

8/08/2023

Tim Doolan
Technical Lead - Planning
NGH Consulting
Level 3, 21 Mary Street
Surry Hills, NSW 2010

Flood Risk Assessment: Hillston Solar Farm

Dear Tim,

Cumulus Engineering has undertaken a Flood Risk Assessment (FRA) for the proposed development located at Hillston Solar Farm (herein referred to as the 'subject site'). Two potential design options have been considered and assessed against the relevant Carrathool Shire Council flood planning controls.

1 Background

The subject site is located approximately 4km south of the township of Hillston which lies within the Carrathool Shire region of New South Wales, 400km west of Sydney. The site is bordered by the Temora-Roto railway line to the west and agricultural land to the north, south and east as illustrated in Figure 1-1. The proposed development consists of the construction of a new solar farm facility on existing rural land.

The site has been identified as being subject to flood risk by Council and as such, the proponent must demonstrate the proposed development complies with the objectives of the Carrathool LEP 2012 (Section 5.21 Flood Planning Provision).

Cumulus Engineering have therefore been engaged to prepare a Flood Risk Assessment (FRA) for the proposed development to fulfil Council requirements. Our scope of work was inclusive of the following:

- Collation and desktop review of available design flood information and relevant data including development plans and topographical data.
- Review of flood related planning requirements (Carrathool LEP 2012, State Environmental Planning Policy (Transport & Infrastructure) 2021).
- Provision of advice relating to planning controls.
- Assessment of the proposed development to ensure compliance with relevant flood related development controls.

Cumulus Engineering has assessed the flood risk at the site using existing flood data which has been provided by the Carrathool Shire Council (CSC) and was procured as part of the Hillston Flood Risk Management Study and Plan completed by Catchment Simulation Solutions in 2022.

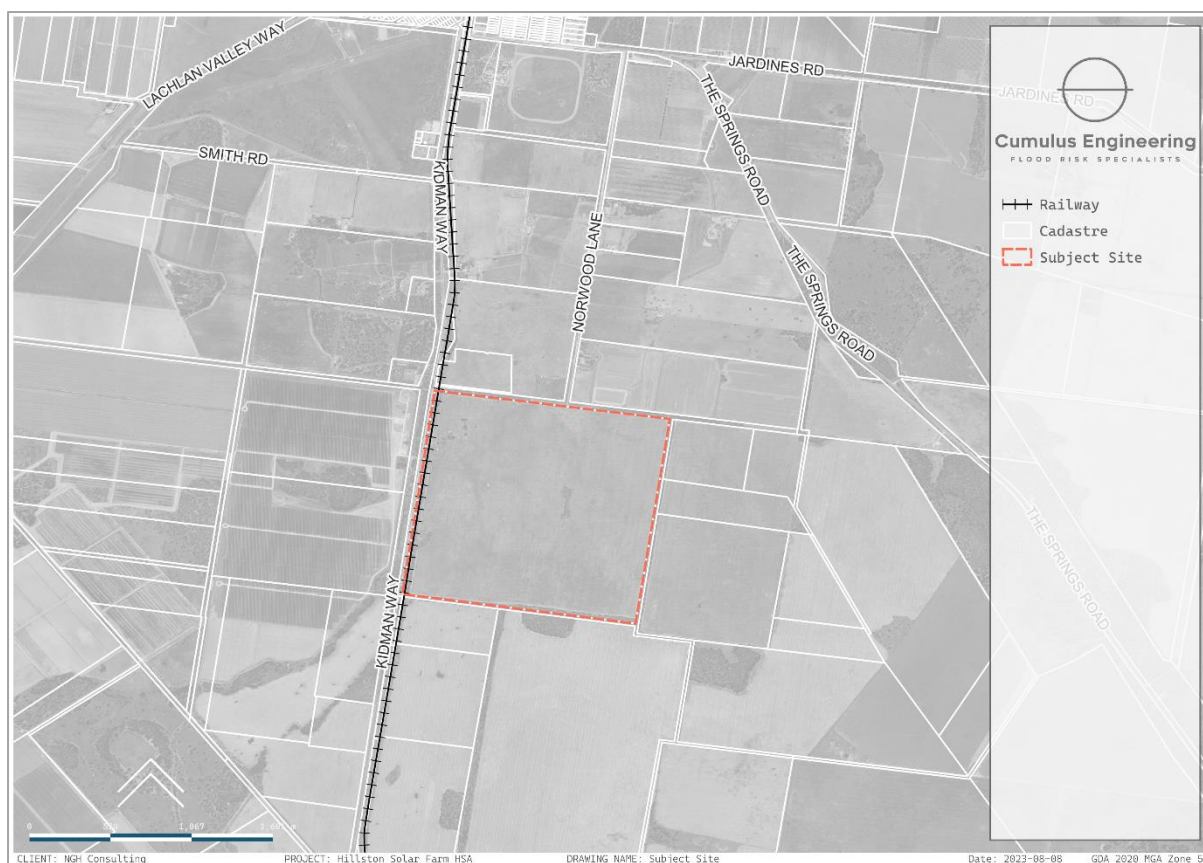


FIGURE 1-1 **SUBJECT SITE**

1.1 Carrathool Local Environmental Plan (LEP)

The Carrathool LEP (2012) aims to make local environment planning provisions for land within the Hillston region. The plan sets out intended objectives and requirements for development in the area. Section 5.21, Flood Planning, details planning provisions for development in regard to flooding and flood behaviour. The objectives of the LEP include the following:

- To minimise the flood risk to life and property associated with the use of land.
- To allow development on land that is compatible with the flood function and behaviour on the land, considering projected changes as a result of climate change.
- To avoid adverse or cumulative impacts on flood behaviour and the environment.
- To enable the safe occupation and efficient evacuation of people in the event of a flood.

