REPORT

Narrabri 3A Solar Farm

Water Assessment

Submitted to:

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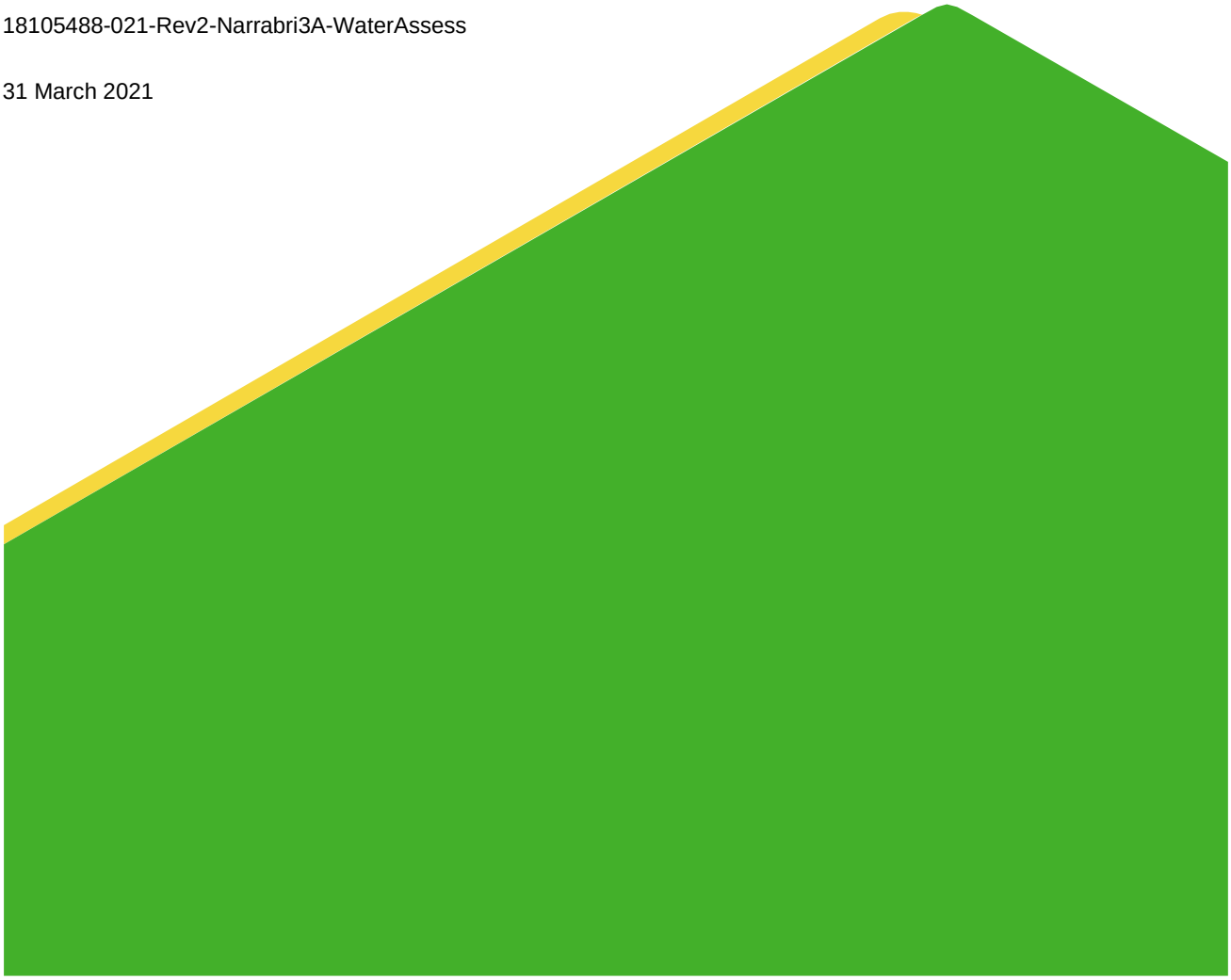
18105488-021-Rev2-Narrabri3A-WaterAssess

31 March 2021



Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

Distribution List

ITP Development Pty Ltd

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

Table of Contents

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

TABLES

FIGURES

APPENDICES

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

1.0 INTRODUCTION

The proposed Narrabri 3A Solar Farm is located at 11498 Newell Hwy, 4.5 km south-west of the town of Narrabri in NSW, within the Narrabri Shire Council local government area (LGA). The Project site is within Lot 102 / DP 579423. ITP Development Pty Ltd (ITP Development) propose to construct a 5 MW solar facility within the site that has recently been used for grazing and recently destocked.

This report, which provides a desktop water assessment to support the Development Application for the project, includes a:

- Desktop review of local hydrology and catchment and water quality data.
- Desktop review of surface and groundwater quality data.
- Desktop review of the flood risk potential against the published references, Local Environmental Plan and Land-use Plan.
- Desktop impact assessment against New South Wales (NSW) policies and referenced industry standards for solar arrays.
- Desktop management assessment with mitigation measures recommend for construction and operation.

1.1 Limitations of assessment

The assessment is based on publicly available information and data and does not include a site inspection, sampling, or any additional hydrological and/or hydraulic modelling.

1.2 Important information relating to this report

Your attention is drawn to the document titled - “Important Information Relating to this Report”, which is included in Appendix A of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

2.0 PROJECT DESCRIPTION

The proposed Narrabri 3A Solar Farm is located at 11498 Newell Hwy, approximately 4.5 km south-west of the town of Narrabri in NSW (Figure 2).

Narrabri is located on the western side of the Great Dividing Range within the Namoi Valley, approximately 521 km north-west of Sydney in the North West slopes and plains of NSW. The Project area is within the Narrabri Shire Council area.

The town of Narrabri is located within the floodplain and on the banks of the Namoi River, a major perennial river which forms part of the Barwon catchment of the Murray-Darling Basin and is significant in the region.

The Namoi River divides into two branches, the Namoi River and Narrabri Creek, the approximately 2.5 km upstream of Narrabri's town centre before re-joining approximately 10 km downstream of Narrabri. All flow is carried by Narrabri Creek under normal flow conditions, as a large sand and gravel bar in the Namoi River at its offtake from Narrabri Creek prevents flow entering into the Namoi River until low-level flooding from Narrabri Creek starts to occur (Ribbons, Bewsher & Booby, 1995).

The topography of Narrabri is relatively flat being located within a floodplain, with slight hills rising in the north-east of the town which form part of the Nandewar Range further east. The area south-east of Narrabri is characterised by river valleys with broad floodplains bounded by low hills. West of Narrabri there is low topographic relief, with the land forming an extensive alluvial plain (Australian Government, 2018).

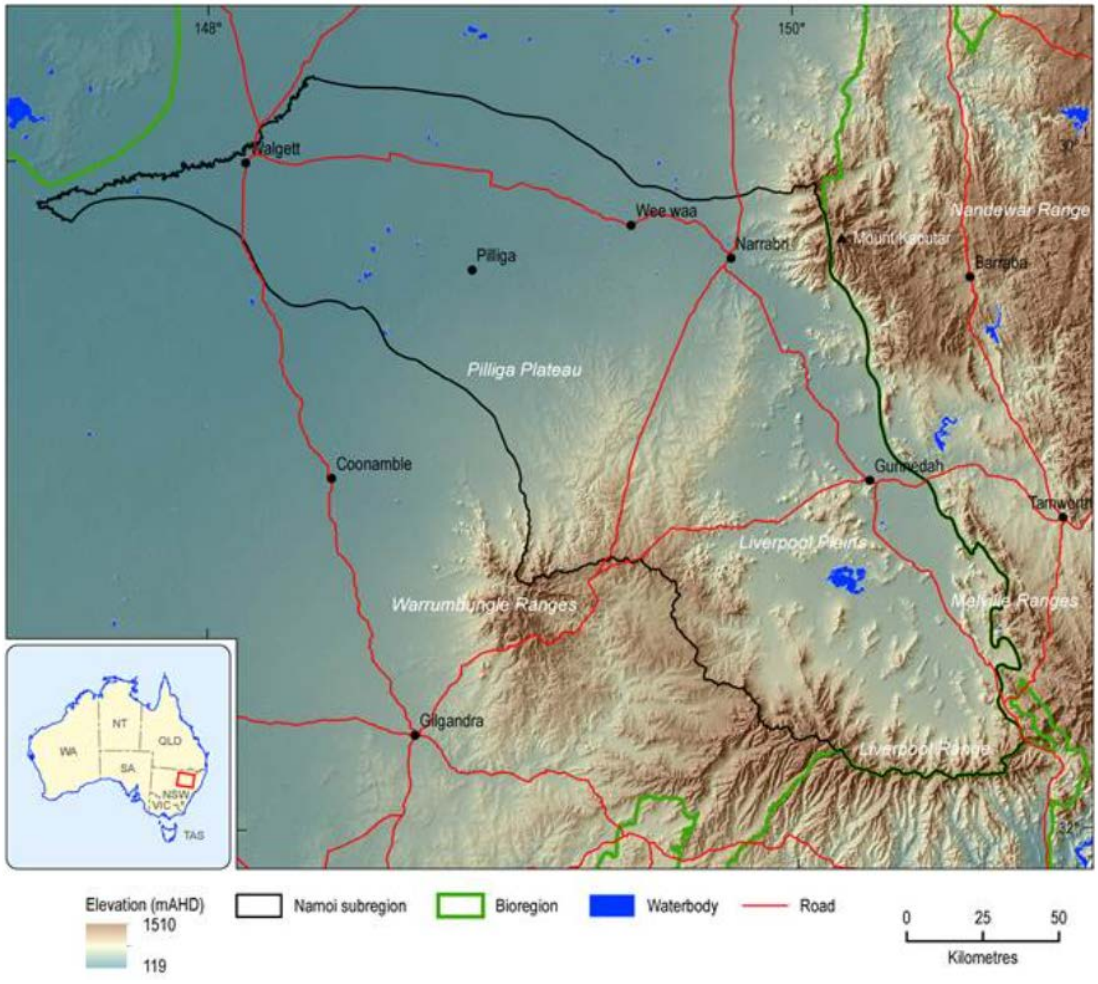


Figure 1: Digital elevation model of Namoi sub-catchment (Australian Government, 2018)

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

The proposed facility is located 1.2 km west of the Namoi River. The Project area is relatively flat, with the land gently sloping towards the south and west by 2 and 3 metres, respectively, ranging between 219 mAHD in the west and 215 m AHD in the south. A 2nd order drainage line flows through Lot 102 / DP579423 directly east of the Project area outside of the proposed Project footprint to Narrabri Lake located 1.5 km to the north. The land is mostly cleared of native vegetation and has historically been used for grazing, though was recently destocked (Figure 3).

ITP Development propose to construct a solar farm on the parcel of land (Lot 102 / DP 579423). The land has recently been used for grazing. The system will have a DC array capacity of 6.4 MW_{DC} and an AC output of 5 MW_{AC}. Details are contained on the layout provided by ITP Development and attached in Appendix B.

Approximately 12,100 solar modules will be installed in 140 rows (each row being ~103 m long and ~2 m wide) running north-south across the site. Each row of PV modules will rotate to track the sun across the sky from east to west each day. There is approximately 6.25 m spacing between each row. The hub height of each tracker is 1.53 m with the peak of the modules reaching a height of approximately 2.75 m when the array is fully tilted to 60 degrees from horizontal.

The solar farm will also contain two 3 MW inverter stations, located within the arrays and mounted on a 12.19 m skid. The inverter stations will incorporate High/Medium voltage switchgear and transformers.

The mounting system will be constructed on piles that are driven into the ground. Trenching requirements for low voltage cabling is around 600 mm and, for high voltage, is around 1,200 mm. During construction, which is expected to take approximately 3 months, there is expected to be around 50 personnel on site working from 7 am – 4 pm Monday to Friday. Once operational the site will be unmanned with maintenance expected to be carried out quarterly by a crew of 2 – 3 people.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

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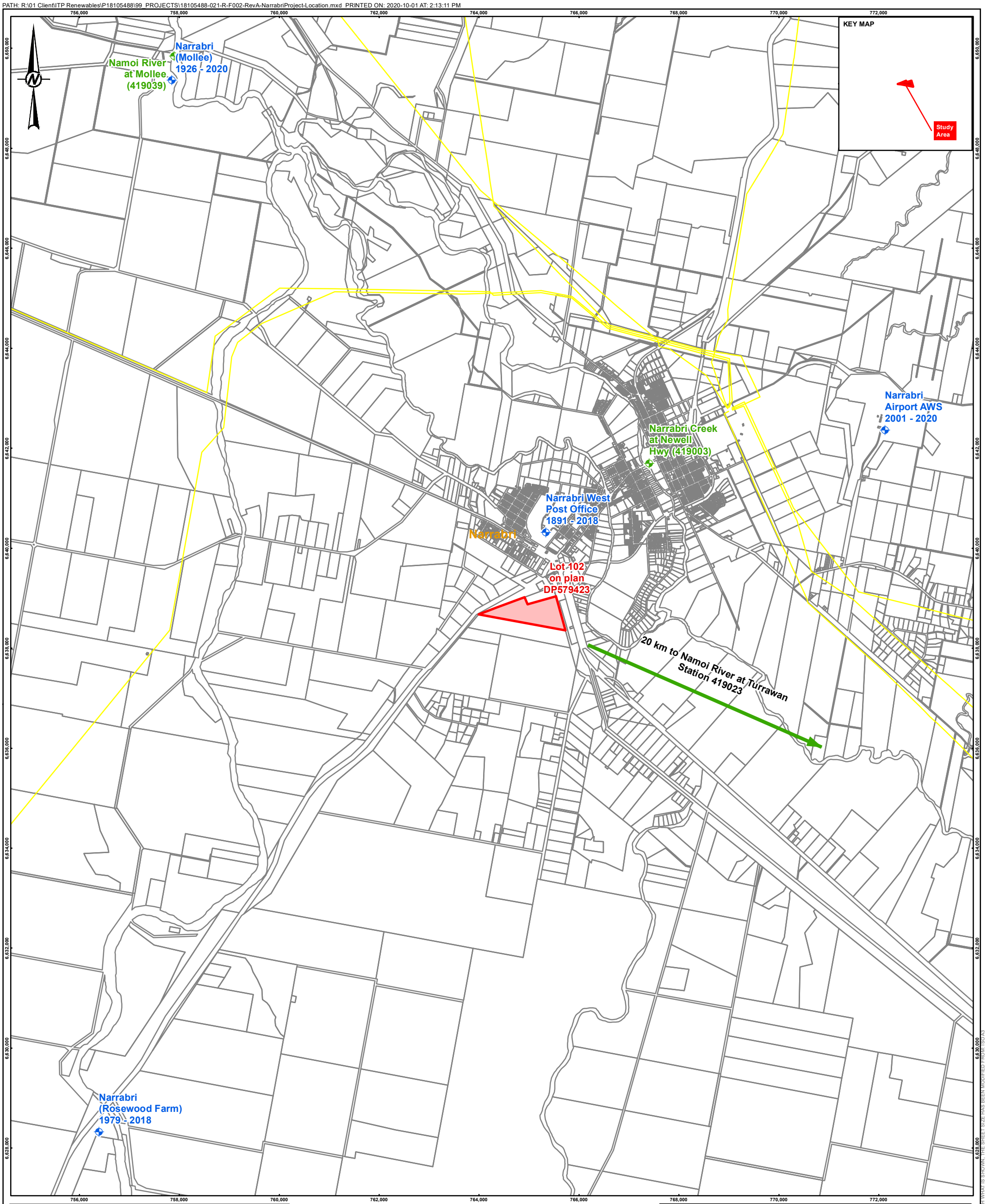

