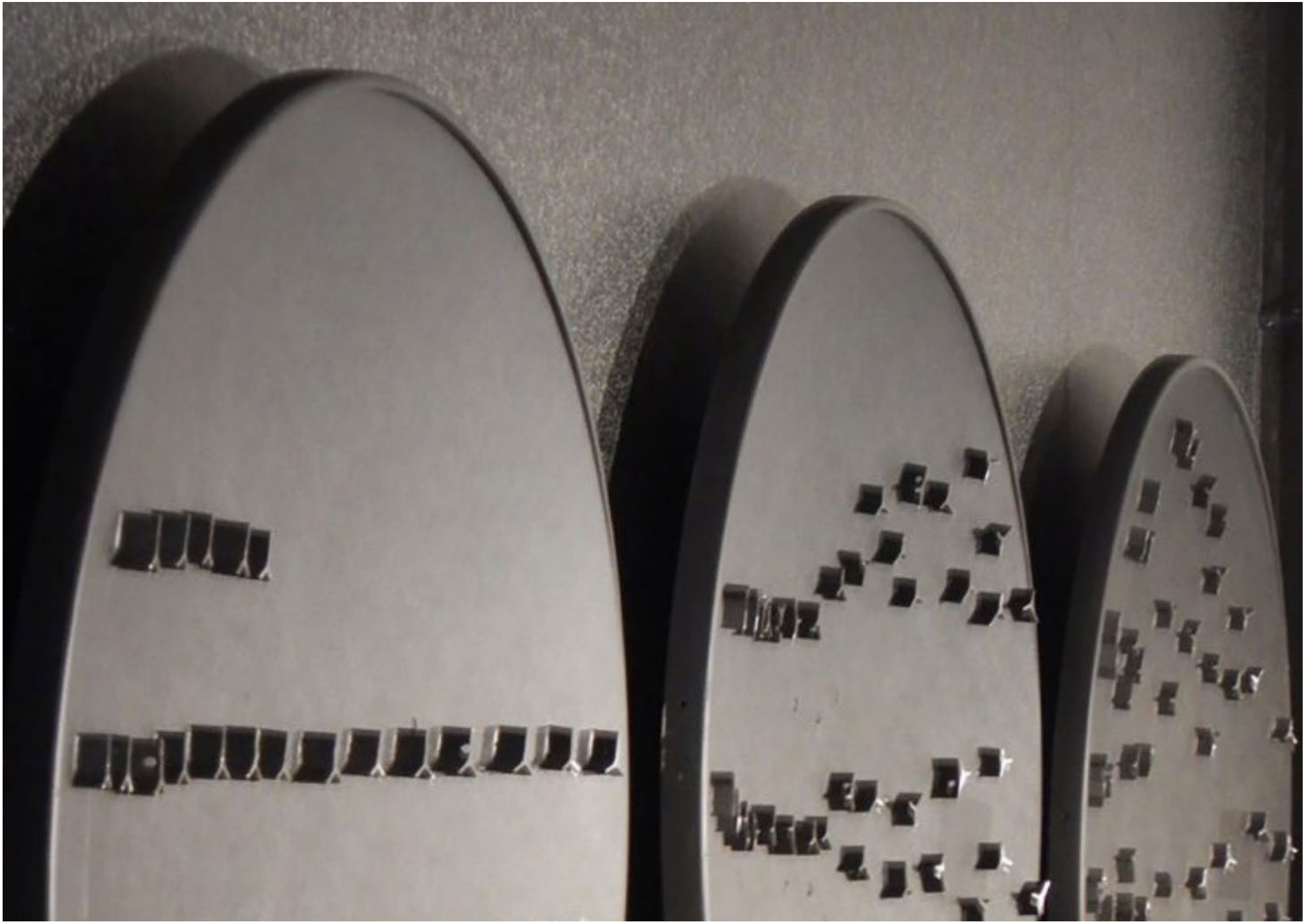
ABORIGINAL POPULATION BY LGA



CREATIVE EMPLOYMENT

The Arts OutWest has a strong representation of arts practitioners and people working within the creative industries. The rate is lower than in Sydney but is growing at a rate of 4% per annum (BYP, 2017).