Planning requirements are detailed and addressed for each of the potential design options.

2 Design Options

2.1 Design Option A

Figure 2-1 displays the layout plan for Design Option A, which proposes accessing the site from the west via Kidman Way. Within the leased area, the proposed solar farm includes two full rows of solar panels. In the north-western part of the site, the site office and laydown area are separated by the access track, which extends to the eastern end of the solar panels.

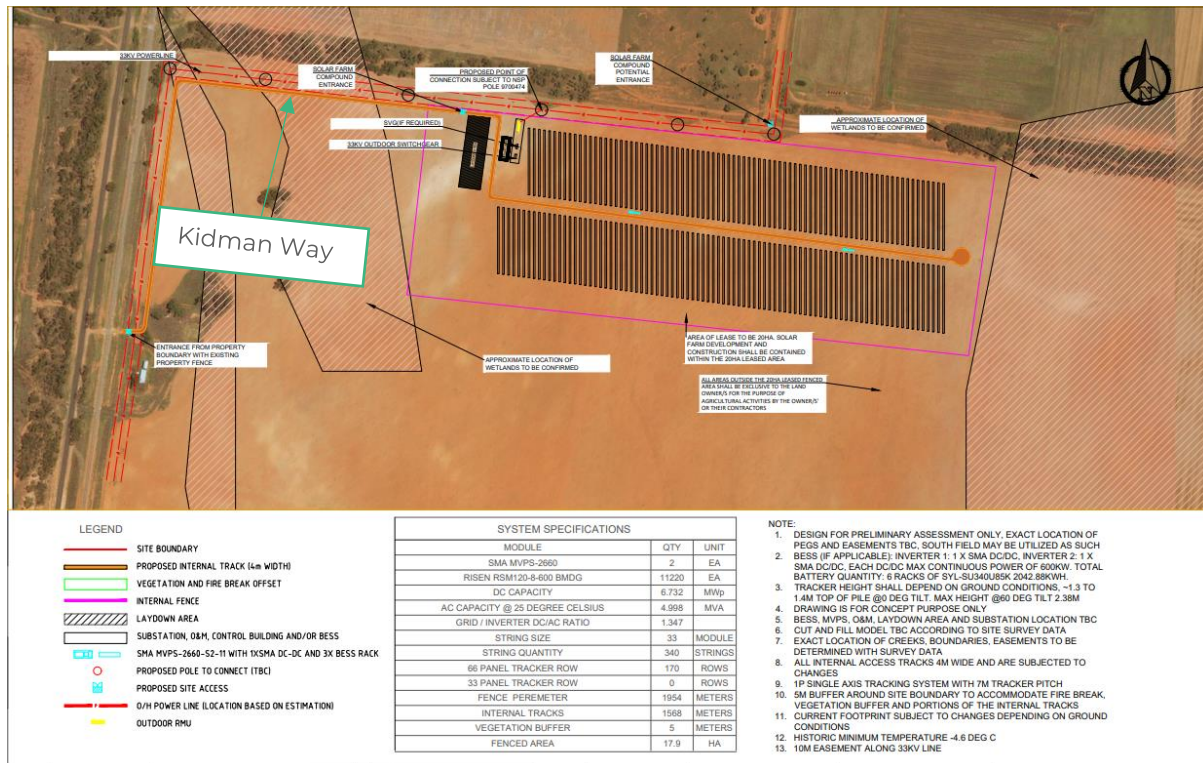


FIGURE 2-1 OPTION A - LAYOUT PLAN

2.1.1 Flood Risk at Site

Depths for the 1% AEP flood event with the layout plan for Option A are illustrated in Figure 2-2 and indicates that the leased area experiences flooding with varying depths throughout. Most notably, the floodwaters are shown to inundate both the site office and sections of the solar farm with the western boundary of the leased area subject to flooding with depths of up to 500 mm, while the eastern boundary experiences flooding depths of up to 130 mm.

Solar farm infrastructure may also be impacted by flooding, with depths reaching up to 270 mm. This could compromise the functionality of the solar farm. It should be noted however that the area of which infrastructure impacted is small with much of the infrastructure remaining outside of the flood extent.

