NORTHROP



Flooding Assessment

for

Maison Dieu Solar Farm

for RPS AAP Consulting Pty Ltd

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Acronyms

1 in 500 AEP	1 in 500 Chance of Flooding in Any Given Year
1 in 200 AEP	1 in 200 Chance of Flooding in Any Given Year
1% AEP	1% Chance of Flooding in Any Given Year
2D	Two-dimensional
10% AEP	10% Chance of Flooding in Any Given Year
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ALS	Airborne Laser Survey (LiDAR)
AR&R	Australian Rainfall and Runoff
BESS	Battery Energy Storage System
DTM	Digital Terrain Model
ha	Measure of area (hectares)
HPC	Heavily Parallelised Computation
IFD	Intensity-Frequency-Duration
GPU	Graphics Processing Unit
GSDM	Generalised Short-Duration Method
kV	Measure of electric potential (voltage)
LGA	Local Government Area
LiDAR	Light Detection and Ranging (also see ALS)
m	Measure of length / height / distance (metres)
m AHD	Metres above Australian High Datum
m/s	Measure of velocity (metres per second)
m^3/s	Measure of flow rate (cubic metres per second)
NSW	New South Wales
PMF	Probable Maximum Flood
PV	Photovoltaic
SEARs	Secretary's Environmental Assessment Requirements
TUFLOW	One and two-dimensional hydraulic modelling software

1 Introduction

1.1 Overview

Northrop Consulting Engineers Pty Ltd (Northrop) was engaged by RPS AAP Consulting Pty Ltd (RPS) to conduct a flood assessment of the Maison Dieu Solar Farm at Maison Dieu, near Singleton in NSW (the Project) for Terrain Solar Pty Ltd (the Applicant).

The impacts and proposed mitigation of flooding from the proposed construction, operation and decommissioning phases of the Project are addressed in this report in accordance with relevant regulatory requirements and guidelines (this assessment).

This report supports a State Significant Development (SSD) Development Consent application under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (SSD-48160216), as an appendix to the Environmental Impact Statement (EIS) for the Project.

The following guidelines have been considered in this assessment:

- Australian Rainfall and Runoff (AR&R) 2019.
- Flood Risk Management Manual 2023.
- Singleton LEP 2013.

A response to SEARs is reference in the below Table 1.

Table 1 - SEARs References

SEAR	Where addressed in this report
BCD - Flooding	Refer to Section 7.6 - SEARs Requirements and Response

1.2 Project Description

The Project will involve the construction, operation and decommissioning of a photovoltaic (PV) solar farm, Battery Energy Storage System (BESS) and associated infrastructure.

The Project is within the Project Area as shown on Figure 1 and includes:

- Construction:
  - Up to 18 months with maximum worker numbers of up to 150 Full Time Equivalent (FTE) personnel;
  - Hours of work generally between 7 am to 6 pm, Monday to Friday and 8 am to 1 pm, Saturday;
  - Pre-construction activities and site establishment;
  - Civil works and access upgrades;
  - Major components transported via Port of Newcastle or Port Botany;
  - PV array construction utilising external equipment;
  - Installation and use of temporary infrastructure (including office, parking, amenities, laydown, waste storage, stockpile, power supply, fencing, communications, services and utilities);
  - Ancillary activities (including import of gravel, sand and aggregate; and water);

- Rehabilitation;

- Operation:
  - Approximately 110,000 PV solar panels with a total capacity of 60 MWac;
  - BESS with a capacity of 40 MW / 80 MWh;
  - Electrical infrastructure including:
    - Solar PV power conversion units with inverters;
    - Substation compound and switching station;
    - Electrical reticulation grid and infrastructure connecting to the existing Ausgrid Singleton Substation;
  - Site access and external transport;
  - Other associated infrastructure (including retained temporary construction infrastructure and its maintenance);
  - Internal and external ancillary activities;
  - 24 hours a day, 7 days a week with up to five FTE personnel;
- Decommissioning:
  - Individual components are expected to operate for up to 30 years, after which one of the following actions will be taken:
    - Replace the existing project components within the project description and impacts assessed in this EIS and continue operations in consultation with relevant associated holders; or
    - Seek relevant approvals should technological advances not confirm the viability of Option 1; or
    - Decommission the Project and rehabilitate the site.

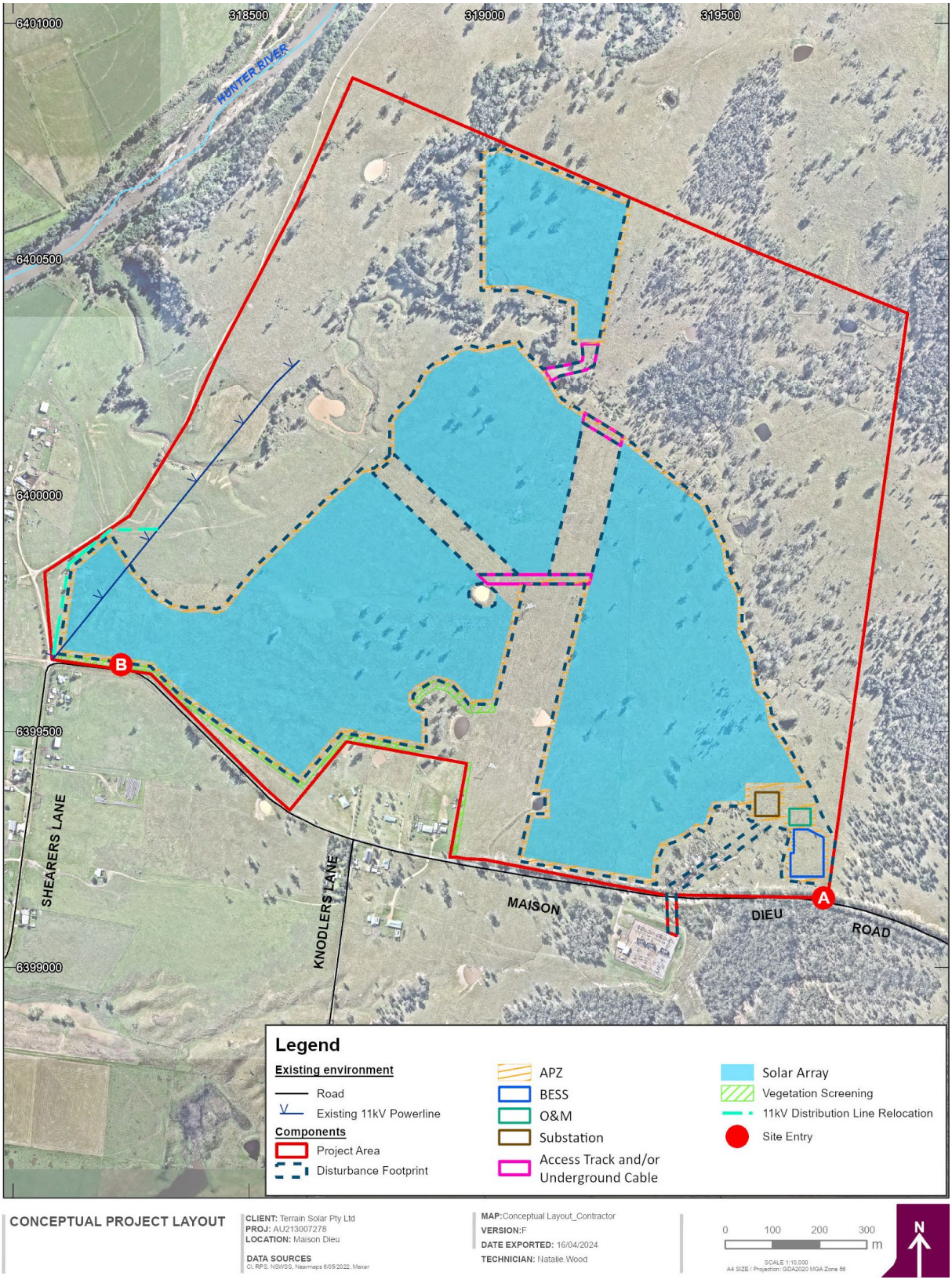


Figure 1 Conceptual Project Layout

2 Methodology

The assessment was undertaken using the following methodology.

- Desktop review of available background information including terrain data, aerial imagery, design plans and draft Singleton Flood Study (2022).
- Setup of two-dimensional TUFLOW hydraulic model.
- Run the existing case TUFLOW model for the 10%, 1%, 1 in 200, 1 in 500 Annual Exceedance Probability (AEP) (with 1 in 200, 1 in 500 AEP as a climate change proxy) and Probable Maximum Flood (PMF) events.
- Amend the TUFLOW model to represent the proposed Project in its operational state, run the model and compare the results with the existing case to review the potential impact the proposed Project has on the existing flood conditions on-site, in adjacent properties and across the catchment and floodplain, and recommend measures to mitigate.
- Review SEARs flooding requirements and assess the Project with respect to this document.

3 Project Area and Catchment Context

3.1 Project Area Description

The Project Area is located at Maison Dieu approximately ten kilometres west of Singleton, NSW. The Project is contained within five lots being Lot 1 DP 616940, Lot 1 DP 1133341, Lot 104 DP 817010, Lot 3 DP 252505, and Lot 51 DP 1133756. The total disturbance footprint of the Project is approximately of 90 ha with elevations ranging from 55m AHD to 105m AHD. The terrain generally falls east to west towards the Hunter River. The locality of the project is presented in Figure 2 overleaf.

The Project Area is currently predominantly native and non-native grassland with scattered trees. Several farm dams are located within the Project Area and collect runoff from upstream watercourses during rainfall events. All watercourses within the Project Area are ephemeral and typically dry for most of the time.

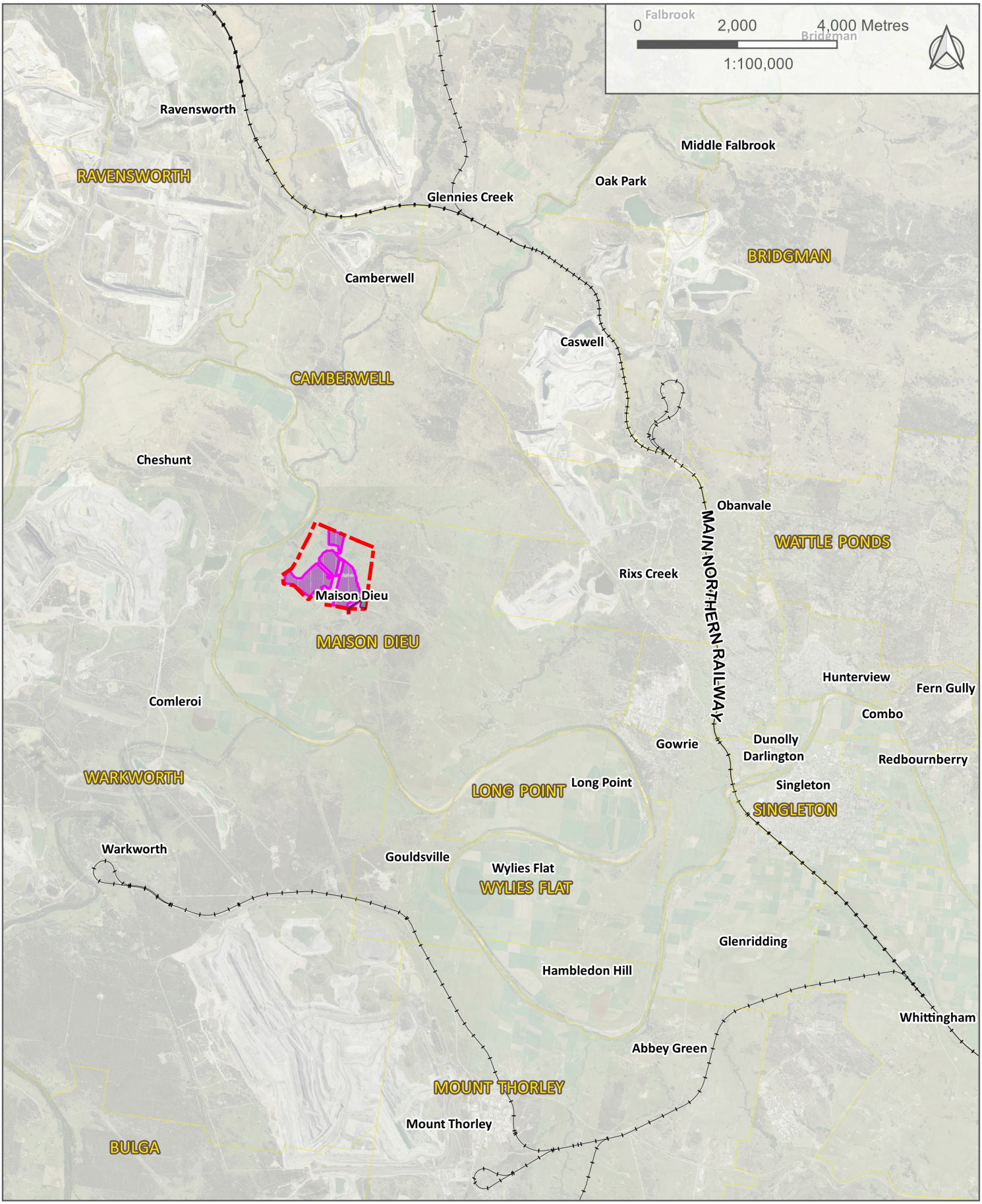
The Project Area is impacted by flooding from two mechanisms – local catchment runoff and Hunter River flooding. The study extent has been selected to consider both mechanisms and is described below.

3.2 Study Extent Description

The study extent and disturbance footprint is presented overleaf in **Appendix A – Figure A1**. It extends approximately two kilometres upstream and 500 metres downstream of the Project Area along the Hunter River. The local catchment has been represented in its entirety. The study catchment characteristics are presented in **Table 2** below.

Table 2 – Study Catchment Characteristics

Characteristic	
Total Area (km²)	31
Highest Elevation (m AHD)	150
Lowest Elevation (m AHD)	54
Typical Land Use	Native or non-Native Grassland, Pastures, Dense Vegetation



Legend

Substation / BESS / O&M
Hardstand
Grid Connection Easement
O&M Compound Footprint
Substation Footprint
Solar Farm
Disturbance Area
Project Area

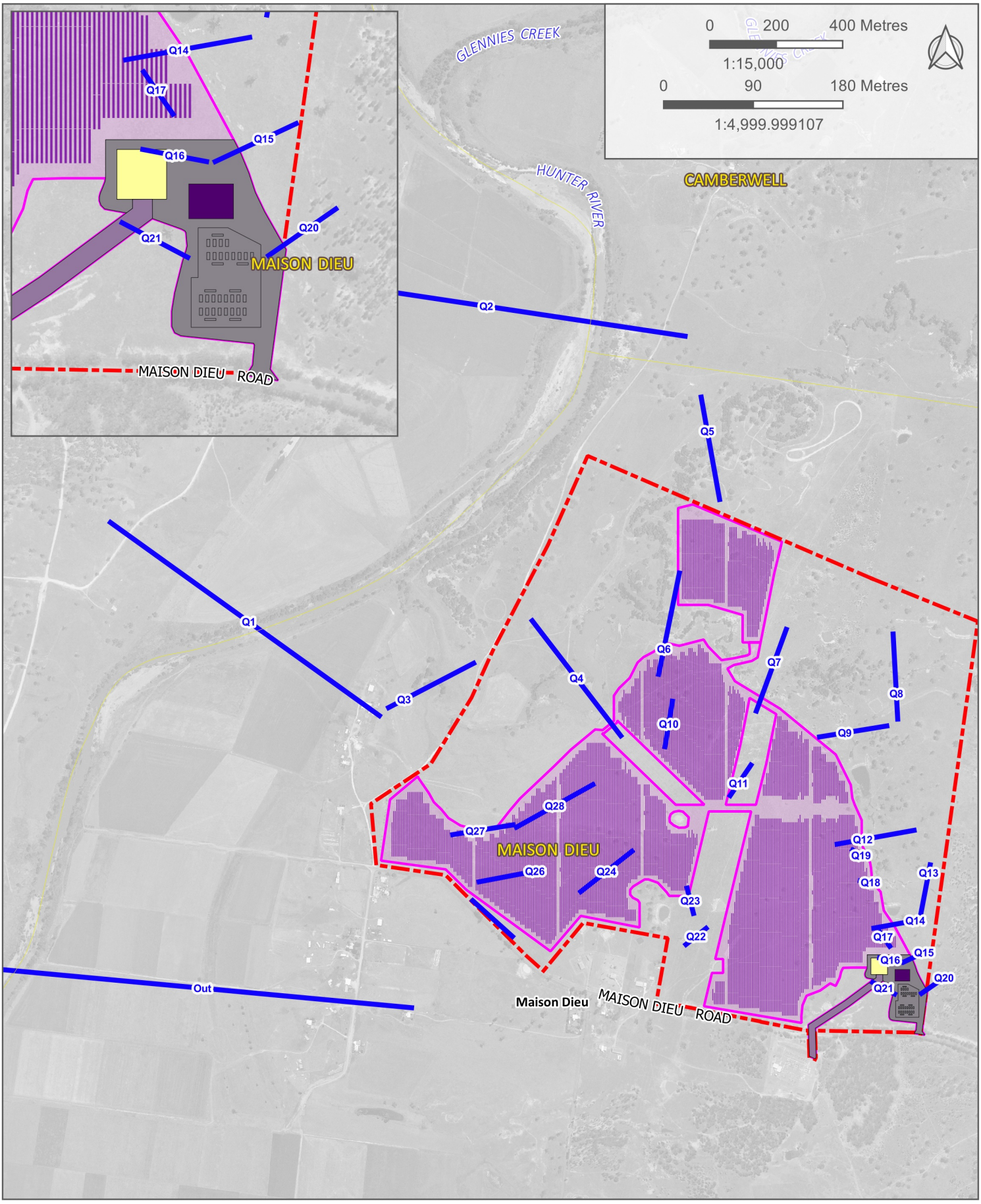
Figure 2

Locality

Solar Farm Maison Dieu

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Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

Substation / BESS / O&M
Disturbance Footprint
Grid Connection Easement
O&M Compound Footprint
Substation Footprint
Solar Farm
Reporting Lines
Project Area
Disturbance Area

Figure 3

Proposed Project

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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4 Flood Model Setup

4.1 Overview

Detailed two-dimensional hydraulic modelling was undertaken using the TUFLOW hydrodynamic modelling software. TUFLOW version 2020-01-AA with HPC GPU solver was used for the assessment. The modelling was undertaken to assess local flood behaviour for the 10% AEP, 1% AEP, 1 in 200 AEP, 1 in 500 AEP and PMF flood events.

Presented below are the hydrological and hydraulic model parameters used in preparation of the TUFLOW model.

4.2 Hydrological Parameters

Direct Rainfall (Rainfall-on-Grid) hydrology has been adopted for this assessment. Applying rainfall directly to the two-dimensional grid is expected to provide the most realistic representation of the distributed nature of the terrain when compared to traditional one-dimensional approaches.

As per the latest AR&R 2019 guidelines, an entire storm event approach has been considered as part of this study as shown in the below **Figure 4**. Probability neutral burst initial loss has been applied to consider the pre-burst rainfall and initial loss.

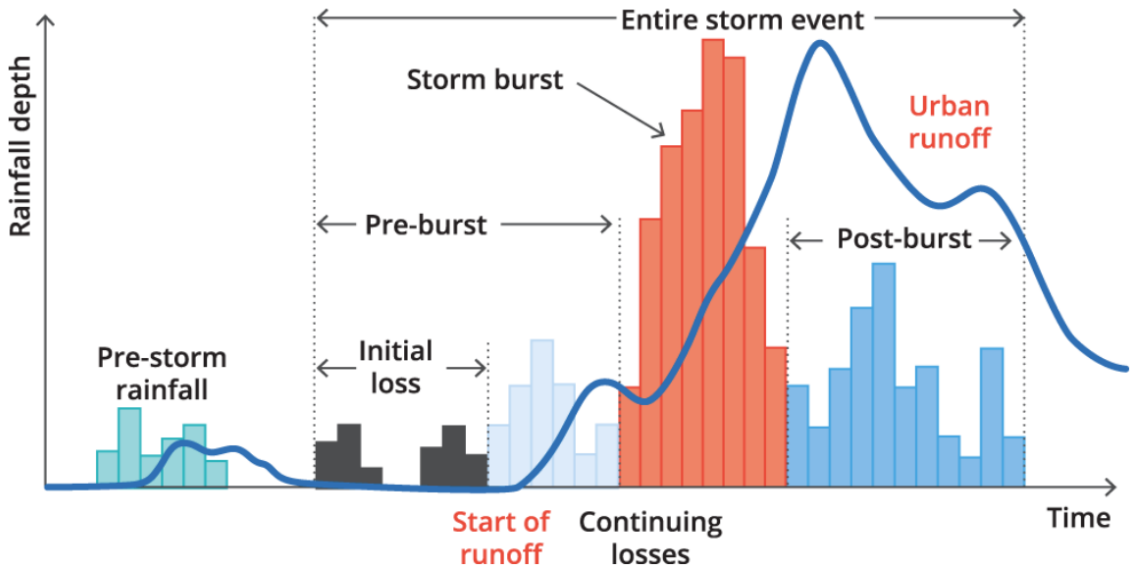


Figure 4 - Conceptual Design Storm Pattern (ARR 2019 Figure 9.6.4)

4.2.1 Burst Rainfall

The latest AR&R 2019 rainfall has been obtained from the Bureau of Meteorology (http://www.bom.gov.au/water/designRainfalls/revised-ifd/) while the accompanying rainfall temporal patterns (design rainfall depths temporal distribution) have been obtained by the AR&R Data Hub for a location over the study area.

AR&R 2019 recommends the use of the storm ensemble method using 10 temporal patterns for each storm duration. For this investigation, storm durations ranging from the 10-minute through to 12-hour events were assessed in the hydrological model for the 10% AEP, 1% AEP, 1 in 200 AEP and 1 in 500 AEP design storm events. Similarly, durations ranging from the 15-minute to 6-hour durations were reviewed for the PMF.

A summary of the burst rainfall depths is listed in **Table 3** overleaf.

Table 3 – Intensity-Frequency-Duration (IFD) Rainfall Depths (mm)

Duration (min)	10% AEP (mm)	1% AEP (mm)	1 in 200 AEP (mm)	1 in 500 AEP (mm)	PMF (mm)
10	17.7	29	32.4	37.6	-
15	22.1	36.5	40.7	47.3	180
20	25.4	41.7	46.6	54.1	-
25	27.8	45.5	50.9	59.2	-
30	29.9	48.5	54.4	63.2	250
45	34.3	54.9	61.5	71.6	320
60	37.4	59.2	66.4	77.2	370
90	41.9	65.4	73.3	85.3	470
120	45.4	70.3	78.7	91.5	550
150	-	-	-	-	610
180	50.9	78.5	87.5	102	680
270	57.6	88.9	98.9	115	-
360	63.4	98.3	109	127	-
540	73.3	115	127	148	-
720	81.7	129	143	167	-

4.2.2 Rainfall Losses

The below **Table 4** and **Table 5** present the Initial and Continuing losses used for the study. The latest Probability Neutral Burst Initial Losses were obtained from the AR&R Data Hub. Similarly, the latest Office of Environment and Heritage (OEH) guidelines recommend reducing the continuing loss values provided by the AR&R Data Hub, by a factor 0.4 for un-calibrated models within NSW. As such, modelled continuing losses have been reduced accordingly.

Table 4 – Infiltration Loss Parameters

Parameter	Value	Comment
Pervious initial loss (mm), 10%, 1%, 1 in 200 and 1 in 500 AEP	Variable	Probability Neutral Burst Initial Loss (Table **5**)
Pervious initial loss (mm), PMF	0	
Pervious continuing loss (mm/hr), 10%, 1%, 1 in 200 and 1 in 500 AEP	0.7	Factored by 0.4 from ARR data hub values
Pervious continuing loss (mm/hr), PMF	0	
Impervious initial loss (mm)	1	Includes area under panels
Impervious continuing loss (mm/hr)	0	

Table 5 - Probability Neutral Burst Initial Loss (mm)

Storm Duration	Flood Event			
	10% AEP	1% AEP	1 in 200 AEP	1 in 500 AEP
10-minute	12.5	10.8	0	0
15-minute	12.5	10.8	0	0
20-minute	12.5	10.8	0	0
25-minute	12.5	10.8	0	0
30-minute	12.5	10.8	0	0
45-minute	12.5	10.8	0	0
1-hour	12.5	10.8	0	0
1.5-hour	11.1	7.9	0	0
2-hour	11.6	10.1	0	0
3-hour	10.9	7.6	0	0
4.5-hour	11.2	6.4	0	0
6-hour	11.5	5.2	0	0
9-hour	12.1	6.1	0	0
12-hour	12.7	6.9	0	0

4.3 Critical Durations

To determine the critical storm duration for the Project Area the guidance provided in the latest AR&R 2019 guidelines was considered as summarised below:

- Classification of the median value of the ten temporal patterns for each storm duration.
- Selection of the duration(s) that produces the maximum median value for each return interval.
- Selection of two representative temporal patterns for the design quantile.

Water depth was used in this investigation to define the median value.

Durations from 10-minutes to 12-hour were used to determine the critical duration for each of the 10% AEP, 1% AEP, 1 in 200 AEP and 1 in 500 AEP flood events local catchment flooding. Similarly, durations from 15-minutes to 6-hours were modelled to define the critical duration for the PMF flood event local catchment flooding.

4.4 Hydraulic Parameters

The TUFLOW model extent and existing topography are shown in **Figure A1** of Appendix A. The model covers a full extent of the study catchment with an approximately 5.5 kilometres long floodplain section of the Hunter River.

4.4.1 Model Terrain

The TUFLOW model DTM was developed using LiDAR survey dated October 2011 and May 2017 which was sourced from the NSW Government spatial data portal. Some manual amendments were made in the upper reaches of the catchment and for the Hunter River channel. A three-metre grid size was adopted as it was determined to provide a reasonable balance between model run time and the representation of catchment overland flow and flood behaviour through creek and watercourses.

4.4.2 Developed Landform Modifications

The potential earthworks within the Project Area disturbance footprint were included in the TUFLOW model DTM for the substation and compound area. It was assumed this area is elevated by two metres to represent appropriate finished flood levels and diversion infrastructure. All earthworks assumed in the modelling are exclusively for flood impact assessment purposes and subject to future detailed landform design. These assumptions are not intended to commit the project to a specific level The location of these filled areas is presented in Figure 3 with the reference “Terrain Modification”.

4.4.3 Boundary Conditions

Inflows into the two-dimensional model for the local catchment flood event were produced through the Rainfall-on-Grid hydrology. Burst rainfall was applied directly to the two-dimensional grid with rainfall losses removed from the model based on the land use assigned to each grid cell.

Coincident flooding for the local catchment event in the Hunter River has been assumed as the 10% AEP. Boundary conditions for tailwater and upstream inflow were estimated from the Singleton Floodplain Risk Management Study and Plan - Volume 1: Flood Study (Draft) 2022. The input locations are presented on Figure A1 of Appendix A.

4.4.4 Surface Roughness

Surface roughness was based on a review of hydraulic literature, recent aerial photography and consistent with the values used in the *Singleton Floodplain Risk Management Study and Plan - Volume 1: Flood Study (Draft) 2022.*

Figures A2 and **A3** of Appendix A present the modelled land use across the model extent for both the existing and developed cases, respectively. Modelled roughness values are summarised below in **Table 6**.

Table 6 – Surface Roughness Values

Land Use	Manning’s Value
Buildings	0.70
Sealed Roads / Hard Stand	0.02
Unsealed Roads	0.02
Open Water	0.02
Channels	0.06
Dense Vegetation	0.10
Medium Vegetation	0.07
Pasture Grass	0.04
Panels	0.03

The following land uses were adopted for the Project Area for the developed case:

- PV array – Panels. This assumes a reduction in vegetation mass under the panels.
- Vegetation screen – Dense Vegetation.
- Access Road, Substation, BESS compound, O&M facility – Compacted Tracks / Hardstand.

4.4.5 Building Representation

Buildings were incorporated into the model based on the existing building footprints delineated using aerial imagery. Existing buildings top elevation was represented as maximum ground elevation within the building footprint plus 500mm. Developed buildings are represented as hardstand and incorporated in the terrain modification.

4.4.6 PV Panels Representation

A schematic of modelled concentrated runoff from the PV panels is presented in **Figure 5** below.

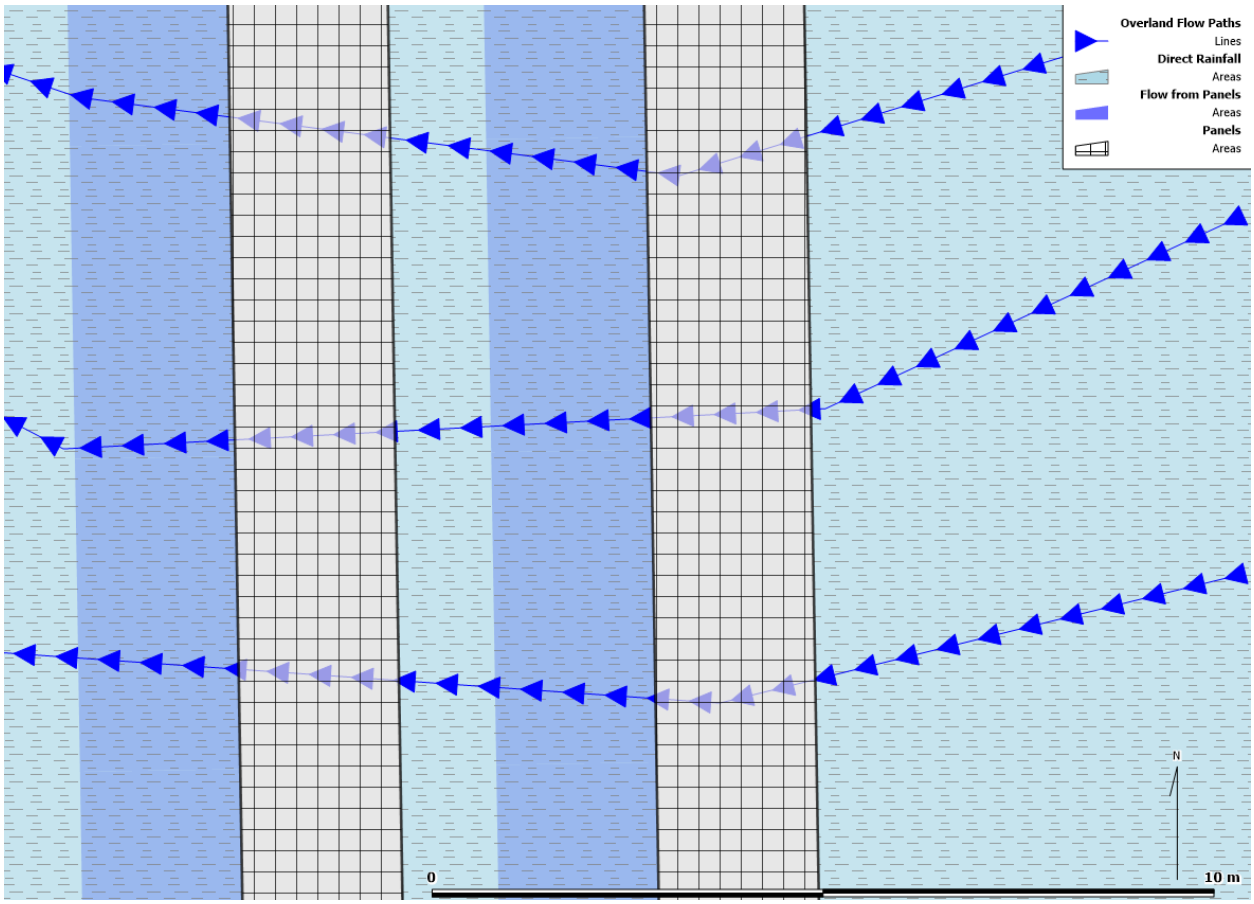


Figure 5 – Schematic of Modelled Concentrated Flow from PV panels.

As shown in the above figure the PV panels will not receive direct rainfall. Areas immediately downstream of the PV panels will receive direct rainfall and concentrated runoff from the PV panels. Areas under the PV panels are still pervious and will receive upstream overland flow.

4.4.7 Hydraulic Structures

No hydraulic structures have been included in the model which is a conservative assumption for peak flow. The grading of access tracks and the inclusion of any culvert crossing required shall be considered during the detailed design phase and are likely to reduce the peak flow leaving the site.

5 Existing Flood Behaviour

5.1 Local Catchment Critical Duration

Critical duration maps for 10% AEP, 1% AEP, 1 in 200 AEP, 1 in 500 AEP and PMF flood events are presented in **Figures A4 to A8** of Appendix A.

The two-dimensional TUFLOW modelling indicates the following storm durations are typically critical for the Project Area:

- 10% AEP – 60 minutes TP03, 180 minutes TP04.
- 1% AEP – 45 minutes TP06, 120 minutes TP09.
- 1 in 200 AEP – 25 minutes TP03, 45 minutes TP09.
- 1 in 500 AEP – 25 minutes TP03, 45 minutes TP09.
- PMF – 15 minutes GSDM, and 60 minutes GSDM.

5.2 Existing Case Results

The results of the existing case flooding without the solar farm, for the 10% AEP, 1% AEP, 1 in 200 AEP, 1 in 500 AEP and PMF flood depth, velocity, hazard, and hydraulic categories are presented in **Figure B1-1** to **B5-4** of Appendix B. These figures show an envelope of the Hunter River and local catchment flooding.

Peak flows at selected locations from local catchment flooding only are presented in **Table 7**. Reporting locations are presented in Figure 3.

Table 7 – Peak flows at selected locations in the existing case

Location	Existing (m^3/s)				
	10% AEP	1% AEP	1 in 200 AEP	1 in 500 AEP	PMF
Out	622.5	660.3	697.0	729.6	1633.4
Q1	660.1	696.7	726.4	753.0	1690.4
Q2	801.9	813.4	826.4	833.6	868.5
Q3	44.4	88.7	106.6	136.7	1262.5
Q4	43.4	88.7	108.9	143.3	1321.9
Q5	34.3	73.9	103.2	130.8	1008.1
Q6	26.9	59.3	78.4	95.4	458.8
Q7	27.4	59.9	80.1	97.4	454.2
Q8	18.4	39.1	55.1	66.8	315.8
Q9	9.2	20.3	28.3	33.8	187.7
Q10	0.6	1.1	1.9	2.2	9.6
Q11	0.5	0.8	1.7	2.0	8.0
Q12	9.4	18.1	27.7	33.5	165.4
Q13	6.5	11.8	19.2	23.1	109.9
Q14	2.1	3.5	6.6	7.8	32.2
Q15	0.7	1.2	2.2	2.6	11.2
Q16	0.6	0.9	1.8	2.2	8.4

Location	Existing (m^3/s)				
	10% AEP	1% AEP	1 in 200 AEP	1 in 500 AEP	PMF
Q17	0.6	0.9	1.9	2.3	9.0
Q18	0.7	1.1	2.2	2.6	10.4
Q19	0.2	0.3	0.7	0.8	3.2
Q20	0.5	0.8	1.4	1.6	6.9
Q21	0.3	0.5	1.1	1.3	5.4
Q22	0.6	1.0	1.8	2.1	8.7
Q23	1.0	1.8	3.3	4.0	17.3
Q24	3.0	5.7	9.0	11.0	53.1
Q25	1.0	2.1	3.3	4.0	19.8
Q26	2.4	4.9	7.4	9.1	47.0
Q27	3.6	7.5	10.9	13.3	71.7
Q28	3.7	7.6	11.6	14.0	72.5

6 Developed Flood Behaviour

6.1 Developed Case Results

The results of the developed case flooding with the solar farm, for the 10% AEP, 1% AEP, 1 in 200 AEP, 1 in 500 AEP and PMF flood depth, velocity, and hazard are presented in **Figure C1-1** to **C5-4** of Appendix C. These figures show an envelope of the Hunter River and local catchment flooding.

Peak flows at selected locations from local catchment flooding only are presented in **Table 8**. Reporting locations are presented in Figure 3.

