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PROVISION OF CONSULTING ENGINEERING SERVICES

FLOOD STUDY – COOLAH
DRAFT REPORT

24 APRIL 2025

REFERENCE: TX17494.00-01-COOLAH.RPT.JD_DRAFT

DOCUMENT CONTROL

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0	Ji.D	G.DS	22/04/25

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EXECUTIVE SUMMARY

Triaxial Consulting have been engaged to investigate flooding in the Town of Coolah, NSW.

Coolah lies on the banks of the Coolaburragundy River with a catchment extending to the North East towards the Coolah Tops National Park.

A hydrologic model was constructed using RORB software to analyse the catchment behind the Coolaburragundy River as it flows through Coolah and provide hydrographs to be used in the hydraulic modelling of the town. This included the PMF, 0.5%, 1%, 2%, 5%, 10% and 20% design storm events.

For the Coolah town events, a direct rainfall model was developed to assess the Coolah town catchment. Stormwater network information was included courtesy of Warrumbungle Shire Council.

Using the design hydrographs from the RORB model, a 2-Dimensional flood model was developed using TUFLOW and QGIS software.

The TUFLOW model output includes the design storm events including flood level, depths, velocities and hazard level for each event.

INTRODUCTION

GENERAL

Coolah is located approximately 136 km North East of Dubbo, NSW. It is situated on the banks of the Coolaburragundy River and has a population of approximately 1290 at last census date. Coolah sits within the Warrumbungle Shire Council local government area.

PURPOSE OF THIS FLOOD STUDY

The purpose of this study is to investigate the flooding conditions in the Town of Coolah and surrounding area by both the Coolaburragundy River and localised town catchments and to provide a basis for further assessment of flood mitigation measures to effectively control the risk associated with large storm events in the catchment.

Figure 1. Coolah aerial image

BACKGROUND ON STUDY AREA

CATCHMENT DESCRIPTION

The Coolaburragundy River runs through the township of Coolah and is fed by several smaller creeks and gullies that extent to the East and the perimeter of the Coolah Tops National Park. The catchment ranges from elevations from 1109m down to 493m. The catchment size was measured at 237km² and is shown on the image below:

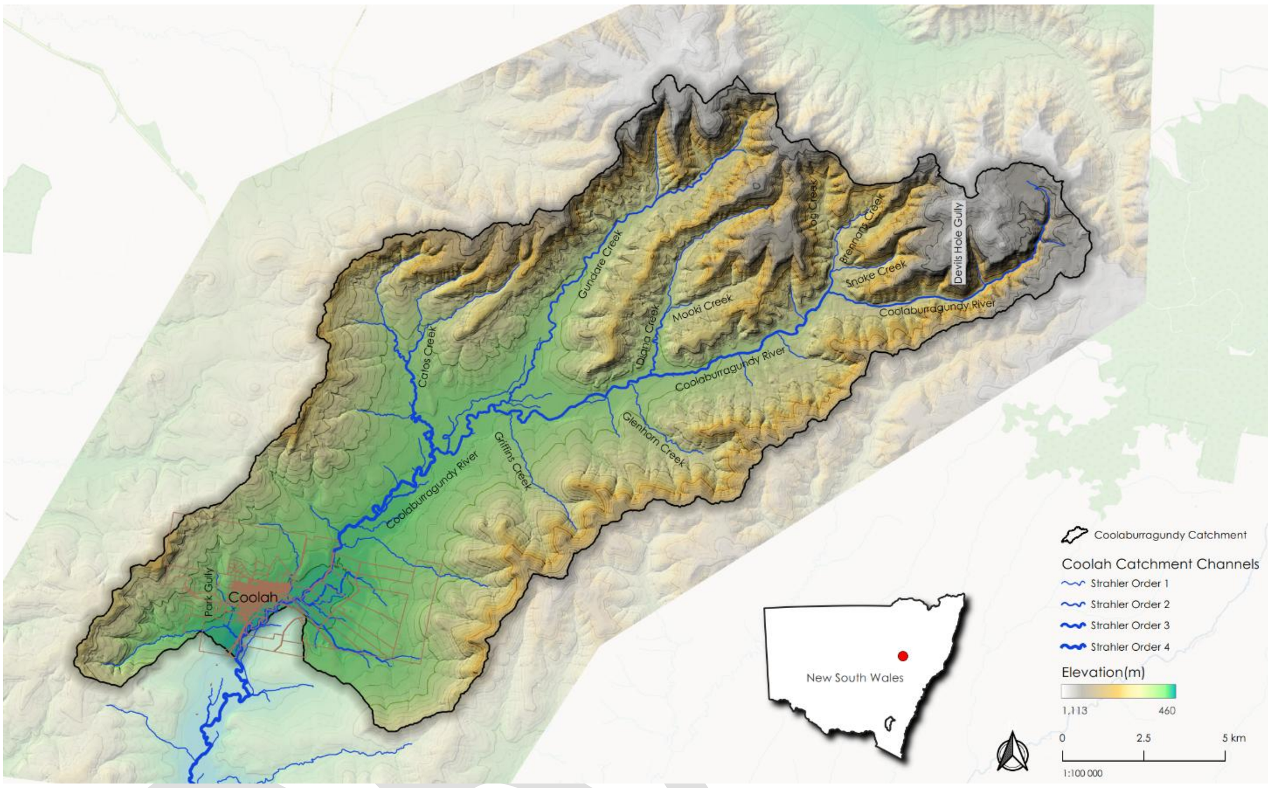


Figure 2. Coolaburragundy River Coolah catchment.

