Flood Risk Report

ACEnergy BESS – 116 Cremasco Rd, Yenda, NSW

ACEnergy Pty Ltd

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Project Details

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1 INTRODUCTION

1.1 Overview

ACEnergy Pty Ltd are proposing to construct a large scale Battery Energy Storage System (BESS) at 116 Cremasco Road, Yenda, NSW (the subject site). The study objective was to better understand the flooding mechanisms within the site, particularly across the location where the battery farm is proposed to be constructed. This site is referred to as 'the subject site' within this report. The report presents the flood modelling assumptions and results together with an investigation of the subject site flood risk.

1.2 Objectives

To provide ACEnergy with a better understanding of the flooding and drainage behaviour within the subject site, the following tasks were completed:

- Review of existing flood information. An existing flood study is available for the study area and is discussed in Section 2.1.
- Development of a 2D (Two-Dimensional) hydraulic flood model (TUFLOW), using a Rain-on-Grid (RoG) methodology to assess flood risk from stormwater runoff.
- Provision of high-level recommendations for any mitigation or design alterations which may be required to reduce potential risks associated with flooding and drainage.

1.3 Site

The subject site is located approximately 1.6 km east of Yenda, 15.0 km northeast of Griffith in the Riverine district of NSW, as shown in Figure 1-1. The subject site has an agricultural land use, dominantly livestock grazing.

The site facility is proposed to be installed on flat terrain at an average elevation of 131.5 mAHD (Figure 1-3). There are several irrigation channels around the proximity of the subject site. The Main Canal is approximately 1.2 km to the southwest of the subject site.

