Summary Technical Report

ARUP

Level 10 201 Kent Street
PO Box 76 Millers Point
Sydney 2000
Australia
www.arup.com

t +61 2 9320 9320
f +61 2 9320 9321
d +61 2 9320 9540

Project title	Jemalong Solar PV Plant	Job number	258584/00
cc		File reference	TN-JM-FL-01.docx
Prepared by	Tina Fang, Ivan Varga Sampedro	Date	13 November 2017
Subject	Flood Study of Jemalong Solar PV Plant – Summary Technical Report		

1 Introduction

A number of flood studies have investigated flood behaviour in the Lachlan River Floodplain, covering the area where the proposed Jemalong Solar PV Plant is proposed. These previous studies are:

- Lachlan River (Jemalong Gap to Condobolin) Rural Flood Study (Parsons Brinckerhoff, 2004);
- Lachlan River Jemalong Gap to Condobolin Floodplain Risk Management Study (FRMS) (Parsons Brinckerhoff, 2009); and
- Flood Impact Assessment – Jemalong Solar Station 30MW CSP Plant (Southeast Engineering & Environmental, 2015).

All of these previous studies were based on a 1D MIKE11 model. The flood levels and flood extents on the floodplain were interpreted by the 1D results and the topographic data.

Arup was commissioned by Vast Solar to investigate the flood behaviour under the existing conditions at Jemalong Solar PV Plant.

A fully dynamic two dimensional (2D) TUFLOW model was developed for this study. The primary objective of this study is to define the flood behaviour around the Jemalong Solar PV Plant. This study also identifies whether flood mitigation measures will be required to alleviate flood risk as a result of the proposed solar station.

2 Hydraulic Modelling

Hydrology and hydraulics are two essential processes in simulating the catchment responses to rainfall. TUFLOW is a comprehensive software package which has a capacity to simulate the catchment hydrological and hydraulic responses to rainfall.

This study developed a TUFLOW model that simulates the hydraulic process by producing the water levels and velocities by converting runoff (from a hydrology model MIKE11) throughout the major flow paths in the study area. The TUFLOW model layout is shown in Figure 1.