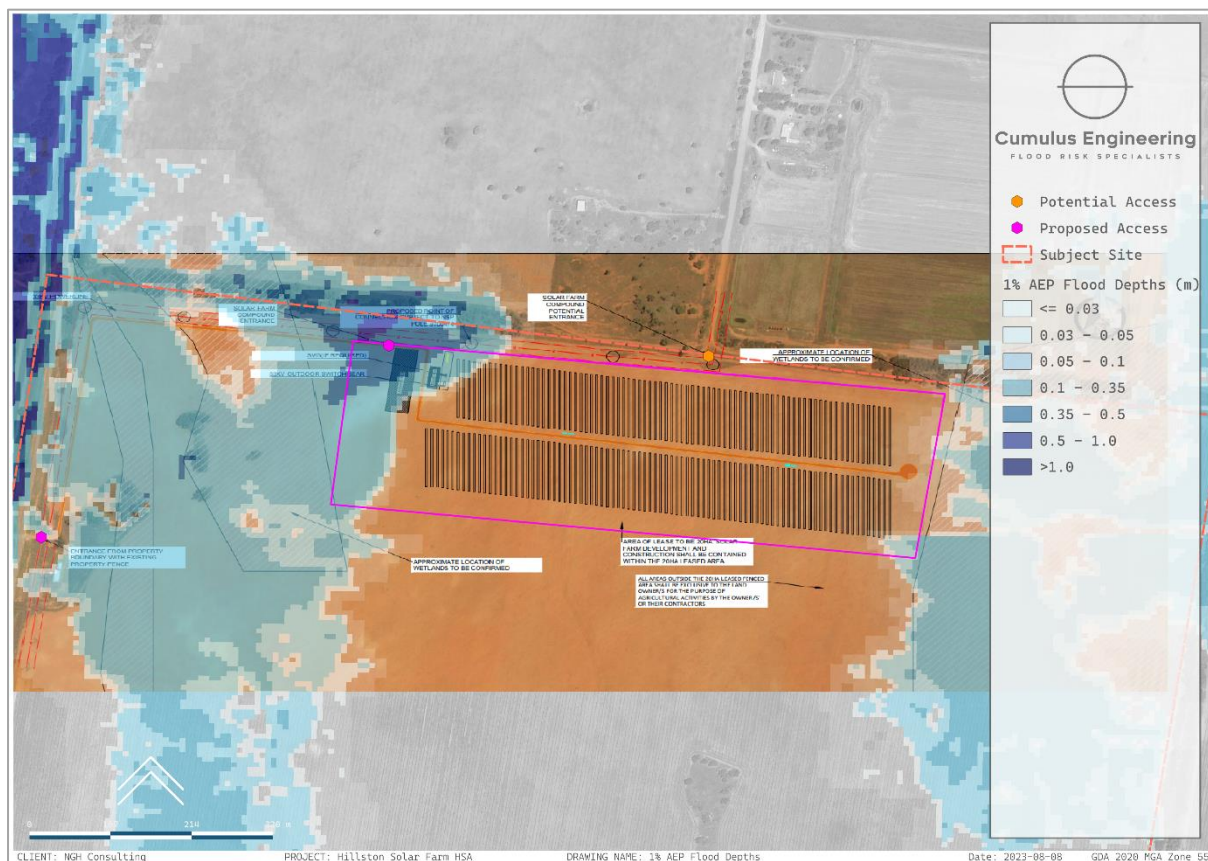


FIGURE 2-2 OPTION A – FLOOD DEPTHS

2.1.2 Flood Risk to Access Site

The proposed internal site access track from Kidman Way is directly inundated by floodwaters up to 500 mm deep (as illustrated Figure 2-3) impacting access to the site. This scenario presents challenges as it obstructs safe vehicular access to and from the site from Kidman Way during a 1% AEP flood event. This poses a risk to the safety of individuals, impeding their ability to enter or exit the site during flood events.

The compromised site access also adversely affects emergency response operations in the event of a flood occurring on-site. Emergency personnel and vehicles may face difficulties reaching the affected areas promptly.

A flood response plan is recommended for the site to ensure it is evacuated in advance of inundation of the surrounding access roads. In addition, the site layout could be modified by realigning the access track to avoid the deeper area of flooding.