GOALS

Leadership	•Arts OutWest is a leader in arts and cultural development, acting as the peak body in the region to provide advice and assistance to the sector.
Promotion	•Arts OutWwest Conducts a media and promotions program that encourages people in the region to participate in arts and cultural activity and which celebrates the success and diversity of the sector in our region.
Facilitation	•Arts OutWest actively facilitates projects that demonstrate good or best practice, builds networks and creates links to other sectors.
Education	•Arts OutWest provides opportunites for arts education across different levels including professional development, industry knowledge, and hobbyist participation
Advocacy	• Arts OutWest is an effective advocate for the region's arts and cultural sector, providing a voice at local, regional, state and national levels.
Mangement	•Arts OutWest is run as an efficient and sustainable organisation, accountable to our members, our supporters and our stakeholders.

Arts OutWest has been working at capacity for some years. We therefore do not aim to extend the quantity of many of our key performance indicators, but rather to strive for consistently high quality in all that we do.

Goal 1: LEADERSHIP

Arts OutWest is a leader in arts and cultural development, acting as the peak body in the region to provide advice and assistance to the sector.

A

ACTIVITY	Build capacity in individual creative practitioners by giving advice and support
TARGET	Number of individuals given advice or assistance
CURRENT (2018)	100
ANNUAL TARGET	100

B

ACTIVITY	Build capacity in organisations engaged in the arts by giving advice and support
TARGET	Number of organisations given advice or assistance
CURRENT (2018)	100
ANNUAL TARGET	100

C

ACTIVITY	Build partnerships with other organisations in order to ensure effective delivery of arts and cultural development projects and programs
TARGET	Number of partnerships maintained
CURRENT (2018)	NM
ANNUAL TARGET	10

KPI targets

Goal 2: PROMOTION

Conduct a media and promotions program that encourages people in the region to participate in arts and cultural activity and which celebrates the success and diversity of the sector in our region. This includes promoting the region's events within the region, sharing the region's success outside the region and ensuring that the work and outcomes Arts OutWest's projects are disseminated.

Notes:
2c. *11 platforms = website, social media (3), radio stations (5), print media, other editorial, printed collateral.*
2f. *Clean up of data and consolidation of some entries will result in less database records.*

A

ACTIVITY	Encourage the development of regional audiences through promoting and supporting events in the AOW region
TARGET	Number of workshops offered to the public by AOW
CURRENT (2018)	1755
ANNUAL TARGET	1800

B

ACTIVITY	Ensure that active participation is high in the region by presenting and supporting a diverse range of arts and cultural activities
TARGET	Number of attendances at events presented by AOW
CURRENT (2018)	16682
ANNUAL TARGET	15000

C

ACTIVITY	Work across a range of platforms to publicise activity and opportunities
TARGET	Number of publicity outlets and platforms used
CURRENT (2018)	11
ANNUAL TARGET	12

D

ACTIVITY	Build awareness of the success and importance of regional practice by sharing the work that occurs within the region to platforms both in and outside the AOW region
TARGET	Times that stories of successful practice in the AOW region is covered/shared by AOW
CURRENT (2018)	NM
ANNUAL TARGET	300

E

ACTIVITY	Disseminate the work of AOW and share the learning that emerges from our projects
TARGET	Number of AOW stories shared
CURRENT (2018)	NM
ANNUAL TARGET	30

F

ACTIVITY	Maintain databases of people, organisations, venues in order to manage information about the region
TARGET	Number of database entries
CURRENT (2018)	8500
ANNUAL TARGET	6000

Goal 3: FACILITATION

Arts OutWest actively facilitates projects that demonstrate good or best practice, builds networks and creates links to other sectors.