REVIEW OF AVAILABLE DATA

PREVIOUS STUDIES

Previous studies were completed in 1984 for Coolah Council but no flood information on peak flows, design storms or hydrograph outputs was available at time of study. No further studies that provided significant flow information or an assessment of the Coolaburragundy River could be located however council provided some flood maps that were interpreted from earlier paper maps, likely derived from the earlier 1984 flood study.

Some historical information was passed on from local residents who indicated that in the last major flood event water was observed reaching the main street (Binna Street). There were also submissions from the public including photos and written statements identifying significant flooding events in recent years. One particular event was the subject of further investigation by Warrumbungle Shire Council, who recorded water levels during the flood event via survey.

TOPOGRAPHY

The Coolah catchment ranges from an elevation of 1109 to 493m. Slopes within the catchment range from over 10% at the upper end of the catchment at the Coolah Tops National Park to under 1% on the Coolah floodplain.

SPATIAL DATA

Detailed spatial data was obtained from the ELVIS website produced by the Intergovernmental Committee on Surveying and Mapping.

Spatial data used in the modelling included a digital elevation model completed by LiDAR survey with a 1m grid spacing. Fringe flooding areas and upstream floodplain areas utilised a 5m Lidar grid.

Additional datasets were used in the development of the model for reference and identification of sites and boundaries including:

- Coolah Flood Study 1984 (Department of Water Resources) – hard copy obtained from Warrumbungle Shire Council Staff
- NSW SES data (mapping in hard copy form) from Craig Ronan (Chief Inspector – Emergency Planning Western Region).
- Coolah Flood Study Reference Plan – Coolaburragundy River
- GIS mapping information consisting of the following:
- NSW Hydro line GIS data
- NSW Spatial data (Lidar)
- Aerial Imagery
- Asset data provided by Warrumbungle Shire Council – stormwater pit and pipe network

HYDROLOGIC MODEL DEVELOPMENT

OVERVIEW

A RORB catchment model was developed in order to determine design stream flows through the Coolaburragundy River.

No stream gauge data for the Coolaburragundy River was available for use on the Coolah catchment, as such no at-site flood frequency analysis was undertaken.

Previous flood studies undertaken in 1984 did not contain any relevant hydrological assessment.

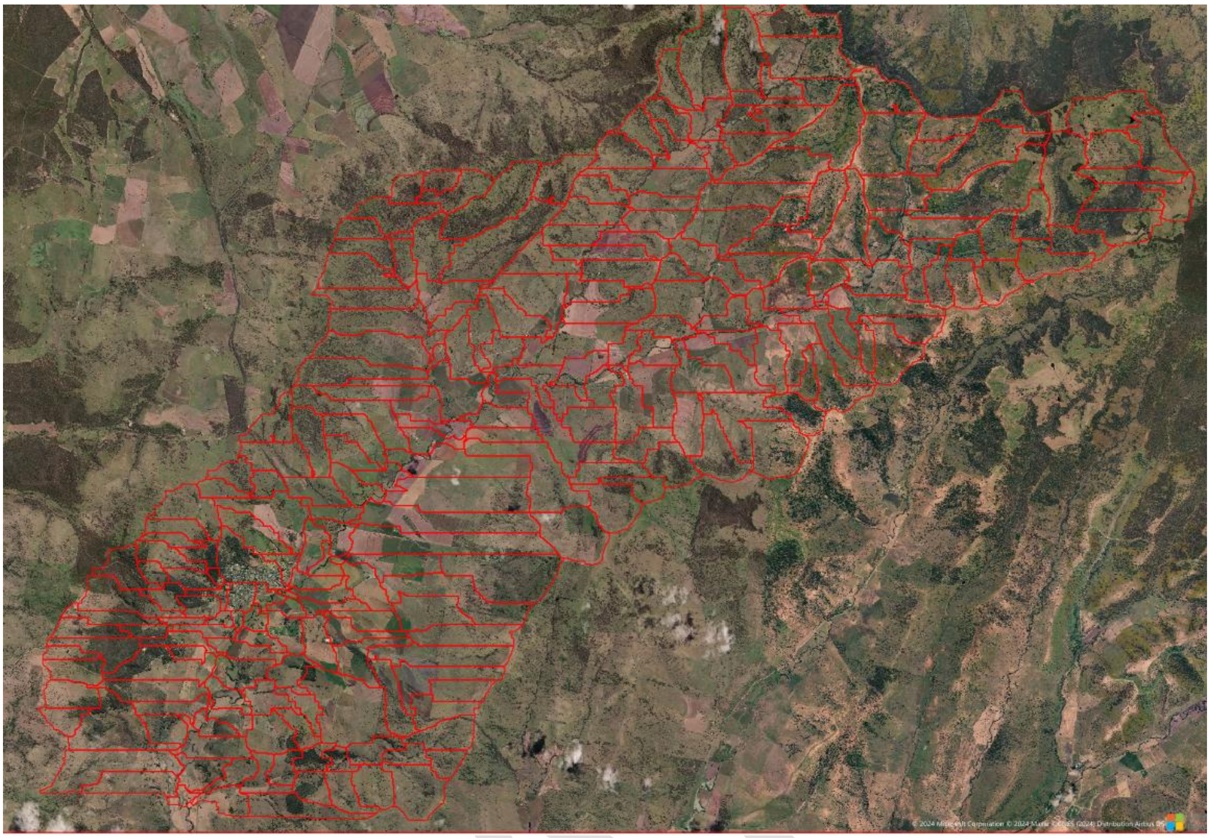


Figure 3. RORB model sub-catchments used in modelling

Strong comparisons have been made to nearby Neilrex gauged catchment reviewed by Podger et al. (2019) for its adjacency to the Coolah catchment.