LEGEND

- BOM Stations
- Streamflow Locations
- Electricity Transmission Line
- Cadastre
- Lot 102 DP579423
- Denotes distance to streamflow station from site

0 1 2 3
Kilometers
1:70,000 @A3 KILOMETERS

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
Electricity Transmission Lines, Cadastre: © State of NSW (Spatial Services - Department of Finance, Services and Innovation) 2018
Rainfall Stations: WaterNSW 2018

CLIENT
ITP DEVELOPMENT PTY LTD

PROJECT
NARRABRI 3A SOLAR FARM

CONSULTANT
[redacted]

DD/MM/YYYY	01/10/2020
DESIGNED	HPB
PREPARED	HPB
REVIEWED	SB
APPROVED	SB

TITLE
PROJECT LOCATION

PROJECT NO.	CONTROL	REV.	FIGURE
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764,000

766,000

6,640,000

6,638,000

KEY MAP

Study Area

Narrabri Lake

COOMA ROAD

Unnamed Creek 1st Order

NEWELL HIGHWAY

Lot 102
on plan
DP579423

Unnamed Creek 2nd Order

KAMILAROI HIGHWAY

NAMOI RIVER

LEGEND

- 10 m surface elevation contours
- Roads
- electricitytransmissionline
- Hydroline
- Hydroareas (i.e. dams, lakes, etc.)
- Cadastre
- Vehicle Access Path
- Solar Farm Extent
- Lot 102 DP579423

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994

0 100 200 300 400 500

1:12,000 @A3 METRES

NOTE(S)

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Rainfall Stations: WaterNSW 2018

CLIENT
ITP DEVELOPMENT PTY LTD

PROJECT
NARRABRI 3A SOLAR FARM

CONSULTANT
[redacted]

DD/MM/YYYY	01/10/2020
DESIGNED	SD
PREPARED	SD
REVIEWED	JR
APPROVED	JR

TITLE
PROJECT AREA

PROJECT NO.	CONTROL	REV.	FIGURE
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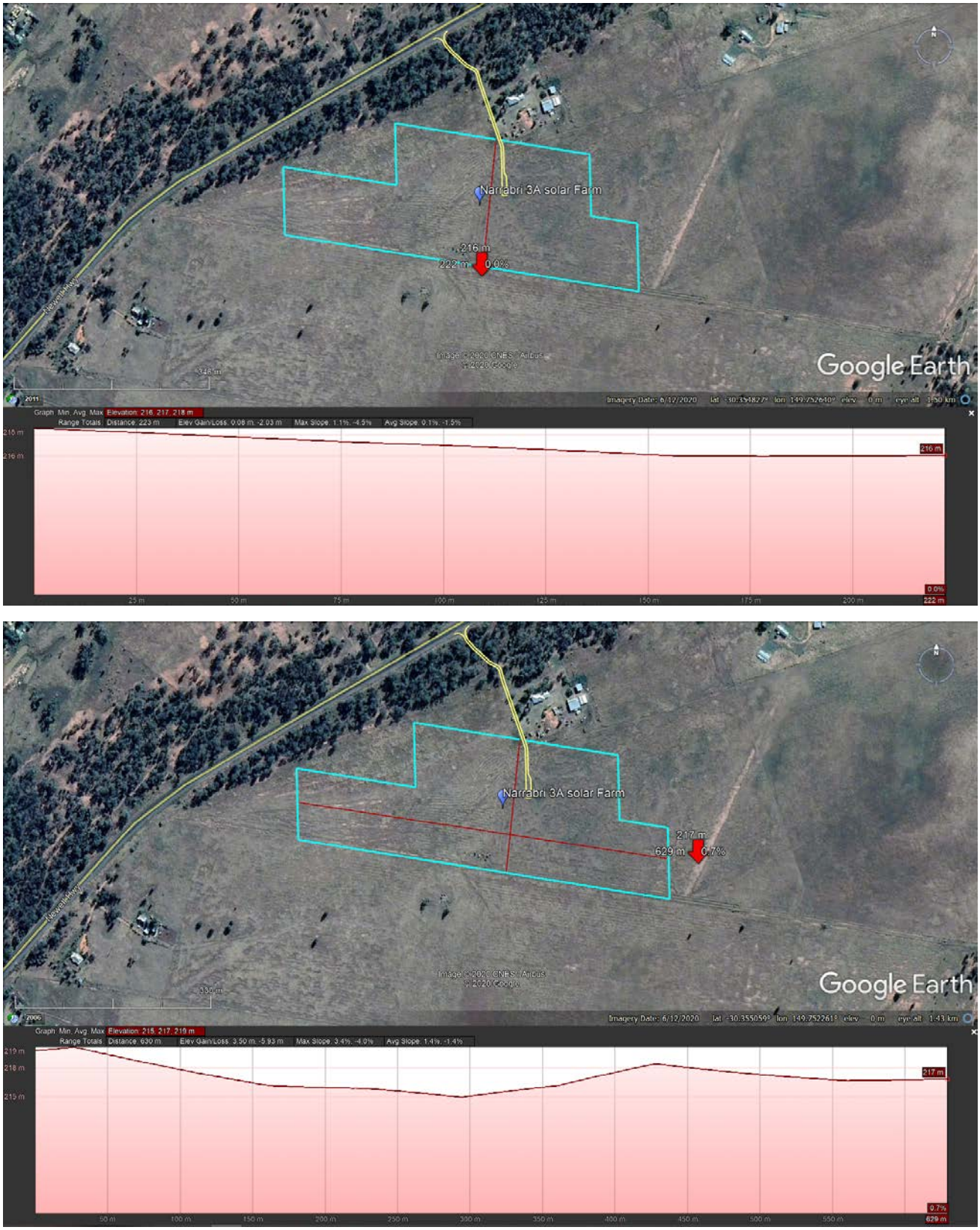

Figure 4: Project area elevation

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

3.0 LEGISLATIVE CONTEXT

NSW has a comprehensive legislative and policy framework for the management of floodplain risk and flood prone areas of the state with clear areas of responsibility as outlined below in Figure 5.

Figure 5: Floodplain risk management and planning process

3.1 Local Government Act 1993

This Act provides a legal framework for the NSW system of local government. The Floodplain Management Manual was gazetted in 2005 as the manual relating to the development of flood-liable land for the purposes of section 733. This section exempts councils from liability in relation to flood prone land provided they have undertaken assessments substantially in accordance with the latest manual.

The Floodplain Development Manual (NSW Government, 2005) is the approved Section 733 manual for flood prone land. The manual supports the NSW Government's Flood Prone Land Policy in providing for the development of sustainable strategies for the management of floodplains specifically in relation to human occupation. It provides a framework for councils to implement the policy and a process for managing floodplain risk.

3.2 Environmental Planning and Assessment Act 1979

This is an Act to institute an environmental planning system and assessment arrangements for NSW. In 2017 there were major amendments passed with a view to improving the planning system through simpler processes, improved strategic planning and community participation in order to enable more balanced and transparent decision making. Clause 3.43 makes provision for the preparation of development control plans by relevant authorities (outlined further in Section 3.4.1).

3.3 Water Management Act 2000

The Act provides for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. Water management principles intended to guide decision making under the Act in relation to floodplain management require the existing and future risk to human life and property arising from occupation of the floodplain to be minimised.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

3.3.1 Surface water sharing plan

The *Water Management Act 2000* applies to areas of NSW that have a water sharing plan. The Project area is located within the Water Sharing Plan for the Namoi and Peel Unregulated Rivers Water Sources 2012 area. The water sources for the area are listed as being the Upper Namoi and Maules Creek Water Sources.

Water sharing plans relate to the protection of surface water resources. The Namoi and Peel Unregulated Rivers Water Sources 2012 covers 31 unregulated surface water sources. As this plan relates to licencing and use of water resources under the *Water Management Act 2000*, it is not relevant for the Project (as no water extraction is proposed).

3.3.2 Groundwater sharing plan

The relevant groundwater sharing plan for the Project area is the Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources 2020 under the *Water Management Act 2000*. The site is within the Southern Recharge Groundwater Source area.

As this plan relates to licencing and use of water resources under the *Water Management Act 2000*, it is not relevant for the Project (as no water extraction is proposed).

3.3.3 Controlled activity approvals

Controlled activity approvals are a requirement of the *Water Management Act 2000* for activities that are defined as a controlled activity under the *Water Management Act 2000* (such as, earth works), and are carried out on waterfront land, which is the bed of any river, lake or estuary, and the land within 40 me of the riverbanks, lake shore or estuary mean high water mark.

A 2nd order drainage line flows through Lot 102 / DP579423 directly east of the Project area outside of the proposed Project footprint. This drainage line flows to Narrabri Lake located 1.5 km to the north. As shown in Figure 3, the proposed project footprint is approximately 500 m away from this drainage line. Given the setback to this watercourse is greater than 40 m, from the high water mark of the watercourse, a controlled activity approval is not required.

3.4 Narrabri Local Environmental Plan 2012

The Narrabri Local Environmental Plan 2012 (hereby referred to as the Plan) makes local environmental planning provisions for land in Narrabri in accordance with the relevant standard environmental planning instrument. The regional area covered by the Plan includes towns of Narrabri, Boggabri, Wee Waa and Bellata. It is noted that the Plan pre-dates the Narrabri Flood Study (Section 4.1).

The Plan details prohibited and permitted types of development within the local area. Some types of development are also regulated by particular state environmental planning policies.

The Plan (Part 6.2) provides specific management requirements for flood planning which applies to land at or below the flood planning level (1 in 100 ARI plus 0.5 m freeboard). It requires that development consent cannot be granted unless the proposed development is compatible with the flood hazard of the land, will not cause significantly adverse impacts to other developments, the environment and the community and incorporates measures to manage risk to life.

According to the flood planning map accompanying the Plan, the site is not considered to be within a mapped flood planning area (see Figure 6 with the Project area marked in red and Appendix C for the full Flood Planning Map - Sheet FLD_004B from the Local Environmental Plan). The closest flood planning area is located approximately 600 m to the north of the Project area, which is indicated by blue shading to the south of Narrabri Lake.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

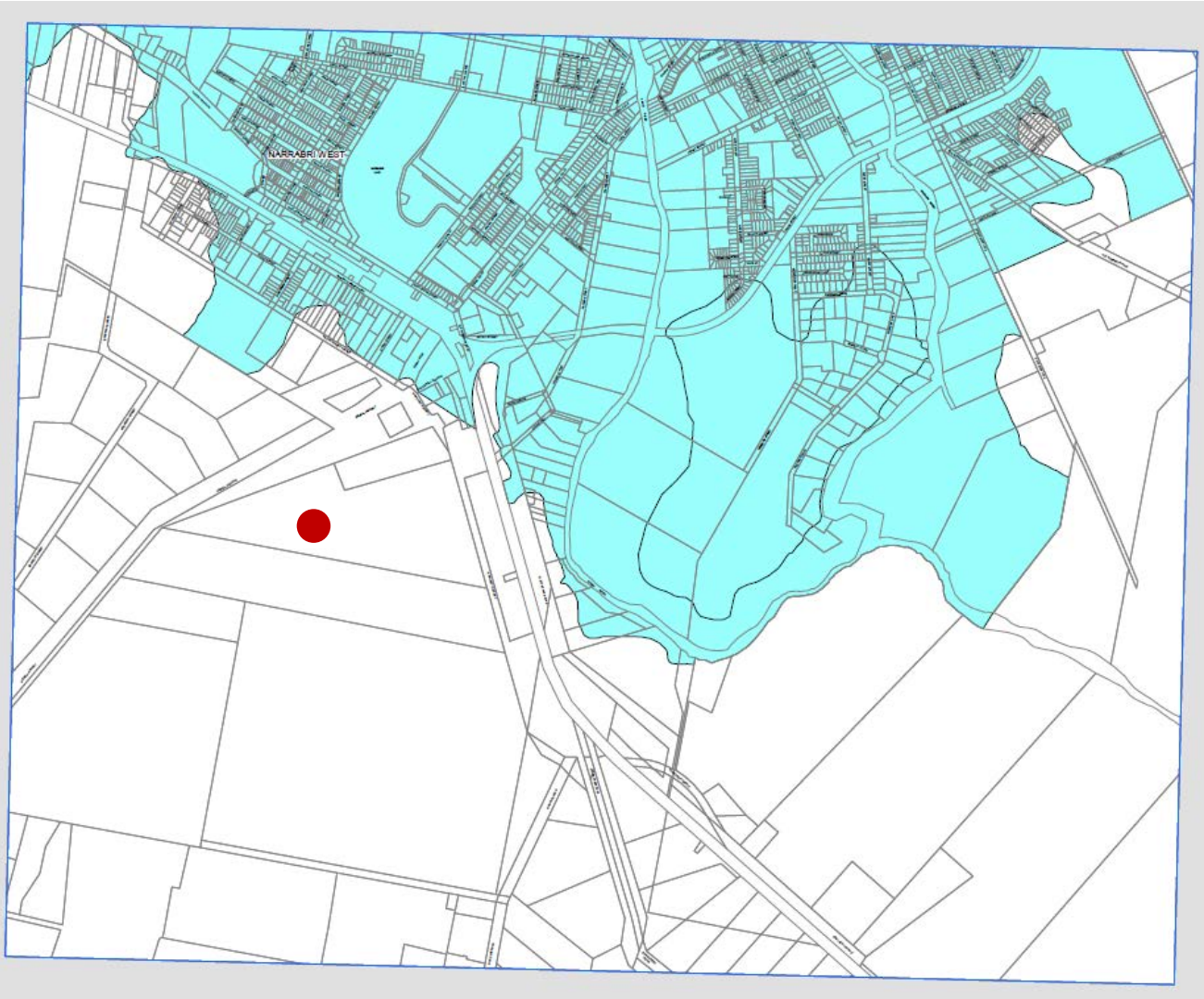

Figure 6: Flood planning area

The Plan provides additional provisions for earthworks to ensure that earthworks for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land.

Additionally, provisions for essential services require that the consent authority is satisfied that services such as the supply of water, electricity, stormwater drainage or on-site conservation, are available or that adequate arrangements have been made to make them available when required.

3.4.1 Narrabri Development Control Plan 2000

The Narrabri Development Control Plan 2000 (DCP) provides guidance for developments and supports the statutory planning controls of the Local Environmental Plan. The guidance provides proponents assistance with criteria to address in development applications, however this relates mostly to housing developments.