Table 8 - Peak flows at selected locations in the developed case

Location	Developed (m^3/s)				
	10% AEP	1% AEP	1 in 200 AEP	1 in 500 AEP	PMF
Out	625.2	663.0	699.4	732.1	1646.4
Q1	662.9	698.7	728.4	755.6	1705.3
Q2	801.2	812.3	825.5	832.2	870.1
Q3	44.7	89.0	106.5	136.8	1290.3
Q4	43.6	89.0	109.1	143.4	1331.6
Q5	34.3	73.9	103.2	130.9	1008.1
Q6	27.2	59.8	79.2	96.5	465.2
Q7	27.7	60.5	80.9	98.3	459.9
Q8	18.4	39.1	55.1	66.8	315.8
Q9	9.5	20.9	29.1	34.9	199.2
Q10	0.9	1.4	2.6	3.1	13.5
Q11	0.7	1.0	2.1	2.5	9.6
Q12	9.4	18.5	27.7	33.5	173.4
Q13	6.5	11.8	19.2	23.1	109.9
Q14	1.9	3.1	5.7	6.8	32.6
Q15	0.7	1.2	2.1	2.5	10.9
Q16	0.2	0.6	1.1	1.4	8.3
Q17	0.8	1.1	2.5	2.9	11.0
Q18	1.1	1.6	3.4	4.0	15.2
Q19	0.3	0.5	1.1	1.3	4.6
Q20	0.5	0.8	1.4	1.6	6.9
Q21	0.3	0.4	1.0	1.1	5.7
Q22	0.8	1.3	2.6	3.0	11.3
Q23	1.6	2.4	5.1	6.0	24.4
Q24	4.2	7.2	12.3	14.7	66.6
Q25	1.0	2.1	3.3	4.0	19.8
Q26	2.7	5.5	8.1	9.9	51.7
Q27	4.2	8.7	12.3	15.1	83.6
Q28	6.1	10.5	15.9	19.3	93.8

6.2 Flood Effects

Figures DL1-1 to DL1-5 of Appendix D presents the impact of the proposed Project during the full range of local flood events considered. These results show the local catchment flooding only.

A comparison of the peak flows for the existing and developed cases at the flow reporting locations are presented below in **Table 9.** These flows have considered an unmitigated operational case and mitigation options can be considered during the detailed design phase. Some minor increases are observed due to changes in roughness and losses from the development, and some negative values are observed due to slowing of flow through vegetation screening or behind small crossings and terrain changes.

Table 9 - Flow Differences

Location	Difference (m^3/s)					Difference (%)				
	10% AEP	1% AEP	1 in 200 AEP	1 in 500 AEP	PMF	10% AEP	1% AEP	1 in 200 AEP	1 in 500 AEP	PMF
Out	2.7	2.7	2.4	2.5	13.0	0.4	0.4	0.3	0.3	0.8
Q1	2.8	2.0	2.0	2.6	14.9	0.4	0.3	0.3	0.3	0.9
Q2	-0.7	-1.1	-0.9	-1.4	1.6	-0.1	-0.1	-0.1	-0.2	0.2
Q3	0.3	0.3	-0.1	0.1	27.8	0.7	0.3	-0.1	0.1	2.2
Q4	0.2	0.3	0.2	0.1	9.7	0.5	0.3	0.2	0.1	0.7
Q5	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Q6	0.3	0.5	0.8	1.1	6.4	1.1	0.8	1.0	1.2	1.4
Q7	0.3	0.6	0.8	0.9	5.7	1.1	1.0	1.0	0.9	1.3
Q8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q9	0.3	0.6	0.8	1.1	11.5	3.3	3.0	2.8	3.3	6.1
Q10	0.3	0.3	0.7	0.9	3.9	50.0	27.3	36.8	40.9	40.6
Q11	0.2	0.2	0.4	0.5	1.6	40.0	25.0	23.5	25.0	20.0
Q12	0.0	0.4	0.0	0.0	8.0	0.0	2.2	0.0	0.0	4.8
Q13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q14	-0.2	-0.4	-0.9	-1.0	0.4	-9.5	-11.4	-13.6	-12.8	1.2
Q15	0.0	0.0	-0.1	-0.1	-0.3	0.0	0.0	-4.5	-3.8	-2.7
Q16	-0.4	-0.3	-0.7	-0.8	-0.1	-66.7	-33.3	-38.9	-36.4	-1.2
Q17	0.2	0.2	0.6	0.6	2.0	33.3	22.2	31.6	26.1	22.2
Q18	0.4	0.5	1.2	1.4	4.8	57.1	45.5	54.5	53.8	46.2
Q19	0.1	0.2	0.4	0.5	1.4	50.0	66.7	57.1	62.5	43.8
Q20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q21	0.0	-0.1	-0.1	-0.2	0.3	0.0	-20.0	-9.1	-15.4	5.6
Q22	0.2	0.3	0.8	0.9	2.6	33.3	30.0	44.4	42.9	29.9
Q23	0.6	0.6	1.8	2.0	7.1	60.0	33.3	54.5	50.0	41.0
Q24	1.2	1.5	3.3	3.7	13.5	40.0	26.3	36.7	33.6	25.4
Q25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q26	0.3	0.6	0.7	0.8	4.7	12.5	12.2	9.5	8.8	10.0
Q27	0.6	1.2	1.4	1.8	11.9	16.7	16.0	12.8	13.5	16.6
Q28	2.4	2.9	4.3	5.3	21.3	64.9	38.2	37.1	37.9	29.4

Climate Change Sensitivity

The 1 in 200 AEP and 1 in 500 AEP flood events were modelled as a proxy climate change scenario as required in the SEARs. These events scale rainfall compared to the 1% AEP by approximately 10 percent and 30 percent respectively. This compares to the 2090 RCP 4.5 (9.5%) and 2090 RCP 8.5 (19.7%). It was concluded these events are appropriate to consider the impacts of climate change.

The climate change sensitivity modelling suggests that flood depth and velocity will increase under the climate change scenarios within the Project area and across the study catchment.

Hunter River Flooding

No developed case modelling has been prepared for the Hunter River flood mechanism. This is due to the following.

- There is no filling proposed for the solar array which is affected in this event.
- The solar array is generally located outside the 1% AEP extent.
- The solar panels are not expected to consume a significant amount of storage where the array is in a flood storage area for the 1 in 200 AEP, and 1 in 500 AEP events.
- The velocity in the affected area is low – generally less than 0.1m/s in the events up to and including the 1 in 500 AEP, and less than 0.5m/s in the PMF.

7 Discussion

7.1 Hydraulic Hazard and Hydraulic Categories

Flood hazard categories have been based on the latest AR&R 2019 categories presented in **Figure 6** below**.**

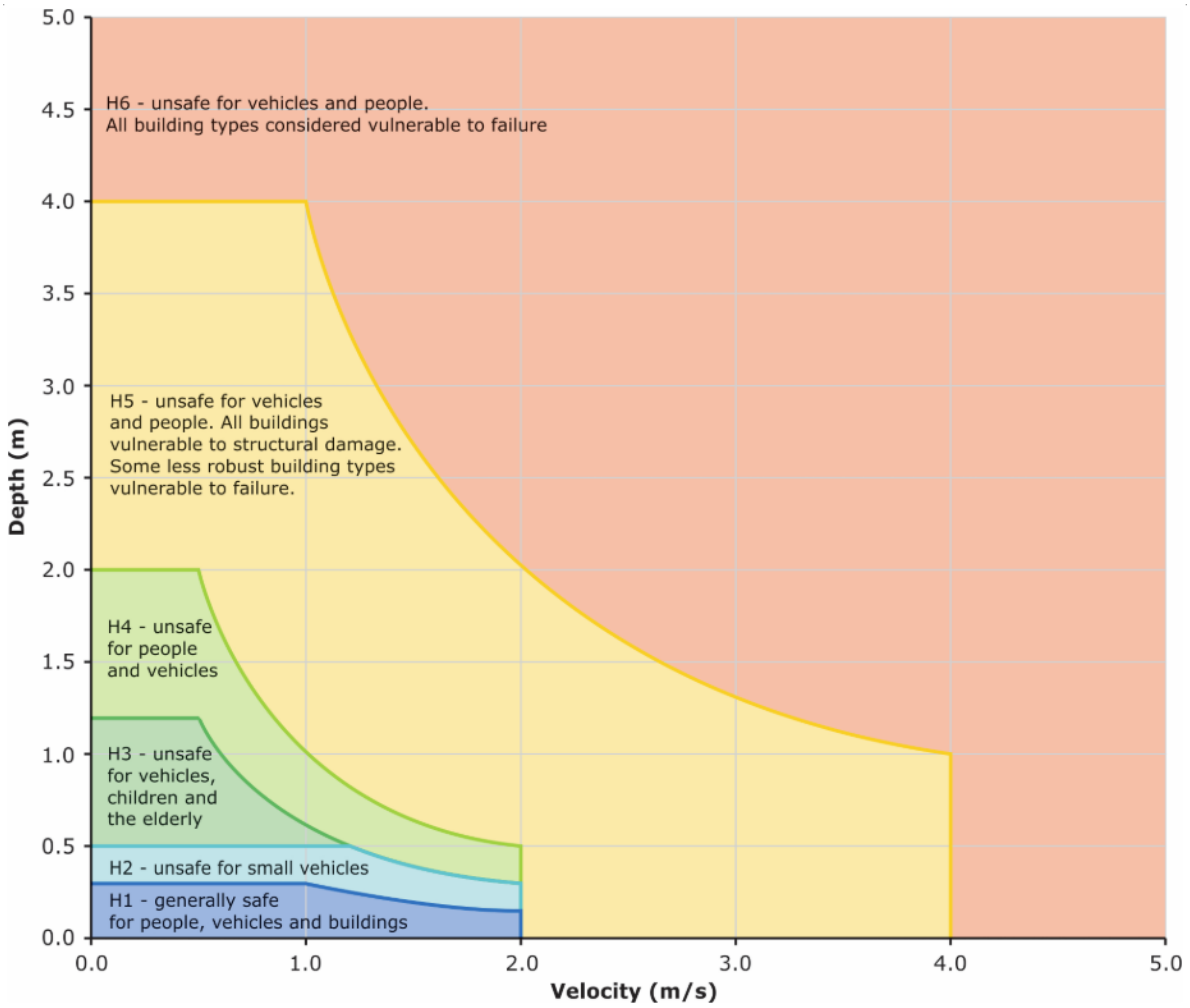


Figure 6 – Australian Rainfall and Runoff (2019) Hazard Categories

Hydraulic categories are used to explain the function of a particular area in the context of the floodplain. These include Floodway, Flood Storage, and Flood Fringe. These are typically dependant on hydraulic characteristics of depth, velocity, and velocity depth product. The following classification in Table 10, Table 11, and Table 12 below has been used for this study and is reproduced from the draft *Singleton Floodplain Risk Management Plan* (BMT WBM, 2022).

Table 10 - Flood function criteria for 10% AEP and 1% AEP

Classification	Criteria	Description
Floodway	V x D ≥ 1.0m²/s AND Velocity ≥ 0.6m/s	Areas and flow paths where a significant proportion of floodwaters are conveyed (including all bank-to-bank creek sections)

Classification	Criteria	Description
Flood Storage	Depth ≥ 1.5m	Areas where floodwaters accumulate before being conveyed downstream. These areas are important for detention and attenuation of flood peaks.
Flood Fringe	Remaining Flood Extent	Areas that are low-velocity backwaters within the floodplain. Filling of these areas generally has little consequence to overall flood behaviour.

Table 11 - Flood function criteria for 1 in 200 AEP, 1 in 500 AEP, and PMF

Classification	Criteria	Description
Floodway	V x D ≥ 1.5m²/s AND Velocity ≥ 0.6m/s PLUS 1% AEP Floodway	Areas and flow paths where a significant proportion of floodwaters are conveyed (including all bank-to-bank creek sections)
Flood Storage	Depth ≥ 1.5m	Areas where floodwaters accumulate before being conveyed downstream. These areas are important for detention and attenuation of flood peaks.
Flood Fringe	Remaining Flood Extent	Areas that are low-velocity backwaters within the floodplain. Filling of these areas generally has little consequence to overall flood behaviour.

Table 12 - Flood function criteria for local catchment

Classification	Criteria	Description
Floodway	V x D ≥ 1.0m²/s AND Velocity ≥ 0.1m/s OR Velocity > 0.8m/s	Areas and flow paths where a significant proportion of floodwaters are conveyed (including all bank-to-bank creek sections)
Flood Storage	Depth ≥ 1.5m	Areas where floodwaters accumulate before being conveyed downstream. These areas are important for detention and attenuation of flood peaks.
Flood Fringe	Remaining Flood Extent	Areas that are low-velocity backwaters within the floodplain. Filling of these areas generally has little consequence to overall flood behaviour.

7.2 Flood Events and Coincident Flood Probabilities

High Hunter River water levels will attenuate potential impact from the upstream local catchment flooding. Therefore, the local catchment modelling with approximately a 10% AEP downstream boundary condition for the Hunter River has been chosen as it will potentially produce a larger impact from the proposed Project on flood behaviour.

Furthermore, it is unlikely that the same recurrence interval event will be occurring within the river and local catchment simultaneously. If this was the case, this would result in a much rarer probability event.

Comparison figures in Appendix D show the impacts of the development assuming the lower tailwater condition. Flood behaviour figures have been shown as the maximum envelope of the Hunter River and local catchment flooding.

The 1 in 200 and 1 in 500 AEP flood events are presented as a proxy climate change scenario.

PMF flood event is presented for an understanding of the full range of flood behaviour and potential flood emergency planning.

7.3 Existing Flood Behaviour

7.3.1 Local Catchment Flooding

Local catchment flooding in the 10% AEP, 1% AEP, 1 in 200 AEP and 1 in 500 AEP is generally contained to the gullies which run in between the solar array extent. There are some areas in the southern array adjacent to Maison Dieu Road where the flood depth in these events is approximately 600mm within the existing gully. In the PMF, the flood depth on the northwestern extent of the panel array is up to 5.5 metres.

Similarly, the flood hazard across the solar array extent is low in the 10% AEP, 1% AEP, 1 in 200 AEP and 1 in 500 AEP. Hazards are generally H1, with a small section of up to H5 in the southern gully. In the PMF, hazards are generally H5 along this interface.

7.3.2 Hunter River Flooding

The solar array is generally unaffected in events up to and including the 1% AEP. Depths increase in the 1 in 200 AEP, 1 in 500 AEP, and PMF to a maximum of 1.0m, 2.2m, and 5.5m respectively.

Velocities in this area are low, with generally less than 0.1m/s in all events up to the 1 in 500 AEP, and less than 0.5m/s in the PMF.

This is reflected in the hydraulic categories with flood fringe where depths are less than 1.5 metres and flood storage for the remainder.

7.3.3 Flood Planning Area

The flood planning area has been estimated based on both Hunter River flooding and local catchment flooding with depth greater than 100mm, as land impacted by the 1% AEP plus 500mm freeboard. This is presented in **Figure B0** in Appendix B.

7.4 Developed Flood Behvaiour and Flood Impacts

7.4.1 Within the Project Area

Changes to the flood behaviour within the Project Area is expected to be due to changes in terrain and vegetation.

Minor increases are noted on the southern boundary of the Project due to the introduction of a dense planting screen slowing the flow of water.

The terrain assumptions made in the modelling include filling of the compound area to exclude flood water. This results in an increase in wet area upstream of the compound where water is being detained.

No filling has been assumed across the arrays or for access track crossings. It is expected that any embankments and culverts for access tracks would only act to further detain water prior to leaving site, and regrading throughout the arrays would not significantly affect the local distribution of runoff. Furthermore, these crossings may be designed as level crossings during the detailed design phase.

Other potential impacts for flow include the existing farm dams, and only one of these has been removed as part of the project.

7.4.2 Outside the Project Area

For the local catchment flooding, minor increase is calculated to the west of the Project due to the amendments of roughness and hydraulic losses under the panels and for the perimeter access roads.

Small decreases have been calculated to the east based on the topographic adjustments for the hardstand area.

The impact of the Project on Hunter River flooding has not been quantified on the basis that no fill is proposed across the array, the array is located generally outside the 1% AEP, the array does not occupy a significant amount of flood storage in rarer flood events, and the velocity in the affected areas is low (less than 0.1m/s in the 1 in 200 AEP, 1 in 500 AEP, and less than 0.5m/s in the PMF).

From the modelling undertaken, and review of available studies, it is our opinion that the Project will not result in a significant adverse flood impacts outside of the Project Area.

7.5 Singleton Floodplain Risk Management Plan

The draft *Singleton Floodplain Risk Management Plan* (BMT WBM, 2022) includes recommendations for floodplain management including property modification, response modification, and flood modification.

The Project is consistent with this document as considerations are given to all management options. Recommendations for property modification are included in the **8.2 Recommendations – Finished Floor Level** section of this report. Management of emergency response is included in the **8.3 Recommendations – Flood Emergency** section. Flood modification is not considered at this stage given the local catchment nature of flooding in the more frequent events. This will be considered as part of the detailed design phase of works.

7.6 SEARs Requirements and Response

SEARs and responses are outlined in Table 13 below.

Table 13 - SEARs Requirements

Requirement	Response
BCD – Flooding	
The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW GOVERNMENT 2005) including: s) Flood prone land	Consideration has been given to the PMF for both the local catchment and Hunter River flooding. Refer to Section 5 - Existing Flood Behaviour.
t) Flood planning area, the area below the flood planning level	The Flood Planning Area for the local catchment and Hunter River flooding has been estimated. Refer to Section 7.3 - Existing Flood Behaviour.

Requirement	Response
u) Hydraulic categorisation (floodways and flood storage areas)	Hydraulic categories for the local catchment and Hunter River flooding have been estimated. Refer to Section 5 - Existing Flood Behaviour.
The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100 year flood levels and the probable maximum flood, or an equivalent extreme event.	The 10% AEP (1 in 10 year), 1% AEP (1 in 100 year), and PMF have been considered as part of this assessment. Refer to Section 5 - Existing Flood Behaviour.
The EIS must model the effect of the proposed development (including fill) on the flood behaviour under the following scenarios: v) Current flood behaviour for a range of design events as identified in 11 above. This includes the 1 in 200 and 1 in 500 year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	Consideration of the 1 in 200 AEP, and 1 in 500 AEP has been included in this assessment. Refer to Section 5 - Existing Flood Behaviour.
Modelling in the EIS must consider and document: w) The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood.	Consideration has been given to both existing and developed conditions for all local events considered. Refer to Section 6.2 - Flood Effects.
x) Impacts of the development on flood behaviour resulting in detrimental changes in potential flood	Consideration has been given to both existing and developed conditions for all local events considered. Refer to Section 6.2 – Flood Effects.
y) affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories.	Consideration has been given to both existing and developed conditions for all local events considered. Refer to Section 6.2 - Flood Effects.
z) Relevant provisions of the NSW Floodplain Development Manual 2005.	Consideration has been given to the revised Flood Risk Management Manual 2023.
The EIS must assess the impacts on the proposed development on flood behaviour, including: aa) Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure.	Consideration has been given to both existing and developed conditions for all local events considered. Refer to Section 6.2 – Flood Effects.
bb) Consistency with Council floodplain risk management plans.	A summary of consistency with the draft Singleton Floodplain Risk Management Plan is included.

Requirement		Response
		Refer to Section 7.5 – Singleton Floodplain Risk Management Plan.
cc)	Compatibility with the flood hazard of the land.	Flooding is generally low hazard local overland flow. Where the Project Area is affected by Hunter River flooding, this is also generally low hazard in the more frequent events. Refer to Section 5 – Existing Flood Behaviour.
dd)	Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.	The site is generally located within local overland flooding. Where the Project Area is affected by Hunter River flooding, this is flood fringe and storage, and not expected to cause a significant impact. Refer to Section 5 - Existing Flood Behaviour.
ee)	Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.	We do not believe there will be adverse impacts to beneficial inundation. Solar panels are open structured and are generally only inundated in events in excess of the 10% AEP. Refer to Section 5 - Existing Flood Behaviour.
ff)	Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	We do not believe there will be any significant increase in erosion, siltation, destruction of riparian vegetation, or reduction in the stability of riverbanks from the Project due to the implementation of the recommendations discussed in Section 8 below, and in the Water Impact Assessment (Northrop, 2023).
gg)	Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council.	The Project is not expected to have a significant impact on emergency response arrangements for this vicinity. Refer to Section 8.3 - Flood Emergency.
hh)	Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council.	We believe it is feasible for the Project to implement strategies to manage risk to life as part of detailed design. There is flood free land available on-site in the PMF. Additional measures may include flood emergency response plans. Refer to Section 8.3 - Flood Emergency.
ii)	Emergency management, evacuation and access, and contingency measures for the development	Consideration has been given to emergency response. Refer to Section 8.3 - Flood Emergency.
jj)	considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the SES.	This has considered the full range of flood events up to and including the PMF for both the local and regional flood events. Refer to Section 8.3 - Flood Emergency

Requirement	Response
kk) Any impacts the development may have on the social and economic costs to the community as consequence of flooding.	We do not believe the Project will have social or economic costs to the community as the Applicant accepts the risk to property, and has measures to manage the risk to life.
The [EIS/EA] must describe the potential effects of coastal processes and hazards (within the meaning of the Coastal Management Act 2016), including sea level rise and climate change: ll) On the proposed development mm) Arising from the proposed development.	The Project Area is above 40m AHD and we believe it is unlikely to be impacted by coastal processes.
The [EIS/EA] must have regard to any certified Coastal Management Program (or Coastal Zone Management Plan) and be consistent with the management objectives described in the Coastal Management Act 2016 and development controls for coastal management areas mapped under the State Environmental Planning Policy (Coastal Management) 2018.	The Project Area and adjacent Hunter River channel is outside the study extents of the Hunter Estuary Coastal Zone Management Plan (BMT WBM, December 2017), which terminates at Oakhampton.

7.7 Council Requirements

Council LEP requirements relating to flooding are presented below in Table 14.

Table 14 – LEP requirements

Requirement	Response
(1) The objectives of this clause are as follows	
(a) to minimise the flood risk to life and property associated with the use of land,	Recommendations to minimise risk to life and property are discussed in Section 8.
(b) to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change,	Consideration has been given to the flood function of the land based on both Hunter River and local catchment flooding. The Project is in predominately flood fringe with some flood storage. The Project is considered compatible with the flood function due to the lack of fill in flood storage and open panel configuration.
(c) to avoid adverse or cumulative impacts on flood behaviour and the environment,	The Project proposes no fill in flood storage areas affected by Hunter River flooding. Infrastructure within these areas consists of panels which are unlikely to consume significant flood storage volume. Cumulative impacts are unlikely as a result.
(d) to enable the safe occupation and efficient evacuation of people in the event of a flood.	Vehicular access to Maison Dieu Road is away from the Hunter River flooding on the east of the

Requirement	Response
	site and likely to facilitate early evacuation if required. Shelter in place is also considered feasible as an option of last resort.
(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development	
(a) is compatible with the flood function and behaviour on the land, and	Consideration has been given to the flood function of the land based on both Hunter River and local catchment flooding. The Project is in predominately flood fringe with some flood storage. The Project is considered compatible with the flood function due to the lack of fill in flood storage and open panel configuration.
(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and	The Project proposes no fill in flood storage areas affected by Hunter River flooding. Infrastructure within these areas consists of panels which are unlikely to consume significant flood storage volume. Impacts on Hunter River flooding is not expected as a result. Local flood impacts have been modelled and calculated to be insignificant.
(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and	Vehicular access to Maison Dieu Road is away from the Hunter River flooding on the east of the site and likely to facilitate early evacuation if required. Shelter in place is also considered feasible as an option of last resort.
(d) incorporates appropriate measures to manage risk to life in the event of a flood, and	Recommendations for flood emergency response have been discussed in Section 8.3.
(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.	Recommendations for flood emergency response have been discussed in Section 8.1.
(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters	
(a) the impact of the development on projected changes to flood behaviour as a result of climate change,	Both the 1 in 200 AEP and 1 in 500 AEP have been considered as proxies for climate change.
(b) the intended design and scale of buildings resulting from the development,	The Project is not expected to impact flooding and therefore we believe the scale of development is appropriate.
(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,	The Project has a feasible emergency response strategy which is discussed in Section 8.3.

Requirement	Response
(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.	The Project involves consideration of decommissioning which can be activated should flood behaviour become an unacceptable risk.

8 Recommendations

8.1 PV Array

An approximately 100mm maintained grass cover is recommended for the solar array area. The grassed areas will reduce the likelihood of erosion from concentrated flow from PV panels during rainfall events.

We recommend consideration is given to lowering the risk to property through appropriate location of the panels and supporting infrastructure. This is to be considered during detailed design and there are various options to achieve this including regrading of the terrain and inclusion of stormwater infrastructure.

8.2 Finished Floor Level

Finished floor level for all habitable uses within the Project Area such as office and control rooms should be at a minimum above 1% AEP flood level + 500mm freeboard. The Applicant may choose a different higher standard based on their risk appetite. Recommended finished floor level for other non-habitable uses is 1% AEP flood level + 300mm freeboard.

This applies to all buildings on-site. There are several design responses as to how this can be achieved for the BESS and compound area including fill, upstream diversions, culverts, and flood protection walls. Finished floor levels and arrangements for how this this is to be achieved to be determined during the detailed design phase.

8.3 Flood Emergency

If significant rainfall is predicted, we recommend early evacuation of the site during work hours and that consideration be given to advising staff and visitors not to attend site until the hazard has passed if outside work hours.

The storage of potable water and non-perishable food items on-site is recommended should refuge be required as an option of last resort in local flash flood conditions. The modelling indicates critical durations expected are less than three hours. In these events, the time of isolation on-site is likely to be less than six hours.

This emergency response strategy reflects the recommendations generally provided by the SES and outlined in the *Draft Shelter in Place Guideline* (NSW DPE, 2023).

8.4 Location of Flood Protection Measures

We understand the detailed design phase of the Project will provide further information regarding the terrain adjustments, culvert designs, and flood protection walls. All of these elements are likely to be situated immediately adjacent to the related infrastructure, and we believe it is feasible to locate these within the proposed disturbance footprint.

9 Conclusion

Northrop Consulting Engineers were engaged by RPS AAP Consulting Pty Ltd to undertake a flooding assessment for the proposed Project at the Maison Dieu Solar Farm, Maison Dieu NSW.

9.1 Risk to Property

The project has reduced the risk to property by adopting the following measures.

- Choosing a layout which generally avoids the 1% AEP flood extent.
- Having floor levels above the 1% AEP plus freeboard.

9.2 Risk to Life

The project has reduced the risk to life by the adopting following measures.

- Considering the likely flood emergencies.
- Recommending a flood emergency response strategy.

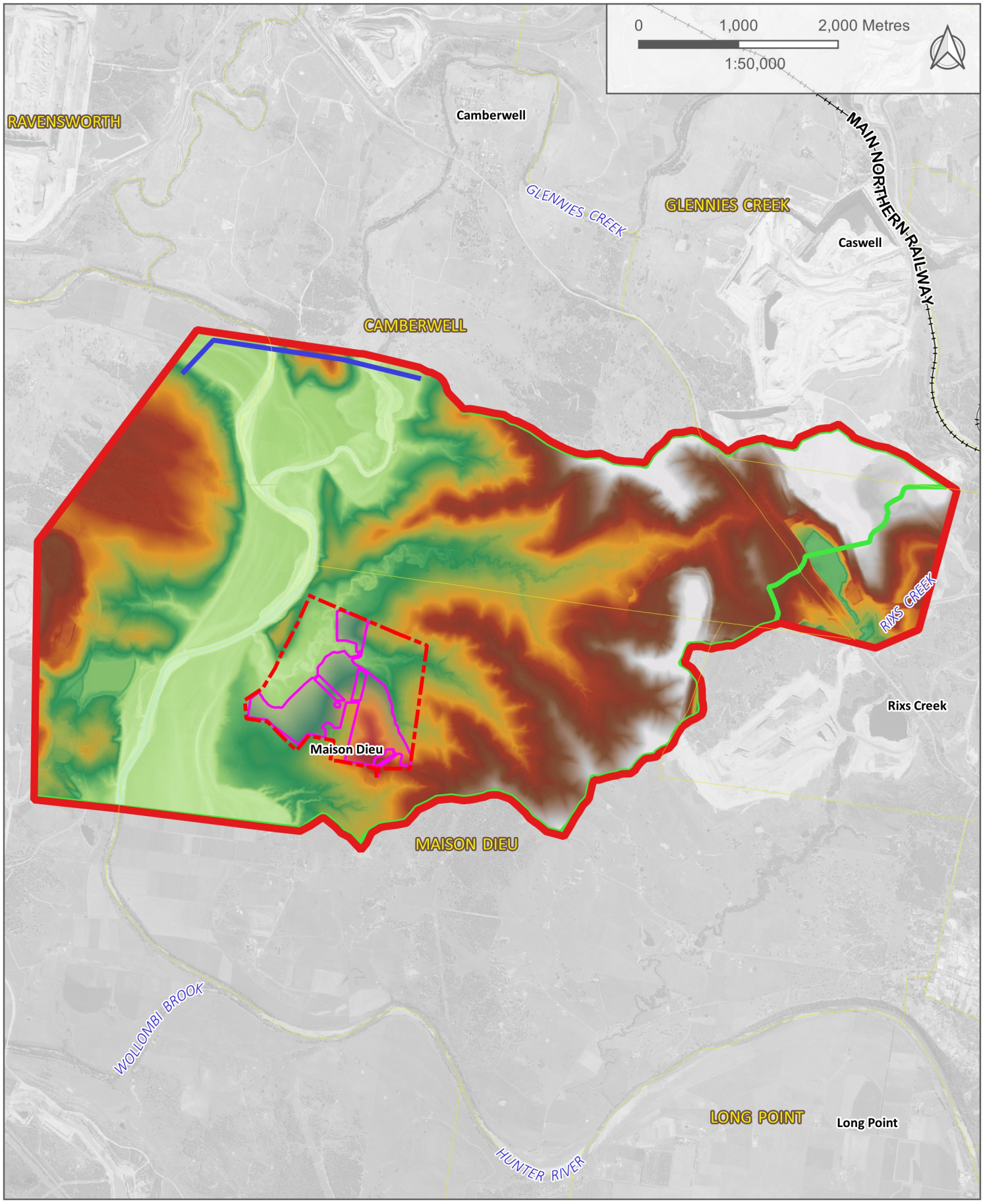
9.3 Flood Impacts

Based on the assessment undertaken, we do not believe there are any significant adverse impacts to flood behaviour on the Project Area, downstream properties, and floodplain.

9.4 Authority Requirements

This assessment responds to the SEARs requirements with respect to flooding.

Appendix A – Model Setup and Critical Durations



Legend

Model Terrain (m AHD)
150
40

TUFLOW Model Extent

Boundary Conditions
HT
QT

Disturbance Area
Project Area

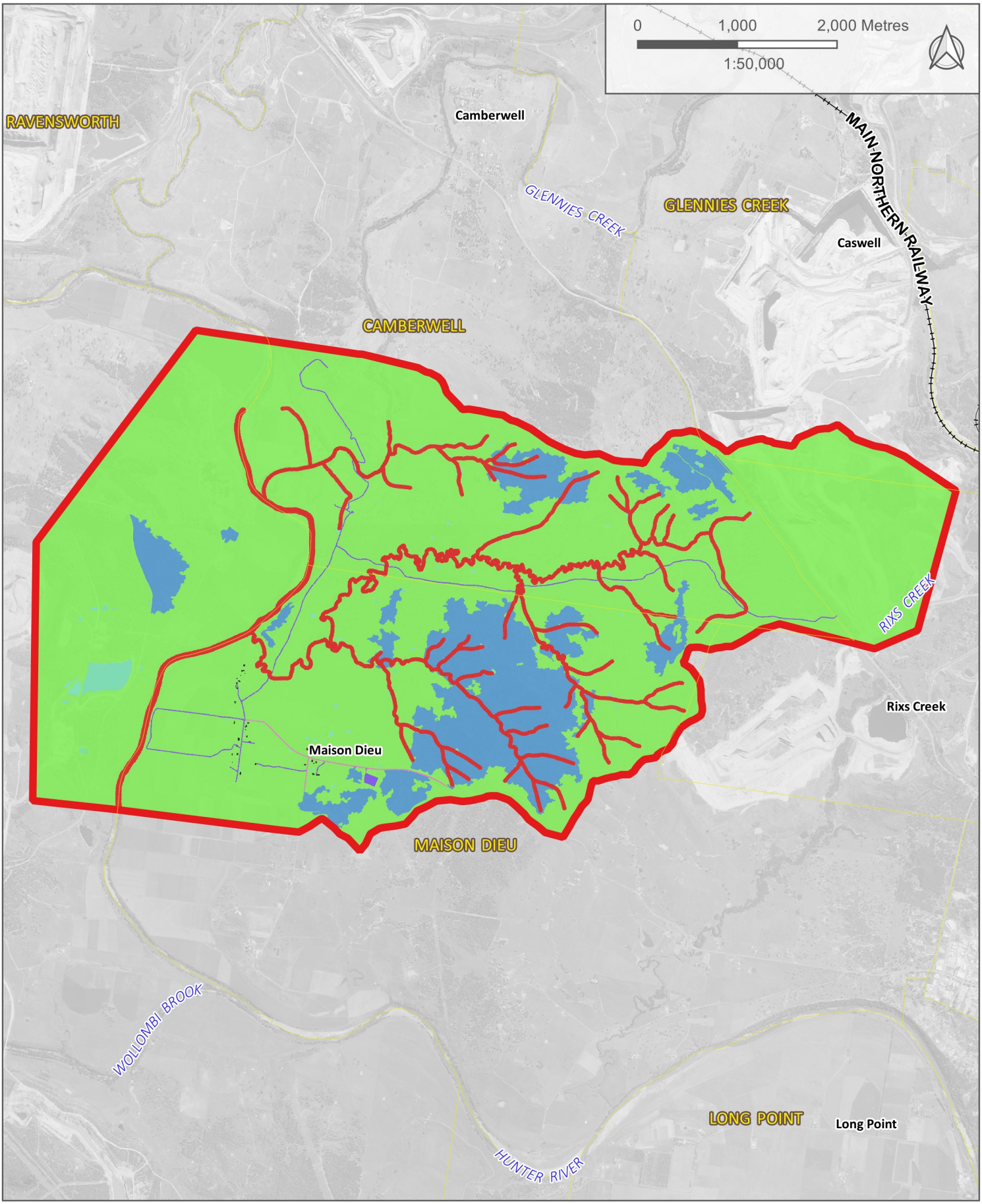
Figure A1

Existing Terrain and Model Extent

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
15/5/2024 X:\PROJECTS\NEWCASTLE\YEAR 2022 Jobs\NL222472 - Maison Dieu Solar Farm\FIGURES\WORKSPACE\Maison Dieu Figures - May 2024.qgz



Legend

- TUFLOW Model Extent
- Surface
- 0.70 - Buildings
- 0.02 - Sealed roads
- 0.02 - Unsealed roads
- 0.02 - Open water
- 0.06 - Channels
- 0.10 - Dense vegetation
- 0.04 - Pasture grass
- 0.07 - Medium Vegetation
- 0.03 - Panels

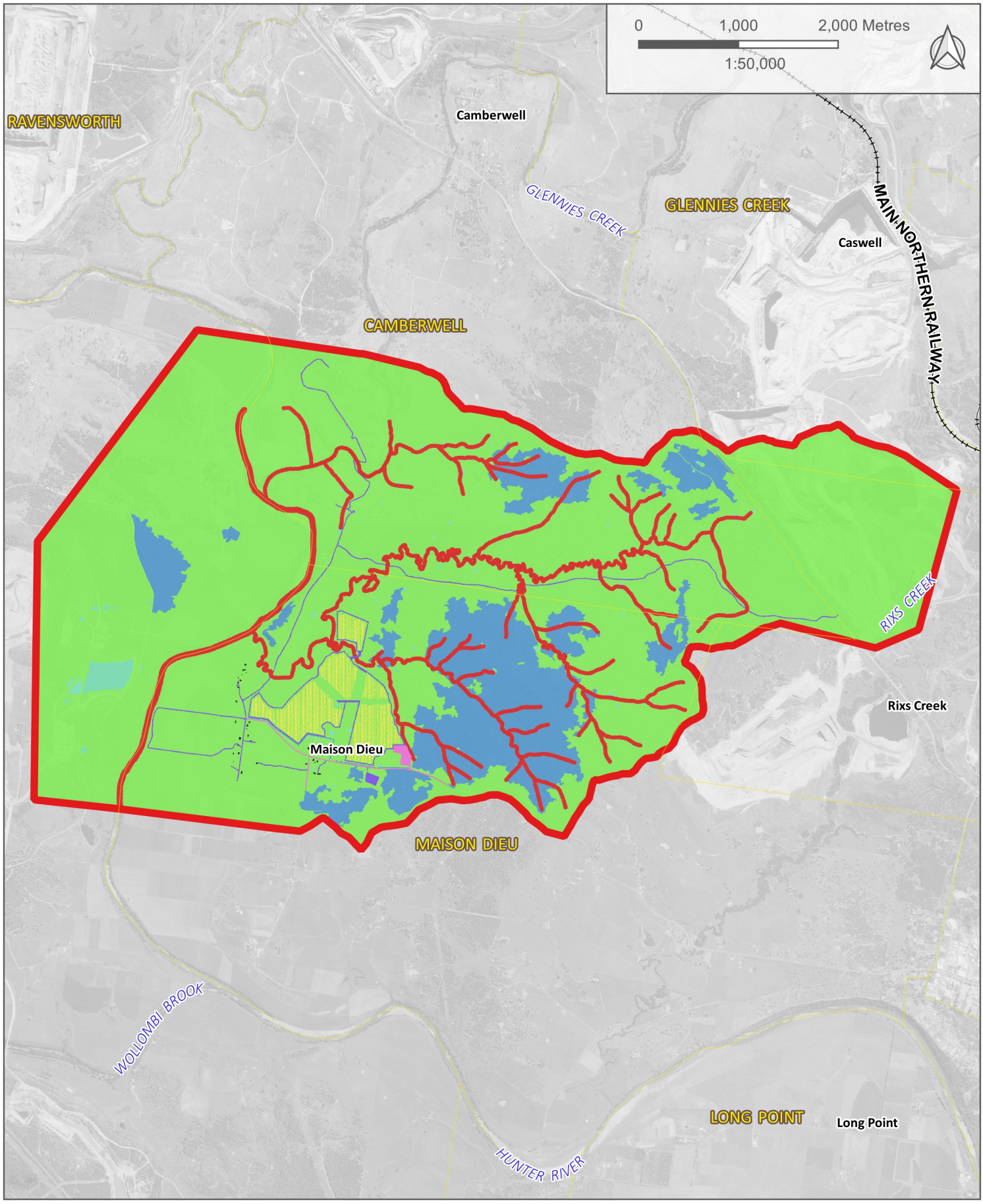
Figure A2

Existing Surface Roughness

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- TUFLOW Model Extent
- Surface
  - 0.70 - Buildings
  - 0.02 - Sealed roads
  - 0.02 - Unsealed roads
  - 0.02 - Open water
  - 0.06 - Channels
  - 0.10 - Dense vegetation
  - 0.04 - Pasture grass
  - 0.07 - Medium Vegetation
  - 0.03 - Panels