A

ACTIVITY	Arts OutWest leads or partners on projects that further our 4 current focus areas: 1) Arts & Health; 2) Aboriginal arts development; 3) Cultural Tourism; and 4) Music Industry Support* (2021 addition in response to Covid-19)
TARGET	Number of projects AOW is actively involved in presenting
CURRENT (2018)	42
ANNUAL TARGET	40

B

ACTIVITY	Arts OutWest builds networks – face-to-face and virtual – to connect practitioners
TARGET	Number of networks that have met or engaged together
CURRENT (2018)	4
ANNUAL TARGET	6

C

ACTIVITY	Arts OutWest makes links to other sectors outside the arts
TARGET	Number of other sectors engaged with AOW and arts practice
CURRENT (2018)	NM
ANNUAL TARGET	4

D

ACTIVITY	Employ a diverse range of facilitators to work on AOW projects
TARGET	Number of facilitators and contractors employed on AOW projects
CURRENT (2018)	109
ANNUAL TARGET	100

Goal 4: EDUCATION

Arts OutWest is a leader in arts and cultural development, acting as the peak body in the region to provide advice and assistance to the sector.

A

ACTIVITY	Professional development opportunities provided by AOW for individuals and organisations in the region
TARGET	Number of workshops offered to the public by AOW
CURRENT (2018)	6
ANNUAL TARGET	10

B

ACTIVITY	Professional development provided to AOW staff and board members
TARGET	Number of professional development opportunities attended by AOW staff
CURRENT (2018)	8
ANNUAL TARGET	8

C

ACTIVITY	Number of other education providers linked with to provide opportunities for people in AOW region or evaluation of outcomes
TARGET	Number of education partners linked to AOW
CURRENT (2018)	NM
ANNUAL TARGET	4

Goal 5: ADVOCACY

Arts OutWest is an effective advocate for the region's arts and cultural sector, providing a voice at local, regional, state and national levels.

A

ACTIVITY	Give presentations to various audiences about arts and culture and the work of AOW
TARGET	Number of presentations given
CURRENT (2018)	21
ANNUAL TARGET	20

B

ACTIVITY	Do submissions and give input to political and organisational developments in the sector and sit on assessment panels for arts and funding decisions
TARGET	Number of submissions, input to processes and membership of assessment panels
CURRENT (2018)	8
ANNUAL TARGET	10

C

ACTIVITY	Join advisory bodies to affect change and development in the sector
TARGET	Number of advisory bodies of which AOW staff are members
CURRENT (2018)	4
ANNUAL TARGET	4

D

ACTIVITY	Provide public commentary about the arts
TARGET	Number of times opinion and commentary on the arts is publicly given
CURRENT (2018)	NM
ANNUAL TARGET	12

Goal 6: MANAGEMENT

Arts OutWest is run as an efficient and sustainable organisation, accountable to our members, our supporters and out stakeholders.

A ACTIVITY	Ensure that the AOW Board and the AOW Advisory Council are active and working to the standards of Fair Trading
TARGET	Number of meetings successfully conducted
CURRENT (2018)	7
ANNUAL TARGET	7

B ACTIVITY	The income of the organisation is sourced from multiple sources, with the aim of Create NSW core funding not exceeding 35% of overall income
TARGET	Percentage of funding from sources other than Create NSW core funding
CURRENT (2018)	50
ANNUAL TARGET	65

C ACTIVITY	Policies and procedures fully documented and reviewed annually
TARGET	Policies and Procedures Manual complete & up to date
CURRENT (2018)	1
ANNUAL TARGET	1

D ACTIVITY	Reports & acquittals completed
TARGET	Percentage of reports and acquittals completed
CURRENT (2018)	100
ANNUAL TARGET	100

E ACTIVITY	All insurances, office amenities and agreements maintained
TARGET	Processes checklist maintained
CURRENT (2018)	1
ANNUAL TARGET	1

F ACTIVITY	Staff management processes in place
TARGET	Staff reviews completed
CURRENT (2018)	7
ANNUAL TARGET	10

PRIORITY areas

ABORIGINAL ARTS DEVELOPMENT

1. Continue curating work by Aboriginal arts from the NSW central west region for Kew-Y-Ahn Gallery in the Hartley Historic Precinct, in partnership with National Parks and Wildlife Services
2. Create showcases for Aboriginal artists within the region
3. Make links to organisations outside the region to offer opportunities to Aboriginal artists
4. Provide professional development opportunities in art-form development, promotion and business skills
5. Offer platforms for networking and sharing opportunities (eg. Facebook page)
6. Build the profile of Aboriginal arts through sharing success stories over a range of media.

