VENANT SOLUTIONS

Hazelwood North Solar Farm

Hydrology and Flood Impact Assessment – Concept Design

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1 Introduction

Venant Solutions was commissioned by Manthos Investments Pty Ltd to undertake a hydrology and flood impact assessment for a proposed solar farm development in Hazelwood North (the Site) to support the planning approval process.

The purpose of this assessment is to:

- Identify the regulatory requirements and guidelines that inform the approval and design criteria for the prosed solar farm
- Define the flood risk across the Site
- Develop concept flood mitigation works based on the concept design to inform future design phases.

This assessment was informed by a Site Visit undertaken on 16 May 2022 and inputs from other disciplines as described throughout the report.

The focus of this assessment is on managing the risks associated with stormwater and flood water quantity. Stormwater quality and groundwater quality objectives and management measures have not been assessed.

The outcomes of this assessment (Version 1) were presented to the West Gippsland Catchment Management Authority (WGCMA) on 30 March 2023.

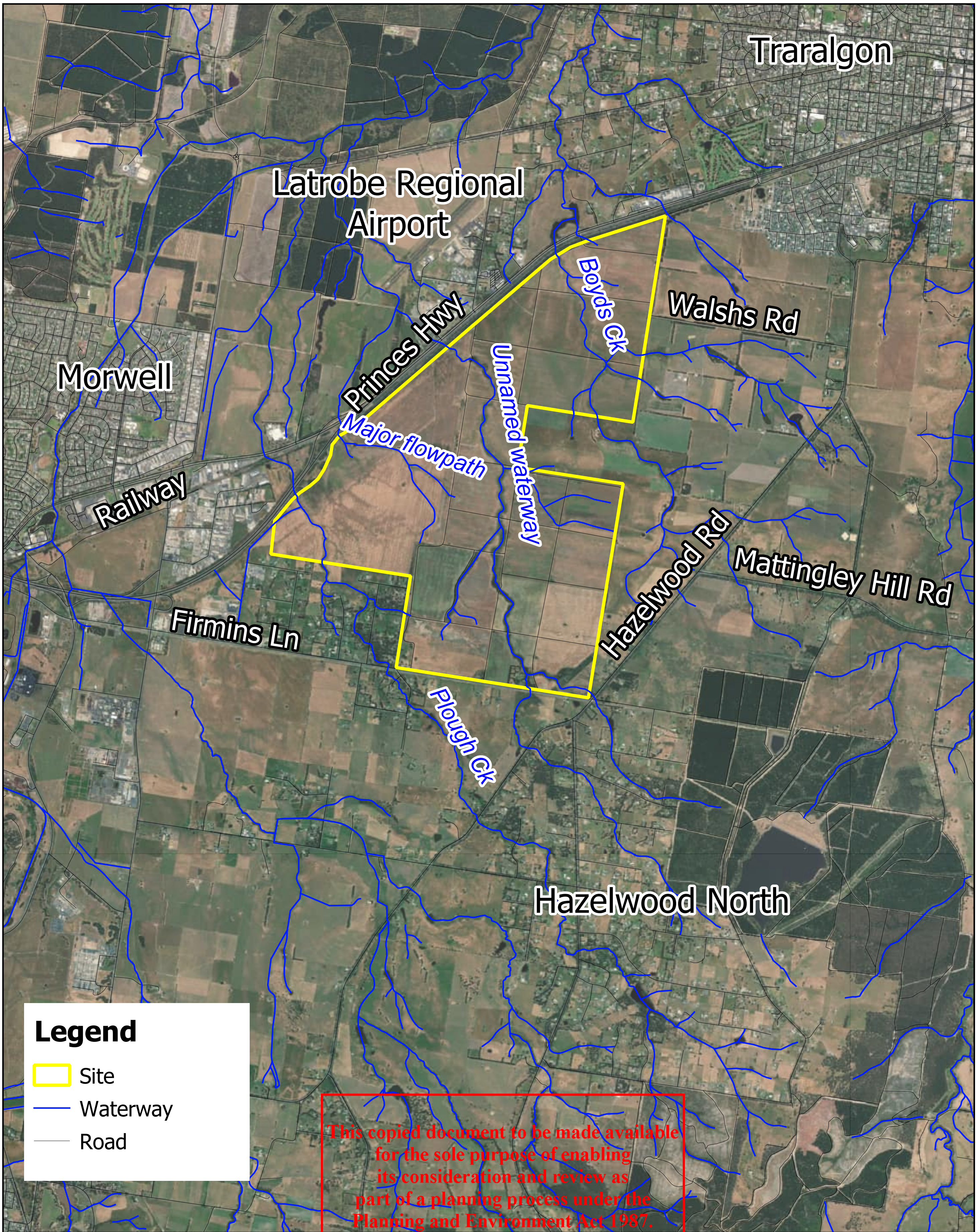
1.1 Site and catchment description

The Site (Figure 1-1) is located in Hazelwood North approximately 5 km west of central Morwell between the Princes Highway, Firmins Lane and Hazelwood Road. The Site covers an area of approximately 1,100 ha that is currently primarily used for grazing and cropping.

As shown in Figure 1-1 there are three main waterways, that run through the Site from south to north; Plough Creek in the east, an unnamed waterway through the centre and Boyds Creek in the west. These waterways are tributaries of Wades Creek which discharges into the Latrobe River via a wetland system. Throughout most of the Site the waterways have been cleared of vegetation (Figure 1-2) with small dams (Figure 1-3) and track crossings along their reaches. In the southern portion of the Site the unnamed waterway is densely vegetated to Firmins Lane (Figure 1-4). Flow into the Site from Plough Creek and the unnamed waterway is constrained by the culvert crossings under Firmins Lane.

As shown in Figure 1-1 there are also several smaller tributaries within the Site that are mapped as waterways in the VicMap Watercourse GIS layer. Rather than been clearly defined natural channels, these tributaries are primarily localised gullies that have been cleared of vegetation draining to the main waterways. Of note to this assessment is the tributary of the unnamed waterway identified as Major Flowpath on Figure 1-1 which conveys significant flow during flood events as described in Section 3.4.

The catchments, which originate in the hills south of Hazelwood North and flow north to the Princes Highway, have contributing areas of approximately 11 km^2, 13 km^2 and 16 km^2 for Plough Creek, the unnamed waterway and Boyds Creek respectively. The catchments primarily comprise of farmland used as pasture, but there is also an area of low density rural living in the southern catchment and plantations at the extreme southern limits.



Title: Hazelwood North Solar Farm
Site and Catchment Location

Figure:	Rev:	Scale		By: JS
1-1	A	1 0 1 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.	Date: Feb 2023

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Figure 1-2 Photo of typical waterway through the Site

Figure 1-3 Photo of dam on waterway in the Site

Figure 1-4 Photo of densely vegetated channel and riparian zone in the Site

1.2 Concept solar farm layout and description

The concept layout of the proposed solar farm layout is shown in Figure 1-5 and includes:

- **Solar Panels** – An approximately 550 MW (DC) solar farm made up of over 1 million 550 W individual solar panels mounted on 8,953 trackers (arrays of 112 solar panels) orientated in the north-south direction. The details of the solar panels and arrays are provided in Appendix A and relevant dimensions are presented in Table 1-1. In the stow position (horizonal) the solar panels cover approximately 45% of the ground in the areas of the Site they are installed.

Table 1-1 Solar panel and trackers dimensions

Dimension	Measurement (m)
Tracker length	67.134 m
Tracker width (in stow position)	4.594 m
Distance between trackers (north-south)	0.5 m
Distance between rows of trackers (east-west) (in stow position)	5.61 m
Elevation of panel above ground in vertical position (+/- 50 degrees)	Typically 500 mm (minimum 300 mm above ground or 1% AEP flood level)

During the operation life of the solar panels, the Site will continue to be used for sheep grazing throughout the solar panels, between and under the trackers.

- **Battery Energy Storage System (BESS)** – BESS covering an area of 6 ha. The location shown in Figure 1-5 has been included in this assessment but may be revised in future phase of design.
- **Solar Collection Inverter Stations** – Over 50 solar collection inverter stations located throughout the solar panel arrays as shown in Appendix A.
- **Sub-Station options** – A 4.8 ha sub-station located adjacent to the BESS as shown in in Figure 1-5.
- **Access Tracks** – As shown in Figure 1-5, the proposed primary Site access is off Firmins Lane while there are secondary / emergency access points at the end of Walshs Road and Groppi Road. The internal access tracks are 4 m wide with 8-10 m corridors. The layout of the internal access tracks have been developed to use the existing tracks and waterway/gully crossings.
- **Construction Compound** – As shown in Figure 1-5 located in the south of the Site with an area of approximately 3 ha. In concept design construction compound is not retained and developed with solar panels but it is possible that the construction compound will be used to support the agricultural operations.
- **Fencing** – Fencing will be required to keep the sheep outside of the waterway corridors. These fences will of post and wire type. Security fencing will also be required around the perimeter of the Site.
- **Grid Connection** – *At the time of preparing this assessment, the grid connection options are still being explored. As such, the hydrology and flood assessment for the transmission lines will be documented separately.*

The concept layout includes buffers along the waterways for which there are no works proposed, except for internal access track crossings. There is also a Public Acquisition Overlay (PAO) running along the northern boundary of the Site where there are also no works proposed.

It is estimated that the construction period will be approximately 18 months during 2024/25 with an estimated 500 direct full time equivalent (FTEs) people working on the construction during this period. The estimated 500 construction workers is based on the full supply chain requirements and the number of people on Site on any given day will be much smaller.

It is expected that the solar farm will enter operation during 2025 with a 25 year operational life. During this period, it is estimated that 11 FTEs people will be working at the solar farm with additional people undertaking farming activities, but the number of people present on the Site at any given time will be smaller.

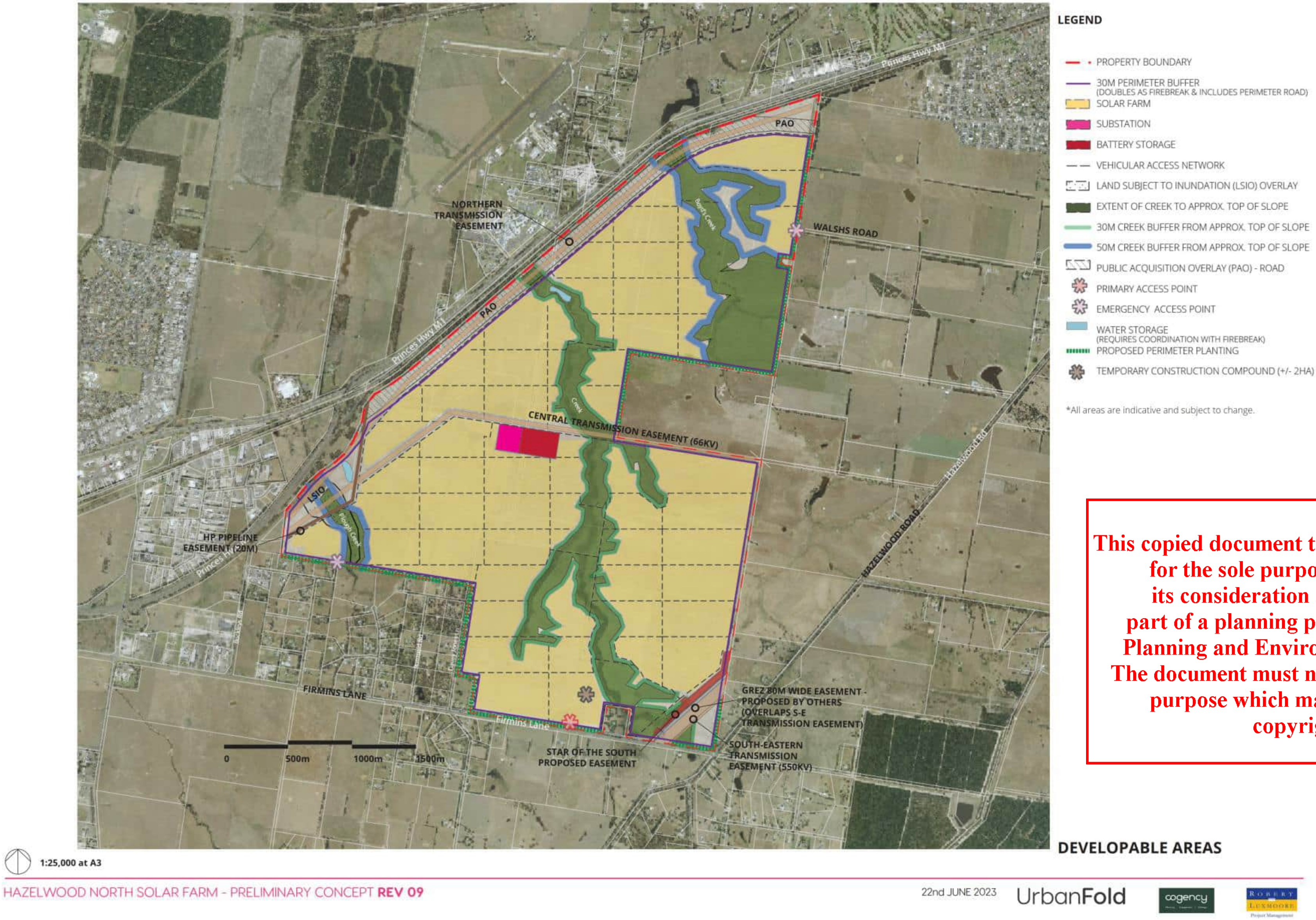


Figure 1-5 Proposed solar farm layout

2 Regulatory requirements and guidelines

The key pieces of legislation, strategies and guidelines that outline the approval requirements relevant to hydrology and flooding are summarised in the following sections. The performance of the concept design layout and mitigation measures against the key approval requirements is summarised in Section 4.

2.1 Solar Energy Facilities Design and Development Guideline

The *Solar Energy Facilities Design and Development Guideline* (DELWP 2022) provides an overview of the policy, legislative and statutory planning arrangements to assist in the development and approval of ground mounted solar energy facility projects in Victoria. Guidance relevant to hydrology and flooding includes:

- A proponent should avoid siting a solar energy facility within an identified floodplain to a major river system and a mapped wetland area, to avoid unnecessary risk to the facility and its associated infrastructure and the consequential need for flood attenuation measures such as flood levies and barriers
- A solar energy facility can occupy a large site, and earthworks to grade or level a site can change the overland flow of water, which can change natural and constructed drainage patterns. This can increase the risk from future flood events on the site and neighbouring land
- A solar energy facility should not increase flood risks on the site or in the immediate area. Flood risks (unlike most other natural hazards) are predictable in terms of their location, depth and extent. This means a proponent can implement measures to reduce flood damage, including:
  - Minimising grading or levelling of the site, to avoid changes to overland water flow and discharge patterns
  - Avoiding locations within the immediate floodplain or a watercourse or river system
  - Elevating structures above the floodplain

The above guidance is represented in the state and local planning requirements for development in flood prone areas as described below.

2.2 Latrobe Planning Scheme

The Latrobe Planning Scheme provides a framework for decisions about the use and development of land in Latrobe City Council (Council) region. The planning strategies relevant to hydrology and flooding include:

- **Clause 13.01-1S – Natural hazards and climate change**
  - Site and design development to minimise risk to life, health, property, the natural environment and community infrastructure from natural hazards
- **Clause 13.03-1S – Floodplain Management**
  - Avoid intensifying the impact of flooding through inappropriately located use and development
  - Plan for the cumulative impacts of use and development on flood behaviour
  - Ensure land use on floodplains minimises the risk of waterway contamination occurring during floods and floodplains are able to function as temporary storage to moderate peak flows and minimise downstream impacts
- **Clause 14.02-1S – Catchment planning and management**
  - Retain natural drainage corridors with vegetated buffer zones at least 30 metres wide along each side of a waterway

  - Undertake measures to minimise the quantity and retard the flow of stormwater from developed areas
- **Schedule 1 to Clause 35.07 – Farming Zone**
  - A permit is required for earthworks which change the rate of flow or the discharge point of water across a property boundary
- **Clause 44.04 – Land Subject to Inundation Overlay**
  - As shown in Figure 2-1 there is a Land Subject to Inundation Overlay (LSIO) on Plough Creek identifying land that is subject to inundation in a 1% Annual Exceedance Probability (AEP) event requiring a permit application to the satisfaction of the responsible authority. The West Gippsland Catchment Management Authority (WGCMA) is the referral authority in this region. WGCMA's decision guidelines are summarised in Section 2.4.

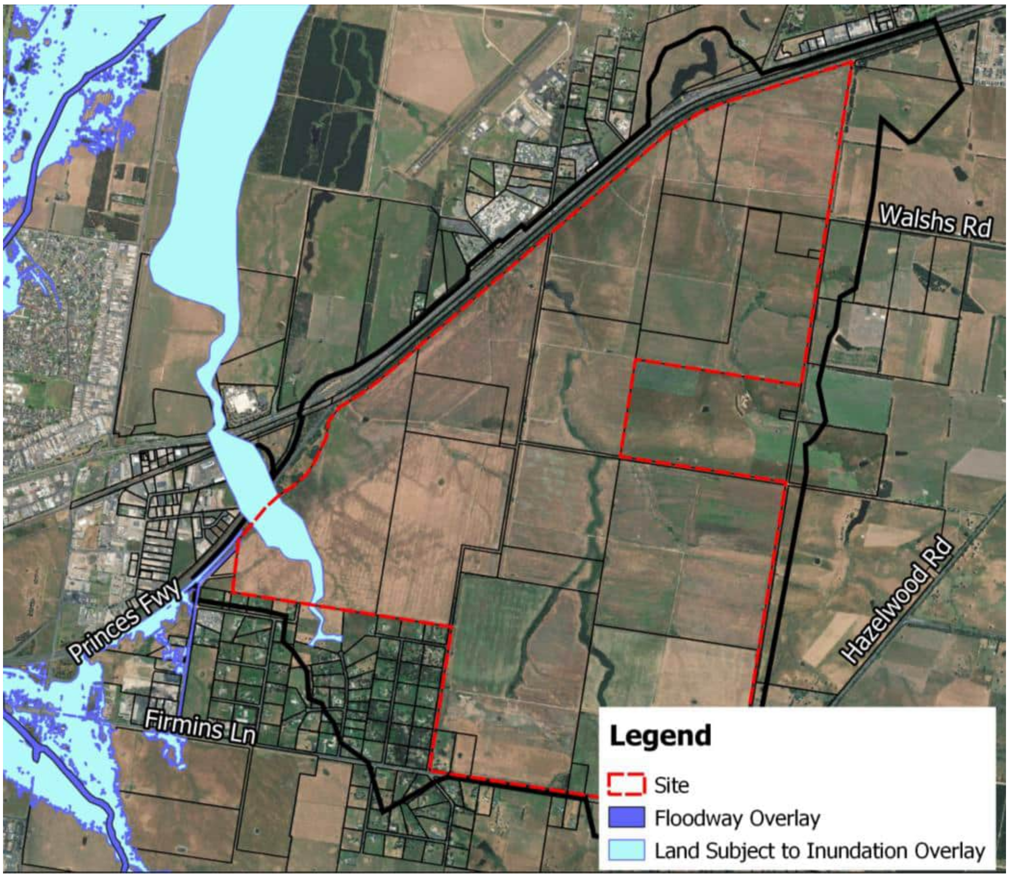


Figure 2-1 Land Subject to Inundation Overlay

2.3 Guidelines for Development in Flood Affected Areas

The *Guidelines for Development in Flood Affected Areas* (DELWP 2019) provide an assessment framework and method under the regulatory framework to assist decisions on development in flood affected areas across Victoria.

Floodplain managers assess development proposals against four key objectives described in Table 2-1.

Table 2-1 Guidelines for Development in Flood Affected Areas objectives

Guiding Principal	Assessment Criteria
Safety	
Site and access safety must not be compromised.	Development should not be allowed on properties where the depth and flow of floodwaters would be hazardous to people or vehicles entering and leaving the properties. Refer to Table 2-2 for specific criteria.
Development must be located on sites of lowest overall hazard.	Development and access should be located on land with the lowest overall hazard.
Hazardous materials must not contaminate floodwater.	Developments and uses which involve the storage or disposal of hazardous materials must not be located on floodplains unless the materials are totally isolated from floodwaters.
Flood damage	
Buildings must not interfere with existing or proposed water, sewer or drainage services.	Buildings and building envelopes should be located sufficiently away from a water, sewer or drainage asset to enable that asset to be serviced.
Buildings must be designed to avoid significant financial impacts of flood damage.	The floor levels of buildings should be set in accordance with required levels. Refer to Table 2-2 for specific criteria.
Those parts of buildings affected by flooding must be able to withstand the effects of inundation.	Any building or portion of a building below the 1% AEP flood level should be constructed from flood-resistant materials.
Services to a building must be capable of functioning during and after a flood.	Essential services to a building should be flood proofed or raised above the Nominal Flood Protection Level (1% AEP flood level plus the applicable freeboard).
Flood impacts	
The natural function of floodplains and overland flow paths to convey and store floodwater must not be compromised.	Development (including earthworks) should not divert floodwaters to the detriment of any adjoining property.
	Development (including earthworks) should not increase the flood velocity on any adjoining property.
	Development (including earthworks) should not increase flood levels on any adjoining properties.
	Earthworks and buildings should not result in a detrimental loss of flood storage.
Waterway and floodplain protection	
Development impacting on waterways and floodplains must consider their environmental qualities.	Development should maintain or improve waterway and floodplain conditions.
	Development should allow access to maintain riparian corridors.
	Development should maintain or improve water quality.
	Development should maintain (by avoidance or offset) the natural function of floodplains and waterways in storing and conveying floodwater.
	Development should retain or improve significant vistas or landscapes within the riparian corridor.

2.4 West Gippsland Catchment Management Authority Flood Guidelines

The WGCMA *Flood Guidelines: Guidelines for development in flood prone areas* (WGCMA 2020) have been developed with the specific purpose of helping the West Gippsland community meet the objective of the *West Gippsland Floodplain Management Strategy* (WGCMA 2017) to avoid future flood risks by ensuring development across our region responds appropriately and consistently to the flood hazard.

The WGCMA assess development proposals against seven key objectives presented in Table 2-2 which are subsets of the key objectives described in DELWP (2019) (Section 2.3) including specific criteria for this assessment as confirmed by WGCMA (email dated 9 June 2022).

The WGCMA confirmed that as a minimum climate change should be accounted for as a sensitivity analysis and depending on how sensitive the area is the WGCMA may recommend locating long term infrastructure away from the identified risk.

Table 2-2 WGCMA Flood Guidelines objectives

Objective	Specific Criteria
Safety	
Objective 1: Site safety Development must not be located where the depth and flow of floodwaters is hazardous.	Maximum flood depth of 0.3 m where velocities are less than 0.5 m/s, otherwise in accordance with General flood hazard vulnerability curves (AIDR 2017): • Depth < 0.3 m • Velocity < 2.0 m/s • Velocity x Depth < 0.3 m^2/s
Objective 2: Site access Development must not be located where the depth and flow of floodwaters along the access to or from the property is hazardous.	
Flood damage	
Objective 3: Flood damage Development must be designed to minimise the potential damage to property due to flooding.	Industrial buildings and electronic equipment must have 300mm freeboard above the 1% AEP event (Nominal Flood Protection Level).
Flood impacts	
Objective 4: Flood flow Works or structures must not adversely affect floodwater flow capacity or the physical form of a waterway.	Increases of in flood level of no more than 5 mm in a 2D flood model.
Objective 5: Flood storage Works or structures must not reduce floodwater storage capacity.	
Waterway and floodplain protection	
Objective 6: Floodplain and waterway condition Development must ensure protection of floodplains and the maintenance or improvement of waterway condition including vegetation and physical form.	30m buffers to both sides of the waterways in accordance with Clause 14.02-1S – Catchment planning and management of the Latrobe Planning Scheme. The WGCMA website indicates that all of the waterways mapped in the VicMap Watercourse GIS layer (Figure 1-1) are designated waterways (https://www.wgcma.vic.gov.au/for-farmers/drainage).
Objective 7: Water quality Development must maintain or improve the quality of stormwater and catchment run-off in rural and urban areas	Water quality not included in scope of the assessment.

3 Flood model development

For this assessment a flood model comprising of a RORB hydrologic and TUFLOW hydraulic model was developed. The RORB hydrologic model converts rainfall to runoff for a given design event to provide the flow rate and timing of inflows into the TUFLOW hydraulic model which simulates the movement of flow through catchment producing flood mapping outputs such as flood extent, level, depth and velocity.

Due to the large area of the Site three models were developed:

- **Model 1** – Plough Creek catchment
- **Model 2** – Central unnamed waterway (including the major flowpath) catchment
- **Model 3** – Boyds Creek catchment

Flood modelling and mapping was completed for the following design events:

- 20% (or 1 in 5) Annual Exceedance Probability (AEP)
- 10% (or 1 in 10) AEP (including RCP 4.5 and 8.5 2100 climate change)
- 5% (or 1 in 20) AEP
- 2% (or 1 in 50) AEP
- 1% (or 1 in 100) AEP
- 1% (or 1 in 100) AEP RCP 8.5 2100 climate change scenario (1% AEP + CC)

The flood model was developed in accordance with guidance provided in the 2019 release of Australian Rainfall and Runoff (ARR 2019) (Ball, et al. 2019) and the flows were validated against Regional Flood Frequency Estimates (RFFEs).

3.1 RORB model development

The RORB hydrologic modelling package was adopted for this assessment as it is a widely used hydrologic modelling package across Victoria and Australia that incorporates many of the rainfall parameters and routines from ARR 2019.

3.1.1 RORB model version

RORBwin Version 6.45 was used.

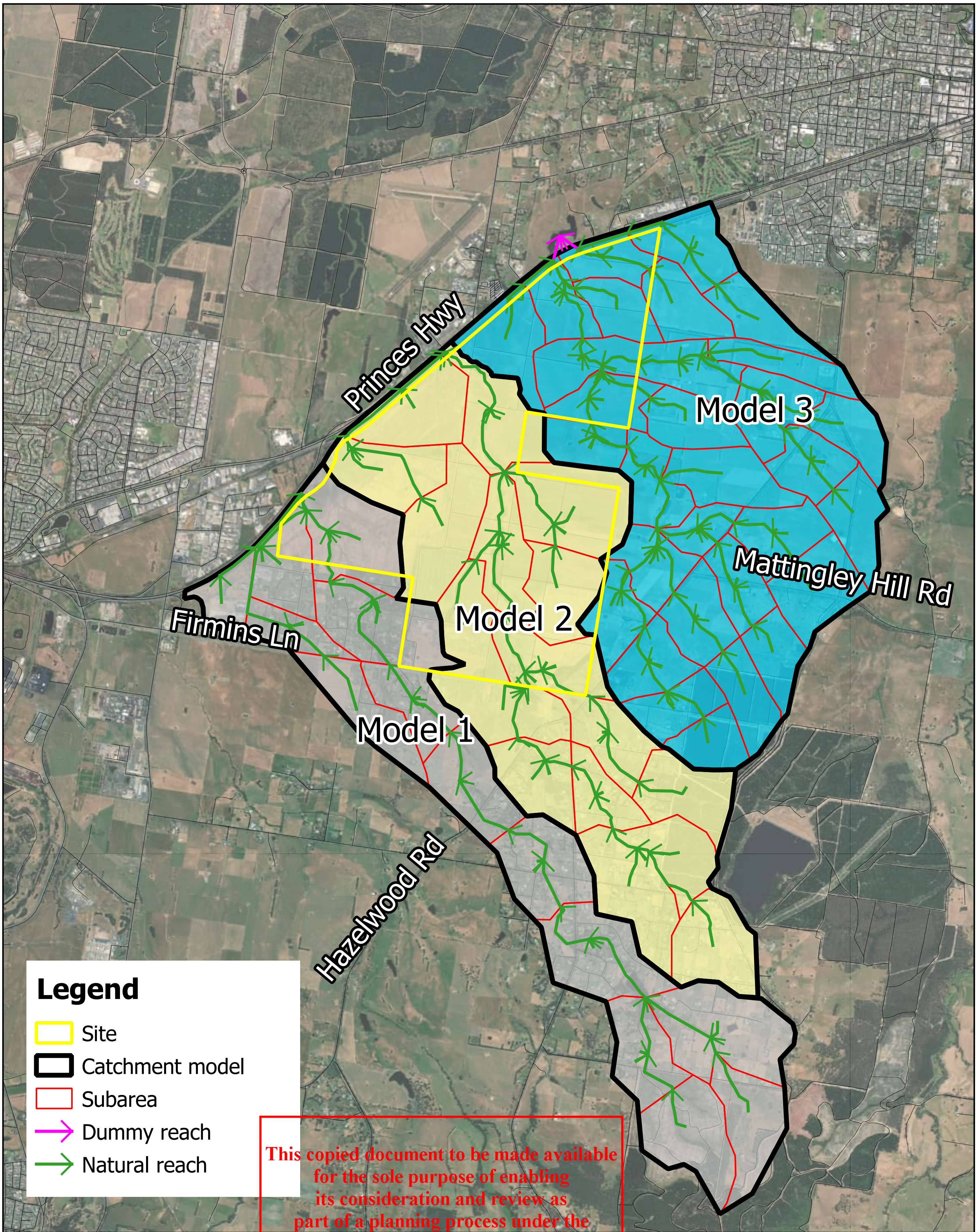
3.1.2 Catchment, sub-catchment and reach definition

As shown in Figure 3-1 the RORB models developed for each waterway cover the catchments to the Princes Highway which bounds the floodplain immediately north of the Site. The catchment and sub-catchments boundaries were defined using LiDAR data. The sub-catchments were defined to ensure there were sufficient sub-catchments (minimum 3-4) upstream of the Site to provide reliable inflow hydrographs for the TUFLOW model. Reaches were digitised to follow the overland flow paths using the natural Reach Type 1.

3.1.3 Impervious area

It was assumed that catchment was made entirely of pervious area. This is consistent with standard modelling approaches for primarily rural / open space catchments, especially in catchments such as those draining to the Site where the impervious surfaces such as roads, driveways and roofs would be considered Indirectly Connected Areas (ICAs) as they do not drain directly to the main flow paths.

Within the Site, the influence of the proposed solar farm on impervious area was assessed in the TUFLOW model as discussed in Section 4.1.



Title: Hazelwood North Solar Farm
Site and Catchment Location

Figure: 3-1 | Rev: A | 1 0 1 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

By: JS
Date: Feb 2023

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3.1.4 Design storm events

The 1% AEP Climate Change design storm event was modelled based on the following rainfall parameters using inbuilt Functionality in RORBwin to generate rainfall inputs into the RORB model:

- **Intensity-Frequency-Duration (IFDs)** - Sourced from the Bureau of Meteorology's Design Rainfall Data System (2016) (www.bom.gov.au/water/designRainfalls/revised-ifd/) for the co-ordinates; Latitude -38.2655, Longitude 146.4759.

  As the catchments had an area of less than 20 km^2 rainfall was not spatially varied as per ARR 2019.

- **Climate Change Increased Rainfall Intensity** - The ARR 2019 DataHub (http://data.arr-software.org/) Representative Concentration Pathway (RCP) 8.5 2090 interim climate factor was extrapolated to 2100 to give an increased rainfall intensity of 18.4%. The IFDs were factored by 18.4% to provide the increased rainfall intensity design rainfalls.

- **Temporal Patterns** - As per ARR 2019 for catchments less than 75 km^2 point temporal patterns for the Southern Slopes (mainland) region were used. The temporal patterns were filtered using the in-built functionality in RORBwin.

- **Aerial Reduction Factors (ARFs)** –ARFs were applied using the in-built functionality in RORBwin.

  To assess the influence of the solar panels and other impervious surfaces on runoff, local storm events were also assessed in the TUFLOW model with the ARFs set to 1. More details of this methodology are provided in Section 3.3.

- **Storm losses** – The regional initial and continuing loss values of 21 mm and 4 mm/hr from the ARR 2019 DataHub were adopted. The initial losses were reduced to account for 75th percentile pre-burst depths as per the guidance provided in HARC (2020).

  For storms durations shorter than 1 hour, the 1 hour pre-burst depths were used.

3.1.5 Model Validation

The RORB model 'K_c' routing parameters presented in Table 3-1 are validated against the Regional Flood Frequency Estimate (RFFE) (refer to Section 3.1.5.1) for the 20%, 10%, 5%, 2% and 1% AEP event. The Plough Creek catchment (Model 1) has an unusual shape and the RFFE results have lower accuracy (Section 3.1.5.1), therefore the method used to validate the three models to the RFFE was to select a K_c / D_{ave} of 1.15 that best matched the RFFE flows for Model 2 and Model 3. This K_c / D_{av} was then adopted in Model 1. The average flows from the ensemble were used to validate the flows.

The default 'm' routing parameter value of 0.8 was adopted as there was no justification for an alternative value.

Table 3-1 K_c Validation results

Event	Model 1 Kc = 6.00	Model 2 Kc = 5.04			Model 1 Kc = 4.17		
	RORB (m^3/s)	RORB (m^3/s)	RFFE (m^3/s)	% Diff.	RORB (m^3/s)	RFFE (m^3/s)	% Diff.
20% AEP	8.4	10.3	11.9	-13%	15.7	13.1	20%
10% AEP	12.2	14.85	16.8	-12%	22.6	18.5	22%
5% AEP	16.0	20.03	22.5	-11%	30.4	24.7	23%
2% AEP	21.0	27.76	31.4	-12%	41.6	34.5	21%
1% AEP	25.1	34.9	39.2	-11%	52.1	43.1	21%

To assess the sensitivity of the adopted Kc routing parameters, the resulting flows were compared against those derived using regional K_c equations Table 3-2 for the critical 1% AEP event. It should be noted that the Site is located in an area that receives approximately 800 mm of rainfall a year. The regional equations for areas with mean annual rainfall (MAR) greater and less than 800 mm were used for the sensitivity assessment.

The results of the sensitivity assessment show that K_c derived from the different regional equations vary significantly but the K_c parameters adopted by validating the flows to RFFEs are within the range of regional equations and matches well with the Pearse et al. (2002) equation.

Table 3-2 K_c parameter sensitivity assessment results

Regional equation	Model 1		Model 2		Model 3	
	K_c	1% AEP flow (m^3/s)	K_c	1% AEP flow (m^3/s)	K_c	1% AEP flow (m^3/s)
Adopted	**6.00**	**25.1**	**5.04**	**34.9**	**4.17**	**52.1**
RORB v6 User Manual	7.28	21.0	7.97	22.0	8.89	23.8
Pearse et al. (2002)	6.53	23.2	5.48	31.7	4.54	47.2
ARR 2019 MAR < 800 mm	2.32	58.2	2.61	65.1	3.01	69.8
ARR 2019 MAR > 800 mm	7.55	20.3	8.18	21.4	9.03	24.0

3.1.5.1 *Regional Flood Frequency Estimates (RFFE)*

The Regional Flood Frequency Estimation Model inputs and flow estimates are presented in Table 3-3.

Table 3-3 RFFE inputs and flow estimates

Parameter/Output	Model 1[1]	Model 2	Model 3
Latitude at catchment outlet	-38.2353	-38.2209651	-38.2110
Longitude at catchment outlet	146.4538	146.4718	146.4866
Latitude at catchment centroid	-38.2689	-38.2550	-38.2353
Longitude at catchment centroid	146.4797	146.4828	146.5082
Catchment area	10.9	13.11	16.32
Peak flow estimates (m^3/s)			
20% AEP	10.9	11.9	13.1
10% AEP	15.4	16.8	18.6
5% AEP	20.6	22.5	24.9
2% AEP	28.7	31.4	34.7
1% AEP	35.9	39.2	43.3

1. The catchment has an unusual shape. Results have lower accuracy and may not be directly applicable in practice.

3.1.6 Design event flows and critical events

The ensemble event method was used to determine the peak flows and critical durations for AEP events. The critical temporal pattern for each duration was selected as the first event with a peak flow above the average. The resulting peak flows and critical events are presented in Table 3-4.

Table 3-4 Catchment design event peak flows

Event	Model 1			Model 2			Model 3		
	Flow (m3/s)	Dur.	TP	Flow (m3/s)	Dur.	TP	Flow (m3/s)	Dur.	TP
50% AEP	4.2	2 h	4	4.6	2 h	5	7.0	2 h	5
20% AEP	8.5	2 h	4	11.0	2 h	9	15.7	2 h	3
10% AEP	12.3	2 h	17	14.9	2 h	13	22.7	2 h	20
5% AEP	16.1	2 h	17	20.3	2 h	15	30.7	2 h	15
2% AEP	21.3	2 h	27	27.8	3 h	27	41.8	3 h	27
1% AEP	25.5	2 h	27	35.3	3 h	28	52.6	3 h	28
1% AEP + CC	32.1	2 h	27	45.5	3 h	21	67.7	3 h	28

3.2 TUFLOW model development

Three TUFLOW 1D/2D hydraulic models were developed to establish the extent, depth and velocity of flows across the Site. The model layouts are shown in Figure 3-2, Figure 3-3 and Figure 3-4.