MODEL PARAMETERS

Determination of RORB lag parameter K_c from ARR2019 recommended equation (7.6.13) (Ball, et al., 2019),

$$K_c = 1.18A^{0.46}$$

Eq. 1

$$K_c = 1.18 \times 237^{0.46}$$

$$K_c = 14.60$$

Non-linearity parameter, m, set to 0.8.

Initial Loss and continuing loss values obtained from ARR Data Hub (2019) and compared to regional values in the absence of at site FFA derived values.

Datahub,

- IL = 39 mm
- CL = 1.5 mm/hr (or 1.5×0.4=0.6mm/hr as recommended for NSW catchments)

Nearby FFA derived initial and continuing loss values from regional gauged catchments from a report by Podger et al. (2019) for the Office of Environment and Heritage (OEH).

Castlereagh Basin,

- Neilrex – IL = 80mm, CL = 0.6mm/hr
- Bearbung – IL = 73mm, CL = 4mm/hr

Macquarie/Bogan,

- Obley No.2 – IL = 24mm, CL = 1.9mm/hr

Namoi River Basin,

- Old Warah – IL = 35mm, CL = 0.002mm/hr
- Halls Ck – IL = 50mm, CL = 2.7mm/hr

Datahub values for IL and CL appear to underestimate the initial loss and overestimate the continuing loss when compared to the nearest FFA derived loss values of the Neilrex catchment that lies adjacent to the Coolah catchment.

For use in the hydrological model the nearby Neilrex catchment IL and CL FFA derived values have been used.

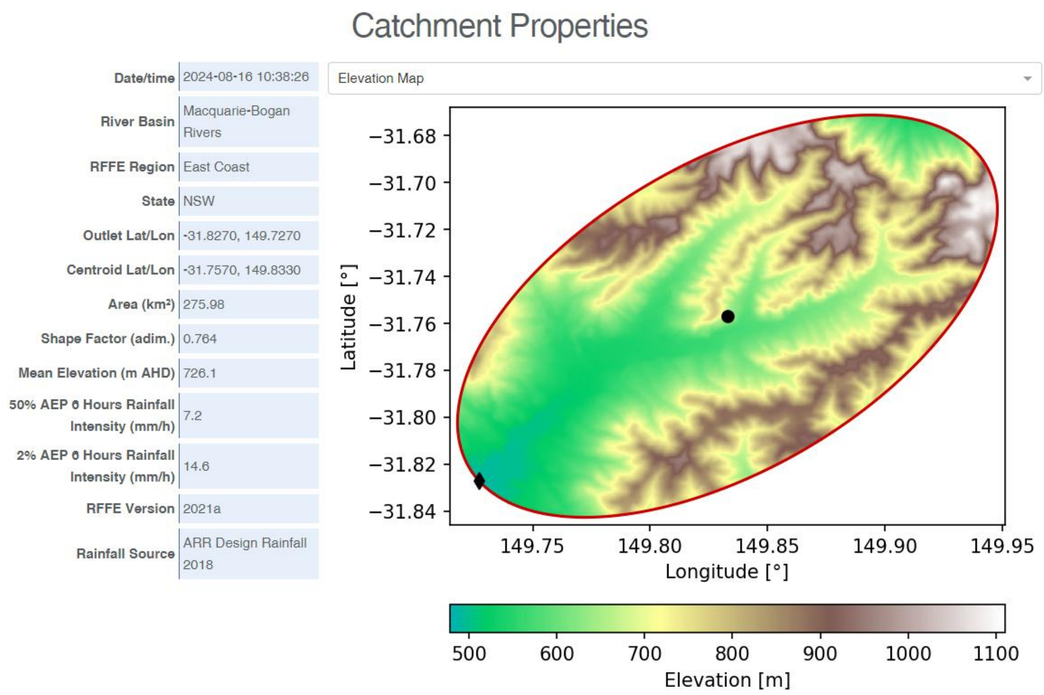


Figure 4. Catchment properties of the Coolabarrugundy

Prior to hydrologic analysis a review of the temporal patterns for the catchment was undertaken. As a result of the analysis and review the following temporal patterns were removed as they do not represent natural rainfall events. These same temporal patterns were also highlighted in a conference paper presented to the Hydrology and Water Resources Symposium 2021, the paper presented was "A review of temporal patterns from Australian Rainfall and Runoff" (Ladson 2021).

Region	Duration	Area	Event ID
Central Slopes	48	500	3950
	48	500	3951
	72	200	4029
	72	500	4043
	96	200	4116
	96	200	4119
	120	200	4207

Figure 5. Temporal patterns removed from hydrological analysis

HYDROLOGIC MODEL CALIBRATION

Previous flood studies undertaken in 1984 did not contain any relevant hydrological assessment.

Direct hydrologic model calibration was not undertaken as there was no available stream gauge data to calibrate from.