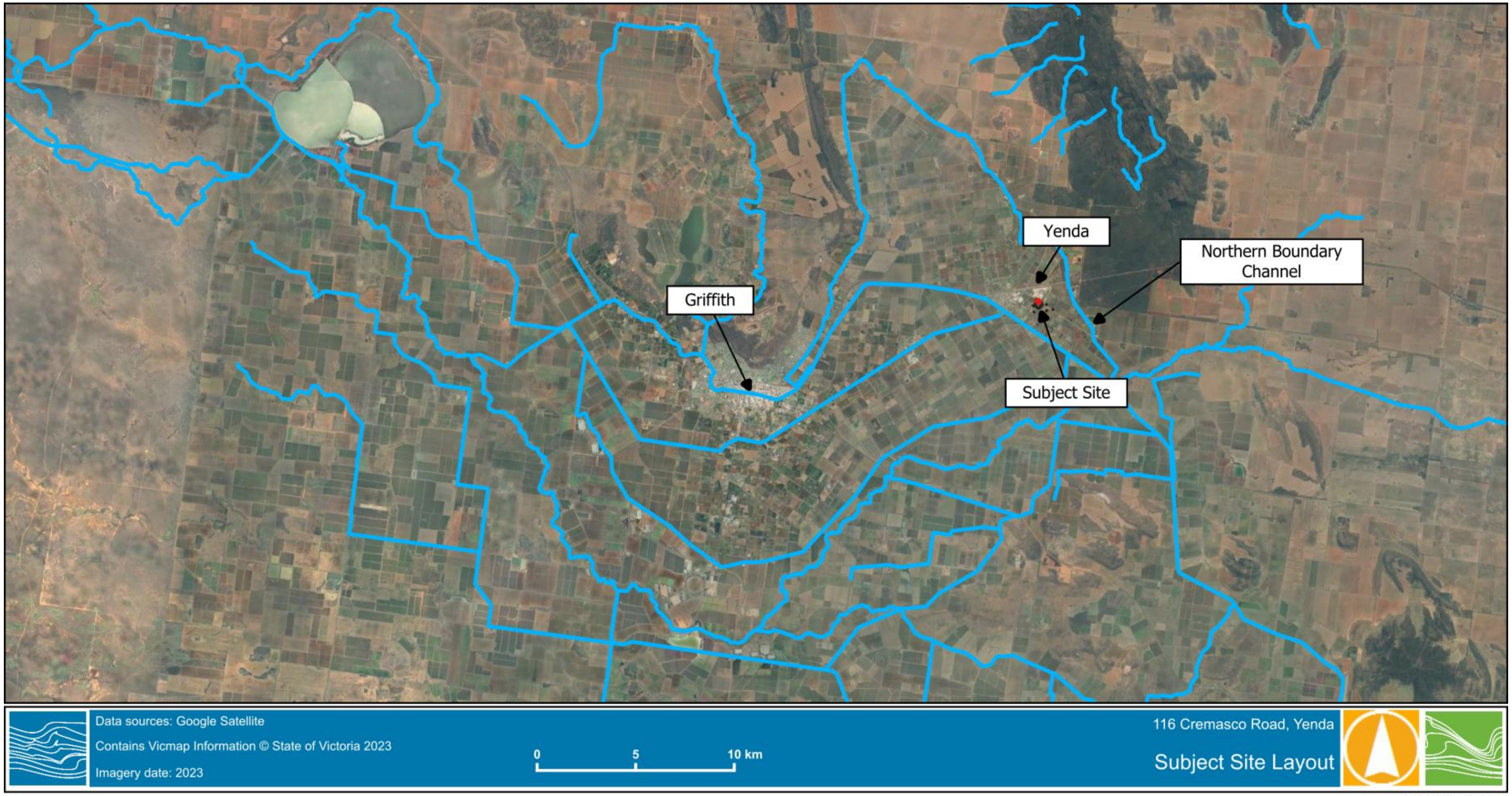

FIGURE 1-1 SUBJECT SITE LOCATION

FIGURE 1-2 SUBJECT SITE

FIGURE 1-3 SUBJECT SITE TOPOGRAPHY

2 FLOODING

2.1 Previous Flood Study

The *Griffith Main Drain J and Mirrool Creek Flood Study Update* was conducted for Griffith City Council in 2021[1]. Figure 2-1 shows the Griffith Main Drain J Catchment 1% AEP flood conditions around the subject site. The subject site is not impacted by the 1% AEP flood extent.