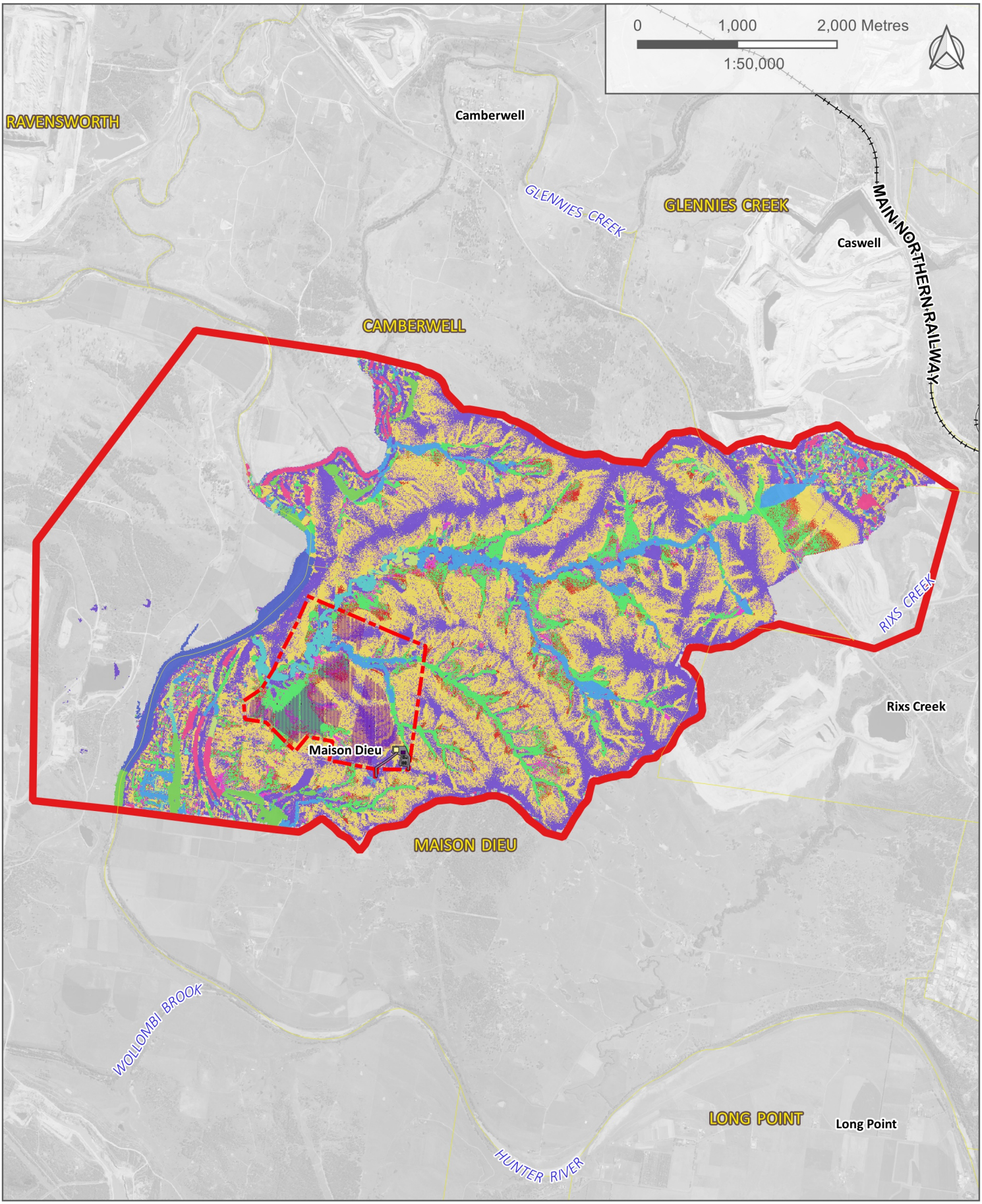
Figure A3

Developed Surface Roughness

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
15/5/2024 X:\PROJECTS\NEWCASTLE\YEAR 2022 Jobs\NL222472 - Maison Dieu Solar Farm\FIGURES\WORKSPACE\Maison Dieu Figures - May 2024.qgz



Legend

- TUFLOW Model Extent
- Solar Farm
- Project Area
- Substation / BESS / O&M
- Disturbance Footprint
- Grid Connection Easement
- Substation Footprint
- BESS

Maximum Median Duration

- 10min
- 15min
- 20min
- 30min
- 45min
- 60min
- 90min
- 120min
- 180min
- 270min
- 360min
- 540min
- 720min

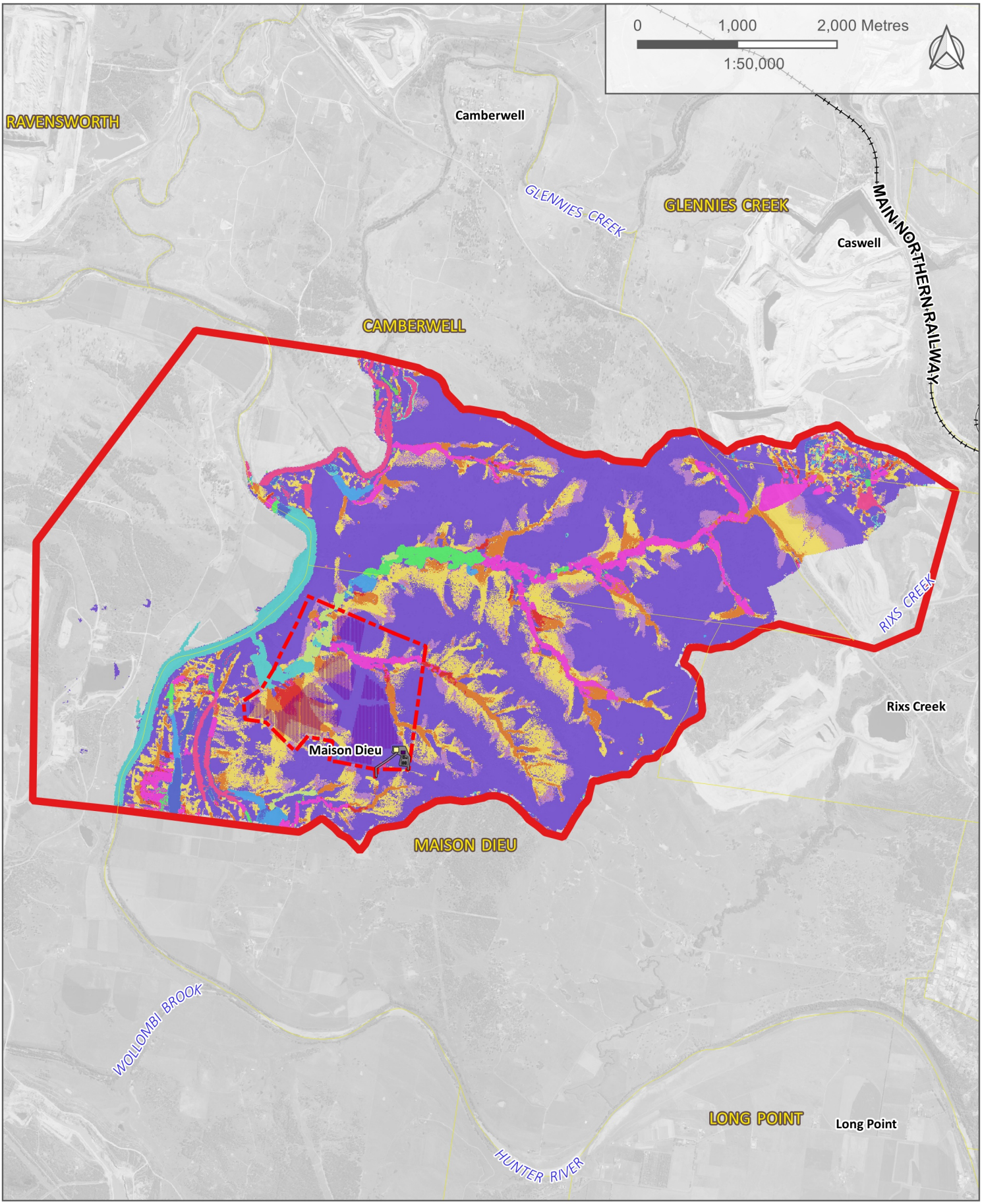
Figure A4

10% AEP Critical Durations

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- TUFLOW Model Extent
- Solar Farm
- Project Area
- Substation / BESS / O&M
- Disturbance Footprint
- Grid Connection Easement
- Substation Footprint
- BESS

Maximum Median Duration

- 10min
- 15min
- 20min
- 30min
- 45min
- 60min
- 90min
- 120min
- 180min
- 270min
- 360min
- 540min
- 720min

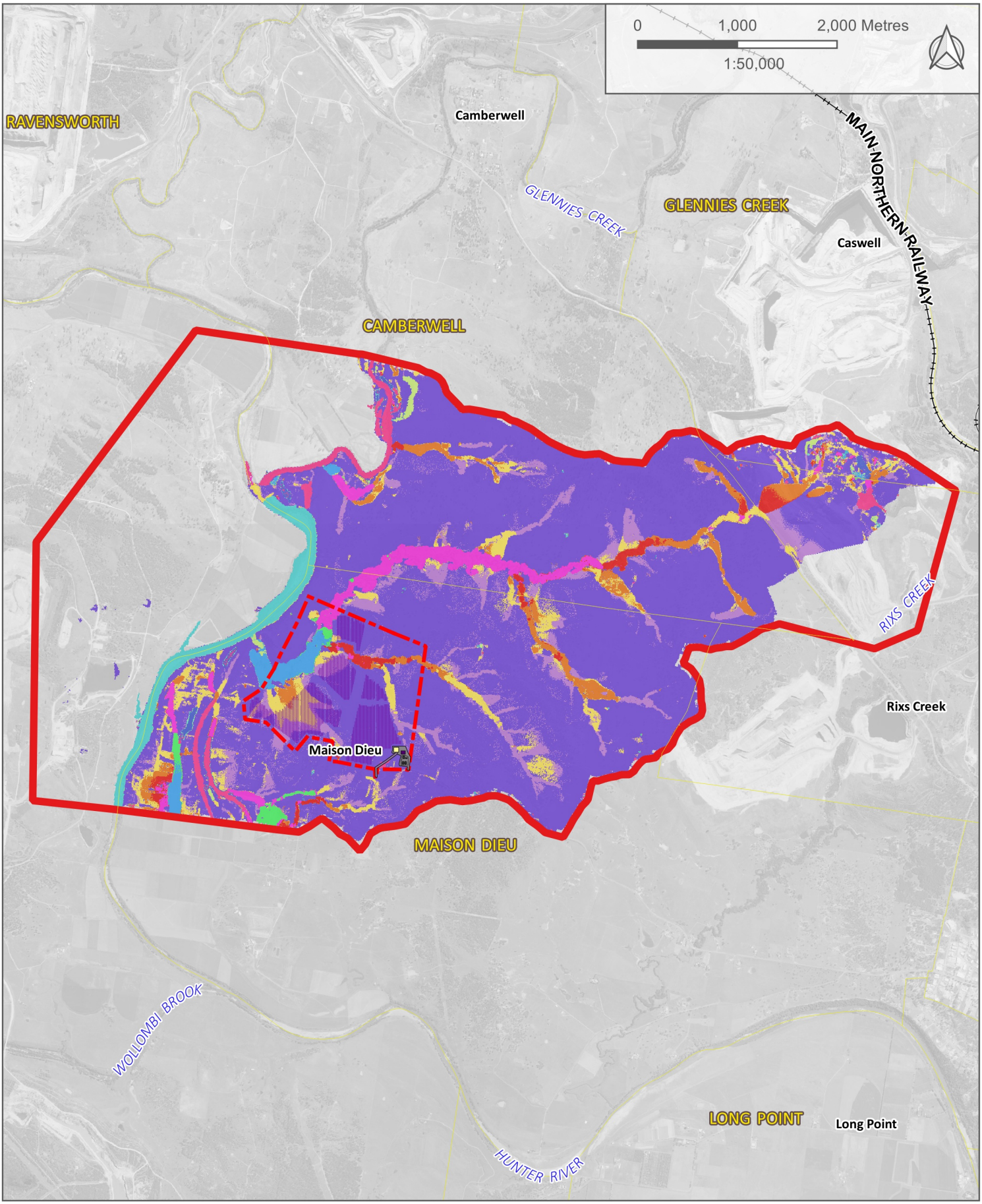
Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Figure A5

1% AEP Critical Durations

Solar Farm Maison Dieu

NORTHROP



Legend

- TUFLOW Model Extent
- Solar Farm
- Project Area
- Substation / BESS / O&M
- Disturbance Footprint
- Grid Connection Easement
- Substation Footprint
- BESS

Maximum Median Duration

- 10min
- 15min
- 20min
- 30min
- 45min
- 60min
- 90min
- 120min
- 180min
- 270min
- 360min
- 540min
- 720min

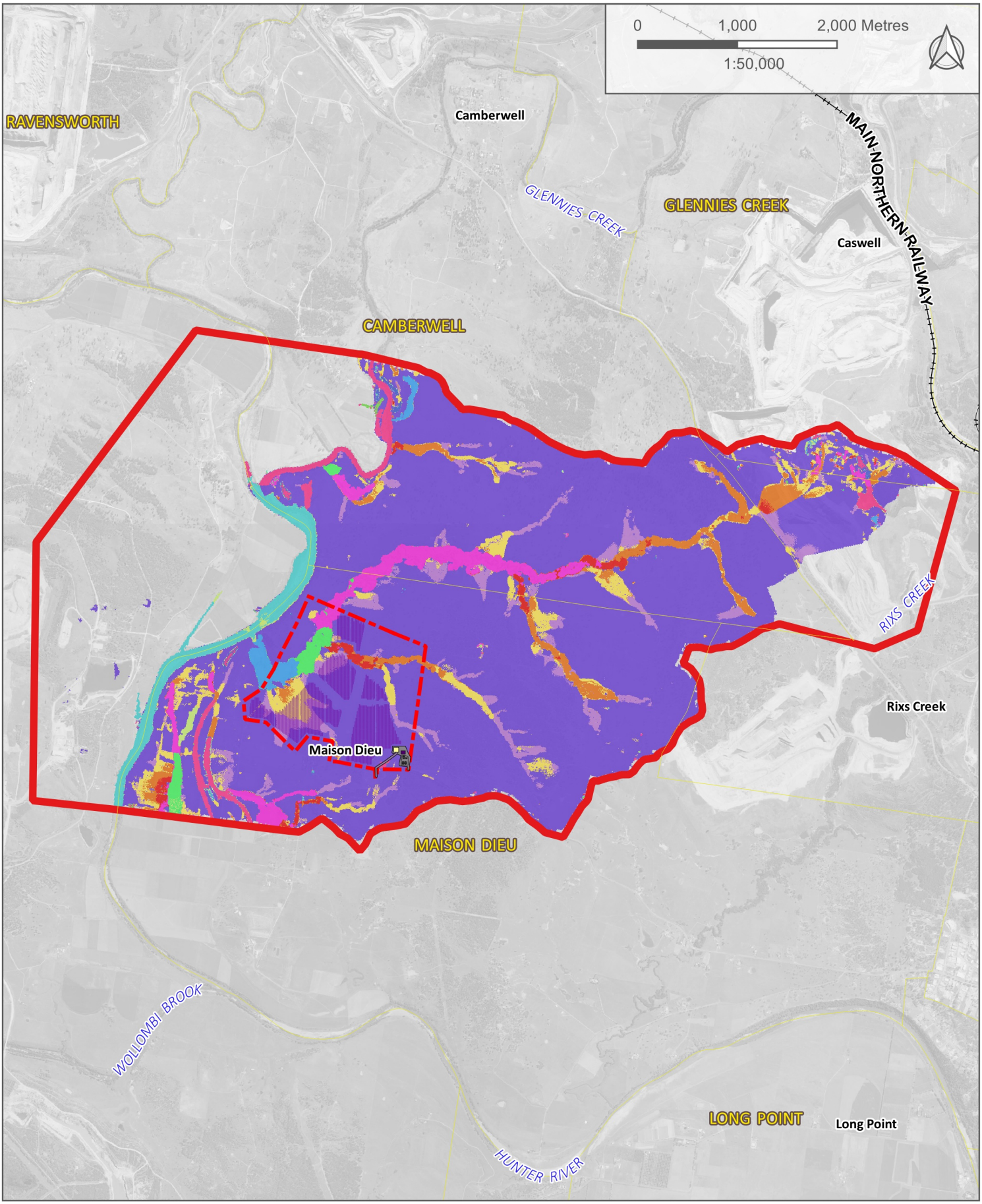
Figure A6

1 in 200 AEP
Critical Durations

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- TUFLOW Model Extent
- Solar Farm
- Project Area
- Substation / BESS / O&M
- Disturbance Footprint
- Grid Connection Easement
- Substation Footprint
- BESS

Maximum Median Duration

- 10min
- 15min
- 20min
- 30min
- 45min
- 60min
- 90min
- 120min
- 180min
- 270min
- 360min
- 540min
- 720min

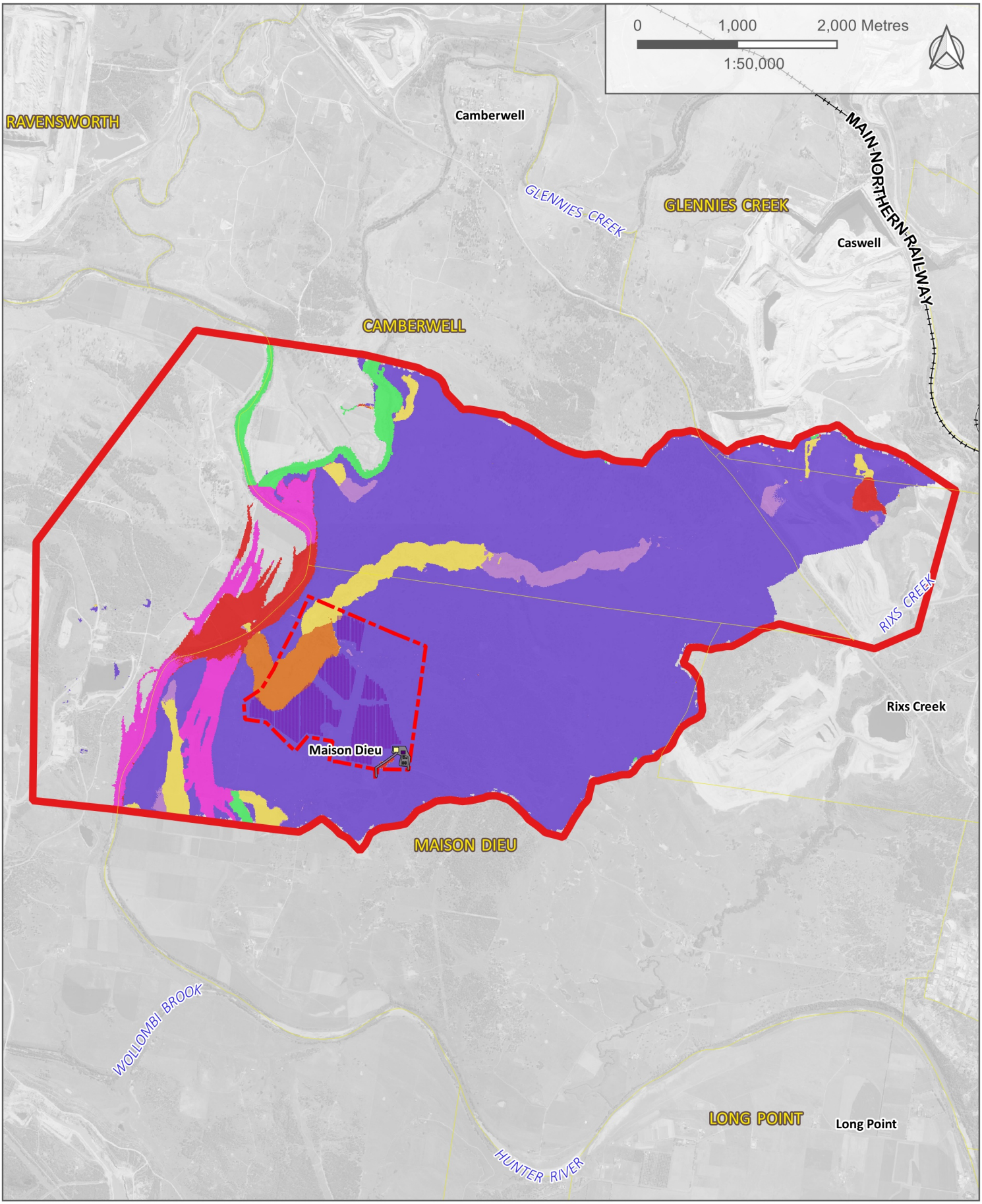
Figure A7

1 in 500 AEP
Critical Durations

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- TUFLOW Model Extent
- Solar Farm
- Project Area
- Substation / BESS / O&M
- Disturbance Footprint
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Max Duration

- 15min
- 30min
- 45min
- 60min
- 90min
- 120min
- 180min

Figure A8

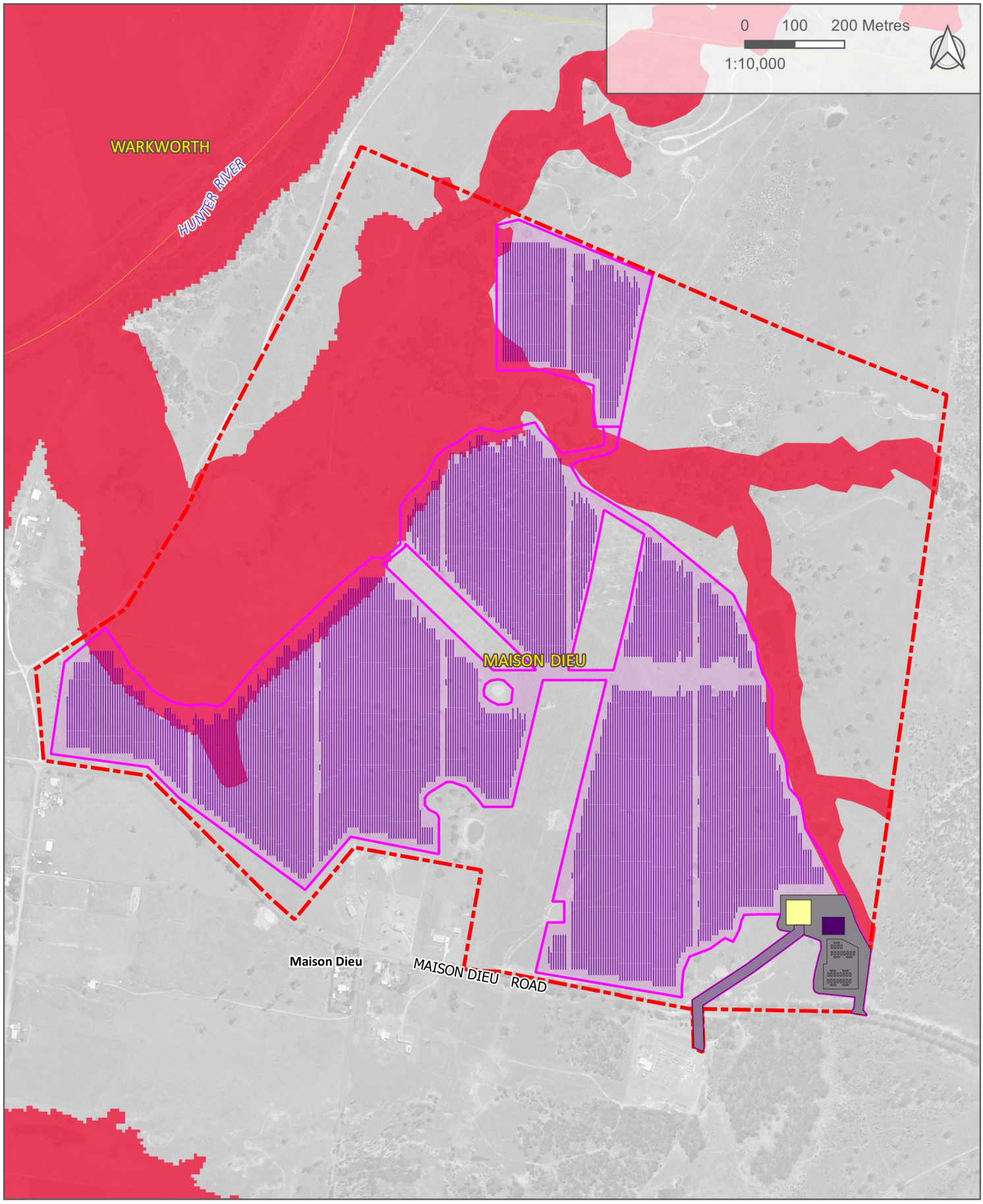
PMF Critical Durations

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Appendix B – Existing Case Flooding



Legend

- Flood Planning Area
- Project Area
- Disturbance Area
- Solar Farm
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

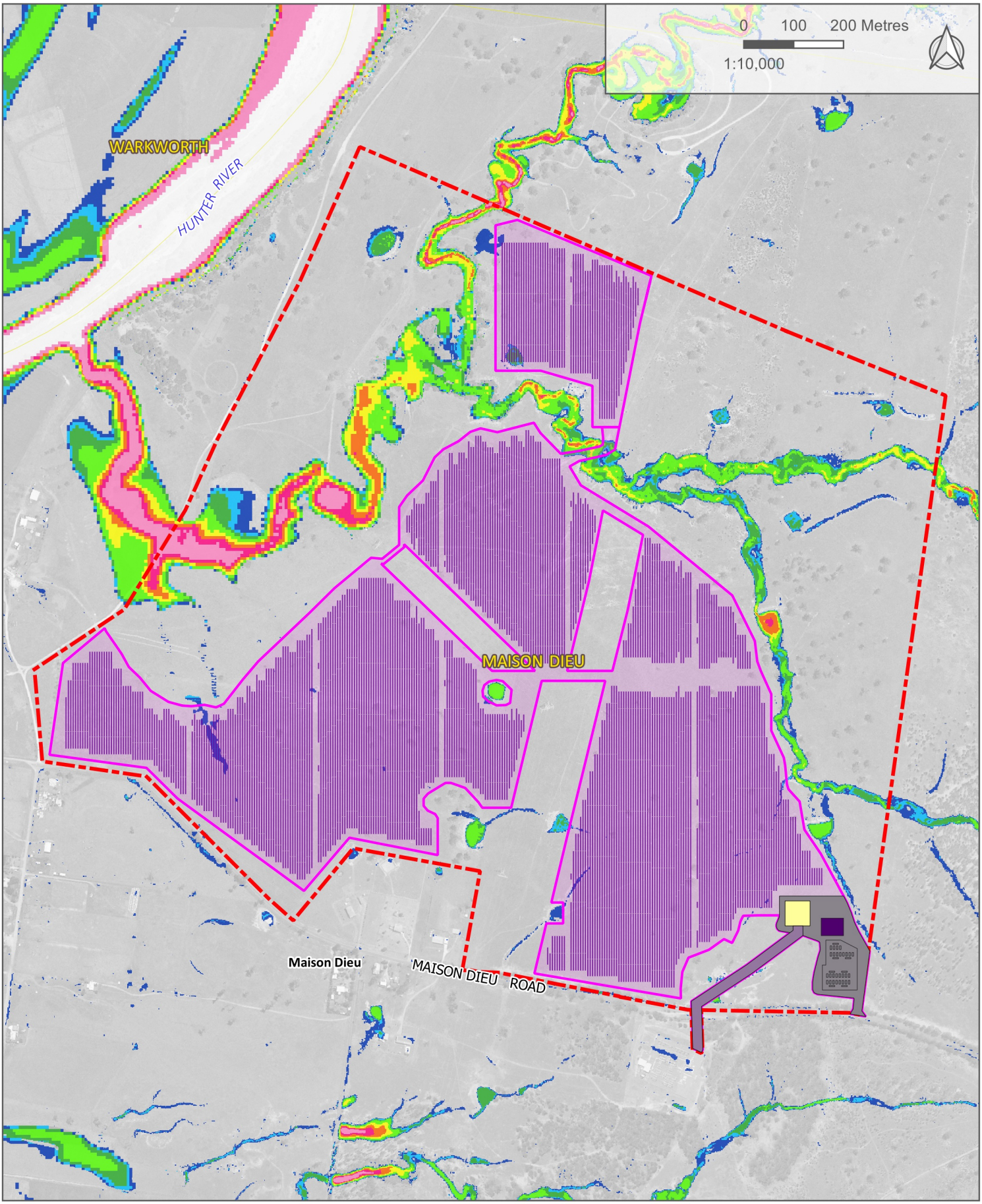
Figure B0

Combined Flood Planning Area
1% AEP plus 500mm Freeboard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

