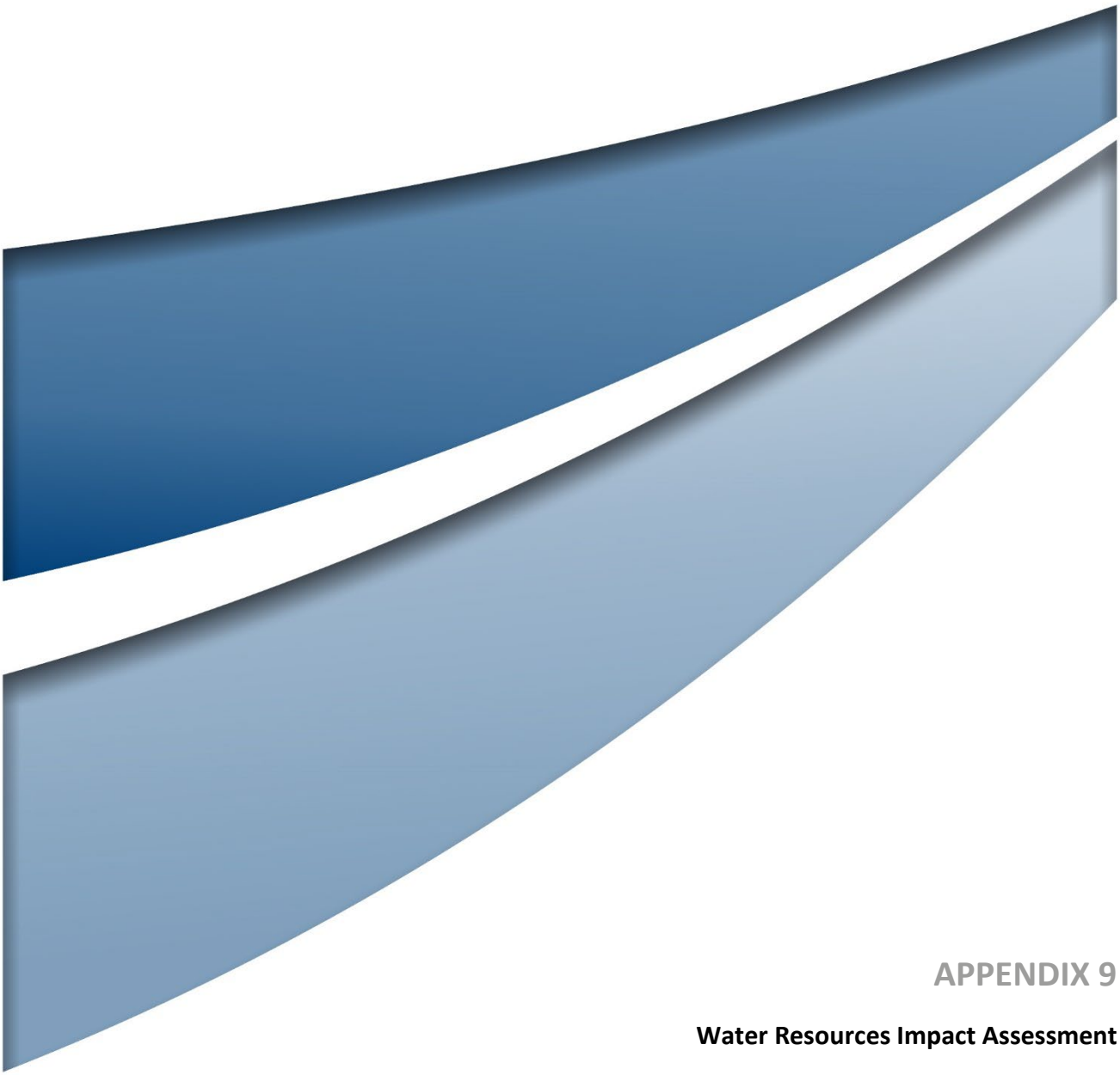

# APPENDIX 9

## Water Resources Impact Assessment

This report has been prepared for Richmond Valley Solar & BESS Pty Ltd (ABN 43 672 993 869) a wholly owned special purpose vehicle of Ark Energy Projects Pty Ltd and the Proponent of the Project. Richmond Valley Solar & BESS Pty Ltd will herein be referred to as Ark Energy or Ark Energy Projects.

# RICHMOND VALLEY SOLAR FARM FLOOD STUDY & IMPACT ASSESSMENT

10 MAY 2024

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[10 May 2024]

**Our Ref:**

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## Version Control

| Revision No. | Date Issued | Description | Author | Approver |
|---|---|---|---|---|
| A | 20/12/2023 | Working draft to client | Richard Feng | Mark Colegate |
| B | 22/01/2024 | For issue | Richard Feng | Mark Colegate |
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| E | 02/05/2024 | Final | Mark Colegate | Bennet Davies |
| F | 10/05/2024 | Final Issue | Mark Colegate | Bennet Davies |

# Contents

# Tables



# Figures

# Acronyms and Abbreviations

| Acronym | Definition |
|---|---|
| **AEP** | Annual Exceedance Probability |
| **AHD** | Australian Height Datum |
| **ARR** | Australian Rainfall and Runoff (Guidelines 2019) |
| **BESS** | Battery Energy Storage System |
| **BoM** | Bureau of Meteorology |
| **FFA** | Flood Frequency Duration |
| **FIA** | Flood Impact Assessment |
| **IFD** | Intensity Frequency Duration |
| **IWL** | Initial Water Level |
| **O&M** | Operation and Maintenance |
| **PMF** | Probable Maximum Flood |
| **PMP** | Probable Maximum Precipitation |
| **RVSF** | Richmond Valley Solar Farm |
| **SEARs** | Secretary's Environmental Assessment Requirements |

# Executive Summary

Arcadis Australia Pacific Pty Limited (Arcadis) was engaged by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Ark Energy Pty Ltd (Ark Energy) to prepare a flood impact assessment for the Richmond Valley Solar Farm (the Project).

The Project is located approximately 7 kilometres to the east of the town of Rappville, 25 kilometres south of Casino and 26 kilometres to the west of Woodburn within the Richmond Valley LGA.

The Project involves the construction, operation and decommissioning of up to 500 megawatts (MW) DC solar photovoltaic (PV) generation, Battery Energy Storage System (BESS) with power capacity of 275MW and energy storage capacity up to 2,200-megawatt hour (MWh) over 8 hours and a transmission line to connect the Project from the switching substation to the national electricity market. The Project will include various associated infrastructure including, temporary construction facilities, operation and maintenance buildings, internal access roads, civil works and other required electrical infrastructure. The Project is anticipated to have an operational life of 30 years or more.

A Flood Risk Assessment was undertaken and subsequently a Flood Impact Assessment (FIA) was prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued for the Project and with consideration of the Australian Rainfall and Runoff 2019 (ARR2019) Guidelines from Geoscience Australia and NSW Floodplain Development Manual (2005).

A hydrological model was developed using data from the ARR Datahub and the modelling was undertaken in accordance with the latest data ARR2019. The inflows from the hydrological model were then used in a hydraulic model.

The proposed works was analysed in the flood model against a range of storm event probabilities including the 5% AEP, 2% AEP, 1% AEP, 1% AEP with climate change, 0.5% AEP and 0.2% AEP events, as well as the Probable Maximum Flood (PMF) event.

The results of the flood risk assessment undertaken with the Preliminary Design showed that the proposed Battery Energy Storage System (BESS), construction compound, substation and staff car park have a low flood risk.  Avenue Road and the proposed operation and maintenance (O&M) facility flood risk was high in the PMF event. Subsequently, to avoid impacts and minimise risk the O&M facility was relocated outside of the area of risk.

The Flood Risk Assessment of the preliminary design identified the following risks and hazards associated with flood function:

- The proposed BESS, construction compound and substation are outside the PMF event flood extent.
- The staff car park is within the 5% Annual Exceedance Probability (AEP) to PMF event flood extent. Exhibits a flood hazard category of H1 - which is safe for vehicles, people and buildings.
- The O&M facility flood hazard is H4 in the PMF event and H1 in the 1% AEP event. H4 is unsafe for all people and all vehicles.
- The Avenue Road maximum hazard class is H5 in the PMF event but is affected by hazard categories ranging from H2 to H4 during events 1% AEP CC up to 0.2 % AEP. The existing hazards render the sole access/egress route from the site unsafe for all vehicles and people.

A flood impact assessment was undertaken on the proposed design. The Project Area is bounded by a chain mesh security fence that traverses many of the overland flood flow paths. Although the fence did not obstruct the passage of flows it did create a blockage potential for flood flows transporting debris. The blockage potential was analysed and several blockage scenarios were assessed in the FIA.

Afflux was observed upstream of the fence line with the most severe occurring under the calculated ‘high blockage potential’ scenario. Although, the impacts are minor and do not create additional flood hazards or adverse impacts.

# 1 Introduction

## 1.1 Project Background

Ark Energy Pty Ltd (Ark Energy) proposes to develop the Richmond Valley Solar Farm (the Project) in the Northern Rivers region of New South Wales (NSW), approximately seven kilometres (km) to the east of the town of Rappville in the Richmond Valley Local Government Area (LGA).

The Project involves the construction, operation and decommissioning of up to 500 megawatts (MW) of DC solar PV generation, Battery Energy Storage System (BESS) with a power capacity of 275 megawatts and an energy storage capacity of up to 2,200-megawatt hour (MWh) over eight hours and a transmission line to connect the Project from the switching substation to the National Electricity Market (NEM). The Project will include various associated infrastructure including, temporary construction facilities, Operation & Maintenance (O&M) facility, internal roads, civil works and other required electrical infrastructure.

The Project covers an area of approximately 1,475 ha (Study Area) and the solar farm and associated infrastructure is proposed to have a Development Footprint of approximately 803 ha and the road upgrade Footprint is proposed to be approximately 11 ha.

The Study Area and full regional context is presented in Figure 4-1.

## 1.2 Project Location and Catchment Description

The Project is located in the Richmond River basin, which includes local catchments of Myrtle Creek and Two Mile Creek to the southeast of the Project Area, and Bungawalbin Creek and Lower Bungawalbin Wetlands to the east (Refer Figure 4-1). Physics Creek is a small tributary of these systems which traverses the lower floodplain area in the south-east of the Project Area and incorporates some low-lying wetland areas.

The relatively flat topography provides for a broad floodplain with numerous minor flow paths and topographical depressions which are likely to accumulate surface water under local catchment flooding conditions. There is some watercourse connectivity through what appear to be constructed channels, that link a number of the low-lying areas and in-stream storages and depressions.

The following assessment is undertaken and discussed over three (3) scales within this report –

1. Study Area – the extent of the hydrologic and hydraulic modelled area. Consisting of the entirety of the contributing catchment areas of Myrtle Creek, Two Mile Creek and Physics Creek
2. Project Area – the Richmond Valley Solar Farm (RVSF) property boundary and local catchment area. The project area is captured within the extent of the hydraulic model area, and
3. Development Footprint – the developable portion of the Project Area. Featuring extent of proposed works.

## 1.3 Report Structure

The following report structure is in alignment with the analytical process undertaken to define the flood characteristics of the contributing catchments, flood risks to the project area and flood impact of the proposed development.

The Flood Study and Flood Risk Assessment were undertaken during the initial investigation stage (Stage 1). The Flood risk assessment referenced the preliminary development layout plan (Received 18 December 2023).

The Flood Study defined the existing hydrology and hydraulics of the RVSF study area. This generates the 'base case' scenario for calibration and design comparison. The Flood Risk Assessment assesses the potential risk the existing regional flooding can have on the proposed development layout.

The output of these assessments was used to inform and revise the proposed design to mitigate the risks associated with regional flooding on the proposed Solar Farm and the impact of the proposed works on the surrounding area.

A revised development layout plan was provided 23 February 2024 and incorporated into the Flood Impact Assessment (Stage 2) undertaken to identify any residual risks associated with the proposed development following avoidance and mitigation applied from risk assessment including impacts of the development on floods i.e., afflux, hazards, etc.

Conclusions/Mitigation and Management Measures - This section has been provided to identify recommendations for mitigating and managing impacts.

### 1.3.1 Terminology

Annual Exceedance Probability (AEP) terminology has been adopted for consistency with the recommended probability terminology in Australian Rainfall and Runoff (ARR) guidelines 2019. The use of Average Recurrence Interval (ARI) is no longer recommended and has changed to AEP, which is the probability or likelihood of an event occurring or being exceeded within any given year for flood risk.

It is noted that some regional methods utilised in this report and prior assessments utilised ARI terminology. The results for the ARI methods have been rounded towards the closest AEP descriptor for frequent storm events. The relationship between the two probability descriptors is presented in Table 1-1.

*Table 1-1: AR&R Probability Terminology*

| Frequency Descriptor | AEP (%) | AEP (1 in X) | ARI (years) |
|---|---|---|---|
| Very Frequent | 63.21 | 1.58 | 1 |
| Frequent | **50** | **2** | **1.44** |
| | 39.35 | 2.54 | 2 |
| | **20** | **5** | **4.48** |
| | 18.13 | 5.52 | 5 |
| | **10** | **10** | **9.49** |
| Rare | **5** | **20** | **20** |
| | **2** | **50** | **50** |
| | **1** | **100** | **100** |

| Frequency Descriptor | AEP (%) | AEP (1 in X) | ARI (years) |
|---|---|---|---|
| Very Rare | | | |

# 2 Study Objectives

The primary objective of the assessment is to identify flooding constraints to assist in the development of the Project's layout and configuration.

The flood assessment, documented in the following report, is underpinned by the development of hydrological and hydraulic models to estimate design flood conditions. The modelling and mapping outputs contribute to:

- Defining the existing flood behaviour from the local catchment and mainstream flooding in the Development Footprint;
- Informing the development of the Project layout including the location of infrastructure and planning requirements associated with flood risk-related development control;
- Providing baseline conditions and a tool for assessing the potential impacts of the Project on the existing flooding behaviour.

## 2.1 Secretary's Environmental Assessment Requirements (SEARs)

**Relevant SEARs**

The project is to include -

- an assessment of the likely impacts of the development (including flooding) on surrounding watercourses (including their Strahler Stream Order) and groundwater resources and measures proposed to monitor, reduce and mitigate these impacts;
- details of water requirements and supply arrangements for construction and operation;
- where the project involves works within 40 metres of any river, lake or wetlands (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the following (where applicable):
  - DPI Guidelines for Controlled Activities on Waterfront Land (2018)
  - Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (DPI 2003)
  - Policy & Guidelines for Fish Habitat Conservation & Management (DPE, 2013)
- a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with Managing Urban Stormwater: Soils & Construction (Landcom, 2004).

## 2.2 Agency Requirements

**Relevant Agency Requirements – Biodiversity and Conservation Division**

10. The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:

a. Flood prone land.

b. Flood planning area, the area below the flood planning level.

c. Hydraulic categorisation (floodways and flood storage areas).

d. Flood hazard

**Addressed in report – refer to Section 5 and Section 7**

11. The EIS must describe flood assessment and modelling undertaken in determining the project's design flood levels for events, including a minimum of the 5% Annual Exceedance Probability (AEP), 1% AEP, flood levels and the probable maximum flood, or an equivalent extreme event.

**Addressed in report – refer to Section 4 and Section 6**

12. The EIS must model the effect of the project (including fill) on the current flood behaviour for a range of design events as identified in 11 above including the 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.

**Addressed in report – refer to Section 6 and Section 7**

13. Modelling in the EIS must consider and document:

Existing council flood studies in the area and examine consistency to the flood behaviour documented in these studies.

The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood, or an equivalent extreme flood.

e. Impacts of the project on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazard categories and hydraulic categories.

f. Relevant provisions of the NSW Floodplain Development Manual 2005.

**Addressed in report – refer to Section 7 and Appendix D**

14. The EIS must assess the impacts of the project on flood behaviour, including:

Whether there will be detrimental increases in the potential flood affectation of other properties, assets, and infrastructure.

g. Consistency with Council floodplain risk management plans.

h. Consistency with any Rural Floodplain Management Plans.

i. Compatibility with the flood hazard of the land.

j. Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.

k. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the project area.

l. 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.

m. Any impacts the project may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the NSW SES and Council.

n. Whether the project incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the NSW SES and Council.

o. Emergency management, evacuation and access, and contingency measures for the project considering the full range of 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 NSW SES.

p. Any impacts the project may have on the social and economic costs to the community as consequence of flooding.

**Addressed in report – refer to Section 6, Section 7 and Appendix D**

# 3 Data Collection and Review

## 3.1 Topographical Data

The Study Area, Project Area and Development Footprint are covered by high-resolution LiDAR datasets obtainable from Geoscience Australia. The western half of the Myrtle Creek and Two Mile Creek catchments within the Study Area is covered by a 2-metre resolution LiDAR dataset flown in July 2017 (GA, 2017).

The Physics Creek catchment and the eastern half of the Myrtle Creek and Two Mile Creek catchments (covering the project area) are covered by a 1-metre resolution LiDAR dataset flown in June 2010 and July 2017.The LiDAR coverage is shown in Figure 3-1.

Elevations range from approximately 90 m Australian Height Datum (AHD) along the catchment boundary ridgelines to the north down to around 24.4 m AHD in the broader floodplain expanse at the southern boundary.

It is noted that the LiDAR does not pick up the creeks' bathymetry (topography below water surface) where the waterways are nonephemeral. Consideration of bathymetry and LiDAR resolution is required when assessing the definition of the waterway profiles in the digital elevation model (DEM) to ensure the waterway conveyance capacity is suitably represented.

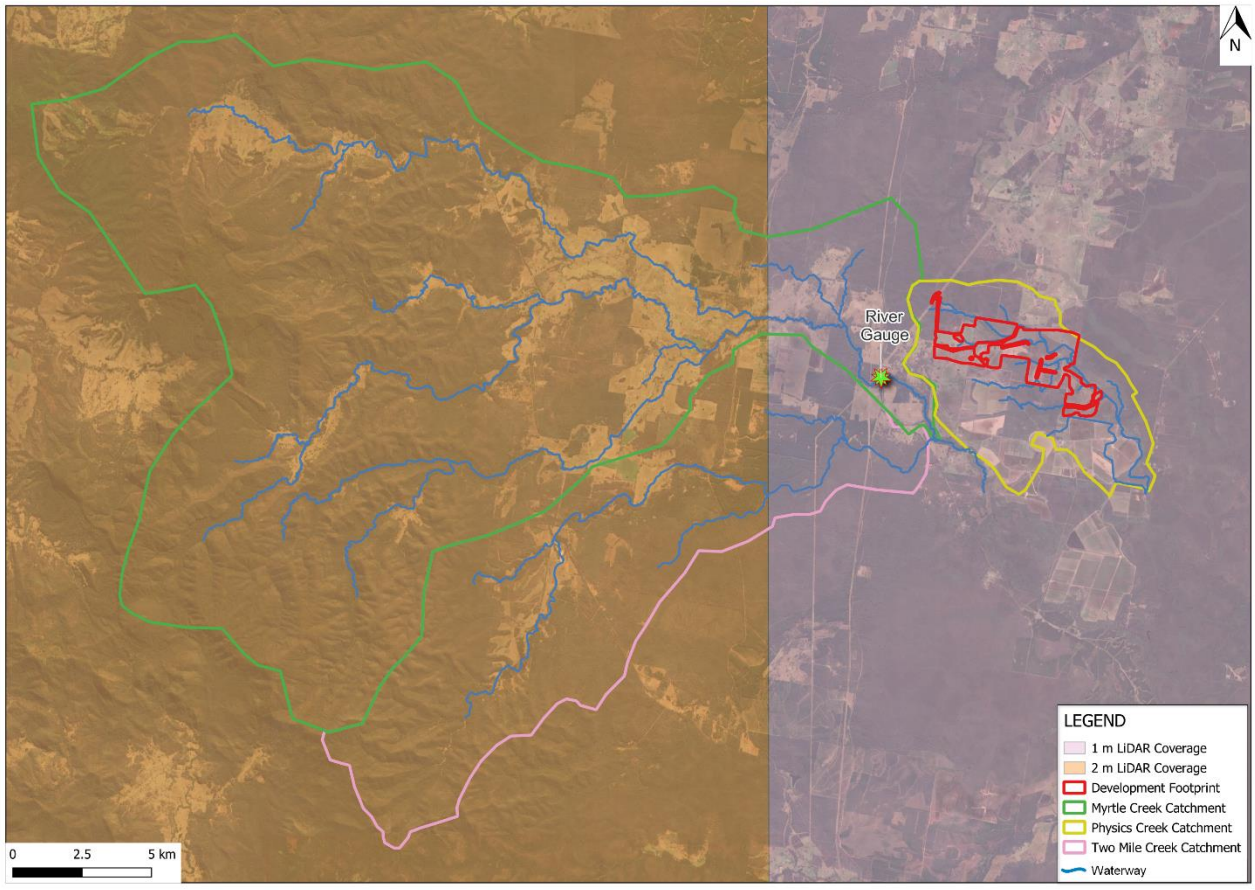


*Figure 3-1: LiDAR Coverage*

### 3.1.1 1-metre LiDAR Data

The 1-metre LiDAR data, obtained from Geoscience Australia, providing coverage for the site was generated in the 2010 and 2017 Woodvale LiDAR project. The data has been processed and made available in clearly delineated data tiles.

There is no overlap with the data tiles, therefore, the DEM is constructed by triangulating the data points in both datasets. The transition from 2017 to 2010 data sets dissects the Project Area along a north south axis. There appears to be a minor difference in vertical accuracies between the two datasets (2010/2017), resulting in a 'step' along the plain where the tiles join.

Ground truthing or validation of the datasets is not possible due to the lack of additional survey data in the area. The 'step' (< 0.2 m) is upstream of the flow direction resulting in attenuation of flood depths greater than expected. However, this only impacts the early flows and does not impact the peak. Therefore, flood extents (flood levels) are not affected.

As a result, it is unlikely the flood depths and hydraulic hazards modelled within the site are what would be observed in the affected location due to the difference in vertical accuracies, refer Figure 3-2. The DEM can be considered 'fit-for-purpose' for this study. However, inclusion of ground survey or additional LiDAR could be used to refine the DEM and remove artefact.

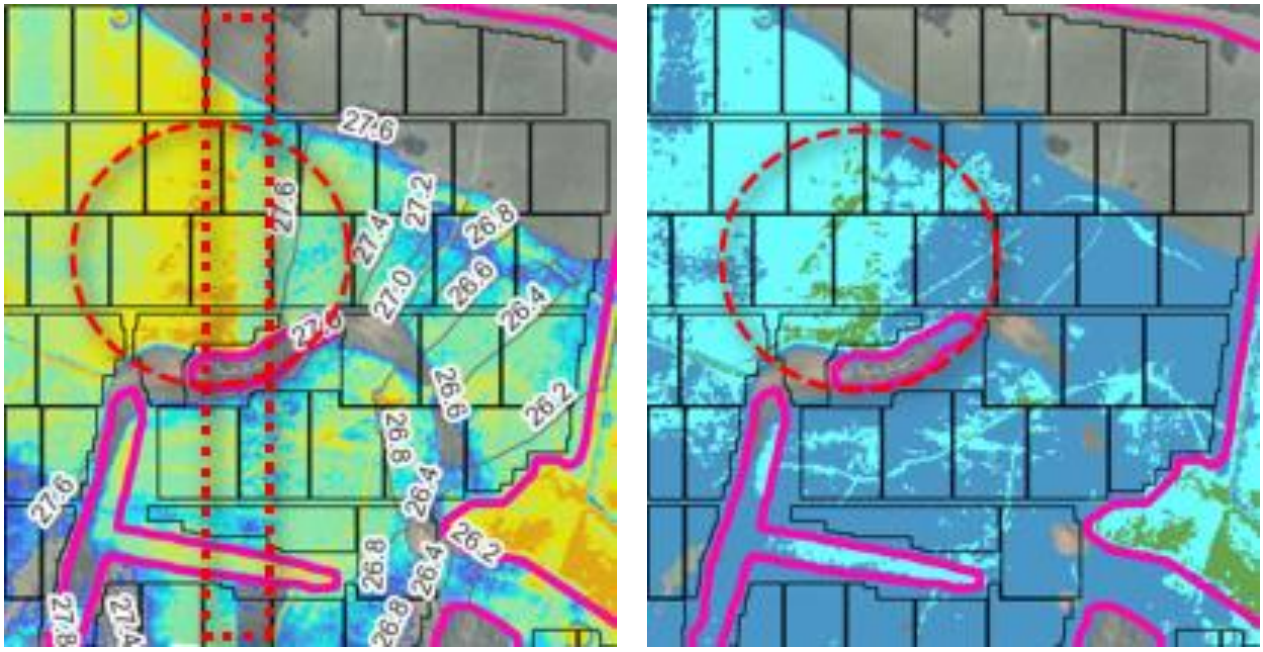


*Figure 3-2: LiDAR vertical accuracy artefact*

### 3.1.2 2023 LiDAR Data

It was noted that a LiDAR acquisition project was commissioned to capture a higher resolution coverage of the RVSF area. The LiDAR capture was flown 31 July 2023. The LiDAR data was provided to Umwelt (and passed onto Arcadis) after it had undergone partial data processing. It appears that the LiDAR point cloud had undergone a limited filtering and cleaning process to delineate the data sets capturing the terrain, water bodies and surface objects.

The data set was potentially suitable to generate a Digital Surface Model (DSM) - A DSM is a 3D model of the Earth's surface, including both the terrain and any objects on the surface (such as buildings, trees, etc.). However, it had not been suitably processed to be able to develop a DEM - A DEM is a 3D model of the terrain, showing the elevation of the ground at each point in the point cloud. It is the DEM that is required for flood modelling.

Isolating the terrain layer in the point cloud resulted in large holes in the data points where vegetation had been removed. There is an extensive coverage of dense pockets of trees within the project area. The removal of the vegetation layers from the point cloud leaves large 'holes' within the terrain data. This does not allow the standalone use of the 2023 LiDAR data to model the project area. Therefore, the 2023 LiDAR data could not be adopted in this study.

## 3.2 Hydrometric Data

There are no water level recording stations for Physics Creek, the watercourse within the Project Area. The nearest active gauge location is Myrtle Creek at Rappville (Station No 203030) located at the Summerland Way bridge crossing approximately 2 km west of the Project Area and was adopted in this study. Refer to Figure 3-1 for gauge location.

The Myrtle Creek gauging station has rainfall and flow water level records. The rainfall records are continuous over the period from 1994 to present and water level records are continuous over the period from 1979 to present.

There is significant break-out flow upstream of the gauge from Myrtle Creek to the Two Mile Creek catchment to the south and therefore a considerable portion of the flow would bypass the gauge. Given this, it is expected there would be issues with the rating curves developed with consideration of rarer events. Therefore, only lower events were considered for calibration for the current flood assessment for flood frequency analysis.

Accordingly, there is limited data available for water level and flow calibration.

# 4 Stage 1 - Model Development

## 4.1 General Approach

The primary objective of the flood assessment is to define the flood conditions within the Study Area through the establishment of appropriate numerical models. The Study Area is the 'modelled' area and consists of the greater extent of the Myrtle Creek, Two Mile Creek and Physics Creek catchment area, in addition to the Project Area. Simulation of design flood behaviour using the developed models is undertaken to estimate flood inundation extents, levels, depths and velocities to assess flood risk and flood impacts for the Project and guide the development planning.

The assessment included the development of both hydrological and hydraulic models.

- A RORB software hydrological model was developed to simulate the catchment rainfall-runoff processes in the upper catchments of Myrtle Creek, Two Mile Creek and the catchment of the Project Area. The RORB model output flow rate was used in the 2D hydraulic (TUFLOW) model. The RORB model setup and outflow location are shown in Figure 4-1.
- A considerable breakout flow was expected between Myrtle Creek and Two Mile Creek as well as floodplain storage, to simulate the flow behaviour of the overland flow paths and waterways producing flood inundation extents, water levels, flow depths and velocities. The 2D hydraulic model extent covers the upstream of the Myrtle Creek and Two Mile Creek junction and the Project Area. The inflow from Myrtle Creek and Two Mile Creek is from the RORB model with the overall outflow for the creek catchment and the rainfall excess (rainfall depths minus loss) hydrographs for each sub-catchment extracted and used as inflows in TUFLOW.

## 4.2 Hydrological Model

A RORB hydrology model was developed and calibrated against observed hydrographs for flow events at the gauging station using the recorded rainfall data. RORB is a general runoff and streamflow routing program used to calculate flood hydrographs from rainfall and other channel inputs. It subtracts losses from rainfall to produce rainfall-excess and routes this through catchment storage to produce the hydrograph.

Iterative runs of the RORB model were conducted with adjustment of the RORB parameters to best represent the study catchment characteristics. The calibrated RORB model was then utilised to develop design hydrographs using the ARR2019 ensemble rainfall patterns.

The methodology adopted for the estimation of design flows and generation of design hydrographs for this investigation is detailed below:

- Delineate catchments and review regionally available hydrology and catchment data.
- Develop and calibrate a rainfall-runoff model (RORB) which includes outputs at the gauging station.
- Adopt appropriate hydrographs and peak flows from the calibrated RORB model for use in design.

## 4.3 Catchment Delineation

The hydrological model was split into a network of 41 sub-catchments as shown in Figure 4-1 with cumulative sub-catchment areas of Myrtle Creek, Two Mile Creek and Project Area of 392 $km^2$, 132 $km^2$ and 44 $km^2$ respectively. Review of satellite imagery indicates that the contributing rural catchment area does not contain any effective (directly connected) impervious area. The catchments contain small areas of disconnected and distributed impervious area which would not influence the regional runoff characteristics. Therefore, the rural catchments were considered to be 100% pervious.

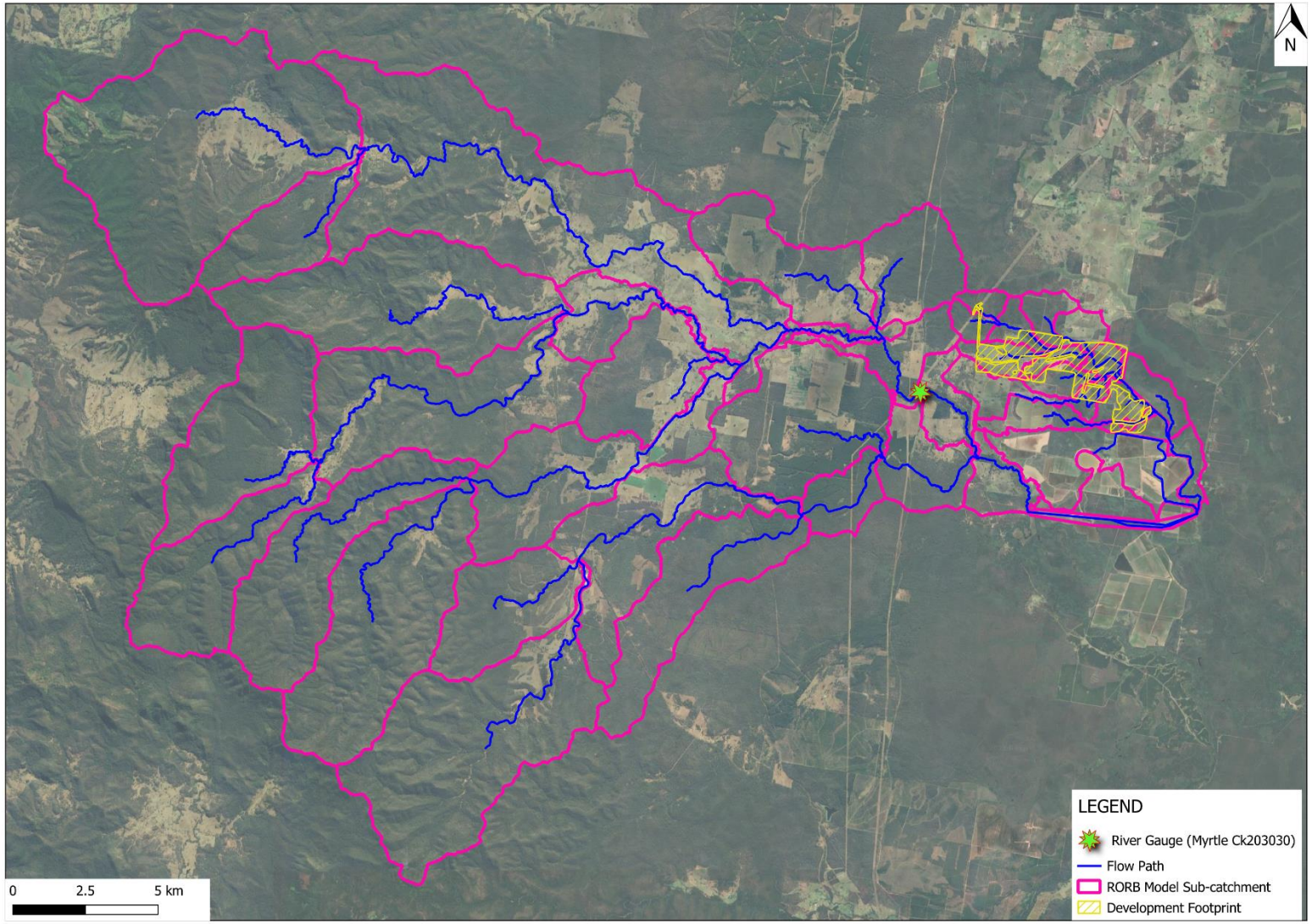


*Figure 4-1: RORB Model Sub-catchments*

## 4.4 Stream Gauge

A stream flow gauging station monitored by the NSW - Department of Climate Change, Energy, the Environment and Water is located at Myrtle Creek at Rappville (Station No 203030) located at the Summerland Way bridge crossing approximately 2 km west of the Project Area. Stream flow data was obtained from the WaterNSW website (November 2023). A summary of the station is presented in Table 4-1.

The gauge recorded rainfall data and flow data are presented in Figure 4-2. It appears that the rainfall gauge is unreliable after 2009. The rainfall records do not reflect the previous records and do not align with the stream gauge data.

*Table 4-1: Stream Gauges*

| Station | 203030 Myrtle Creek at Rappville |
|---|---|
| Date Start | Flow data: 27/09/1979 |
| Total years of record | Flow data: 44 |
| Latitude | -29.11 |
| Longitude | 153.00 |
| Catchment area ($km^2$) | 332 |

**Data extracted 14/11/2023*

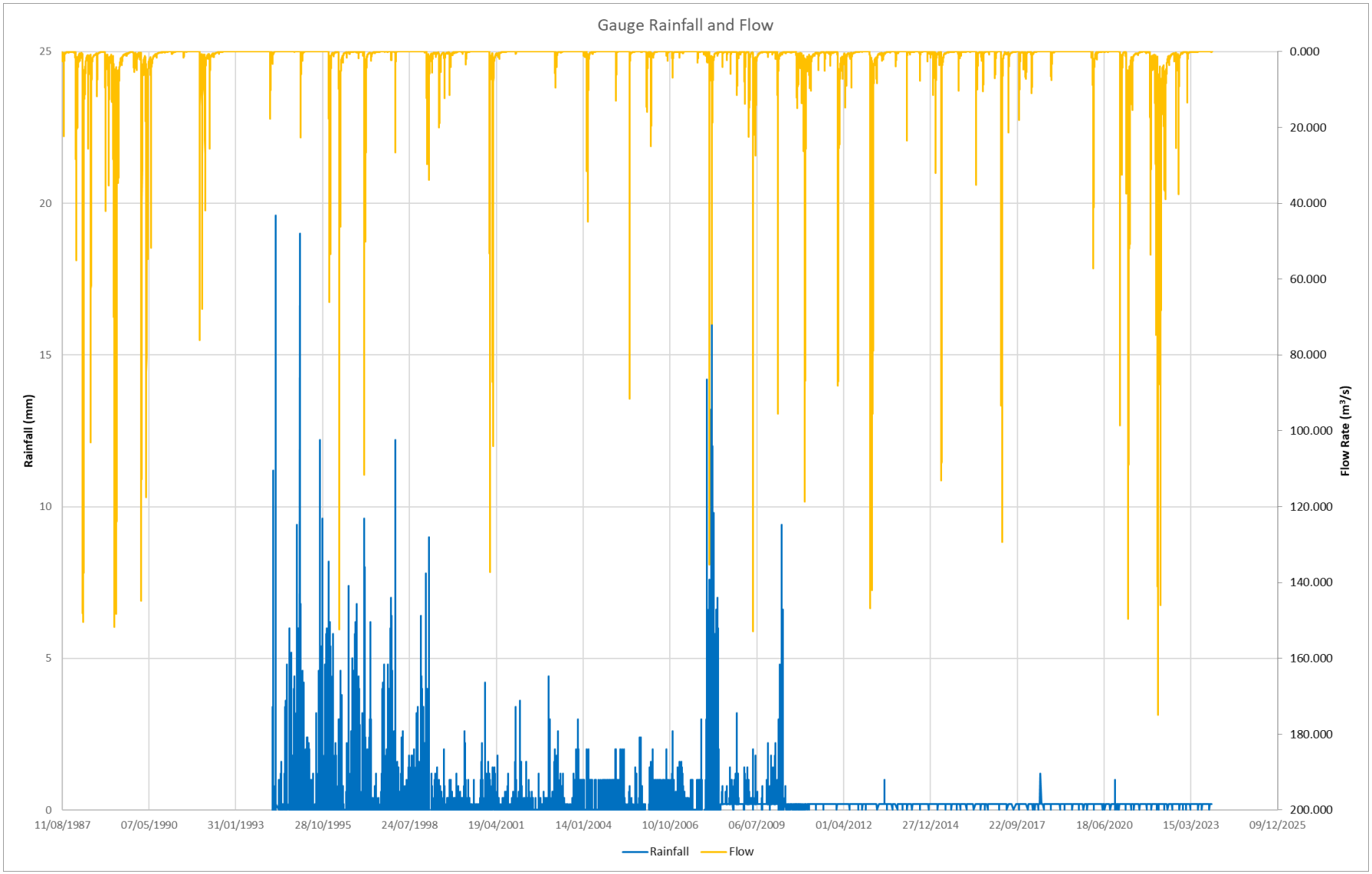


*Figure 4-2: Gauge 203030 recorded flow and rainfall data*

## 4.5 Flood Frequency Analysis

Flood frequency estimates of the flows at Myrtle Creek at Rappville (#203030) were provided by the Bureau of Meteorology (BoM) (November 2023). The BoM Flood Frequency Analysis (FFA) plot is shown in Figure 4-3. The FFA figure shows that the flow rate does not change much after 4-year return period (25% AEP) which means the stream flows overtop the bank beyond 4-year return period. The calibration event should not be chosen bigger than the 4-year return period.