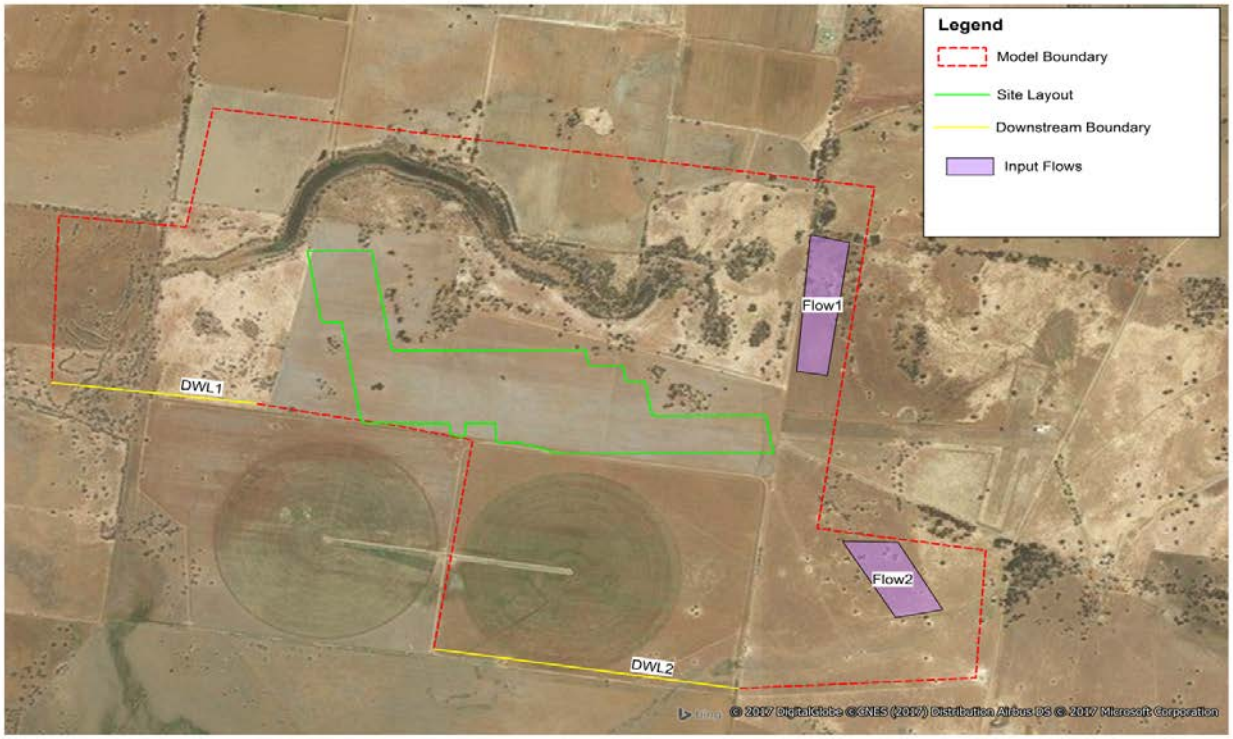

Figure 1: TUFLOW Model Layout

2.1 Model Terrain

The model DTM (Digital Terrain Model) was based on the ground survey data provided Geolyse Surveyors on 7/11/2017. The model adopted a high-resolution grid of 5m.

2.2 Boundary Conditions

The upstream boundary conditions were defined by the steady state peak flows of 1990 storm event from the MIKE11 model. The downstream boundary conditions were defined by the peak flood levels of 1990 storm event. The 1990 storm event is the most recent significant flood event (more significant than the 2016 event) for which there is accurate input data available. This event is referred to Figure 4.1 and Figure 4.5 in Lachlan River Floodplain Management Study (Parsons Brinckerhoff, 2009) for details. The details of boundary conditions adopted from this report for the TUFLOW model are provided in Table 1.

Table 1: Details of Boundary Conditions

Storm Event	Upstream Input Flow (m^3/s)		Downstream Flood Level (m AHD)	
	Flow1	**Flow2**	**dwl1**	**dwl2**
1990	203.5	185.1	215.3	215.6

2.3 Hydraulic Roughness

A hydraulic roughness map is required for 2D modelling to classify the surface roughness for various land uses. The roughness map was determined using the aerial photograph (sourced from https://maps.six.nsw.gov.au/). The roughness values are in a range of 0.035 and 0.045 for the Lachlan River floodplain, shown in Figure 2.