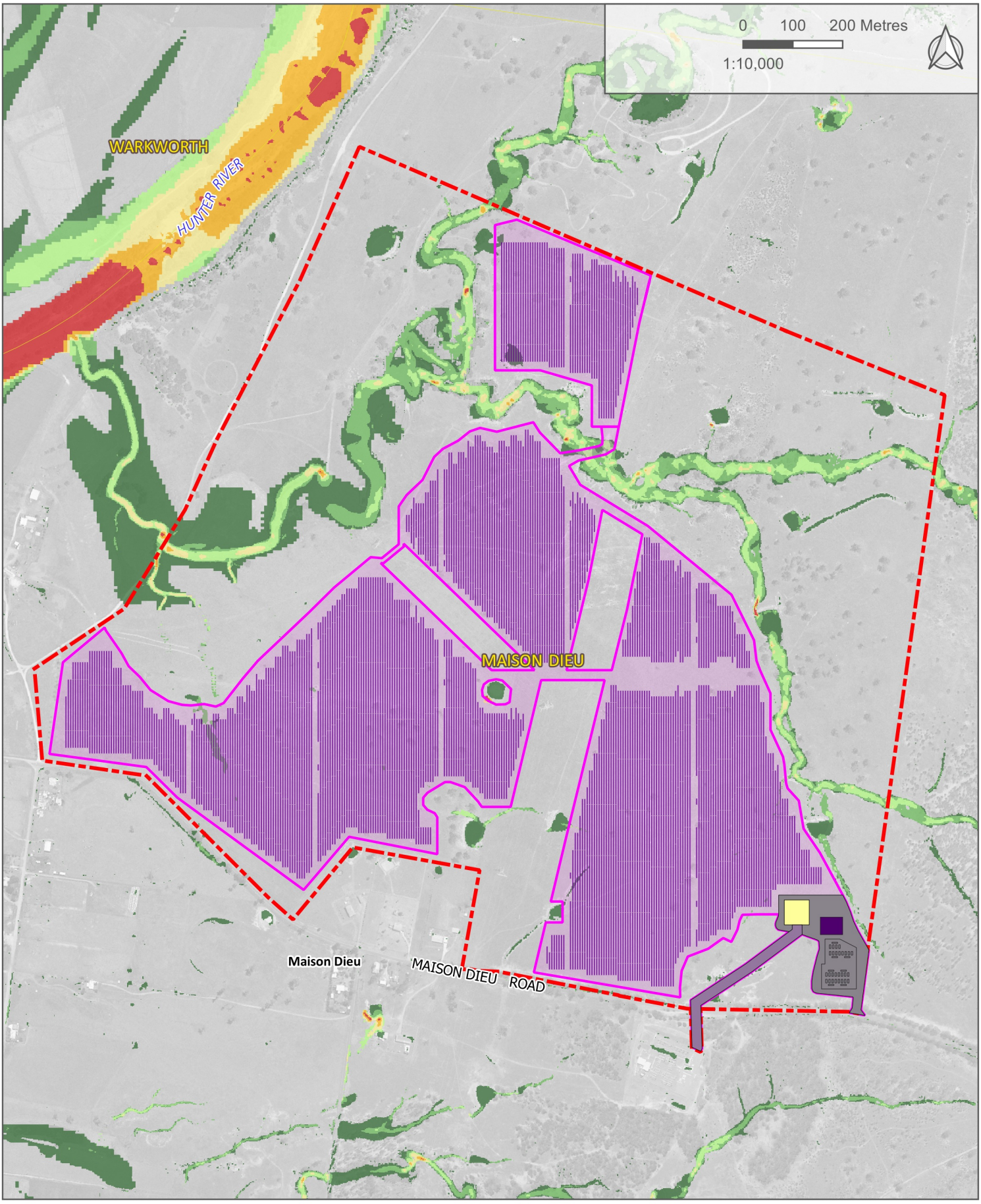
Figure B1-1

10% AEP Existing Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

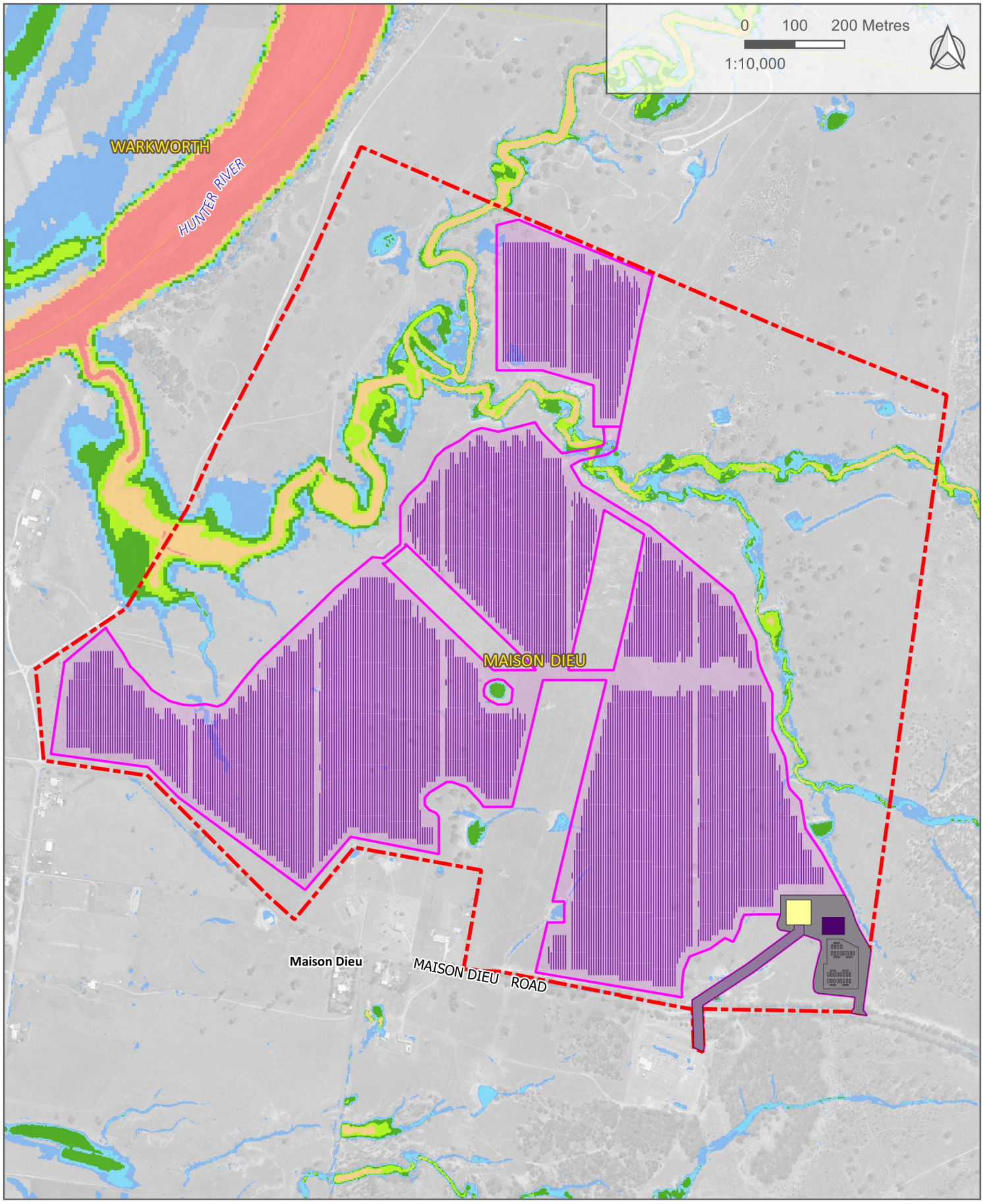
Figure B1-2

10% AEP Existing Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

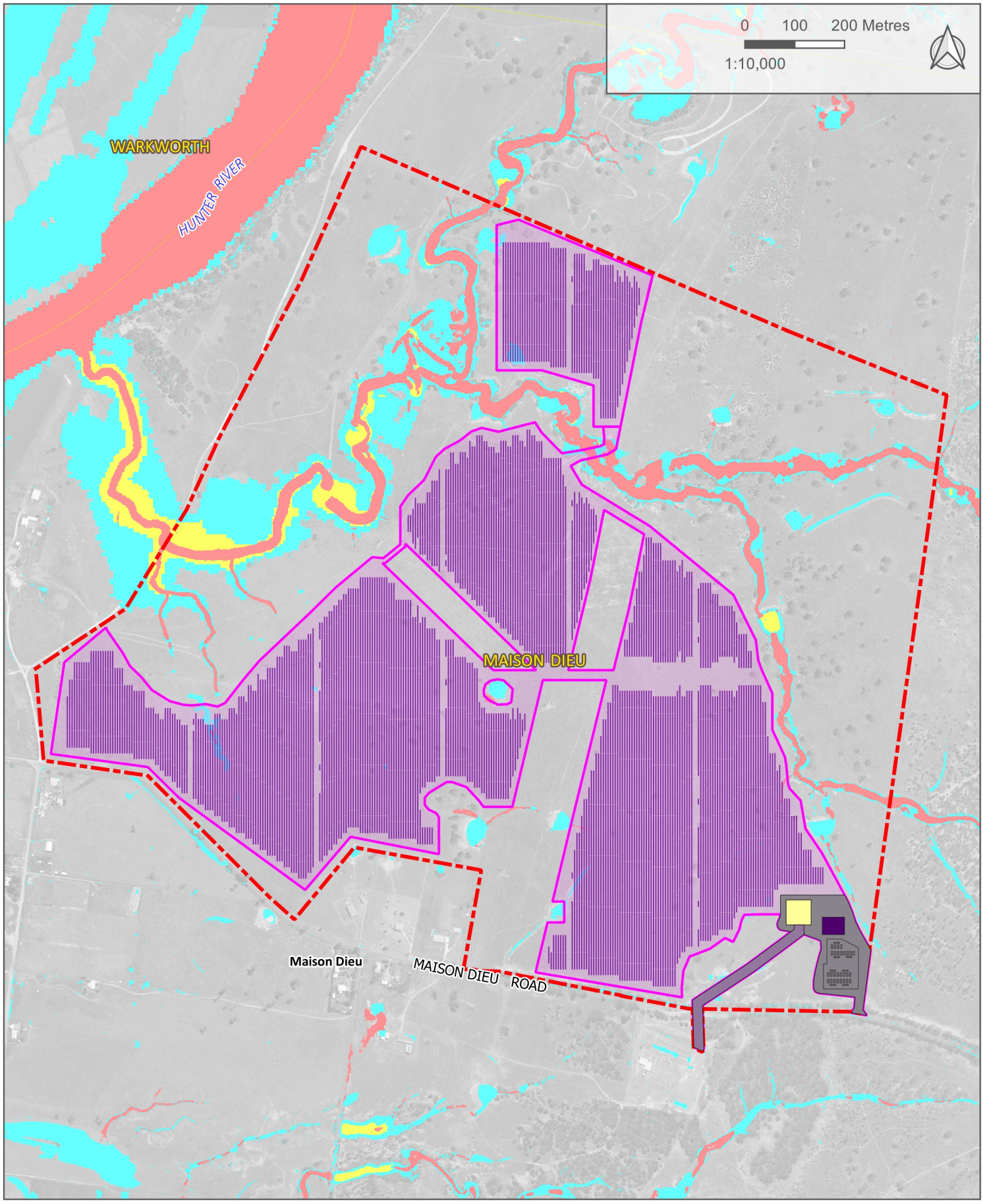
Figure B1-3

10% AEP Existing Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

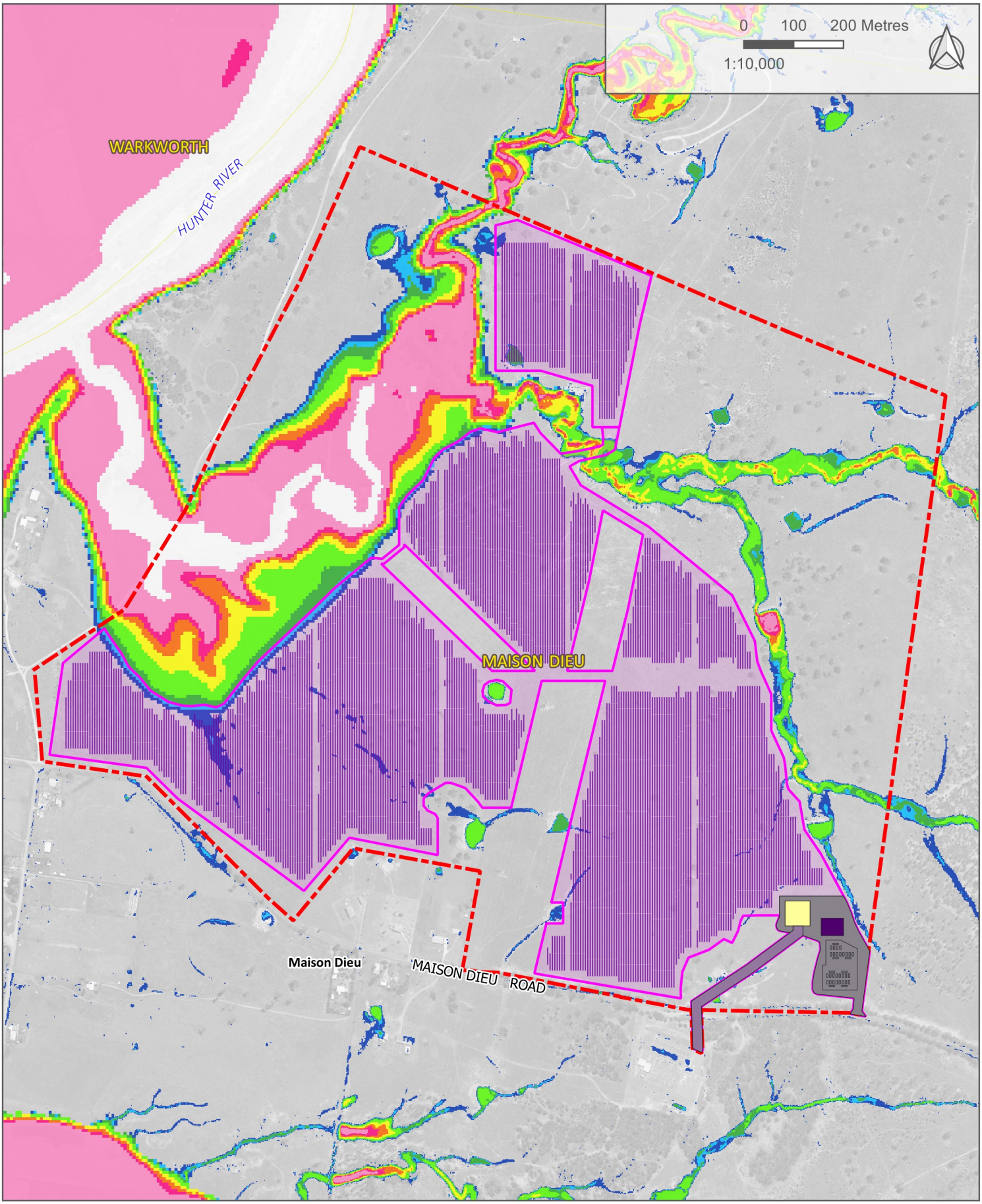
Figure B1-4

10% AEP Existing Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

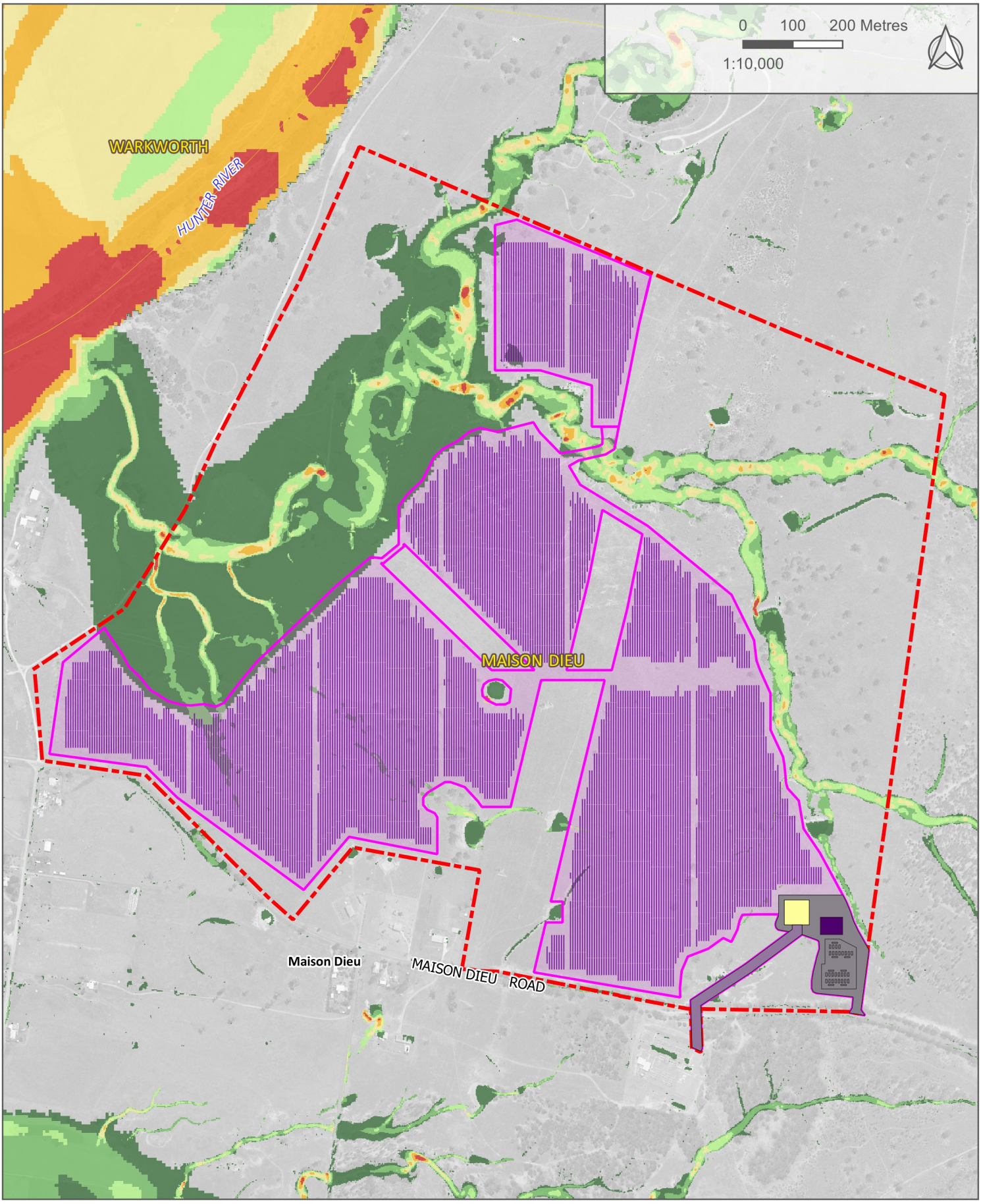
Figure B2-1

1% AEP Existing Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

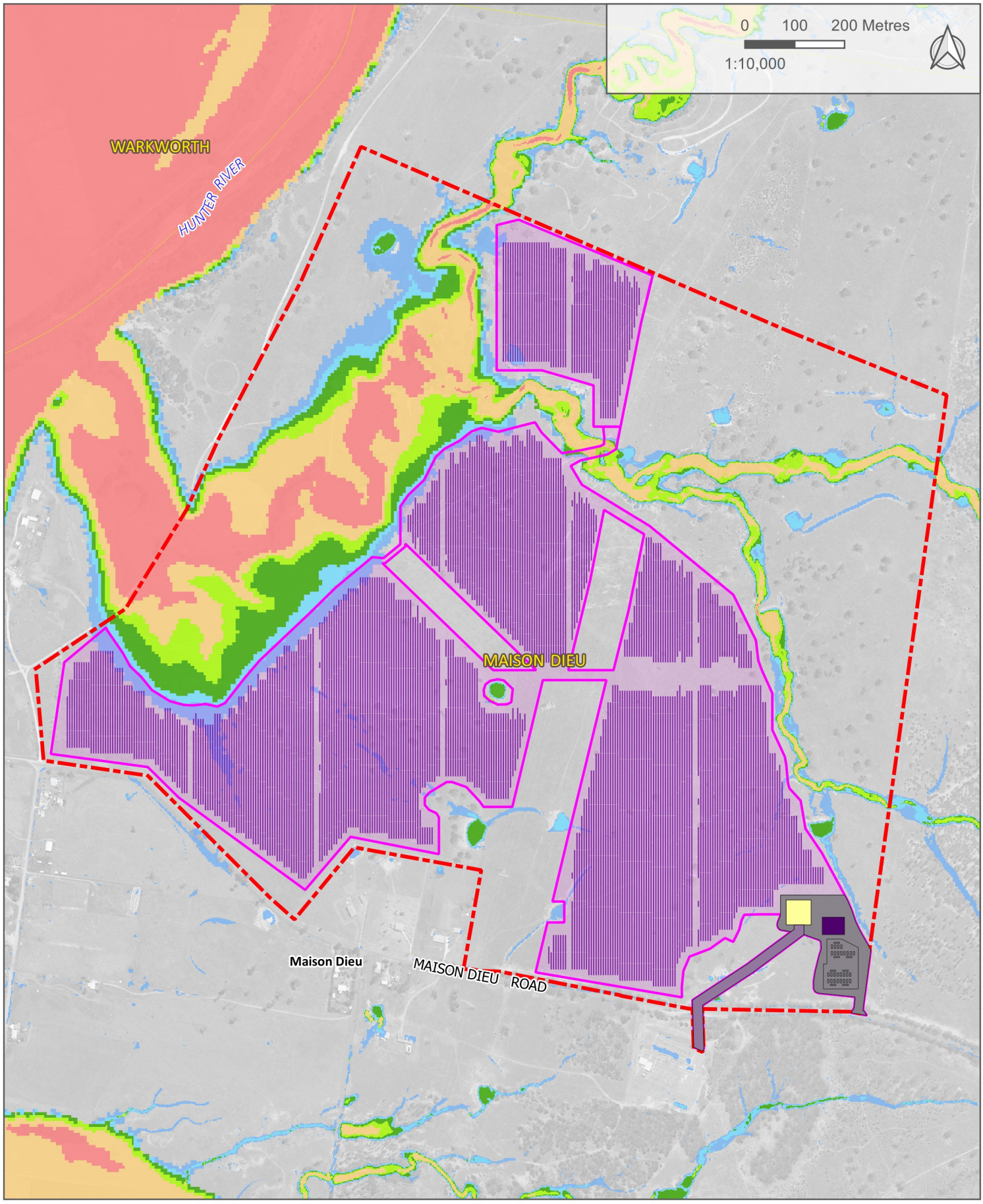
Figure B2-2

1% AEP Existing Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

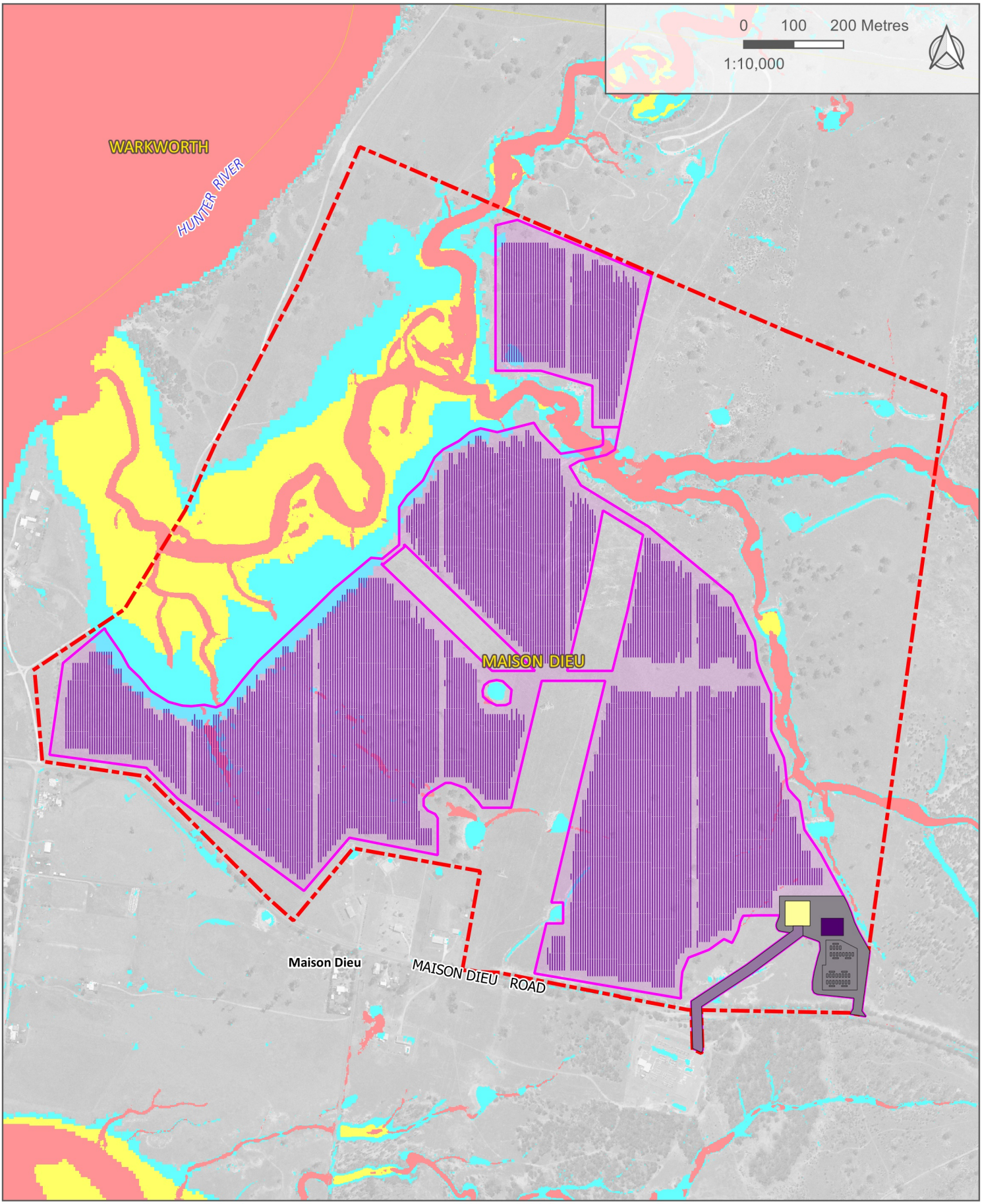
Figure B2-3

1% AEP Existing Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

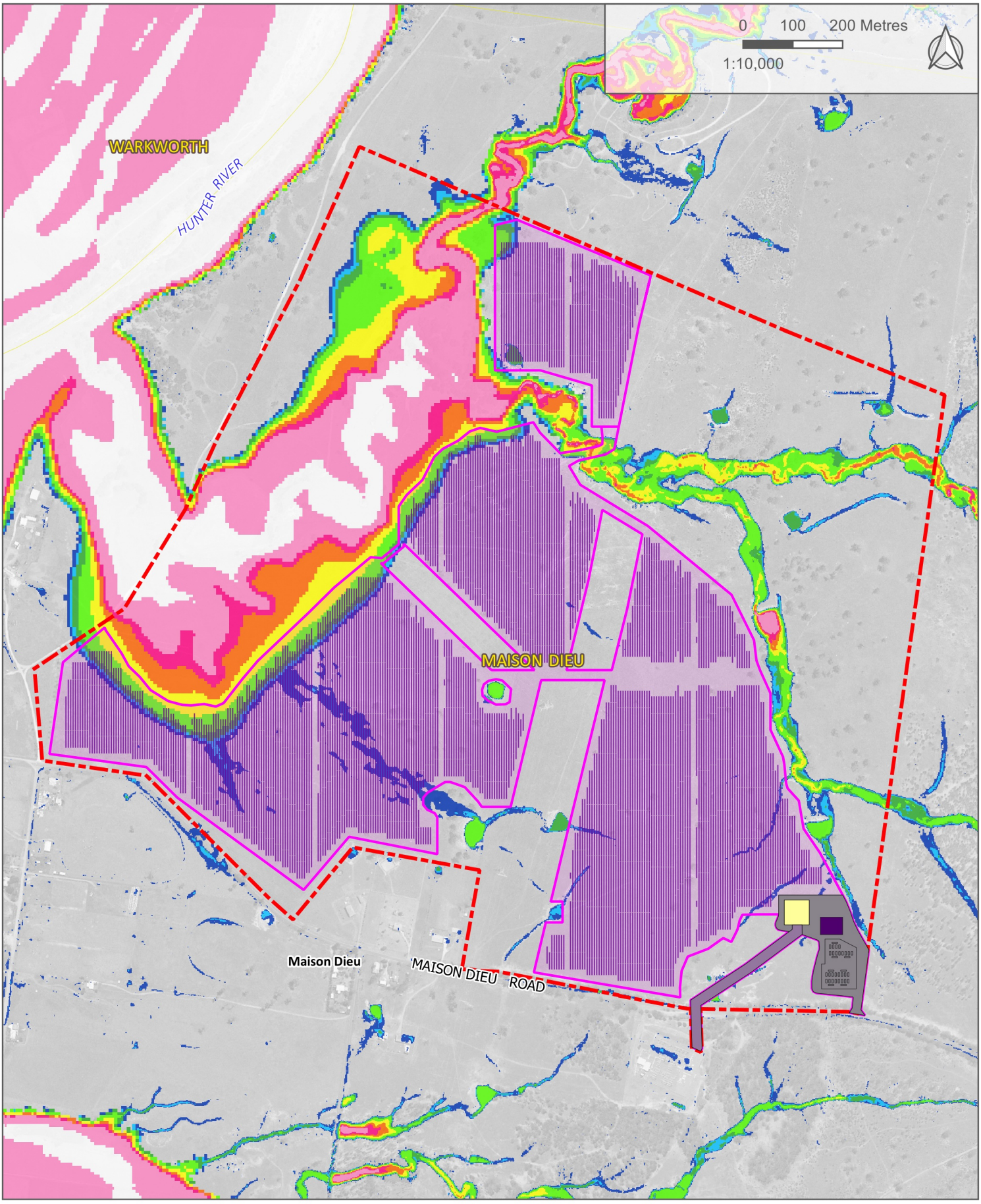
Figure B2-4

1% AEP Existing Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

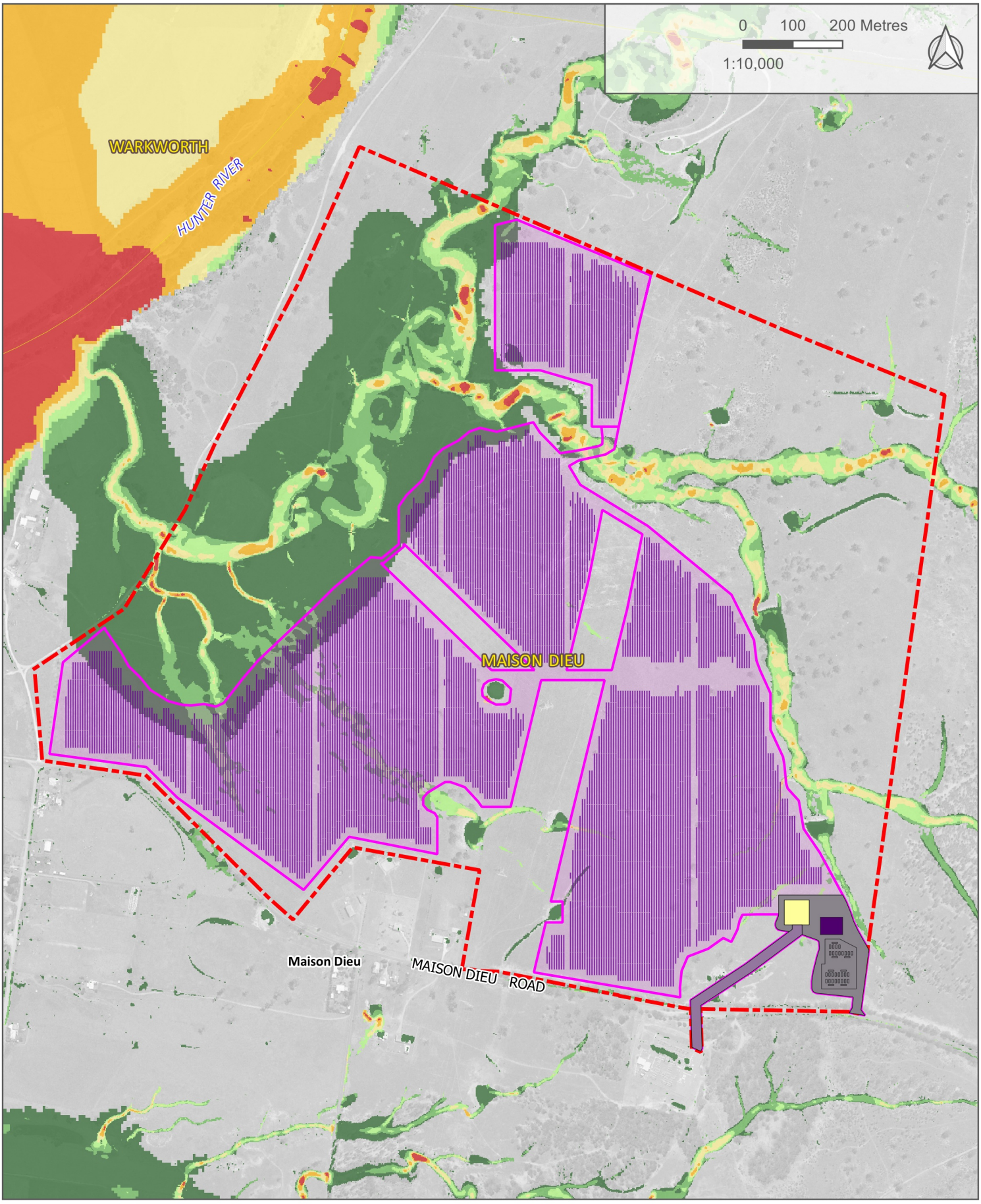
Figure B3-1

1 in 200 AEP Existing Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

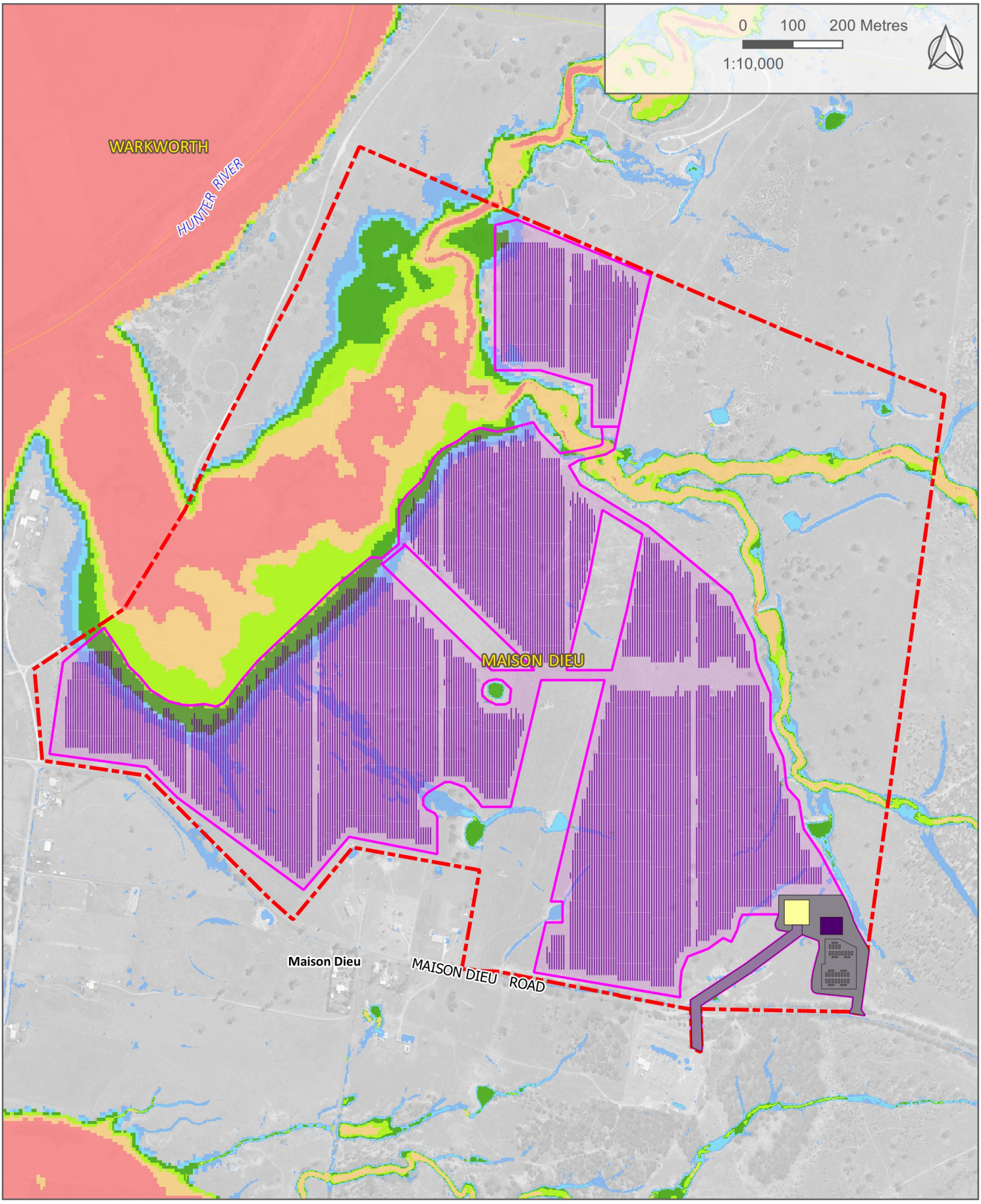
Figure B3-2

1 in 200 AEP Existing Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

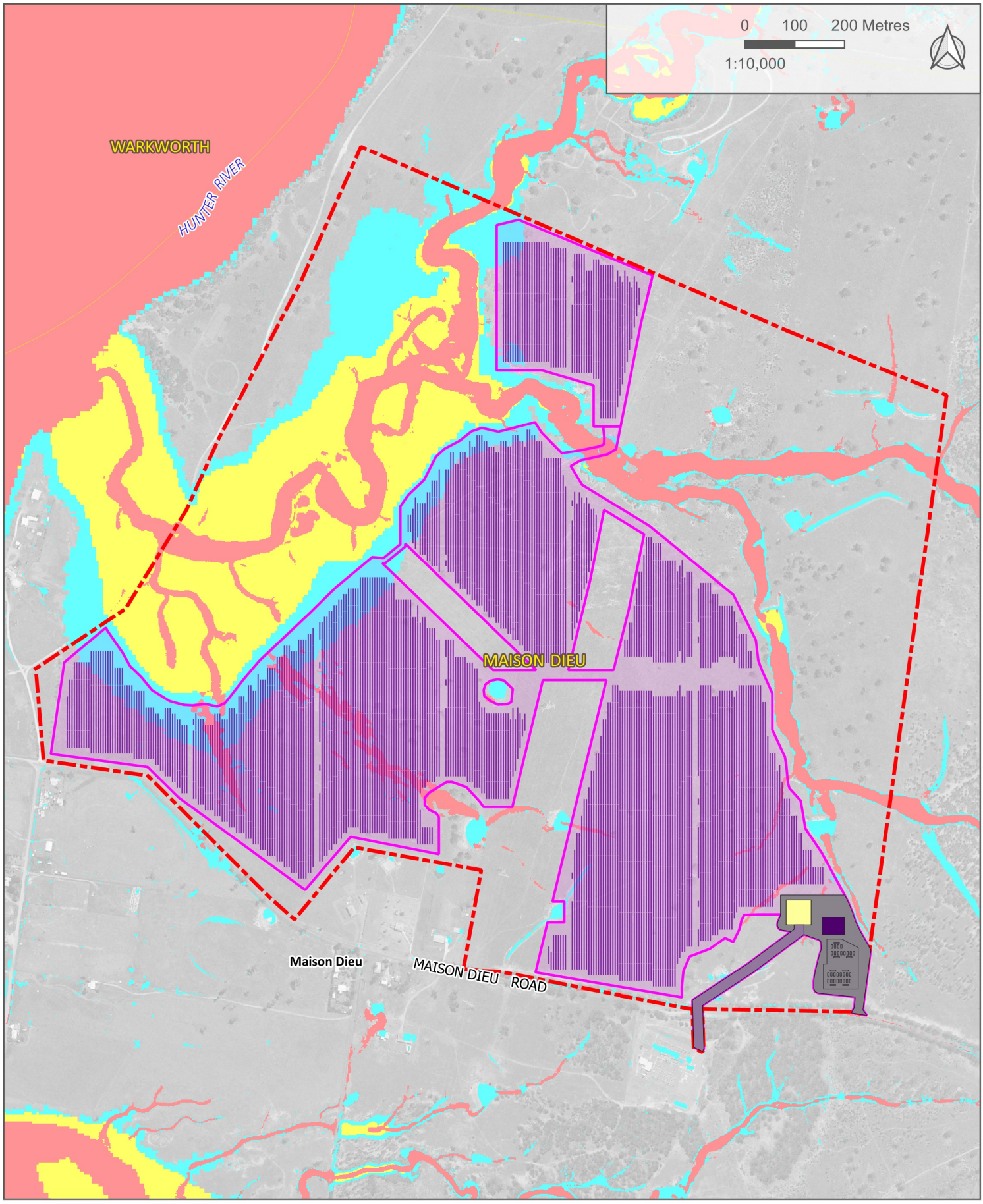
Figure B3-3

1 in 200 AEP Existing Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
15/5/2024 X:\PROJECTS\NEWCASTLE\YEAR 2022 Jobs\NL222472 - Maison Dieu Solar Farm\FIGURES\WORKSPACE\Maison Dieu Figures - May 2024.qgz



Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

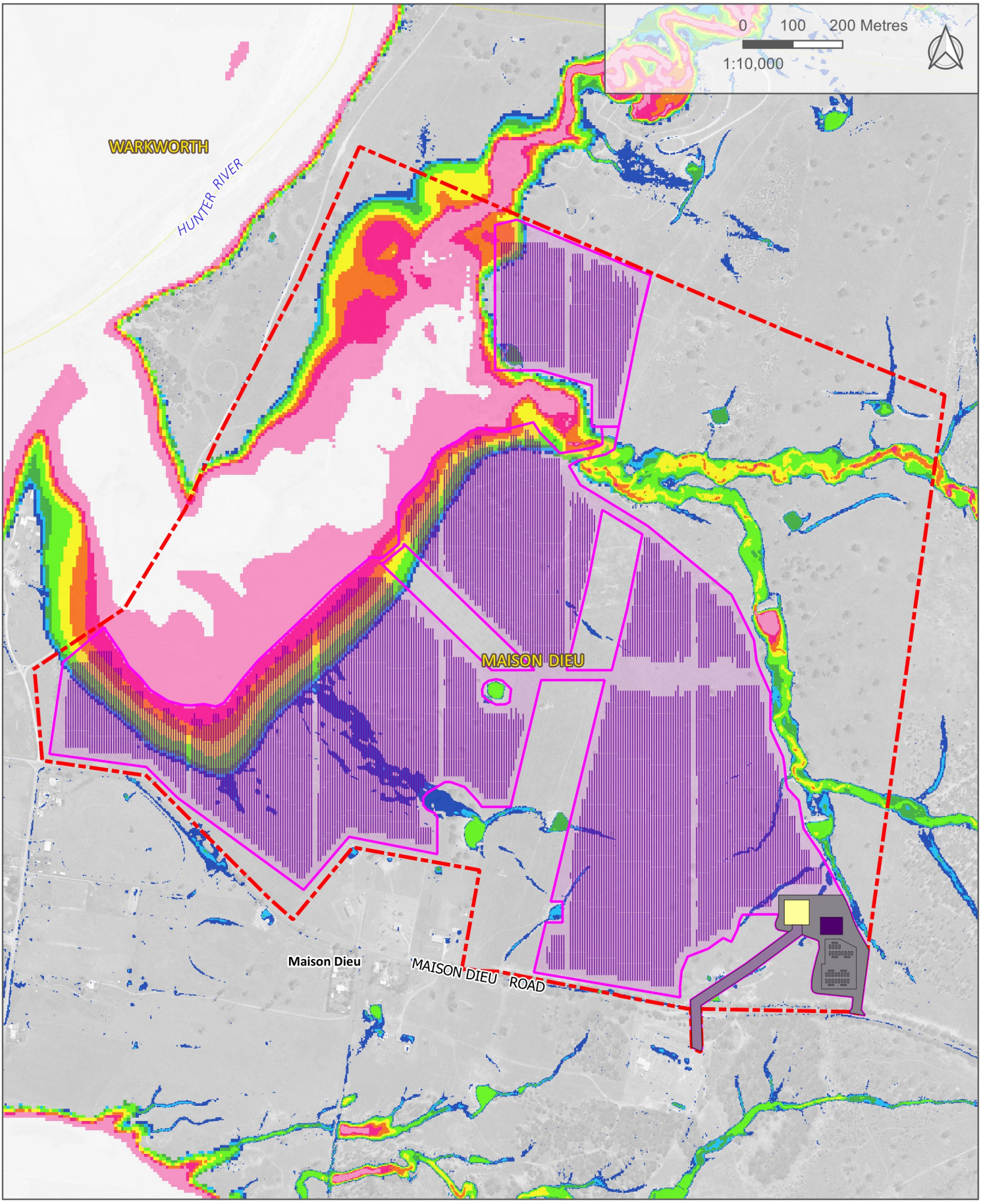
Figure B3-4

1 in 200 AEP Existing Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

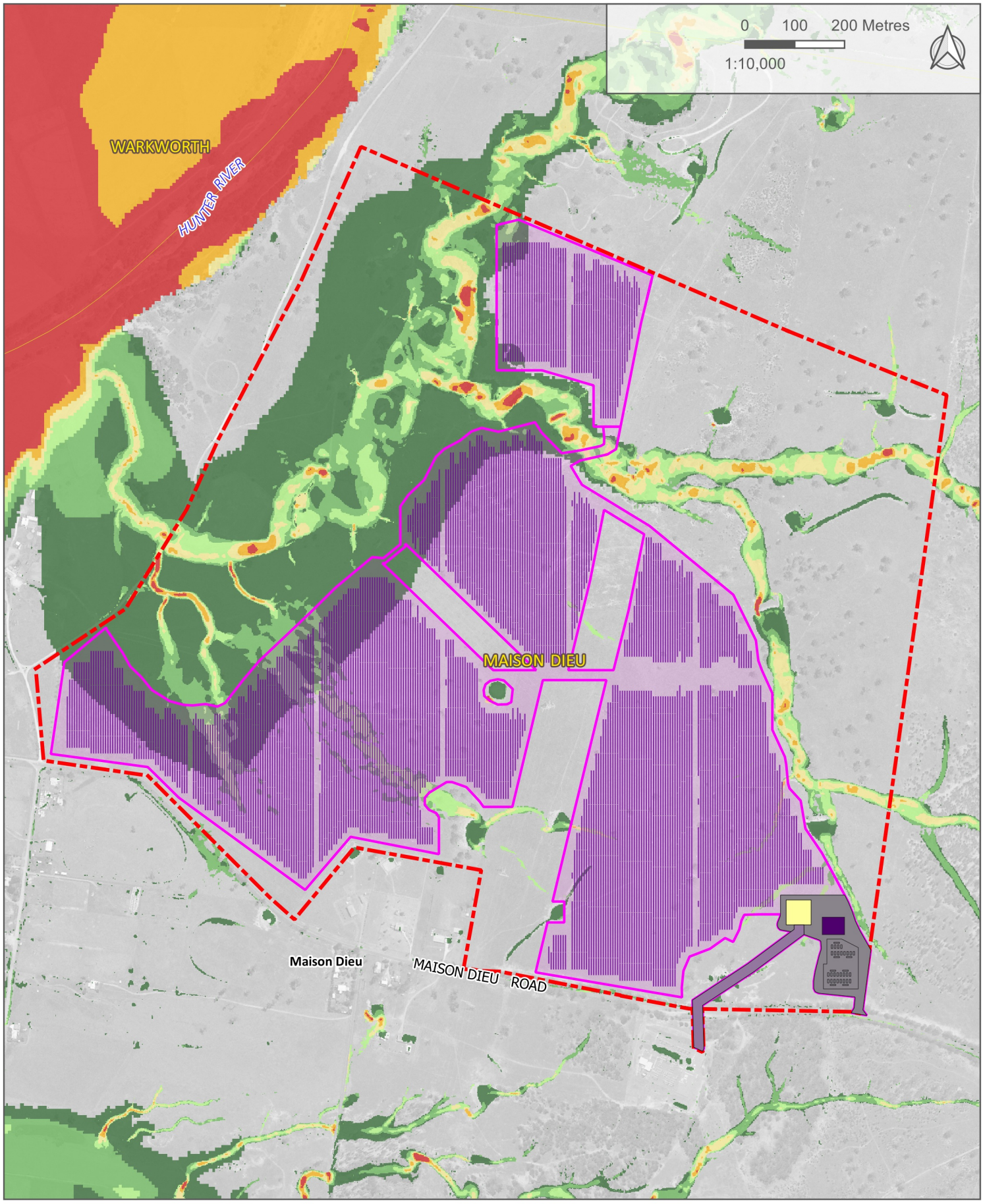
Figure B4-1

1 in 500 AEP Existing Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
15/5/2024 X:\PROJECTS\NEWCASTLE\YEAR 2022 Jobs\NL222472 - Maison Dieu Solar Farm\FIGURES\WORKSPACE\Maison Dieu Figures - May 2024.qgz



Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

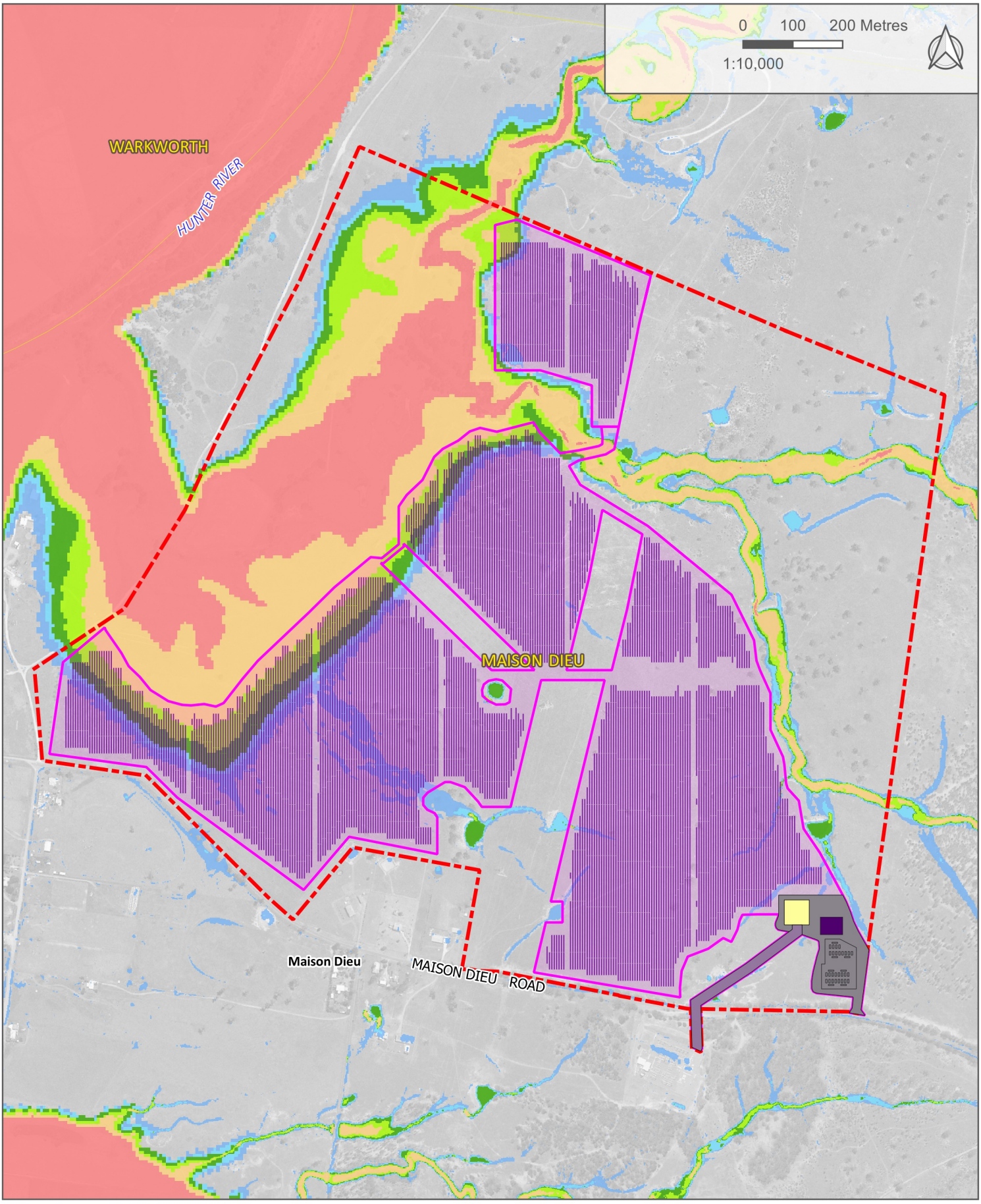
Figure B4-2

1 in 500 AEP Existing Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard
- H1
- H2
- H3
- H4
- H5
- H6

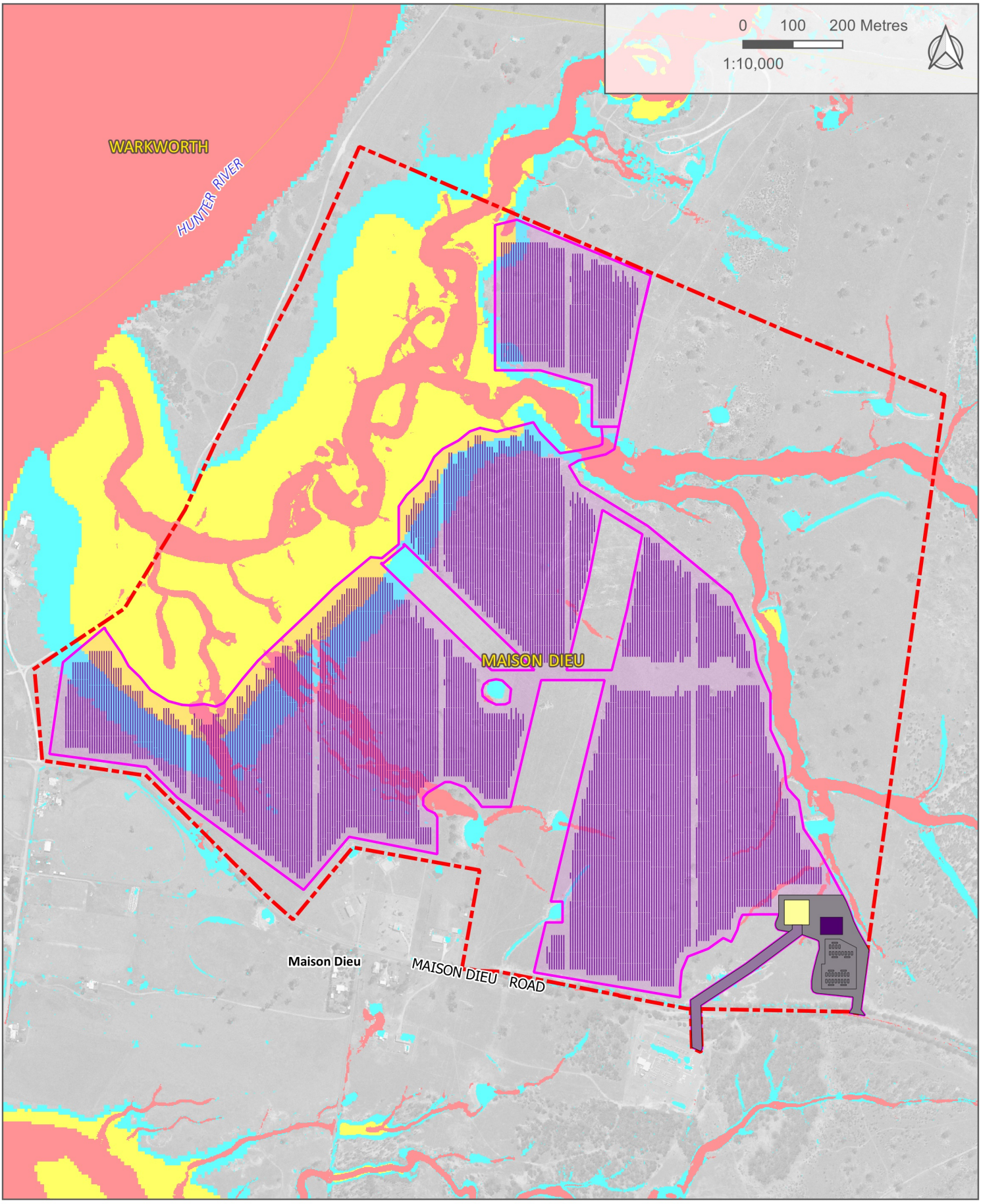
Figure B4-3

1 in 500 AEP Existing Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

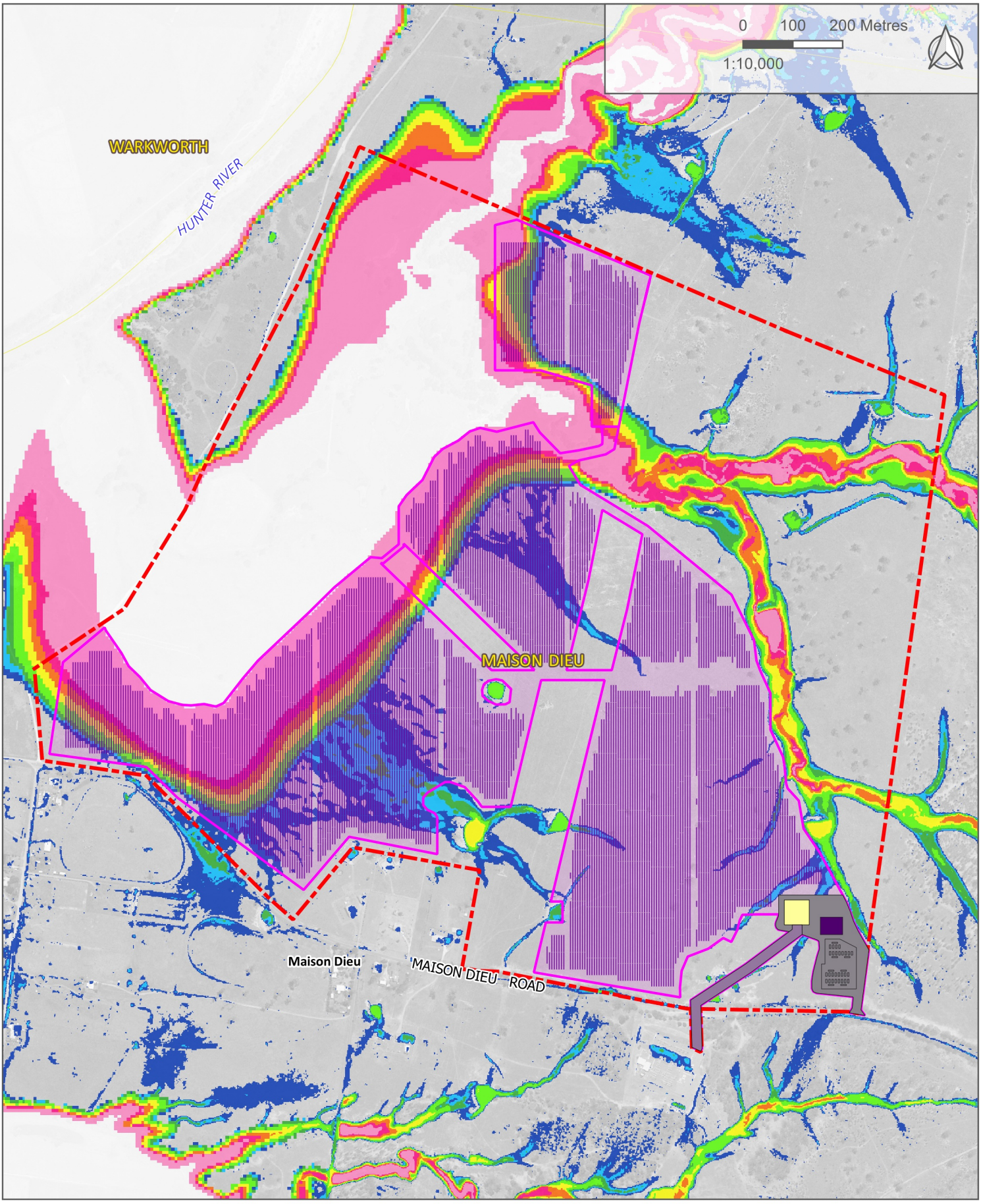
Figure B4-4

1 in 500 AEP Existing Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

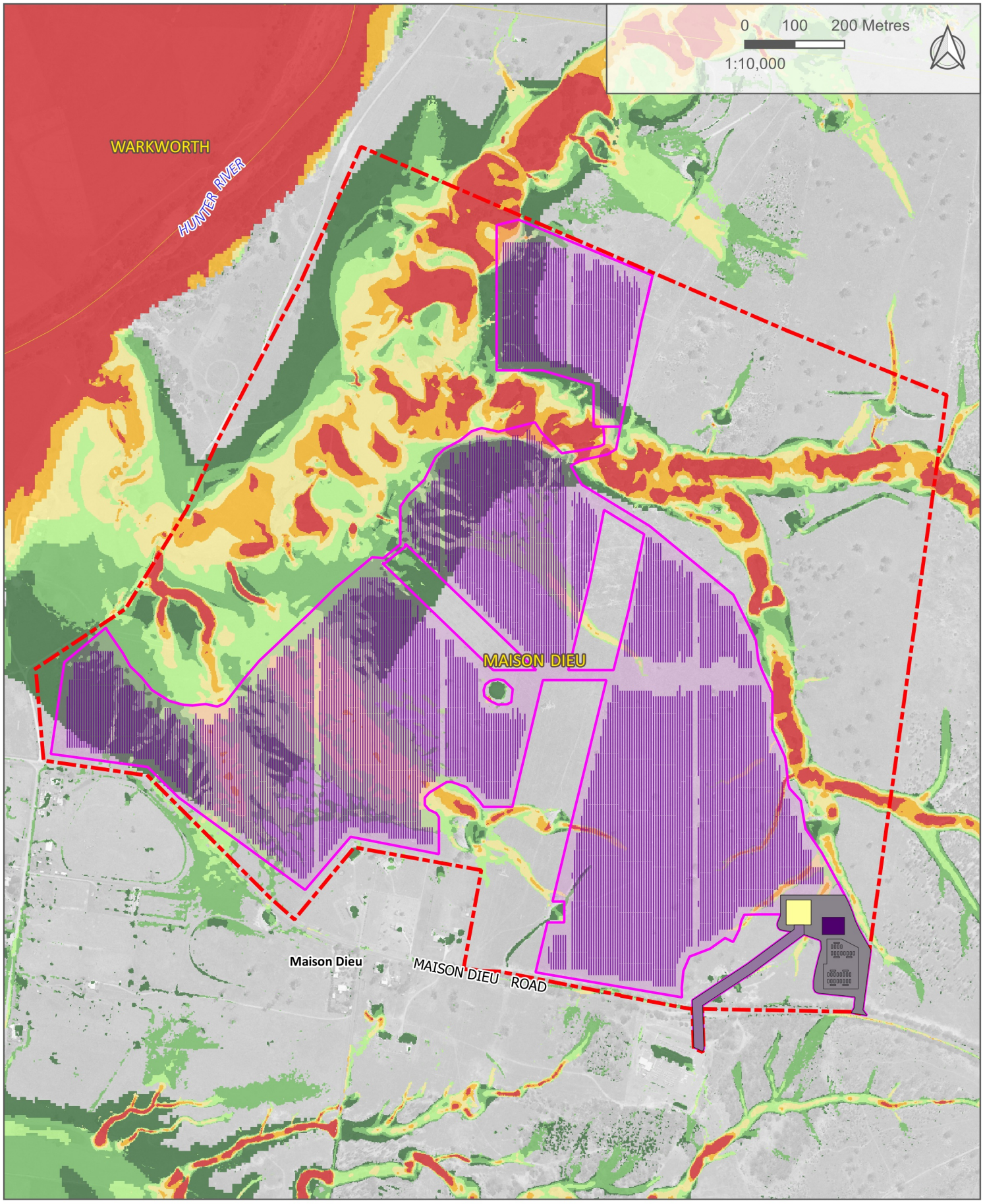
Figure B5-1

PMF Existing Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

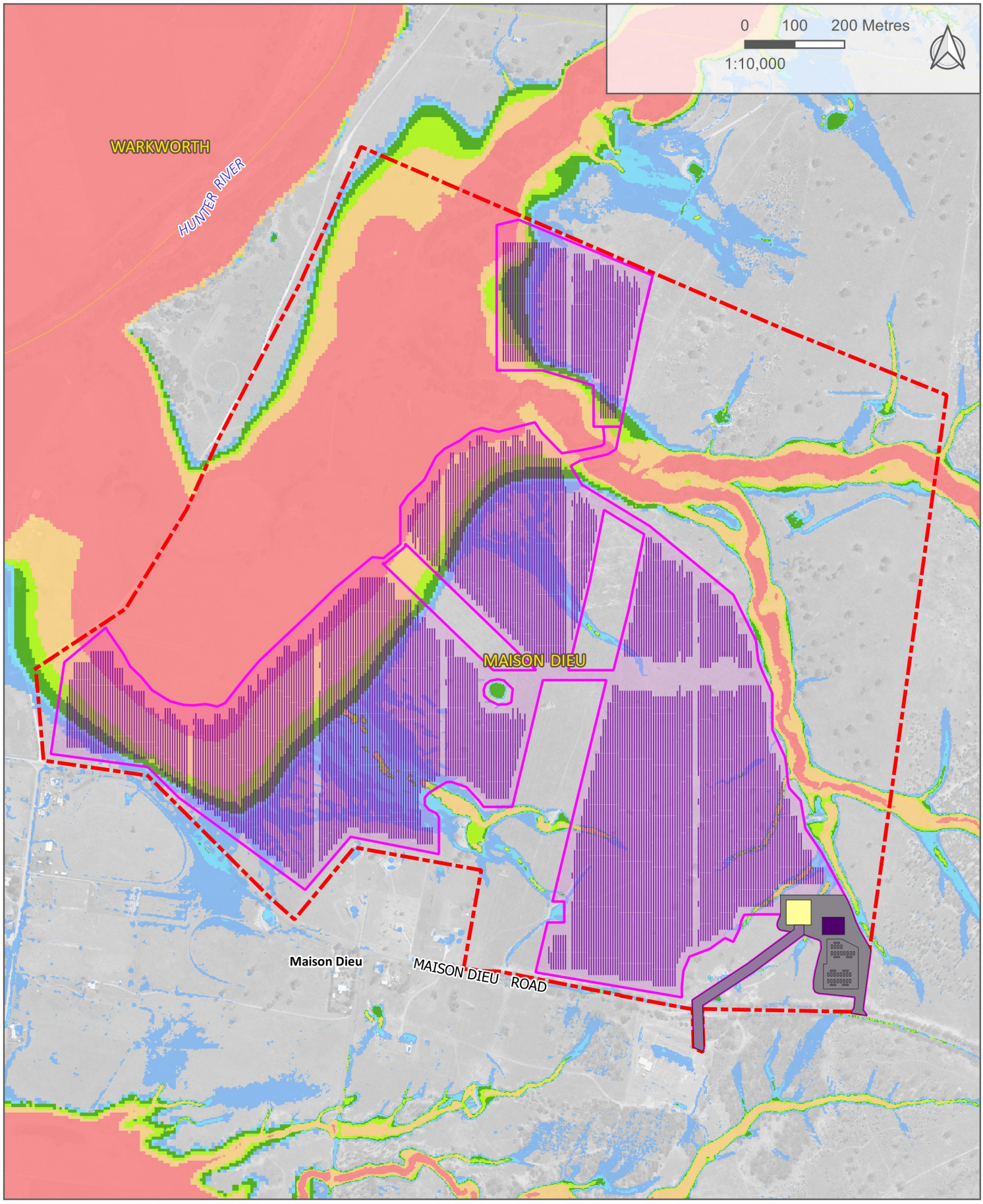
Figure B5-2

PMF Existing Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

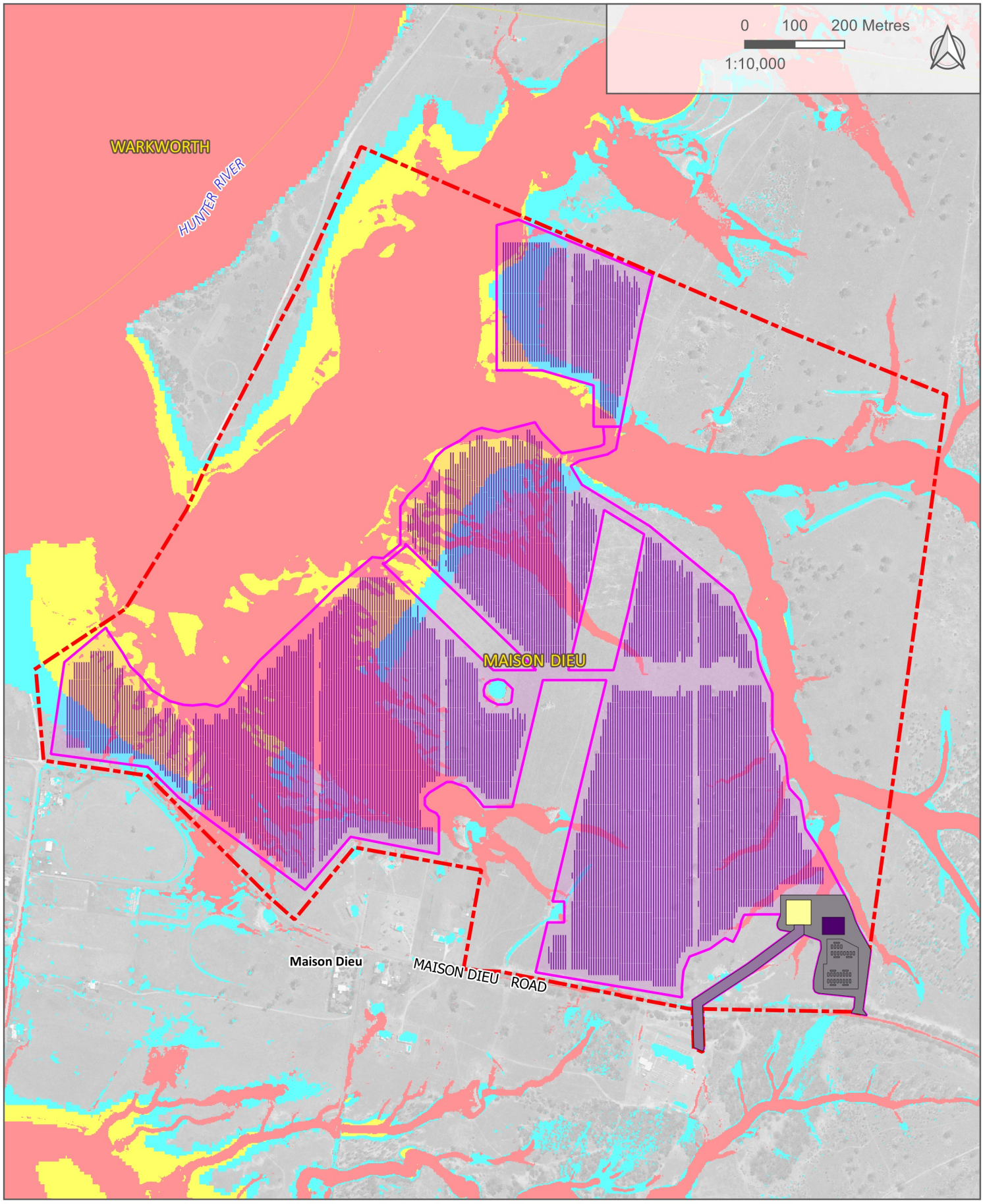
Figure B5-3

PMF Existing Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

Figure B5-4

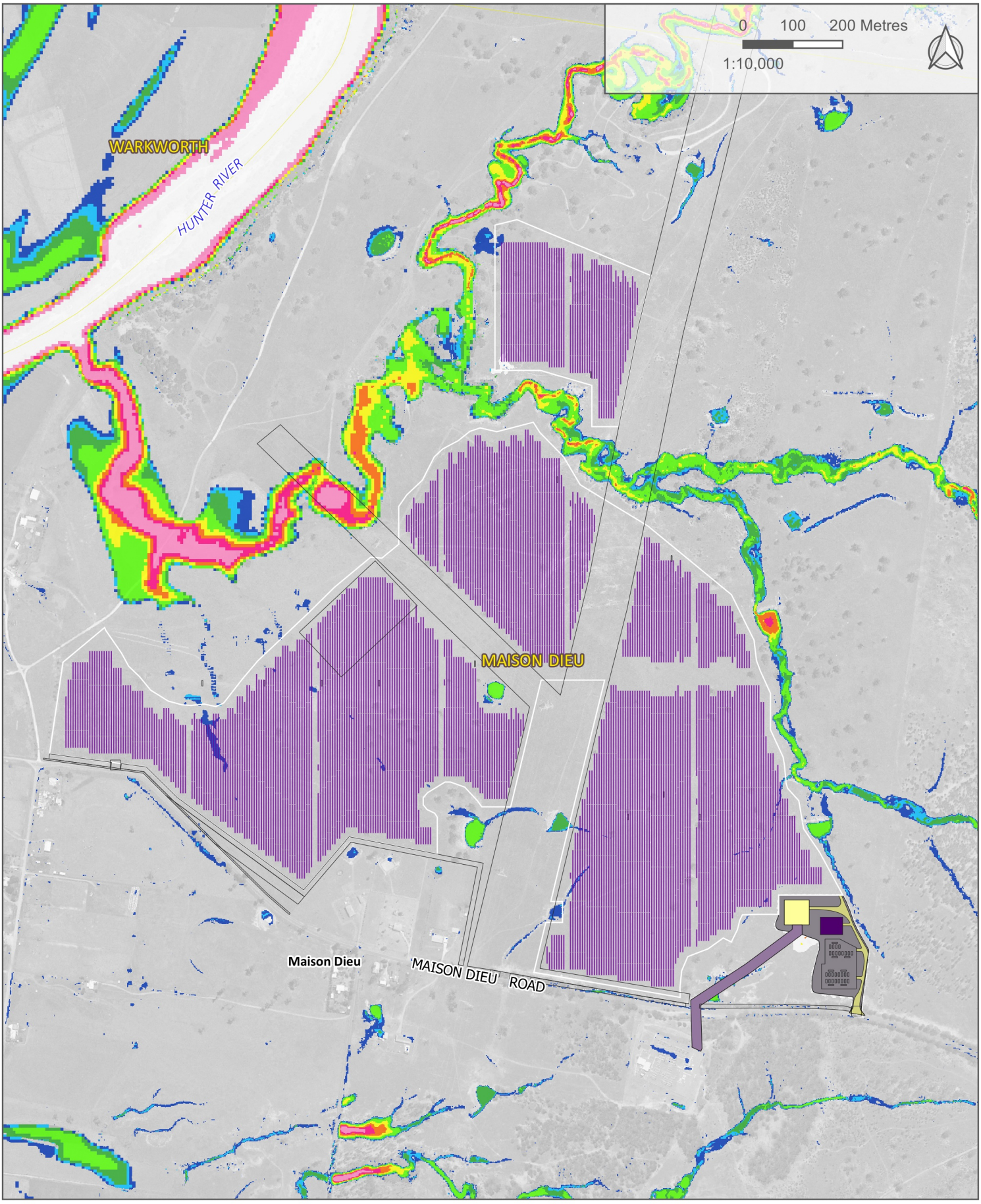
PMF Existing Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Appendix C – Developed Case Flooding



Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

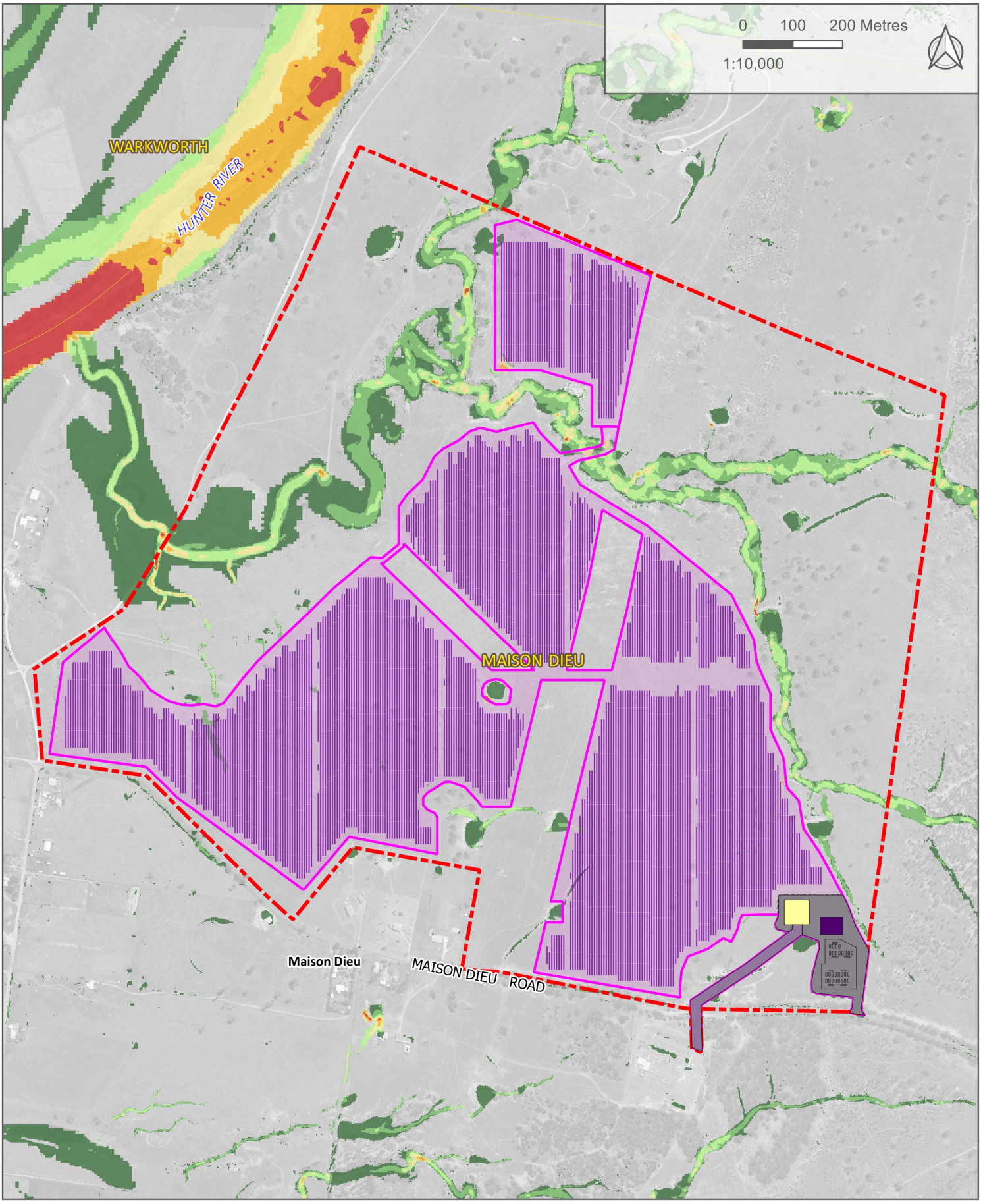
Figure C1-1

10% AEP Developed Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

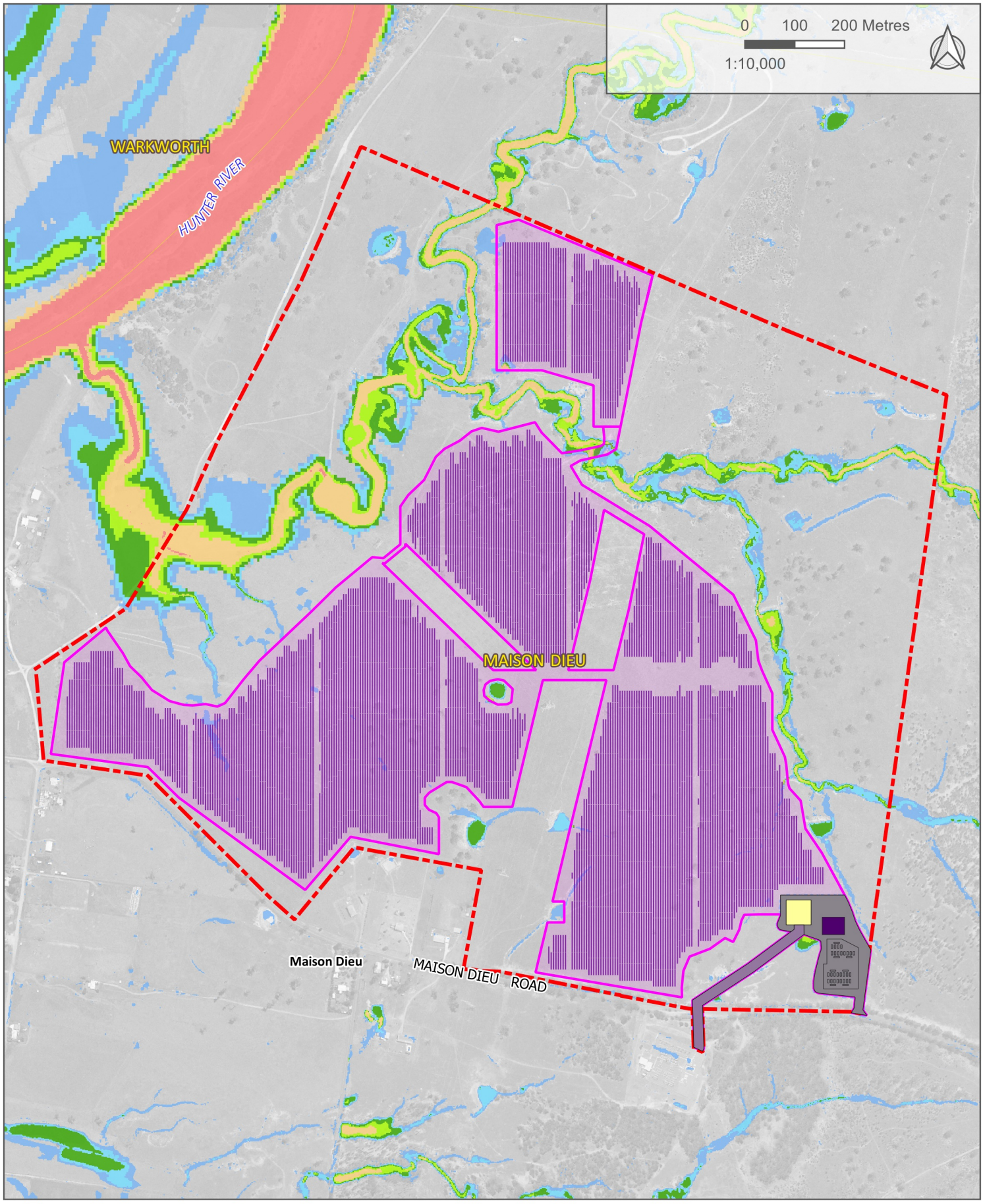
Figure C1-2

10% AEP Developed Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

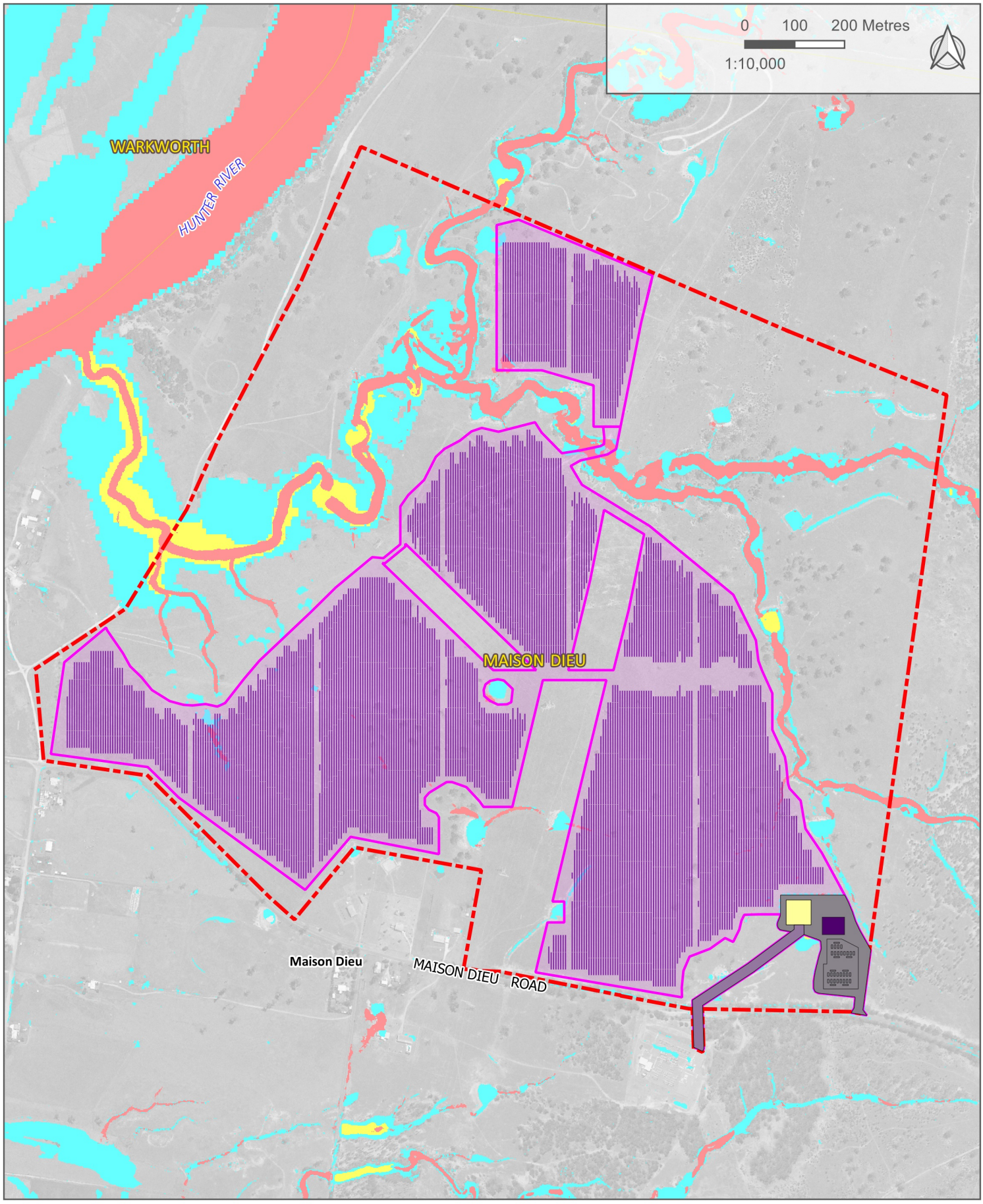
Figure C1-3

10% AEP Developed Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

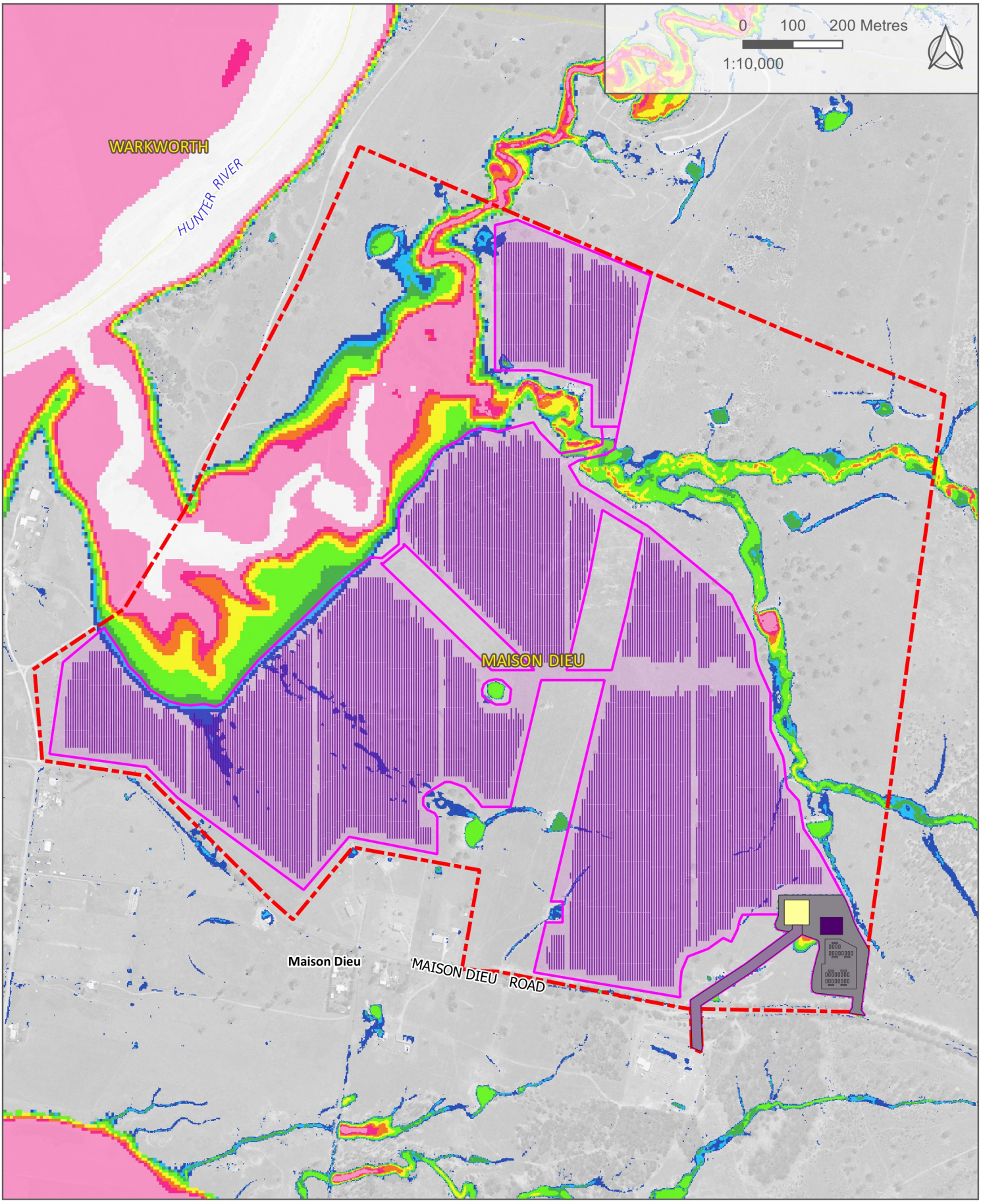
Figure C1-4

10% AEP Developed Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

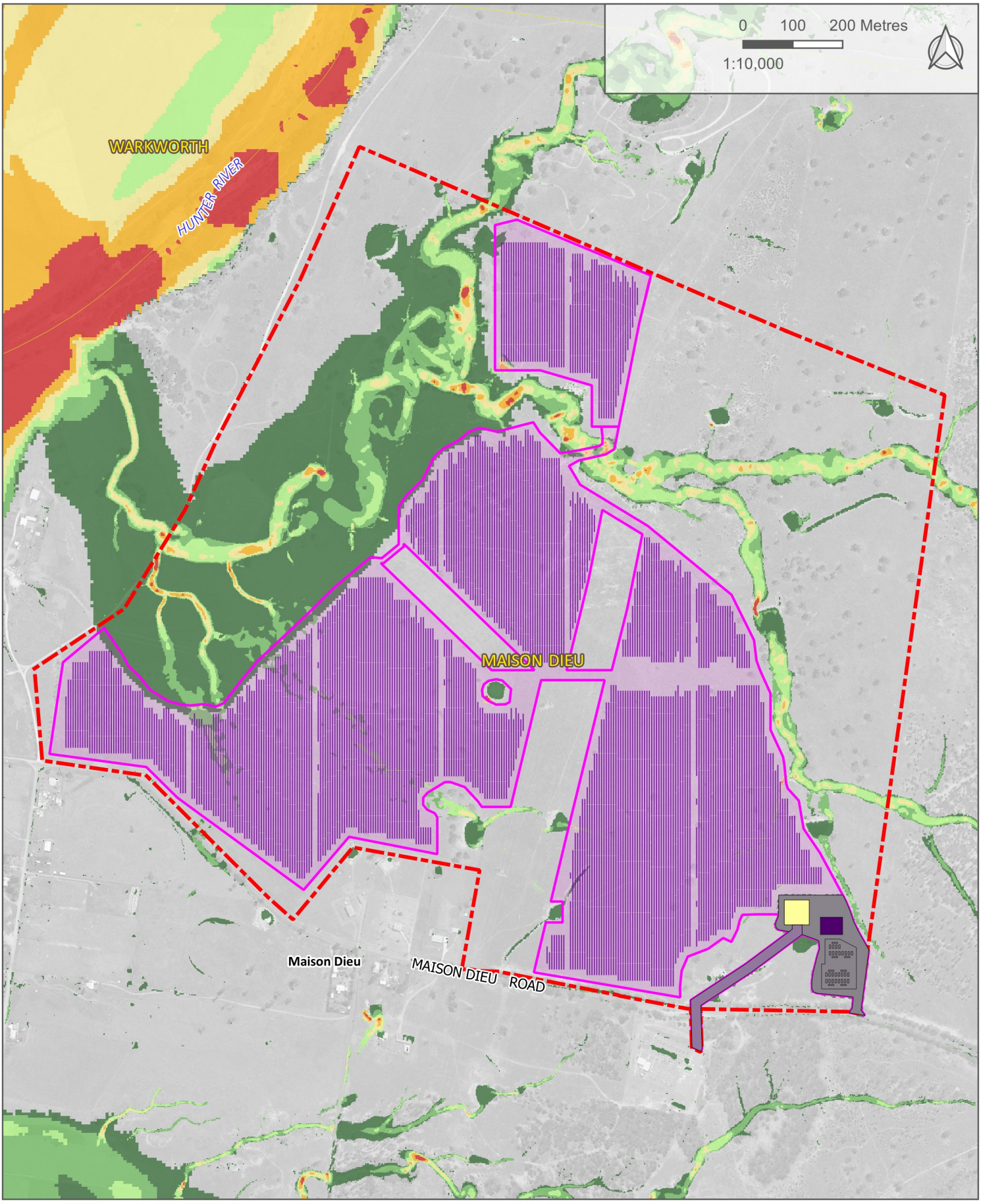
Figure C2-1

1% AEP Developed Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

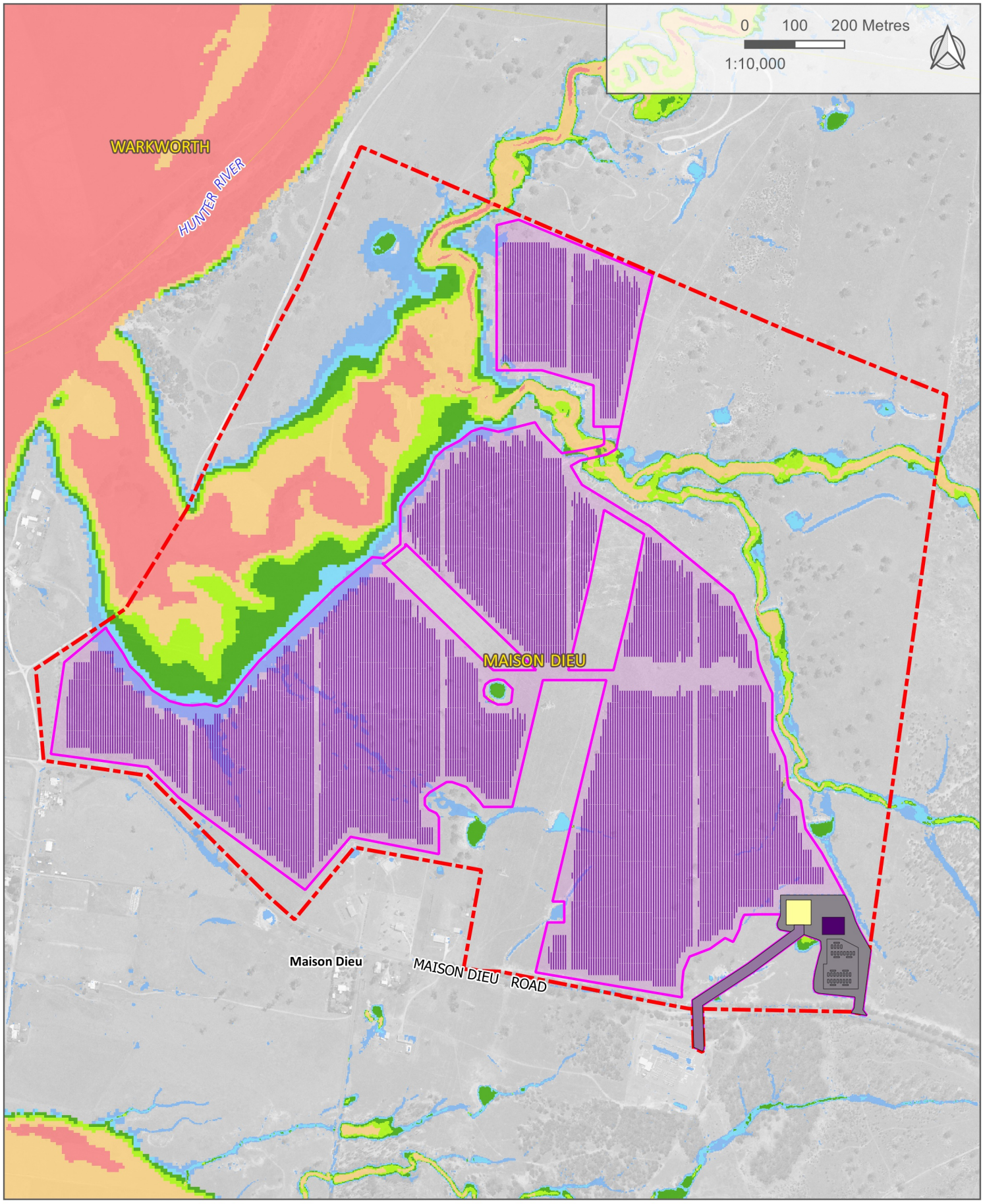
Figure C2-2

1% AEP Developed Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

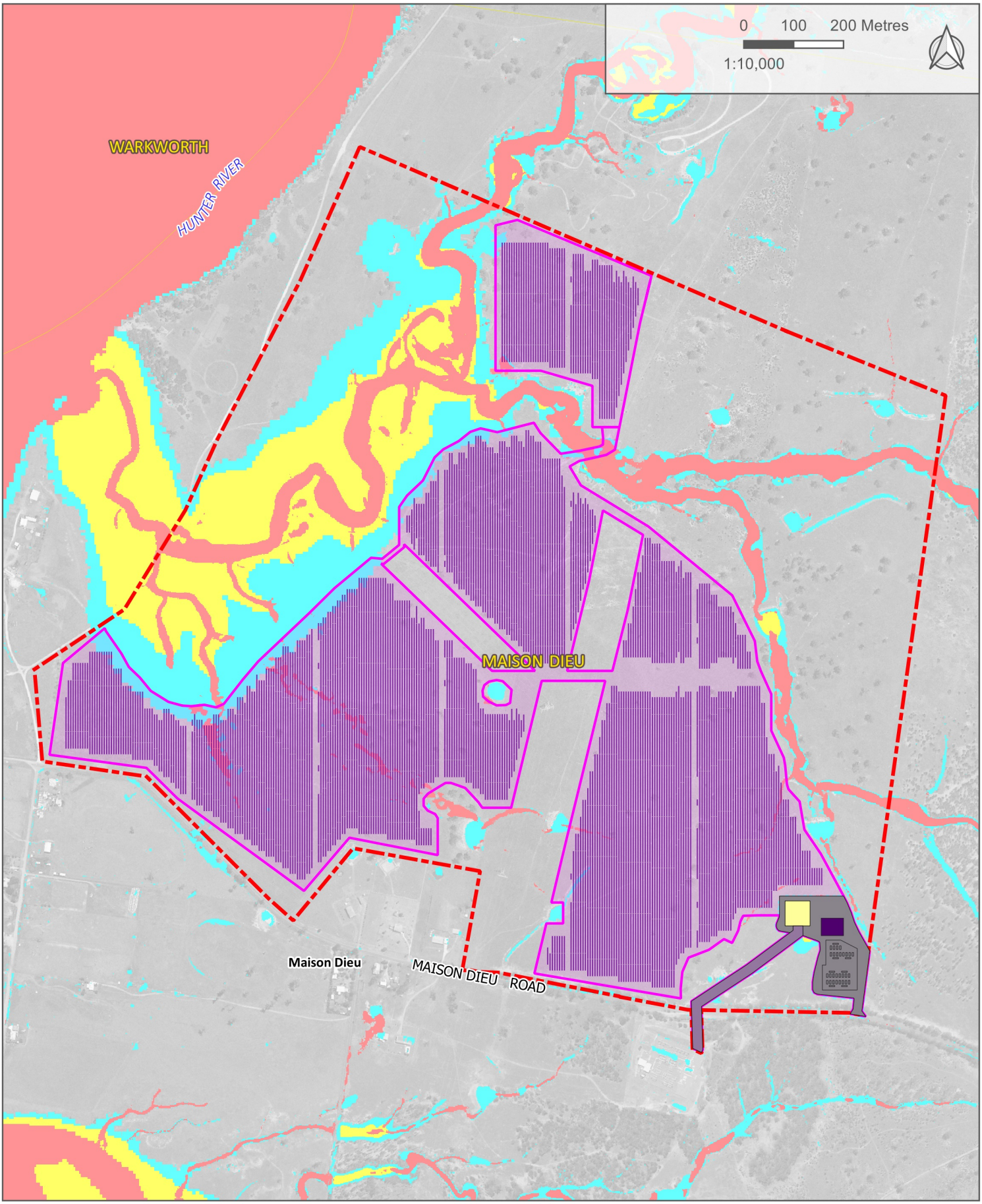
Figure C2-3

1% AEP Developed Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

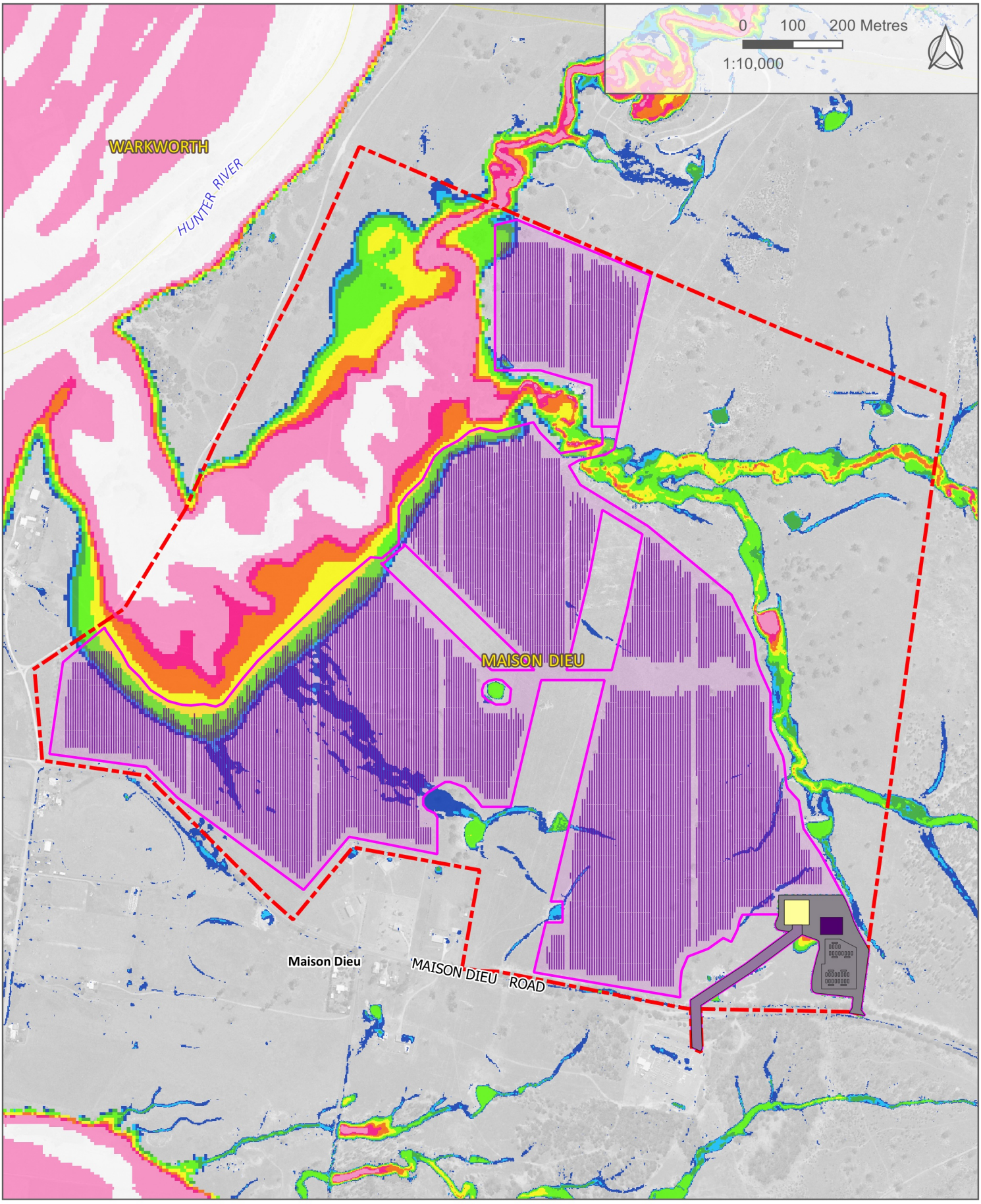
Figure C2-4

1% AEP Developed Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

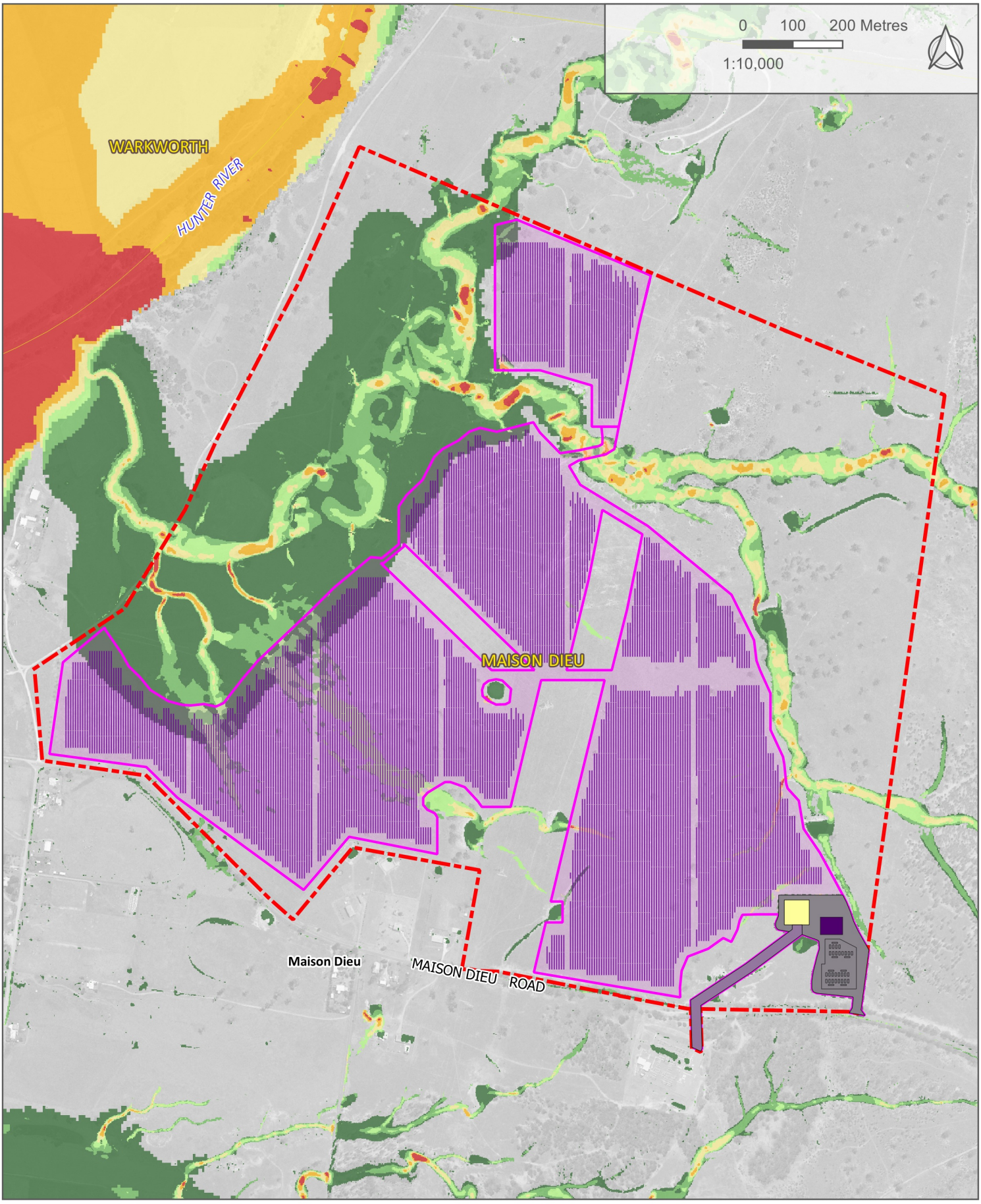
Figure C3-1

1 in 200 AEP Developed Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

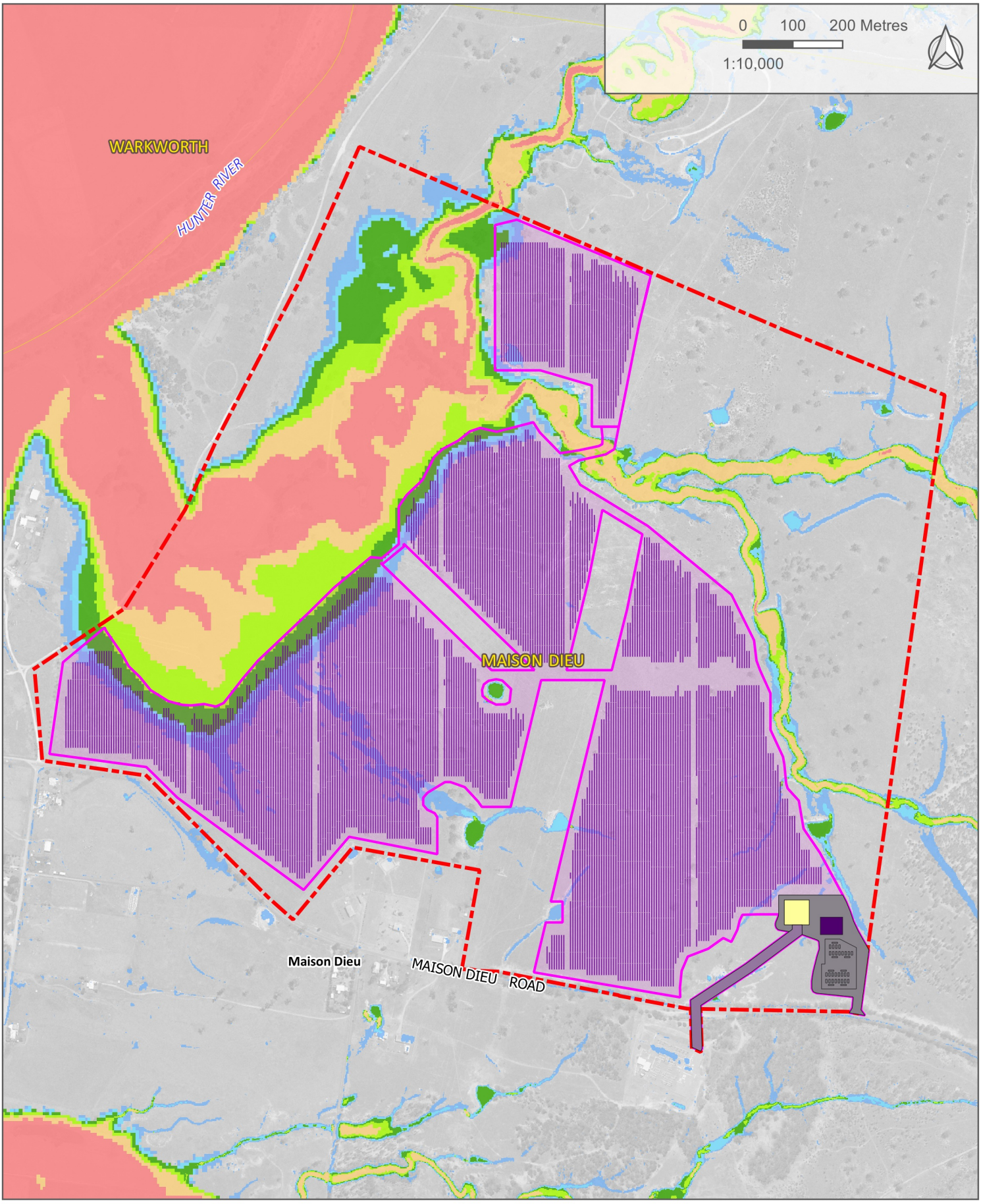
Figure C3-2

1 in 200 AEP Developed Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

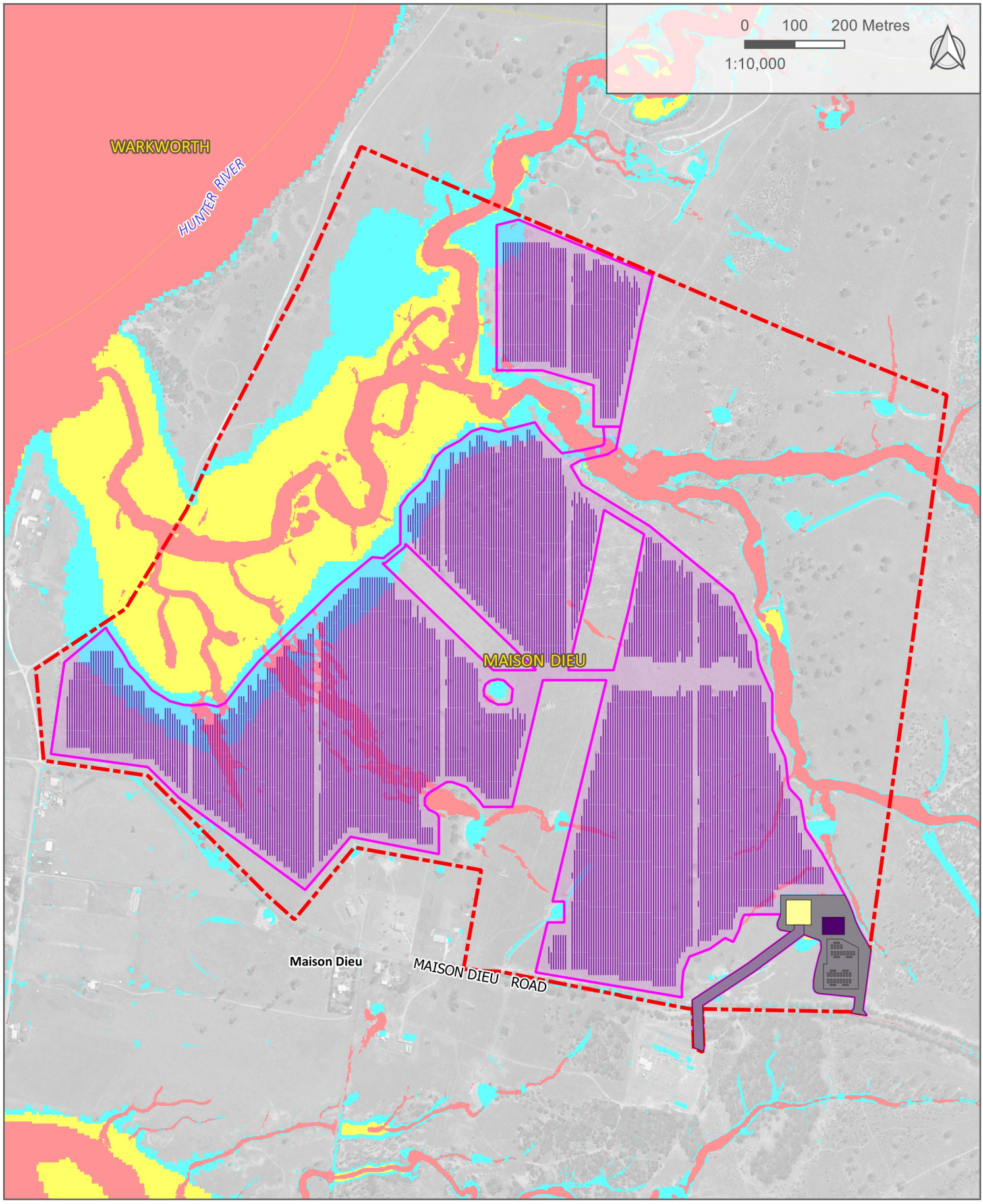
Figure C3-3

1 in 200 AEP Developed Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

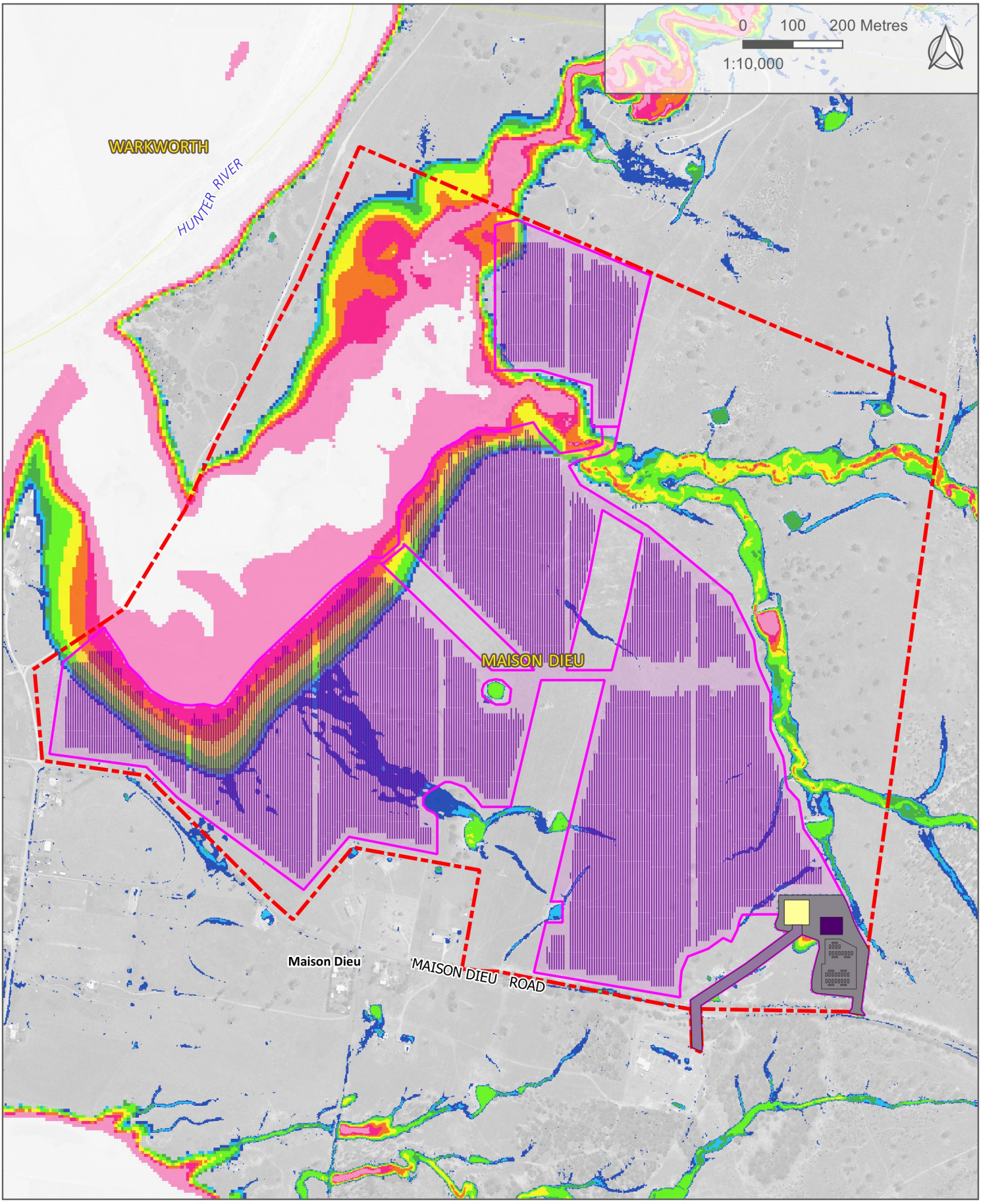
Figure C3-4

1 in 200 AEP Developed Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