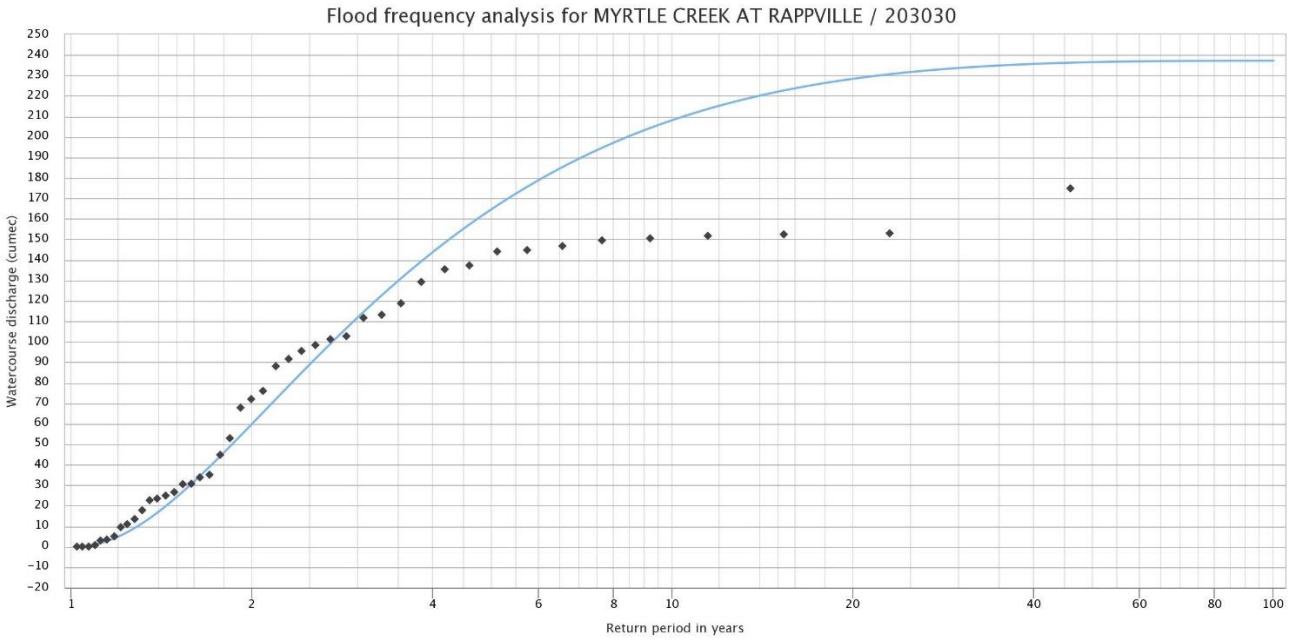


*Figure 4-3: Flood Frequency Analysis from BoM*

## 4.6 RORB Model Calibration

### 4.6.1 Calibration event

The gauged data was analysed and suitable event was identified which exhibited reliable data records. The selected event was from the end of June to the beginning of July 2005. The rain and streamflow is shown in Figure 4-4. It is a single flow peak event, the flow peak is 91.6 $m^3/s$ and the return period is 2.3 years (43% AEP).

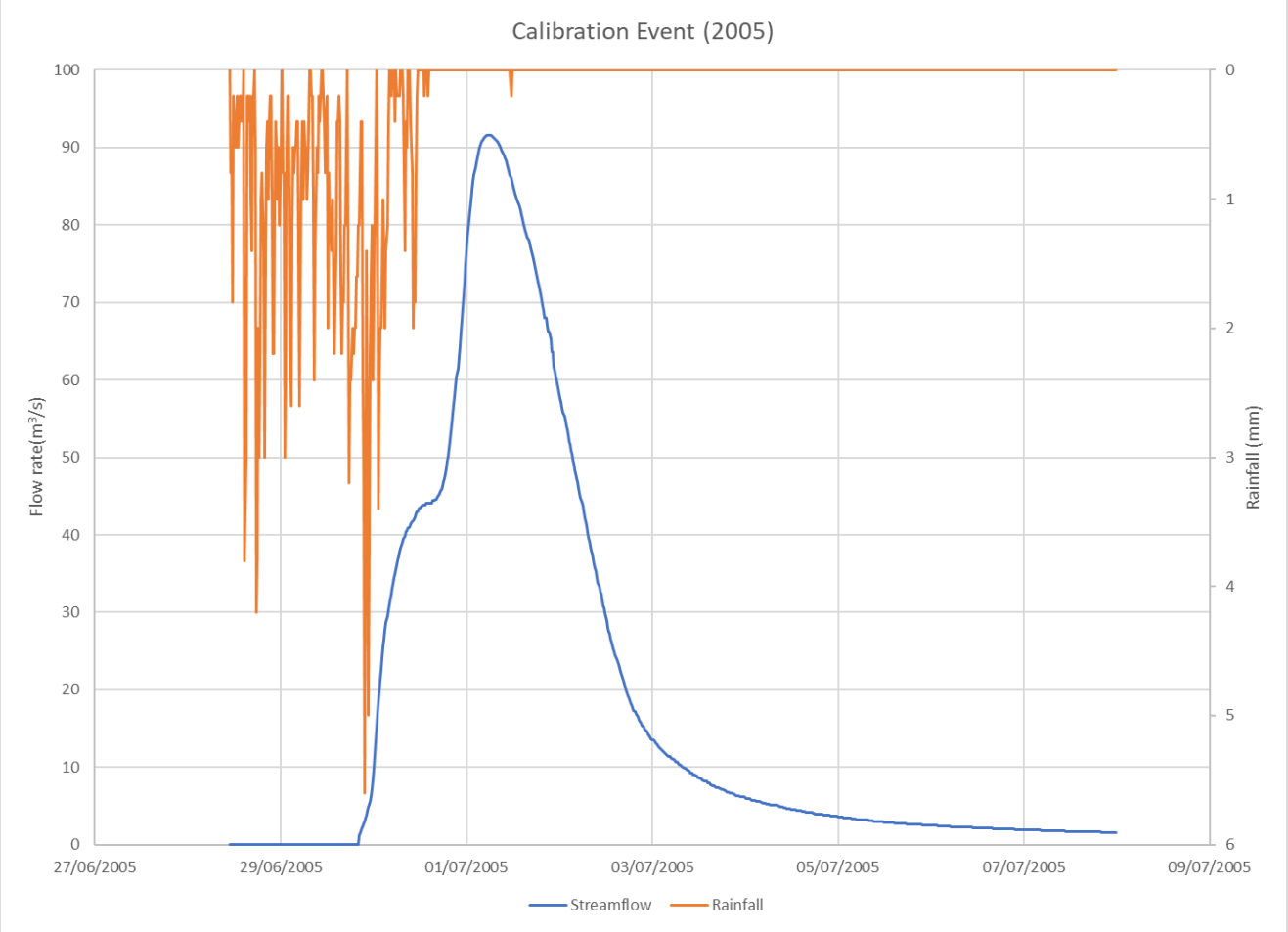


*Figure 4-4: Selected calibration event*

## 4.6.2 RORB calibration summary

The summary results from the calibration of the RORB models are presented in Table 4-2 whilst details of the adopted hydrology approach for this project are presented later in this section.

*Table 4-2: RORB summary results*

| Parameter | Value |
|---|---|
| Station | 203030 Myrtle Creek at Rappville |
| Non-linearity Parameter (m) | 0.8 |
| Lag Parameter (Kc) | 90 |
| Initial Loss | 42 mm |
| Continuing Loss | 4.45 mm/hour |

# 4.7 RORB Model for Design Event

## 4.7.1 Design Rainfall

Rainfall depths for design flood events are most commonly determined by the estimation of intensity-frequency-duration (IFD) design rainfall relationships for the catchment. The BoM has standard procedures for the derivation of these relationships using the ARR 2016 IFD analysis (BOM, 2023).

Design rainfall depths for a range of design flood magnitudes AEP and storm durations are shown in Table 4-3 for the entire Myrtle Creek, Two Mile Creek and Physics Creek catchment respectively.

*Table 4-3: Design Rainfall Depths (mm) for Various Event Durations and AEPs – Myrtle Creek*

| Duration (min) | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.1% AEP | 0.05% AEP |
|---|---|---|---|---|---|---|---|
| 60 | 60.4 | 70.7 | 78.6 | 86.8 | 99.2 | 109 | 119 |
| 90 | 67.6 | 79.3 | 88.3 | 97.6 | 111 | 122 | 133 |
| 120 | 73.3 | 86.1 | 96.1 | 106 | 121 | 133 | 145 |
| 180 | 82.9 | 97.8 | 110 | 121 | 138 | 152 | 165 |
| 270 | 95.1 | 113 | 127 | 140 | 160 | 176 | 192 |
| 360 | 106 | 126 | 143 | 157 | 180 | 197 | 215 |
| 540 | 125 | 150 | 170 | 188 | 215 | 236 | 257 |
| 720 | 142 | 171 | 195 | 214 | 245 | 269 | 294 |
| 1080 | 172 | 207 | 236 | 260 | 297 | 326 | 357 |
| 1440 | 197 | 237 | 270 | 298 | 340 | 373 | 408 |
| 1800 | 217 | 262 | 298 | 332 | 380 | 418 | 457 |
| 2160 | 235 | 284 | 321 | 359 | 411 | 452 | 494 |
| 2880 | 264 | 317 | 359 | 401 | 458 | 502 | 548 |
| 4320 | 303 | 361 | 406 | 451 | 512 | 558 | 606 |

## 4.7.2 Temporal Patterns

The suite of 10 temporal patterns appropriate to the study location (i.e. East Coast South temporal patterns) was downloaded from ARR 2019 Data Hub and applied to the RORB model.

## 4.7.3 Climate Change Effects

Two climate change effects are relevant to flooding- sea level rise and increased rainfall. Sea level rise has been excluded from the assessment due to the location and elevation of the Study Area. A rainfall multiplier has been applied for the 1% AEP storms to replicate increases in rainfall intensity. The ARR Datahub provides interim climate change factors up to the year 2090 and nominates an 18.1% increase in rainfall assuming a Representative Concentration Pathway (RCP) of 8.5 for the year 2090. The RCP is a projection of the carbon dioxide emissions, with 8.5 corresponding to the worst-case of the three RCPs provided.

### 4.7.4 Probable Maximum Precipitation (PMP) Calculation

As the catchment size is less than 1000 km$^2$ and the catchment is north of 30°S, Generalised Short-Duration Method (GSDM) is selected to calculate the PMP. The Estimated PMP depth and Design Temporal Distribution are shown in Table 4-4 and Table 4-5.

*Table 4-4: Estimated PMP depth*

| Duration (hours) | Rounded PMP Estimate (mm) |
|---|---|
| 0.25 | 100 |
| 0.5 | 140 |
| 0.75 | 180 |
| 1 | 220 |
| 1.5 | 270 |
| 2 | 310 |
| 2.5 | 340 |
| 3 | 370 |
| 4 | 420 |
| 5 | 450 |
| 6 | 480 |

*Table 4-5: PMP Design Temporal Distribution*

| Time% | Depth % | Time% | Depth % |
|---|---|---|---|
| 0 | 0 | 55 | 70 |
| 5 | 4 | 60 | 75 |
| 10 | 10 | 65 | 80 |
| 15 | 18 | 70 | 85 |
| 20 | 25 | 75 | 89 |
| 25 | 32 | 80 | 92 |
| 30 | 39 | 85 | 95 |
| 35 | 46 | 90 | 97 |
| 40 | 52 | 95 | 99 |
| 45 | 59 | 100 | 100 |
| 50 | 64 | | |

### 4.7.5 Analysis of RORB Hydrographs

- ARR2019 provides ten probability rainfall temporal patterns (East Coast South) for each standard storm duration and AEP.
- PMP depth and Temporal Distribution applied in the RORB model.
- The hydrographs resulting for PMP are from 0.5 hours to 6 hours and 9 hours to 72 hours for the remaining events.
- For Probable Maximum Flood (PMF), the maximum flow peak hydrograph of the 11 durations has been selected to represent the PMF hydrograph.
- For all the design events other than PMF the median flow rate of the 10 temporal patterns has been chosen to represent each duration and the max flow rate of each duration has been used to determine the critical duration of the design AEP.
- As there are cross-catchment flows from the Myrtle Creek and Two Mile Creek catchment, the critical duration for all three catchments are selected to run the Hydraulic model.

## 4.8 Hydraulic Model

Hydraulic modelling of the Project Area was carried out using the TUFLOW software package build 2023-03-AC. The model was simulated using the HPC (highly parallelised compute) solution scheme to improve model simulation time. Sub Grid Sampling (SGS) capabilities were employed to better represent the underlying creek profile and improve the accuracy of simulated results while utilising a coarse computational grid size. The following sections detail the development of the model.

### 4.8.1 Model Set-up

The model was developed based on the following data, approach and assumptions:

- A 5 m cell size was adopted for the modelling.
- An adaptive time-stepping mode was used in all model runs with an initial time step of 2 seconds.
- Roughness coefficients as noted in Section 4.8.2 were applied across the model domain.
- A wet-dry depth of 0.2 mm was applied uniformly for all model runs.
- The outflow boundaries of the model are normal depth based on the model topography and representative water surface slope.
- The adopted TUFLOW model layout is shown in Figure 4-5

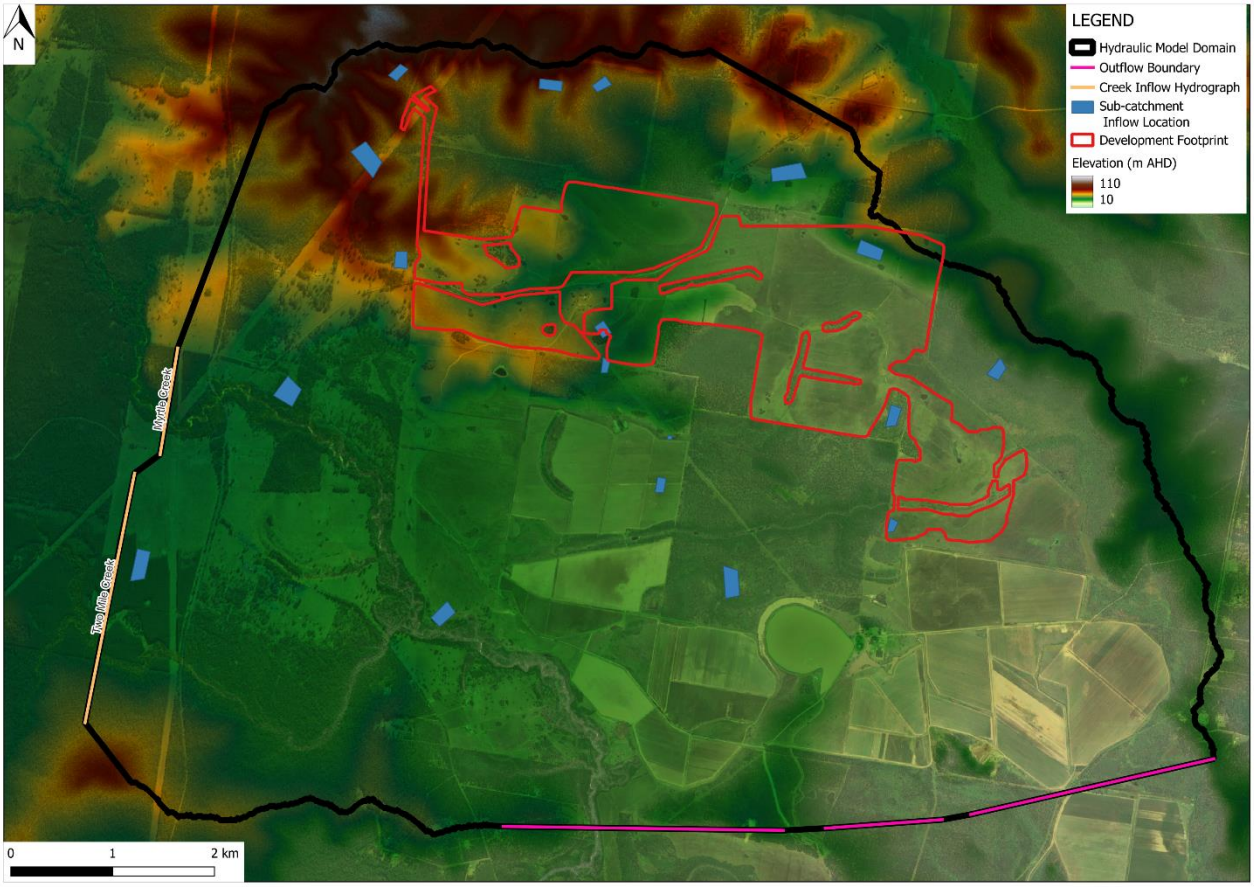


*Figure 4-5: TUFLOW Model Layout*

## 4.8.2 Hydraulic Roughness

The development of the TUFLOW model requires the assignment of different hydraulic roughness zones (defined by Manning's 'n' parameter) for modelling the variation in flow resistance based on land use, surface coverage type and presence of vegetation. The adopted Manning's 'n' parameters are provided in **Table 4-6** and shown in Figure 4-6**.**

*Table 4-6: Adopted Manning's 'n' Values*

| Land Use Description | Adopted Manning's 'n' Value |
|---|---|
| Pasture / cultivated field | 0.06 |
| Medium density vegetation | 0.08 |
| Dense vegetation | 0.10 |
| Very dense vegetation | 0.12 |

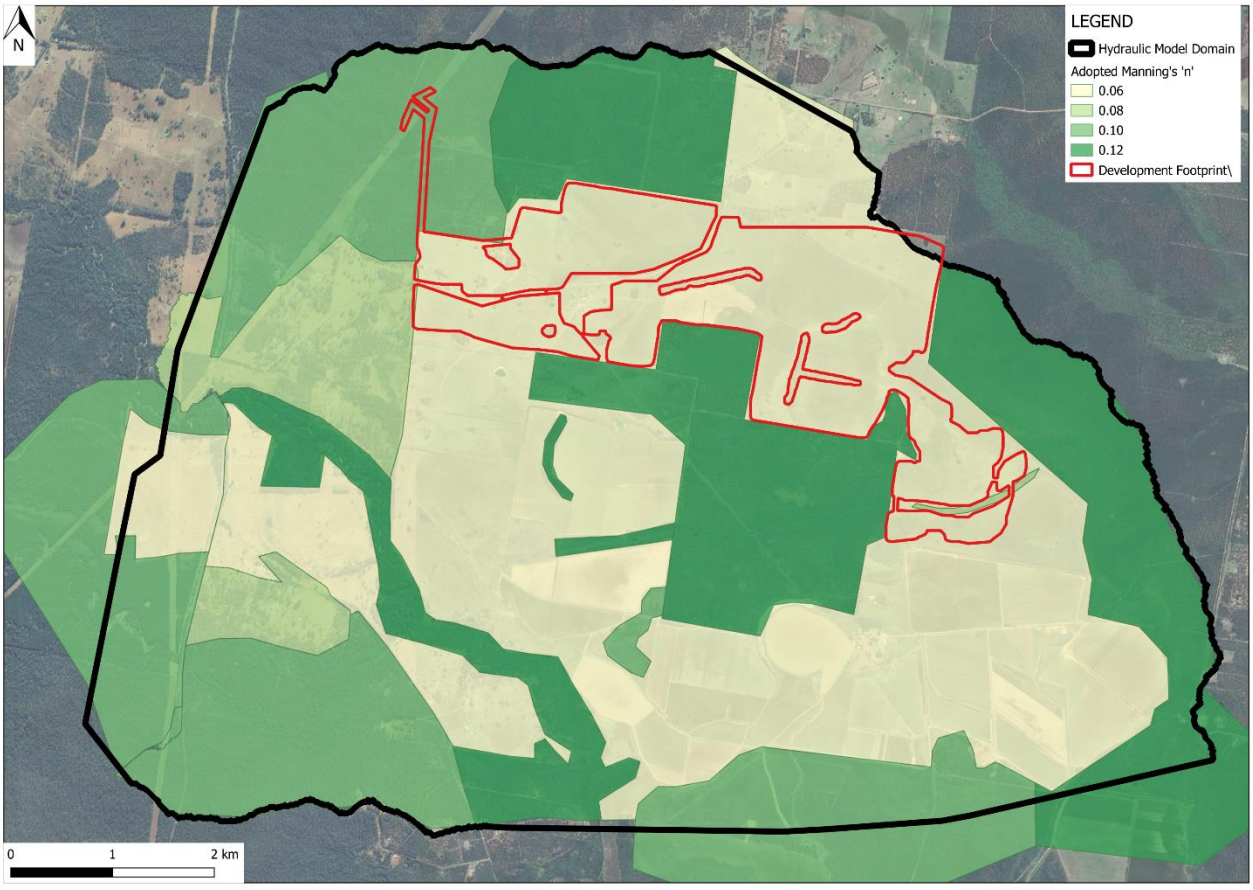


*Figure 4-6: Roughness Map*

## 4.8.3 Structures

There are existing bridges at the Myrtle Creek and Two Mile Creek crossings at Summerland Way. LIDAR data provides for clear spans between abutments and no hydraulic loss parameters were applied to these structures. It is noted that the principal inclusion of the structures in the model is to provide flow continuity across road embankment structures, rather than a detailed analysis of structure performance.

There are no other major hydraulic structures within the model domain that are expected to have any significant influence on design flood behaviour within the broader Study Area. A review of aerial imagery indicates there are some minor cross-drainage structures on some road crossings, e.g. on Avenue Road. These appear to be limited to minor culvert structures and would be anticipated to have a design flood immunity significantly lower than the 1% AEP design flood condition, and for design purposes would typically have a 100% blockage factor applied. Accordingly, no structure details are incorporated into the model configuration, assuming 100% blockage and provision for overtopping the existing road profiles.

## 4.9 Modelled Events

A range of storm duration and temporal patterns were simulated in the RORB model to identify the rainfall profiles providing for the peak flow conditions within the Study Area. The critical storm durations for the Myrtle Creek, Two Mile Creek and Physics Creek catchment and all the 10 temporal pattern flow hydrographs have been modelled for the design 5% AEP, 2% AEP, 1% AEP, 1% AEP with climate change, 0.5% AEP and 0.2% AEP events and 6 hours duration flow hydrograph has been applied to the PMF event. Table 4-7 shows the events, durations and temporal patterns that have been modelled in the TUFLOW model.

*Table 4-7: Design Flow Estimates*

| Events | Durations | Temporal patterns |
|---|---|---|
| 5% AEP | 24 hours | Full ensemble for each duration |
| 2% AEP | 24 hours and 48 hours | |
| 1% AEP | | |
| 1% AEP Plus Climate Change | | |
| 0.2% AEP | | |
| 0.5% AEP | | |
| PMF | 6 hours | 1 temporal patterns |

# 5 Results - Flood Study

## 5.1 Flood Mapping Methodology

Flood envelopes to select the peak values of flood depth, flood level, velocity, and flood hazard were generated. This process involves the following steps:

- For each duration, the maximum grids from the 10 rainfall patterns were compared and the median value at each cell was selected. This produces a median value grid for each duration.
- The median grids were then compared and the maximum value at each cell was selected. This produces the maximum value grid for each frequency.
- This process is repeated for each frequency for flood depths, flood levels, velocity, and flood hazard.
- Results from the cutdown model were combined with the results from the wider model to produce flood maps.

Flood maps are attached in Appendix A.

## 5.2 Flood Hazard

The Australian Disaster Resilience Handbook Collection deals with floods in Handbook 7 (Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia). The supporting guideline 7-3 contains information relating to the categorisation of flood hazards. A summary of this categorisation is provided in Figure 5-1.

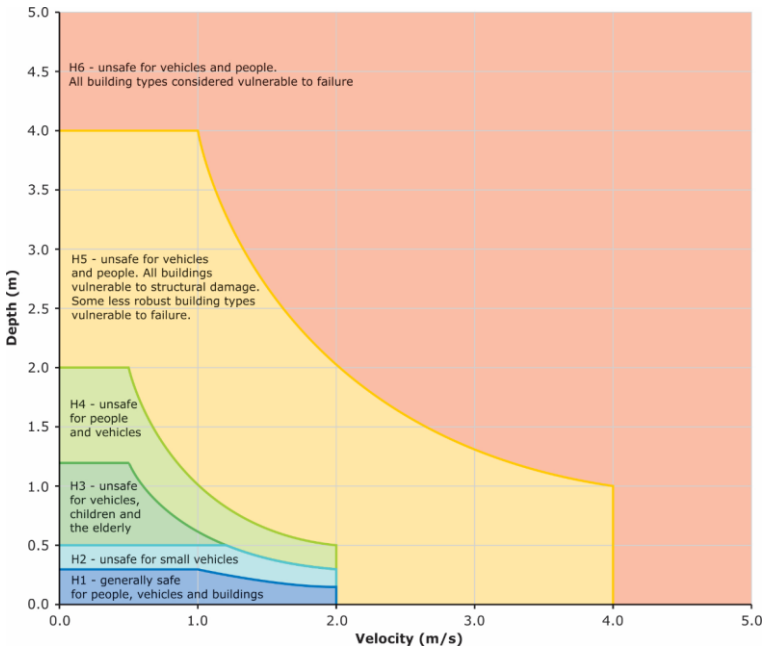


*Figure 5-1: Flood Hazard Categorisation (ADR Handbook 7)*

As outlined in Handbook 7 “The combined flood hazard curves set hazard thresholds that relate to the vulnerability of the community when interacting with floodwaters.’ This classification provides a more detailed distinction and practical application of hazard categories, identifying the following 6 classes of hazards during flood events:

- H1 – No constraints, generally safe for vehicles, people and buildings;
- H2 – Unsafe for small vehicles;
- H3 – Unsafe for all vehicles, children and the elderly;

- H4 – Unsafe for all people and all vehicles;
- H5 – Unsafe for all people and all vehicles. All building types are vulnerable to structural damage. Some less robust building types are vulnerable to failure. Buildings require special engineering design and construction; and
- H6 – Unsafe for all people and all vehicles. All building types are considered vulnerable to failure.

## 5.3 Flood Behaviour

### 5.3.1 Project Area

The Project Area Hazard is mainly hazard class H3 and H4 for PMF event and hazard class H2 and H3 for 1% AEP event. Preliminary Design (8/9/23) located the O&M facility, BESS, Construction Compound and Substation outside the PMF event flood extent as shown in Figure 5-2.

Following further design developed, Preliminary Design Rev 2 (18/12/23) located the O&M facility and staff car park (within the flood extent of all events modelled. The hazard class is H1 for the staff car park in the PMF event and H4 for the O&M facility in the PMF event and H1 in the 1% AEP event.

Avenue Road maximum hazard class is H5 in the PMF event and H2 in the 1% AEP event. The locations marked by white dashed polygons in Figure 5-2 show where Avenue Road crosses or interacts with a defined flood flow path entering the Project Area. The maximum hazard category observed within the Project Area is H5, during the PMF event and H3 during the 1% AEP event. A category H5 hazard is considered unsafe for all vehicles and people.

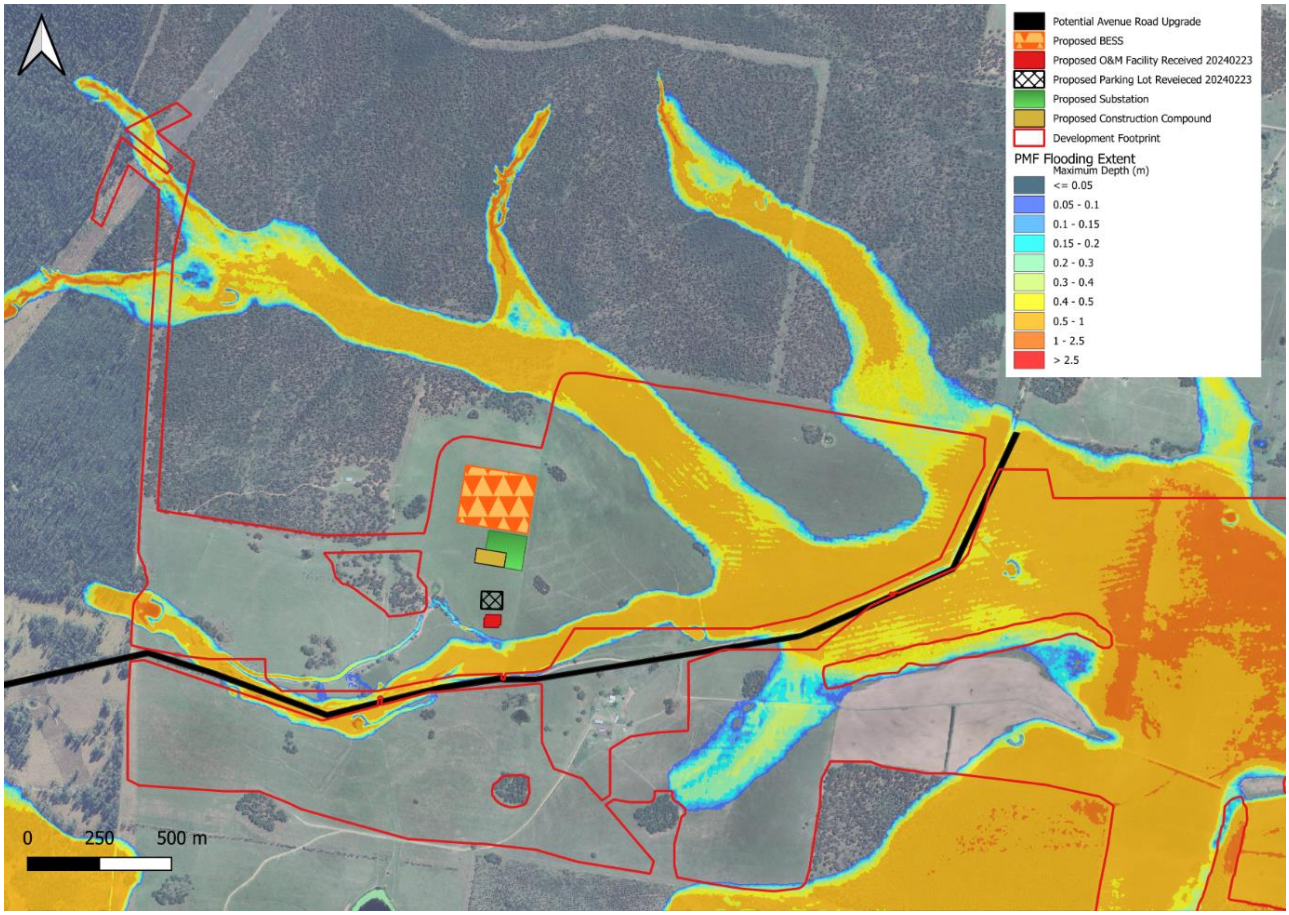


*Figure 5-2: PMF event flood depths*

## 5.4 Flood Risk

The Project Area , as a whole, exhibits a varying flood risk. As detailed in Section 5.3, operations critical infrastructure is mostly located outside of the flood extent, the O&M facility (Preliminary Design Rev 2) location being the only exception. The critical risk characteristics throughout the Project Area is identified in Table 5-1 for the assessed range of flood event probabilities.

*Table 5-1: Maximum flood depth, velocity, and hazard within the Project Area*

| Event | Flood Depth (m) | Velocity (m/s) | Flood Hazard |
|---|---|---|---|
| 5% AEP | 1.4 | 1.0 | H4 |
| 2% AEP | 1.5 | 1.0 | H4 |
| 1% AEP | 1.5 | 1.1 | H4 |
| 1% AEP with Climate Change | 1.6 | 1.1 | H4 |
| 0.2% AEP | 1.6 | 1.1 | H4 |
| 0.5% AEP | 2.1 | 1.1 | H4 |
| PMF | 1.6 | 1.7 | H5 |

# 6 Conclusion – Flood Risk Assessment

A Flood Risk Assessment was undertaken to assess the flood risks of preliminary designs and inform design refinements, avoidance of impacts and mitigation for the Final Design of the Project. The conclusions outlined below were incorporated into the Final Design which has been assessed in Section 7.

It is noted that the proposed BESS, Construction Compound and Substation are outside the PMF event flood extent. The staff car park is within the 5% AEP to PMF event flood extent the flood hazard class is H1 which is safe for vehicles, people and buildings.

The FRA identified that the nominated location of the O&M facility (Preliminary Design Rev 2) was within a H4 flood risk category zone during the PMF event and H1 in the 1% AEP event. The H4 category renders the location unsafe for all people and all vehicles.

It was recommended that design refinements consider relocation of the O&M facility to outside of the estimated flood extents. This would mitigate the risk to plant operators and the O&M building structure itself.

Safe movement within the Project Area during the PMF flood event is restricted between the proposed site operations area, i.e., O&M facility, staff carpark, construction compound, substation and BESS, and the plant managers residence to the southeast. These areas are delineated by the southern minor overland flow path with hydraulic hazard categories ranging from H3 to H4.

Safe movement is not achieved within many of the solar panel's arrays to the east and southeast of the Project Area due to hydraulic hazard categories reaching H3 to H4 in a range of event probabilities.

The proposed Avenue Road extension provides access to the Project Area as well as egress from the Project Area. The proposed alignment follows the southern overland flow path. The road alignment passes through a maximum hydraulic hazard class of H5 during the estimated PMF event. H5 category is

considered unsafe for all vehicles and people. This would make the safe egress from the Project Area impossible during a PMF event.

However, the safe access and or egress from the Project Area is restricted further to the west, along Avenue Road, where is joins Main Camp Road, before entering onto Summerland Way. Flooding from Myrtle Creek generated during the 1% CC, 0.5%, 0.2% AEP and PMF events result in peak flood hazards between H2 and H3, refer Appendix B.

It is noted that realignment of the Avenue Road extension will not facilitate the safe access or egress from the Project Area to Summerland Way due to the hazard at Main Camp Road and Avenue Road to the west, present during a wider range of flood event probabilities.

Consideration of a safe route between the area of operations and onsite residence will provide operators and or visitors the ability to 'hunker in place' during extreme flood events. It is recommended a Flood Response Plan (FRP), otherwise known as a flood action plan, be developed to manage risks to site operations associated with flooding.

In summary, the Flood Risk Assessment has identified the following flood characteristics and risks for consideration to avoid and minimise impacts during design refinement -

- The proposed BESS, Construction Compound and Substation were located outside the PMF event flood extent.
- The staff car park was positioned within the 5% AEP to PMF event flood extent. Exhibits a flood hazard category of H1 - which is safe for vehicles, people and buildings.
- The latest design of the O&M facility flood hazard was H4 in the PMF event and H1 in the 1% AEP event. H4 is unsafe for all people and all vehicles.
- The Avenue Road maximum hazard class was identified as H5 in the PMF event but was affected by hazard categories ranging from H2 to H4 during events 1% AEP CC up to 0.2 % AEP. The existing hazards rendered the sole access/egress route from the Project Area unsafe for all vehicles and people.
- Relocation of the O&M facility was recommended.
- Development of a site operations Flood Response and Action Plan was recommended.

# 7 Stage 2 - Flood Impact Assessment

A Flood Impact Assessment was undertaken to assess risks and impacts associated with the Project using the Final Design (26/02/2024). The final design was informed and revised following advice and recommendations detailed in the Flood Risk Assessment (Section 6).

The recommendations and mitigation measures identified from this assessment should be implemented prior to and during the construction and operation of the Project.

## 7.1 Design Hydraulics

The Development Footprint design layout plan was provided to Arcadis on 21/12/2023. The development plan proposed works to the internal roads, construction of solar array foundations and inverter fill platforms, as well as a number of O&M structures. The following directions were received:

- *Finished levels of internal roads will match the existing ground levels (road grades will not be raised)*
- *Top surface levels of* building *foundations and inverter platform fill will be a minimum of 300 mm above existing ground surface level.*

A Final Design (26/2/24) was provided to Arcadis with the following key design changes and considerations noted:

- *Extent of works on Avenue Road (reduced in length to site access points only)*
- *The O&M facility relocated to the north out of the flood zone in accordance with recommendations from the Flood Risk Assessment*
- *Increase in the APZ buffer along the northern and western sides of the BESS to 100 m - note this will result in some additional veg clearing*
- *Amendments to the position of fencing - in some areas, to align with the Project Area (lot boundary), and/or, alignment with the Development Footprint boundary.*
- *Additional changes to the Project's design based on recommendations from various technical reports - these will…include matters such as the addition of a bus stop at Summerland Way/Main Camp Road, assumptions on worker location and trip generation, Project working hours etc.* (Note: no further changes were specified beyond the above).