The DCP does not contains schedules relating to flood or stormwater management in relation to new developments.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

3.4.2 Narrabri Shire Community Strategic Plan 2027

The Narrabri Shire Community Strategic Plan is planned and executed under four key themes with a defined strategic direction:

- Theme 1: Our Society, Strategic Direction 1: Safe, Inclusive and Connected Community
- Theme 2: Our Environment, Strategic Direction 2: Environmentally Sustainable and Productive Shire
- Theme 3: Our Economic, Strategic Direction 3: Progressive and Diverse Economy
- Theme 4: Our Civic Leadership, Strategic Direction 4: Collaborative and Proactive Leadership.

The themes do not contain specific flood or water management aspects. However, within the 'Our Environment' theme, one strategy includes the conservation and management of natural water resources for environmental and agricultural sustainability to meet an objective of reducing and managing natural resource consumption (keeping water supplies resourced and waterways clean).

3.4.3 Narrabri Shire 2040 Local Strategic Planning Statement

The purpose of the Local Strategic Planning Statement (LSPS) is to outline the Narrabri Local Government Area's (LGA) economic, social and environmental land use needs over the next 20 years

The LSPS gives effect to the New England North West Regional Plan 2036 (NENWRP), implementing the directions and actions at a local level. It is also informed by other state-wide and regional policies including Future Transport Plan 2056 and the State Infrastructure Strategy. The LSPS outlines how these plans will result in changes at the local level, such as new or improved transport connections.

The LSPS works with Council's Community Strategic Plan, which has a similar but broader purpose on how Council will work to meet on the community's needs. The LSPS has been derived from the community strategic visioning process that was conducted as part of the Community Strategic Plan.

The LSPS identifies the following actions that council will undertake to ensure that developments are not located in areas identified as high flooding risk:

- Complete Flood Studies for Wee Waa, Narrabri, Boggabri
- Complete Flood Risk Management Plans for Wee Waa, Narrabri, Boggabri
- Amend the LEP zones to restrict development in high flood-risk constrained areas.

3.5 State Environmental Planning Policy (Infrastructure) 2007

Division 4 of the State Environmental Planning Policy (Infrastructure) 2007 relates to 'Electricity generating works or solar energy systems'. The policy relates to the approval process for solar energy systems, and there are specific details required for flood liable land which means land that is susceptible to flooding by a probable maximum flood event. The policy states consultation with the relevant council is required if the proposal will alter flood patterns other than to a minor extent and their response must be taken into consideration.

The Project area is not in an area mapped as being within the flood planning area under the Local Environmental Plan.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

3.6 Protection of the Environment Operations (POEO) Act 1997

The POEO Act aims to protect and restore and enhance the quality of the environment in NSW, while still having regard to ecologically sustainable development.

With relevance to the site, the Act aims to reduce risks to human health and to prevent degradation of the environment by promoting pollution prevention and the reduction in the use of materials and the re-use, recovery or recycling of materials. The Act contains the requirements for the management of water discharges and also the offences that relate to pollution. Section 148 requires that any pollution incidents or those that threaten material harm to the environment must be notified to the relevant authority (e.g., NSW Environment Protection Authority).

3.7 Soil Conservation Act 1938

This Act makes provision for the conservation of soil resources and for the mitigation of erosion. The act allows the Minister for Primary Industries[1] to issue soil conservation notices, declare areas to be sites of erosion hazard, proclaim works in catchment areas and outlines specific regulations regarding the Rural Assistance Act 1989.

Of general relevance to this Project is the promotion of sustainable use and prevention of loss of soil resources from a site.

[1] Except Parts 2A, 3 and 4, and sections 15 and 30A in so far as they relate to Parts 2A, 3 and 4, jointly with the Minister for the Environment

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

4.0 CATCHMENT AND FLOOD HISTORY

The Project site is located in the Narrabri Shire Council LGA, 4.5 km south-west of the town of Narrabri. The proposed facility is located 1.2 km west of the Namoi River (Figure 3). The township of Narrabri is located on the Namoi River floodplain and is drained by a number of smaller tributaries including Mulgate Creek, Horsearm Creek and Long Gully. Narrabri has experienced above floor flooding from each of these sources on a regular basis in the past (WRM Water and Environment, 2016).

The proposed facility is located 1.2 km west of the Namoi River. The Project area is relatively flat, with the land gently sloping towards the south and west by 2 and 3 metres, respectively, ranging between 219 mAHD in the west and 215 mAHD in the south (Figure 4).

A 2nd order drainage line flows through Lot 102 / DP579423 directly east of the Project area outside of the proposed Project footprint. This drainage line subsequently flows to Narrabri Lake located 1.5 km to the north. The land is mostly cleared of native vegetation and has historically been used for grazing, though was recently destocked (Figure 3).

4.1 Narrabri Flood Study 2016

The Narrabri Flood Study: Namoi River, Mulgate Creek and Long Gully (WRM Water and Environment, 2016) aimed to:

- Determine the flood behaviour including design flood levels over the full range of flooding up to and including the Probable Maximum Flood (PMF) from both the Namoi River and the local tributaries;
- Provide a model that can establish the effects on flood behaviour of future development;
- Assess the sensitivity of flood behaviour to potential climate change effects such as increases in rainfall intensities; and
- Assess the provisional hydraulic categories and undertake mapping of provisional hazard, preliminary emergency response planning classifications, and preliminary flood planning extent areas.

This study was commissioned by Narrabri Shire Council, with funding assistance administered by the NSW Office of Environment and Heritage (OEH), to define the flood behaviour at Narrabri.

The study identified three catchments for the flood study, that were further divided into 69 sub-catchments. The Project site is located within the Long Gully catchment, with the subject land parcel straddling both the Narrabri and Long Gully catchments.

The study assessed the Annual Exceedance Probability and the Probable Maximum Flood (PMF) extent for Long Gully catchment (at the Narrabri Walgett Railway). The PMF is described as the limiting value of floods that could reasonably be expected to occur. The PMF discharge estimate for Long Gully was calculated to be 480 m^3/s.

The report notes that the 1955 flood was the highest on record, marginally higher than the 1910 flood. The hydraulic model was calibrated to the recorded water level data for three Namoi River flood events including the 1955, 1971 and 1998 floods. However, the two largest flooding events that occurred within the last 20 years were in December 2004 and February 2012.

Figure 7 shows the predicted February 2012 flood extents for Mulgate Creek and Long Gully catchments as derived by the model. The recorded Narrabri Creek at Narrabri (GS419003) gauge flows were used to represent the Namoi River/Narrabri Creek flow that occurred during the event. The peak Namoi River flow during the event was approximately 1,500 m^3/s, which had an AEP of between 10% and 20%.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

Some minor flooding at the east of the subject lot associated with the 2nd order drainage line that connects to the Narrabri lake has been predicted by this flood study. The majority of the Project footprint does not fall within this predicted flood level, however the western extent of the Project site may be impacted by flooding during a similar event, as shown in Figure 7 with the Project area marked in red.

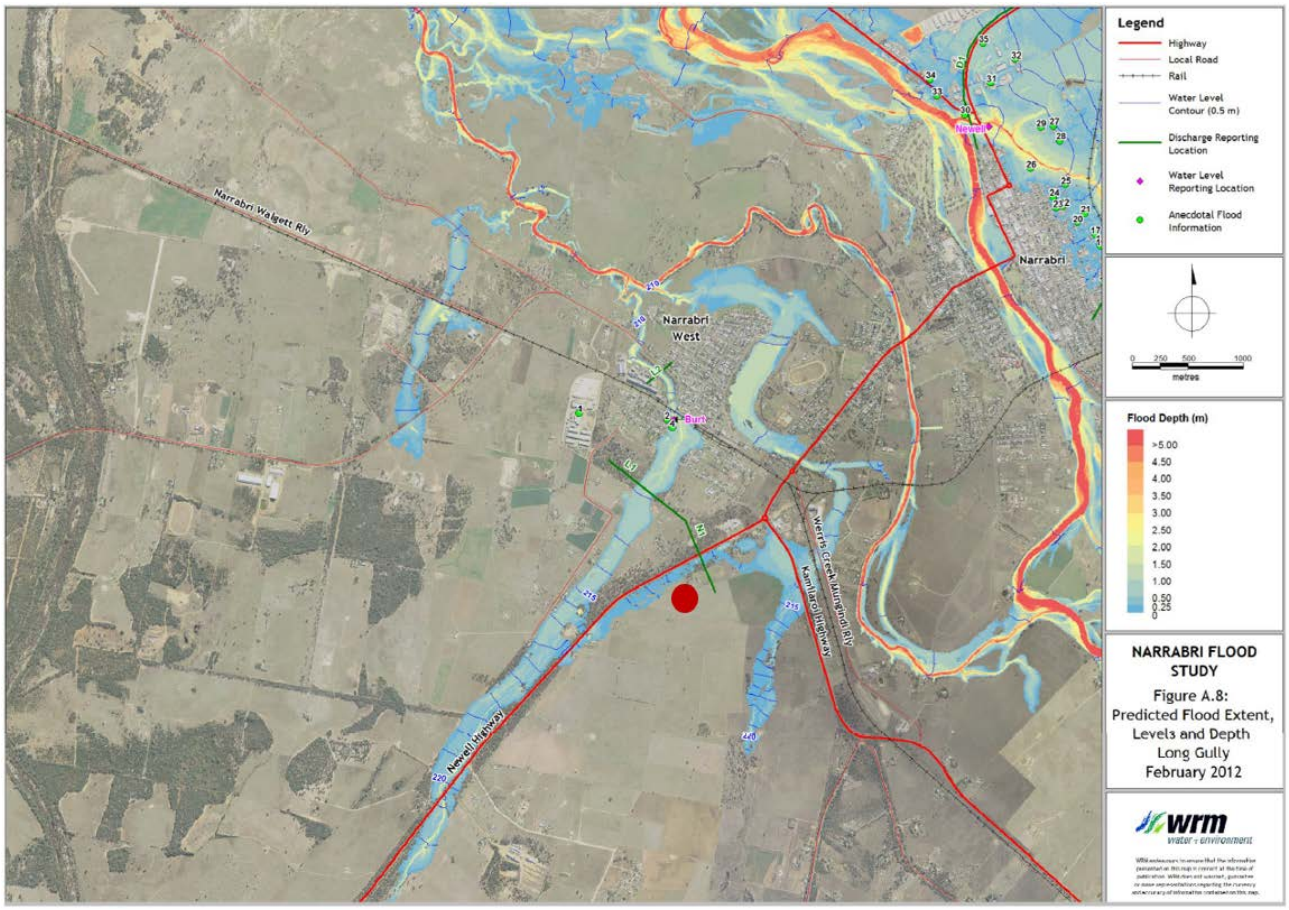

Figure 7: Long Gully catchment – predicted flood extent

Design event mapping shows that the 2004 event had an AEP of between 5% and 2% in Mulgate Creek and Long Gully, and the 2012 event had an AEP of between 5% and 2% in Mulgate Creek and about a 5% AEP in Long Gully. Note that these flow distributions assume that the levees and bunds do not fail during flooding. The flow distributions and flood levels could potentially change if the levees and bunds fail. A description of flooding for the various events in the Mulgate Creek and Long Gully catchments are given below.

4.2 Narrabri Floodplain Risk Management Study and Plan 2019

The Narrabri Floodplain Management Study and Plan (FMSP) (WRM Water and Environment, 2019) was developed to update the flood modelling conducted for the 2016 Narrabri Flood Study to bring the modelling up to date. Accordingly, the results presented in the Floodplain Management Study and Plan supersede the 2016 Flood Study.

The flood modelling results show that regional flooding poses the greatest threat to the developed areas of Narrabri. Significant areas of Narrabri are liable to flooding to varying levels of risk. Any development within flood prone areas would therefore be considered to be in a flood hazard zone as they are prone to damage if mitigation measures are not implemented. Provisional hydraulic hazard mapping has been prepared by combining the hazards from both local and regional flooding (WRM Water and Environment, 2019). Appendix D shows the provisional hydraulic hazard categories in the study area from a combination of local and regional

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

catchment flooding. Provisional hydraulic hazards have been defined using the depth and velocity of the floodwaters calculated using the flood model as prescribed by the NSW Floodplain Development Manual (NSW Government, 2005). These predicted hazard maps indicate the site is within the Low Hazard category for 1%, 2%, 5%, 10%, 20% AEP and Extreme Events.

The FMSP recommends future updates to the Local Environmental Plans and Development Control Plans to consider the modelled flood planning levels.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

5.0 AVAILABLE DATA

Climatic data and water quantity and quality monitoring information is available in the region as outlined in the following sections.

5.1 Rainfall

The Bureau of Meteorology (BOM) has four stations in and within proximity to Narrabri (Figure 2), being Narrabri West Post Office (station 053030) located 2 km north of the site, Narrabri Airport AWS (station 054038) located 8.5 km north-east of the site, Narrabri (Mollee) (station 053026) located 13 km north-west of the site and Narrabri (Rosewood Farm) (station 0531030) located 13 km south-west of the site. Table 1 outlines the average annual, maximum annual, maximum daily and maximum monthly rainfall. Average monthly values for the two rainfall stations are in Table 2.

Table 1: Rainfall

Station Number	Station Name	Period of Record	Rainfall (mm)			
			Average Annual	Highest Annual	Maximum Daily	Highest Monthly
053030	Narrabri West Post Office	1891 - 2018	658.5	1012.1	159	307.0
054038	Narrabri Airport AWS	2001 - 2020	540.5	891.4	125.2	247.4
053026	Narrabri (Mollee)	1926 - 2020	595.9	1002.6	178	293.4
053103	Narrabri (Rosewood Farm)	1979 - 2018	678.0	992.8	195.5	406.9

Table 2: Average Monthly Rainfall

Station Number	Rainfall (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
053030	82.9	61.1	60.0	38.1	46.7	49.0	45.2	39.9	40.8	51.4	60.3	75.7
054038	69.1	58.3	60.5	28.2	23.9	48.4	28.2	29.4	31.0	36.6	70.9	64.6
053026	84.0	66.6	48.9	33.8	42.9	40.8	39.4	33.3	35.7	49.4	60.9	63.4
053103	83.9	64.1	41.5	25.1	47.8	50.0	47.6	30.5	44.6	47.6	76.3	87.2

Flood producing weather systems across the region include inland troughs, cold fronts, and thunderstorms. Consequently, each rainfall event is a function of the prevailing meteorological conditions. Therefore, the rainfall data provides useful information about expected seasonal rainfall in the area.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

5.2 Streamflow

There are three government surface water monitoring sites located within 20 km of the site. Streamflow records (Table 3) for these sites are available for various locations in the region from the WaterNSW portal.

Table 3: Stream Gauging Stations

Station Number	Station Name	Available/Relevant Data	Distance from project area
419003	Narrabri Creek at Newell Hwy	Level, discharge, EC, water temp	1.5 km north
419039	Namoi River at Mollee	Level, discharge, EC, water temp, turbidity	13 km north-west
419023	Namoi River at Turrawan	Level, discharge	13 km south-east

Generally, data from the available stream gauges do not provide specific information on local site flooding but are more useful in the context of assessing major regional flooding events which may impact on site access. Information is publicly available from WaterNSW Real-time data portal and could be incorporated into site management plans.