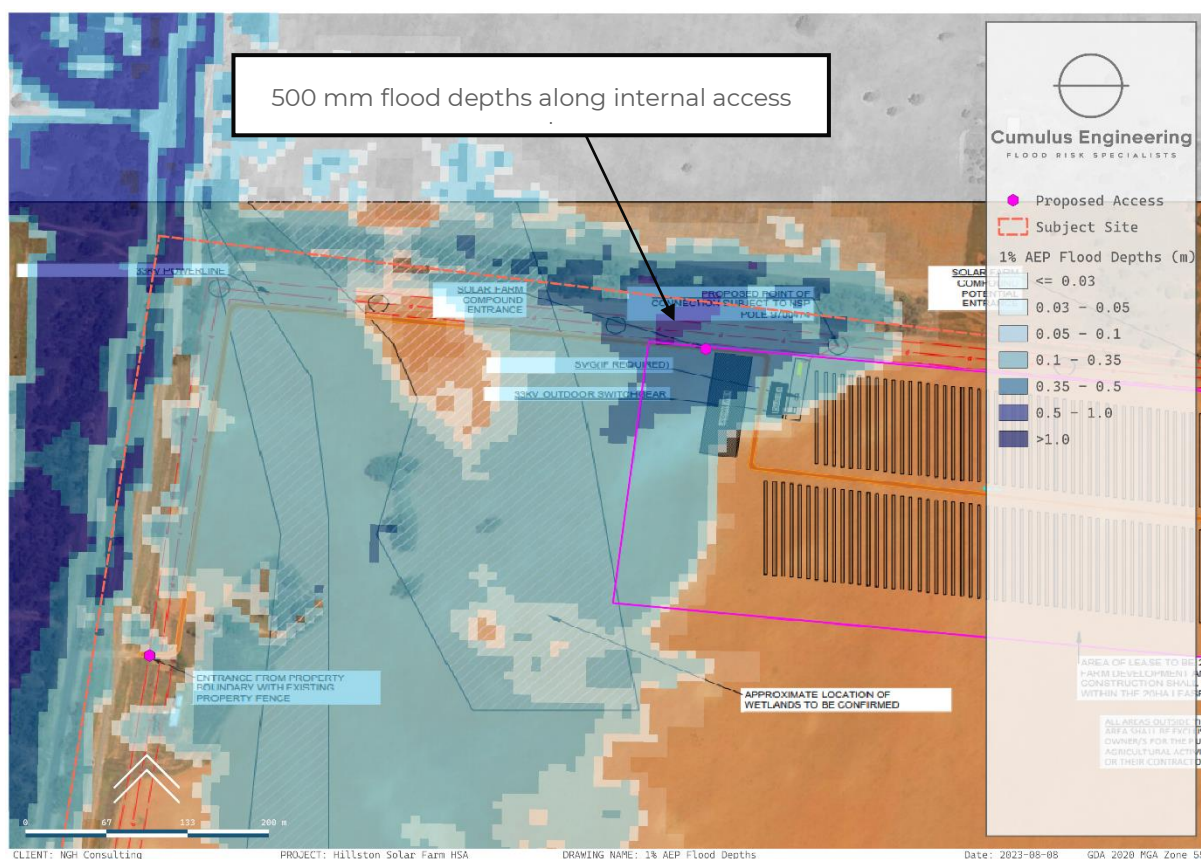


FIGURE 2-3 OPTION A – FLOOD DEPTHS ON ACCESS ROAD

2.1.3 Compliance with Planning Codes

Cumulus Engineering has reviewed the state and local planning requirements for the site and assessed Design Option A against the relevant flood-related planning requirements.

Table 2-1 shows the design meets all the planning requirements set out in Section 5.21, Flood Planning of the Carrathool LEP and outlined in Section 1.1 of this memo.

TABLE 2-1 OPTION A – COMPLIANCE WITH PLANNING CONTROLS

PLANNING REQUIREMENTS	CUMULUS ENGINEERING COMMENT	COMPLIANT (TICK/CROSS)
(1) OBJECTIVES	See list above	n/a
(2) DEVELOPMENT CONSENT MUST NOT BE GRANTED TO DEVELOPMENT ON LAND THE CONSENT AUTHORITY CONSIDERS TO BE WITHIN THE FLOOD PLANNING AREA UNLESS THE CONSENT AUTHORITY IS SATISFIED THE DEVELOPMENT:	<p><i>The proposed development is partially impacted by flood-prone areas as shown in Figure 2-2 and satisfies the planning requirements as outlined below.</i></p> <p>A) IS COMPATIBLE WITH THE FLOOD FUNCTION AND BEHAVIOUR ON THE LAND</p> <p><i>Flood mapping shows that the site of the proposed development is partially impacted by inundation in the 1% AEP event however the flooding is generally shallow (less than 300mm), and the bulk of the development remains flood-free. A proposed site office is within the flood extent and provided the flood level is raised a minimum of 500mm above the flood level the proposal is considered appropriate.</i></p> <p><i>A flood response plan is recommended for the site to ensure evacuation of the site in advance of a flood event.</i></p> <p>B) WILL NOT ADVERSELY AFFECT FLOOD BEHAVIOUR IN A WAY THAT RESULTS IN DETRIMENTAL INCREASES IN THE POTENTIAL FLOOD AFFECTATION OF OTHER DEVELOPMENT OR PROPERTIES</p> <p><i>The proposed development is only partially impacted by inundation and generally the inundation is shallow and of low velocity. There is no fill proposed within the flood extent and therefore there will be no adverse impacts to other properties.</i></p> <p>C) WILL NOT ADVERSELY AFFECT THE SAFE OCCUPATION AND EFFICIENT EVACUATION OF PEOPLE OR EXCEED THE CAPACITY OF EXISTING EVACUATION ROUTES FOR THE SURROUNDING AREA IN THE EVENT OF A FLOOD</p> <p><i>The access route within the site is flood impacted however only a short distance is considered hazardous. The access track could be realigned 150-200 metres to the south to avoid the deeper area of flooding. In addition, a flood response plan for the site is recommended to ensure the site is evacuated in advance of a flood event.</i></p> <p><i>The available flood data indicates there will be safe access/egress route from the site entrance along Kidman Way to the north into Hillston. The highway passes through inundated areas however the road appears raised and trafficable based on the flood data.</i></p> <p><i>This design option is considered compliant provided a flood response plan is developed and maintained for the site.</i></p> <p><i>The site office floor level will be raised a minimum of 500mm above the 1% AEP flood level.</i></p> <p>D) INCORPORATES APPROPRIATE MEASURES TO MANAGE RISK TO LIFE IN THE EVENT OF A FLOOD,</p> <p><i>The access route within the site is flood impacted however only a short distance is considered hazardous. The access track could easily be realigned to avoid the deeper area of flooding. In addition, a flood response plan for the site is recommended to ensure the site is evacuated in advance of a flood event.</i></p>	<p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p>

PLANNING REQUIREMENTS

CUMULUS ENGINEERING COMMENT

COMPLIANT
(TICK/CROSS)