ARTS and HEALTH

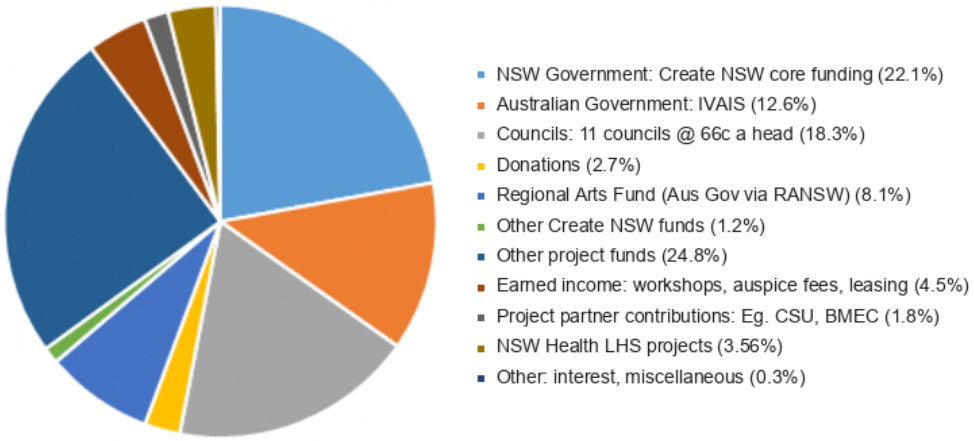
1. Extend the work in hospitals (includes MPS and MPU facilities) through a range of artforms and across many aspects of health (including dementia and disability)
2. Advise and support health sector workers to develop their programs and support strategic development
3. Build links with other service providers in the health sector (eg. Bloomfield Hospital, Bathurst Seymour Centre)
4. Support arts practitioners to be trained and aware of best practice approaches to working in health settings
5. Continue to take a leadership role in the sector (Eg. participation in the NSW/ACT Leadership Group).

CULTURAL TOURISM

1. Create material that showcases the region's culture to tourists
2. Create partnerships with providers and promoters of tourism
3. Partner on events and projects that provide outcomes in building cultural tourism
4. Create networks that support cultural tourism.