The modelled design works can be seen in Figure 7-1, (refer Appendix D - Fig. 1-1).

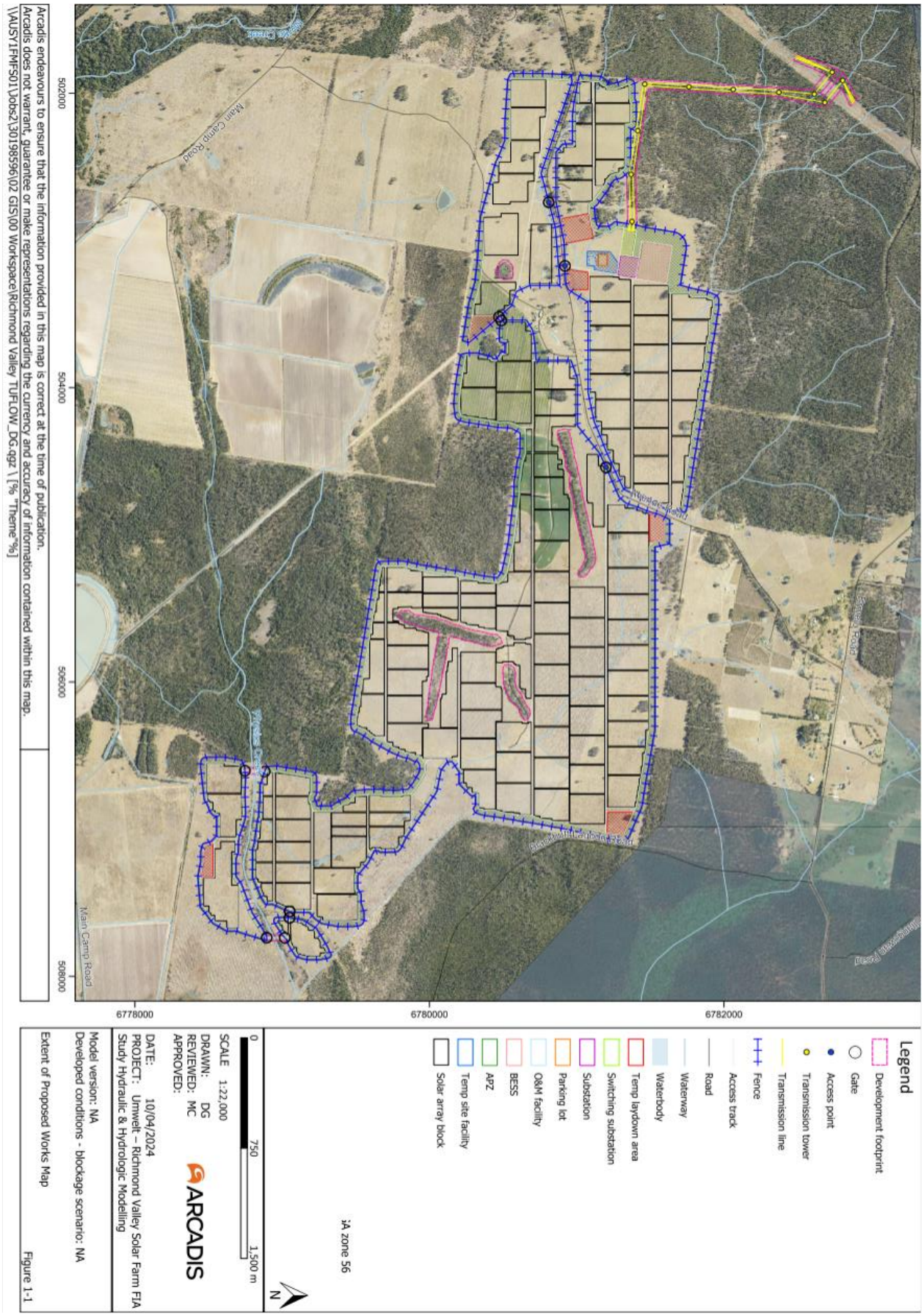


*Figure 7-1: Proposed design works*

A risk assessment of the proposed design relative to the existing flood characteristics indicates that the potential for the greatest impacts comes from the proposed perimeter fencing. The majority of the additional works is outside of the flood extent and or does not change the existing topography within the flood conveyance areas of the Project Area.

## 7.2 Blockage Analysis

### 7.2.1 Methodology

The proposed chain link fencing surrounding the Development Footprint falls within the 1% AEP flow path. As such, a blockage analysis was undertaken to the method outlined in Australian Rainfall and Runoff 2019 (Book 6 Chapter 6). The gaps in the chain links were regarded as culverts when utilising this methodology. This method considers floating, non-floating, and 'urban' debris. Given the highly vegetated condition of the catchment with no major visible signs of erosion, and no significant upstream urban areas, floating debris alone was deemed the likely source of blockage.

For floating debris, the method considers three main mechanisms associated with the transfer of debris from catchment to fence:

- The availability of a particular type of debris able to reach the fence;
- How mobile that debris may be to travel from the source to the concentrated flow feeding the fence;
- How transportable the debris may be once it is within the concentrated flow to arrive at the fence.

Each of these parameters are required to be estimated as one of three categories: Low, Medium, and High. Application of the method parameters is outlined in the following sections.

The debris type is simplified into a length dimension. The analyst is required to estimate this length at the expected top 10% of possible lengths (the 90$^{th}$ percentile).

The fence surrounding the Project Area was classified into three zones based on their upstream catchments:

- Zone 1 – fence inside of existing 1% AEP critical flow path with forested area directly upstream
- Zone 2 – fence inside of existing 1% AEP critical flow path situated downstream of another fence
- Zone 3 – fence outside of existing 1% AEP critical flow path

For Zone 1 and 2, a blockage factor was calculated and applied to a depth of the existing 1% AEP critical flood level for all storm events. For the remaining fence above the existing 1% AEP critical flood level, a blockage factor was calculated for the fence caused by the chain mesh. A chain wire fence with 50x2.5mm mesh, at 2.1m high was assumed in this assessment. The fence blockage factor is detailed in Table 7-1 and applied to all storm events.

*Table 7-1: Fence Blockage*

| Fence Type | Mesh/ Pales Details | Clear Opening (%) | Blockage (%) |
|---|---|---|---|
| Close Space Welded Mesh | Chain wire 50 x 2.50 Mesh | 90.3 | 10 |

For Zone 3, it was assumed that as the fence falls outside of the 1% AEP critical flow path, blockage from the upstream catchments would not reach or affect these areas, thus only the fence blockage itself was considered.

Blockage analysis parameters and calculations are provided in Appendix 1 – Culvert Blockage Table.

#### 7.2.1.1 Selection of L10

The selection of the longest 10% of anticipated floating debris (the L10 values) was guided by the aerial visualisation of the upstream catchments within the debris zones. Trees were identified as a source of two potential L10's: 3.0m for trees in proximity to the proposed fence, and 1.5m for distant trees. The rationale was that a 3.0m L10 that must travel some distance to become debris at the fence would be broken down to a smaller length (1.5m) or get snagged along the way by an upstream fence.

#### 7.2.1.2 Debris Availability

The ARR2019 culvert blockage method considers that the relevant source area for potential blockage debris is typically the 1% AEP flood extent, plus additional areas for steep sided tributaries and larger rills.

#### 7.2.1.3 Debris Mobility

Mobility is the ease with which available debris can be moved into a stream. This will be influenced by the steepness of the terrain. Steep-walled gullies will have higher debris mobility than gently undulating terrain, and debris within clearly defined overland flow-paths will also have higher mobility potential.

GIS plan and perspective views of the terrain data were used to aid decisions on debris mobility for each L10. The debris zones and immediate surrounds were used as a guide to estimate how mobile each debris source may be in arriving at a transportable waterway.

#### 7.2.1.4 Debris Transportability

Transportability is the ease with which mobilised debris is transported towards a culvert once it enters a stream. The main influences on transportability are stream width, flow depth, velocity, and flow magnitude. These data were available from the TUFLOW velocity and velocity-depth output.

ARR2019 provides guidance on depths and velocities for high and low transportability. The velocity guidance was the main source of influence on the choice of transportability ranking. Velocities along waterways of generally 1m/s or less were categorised as Low, this was the case for all Zones.

#### 7.2.1.5 Sensitivity Analysis

The blockage methodology is subjective and dependant on the analyst's debris factor derivation. To reduce some of the subjectivity, a sensitivity test was performed where three combinations of blockage factors were tested in the TUFLOW model. These are provided in Appendix C.

# 8 Results – Flood Impact Assessment

Developed conditions flood modelling was conducted for representative temporal patterns for the events and event durations identified in Table 4-7. The envelop (maximum) of all durations was created for each of the flood characteristics, e.g., depth, level, velocity, and depth × velocity.

The flood impact maps, i.e., change in flood level (developed vs existing), for all seven (7) AEPs are shown in Appendix D (Figure 1-2 onwards).

The most severe blockage Scenario (SEN_A) creates localised impacts (afflux) immediately upstream of the chain mesh fence. The severity of the afflux is relative to the rarity of the flood event. For instance, the 1 in 20-year AEP (5% AEP) event shows minor afflux along the upstream side of the chain wire fence line, which does result in a reduction in flood level immediately downstream within several of the tributary channels entering the Project Area (refer to Figure 8-1).

Modelled changes in flood level are within ±100 mm. Impacts extend outside the project boundary, although these are typically contained within the densely vegetated areas, waterway channels and open fields. No roads or building structures are impacted. Flood impacts do not extend beyond Physics Creek.

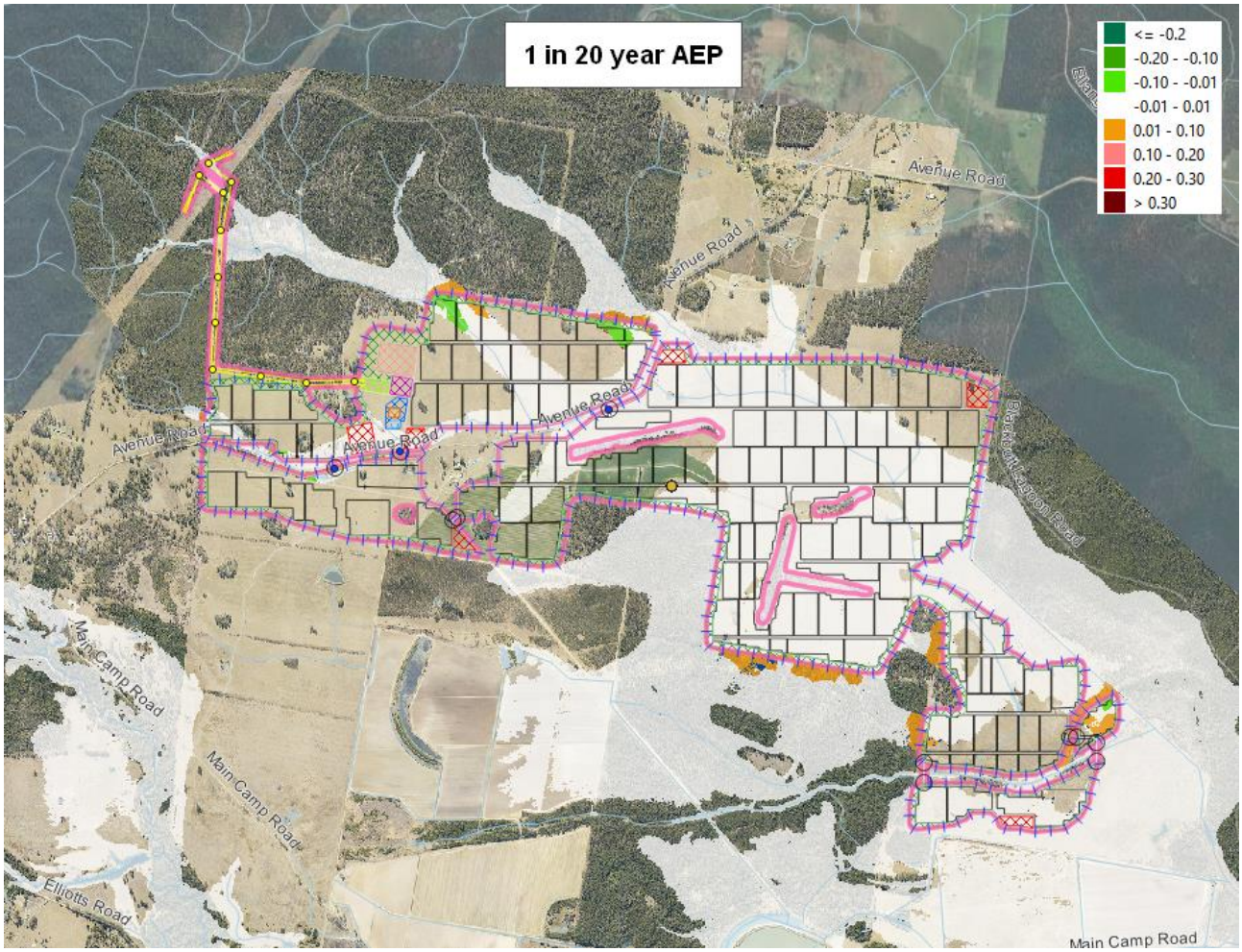


*Figure 8-1: 5% AEP Afflux Mapping*

In rarer events, such as the 0.2% AEP (1 in 500 yr AEP) the impact of chain mesh fence is more evident. The potential blockage of the fence structure results in an increase in extent of afflux as well as the area of effect for the flood level reduction. Although, all variation are remains within ±100 mm. The most notable

increase can be seen at the southeast of the Project Area within the open fields where the simulated blockage restricts the free movement of flood water across the project boundary.

Impacts do not extend beyond Physics Creek, do not adversely impact existing or proposed structures, and generally do not impact Avenue Road. However, there is an observed increase in flood level (< 100 mm) within Avenue Road at the west access point to the Project Area. This is a result of the narrow fence line restricting the conveyance of flows under a high potential blockage scenario.

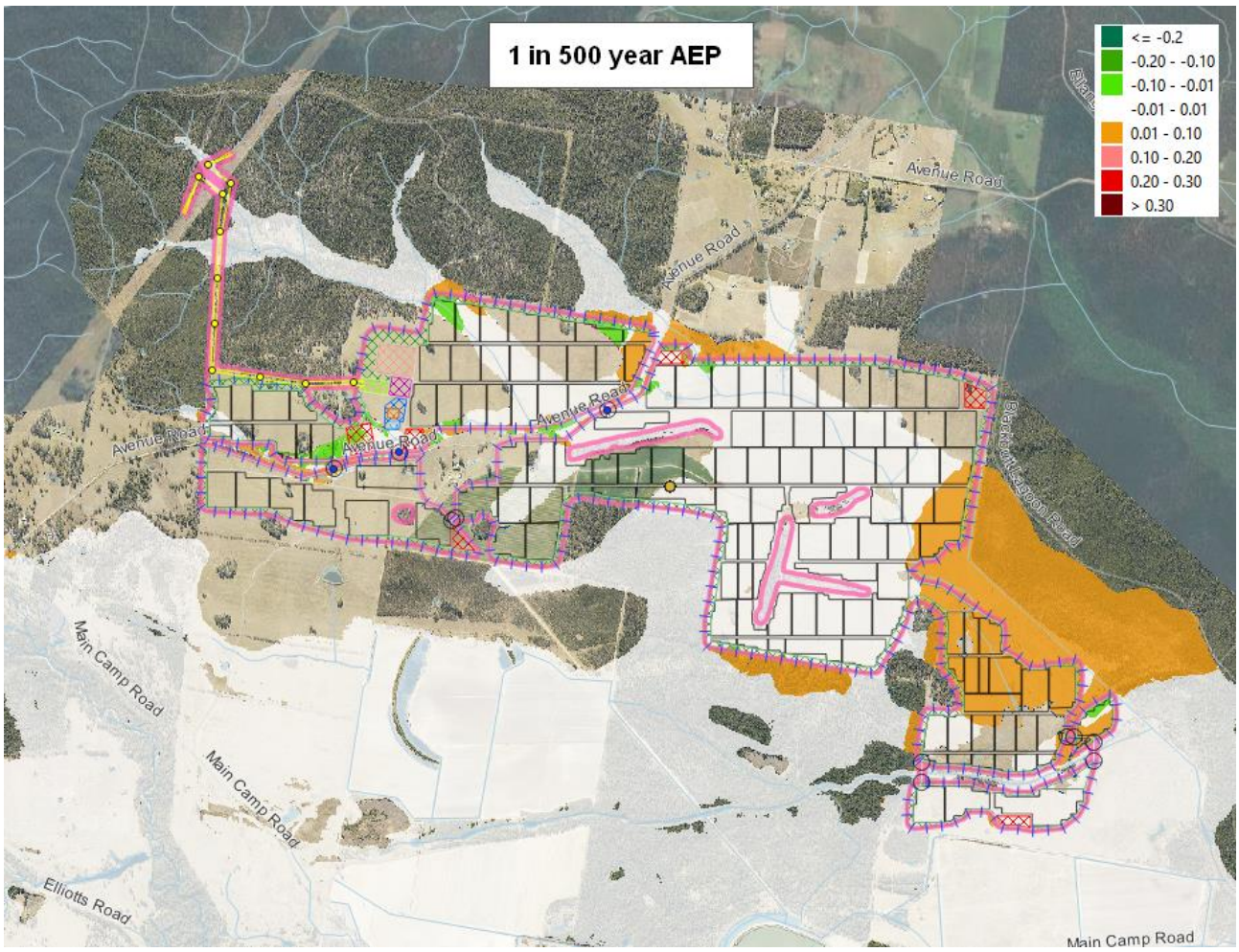


*Figure 8-2: 0.2% AEP Afflux Mapping*

Hydraulic hazard maps for developed conditions are shown in Appendix A. The existing flood hazard profile - classified with respect to flood depth, velocity and the velocity depth product; ranges across the site from Category H1 to H3.

Review of the developed conditions hazard maps (Appendix D) with respect to the existing conditions hazard maps indicates that the proposed works does not adversely change the flood risk and hazard profile, as depicted in the side-by-side map in Figure 8-3 for the 1% AEP under the high blockage scenario (SEN_A). Review of the 0.2% (1 in 500 yr AEP) shows that the hydraulic profile does not adversely increase within the Study Area, even though afflux > 10 mm is experienced outside of the project boundary in the high blockage potential scenario (SEN_A) – refer to Figure 8-4.

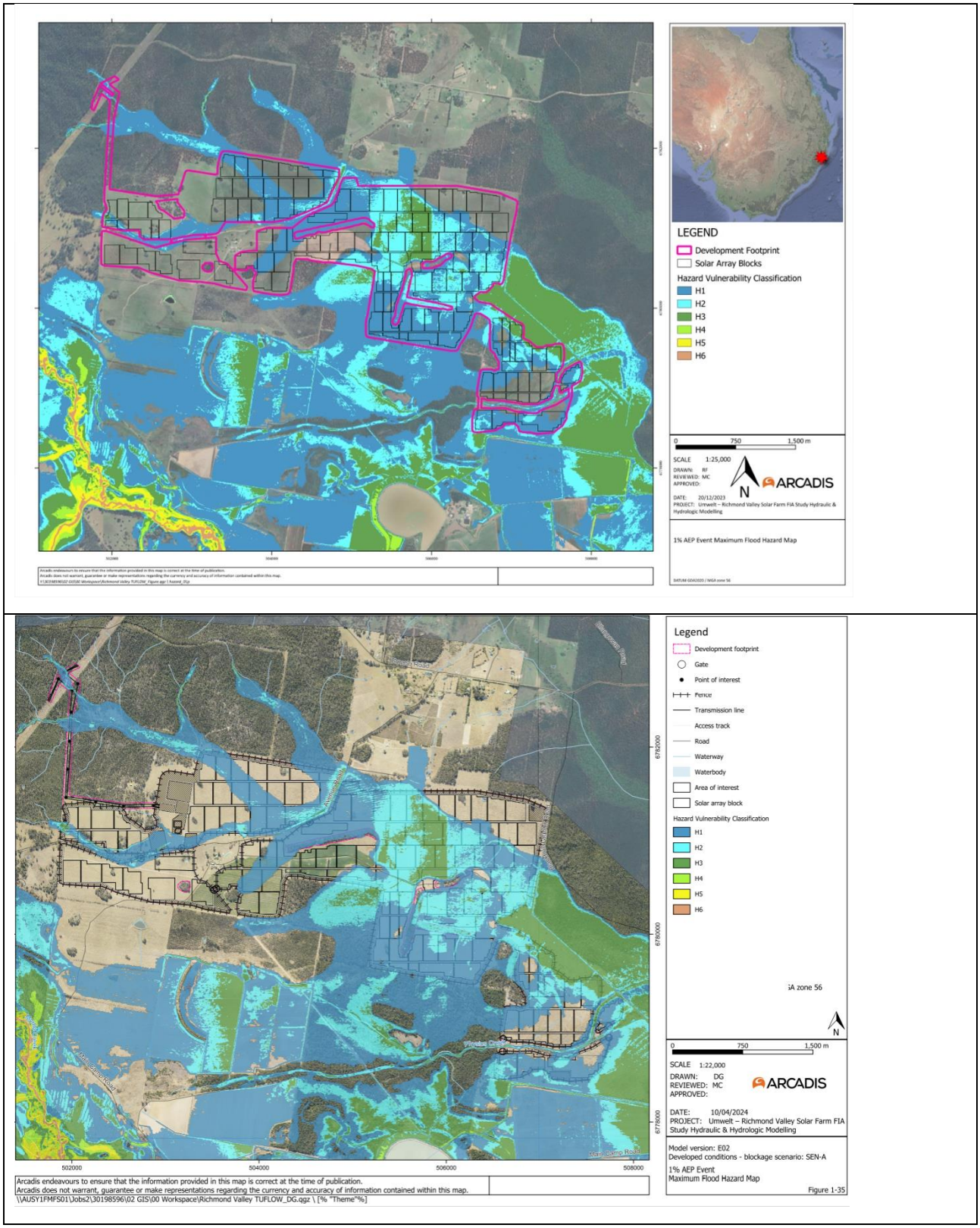


*Figure 8-3: 1% AEP Hydraulic Hazard - existing (top) vs design (bottom)*

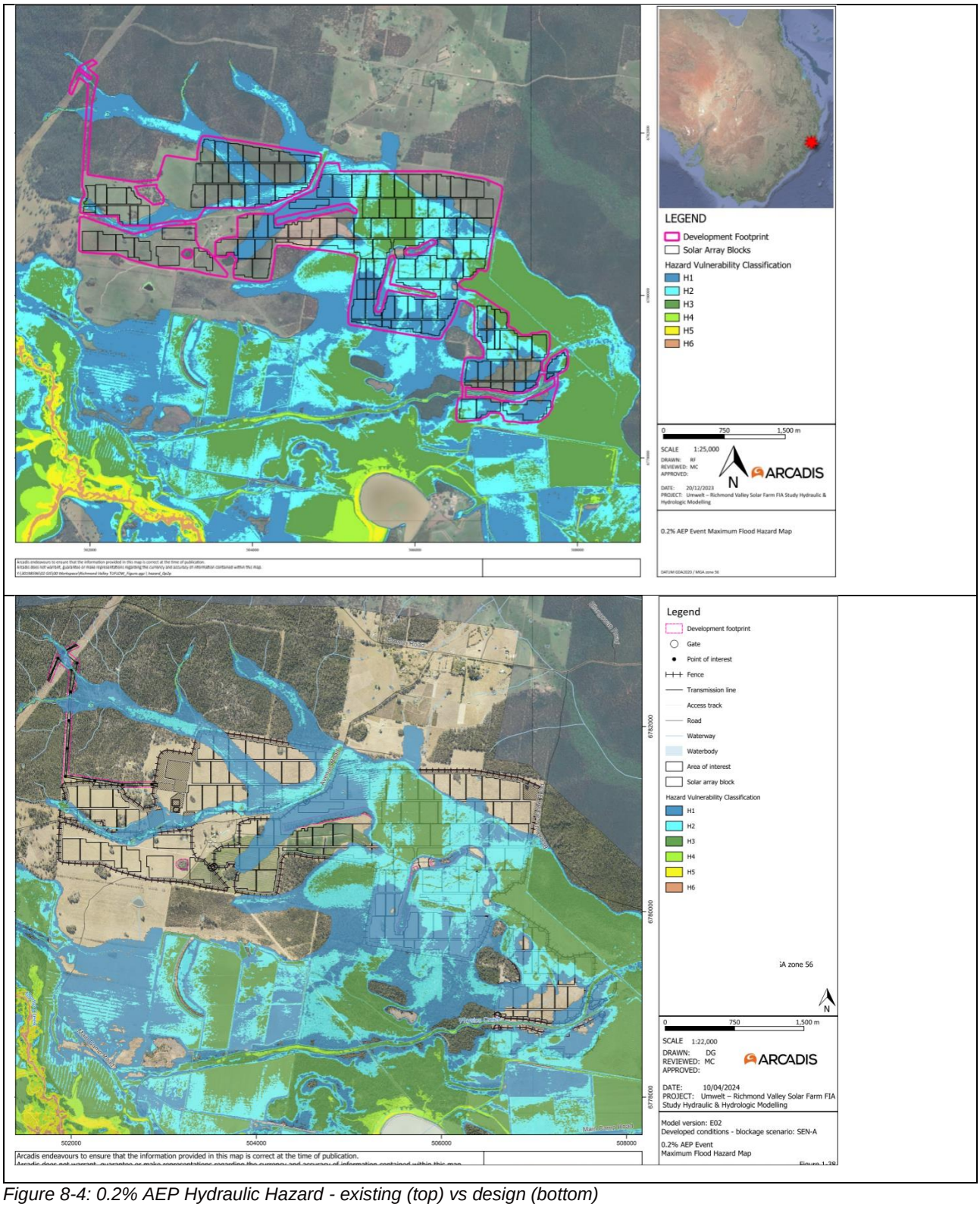


*Figure 8-4: 0.2% AEP Hydraulic Hazard - existing (top) vs design (bottom)*

# 8.1 Avenue Road

Avenue Road is an important evacuation route for the operations staff within the RVSF during a flood event. The road alignment crosses the Physics Creek overland flow path which can present the following risk characteristics during the modelled range of flood events, refer Table 8-1.

*Table 8-1: Physics Creek @ Avenue Road – Hydraulic Hazards*

| Flood Event Probability (%) | Depth (m) | Velocity (m/s) | Hydraulic Hazard Category | Velocity x Depth ($m^2/s$) |
|---|---|---|---|---|
| 5% AEP | 0.292 | 0.716 | H1 | 0.159 |
| 2% AEP | 0.328 | 0.778 | H2 | 0.200 |
| 1% AEP | 0.354 | 0.828 | H2 | 0.236 |
| 1% AEP Plus Climate Change | 0.392 | 0.990 | H2 | 0.299 |
| 0.2% AEP | 0.371 | 0.886 | H2 | 0.261 |
| 0.5% AEP | 0.398 | 1.02 | H2 | 0.317 |
| PMF | 0.748 | 1.836 | H5 | 1.358 |

# 9 Conclusion – Flood Impact Assessment

Impacts of the proposed development are nominal. The proposed site works largely leaves the site morphology unchanged within the areas subject to inundation. The greatest impact to flooding is the inclusion of the chain mesh perimeter fencing and it potential for blockage generated by debris transported within the flood flows.

The blockage potential was calculated, and the most severe scenario shows minor impacts largely contained within waterway channels, forested areas and the open fields of the flood plain.

The impacts do not result in an increase of flood hazard profile and mitigation is unlikely required. Should no afflux be sought – the option of using ‘collapsable’ fencing will be an effective mitigation option.

The regional flood still presents a risk to Avenue Road and site evacuation during the 1% AEP Climate Change, 0.2% AEP and modelled PMF events. These can be mitigated through structural (road regrading) and non-structural (flood response/action plan) measures. It is recommended that this be undertaken prior to plant operations commencing.

# 10 Limitations

As mentioned in Section 3.1, the topographical data doesn’t pick up the bathymetry of the creeks. This will impact the accuracy of the model due to a loss in conveyance capacity within the waterway, resulting in an increased overbank flow. Although it is expected that the impact would be minor.

It is essential to take into account the data's quality and associated potential risks when making decisions based on the findings of this assessment,

Extended bathymetry survey capture could be considered for further assessment of risks.

The issues associated with the LiDAR vertical accuracies can be addressed through obtaining additional topographical data. It is expected that a change (reduction) in the flood depth profile along the data joining alignment within the Project Area will be observed.

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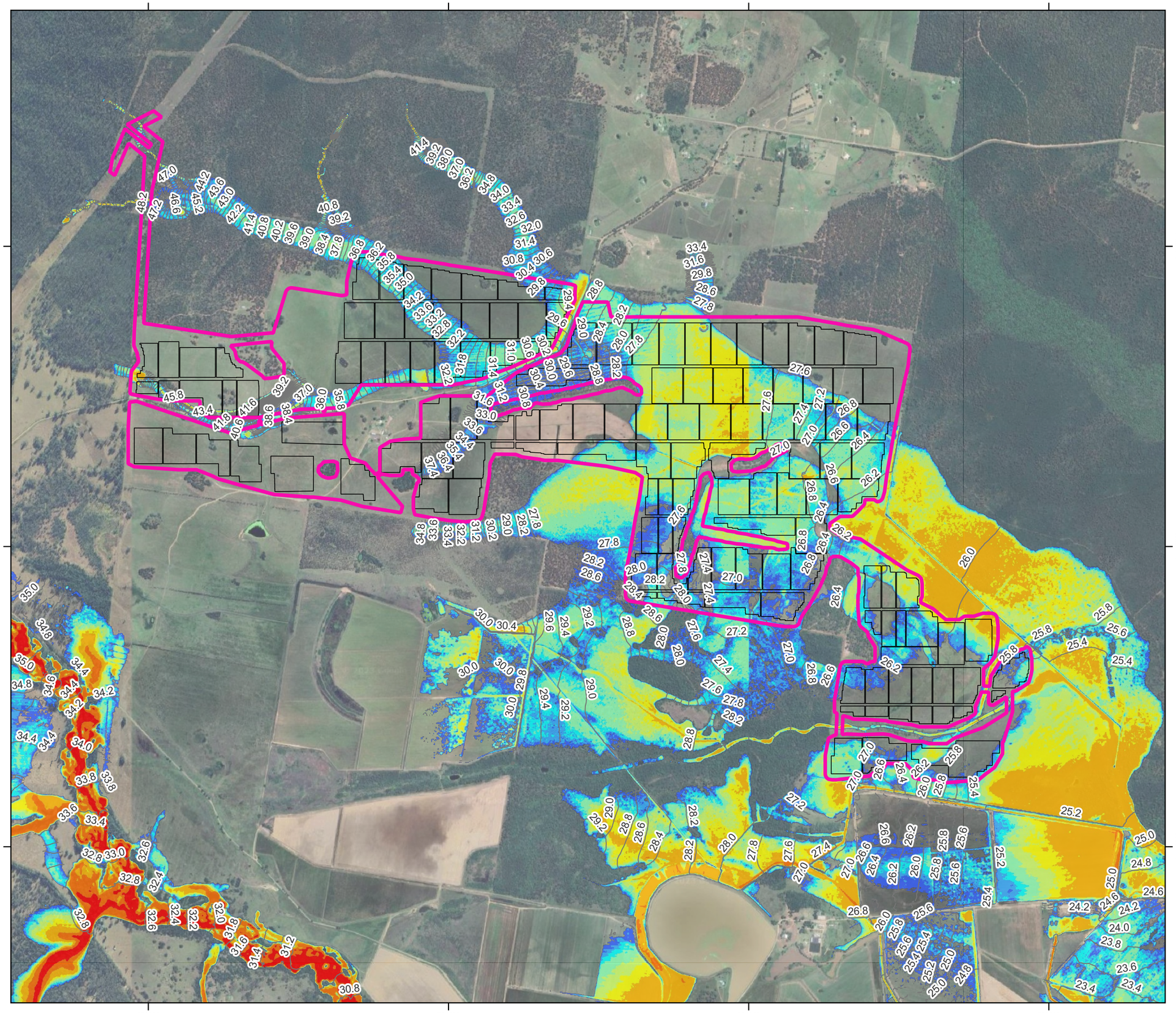
# APPENDIX A

## Flood Maps - Predeveloped




## LEGEND

- Development Footprint
- Solar Array Blocks
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

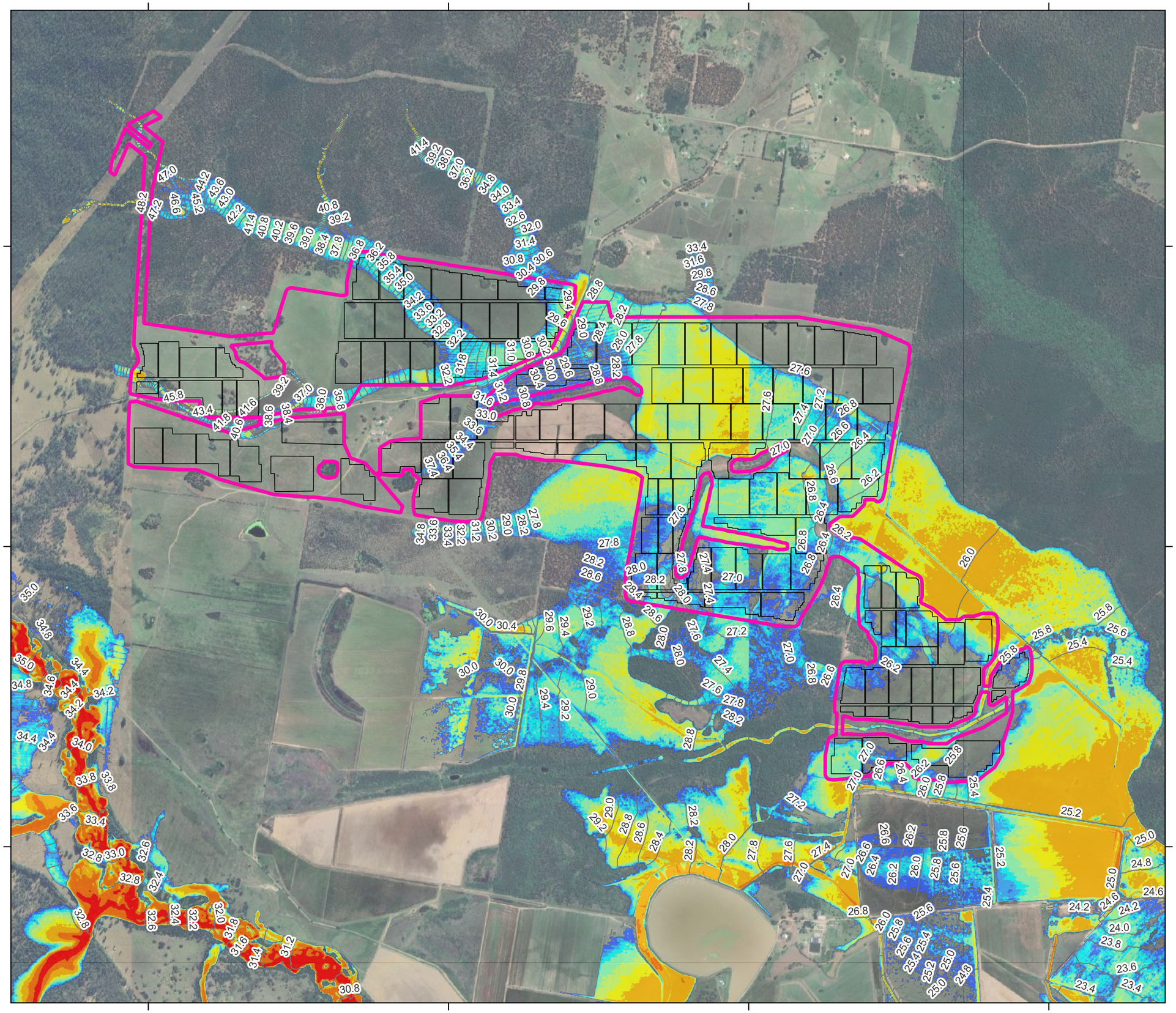
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 5% AEP Event Maximum Flood Extents and Depth Mapping

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ depth_05p*




## LEGEND

- Development Footprint
- Solar Array Blocks
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