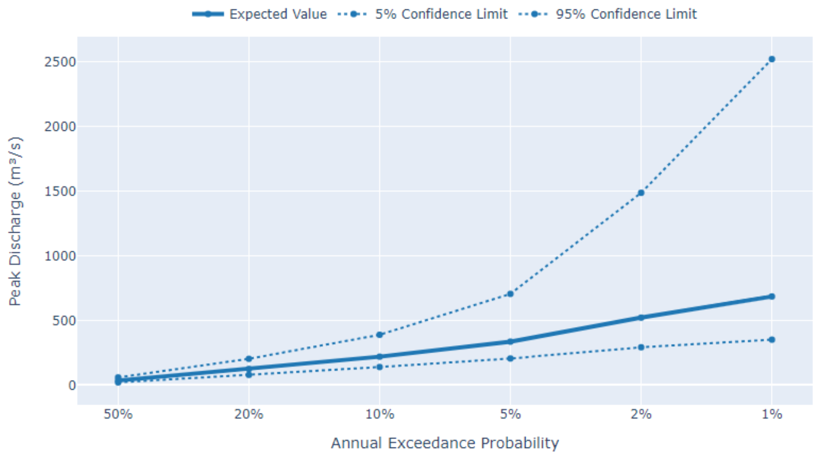
Comparisons with the Australian Rainfall and Runoff Regional Flood Frequency Estimator (RFFE) were made with results shown below. The RFFE provides an extreme upper and lower bound estimate of the peak discharge rate.

Additionally, comparing levels from the hydraulic study to approximate flood levels from historic floods were used to back calibrate. This was general in approach only and was completed using a 1-Dimensional HECRAS model to determine approximate flood levels.

HYDROLOGIC MODEL OUTPUT

OVERALL [RECOMMENDED] | SMALL CATCHMENTS | LARGE CATCHMENTS | AVERAGE | ALL MODELS

Region	Model Type	Regression Type	Fitting Method	Predictors	Min Nearby Stations	Max Nearby Stations
1	Overall [Recommended]	QRT	OLS	Area km2, IFD 2% 72.0h, Slope Mean	50	50



AEP (%)	Expected Value (m³/s)	Lower Confidence Limit (m³/s)	Upper Confidence Limit (m³/s)
50%	35.34	20.84	59.58
20%	124.94	79.35	203.34
10%	219.82	139.83	389.17
5%	336.13	205.74	705.23
2%	521.47	292.64	1486.49
1%	685.25	351.46	2519.89

Figure 6. Upper and lower confidence limits of RORB model output.

The proposed peak discharge during the 1% AEP event was determined to be 435m³/s in the 24hr event, which is in between the upper and lower bound estimates, closer to the lower bounds estimate. Figure shows the RORB model is underestimating values when compared to the regional flood frequency estimator tool.

Further investigation of this value was made by comparing to hydraulic levels and these generally appeared to match anecdotal reports of flood extents so was adopted for the main hydraulic model.

A sensitivity analysis was conducted on an upper bounds flood flow estimate, this was found to be overly conservative when modelled in the TUFLOW hydraulic model.

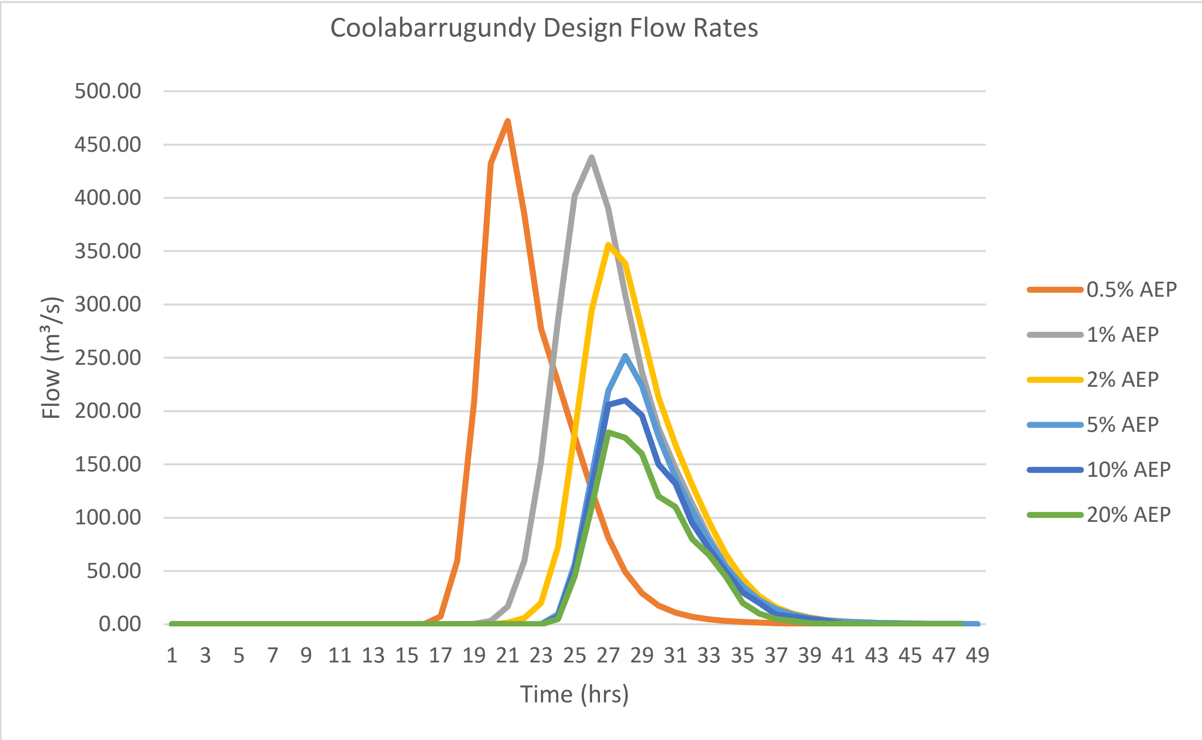


Figure 7. RORB Hydrographs – output for hydraulic modelling

HYDRAULIC MODEL DEVELOPMENT

OVERVIEW

The model used in the analysis was a TUFLOW model, a 2-Dimensional flood analysis program that provides accurate simulations of free-surface water flow in 2 dimensions and can model a wide variety of criteria, including depth, water level, velocity, hazard level and flood planning areas.