5.3 Groundwater

The Project area falls within the Namoi catchment area where groundwater sources include:

- Alluvium of the Upper and Lower Namoi River, Great Artesian Basin, Peel Valley and Barwon region
- Fractured rock aquifers of the New England Fold Belt, Warrambungle Basalt, Liverpool Ranges Basalt and Peel Valley
- Porous rock aquifers associated with the Gunnedah Basin, Great Artesian Basin and Oxley Basin.

The lower part of the catchment to the west of Narrabri is underlain by the aquifers of the Great Artesian Basin. This is one of the largest artesian basins in the world covering 1.7 million km^2 or 22 per cent of Australia (Crabb, 1997) and containing an estimated 8,700 million ML of artesian water (Thoms et al. 2004).

Shallow aquifers that are highly connected to the river system are common in the Peel and Upper Namoi and as a result levels are highly dependent on surface water flows. As expected in these areas the quality of the water is high and suitable for most purposes. Water quality deteriorates towards the western end of the catchment where groundwater quality is brackish to saline, and is sometimes too salty for stock (Figure 8). The aquifers of the Great Artesian Basin have high levels of sodium which make them unsuitable for irrigation use. However, the water from these aquifers is generally suitable for domestic and town water supply (NSW Office of Water, 2011).

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

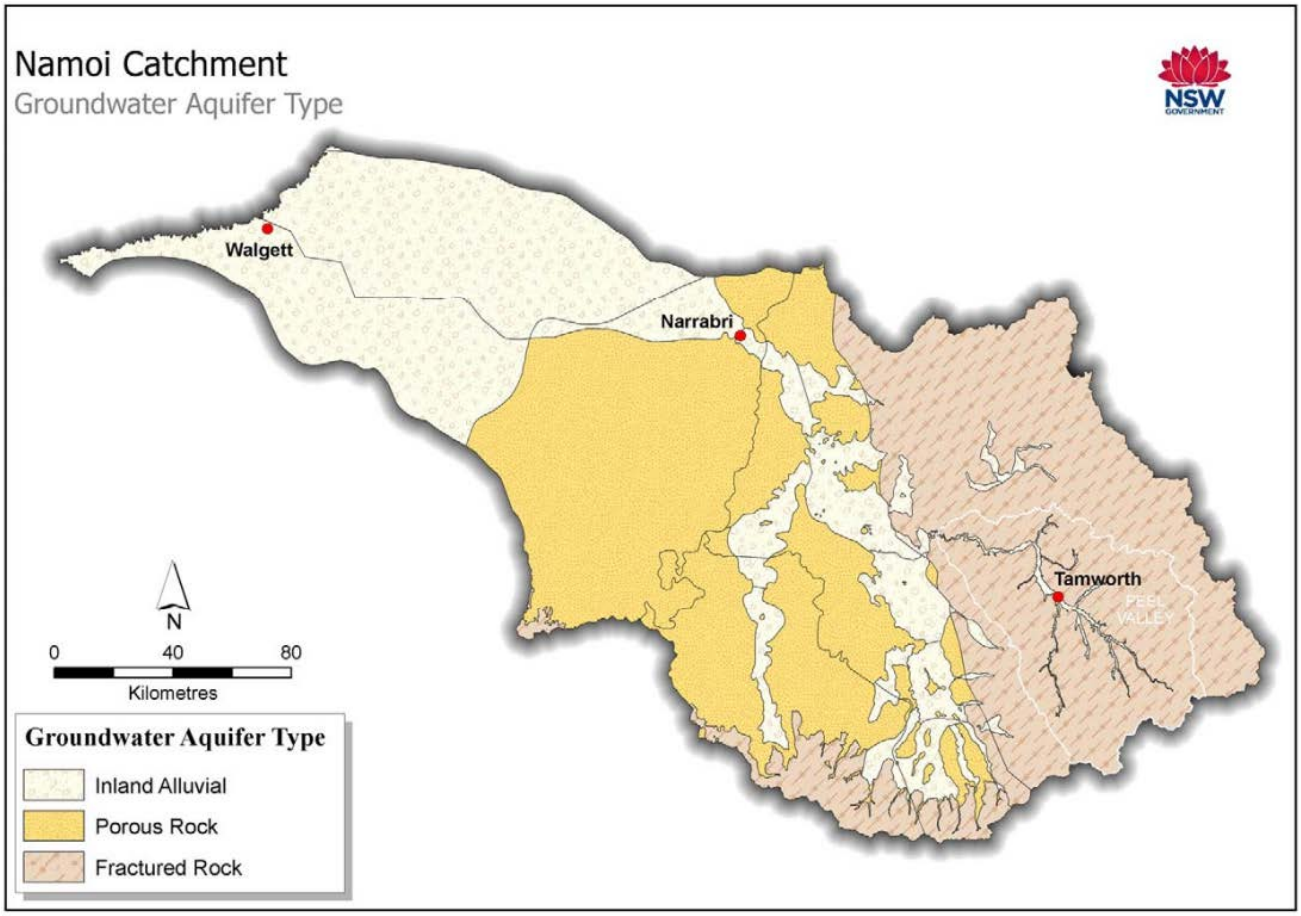

Figure 8: Namoi Catchment Groundwater Aquifer Type (NSW Office of Water, 2011)

The NSW Great Artesian Basin (GAB) Groundwater sources comprise all water contained in the sandstone aquifers of the GAB. The aquifers are comprised of predominantly sandstones, confined by aquitards of both fluvial and marine siltstones, mudstones and shale. These are described as the geological formations of the Cretaceous and Jurassic age, 65 to 210 million years old, belonging to the GAB, and the intake beds of the GAB. The GAB has been divided into five groundwater sources, for management purposes. Two of these (the Eastern and Southern Recharge Groundwater Sources) are in the non-artesian part of Basin. The remaining three (Surat, Warrego and Central Groundwater Sources) are in the artesian part of the Basin, where water in bores flows naturally to the surface (Department of Water and Energy, 2009).

The Southern Recharge Groundwater Source is bounded by outcrops of Gunnedah - Oxley Basins to the east, the Surat Groundwater Source to the west and Lower Macquarie groundwater sources to the south. The Southern Recharge Groundwater Source overlies the Lachlan Fold Belt in the west and the Gunnedah Basin in the east. It in turn underlies the Warrumbungle Basalt Groundwater Source and parts of Lower Namoi, Upper Namoi, Upper Macquarie and Castlereagh alluvial groundwater sources.

The Southern Recharge Groundwater Source increases in thickness northward and westward, being up to 300 m thick in its north-west portion. Recharge to the Southern Recharge Groundwater Source occurs directly through exposed out crops of Pilliga Sandstone and via overlying strata. The recharge takes place as diffuse rainfall recharge as well as leakage from overlying alluvium and rivers. The groundwater flows from the east to a westerly direction in this groundwater source (Department of Planning, Industry and Environment, 2020).

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

The groundwater is used for stock, domestic, industrial, irrigation and town-water supply purposes. The low sodium content and low salinity of this groundwater make it suitable for irrigation. Moderate scale groundwater irrigation occurs near Narromine, Collie, Gilgandra and Narrabri with the bores yielding up to 50 L/s (Department of Planning, Industry and Environment, 2020).

WaterNSW monitors groundwater level, pressure and quality through its network of groundwater observation bores across NSW. Monitoring bores are designed to monitor a specific aquifer for water level and water quality. The nearest bore screened within the Southern Recharge Groundwater Source is GW030123, located approximately 500 m north of the Project site. Long-term data from this bore (Figure 9) indicates a relatively stable water level which is impacted by seasonal fluctuations.

The nearest real time Groundwater Monitoring Site on the Water NSW database (WaterNSW, 2019) is located approximately 5 km north of the Project site at Narrabri Speedway (Site no. GW030121.1.3). The levels recorded on 1 October 2020 indicated that the bore level below MP was 9.505 m and the ground water level 202.135 m AHD (Figure 10).

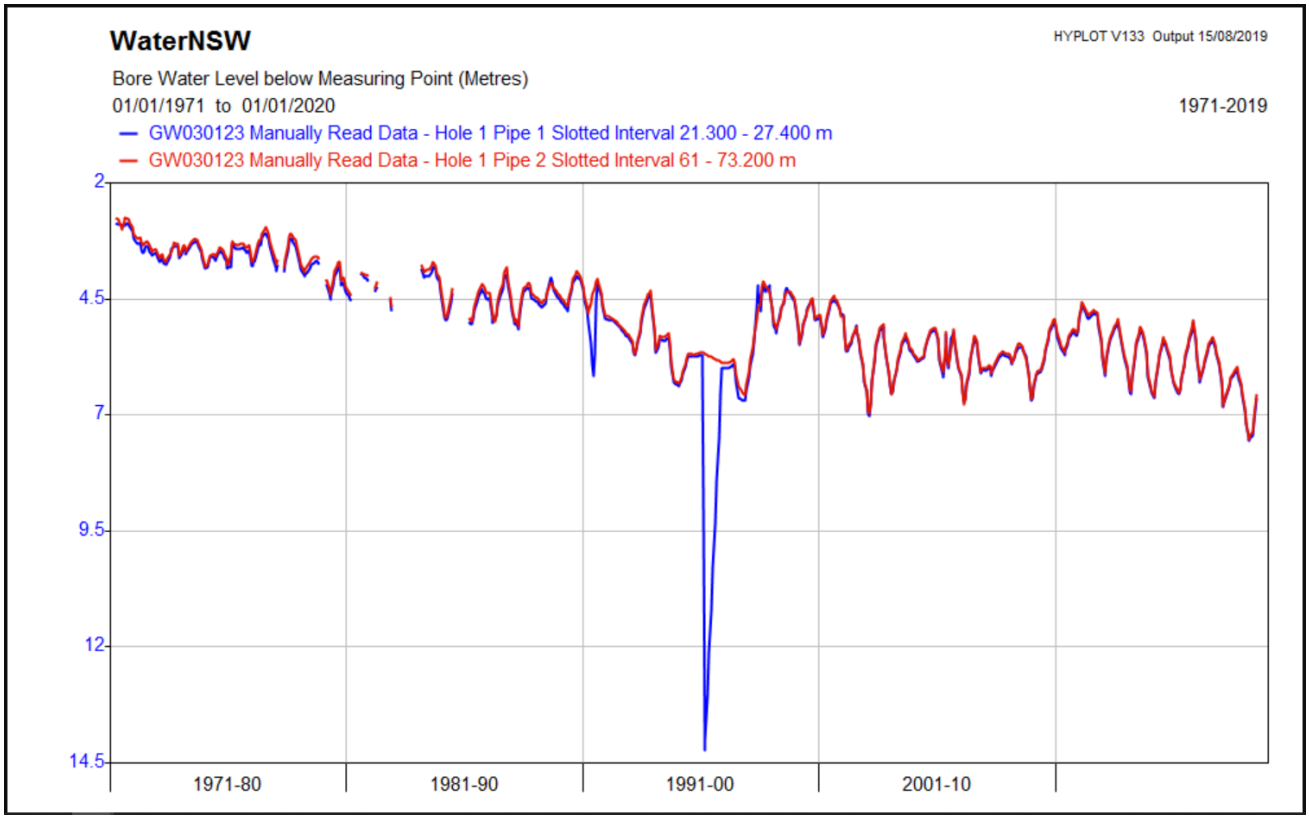

Figure 9: Southern Recharge Groundwater Source bore levels in GW030123

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

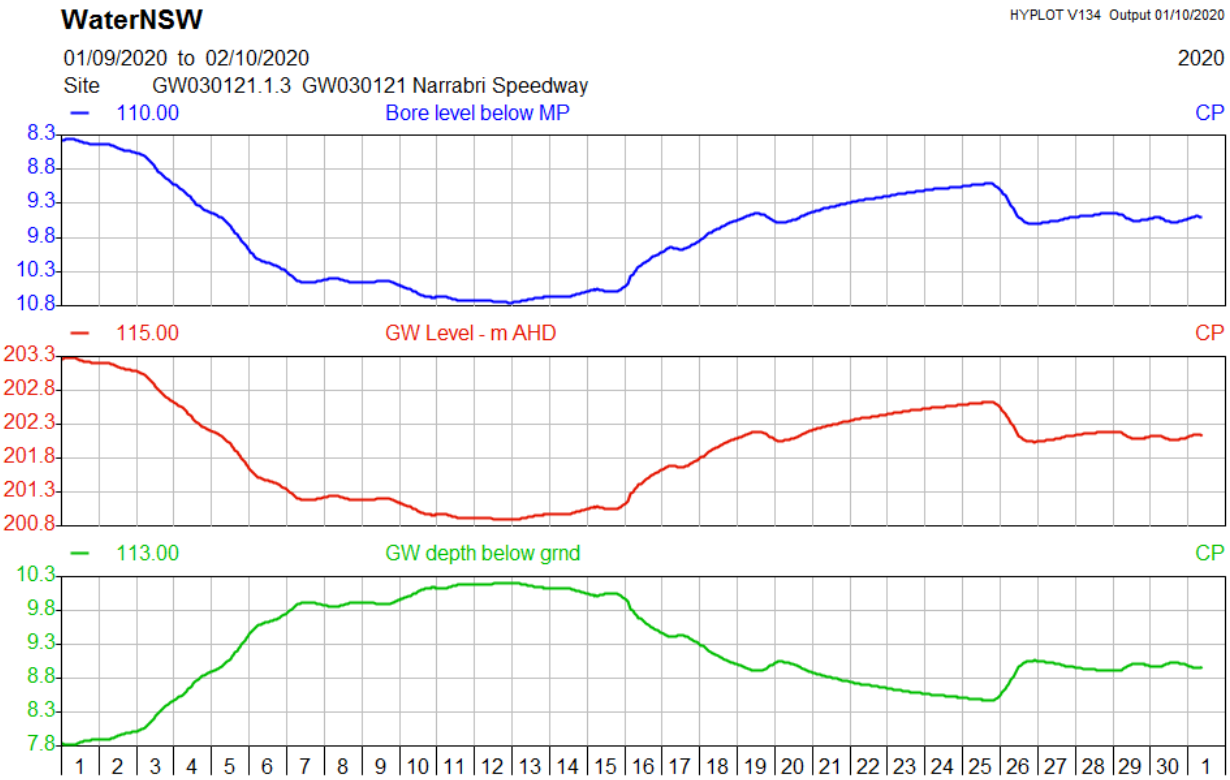

Figure 10: Narrabri Speedway GW030121.1.3 groundwater levels (levels recorded on 1 October 2020)

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

6.0 POTENTIAL IMPACTS

The site is not located within any mapped areas that may be sensitive to flooding or groundwater impacts as prescribed by the LEP.

Accordingly, proposed on-site activity is not expected to materially contribute to any regional groundwater issues, particularly those associated with nearby irrigation districts. Proposed trenching would be to a maximum 1,200 mm deep and piling would extend to a maximum depth of 1.5 m, which is expected to be above the local groundwater level.

Generally, there are two potential impacts a solar farm could have on flooding and runoff external to the Project Area:

1) Impacts on riverine flood levels due to the Project Area obstructing flow.

