Appendix L Flood Impact Assessment Report

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13 October 2021

Flood Assessment Report

Daroobalgie Solar Farm

Reference No. 30012765
Prepared for Pacific Hydro Australia Developments Pty Ltd
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The findings of this this report are the result of methodologies used in accordance with normal practices and standards. We consider that they represent a reasonable interpretation of the general conditions of the Site at the time they were assessed and at the time of writing this report, but under no circumstances, can it be considered that these findings represent the actual state of the Site in all areas.

In preparing this report, current guidelines for hydrologic/hydraulic assessment were followed. This work has been conducted in good faith in accordance with SMECs understanding of the client's brief and general accepted practice for environmental consulting.

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List of Acronyms

Acronyms used in the current report are outlined below.

Acronym	Definition	Description
AEP	Annual Exceedance Probability	The probability of a flood event occurring in any year, measured as a percentage
AHD	Australian Height Datum	The topographic datum used in Australian standard drawings, last updated on the 5th May 1971 (Australian Government, 2019)
ARR	Australian Rainfall and Runoff	A national guideline document, data and software suite that can be used for the estimation of design flood characteristics in Australia. If ending in 19 (i.e. ARR19), this denotes the data has last been updated in 2019
BoM	Bureau of Meteorology	An Executive Agency of the Australian Government responsible for providing weather services to Australia and surrounding areas
CL	Continuing Loss	The average loss rate throughout the remainder of the rainfall event after the initial loss has been satisfied. (Australian Rainfall and Runoff, 2019)
DEM	Digital Elevating Model	A digital dataset containing topographic elevations
ELVIS	Elevation Foundation Spatial Data	An online repository that hosts Australian elevation datasets from both LiDAR and satellite sources.
ETL	Electricity transmission line	The ETL connects the solar farm site to the switchyard site located near the existing Forbes-Parkes 132 kV transmission line. The ETL easement is approximately 8.5 kilometre long and approximately 45 metre wide.
HPC	Highly Parallelised Compute	A computational method with adaptive time stepping (BMT, 2018)
HQ	Height vs Flow (Stage-Discharge)	A type of hydraulic outlet boundary conditions related to topographic slope (BMT, 2018)
IFD	Intensity-Frequency-Duration	The rainfall (in mm or mm/h) adopted from (Australian Rainfall and Runoff, 2019) for frequent events
ILCL	Initial Loss Continuing Loss	A hydrologic loss setup combining all loss parameters into Initial Loss and Continuing Loss
IL	Initial Loss	The global loss applied the beginning of a storm, prior to the commencement of surface runoff (Australian Rainfall and Runoff, 2019)
LiDAR	Light Detection and Ranging	Lidar is a surveying method that measures distance to a target by illuminating the target with laser light and measuring the reflected light with a sensor
SRTM	Shuttle Radar Topography Mission	A satellite elevation dataset produced by NASA, with worldwide coverage at approximately a 30 m grid resolution.
The Project	Daroobalgie Solar Farm	The Project is proposed to comprise the solar farm site, an electricity transmission line and switchyard site.

Acronym	Definition	Description
TP	Temporal Pattern	A distribution of peak flow over time
WSL	Water Surface Level	The level of water measured above a datum
kV	Kilovolts	
MW	Megawatts	

1 Introduction

1.1 Background

This report presents the findings of the flood assessment carried out by SMEC Australia Pty Ltd (SMEC) for the proposed Daroobalgie Solar Farm (the Project) located in Daroobalgie, NSW. The purpose of this flood study for Pacific Hydro Australia is to determine optimum levels and locations for infrastructure across the proposed development and identify potential risks and mitigations to minimise any risks.

The Project is proposed to comprise the solar farm site which includes installation of approximately 420,000 solar photovoltaic (PV) panels, associated infrastructure (i.e. substation, Battery Energy Storage System, inverters, power cabling, site offices, car parking, and new access tracks), an electricity transmission line (ETL) and switchyard site. The ETL will connect the solar farm to the switchyard site and national grid alongside. The Project will have an estimated capacity of approximately 100 megawatts (MW) and will provide enough electricity to power up to the equivalent of 34,000 homes each year.

The proposed solar farm site is located approximately 11 kilometres (km) northeast of the township of Forbes, NSW. The surrounding road network includes Troubalgie Road to the north, Forest Road to the west, and The Escort Way to the south. The site slopes gently to the south and the historic land use has been livestock grazing and agriculture. The ETL easement is approximately 8.5 km long and approximately 45 metre (m) wide. The easement traverses a number of private properties and road reserves. The switchyard site is adjacent to the existing Forbes-Parkes 132 kV transmission line located approximately 500 m west of the Newell Highway. It will be accessed from Daroobalgie Road.

The site locality is shown in Figure 1-1.

The Project comprises:

- A network of PV solar panel arrays and power conversion units (PCUs) (DC-AC inverters)
- Battery Energy Storage System (BESS)
- Electrical collection systems including underground cabling, substation and control room
- Temporary construction compound
- Operations and maintenance facility, including demountable offices, amenities, equipment sheds, storage and parking areas
- Internal access roads
- Electricity transmission line (ETL)
- Switchyard to connect to existing TransGrid infrastructure (i.e. Forbes-Parkes 132 kV transmission line)
- Perimeter security fencing at solar farm and switchyard sites.

The purpose of this flood study is to assess potential flood impacts of the proposed development. This report presents the findings of the flood assessment carried out by SMEC for the Project.

Figure 1-1. The Project

The solar farm site will include the following infrastructure:

- Solar module mounting structure area
- Control room, security room and transformer
- Electrical collection systems, Substation, BESS, and PCUs
- Inverter station area
- Laydown area
- Internal roads
- Drainage and trenches
- Perimeter security fencing

An indicative general arrangement plan for the proposed solar farm including substation drawing are provided in Appendix E.

The switchyard is proposed approximately 8 km to the west of the solar farm site adjacent to the existing Forbes-Parkes 132 kV transmission line. The flood impact assessment for the switchyard was undertaken separately because of having a different hydraulic model extent and methodology. The flood assessment for the switchyard is provided in Appendix F.

1.2 Objectives

The purpose of this study is to undertake a flood assessment to determine the likely extents of flooding across the site and assess potential impacts of the proposed development on the surrounding properties and watercourses. Results will be used to address the project's Secretary's Environmental Assessment Requirements (SEARs)issued 19 December 2019. Results also will be used to inform preliminary formation/pad levels for various proposed infrastructures in the site.

1.3 Scope of Works

The flood impact assessment has been conducted in accordance with the approved proposal dated on 18/03/2020 and further communication with the client. The scope of this assessment includes:

- A review of topographical and hydrological existing data.
- Hydrological and hydraulic modelling to determine overland flow behaviour crossing the site location.
- Development of a 2D TUFLOW hydraulic to assess potential flood impacts due to the proposed development for 1% Annual Exceedance Probability (AEP), 5% AEP and 20% AEP storm events.

- A site visit in a wet season to understand the expected flood behaviours and overland flow paths (qualitative assessment).

2 Project Data

2.1 Topographical and Hydrological Data

Data was obtained from several sources for this assessment as detailed in Table 2-1.

Table 2-1 Data Summary (description, source and purpose)

Data Description	Data Source	Purpose in this Study
1 m grid LiDAR (File reference: *"Parkes201511-LID1-AHD_6026308_55_0002_0002_1m.asc",* *"Parkes201511-LID1-AHD_6046308_55_0002_0002_1m.asc", "Parkes201906-LID1-AHD_6026310_55_0002_0002_1m.asc",* *"Parkes201906-LID1-AHD_6046310_55_0002_0002_1m.asc")*	ELVIS (https://elevation.fsdf.org.au/).	Provides topographic information in areas not covered by survey, however, required for the hydraulic model. Based on the data release note for 1 m Digital Elevation Model (DEM) data, the general relative vertical accuracy is 300 mm. However, it is expected that the relative vertical accuracy for these files will be much better as the site is in relatively flat area with scattered short vegetation
Substation design (File reference: "Substation_Pads.tif")	Pacific Hydro (client)	Provides topographic information for the proposed substation to be used in the hydraulic model for the proposed case conditions
Proposed general arrangement plan and substation layout (File reference: "DAR-G-0006 Layout 20210216.dwg" & "NSW202525-C3D-Model-ISSUED FOR DA.dwg")	Pacific Hydro (client)	Determines the proposed layout for solar panels, internal road, access road, and substation. This information is used to delineate landuse and hydraulic roughness in the hydraulic model for the proposed case conditions
Aerial imagery	ESRI	Used to delineate land uses and appropriate hydraulic roughness parameters to use in the hydraulic model.
Rainfall Intensity-Frequency-Duration (IFD) data	Bureau of Meteorology (BoM)	Provides the necessary probabilistic rainfall input data to the hydraulic model.
Hydrological parameters	Australian Rainfall and Runoff (ARR) 2019 Data Hub	Required to develop hydrology model
Site visit photos	SMEC (30 April 2020)	To check flood behaviour results with field observation

All geographically referenced data for this Project has been projected on Map Grid of Australia 1994 Zone 55 and Australian Height Datum (AHD).

3 Flood Assessment

3.1 Existing Condition

This flood assessment was undertaken using an XP-RAFTS rainfall runoff model and a TUFLOW hydraulic model. The XP-RAFTS model was used to generate inflow hydrographs for the TUFLOW model for the hydraulic assessment.

3.1.1 Catchments

The rainfall runoff model requires that the catchment be delineated into a number of sub-catchments which is detailed in Figure 3-1. As shown in Figure 3-1, the site catchment mainly includes sub-catchment 2. However, a part of the site catchment is sub-catchment 4 which has a large upstream catchment linked to the sub-catchment 3.

3.1.2 Hydrological Model

Design storms are generated using XP-RAFTS rainfall runoff model. These design flood hydrographs are used as input to the TUFLOW hydraulic model. The design storms were generated according to the recommendations stipulated in 2019 Australian Rainfall and Runoff Guideline (Ball et al. 2019). Design rainfalls were obtained from the Bureau of Meteorology (BoM) and are included in Appendix A. Further, storm losses were calculated within Storm Injector program by subtracting the pre-burst losses from the global losses obtained from the ARR2019 data hub website.

3.1.3 Hydraulic Model

A 2D TUFLOW hydraulic model was developed with the hydraulic domain extent (approximately 4.05 square km in size) shown in Figure 3-1. The hydraulic domain comprises sub-catchments 2 and 4.

A rainfall on grid approach was applied to the hydraulic model domain (catchments 2 and 4) covering the subject site. The impact of the other upstream sub-catchments on flood behaviour within the hydraulic domain was considered by applying routed runoff hydrographs, extracted from hydrology model results, as upstream boundary conditions.

The terrain for the 2D TUFLOW hydraulic model was built with a 2 m cell size. The TUFLOW hydraulic model using the TUFLOW.2020-01-AB engine was run for existing conditions under 20% AEP, 5% AEP, and 1% AEP storm conditions. A range of durations (2hr-12hr) were simulated for each AEP event to determine peak flood levels and the corresponding critical duration.

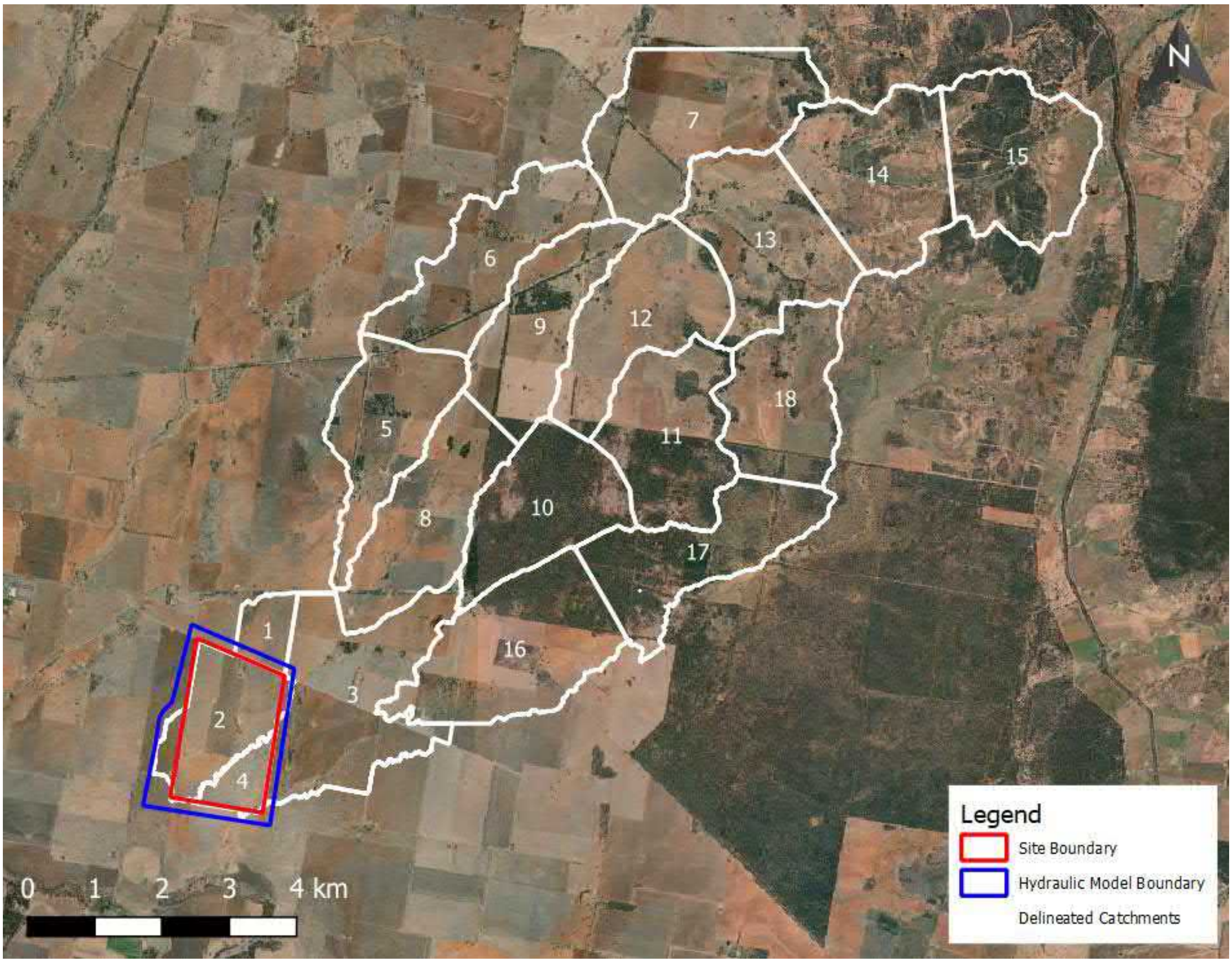

Figure 3-1 Hydraulic model extent and delineated sub-catchments

3.1.3.1 Topography and Hydraulic Parameters

The topographical features for the hydraulic model were sourced from the 1 m grid LiDAR data for existing conditions.

The land use types for existing conditions in the modelled extent were determined through an inspection of aerial imagery in the region. The final land use delineation in the hydraulic model is presented in Figure 3-2. Land use types were represented in the model by the Manning's hydraulic roughness coefficient, or "n" value. Broadly speaking, hydraulic roughness is a measure of the impediment to flow imparted by different types of natural or man-made materials. Hydraulic roughness values, sourced from Open Channel Hydraulics (Chow, 1959), adopted for each land use type and are presented in Table 3-1.

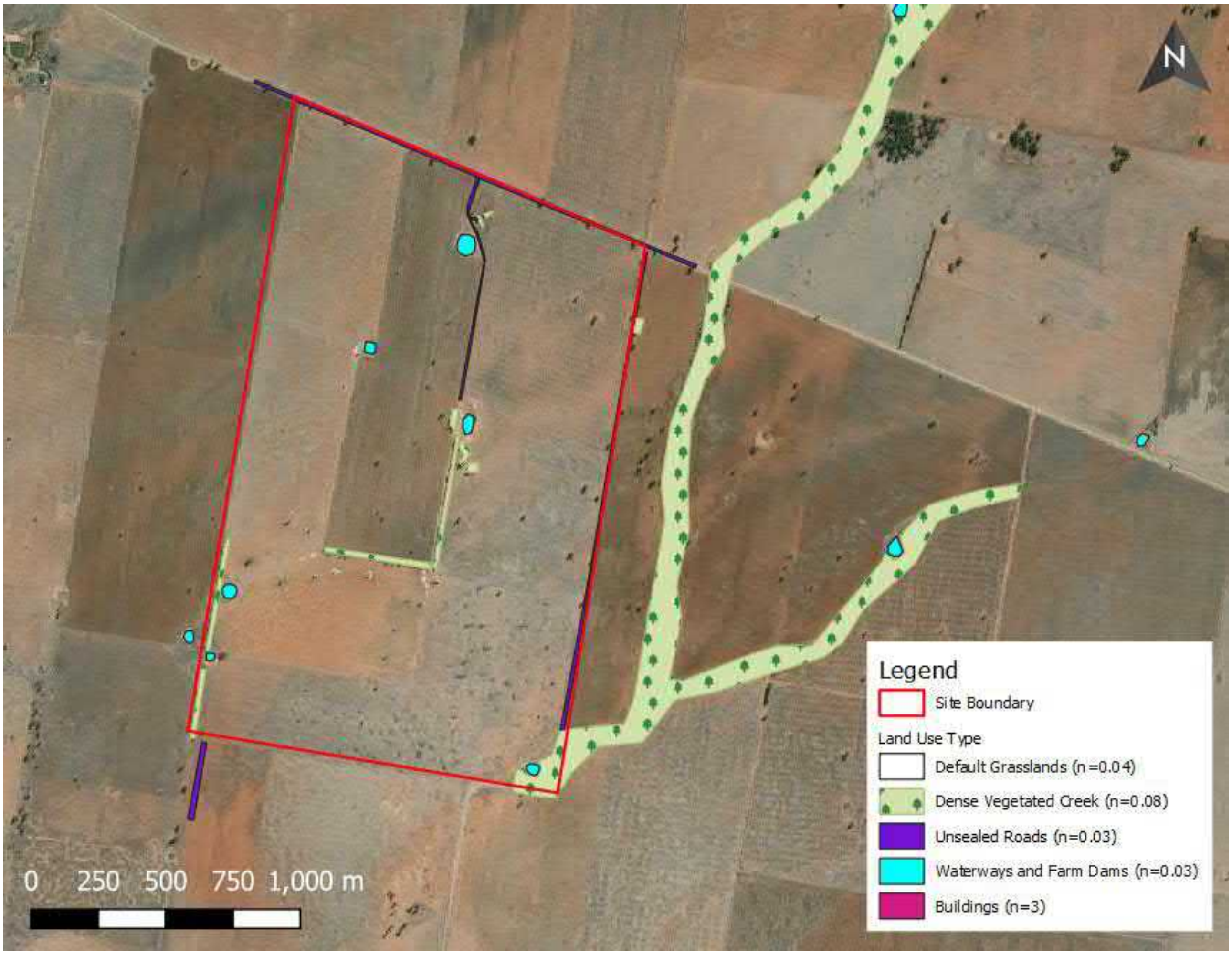

Figure 3-2 Land use map in hydraulic model for existing conditions

Table 3-1 Adopted Manning's Roughness

Land use	Manning's Roughness "n"
Pasture (all undefined areas in Figure 3-2)	0.04
Dense Vegetation	0.08
Access Road/Concrete Pad	0.02
Unsealed Road	0.03
Waterways and Farm Dams	0.03
Solar Panel	0.06

3.1.3.2 Hydraulic Boundaries

The rainfall on grid method was applied to the entirety of the hydraulic model domain which covers the sub-catchments 2 and 4 as shown in Figure 3-1. Critical temporal patterns with the corresponding durations were identified for these two sub-catchments using XP-RAFTS hydrology model according to ARR2019 guideline. These temporal patterns were further used in developing the rainfall hyetograph that was applied to the hydraulic model domain in the rainfall on grid method.

The runoff from the upstream catchments was considered by applying as inflow hydrographs, corresponding to the critical temporal patterns, at the north and eastern side of the hydraulic model boundary.

Outflow boundaries were specified in the form of normal-depth rating curves, with the implied hydraulic gradient taken from the prevailing ground slope. Eight such boundaries were implemented at the locations where the topography suggested that flow would naturally leave the model domain. The ground slope was measured over a distance straddling each side of the boundary for each of the boundary conditions. The hydraulic model extent and boundaries are shown in Figure 3-3.

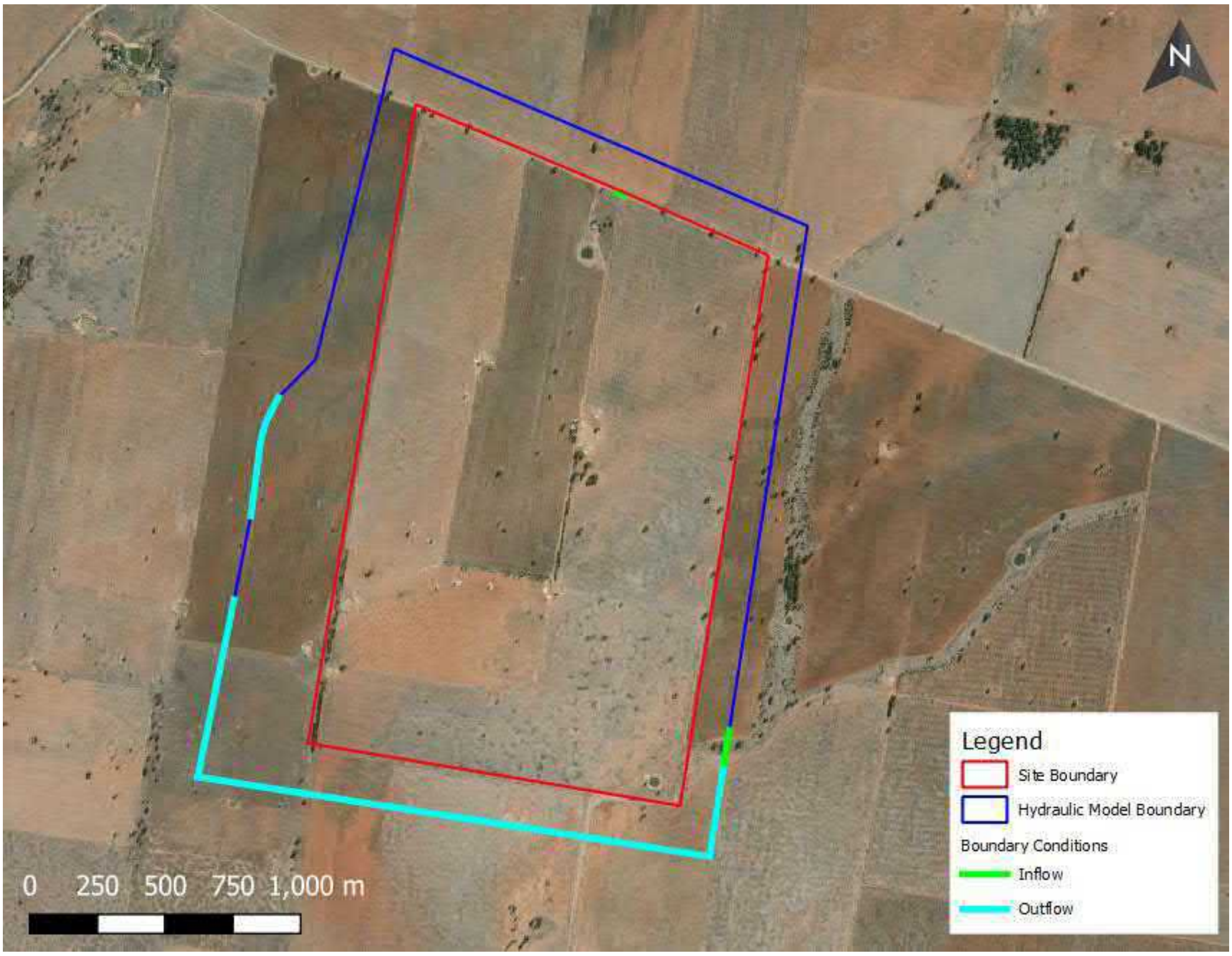

Figure 3-3 Hydraulic Model Extent and Boundaries.

3.1.4 Critical Duration Assessment

The critical duration (i.e. the storm duration that produces the highest peak discharge) was calculated by running six durations between 2 hr and 12 hr, adopted from XP-RAFTS model results, for the 20%, 5%, and 1% AEP design storm events. Any one point within the model domain will have a single critical duration, but this duration will typically change (increase) with increasing distance downstream from the top of the catchment. Thus an “envelope” approach was employed, such that when sampling for results maxima, all storm durations were analysed, and the duration producing the highest value at each point was adopted as the peak result. Across a large portion of the site, the 2 hr and 3 hr storms were found to be the critical durations except for the south-eastern corner where a 12 hr or 9 hr storm was found to be critical under 1% AEP and 5% AEP storm events. All figures in Appendix C were produced using this approach.

3.1.5 Flow Comparison

There was no gauge data available linked to the site catchment. However, Flood Frequency Analysis (FFA) was conducted for nearby gauge stations which have different corresponding catchment sizes. Since, all of these stations recorded at least 10 years of data, FFA was undertaken for the 10-year return period (10% AEP) at different stations. Since the majority of the upstream sub-catchments discharge into sub-catchment 4 (total catchment size of 69.95 square km), XP-RAFTS hydrology model results at the outlet of sub-catchment 4 were used to compare with FFA results shown in Figure 3-4.