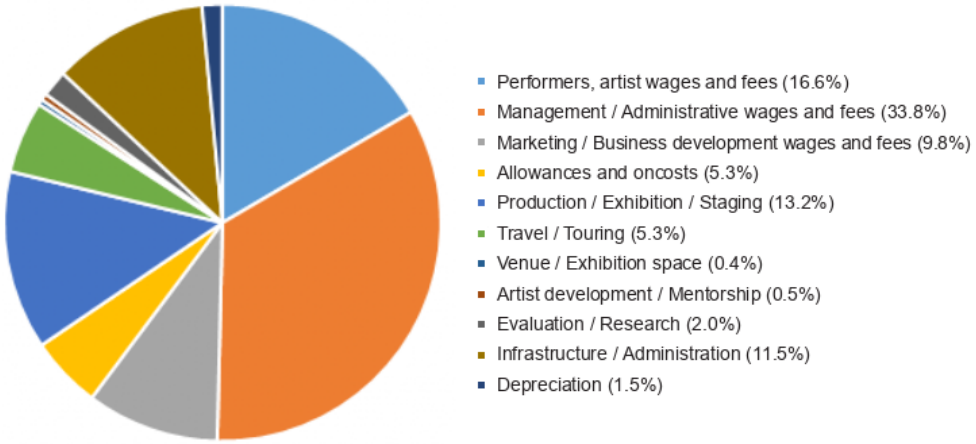
INCOME

Arts OutWest 2019 Income Breakdown
Total = $632,633



EXPENDITURE

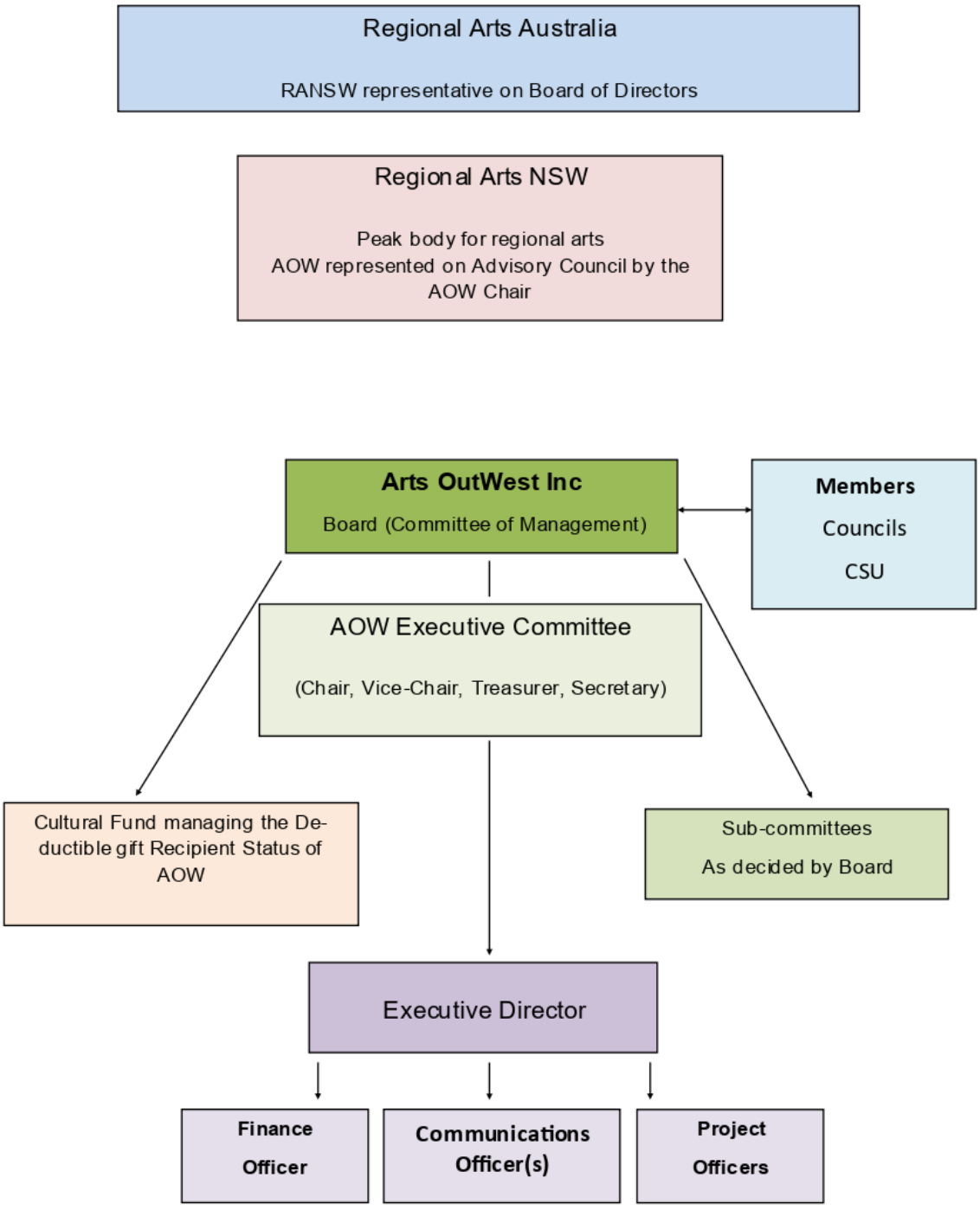
Arts OutWest 2019 Expenditure Breakdown
Total = $625,981