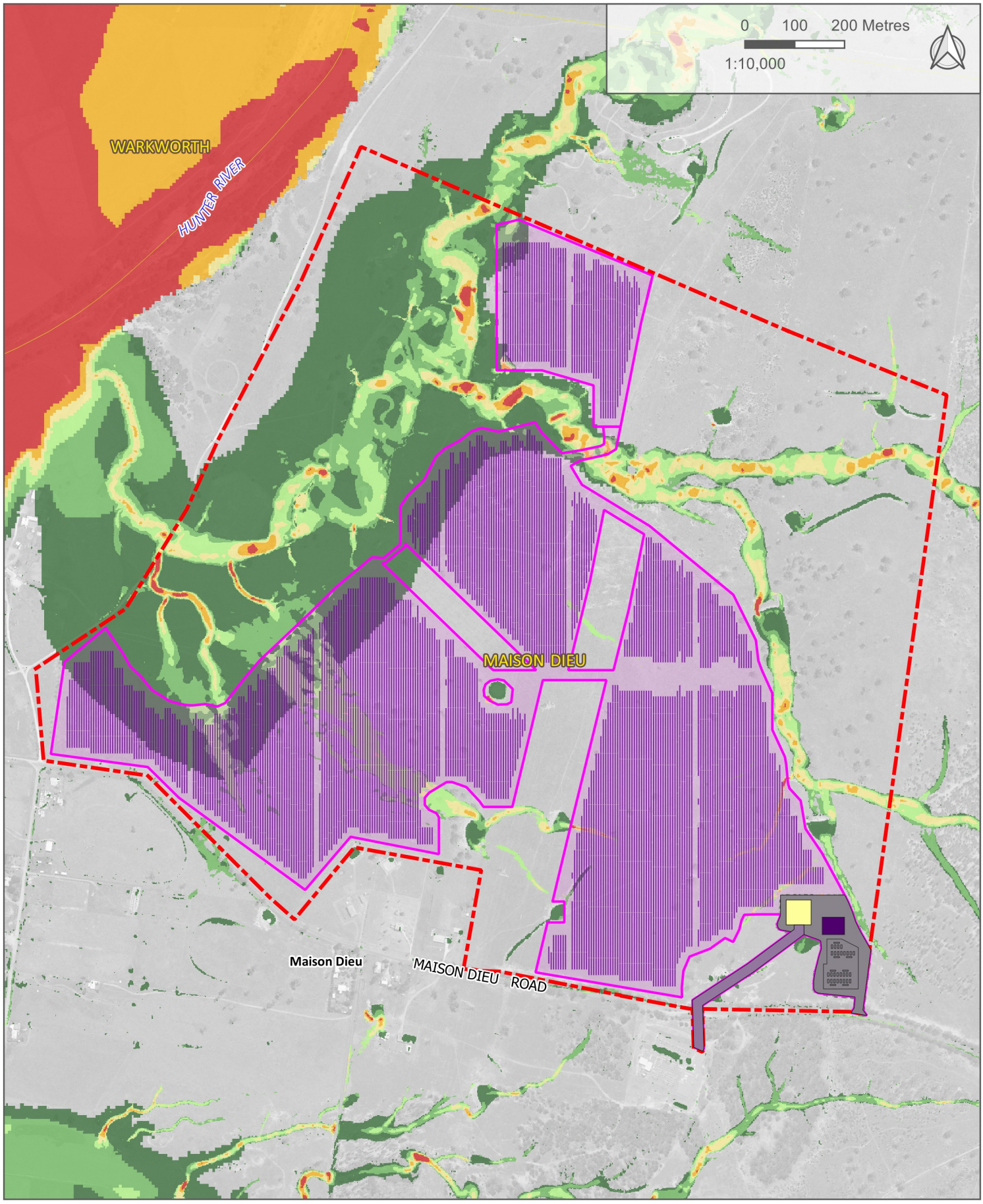
Figure C4-1

1 in 500 AEP Developed Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

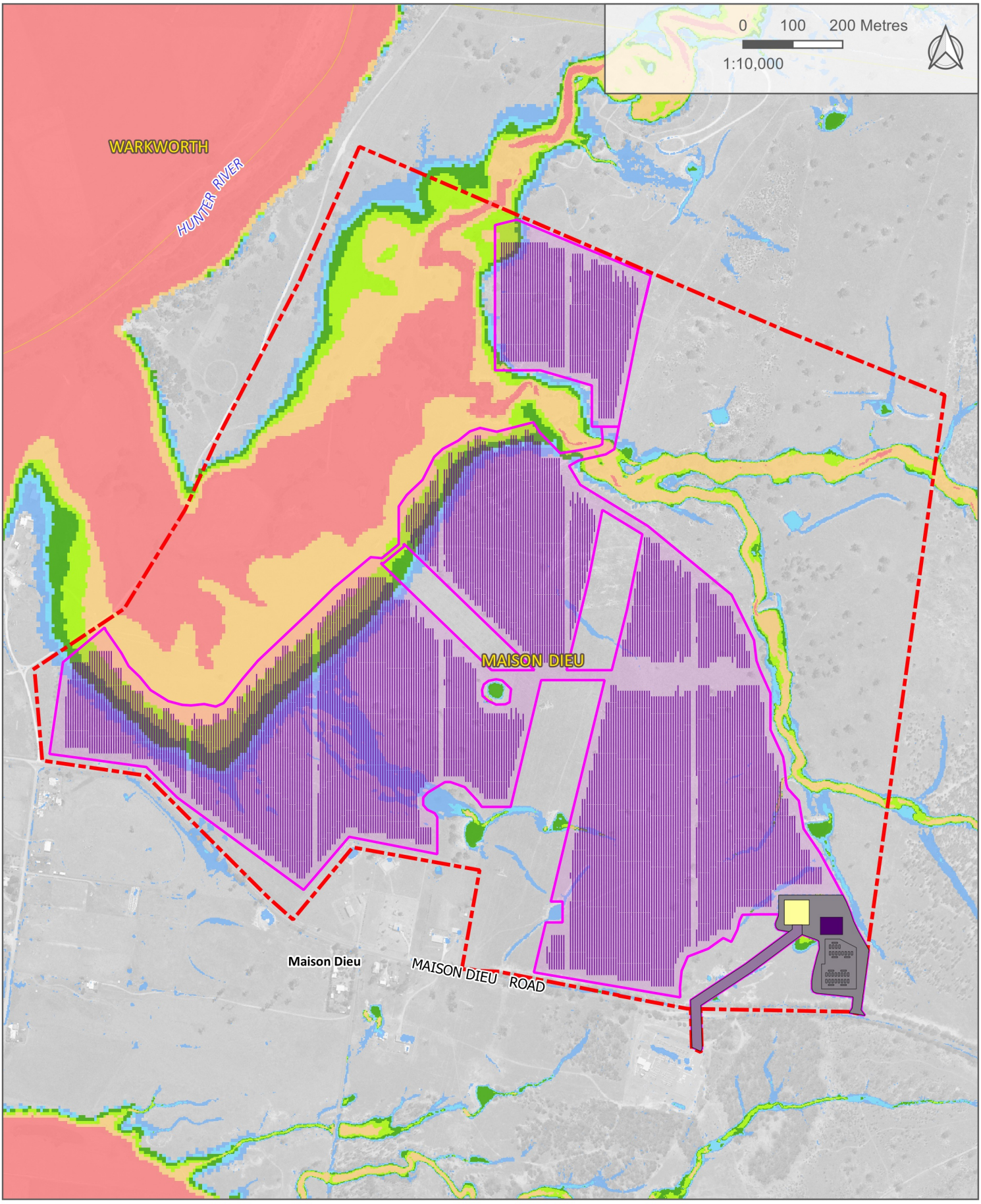
Figure C4-2

1 in 500 AEP Developed Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

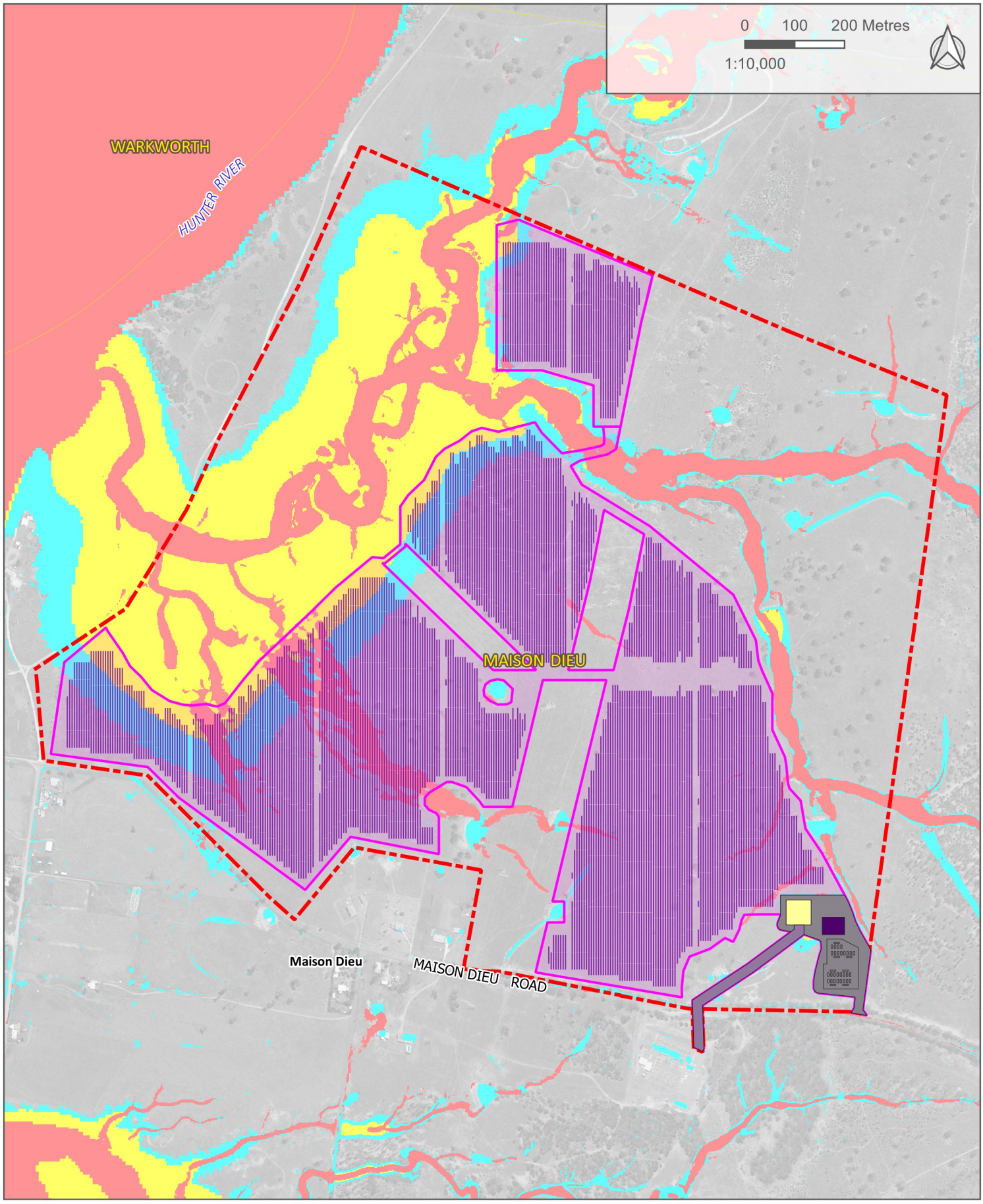
Figure C4-3

1 in 500 AEP Developed Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
15/5/2024 X:\PROJECTS\NEWCASTLE\YEAR 2022 Jobs\NL222472 - Maison Dieu Solar Farm\FIGURES\WORKSPACE\Maison Dieu Figures - May 2024.qgz



Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

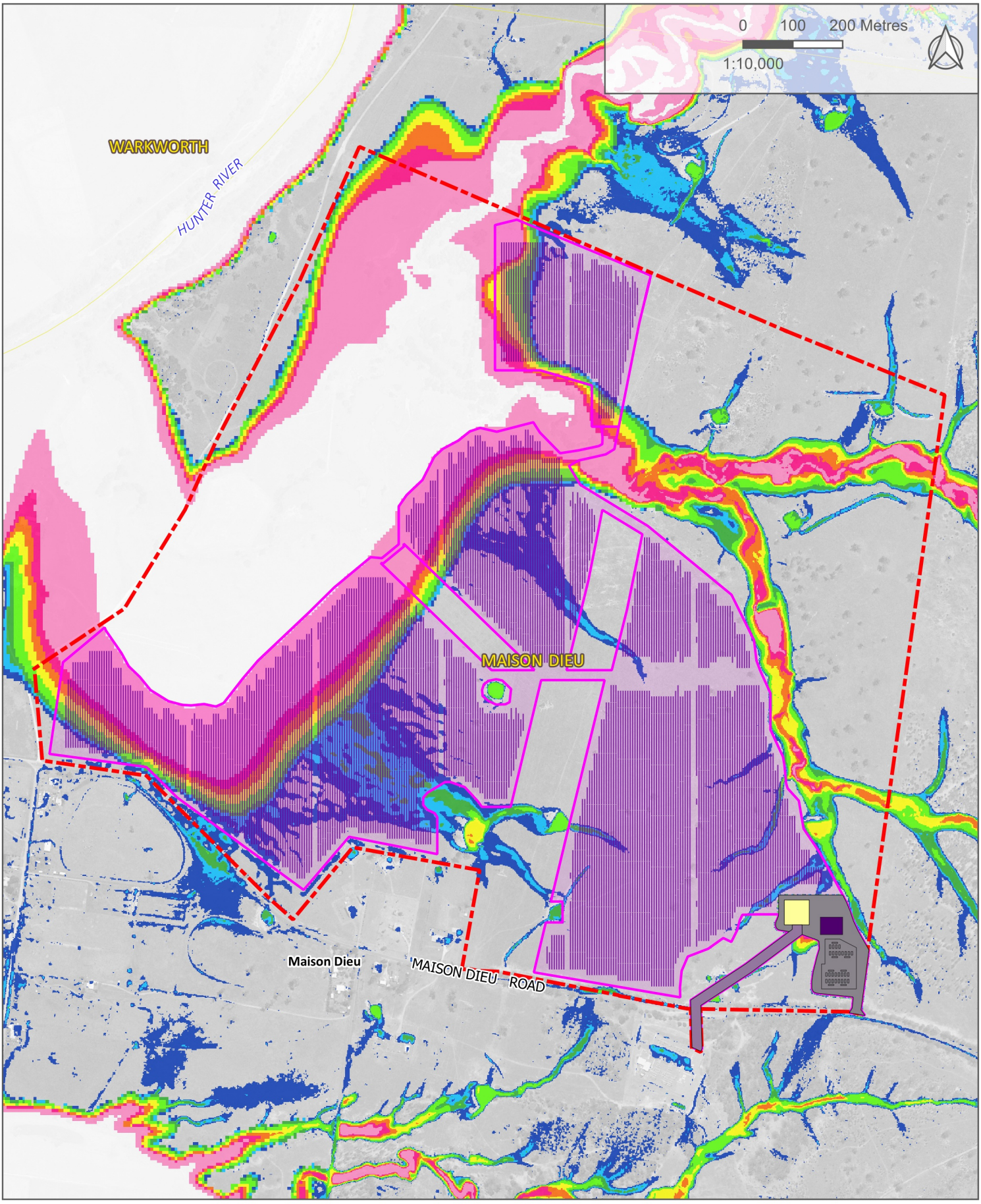
Figure C4-4

1 in 500 AEP Developed Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M

- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 5.0
- > 5.0

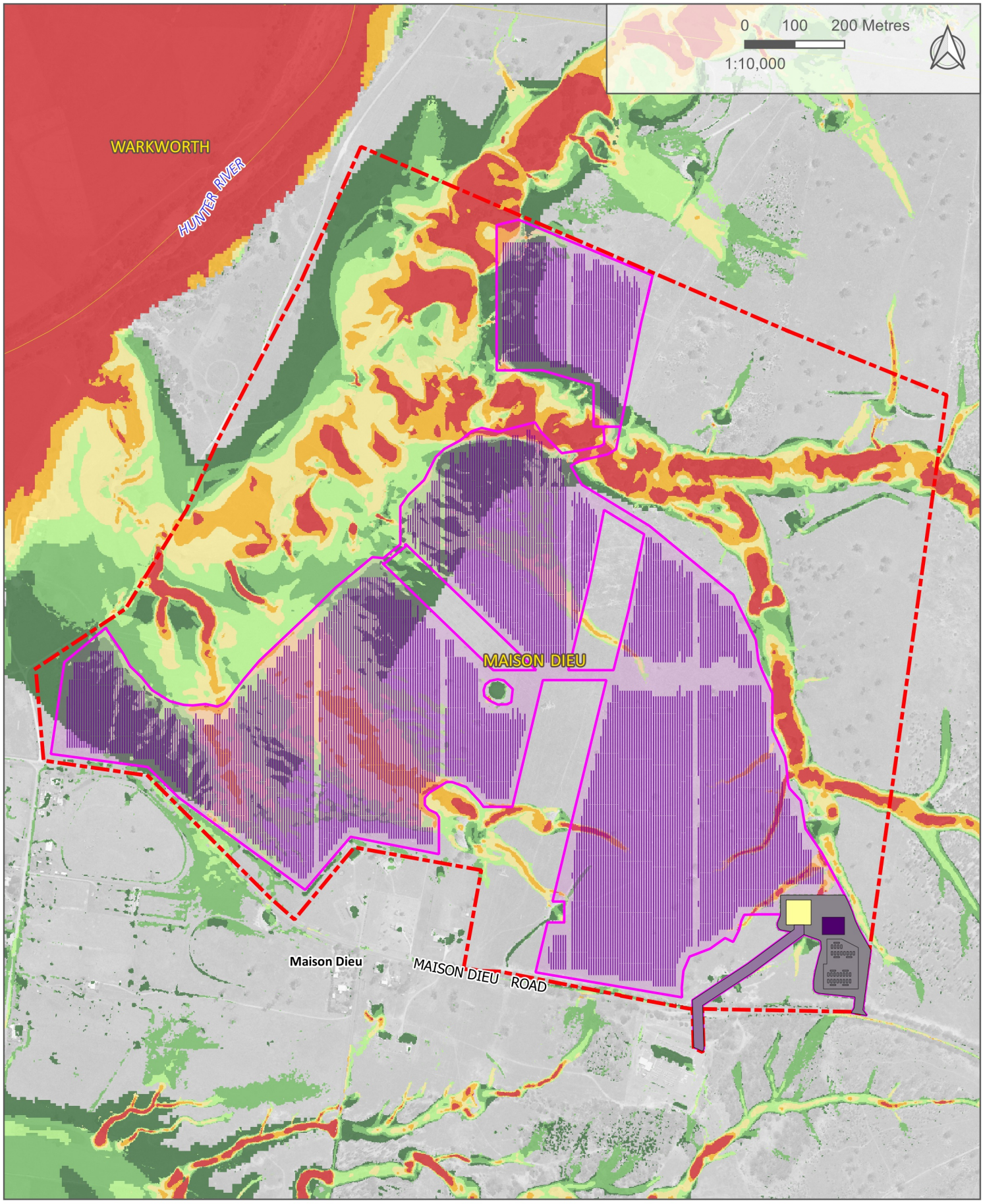
Figure C5-1

PMF Developed Flood Depth

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

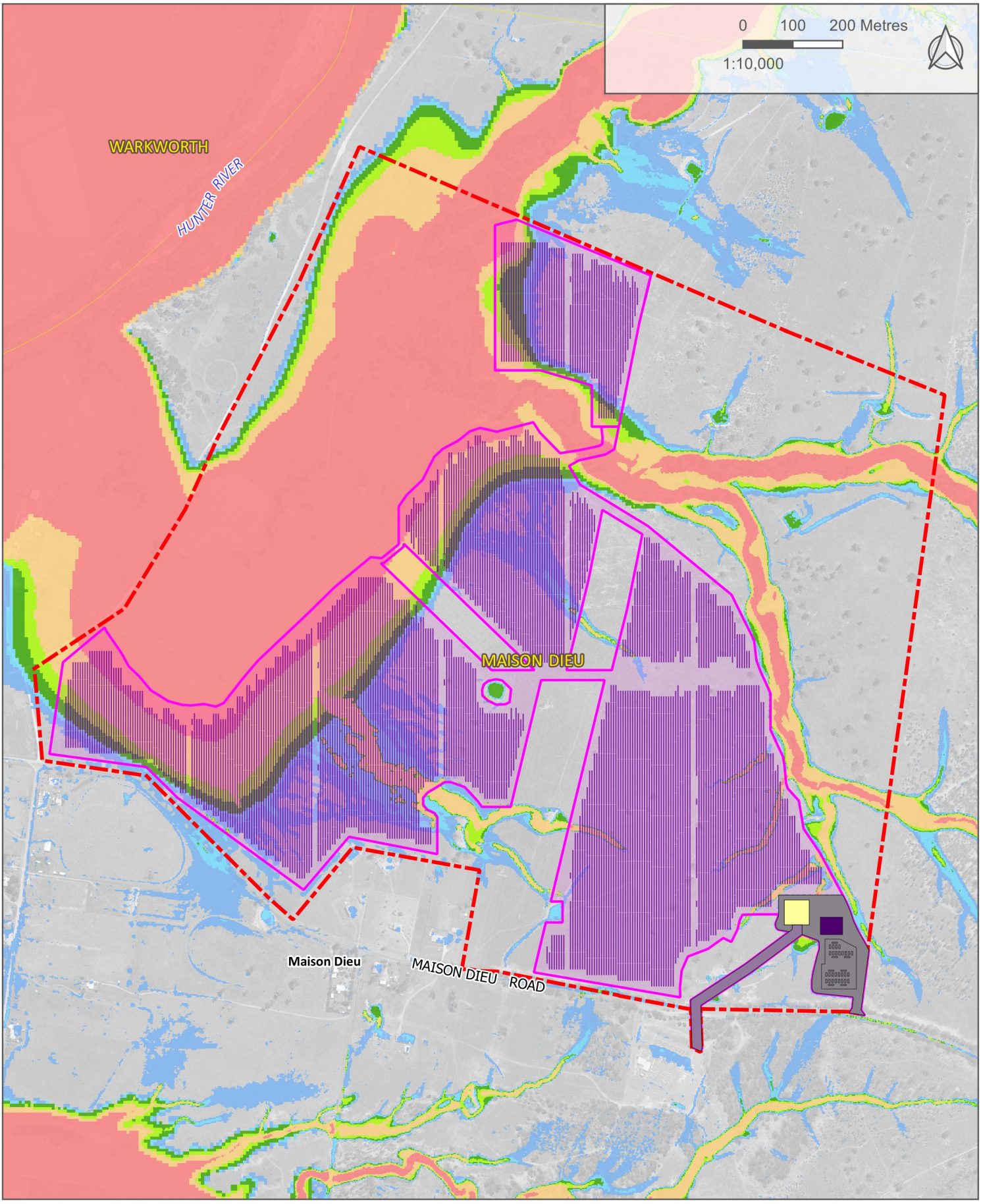
Figure C5-2

PMF Developed Flood Velocity

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

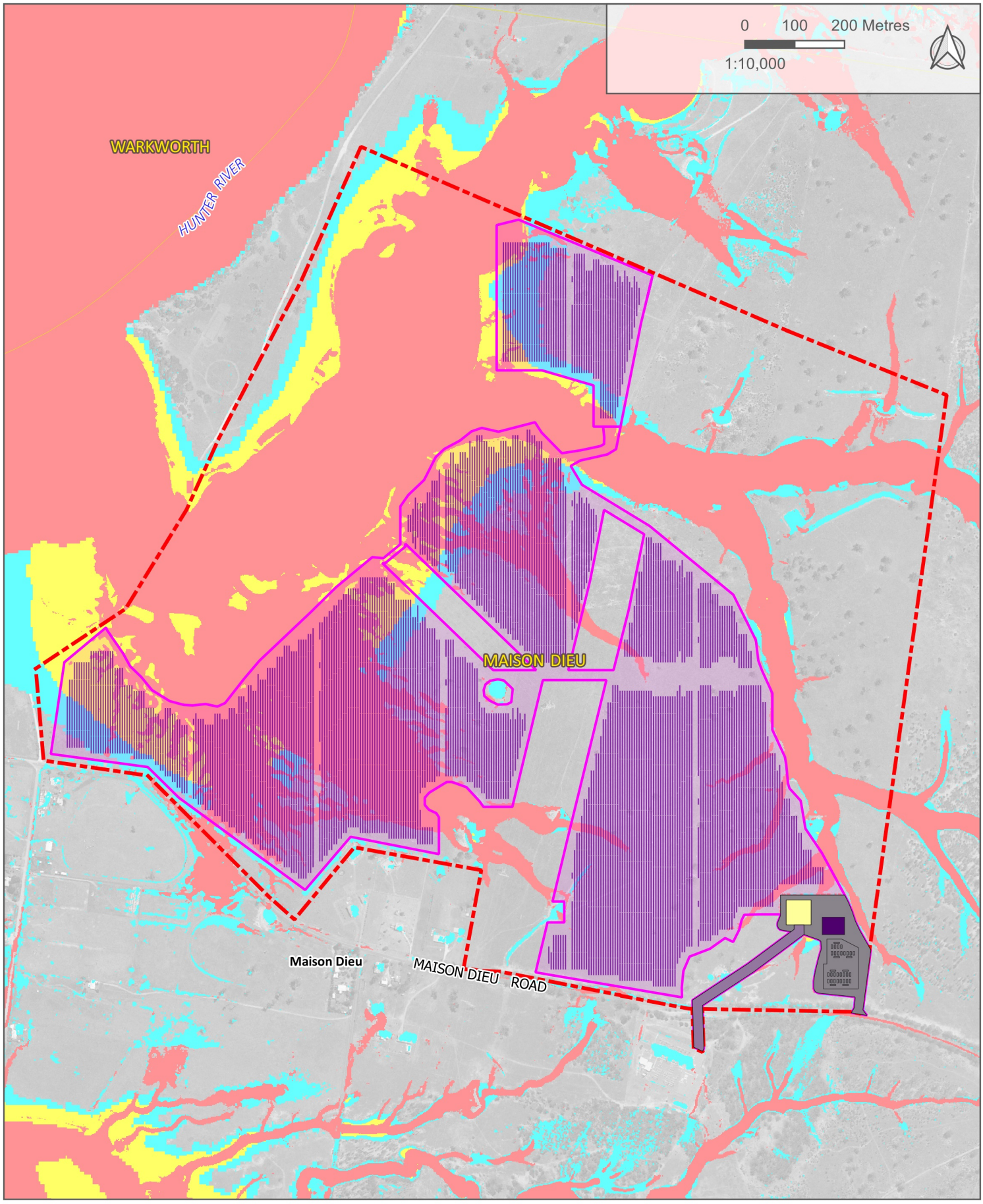
Figure C5-3

PMF Developed Flood Hazard

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Hydraulic Categories
- Floodway
- Flood Storage
- Flood Fringe

Figure C5-4

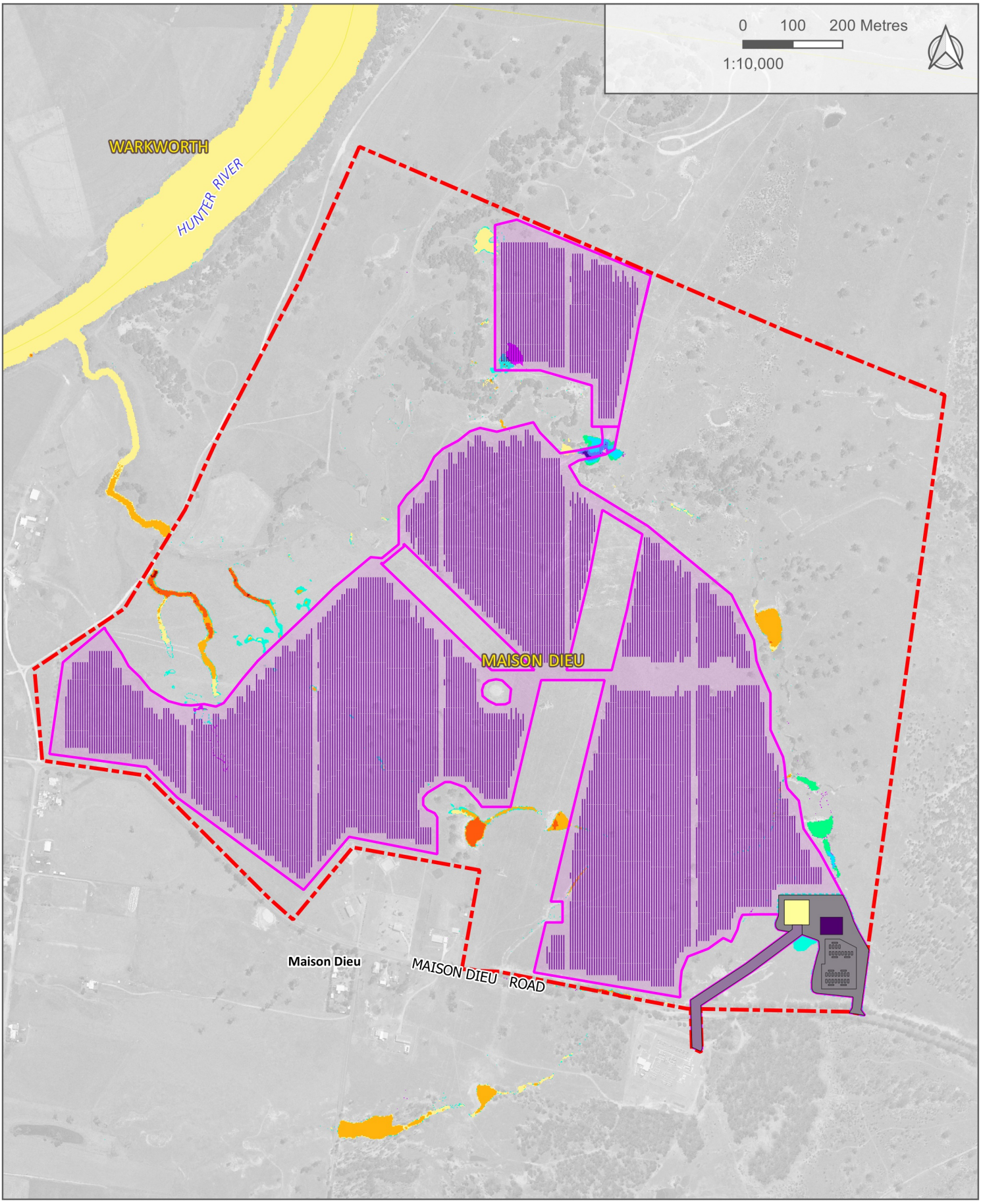
PMF Developed Hydraulic Categories

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Appendix D - Comparisons



Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS
- Wet Dry
- Was Wet Now Dry
- Was Dry Now Wet
- Difference (m)
- <= -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10