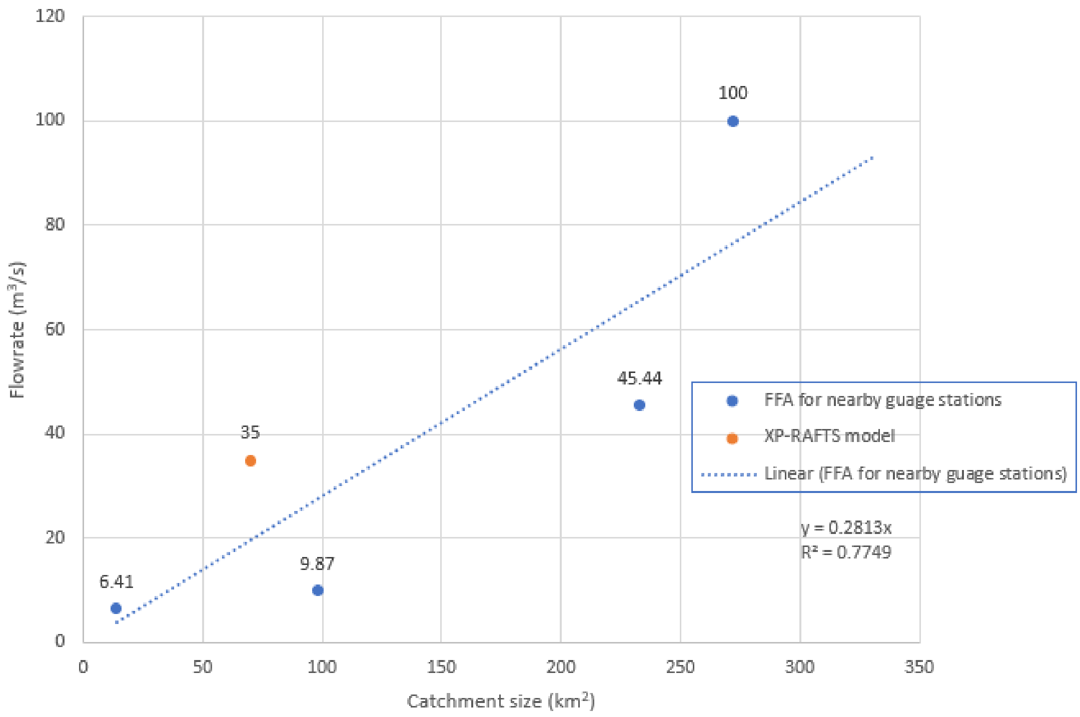

Figure 3-4 Flood Frequency Analysis (FFA) for 10% AEP at different gauge stations versus XP-RAFTS model results

Results show that XP-RAFTS model results for the site catchment (at the outlet of sub-catchment 4) is towards the upper limit of the range, but it is plausible and deemed to be acceptable.

Further, hydraulic model results at the sub-catchment 4 outlet are compared with those from XP-RAFTS hydrology model and Regional Flood Frequency Estimation model (RFFE) (https://rffe.arr-software.org). The comparison of results is presented in Table 3-2.

Table 3-2 Comparison of Peak Discharge Estimates

AEP (%)	Storm Duration (min)	XP-RAFTS Peak Discharge (m^3/s)	TUFLOW Peak Discharge (m^3/s)	Regional Flood Frequency Estimation Model Peak Discharge (m^3/s)
20% AEP	720	26	26	16
5% AEP	540	44	44	34
1% AEP	720	66	67	69

The TUFLOW model results and the XP-RAFTS model results show a good level of agreement when assessed at the downstream end of the hydraulic model boundary. Furthermore, these peak flow discharges are generally consistent with the RFFE results from available gauge stations. Hence TUFLOW hydraulic model results are deemed to be appropriate to further assess flood impacts of the proposed development.

3.2 Proposed Conditions

The TUFLOW hydraulic model for existing conditions was modified to reflect changes in the site for proposed conditions. Main hydrology components from the existing case hydraulic model were retained. In fact, the adopted rain on grid method in the developed hydraulic model allows us to simulate the impact of the increased impervious area due to the proposed development by simply changing manning's "n" values and initial and continuing losses from those adopted for existing conditions. The proposed access road, internal roads, and substation were modelled as impervious areas. This reduces initial storm loss, which considers rain infiltration into ground, for these area to zero, and hence increases stormwater runoff.

The terrain model for the existing conditions was modified by:

- Incorporating the preliminary design surface, which essentially raises existing levels, for the substation area (Provided by Pacific Hydro reference file: “Substation Pads.tif”); and

- Filling two existing farm dams (as shown in layout plan).

No further changes were made to existing terrain for other areas since information regarding the design surface for the main access track, internal tracks, and earthworks will not be available until detailed design stage. It is expected, however, that internal tracks will generally follow natural site contours and earthworks will be minimal. The modifications to existing terrain are shown in Figure 3-5

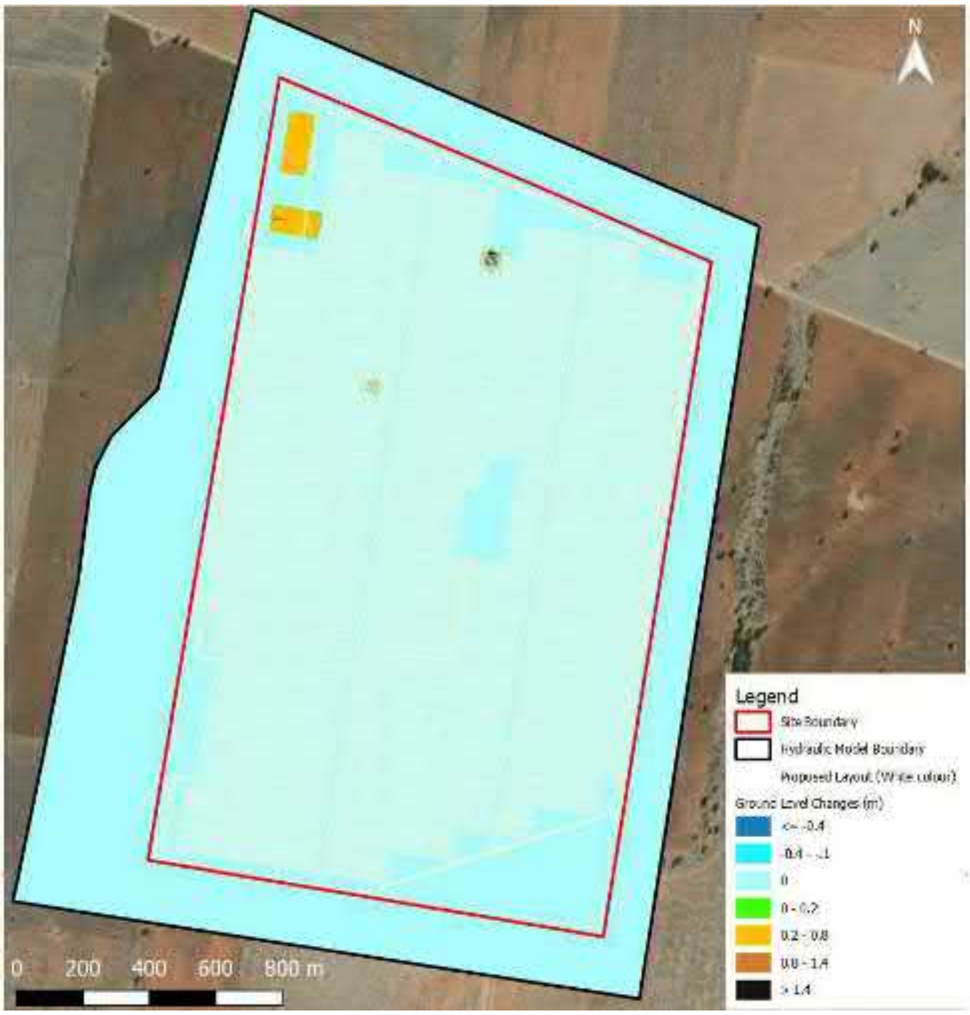

Figure 3-5. Terrain modifications for proposed conditions (compared to existing)

Furthermore, based on the provided general arrangement plan (DAR-G-0006 Layout 20210216 in Appendix E), proposed internal tracks (unsealed roads), access road (main access track), and solar panels were digitised with their corresponding appropriate manning’s “n” values (presented in Table 3-1) in the hydraulic model. Land use changes for proposed conditions are presented in Figure 3-6. Also, the retained farm dams are shown in Figure 3-6.

Figure 3-6. Land use under proposed conditions

The modified TUFLOW hydraulic model for proposed conditions was run under 20% AEP, 5% AEP, and 1% AEP storm conditions. A range of durations (2 hr-12 hr) were simulated, and enveloped flood results were produced under each AEP event.

4 Results

The complete suite of modelled water surface level (WSL), flood depth, velocity and hazard maps are presented in Appendices C and D.

4.1 Existing Conditions

The flood depth maps provided in Appendix C illustrate that there are two major overland flow paths (flood ways) traversing the site. The first one originates from the north and crosses the site towards the south-western boundary where there are three existing farm dams. The other major flow path (flood way) affecting the site is at the south-eastern corner where there is an existing watercourse. Flood inundation is much greater in this area compared to the first major flow path. Existing farm dams act as flood storage for the site and partially attenuate peak overland flows. Further, results show that 1% AEP peak water depth in most of the site is up to 300 mm except for the farm dams and the floodway at south-east corner where ponding reaches up to 1.5m. It is worth noting that flood depth results are generally consistent with the site visit observation conducted on 30/04/2020. Site visit photos are provided in Appendix B.

Peak velocity maps are shown in Figures C2-1, C2-2, and C2-3 in Appendix C. Peak velocity increases with storm size, and peak velocity within the site under the 1% AEP storm events is generally below 1 m/s.

The Flood Hazard Categories displayed in the mapping in Appendix C are those specified by the Australian Emergency Management Institute, with the flood hazard vulnerability curves outlined in Figure 4-1.

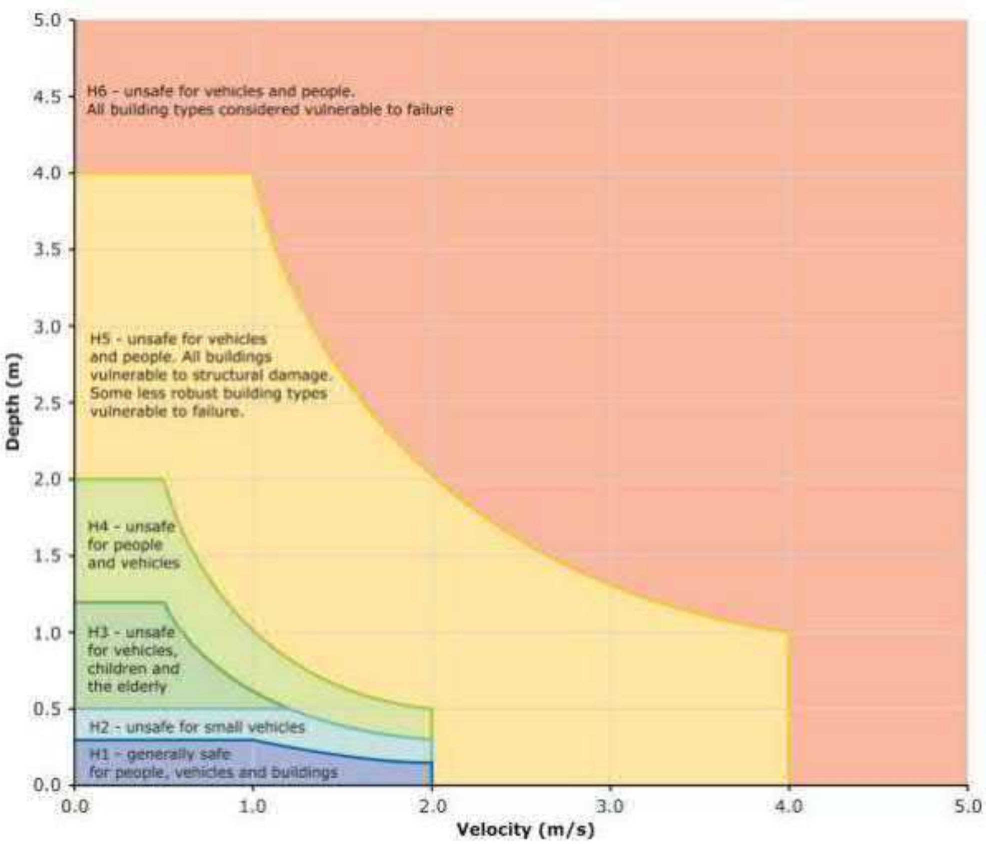

Figure 4-1 Flood Hazard Vulnerability Curves

- H1 – Relatively benign flow conditions. No vulnerability constraints
- H2 – Unsafe for small vehicles
- H3 – Unsafe for all vehicles, children and the elderly
- H4 – Unsafe for all people and all vehicles
- H5 – Unsafe for all people and all vehicles. Buildings require special engineering design and construction
- H6 – Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure

The hazard classification throughout most of the site in a 1% AEP storm event was calculated to be H1, that is, generally safe for people, vehicles and buildings. This is the expected result given the generally low depths and velocities modelled across much of the site. However, hazard classifications as high as H3 for a 1% AEP storm event are observed in existing farm dams and in the south east corner (where both depths and velocities are higher).

4.2 Proposed Conditions

Flood maps for proposed conditions are presented in Appendix D. These results were produced based on preliminary data for the purpose of preliminary impact assessment. More detailed modelling will be carried out in a later design stage to incorporate civil design (including internal tracks and earthworks) and drainage design for the site.

Peak water depth results for 1% AEP storm event show that ponding depth at the solar panel site is generally up to 300mm.

Velocities for the 1% AEP storm event are generally below 1 m/s within the site. Peak velocity maps are provided in Appendix D for proposed conditions.

Afflux map for 1% AEP storm event is presented in Figure D1.4 in Appendix D and Figure 4-2. At the substation area, overland flow path is blocked by the substation and it is re-directed to the west of the substation pad. This increased flood extent, shown in blue in Figure 4-2, has localised inundation depth of generally below 30mm within the adjacent lot boundary.

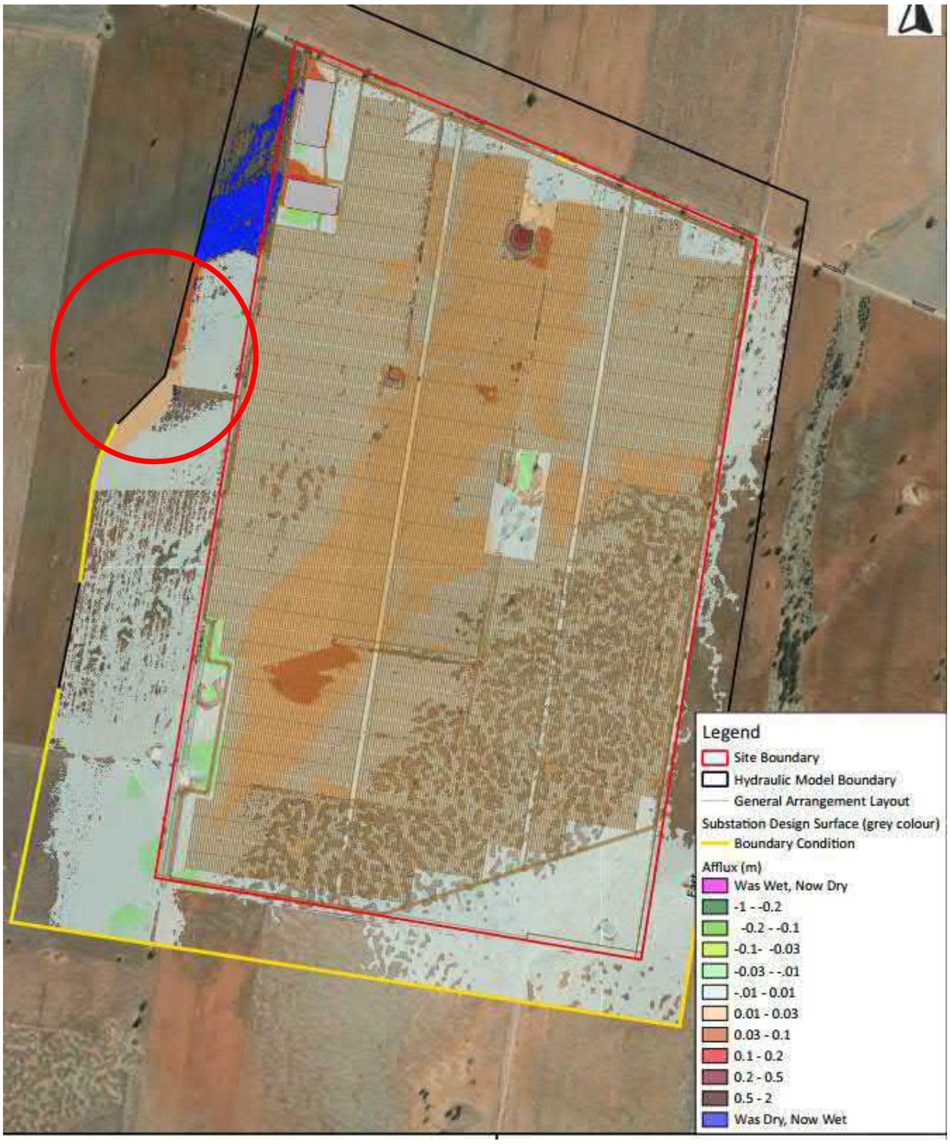

Figure 4-2. Afflux map for 1% AEP storm

Also, as shown in Figure 4-2, filling the two farm dams increases flood depth/level up to 40mm for a large portion of the lot in 1% AEP storm event.

The afflux in the area in the red circle in Figure 4-2 is due to lack of a boundary condition applied in the TUFLOW model. However, this glass wall effect doesn’t impact afflux results due to the proposed development since the overland flow would naturally follow the general ground slope to the south-west.

4.3 Conclusion

Based on provided data, the following conclusions are made:

1. Flood behaviour for proposed and existing conditions are essentially the same because:
    - There are no major changes proposed to the terrain.
    - The proposed layout maintains the major flow paths (flood ways) compared to existing conditions.
    - Although the flood storage for proposed conditions is reduced compared to existing conditions, this seems to impact water levels and inundation depth minimally and within the property boundary only.
2. The proposed development would not impact adjacent watercourse at the south east corner adversely.
3. The adjacent western property is further inundated in proposed conditions – compared to existing conditions - due to the proposed substation. However, the inundation depths are very small and generally below 30mm.
4. The proposed overhead ETL is not anticipated to change existing flood behaviour (flow path and flood levels).

Our recommendations are as follows:

1. A shallow swale (north to south) adjacent to the proposed substation to be provided to mitigate afflux in the neighbouring property.
2. Finished flood level of substation, BESS, O&M buildings and switchyard shall be above 1% AEP flood level plus an appropriate freeboard (generally 300 mm – 500 mm depending on type of the structure).
3. Detailed design will need ensure that PV Panels will have a minimum 300mm freeboard to 1% AEP flood levels.
4. Access road and internal tracks (unsealed roads) should be designed to remain trafficable under 10% AEP design storm event to allow required access to and maintenance of solar panels and PCUs, etc.
5. Further flood modelling is required in a later design stage to incorporate civil and drainage design.

5 References

Babister, M., Trim, A., Testoni, I. & Retallick, M. 2016. The Australian Rainfall and Runoff Datahub, 37th Hydrology and Water Resources Symposium Queenstown NZ

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Bureau of Meteorology website: www.bom.gov.au.

Chow V.T., 1959. *Open Channel Hydraulics*. McGraw Hill, New York

Appendix A - Hydraulic Data Inputs

Table A-1 Intensity-Frequency-Duration Design Rainfall Depths (mm) for the Daroobalgie Solar Farm site (BoM Website)

Duration	Annual Exceedance Probability (AEP) – Rainfall Intensity (mm)						
	63.2% AEP	50% AEP	20% AEP	10% AEP	5 % AEP	2 % AEP	1 % AEP
15 mins	10.6	12.1	16.9	20.3	23.8	28.6	32.4
30 mins	14.2	16.2	22.8	27.4	32.1	38.6	43.8
45 mins	16.4	18.8	26.4	31.8	37.3	44.8	50.8
1 hour	18.1	20.7	29.1	35	41.1	49.3	55.8
2 hours	22.5	25.7	36	43.3	50.6	60.5	68.3
3 hours	25.4	29	40.5	48.6	56.6	67.5	76
4.5 hours	28.7	32.7	45.5	54.3	63.1	75	84.3
6 hours	31.3	35.6	49.3	58.7	68.1	80.8	90.6
9 Hours	35.3	40.1	55.2	65.6	75.8	89.7	100
12 hours	38.4	43.5	59.7	70.9	81.8	96.6	108
18hr	43.0	48.7	66.6	78.9	91	107	120
24hr	46.4	52.5	71.8	85.0	98.0	115	129

Appendix B - Site Visit Photos (30/04/2020)

Based on measured 24hr rainfall of 42.2mm and 11.5mm for that day and the following day, it may be estimated that site visit photos represent a 63.2% AEP to 50% AEP storm event. Further hydrological and rainfall analysis are required to confirm this.