		<i>The site office will be raised a minimum of 500mm above the 1% AEP flood level.</i>	
	E) WILL NOT ADVERSELY AFFECT THE ENVIRONMENT OR CAUSE AVOIDABLE EROSION, SILTATION, DESTRUCTION OF RIPARIAN VEGETATION OR A REDUCTION IN THE STABILITY OF RIVERBANKS OR WATERCOURSES.	<i>There are no significant works of fill proposed within the flood extent which would have an impact on riparian vegetation or riverbank stability.</i>	✓
(3) IN DECIDING WHETHER TO GRANT DEVELOPMENT CONSENT ON LAND TO WHICH THIS CLAUSE APPLIES, THE CONSENT AUTHORITY MUST CONSIDER THE FOLLOWING MATTERS:	A) THE IMPACT OF THE DEVELOPMENT ON PROJECTED CHANGES TO FLOOD BEHAVIOUR AS A RESULT OF CLIMATE CHANGE	<p><i>An increase in rainfall intensity associated with climate change could be expected to increase overland flow depths and durations, however the flood risk is low at the subject site and the floor level of the site office will be raised more than 500mm above the 1% AEP flood level across the building footprint. In addition.</i></p> <p><i>A flood response plan is recommended for the site to ensure evacuation of the site in advance of a flood event.</i></p>	✓
	B) THE INTENDED DESIGN AND SCALE OF BUILDINGS RESULTING FROM THE DEVELOPMENT	<i>The only building proposed is a site office which is located within the flood extent but in an area of low hazard. The flood level would be raised a minimum of 500mm above the 1% AEP flood level. The proposed development is compliant.</i>	✓
	C) WHETHER THE DEVELOPMENT INCORPORATES MEASURES TO MINIMISE THE RISK TO LIFE AND ENSURE THE SAFE EVACUATION OF PEOPLE IN THE EVENT OF A FLOOD	<p><i>The area of the proposed development is located in an area of flood fringe and very low velocities and flood hazards in the 1% AEP flood risk. The flood risk is considered low at the site of the proposed development.</i></p> <p><i>In addition, the proposed site office will have a floor level set 500mm above the applicable 1% AEP flood level across the building footprint.</i></p> <p><i>A flood response plan will also be prepared for the site ensuring the site is evacuated in advance of a flood event.</i></p>	✓
	D) THE POTENTIAL TO MODIFY, RELOCATE OR REMOVE BUILDINGS RESULTING FROM DEVELOPMENT IF THE SURROUNDING AREA IS IMPACTED BY FLOODING OR COASTAL EROSION.	<i>It is unlikely this will be necessary given the low flood risk within an area of flood fringe, and that there is only a single small site office proposed. The floor level of the site office of be raised a minimum of 500mm above the average 1% AEP flood level across the building footprint.</i>	✓

2.2 Design Option B

Design Option B is illustrated in Figure 2-4 and shows proposed access to the site from the north of via Norwood Lane. The access track into the site bisects the northern row of solar panels as well as the southern and northern row of solar panels providing access to the site office and laydown area towards the west of the site. The site office and laydown area have been relocated away from the northwestern corner of the site in comparison to Option A.

