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& CONSULTING PTY LTD

23 May 2018

Senior Land & Development Manager
OVERLAND Sun Farming
Level 3
349 Coronation Drive
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Attention: Sten Fraser

Sten,

Re: Gunnedah Solar Farm EIS – Flood Impact Assessment Review

As requested I have read and reviewed the Flood Impact Assessment report which comprises Appendix J of the Gunnedah Solar Farm Environmental Impact Statement (EIS). The report was prepared by Pit & Sherry for Gunnedah Solar Farm Pty Ltd and is dated 22 March 2018.

The following table presents my review comments, referencing specific text, figures or tables in the report.

Report Reference	Text	Comment
Table 2 – Item 10	3rd column, 1st row: "The site is located within an area that is prone to flooding in events less than 5%AEP"	There is no apparent basis or justification for these statements, nor is a reference given to where this is supported by the reported analysis.
	3rd column, 3rd row: "The site is located in the floodplain of the Namoi River and functions principally as flood storage."	
4.1 General Approach	"…and the Gunnedah and Carroll Floodplain Management Plan 1999 (SMEC Study, updated 2014)."	No references section provided. I am unaware of this report, what it contains and if it differs from the 2003 SMEC report that we were provided.

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Report Reference	Text	Comment
4.1 General Approach	Second sentence: "The terrain data used were acquired from the Shuttle Radar Topography Mission (SRTM), which comprises a digital elevation model (DEM) with a grid size of about 30m."	The 30 m grid size is insufficient to simulate the Namoi River channel with any degree of accuracy. As indicated in our report, the river is approximately 35-40 m in width (20 to 25 m per Section 4.4.4 in the reviewed report). Therefore the use of a DEM with a 30 m spacing would result in it being approximated as a 'Vee-drain'. It is likely that this would significantly misrepresent the conveyance of the river channel and hence the volume of flow in the overbank (floodplain) areas.
4.2 Previous assessments, studies and sources of flood information	1st dot point: "Stewart Surveys, which estimated a 1% AEP flood level at RL 269.95 at the site for Lot 2 DP 801762"	It is unclear when this survey occurred or what this data was used for in the subsequent analysis.
4.3.2 Terrain data	3rd paragraph: "The digital elevation model (DEM) has a vertical and horizontal accuracy of 9.8m against 90% of tested heights…"	Such a level of accuracy is insufficient for modelling of a river channel and floodplain with the dimensions of the Namoi River.
	3rd paragraph: "It is considered that although absolute levels may not be precise in the flood plain around the site, they are consistent, which should allow a fair reflection of the extent and nature of flooding in the vicinity, and the potential impacts of the proposed Solar Farm."	The Geoscience Australia quoted text does not state that the elevations are consistent. It indicates that the "hydrological connectivity" of watercourses is consistent - i.e. the streamlines are continuous. This does not mean the data is consistent across floodplain areas. Therefore I disagree with the conclusion.
4.3.3 Flood frequency analysis of gauge data	"The annual maxima flood data were extracted from the Bureau of Meteorology (BoM) records for each gauge and each calendar year."	Section 4.3.1 indicates that stream flow data was obtained from the NSW Department of Primary Industries Office of Water. It is unclear if this is different data and how it differs.
Figures 3 Results of LPIII flood frequency analysis of flow record at Gauge 419001	-	It is unclear what period of data was analysed. The station commenced in 1891.