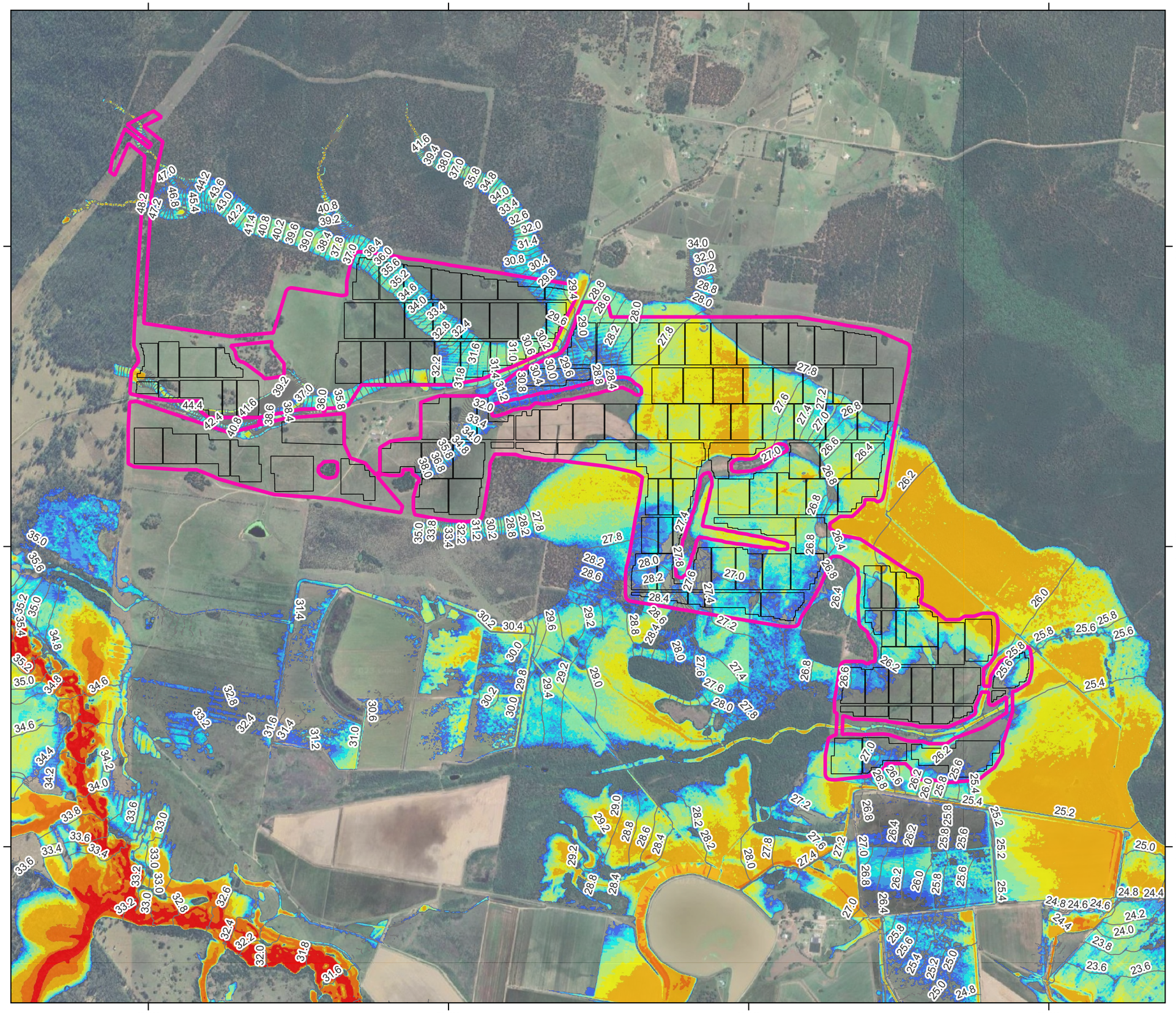
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 5% AEP Event Maximum Flood Extents and Depth Mapping

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ depth_05p*




## LEGEND

- Development Footprint
- Solar Array Blocks
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

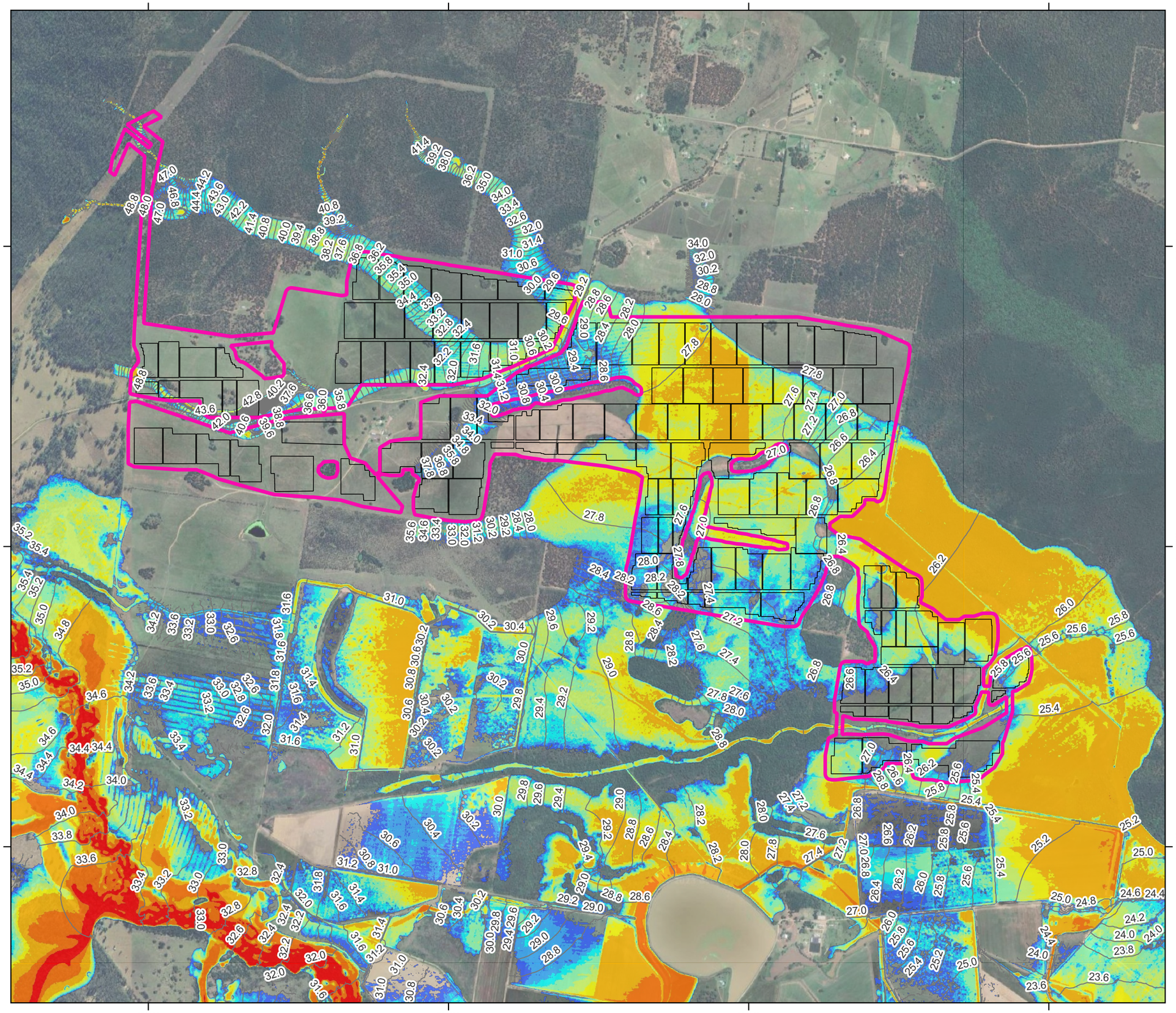
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 2% AEP Event Maximum Flood Extents and Depth Mapping

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ depth_02p*




## LEGEND

- Development Footprint
- Solar Array Blocks
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

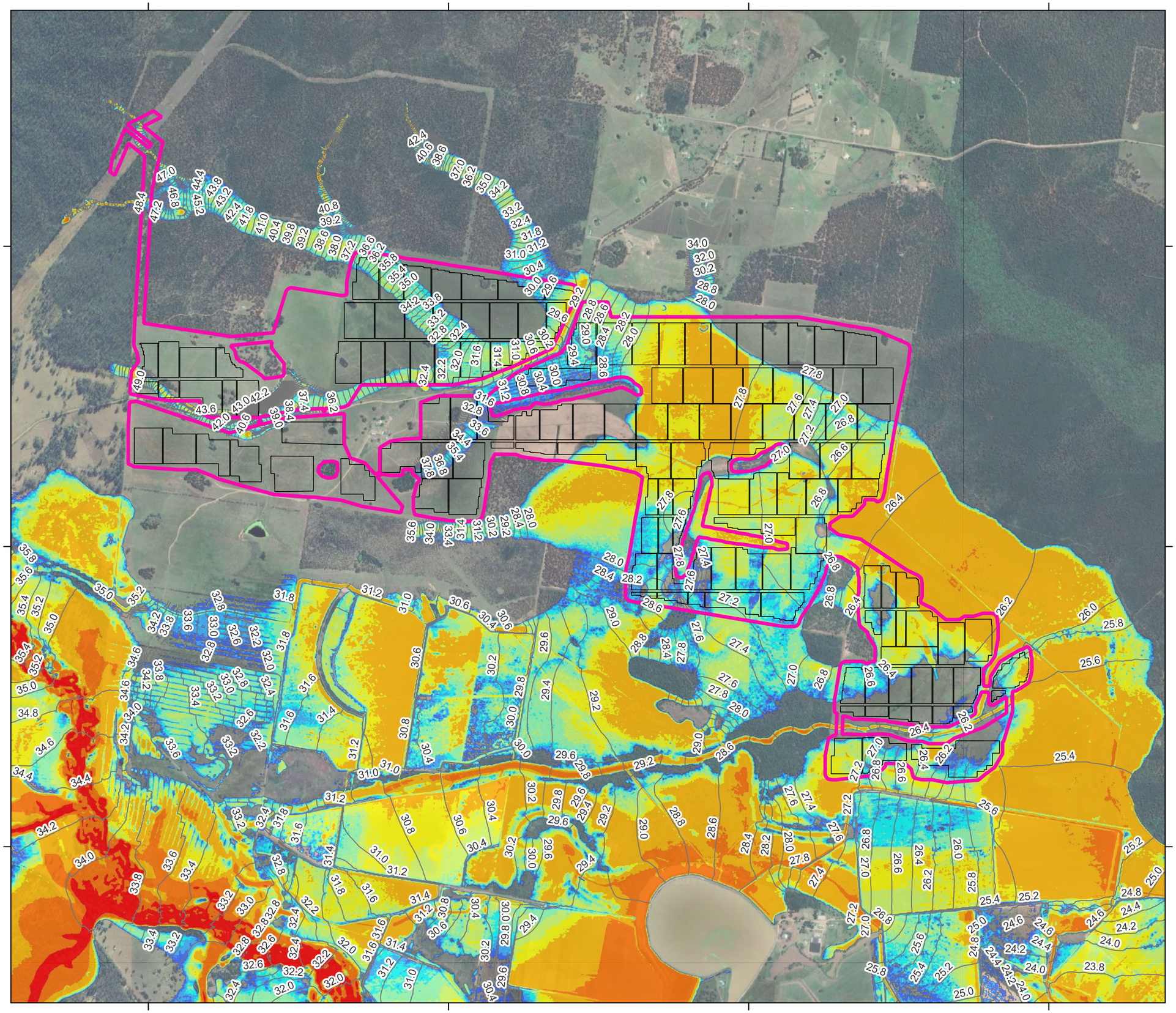
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 1% AEP Event Maximum Flood Extents and Depth Mapping

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ depth_01p*




## LEGEND

- Development Footprint
- Solar Array Blocks
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

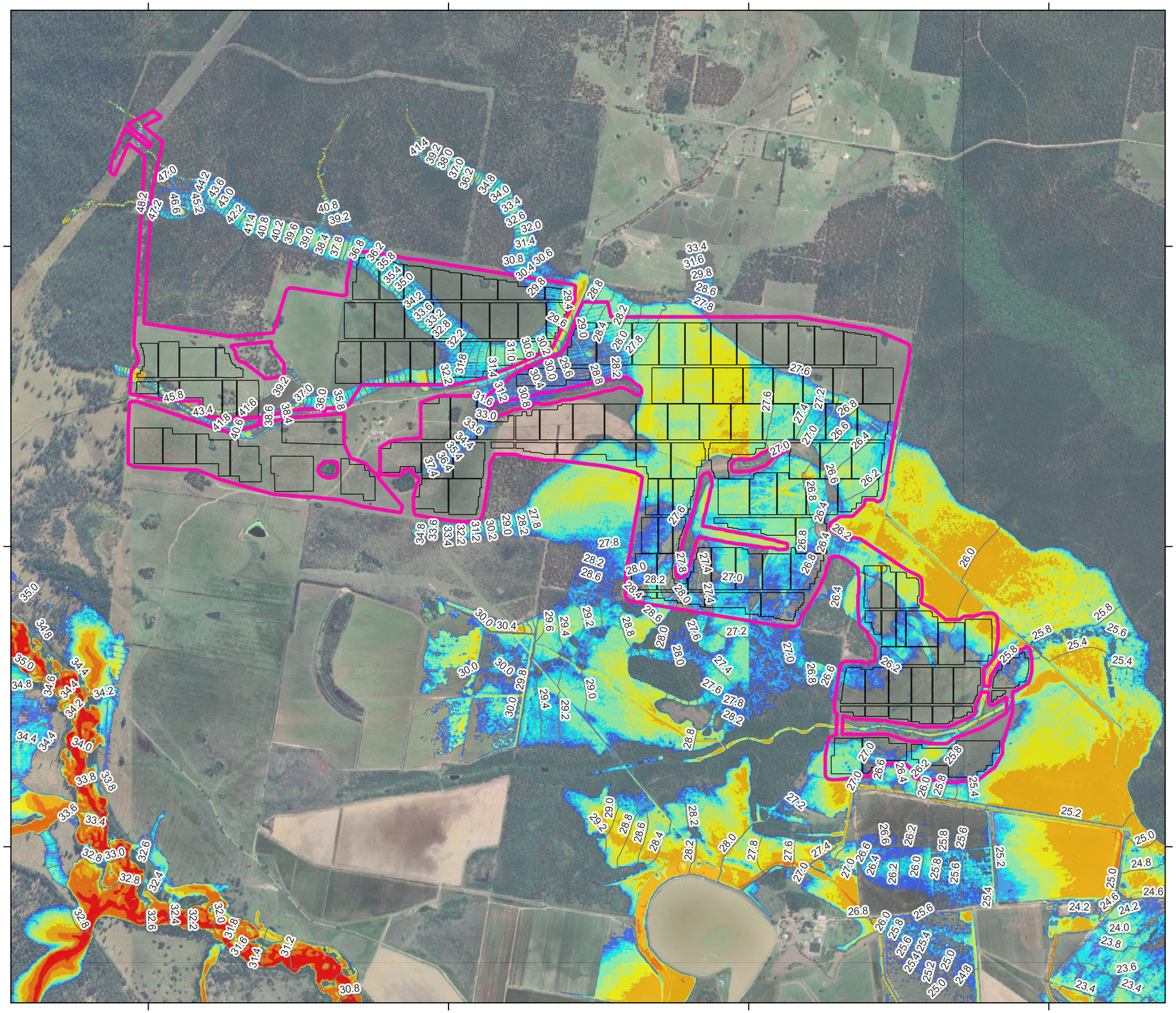
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 1% AEP Climate Change Event Maximum Flood Extents and Depth Mapping

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ depth_01pCC*




## LEGEND

- Development Footprint
- Solar Array Blocks
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

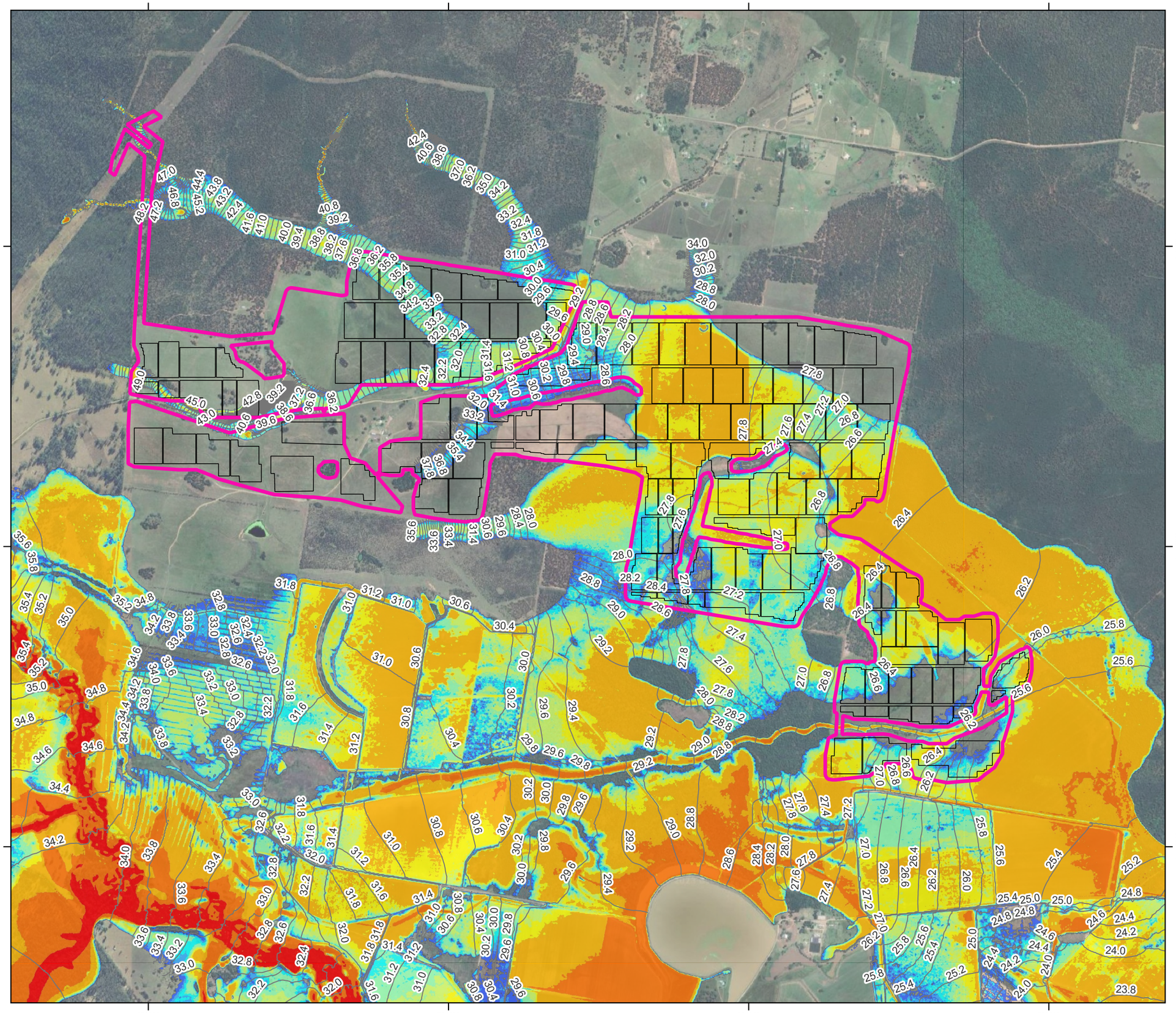
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

0.5% AEP Event Maximum Flood Extents and Depth Mapping

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ depth_0p5p*




## LEGEND

- Development Footprint
- Solar Array Blocks
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

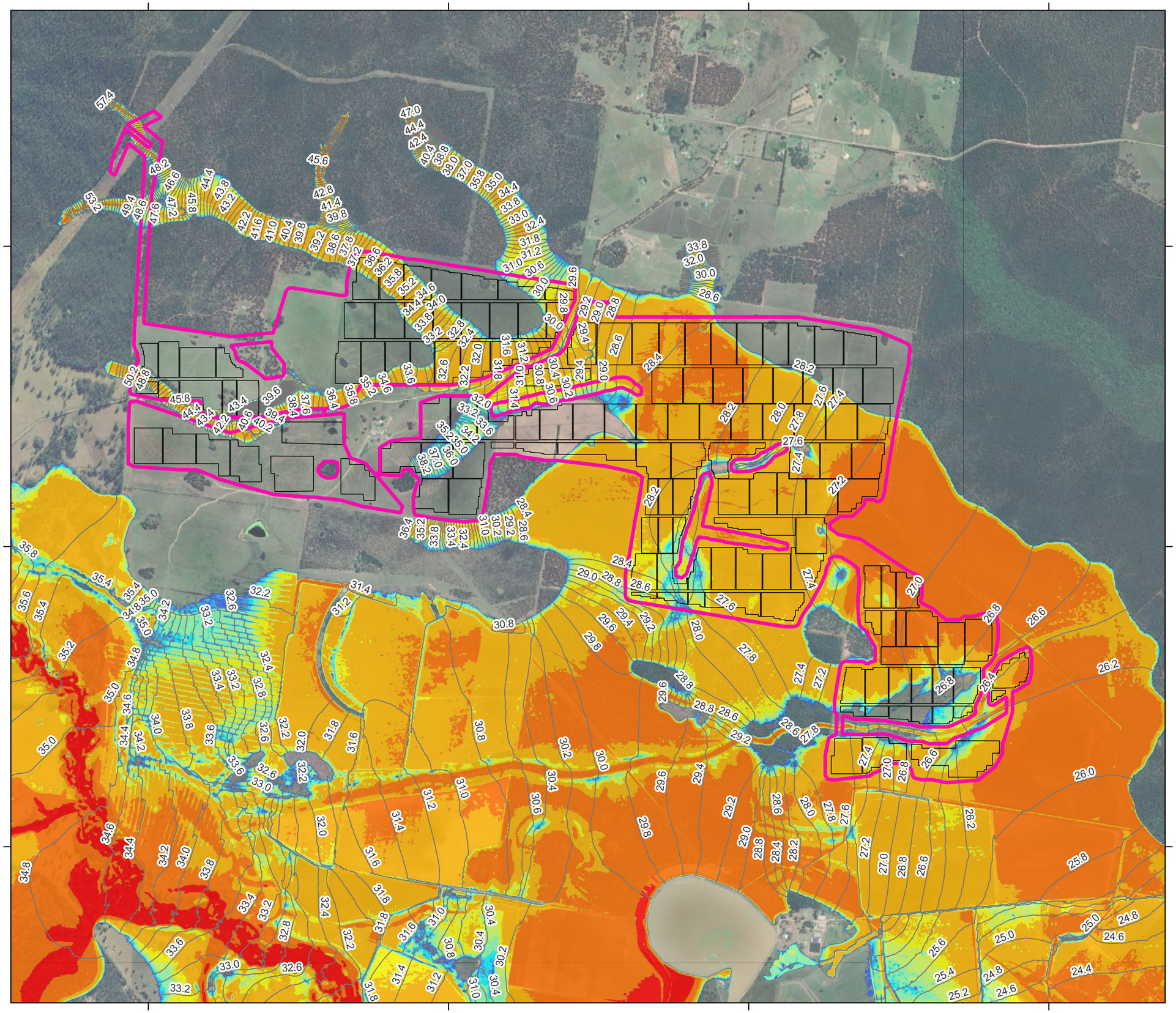
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

0.2% AEP Event Maximum Flood Extents and Depth Mapping

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ depth_0p2p*




## LEGEND

- Development Footprint
- Solar Array Blocks
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

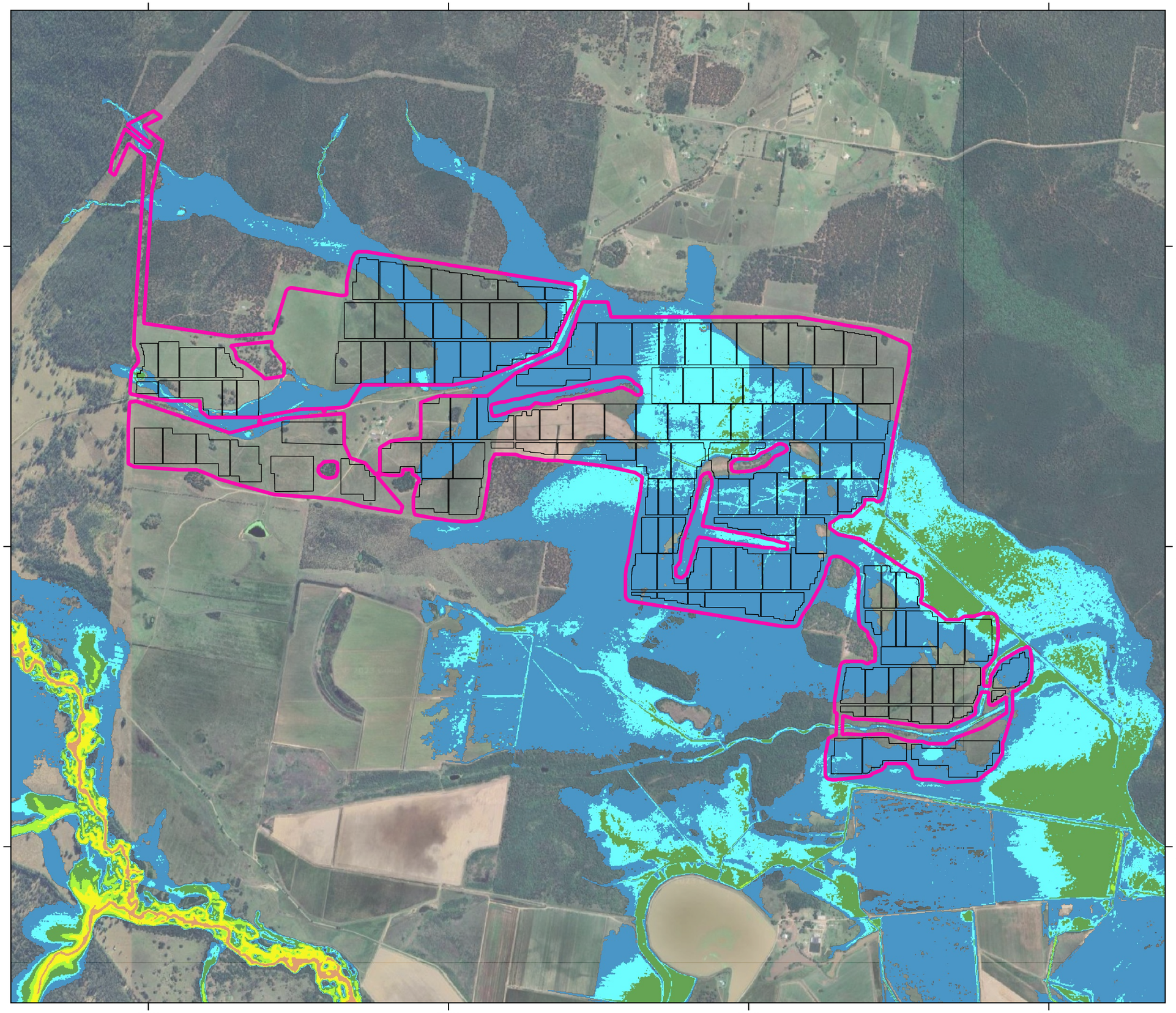
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

PMF Event Maximum Flood Extents and Depth Mapping

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ depth_PMF*




## LEGEND

- Development Footprint
- Solar Array Blocks

Hazard Vulnerability Classification

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

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

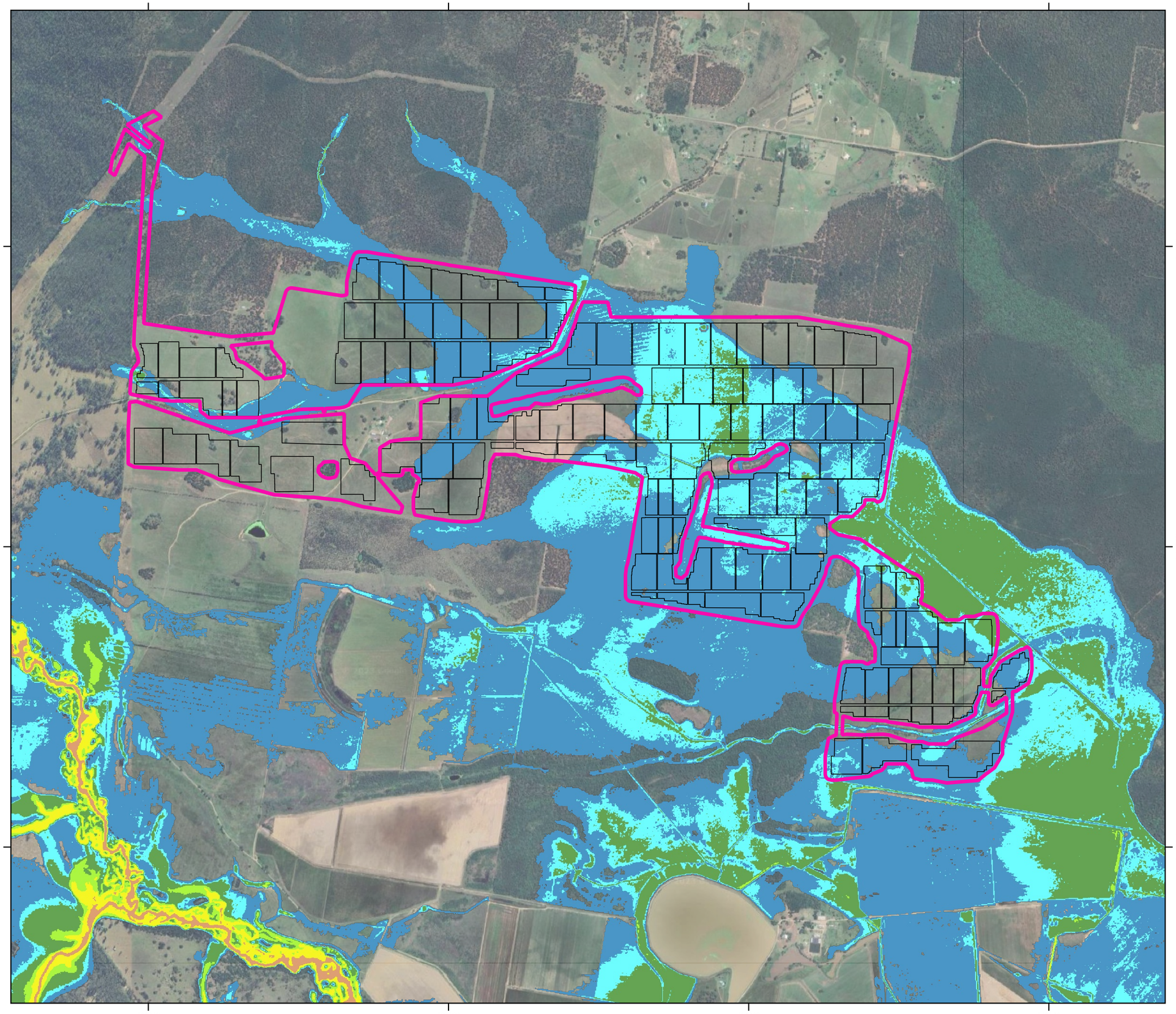
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 5% AEP Event Maximum Flood Hazard Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ hazard_05p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Hazard Vulnerability Classification

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

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

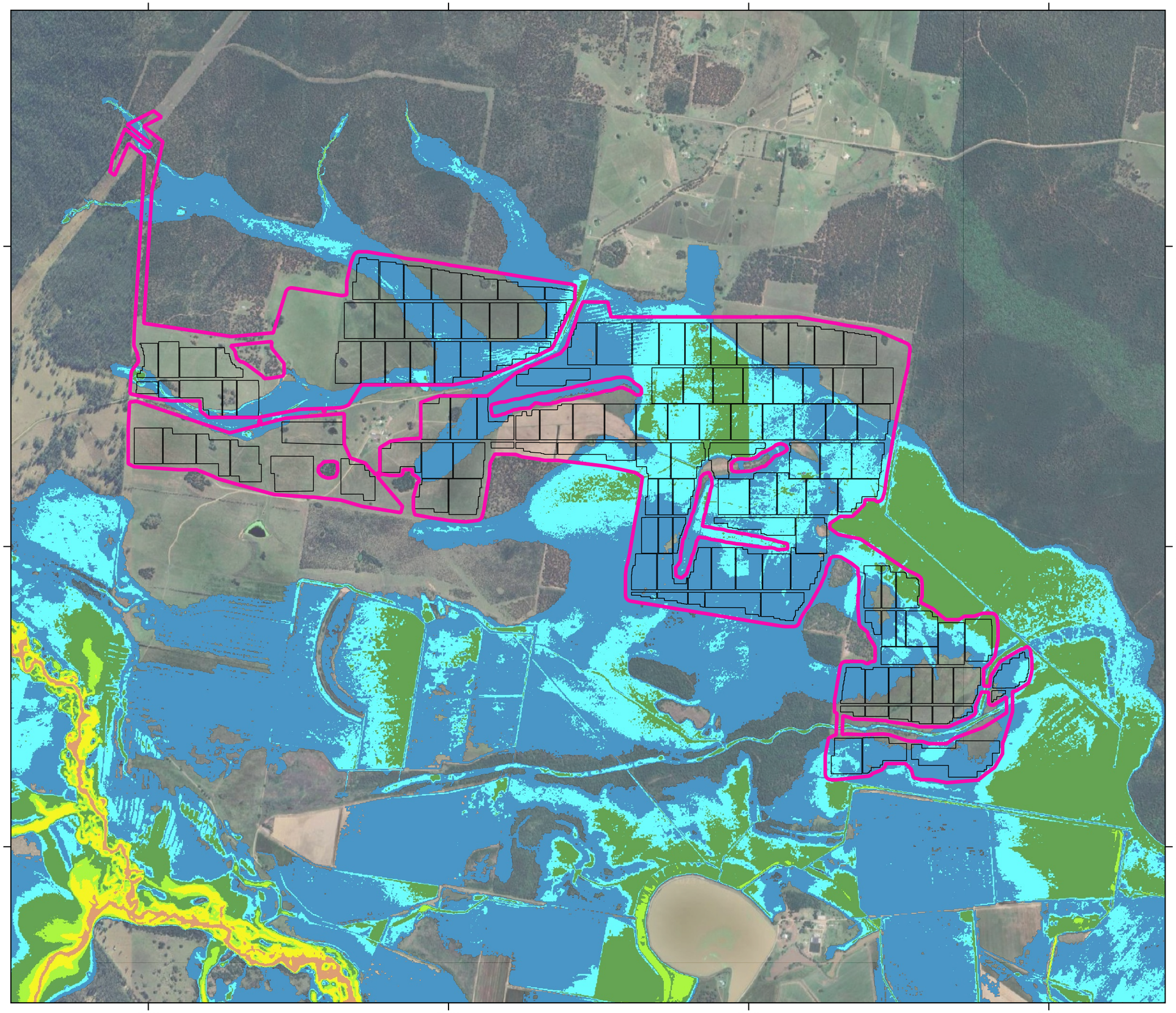
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 2% AEP Event Maximum Flood Hazard Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ hazard_02p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Hazard Vulnerability Classification

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

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

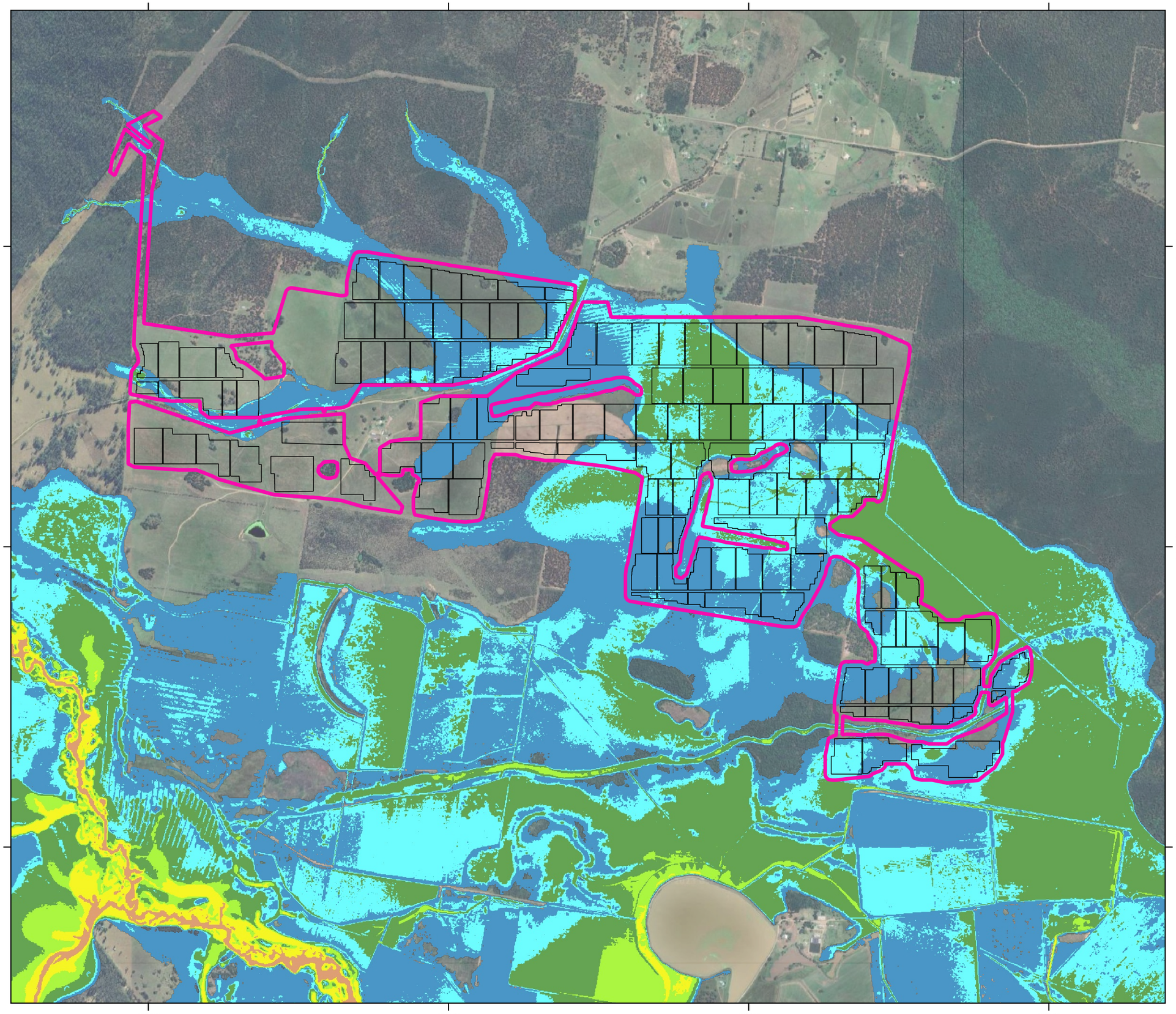
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 1% AEP Event Maximum Flood Hazard Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ hazard_01p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Hazard Vulnerability Classification