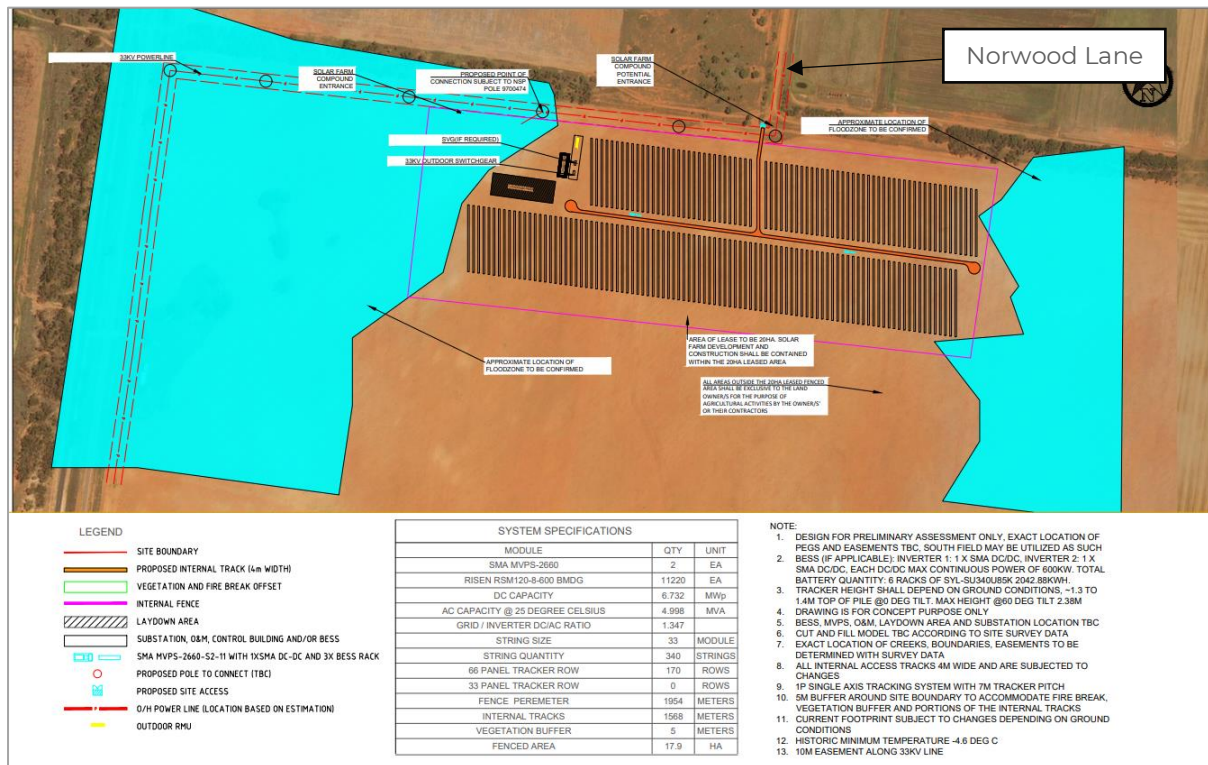


FIGURE 2-4 OPTION B – LAYOUT PLAN

2.2.1 Flood Risk at Site

Depths for the 1% AEP flood event with the layout plan for Option B are illustrated in Figure 2-5 and is reflective of the inundation presented for Option A however the modified design layout results in a significant reduction in impacts to solar farm infrastructure with only a small section of the southern row of solar panels on the western side experiencing depths of up to 60 mm. Furthermore, the site office within Option B's layout remains unaffected by flood flows.

Flooding has an overall reduced impact on the proposed solar farm development in Option B when compared to Option A, as much of the development is free from inundation.

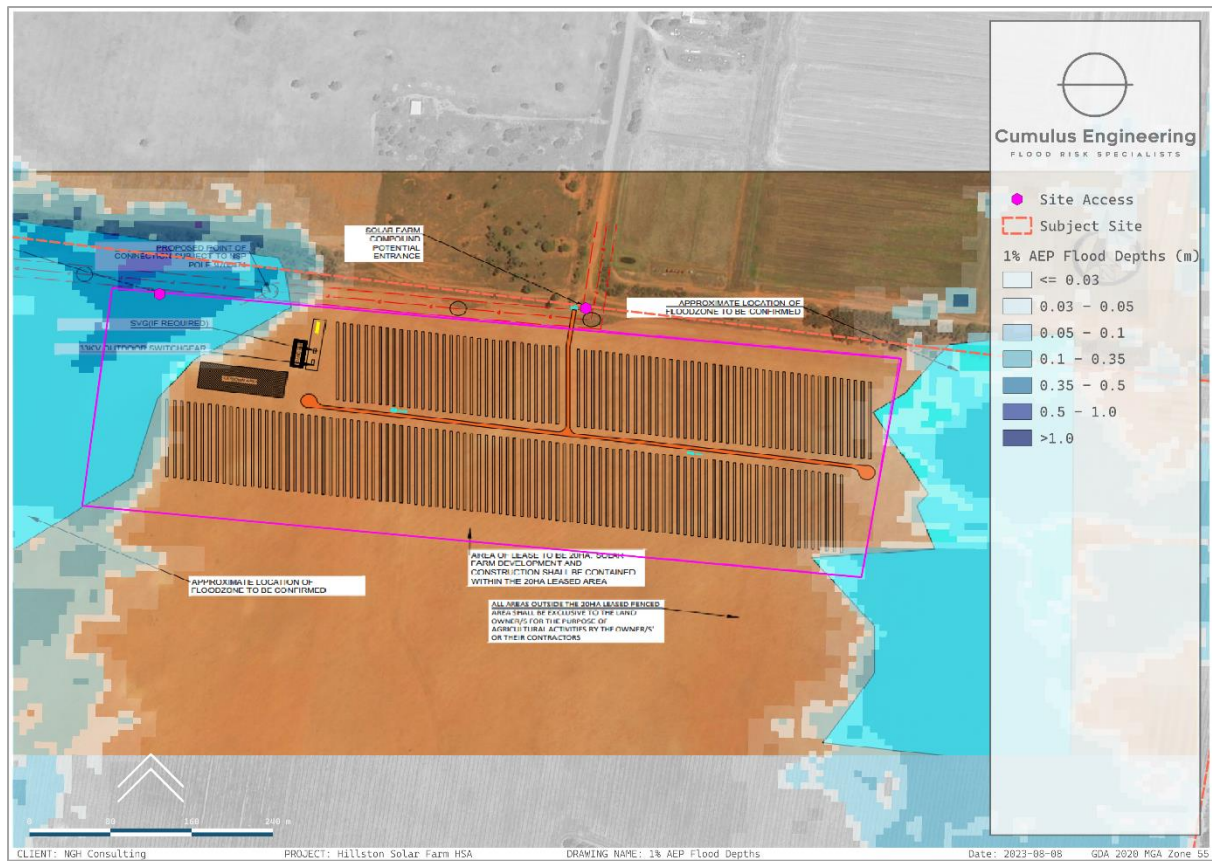


FIGURE 2-5 OPTION B - FLOOD DEPTHS

2.2.2 Flood Risk to Access Site

For Option B, Norwood Lane and the internal access routes are unimpeded in the 1% AEP flood event however, access to the property along Norwood Lane is restricted, as flood depths up to 500 mm deep approximately 1.5 km north of the property as illustrated in Figure 2-6.

A flood response plan is recommended for the site to ensure the site is evacuated prior to inundation of Norwood Lane. Additionally, upgrades to Norwood Lane could be considered to increase the road elevation in order to reduce flood risk when accessing the site during a flood event.