2) Impacts on flood levels due the impervious nature of development surfaces associated with the Project causing more rapid runoff.

Based on the current available information, potential adverse surface water-related impacts at the site include:

- Site accessibility and inundation
- Managing downstream sedimentation.

As there will be no extraction of groundwater or interference with the groundwater table during Project activities, potential for impacts to groundwater have not been considered further.

6.1 Flooding

Flood planning maps refenced by the LEP indicate that site is not within an area likely to flood. However, heavy rainfall during storm events (or flash flooding) may cause disruption during construction activities or for material suppliers.

The Narrabri Flood Study 2016 (WRM Water and Environment) modelled predicted flood extents, depths and flood contours for the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP and the PMF, in the context of both regional scale flood events and localised flood events. Appendix E shows the modelled extents of flood impacts under each of these scenarios.

Regional flooding has no impacts under each of the above AEP scenarios, however, flood impacts under the extreme event scenario at the northern extent of the lot (although beyond the proposed development site) up to 2 m are predicted.

Local flooding may have impacts in the northern extent of the lot of up to 0.5 m under the 20% and 10% AEP, up to 1 m under the 5%, 2% and 1% AEP, and up to 2 m of flood impacts in an extreme event. With the exception of the extreme event, none of these scenarios will significantly impact the area of the proposed Project development footprint.

Within the model, the flood storage was defined by the 1% AEP flood extent outside the floodway areas, while the flood fringe was defined by the residual area between the 1% AEP extent and the extreme event extent. The proposed Project area is therefore within the flood fringe, however, the results of the modelling showed that these non-floodplain areas were not inundated during flooding events (i.e., the hill slope areas on the fringe of the hydraulic model (WRM Water and Environment, 2016)). Additionally, development in the flood fringe areas is not expected to have any significant effect on the pattern of flood flows.

As a 2nd order drainage line exists within the land parcel, to the east of the Project footprint, there is potential for localised overland flow during rainfall.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

Additionally, the flood study identifies potential flood hazard areas along the apron of the Newell Highway and associated with the drainage line.

Given any modelled flood impacts are limited to a small area within the most northern extent of the lot, though generally not intersecting the Project footprint, potential impacts from runoff obstruction (blockage) due to the solar farm would be limited. Solar panel pile depths will be in the range of 1.5 m bgl, with any excavated areas around the site backfilled and cover reinstated following installation.

A study conducted by Cook and McCuen (2013) concluded that solar panels themselves do not have a significant effect on catchment runoff volumes, peaks, or times to peak for flood events, unless the runoff characteristics of the final ground cover under the panels is increased. Potential impacts of the solar farm obstructing the relatively shallow overland flow observed in the catchment are therefore considered likely to be negligible.

Similarly, the solar panel structure will be sufficiently designed and constructed to withstand impacts to the stability and integrity of the panels from any inundation or overland flow that may occur due to flooding. The solar panels will be elevated above modelled maximum flood levels, and the pilings will be installed to sufficient depths and may also be fitted with a 300 mm concrete collar if required, depending on soil type.

6.2 Water quality and erosion

The Project has the potential to alter existing water quality conditions within the site. The impervious area of solar facilities is typically only marginally increased owing to associated hardstand and building areas. However, the panels may impact the nature of vegetation/grass coverage on the site, which has the potential to increase surface runoff and peak discharge. Increased flow concentration off the panels also has the potential to erode soil at the base of solar panels (Cook & McCuen, 2013).

Furthermore, as the site has been historically used for grazing there is very little natural ground cover vegetation.

The Project site occurs on soils that are characterised as grey sodosols. Sodosols are texture-contrast soils with impermeable subsoils due to the concentration of sodium. These soils are slowly permeable and poorly drained, run on is moderate and runoff is low. Generally. Sodosols have a low-nutrient status and are very vulnerable to erosion and dryland salinity when vegetation is removed (Office of Environment and Heritage, 2017).

There is the potential that site runoff will contain sediments and increase turbidity or impact water quality parameters in downstream water ways. The existing farm dam should capture surface flow from the site and reduce sedimentation downstream.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

7.0 PROPOSED MITIGATION MEASURES

7.1 Site accessibility and inundation

The site accessibility and potential for inundation issues may be managed in the project's risk management register(s) owing to the regional nature of the events and the potential to impact whole of site works. There should be procedures in place to halt construction during heavy rainfall to reduce impacts to the project construction and also to increase sedimentation downstream.

7.2 Downstream sedimentation

Impacts associated with erosion and sedimentation resulting from construction activities can be minimised by undertaking works in accordance with provisions of the NSW government's best practice sediment and erosion control series Managing Urban Stormwater: Soils and Construction (DECC, 2008).

Proposed mitigation measures associated with managing downstream actionable nuisance (sedimentation) are outlined in Table 4.

Table 4: Proposed Mitigation Measures

Stage	Measure	Activities/Approach
Design	Site drainage and water quality controls	Design Basis ■ Undertake hydrological assessment of the catchment in which the site sits in accordance with relevant methods outlined in Australian Rainfall and Runoff. ■ Determine sediment management targets and drainage control standards in accordance with Managing Urban Stormwater: Soils and Construction Vol 1 (Blue Book) (DECC, 2008). ■ Develop a site erosion and sediment control plan in accordance with the Blue Book. ■ Develop site drainage design incorporating detention basins and sedimentation management structures where relevant. ■ Permanent site drainage should coincide with temporary arrangements where possible.
Construction and/or Demolition	Site drainage and water quality controls	General site works: ■ Project construction period to occur entirely within the dry season to prevent flooding, sedimentation and water quality impacts to waterways. ■ Catch drains to be located downslope of any proposed road works. ■ Install location appropriate sediment fences or other applicable control measures depending on whether the feature is upstream or downstream of a disturbed part of the site or will need to be trafficable. ■ All stormwater collection points need to have appropriate sedimentation and erosion controls.

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

Stage	Measure	Activities/Approach
		■ Undertake ongoing inspections of stormwater facilities and water control measures to assess their effectiveness. ■ Vibration grids or wash bays at all construction exits. ■ Level spreaders at locations where concentrated flow is discharged offsite to ensure sheet flow like conditions are maintained. ■ Flat land erosion control options include erosion control blankets, gravelling, mulching, soil binder, turfing and revegetation.
Construction and/or Demolition	Stormwater point source control	In the event of concrete works: ■ Do not undertake works if chance of heavy rain. ■ Store rinsate[2] water, if applicable, separately to other water on site and dispose of offsite as appropriate. ■ Block on site drains in the area of the works and remove any contaminated runoff. In the event that dewatering practices are required: ■ Pump hose intakes for withdrawing water from excavations will be elevated to minimise sediment pumping and directed to a containment area for settling prior to discharge. ■ Limit direct discharge off site (consistent with the design requirements for sediment pond discharge). ■ Stormwater collected on site should be reused where possible. Controls should be inspected and maintained on a regular basis. All water released from sediment basins should be clear or disposed off site by vehicle. ■ Material and waste storage areas should be designed and operated to minimise interaction with surface waters. ■ Vehicle washdown areas should be located away from water courses.

[2] A dilute solution of chemical resulting from washing the container and equipment with water, as defined by NSW EPA accessed 20 December 2018 https://www.epa.nsw.gov.au/licensing-and-regulation/licensing/environment-protection-licences/authorised-officers/glossary#r

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

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Version: 1, Version Date: 12/04/2021

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Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

Signature Page

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Senior Environmental Scientist

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Principal Environmental Scientist

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https://golderassociates.sharepoint.com/sites/29921g/deliverables/r-021-narrabri3a-water/18105488-021-rev2-narrabri3a-waterassess.docx

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

APPENDIX A

Important Information Relating to this Report

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

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Version: 1, Version Date: 12/04/2021

APPENDIX B

Proposed Layout

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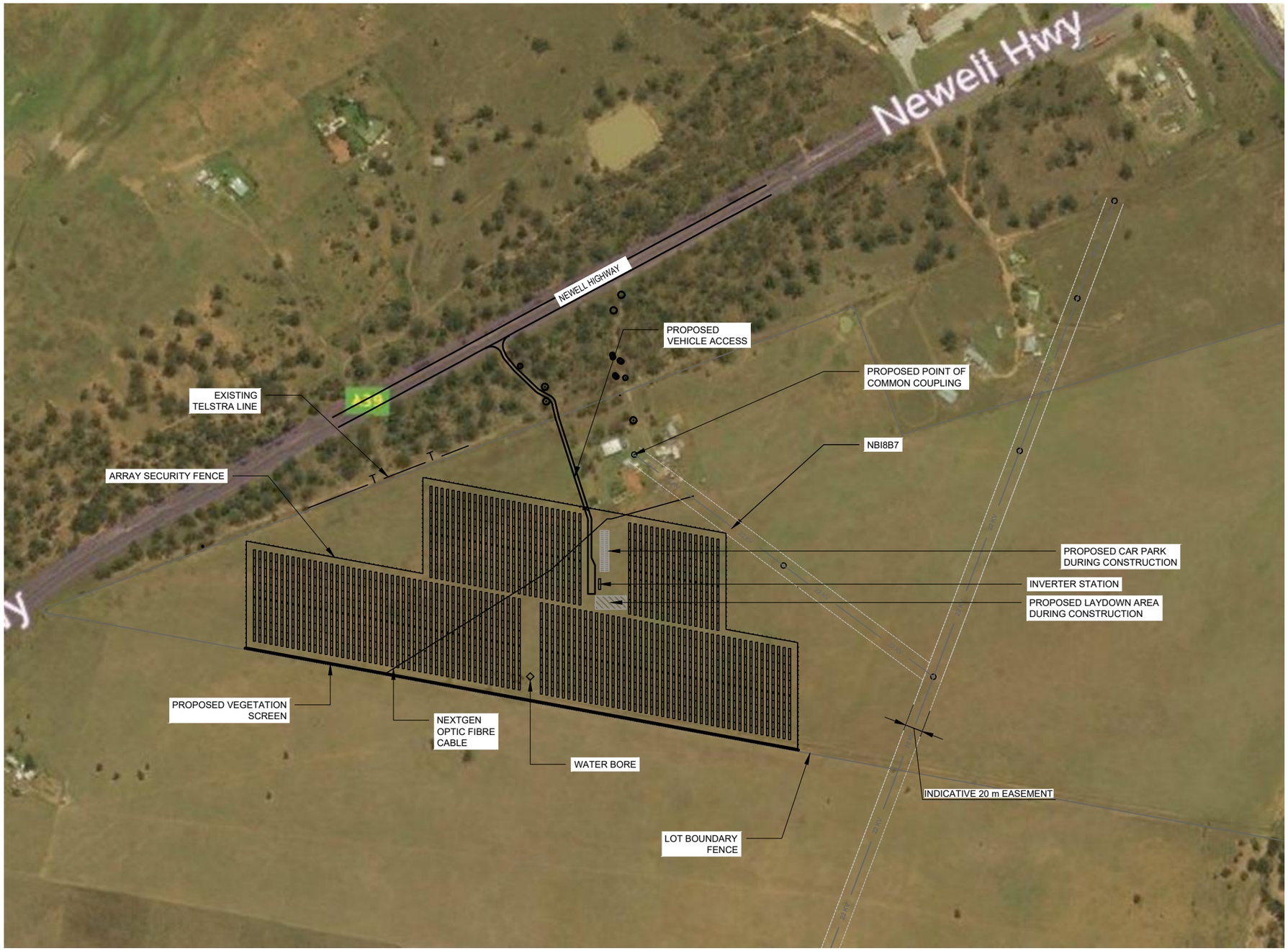
Version: 1, Version Date: 12/04/2021



SITE INFORMATION

LOT / DP	102/579423
ADDRESS	11498 NEWELL HIGHWAY, NARRABRI, NSW 2390
LGA	NARRABRI SHIRE COUNCIL
LAT / LONG	-30.355485 / 149.760305
ELEVATION	212 m
LOT AREA	61.64 ha
FENCED AREA	11.24 ha
DNSP	ESSENTIAL ENERGY

PROJECT INFORMATION

AC CAPACITY	5.0 MW
INVERTERS	2 x 3.0 MW AC
TRACKER SPACING (N-S)	5.5 m
ARRAY PITCH	6.25 m
CONNECTION VOLTAGE	22 kV
CONNECTION FEEDER	ESSENTIAL ENERGY NBI8B5
CONNECTION SUBSTATION	ESSENTIAL ENERGY NARRABRI
SECURITY FENCE SETBACK	ALIGNED WITH PROPERTY BOUNDARY
ARRAY SETBACK	MIN. 8 m FROM SECURITY FENCE
VEHICLE ACCESS WIDTH	4 m

1 / - GENERAL ARRANGEMENT PLAN

SCALE: 1:5000

PRELIMINARY DESIGN

NO.	STAGE	DATE
1	ISSUED FOR INVESTOR APPROVAL	19/3/20
2	ADDED 2M SETBACK FROM THE OPTIC FIBRE CABLE	22/7/20
3	UPDATED MODULES AND REMOVED SETBACK FROM OF CABLE	7/8/20
4	----	----
5	----	----
6	----	----

NOTES

PARTNERS

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CHECKED PM
APPROVED SD

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DRAWING **GENERAL ARRANGEMENT PLAN**

PROJECT NARRABRI 3A 5MW SOLAR FARM
CLIENT ITP DEVELOPMENT
ADDRESS 11498 NEWELL HIGHWAY NARRABRI, NSW 2390

DRAWING NO. **A5000 NAR3A-G-210**

SCALE	AS NOTED
SHEET SIZE	A3
ORIG. DATE	10/3/20
REV. DATE	21/8/20
REV NO.	3

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

APPENDIX C

Narrabri LEP Maps

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

Narrabri Local Environmental Plan 2012

Flood Planning Map - Sheet FLD_004B

Flood Planning Land

Flood Planning Area

Cadastre

Cadastre 18/03/2011 © Land & Property Information (LPI)