The TUFLOW hydraulic modelling package was adopted for this assessment as it is the most widely used hydraulic modelling package across Victoria and Australia and can model soil infiltration which is required to model the impacts of solar panels on storm event runoff.

3.2.1 TUFLOW model version

TUFLOW version 2020-10-AD-iSP-w64 was used for this assessment. The models were run with TUFLOW's HPC solver.

3.2.2 Grid size and orientation

A 2 m grid size was used with a north-south orientation. This provided sufficient detail to represent the rows of solar panels in the model.

3.2.3 Topography

The base topography was defined by a 1 m LiDAR DEM created from the Morwell & Briagolong LiDAR Project, captured between January and February 2018 with a stated vertical accuracy of 0.15 m.

This LiDAR data was captured after the plantations had been burnt and the Site returned to pasture so is considered representative of current ground conditions.

3.2.4 Surface roughness

The adopted Manning's 'n' surface roughness values are summarised in Table 3-5 and the coverage mapped in Figure 3-2. The values were selected from Chow (1959) and MW (2020), and were confirmed with the observations made during the Site Visit.

Table 3-5 Adopted Manning's 'n' values

Surface type	Manning's 'n'
Open space (pasture)	0.04
Moderate vegetation	0.06
High density vegetation	0.09
Waterway (clean and straight)	0.03
Waterway (relatively clean and straight with moderate vegetation)	0.06
Waterway (dense vegetation with pools)	0.09
Dams	0.025
Roads	0.025
Dirt roads / tracks	0.03
Railway	0.1
Buildings	0.3

3.2.5 Drainage structures

Culvert assets were modelled as 1d network pipes. Department of Transport data was used where available to model culvert dimensions and inverts. Where Department of Transport data was not available dimensions measured during the Site Visit were used and the culvert inverts were extracted from the DEM.

The rail bridges along the northern boundary of the Site were modelled as 2d layered flow constrictions. Structure data was not able to be obtained from V/Line. A uniform form loss of 0.2 and zero blockage was assumed for all bridges with the deck levels assumed to be above the 1% AEP + CC. This is considered a reasonable modelling assumption given that immediately downstream of the railway is the Princes Highway with smaller drainage assets (culverts) which will act as the hydraulic control across the floodplain.

3.2.6 Boundary conditions

External catchment flow hydrographs from the RORB model were applied using QT (flow-time) boundaries upstream of the Site.

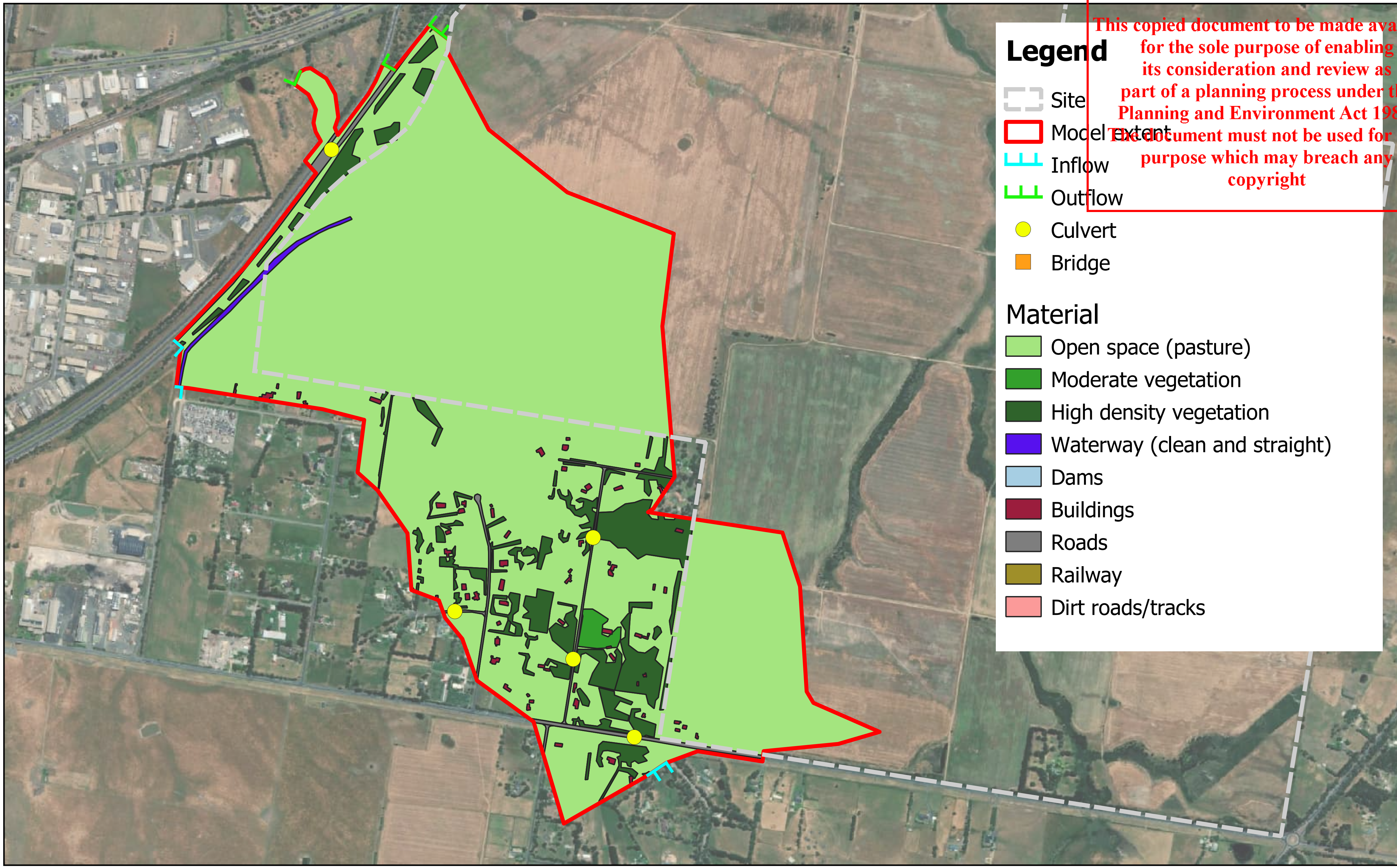
Internal rainfall boundaries were applied to the entire 2D model area using the 2D SA (source-area) All boundary type. This allows for the influence of the solar panels

The downstream boundary was defined by an automatically generated HQ (height-flow) boundary.

3.2.7 Storm losses

Storm rainfall losses were modelled within the 2D model extents using the TUFLOW's Initial Loss/Continuing Loss soil infiltration model. Therefore, excess rainfall hydrographs from RORB initial and continuing losses were applied as 2D SA Alls.

Different impervious area types were spatially varied using a Soils Layer based on the loss model described in Section 3.1.4. For Existing Conditions modelling it was assumed that there are no pervious areas across the Site. The influence of the proposed solar farm on impervious areas was assessed in the TUFLOW as discussed in Section 4.2.



Title: Hazelwood North Solar Farm
TUFLOW Model 1 Layout

Figure: 3-2

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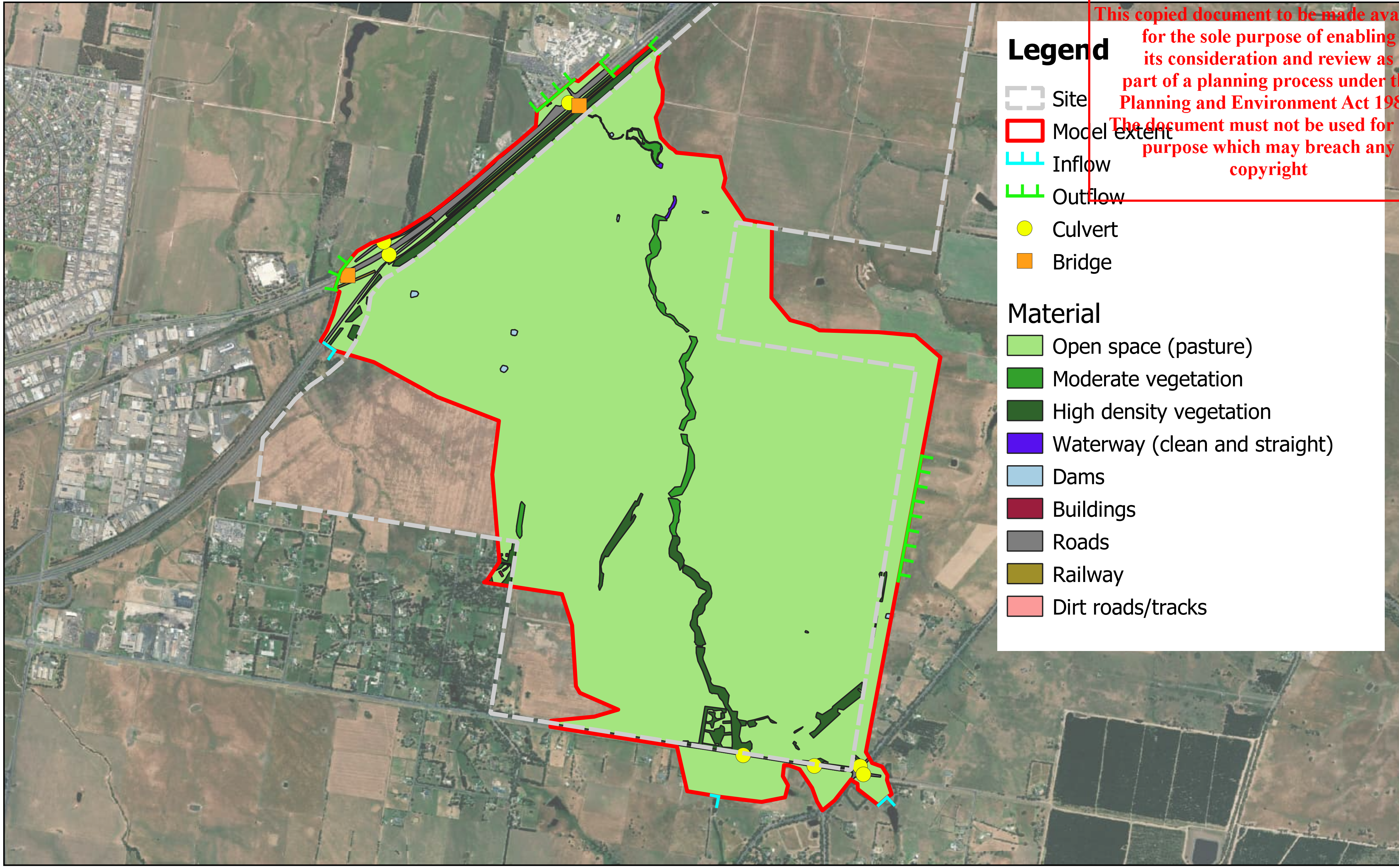

Title: Hazelwood North Solar Farm TUFLOW Model 2 Layout	Figure: 3-3	Rev: A	400 0 400 m	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.	VENANT SOLUTIONS
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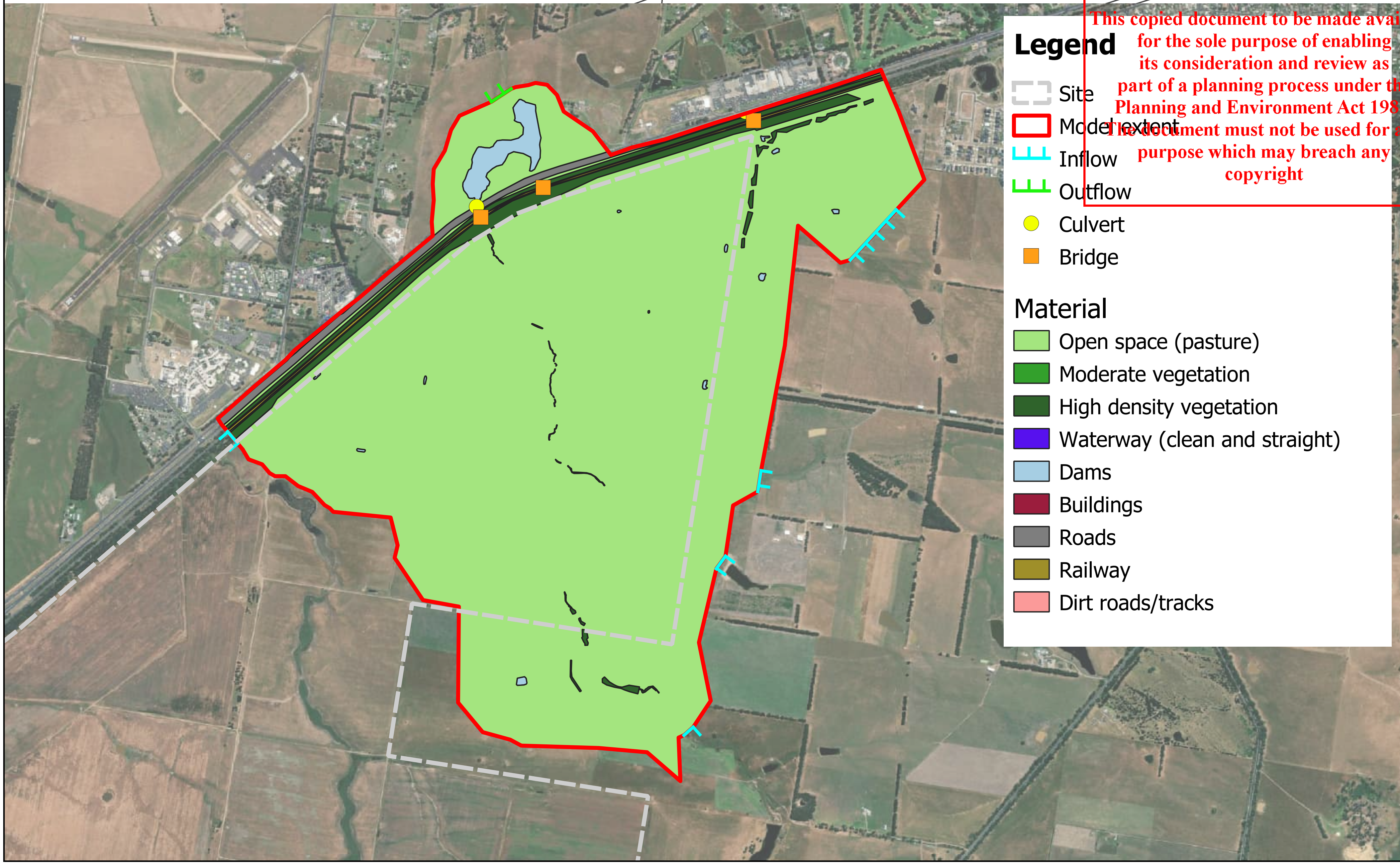

Title: Hazelwood North Solar Farm
TUFLOW Model 3 Layout

Figure: 3-4

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3.3 Design event scenarios

Design event modelling has been undertaken for the 50%, 20%, 10%, 5%, 2% and 1% AEP events along with the 1% AEP + CC event.

To capture the influence of the proposed solar farm on both catchment wide rainfall events and intense rainfall events over the Site, two design event scenarios have been modelled:

- **Regional Event – Peak flood levels and flows along waterways**
  - External inflow boundaries (RORB model flows) and internal rainfall had aerial reduction factors applied to the rainfall
  - Critical events as listed in Table 3-4 were selected from RORB flows

- **Local Event – Intense rainfall and runoff from the Site**
  - External inflow boundaries (RORB model flows) had aerial reduction factors applied to the rainfall
  - Internal rainfall had the aerial reduction factor set to 1
  - The critical events as listed in Table 3-6 were selected from ensemble modelling in TUFLOW with the selected events representing the first event with levels above the average

Table 3-6 Local design event critical events

Event	Model 1		Model 2		Model 3	
	Duration	TP	Duration	TP	Duration	TP
50% AEP	1 h	5	1 h	5	1 h	5
20% AEP	1 h	4	1 h	4	1 h	4
10% AEP	1 h	18	1 h	17	1 h	15
5% AEP	1 h	18	1 h	16	1 h	18
2% AEP	1 h	27	1 h	27	1 h	27
1% AEP	1 h	27	1 h	27	1 h	27
1% AEP + CC	1 h	27	1 h	27	1 h	28

The flood mapping described in Section 3.4 and Section 4 show a maximum envelope of the two design event scenarios.

It should be noted that each of the three catchments flowing through the Site were modelled individually. As such the resulting flood mapping shown across the Site is conservative, as a storm event that occurs over all three catchments would have slightly less intense rainfall because of the aerial reduction factor adjustment.

3.4 Existing Conditions flood mapping

The existing conditions flood mapping for the 50%, 20%, 10%, 5%, 2%, 1% and 1% + CC AEP events is shown in:

- Appendix B – Existing Conditions Flood Depth Mapping
- Appendix C – Existing Conditions Flood Velocity Mapping
- Appendix D – Existing Conditions Flood Hazard Mapping

Because rainfall within the Site has been applied as flow across the whole model, the entire model is "wet" and the outputs from the model include very shallow flow which is not considered flooding. For the purposes of this mapping, a mapping cut-off depth of 50 mm was adopted, i.e., an area is not shown as flooded on the maps if the depth is less than 50 mm. Applying the cut-off depth results in the “patchy” flood mapping shown in the appendices away from the main flow paths.

The existing conditions flood depth mapping presented in Appendix B shows that from 50% AEP up to the 1% AEP + CC event deep flows, 0.5 m and above, are mostly contained within the three waterway corridors. However, there is a fourth significant flowpath (identified as Major Flowpath in Figure 1-1) between Plough Creek and the unnamed waterway that is approximately 50 m wide with depths up to approximately 0.8 m in the 1% AEP + CC event. Outside of these major flowpaths, local runoff results in inundation depths generally below 0.1 m with some concentrated flows of depths up to approximately 0.3 m in the 1% AEP + CC event.

The existing conditions flood velocity mapping presented in Appendix C shows that similar to the flood depth mapping high velocities of 1.0 m/s and above are primarily contained within the waterway corridors in all mapped events up to the 1% AEP + CC event. Across the majority of the Site the flow velocities are very low being below 0.5 m/s, and up to 1.0 m/s in the concentrated flowpaths.

The flood hazard mapping presented in Appendix D was undertaken using the general flood hazard classification criteria presented in AIDR (2017). As shown in Figure 3-5, hazard is defined in terms of the depth and velocity - depth product in six classifications:

H1 - Generally safe for vehicles, people and buildings

H2 - Unsafe for small vehicles

H3 - Unsafe for vehicles, children and the elderly

H4 - Unsafe for vehicles and people

H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure

H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure

The existing conditions flood hazard mapping presented in Appendix C shows that majority of the Site is generally safe for vehicles, people and buildings (H1) for all mapped events up to the 1% AEP + CC event. There are some exceptions to this in the concentrated flow paths where flow does become unsafe for vehicles and people (H4) in the 1% AEP + CC event.

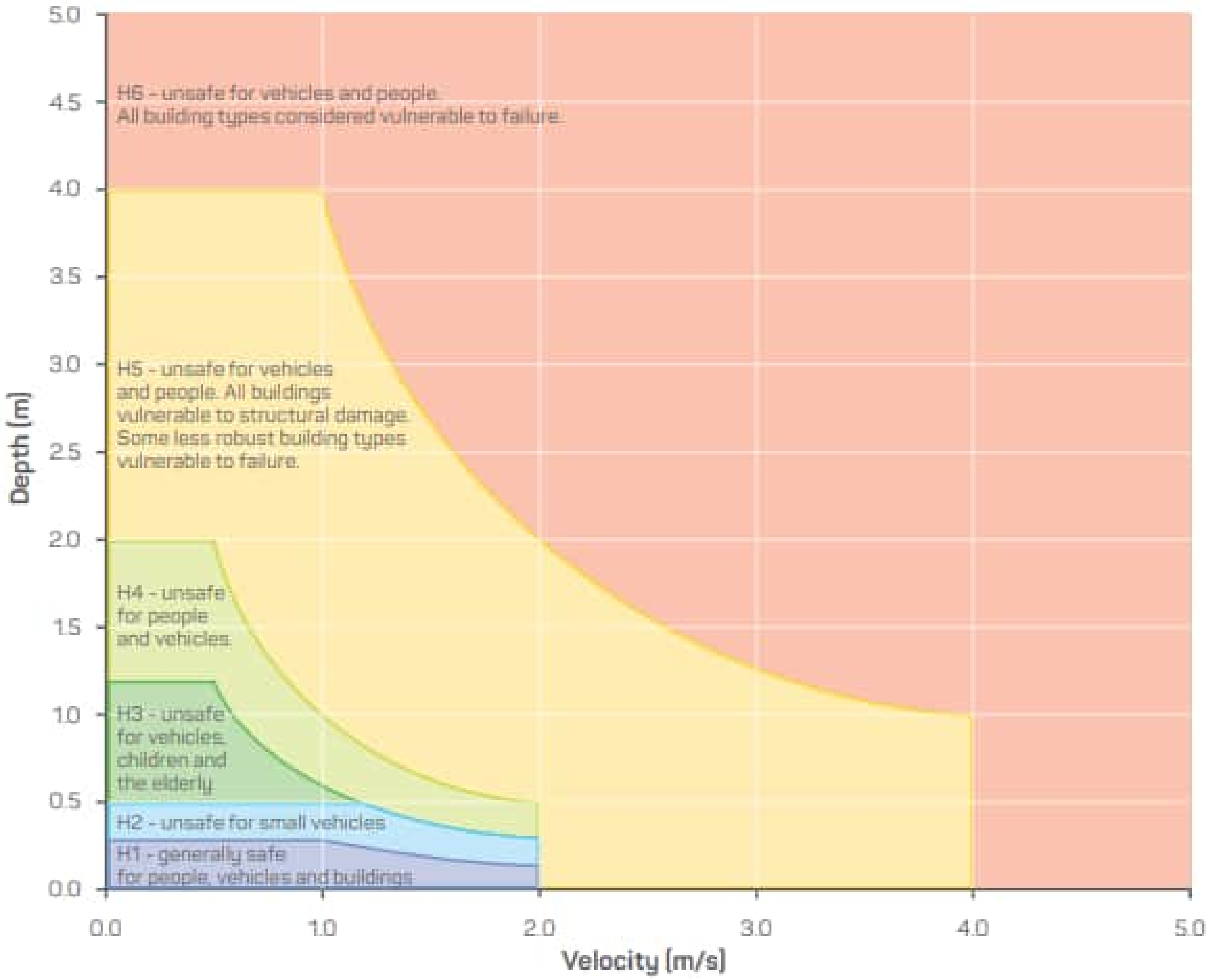


Figure 3-5 General flood hazard classification curves (AIDR 2017)

4 Flood impact assessment

This section presents the outcomes of the flood impact assessment undertaken on the concept solar farm design as described in Section 1.2.

The flood impact assessment is supported by the concept design flood mapping for the 50%, 20%, 10%, 5%, 2%, 1% and 1% + CC AEP events is shown in:

- Appendix E – Concept Design Flood Depth Mapping
- Appendix F – Concept Design Flood Velocity Mapping
- Appendix G – Concept Design Flood Hazard Mapping
- Appendix H – Concept Design Flood Level Impact Mapping

4.1 Concept design modelling

To represent the solar farm into the hydraulic model, the following inputs were added to the existing model as shown in Figure 4-1:

- **Solar arrays:**
  - A key aspect of the assessment was representing the solar panels in the model, particularly how they might influence the infiltration of rainfall into the soil and hence alter the runoff from the Site. The panels are impervious, but they are elevated above the ground. Therefore, the ground under the panel will remain pervious but will not receive direct rainfall when the panels are in the stow position. Rainfall falling onto the panels will run off the panels into the gaps between the arrays and would then flow in the direction of the ground slope, including back under the panels where the runoff can infiltrate into the soil.
  - For the existing conditions assessment, the rainfall (as flow) was distributed evenly across the site. Recognising that the solar panels would concentrate the rainfall into the gap between the array rows, the application of the rainfall in the model was concentrated by applying the same amount of total flow into these gaps. To be clear, the amount of flow from rainfall was not reduced, rather the same rainfall was applied over a smaller area. In the model rainfall boundary, this was done by applying no flow to the areas covered by the panels (assumed in the stowed position).
- **BESS, Solar Collection Inverter Stations and Sub-Station options**
  - Represented as fully impervious (initial and continuing loss = 0) in the Solis Layer.
  - The BESS and Sub-Station are located adjacent to local flowpaths within the Site and as such have been modelled as fill platforms raised 300 mm above the adjacent 1% AEP flood levels (refer to Section 4.3.1 for levels).

    The Solar Collection Inverter Stations have been represented in the model as a single combined station adjacent to the Sub-Station as shown in Figure 4-1. This is a conservative assumption as the volume of local flow displaced by the single station at this location is more than would be from multiple smaller locations located throughout the arrays (Appendix A) as many of them will be outside of the flood extents.
- **Access tracks**
  - Internal access roads will be constructed to follow existing surface topography so have been represented in the model without any topography modification. Waterway crossings were not

included in the concept design but Section 4.3.3 provides flow and level inputs for future design requirements.

- Represented as fully impervious (initial and continuing loss = 0) in the Soils Layer.
- A surface roughness of 0.03 was applied.
- Left and right turning lanes are proposed at the primary access point on Firmins Lane. These works will alter the local road drainage but as the flood model was developed to assess only the major catchment inflows to the Site these works could not be assessed.

It should be noted that the concept layout assessed does not include earthworks other than those associated with the fill platforms for the BESS and Sub-Station to meet flood planning level requirements and will need to be addressed in further stages of the design.

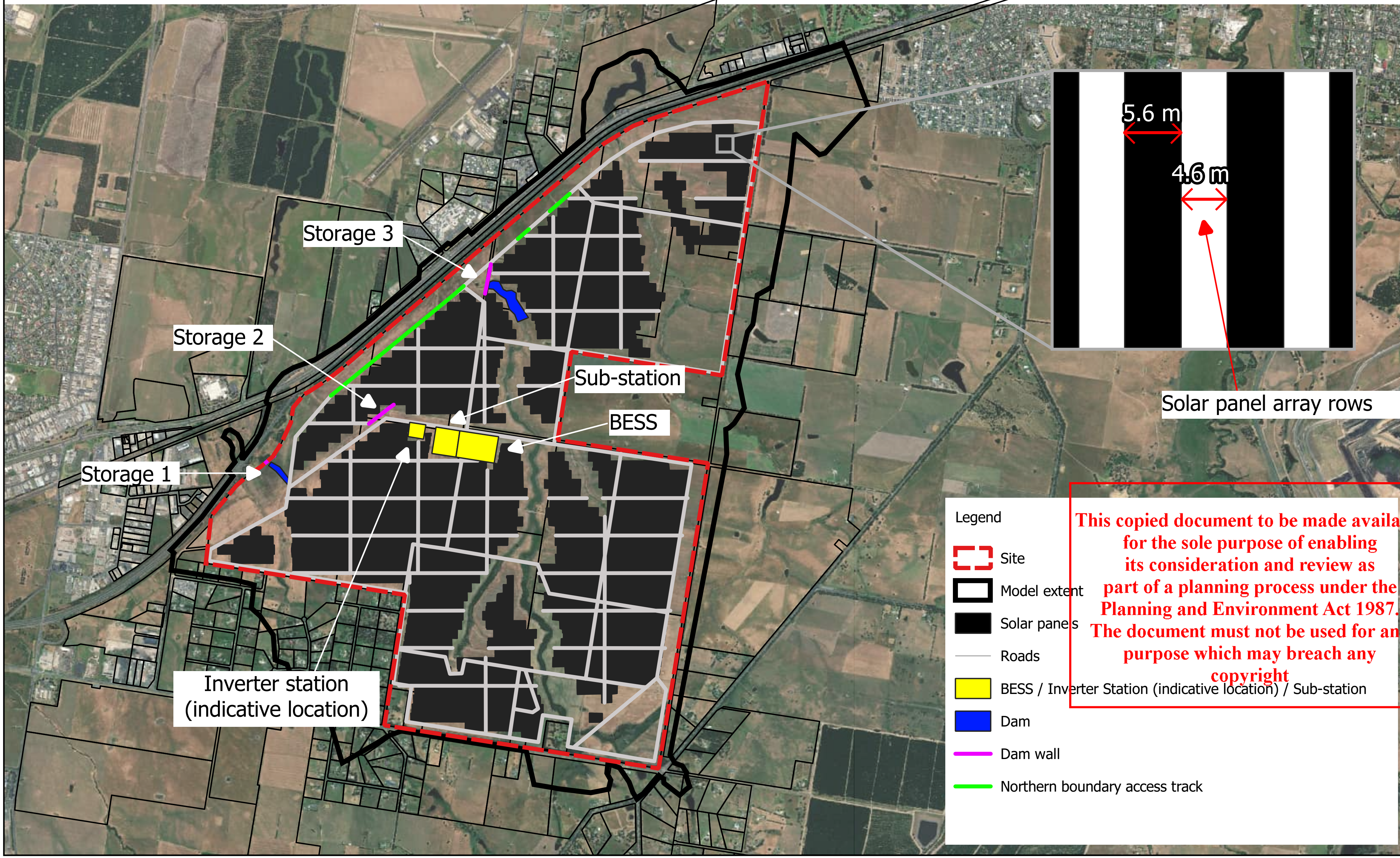
4.1.1 Flood mitigation concept design

To manage downstream flood impacts (Section 4.2.3) the following concept design flood mitigation options were developed as shown in Figure 4-1:

- **Storage 1**
  - Excavated an area of approximately 8,250 m^2 to a level of 65 m AHD behind the existing site boundary access track to create an additional 3,850 m^3 of storage.
  - A 225 mm circular culvert was modelled to ensure minor flows could still pass under the access track.
- **Storage 2**
  - The existing access track embankment across the flowpath was raised by approximately 1 m to a level 64.2 m AHD providing an additional 9,400 m^3 of storage.
- **Storage 3**
  - The water level in the existing farm dam on the unnamed waterway was lowered to 56 m AHD. This may require excavation of the existing dam so that water can be retained to provide a source of water for farming purposes.

    The current dam has a low flow culvert maintaining the water level in the dam. However, during the Site Visit this culvert was observed to be damaged and would not be able to pass any flow. This culvert would need to be reinstated to maintain the water level in the dam below 56 m AHD.
  - An additional 11,300 m^2 adjacent to the existing dam was excavated to a level of 57.4 m AHD.
  - The dam wall was also raised to a level of 58.1 m AHD and 58.3 m AHD south and north of the existing spillway respectively which had its level maintained at approximately 57.5 m AHD.
  - In total the work described above provided an additional 24,200 m^3 of storage volume.
- **Northern boundary access track works**
  - A 1.3 km section of the northern boundary access track was raised by 0.1 m, with a 0.3 m deep - 2 m wide table drain on the upstream side of the track to divert flows into the unnamed waterway.
  - A further two shorter sections of the northern boundary access track were also raised to 56.3 m AHD and 55.6 m AHD to locally divert flow in consolidated overland flowpaths.

All of the above works are located south of the Public Acquisition Overlay so that they would not require alteration if that portion of the Site is developed in the future.



Title: Hazelwood North Solar Farm
Concept Design TUFLOW Model Layout

Figure: 4-1

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500 0 500 m

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4.2 Approval requirements

The performance of the solar farm concept design against the approval requirements described in Section 2 is discussed in Table 4-1.

Table 4-1 Summary of flood approval requirements

DEECA Objective[1]	WGCMA Objective[2]	Solar Facilities Guidelines[3]	Concept design performance
Safety	**Objective 1: Site safety** Development must not be located where the depth and flow of floodwaters is hazardous.	A proponent should avoid siting a solar energy facility within an identified floodplain to a major river system and a mapped wetland area, to avoid unnecessary risk to the facility and its associated infrastructure and the consequential need for flood attenuation measures such as flood levies and barriers. A proponent can implement measures to reduce flood damage, including: • Avoiding locations within the immediate floodplain or a watercourse or river system	• Significant creek buffers where no works are proposed have been provided along the waterways. The flood depth mapping (Appendix E) shows up to the 1% AEP + CC event flooding along the waterways is well within the creek buffers. • As described in Section 4.2.1 there are some locations within the solar panel arrays that show maximum flood depth of 0.3 m where velocities are less than 0.5 m/s in the 1% AEP event but well within the limits for buildings.
	Objective 2: Site access Development must not be located where the depth and flow of floodwaters along the access to or from the property is hazardous.		• Firmins Lane provides flood free access/egress to the Site in events up to the 1% AEP event. • Key waterway crossings in the final site layout should be designed to meet the safety criteria to provide an internal evacuation route.
Flood damage	**Objective 3: Flood damage** Development must be designed to minimise the potential damage to property due to flooding.	A proponent can implement measures to reduce flood damage, including: • Elevating structures above the floodplain	• The solar panels will typically be raised 500 mm above ground level but at a minimum above the Nominal Flood Protection Level (NFPL) (1% AEP + 300 mm freeboard) minimum 300 mm 1% AEP flood level when in their closest to vertical position. • DC Combiner Boxes located on the end of every third or fourth tracker row will be raised above the NFPL. • The Sub-Station and Solar Collection Inverter Stations (indicate location) are located on fill platforms set at the NFPL.

DEECA Objective[1]	WGCMA Objective[2]	Solar Facilities Guidelines[3]	Concept design performance
Flood impacts	**Objective 4: Flood flow** Works or structures must not adversely affect floodwater flow capacity or the physical form of a waterway.	A solar energy facility should not increase flood risks on the site or in the immediate area. A proponent can implement measures to reduce flood damage, including: • Minimising grading or levelling of the site, to avoid changes to overland water flow and discharge patterns	• Offsite flood level impacts are mitigated to be below 5 mm as described in Section 4.2.3 and mapped in Appendix H. • A comparison of the existing conditions flood velocity mapping (Appendix C) to the concept design flood velocity mapping (Appendix F) shows that there is no notable offsite increases in flood velocity. • The Site perimeter fencing will be of a security fencing type, not post and wire type. Therefore, they might obstruct flood flows (and be subject to damage) as debris is caught on them. Open style or break-away fencing should be considered for the perimeter fence waterway crossings.
	Objective 5: Flood storage Works or structures must not reduce floodwater storage capacity.		• There is no net loss of floodplain storage. The floodplain storage lost as a result of fill platforms for The Sub-Station and Solar Collection Inverter Stations (indicate location) has been accounted for in the additional storage provided in the mitigation storages. • The mitigation storages also address the increase in runoff from the hard surfaces (access tracks, BESS, Sub-Station) and from concentrating rainfall between the solar panel arrays. • Earthworks other than those described above have not been assessed and will need to be addressed in further stages of the design.

DEECA Objective[1]	WGCMA Objective[2]	Solar Facilities Guidelines[3]	Concept design performance
Waterway and floodplain protection	**Objective 6: Floodplain and waterway condition** Development must ensure protection of floodplains and the maintenance or improvement of waterway condition including vegetation and physical form.		• Detailed habitat assessment is provided in Hazelwood North Solar Farm Flora and Fauna Assessment (Nature Advisory 2023a). The assessment did not identify any areas of native vegetation where the flood storages or other works mitigation are proposed. • There is an opportunity for the mitigation works design to incorporate revegetation works to improve waterway condition as detailed in the Waterway Revegetation Plan (Nature Advisory 2023b). • Figure 4-2 shows that creek corridors provide at least a 30 m buffer (50 m buffer provided along Boyds Creek and Plough Creek) from each side of the main waterways. The creek corridors will be fenced to ensure sheep are excluded. • A desktop assessment found that it is likely that Aboriginal cultural heritage is present on the low rises associated with the creek lines (Tardis Archaeology 2022). This and the results of the archaeological survey should be considered during detailed design of the mitigation works and managed accordingly.
	Objective 7: Water quality Development must maintain or improve the quality of stormwater and catchment run-off in rural and urban areas		• Stormwater and groundwater quality objectives and management measures have not been assessed. • With the inclusion of standard stormwater management and spill prevention measures in detailed design it is not considered that there will be any significant impact on surface water quality. • With the exclusion of agricultural uses from the creek corridors and the re-vegetation works water quality from the Site could be improved. This has not been quantifiably assessed. • The proposed works will not noticeably alter the volume or quality of water infiltrating into the groundwater and hence it is not expected to impact on the groundwater. It is assumed that significant groundwater extraction is not proposed.

1. Guidelines for Development in Flood Affected Areas (DELWP 2019), DELWP now the Department of Energy, Environment and Climate Action (DEECA)
2. West Gippsland Catchment Management Authority Flood Guidelines (2020)
3. Solar Energy Facilities Design and Development Guideline (DELWP 2022)

4.2.1 Safety

Safe Site access/egress is provided to the Site via the primary access point of Firmins Lane which remains open during events up to the 1% AEP + CC.