The development of the 2D model was done in separate stages. The first was the major river system flow modelling, which was modelled with a hydrograph input from each contributing tributary with a boundary input upstream and downstream of Coolah. The input hydrographs for the Coolaburragundy River were observed to be much longer than the short time of concentration and peak storm events of the Coolah town area subcatchments. As the two major town and river catchments did not significantly overlap a separate model was developed for each.

The second stage of the modelling was a direct rainfall (rain on grid) model of the Coolah township. The direct rainfall method applies a rainfall amount to each cell in the model, which then determines direction and velocity of the town catchments based on the available detailed Lidar survey information. It was deemed appropriate to use a direct rainfall model as it defines catchments and flow directions more accurately for undefined or complex catchment geometry and does not rely on accurate input of the boundary flow locations.

MODEL CONFIGURATION

The TUFLOW model included the following key parameters:

- Design flowrates based on the output from the RORB hydraulic modelling, including a conservative estimate of the 1% AEP peak flow through the Coolaburragundy River of 438m³/s.
- Manning's n value assumed to be 0.06 in line with farmland / crop typical of existing floodplain conditions including low and medium level vegetation cover.
    - Note: Direct rainfall modelling techniques included a varying manning's n value for rooftop areas to account for overland flow path barriers introduced by buildings.
- Upstream boundary conditions adopted was the flow (Q) versus time (t) input hydrograph. The position of the upstream boundary was adopted at approximately 3km upstream from the Vinegaroy Road bridge to allow sufficient time for the flow to simulate flooding conditions.
- Downstream boundary conditions were taken as the average slope at the downstream boundary based on the lidar survey information.
- Detailed spatial data was obtained from the ELVIS website produced by the Intergovernmental Committee on Surveying and Mapping. Digital Elevation Model (DEM) files adopted to produce the model included:

Coolah201109-PHO3-AHD_7526466_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	704 KB
Coolah201109-PHO3-AHD_7526468_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	754 KB
Coolah201109-PHO3-AHD_7526470_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	759 KB
Coolah201109-PHO3-AHD_7526472_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	724 KB
Coolah201109-PHO3-AHD_7526474_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	741 KB
Coolah201109-PHO3-AHD_7526476_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	740 KB
Coolah201109-PHO3-AHD_7546466_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	686 KB
Coolah201109-PHO3-AHD_7546468_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	706 KB
Coolah201109-PHO3-AHD_7546470_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	698 KB
Coolah201109-PHO3-AHD_7546472_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	690 KB
Coolah201109-PHO3-AHD_7546478_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	687 KB
Coolah201109-PHO3-AHD_7566466_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	732 KB
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Coolah201109-PHO3-AHD_7566470_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	702 KB
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Coolah201109-PHO3-AHD_7606470_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	726 KB
Coolah201109-PHO3-AHD_7606472_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	675 KB
Coolah201109-PHO3-AHD_7606474_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	711 KB
Coolah201109-PHO3-AHD_7606476_55_0002_0002_5m	5/08/2024 2:45 PM	TIF File	691 KB

Figure 8. RORB Hydrographs – output for hydraulic modelling

Output from the Hydraulic model was obtained in the form of a flood map produced by the QGIS TUFLOW module. Output from the modelling included water level, water depth, velocity and hazard level.

The hazard criteria adopted for the hydraulic modelling was as per the general flood hazard vulnerability curve listed in the NSW Department of Planning and Environment "Flood Hazard – Risk Management Guideline FB03" 2023.