N

0 0.5 1

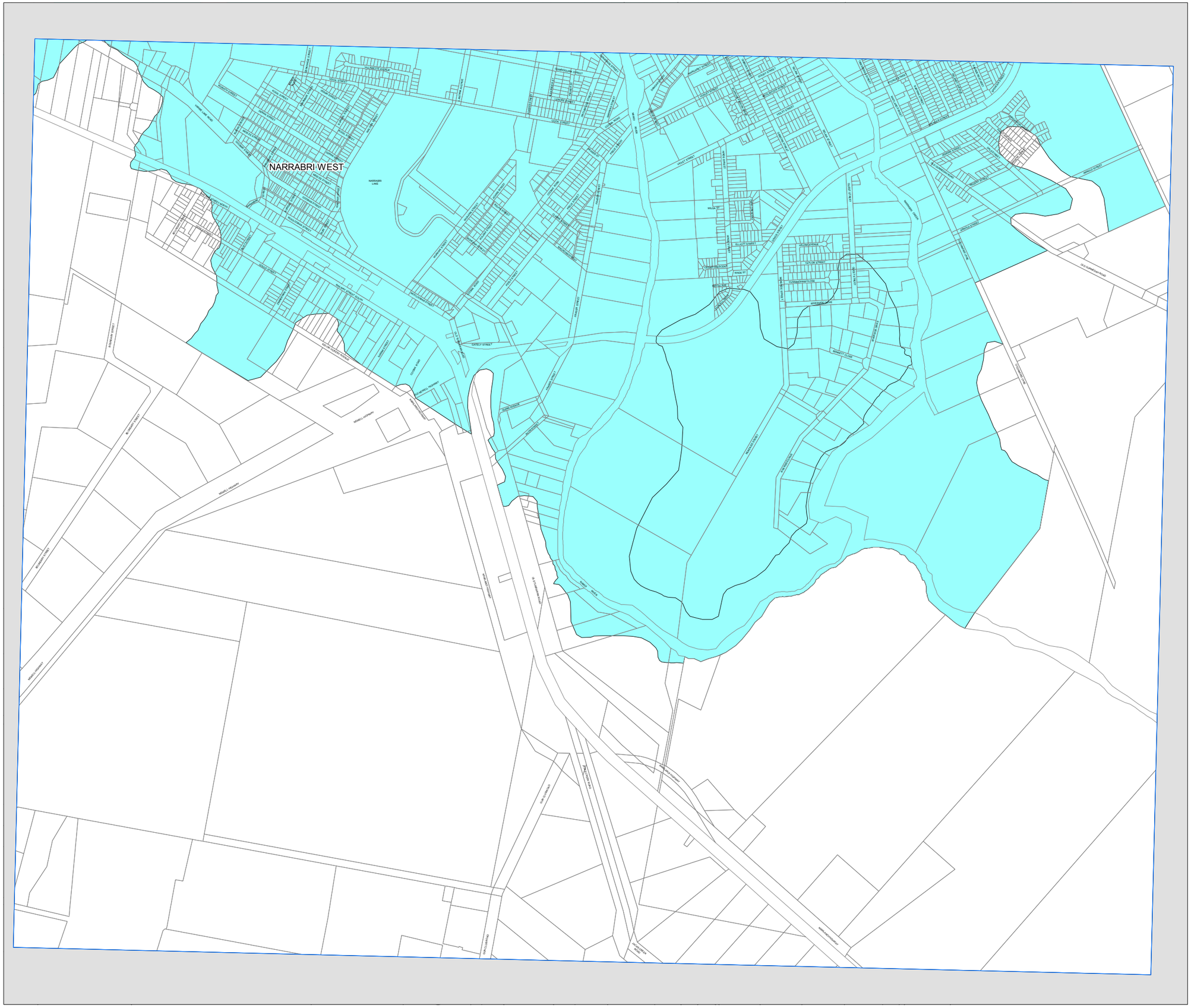
Kilometres

Projection: GDA 1994
MGA Zone 55

Scale: 1:20,000 @ A3

Map Identification Number:

5750_COM_FLD_004B_020_20121024



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Version: 1, Version Date: 12/04/2021

APPENDIX D

Provisional Hydraulic Hazard Mapping

Document Set ID: 1852230
Version: 1, Version Date: 12/04/2021

Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Stony Creek Rd
Narrabri Walgett Rly
Narrabri
Narrabri West
Werris Creek Mungindi Rly
Kamilaroi Highway
Newell Highway
Old Gunnedah Rd

Legend

- Highway
- Local Road
- Rail

0 0.5 1 2
kilometres

Hydraulic Hazard Category

- High Hazard
- Intermediate Hazard
- Low Hazard

NARRABRI FLOOD STUDY

Figure C.1:
Preliminary Hydraulic Hazards
20% AEP Event

wrm water + environment

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Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Stony Creek Rd
Narrabri Walgett Rly
Narrabri West
Narrabri
Werris Creek Mungindi Rly
Kamilaroi Highway
Newell Highway
Old Gunnedah Rd

Legend

- Highway
- Local Road
- Rail

0 0.5 1 2
kilometres

Hydraulic Hazard Category

- High Hazard
- Intermediate Hazard
- Low Hazard

NARRABRI FLOOD STUDY

Figure C.2:
Preliminary Hydraulic Hazards
10% AEP Event

wrm water + environment

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Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Stony Creek Rd
Narrabri Walgett Rly
Narrabri
Narrabri West
Werris Creek Mungindi Rly
Old Gunnedah Rd
Newell Highway
Kamilaroi Highway

Legend

- Highway
- Local Road
- Rail

0 0.5 1 2
kilometres

Hydraulic Hazard Category

- High Hazard
- Intermediate Hazard
- Low Hazard

NARRABRI FLOOD STUDY

Figure C.3:
Preliminary Hydraulic Hazards
5% AEP Event

wrm water + environment

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Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Stony Creek Rd
Narrabri Walgett Rly
Narrabri
Narrabri West
Werris Creek Mungindi Rly
Kamilaroi Highway
Newell Highway
Old Gunnedah Rd

Legend

- Highway
- Local Road
- Rail

0 0.5 1 2
kilometres

Hydraulic Hazard Category

- High Hazard
- Intermediate Hazard
- Low Hazard

NARRABRI FLOOD STUDY

Figure C.4:
Preliminary Hydraulic Hazards
2% AEP Event

wrm water + environment

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Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Stony Creek Rd
Narrabri Walgett Rly
Narrabri West
Narrabri
Werris Creek Mungindi Rly
Kamilaroi Highway
Newell Highway
Old Gunnedah Rd

Legend

- Highway
- Local Road
- Rail

0 0.5 1 2
kilometres

Hydraulic Hazard Category

- High Hazard
- Intermediate Hazard
- Low Hazard

NARRABRI FLOOD STUDY

Figure C.5:
Preliminary Hydraulic Hazards
1% AEP Event

wrm water + environment

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Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Stony Creek Rd
Narrabri Walgett Rly
Narrabri
Narrabri West
Werris Creek Mungindi Rly
Kamilaroi Highway
Newell Highway
Old Gunnedah Rd

Legend

- Highway
- Local Road
- Rail

0 0.5 1 2
kilometres

Hydraulic Hazard Category

- High Hazard
- Intermediate Hazard
- Low Hazard

NARRABRI FLOOD STUDY

Figure C.6:
Preliminary Hydraulic Hazards
Extreme Event

wrm water + environment

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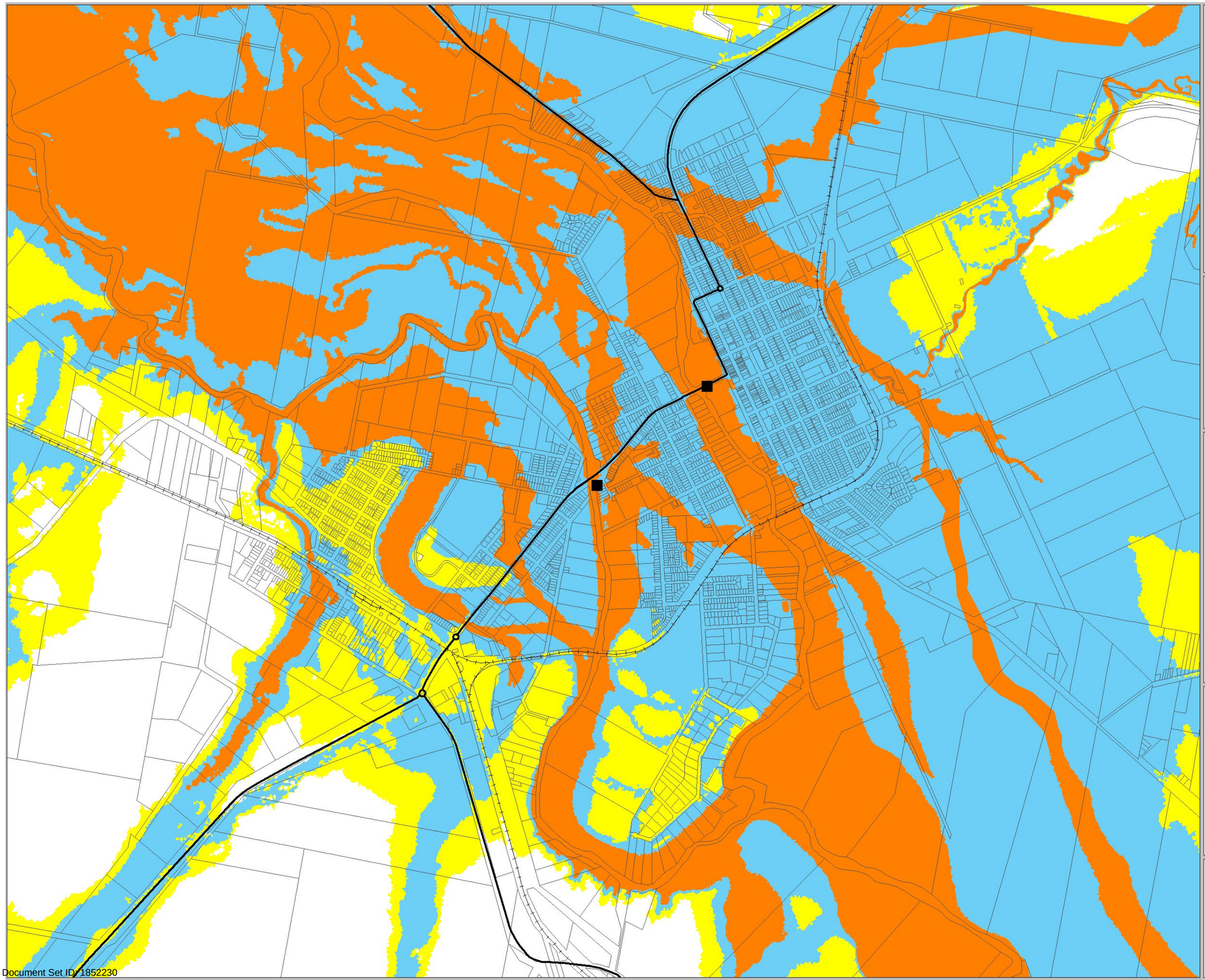

Legend

- Cadastre
- Rail
- Highway
- Streamgauge

0 250 500 1000
metres

Hydraulic Categorisation

- Floodway
- Flood storage
- Flood fringe

NARRABRI FLOOD STUDY

Figure C.7:
Provisional Hydraulic Categorisation

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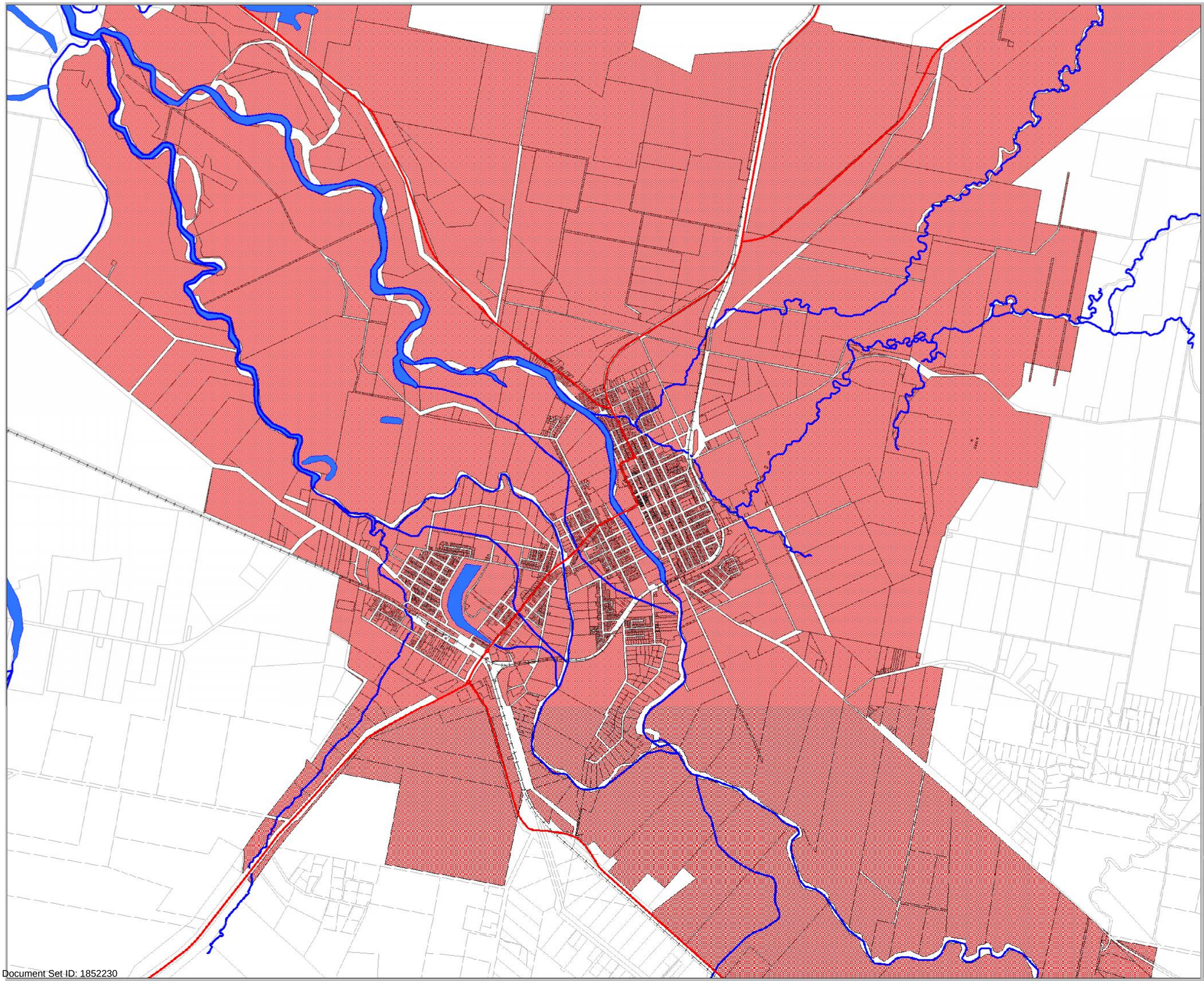

NARRABRI FLOOD STUDY

Figure C.8:
Flood Planning Area

wrm water + environment

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APPENDIX E

Narrabri Flood Study 2016 - Predicted Flood Extents

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Version: 1, Version Date: 12/04/2021

Legend

- Cadastre
- Rail
- Highway
- Streamgauge
- Water Level Contour (1.0 m)

0 250 500 1000
metres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.1:
Predicted Flood Extent, Level and Depth
Regional 20% AEP Event

wrm water + environment

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Legend

- Highway
- Local Road
- Rail
- Water Level Contour (0.5 m)
- Discharge Reporting Location
- Water Level Reporting Location