There are locations within the Site that safe access/egress to either primary or secondary access point is not able to be maintained. This is because waterway and major flowpath crossings are required are required to reach the access points. At these crossings flow is above the WGCMA safety criteria of maximum flood depth of 0.3 m where velocities are less than 0.5 m/s and the general flood hazard vulnerability criteria that is safe for vehicles, people and buildings (H1). Dependent on the final access track layout key waterway crossings may need to be designed to a standard that provides safe evacuation paths across the Site. Peak flood level and flow at the access track flowpath crossings are provided in Section 4.3.3 for further design purposes.

During construction it is not expected that work would be able to proceed during significant storm events due to the rain and the Site would not be subject to “sunny day” flooding. Staff are not required on the Site during a storm/flood event over the operation phase of the solar farm as it can continue to function.

The flood depth mapping presented in Appendix E shows that there are areas of inundation within the solar panel arrays that exceed WGCMA safety criteria of maximum flood depth of 0.3 m where velocities are less than 0.5 m/s. However, the flood hazard mapping presented in Appendix G shows that in the 1% AEP event the flow conditions are well within the general flood hazard vulnerability criteria for buildings (H5 and H6).

4.2.2 Flood damage

In the vertical most position the solar panels will typically be 500 mm above ground level but raised a minimum 300 mm above the Nominal Flood Protection Level (NFPL) (1% AEP + 300 mm freeboard). The DC Combiner Boxes located on the end of every third or fourth tracker row will be raised above the NFPL.

BESS and Solar Collection Inverter Stations (indicative location) are located on fill platforms set at the NFPL.

As the design progresses and the locations of these assets are confirmed the 1% AEP flood levels can be extracted from the model to confirm that Nominal Flood Protection Levels are met.

To minimise damage to access tracks during flood events, which could disrupt construction and operation activities and incur higher ongoing maintenance costs to repair, the construction of waterway crossings to a standard that can withstand inundation should be considered during detailed design. Peak flood level and flow at the access track flowpath crossings are provided in Section 4.3.3 for further design purposes.

To minimise damage to the Site perimeter security fencing open style or break-away fencing should be considered at the waterway crossings.

4.2.3 Flood impacts

Flood level impact mapping for all modelled events from the 50% AEP event to 1% AEP + CC is presented in Appendix H.

In these figures the change in flood level from existing conditions to concept design with mitigation is mapped in ranges in accordance with the colours shown in the legend. The yellow colour represents flooded land where the Proposal does not change (increase or decrease) the flood level by more than a ± 0.05 m (5 mm) modelling tolerance; in this assessment land is considered flooded where the depth is more than 50 mm as noted earlier. The green shades represent flooded land where the Proposal would decrease flood levels, and the brown/red shades represent flooded land where the Proposal would increase flood levels.

As shown in the flood level impact mapping, across all modelled events the concept design mitigation options have contained within the Site with the exception of a small area of increases in flood level up to 10 mm in the

50% AEP event in the railway corridor immediately east of Boyds Creek, and in an area of ponding in low density residential area on the north side of Firmins Lane which shows increases in peak flood level of up to 16 mm in events up to the 20% AEP. These increases in flood levels can be managed with further refinement of the mitigation options.

Although not assessed in the flood model, with standard road drainage design it is not expected that road works at primary access point on Firmins Lane would not have adverse flooding impacts on the adjacent properties.

Also not assessed in the flood model is the is the obstruction of flow potentially caused by the Site perimeter security fencing. Open style or break-away fencing should be considered at the waterway crossings. The internal fencing of the creek corridors will be of post and wire type for which a permit is not required under the LaTrobe Planning Scheme as they are not considered to cause an obstruction to flow.

This assessment also shows that any changes to the rate of flow or the discharge point of water across the Site can be managed in accordance with Schedule 1 to Clause 35.07 – Farming Zone of the LaTrobe Planning Scheme.

4.2.4 Waterway and floodplain protection

It is not expected that proposed works will significantly impact on the environmental values of surface waters or groundwater as prescribed by the Environmental Reference Standards (ERS) under the *Environment Protection* Act (2017) (Vic).

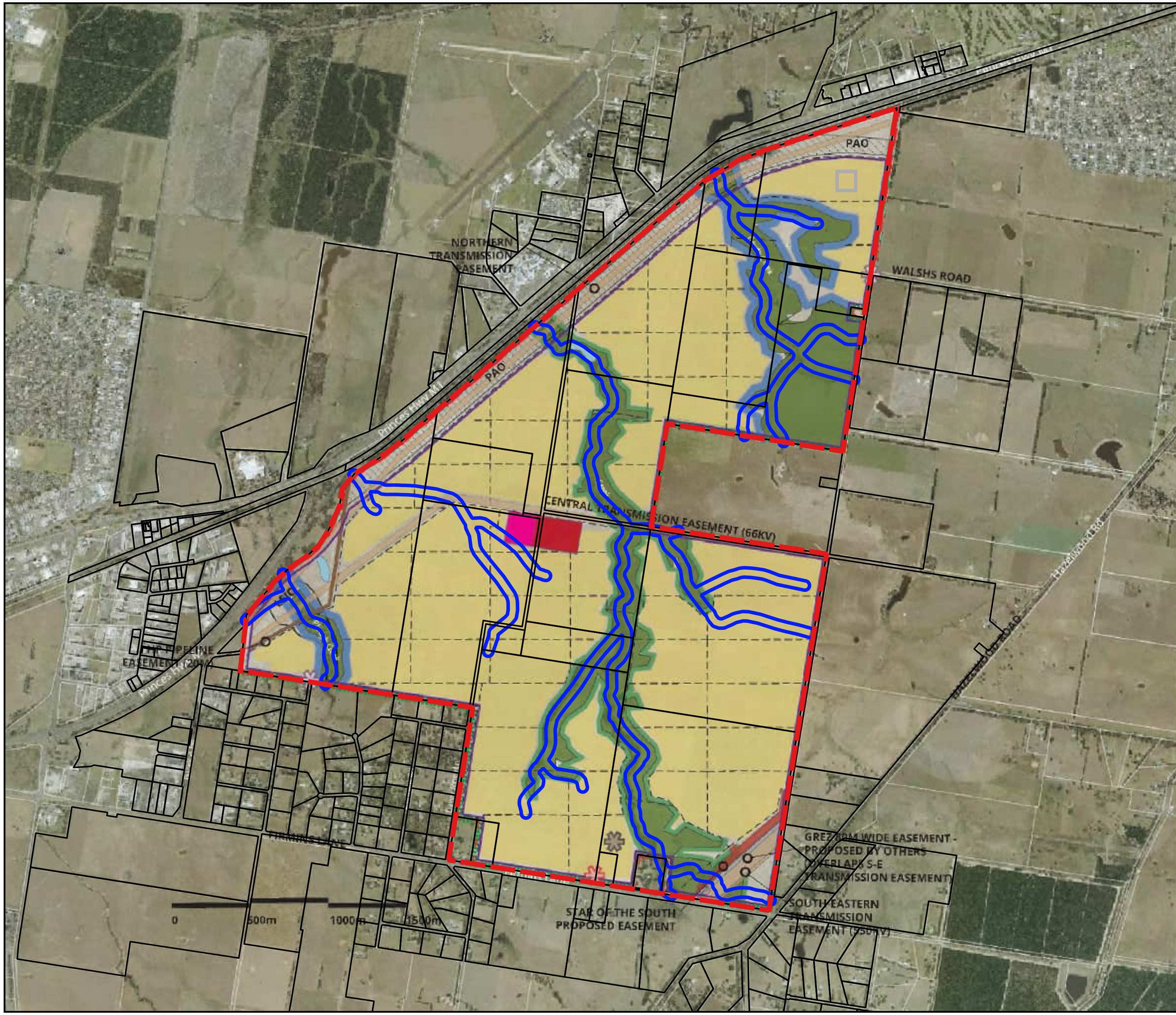
Significant creek buffers where no works are proposed beyond access track crossings have been provided along the main waterways. Figure 4-2 shows that creek corridors provide at least a 30m buffer from each side of the main waterways (50 m for Boyds Creek and Plough Creek). Please note that the buffers shown in Figure 4-2 are 30 m from the waterway centrelines as no detailed top-of-bank mapping has been undertaken. The creek corridors will be fenced to ensure sheep are excluded.

Solar panels are proposed within the 30 m buffer for the minor tributary waterways. However habitat mapping completed across the Site did not identify any areas of native vegetation beyond the waterways where creek corridors have been provided (Nature Advisory 2023a). It should be noted that Grassy Plain Woodlands Ecological Vegetation Type were identified in some of the small farm dams.

The habitat assessment did not identify any areas of native vegetation where the flood storages or other mitigation works are proposed. However, there is an opportunity for the mitigation works design to incorporate revegetation works to improve waterway and water quality condition as detailed in the Waterway Revegetation Plan (Nature Advisory 2023b). Whilst, stormwater quality and groundwater objectives and management measures have not been assessed, with the inclusion of standard stormwater management measures in detailed design it is considered that there will be no significant impact on surface water quality. Examples of standard stormwater quality management measures include spill bunds where hazardous chemicals/materials are kept, silt traps around hardstand and other areas where the soil is disturbed during construction and water quality treatment assets such as swale drains and sedimentation ponds.

The proposed works will not noticeably alter the volume or quality of water infiltrating into the groundwater and hence it is not expected to impact on the groundwater. It is assumed that significant groundwater extraction is not proposed.

A desktop assessment found that it is likely that Aboriginal cultural heritage is present on the low rises associated with the creek lines (Tardis Archaeology 2022). This and the results of the archaeological survey should be considered during detailed design of the mitigation works and managed accordingly.



Legend

- Site_boundary
- 30 m channel buffer

Title:	Figure:	Rev:		
Hazelwood North Solar Farm 30 m Waterway buffer	4-2	A	500 0 500 m	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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4.3 Design inputs

This section provides flood behaviour information for use in further design stages of the solar farm to ensure that flooding is appropriately managed on the Site.

4.3.1 Flood planning levels

The flood planning level at the proposed BESS and Sub-Station is presented in Table 4-2 representing NFPL of the 1% AEP flood level plus an additional 300 mm of freeboard.

Areas of solar panel arrays are also located in overland flowpaths and will need to be elevated above the NFPL in the vertical position. These locations are not presented in Table 4-2 for report clarity reasons.

Table 4-2 Flood planning levels

Location	Existing conditions 1% AEP flood level (m AHD)	Nominal Flood Protection Level (m AHD)
Sub-Station and BESS	66.64	66.94

4.3.2 Storage volumes

The increase in concept design flow volumes from the Site prior to mitigation are presented in Table 4-3 with the reporting locations shown in Figure 4-3.

The flood mitigation concept design detailed in Section 4.1.1 manages these increases in volume to mitigate any increases in peak flood levels downstream of the Site.

Table 4-3 Increase in flow volumes

Location	AEP	Existing condition volume (m^3)	Concept design volume (m^3)[1]	Volume Increase (m^3)
Plough Creek	20%	43,500	43,800	300
	10%	88,100	88,200	100
	5%	135,600	135,600	0
	2%	160,400	160,400	0
	1%	182,300	182,300	0
	1% + CC	244,100	244,000	0
Unnamed Waterway	20%	3,000	5,600	2600
	10%	9,000	11,700	2700
	5%	16,400	18,800	2400
	2%	27,400	29,200	1800
	1%	36,500	37,700	1200
	1% + CC	50,000	50,800	800
Major Flowpath	20%	25,200	26,200	1000
	10%	62,700	64,900	2200
	5%	111,000	114,100	3100
	2%	149,400	151,500	2100
	1%	182,000	184,100	2100
	1% + CC	252,400	254,600	2200
Boyds Creek	20%	115,700	116,200	500
	10%	191,400	191,900	500
	5%	276,800	277,100	300
	2%	317,400	317,800	400
	1%	354,600	354,900	300
	1% + CC	454,100	454,400	300

1. Represents flow volumes prior to any flood mitigation works.

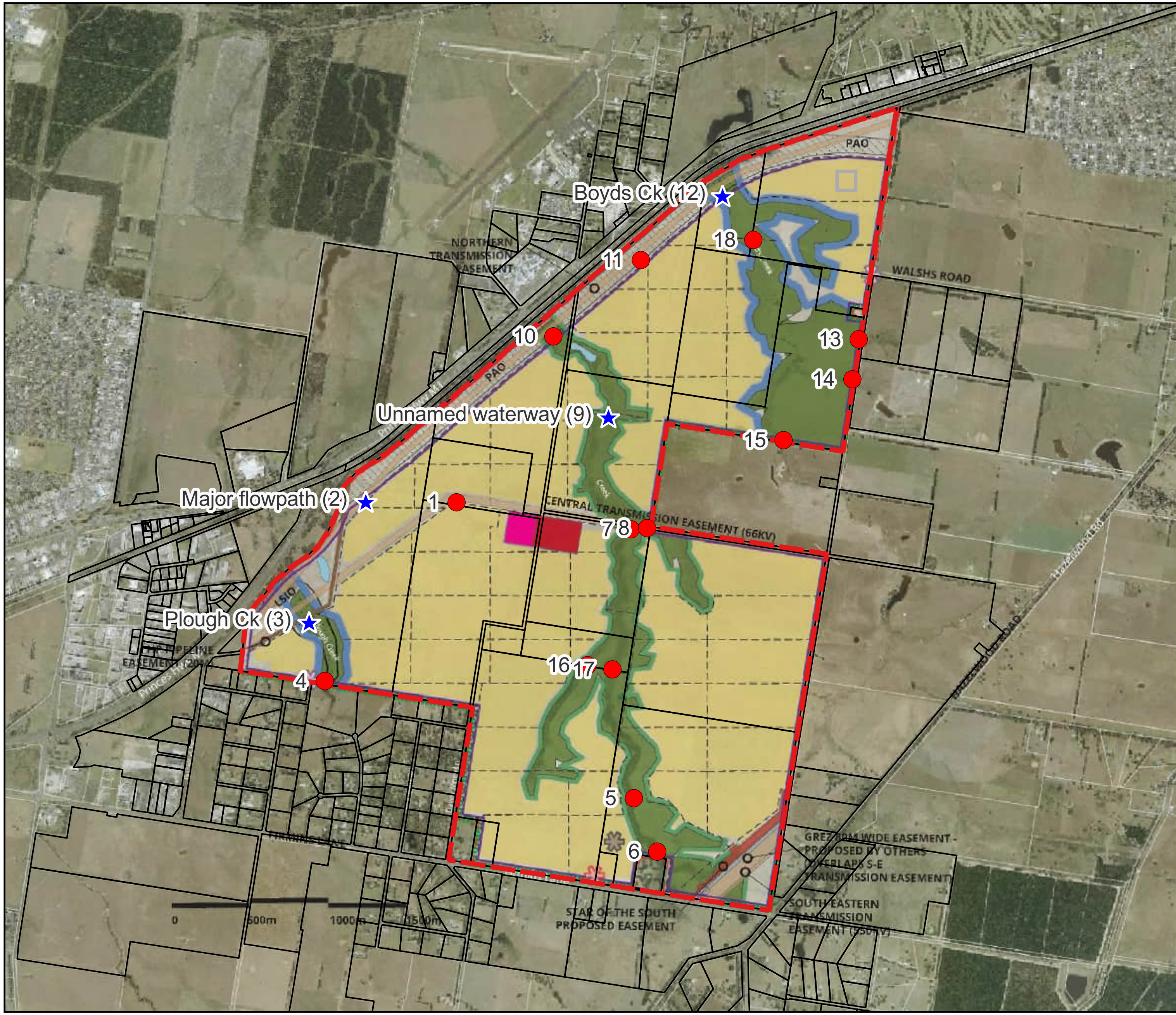
4.3.3 Access Track Crossings

For use in further design stages the peak flood level and flow at the access track crossings are presented in Table 4-4 with the reporting locations shown in Figure 4-3.

Given the short duration of inundation across the Site of generally less than 1 hour, the expected construction timeline of 18 months and no need to maintain access across the whole Site during flood events, it is not expected that formal crossings (culverts or concrete/rock floodways) would be required at each location and would likely only be required at the key crossings.

Table 4-4 Access track crossings peak flood level and flow

Location	Peak flood level (m AHD)						Peak flow (m^3/s)					
	20%	10%	5%	2%	1%	1% + CC	20%	10%	5%	2%	1%	1% + CC
1	63.74	63.76	63.81	63.79	63.84	63.92	2.8	2.7	5.6	4.5	7.2	11.1
2	62.78	62.79	62.83	62.83	62.86	62.91	3.6	4.3	7.8	6.9	10.9	17.8
3	65.62	65.72	65.78	65.83	65.88	65.93	4.9	7.3	10.0	13.1	15.8	19.7
4	68.76	68.82	68.86	68.89	68.92	68.96	4.9	7.1	9.6	12.3	14.7	18.2
5	81.52	81.58	81.64	81.69	81.72	81.83	6.3	9.2	11.9	16.3	18.8	27.4
6	86.32	86.34	86.38	86.39	86.40	86.47	6.3	9.1	11.8	16.1	18.3	26.3
7	65.44	65.63	65.68	65.83	65.91	66.03	6.6	9.9	14.4	18.7	24.0	35.8
8	67.05	66.95	67.03	67.01	67.07	67.20	2.7	3.7	7.7	6.8	10.8	20.0
9	60.42	60.43	60.44	60.59	60.65	60.67	8.3	12.5	20.0	25.2	34.9	55.0
10	55.81	55.78	55.80	56.12	56.33	56.54	7.4	12.2	18.7	24.6	32.6	48.0
11	55.65	55.68	55.67	55.66	55.67	55.68	0.4	1.3	1.0	0.7	1.1	1.5
12	50.19	50.13	50.63	51.29	51.68	51.90	17.1	34.9	30.9	37.0	48.8	69.2
13	60.58	60.70	60.68	60.73	60.77	60.84	5.3	11.0	10.4	12.8	15.8	19.8
14	63.40	63.43	63.41	63.40	63.42	63.43	2.1	4.4	3.5	2.8	3.9	4.8
15	60.52	60.58	60.59	60.65	60.69	60.75	10.7	16.2	21.1	26.5	33.8	42.8
16	73.13	73.14	73.17	73.16	73.19	73.23	0.8	1.3	2.9	2.7	4.0	7.8
17	72.82	72.89	72.92	72.96	72.99	73.06	6.2	9.1	12.1	16.4	19.9	28.3
18	50.66	50.84	50.83	51.31	51.61	51.80	18.2	37.7	35.6	48.0	57.5	72.5



Legend

- Site
- Access track crossing reporting location
- Excess volume reporting location

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Title:	Figure:	Rev:		
Hazelwood North Solar Farm Reporting Locations	4-3	A	500 0 500 m	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\Fig4-3_Reporting_Locations.qgz

By: JS | Jul 2023

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5 Summary

Flood modelling of the waterways flowing through the Site has been undertaken to assess the flood risk of proposed solar farm concept design and to assess and mitigate any potential adverse impacts on surrounding properties. To do this validated RORB models were developed to determine flows into the Site while TUFLOW flood models were developed covering the entire Site. The modelling was developed based on industry best practice and guidance such as the principals outlined in Australian Rainfall and Runoff 2019.

The modelling was used to assess the concept solar farm and battery energy storage system design against the flood related planning approval requirements. The assessment found that there are no significant flood risks, that cannot be managed with standard mitigation measures, that will inhibit further development of the solar farm. It is also not expected that there will be any significant risks to surface water quality or groundwater.

6 References

(AIDR) Australian Institute for Disaster Resilience (2017), *Australian Disaster Resilience Guideline 7-3 Flood Hazard*, Australian Institute for Disaster Resilience.

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I (Ed) (2019), *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia (Geoscience Australia).

Chow V (1959), *Open Channel Hydraulics*, McGraw-Hill, New York.

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(DELWP) Department of Environment, Land, Water and Planning (2019), *Guidelines for Development in Flood Affected Areas*, Department of Environment, Land, Water and Planning.

(HARC) Hydrology and Risk Consulting (2020), *Benchmarking ARR2019 for Victoria Technical Report*, Version 2, Hydrology and Risk Consulting.

(MW) Melbourne Water Corporation (2020), *AM STA 6200 Flood Mapping Projects Specification*, Melbourne Water.

Nature Advisory (2023a), *Hazelwood Solar Farm Flora and Fauna Assessment*, Version 1.2, Nature Advisory.

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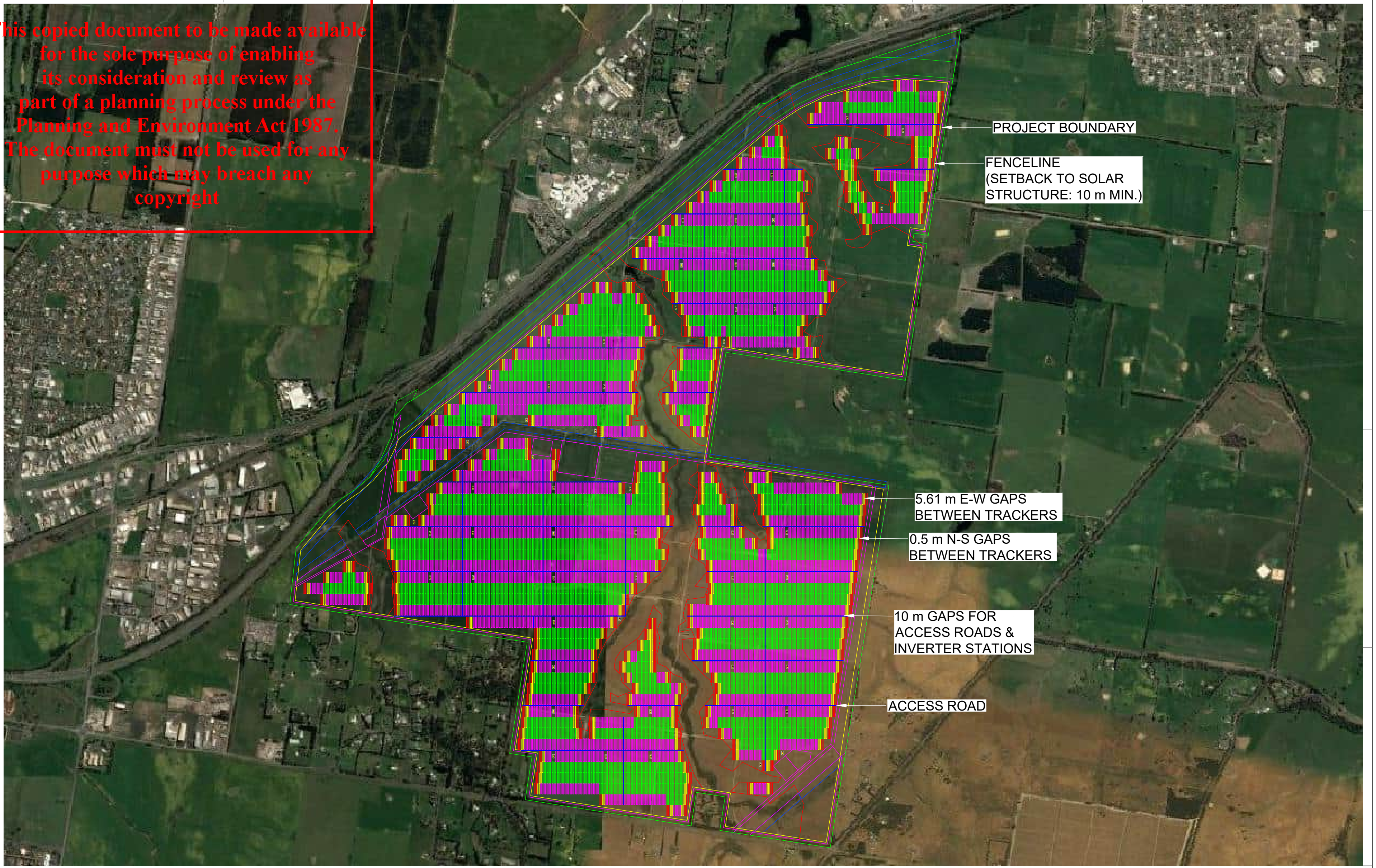
(WGCMA) West Gippsland Catchment Management Authority (2017), *West Gippsland Floodplain Management Strategy*, West Gippsland Catchment Management Authority.

(WGCMA) West Gippsland Catchment Management Authority (2020), *Flood Guidelines: Guidelines for development in flood prone areas*, West Gippsland Catchment Management Authority.

Appendix A Solar panel and tracker details



FTC SOLAR

NOT FOR CONSTRUCTION

STAMP:

OTG ENERGY HAZELWOOD SF

BRODRIBB RD HAZELWOOD
VICTORIA 3840 AUSTRALIA

PROJECT NUM: 0063I00000oAYTLAA4

SHEET TITLE: SITE PLAN

SHEET SIZE: A1
594 X 841 (23.4" x 33.1")
0 1cm 2

NO.	REVISION	DATE	INIT.
A	INITIAL RELEASE	02/21/2022	AMV
B	BOUNDARY REVISED	03/02/2022	AMV
C	BOUNDARY REVISED	08/05/2022	AJJ
D	DC CAPACITY REVISED	08/08/2022	AJJ
E	Inverter Stations, Revised DC Capacity	13/03/2023	AS

DATE:	13/03/2023
DRAWN BY:	AS
ENGINEER:	CM
APPROVED BY:	GK

PROJECT PHASE: PRELIMINARY

SHEET NO.: A-100

PROJECT NOTES

1. UNLESS OTHERWISE NOTED, THESE DRAWINGS ARE PRELIMINARY AND SHALL NOT BE USED FOR CONSTRUCTION PURPOSES.
2. IT IS UNDERSTOOD THAT THE LAND WHICH THIS SOLAR SITE IS PROPOSED UPON IS SUITABLE FOR THIS PURPOSE.
3. ACTUAL OPTIMAL DIMENSIONS MAY DEPEND ON SPECIFIC SITE CONDITIONS; I.E. TOPOGRAPHY & SHADING ELEMENTS.
4. SOLE RESPONSIBILITY FOR CORRECT DESIGN, DETAILS, AND DIMENSIONS, QUANTITIES AND PERFORMANCE REQUIREMENTS TO BE CONFIRMED AND CORRELATED AT THE JOB SITE.
5. REFERENCE FILE: 22021_HAZELWOOD SOLAR_SITE BASE PLAN_REV04

PROJECT DESCRIPTION

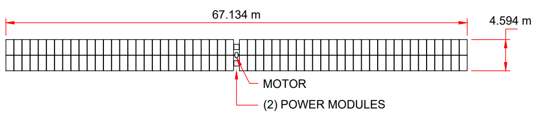
PROJECT SIZE (DC)	551504.80 kW
PROJECT SIZE (AC)	TBD
DC/AC RATIO	TBD
MODULE	(1002736) LONGI SOLAR LR5-72HBD-550M II 550 W
STRINGS	(35182) STRINGS OF (28) MODULES PER STRING
INVERTER	TBD
LATITUDE/ LONGTITUDE	-38.228907°/146.495037°
WIND SPEED	100 MPH
SNOW LOAD	0 PSF
PROJECT AREA	784.904 HECTARES

TRACKER DESCRIPTION

TRACKER TYPE	(8953) VOYAGER TRACKERS		
FULL TRACKERS-EXTERIOR	648	FULL TRACKERS-EDGE	3890
FULL TRACKERS-INTERMEDIATE	636	PARTIAL ROWS-EXTERIOR	0
FULL TRACKERS-INTERIOR	3779	PARTIAL ROWS-INTERIOR	0
RANGE OF MOTION	+/- 50°		
ROW PITCH (E-W)	10.21 METERS		
GAP (N-S)	0.5 METERS		
AZIMUTH	180°		
GROUND COVER RATIO	45%		

VOYAGER LEGEND

112 MODULES
(4) STRINGS OF 28 MODULES



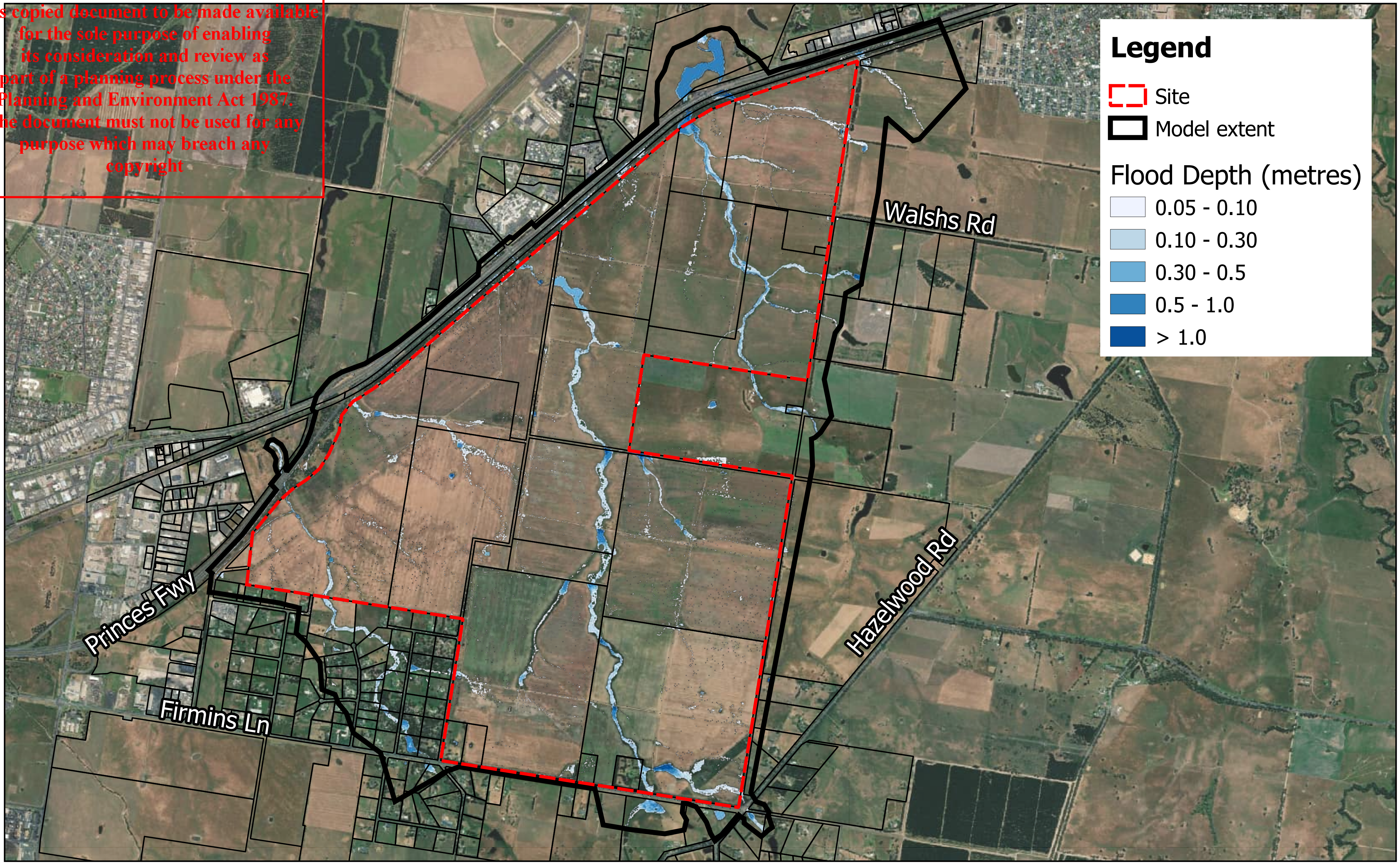
DRAWING NOT TO SCALE

ADVERTISED PLAN

N

0 10m 20 30 40 50 100
1:1000

Appendix B Existing Conditions Flood Depth Mapping



Title: Hazelwood North Solar Farm - Existing Conditions
Peak Flood Depth - 50% AEP

Figure: B-1

Rev: A

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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By: JS

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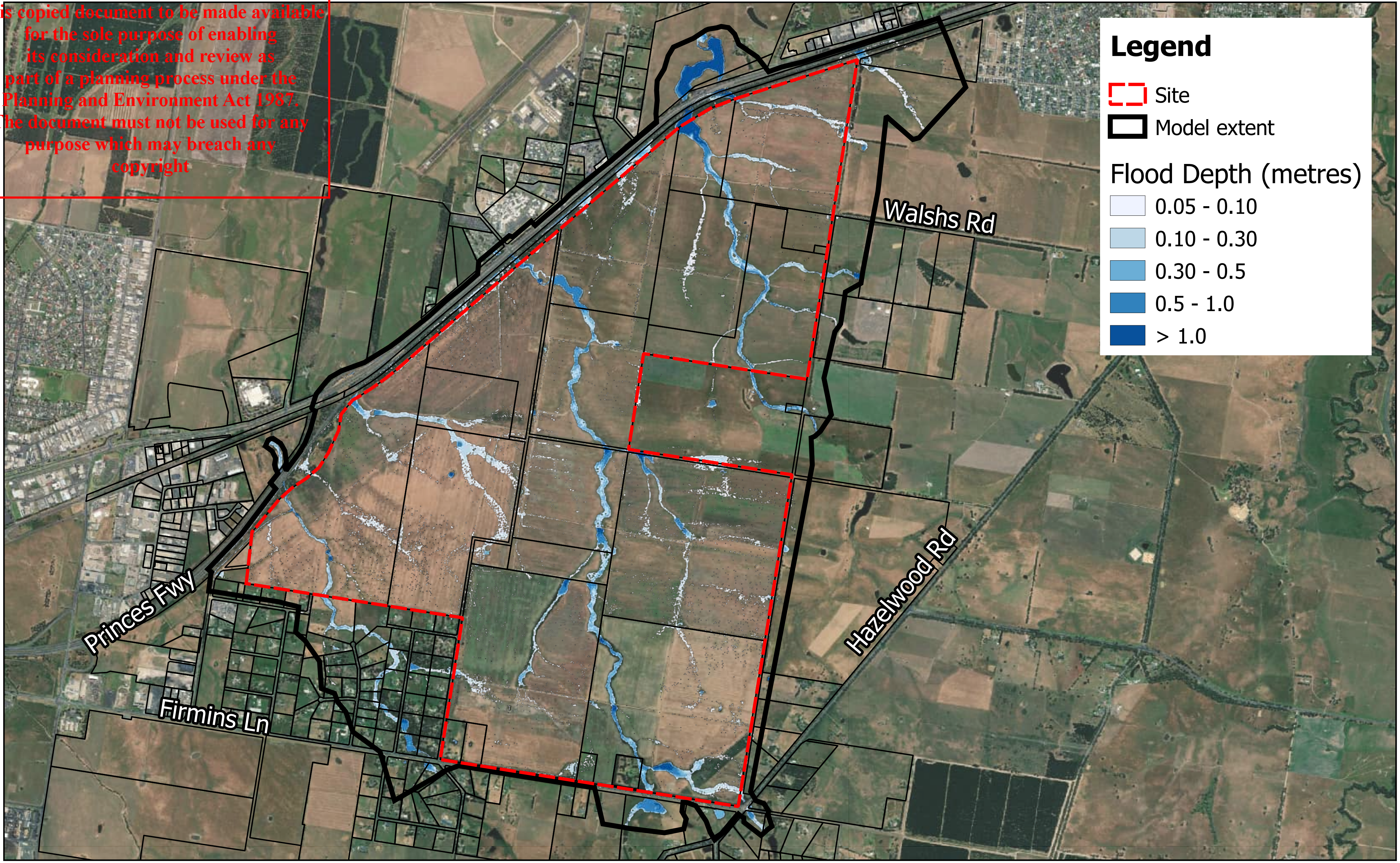

Title: Hazelwood North Solar Farm - Existing Conditions
Peak Flood Depth - 20% AEP