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

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

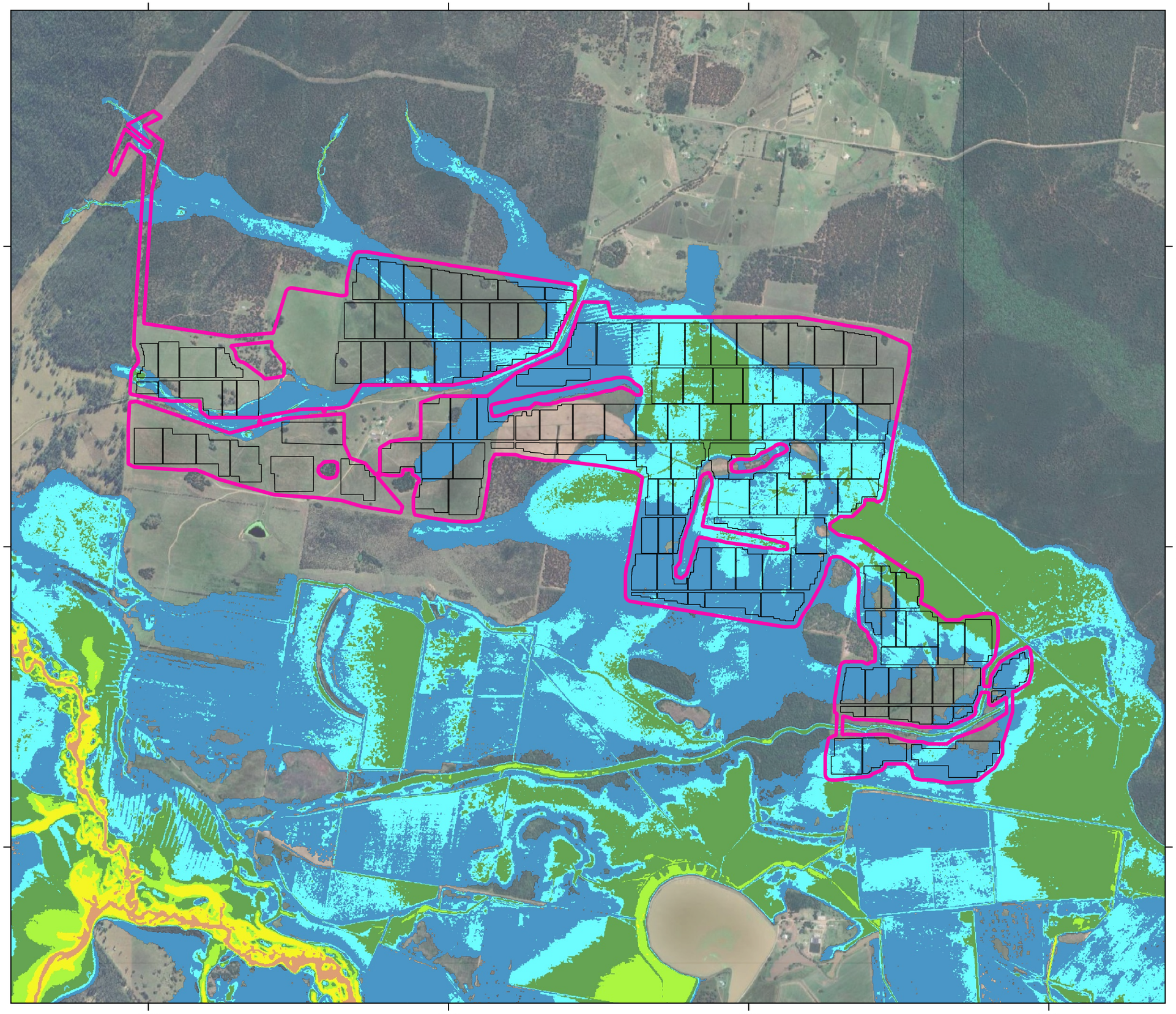
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 1% AEP Climate Change Event Maximum Flood Hazard Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ hazard_01pCC*




## LEGEND

- Development Footprint
- Solar Array Blocks

Hazard Vulnerability Classification

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

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

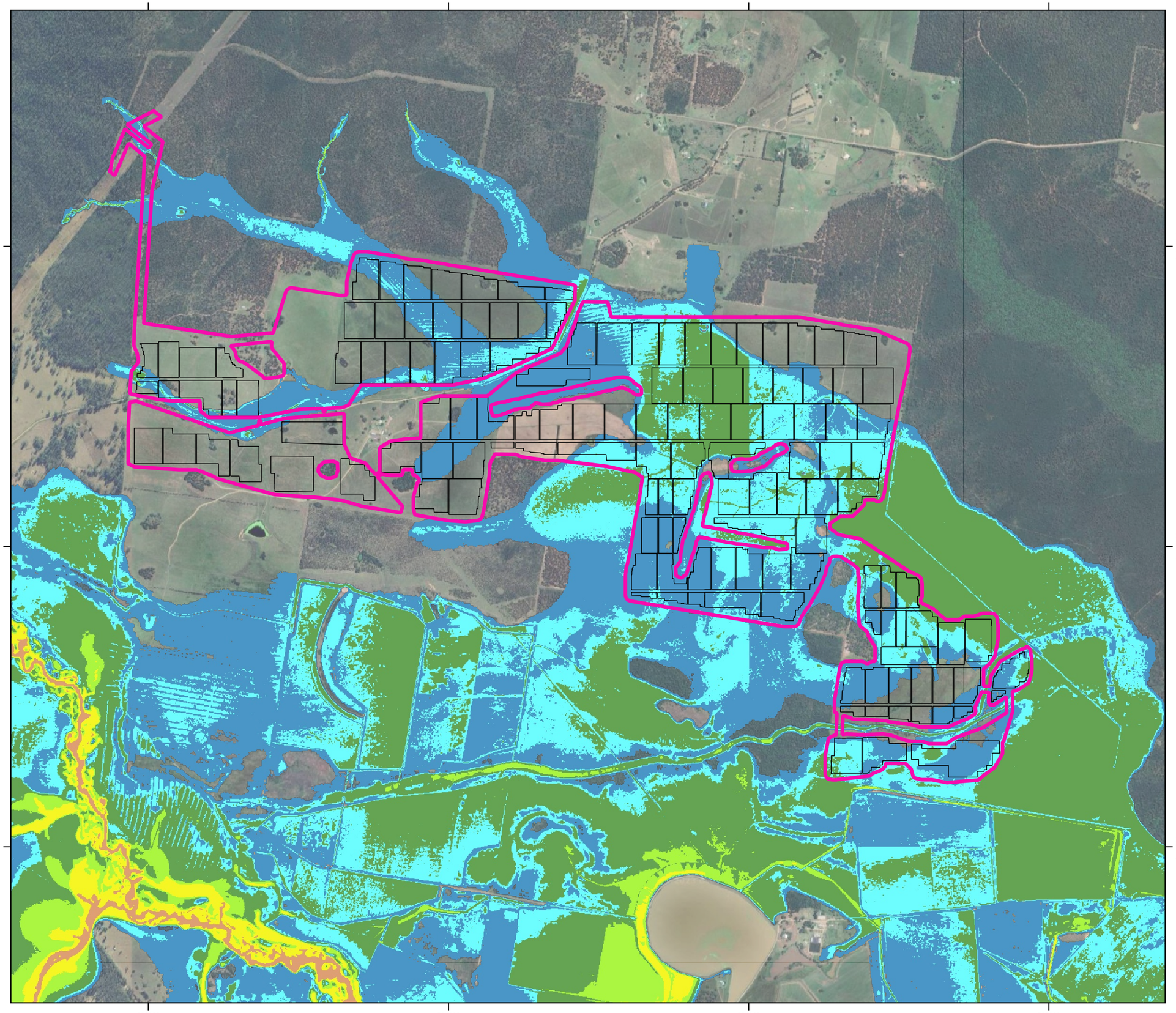
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 0.5% AEP Event Maximum Flood Hazard Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ hazard_0p5p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Hazard Vulnerability Classification

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

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

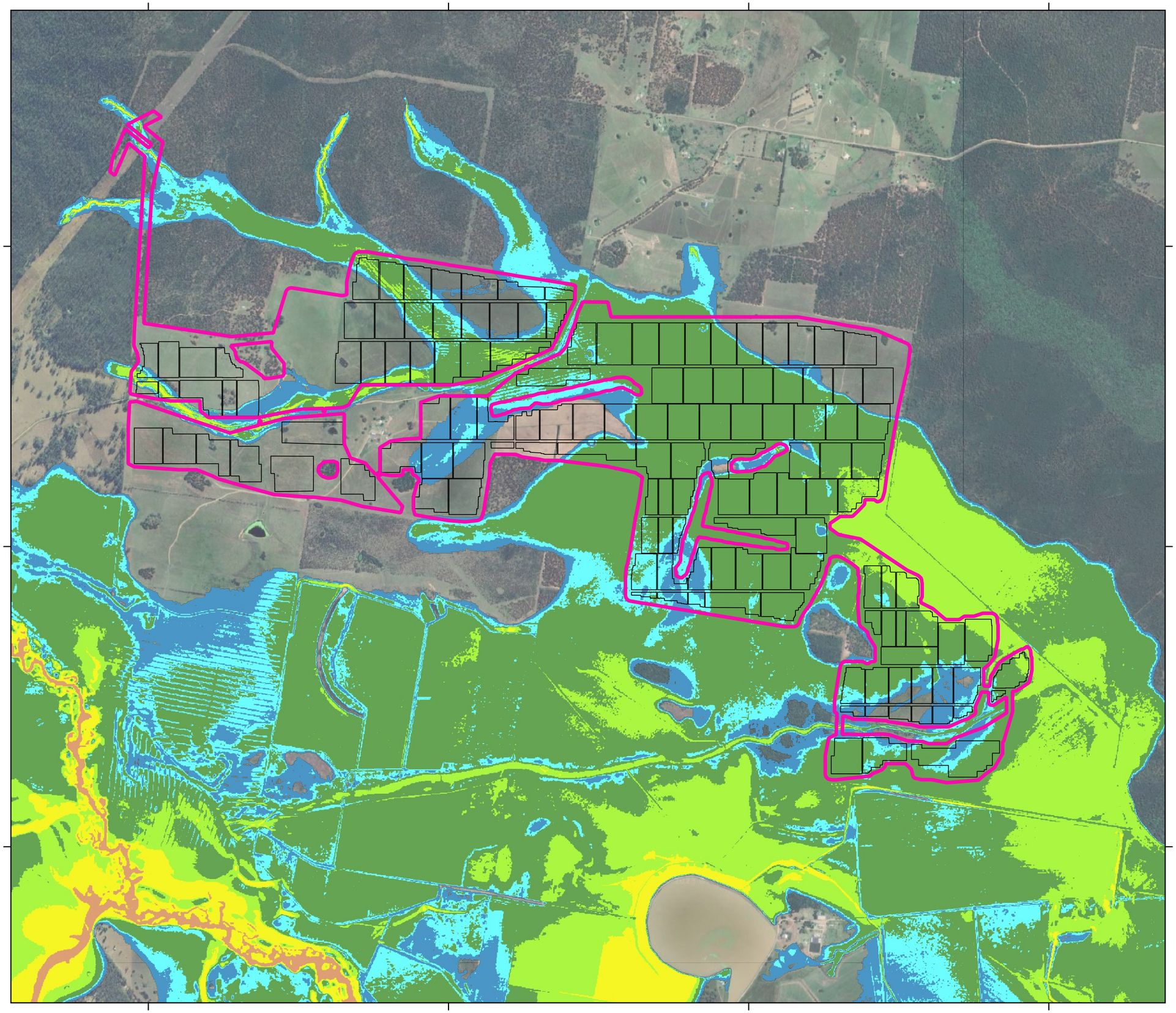
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 0.2% AEP Event Maximum Flood Hazard Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ hazard_0p2p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Hazard Vulnerability Classification

- H1
- H2
- H3
- H4
- H5

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

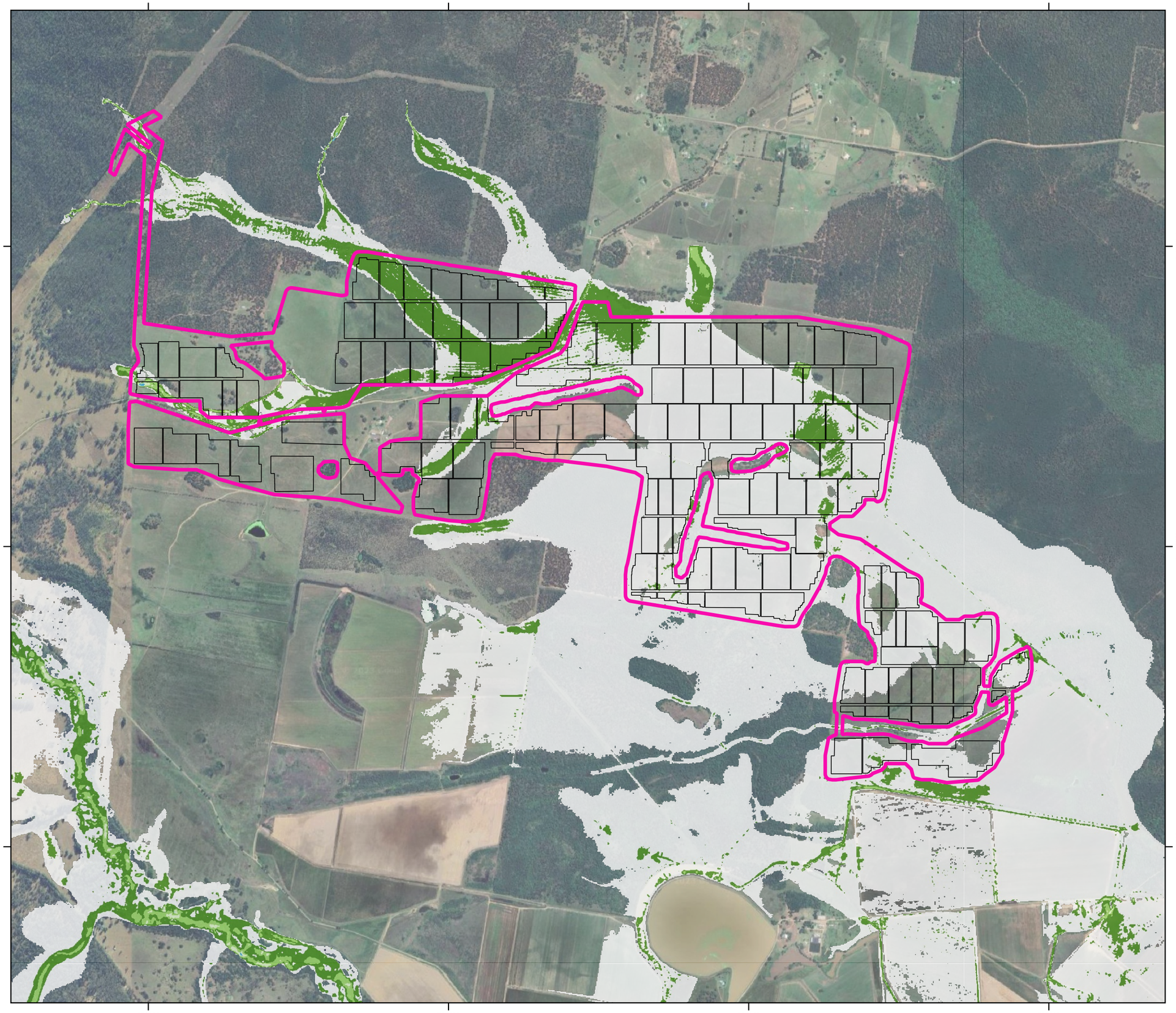
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

PMF Event Maximum Flood Hazard Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ hazard_PMF*




## LEGEND

- Development Footprint
- Solar Array Blocks

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

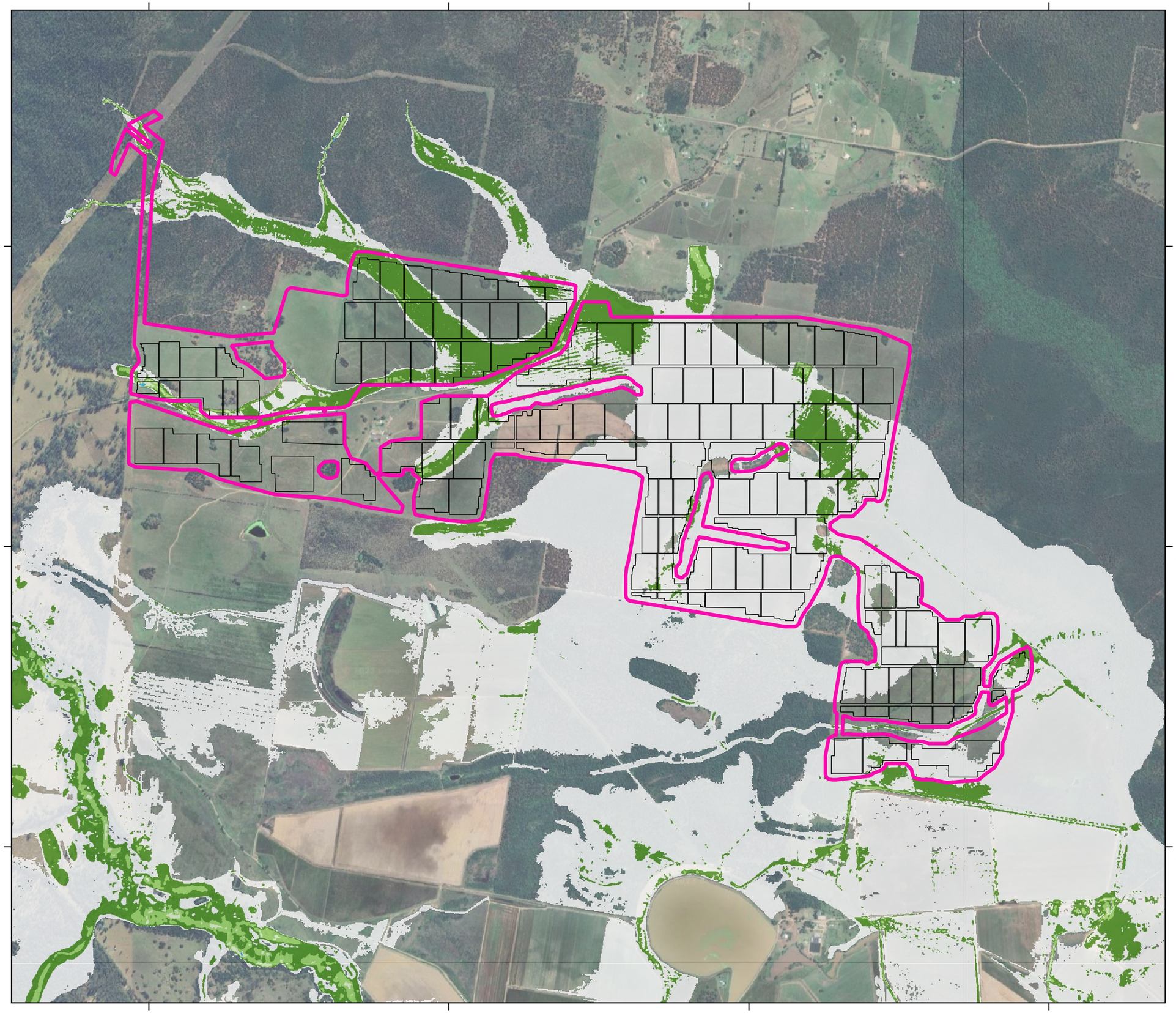
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 5% AEP Event Maximum Flood Velocity Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ velocity_05p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

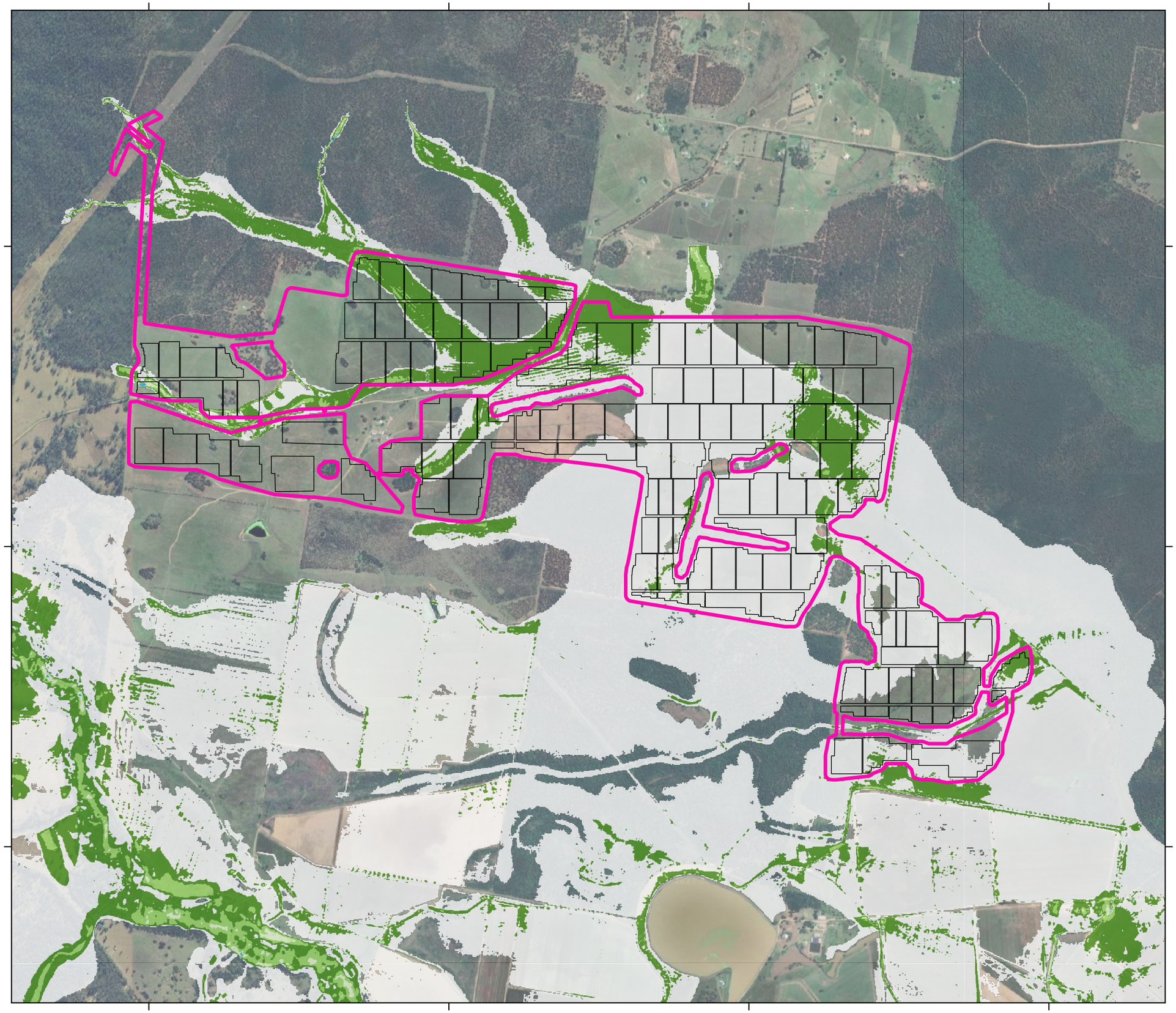
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 2% AEP Event Maximum Flood Velocity Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ velocity_02p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

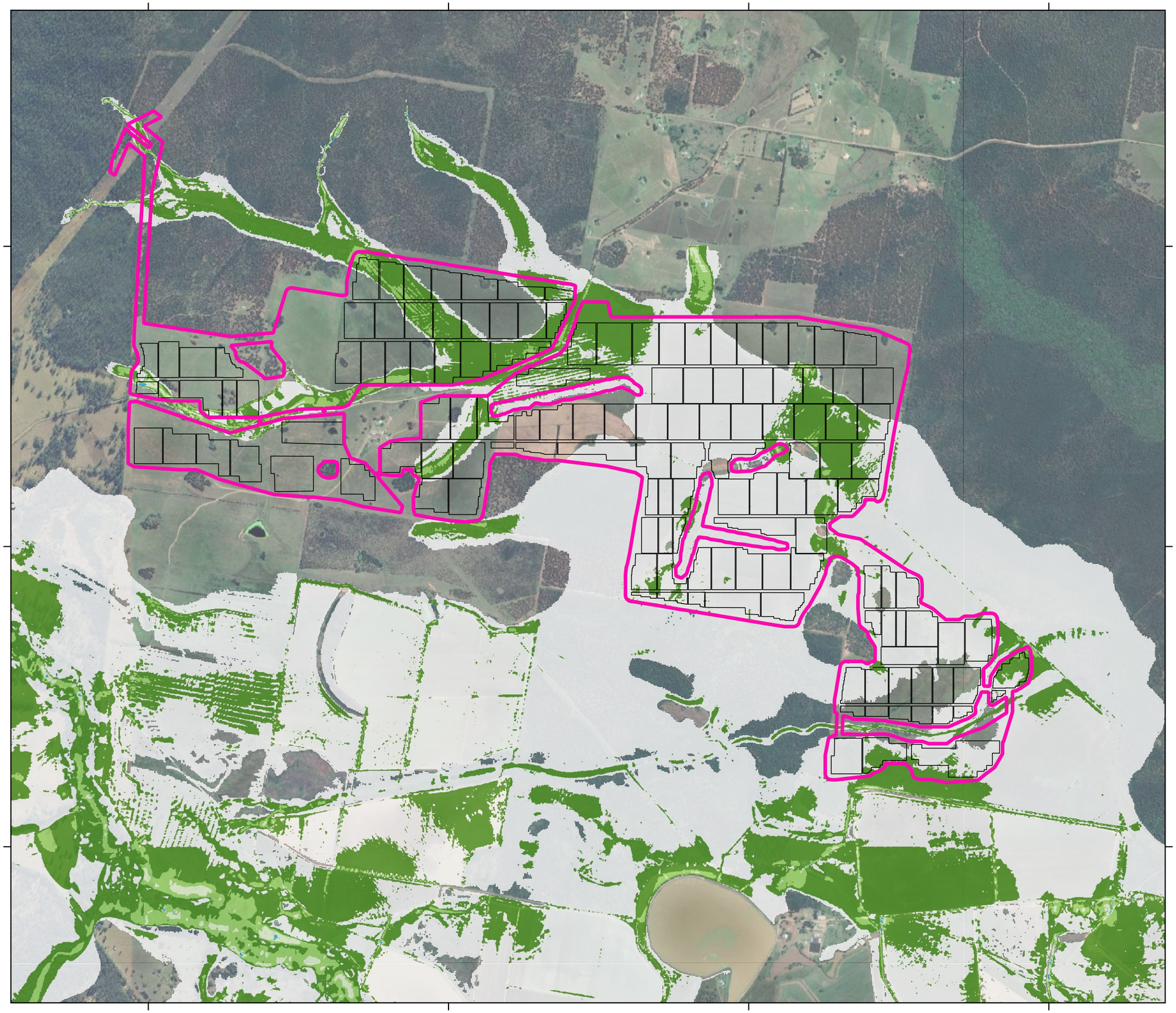
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 1% AEP Event Maximum Flood Velocity Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ velocity_01p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

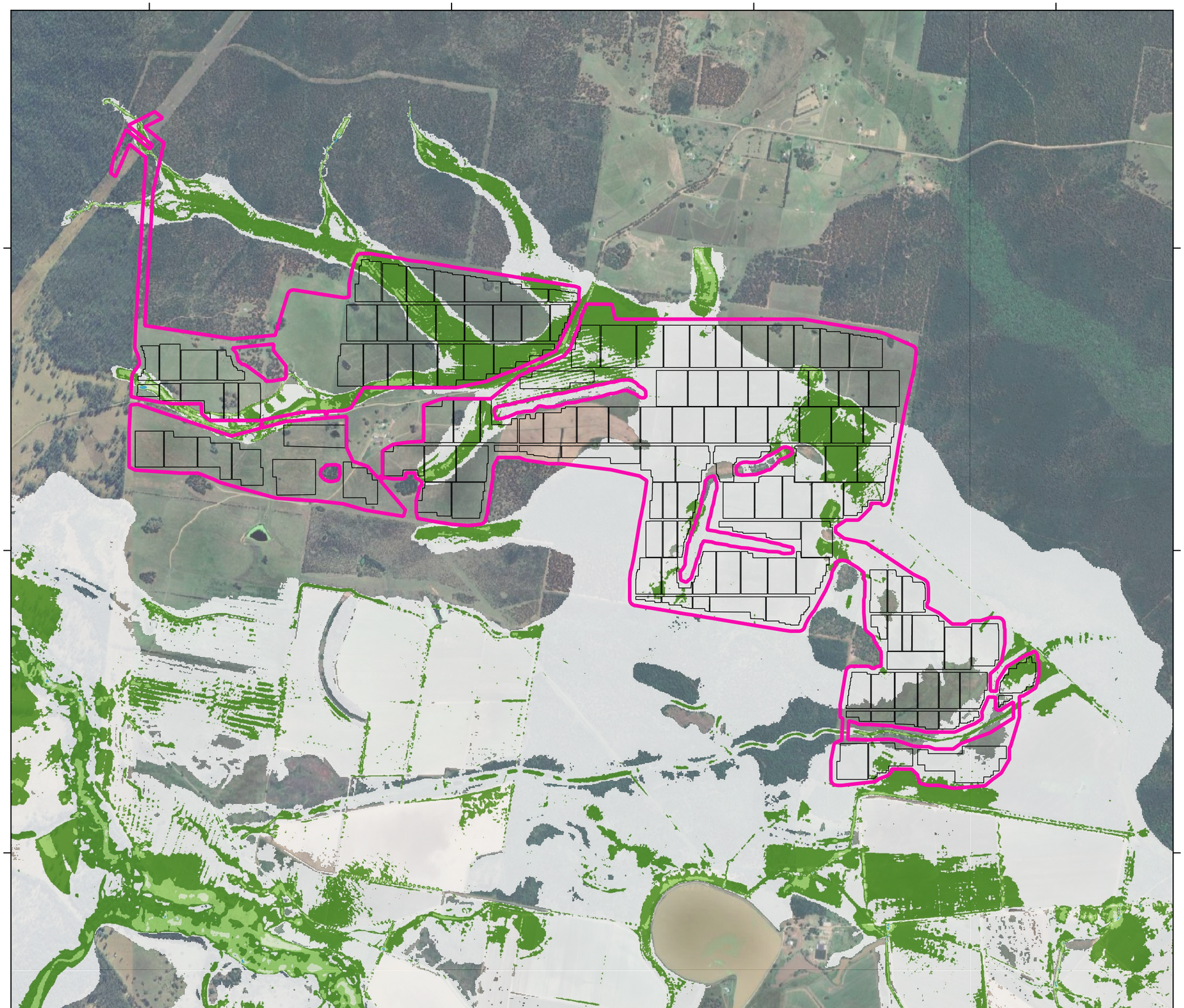
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 1% AEP Climate Change Event Maximum Flood Velocity Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ velocity_01pCC*




## LEGEND

- Development Footprint
- Solar Array Blocks

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

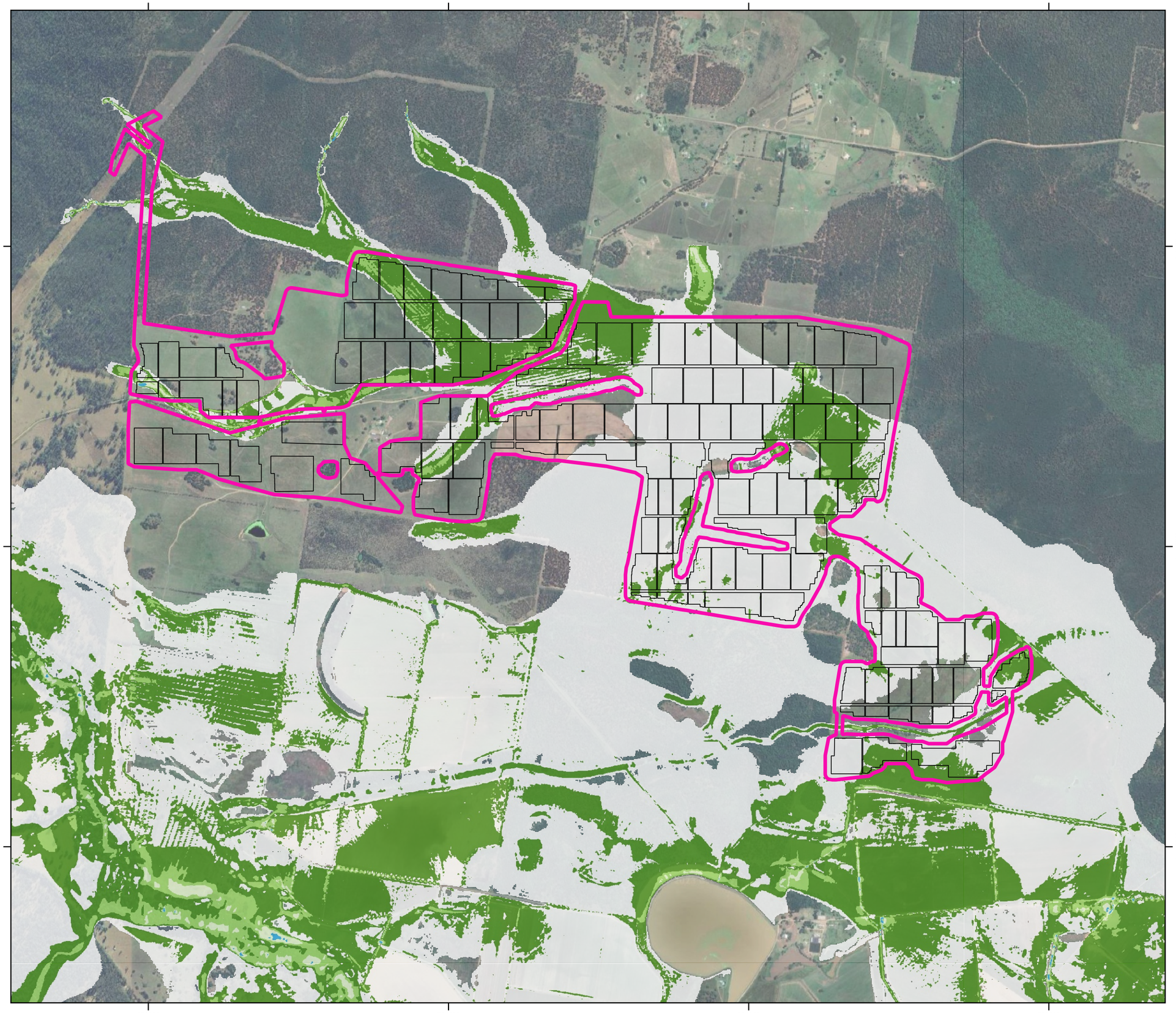
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

# 0.5% AEP Event Maximum Flood Velocity Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ velocity_0p5p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

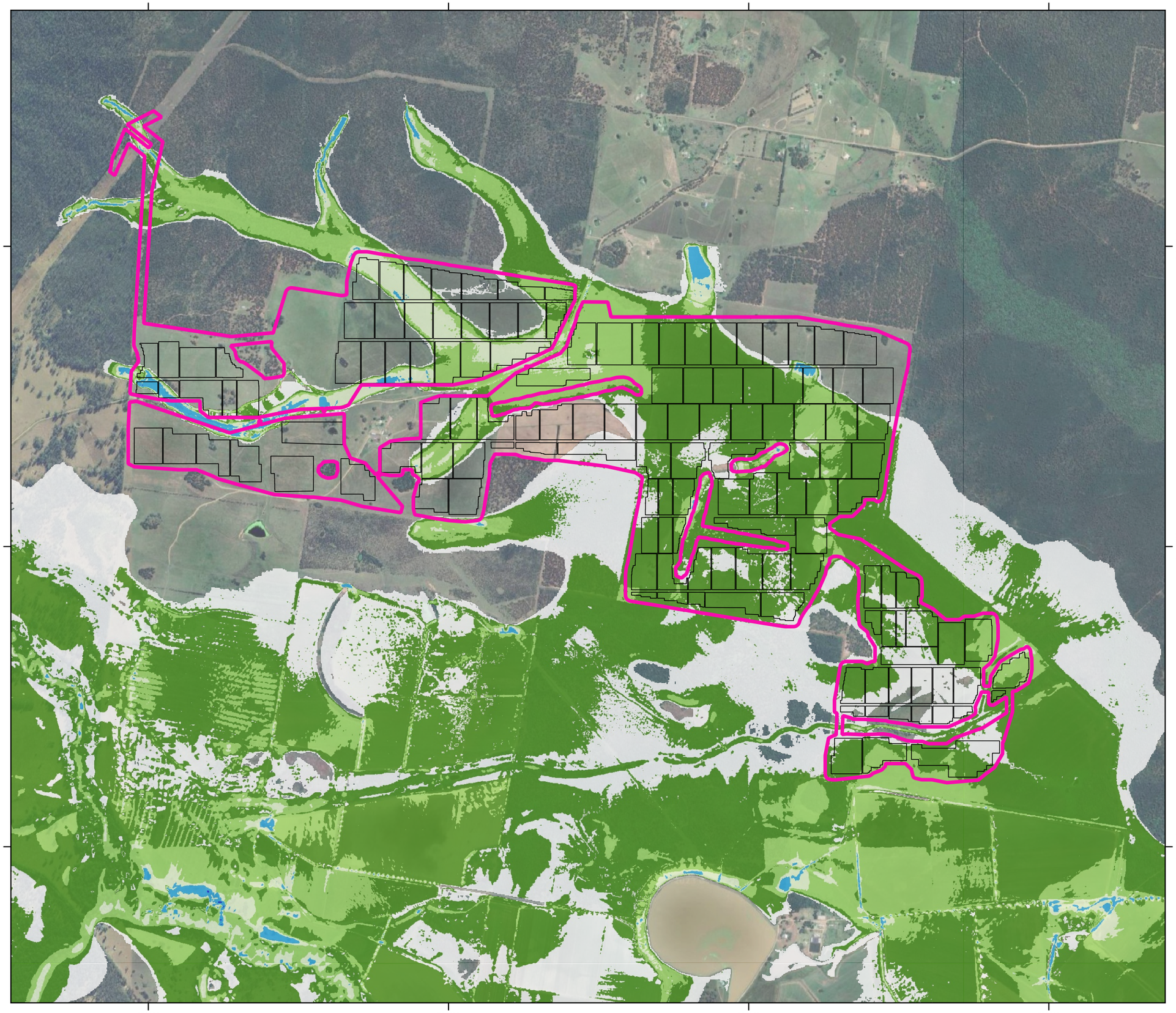
ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