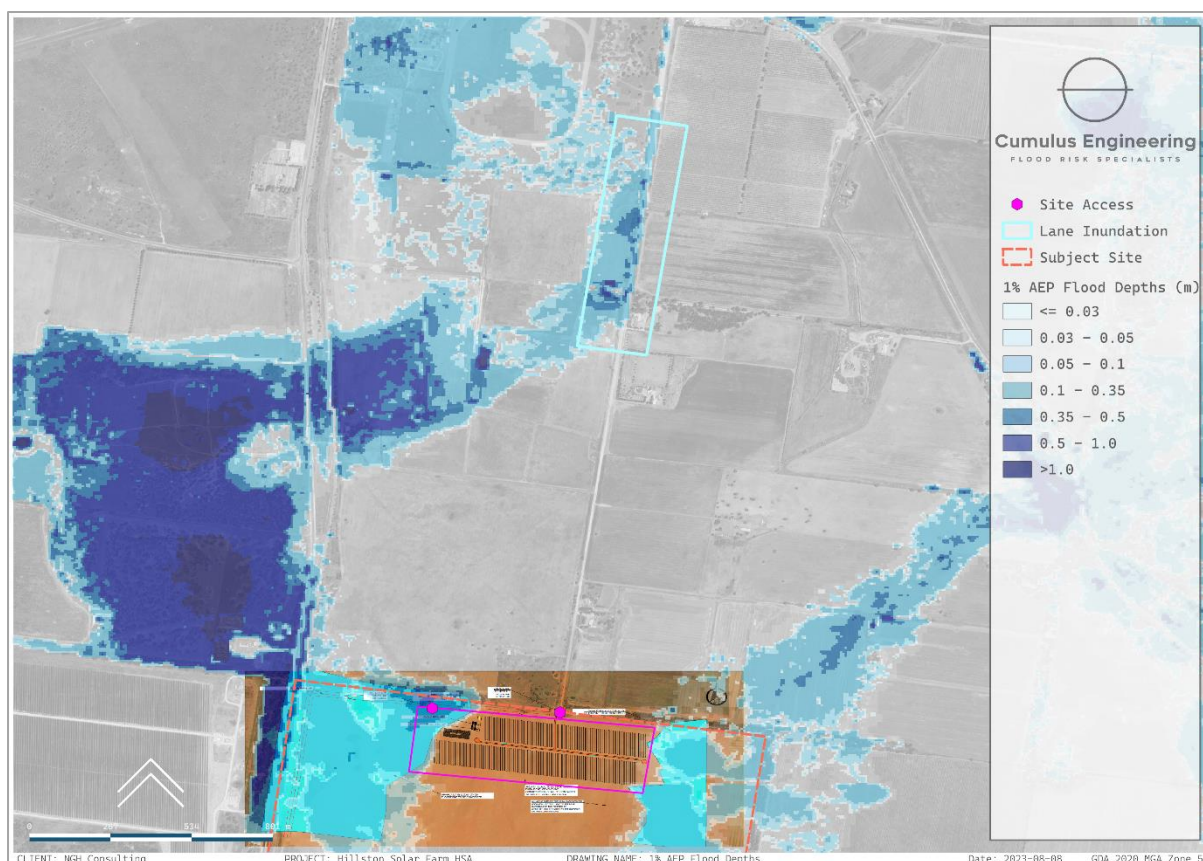


FIGURE 2-6 FLOOD DEPTH INUNDATION ON NORWOOD LANE

2.2.3 Compliance with Planning Controls

Cumulus Engineering has reviewed the state and local planning requirements for the site and assessed the Option B against the relevant flood-related planning requirements.

Table 2-2 shows the design meets all the planning requirements set out in Section 5.21, Flood Planning of the Carrathool LEP and outlined in Section 1.1 of this memo.