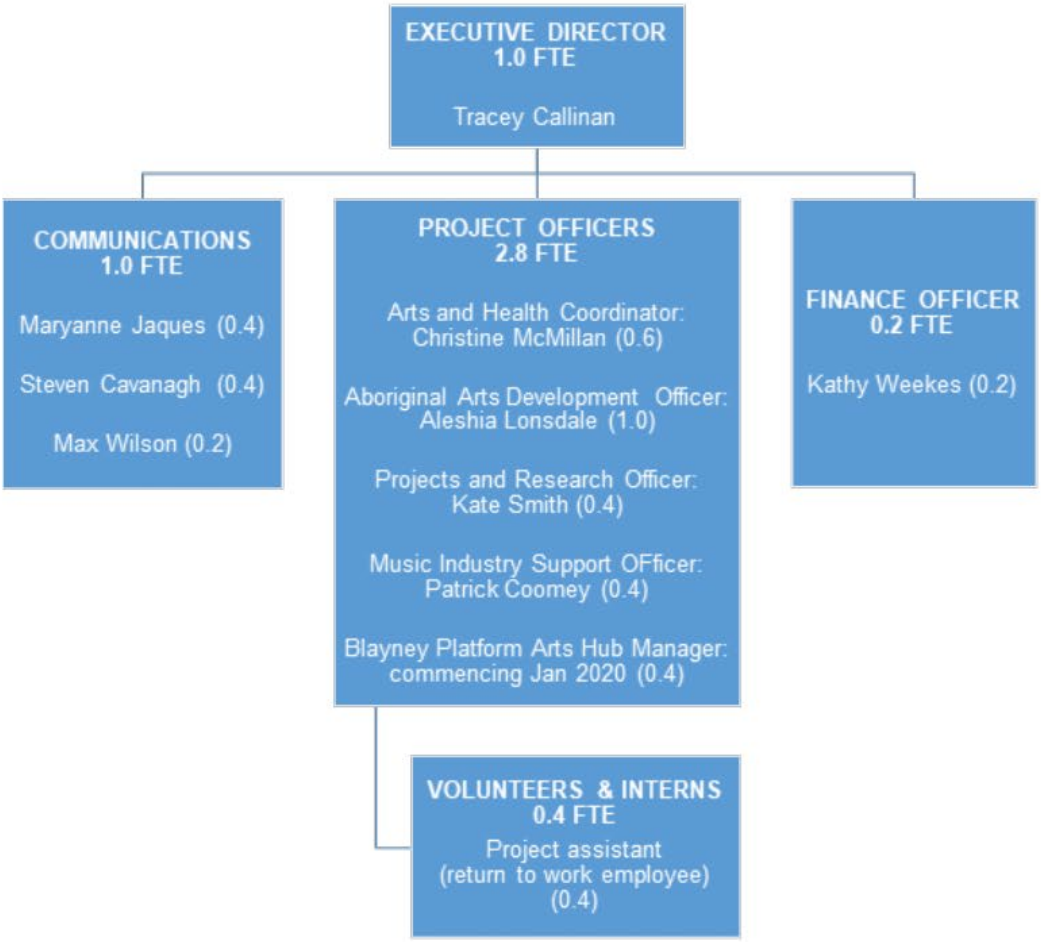
Arts OutWest aims to continue to diversify our income, ensuring that we do not rely heavily on any one source. Previous years demonstrate the way that we have been doing this.