0.2% AEP Event Maximum Flood Velocity Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ velocity_0p2p*




## LEGEND

- Development Footprint
- Solar Array Blocks

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

0 750 1,500 m

SCALE 1:25,000

DRAWN: RF
REVIEWED: MC
APPROVED:

N

ARCADIS

DATE: 20/12/2023
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

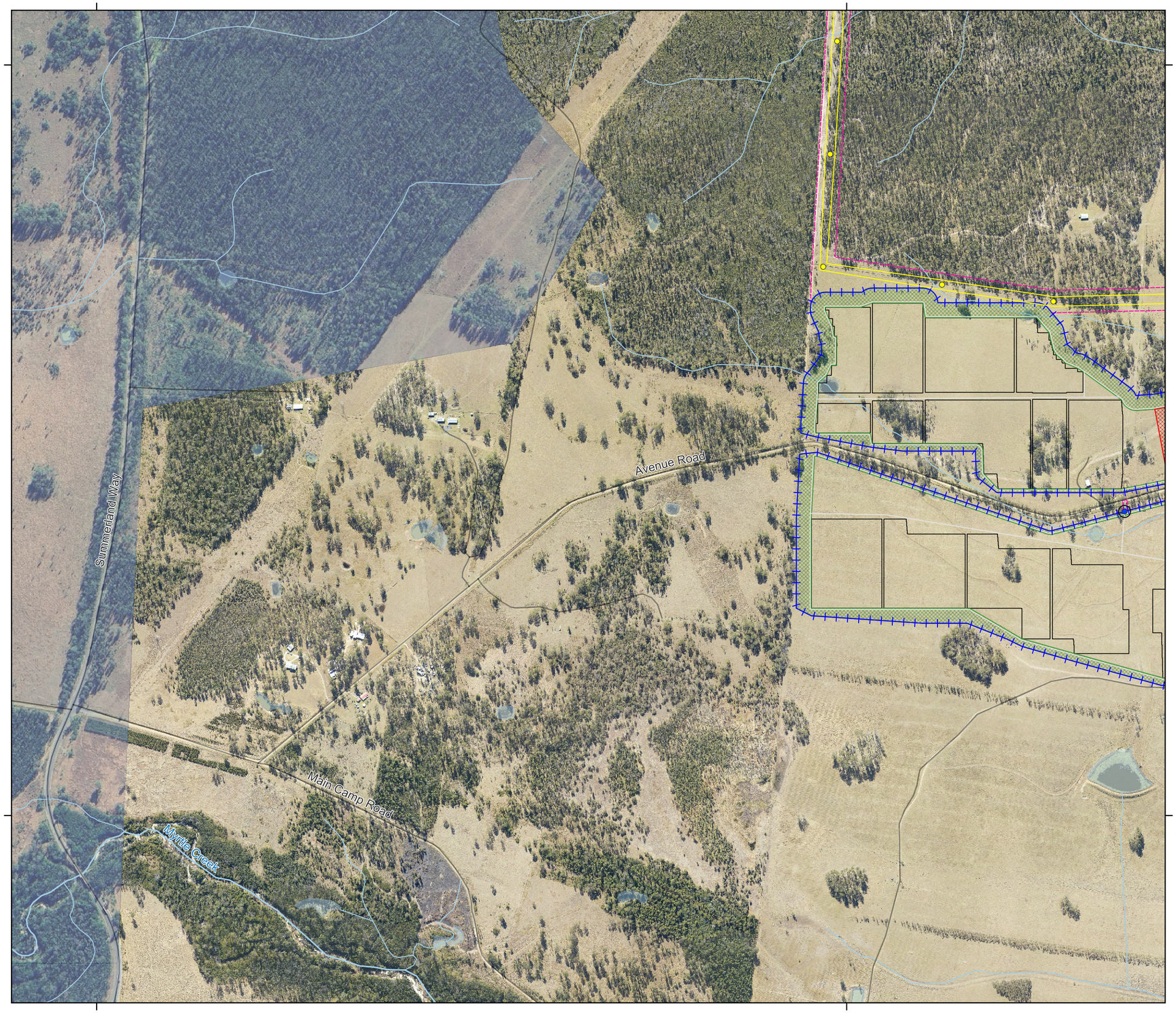
# PMF Event Maximum Flood Velocity Map

DATUM GDA2020 / MGA zone 56


*Y:\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_Figure.qgz \ velocity_PMF*

# APPENDIX B

## Hazard Maps – Main Camp Road & Avenue Road




## Legend

- Development footprint
- Gate
- Access point
- Transmission tower
- Transmission line
- Fence
- Access track
- Road
- Waterway
- Waterbody
- Temp laydown area
- Switching substation
- Substation
- Parking lot
- O&M facility
- BESS
- APZ
- Temp site facility
- Solar array block

GA zone 56

N

0 250 500 m

SCALE 1:10,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

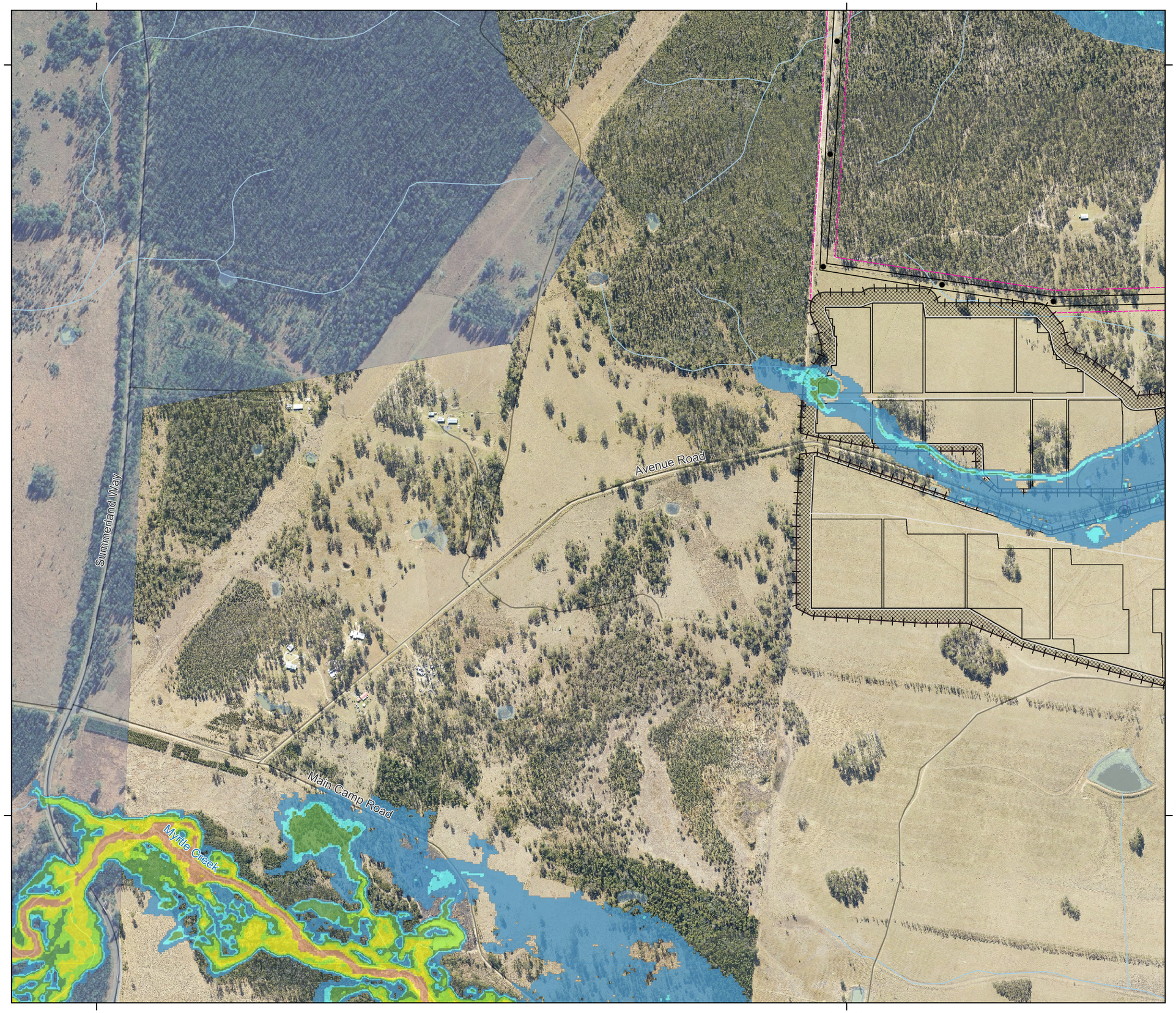
Model version: NA
Developed conditions - blockage scenario: NA

Extent of Proposed Works Map - Avenue Road

Figure 2-1



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 250 500 m

SCALE 1:10,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

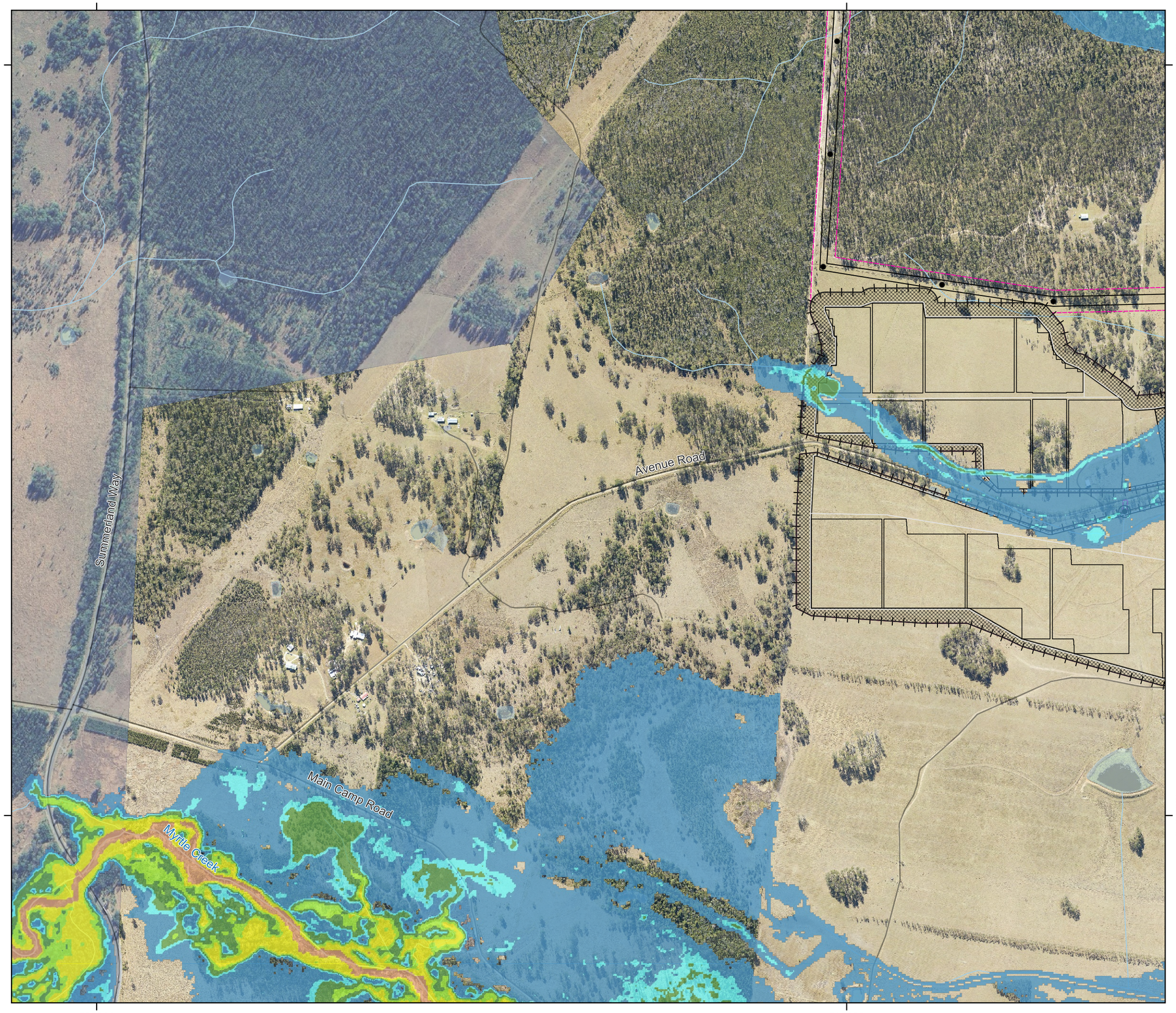
Model version: E02
Developed conditions - blockage scenario: SEN-A

5% AEP Event
Maximum Flood Hazard Map - Avenue Road

Figure 2-2



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 250 500 m

SCALE 1:10,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

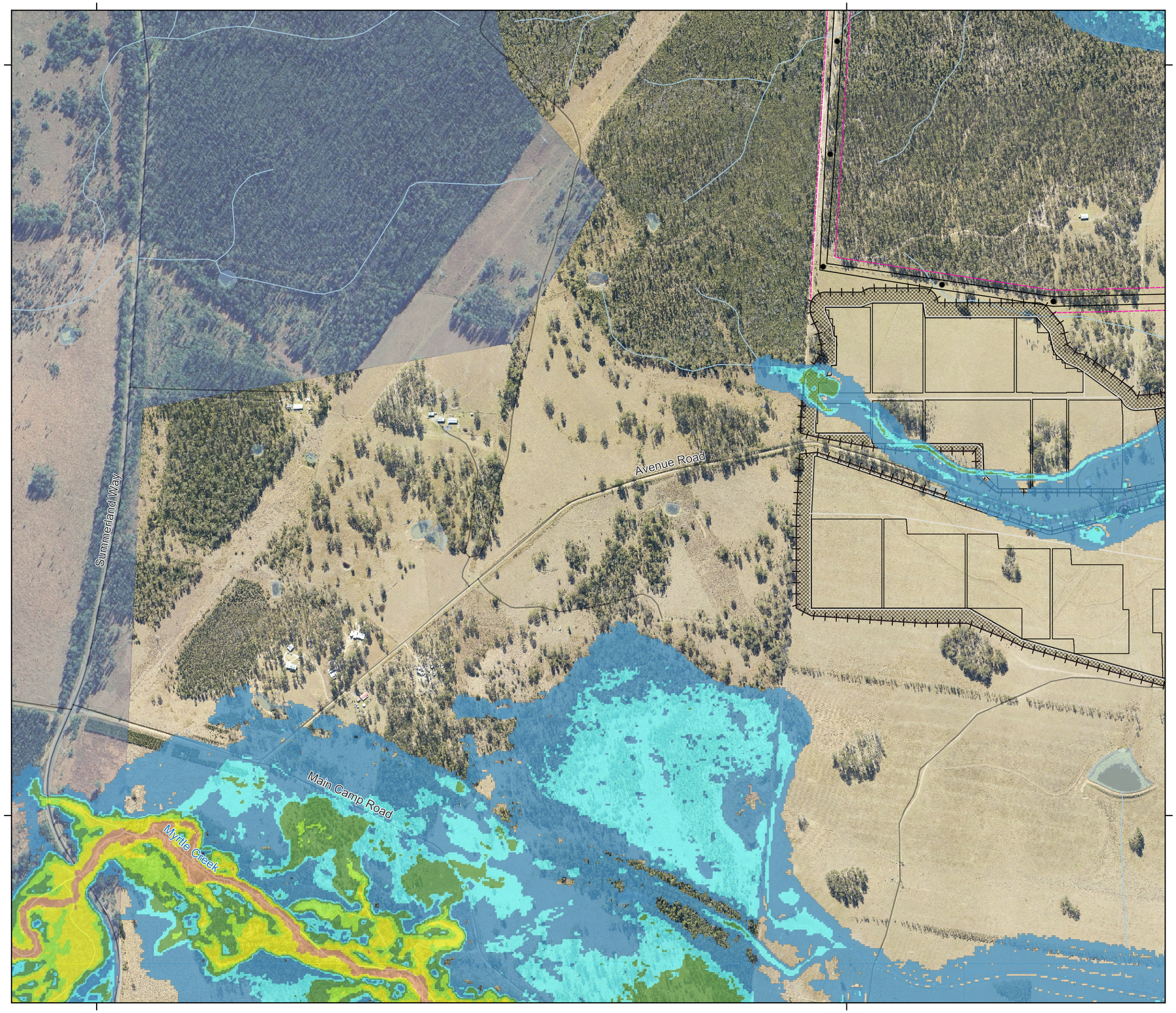
Model version: E02
Developed conditions - blockage scenario: SEN-A

2% AEP Event
Maximum Flood Hazard Map - Avenue Road

Figure 2-3



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 250 500 m

SCALE 1:10,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

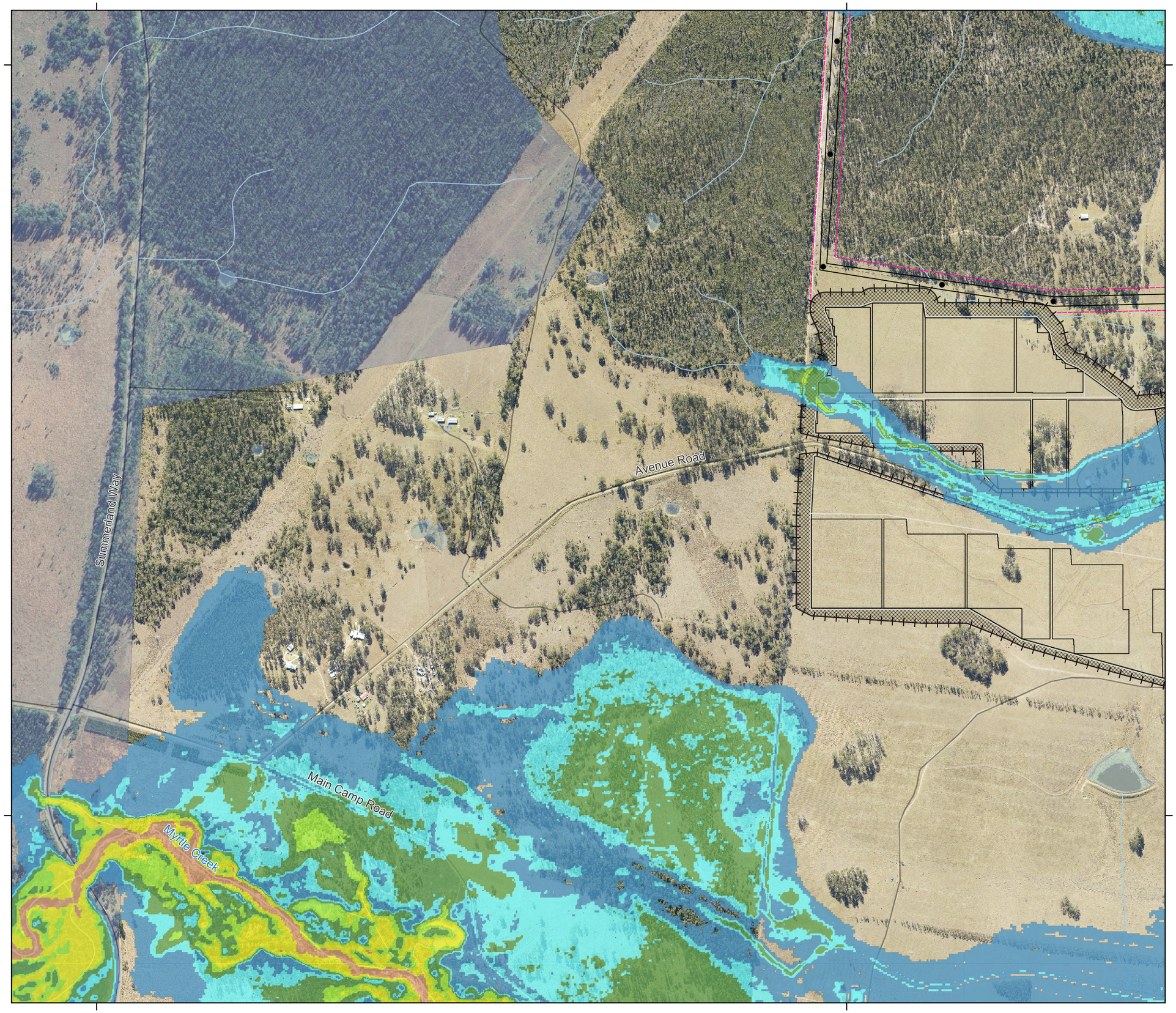
Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Event
Maximum Flood Hazard Map - Avenue Road

Figure 2-4



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 250 500 m

SCALE 1:10,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

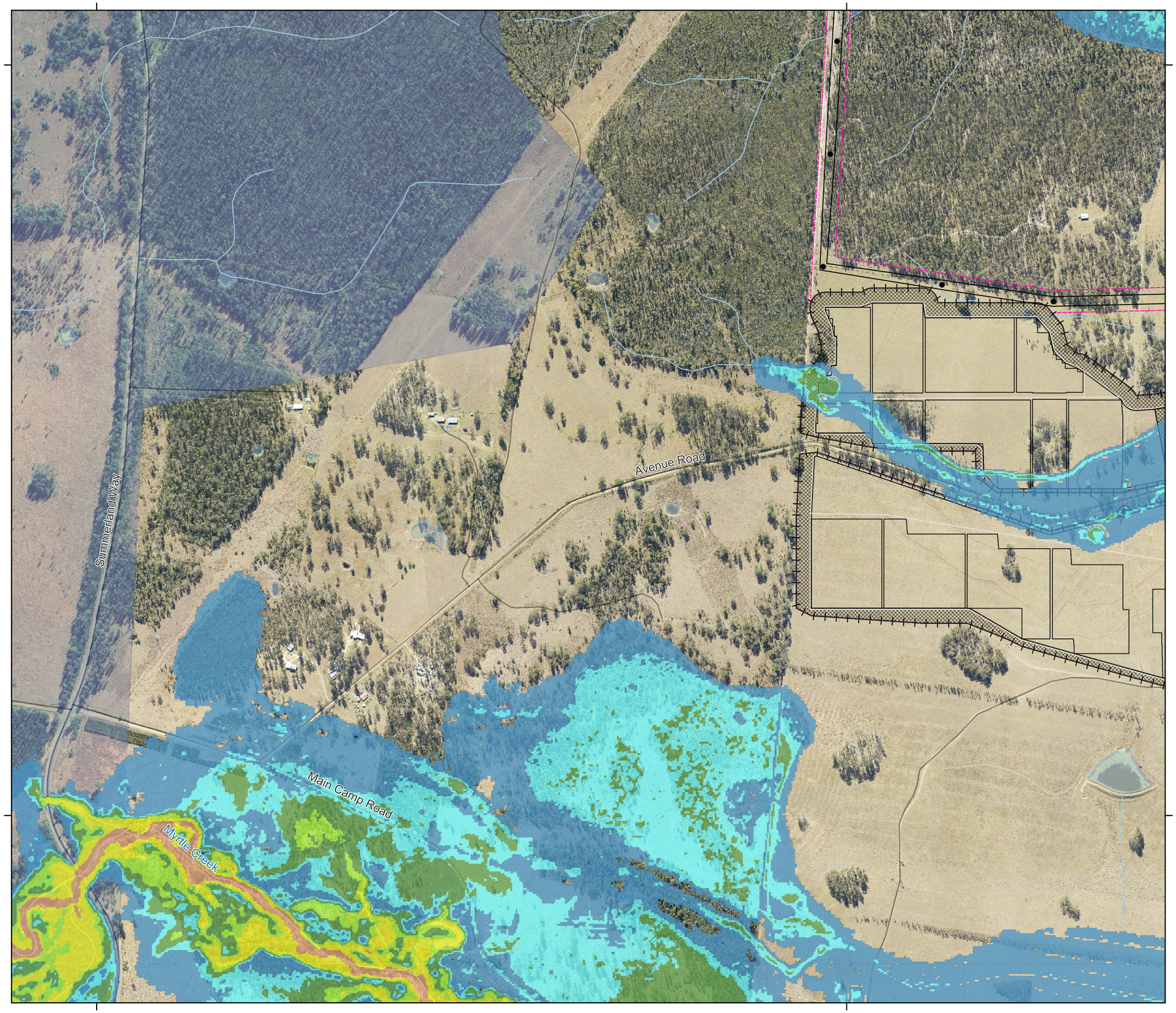
Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Climate Change Event
Maximum Flood Hazard Map - Avenue Road

Figure 2-5



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 250 500 m

SCALE 1:10,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

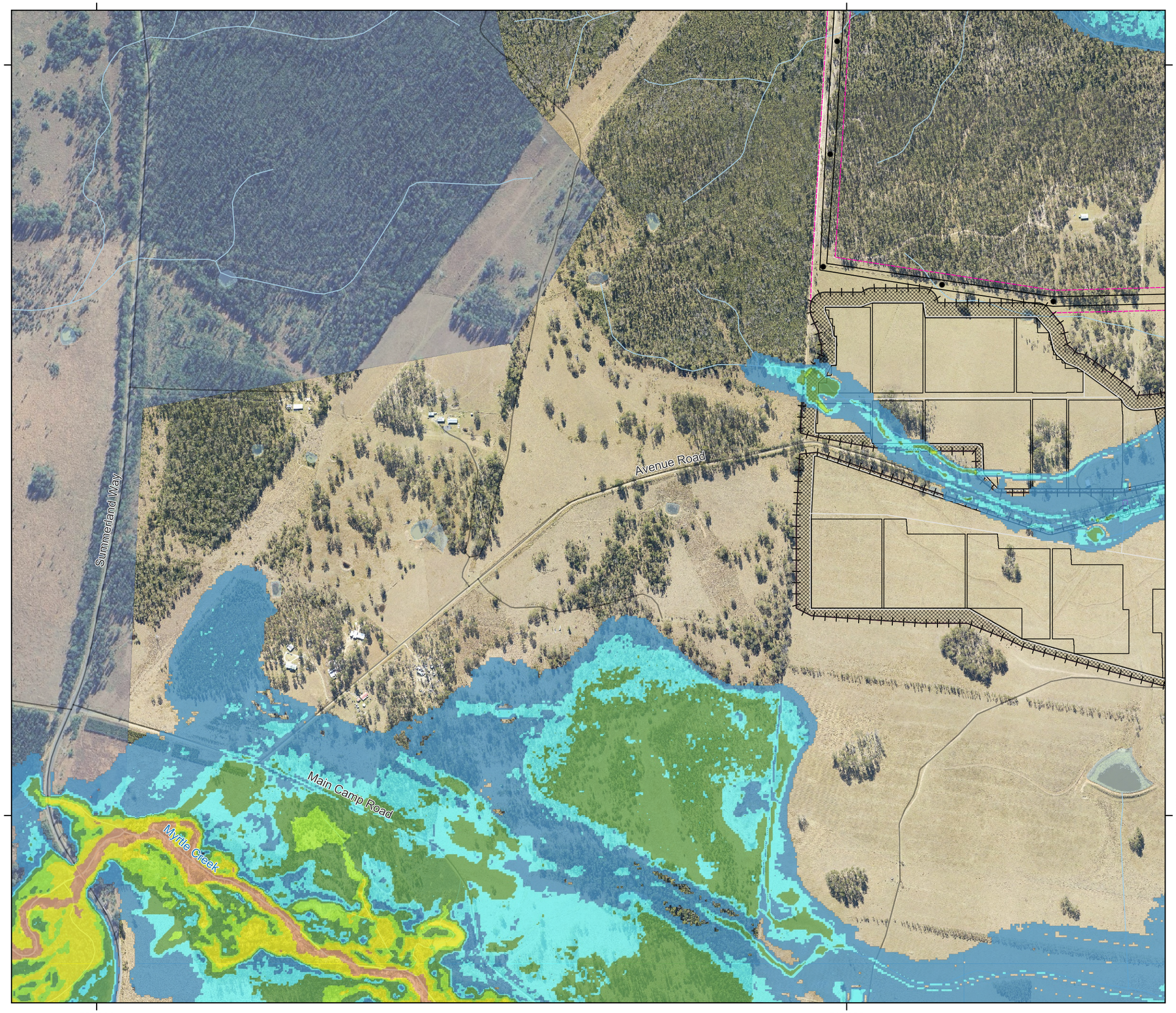
Model version: E02
Developed conditions - blockage scenario: SEN-A

0.5% AEP Event
Maximum Flood Hazard Map - Avenue Road

Figure 2-6



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 250 500 m

SCALE 1:10,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

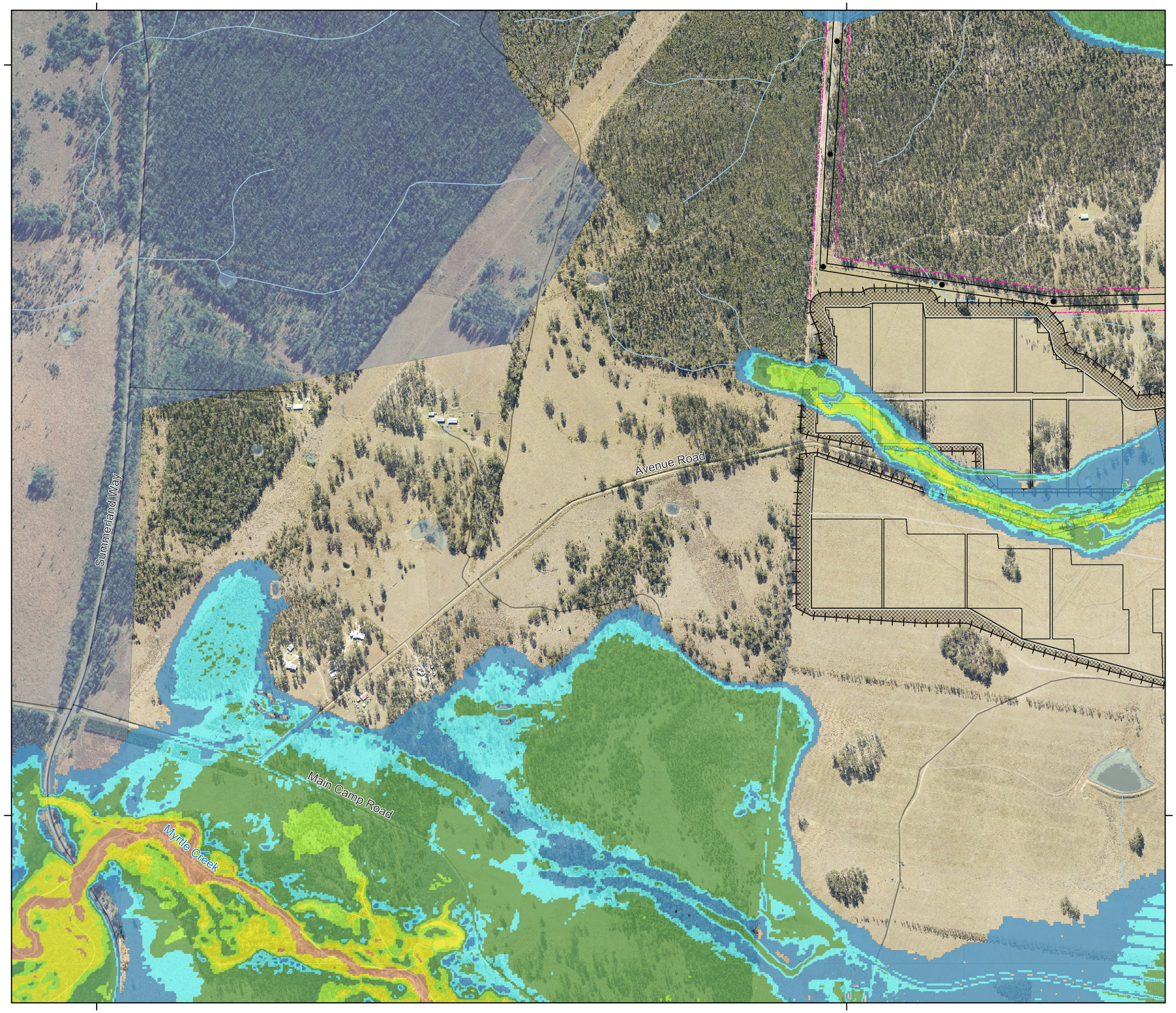
Model version: E02
Developed conditions - blockage scenario: SEN-A

0.2% AEP Event
Maximum Flood Hazard Map - Avenue Road

Figure 2-7



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 250 500 m

SCALE 1:10,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

PMF Event
Maximum Flood Hazard Map - Avenue Road

Figure 2-8



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]

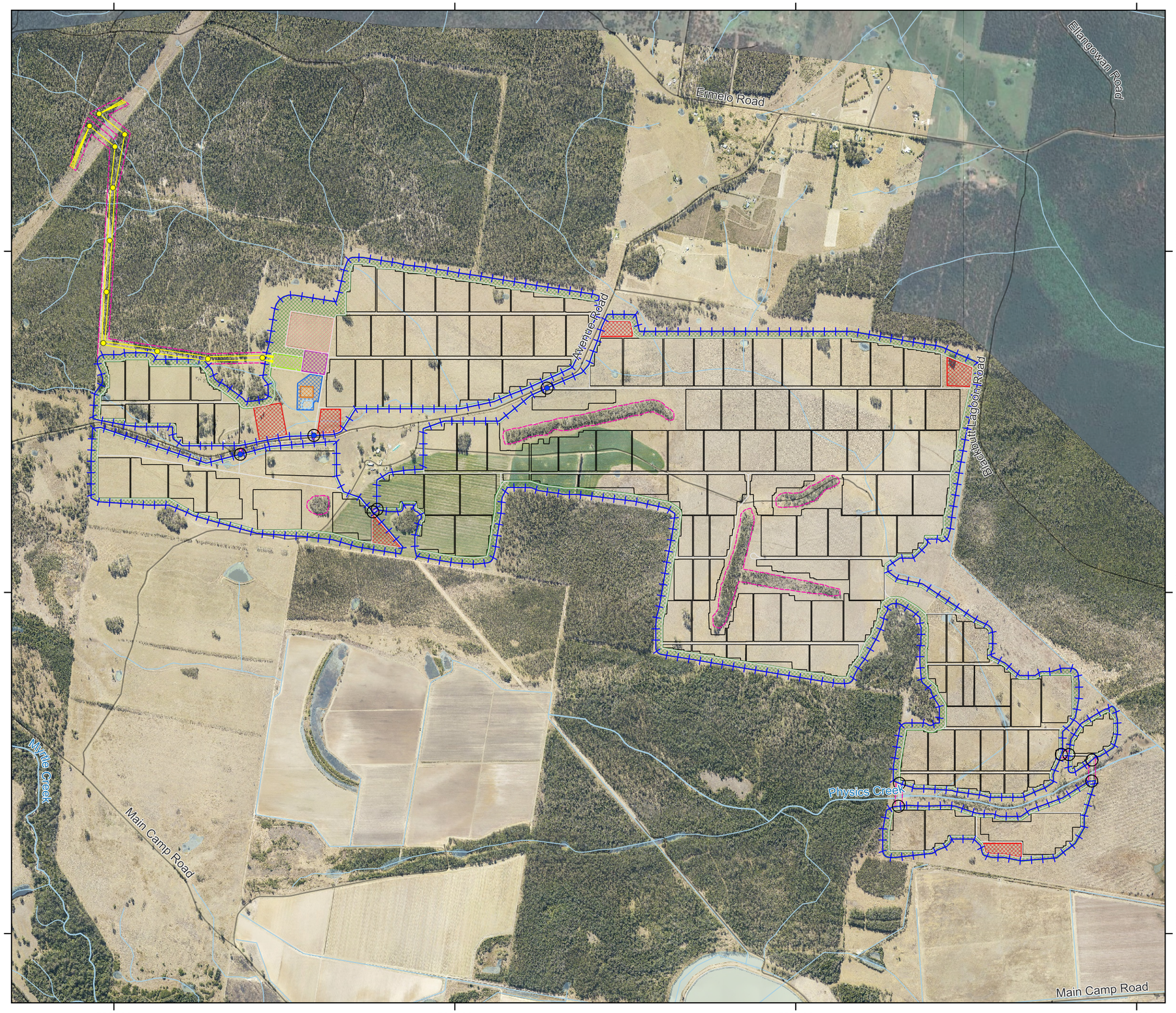
# APPENDIX C

## Blockage computations

| | | | | | | | | | AEP Adjusted Debris Potential | | | Blockage Levels | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Zone** | **Scenario** | **W (m)** | **L10 (m)** | **W compared to L10** | **Debris availability** | **Debris mobility** | **Debris Transportability** | **Debris potential** | **> 5%** | **5% - 0.5%** | **< 0.5%** | **AEP > 5% (frequent)** | **AEP 5% - AEP 0.5%** | **AEP < 0.5% (rare)** |
| 1 | SEN_A | 0.05 | 3 | W<L10 | High | High | Low | High | Medium | High | High | 50% | 100% | 100% |
| 1 | SEN_B | 0.05 | 3 | W<L10 | Medium | Medium | Medium | Medium | Low | Medium | High | 25% | 50% | 100% |
| 1 | SEN_C | 0.05 | 3 | W<L10 | Medium | Medium | Low | Low | Low | Low | Medium | 25% | 25% | 50% |
| 2 | SEN_A | 0.05 | 1.5 | W<L10 | Medium | High | Low | Medium | Low | Medium | High | 25% | 50% | 100% |
| 2 | SEN_B | 0.05 | 1.5 | W<L10 | Medium | Medium | Low | Low | Low | Low | Medium | 25% | 25% | 50% |
| 2 | SEN_C | 0.05 | 1.5 | W<L10 | Low | Low | Low | Low | Low | Low | Medium | 25% | 25% | 50% |