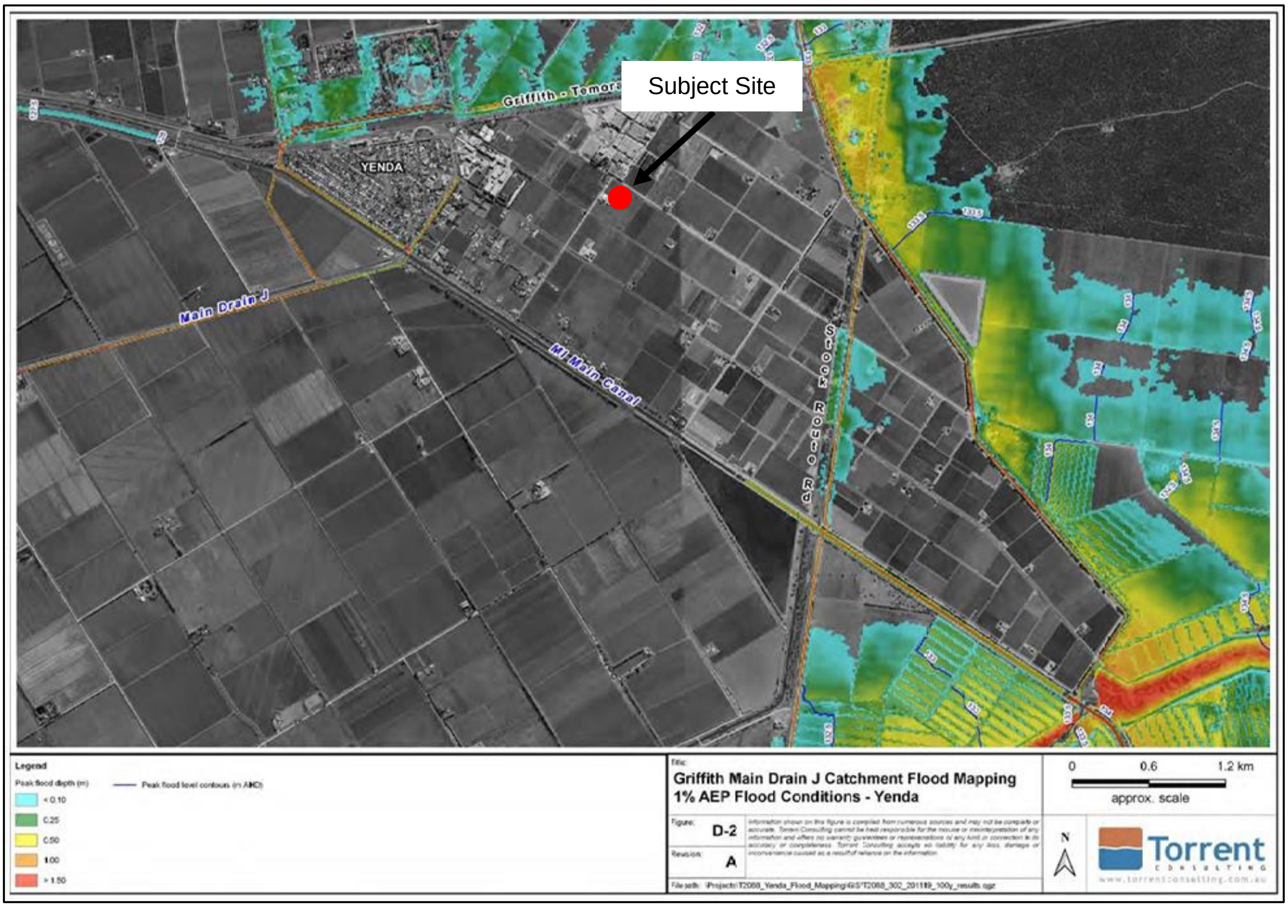

FIGURE 2-1 THE GRIFFITH MAIN DRAIN J AND MIRROOL CREEK FLOOD STUDY UPDATE 1% AEP EXTENT (SOURCE: GRIFFITH CITY COUNCIL)

2.2 Methodology

A two-dimensional Rain on Grid (RoG) hydraulic modelling approach was employed for this investigation using TUFLOW hydraulic flood modelling software. Simulations were completed using TUFLOW Build 2023-03-AB Single Precision with HPC (Highly Parallelised Computations) solution scheme on a GPU solver, and were completed inline with Australian Rainfall and Runoff (ARR) 2019[2] guidelines.

[1] https://files.griffith.nsw.gov.au/Griffith%20Main%20Drain%20J%20&%20Mirrool%20Creek%20Flood%20Study%20Vol%202.%202021.pdf
[2] https://arr.ga.gov.au/arr-guideline

The RoG methodology is extensively used for flood mapping of urban and rural areas. It allows for a comprehensive flood risk assessment by identifying overland flow paths based on the topography dataset as illustrated in the flow chart in Figure 2-2.