Figure: B-2

Rev: A

0.5 0 0.5 km

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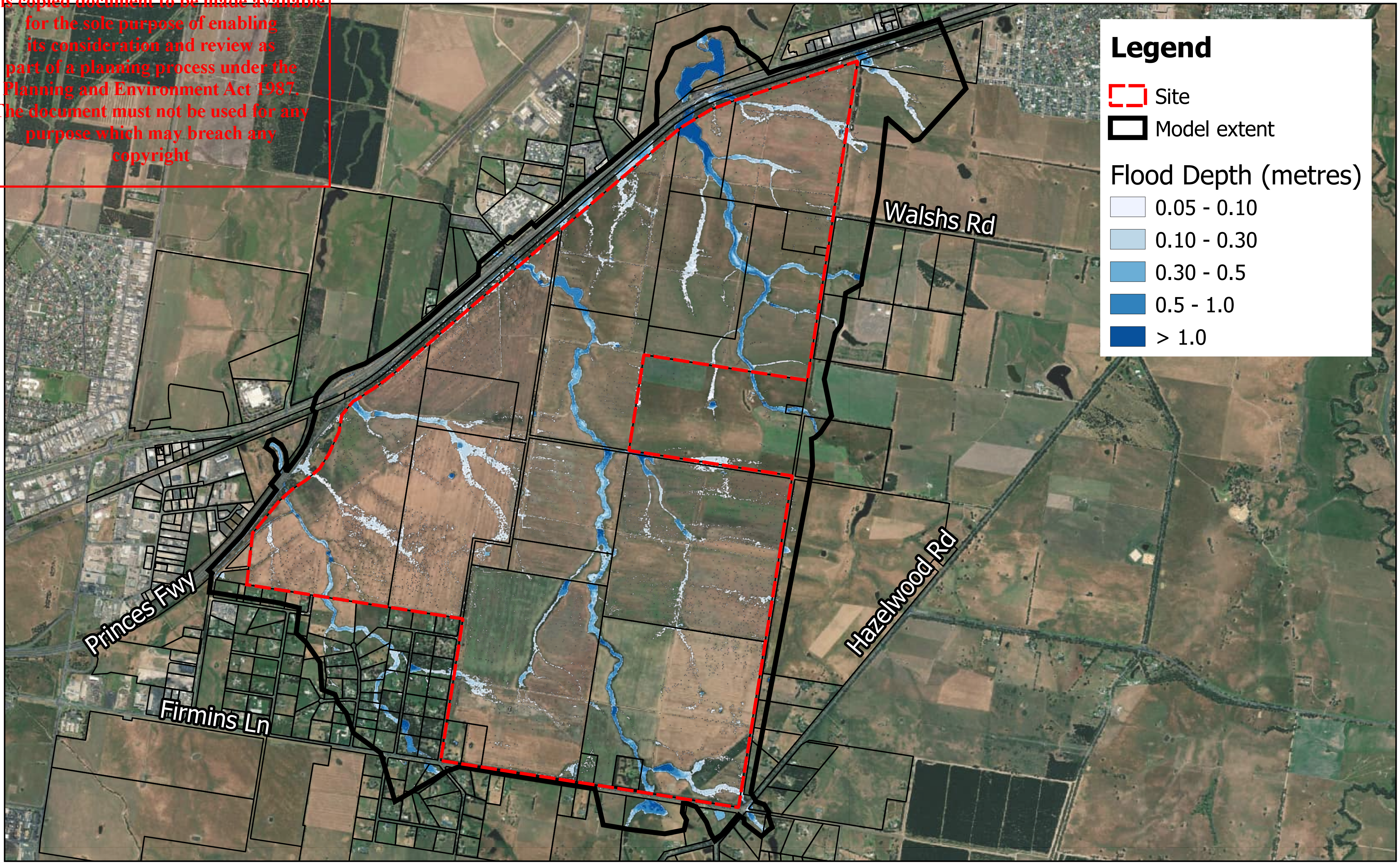
By: JS

Feb 2023



Title: Hazelwood North Solar Farm - Existing Conditions
Peak Flood Depth - 10% AEP

Figure: B-3

Rev: A

0.5 0 0.5 km

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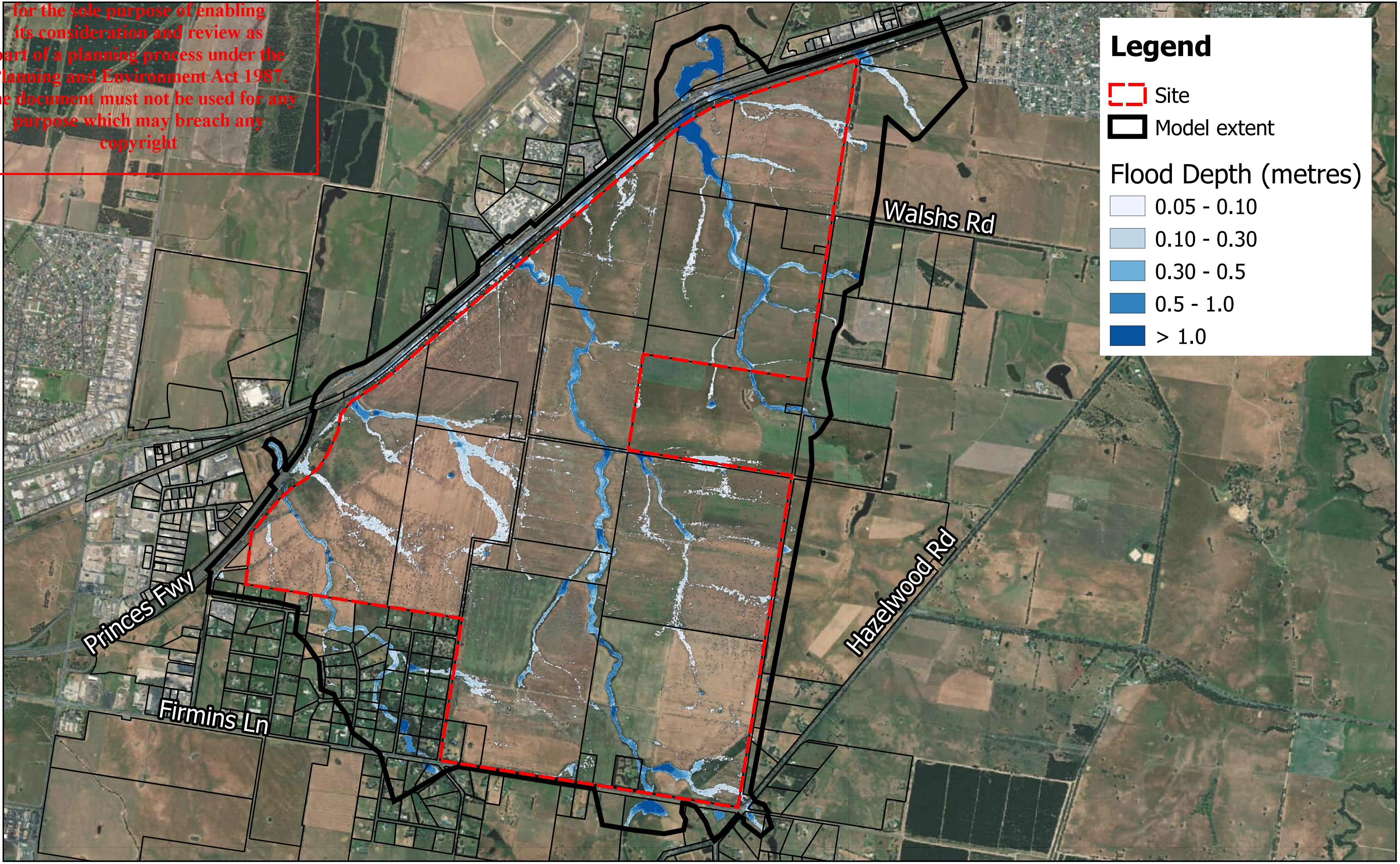
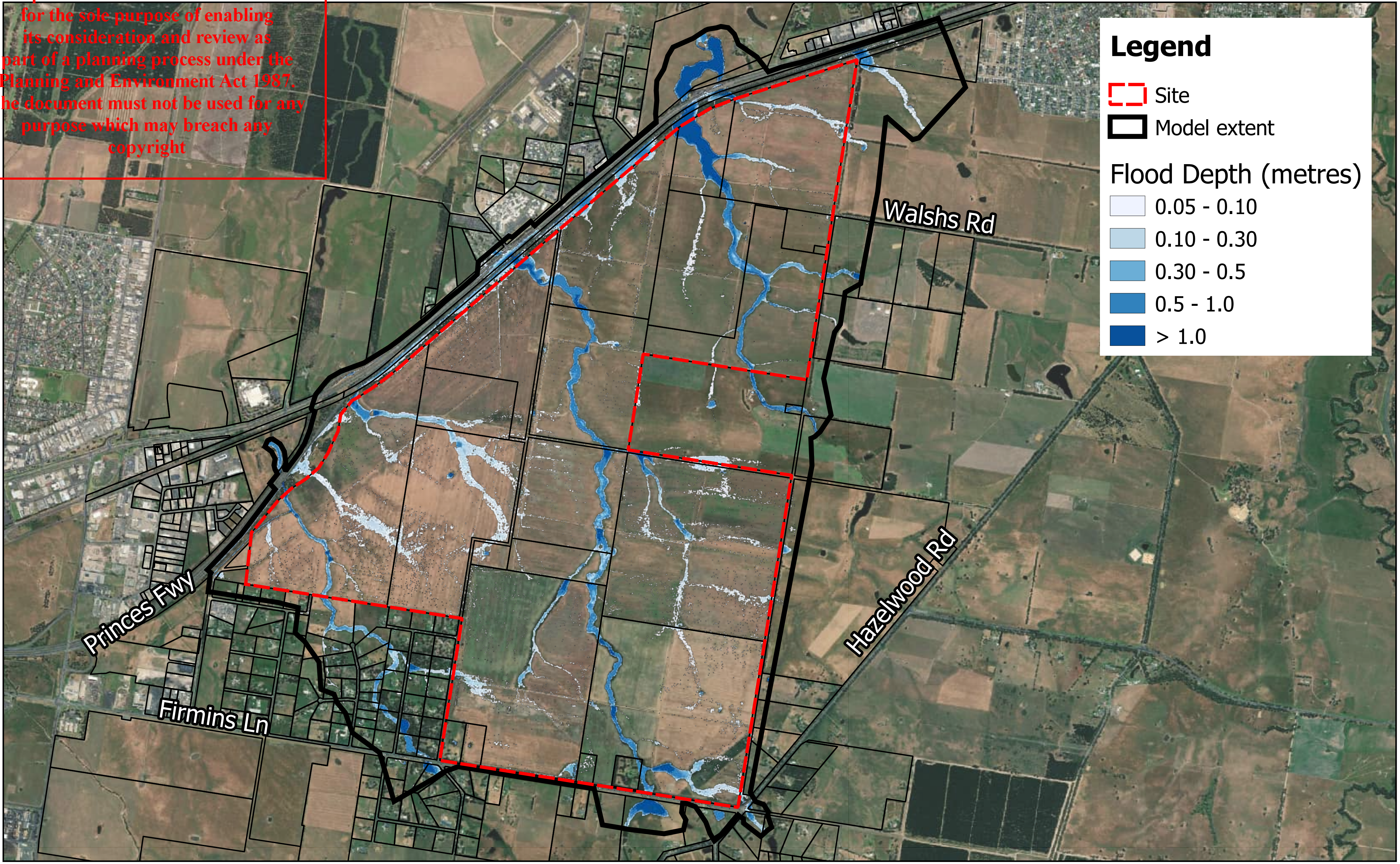


Title:	Figure:	Rev:			
Hazelwood North Solar Farm - Existing Conditions Peak Flood Depth - 5% AEP	B-4	A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.	VENANT SOLUTIONS
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigB-4_E01_20y_009_d_max.qgz				By: JS	Feb 2023	www.VenantSolutions.com.au



Title:	Figure:	Rev:
Hazelwood North Solar Farm - Existing Conditions Peak Flood Depth - 2% AEP	B-5	A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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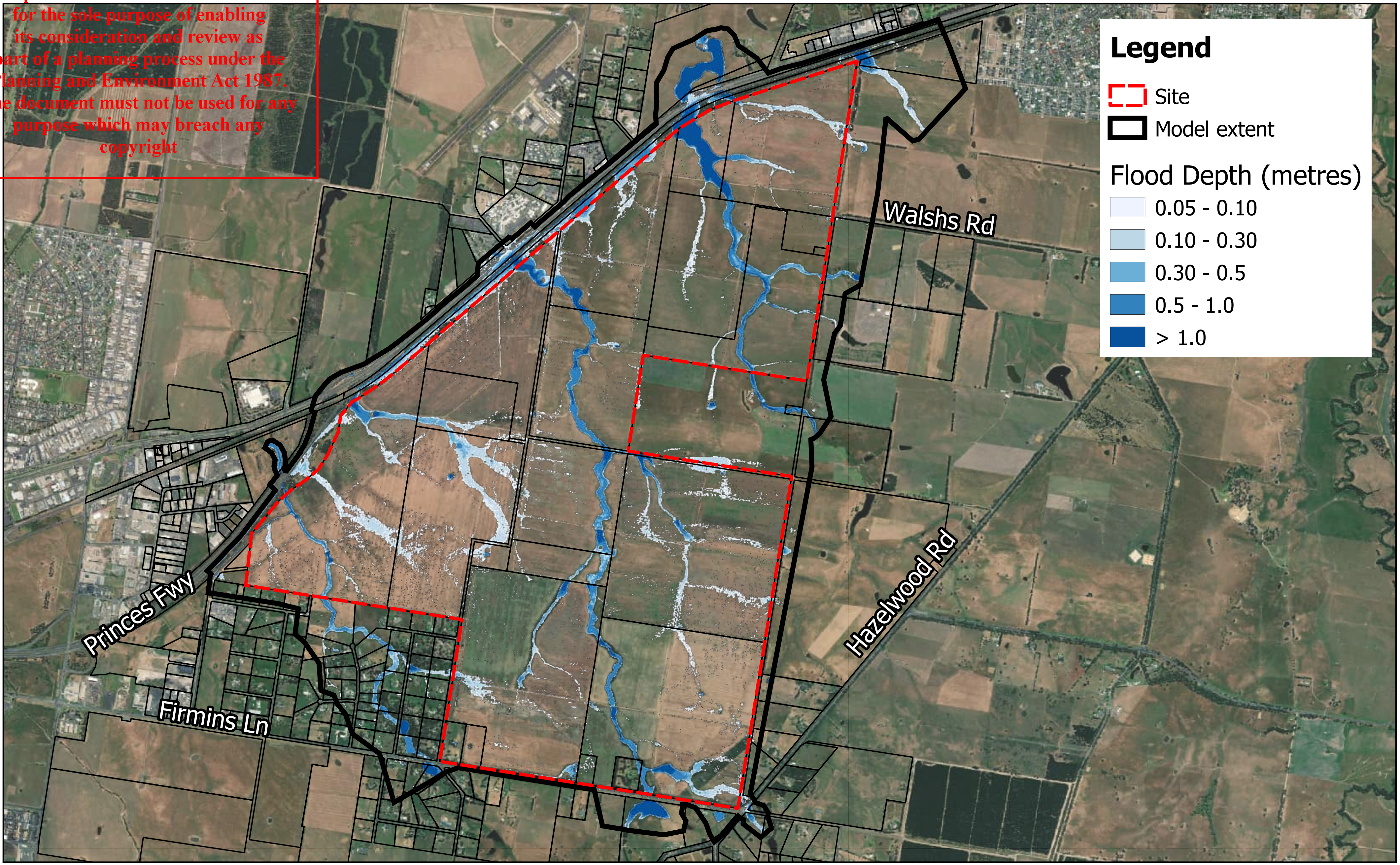

Title:	Figure:	Rev:
Hazelwood North Solar Farm - Existing Conditions Peak Flood Depth - 1% AEP	B-6	A

0.5 0 0.5 km

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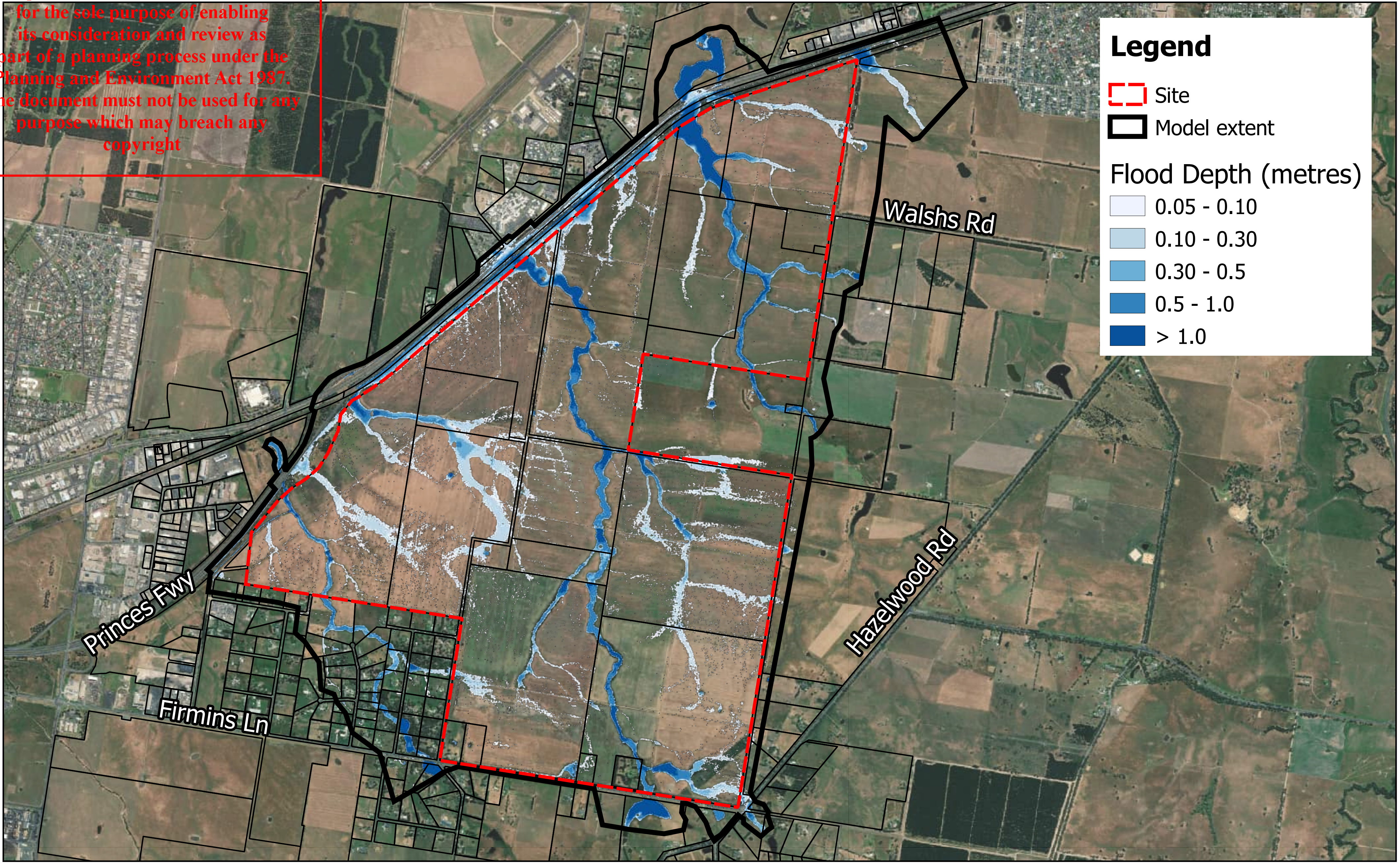

Title:	Figure:	Rev:
Hazelwood North Solar Farm - Existing Conditions Peak Flood Depth - 1% AEP with Climate Change	B-7	A

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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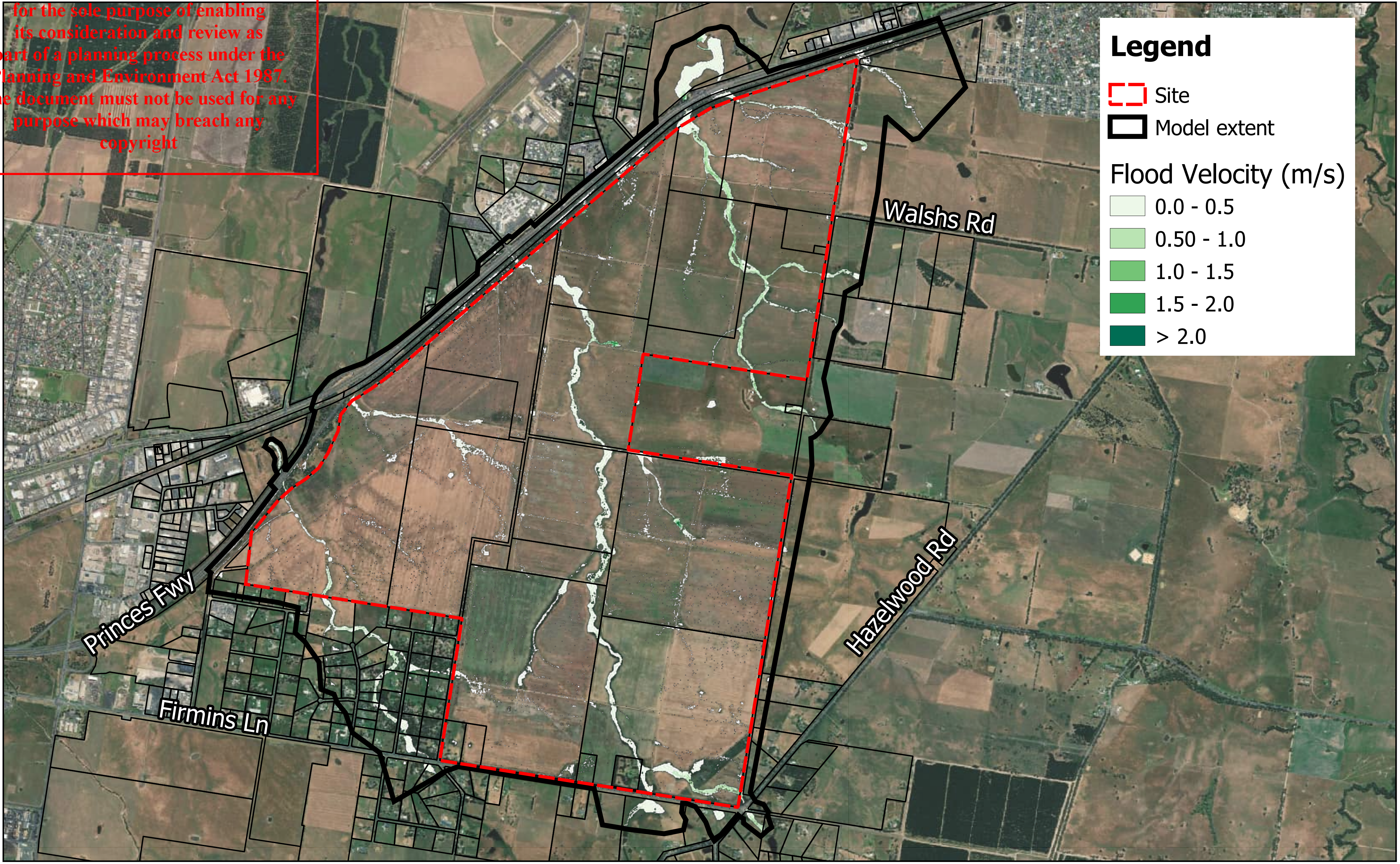
Appendix C Existing Conditions Flood Velocity Mapping



Title: Hazelwood North Solar Farm - Existing Conditions Peak Flood Velocity - 50% AEP	Figure: C-1	Rev: A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.
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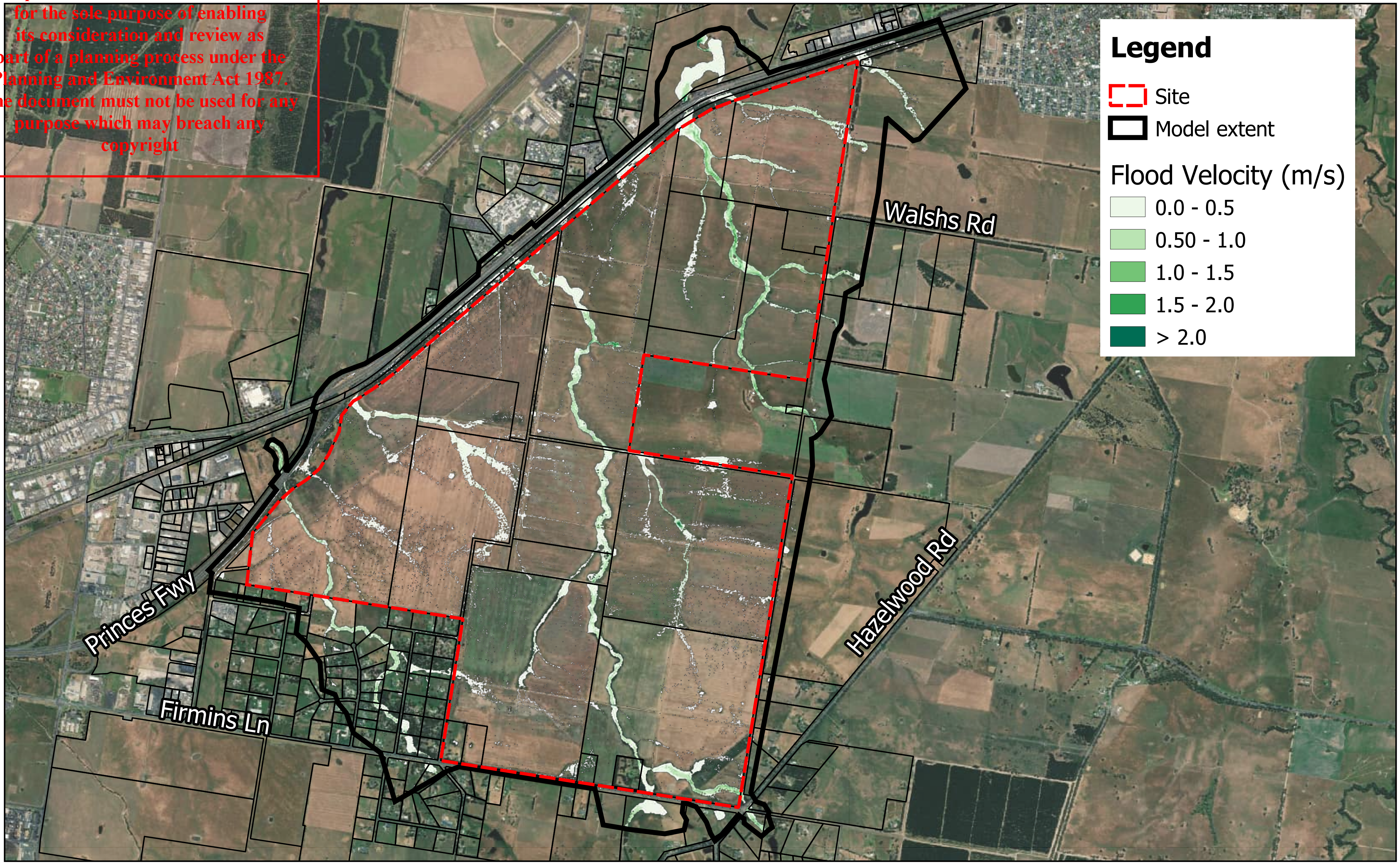

Title: Hazelwood North Solar Farm - Existing Conditions Peak Flood Velocity - 20% AEP	Figure: C-2	Rev: A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigC-2_E01_5y_009_V_max.qgz			By: JS	Feb 2023

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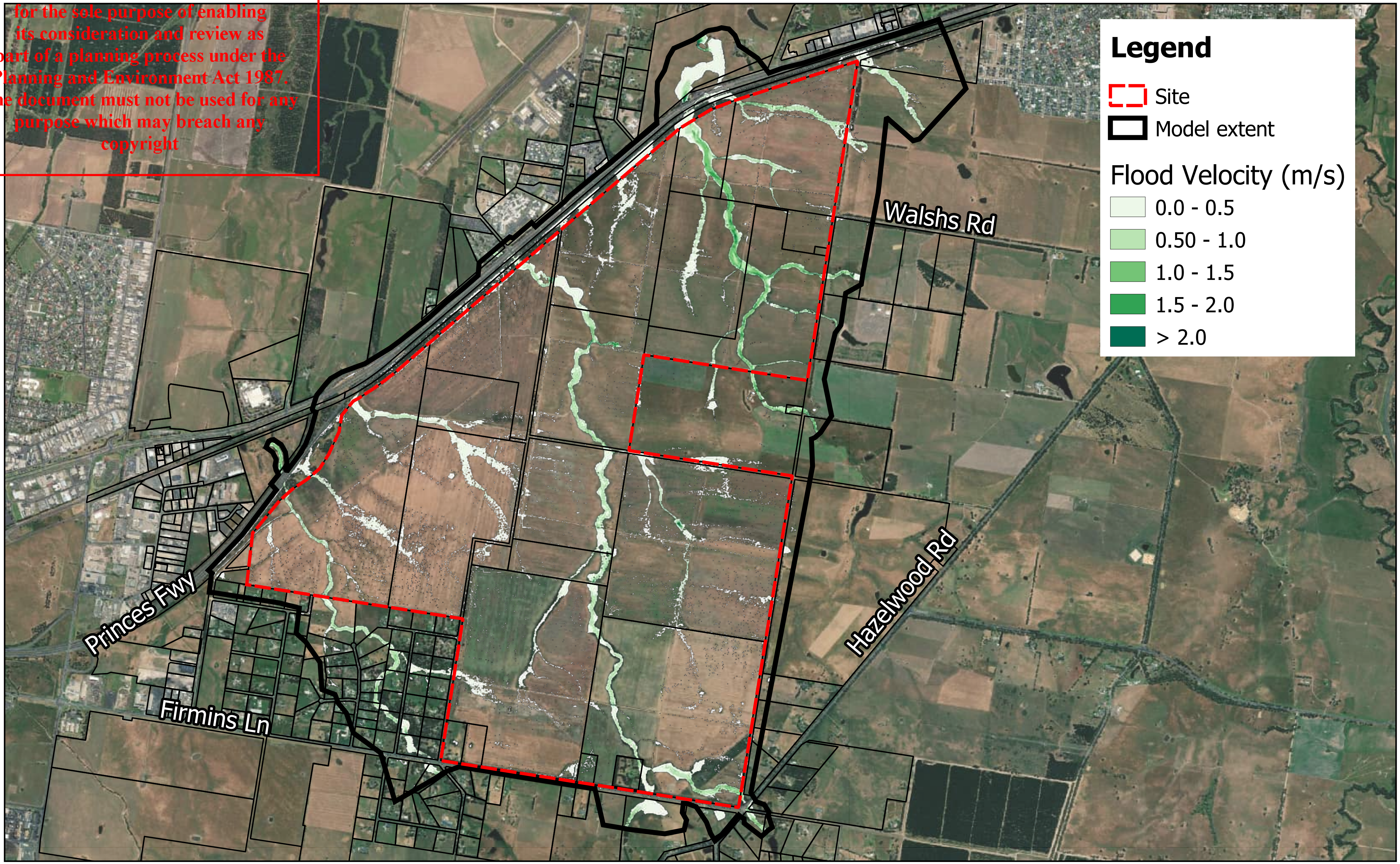
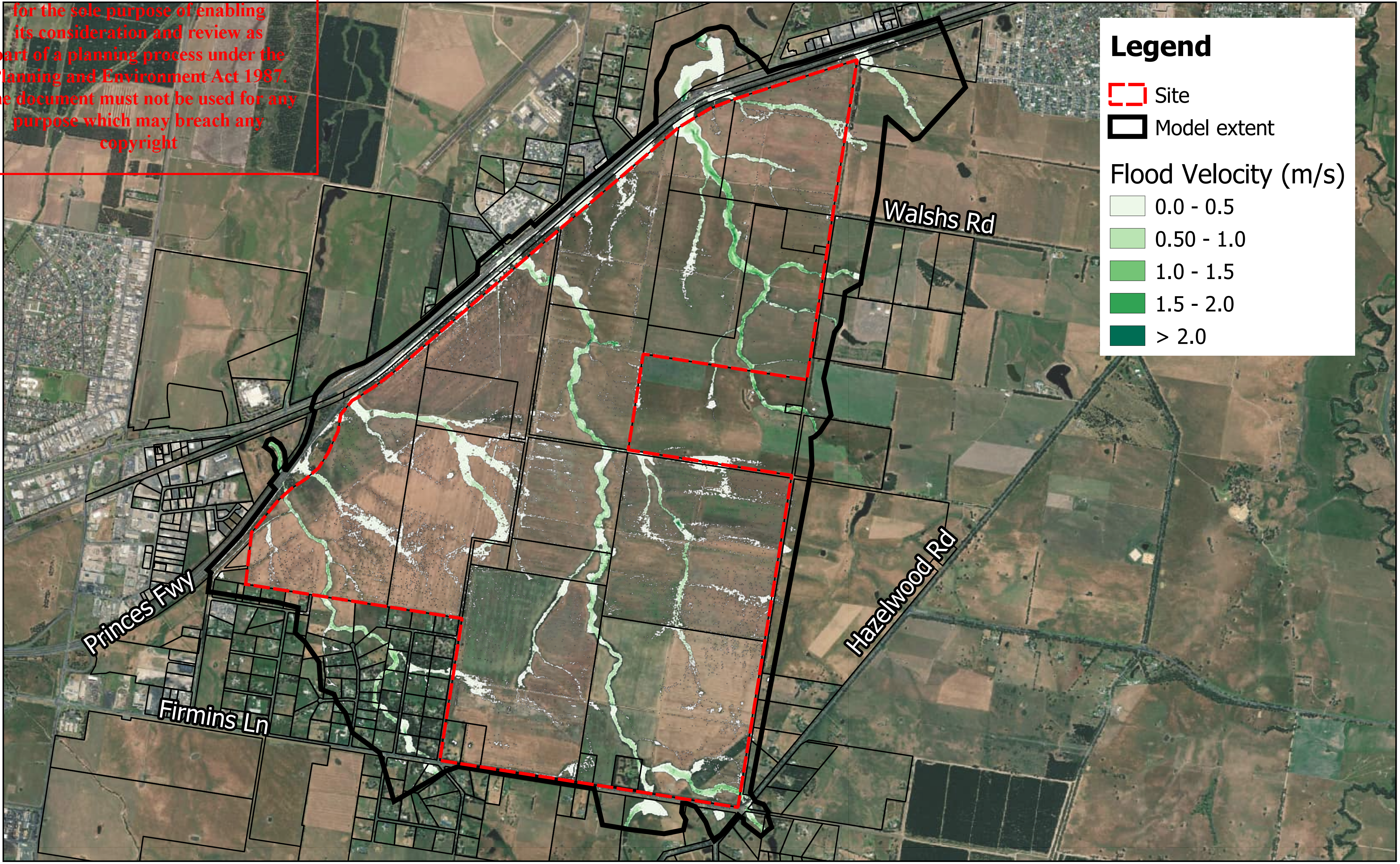


Title: Hazelwood North Solar Farm - Existing Conditions Peak Flood Velocity - 10% AEP	Figure: C-3	Rev: A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.	VENANT SOLUTIONS
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigC-3_E01_10y_009_V_max.qgz				By: JS Feb 2023	www.VenantSolutions.com.au



Title: Hazelwood North Solar Farm - Existing Conditions Peak Flood Velocity - 5% AEP	Figure: C-4	Rev: A	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.
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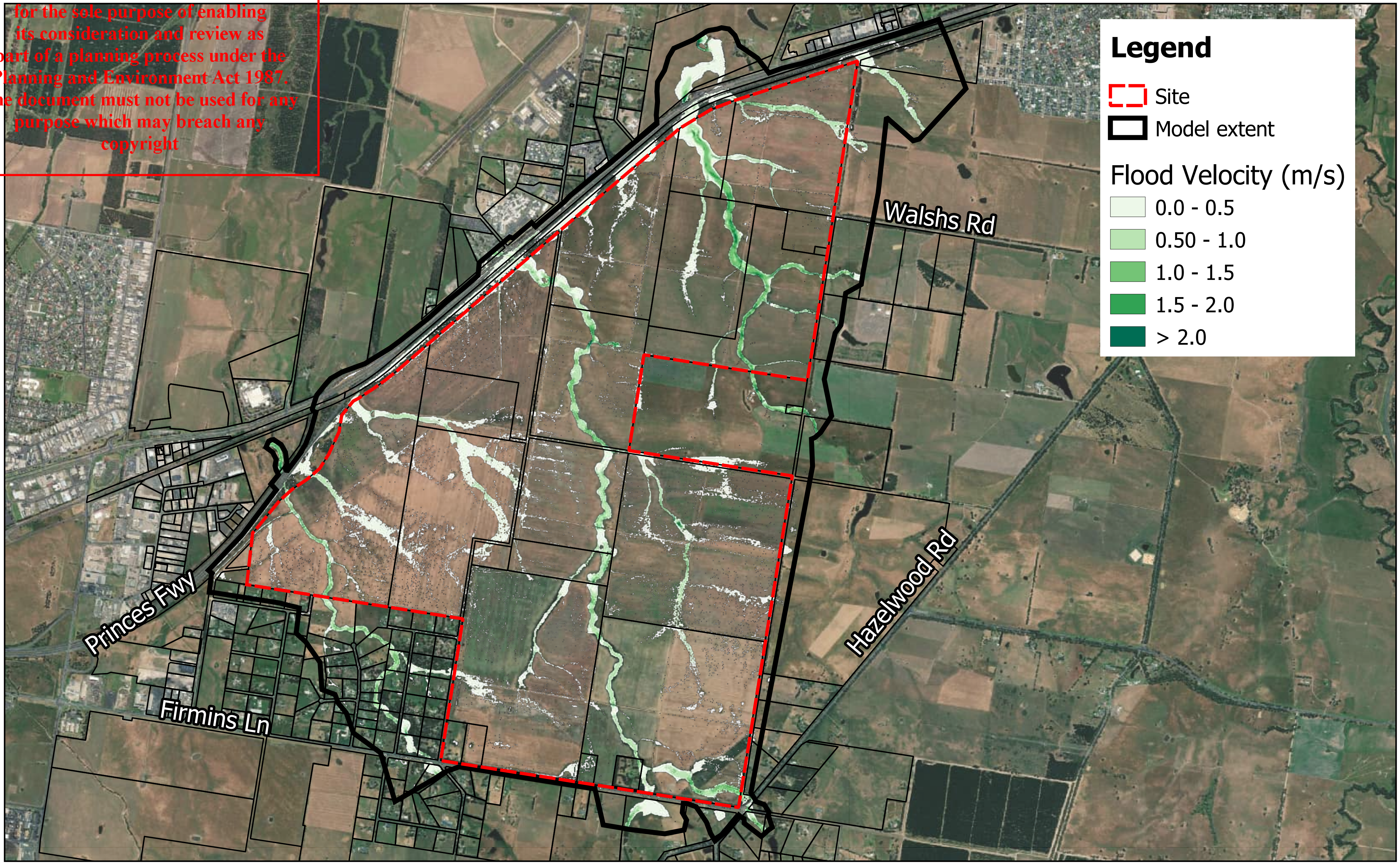