Report Reference	Text	Comment
4.3.4 Flood frequency analysis at the site	1st paragraph: "The flood frequency analysis (FFA) at the site was estimated by combining daily flows from river Gauge 419006 and 419007 with data obtained from the NSW Department of Primary Industries – Office of Water."	It is unclear how the data from the two stations was combined to generate a flow record "at the site" or whether routing was allowed for.
4.3.6 Hydrological verification - Previous assessments – NSW SES	Values in Figure 8.	It is unclear what the basis for the flood level values quoted is – i.e. how were they derived and using what form of modelling or analysis? The veracity of this data should be confirmed before its use in model verification.
4.3.6 Hydrological verification - Previous assessments – NSW DPI Gauge Rating	1st paragraph: "The NSW Department of Primary Industries rating curve for Gauge 419001 Namoi @ Gunndeah [sic] is shown in Figure 9…"	This is the current rating curve. A different curve would almost certainly have been applicable in 1955. Therefore the subsequent estimation of flow rate is flawed.
	2nd paragraph: "By applying the height of the 1%AEP flood (9.73m) to the rating curve, the estimated peak discharge of the 1955 flood is estimated…"	This appears to be confusing the 1%AEP level (9.73m) from Fig 8 with the Feb 1955 flood. Figure 8 shows these as two different events.
4.3.6 Hydrological verification Previous flood studies – Gunnedah and Carroll Floodplain Management Plan	2nd paragraph: "The SMEC study estimated the 1% AEP discharge at Gauge 419001 to be about 9160m³/s (February 1955 event), but this study estimates it to be 5,881m³/s (see Table 3), based on the overlapping period of the Gauge Records (1973 to present)."	It is unclear what "Gauge Records" this refers to and the relevance of any overlapping period of data to a frequency analysis of Gauge 419001 data.
	2nd paragraph: "…it is considered that this study's estimation of the AEPs of flows is appropriate for the purposes of this study …"	This appears to be rejecting the results of the SMEC study (higher flow rates). Potential site impacts would be greater at higher flow rates.
Table 6 - title	"SMEC Study Peak Discharges and Volumes, Gunnedah (419001) (Source DLWC, 1996)"	Source of data/reference (DLWC, 1996) not provided.
Table 7	1st entry, 1st column	The station was not operational in 1864.
4.4.1 Flows used for hydraulic modelling	1st paragraph: "The 1984 event is the largest on record for Gauges 419006 and 419007…"	Downloaded daily maximum flows indicate that largest flow for 419007 was recorded on 6/9/1998.

Report Reference	Text	Comment
Figure 11	-	It is unclear how the 1984 event hydrograph was developed at site.
4.4.3 Input data Topography	1st paragraph: "The DEM was resampled to a 30m grid in HEC-RAS…"	Resampling an already coarse (30 m grid) of data would introduce further inaccuracy.
4.4.3 Input data - Boundaries	1st dot point: "The tail water condition at the downstream boundary, which was set to a normal depth with a hydraulic gradient of 0.016 (m/m)."	The basis for this number or how it was derived is unclear. It seems excessively steep which would result in a lower tailwater level. The lower half of the modelled Namoi River reach in the SMEC report (long sections) gives 0.0005 m/m.
	2nd dot point: "Inflow at the upstream boundary for Namoi River, which was applied with a hydraulic gradient of 0.016 (m/m)."	An upstream boundary is usually a flow (hydrograph) boundary, so it is unclear how the gradient is relevant. Otherwise same comment applies as for 1st dot point.
	Last paragraph: "The upstream and downstream boundaries were set at about 18km upstream and 9km downstream of the site respectively. The distances between the boundaries and the site are sufficient to ensure that hydraulic conditions at the site are not significantly affected by assumptions of conditions at the boundaries."	A distance of 9 km is not a large distance when modelling very high flows (up to the PMF). This assumption should be substantiated by testing different downstream boundary gradients. A plan showing model extents is not provided and would be useful in interpreting the results.
4.4.3 Input data - Fences and floodplain roughness	1st paragraph: "Events modelled comprise of a uniform Manning's roughness coefficient which was applied to the 2D model domain."	The Manning's n value for the river channel will differ significantly to that of the floodplain areas. If such low values were used for the river, the conveyance of the river channel would have been overestimated.
	2nd paragraph: "Estimates of impacts are based on the smooth crop roughness. This approach yields lower depths and higher velocities …it also yields higher impacts because the changes to flood levels are greater when a blockage is introduced to the flood plain. Therefore, it is considered that this approach yields conservatively high estimates of impacts…"	Lower overall flood levels for a given AEP mean that impacts could be underestimated – i.e. if a flood of a given AEP doesn't reach the site.