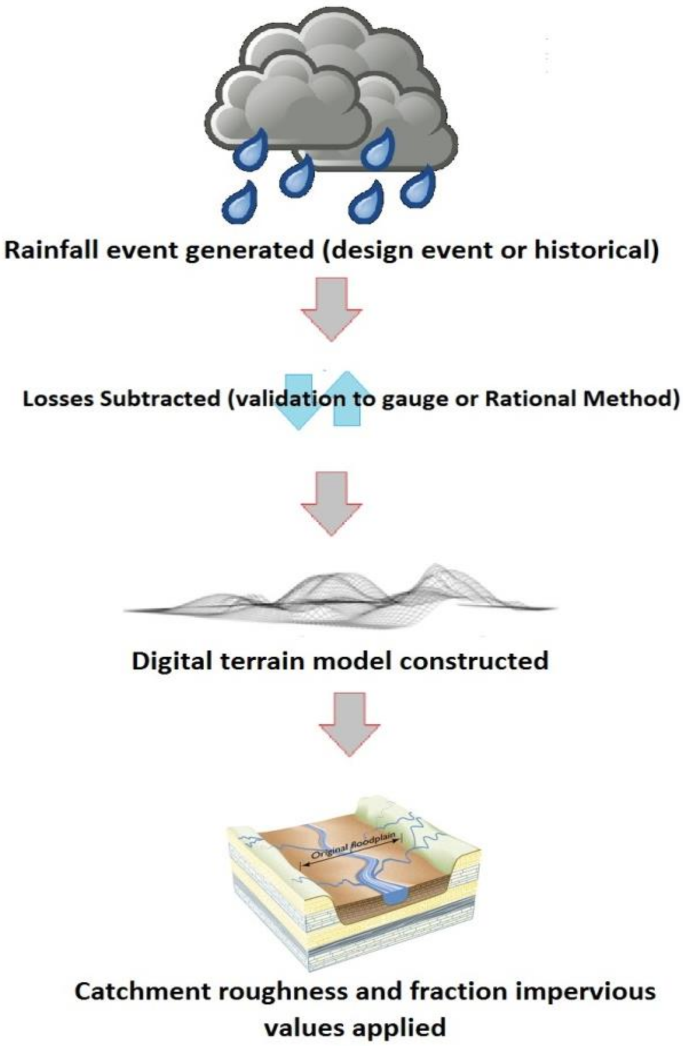

FIGURE 2-2 RAINFALL ON GRID MODELLING APPROACH

A new hydraulic model was constructed using land use, cadastral, topography and aerial photography datasets to identify different land uses which are represented from a hydrologic and hydraulic perspective as surface roughness and initial and continuing loss values.

The upstream catchment and wider area were modelled. The TUFLOW model set-up is presented in Figure 2-3, highlighting the model extent. Other features of the hydraulic model build include:

- The rainfall layer, which consists of one single rainfall polygon over the model extent was produced in a GIS package.
- Hyetographs (rainfall depth timeseries) were created for a range of design rainfall AEP (Annual Exceedance Probability) events and durations using QGIS TUFLOW plugin and the 2016 Bureau of Meteorology (BoM) Intensity Frequency Duration (IFD) at the centroid of the catchment. These were applied to the TUFLOW model to represent catchment rainfall under various durations for the 1% AEP design storm.

FIGURE 2-3 TUFLOW MODEL SETUP

2.2.1 Digital Elevation Model, Losses and Hydraulic Roughness

A Digital Elevation Model (DEM) was generated from 1 m resolution LiDAR, supplied by NSW Spatial Services via Geoscience Australia's Elevation Information System (ELVIS)[3].

Table 2-1 summarises the rainfall losses and hydraulic roughness used for the hydraulic modelling as per the land use types within the model. These values were adopted based on Water Technology's experience with RoG models in the surrounding area.

A check was also undertaken to test the sensitivity of infiltration losses. It was found that reducing the initial loss by 50% for the critical duration (1% AEP, 360 minutes, TP01) had negligible impacts on the flood extent and maximum flood depths (<2cm) around the subject site.

TABLE 2-1 MODEL PARAMETERS

Land use types	Manning's 'n' (roughness)	Initial loss (mm)	Continuing loss (mm/hr)
Open pervious area	0.040	17	4
Residential – rural (low density)	0.150	17	4
Residential – rural (high density)	0.5	0	0
Roads/carpark/paved area	0.025	1	0.5
Industrial/commercial	0.35	0	0

[3] https://elevation.fsdf.org.au/

Land use types	Manning's 'n' (roughness)	Initial loss (mm)	Continuing loss (mm/hr)
Waterways/channels	0.030	0	0

2.2.2 Boundaries

A tailwater (2D TUFLOW 'HQ') boundary was set and extended around the downstream model boundary to allow overland flow to freely drain out of the model, with a constant slope of 0.5%.

2.2.3 TUFLOW Model Checks

- The following checks were undertaken on the TUFLOW model parameters and outputs:
  - 2D timestep: The adaptive 2D timestep drops to a minimum of 0.5 seconds. A 'Classic' TUFLOW model would be expected to have a timestep no less than ¼ of the grid size (5 m), i.e. 1.25 seconds, with a healthy HPC model no lower than a tenth of this figure. Hence, the adopted timestep is within the recommended range.
  - Model mass errors: The mass errors for all models was less than 1% and within the recommended range.
  - Errors and warning messages: No errors were found within the model and all warnings were reviewed and either acceptable or fixed, if required.

2.2.4 Critical Duration and Temporal Pattern Assessment

The model was simulated for the following 1% AEP design storm durations; 3, 6, 12, & 24 hours, using three ARR 2019 temporal patterns representative of front, mid and back loaded storm events.

Results were processed to select the combination of durations and temporal patterns resulting in the maximum flood depths throughout the catchment and covering the site. This is a conservative method of identifying areas prone to inundation in a 1% AEP event.

The modelled durations and temporal patterns are shown in Table 2-2.

