92 Taylor Street, Armidale
NSW 2350
t: (02) 8081 2685

Mr John Goodall

Program Leader – Building and Development

Armidale Regional Council
PO Box 75A
Armidale NSW 2350

30 October 2019

Our ref: 19ARM 13082

Dear John,

RE: Stringybark Solar Farm DA - 112-2019 – Response to Public Submissions

The following responses are provided to Armidale Regional Council on behalf of Stringybark Solar Farm Pty Ltd (the 'Proponent') regarding comments and/or questions raised in public submissions for the proposed development of a solar farm at Gara Road, Metz (DA 112-2019).

Each of the issues raised in the submissions have been categorised and tabulated below so they can be addressed in detail as part of the development assessment process. To assist you in this assessment, where topics have been addressed previously in the Statement of Environmental Effects (SEE), this is also indicated.

Should you have any questions about any aspect of this advice or for further information regarding the development please do not hesitate to contact me on (02) 8081 2689.

Yours sincerely,

Robert Cawley
Senior Consultant

Topic	Topic location(s) in the SEE	Summary of concerns raised	Response by issue
Loss of Agricultural Land	• Section 7.14.3 quantifies the portion of agricultural land that would be lost for the duration of the Proposal and assesses this impact • Classification and soil capability of the land is discussed at Section 7.2.2, see Table 7-2, pg. 50 • Section 5 considers land use conflict from a policy perspective	1. The Proposal would result in a significant loss of agricultural land.	The Proposal Site of 94 ha represents 0.01% of the total land area within the Armidale LGA. Removal of this portion of land from agricultural production for the 30 year life of the Proposal would result in a negligible reduction in the availability of agricultural land at the local, regional and state levels. It should be noted, the Proposal does not represent a permanent land use change as there is a clear request in the SEE for a fixed term permit for 30 years, at which time the Proposal would be decommissioned, and the Site returned to a state suitable for agricultural use.
		2. Solar farms should not be located on highly productive land such as the Proposal Site. They should only be located in very unproductive areas where they do not displace agricultural production.	The Proposal has been strategically located outside any land identified by the NSW Government as Biophysical Strategic Agricultural Land (BSAL) (SEE pp 52). BSAL is defined as '*land with high quality soil and water resources capable of sustaining high levels of productivity*' (DPIE, 2019). As such, in accordance with conclusions made in Section 7.2.2 of the SEE, it is not considered that the Proposal Site is classified as 'highly productive' land. However, while the Proposal Site is not mapped as BSAL, it is acknowledged that the Site is suitable for agriculture. Nevertheless, it is not considered that the loss of 94 ha (0.01% of the total land area within the Armidale LGA), nor its annual production value of 450 (Dry Sheep Equivalent) DSE (Appendix A), for the 30 year life of the Proposal would result in a meaningful displacement of agricultural production at the local, regional or state level. Further to the information provided in Section 7.2.2 of the SEE, an assessment of the Site's productivity has been provided by a local agronomist in Appendix A. The Proposal does not represent a permanent land use change as there is a clear request in the SEE for a 30 year fixed term permit, at which time the Proposal would be decommissioned and the site returned to a state suitable for agricultural use. Solar farms typically locate on agricultural land because of their need for broad-hectare lots, with limited native vegetation. While it may seem preferable to locate solar farms in remote ('very unproductive') environments, this would require extensive new electricity infrastructure to be installed across the landscape to transmit electricity from remote locations to population centres where it is needed. This would result in significant increases to the cost of electricity.
		3. The displacement of agricultural land for the Proposal would have implications for food security.	While it is acknowledged that the construction of a solar farm at the Proposal Site would reduce agricultural production (equivalent to 450 DSE per annum, refer Appendix A), it is not considered that the removal of 94 ha of land with '*low to moderate capacity*' which is not mapped as BSAL would result in a meaningful reduction in food security at the local, regional or national level. Nor would the reduction in agricultural