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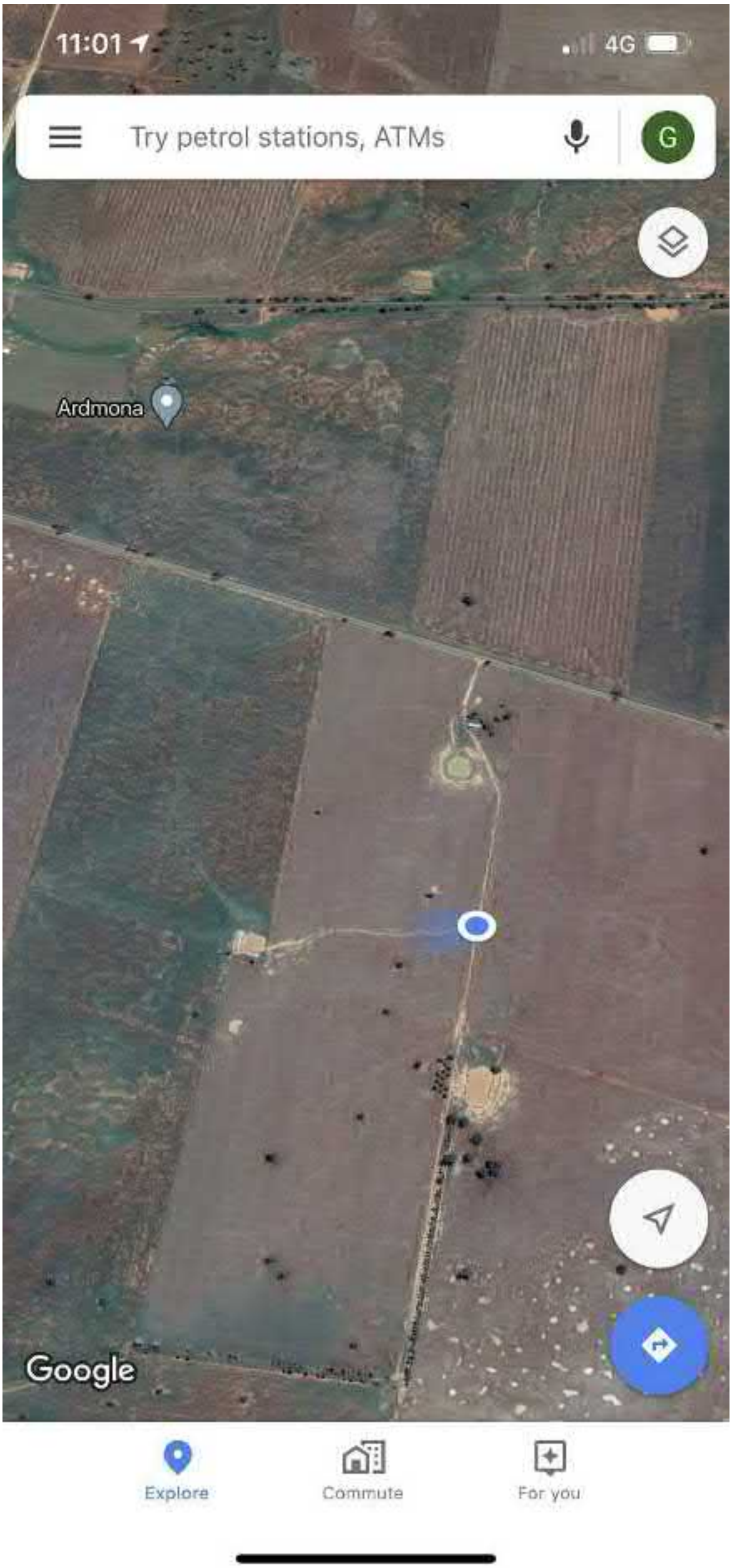
4G
Try petrol stations, ATMs
G
Ardmona
Google
Explore
Commute
For you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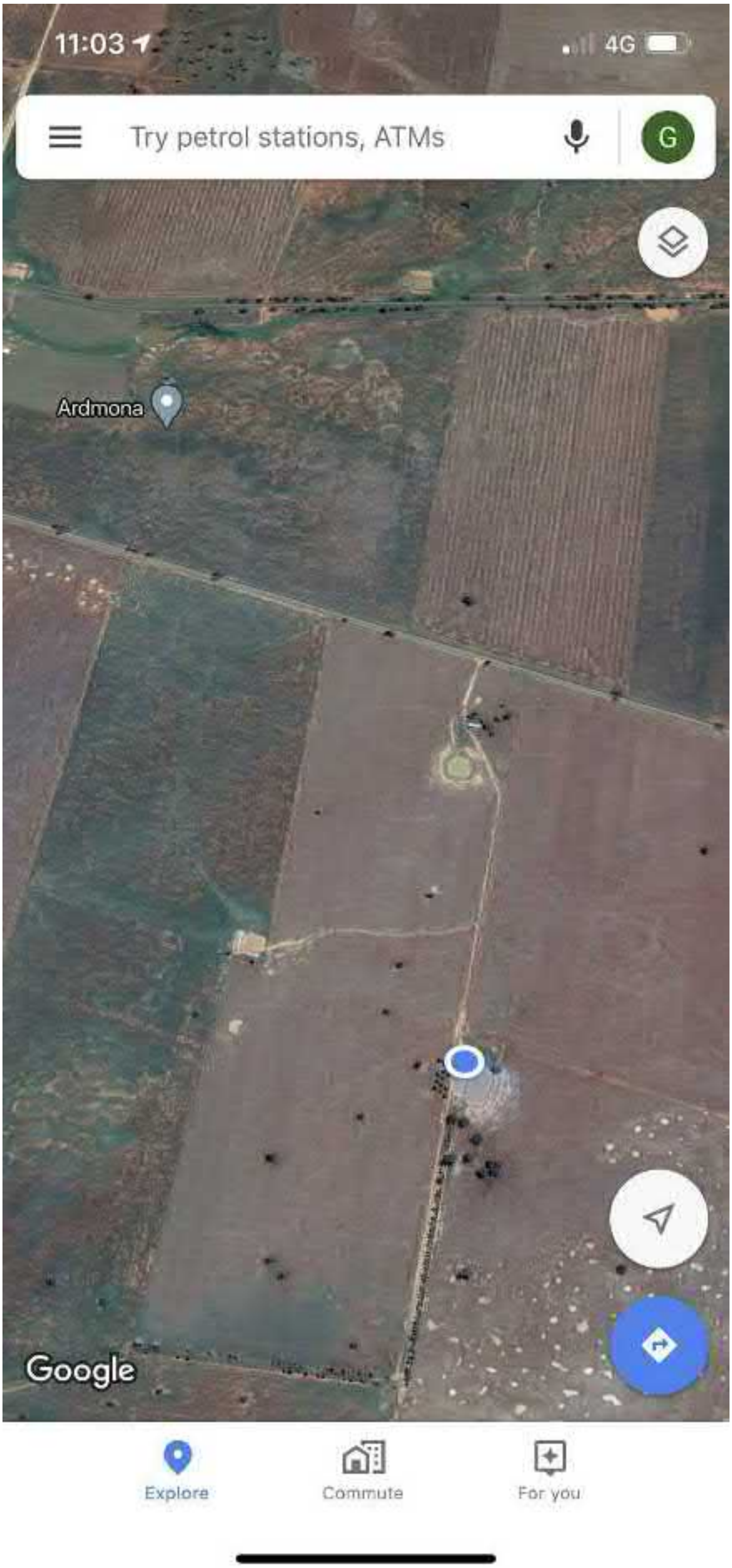
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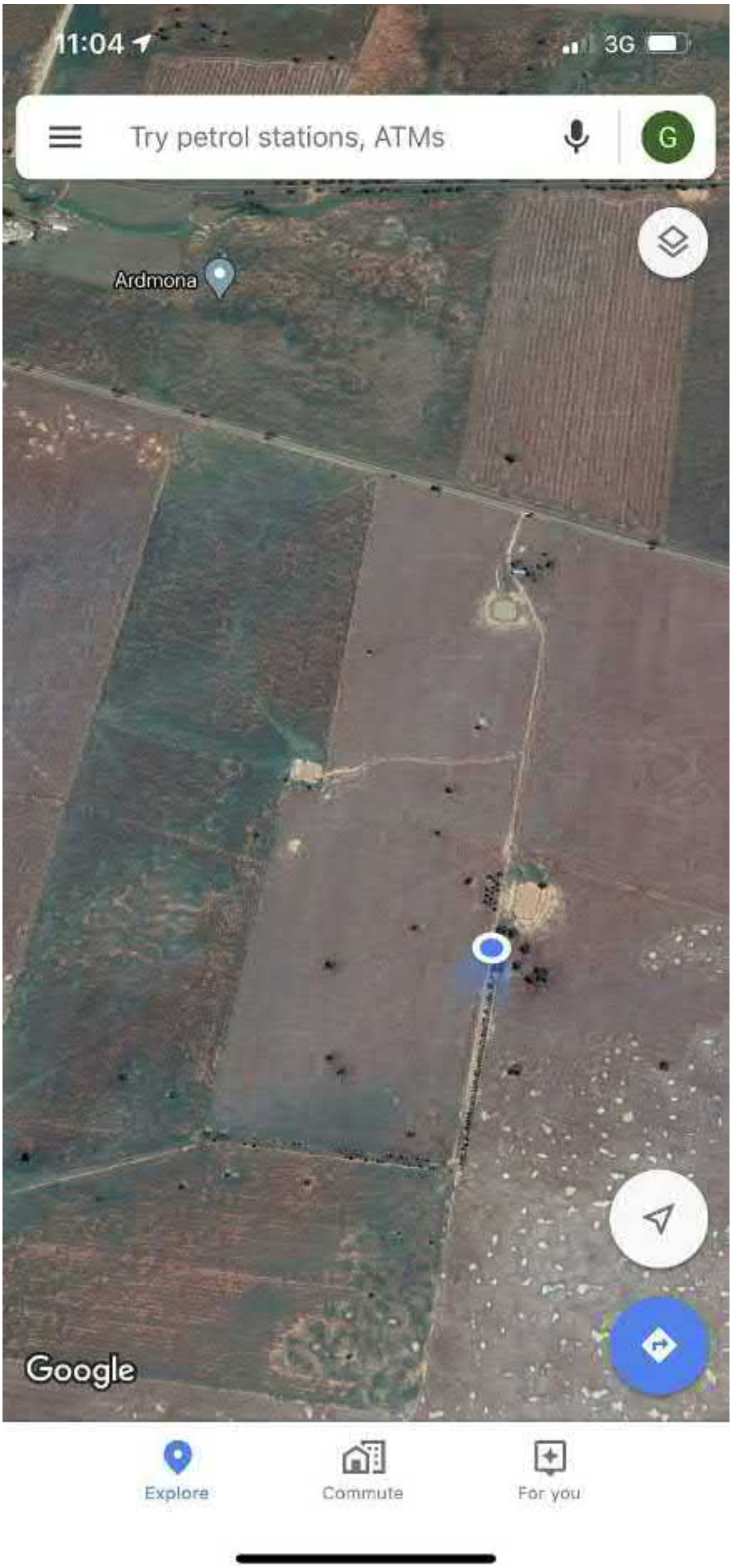
For you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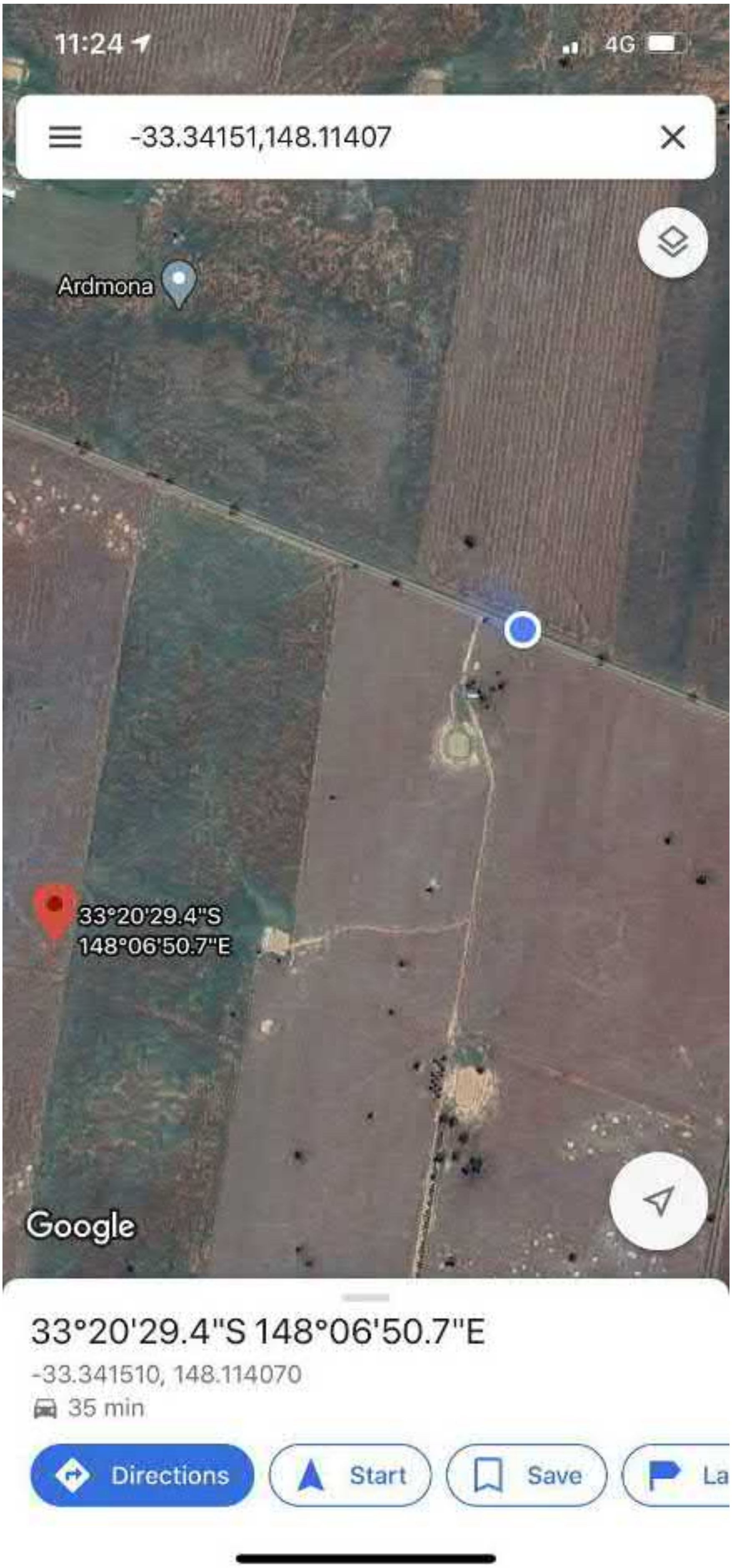
G
Ardmona
Google
Explore
Commute
For you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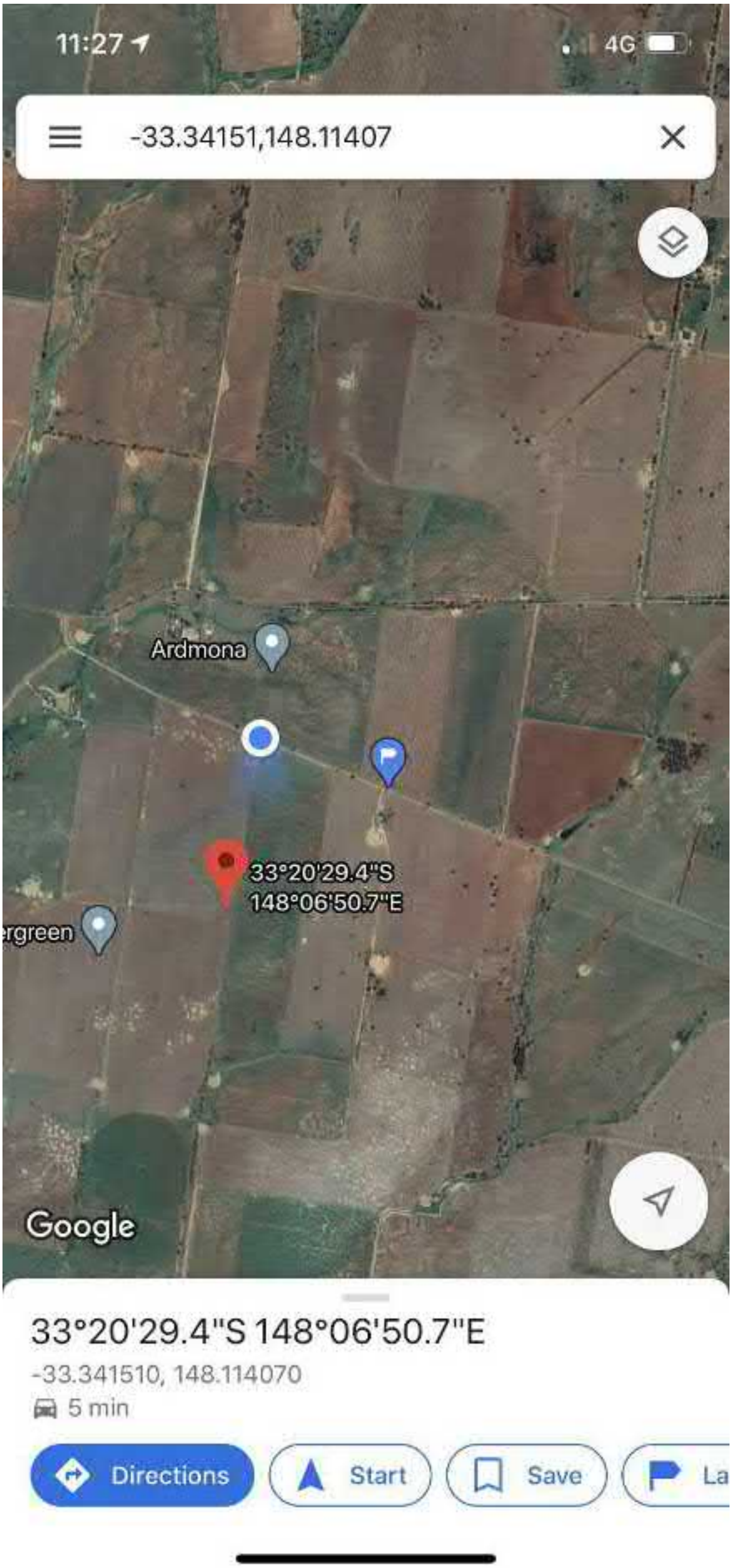
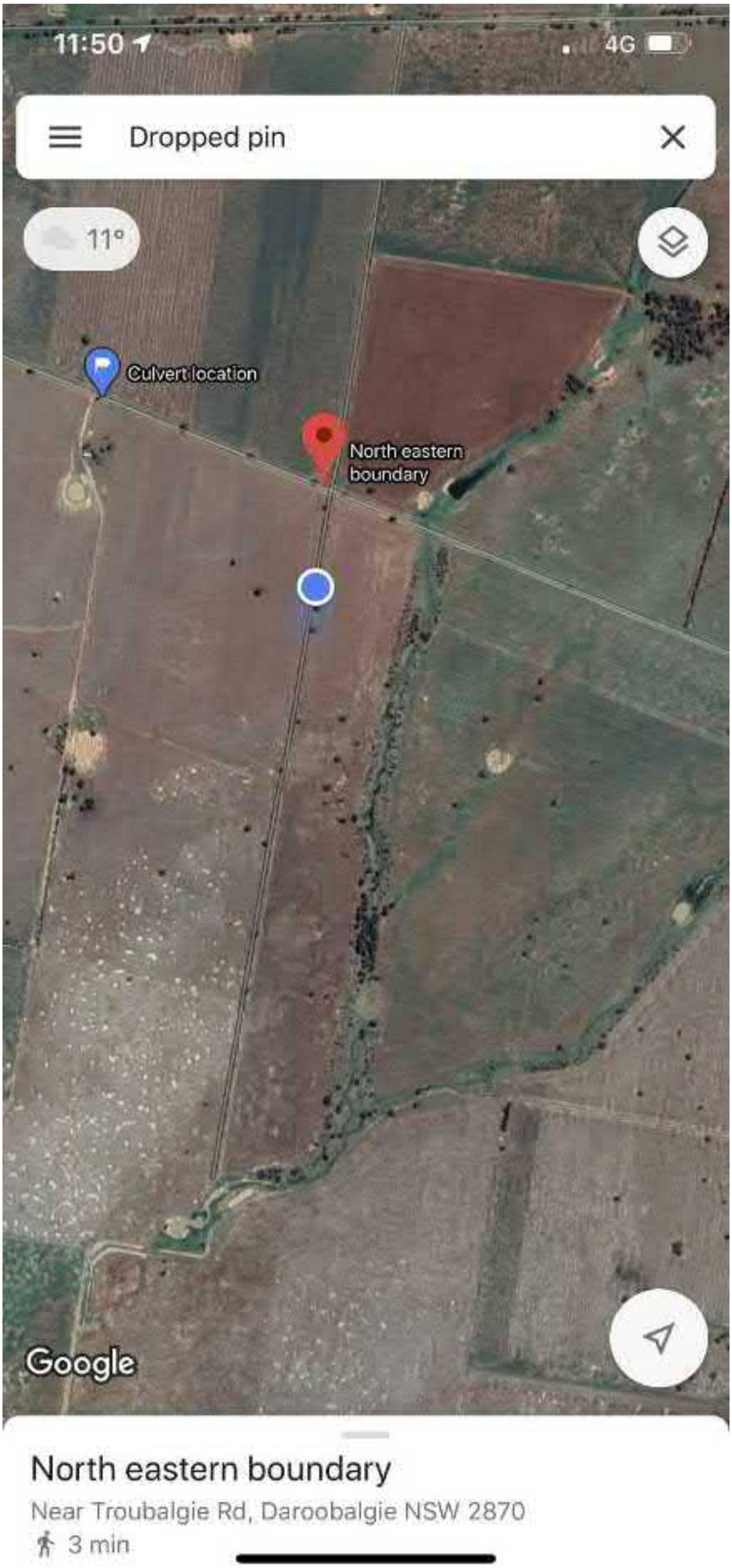
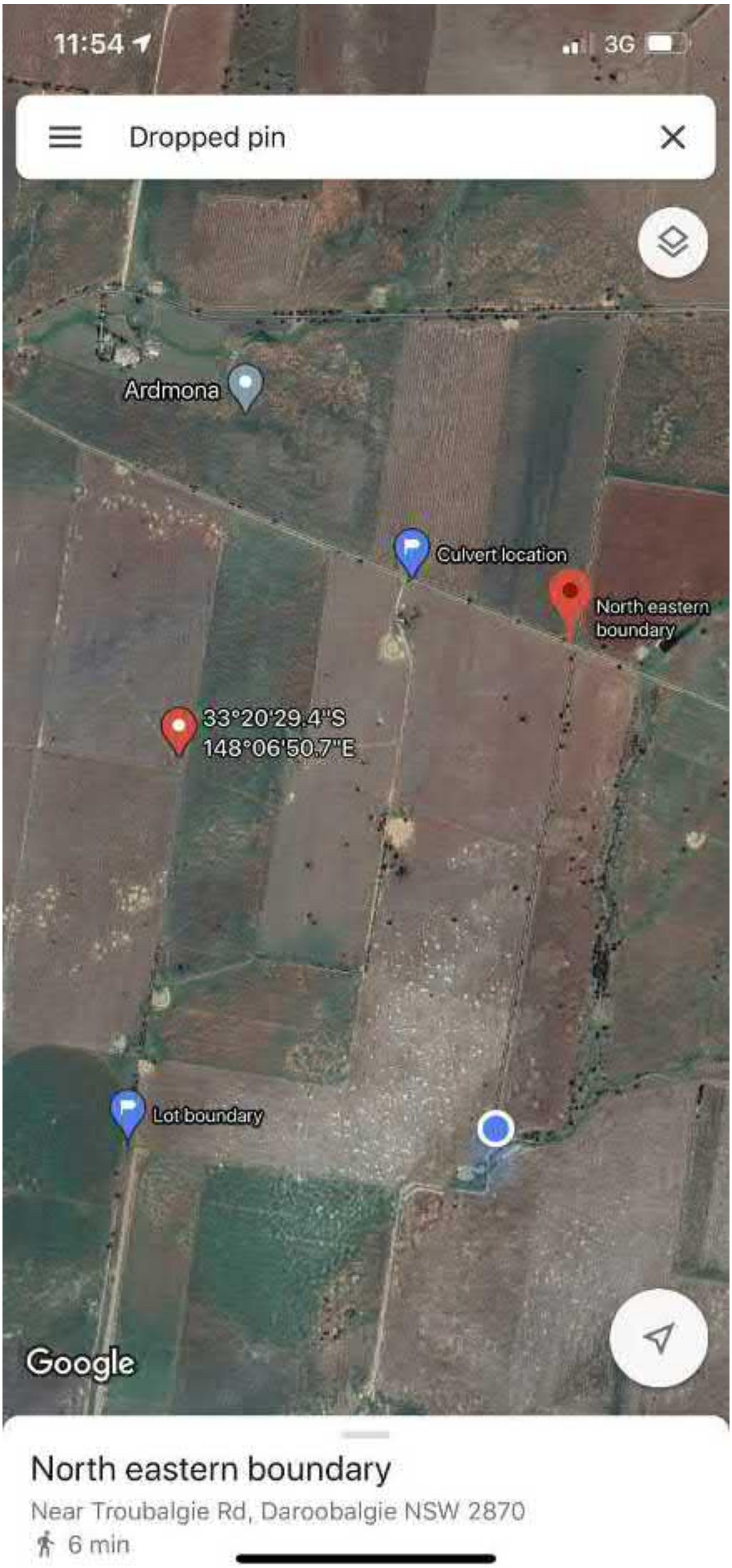
-33.34151,148.11407
Ardmona
33°20'29.4"S
148°06'50.7"E
Google
33°20'29.4"S 148°06'50.7"E
-33.341510, 148.114070
35 min
Directions
Start
Save
La


11:27
4G
-33.34151,148.11407
Ardmona
33°20'29.4"S
148°06'50.7"E
rgreen
Google
33°20'29.4"S 148°06'50.7"E
-33.341510, 148.114070
5 min
Directions
Start
Save
La


Google
200 ft
100 m


11:50
4G
Dropped pin
11°
Culvert location
North eastern boundary
Google
North eastern boundary
Near Troubalgie Rd, Daroobalgie NSW 2870
3 min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Ardmona
Culvert location
North eastern boundary
33°20'29.4"S
148°06'50.7"E
Lot boundary
Google
North eastern boundary
Near Troubalgie Rd, Daroobalgie NSW 2870
6 min

Appendix C - Existing Case Flood Maps

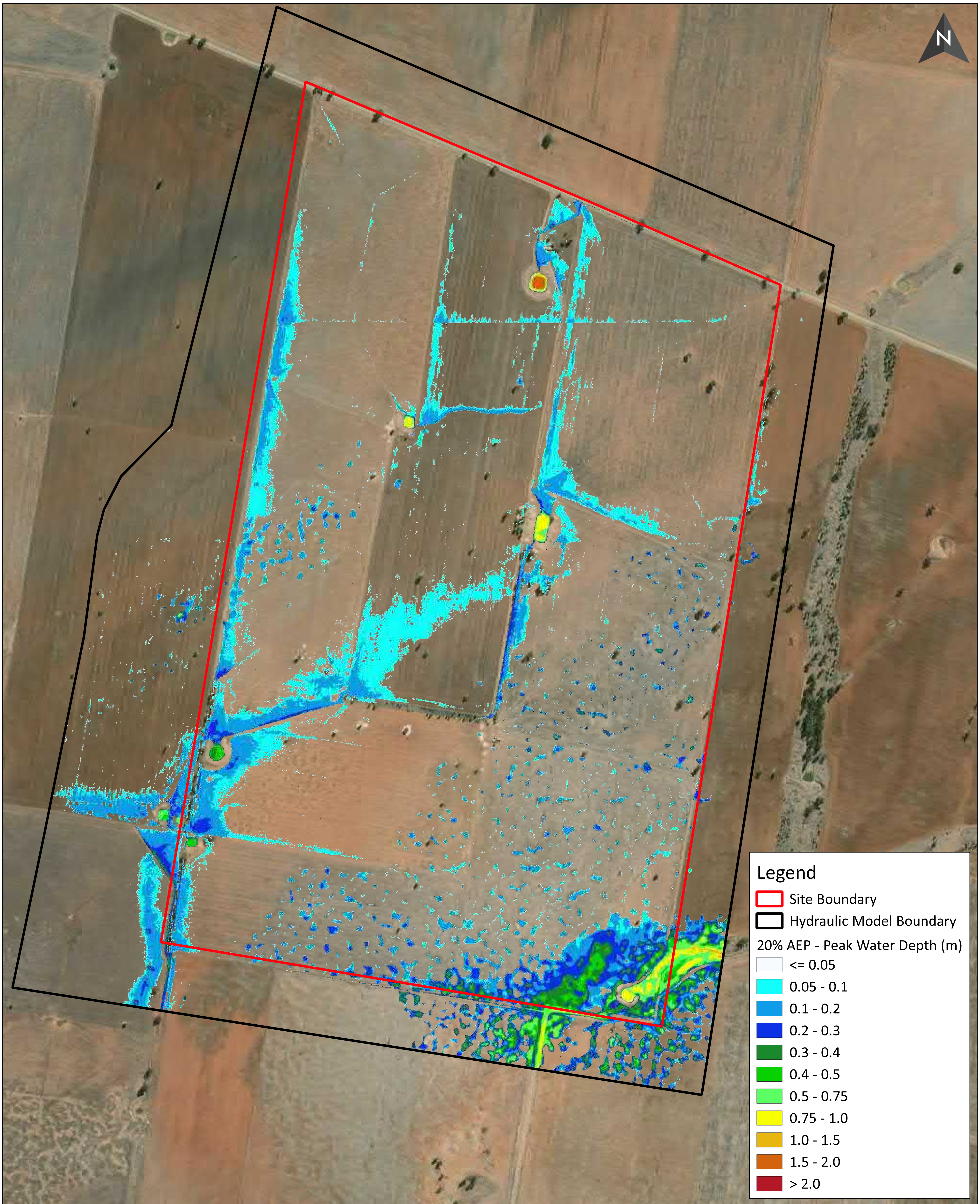

FIGURE TITLE	Peak Water Depth - 20% AEP Design Flood	DATE	29-10-2020
DRAWING NO.	C1.1	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