TABLE 2-2 MODELLED DURATION AND TEMPORAL PATTERN

AEP Event	1%
Durations	3, 6, 12, & 24 hours
Temporal Pattern	TP01, TP05, TP09

2.3 Flood Hazard Classification

Floods can be hazardous, producing harm to people, damage to infrastructure and potentially loss of life. In examining potential flood hazard there are several factors to be considered, as outlined in ARR 2019 (Book 6 Chapter 7)[4]. An assessment of flood hazard should consider:

- Velocity of floodwater.
- Depth of floodwater.
- Combination of velocity and depth of floodwater.
- Isolation during a flood.
- Effective warning time.
- Rate of rise of floodwater.

The flood hazard of the site was assessed in accordance with ARR2019, which defines six hazard categories. The combined flood hazard curves are presented in Figure 2-4 and vulnerability thresholds classifications are tabulated in Table 2-3.

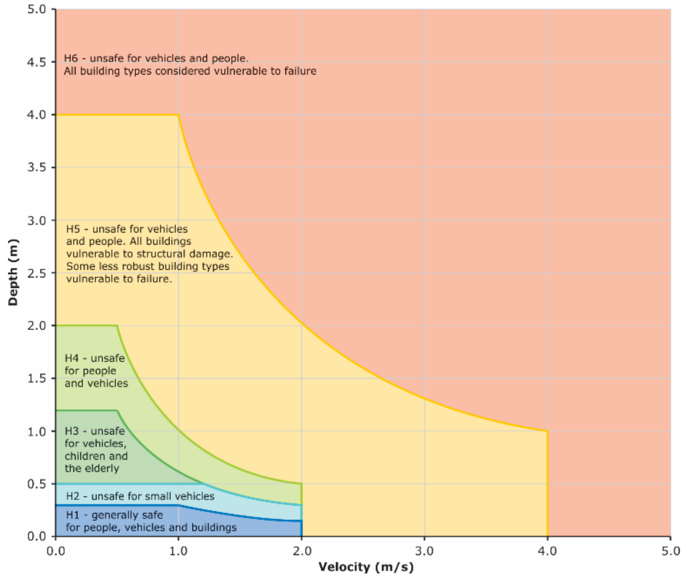

FIGURE 2-4 COMBINED FLOOD HAZARD CURVES

TABLE 2-3 HAZARD CLASSIFICATION (ARR, 2016)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)	Description
H1	D*V ≤ 0.3	0.3	2.0	Generally safe for vehicles, people and buildings.
H2	D*V ≤ 0.6	0.5	2.0	Unsafe for small vehicles.
H3	D*V ≤ 0.6	1.2	2.0	Unsafe for vehicles. Children and the elderly.
H4	D*V ≤ 1.0	2.0	2.0	Unsafe for vehicles and people.
H5	D*V ≤ 4.0	4.0	4.0	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	D*V > 4.0	-	-	Unsafe for vehicles and people. All building types considered vulnerable to failure.

[4] http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/

2.4 Results

The existing conditions 1% AEP depth, velocity and flood hazard results are shown from Figure 2-5 to Figure 2-7. The flood depth map was filtered for small depths (below 0.02 m) and puddles less than $100m^2$ were removed.

The following observations can be made for the 1% AEP storm event:

- The maximum depth within the site is approximately 130 mm. Due to the flat terrain around the area, the main flow path is shallow sheet flow, flowing from the northeast to the southwest of the site. The flood depths on the site are relatively shallow ranging from 50 – 130 mm.
- Modelled peak velocities within the proposed facilities extent are relatively low, with a maximum of approximately 0.07 m/s.
- A flood hazard map was created from the product of both depth and velocity as described in the previous section. The subject site and facilities are classified as H1 ‘Generally safe for vehicles, people, and buildings’. This is to be expected of shallow water with low velocity, ponding across the site rather than traversing it.