			output result in a significant impact to the services that support the agricultural sector at the local, regional or state level.
		4. Farmers are already in drought, loss of agricultural land would further stress the industry.	A change in land use at the Site for the 30 year duration of the Proposal would provide economic diversification at the local level through lease payments to landowners, wage payments to employees and the use of local service providers (see Section 7.14 of the SEE for further details). This diversification would help to strengthen the local economy in times when agricultural activity is low (e.g. during drought conditions).
		5. The use of the land for a Solar Farm would create a land use conflict.	The Proposal will have a lifespan of 30 years and will not involve permanent changes to the Site. The size of the Site (94) ha will not compromise or significantly diminish the availability of land for primary production purposes within the Armidale Regional LGA. Furthermore, due to sunshine harvesting being a passive land use, the Proposal would not have any offsite impacts that would impact the World Heritage National Park nearby, any BSAL, or the continuation of any of the existing or proposed primary land uses in the surrounding RU1 and RU4 land use zones. Once the Proposal is decommissioned, the land will be returned to a suitable state to permit a return to agricultural use. A land use conflict analysis based on the DPI's Living and Working in Rural Areas handbook (Learmonth, Whitehead, Boyd & Fletcher 2017) is presented in Table 7-4 of the SEE.
		6. Grazing sheep within the solar farm would not be viable.	The SEE states that sheep grazing could be used to assist in vegetation and weed management at the Site. This would offset some of the costs of carrying out these activities using alternative methods. It is not suggested that the sheep grazing would be economically viable in its own right, as it is clear that stocking rates would be lower than under normal greenfield conditions. Rather, sheep grazing could help to offset some of the costs associated with Site maintenance and provide an opportunity to further diversify income (at a much reduced scale) at the Site. Claims that it is not possible to graze sheep within solar farms are contrary to actual operational evidence, such as the University of Queensland's 10 ha 3.3 MW solar facility near Gatton, where sheep are successfully utilised to control the pasture that actively grows under the solar panels (Sibson, 2016; Sorensen, 2017).
		7. Agricultural production at the Site would support just as many employees as the Proposal would.	Under the current agricultural regime, the Site provides direct employment for less than 1 full time equivalent position. There would also be some indirect employment generated as a consequence of the current agricultural activities, for example; transport services, agricultural suppliers and contacting services. However, as outlined in Section 7.14 of the SEE, this is less than the estimated 60 equivalent full time construction positions and the 3 to 6 full time operational positions that would be directly generated by the Proposal along with the indirect employment that would be generated over the 30 year lifetime.

		8. The Proposal will impact the agricultural quality of the Proposal Site. As such, the restoration of the Site would be difficult if not impossible due to permanent impacts on soil quality.	There is no evidence to suggest that the establishment and operation of a solar farm would impact the long term agricultural quality of the Site. While the Site will not be used for agricultural activities during the 30 year life of the Proposal (apart from potential sheep grazing for vegetation control), it would be fully decommissioned and returned to a state suitable for agricultural use at the end of its life. All the physical infrastructure would be removed from Site during decommissioning including: • The substation; • Buildings; • Removal of the solar panels, tracking systems, inverters and cables • Removal of onsite tracks and fences unless otherwise agreed with the landowner; and • reinstatement of all disturbed ground. Section 7.2 of the SEE provides mitigation measures to prevent activities at the Site resulting in contamination. It is suggested in some submissions that the Proposal would have long term implications on soil quality due to compaction. This is considered unlikely due to the way solar farms are constructed and the management practices used to operate them. While the reasons for such compaction have not been provided, it may be that it has been assumed that compaction would occur during construction when the panels and the tracking systems are installed or during maintenance activities when the solar farm is operational. As described in the SEE, the panels would be fitted to a single axis tracking system. The tracking system is supported by plies which are typically spaced at intervals between 5 and 10 m along rows. Piles are usually driven into the ground mechanically in the same way that vineyard posts are installed. However, the piles are not solid like vineyard posts but usually formed in metal (approx. 3 mm) in a Z like or U shaped configuration (see below example in **Figure 1**). The piling process is fairly quick, causes little soil disturbance and is usually completed by a small tracked machine that moves systematically along a pre-set GPS coordinate route. The panels are then fitted by hand to a tracking system that sits on top of the piles. Components for this phase of the installation process are usually distributed alongside the rows by small light vehicles. In conclusion, while there will be movement of materials across the Site during construction the activities are unlikely to cause compaction that would result in a reduction in soil quality. During the operational phase of the Proposal there will be permanent access tracks constructed across the Site. These access tracks will be used to access the Array Area for day to day management. However, it will be necessary to traverse between panel rows, which would not have formed access tracks. This would be required for quality checks, maintenance and panel cleaning activities. These activities will be carried out using light vehicles. As such, it is not considered that the proposed level of traffic would result in soil compaction that would lead to a long term reduction in soil quality.

During operation, grass cover will be maintained across the Site both between and under the panel rows to provide groundcover. The groundcover will stabilise soils preventing soil erosion and will assist in localised water penetration. Should mowing be utilised as a method to control grass growth under the solar panels, the grass will be directly mulched back onto the soil surface therefore building soil organic matter and enhancing carbon capture while improving water infiltration.