SMEC
Member of the Surbana Jurong Group
SMEC AUSTRALIA PTY LTD
ABN 47 065 475 149

CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

Filepath: I:\projects\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - OG.qgz

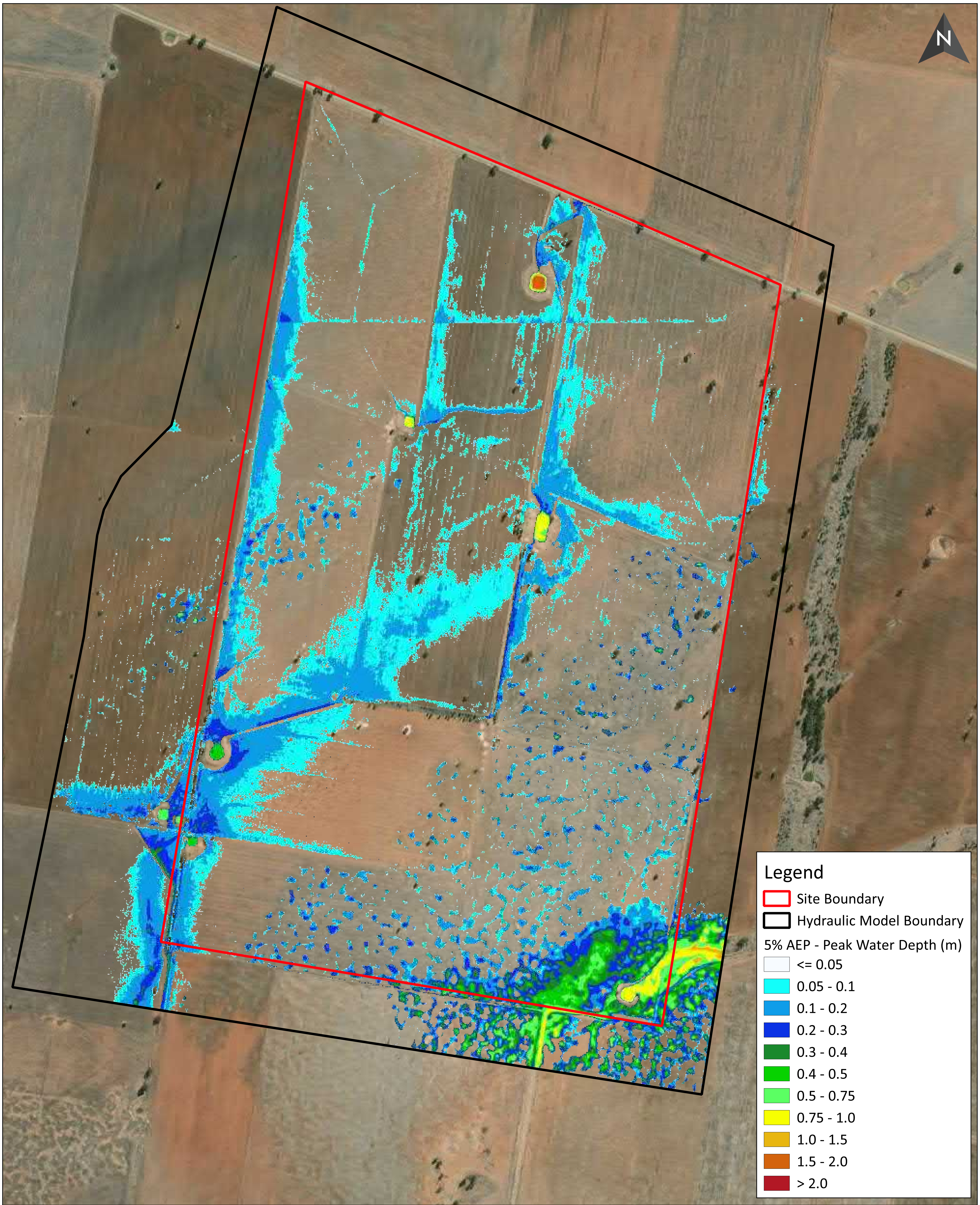

FIGURE TITLE	Peak Water Depth - 5% AEP Design Flood	DATE	29-10-2020
DRAWING NO.	C1.2	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

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CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

Filepath: I:\projects\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - OG.qgz

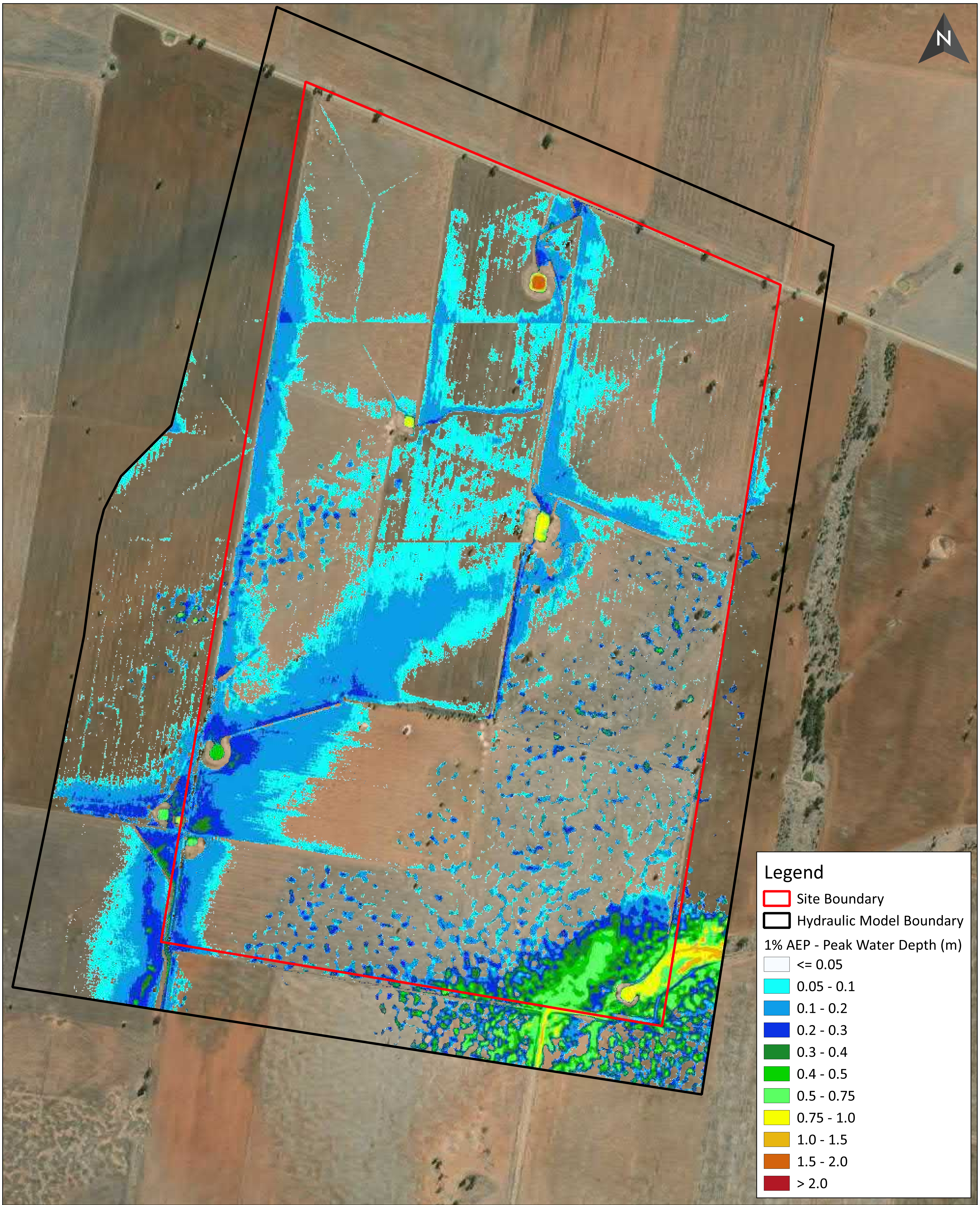

FIGURE TITLE	Peak Water Depth - 1% AEP Design Flood	DATE	29-10-2020
DRAWING NO.	C1.3	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

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CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

Filepath: I:\projects\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - OG.qgz

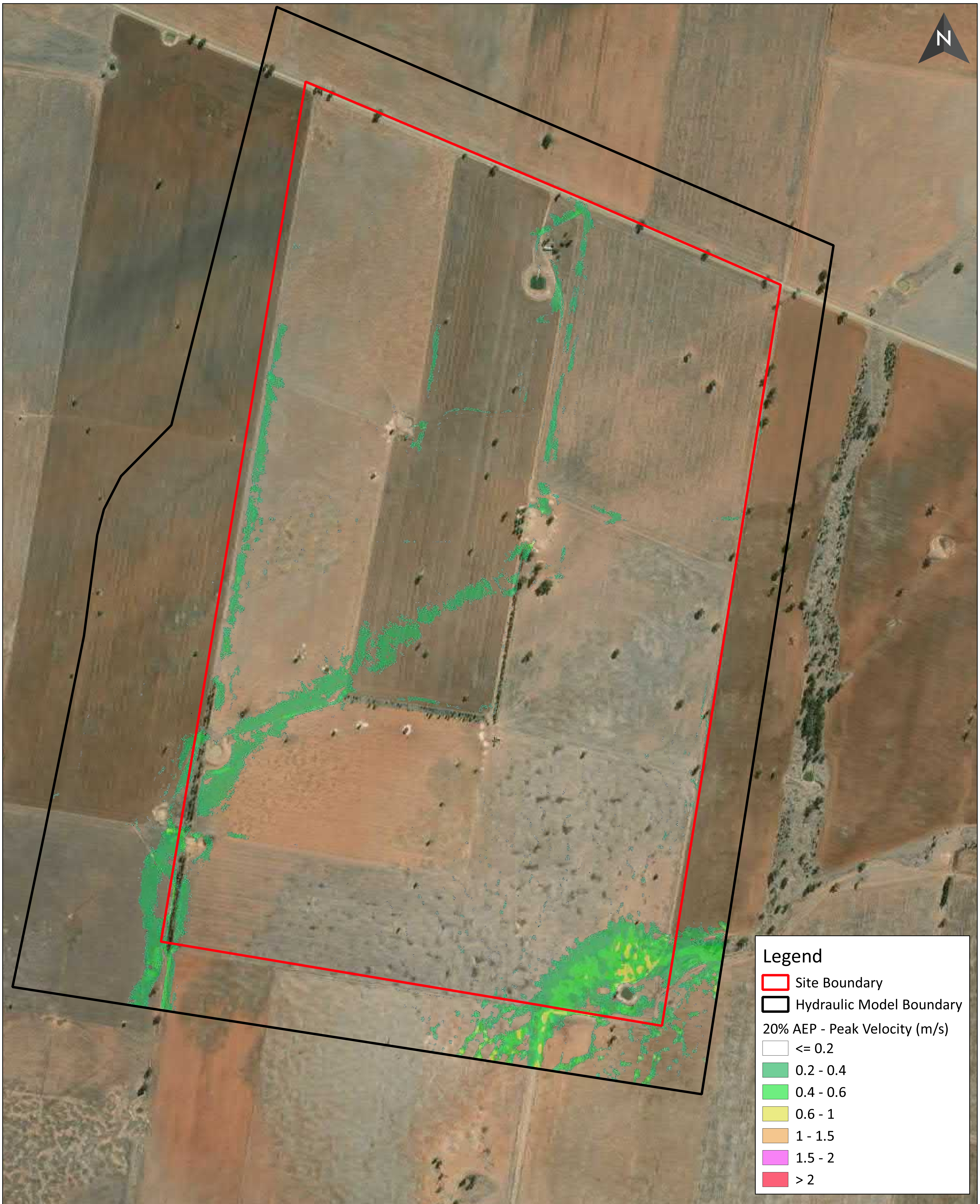

FIGURE TITLE	Peak Velocity - 20% AEP Design Flood	DATE	29-10-2020
DRAWING NO.	C2.1	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

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CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

Filepath: I:\projects\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - OG.qgz

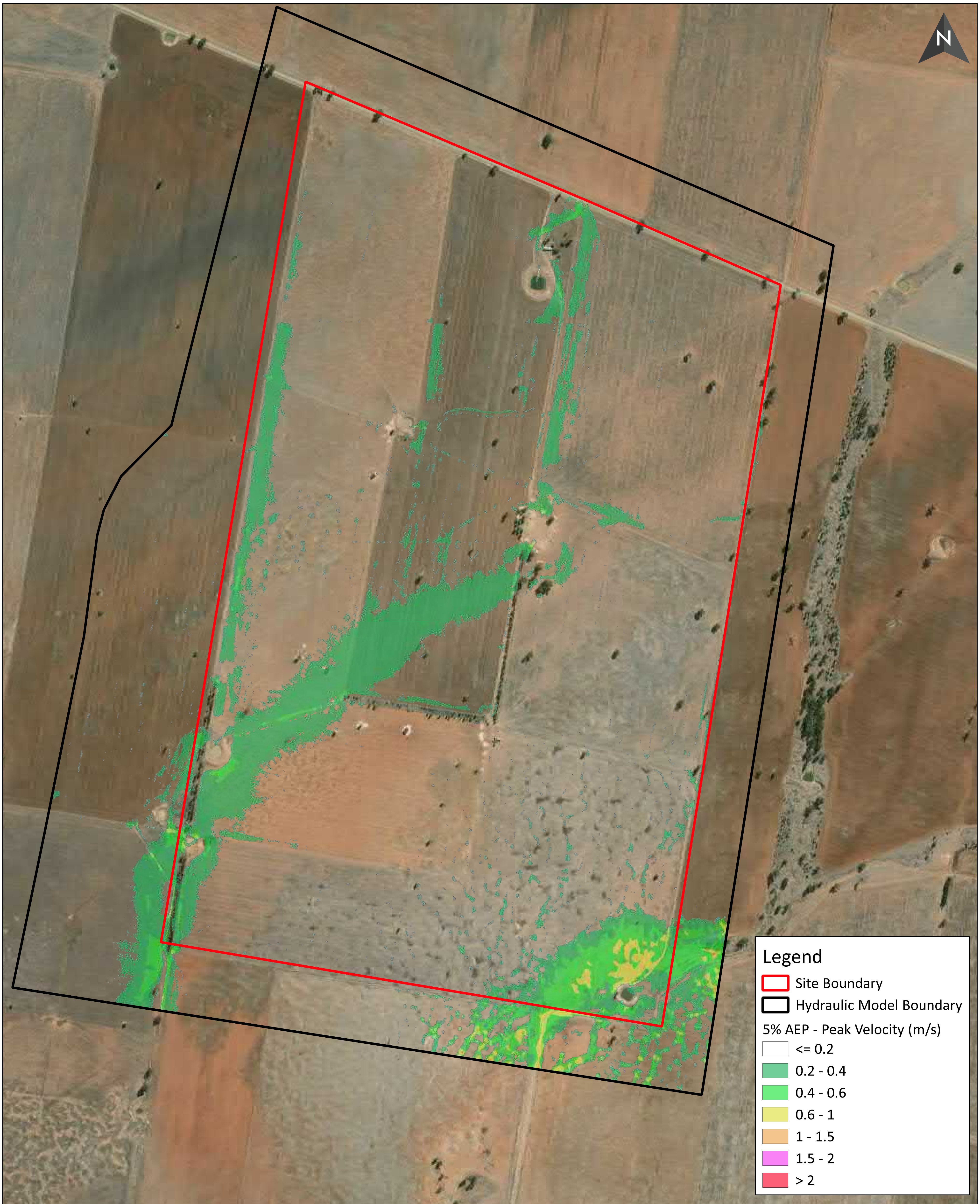

FIGURE TITLE	Peak Velocity - 5% AEP Design Flood	DATE	29-10-2020
DRAWING NO.	C2.2	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

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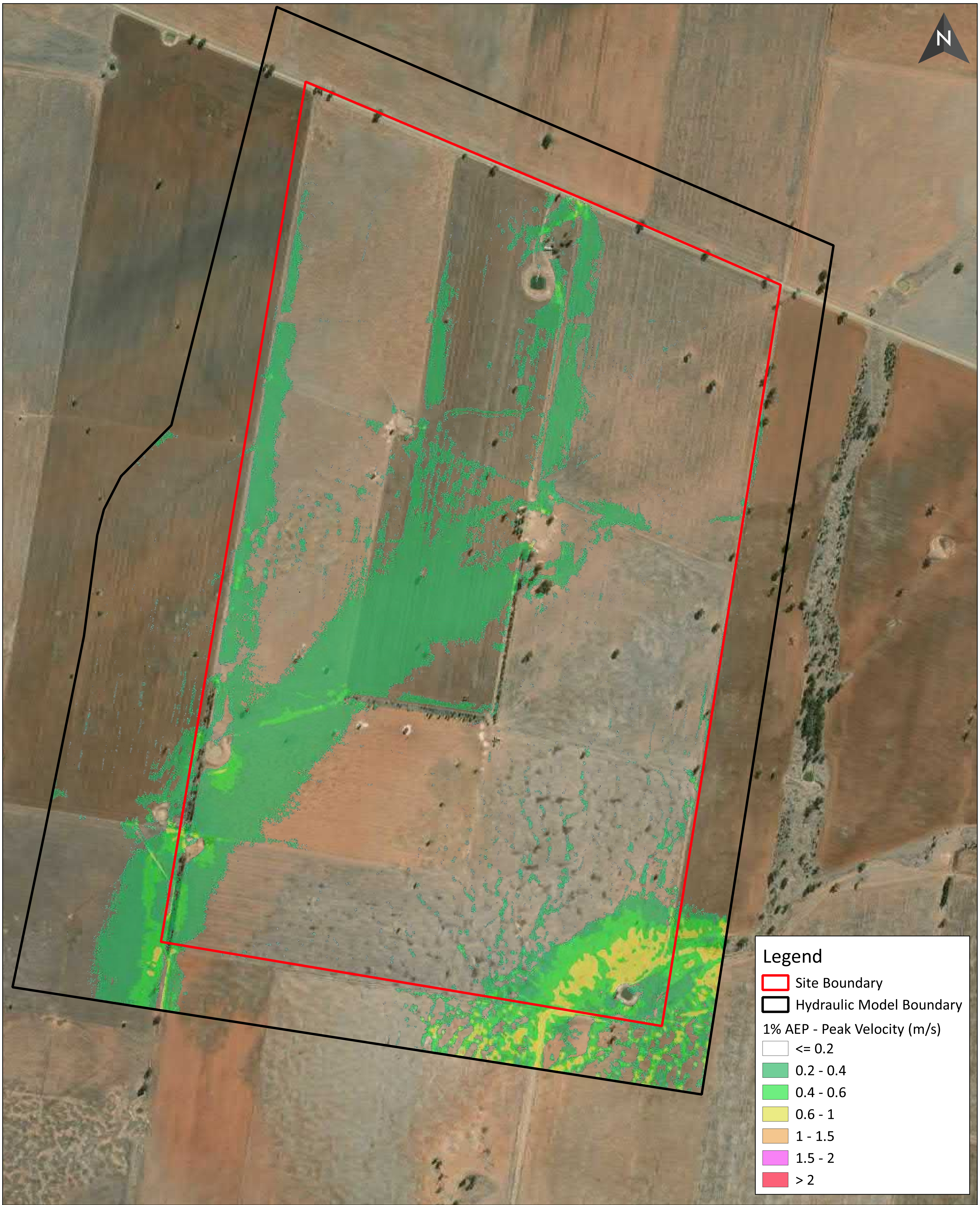
CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

Filepath: I:\projects\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - OG.qgz



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PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm
CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

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0 250 500 750 m

PAGE SIZE A3

Filepath: I:\projects\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - OG.qgz

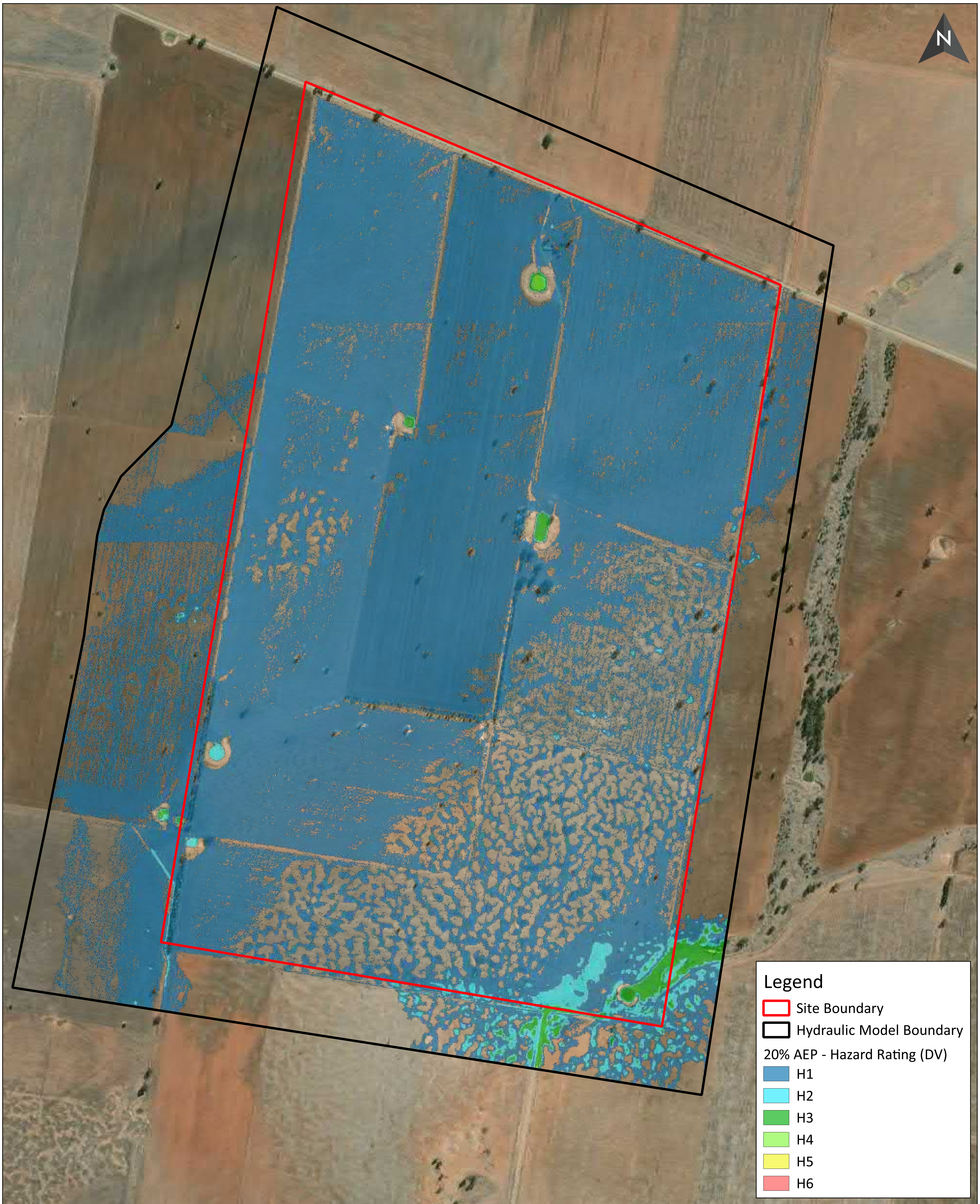

FIGURE TITLE	Hazard Rating - 20% AEP Design Flood	DATE	29-10-2020
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PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

SMEC
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SMEC AUSTRALIA PTY LTD
ABN 47 065 475 149

CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

Filepath: I:\projects\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - OG.qgz