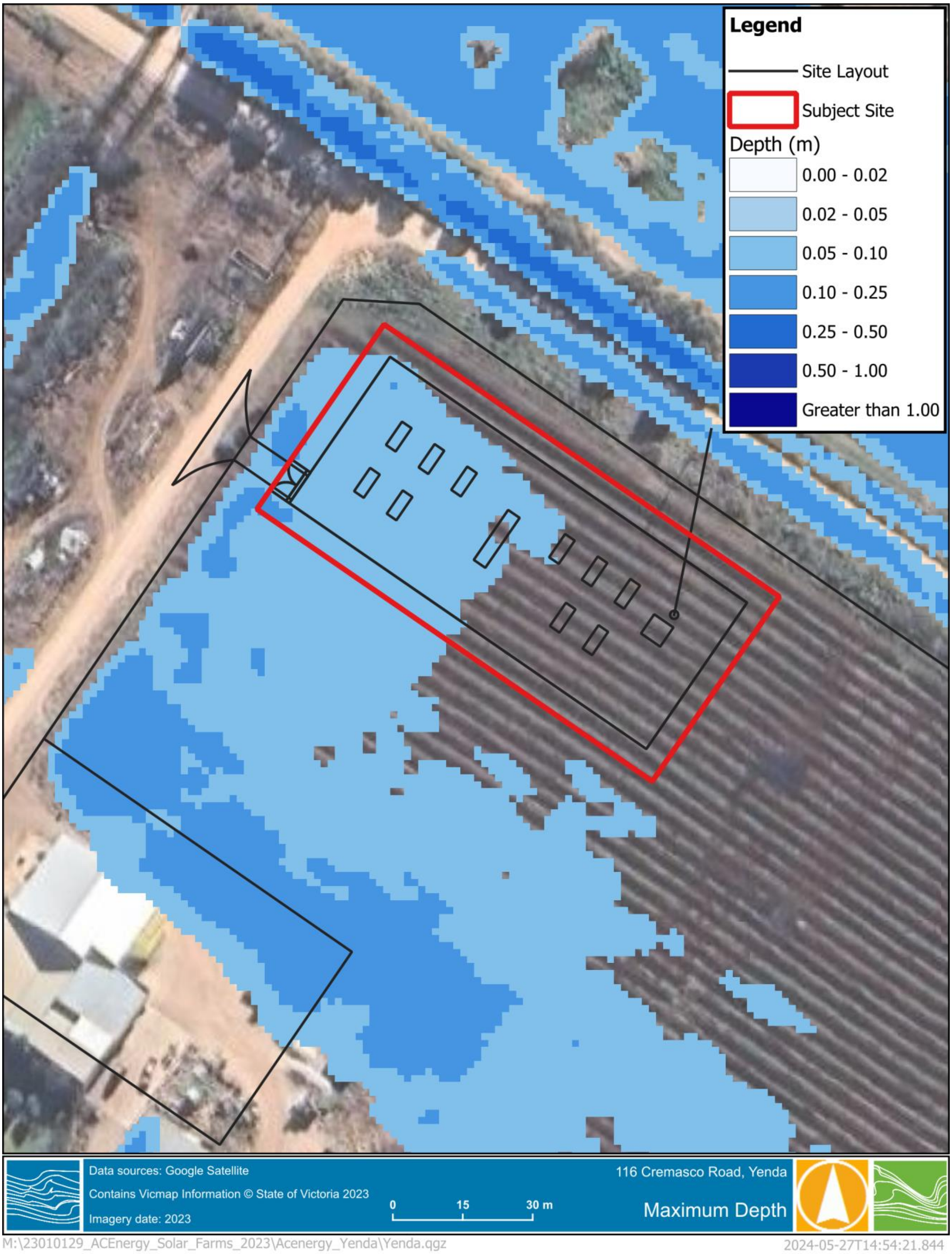

FIGURE 2-5 1% AEP MAXIMUM FLOOD DEPTH (DEPTHS BELOW 0.02M NOT SHOWN)