Title: Hazelwood North Solar Farm - Existing Conditions
Peak Flood Velocity - 2% AEP

Figure: C-5

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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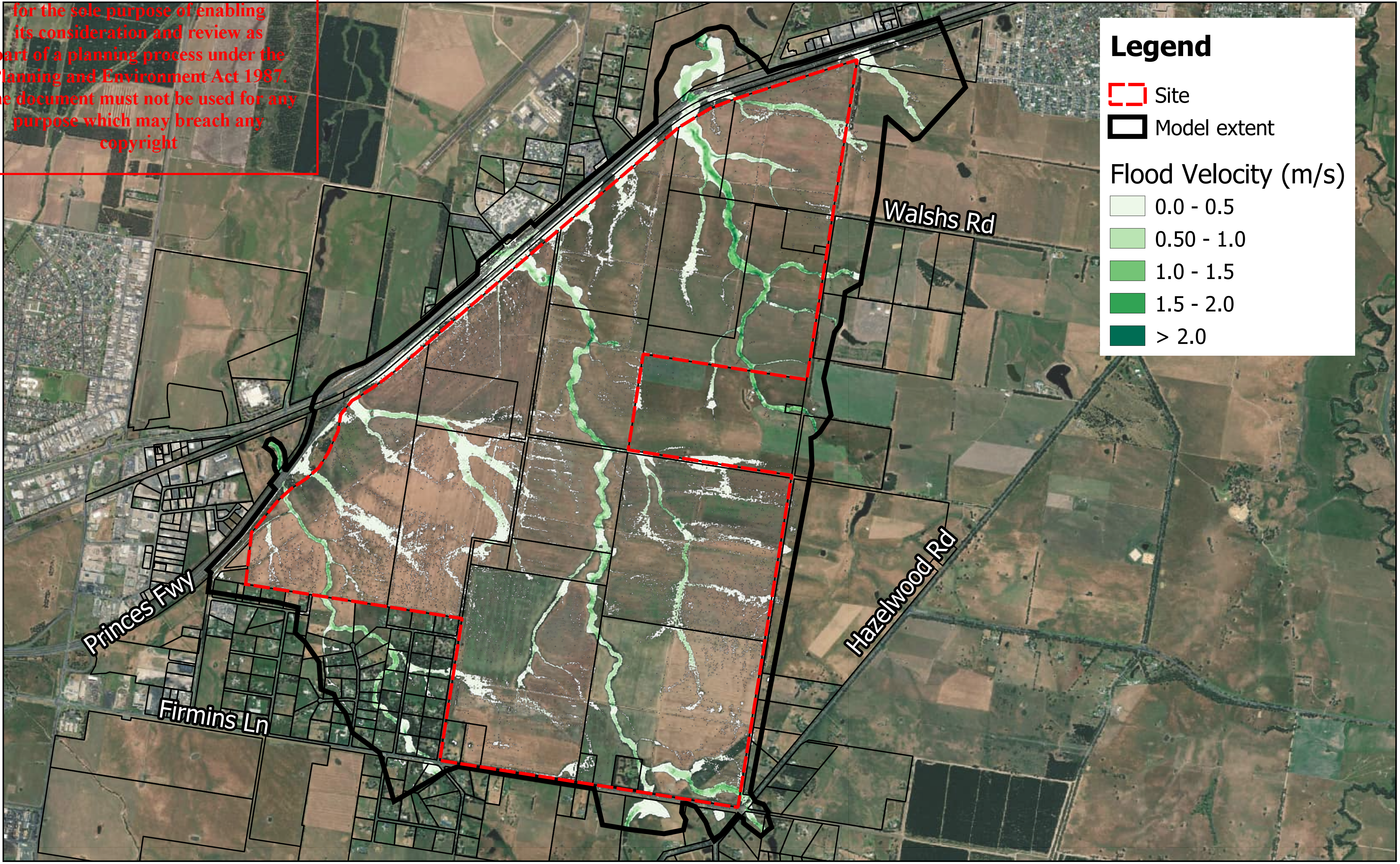

Title: Hazelwood North Solar Farm - Existing Conditions
Peak Flood Velocity - 1% AEP

Figure: C-6

Rev: A

0.5 0 0.5 km

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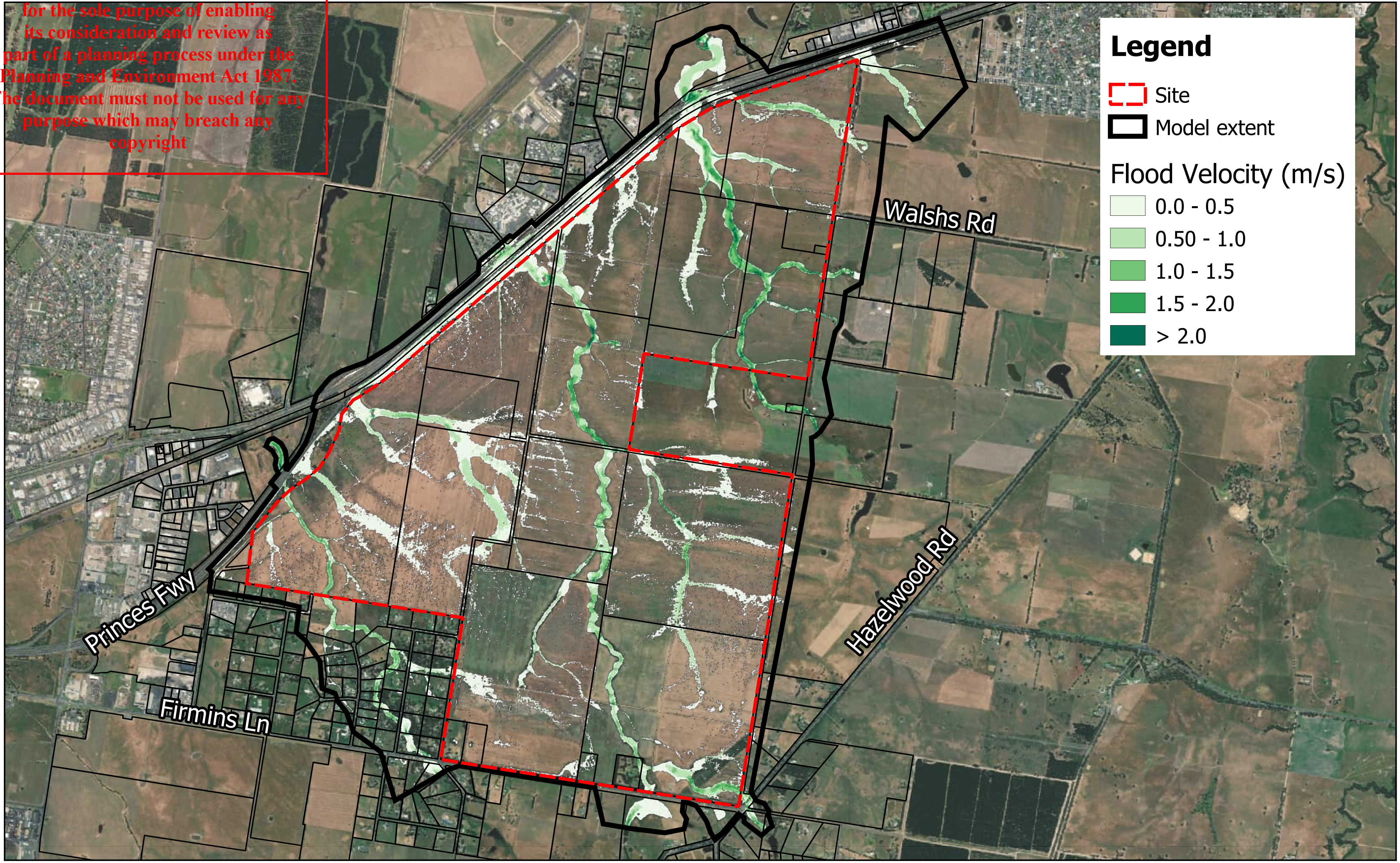

Title:	Figure:	Rev:
Hazelwood North Solar Farm - Existing Conditions Peak Flood Velocity - 1% AEP with Climate Change	C-7	A

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigC-7_E01_100yCC_009_V_max.qgz

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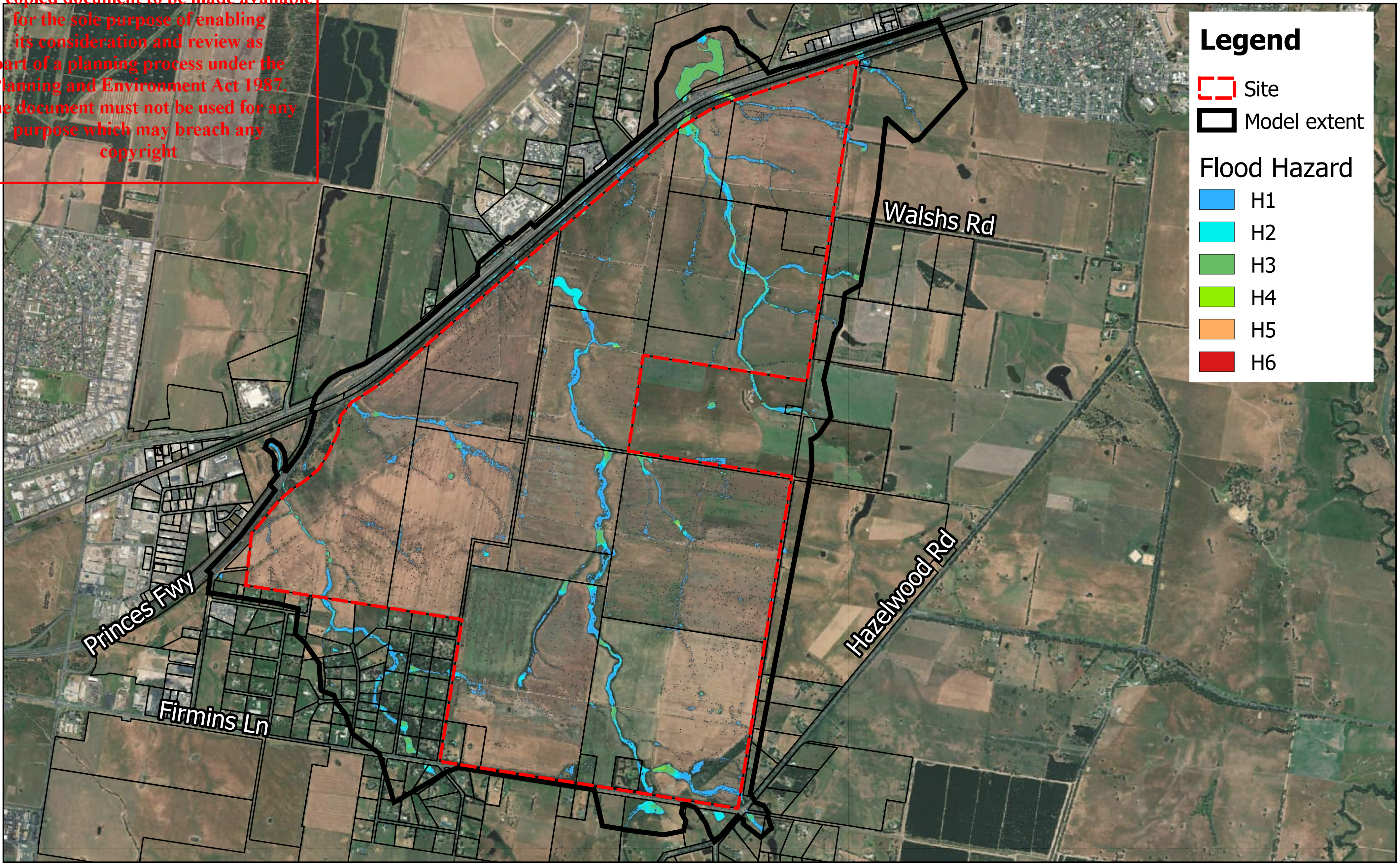
Appendix D Existing Conditions Flood Hazard Mapping



Title:	Figure:	Rev:
Hazelwood North Solar Farm - Existing Conditions Peak Flood Hazard - 50% AEP	D-1	A

0.5 0 0.5 km

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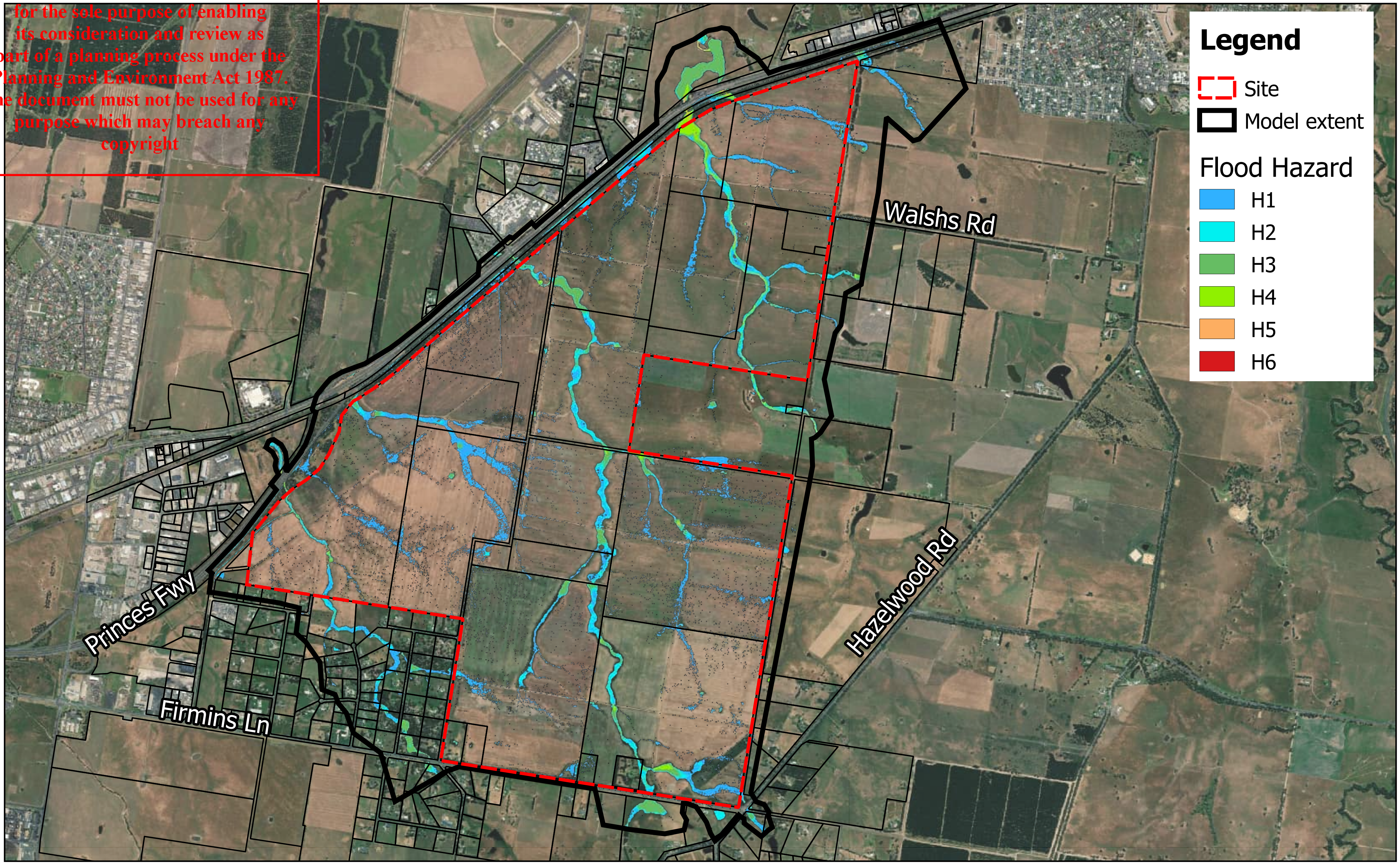

Title:	Figure:	Rev:
Hazelwood North Solar Farm - Existing Conditions Peak Flood Hazard - 20% AEP	D-2	A

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigD-2_E01_5y_009_ZAEM1_max.qgz

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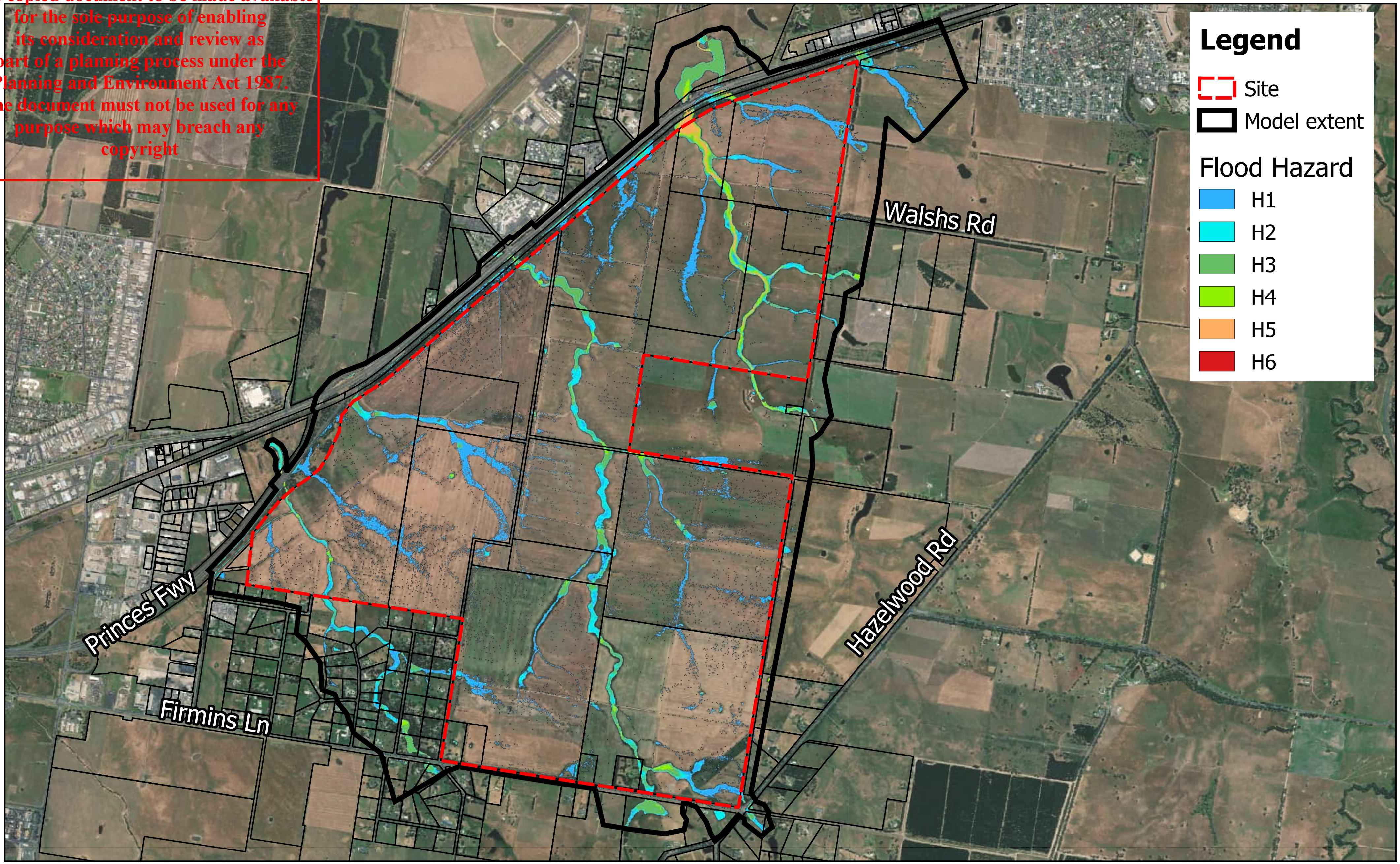

Title: Hazelwood North Solar Farm - Existing Conditions Peak Flood Hazard - 10% AEP

Figure: D-3

Rev: A

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigD-3_E01_10y_009_ZAEM1_max.qgz

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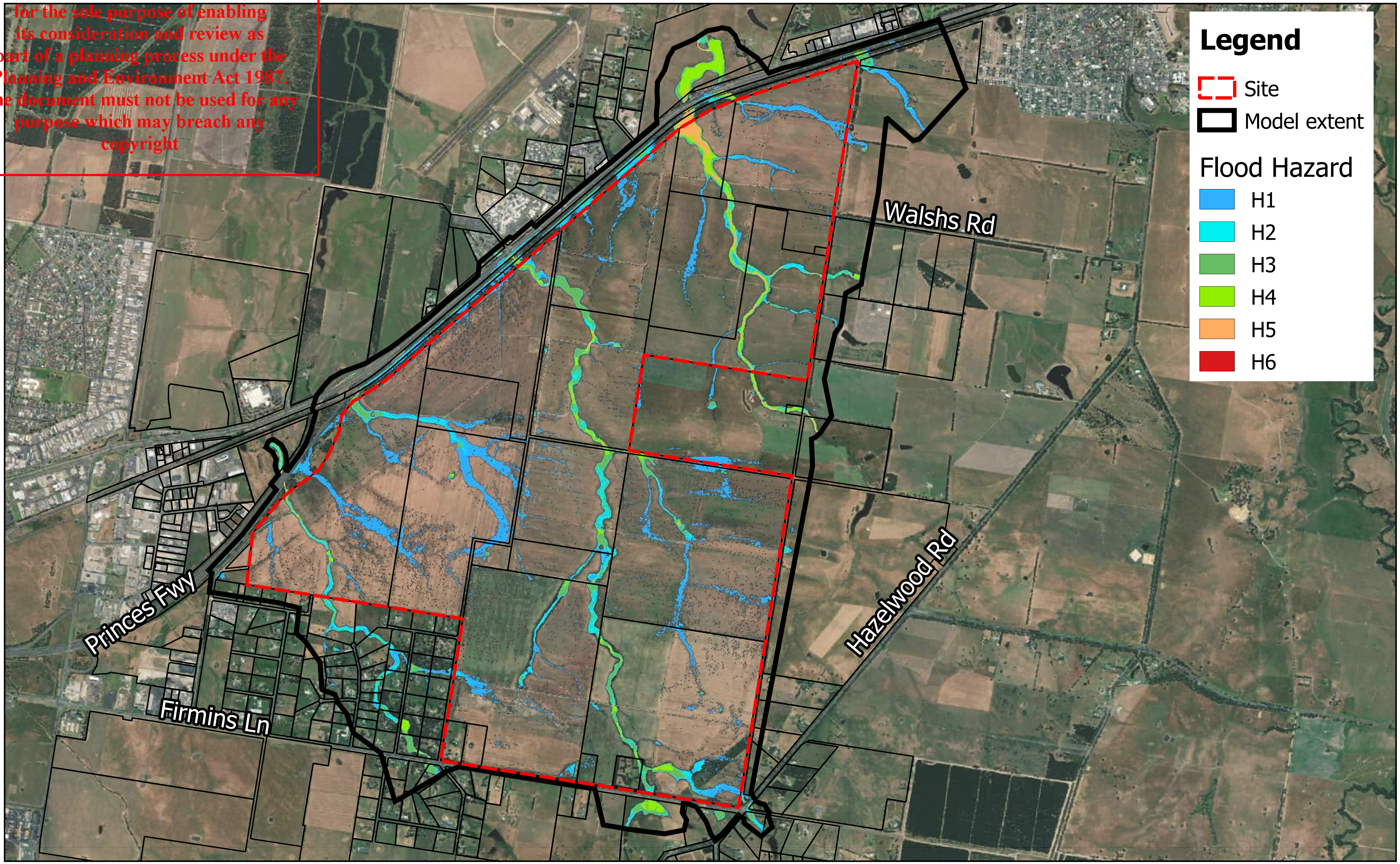

Title: Hazelwood North Solar Farm - Existing Conditions Peak Flood Hazard - 5% AEP	Figure: D-4	Rev: A

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigD-4_E01_20y_009_ZAEM1_max.qgz

By: JS | Feb 2023

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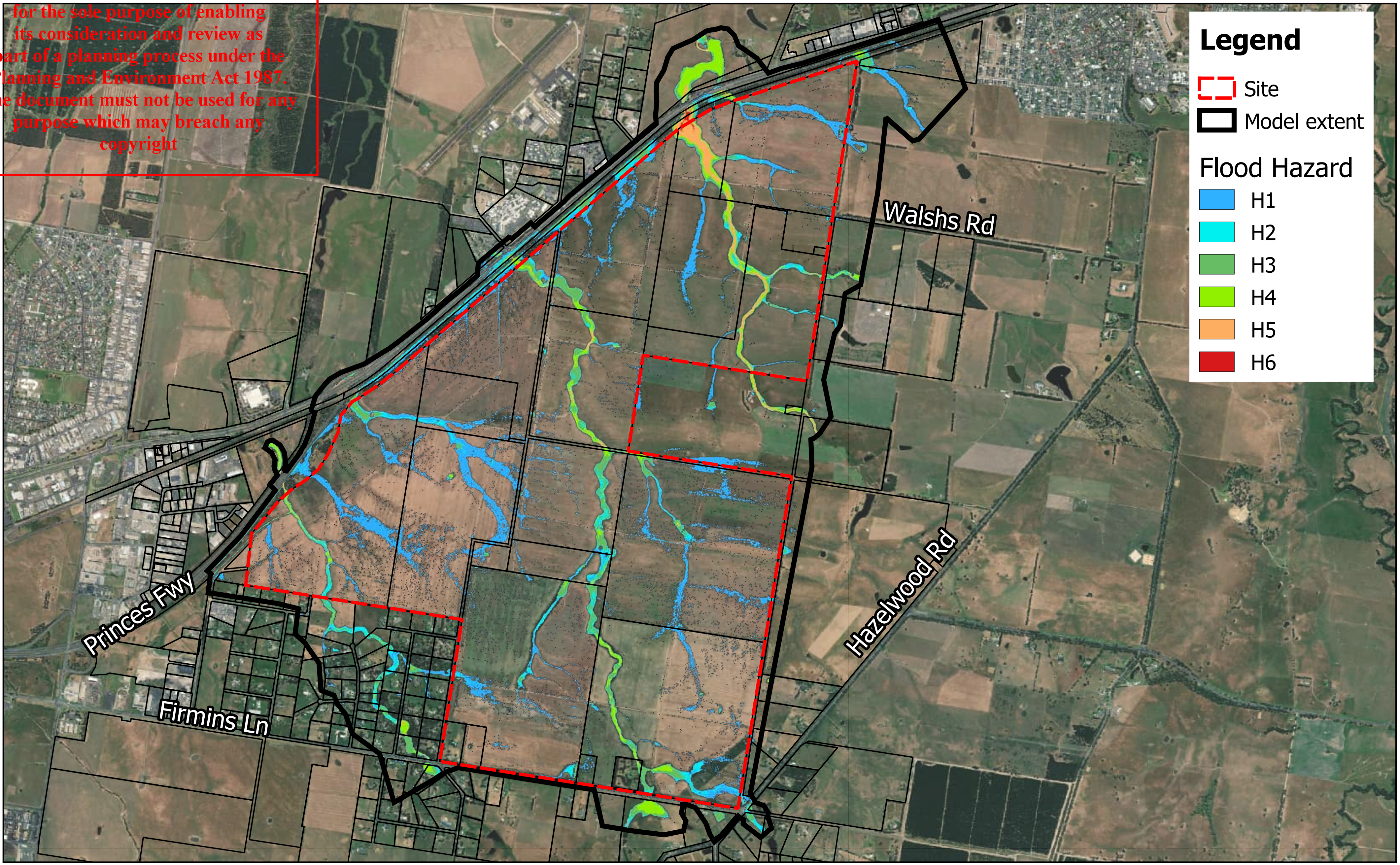

Title: Hazelwood North Solar Farm - Existing Conditions
Peak Flood Hazard - 2% AEP

Figure: D-5

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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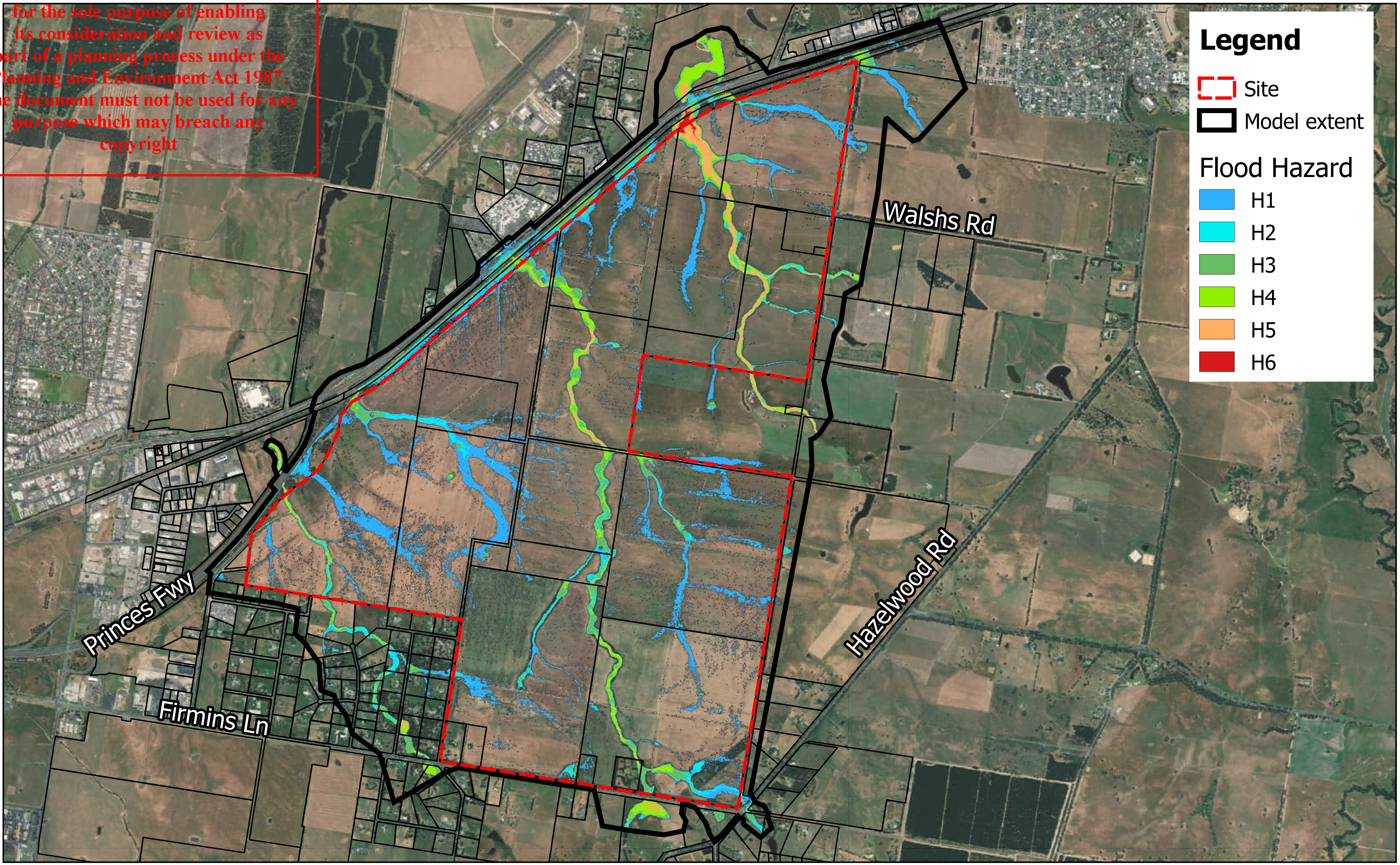
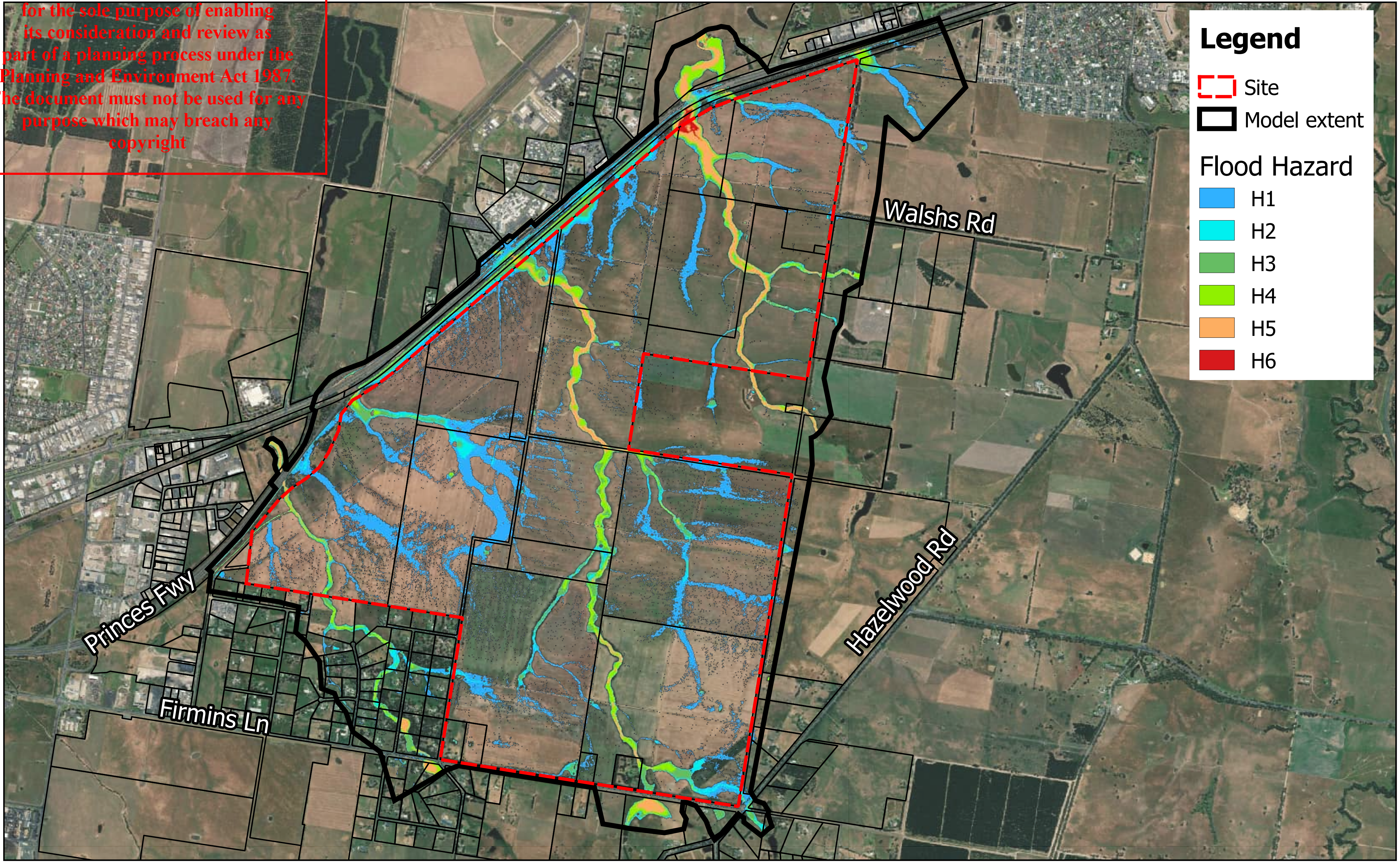
By: JS

Feb 2023



Title: Hazelwood North Solar Farm - Existing Conditions Peak Flood Hazard - 1% AEP	Figure: D-6	Rev: A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.	VENANT SOLUTIONS
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigD-6_E01_100y_009_ZAEM1_max.qgz				By: JS Feb 2023	www.VenantSolutions.com.au