Report Reference	Text	Comment
4.4.3 Input data - Fences and floodplain roughness	Last paragraph: “Individual solar panels were not represented as discrete structures or as changes in the floodplain roughness value…”	In order to simulate an orchard as described in the text, then the Manning's n should be increased to reflect this – this does not appear to have been undertaken here. This will tend to reduce simulated flood levels.
	1st dot point below last paragraph:” The effects on flooding would not be pronounced, because floodwaters would generally pass below the panels…”	It is unclear what “generally” means. Do all modelled flood levels remain below the level of the panels? If not then these will significantly impede the flow and increase flood levels.
4.4.3 Input data - Bridges and structures	The Chandos Street bridge (Figure 14) is located at the downstream boundary of the model and does not significantly affected [sic] flooding at the subject site.	Unclear how this assertion is substantiated. This should be substantiated by testing the model with and without a downstream bridge.
Figure 13	Plotted 1% AEP Flood Level Drawing 31923-003	The drawing reference is to a “preliminary” plan shown in the Gunnedah Shire Council website. Although this plan is on SMEC title, it contains no reference to a report from which it was taken. The coincidence of one modelled flood limit (on one bank) at the downstream end of the model, 9km from site does not demonstrate good correspondence of predictions. Further there should not be a good correspondence given the large difference in peak flow rates used for 1%AEP in the two models.
5.5 Fence Configuration 3 – partially blocked fence with laneways	4th paragraph: “This scenario also includes laneways. The laneways divide the Solar Farm into four paddocks.”	Laneway width not stated. This is key to assessing the viability of these and should be set as a condition for the project.
Table 8	Reported depths.	Unclear what Mannings n values were assumed for this analysis. Use of the 'smooth crop' values will under-estimate these depths.
5.9 Sensitivity analysis	-	Changes in flood depths reported but unclear how flood level increases (afflux) changes nor how velocity and velocity increases change.

Report Reference	Text	Comment
7.2 Hydrology	1st paragraph: "The Mooki River and its flood plain are included in the terrain data, but the current model does not split inflows between the Namoi and Mooki rivers."	As described in Section 4.4.1, inflow to the upstream end of the model appears to be based on 1984 recorded flow rate at gauging stations on the Namoi and Peel Rivers. So it is unclear how the flow in the Namoi and Peel Rivers could be used to "split" inflows" to the Mooki River. Flow from the Namoi passes through 'break out' channels (e.g. Carroll Creek) from the Namoi to the Mooki (included in SMEC modelling). It is unclear if such 'break out' was included in the reported modelling. The inclusion of break out channels would be particularly significant for large flows (e.g. PMF).
Appendix A Model results	-	Flood velocity change maps are not provided – these are equally as important as flood depth change.
	Plotted results	It appears that the Mooki River was included in the modelling (its lower reaches appear on flood maps). However it is unclear what flow rate was assumed in this river. The Mooki is a major tributary of the Namoi and joins the Namoi upstream of Gunnedah. Therefore flows in the Mooki will have a significant influence on flood levels in the Namoi in the modelled area.

In conclusion, the most significant issue in the modelling reported relates to the use of the 30 m grid of SRTM data used to define topography. The grid spacing is insufficient to simulate flows in the Namoi River itself (and any other defined waterways). The reported accuracy of the data is also low in the context of flood modelling. Underestimating or overestimating the flow rate that passes along defined waterways has an effect on the relative flow rate that passes through floodplain areas – i.e. the proposed project site. For this and other reasons given in the table above, the reported model results may be unreliable in terms of predicting absolute flood levels at the project site and for predicting the impacts of the project on flood levels.

Please contact the undersigned if you require further information.

Yours faithfully,

Tony Marszalek
Director