The risk management guidelines

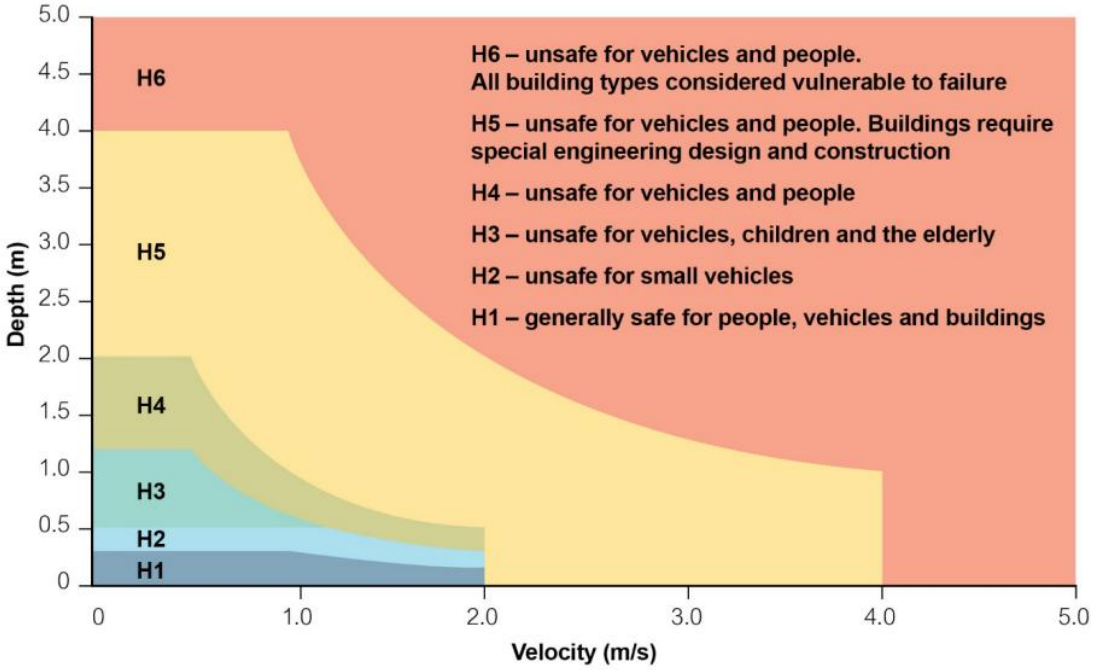


Figure 9. Hazard level rating curves

MODEL CALIBRATION

As no stream gauging station was available to determine design flow rates and calibrate the RORB model to, calibration of the hydrological and hydraulic model was undertaken based on historical rainfall events witnessed and recorded by the residents of Coolah and Warrumbungle Shire Council.

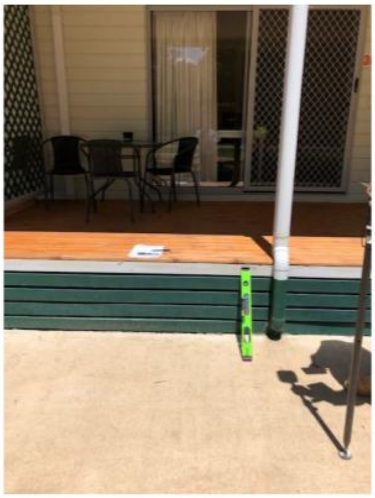
Historical rainfall data was used to calibrate the model wherever possible, along with photographic evidence of flood extents provided by local residents and Warrumbungle Shire Council.

The most recent significant rainfall event was recorded on 26th November 2021, when 168mm of rain (total) was recorded at a location to the North of Coolah town. No other detailed information was available other than the total daily rainfall amount, so no more accurate hydrograph could be determined from the available data.

Using the ARR data hub tools, this most likely equated to a storm slightly more intense than a design 2% event, in general terms around a 1 in 55 to 1 in 60-year event.

Warrumbungle Shire Council recorded the water level caused by this event at locations around Coolah and this data was used to calibrate the design hydraulic model.

A recording of the water height was taken at the caravan park unit 36b as shown in image 13 below:



Verandah at Coolah Caravan Park unit 36b at top of spirt level. RL 490.507

Image 10: AHD height recording of top water level via survey of event from 26/11/21.

The corresponding design 50-year event from the TUFLOW hydraulic model (2% AEP) at the same location shows a water level of 490.471, which is a difference of 36mm.

This close match in water levels at the same location in a very similar theoretical storm event was used as confirmation of the hydrological and hydraulic model reliability.

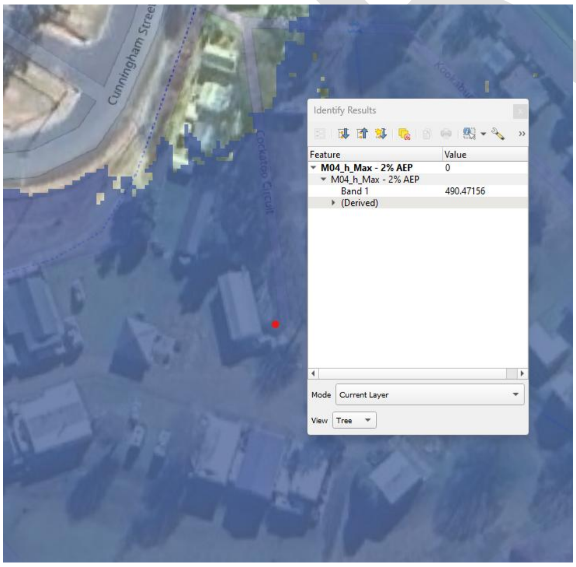


Image 11: Design 2% AEP event showing RL490.471m

Further anecdotal correlation of the model was observed with submissions from the general public of recent flooding events, as shown in images 12 and 13 below.

Image 12: Public submission of flooding event at Binnia St near grain silos

Image 13: Public submission of flooding event at Binnia St near building

Screen shot of TUFLOW flood model from same location:

Image 14: Public submission of flooding event at Binnia St near building

APPENDIX A – FLOOD MAPPING

COOLAH 1% AEP FLOODMAPS

Maps 1-6 Depth

Maps 7-12 Velocity

Maps 13-18 Hazard Rating

Maps 19-24 Water Level

COOLAH 0.5% AEP FLOODMAPS

Maps 25-30 Depth

Maps 31-36 Velocity

Maps 37-42 Hazard Rating

Maps 43-48 Water Level

COOLAH 2% AEP FLOODMAPS

Maps 49-54 Depth

Maps 55-60 Velocity

Maps 61-66 Hazard Rating

Maps 67-72 Water Level

COOLAH 5% AEP FLOODMAPS

Maps 73-78 Depth

Maps 79-84 Velocity

Maps 85-90 Hazard Rating

Maps 91-96 Water Level

COOLAH 10% AEP FLOODMAPS

Maps 97-102 Depth

Maps 103-108 Velocity

Maps 109-114 Hazard Rating

Maps 115-120 Water Level

COOLAH 20% AEP FLOODMAPS

Maps 121-126 Depth

Maps 127-132 Velocity

Maps 133-138 Hazard Rating

Maps 139-144 Water Level

COOLAH PMF FLOODMAPS

Maps 145-150 Depth

Maps 151-156 Velocity

Maps 157-162Hazard Rating

Maps 163-168 Water Level

APPENDIX B – ARR DATA HUB OUTPUT

Results - ARR Data Hub

[STARTTXT]

Input Data Information

[INPUTDATA]

Latitude,-31.760000

Longitude,149.820000

[END_INPUTDATA]

River Region

[RIVREG]

Division,Murray-Darling Basin

River Number,22

River Name,Macquarie-Bogan Rivers

[RIVREG_META]

Time Accessed,01 June 2020 12:01PM

Version,2016_v1

[END_RIVREG]

ARF Parameters

[LONGARF]

Zone,Semi-arid Inland QLD

a,0.159

b,0.283

c,0.25

d,0.308

e,7.3e-07

f,1.0

g,0.039

h,0.0

i,0.0

[LONGARF_META]

Time Accessed,01 June 2020 12:01PM

Version,2016_v1

[END_LONGARF]

Storm Losses

[LOSSES]

ID,5355.0

Storm Initial Losses (mm),39.0

Storm Continuing Losses (mm/h),1.5

[LOSSES_META]

Time Accessed,01 June 2020 12:01PM

Version,2016_v1

[END_LOSSES]

Temporal Patterns

[TP]

code,CS

Label,Central Slopes

[TP_META]

Time Accessed,01 June 2020 12:01PM

Version,2016_v2

[END_TP]

Areal Temporal Patterns

[ATP]

code,CS

arealabel,Central Slopes

[ATP_META]

Time Accessed,01 June 2020 12:01PM

Version,2016_v2

[END_ATP]

Median Preburst Depths and Ratios

[PREBURST]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),0.8 (0.035),0.9 (0.028),0.9 (0.025),0.9 (0.022),0.8 (0.017),0.8 (0.014)

90 (1.5),1.0 (0.038),0.9 (0.024),0.8 (0.018),0.7 (0.014),0.4 (0.006),0.1 (0.002)

120 (2.0),2.0 (0.068),1.4 (0.037),1.0 (0.023),0.7 (0.013),0.5 (0.008),0.4 (0.005)

180 (3.0),0.4 (0.013),0.7 (0.016),0.9 (0.017),1.0 (0.018),1.2 (0.018),1.4 (0.018)

360 (6.0),1.6 (0.038),3.6 (0.066),4.9 (0.077),6.2 (0.085),5.5 (0.065),5.0 (0.053)

720 (12.0),0.7 (0.014),2.5 (0.037),3.7 (0.046),4.9 (0.053),8.5 (0.080),11.3 (0.094)

1080 (18.0),0.0 (0.001),1.0 (0.012),1.6 (0.017),2.1 (0.020),7.1 (0.057),10.8 (0.077)

1440 (24.0),0.0 (0.000),1.9 (0.022),3.1 (0.030),4.3 (0.036),7.5 (0.054),9.9 (0.063)

2160 (36.0),0.0 (0.000),0.6 (0.006),1.0 (0.008),1.4 (0.010),3.0 (0.019),4.3 (0.023)

2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.1 (0.001),0.2 (0.001)

4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

[PREBURST_META]

Time Accessed,01 June 2020 12:01PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST]

10% Preburst Depths

[PREBURST10]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

180 (3.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

[PREBURST10_META]

Time Accessed,01 June 2020 12:01PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST10]

25% Preburst Depths

[PREBURST25]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

180 (3.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.3 (0.002),0.5 (0.003)

1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

[PREBURST25_META]

Time Accessed,01 June 2020 12:01PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST25]

75% Preburst Depths

[PREBURST75]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),7.8 (0.335),7.6 (0.245),7.5 (0.204),7.3 (0.174),8.3 (0.167),9.1 (0.162)

90 (1.5),9.3 (0.353),9.8 (0.279),10.1 (0.245),10.4 (0.219),9.7 (0.172),9.1 (0.145)

120 (2.0),17.2 (0.597),14.9 (0.390),13.4 (0.299),12.0 (0.232),14.0 (0.231),15.6 (0.229)

180 (3.0),12.1 (0.369),13.9 (0.321),15.1 (0.297),16.2 (0.279),17.2 (0.254),18.0 (0.238)

360 (6.0),13.3 (0.324),20.5 (0.377),25.2 (0.398),29.7 (0.412),37.6 (0.447),43.5 (0.465)

720 (12.0),11.5 (0.221),18.5 (0.268),23.1 (0.286),27.5 (0.299),31.3 (0.291),34.1 (0.286)

1080 (18.0),11.0 (0.185),17.9 (0.225),22.4 (0.241),26.8 (0.252),35.5 (0.283),42.0 (0.300)

1440 (24.0),5.5 (0.085),11.6 (0.133),15.7 (0.153),19.6 (0.166),30.3 (0.217),38.4 (0.244)