0 0.5 1 2

kilometres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.2:
Predicted Flood Extent, Levels and Depth
Local 20% AEP Event

wrm water + environment

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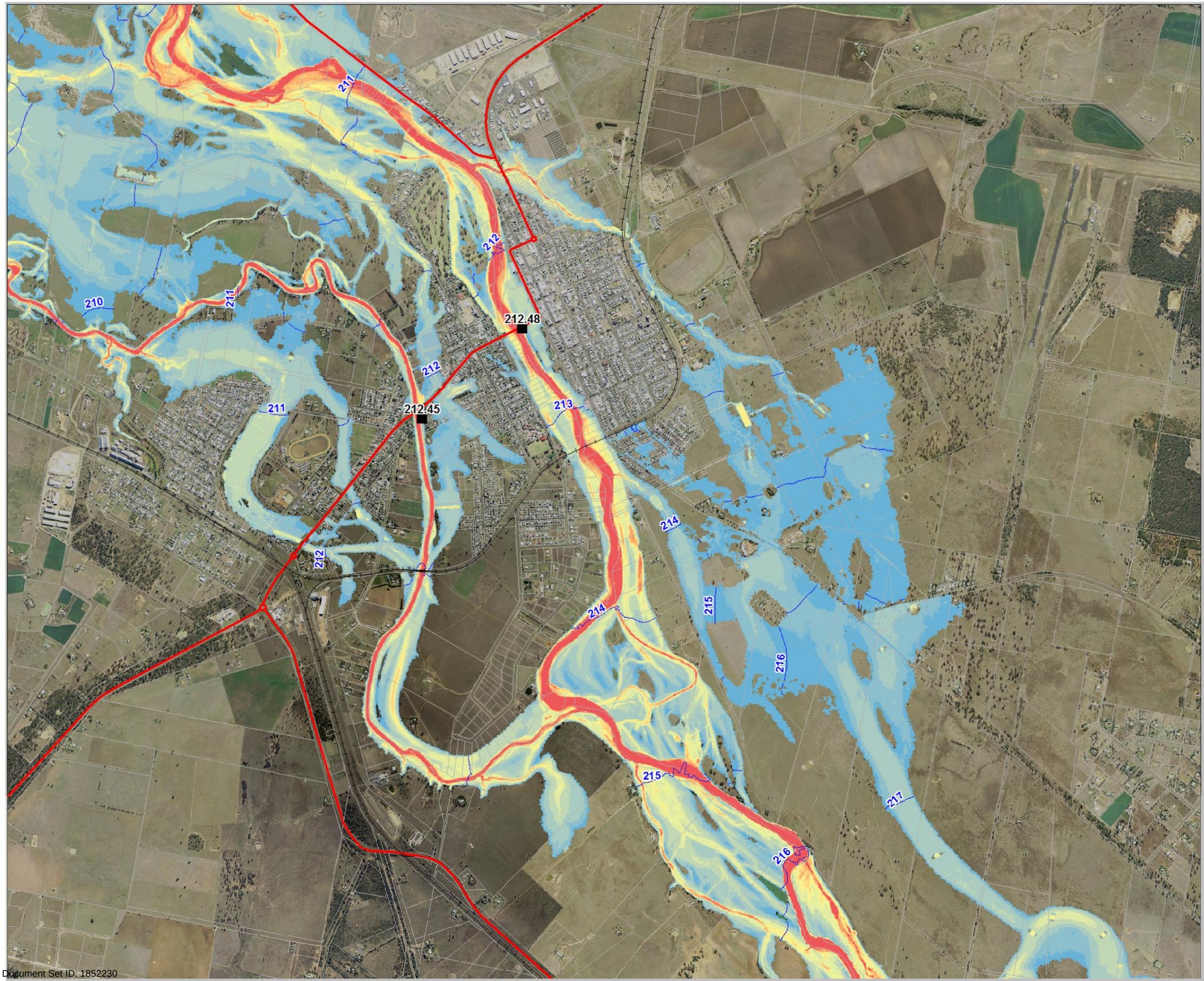

Legend

- Cadastre
- Rail
- Highway
- Streamgauge
- Water Level Contour (1.0 m)

0 250 500 1000
metres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.3:
Predicted Flood Extent, Level and Depth
Regional 10% AEP Event

wrm water + environment

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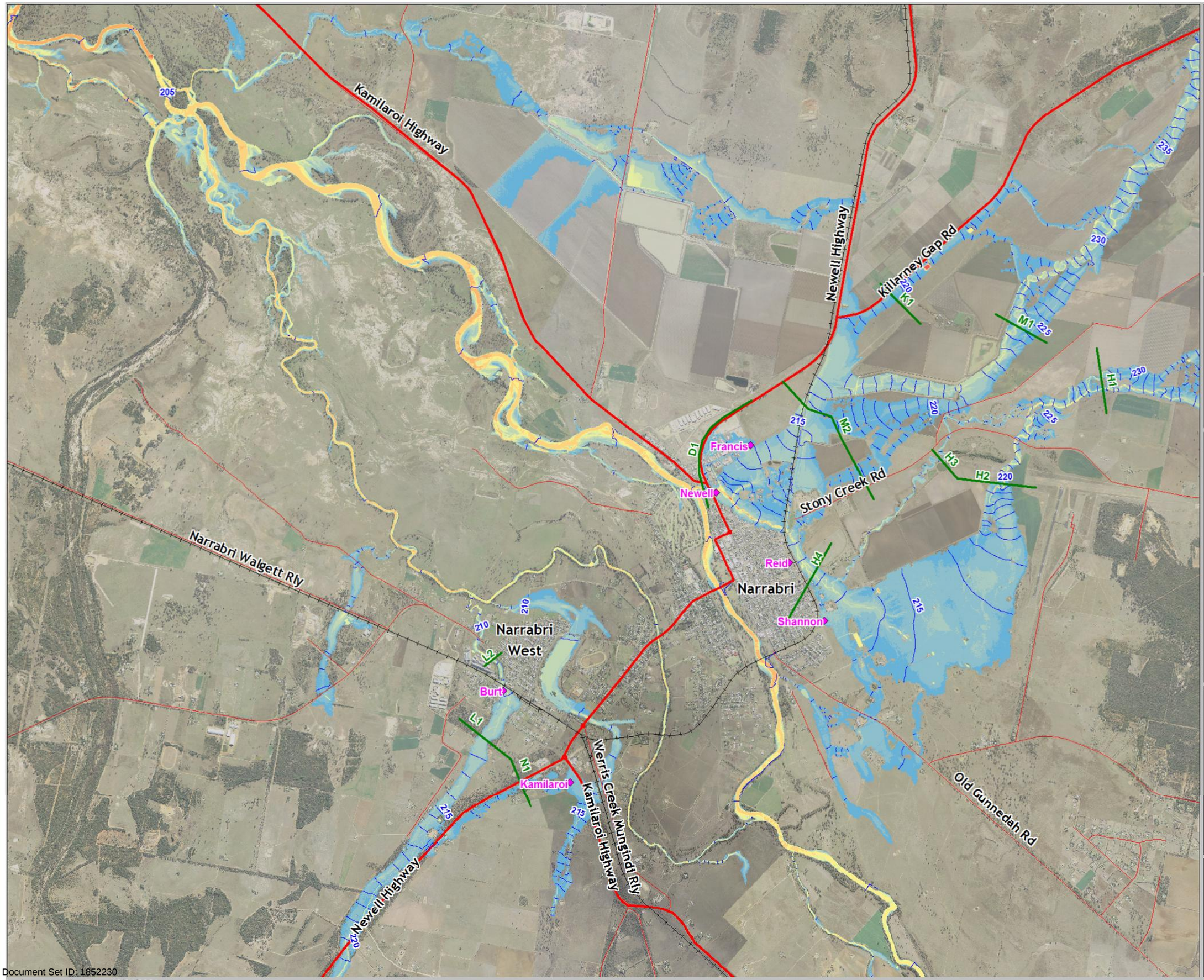

Legend

- Highway
- Local Road
- Rail
- Water Level Contour (0.5 m)
- Discharge Reporting Location
- Water Level Reporting Location

0 0.5 1 2
kilometres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.4:
Predicted Flood Extent, Levels and Depth
Local 10% AEP Event

wrm water + environment

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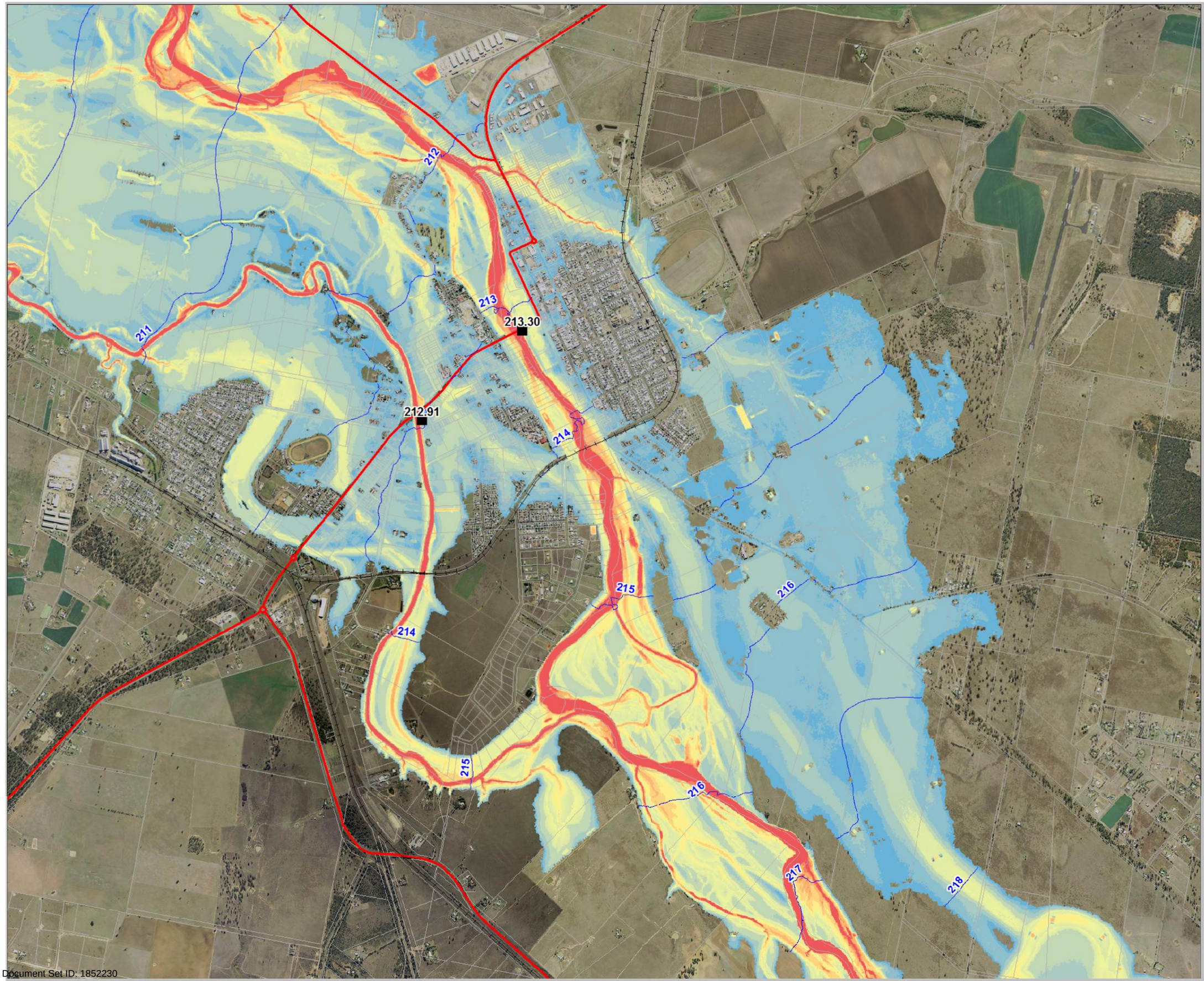

Legend

- Cadastre
- Rail
- Highway
- Streamgauge
- Water Level Contour (1.0 m)

0 250 500 1000
metres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.5:
Predicted Flood Extent, Level and Depth
Regional 5% AEP Event

wrm water + environment

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Version: 1, Version Date: 12/04/2021

Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Narrabri Walgett Rly
Narrabri West
Narrabri
Stony Creek Rd
Old Gunnedah Rd
Werris Creek Mungindi Rly
Kamilaroi Highway
Newell Highway
Francis
Newell
Reid
Shannon
Burt
Kamilaroi
D1
L2
L1
N1
M2
M1
H1
H2
H3
H4
235
230
225
220
215
210

Legend

- Highway
- Local Road
- Rail
- Water Level Contour (0.5 m)
- Discharge Reporting Location
- Water Level Reporting Location

0 0.5 1 2
kilometres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.6:
Predicted Flood Extent, Levels and Depth
Local 5% AEP Event

wrm water + environment

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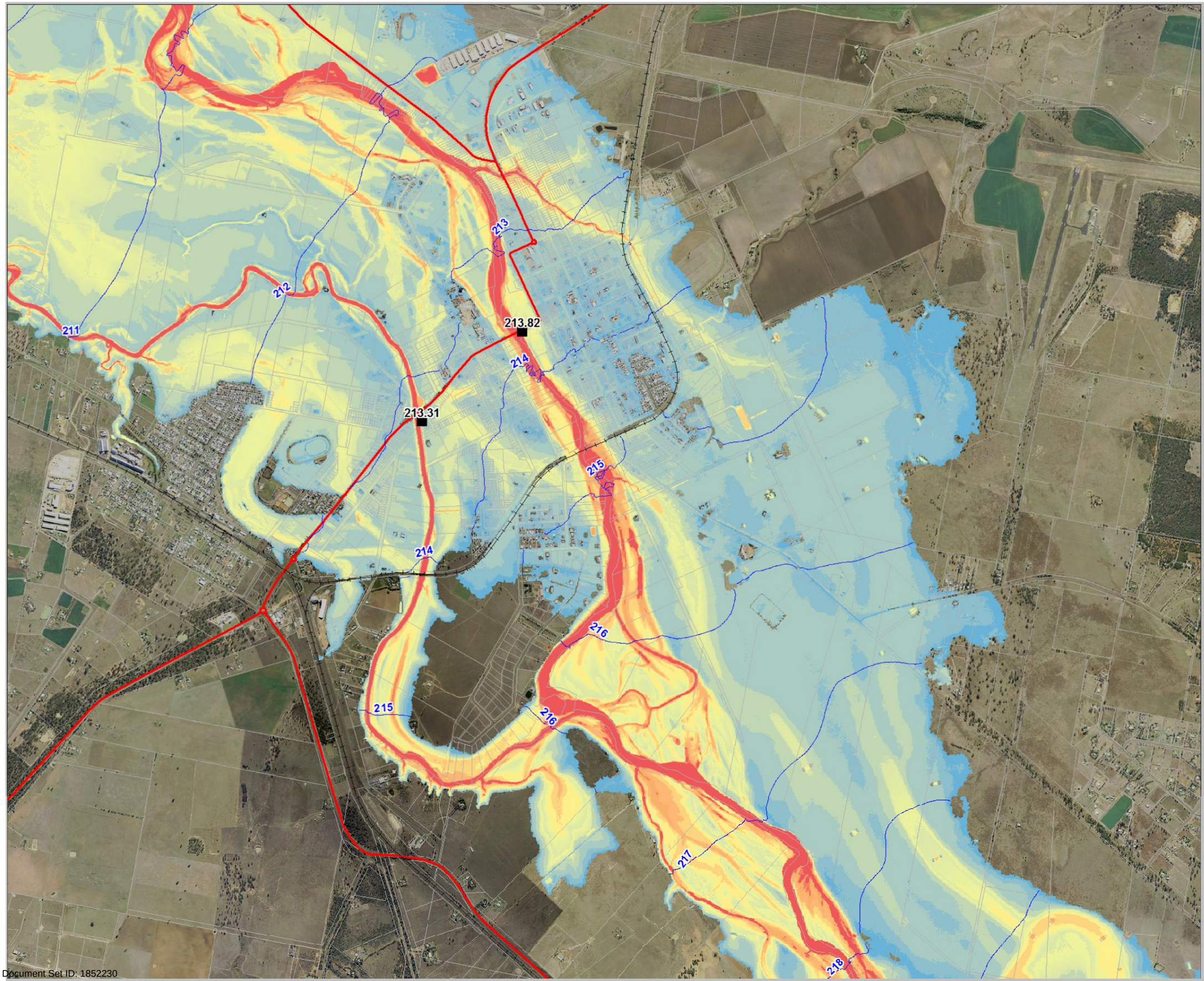