# APPENDIX D

## Flood Maps – Post Developed




## Legend

- Development footprint
- Gate
- Access point
- Transmission tower
- Transmission line
- Fence
- Access track
- Road
- Waterway
- Waterbody
- Temp laydown area
- Switching substation
- Substation
- Parking lot
- O&M facility
- BESS
- APZ
- Temp site facility
- Solar array block

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

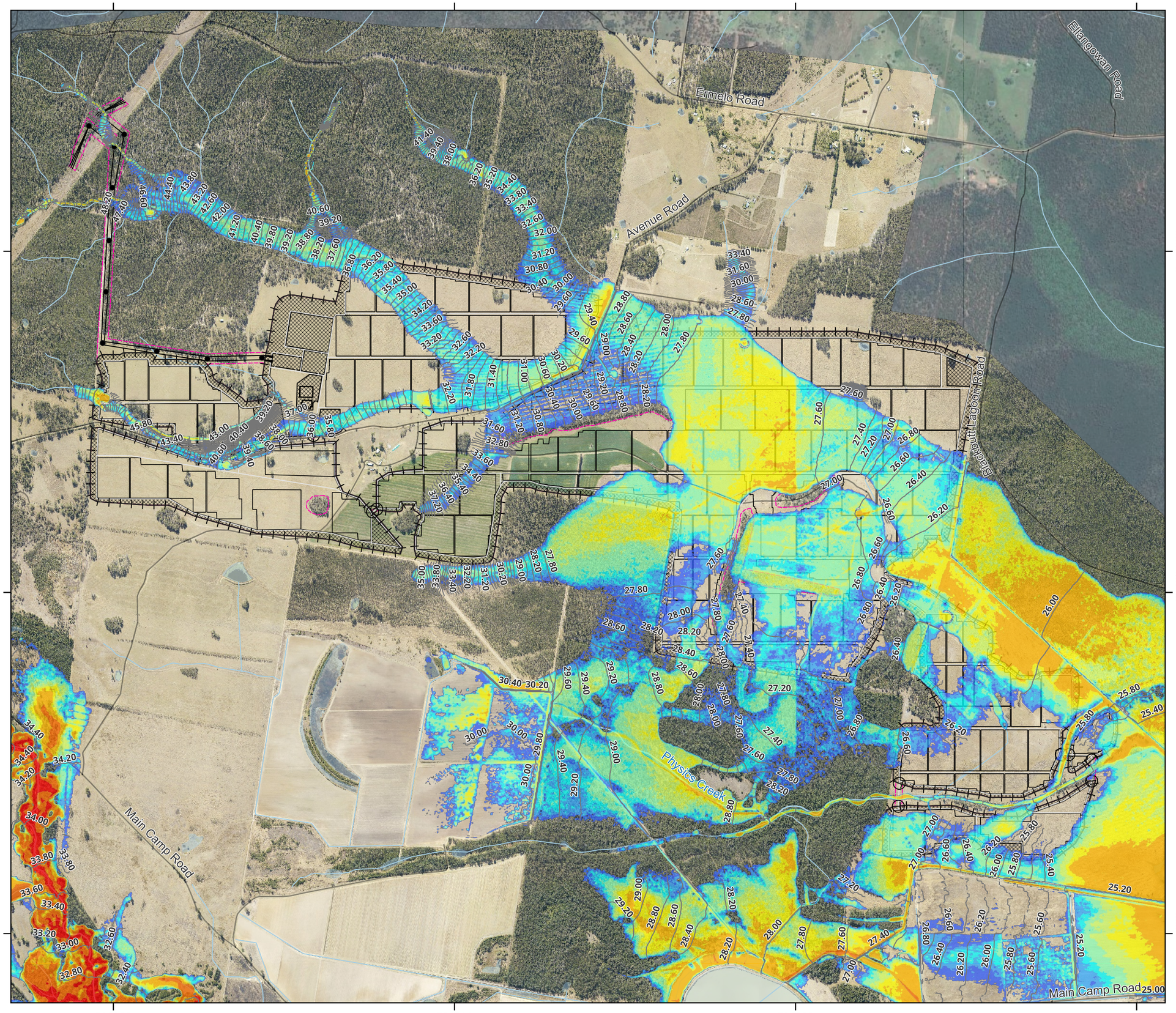
Model version: NA
Developed conditions - blockage scenario: NA

Extent of Proposed Works Map

Figure 1-1



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

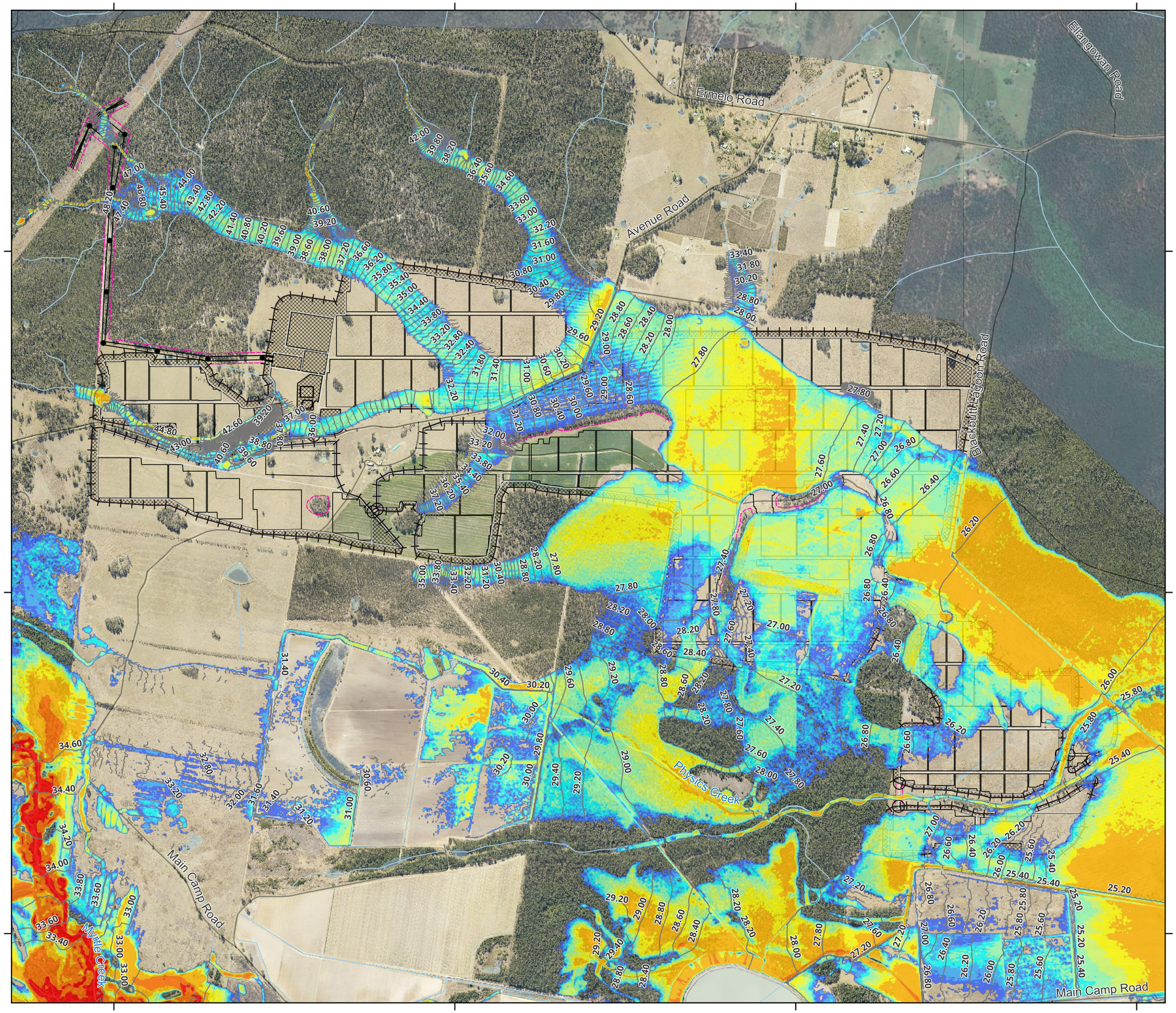
Model version: E02
Developed conditions - blockage scenario: SEN-A

5% AEP Event
Maximum Flood Extents and Depth Map

Figure 1-2



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

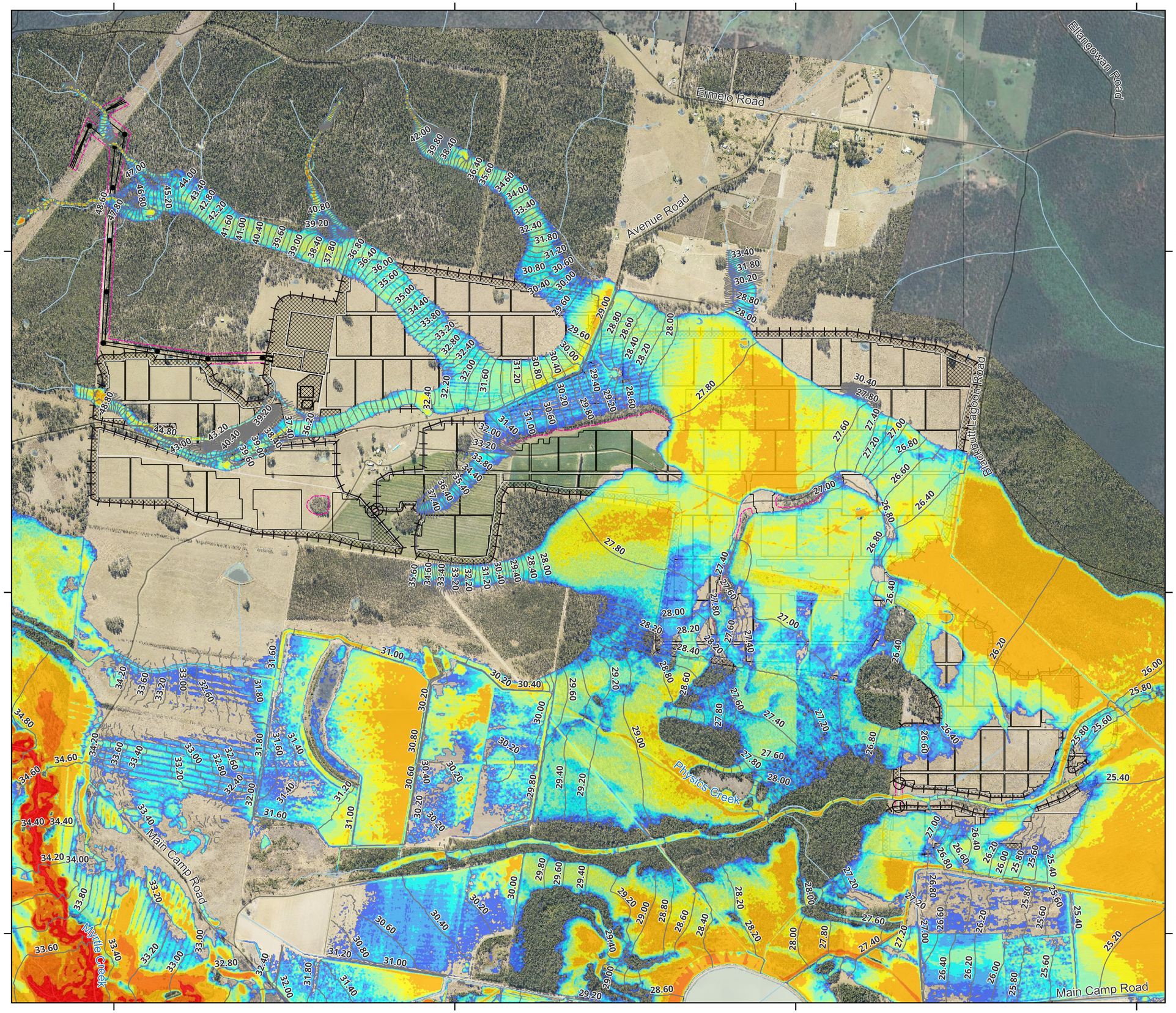
Model version: E02
Developed conditions - blockage scenario: SEN-A

2% AEP Event
Maximum Flood Extents and Depth Map

Figure 1-3



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

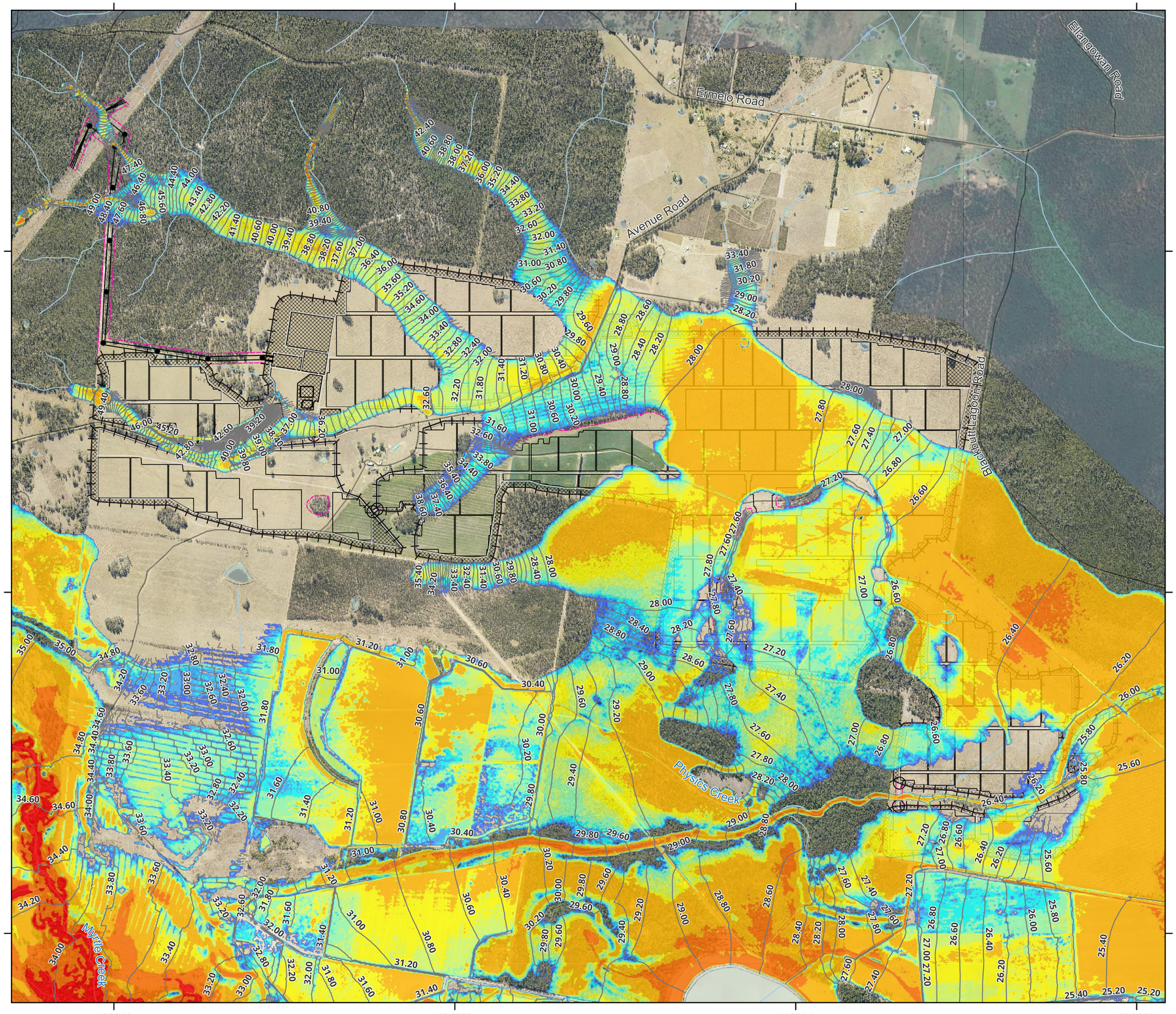
Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Event
Maximum Flood Extents and Depth Map

Figure 1-4



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

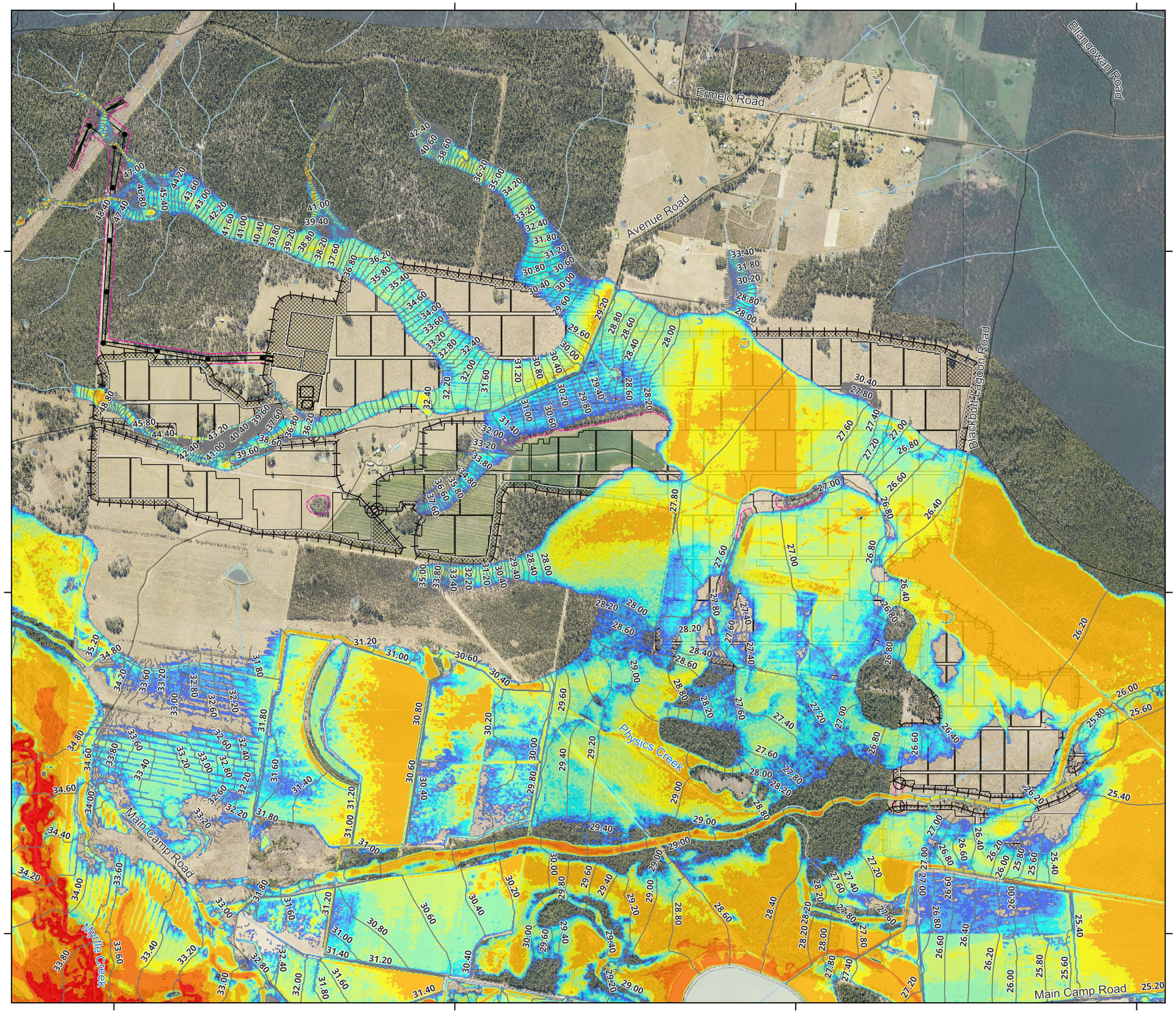
Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Climate Change Event
Maximum Flood Extents and Depth Map

Figure 1-5



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

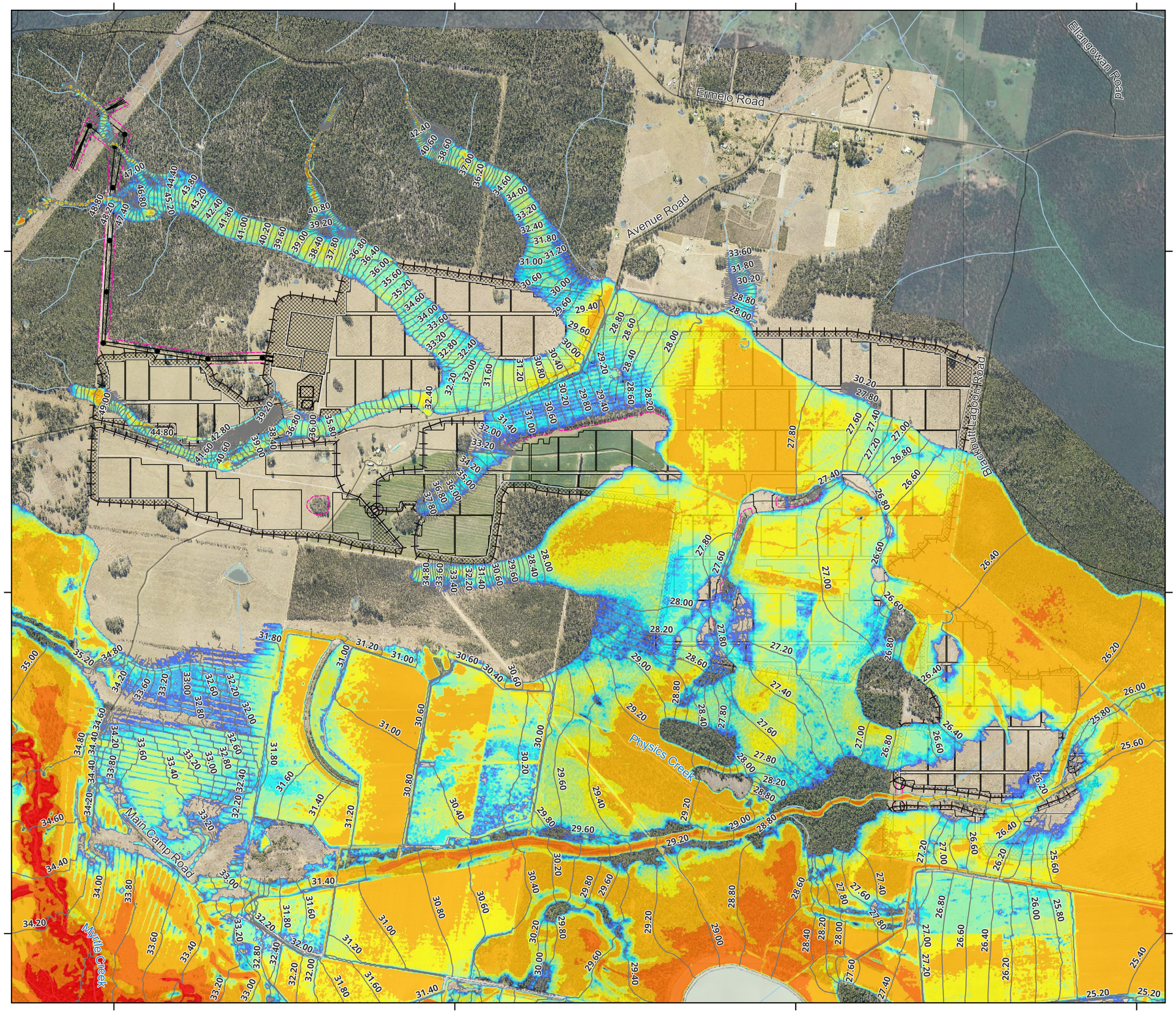
ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

0.5% AEP Event
Maximum Flood Extents and Depth Map

Figure 1-6




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

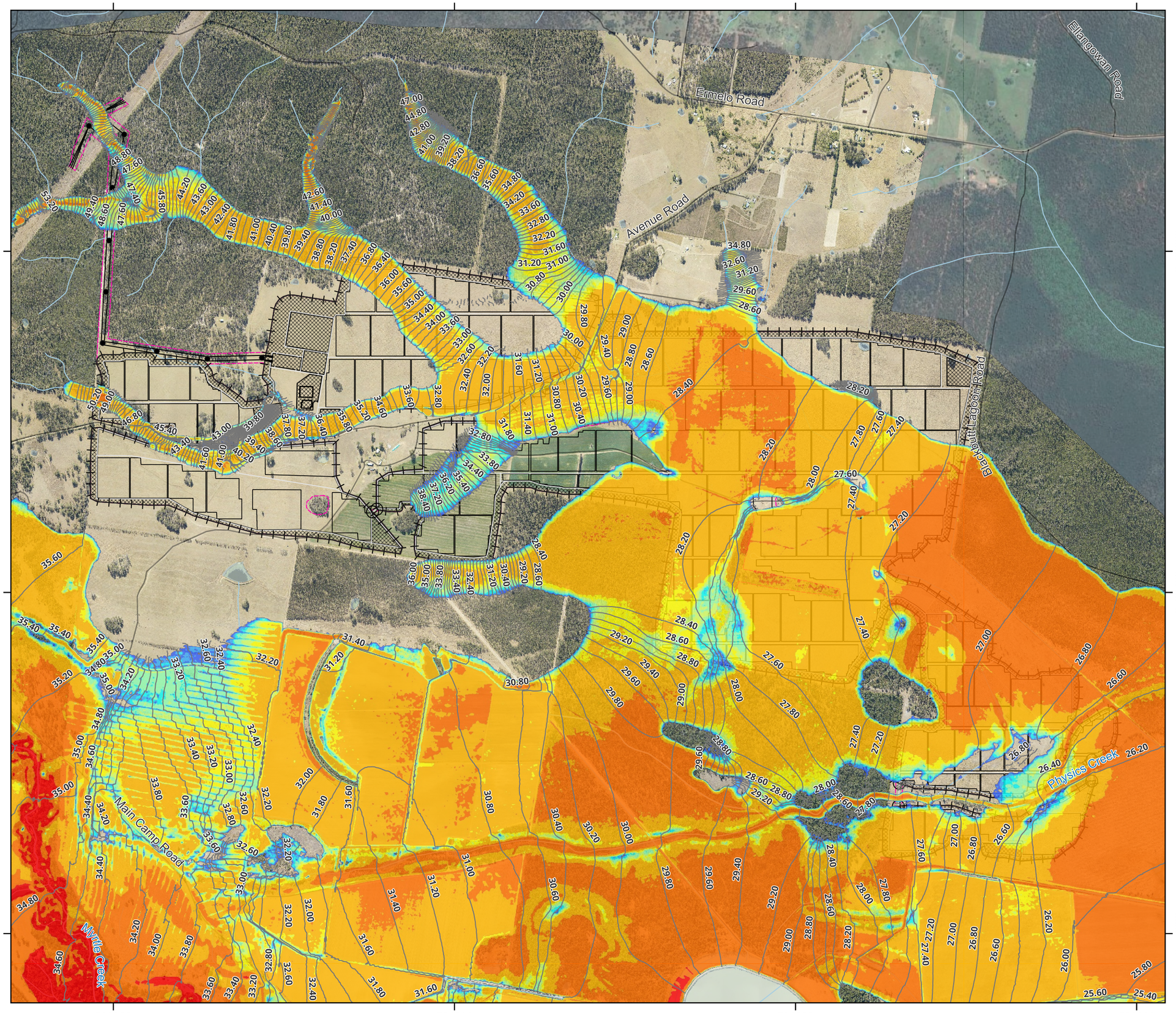
Model version: E02
Developed conditions - blockage scenario: SEN-A

0.2% AEP Event
Maximum Flood Extents and Depth Map

Figure 1-7



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block
- Water Level Contour

Max Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2.5
- > 2.5

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

PMF Event
Maximum Flood Extents and Depth Map

Figure 1-8



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

5% AEP Event
Afflux Mapping - Developed Scenario A vs Existing
5% AEP Event

Figure 1-9



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

2% AEP Event
Afflux Mapping - Developed Scenario A vs Existing
2% AEP Event

Figure 1-10



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Event
Afflux Mapping - Developed Scenario A vs Existing
1% AEP Event

Figure 1-11



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

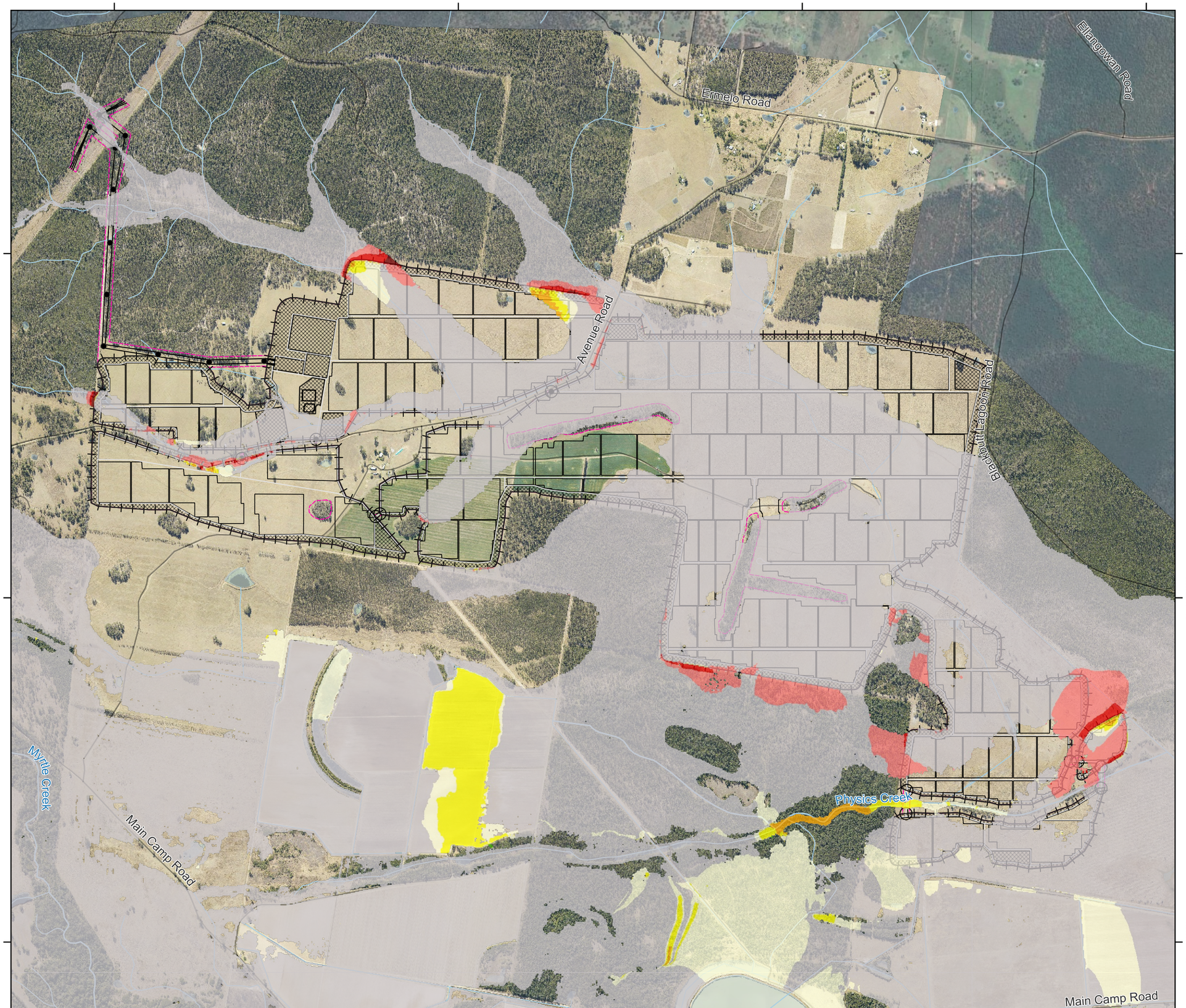
Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Climate Change Event
Afflux Mapping - Developed Scenario A vs Existing
1% AEP Climate Change Event

Figure 1-12



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

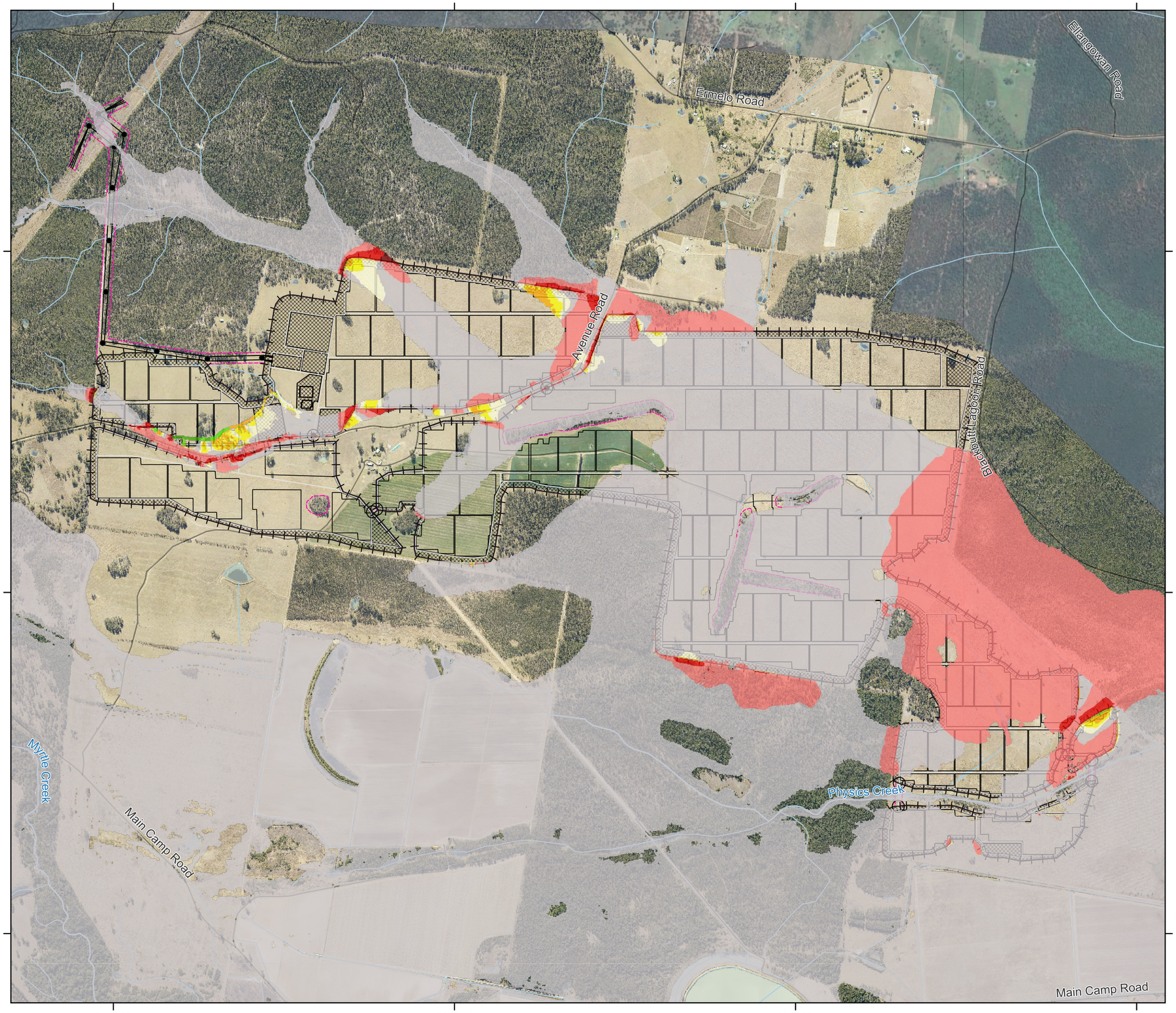
Model version: E02
Developed conditions - blockage scenario: SEN-A