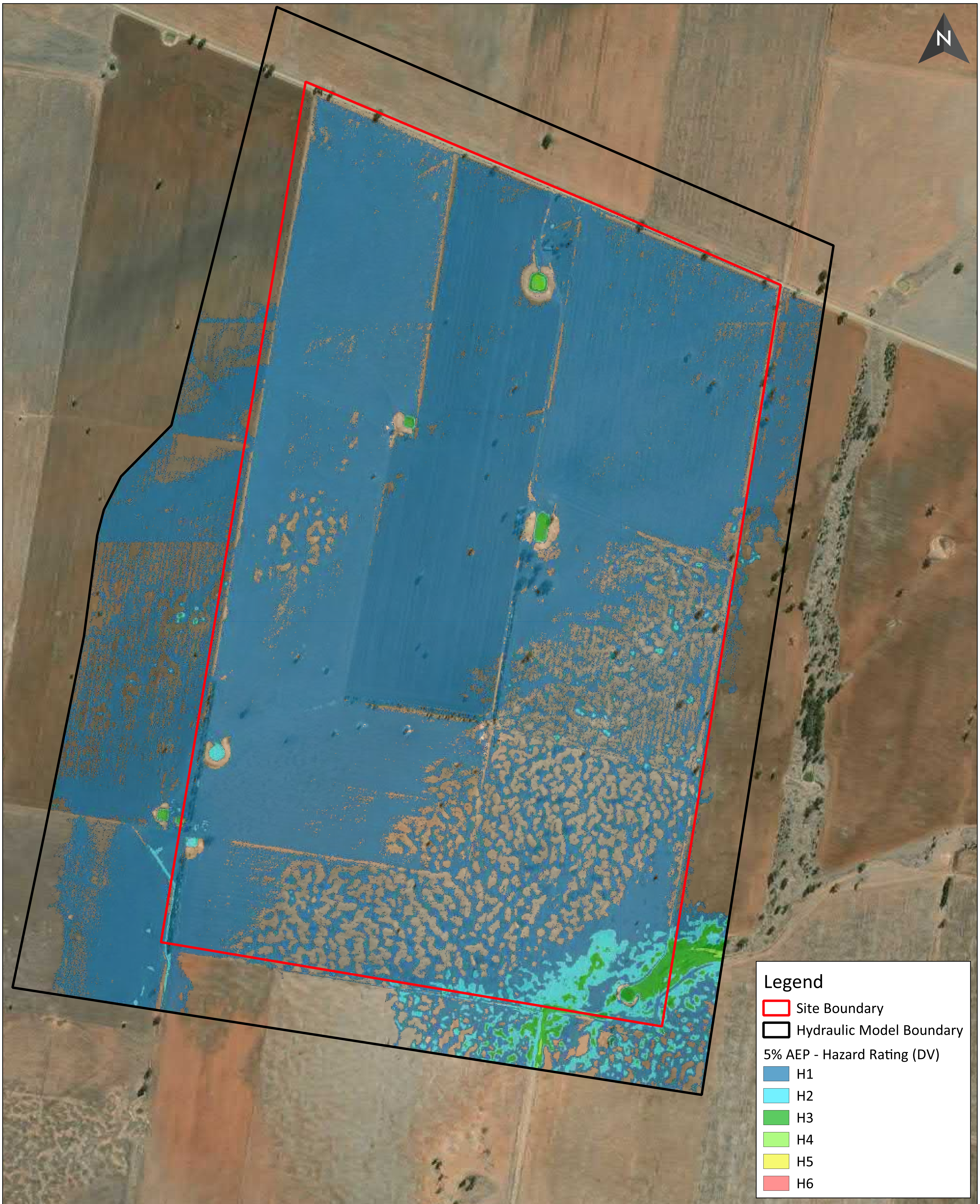

FIGURE TITLE	Hazard Rating - 5% AEP Design Flood	DATE	29-10-2020
DRAWING NO.	C3.2	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

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CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

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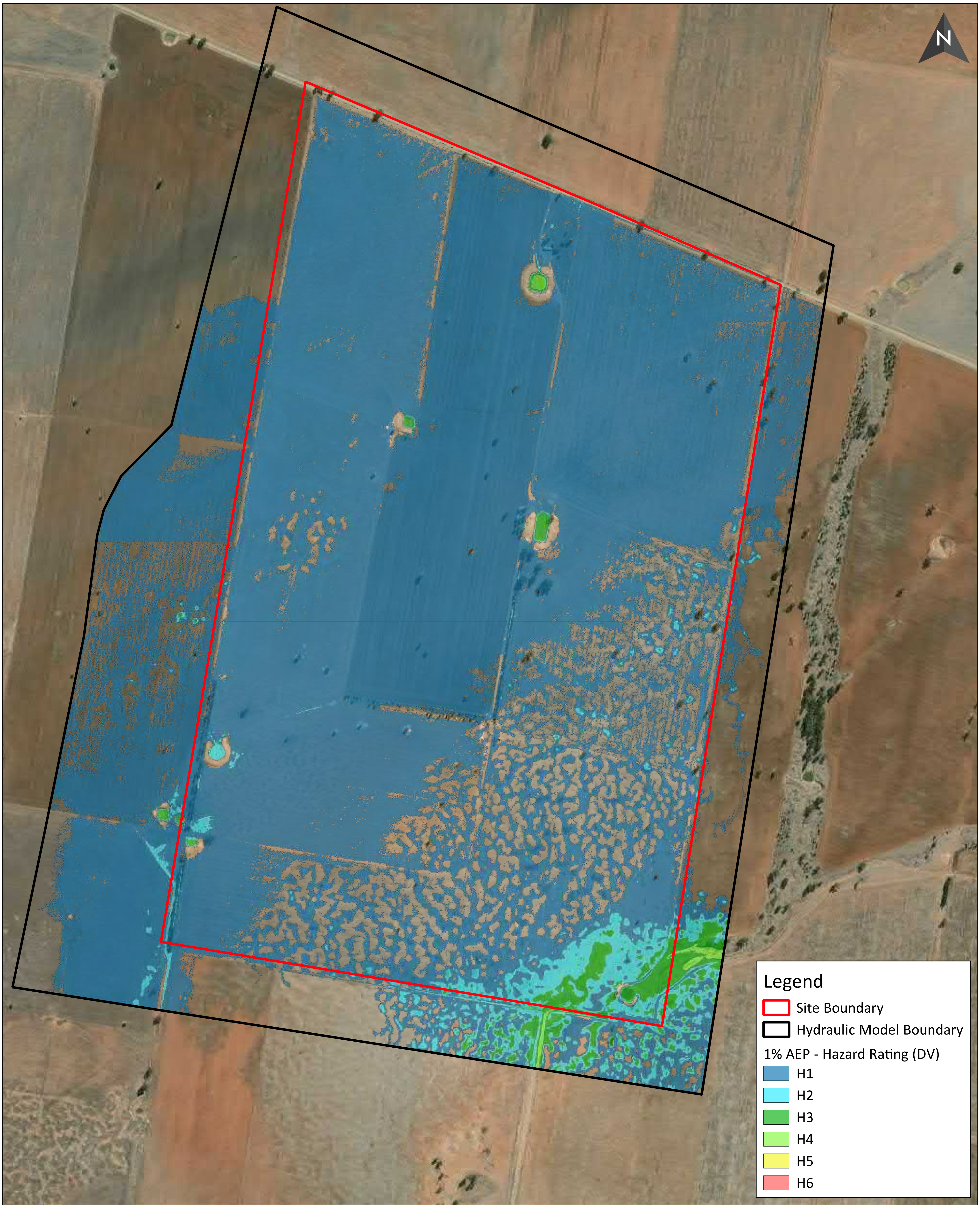

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DRAWING NO.	C3.3	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

SMEC
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ABN 47 065 475 149

CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

Filepath: I:\projects\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - OG.qgz

Appendix D - Proposed Case Flood Maps

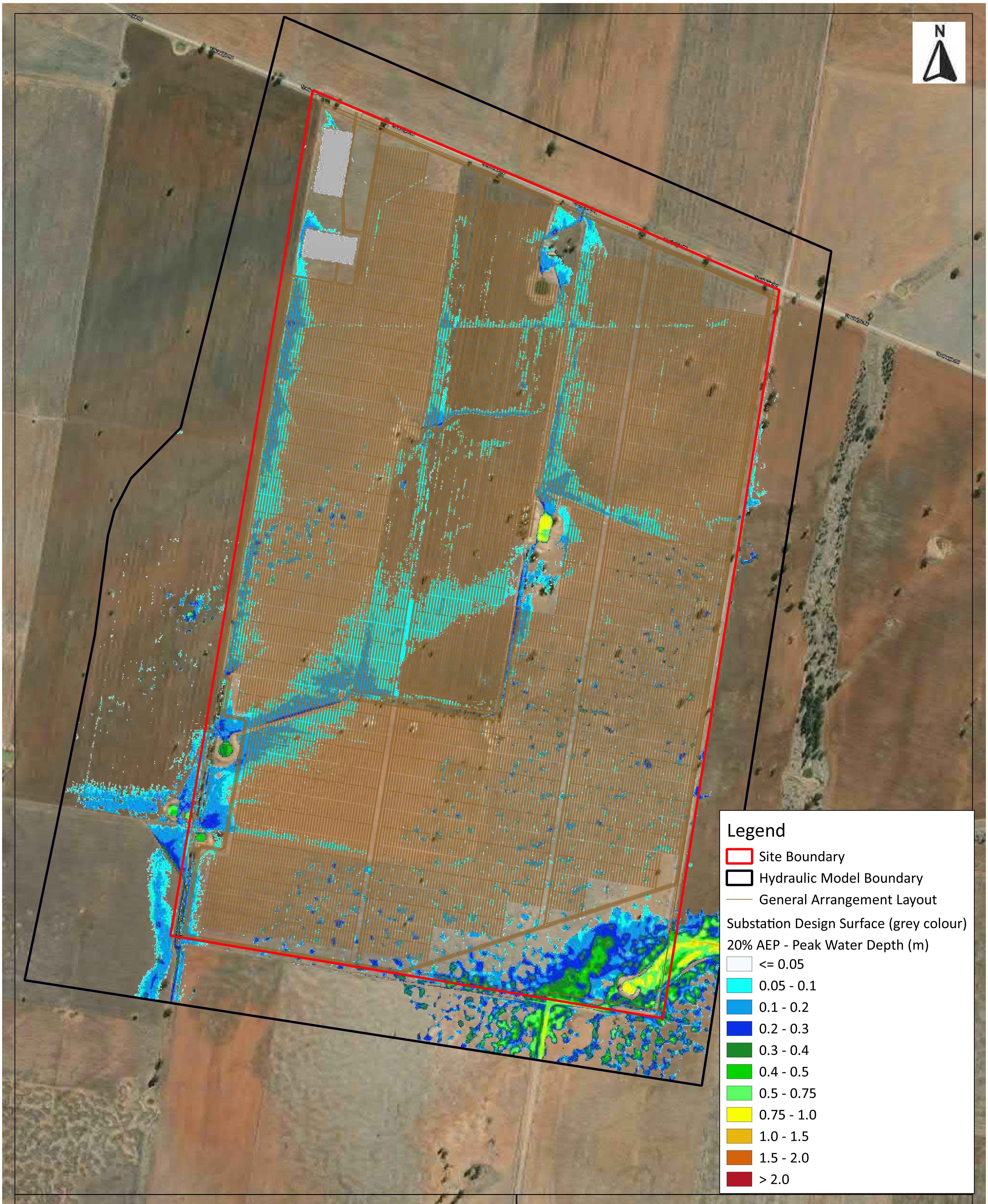

FIGURE TITLE 20% AEP Peak Flood Depth - Proposed Conditions DATE 16-07-2021

DRAWING NO. D1.1 SCALE 1:10,000 at A3

PROJECT NO. 30012765 PROJECT TITLE Daroobalgie Solar Farm

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

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0 250 500 750 m

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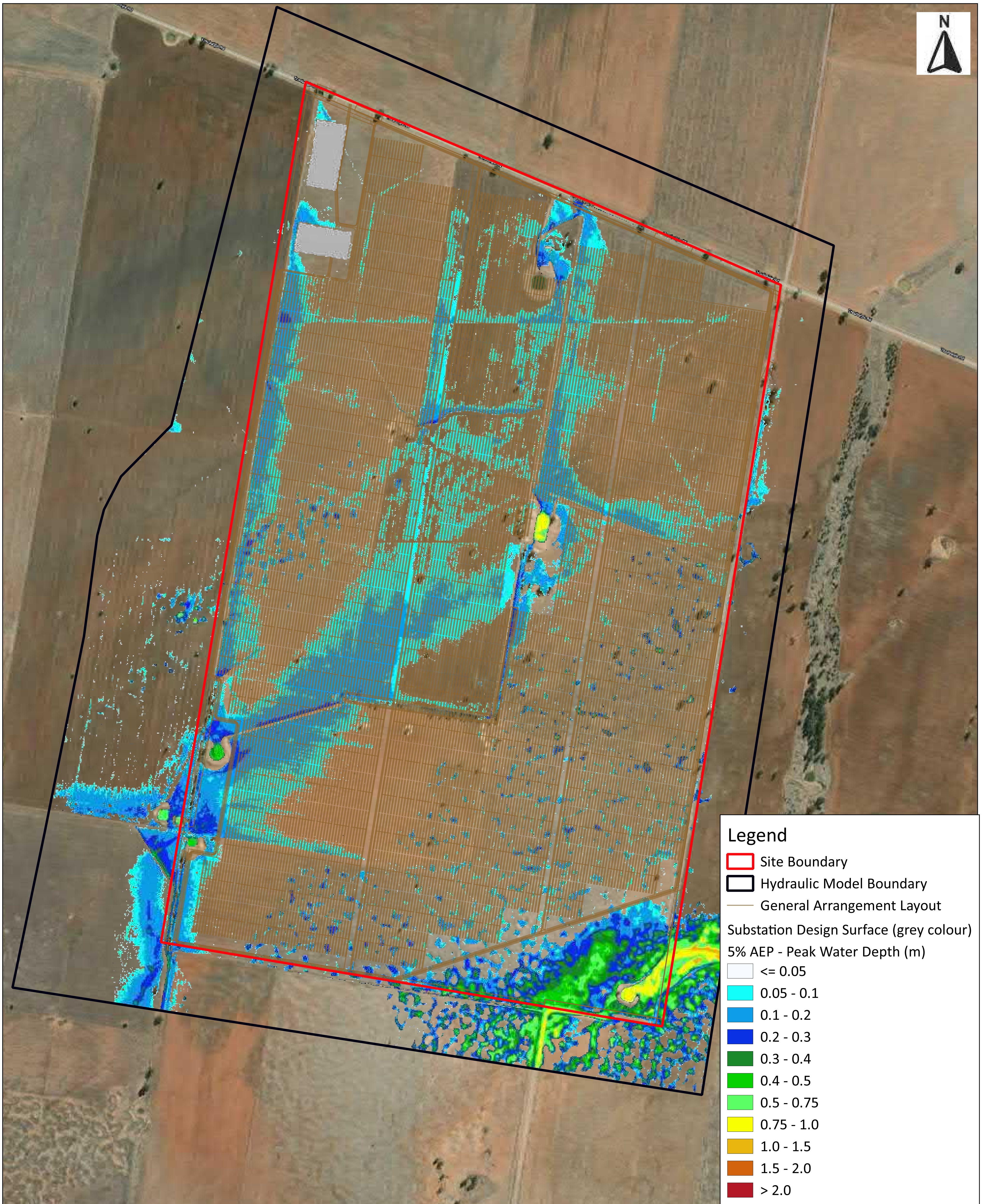

FIGURE TITLE	5% AEP Peak Flood Depth - Proposed Conditions	DATE	16-07-2021
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PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

SMEC
Member of the Surbana Jurong Group
ABN 47 065 475 149

CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

Filepath: X:\Projects\300127\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - GN__PR.qgz

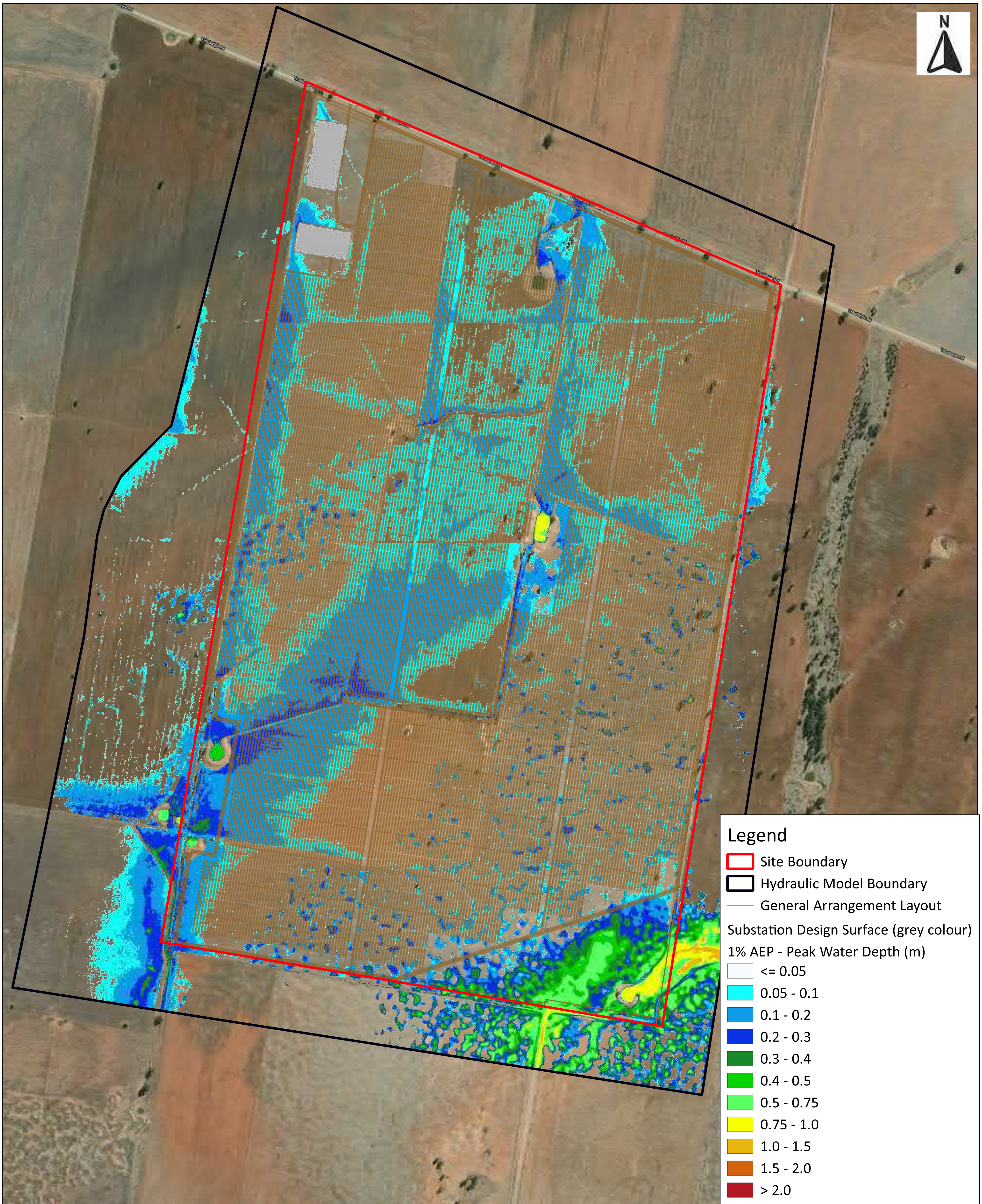

FIGURE TITLE	1% AEP Peak Flood Depth - Proposed Conditions	DATE	16-07-2021
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PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm
CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

SMEC
Member of the Surbana Jurong Group
ABN 47 065 475 149

0 250 500 750 m

PAGE SIZE A3

Filepath: X:\Projects\300127\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - GN__PR.qgz

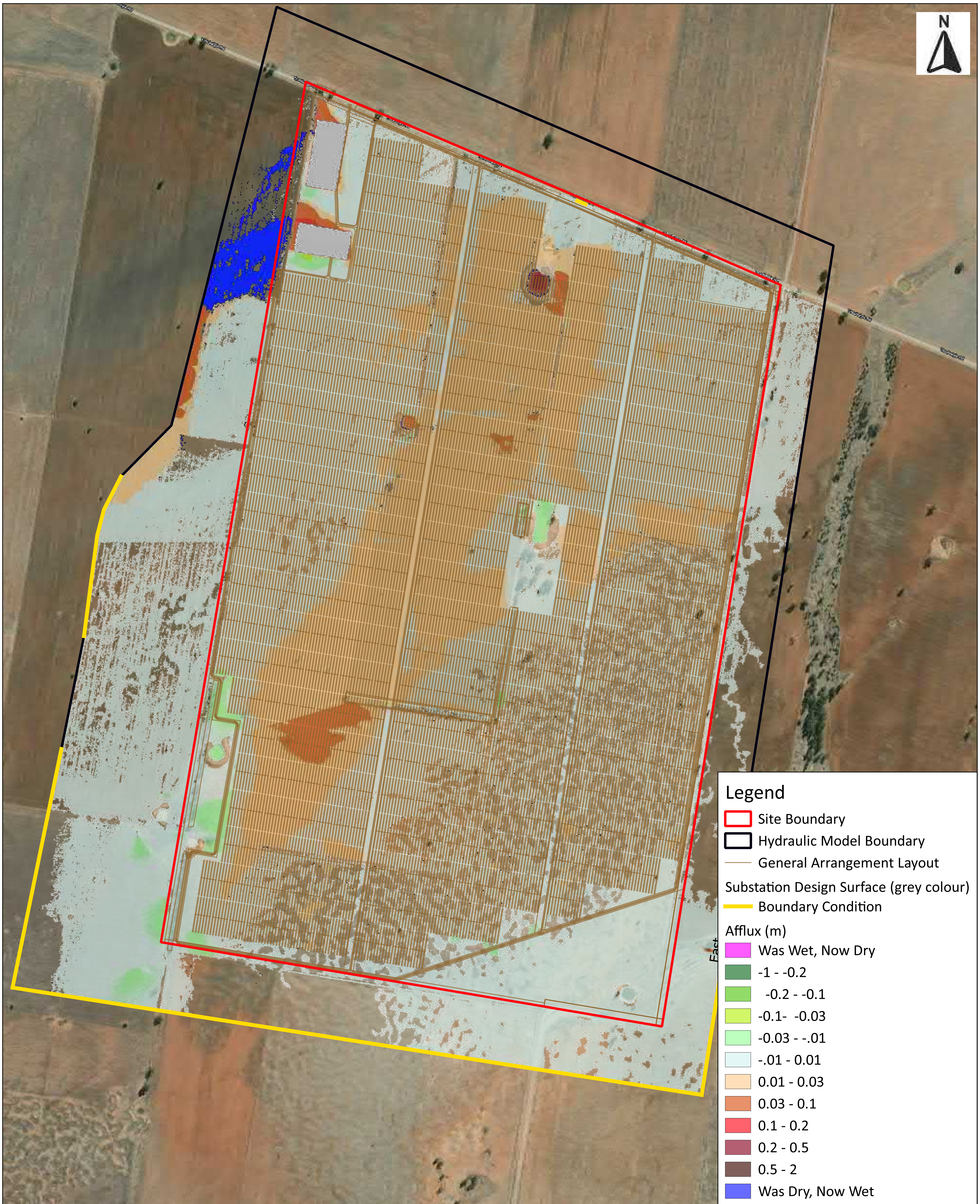

FIGURE TITLE	1% AEP Afflux (Increase in Flood Levels)	DATE	16-07-2021
DRAWING NO.	D1.4	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

SMEC
Member of the Surbana Jurong Group
ABN 47 065 475 149

CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

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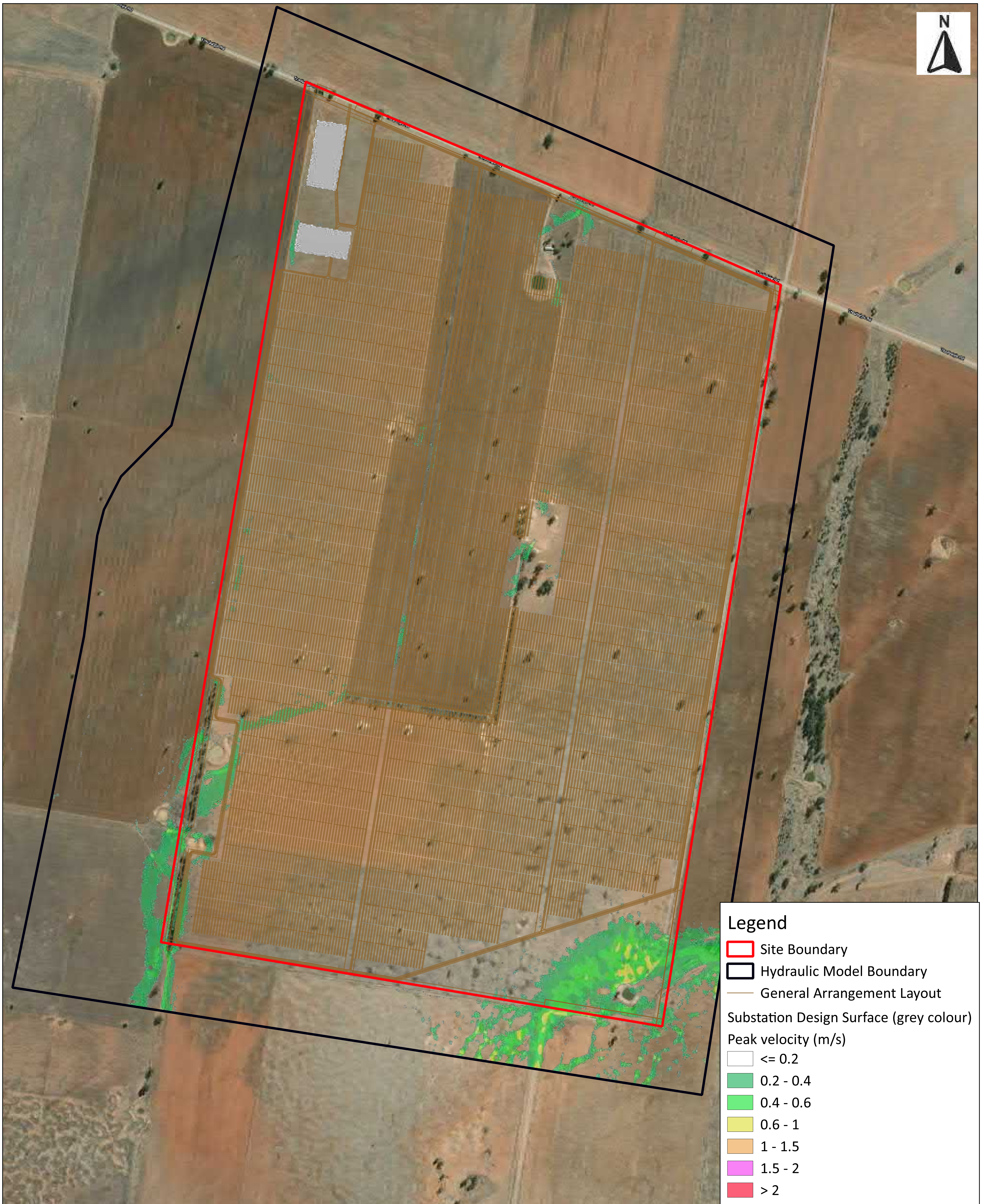