Title: Hazelwood North Solar Farm - Existing Conditions
Peak Flood Hazard - 1% AEP with Climate Change

Figure: D-7

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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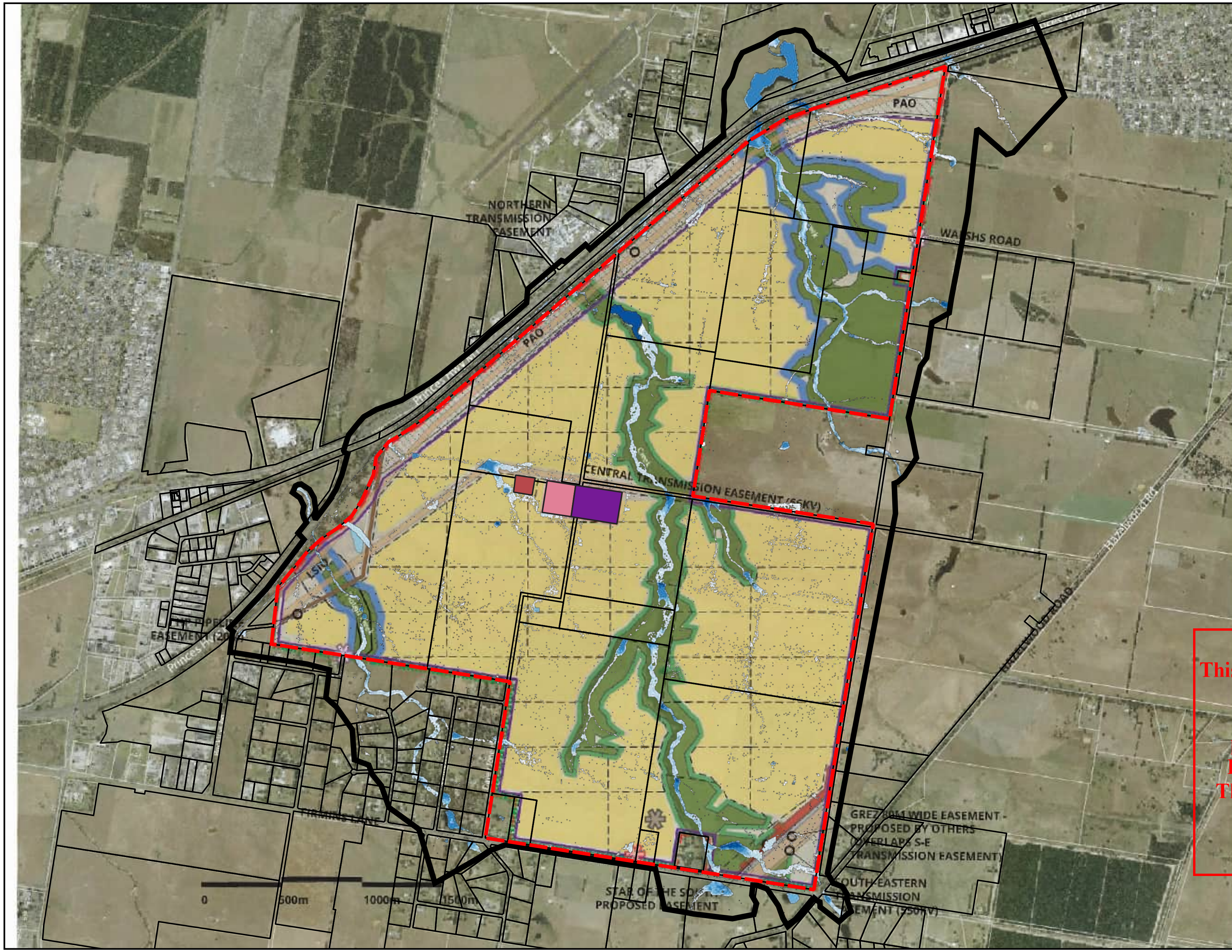
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.01\FigD-7_E01_100yCC_009_ZAEM1_max.qgz

By: JS

Feb 2023

Appendix E Concept Design Flood Depth Mapping



Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Flood Depth (metres)

- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.5
- 0.5 - 1.0
- > 1.0

Title:	Figure:	Rev:	
Hazelwood North Solar Farm - Concept Design Peak Flood Depth - 50% AEP	E-1	A	0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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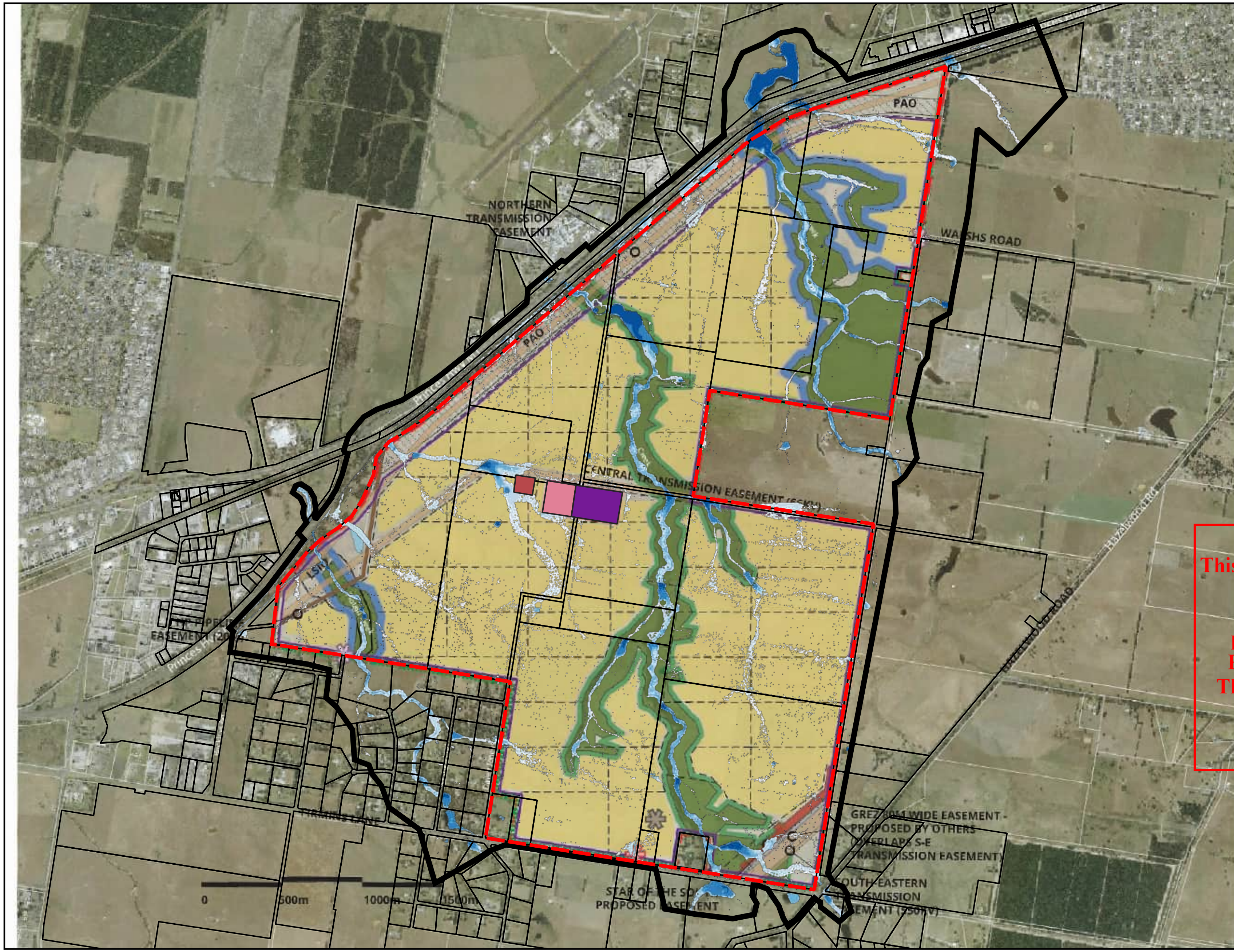
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigE-1_D50_2y_009_d_max.qgz

By: JS | Jul 2023



Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Flood Depth (metres)

- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.5
- 0.5 - 1.0
- > 1.0

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Depth - 20% AEP

Figure: E-2

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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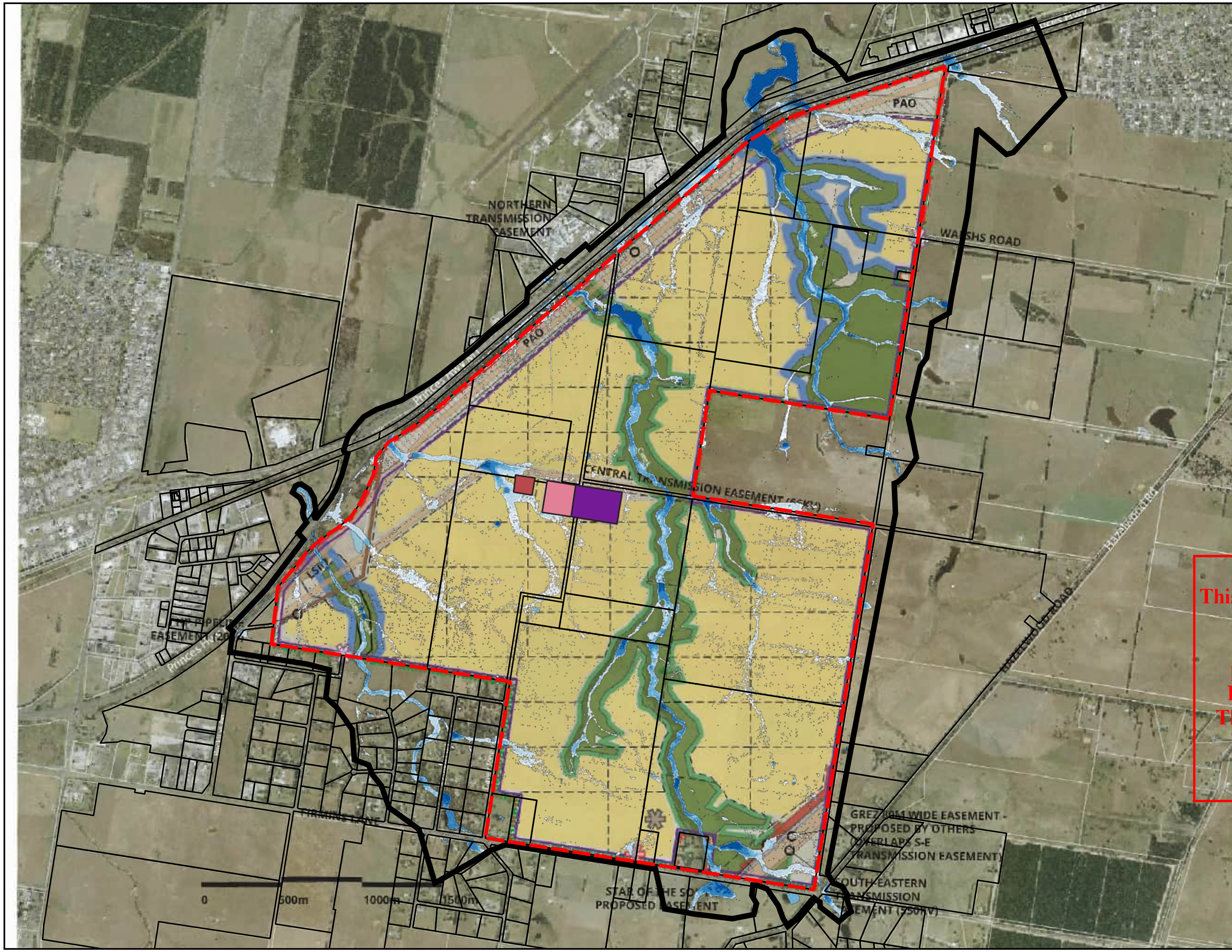
By: JS | Jul 2023



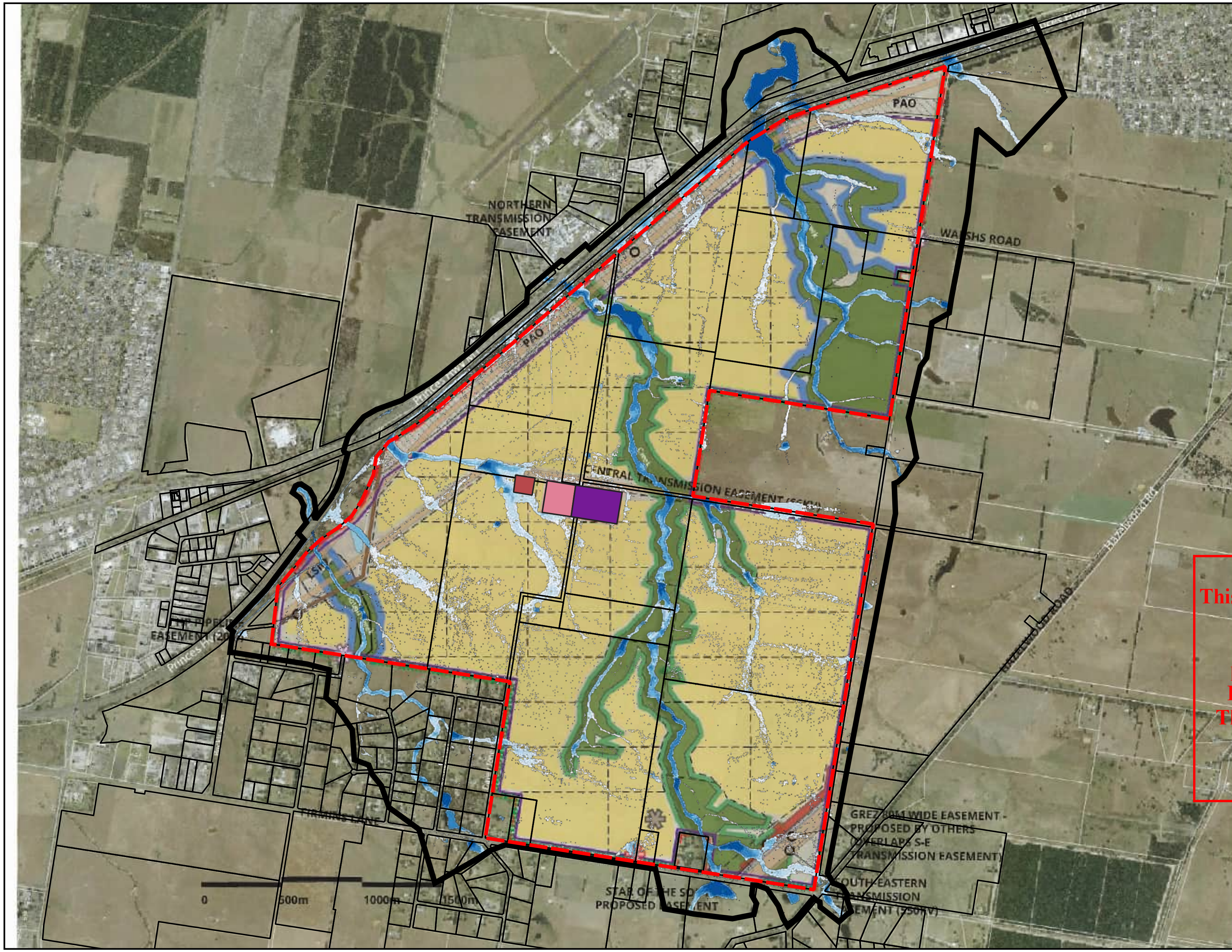
Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Flood Depth (metres)

- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.5
- 0.5 - 1.0
- > 1.0

Title:	Figure:	Rev:			
Hazelwood North Solar Farm - Concept Design Peak Flood Depth - 10% AEP	E-3	A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.	VENANT SOLUTIONS
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigE-3_D50_10y_009_d_max.qgz				By: JS Jul 2023	www.VenantSolutions.com.au



Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Flood Depth (metres)

- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.5
- 0.5 - 1.0
- > 1.0

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Depth - 5% AEP

Figure: E-4

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigE-4_D50_20y_009_d_max.qgz

By: JS

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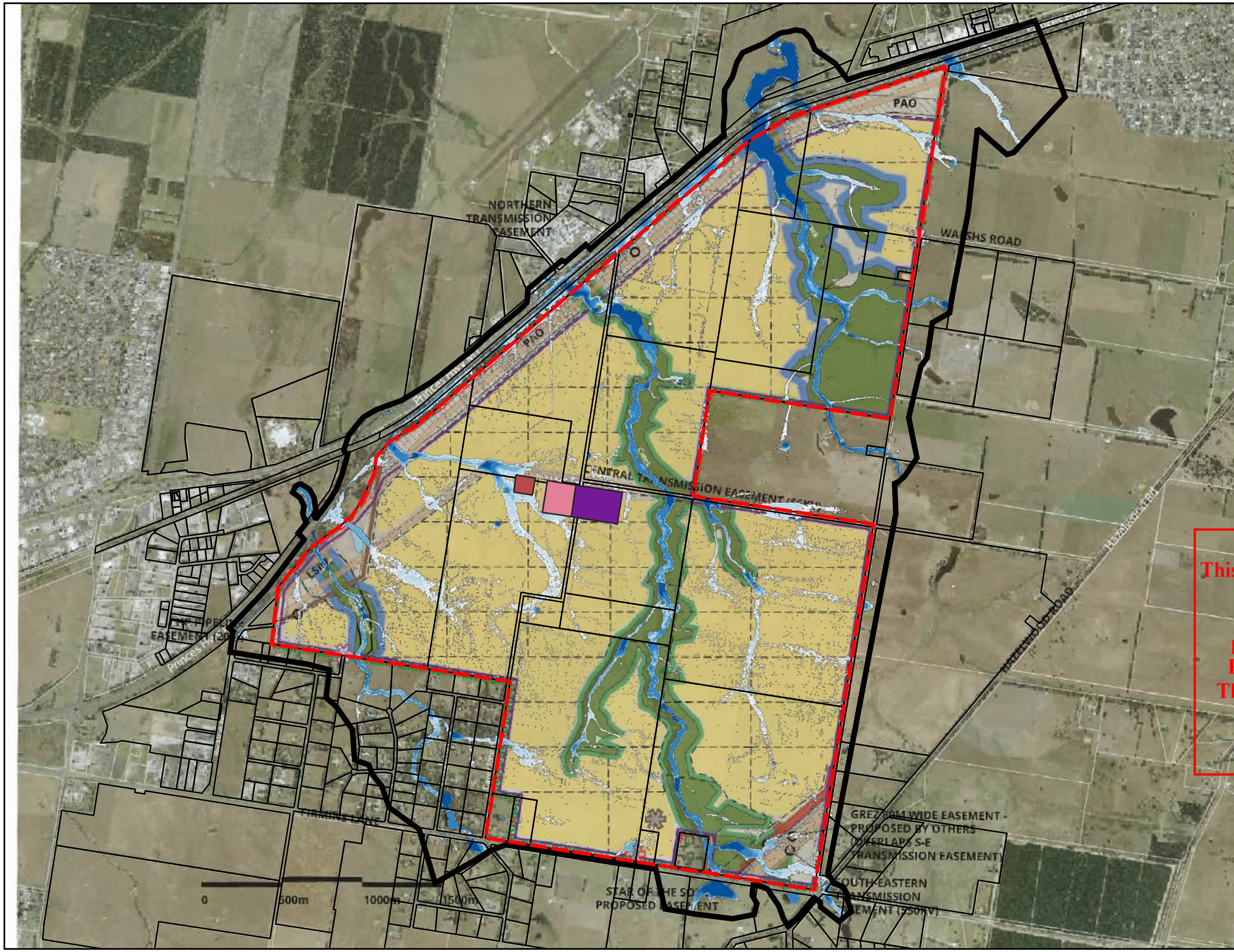

Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Flood Depth (metres)

- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.5
- 0.5 - 1.0
- > 1.0

Title:	Figure:	Rev:		
Hazelwood North Solar Farm - Concept Design Peak Flood Depth - 2% AEP	E-5	A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigE-5_D50_50y_009_d_max.qgz			By: JS	Jul 2023

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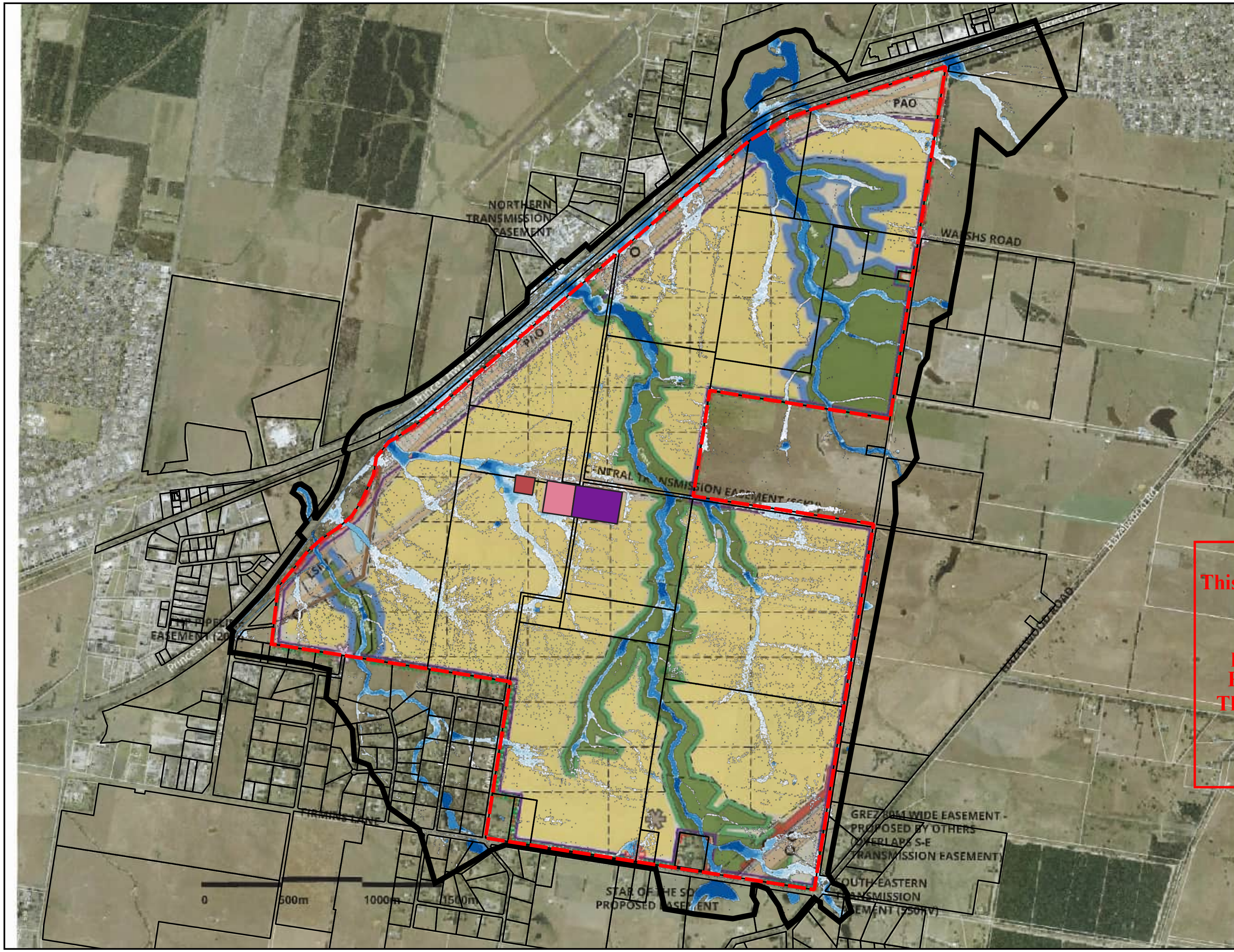

Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Flood Depth (metres)

- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.5
- 0.5 - 1.0
- > 1.0

Title:	Figure:	Rev:
Hazelwood North Solar Farm - Concept Design Peak Flood Depth - 1% AEP	E-6	A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigE-6_D50_100y_009_d_max.qgz

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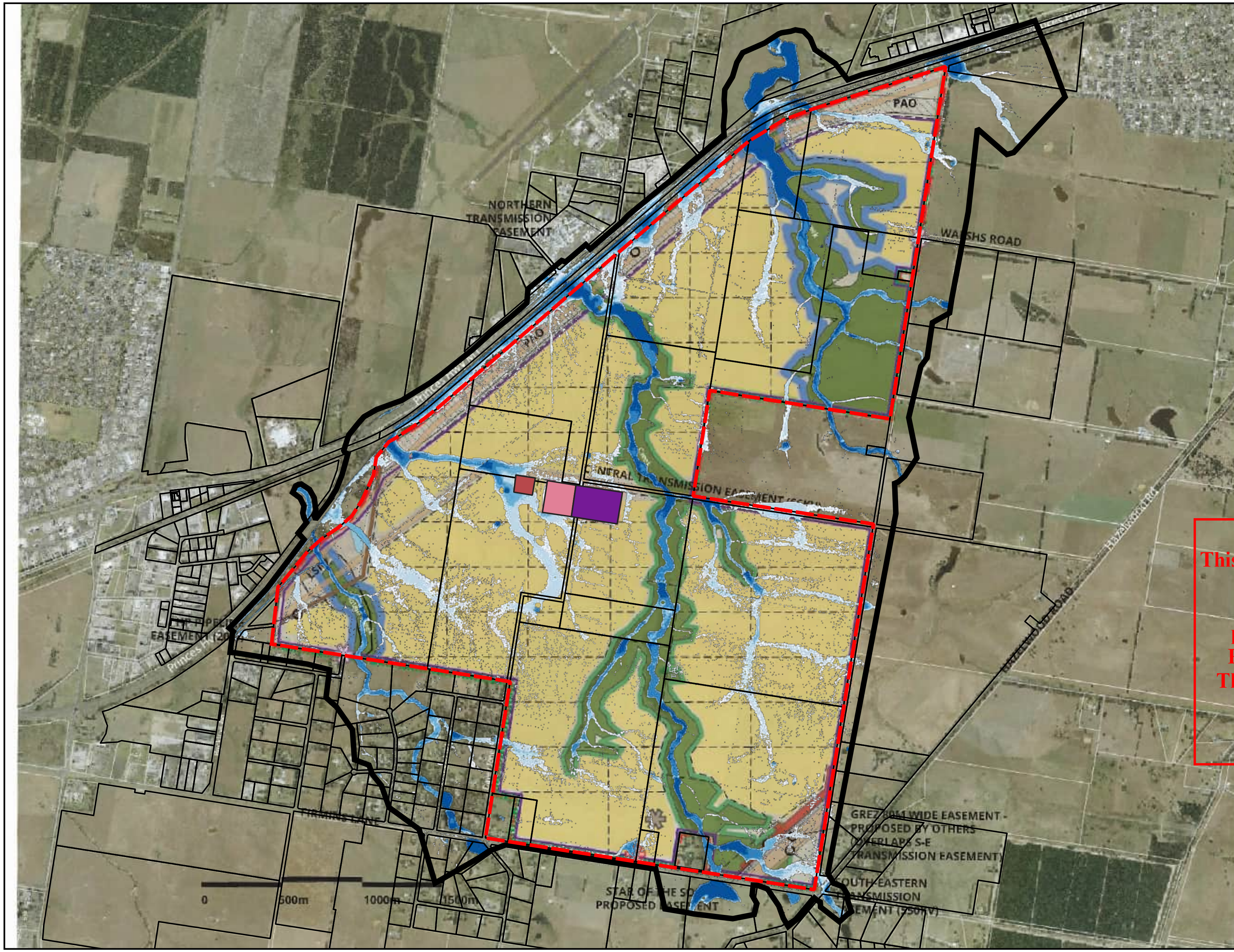


Legend

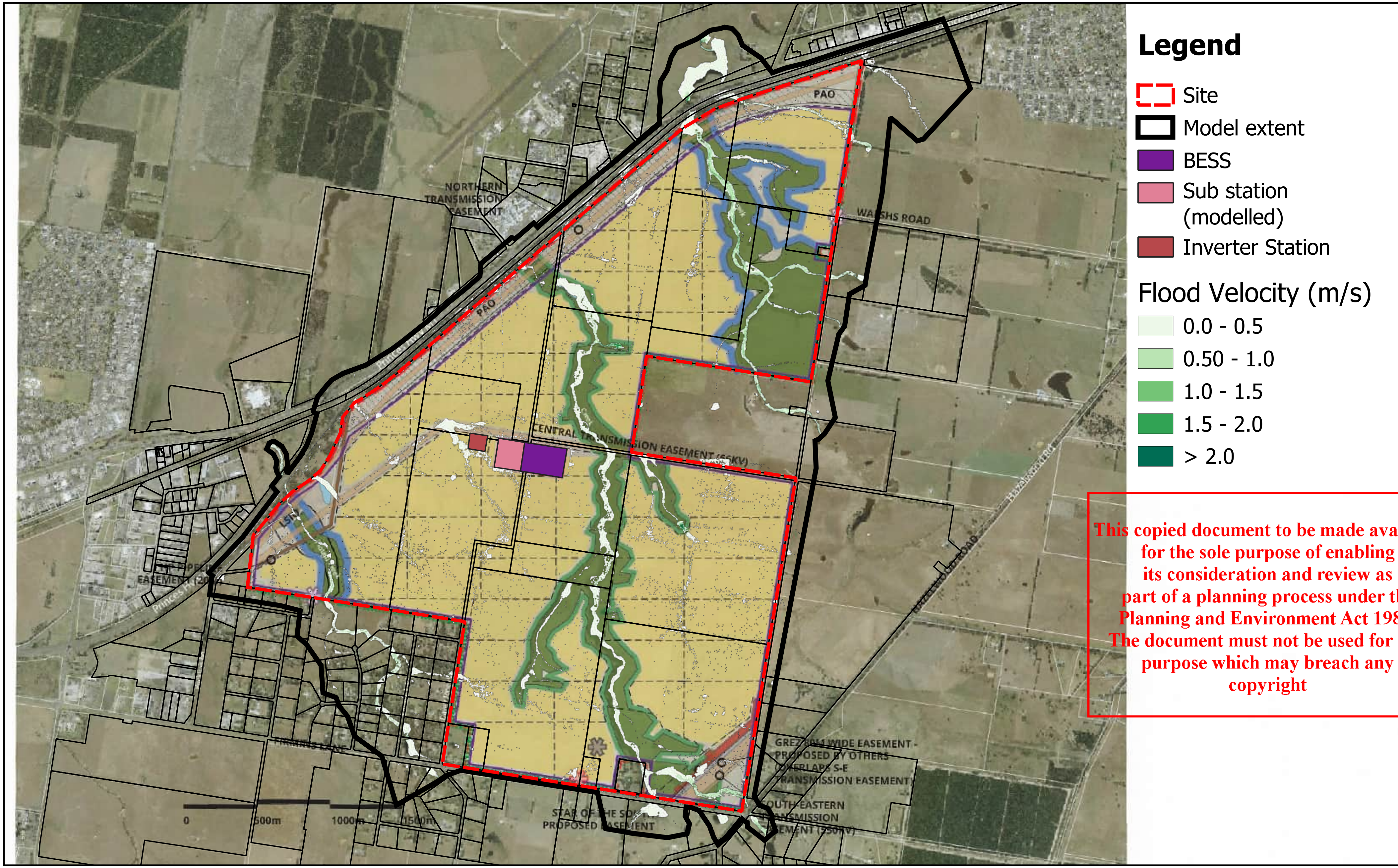
- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Flood Depth (metres)

- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.5
- 0.5 - 1.0
- > 1.0

Title:	Figure:	Rev:	Scale	Note	
Hazelwood North Solar Farm - Concept Design Peak Flood Depth - 1% AEP with Climate Change	E-7	A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.	VENANT SOLUTIONS
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigE-7_D50_100yCC_009_d_max.qgz				By: JS Jul 2023	www.VenantSolutions.com.au

Appendix F Concept Design Flood Velocity Mapping



Title:	Figure:	Rev:
Hazelwood North Solar Farm - Concept Design Peak Flood Velocity - 50% AEP	F-1	A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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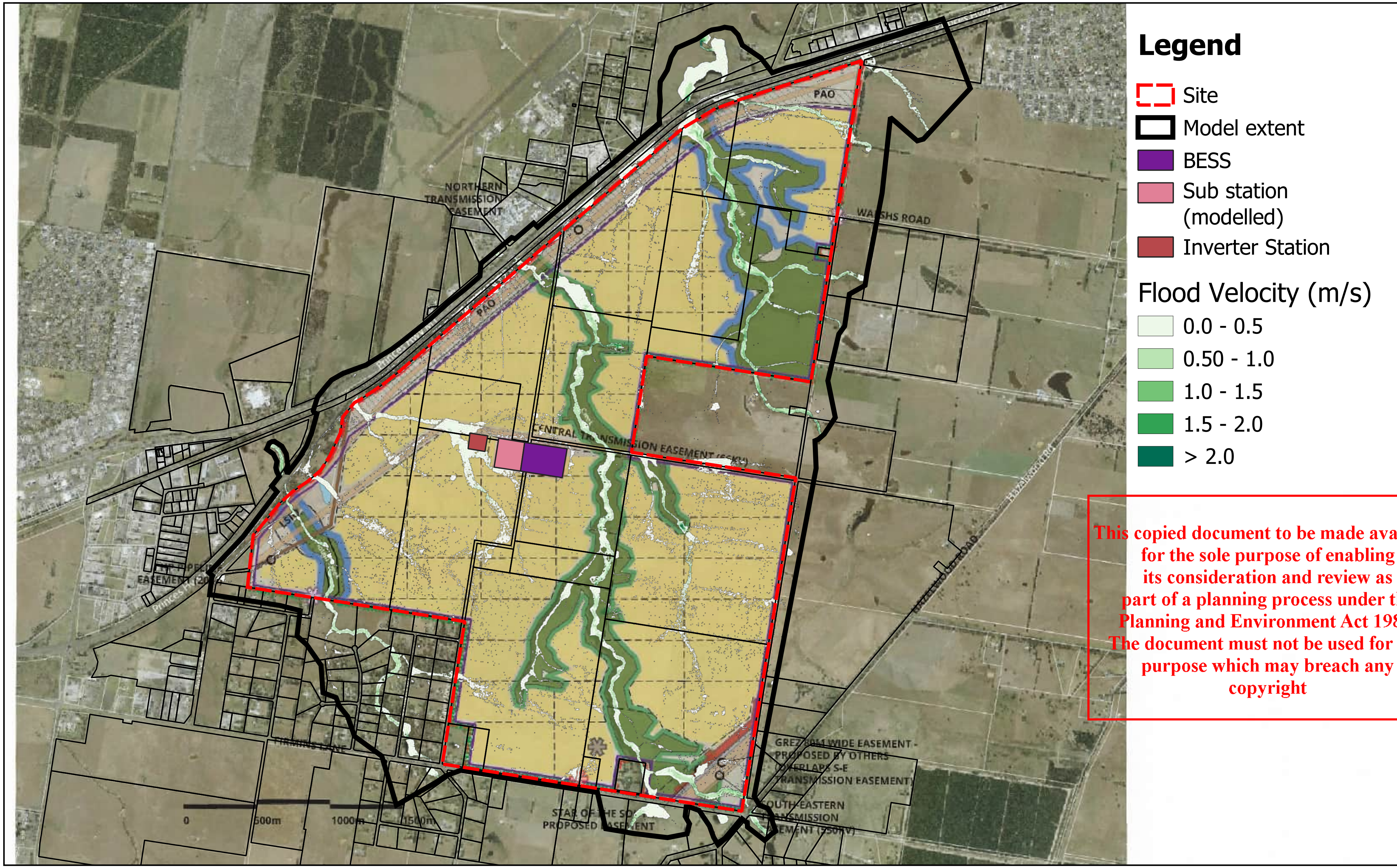
By: JS | Jul 2023



Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Velocity - 20% AEP

Figure: F-2

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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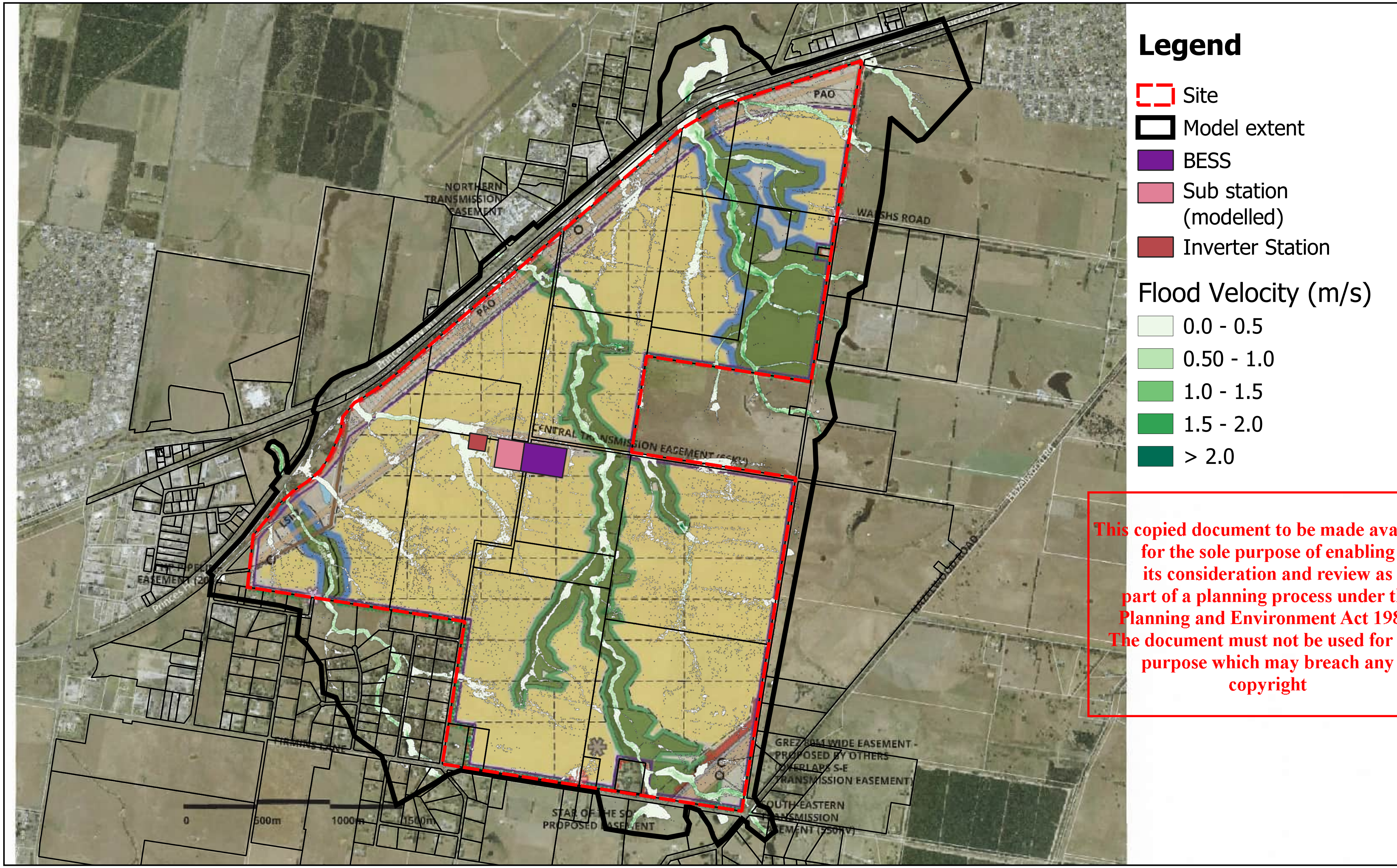
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigF-2_D50_5y_009_V_max.qgz

By: JS | Jul 2023



Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Velocity - 10% AEP

Figure: F-3

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigF-3_D50_10y_009_V_max.qgz

By: JS

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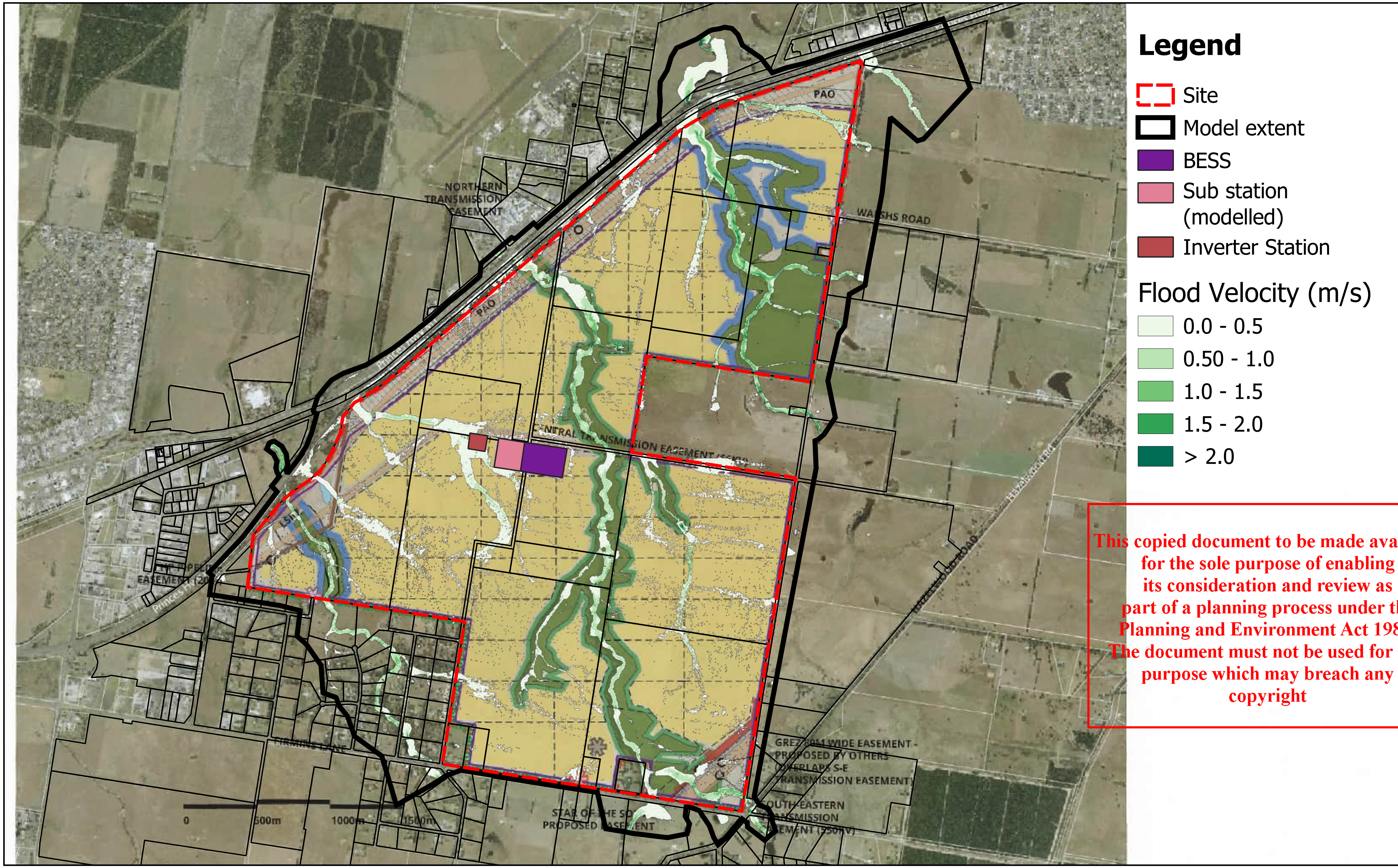

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Velocity - 5% AEP

Figure: F-4 | Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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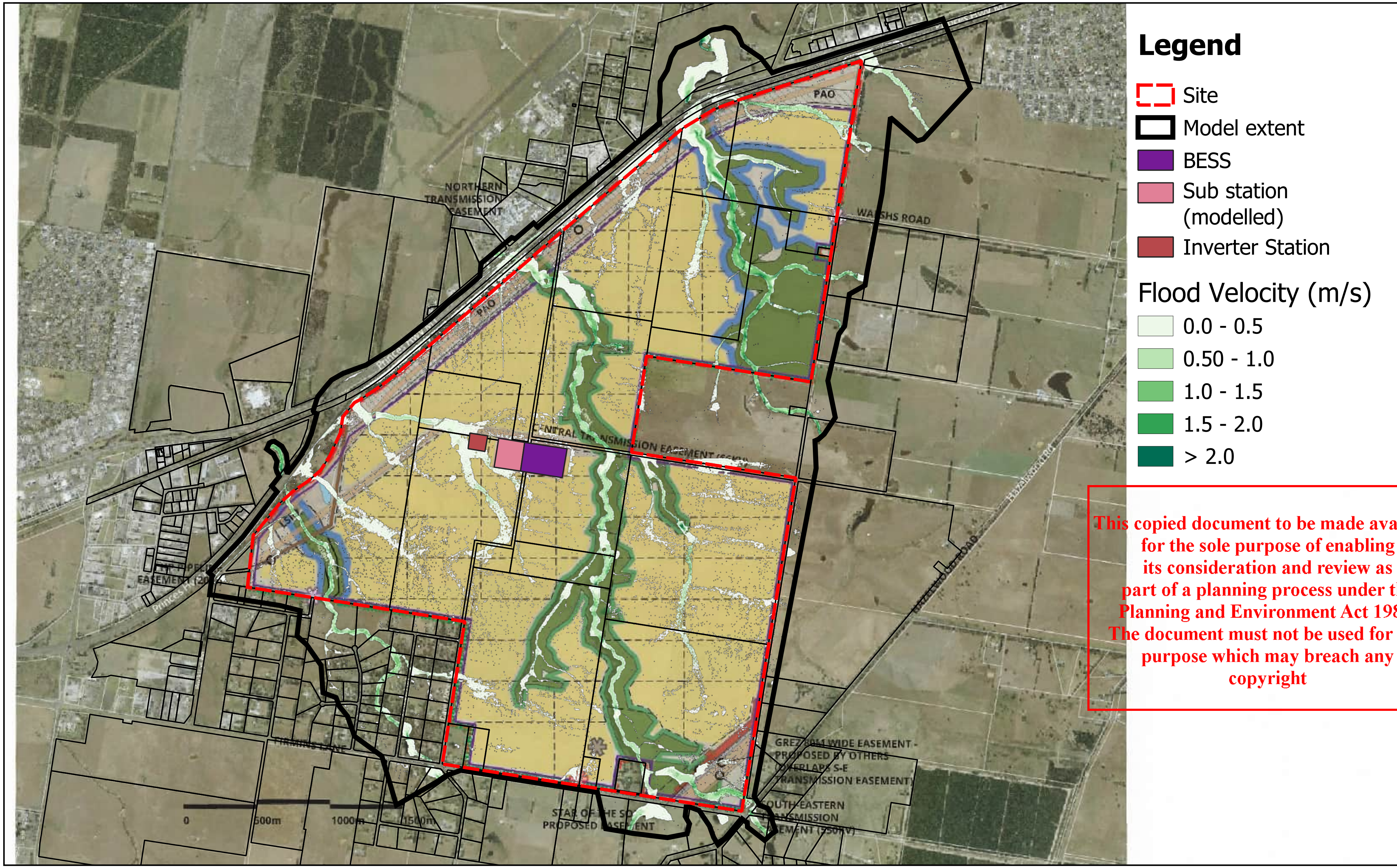
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigF-4_D50_20y_009_V_max.qgz

By: JS | Jul 2023



Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Velocity - 2% AEP

Figure: F-5

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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By: JS

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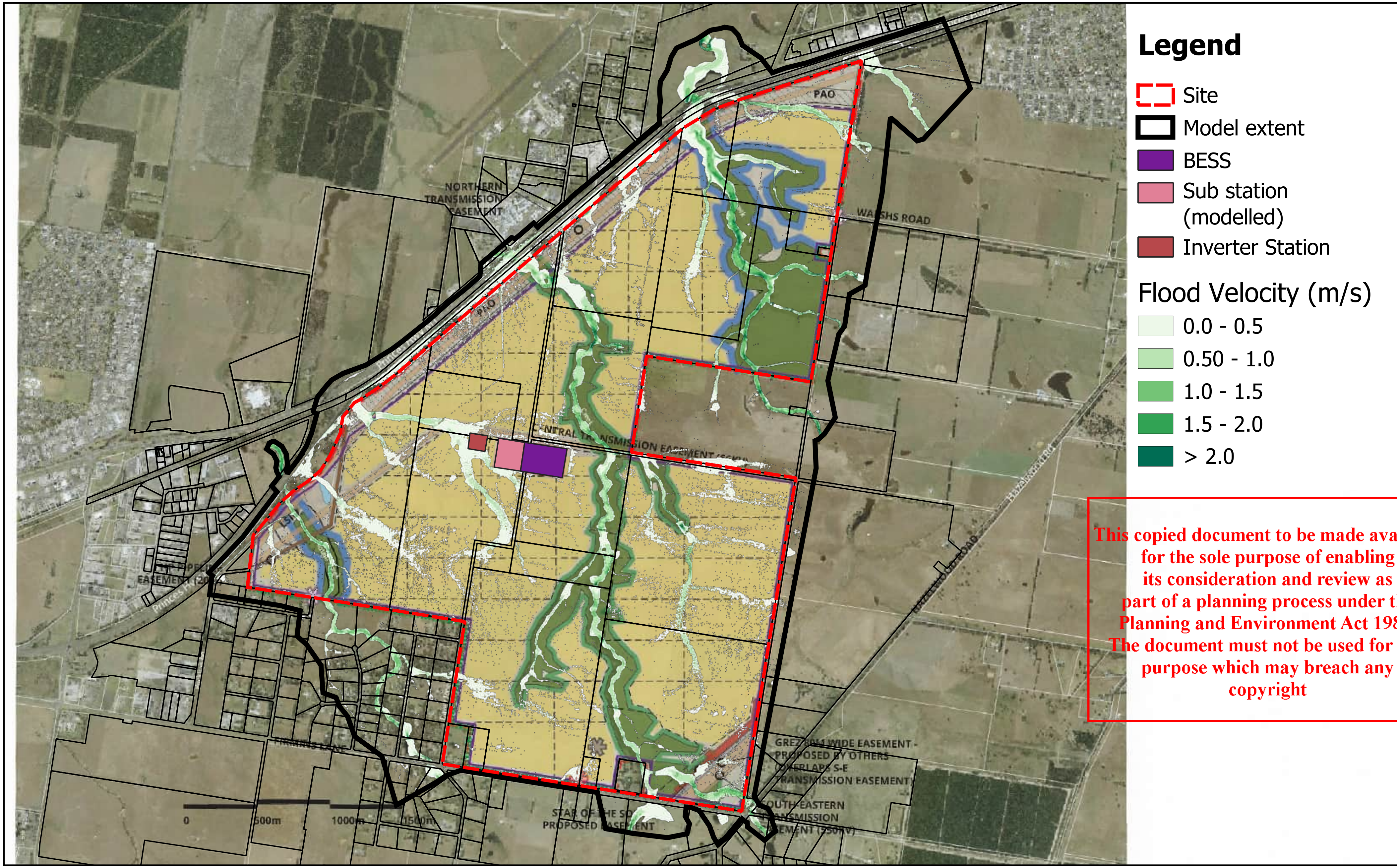

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Velocity - 1% AEP

Figure: F-6

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigF-6_D50_100y_009_V_max.qgz

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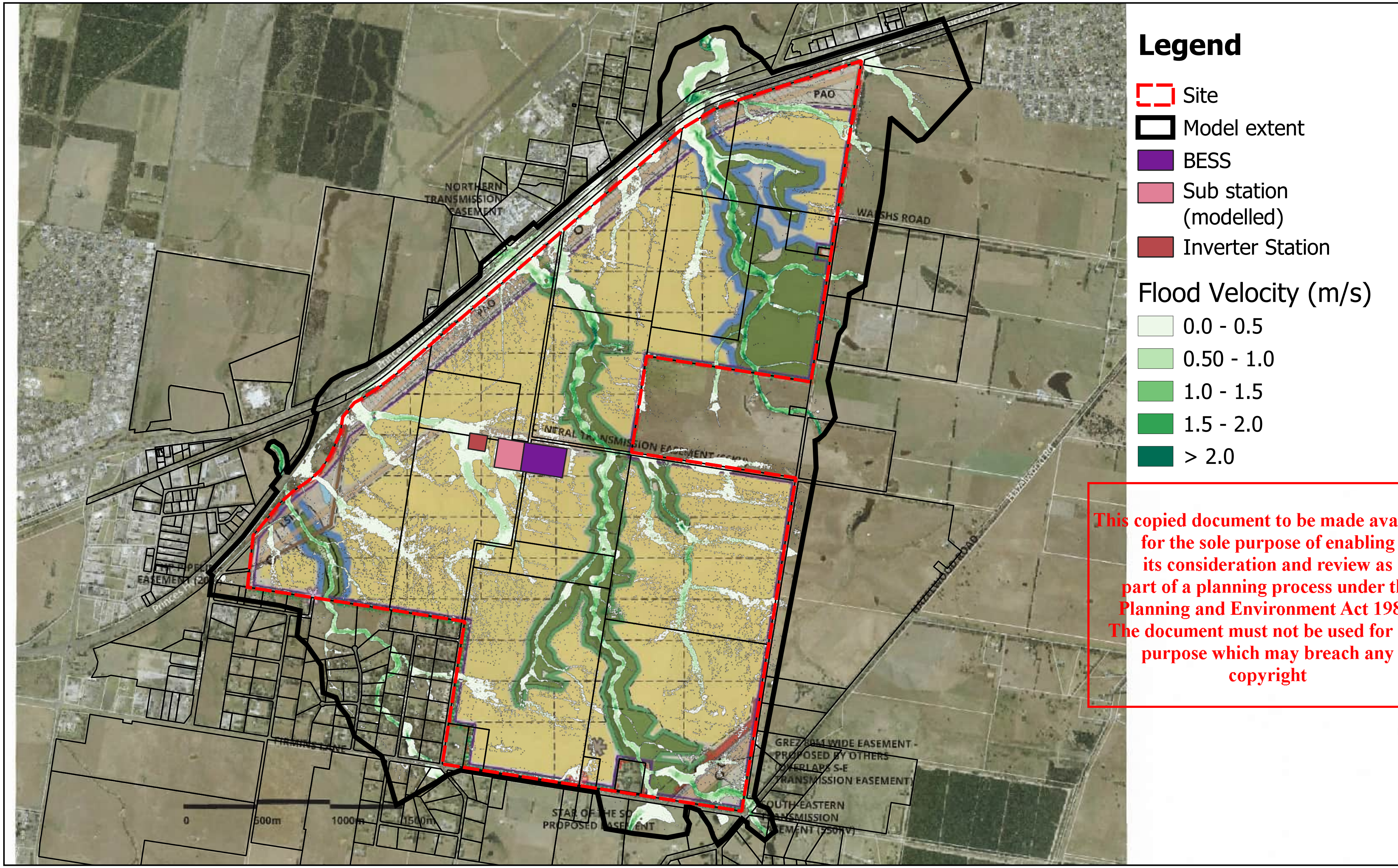

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Velocity - 1% AEP with Climate Change

Figure:	Rev:
F-7	A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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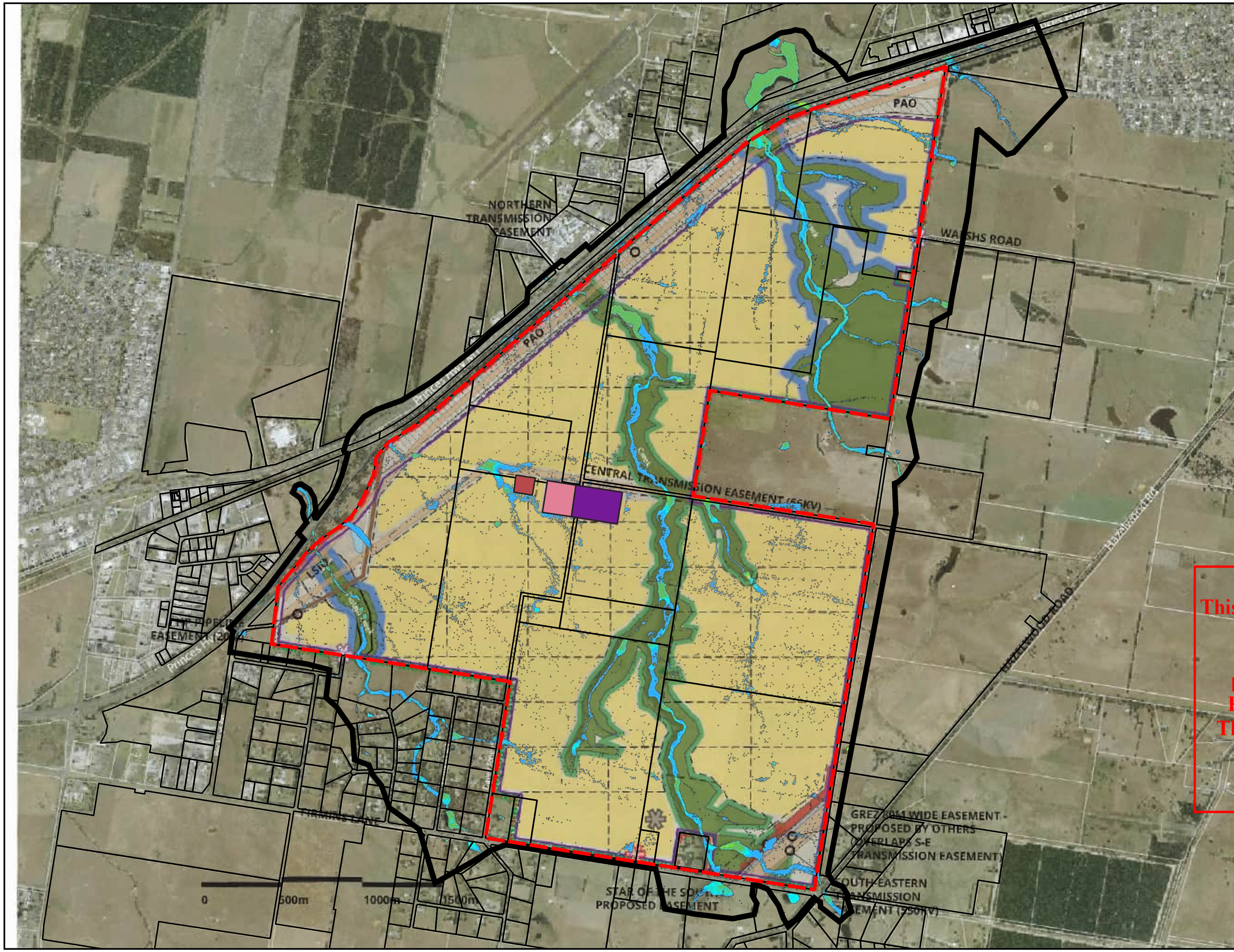
By: JS | Jul 2023

Appendix G Concept Design Flood Hazard Mapping



Title:	Figure:	Rev:
Hazelwood North Solar Farm - Concept Design Peak Flood Hazard - 50% AEP	G-1	A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigG-1_D50_2y_009_ZAEM1_max.qgz

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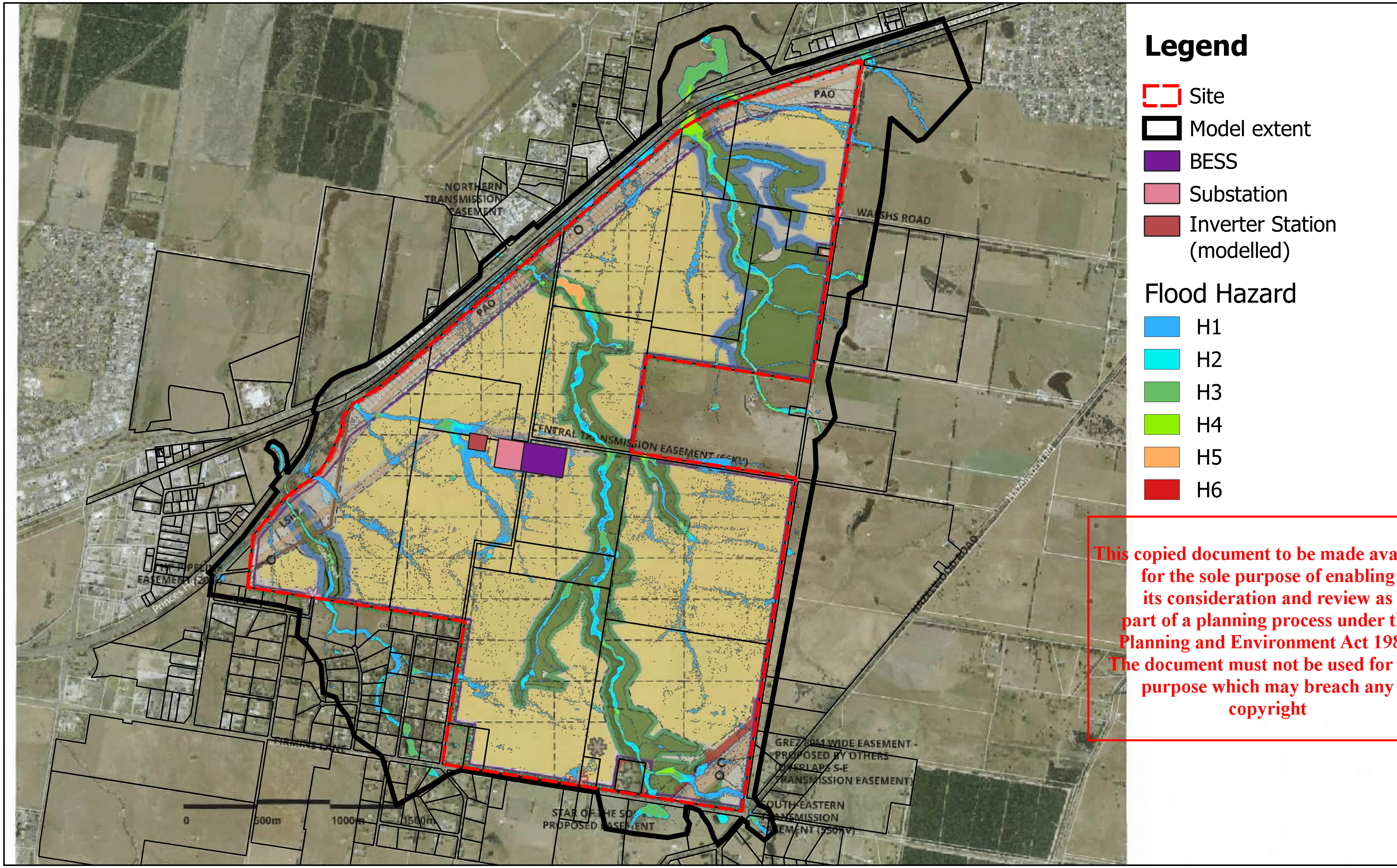
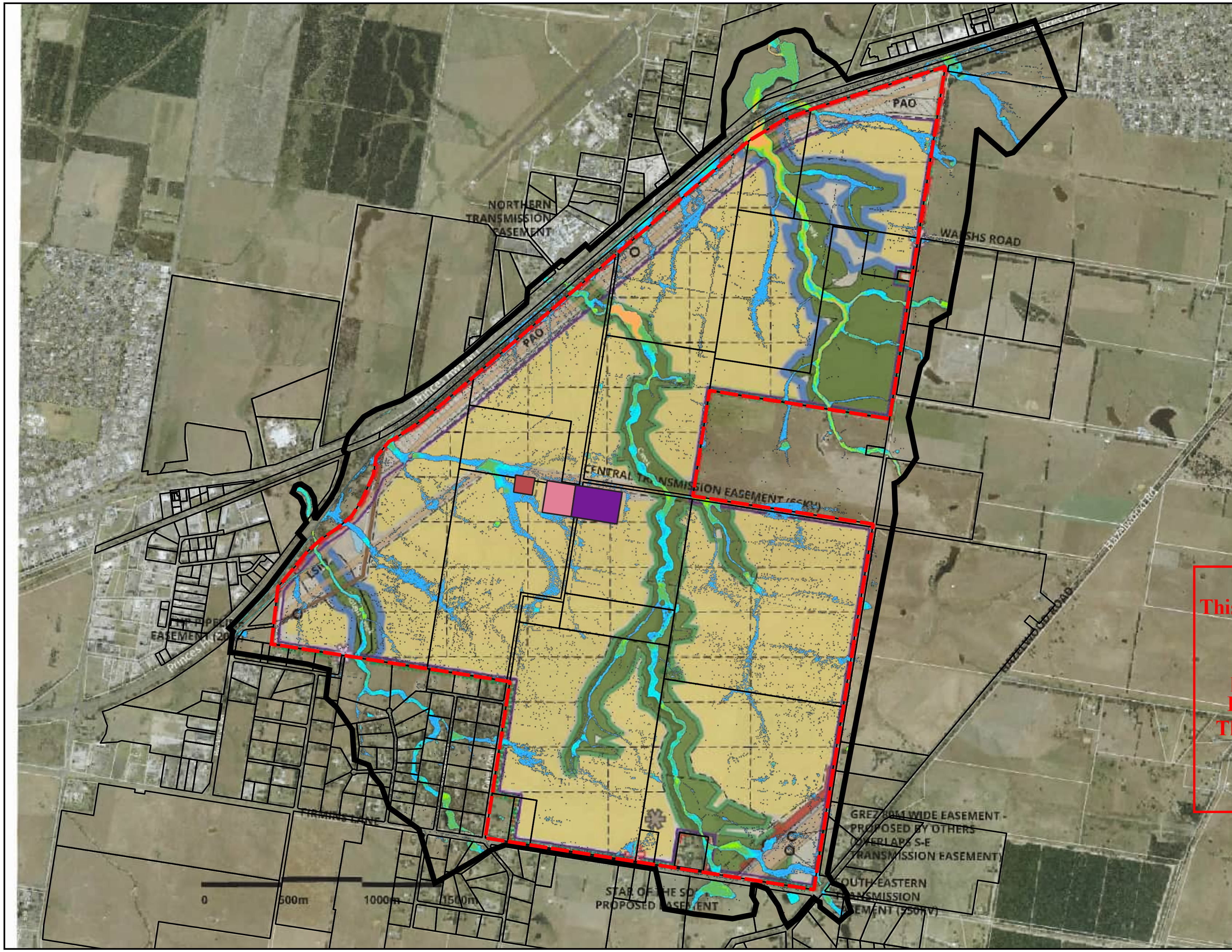


Title: Hazelwood North Solar Farm - Concept Design Peak Flood Hazard - 20% AEP	Figure: G-2	Rev: A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.	VENANT SOLUTIONS
Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigG-2_D50_5y_009_ZAEM1_max.qgz				By: JS Jul 2023	www.VenantSolutions.com.au



Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Flood Hazard

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

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Hazard - 10% AEP

Figure: G-3

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigG-3_D50_10y_009_ZAEM1_max.qgz

By: JS

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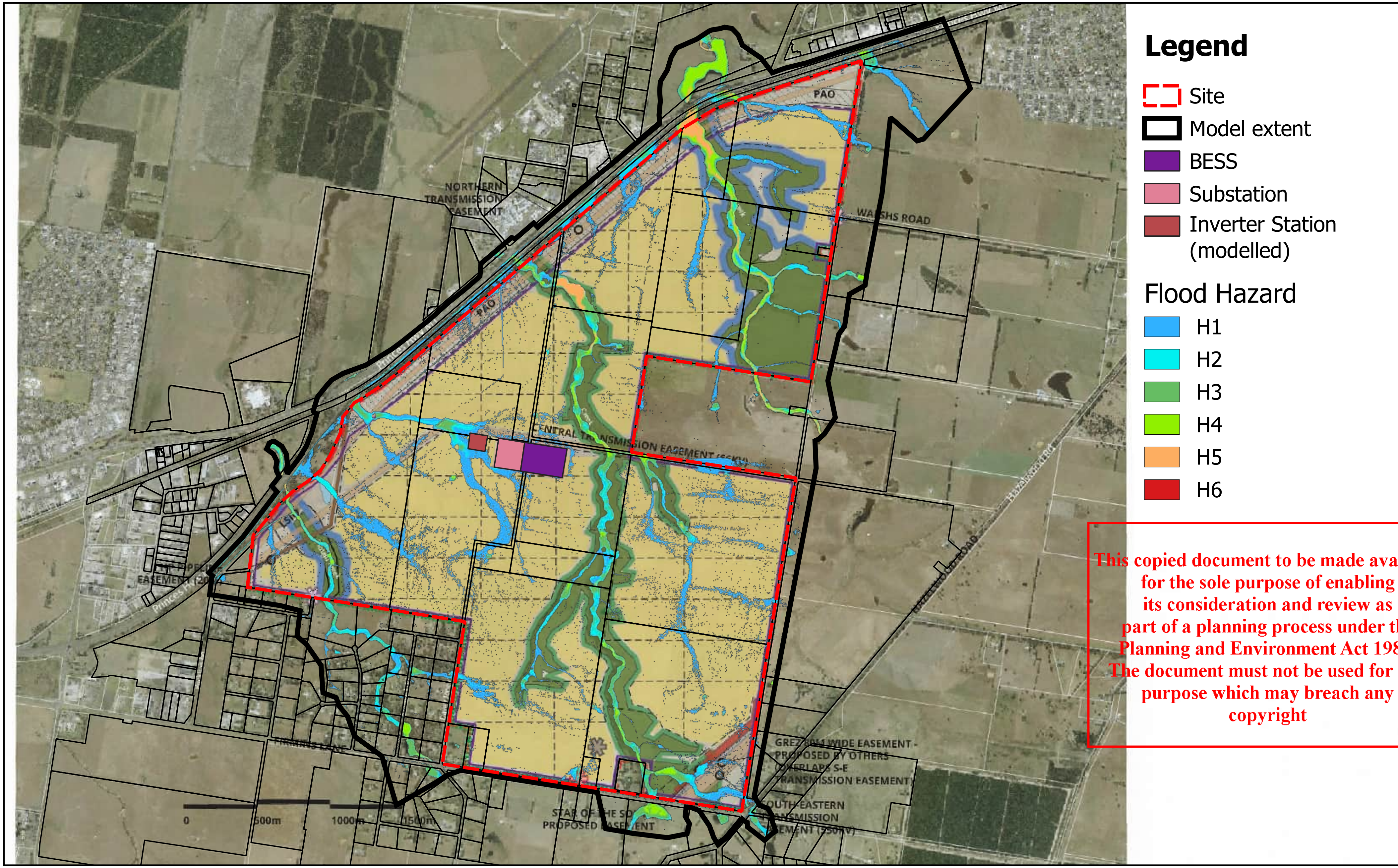

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Hazard - 5% AEP

Figure: G-4

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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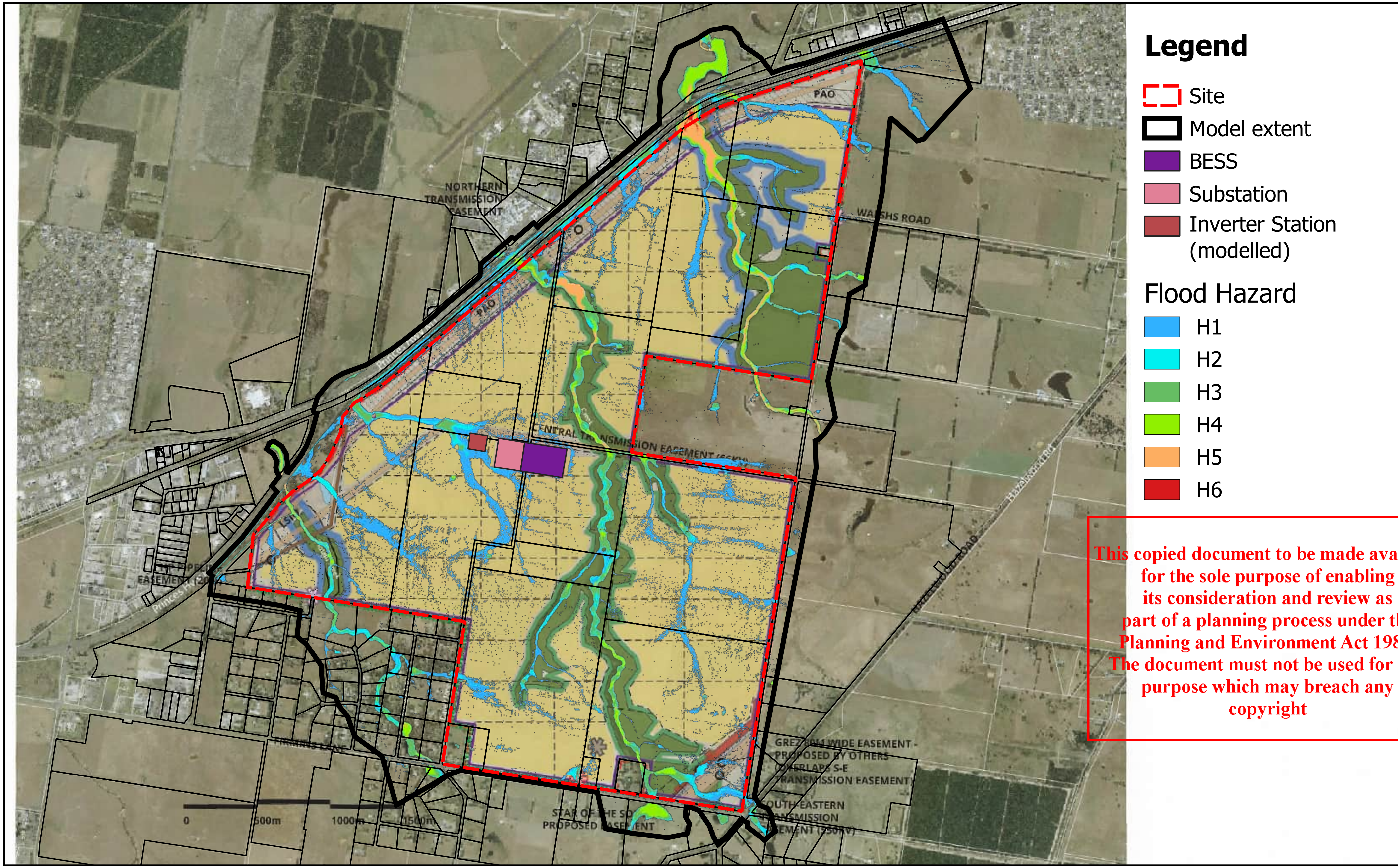
By: JS