TABLE 2-2 OPTION B - COMPLIANCE WITH PLANNING CONTROLS

PLANNING REQUIREMENTS	CUMULUS ENGINEERING COMMENT	COMPLIANT (TICK/CROSS)
(1) OBJECTIVES	See list above	n/a
(2) DEVELOPMENT CONSENT MUST NOT BE GRANTED TO DEVELOPMENT ON LAND THE CONSENT AUTHORITY CONSIDERS TO BE WITHIN THE FLOOD PLANNING AREA UNLESS THE CONSENT AUTHORITY IS SATISFIED THE DEVELOPMENT:	<i>The site is partially impacted by flood-prone areas as shown in Figure 2-5 and satisfies the planning requirements as outlined below. With this option all proposed works are outside of the 1% AEP flood extent.</i>	✓
	<p>A) IS COMPATIBLE WITH THE FLOOD FUNCTION AND BEHAVIOUR ON THE LAND</p> <p><i>Flood mapping shows that the proposed development for Option B entirely remains outside of the 1% AEP flood extent. The access route is impacted along Norwood Lane and therefore a flood response plan is recommended for the site to ensure evacuation of the site in advance of a flood event.</i></p> <p><i>There are no habitable buildings proposed within the 1% AEP flood extent.</i></p>	✓
	<p>B) WILL NOT ADVERSELY AFFECT FLOOD BEHAVIOUR IN A WAY THAT RESULTS IN DETRIMENTAL INCREASES IN THE POTENTIAL FLOOD AFFECTATION OF OTHER DEVELOPMENT OR PROPERTIES</p> <p><i>The proposed development for Option B is entirely outside of the 1% AEP flood extent. There is no fill proposed within the flood extent and therefore there will be no adverse impacts to other properties.</i></p>	✓
	<p>C) WILL NOT ADVERSELY AFFECT THE SAFE OCCUPATION AND EFFICIENT EVACUATION OF PEOPLE OR EXCEED THE CAPACITY OF EXISTING EVACUATION ROUTES FOR THE SURROUNDING AREA IN THE EVENT OF A FLOOD</p> <p><i>The available flood data indicates there will be hazardous flooding in excess of 500 mm deep in the 1% AEP event along the proposed access/egress route from the site entrance along Norwood Lane to the north. The road passes through a low point which flood depths are 500 – 600 mm deep.</i></p> <p><i>A flood response plan is recommended for the site to ensure the safe evacuation of the site prior to a flood event and the access route being impacted. This design option is considered compliant provided a flood response plan is developed and maintained for the site.</i></p> <p><i>The site office will be raised a minimum of 500 mm above the 1% AEP flood level.</i></p>	✓
	<p>D) INCORPORATES APPROPRIATE MEASURES TO MANAGE RISK TO LIFE IN THE EVENT OF A FLOOD,</p> <p><i>The area of development remains flood-free with this option. The access route along Norwood Lane is impacted as described above and therefore a flood response plan for the site is recommended to ensure the site is evacuated in advance of a flood event. This design option is considered compliant provided a flood response plan is developed and maintained for the site.</i></p> <p><i>The site office will be raised a minimum of 500 mm above the 1% AEP flood level.</i></p>	✓

PLANNING REQUIREMENTS	CUMULUS ENGINEERING COMMENT		COMPLIANT (TICK/CROSS)
	E) WILL NOT ADVERSELY AFFECT THE ENVIRONMENT OR CAUSE AVOIDABLE EROSION, SILTATION, DESTRUCTION OF RIPARIAN VEGETATION OR A REDUCTION IN THE STABILITY OF RIVERBANKS OR WATERCOURSES.	<i>There are no significant works of fill proposed within the flood extent which would have an impact on riparian vegetation or riverbank stability.</i>	✓
(3) IN DECIDING WHETHER TO GRANT DEVELOPMENT CONSENT ON LAND TO WHICH THIS CLAUSE APPLIES, THE CONSENT AUTHORITY MUST CONSIDER THE FOLLOWING MATTERS:	A) THE IMPACT OF THE DEVELOPMENT ON PROJECTED CHANGES TO FLOOD BEHAVIOUR AS A RESULT OF CLIMATE CHANGE	<i>An increase in rainfall intensity associated with climate change could be expected to increase overland flow depths and durations, however the flood risk is low at the subject site and the floor level of the site office will be raised more than 500 mm above the 1% AEP flood level across the building footprint. In addition, a flood response plan is recommended for the site to ensure evacuation of the site in advance of a flood event.</i>	✓
	B) THE INTENDED DESIGN AND SCALE OF BUILDINGS RESULTING FROM THE DEVELOPMENT	<i>There are no buildings proposed within the 1% AEP flood extent.</i>	✓
	C) WHETHER THE DEVELOPMENT INCORPORATES MEASURES TO MINIMISE THE RISK TO LIFE AND ENSURE THE SAFE EVACUATION OF PEOPLE IN THE EVENT OF A FLOOD	<i>The area of the proposed development is located in an area of flood fringe and very low velocities and flood hazards in the 1% AEP flood risk. The flood risk is considered low at the site of the proposed development.</i> <i>There are no habitable buildings proposed within the 1% AEP flood extent.</i> <i>A flood response plan will also be prepared for the site ensuring the site is evacuated in advance of a flood event.</i>	✓
	D) THE POTENTIAL TO MODIFY, RELOCATE OR REMOVE BUILDINGS RESULTING FROM DEVELOPMENT IF THE SURROUNDING AREA IS IMPACTED BY FLOODING OR COASTAL EROSION.	<i>There are no habitable buildings proposed within the 1% AEP flood extent.</i>	✓

3 Conclusions and Recommendations

The subject site located at Hillston Solar Farm has been identified as being subject to flood risk by Carrathool City Council and as such Cumulus Engineering have actioned a Flood Risk Assessment (FRA) to review available flood information to understand flood behaviour and flood impact on the development.

Objectives for the development regarding flooding and flood risk must minimise the flood risk to life and property associated with the development and ensure safe egress and evacuation of people in the event of a flood event.

Findings for each of the design options are as follows:

- **Option A** - portions of the solar farm including the site office and laydown area are inundated. Similarly, the internal access to the site is inundated to hazardous depths of more than 500mm impacting access and egress for site staff emergency services to enter or exit the site during a flood event.
- **Option B** – the modified layout and access point removes most of the portions of the development that are inundated by flood flows. While site safety is improved with this option access to the site along Norwood Lane still is impacted by significant flood depths.

For both Option A and Option B it is recommended that a flood response plan for the site is development and maintained to ensure the site is evacuated in advance of a flood event in the vicinity of the site.

Please do not hesitate to contact me if you require further clarification.



Julian Skipworth

Director | Principal Engineer

Attached:

Attachment A – Development Plans

Attachment B – Flood Maps

Attachment C – Julian Skipworth CV