FIGURE TITLE	20% AEP Peak Velocity - Proposed Conditions	DATE	18-07-2021
DRAWING NO.	D2.1	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

SMEC
Member of the Surbana Jurong Group
ABN 47 065 475 149

CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

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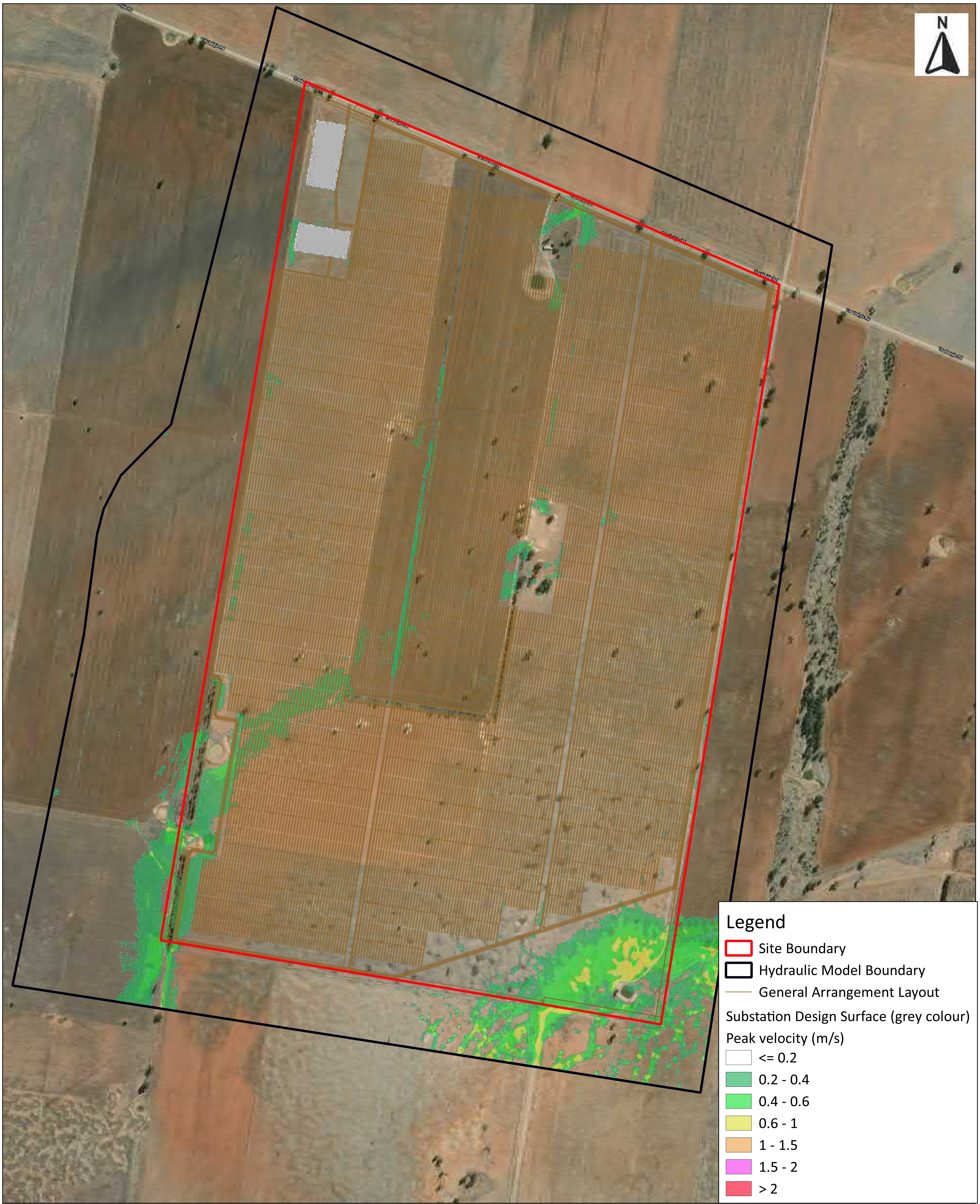

FIGURE TITLE	5% AEP Peak Velocity - Proposed Conditions	DATE	18-07-2021
DRAWING NO.	D2.2	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

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CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

0 250 500 750 m

PAGE SIZE A3

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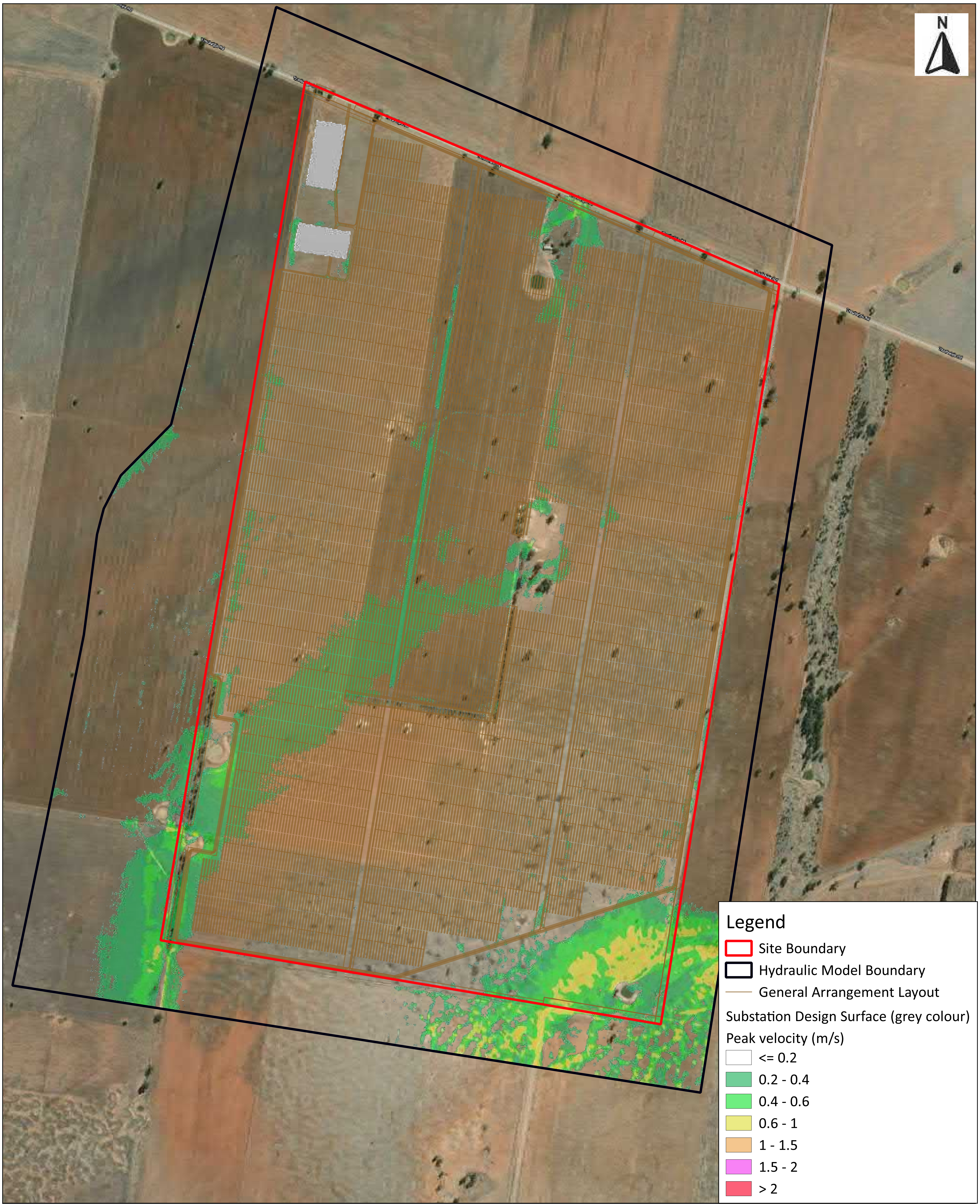


Legend

- Site Boundary
- Hydraulic Model Boundary
- General Arrangement Layout

Substation Design Surface (grey colour)

Peak velocity (m/s)

- <= 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1
- 1 - 1.5
- 1.5 - 2
- > 2

FIGURE TITLE	1% AEP Peak Velocity - Proposed Conditions	DATE	18-07-2021
DRAWING NO.	D2.3	SCALE	1:10,000 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm

SMEC
Member of the Surbana Jurong Group
ABN 47 065 475 149

CREATED BY	G.NAGHIB O.GLIXMAN	SOURCES	ESRI (PROJ: GDA1994 MGA Zone 55)

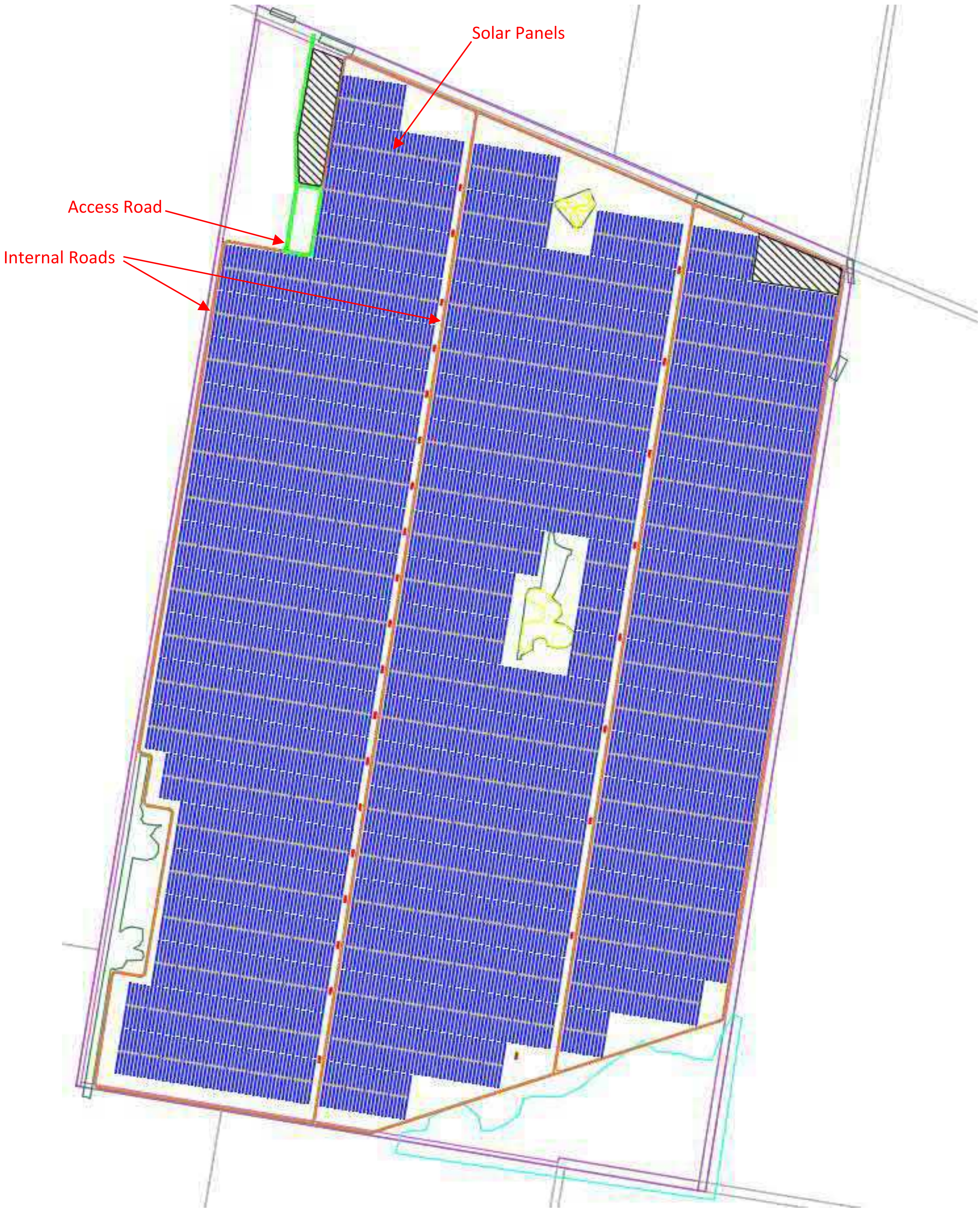
0 250 500 750 m

PAGE SIZE A3

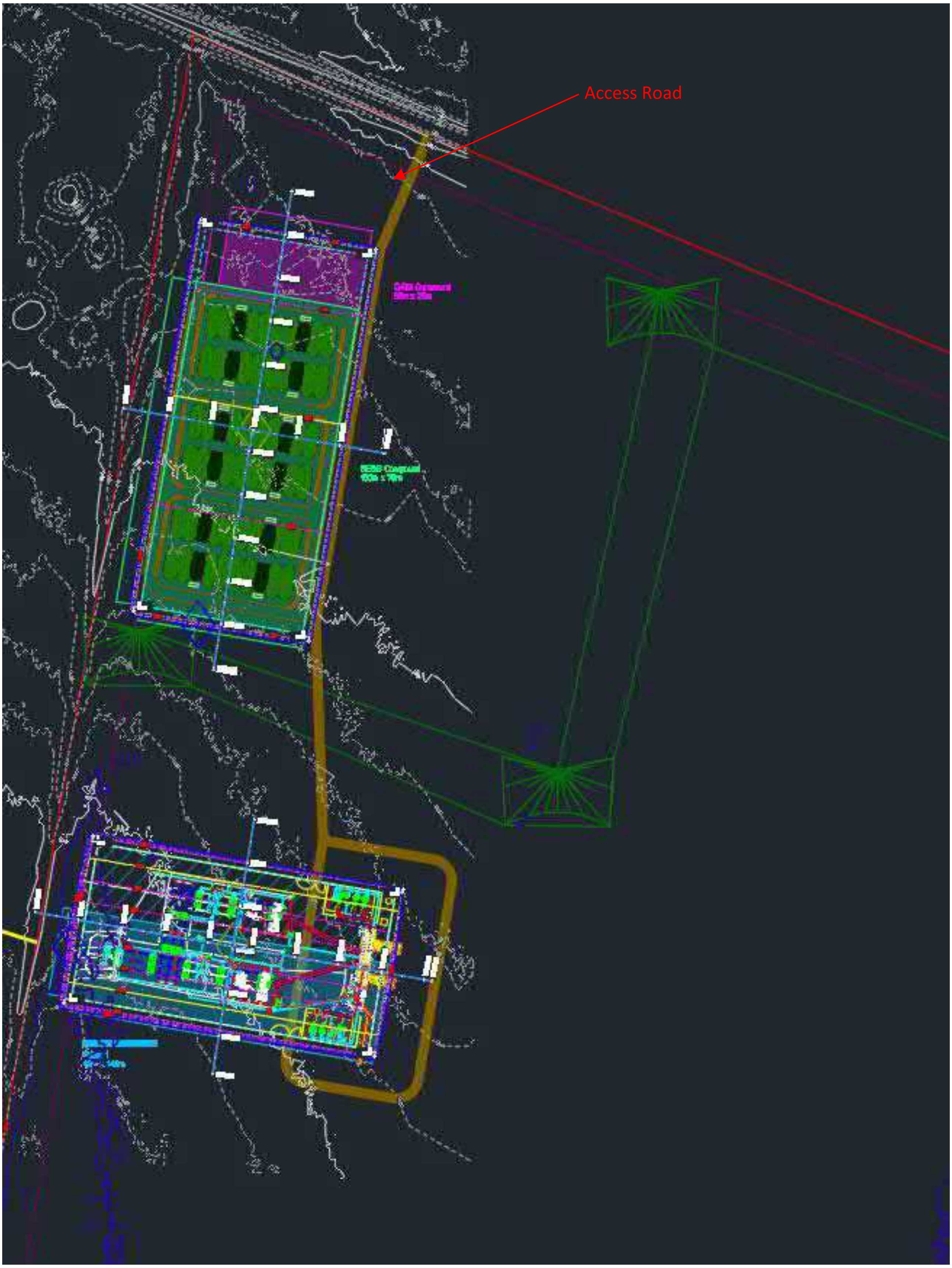
Filepath: X:\Projects\300127\30012765 - Daroobalgie Solar Farm\110 Detailed Design\111 Engineering Design\01 GIS\05 Workspaces\Daroobalgie Solar Farm - GN__PR.qgz

Appendix E - Provided CAD Files

General Layout (DAR-G-0006 Layout 20210216)



Substation (NSW202525-C3D-Model-ISSUED FOR DA)



Appendix F – Switchyard Flood Assessment

Technical Memorandum

Memo No.	30012765-WH-MEM-001	**Date of Issue**	13/10/2021
Subject	Switchyard Flood Impact Assessment	**Discipline**	Water Dams & Hydro
Project Name	Daroobalgie Solar Farm EIS	**Project No.**	30012765
Document No.	30012765-WH-MEM-001	**Revision**	Final
Author	Ollie Glixman/Gus Naghib		
Reviewed by	Gus Naghib	**Approved by**	Jessica Miller
Prepared for	Pacific Hydro Australia	**Attention to**	Kate Munro/Bruno Martins
Attachments	Flood Maps		

1 Purpose

The purpose of this Technical Memo is to provide the findings of hydraulic assessment of the switchyard site for the Daroobalgie Solar Farm Environmental Impact Statement (EIS) Project. The switchyard site is shown in Figure 1. This document is to be read in conjunction with the main EIS report provided by SMEC which assesses flood impacts of the proposed solar farm site (Report file reference: *30012765-Daroobalgie Solar Farm-Flood Risk Impact Assessment Report_Final.doc)*.

2 Introduction

2.1 Background

The proposed switchyard site is located on Daroobalgie Road, Daroobalgie, approximately 6 kilometre (km) north of Forbes and approximately 8 km west of the proposed Daroobalgie Solar Farm. The site covers an area of 5,000 square metres and is shown below in Figure 1 and Figure 2.

This memo report provides a flood impact assessment for the proposed switchyard site and provides future design recommendations.

2.2 Objectives

The purpose of this study is to undertake a flood assessment to determine the likely extents of flooding across the site under existing conditions and further assess potential impacts of the proposed switchyard site on the adjacent developments and watercourse. Results will be used to meet the Secretary's Environmental Assessment Requirements (SEARs) for the project.

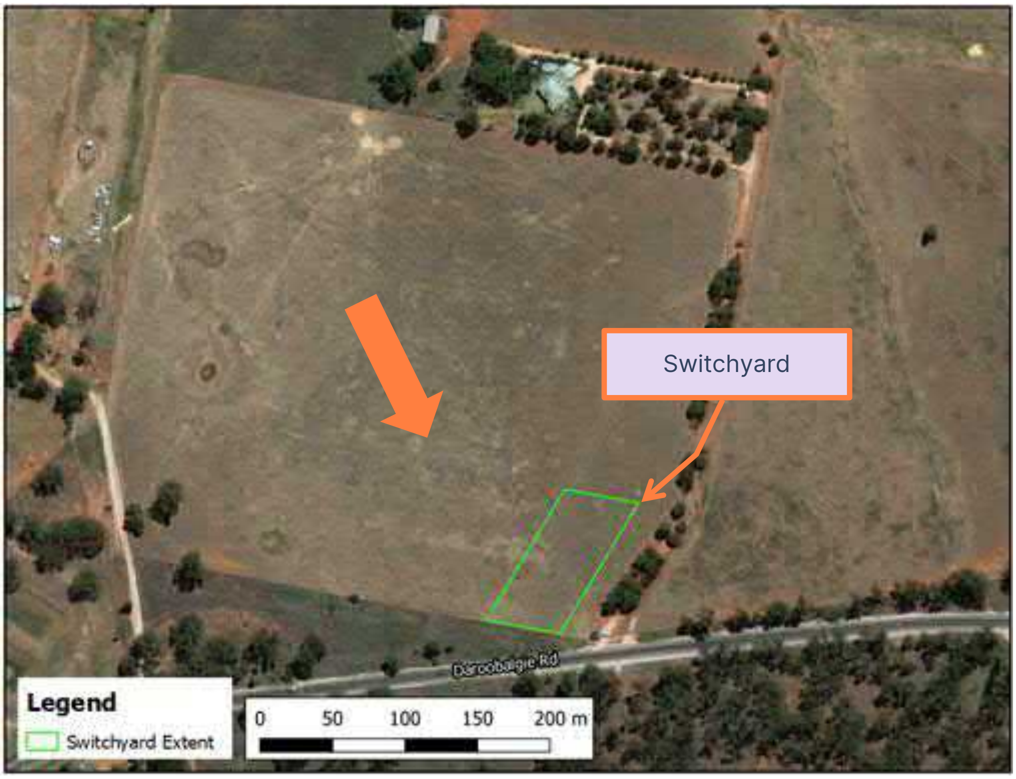


Figure 1: Site Surroundings (Switchyard)

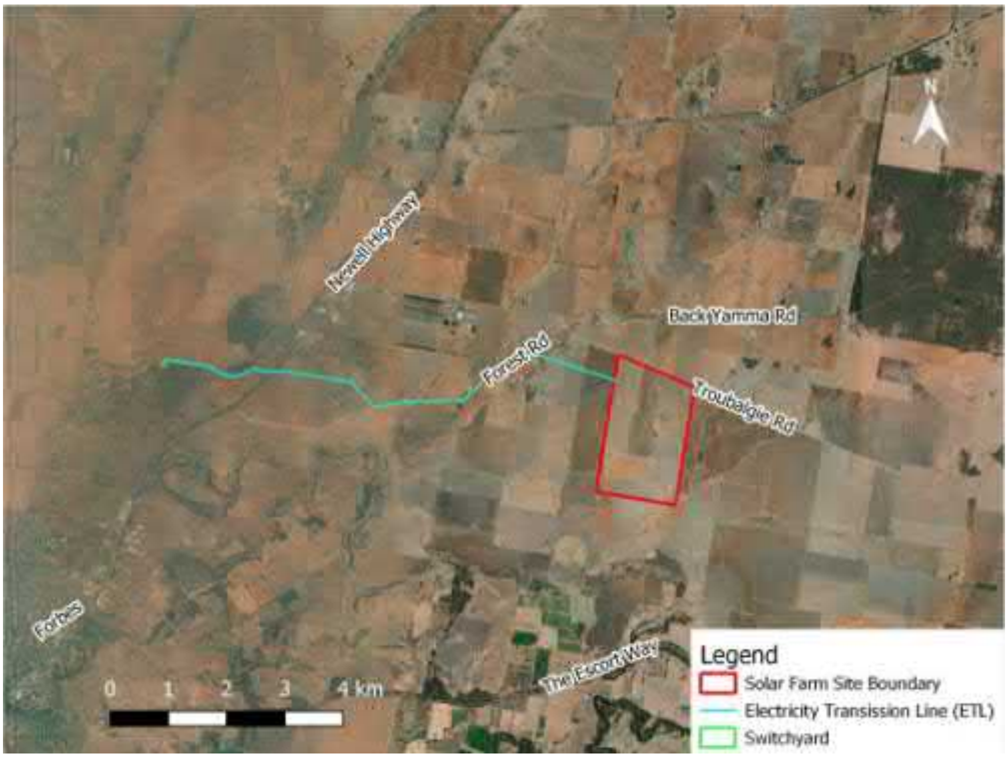


Figure 2: Site Location Reference (Solar Farm & Switchyard)

2.3 Scope

The flood impact assessment has been conducted in accordance with the approved proposal, dated on 18 March 2020, and further communication with Pacific Hydro. A separate 2D TUFLOW hydraulic was developed to assess potential flood impacts due to the proposed switchyard for 1% Annual Exceedance Probability (AEP), 5% AEP and 20% AEP storm events.

2.4 Project Data

The following data has been obtained separately for the sole use of being incorporated into the switchyard site flood model. This information has not been incorporated into the original flood model developed for the solar farm site.

Table 1: Project Data and Description

Data Description	Source	Purpose in this Study
1m LiDAR Grid – File Ref: Parkes201906-LID1-AHD_5946310_55_0002_0002_1m.asc Parkes201906-LID1-AHD_5966310_55_0002_0002_1m.asc	ELVIS (**https://elevation.fsdf.org.au/**)	Provides topographical information used to delineate the upstream catchment. This information was also used as the terrain input for the 2d hydraulic model. The file has a general vertical accuracy of 300mm. However, this data is deemed to be more accurate as the site is generally flat with little undulation.
Aerial Imagery	ESRI	Reference for flood extent in map outputs
Rainfall intensity data	Bureau of Meteorology (BOM)	Provides the input data to create the inflow rainfall hyetographs.
Hydrological parameters	Australian Rainfall & Runoff (ARR) 2019 Data Hub	Used to calculate the critical storms for the site.

3 Methodology

The general methodology for the flooding assessment is similar to what has been used for the solar farm site.

3.1 Catchment

The upstream catchment contributing to the proposed site is shown below in Figure 3. The catchment boundary was defined based on LiDAR data and using QGIS software. The software also calculates a slope of the terrain for the catchment. The analysis indicated that the slope of the terrain mild and, falling from north to south with approximately 1% slope. The catchment is generally covered with grass with sporadic clusters of trees in upper areas and dense trees in the downstream area.

Three distinct overland paths have been identified as shown below in Figure 3. The figure also indicates that the proposed switchyard site sits within the central overland flow path. All three assessed overland flow paths have been included to determine if flows within the central stream passing through the site would overflow into the adjacent streams as a result of modifying the terrain in the proposed case model.