The elimination of grazing or a significant reduction in stocking rates would decrease soil disturbance and therefore reduce the erosion, sedimentation and riparian disturbance at the Site resulting from the current land use. In addition, a decrease in fertiliser use and stocking rates would reduce the potential for nutrients to enter surface waters. **Appendix A** provides detail on the types of grasses that could be utilised at the Site, as well as how they would be successfully established.

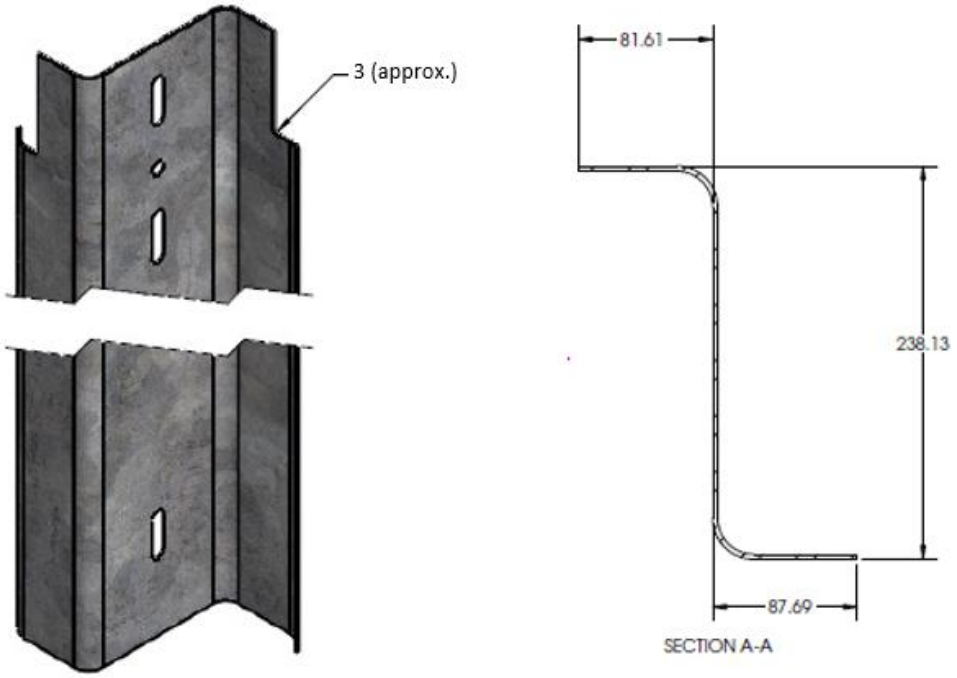

Figure 1: Typical 'Z' pile showing form and cross section (measurements in mm)

Decommissioning & Waste Issues	• Decommissioning of the solar farm is an integral part of the planning permission being applied for – it is considered throughout the application • Waste and resource use is covered in Section 7.13 • Section 3.1.2 outlines site selection	1. There is a lack of recycling facilities in Australia, therefore panels may end up in landfill.	In Australia, despite the industry being relatively young, there is already a commercial scale recycling plant operating in South Australia (Reclaim PV Recycling, https://reclaimpv.com/) and recycling options are expected to increase over time. Components within solar panels, up to 76% glass, (SEE, pg. 113) are readily recyclable with recovery rates increasing as the global industry improves its recycling ability and is increasingly bound by regulation to reduce waste and recycle. As is made clear in the SEE, the Proponent is aware of its responsibilities under the WARR (2001) and POEO (2014) Acts to recover, reuse and recycle waste generated (Section 7.13). Prior to the decommissioning phase, a Decommissioning Management Plan (DMP) will be prepared. The DMP would identify resource recovery and recycling activities and responsibilities.
		2. Panels may leach contaminants into the soil.	There is no clear evidence that the leaching of toxic elements from solar panels during the operational phase is an environmental issue in Australia or abroad (Robinson and Meindi, 2019). Although there are a number of materials used in the manufacture of Panels that are considered toxic, "*for intact PV panels, leaching of these elements is unlikely to occur*" because they are encased in a number of protective layers as explained below (Robinson and Meindi, 2019, emphasis added). During the manufacturing process of a solar panel, the PV cells are typically encapsulated in a clear hardened resin with strengthened glass protecting the front side, as well as a back side made from a polymer such as Tedlar PVF material (Clean Energy Review, 2019). The completed panel is then further protected by an aluminium frame. These features protect the panel from the environment including extremes in temperature, rainfall, hail and humidity (Clean Energy Review, 2019). A robust design, combined with a standard 25 year warranty (DNV-GL, 2017) ensures that the likelihood of cell material being exposed to the environment is very low. Indeed, discussions with manufacturers on this point support this view with one Australian manufacturer stating that: "*In a high quality module, the encapsulant prevents the deterioration and emission of these elements from the module*". Nonetheless, the following procedures would be adopted to ensure that; firstly, panels are unlikely to become structurally compromised; and secondly, if panels do become compromised, potential environmental effects will be avoided. 1. **Due Diligence Process** As a minimum, panels should meet the Australian standard AS/NZS 5033 for photovoltaic modules and the international standard IEC 62804 (Clean Energy Council, 2018); panels should be backed by a 25 year warranty (DNVGL, 2017); and panels should be tested and checked for structural deficiencies (particularly after delivery to site and before installation). 2. **Robust operational protocols governing procedures for checking panel integrity** The Operation Environmental Management Plan (OMEP) would include clear provisions for routinely checking panels to ensure structural integrity and performance throughout the operational period. Any panel found to be defective would be assessed and dealt with in line with the requirements of the WARR (2001) and POEO (2014) Acts (See Section 7.13.3, pg. 113 on panel recycling).