0.5% AEP Event
Afflux Mapping - Developed Scenario A vs Existing
0.5% AEP Event

Figure 1-13



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

0.2% AEP Event
Afflux Mapping - Developed Scenario A vs Existing
0.2% AEP Event

Figure 1-14



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

PMF Event
Afflux Mapping - Developed Scenario A vs Existing
PMF Event

Figure 1-15



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-B

5% AEP Event
Afflux Mapping - Developed Scenario B vs Existing
5% AEP Event

Figure 1-16



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-B

2% AEP Event
Afflux Mapping - Developed Scenario B vs Existing
2% AEP Event

Figure 1-17



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-B

1% AEP Event
Afflux Mapping - Developed Scenario B vs Existing
1% AEP Event

Figure 1-18



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-B

0.5% AEP Event
Afflux Mapping - Developed Scenario B vs Existing
0.5% AEP Event

Figure 1-19



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-B

0.2% AEP Event
Afflux Mapping - Developed Scenario B vs Existing
0.2% AEP Event

Figure 1-20



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-C

5% AEP Event
Afflux Mapping - Developed Scenario C vs Existing
5% AEP Event

Figure 1-21



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-C

2% AEP Event
Afflux Mapping - Developed Scenario C vs Existing
2% AEP Event

Figure 1-22



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-C

1% AEP Event
Afflux Mapping - Developed Scenario C vs Existing
1% AEP Event

Figure 1-23



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-C

0.5% AEP Event
Afflux Mapping - Developed Scenario C vs Existing
0.5% AEP Event

Figure 1-24



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Afflux (m)

- <= -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- > 0.10

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-C

0.2% AEP Event
Afflux Mapping - Developed Scenario C vs Existing
0.2% AEP Event

Figure 1-25



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

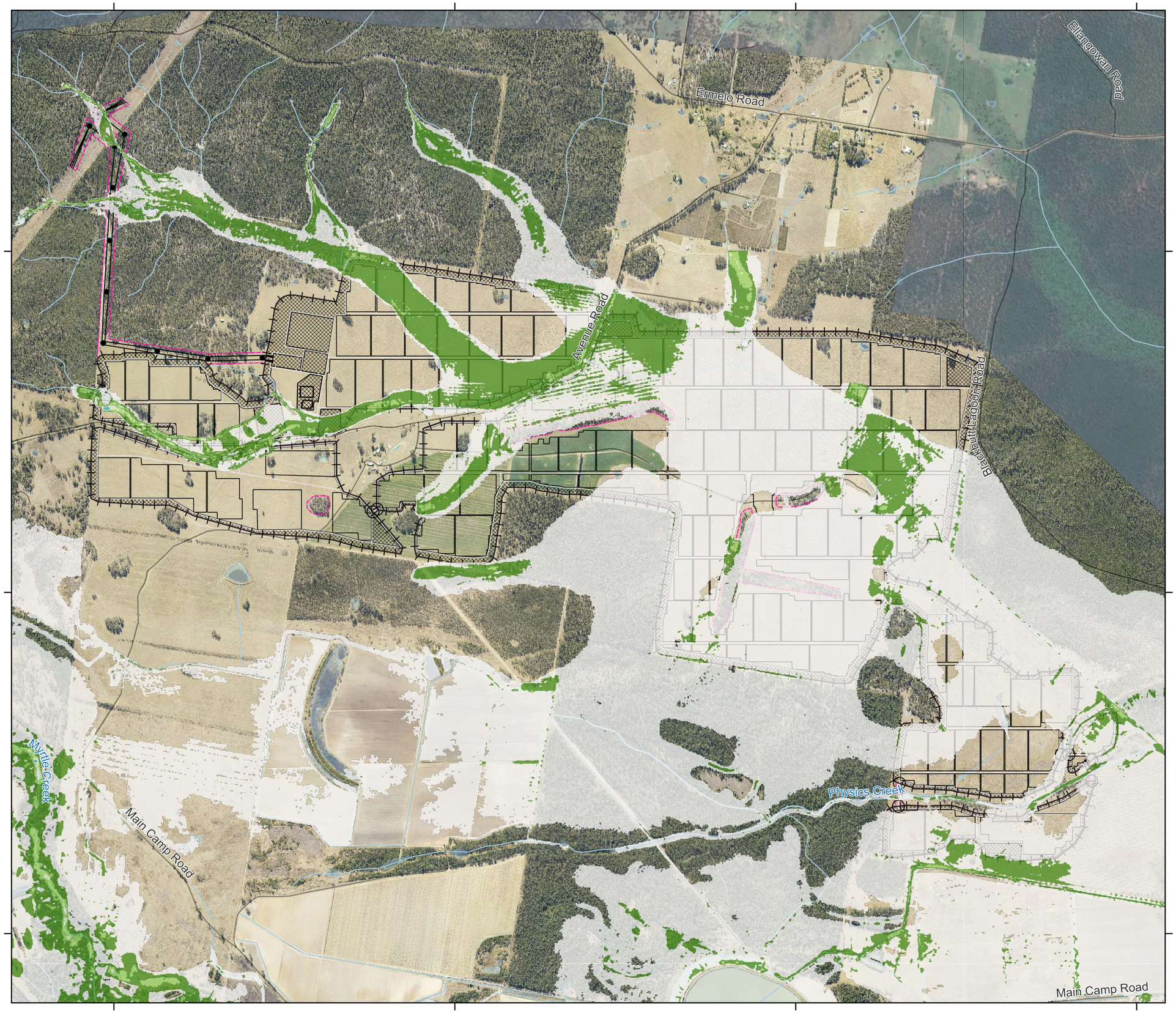
Model version: E02
Developed conditions - blockage scenario: SEN-A

5% AEP Event
Maximum Flood Velocity Map

Figure 1-26



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

2% AEP Event
Maximum Flood Velocity Map

Figure 1-27



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Event
Maximum Flood Velocity Map

Figure 1-28



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Climate Change Event
Maximum Flood Velocity Map

Figure 1-29



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

0.5% AEP Event
Maximum Flood Velocity Map

Figure 1-30



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]


## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

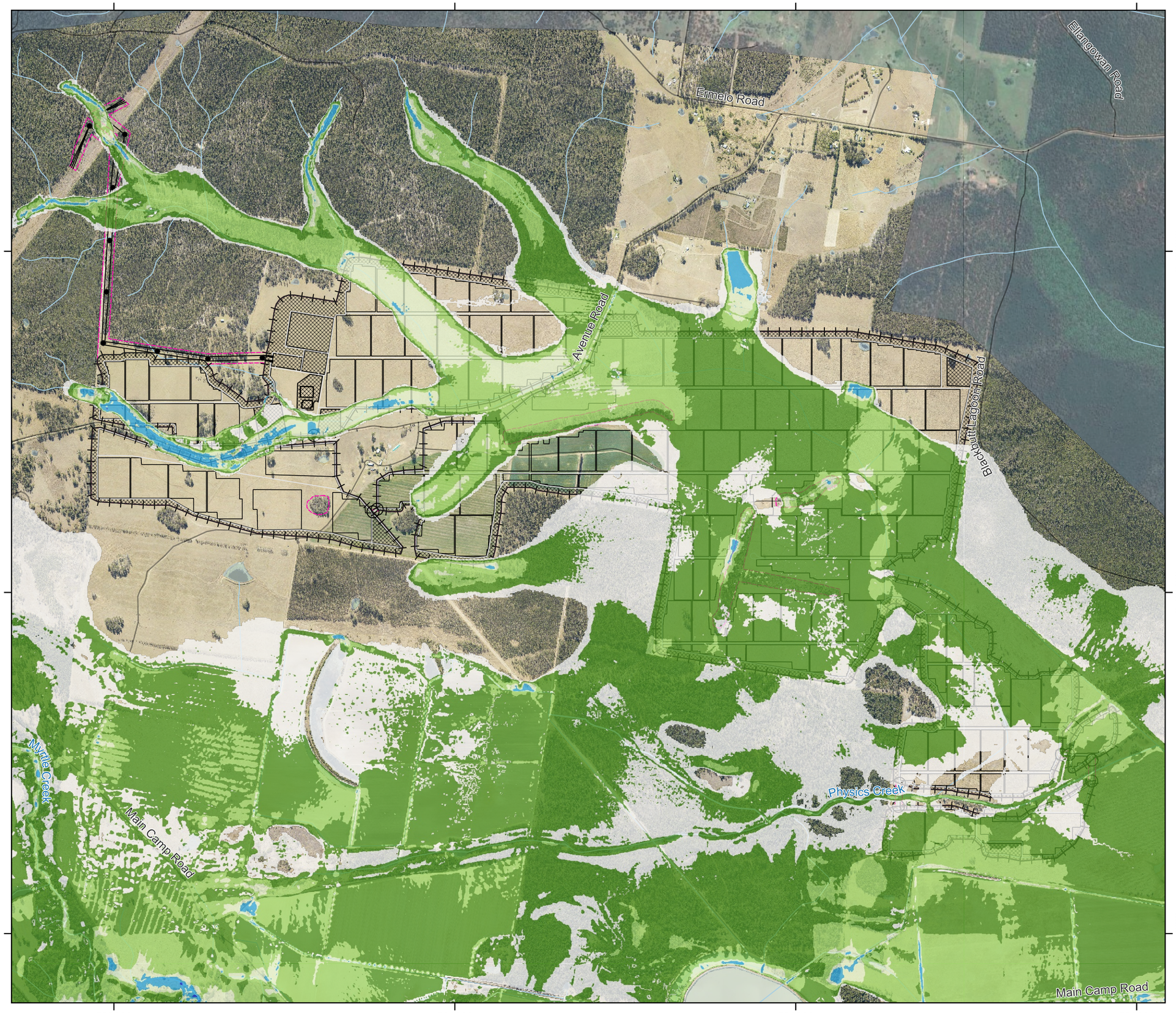
Model version: E02
Developed conditions - blockage scenario: SEN-A

0.2% AEP Event
Maximum Flood Velocity Map

Figure 1-31



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Max Velocity (m/s)

- 0.00 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- > 2

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

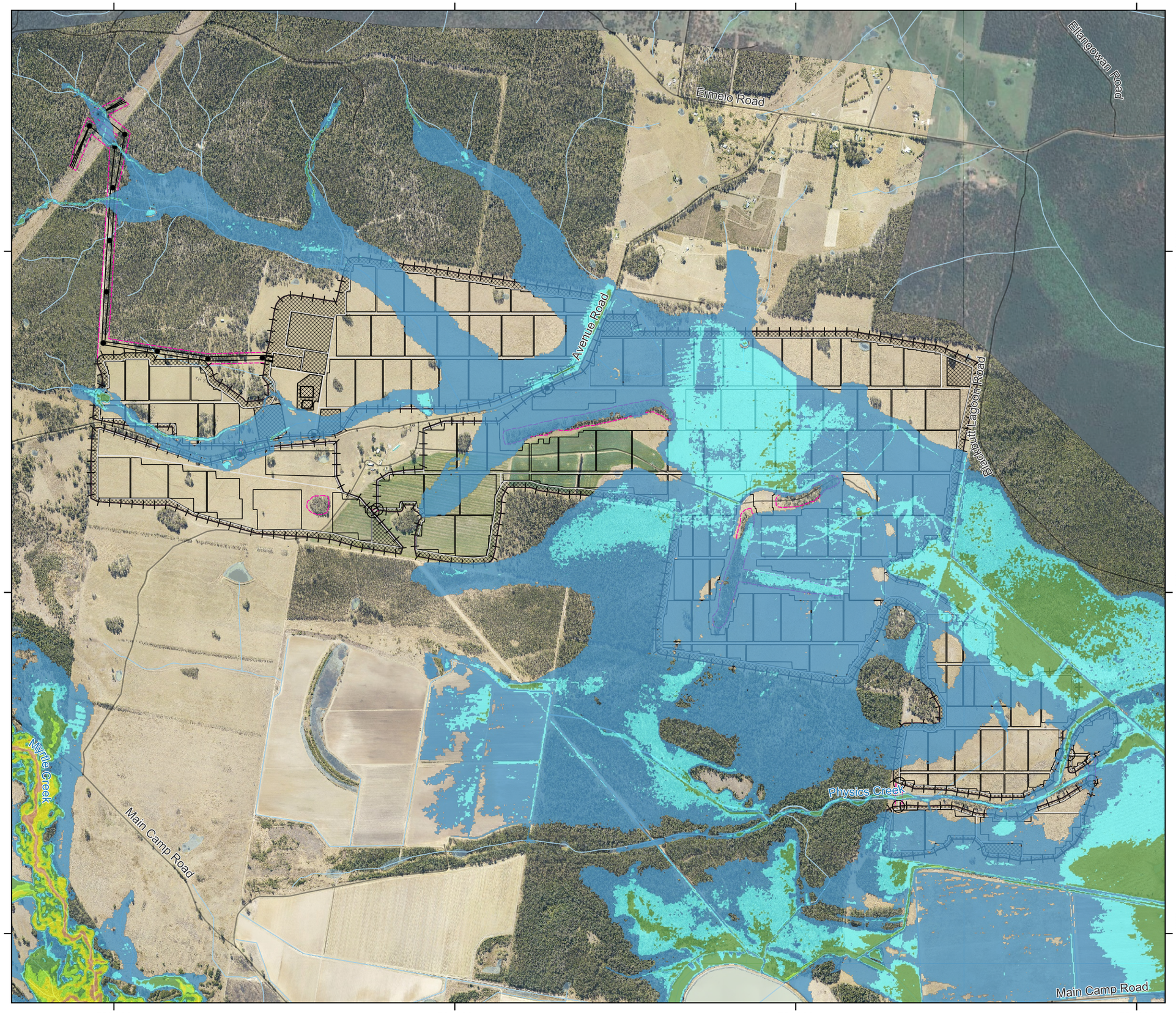
Model version: E02
Developed conditions - blockage scenario: SEN-A

PMF Event
Maximum Flood Velocity Map

Figure 1-32



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

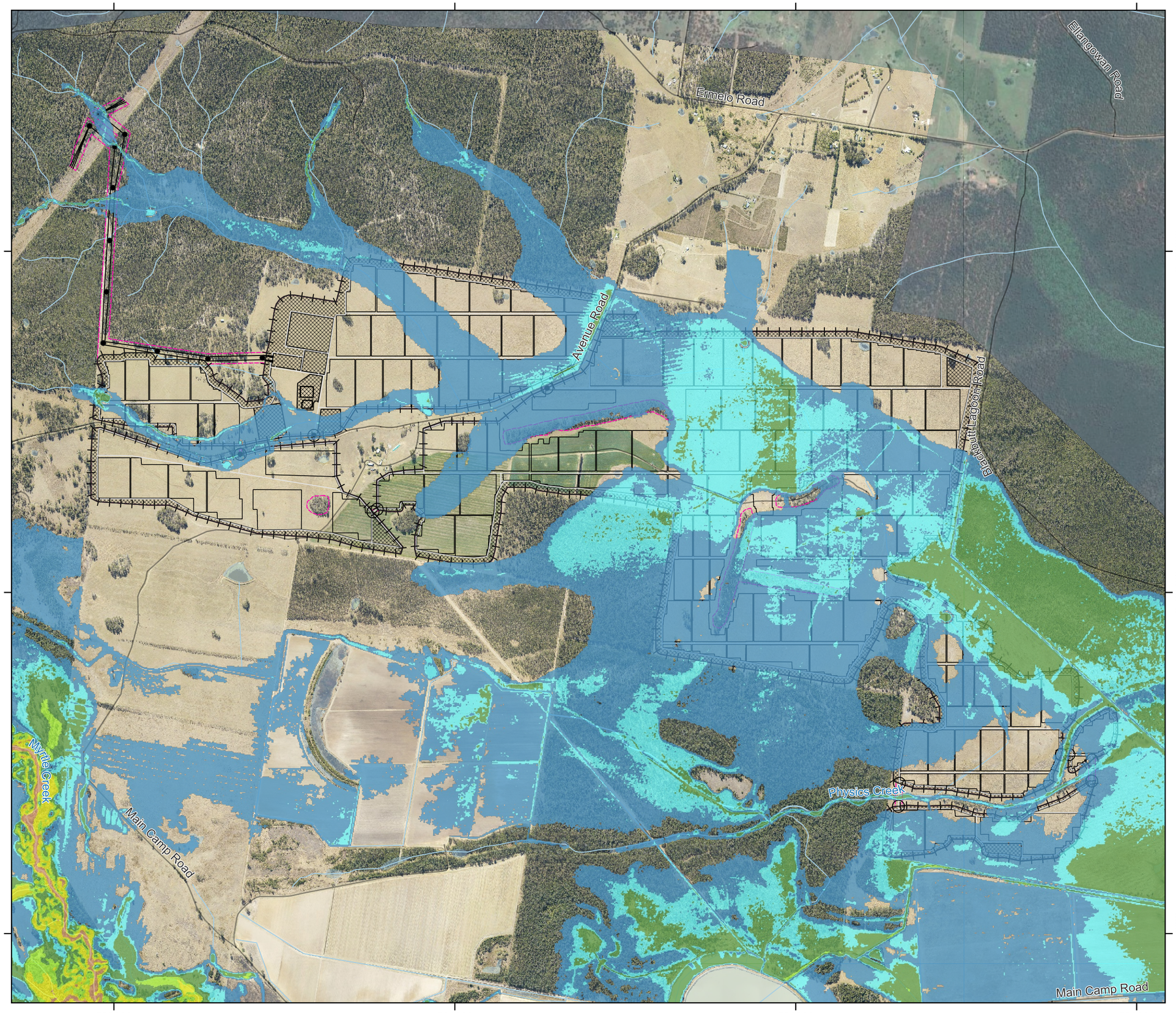
Model version: E02
Developed conditions - blockage scenario: SEN-A

5% AEP Event
Maximum Flood Hazard Map

Figure 1-33



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

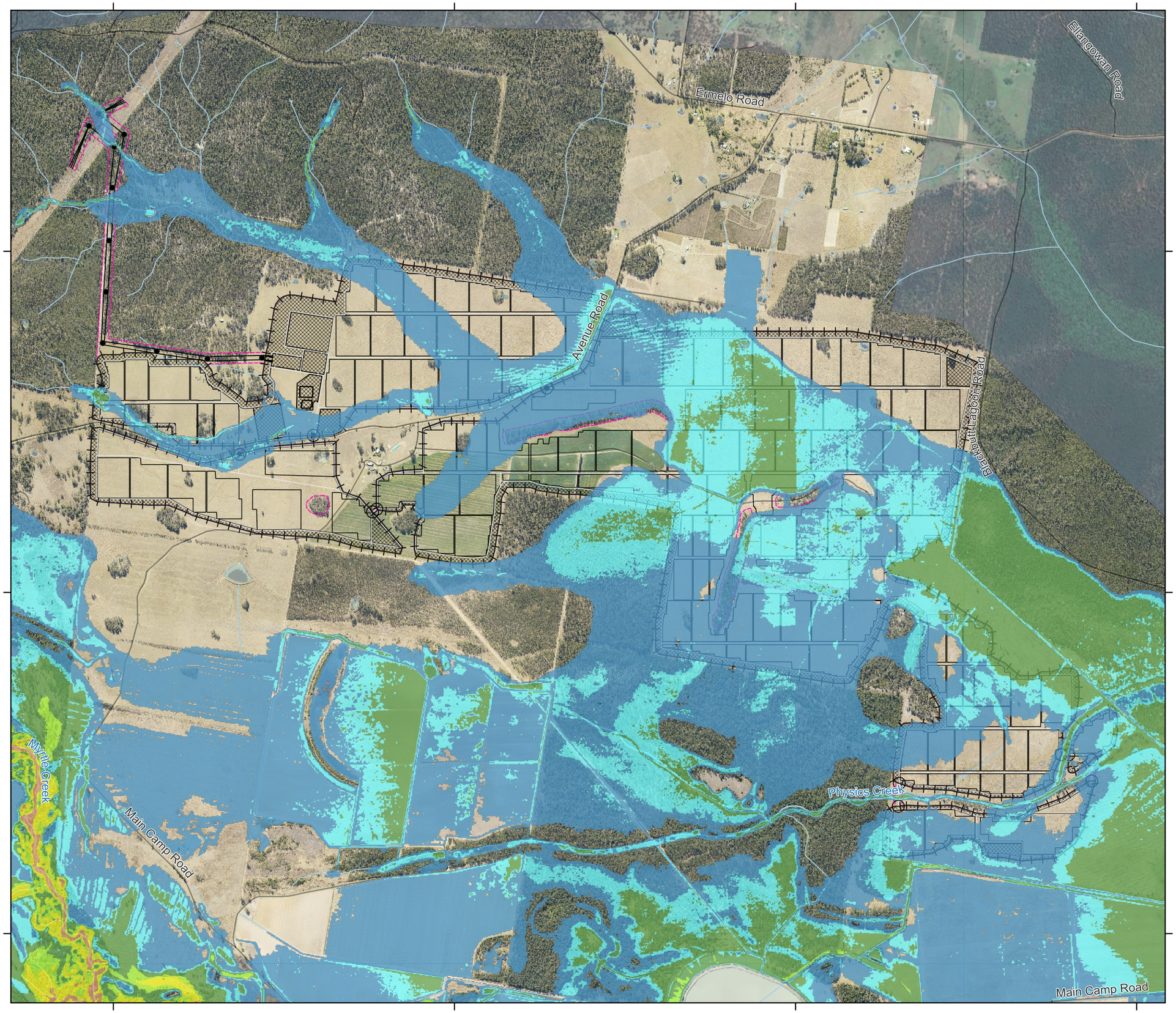
Model version: E02
Developed conditions - blockage scenario: SEN-A

2% AEP Event
Maximum Flood Hazard Map

Figure 1-34



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

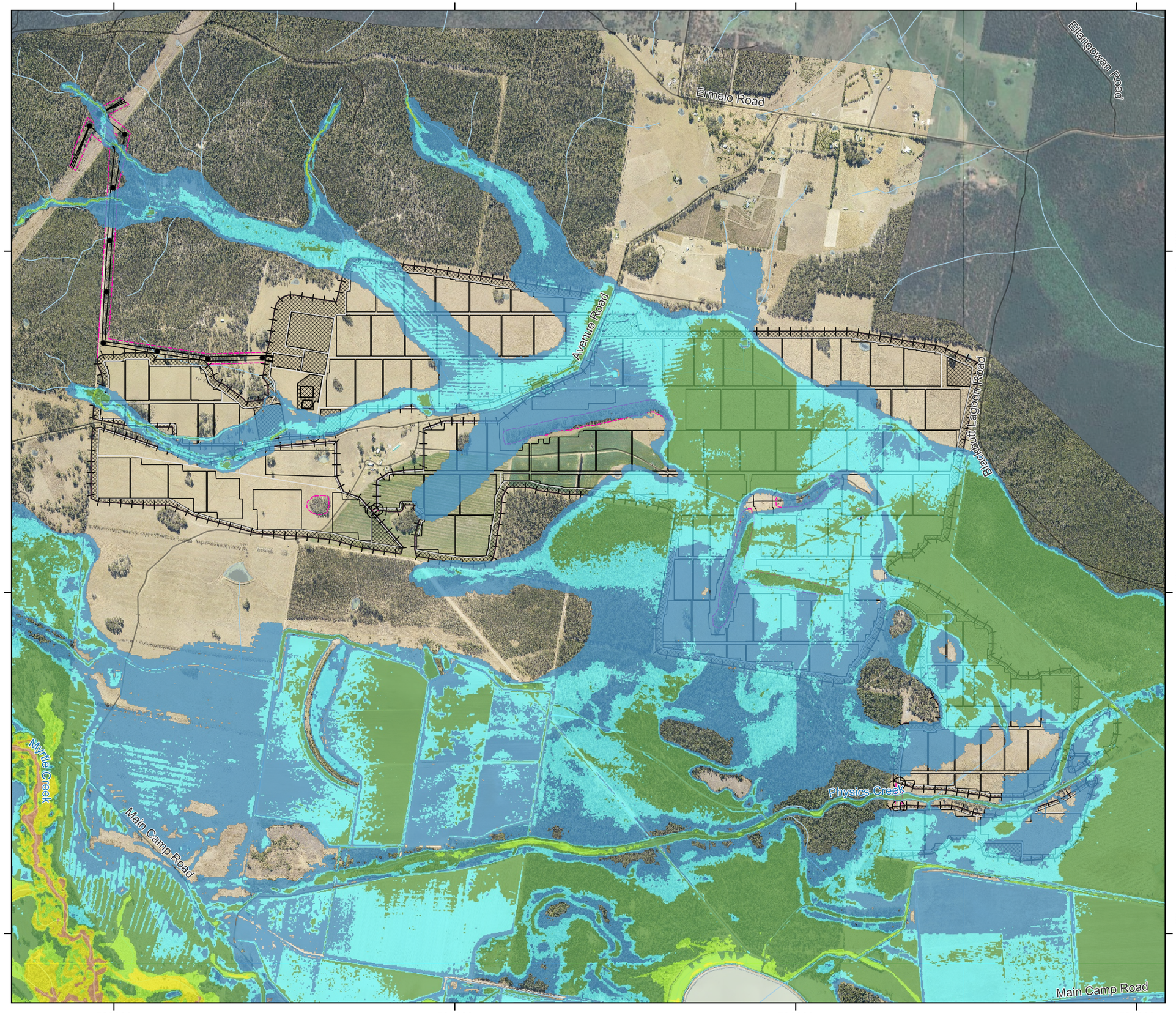
Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Event
Maximum Flood Hazard Map

Figure 1-35



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

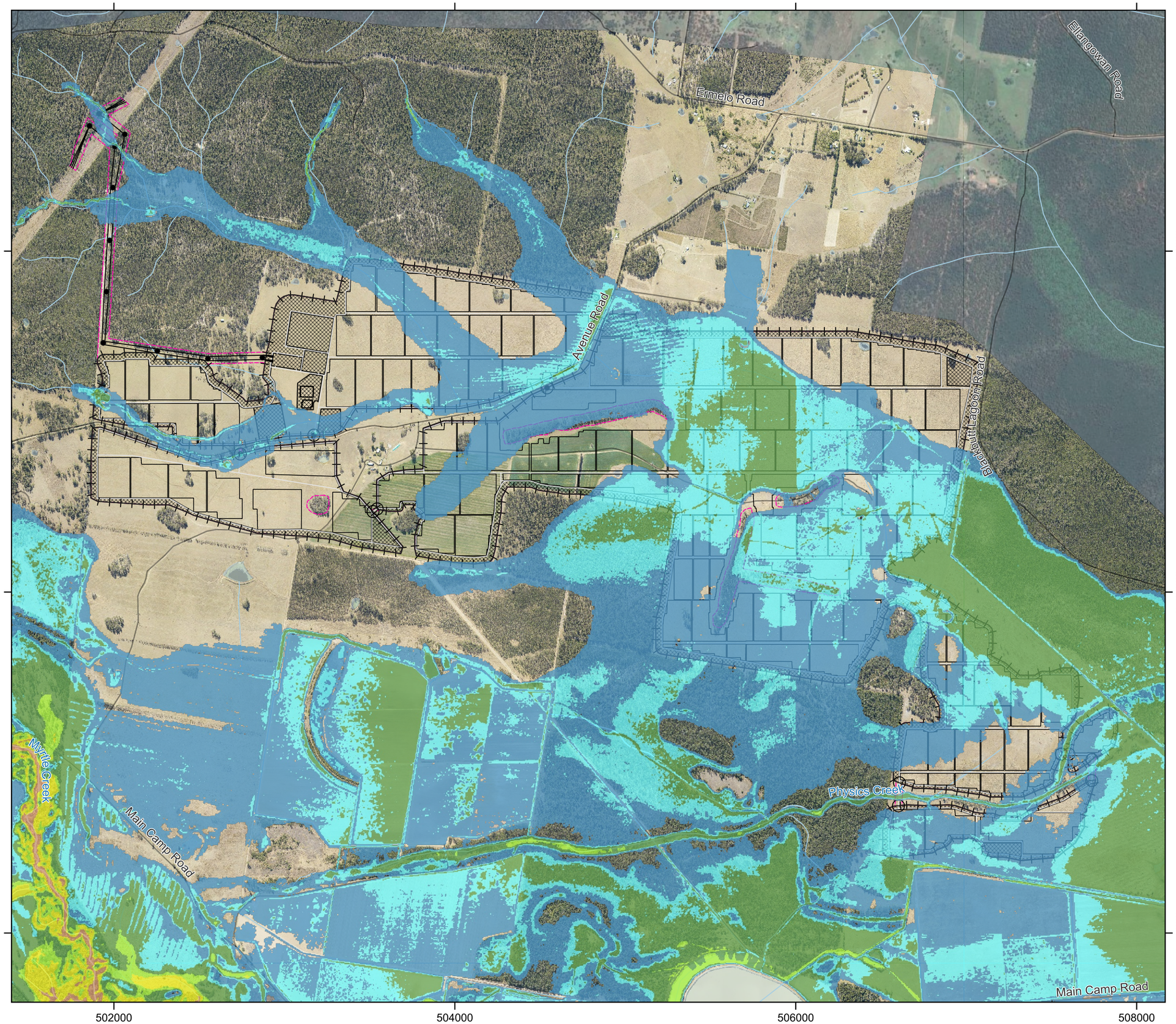
Model version: E02
Developed conditions - blockage scenario: SEN-A

1% AEP Climate Change Event
Maximum Flood Hazard Map

Figure 1-36



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

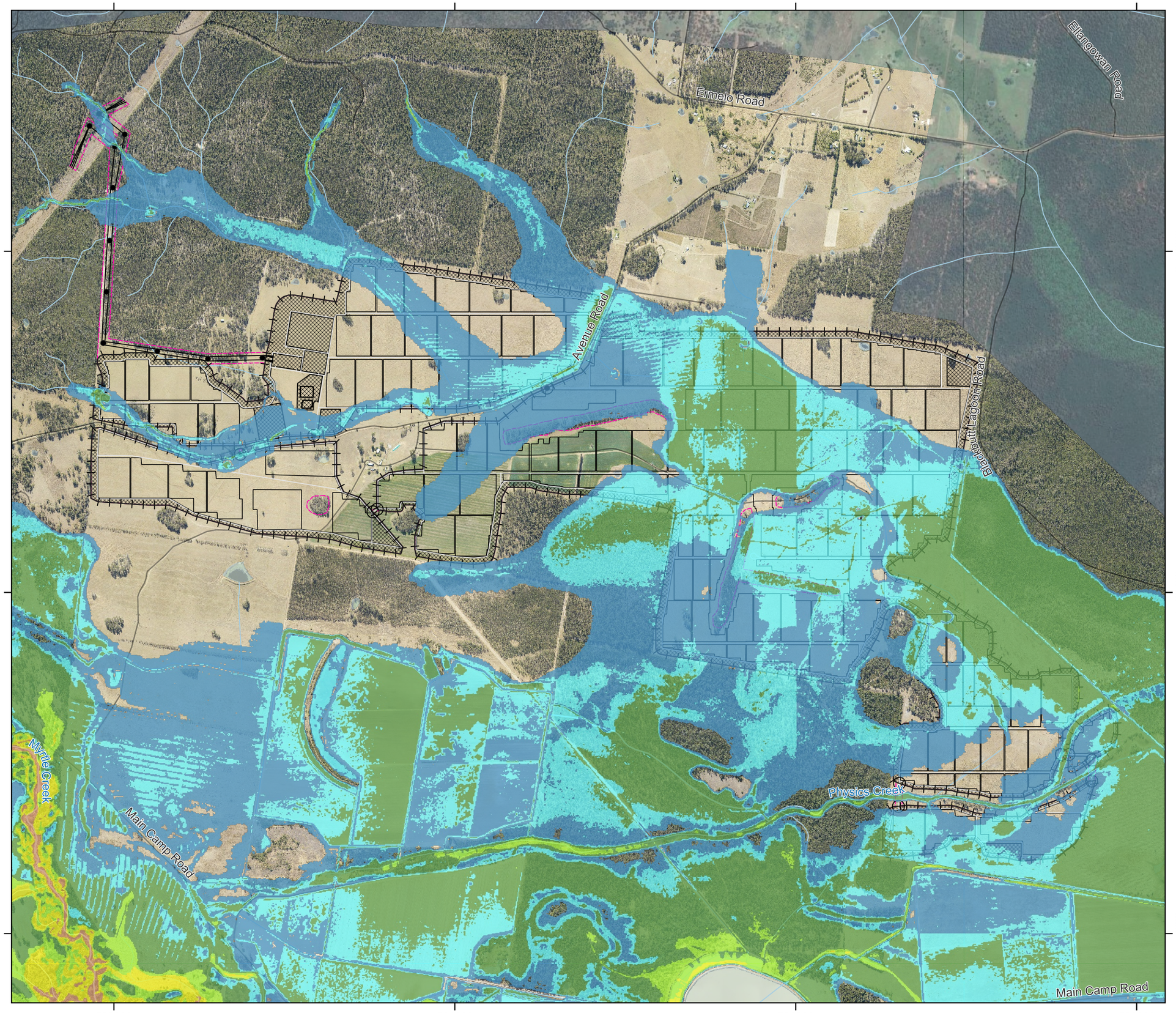
Model version: E02
Developed conditions - blockage scenario: SEN-A

0.5% AEP Event
Maximum Flood Hazard Map

Figure 1-37



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

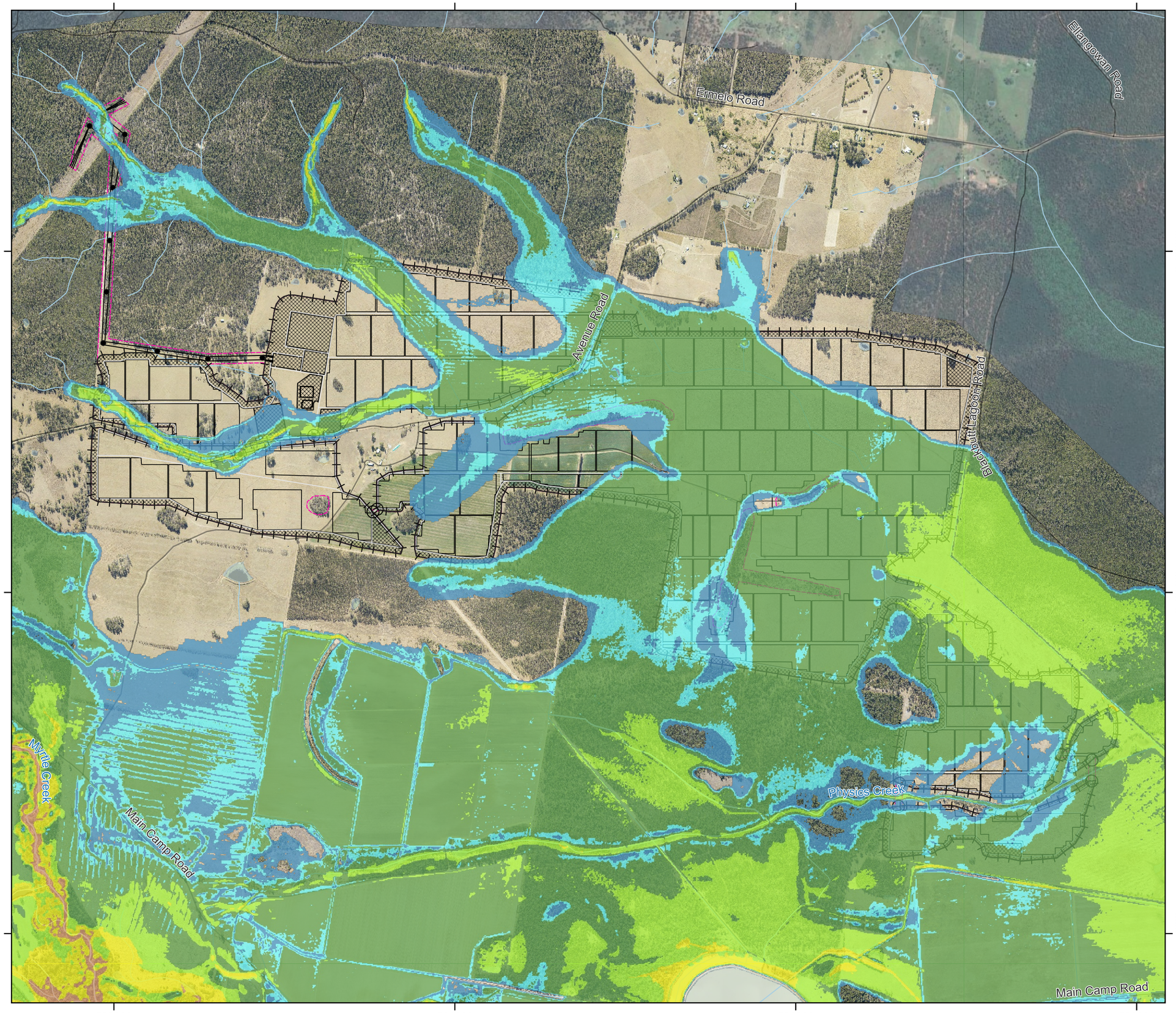
Model version: E02
Developed conditions - blockage scenario: SEN-A

0.2% AEP Event
Maximum Flood Hazard Map

Figure 1-38



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]




## Legend

- Development footprint
- Gate
- Point of interest
- Fence
- Transmission line
- Access track
- Road
- Waterway
- Waterbody
- Area of interest
- Solar array block

Hazard Vulnerability Classification

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

GA zone 56

N

0 750 1,500 m

SCALE 1:22,000

DRAWN: DG
REVIEWED: MC
APPROVED:

ARCADIS

DATE: 10/04/2024
PROJECT: Umwelt – Richmond Valley Solar Farm FIA Study Hydraulic & Hydrologic Modelling

Model version: E02
Developed conditions - blockage scenario: SEN-A

PMF Event
Maximum Flood Hazard Map

Figure 1-39



\\AUSY1FMFS01\Jobs2\30198596\02 GIS\00 Workspace\Richmond Valley TUFLOW_DG.qgz \ [% "Theme"%]