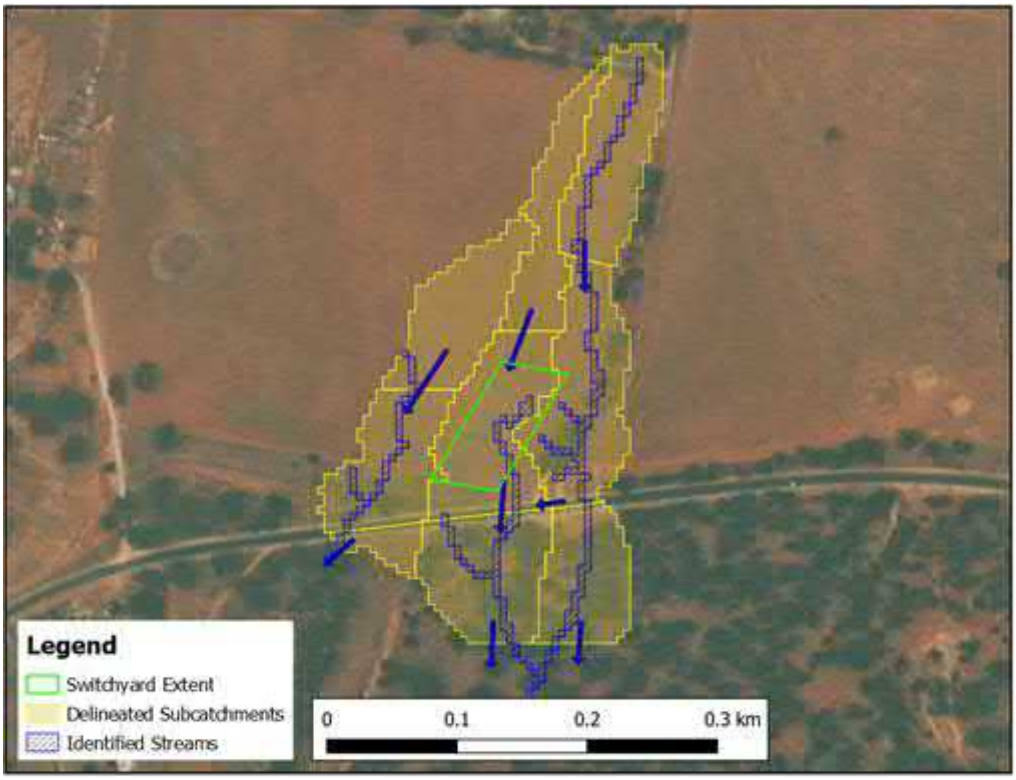


Figure 3: Delineated Sub-catchments.

3.2 Hydrology Model

The rainfall data from the BOM was used for hydrology modelling based on AR&R 2019 guideline.

The sub-catchment areas and main overland flow paths, shown in Figure 3, were used to form the XP-RAFTS hydrology model. Critical storm durations were determined by running the hydrology model for a range of storm durations (10 minutes to 6 hours) and corresponding the temporal patterns for 50% AEP, 20% AEP and 1% AEP storm events. However, results were found to be similar for a couple of storm durations. The critical storm and the two other storm durations that produced similar peak flow results are shown in Table 2. Hence, it was decided to a adopt rain on grid method in the hydraulic model instead for the three identified durations presented in Table 2.

Table 2: Identified Storms Considered in Rain on Grid Method

Storm Event	Critical duration/ Storm Pattern	Two other identified storms with similar peak flows	
1% AEP	15 min TP06	25 min TP05	45min TP02
5% AEP	30 min TP09	15 min TP02	45min TP06
20% AEP	25 min TP10	15 min TP06	45min TP07

3.3 Hydraulics

A 2D TUFLOW hydraulic model was developed with the hydraulic domain extent (approximately 5 hectares in size) as shown in Figure 4.

A rainfall on grid approach was developed for the identified storms presented in Table 2, and it was further applied to the hydraulic model domain covering the subject site, as shown in Figure 4.

There is no upstream sub-catchment for the model. The outflow boundary condition, shown in Figure 4, was specified in the form of normal-depth rating curves with the implied hydraulic gradient taken from the prevailing ground slope.

The terrain in the 2D TUFLOW hydraulic model for existing conditions was built with a 1m cell size based on 1m LiDAR data.

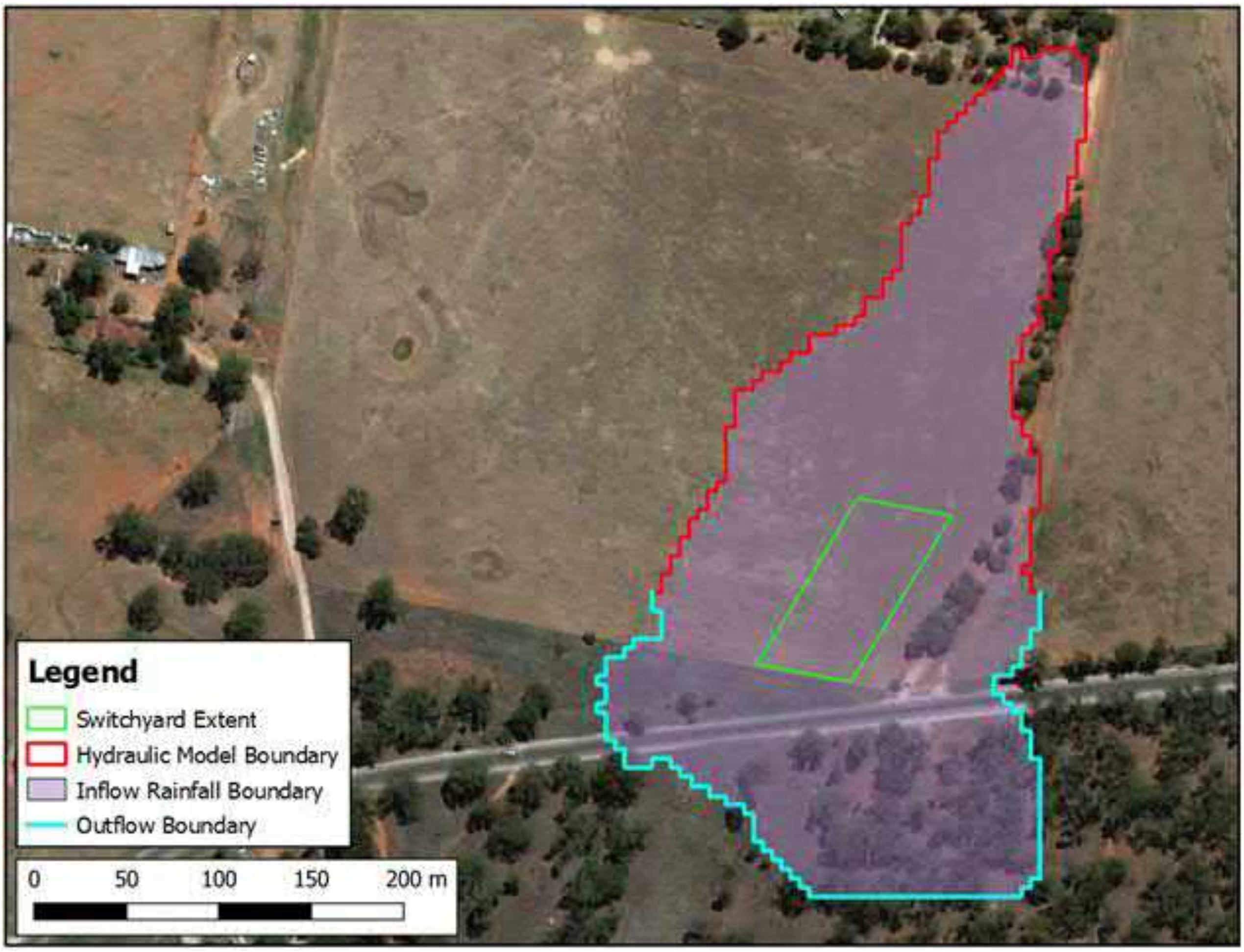


Figure 4: Hydraulic model extent and boundary conditions

3.3.1 Land Use

The land use types for existing conditions in the modelled extent were determined through an inspection of aerial imagery in the region. Land use types were represented in the model by the Manning's hydraulic roughness coefficient, or "n" value. Broadly speaking, hydraulic roughness is a measure of the impediment to flow imparted by different types of natural or man-made materials.

Since the site is open grasslands, the default hydraulic roughness (Manning's n value) was set to 0.04. Identified land use type and corresponding Manning's n values for the hydraulic model are shown in Figure 5.

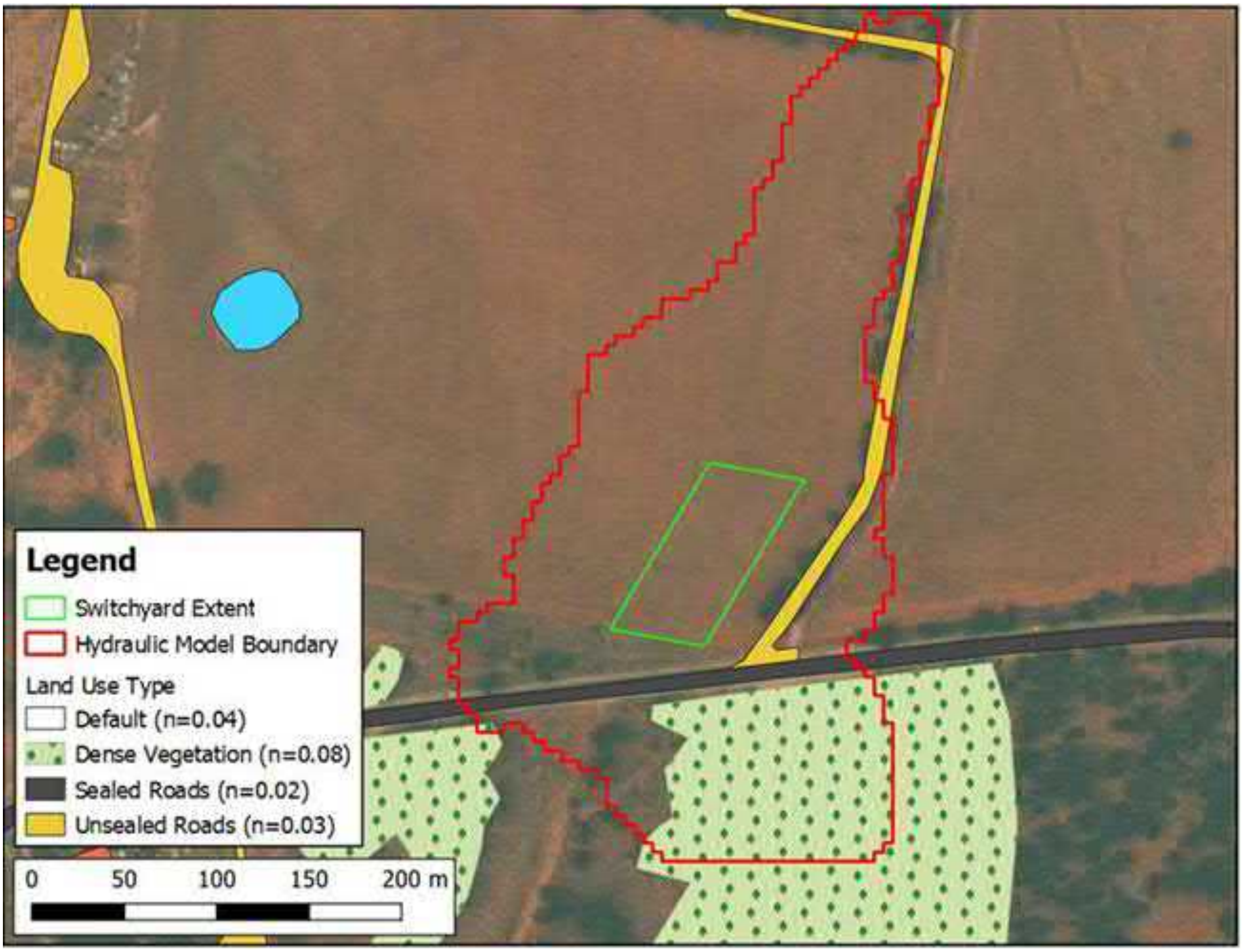


Figure 5: Land Use Types- Existing Conditions

3.3.2 Culverts

Three existing culverts have been identified within the hydraulic model boundary. These culverts are shown in Figure 6 below. Furthermore, Table 3 provides a description and the assumed size of each culvert as no survey data/information was available.

Figure 6: Identified Culverts

Table 3: Culvert Specifications

Culvert No	Assumed Dimensions	Comment
Culv1	1 m (width) x 0.5 m (height)	Intentionally over-sized to ensure all stormwater is conveyed to the sub-catchments south of the road.
Culv2	375 mm (diameter)	Estimated using Google Street view
Culv3	375 mm (diameter)	Estimated using Google Street view

3.3.3 Proposed Conditions

The TUFLOW hydraulic model for existing conditions was modified to reflect changes to the site for proposed conditions. The terrain model for the existing conditions was modified by raising existing levels within the switchyard site and further assuming falling slope from the centre to the sides. This terrain modification was carried out to prevent overland flows from entering the switchyard site as a conservative approach and to simulate potential drainage behaviour for the site. A cross section of the proposed terrain compared to the existing at the switchyard site is shown in Figure 7 below. It is noted that raising existing levels by 2m is not based on proposed switchyard slab level, rather it is just to guarantee that the switchyard site has been modelled as fully blocked (conservative approach) for modelling purposes only. No further modification to the existing terrain was undertaken in the hydraulic model for the proposed conditions.

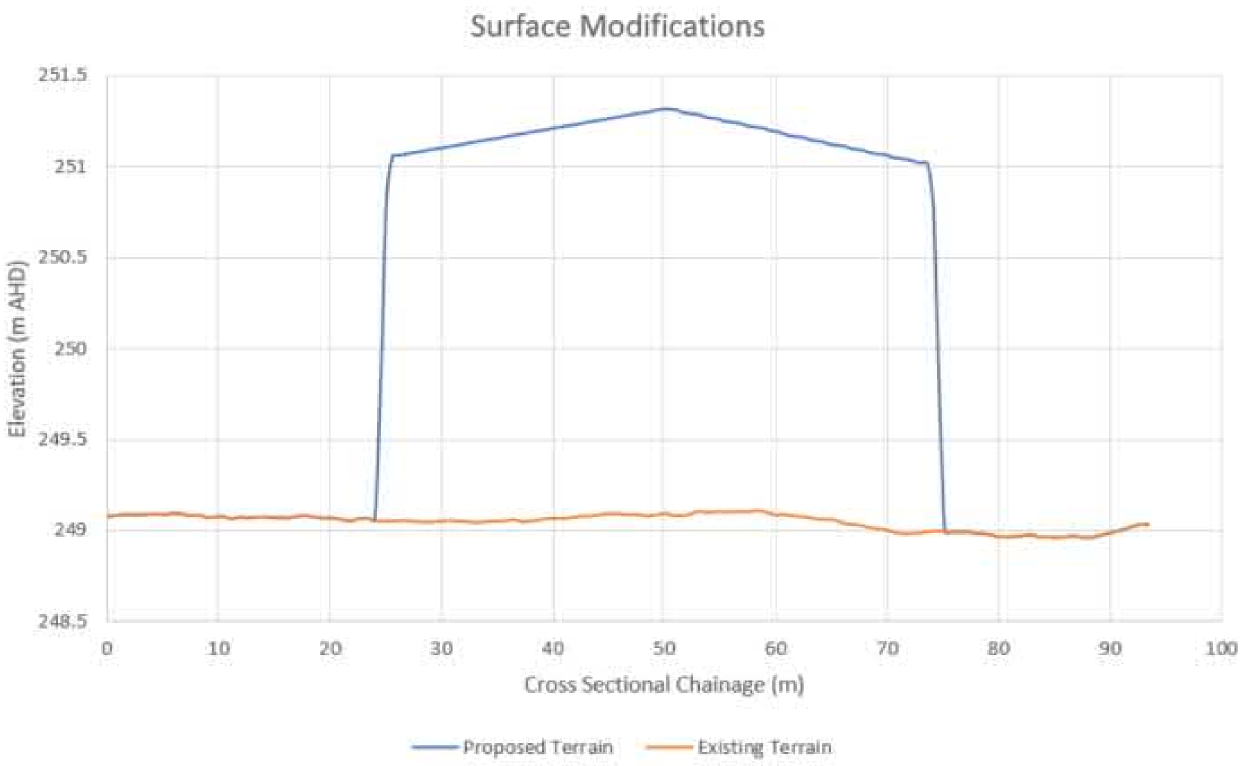


Figure 7: Surface Modification Cross Section. The 2 m raise was assumed just to represent the switchyard as fully blocked against overland flows for modelling purposes only.

The hydraulic roughness (Manning's n value) was changed for the site to 0.02 to reflect the increased impervious area due to the proposed switchyard site as shown in Figure 8.

Figure 8: Land Use Types- Proposed Conditions

The TUFLOW hydraulic model was run for existing and proposed conditions under 20% AEP, 5% AEP, and 1% AEP storm conditions.

3.4 Flow Comparison

There was no gauge data available linked to the site catchment. Hydraulic model results immediately upstream of Daroobalgie Road at the "Culv1" culvert for existing conditions were compared with Probabilistic Rational Method (PRM) results. The comparison of results is presented in Table 4.

It is noted that the catchment size at "Culv1" culvert is outside of the recommended catchment size range (0.5 to 1,000 km^2) required for Regional Flood Frequency Estimation model (RFFE) (https://rffe.arr-software.org). So, RFFE was not considered in the comparison.

Table 4: Comparison of Peak Discharge Estimate

Event	Probabilistic Rational Method Peak Flows (m3/s)	TUFLOW Model Peak Flows (m3/s)
1% AEP	0.48	0.55
5% AEP	0.27	0.14
20% AEP	0.12	0.05

As shown in Table 4, the hydraulic model result is generally in good agreement with the PRM result for the 1% AEP storm. However, the discrepancy of the results becomes larger with a more frequent storm. This discrepancy is suspected to be due to storage within the terrain of the hydraulic model.

4 Results

Once all simulations were run, enveloped flood results were produced from the three simulated durations under each AEP storm event. These enveloped results were used to produce flood maps.

4.1 Existing Conditions

Hydraulic results show that the critical duration for the 1% AEP storm for most of the catchment is 45 minutes.

The flood depth for the 1% AEP storm in the switchyard site is shallow and up to 200 mm. This shows that there is no flood storage area within the site. The ponding depth immediately upstream of Daroobalgie Road reaches up to 300 mm. Flood depth maps are provided in Appendix 1.

Peak flood velocity within the catchment including the switchyard site is up to 0.6 m/s for the 1% AEP storm. Hence, there is no considerable floodway identified within the site as the overland flow is shallow in depth and low in velocity.

Based on peak flood depth and flood velocity results, flood hazard within the site for 1% AEP storm is considered low (H1) and generally safe for people, vehicles and buildings.

4.2 Proposed Conditions

In the proposed conditions, the switchyard site was kept dry due to the conservative terrain modification. Flood depth maps are provided in Appendix 1. As shown in Figure 2.1 in Appendix 1, peak ponding depth for the catchment in 1% AEP storm is up to 300 mm.

Peak flood velocity is almost the same as existing conditions, being 0.7m/s for a 1% AEP storm. Hence, flood hazard within the site for the 1% AEP storm is retained from existing conditions.

Afflux map for the 1% AEP flood event is provided in Figure 9 below and in Appendix 1. Results show afflux of up to 55 mm mainly in the area along the western boundary of the switchyard site. Afflux reduces to 10 – 20 mm further away to the west. Also, as shown in Figure 9, flood level reduces up to 30mm immediately upstream of Daroobalgie Road. Furthermore, there is no afflux downstream of the road for 1% AEP storm event.

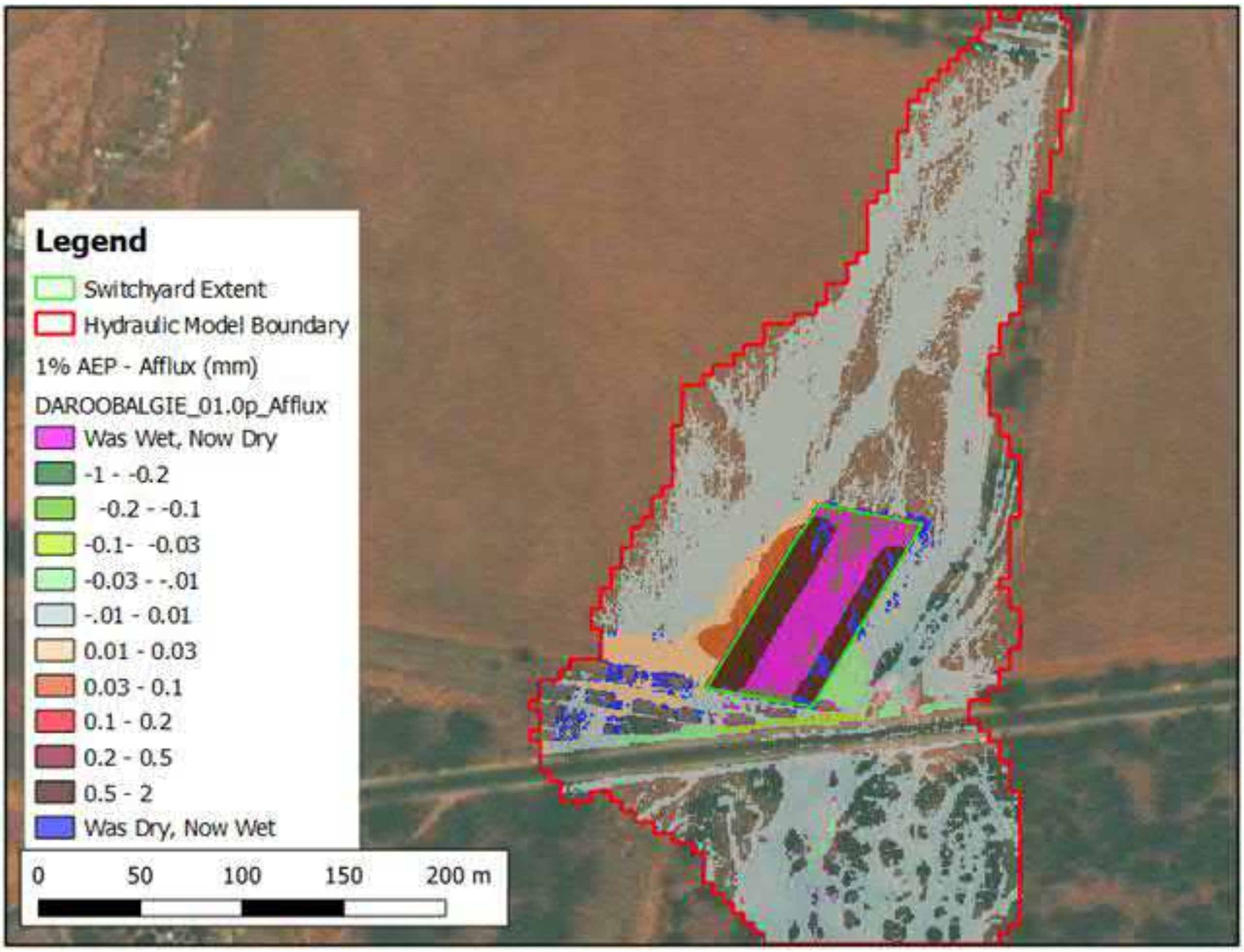


Figure 9: 1% AEP Afflux Map

It is noted that upon review of results for the modelled culverts, no culvert resizing is needed as they don't reach their full capacity.

5 Conclusion

Based on provided data, the following conclusions are made:

- Overland flow traversing the switchyard site is shallow in depth and very low in velocity for existing conditions. Hence, the overland flow path is considered safe for people, vehicles and buildings.
- There is no considerable flood storage area identified within the site catchment.
- Daroobalgie Road is immune against the 1% AEP storm within the catchment for existing conditions.
- Flood behaviour for proposed case scenario is generally the same as existing conditions.
- Flood levels increase in the neighbouring property up to 55mm for 1% AEP storm compared to existing conditions. This afflux is a result of raising the whole switchyard site and blocking the existing overland flow as a conservative approach.
- Flood levels reduce by 30mm immediately upstream of the Daroobalgie Road in 1% AEP storm event for proposed conditions as upstream overland flow is diverted to the west, due to the switchyard site modelled as fully blocked, compared to existing conditions.

Also, based on afflux results, a provision of a shallow swale along the western and southern boundaries of the site is recommended to mitigate the afflux.