		3. Panels will require regular replacement.	Claims that panels require regular replacing are unsubstantiated. As noted above panels supplied for utility scale solar have standard warranty periods of 25 years (DNV-GL, 2017).
		4. The Site is unlikely to be decommissioned.	The commitment to decommission the project is explicit throughout the SEE. The development application includes a decommissioning process to be completed within 30 years of the Proposal's life. It is assumed that the requirement for decommissioning will be a condition of consent. As such, compliance would be required under the EP&A Act.
		5. Future owners would not be bound to decommission the Proposal.	Compliance with any decommissioning condition attached to the consent for the Proposal would be required under the EP&A Act irrespective of future ownership.
Site location and design	• Section 3.1.2 outlines site selection	1. There are many alternative sites in the area that would not have the same impact as the Proposal.	Site selection is a complex process which is driven by a matrix of factors. Renewable generators (solar farms) require a good renewable energy source at their location, transmission lines with capacity to export electricity to end users in proximity to the development, along with a suitable land resource (as defined by the environmental studies that support this development application). In Australia the electricity network has historically been dominated by centralised fossil fuel generators located close to centres where there is high demand for electricity. This has created electrically strong areas of network capacity around large population centres like Sydney, Brisbane and Melbourne with areas of relatively week capacity in the less densely populated rural areas of the network. To maximise the potential of the existing electricity network, new renewable generation must seek out unused capacity in the network. By doing this, the need to construct additional long-distance transmission infrastructure can be avoided while maximising the output of the existing network. Unlike their fossil fuel counterparts, solar generators need to be located where there is access to a sufficient energy resource (sun) and on land that is suitable for solar infrastructure, and in locations that will not result in unacceptable environmental impacts. As such, suitable sites for solar farms are usually located in regional areas, where as explained above, the capacity of electricity network is relatively week and therefore connection opportunities to export additional electricity are limited. For clarity, connection opportunities are not necessarily where transmission lines exist but where there are lines with the potential to facilitate additional electricity distribution. Based on the explanation above, while at a cursory level it may seem like there are abundant sites to locate new solar farms, the real potential is much more limited. The applicant has considered alternative locations, through consultation with network operators, desktop assessments and site visits. The SEE demonstrates that the proposed Site is suitable for solar development and that there would be no unacceptable environmental impacts as a result of the Proposal.
		2. There are too many solar farms in New England already.	Page 123 of the SEE provides a map of consented and proposed SSD solar farms in the local area. Note, only the Metz Solar Farm has been approved.