2160 (36.0),0.0 (0.000),5.5 (0.056),9.1 (0.078),12.6 (0.093),16.8 (0.103),20.0 (0.108)

2880 (48.0),0.0 (0.000),2.1 (0.020),3.5 (0.028),4.9 (0.033),8.6 (0.047),11.3 (0.055)

4320 (72.0),0.0 (0.000),0.1 (0.001),0.1 (0.001),0.1 (0.001),3.4 (0.017),5.9 (0.025)

[PREBURST75_META]

Time Accessed,01 June 2020 12:01PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST75]

90% Preburst Depths

[PREBURST90]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),23.5 (1.011),22.8 (0.732),22.2 (0.607),21.7 (0.514),28.4 (0.568),33.4 (0.595)

90 (1.5),31.9 (1.210),32.1 (0.916),32.3 (0.783),32.4 (0.683),30.1 (0.536),28.3 (0.450)

120 (2.0),41.5 (1.440),42.0 (1.099),42.3 (0.944),42.7 (0.827),52.2 (0.860),59.4 (0.874)

180 (3.0),38.7 (1.184),40.7 (0.941),42.0 (0.829),43.2 (0.745),45.8 (0.673),47.7 (0.629)

360 (6.0),28.6 (0.695),42.7 (0.786),52.0 (0.822),61.0 (0.845),78.6 (0.935),91.9 (0.984)

720 (12.0),30.6 (0.588),49.7 (0.720),62.3 (0.774),74.5 (0.810),75.6 (0.705),76.4 (0.641)

1080 (18.0),25.0 (0.422),40.8 (0.514),51.2 (0.550),61.2 (0.574),74.1 (0.592),83.7 (0.599)

1440 (24.0),27.2 (0.420),36.1 (0.414),41.9 (0.408),47.6 (0.402),59.8 (0.428),69.0 (0.440)

2160 (36.0),14.2 (0.196),23.8 (0.241),30.1 (0.257),36.2 (0.266),48.3 (0.297),57.5 (0.311)

2880 (48.0),4.1 (0.053),15.1 (0.143),22.5 (0.177),29.5 (0.198),46.3 (0.257),58.9 (0.286)

4320 (72.0),2.0 (0.023),4.8 (0.041),6.6 (0.047),8.4 (0.050),26.4 (0.129),39.9 (0.169)

[PREBURST90_META]

Time Accessed,01 June 2020 12:01PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST90]

Interim Climate Change Factors

[CCF]

,RCP 4.5,RCP6,RCP 8.5

2030,0.972 (4.9%),0.847 (4.2%),1.052 (5.3%)

2040,1.225 (6.2%),1.127 (5.7%),1.495 (7.6%)

2050,1.452 (7.3%),1.406 (7.1%),1.971 (10.1%)

2060,1.653 (8.4%),1.685 (8.6%),2.480 (12.9%)

2070,1.827 (9.3%),1.963 (10.1%),3.023 (15.9%)

2080,1.974 (10.1%),2.241 (11.6%),3.599 (19.2%)

2090,2.095 (10.8%),2.518 (13.1%),4.208 (22.8%)

[CCF_META]

Time Accessed,01 June 2020 12:01PM

Version,2019_v1

Note,ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

[END_CCF]

Probability Neutral Burst Initial Loss

[BURSTIL]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),23.5,18.7,16.3,16.2,16.0,14.9

90 (1.5),26.7,17.5,15.7,15.8,16.3,15.1

120 (2.0),28.7,15.2,14.0,14.9,14.2,12.1

180 (3.0),29.8,16.9,15.6,16.0,15.3,12.9

360 (6.0),29.4,18.7,15.0,14.5,12.5,7.9

720 (12.0),30.1,20.5,17.3,16.8,14.4,9.4

1080 (18.0),31.6,22.8,20.2,19.2,15.9,9.4

1440 (24.0),32.4,24.4,22.6,23.0,19.1,11.2

2160 (36.0),35.9,28.8,27.9,28.2,24.1,14.3

2880 (48.0),38.3,31.6,30.6,32.7,28.2,17.9

4320 (72.0),39.4,33.8,35.7,38.6,33.8,22.2

[BURSTIL_META]

Time Accessed,01 June 2020 12:01PM

Version,2018_v1

Note, as this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.

[END_BURSTIL]Transformational Pre-burst Rainfall

[PREBURST_TRANS]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),15.2,20.0,22.4,22.5,22.7,23.8

90 (1.5),12.0,21.2,23.0,22.9,22.4,23.6

120 (2.0),10.0,23.5,24.7,23.8,24.5,26.6

180 (3.0),8.9,21.8,23.1,22.7,23.4,25.8

360 (6.0),9.3,20.0,23.7,24.2,26.2,30.8

720 (12.0),8.6,18.2,21.4,21.9,24.3,29.3

1080 (18.0),7.1,15.9,18.5,19.5,22.8,29.3

1440 (24.0),6.3,14.3,16.1,15.7,19.6,27.5

2160 (36.0),2.8,9.9,10.8,10.5,14.6,24.4

2880 (48.0),0.4,7.1,8.1,6.0,10.5,20.8

4320 (72.0),0.0,4.9,3.0,0.1,4.9,16.5

[PREBURST_TRANS_META]

The tranformational pre-burst is intended for software suppliers in the NSW area and is simply the Initial Loss - Burst Initial Loss. It is not appropriate to use these values if considering a calibrated initial loss.

[END_PREBURST_TRANS]

[ENDTXT]