Appendix 1 – Flood Maps

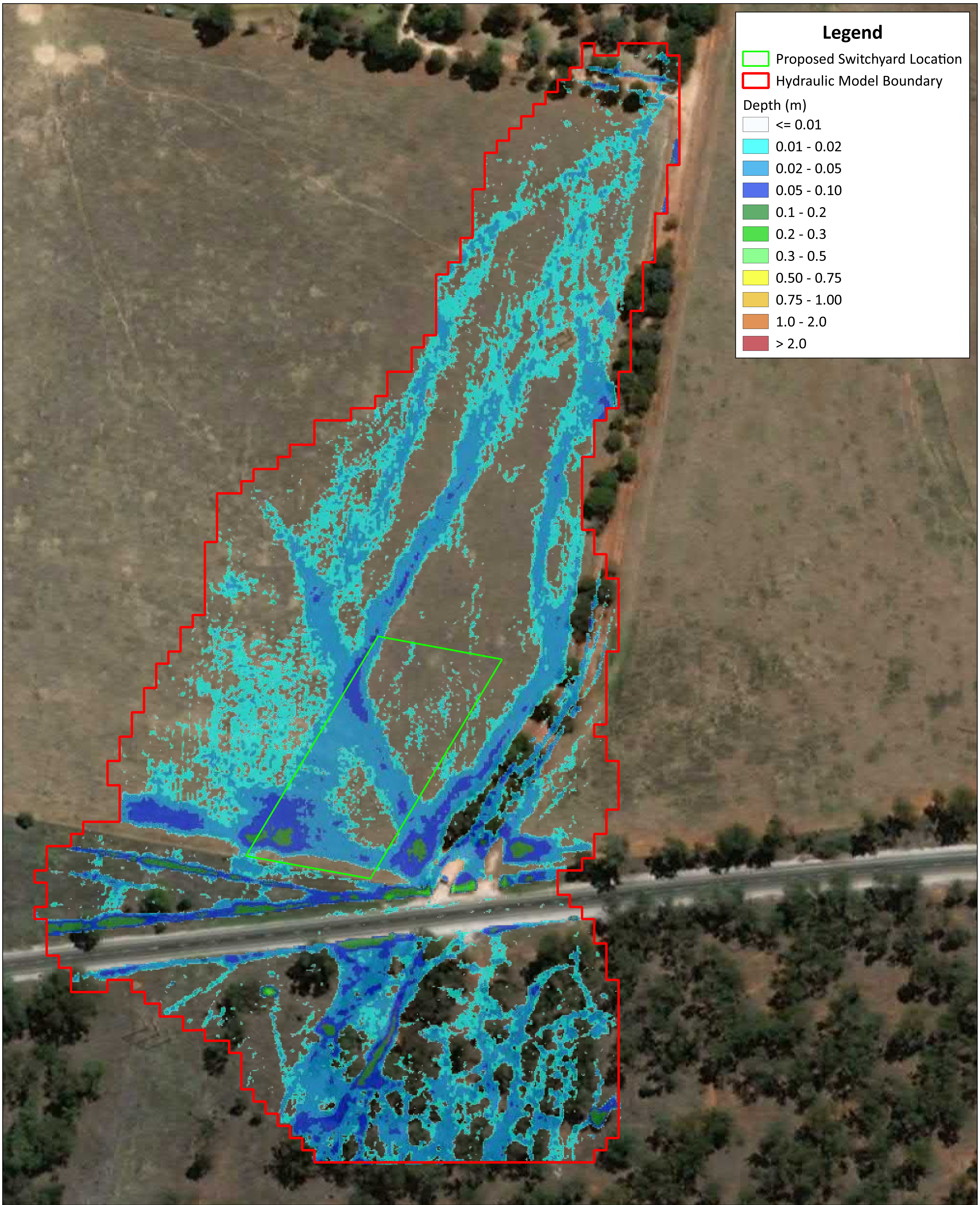


FIGURE TITLE	Peak Water Depth - 1% AEP Design Flood Existing Scenario	DATE	19-07-2021
DRAWING NO.	1.1	SCALE	1:1500 at A3
PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm Switchyard Assessment

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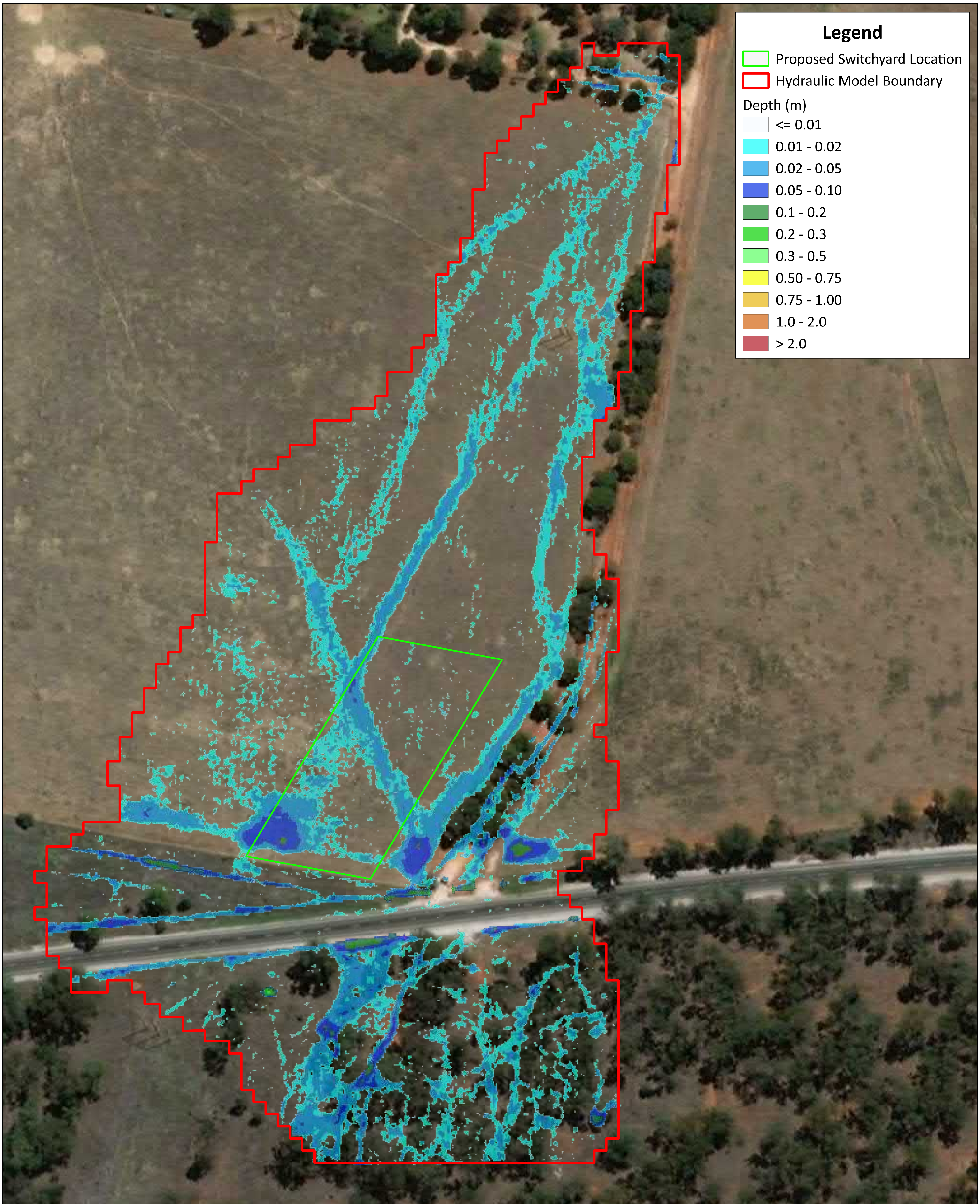

FIGURE TITLE	Peak Water Depth - 5% AEP Design Flood Existing Scenario	DATE	19-07-2021
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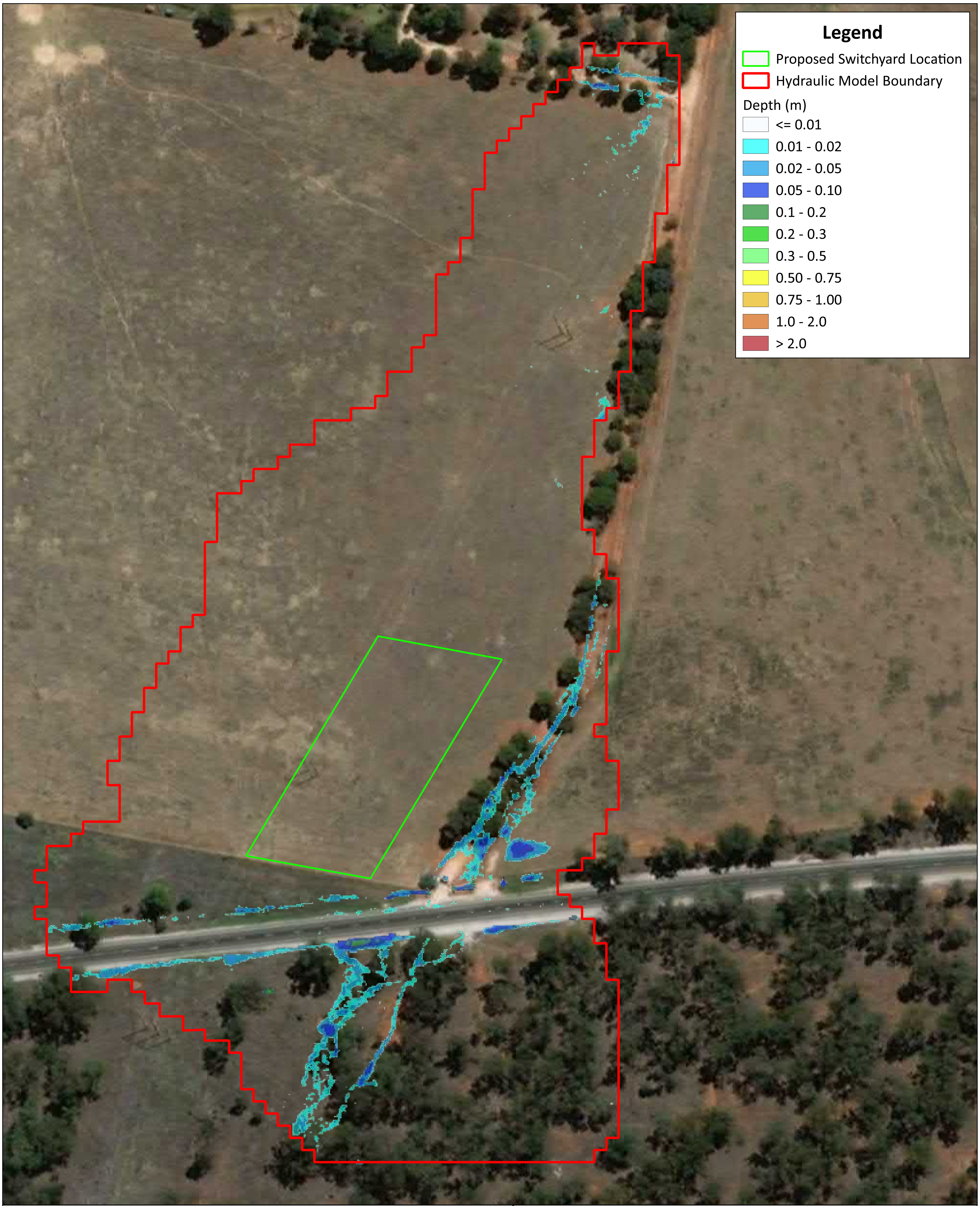

FIGURE TITLE	Peak Water Depth - 20% AEP Design Flood Existing Scenario	DATE	19-07-2021
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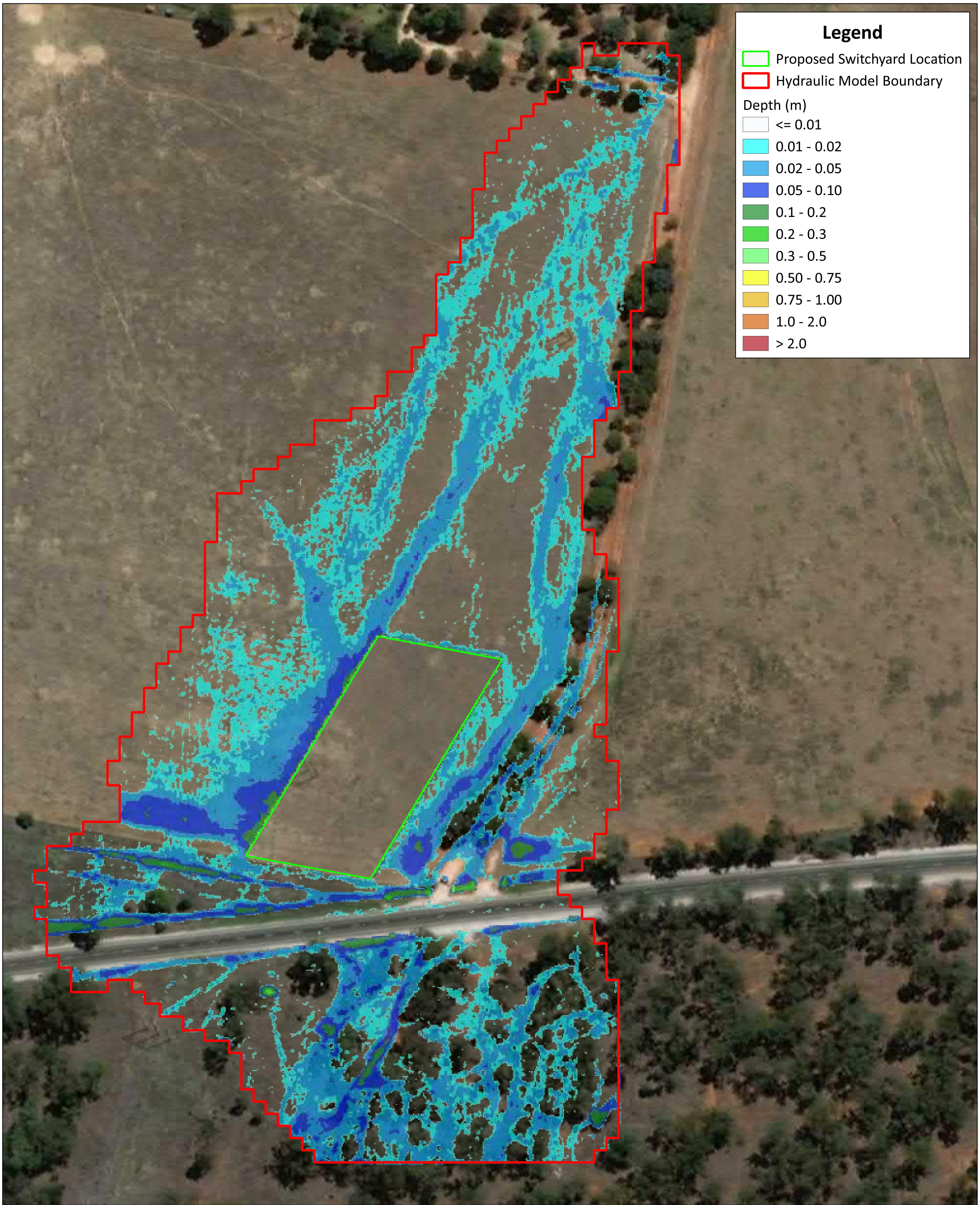

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PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm Switchyard Assessment

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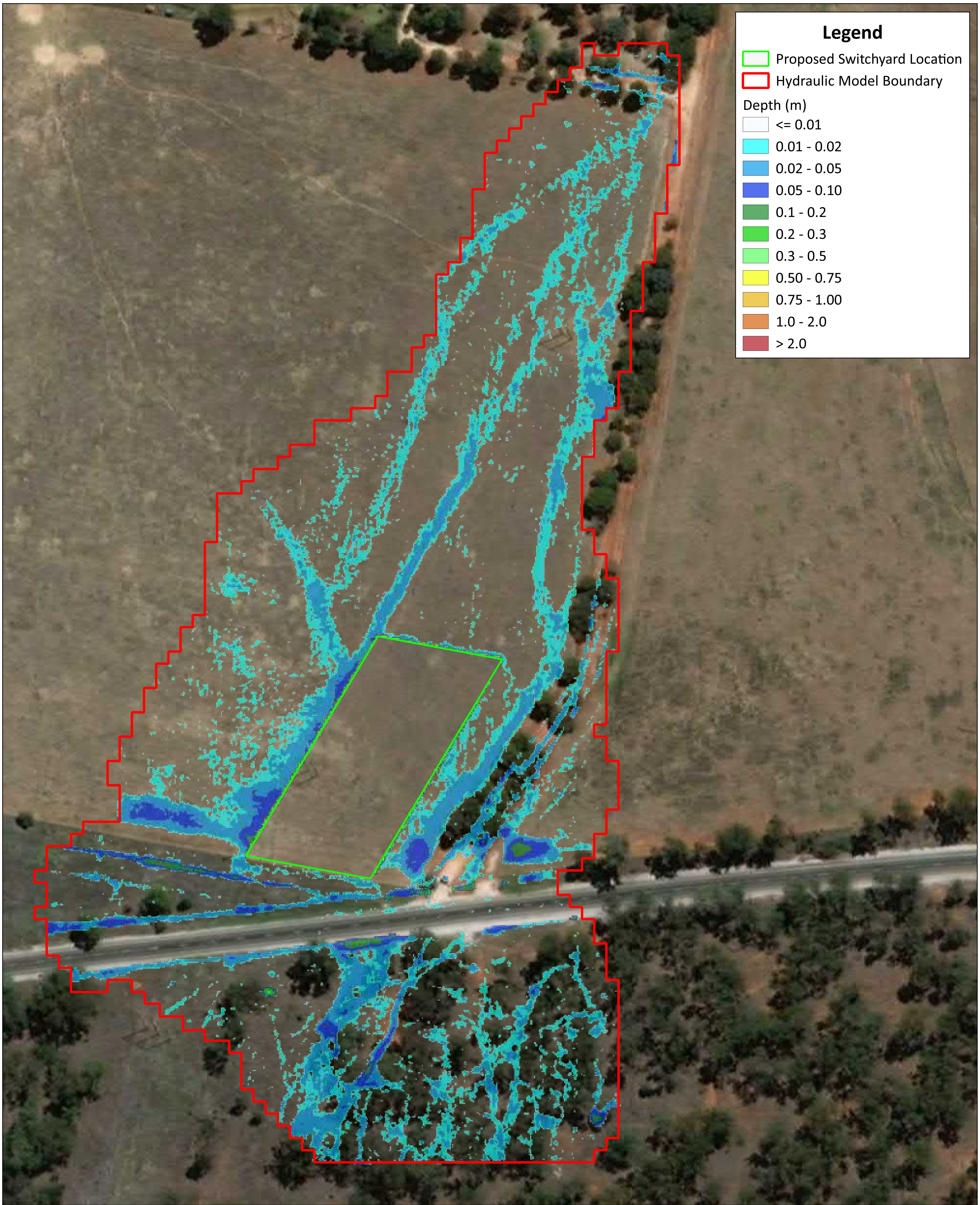

FIGURE TITLE	Peak Water Depth - 5% AEP Design Flood Proposed Scenario	DATE	19-07-2021
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PROJECT NO.	30012765	PROJECT TITLE	Daroobalgie Solar Farm Switchyard Assessment

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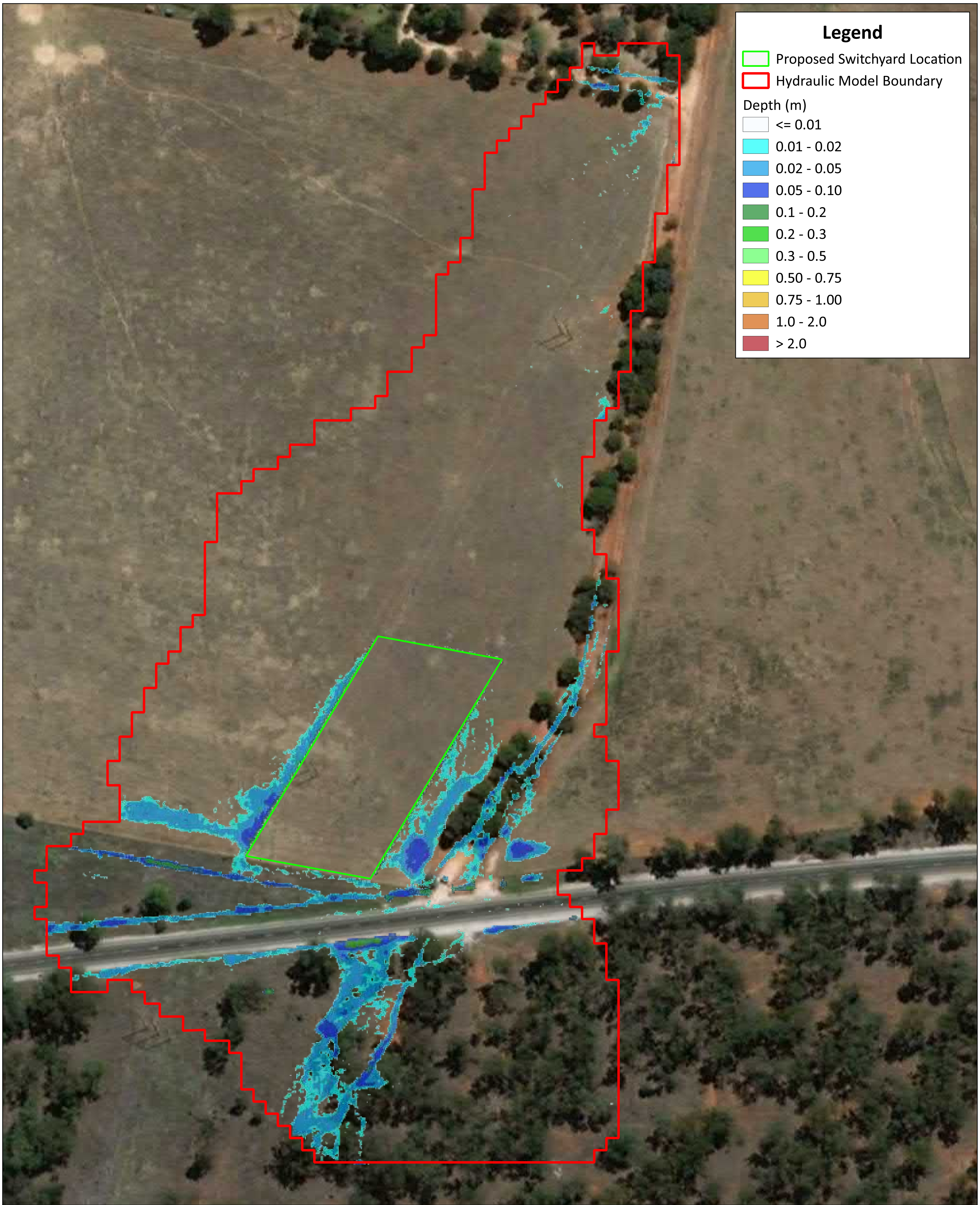

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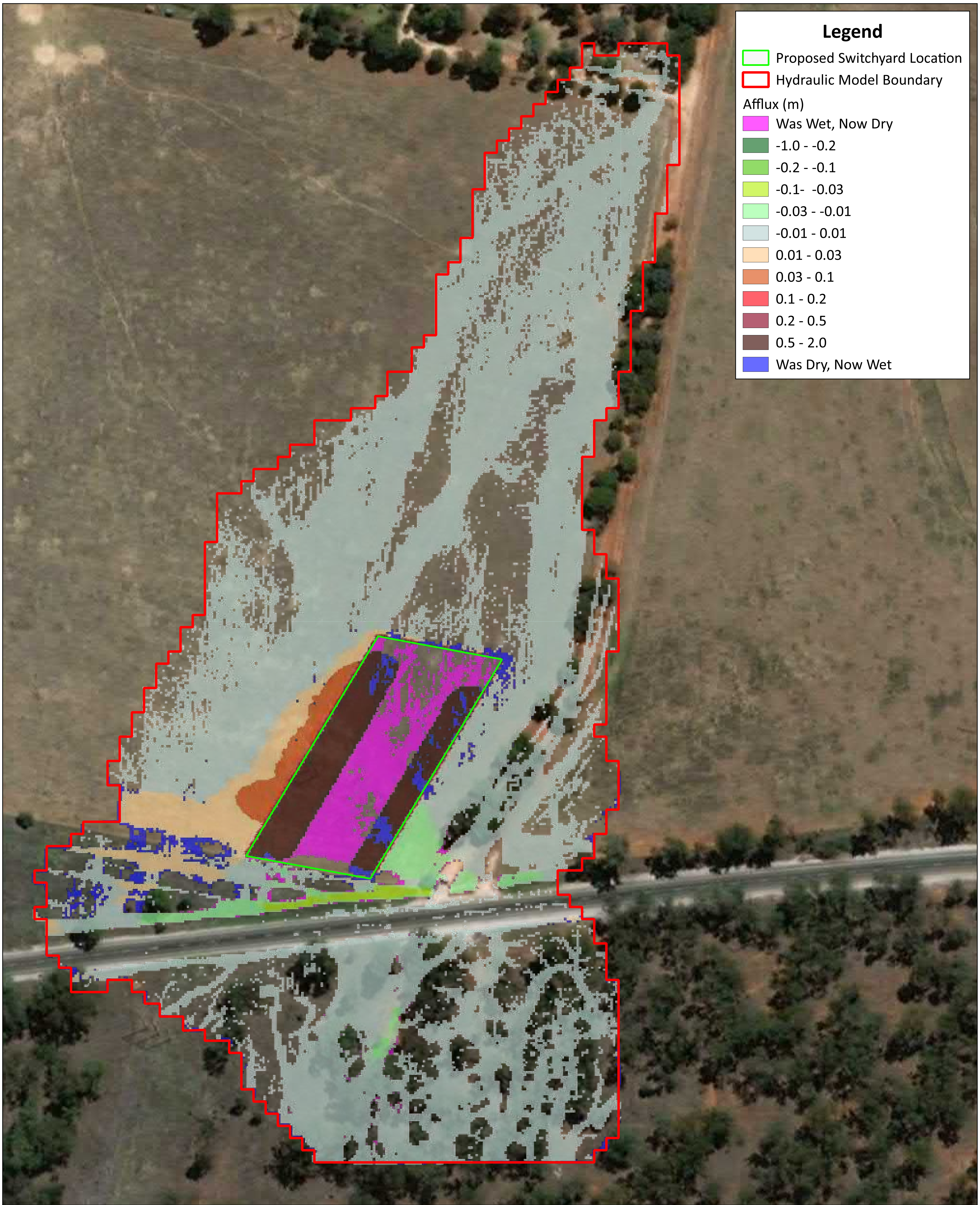

FIGURE TITLE	Afflux - 1% AEP Design Flood	DATE	19-07-2021
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