Legend

- Cadastre
- Rail
- Highway
- Streamgauge
- Water Level Contour (1.0 m)

0 250 500 1000
metres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.7:
Predicted Flood Extent, Level and Depth
Regional 2% AEP Event

wrm water + environment

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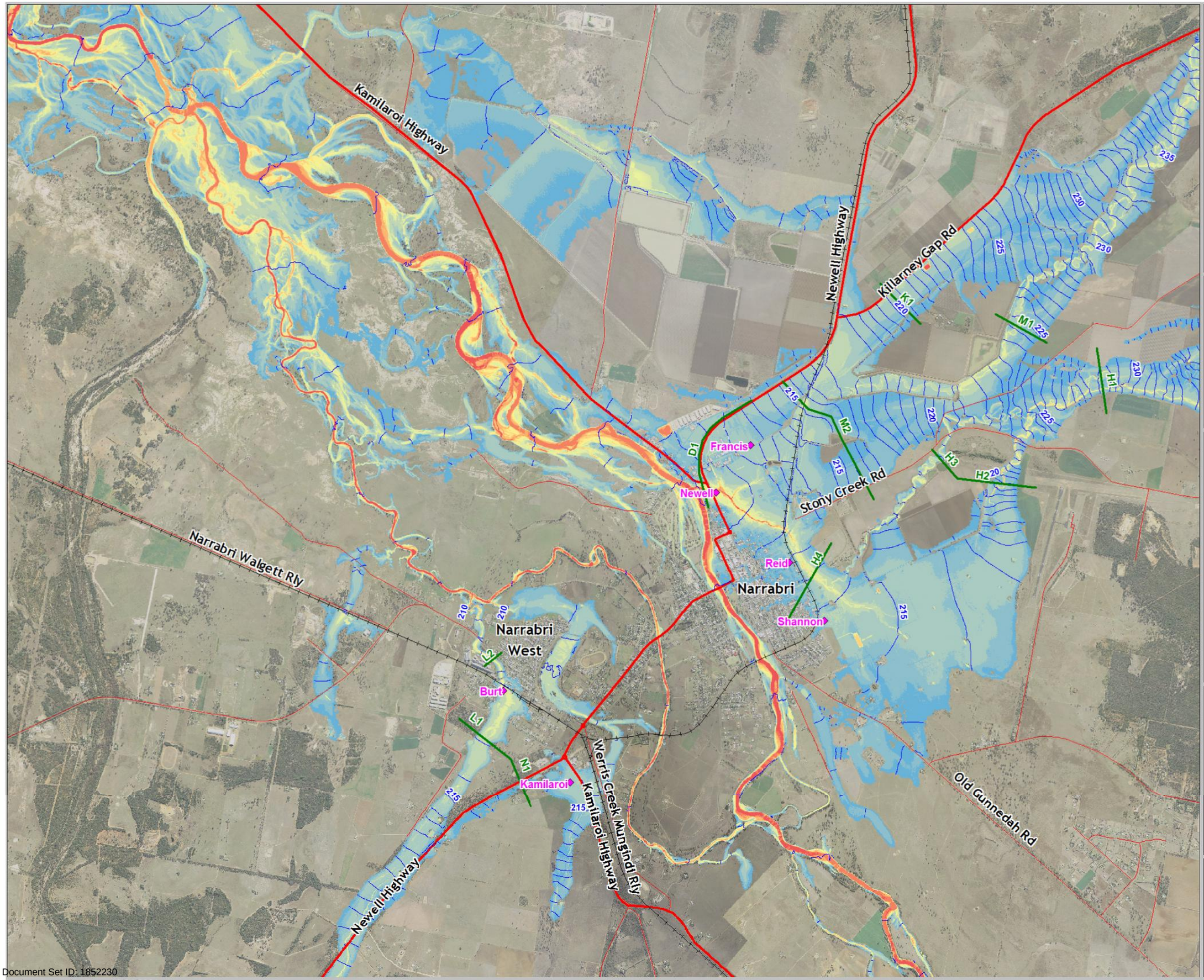

Legend

- Highway
- Local Road
- Rail
- Water Level Contour (0.5 m)
- Discharge Reporting Location
- Water Level Reporting Location

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.8:
Predicted Flood Extent, Levels and Depth
Local 2% AEP Event

wrm water + environment

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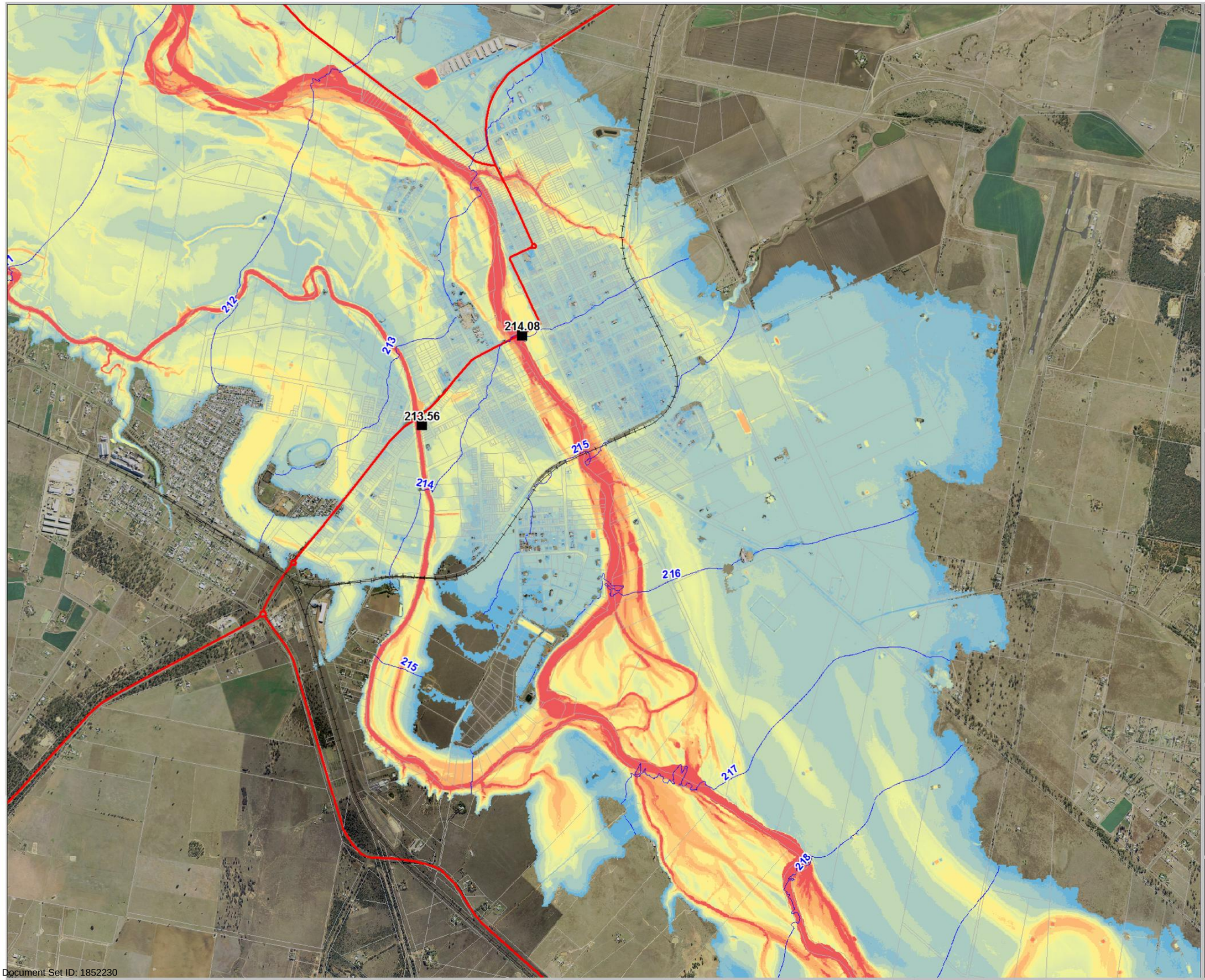

Legend

- Cadastre
- Rail
- Highway
- Streamgauge
- Water Level Contour (1.0 m)

0 250 500 1000
metres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.9:
Predicted Flood Extent, Level and Depth
Regional 1% AEP Event

wrm water + environment

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Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Narrabri Walgett Rly
Narrabri West
Narrabri
Stony Creek Rd
Werris Creek Mungindi Rly
Kamilaroi Highway
Newell Highway
Old Gunnedah Rd
Francis
Newell
Burt
Kamilaroi
Reid
Shannon
D1
K1
M1
M2
H1
H2
H3
H4
L1
L2
N1
210
215
220
225
230
235

Legend

- Highway
- Local Road
- Rail
- Water Level Contour (0.5 m)
- Discharge Reporting Location
- Water Level Reporting Location

0 0.5 1 2
kilometres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.10:
Predicted Flood Extent, Levels and Depth
Local 1% AEP Event

wrm water + environment

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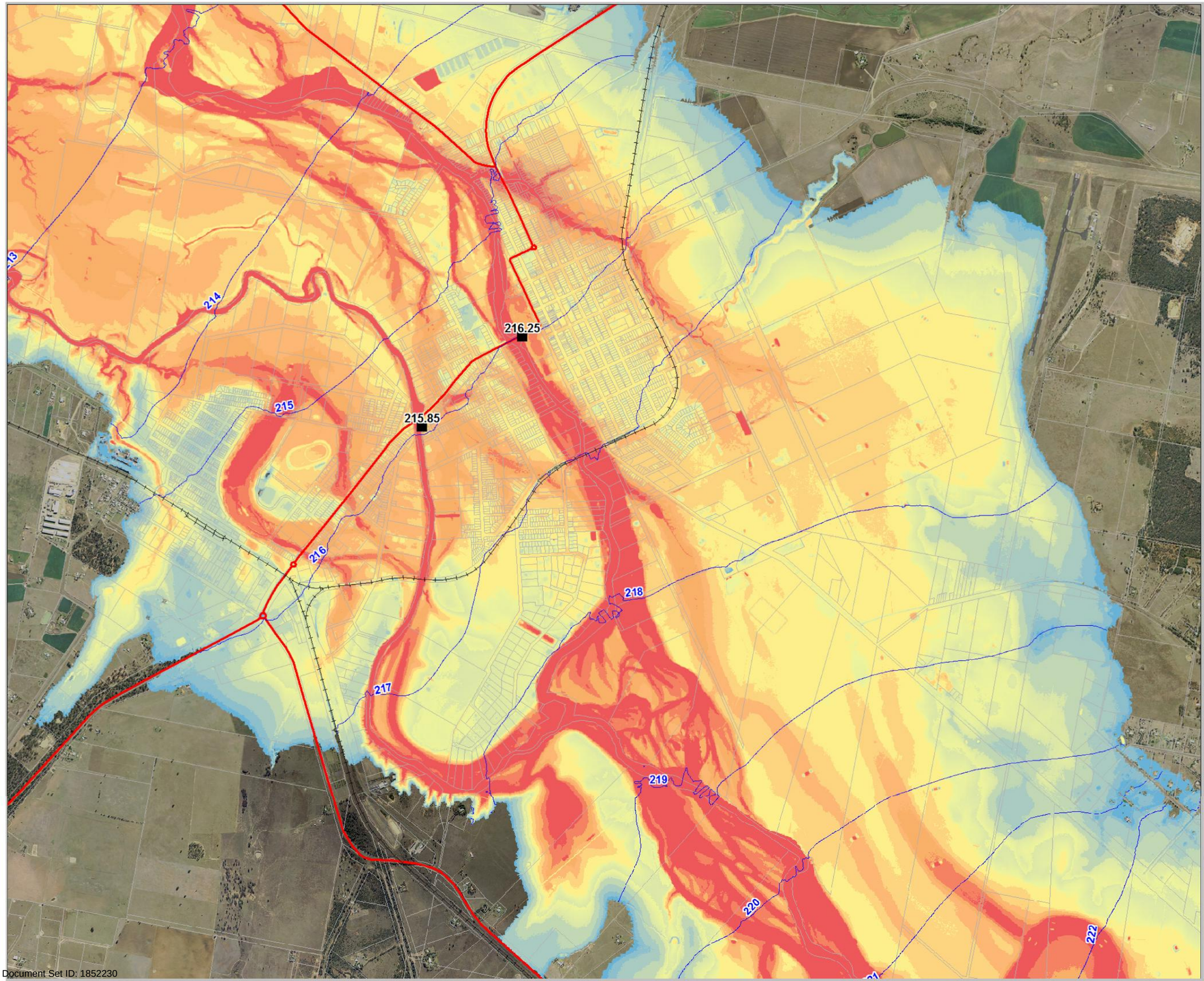

Legend

- Cadastre
- Rail
- Highway
- Streamgauge
- Water Level Contour (1.0 m)

0 250 500 1000
metres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.11:
Predicted Flood Extent, Level and Depth
Regional Extreme Flood

wrm water + environment

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Kamilaroi Highway
Newell Highway
Killarney Gap Rd
Stony Creek Rd
Narrabri Walgett Rly
Narrabri West
Narrabri
Werris Creek Mungindi Rly
Kamilaroi Highway
Old Gunnedah Rd
Newell Highway
Francis
Newell
Reid
Shannon
Burt
Kamilaroi
210
215
220
225
230
D1
K1
M1
M2
H1
H2
H3
H4
L1
L2
N1

Legend

- Highway
- Local Road
- Rail
- Water Level Contour (0.5 m)
- Discharge Reporting Location
- Water Level Reporting Location

0 0.5 1 2
kilometres

Flood Depth (m)

- >5.00
- 4.50
- 4.00
- 3.50
- 3.00
- 2.50
- 2.00
- 1.50
- 1.00
- 0.50
- 0.25
- 0

NARRABRI FLOOD STUDY

Figure B.12:
Predicted Flood Extent, Levels and Depth
Local PMF Event

wrm water + environment

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