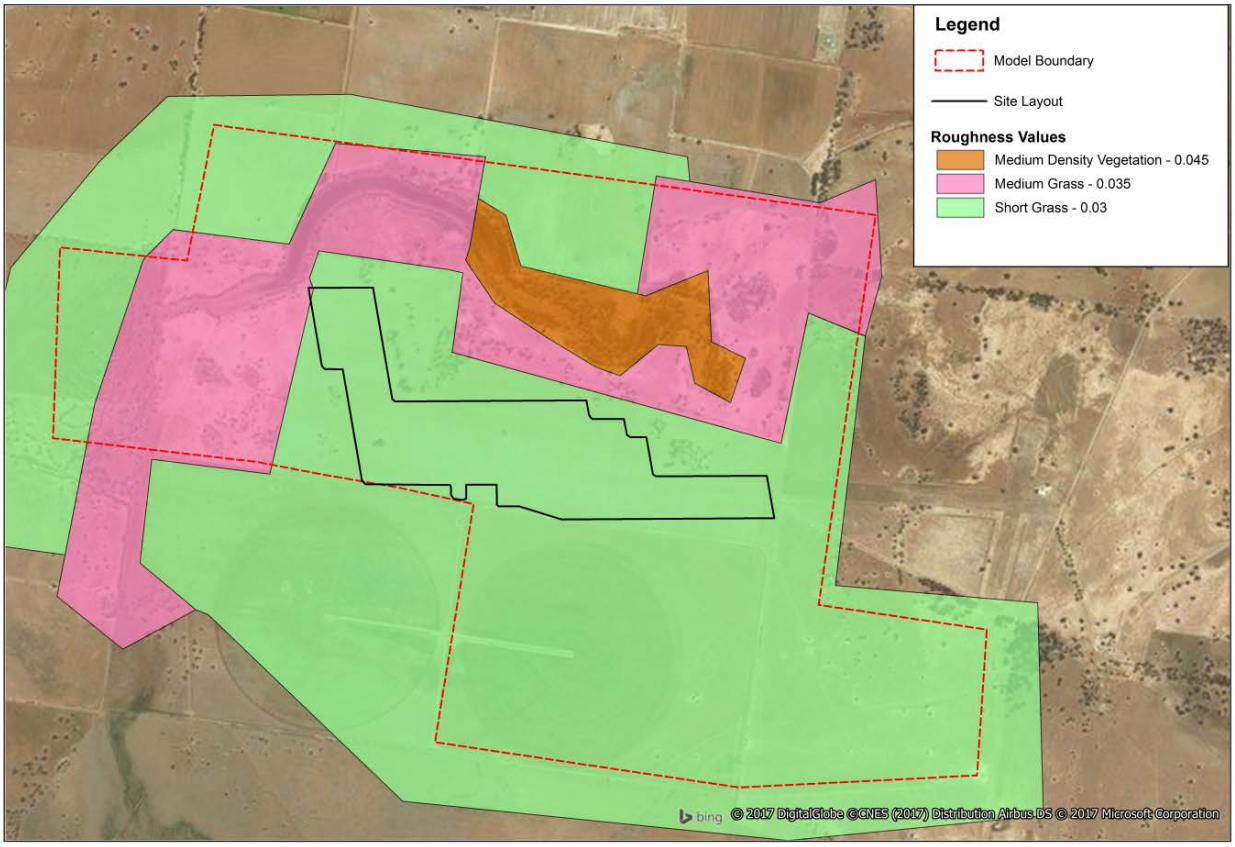

Figure 2: Hydraulic Roughness

2.4 Storm Event

The MIKE11 model simulated the historical storm events (1952, 1974 and 1990) in the Lachlan FMRS; however, the report only provides model results for the 1990 event, which is equivalent to 25 year ARI (Parsons Brinckerhoff, 2009), or the design life of the plant. On this basis the current flood investigation is simulated using data for the 1990 storm event.

2.5 Key Assumptions

This study was based on the following key assumptions or considerations:

- Steady state peak flows from the MIKE11 model were used as the input flows to the TUFLOW model;
- Peak flood levels from the MIKE11 model were used as downstream boundary conditions; and
- The creek cross sections were not extracted from the MIKE11 model due to being unavailable from the MIKE11 model and were instead developed from prior survey.

3 Results

The peak flood depths of the 1990 event are shown in Figure 3. The model results indicate that flooding occurs only in the far western part of the development site. The total flood affected area is approximately 29 hectares. The results associated with the flood affected area are summarised in Table 2.

Table 2: Results Associated with the Flood Affected Area

Minimum Ground Elevation (m AHD)	Maximum Ground Elevation (m AHD)	Average Ground Elevation (m AHD)	Minimum Flood Depth (m)	Maximum Flood Depth (m)	Average Flood Depth (m)
214.78	215.48	215.27	0.07	0.56	0.29