Jul 2023



Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Hazard - 2% AEP

Figure: G-5

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigG-5_D50_50y_009_ZAEM1_max.qgz

By: JS

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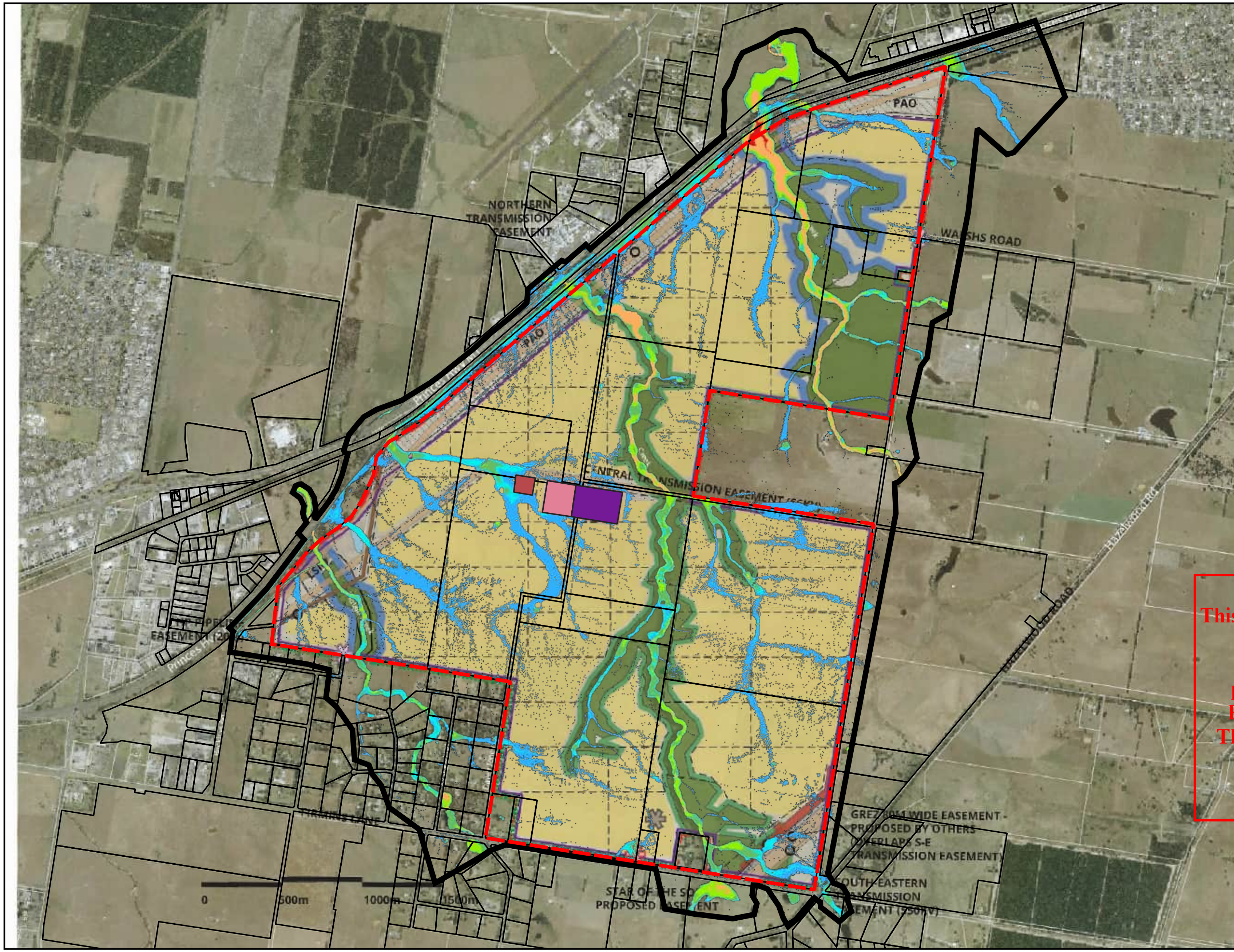

Legend

Site
Model extent
BESS
Substation
Inverter Station (modelled)

Flood Hazard

H1
H2
H3
H4
H5
H6

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Hazard - 1% AEP

Figure: G-6

Rev: A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigG-6_D50_100y_009_ZAEM1_max.qgz

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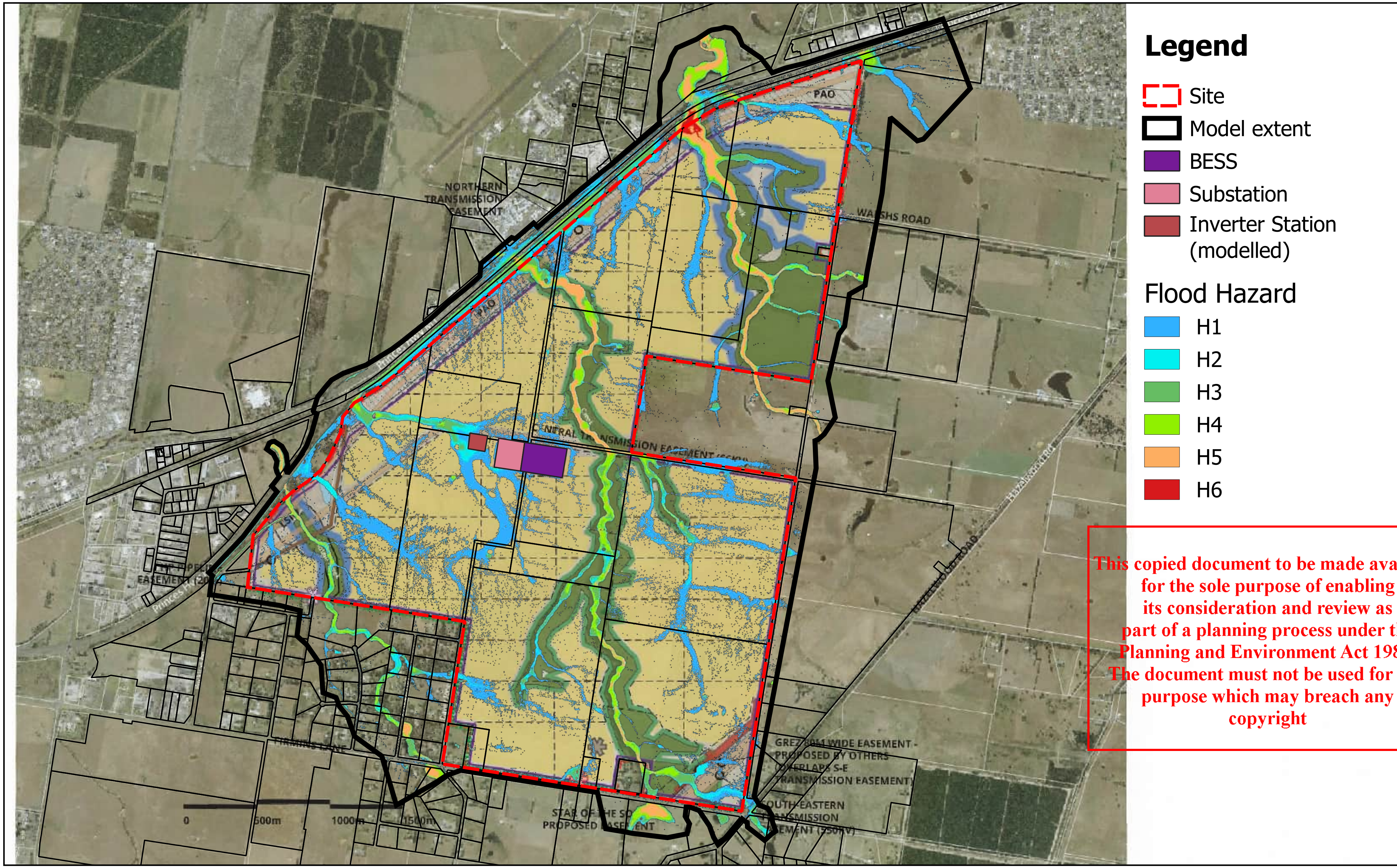

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Hazard - 1% AEP with Climate Change

Figure:	Rev:
G-7	A

0.5 0 0.5 km

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigG-7_D50_100yCC_009_ZAEM1_max.qgz

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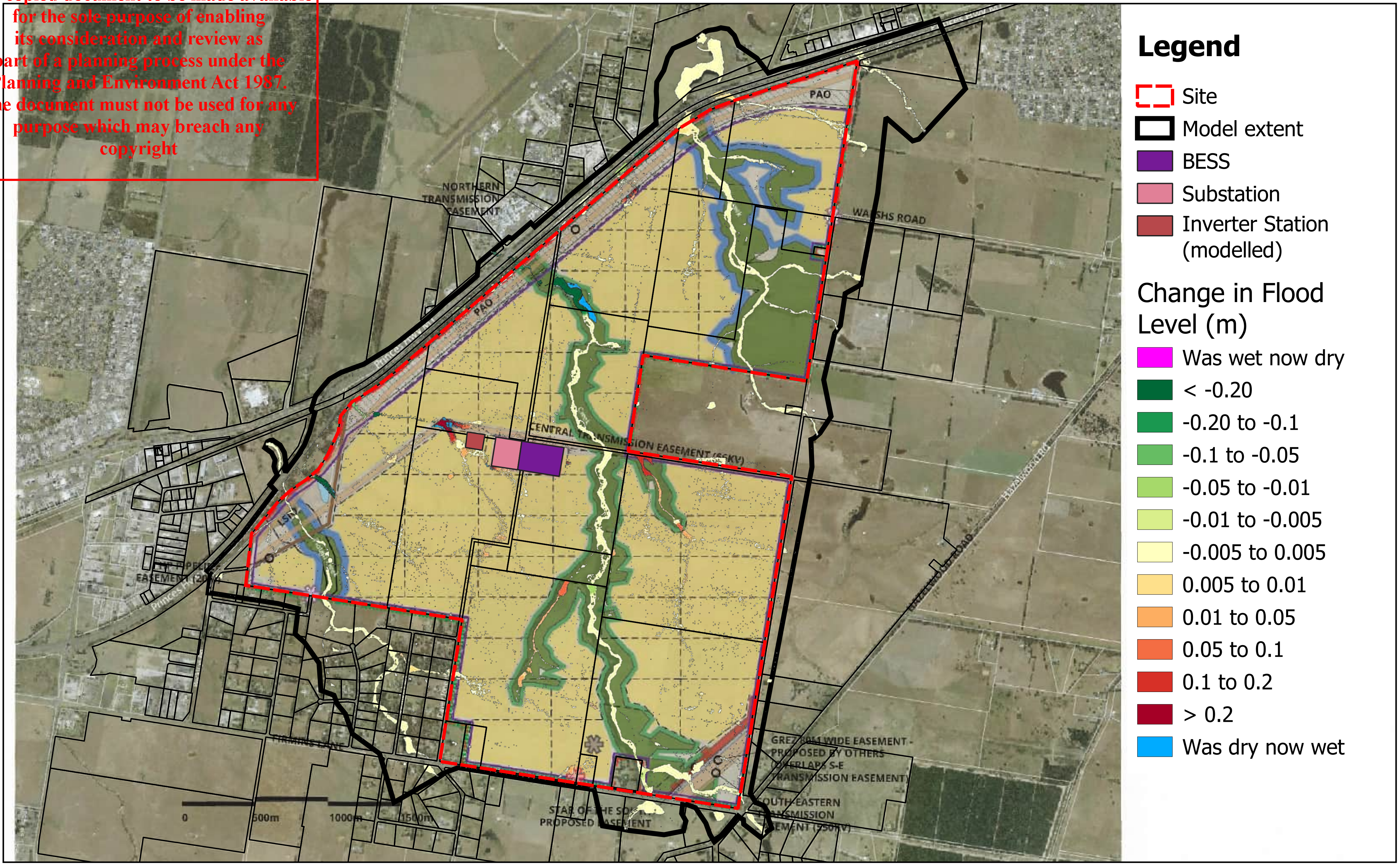
Appendix H Concept Design Flood Level Impact Mapping



Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Level Impact - 50% AEP

Figure: H-1

Rev: A

0.5 0 0.5 km

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Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigH-1_Dif_D50__E01_2y_009_h_max.qgz

By: JS

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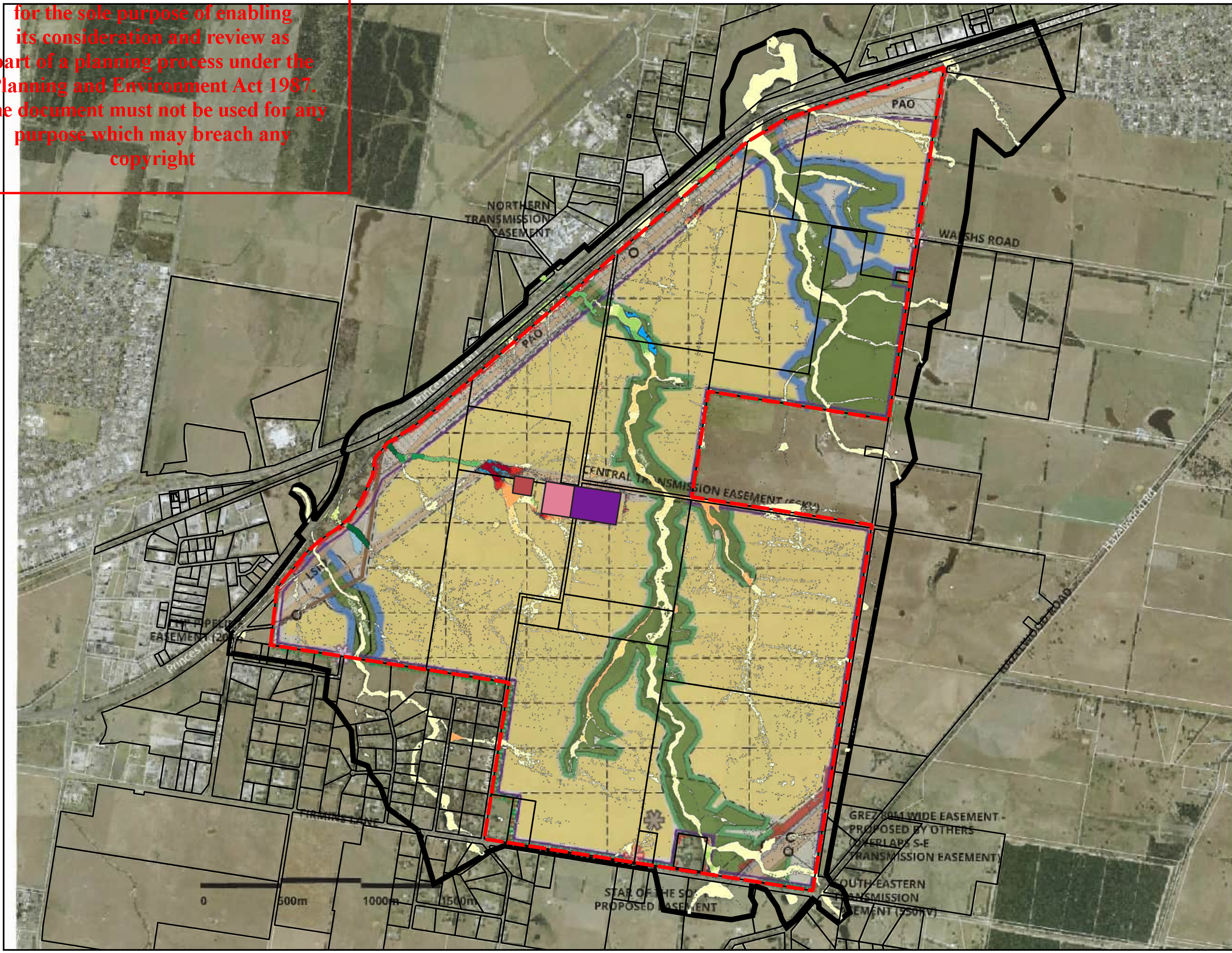

Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Change in Flood Level (m)

- Was wet now dry
- < -0.20
- -0.20 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to -0.005
- -0.005 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- > 0.2
- Was dry now wet

Title:	Figure:	Rev:
Hazelwood North Solar Farm - Concept Design Peak Flood Level Impact - 20% AEP	H-2	A

0.5 0 0.5 km

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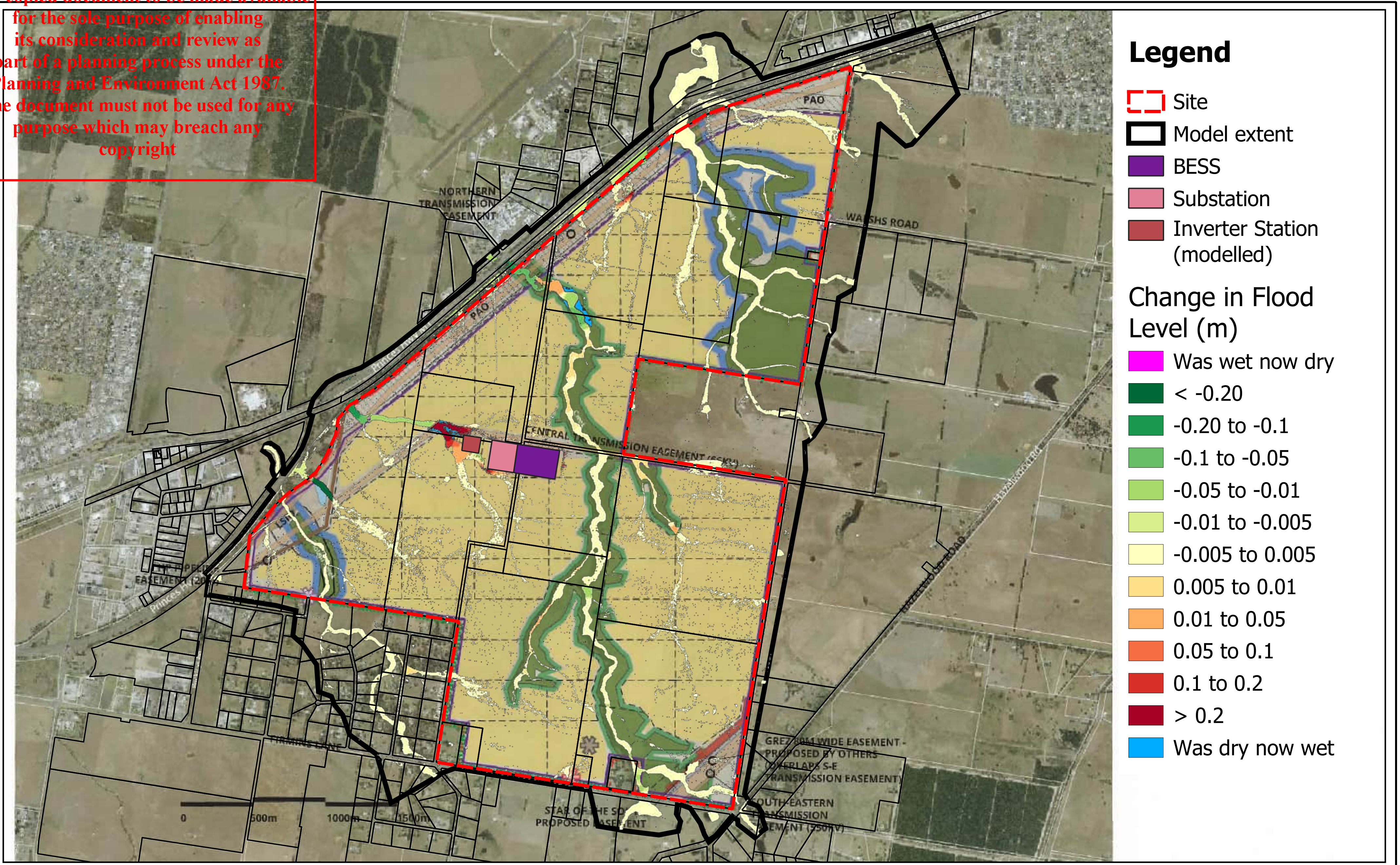

Title:	Figure:	Rev:
Hazelwood North Solar Farm - Concept Design Peak Flood Level Impact - 10% AEP	H-3	A

0.5 0 0.5 km

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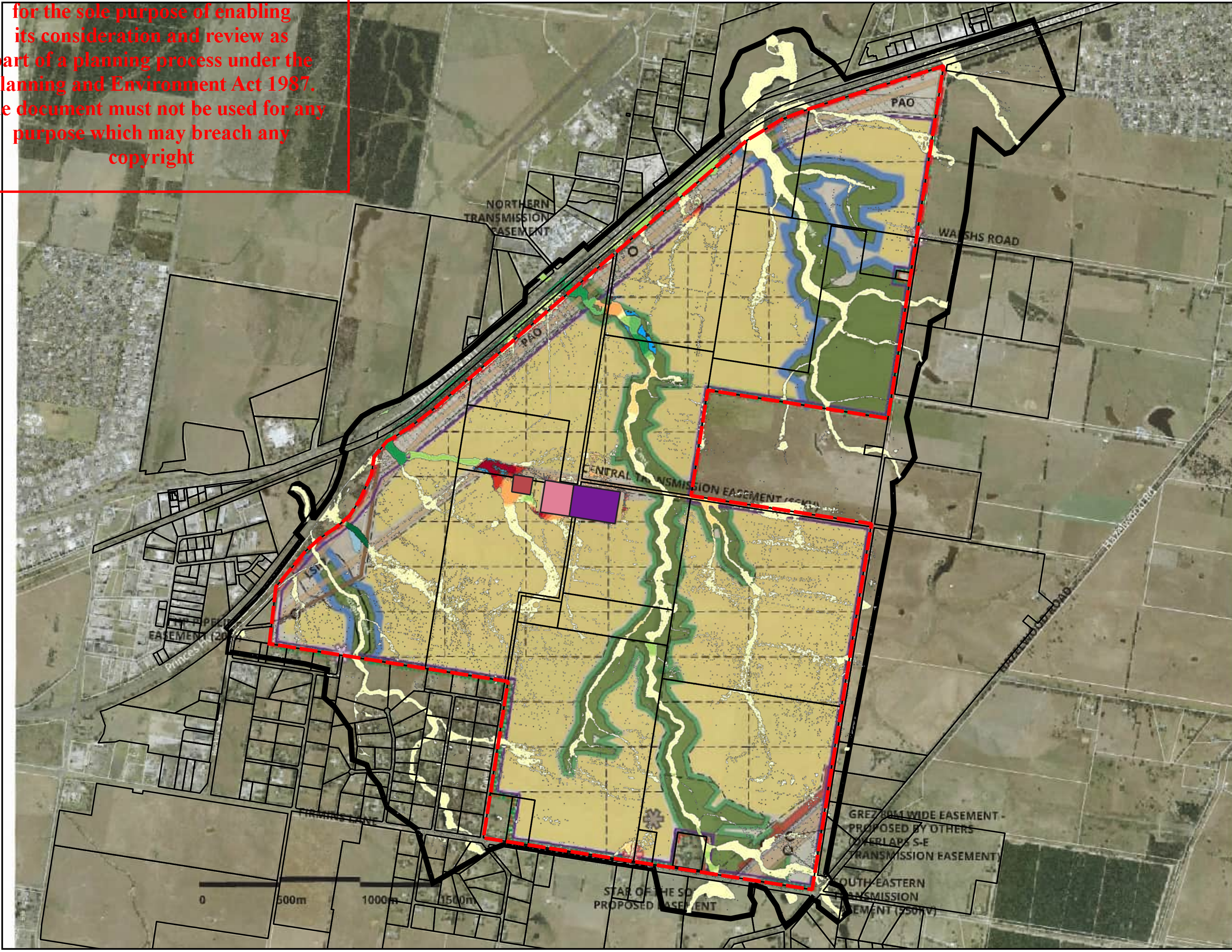

Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Change in Flood Level (m)

- Was wet now dry
- < -0.20
- -0.20 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to -0.005
- -0.005 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- > 0.2
- Was dry now wet

Title:	Figure:	Rev:	Scale	Disclaimer
Hazelwood North Solar Farm - Concept Design Peak Flood Level Impact - 5% AEP	H-4	A	0.5 0 0.5 km	This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

Filename: S:\Projects\M00382.MS.HazelwoodNorthSolarFarm\GIS\Drawings\R.M00382.001.02\FigH-4_Dif_D50__E01_20y_009_h_max.qgz

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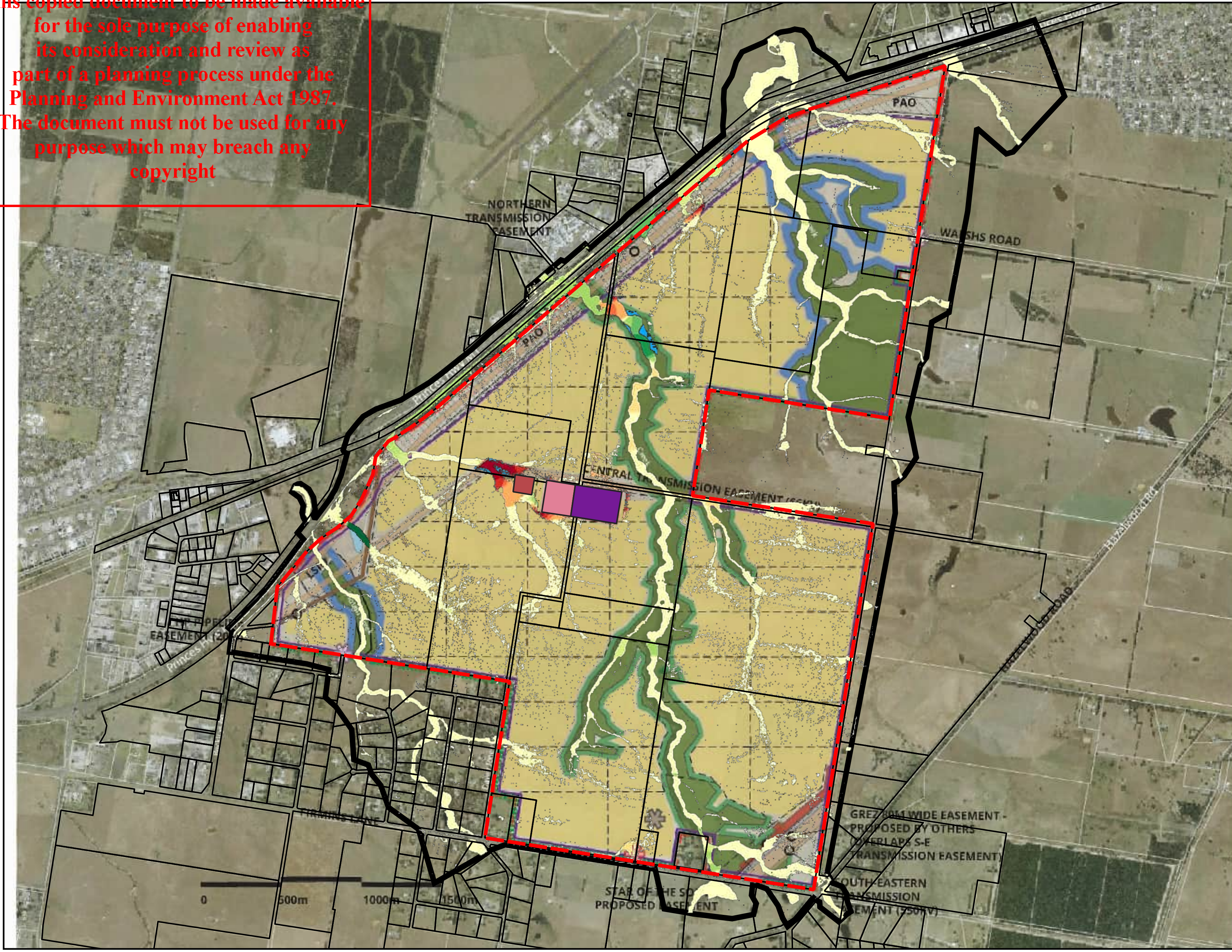

Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Change in Flood Level (m)

- Was wet now dry
- < -0.20
- -0.20 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to -0.005
- -0.005 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- > 0.2
- Was dry now wet

Title: Hazelwood North Solar Farm - Concept Design Peak Flood Level Impact - 2% AEP	Figure: H-5	Rev: A	0.5 0 0.5 km

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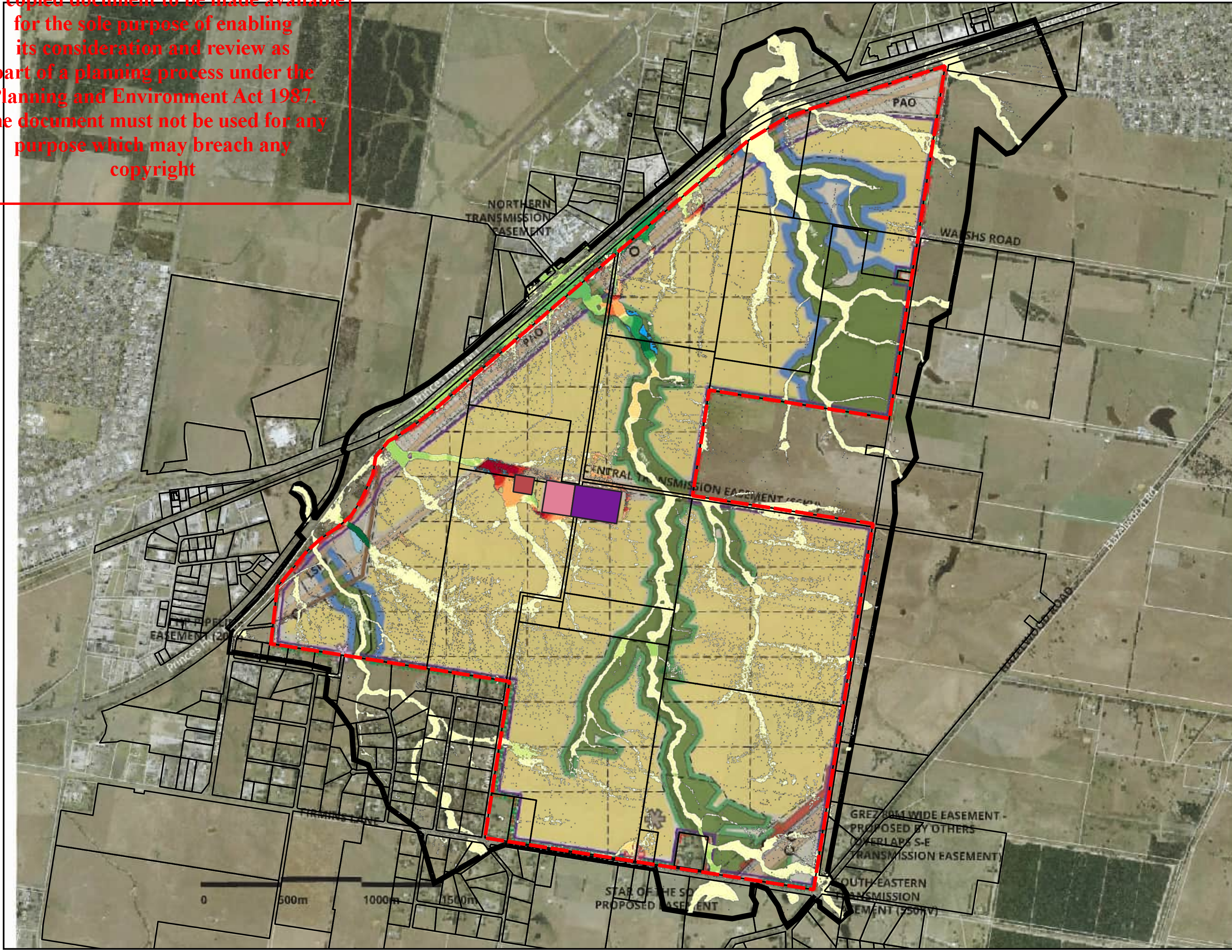

Legend

- Site
- Model extent
- BESS
- Substation
- Inverter Station (modelled)

Change in Flood Level (m)

- Was wet now dry
- < -0.20
- -0.20 to -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to -0.005
- -0.005 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- > 0.2
- Was dry now wet

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Level Impact - 1% AEP

Figure: H-6

Rev: A

0.5 0 0.5 km

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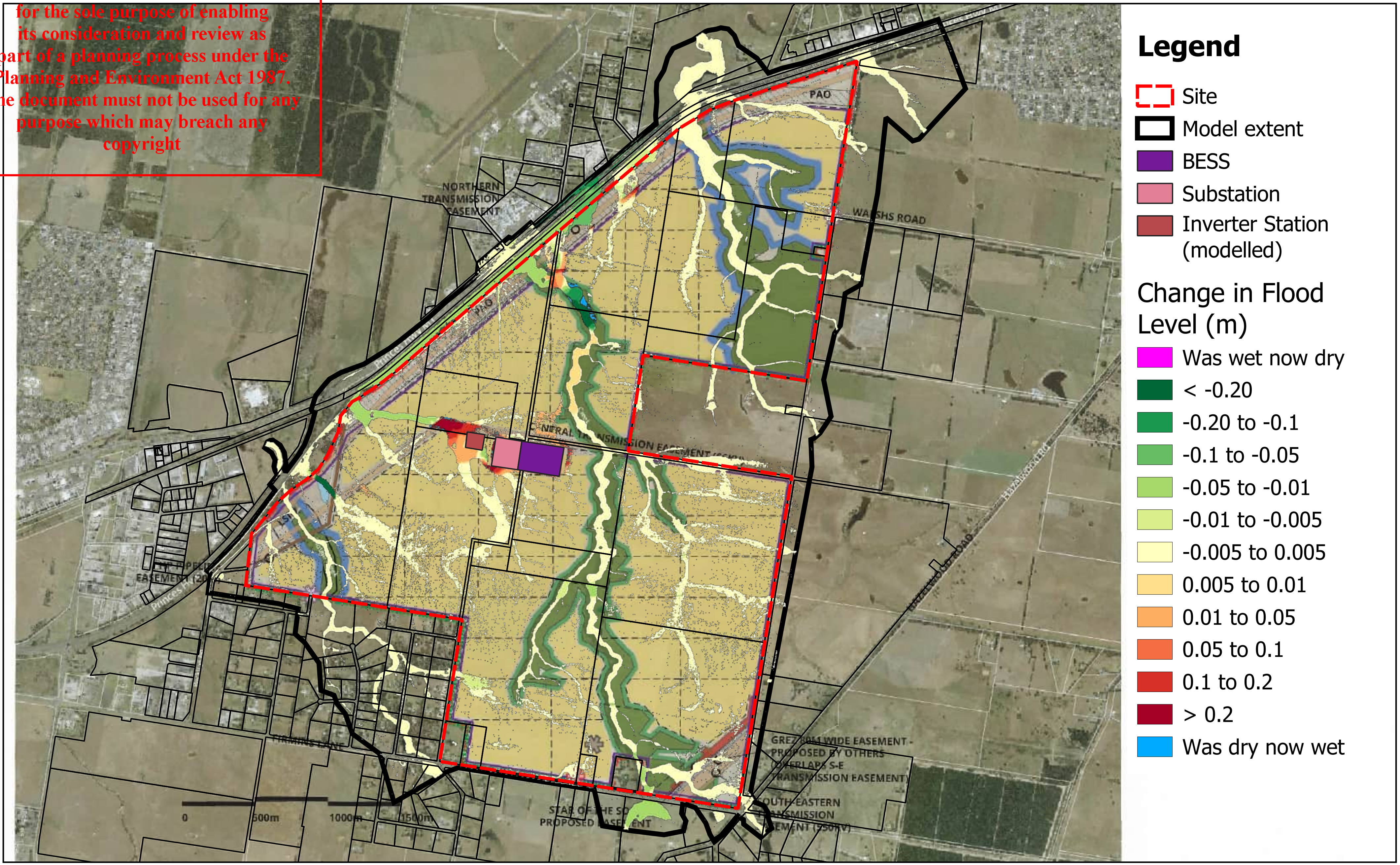

Title: Hazelwood North Solar Farm - Concept Design
Peak Flood Level Impact - 1% AEP with Climate Change

Figure: H-7

Rev: A

This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

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