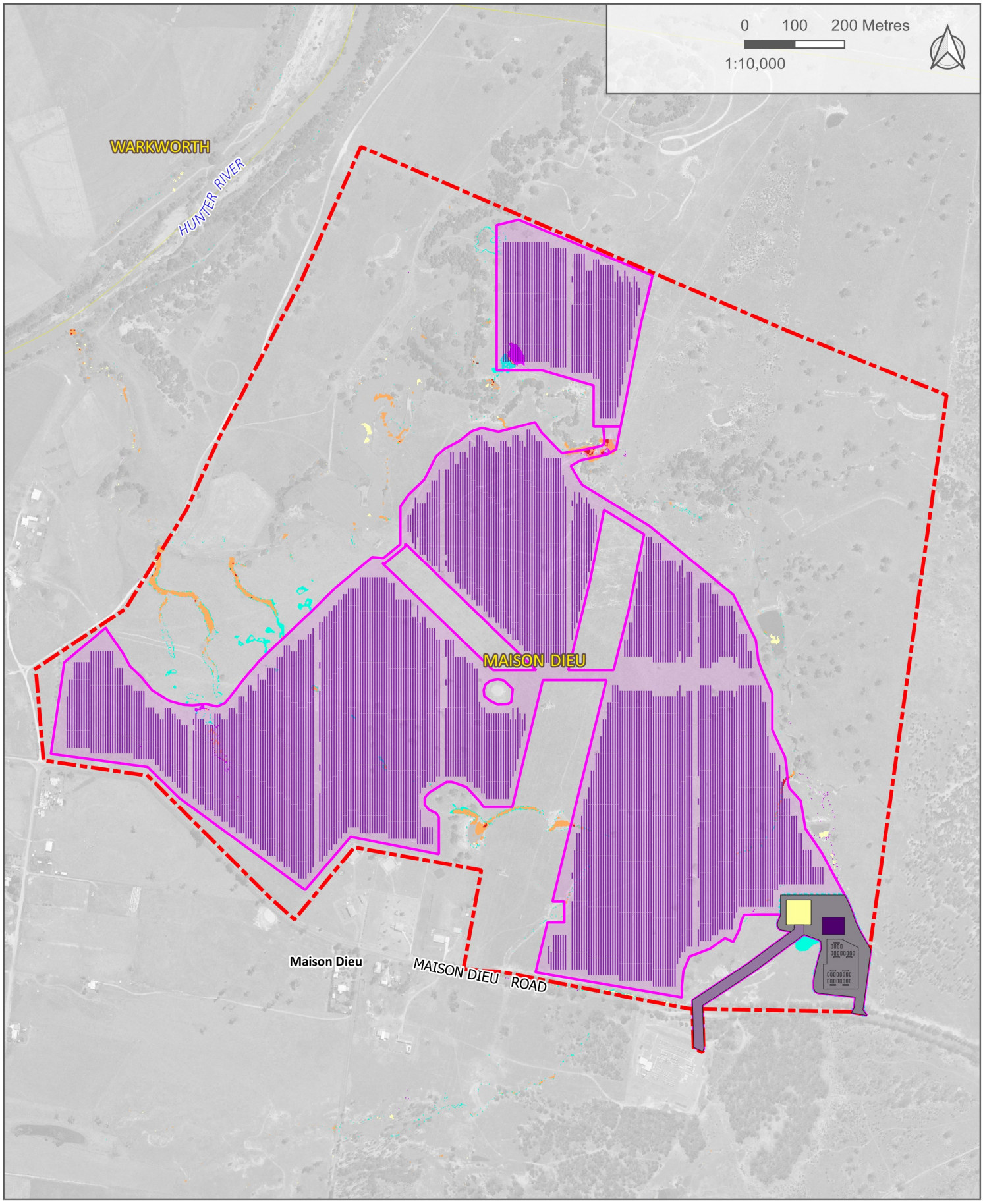
Figure DL1-1

10% AEP
Local Catchment
Depth Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Wet Dry

- Was Wet Now Dry
- Was Dry Now Wet

Difference (m/s)

- <= -1.00
- -1.00 - -0.50
- -0.50 - -0.10
- -0.10 - 0.10
- 0.10 - 0.50
- 0.50 - 1.00

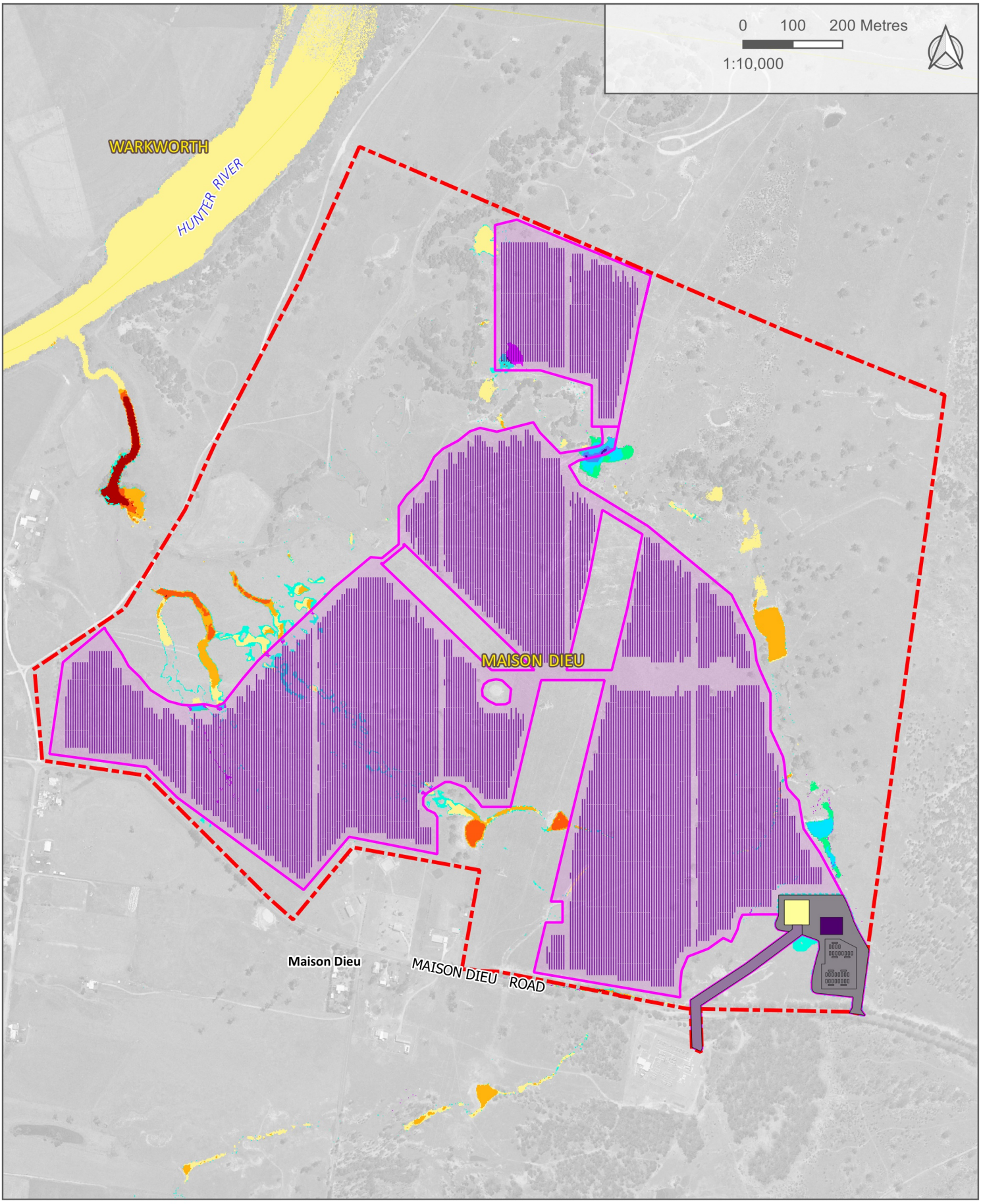
Figure DL1-2

10% AEP
Local Catchment
Velocity Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Wet Dry
- Was Wet Now Dry
- Was Dry Now Wet

Difference (m)
- <= -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10

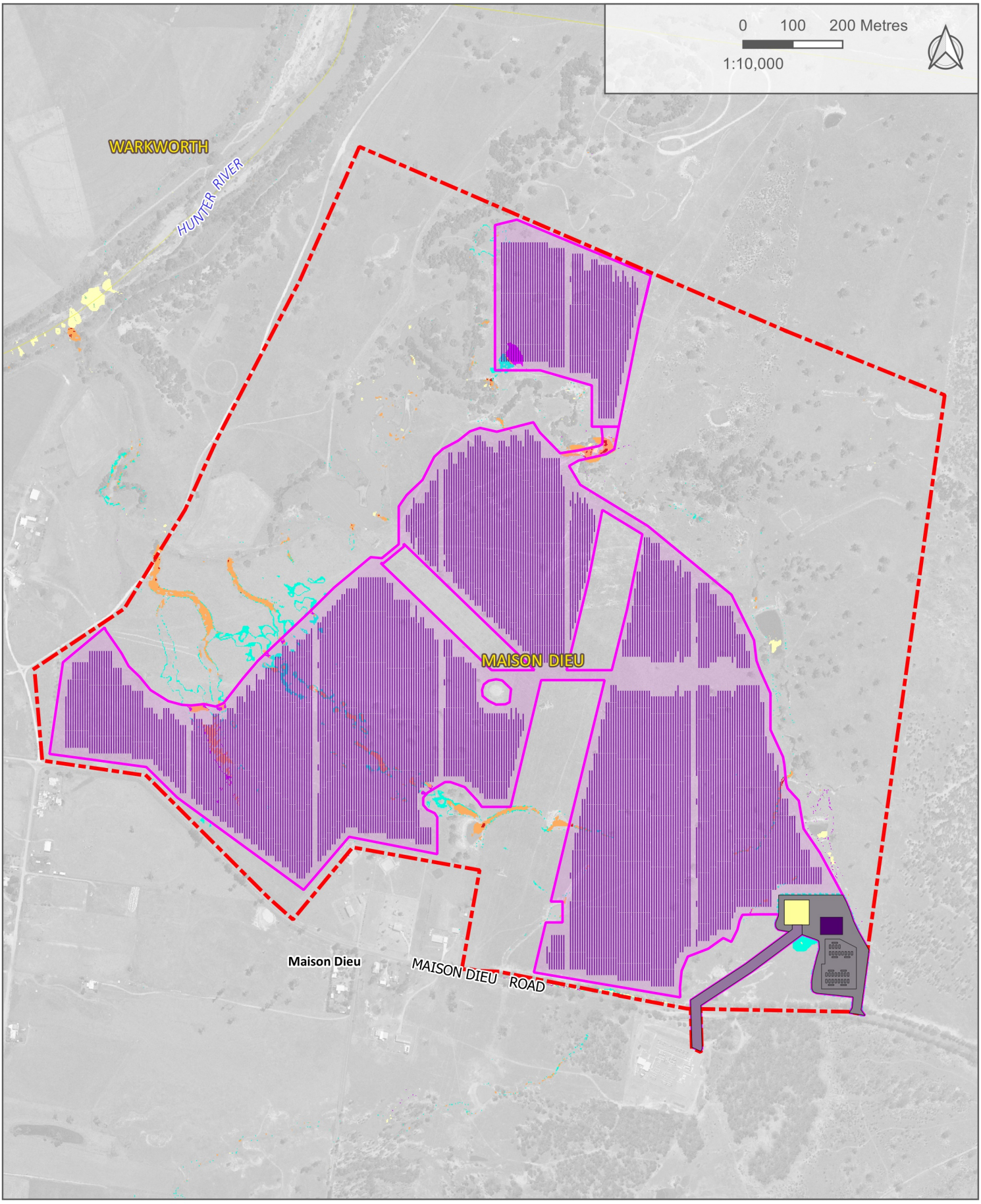
Figure DL2-1

1% AEP
Local Catchment
Depth Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Wet Dry

- Was Wet Now Dry
- Was Dry Now Wet

Difference (m/s)

- <= -1.00
- -1.00 - -0.50
- -0.50 - -0.10
- -0.10 - 0.10
- 0.10 - 0.50
- 0.50 - 1.00

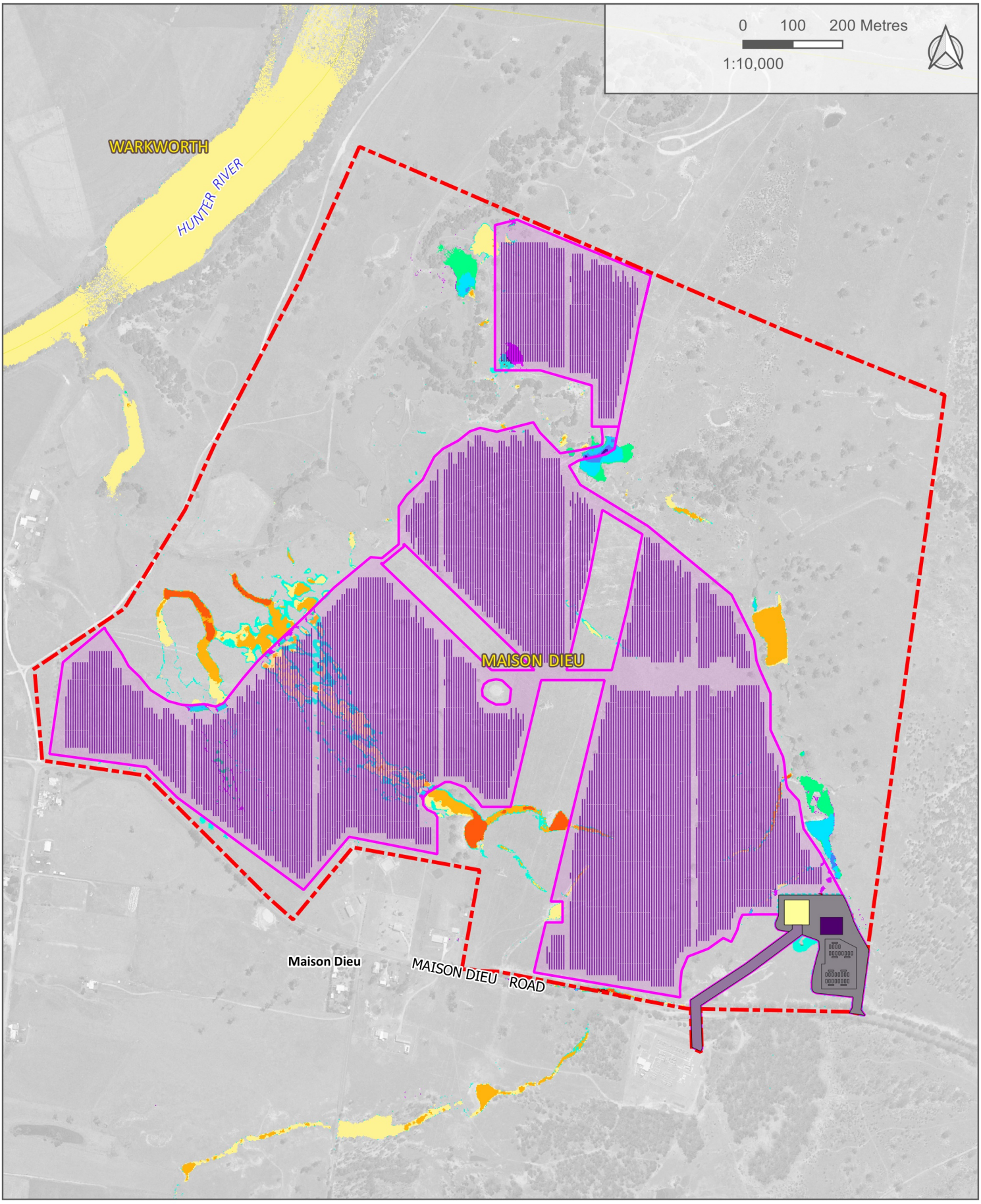
Figure DL2-2

1% AEP
Local Catchment
Velocity Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS
- Wet Dry
- Was Wet Now Dry
- Was Dry Now Wet

Difference (m)

- <= -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10

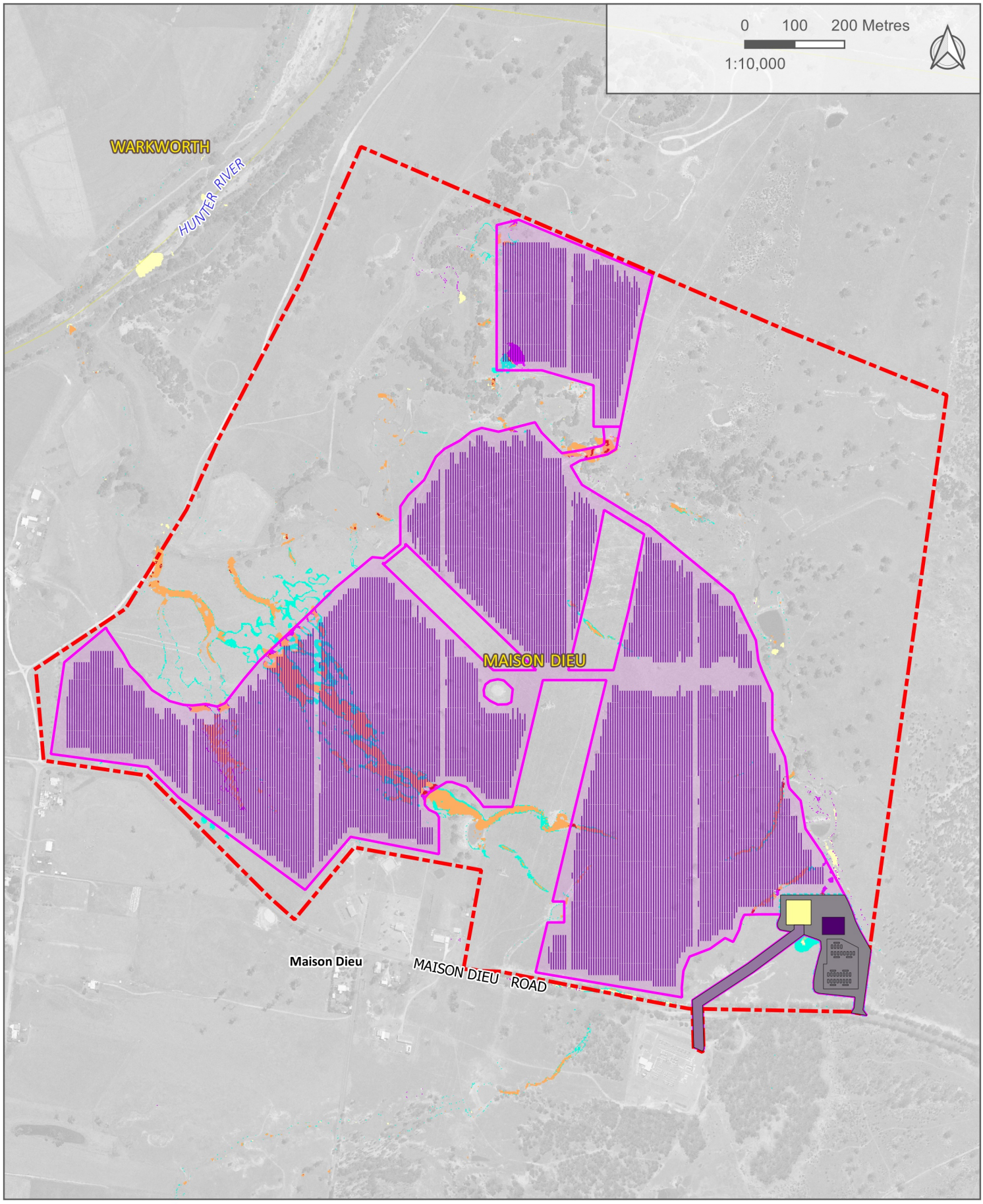
Figure DL3-1

1 in 200 AEP
Local Catchment
Depth Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Wet Dry

- Was Wet Now Dry
- Was Dry Now Wet

Difference (m/s)

- <= -1.00
- -1.00 - -0.50
- -0.50 - -0.10
- -0.10 - 0.10
- 0.10 - 0.50
- 0.50 - 1.00

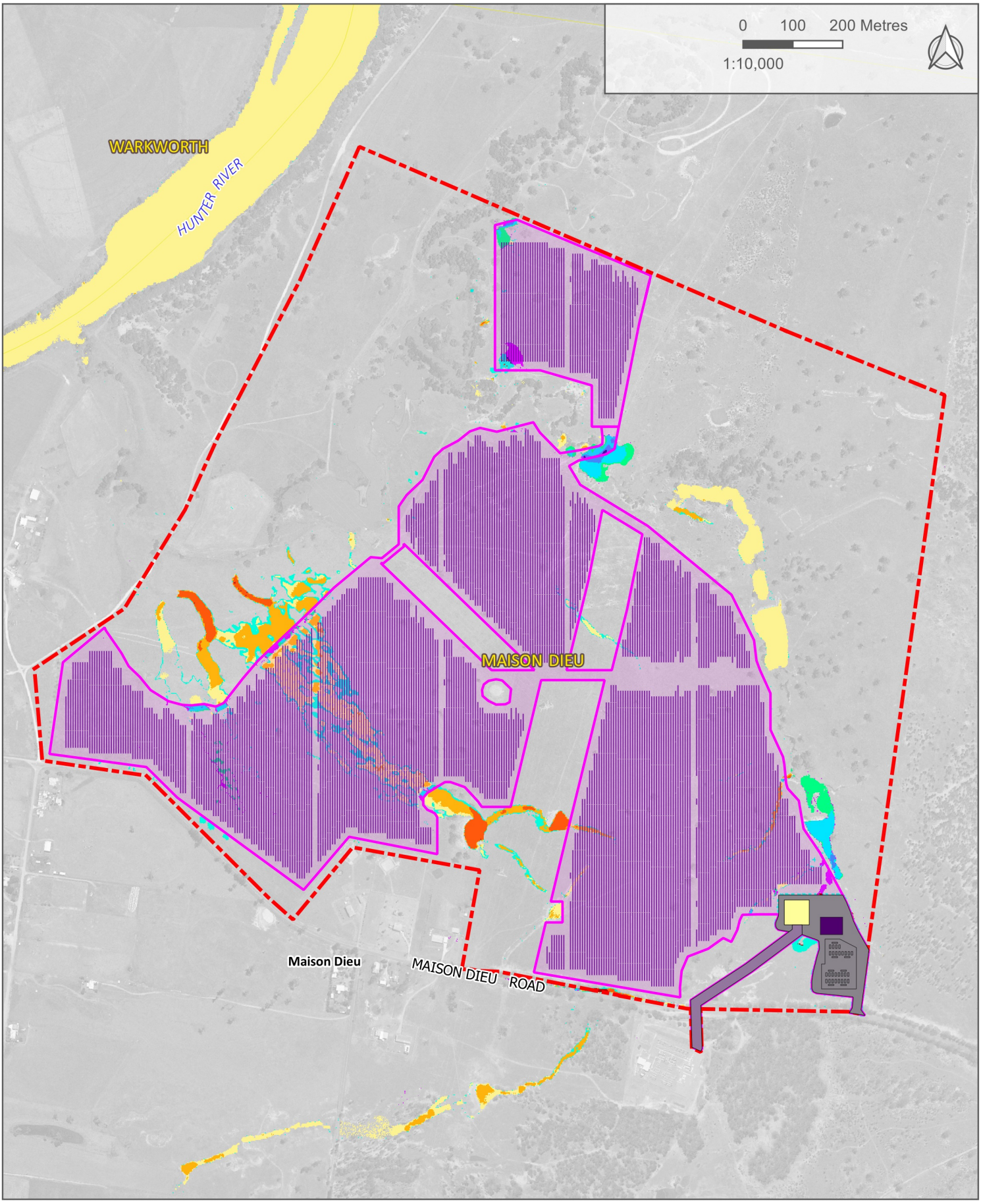
Figure DL3-2

1 in 200 AEP
Local Catchment
Velocity Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS
- Wet Dry
- Was Wet Now Dry
- Was Dry Now Wet

Difference (m)

- <= -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10

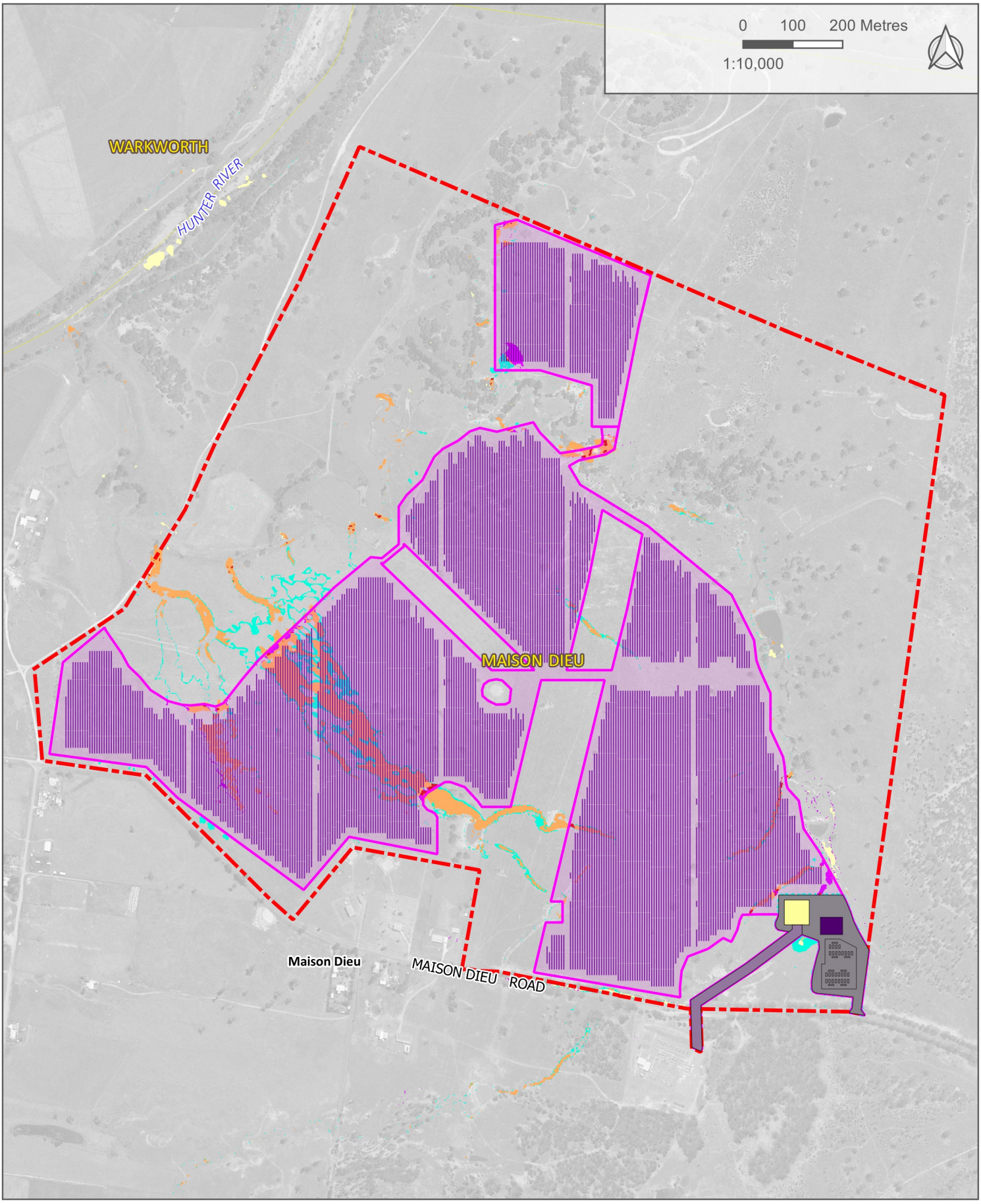
Figure DL4-1

1 in 500 AEP
Local Catchment
Depth Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Wet Dry

- Was Wet Now Dry
- Was Dry Now Wet

Difference (m/s)

- <= -1.00
- -1.00 - -0.50
- -0.50 - -0.10
- -0.10 - 0.10
- 0.10 - 0.50
- 0.50 - 1.00

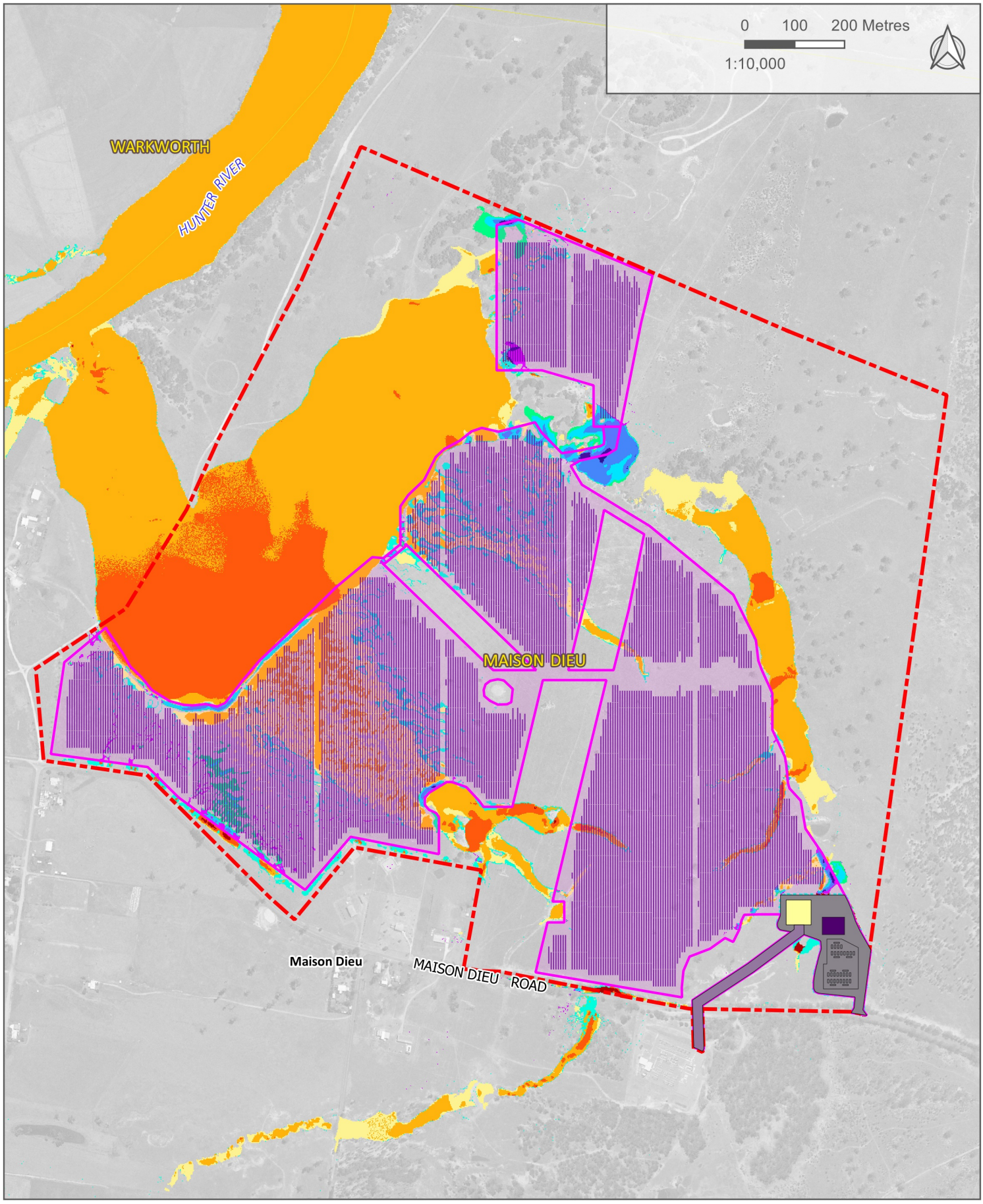
Figure DL4-2

1 in 500 AEP
Local Catchment
Velocity Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area

Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Wet Dry
- Was Wet Now Dry
- Was Dry Now Wet

Difference (m)
- <= -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10

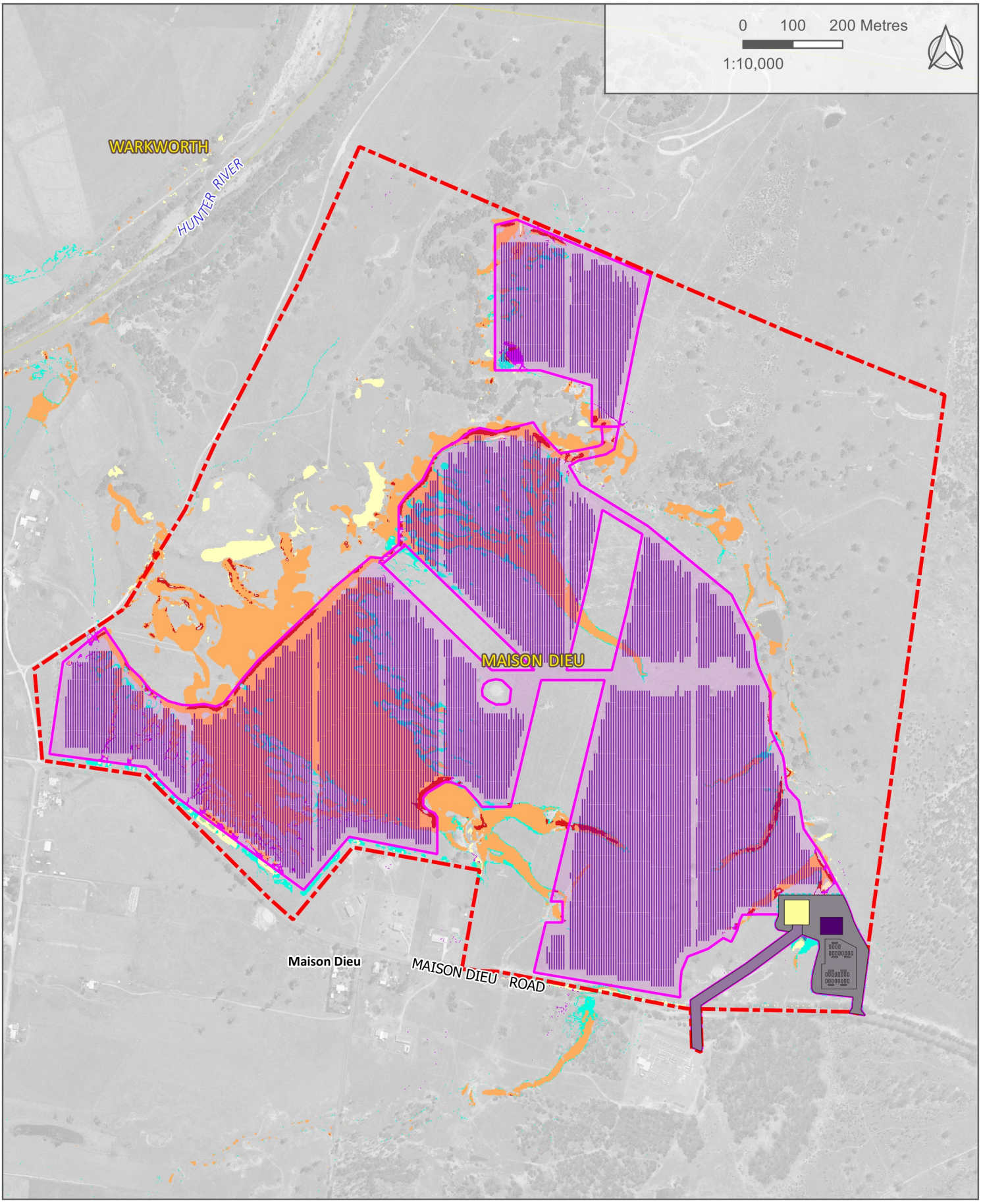
Figure DL5-1

PMF
Local Catchment
Depth Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Legend

- Solar Array
- Disturbance Area
- Project Area
- Substation / BESS / O&M
- Hardstand
- Grid Connection Easement
- O&M Compound Footprint
- Substation Footprint
- BESS

Wet Dry

- Was Wet Now Dry
- Was Dry Now Wet

Difference (m/s)

- <= -1.00
- -1.00 - -0.50
- -0.50 - -0.10
- -0.10 - 0.10
- 0.10 - 0.50
- 0.50 - 1.00

Figure DL5-2

PMF
Local Catchment
Velocity Difference

Solar Farm Maison Dieu

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI), Flood Data (Northrop, Oct 2023), Layout (Terrain, Oct 2023)
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Document Register

Rev	Status	Prepared	Approved	Date
1	Draft – For Client Review	RB	GB	31/10/2023
A	For Approval	GB	GB	1/12/2023
B	Revised Layout	GB	GB	3/04/2024
C	Minor Amendments	GB	GB	5/04/2024
D	Minor Amendments	GB	GB	15/05/2024

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