FINANCE

ORGANISATION STRUCTURE



STAFFING STRUCTURE



AOW communications

AOW's Communications Officers key responsibilities and tasks include reporting to the Executive Director and Board of Arts OutWest:

- Communication with stakeholders, public, project participants, arts and creative industries practitioners as a main point of contact for email, mail and phone enquiries
- Compile information for and present regular What's On segments for local and regional radio (across ABC regional, commercial and community stations)
- Collect, record and publish information on arts and cultural activities within the Central West or relevant to the region
- Compile, design and edit the monthly ebulletin 'Artspeak'
- Manage and update the Arts OutWest website
- Manage and update the Culture Maps Central West website
- Manage and coordinate a regional network of Media Associates to assist with photography of events and projects
- Manage and monitor social media accounts
- Prepare, issue and follow-up media releases
- Identify opportunities for editorial (print, broadcast, online) and prepare content
- Prepare, design and issue the annual report
- Provide promotional and marketing support to Arts OutWest projects and to project staff including design of promotional materials
- Provide media and promotions advice to local organisations, artists and promoters
- Provide advice to stakeholders and community on arts and cultural development
- Maintain the Central West cultural directory database
- Develop and maintain strong local media relationships
- Revise communications and marketing plan
- Assist with the management of computer programs, office admin, digital equipment and office equipment
- Work with the Arts OutWest Executive Director to prepare and deliver reports
- Work with the Executive Director and project staff to organise and deliver training, forums, projects and events.

AOW POLICY STATEMENT

AOW's Policy and Procedures Manual covers a broad range of polices that are constantly updated. Examples of AOW areas covered in the manual include:

- Employment policies
- Finance policies
- Media and communications policies
- Governance policies
- Risk Management
- Work Health and Safety
- Complaints
- Succession plan
- Cyber security

and many others.

CORE FUNDING PARTNERS

Create NSW, Australian Government IVAIS, Charles Sturt University, AOW Member Councils.

PROJECT FUNDING PARTNERS

Create NSW, Australian Government Regional Arts Fund, NSW Health Infrastructure and Lachlan Health Service, Japan Foundation, Wentworth Healthcare, Mazda Foundation.
In-kind support from partners including NSW National Parks & Wildlife Service and many other local and regional organisations.

ARTS OUTWEST

Regional Arts Development Organisation of Central West NSW servicing local government areas:
BATHURST • BLAYNEY • CABONNE • COWRA • FORBES • LACHLAN LITHGOW • OBERON • ORANGE • PARKES • WEDDIN

CONTACT US

Information, links and an interactive version of this document are available on our website:
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@artsoutwest on Facebook, Instagram, Twitter

PHOTOGRAPHY CREDITS

Cover: Out of Office, exhibition of work by Arts OutWest staff for Artstate Bathurst. Photo: Steven Cavanagh AOW
Pg 1: Wiradjuri artist Jonathan Jones assisting with the smoking ceremony at Artstate Bathurst. Photo: Steven Cavanagh AOW
Pg 4: Arts OutWest staff. Photos: Georgie Redfern AOW Media Associate
Pg 6: FLOW exhibition, Forbes River Arts Festival, Ground Work by Aleshia Lonsdale. Photo: Steven Cavanagh AOW
Pg 11: Ken Hutchinson, Dishintegrate, My Own Backyard, Central West regional artist exhibition. Photo: Courtesy the artist
Pg 17: Inland Sea of Sound music festival. Photo: Maryanne Jaques AOW
Pg 19: Colleen Jarrard, Artstate Bathurst Opening Ceremony. Photo: Steven Cavanagh AOW
Pg 20: Oberon MPS Art Group, lead by Christine McMillan & Fran Charge. Photo: Caroline Hide AOW Media Associate
Pg 22: Adverse Camber, Dreaming the Night Field, performance at BMEC. Photo: Steven Cavanagh AOW
Pg 27: Scott Towney, Wiradjuri artist from Peak Hill, projection on to the Skydome at Cementa Festival. Photo: Alex Wisser
Pg 29: Nicole Welch, Bathurst artist on location, Table Top Mountain. Photo: Courtesy the artist

arts OUTWEST

NSW GOVERNMENT

Australian Government
Indigenous Visual Arts Industry Support