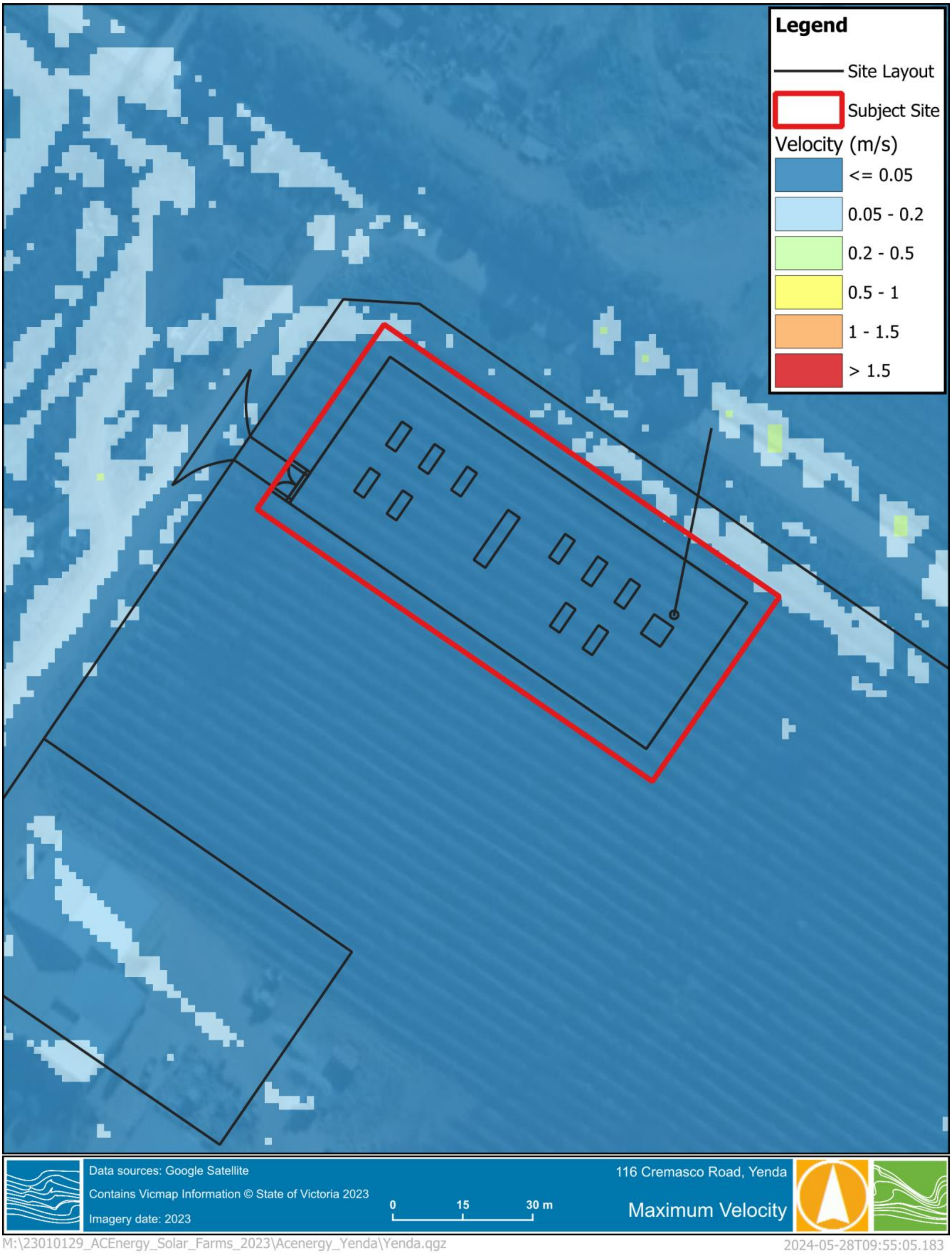

FIGURE 2-6 1% AEP MAXIMUM FLOOD VELOCITY

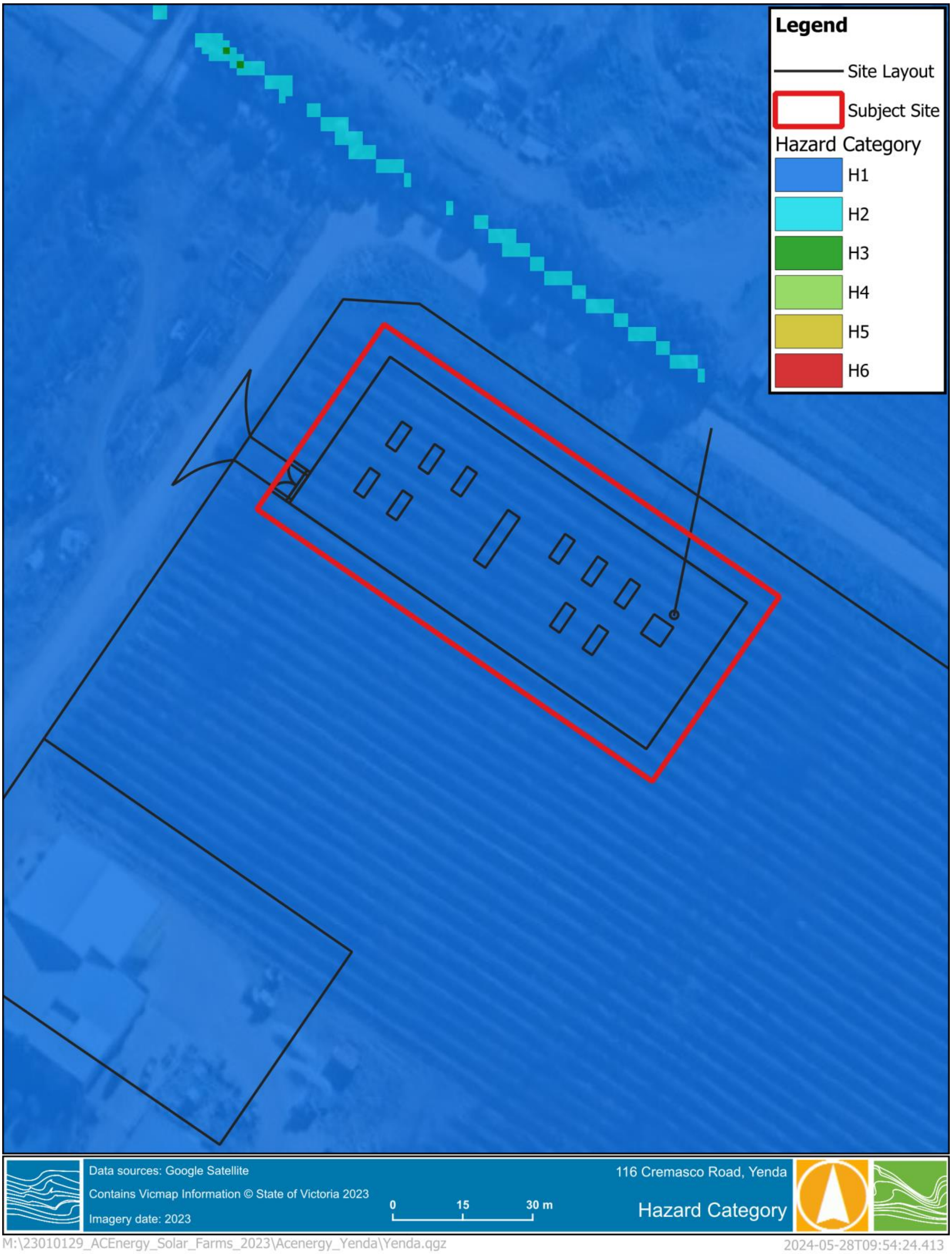

FIGURE 2-7 1% AEP MAXIMUM FLOOD HAZARD

3 CONCLUSIONS AND RECOMMENDATIONS

The flood investigation provided within this report provides flood mapping for the proposed BESS at 116 Cremasco Road, Yenda NSW. A 2D hydraulic flood model was developed and modelling undertaken in line with the latest flood modelling software; industry standards (i.e. BoM IFD and ARR 2019 guidelines) and the latest available 1 metre LiDAR dataset. Modelling simulated the 1% AEP design storm event.

The *Griffith Main Drain J and Mirrool Creek – Yenda Flood Mapping Update* was conducted for Griffith City Council in 2021 to update the existing flood mapping from 2015. The study mapped the 1% AEP flood extent of Main Drain J and Mirrool Creek. The subject site is not impacted by the 1% AEP flood extent with the hydraulic control in place for the flow coming out from the Bunyip State Forest and Northern Boundary Channel.

The flood modelling and mapping, however, show that there are overland flow paths across the site with peak flood depths below 130 mm across the area of interest. Upstream catchment flow is generally excluded from the site due to the Northern Boundary Channel acting as a hydraulic control limiting runoff from entering the site. Additional hydraulic control of raised stormwater channels around the borders of properties around the area has also intercepted some of the flow into the stormwater drain.

Similarly, runoff from within the site shows main flow paths are typically shallow with maximum depths between 50 and 130mm through the site. Maximum flood velocities are all low with a maximum of 0.07 m/s, resulting in the site being classified as flood hazard H1 (generally safe for people, vehicles and buildings).

Given stormwater modelling reaching up to 130 mm, it is recommended that the infrastructure be a minimum of 300 mm above ground level.

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