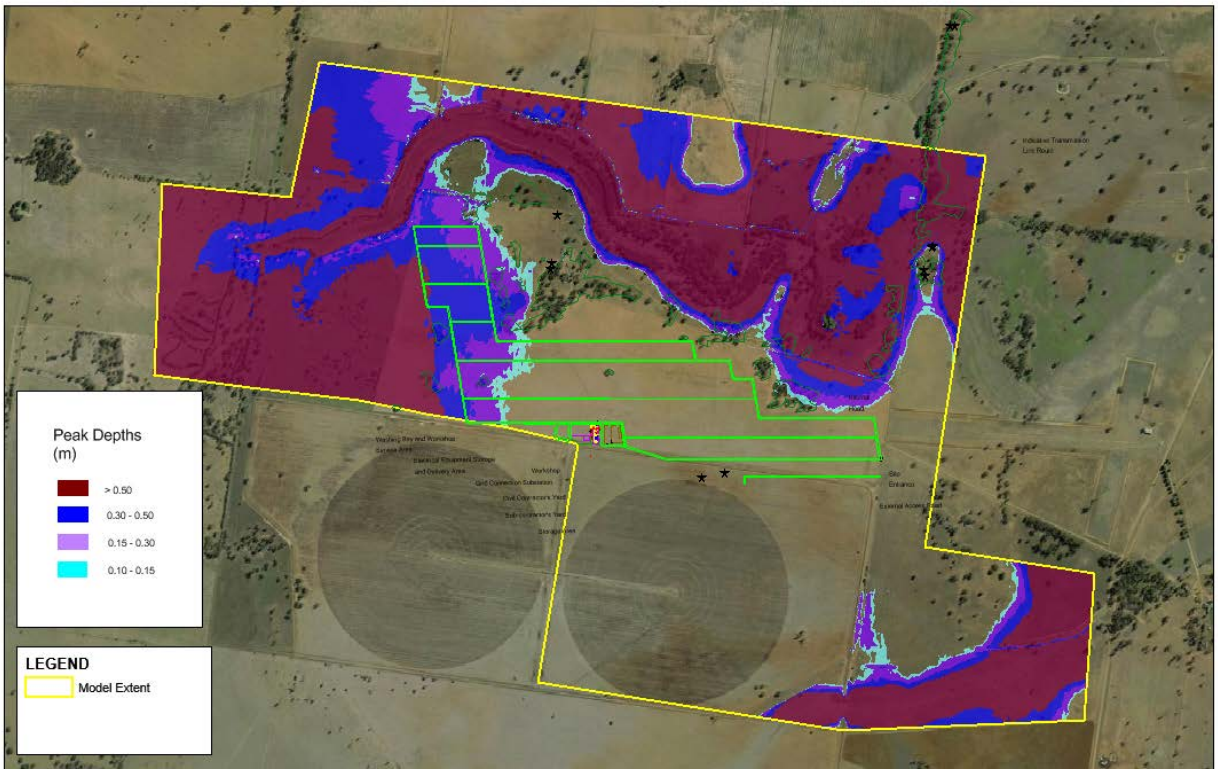

Figure 3: Peak Flood Depths – 1990 Event

4 Flood Mitigation Measures

Based on the flood model results, three flood mitigation measures (FM) have been identified:

- FM1 – ensuring the design of the PV infrastructure protects the infrastructure from the flooding by, for example, raising the PV module support structures by 0.5m and locating power control units on locally raised earthen pads or concrete blockwork;
- FM2 – raising the land elevation within the flood affected area above the peak flood levels; and
- FM3 – construction of a levee to protect the proposed solar PV plant from the flooding.

Approximately 71,500 m^3 water would be stored within the flood affected area for 1990 event. The implementation of FM2 and FM3 would result in this additional volume flowing into the downstream floodplain, which may slightly increase immediate downstream flood levels; however, the additional volume will be a negligible portion of the total water volume through Thurumbidgee Lagoon (approximately 6 minutes of steady state peak flow). Given the large area of the downstream watershed, this additional volume is likely to leave further downstream flood extents unchanged.

5 Conclusions

This flood study investigated the flood behaviour around the Jemalong Solar PV Plant. The model results indicate that the flooding occurs in the western part of the development site using 1990 historical storm event. The three flood mitigation measures have been identified base on the model results.

This model is subject to many assumptions and limitations. The interpretation of the model results should consider these limitations.

DOCUMENT CHECKING (not mandatory for File Note)

	Prepared by	Checked by	Approved by
Name	Tina Fang, Ivan Varga Sampedro	Paul Rasmussen	
Signature			