			In the wider New England area (which covers a large area from Tenterfield to Tamworth) White Rock Solar Farm (SSD) is operational and Sapphire Solar Farm (SSD) is approved near Glenn Innes. A new 3 MW solar farm is currently being built at the University of New England in Armidale. Each application is assessed through structured assessment under the EP&A Act which includes assessment of cumulative impacts on a local and regional scale.
		3. The Proponent has only selected the Proposal Site due to the proximity of the transmission lines.	Proximity to transmission lines with available capacity is a very important aspect of site suitability. However, a successful Proposal must also contain a number of other necessary elements that combine to make it acceptable. These include, but are not limited to: • **Solar irradiation** - the site has excellent irradiation levels; • **A viable connection to the national grid** - the Site represents a relatively rare opportunity (as explained above) to connect to the national grid without the need for extensive new overhead transmission lines to connect a proposal at a more remote location; • **Topography and key landscape features** - the Site has simple topographic features and slope gradients well within the standard tolerance levels for solar infrastructure (See Section 7.2 of the SEE, and **Appendix B** to this document which provides evidence of the Site's suitability from a manufacturer's perspective); • **Minimal environmental constraints / impact** – See Section 7 of the SEE which demonstrates that the Proposal will not result in any unacceptable environmental effects; • **Located and designed such that it will not affect existing land uses** – the construction and operation of the Proposal will not affect adjacent or nearby land from continuing any current land use activities due to negligible offsite effects as a consequence of the Proposal; • **Access to the existing road network** - the Traffic and Transport Assessment demonstrates that the road network (with some upgrades) has the capacity for the Proposal; • **Access to suppliers and materials** – the Proposal has good access to Armidale and its transport networks; and • **Landowner support**.
		4. Solar Farms do not need to be located near high voltage lines.	The cost of building new transmission lines is expensive and will essentially add to the cost of electricity generated by a development, or could make such a solar farm unviable. As such, it is preferable to build developments close to transmission lines which have the capacity to export electricity.
		5. The Proponent has been misleading to state that it has considered other sites.	See point 1 above.

Socioeconomics	• Section 2.4 outlines benefits associated with the Proposal • 7.14 Covers socioeconomic factors	1. Benefits are overstated/not guaranteed.	It is clear that any construction project similar in size to the Proposal would have both local and regional economic benefits. These benefits are outlined on pg. 5 of the SEE and include: • Approximately 60 jobs during the construction phase, sourcing workers from a wide range of fields and expertise, including engineers, construction workers and labourers; • Generation of income in the region through capital expenditure, the provision of wages and expected flow-on benefits; • Between 3 and 6 full time jobs during the operational phase; • Direct business volume benefits for local services, materials and contracting businesses during all stages of the Proposal; and • Diversification of rural income streams over the operational period of the Proposal. Benefits are not overstated. For example, based on an average construction wage of $80,000 pa (ABS, 2018), the level of employment over the 9 month construction period would equate to $3,600,000. Although it is not possible to say how much would be spent in the local area, it is likely that workers would require services throughout their employment. As noted in the Agricultural Land section above (point 7), the Site currently provides direct employment for less than 1 full time position meaning that the Proposal, with 3 - 6 operational jobs, would represent an increase in employment over the 28 year operational period. Wider benefits around the offset of CO_2 emissions from the current energy mix in NSW would have broader economic, social and environmental benefits over the Proposal's lifetime.
		2. Benefits will not be kept local in contrast to farming related activities.	As noted above, there will be ongoing local benefits, specifically through the provision of wages and predicted flow-on benefits; and through the ongoing requirement of local goods and services, for example fencing and track maintenance.
Noise	• Noise is addressed at Section 7.9	1. There would be noise at the closest residence to the Proposal (686 Gara Road)	The construction noise assessment acknowledged that there would be some noise impacts at 686 Gara Rd. However, while construction noise is expected to be noticeable (as is typical of construction projects), the degree of adverse impact is expected to be low and can be managed with mitigation. The operational noise assessment showed that there would be negligible noise impacts at neighbouring residents during the operation of the Proposal.
Precedent for other solar farms	• Cumulative impacts are dealt with in Section 7.15	1. The approval of Stringybark Solar Farm would set a precedence for other solar farms in the area (in particular the Oxley Solar Farm).	Approval of the Stringybark Solar Farm would not set a precedence for Solar Farms in the area as any future Development Application must be assessed on its merits.

Landscape and visual Impact (LVIA)	• Appendix E provides a LVIA of the Proposal • Section 7.7 provides a summary of the LVIA	See Appendix C	Appendix C provides a report in response to topics raised about potential landscape and visual impact.
Traffic impacts	• Appendix G provides a Traffic and Transport Assessment (TTA) of the Proposal • Section 7.7 provides a summary of the TTA	See Appendix D	Appendix D provides a report in response to topics raised about potential traffic impacts.
Terrestrial Ecology	• Appendix A provides a BDAR ecological assessment in accordance with the Biodiversity Assessment Methodology (BAM) under the NSW *Biodiversity Conservation Act 2016* (BC Act).	1. Concern that the ecological assessment has under represented the number of endangered communities present at the Site.	The 12 full-floristic vegetation integrity plots undertaken in accordance with the Biodiversity Assessment Methodology (BAM) were surveyed to confirm the identification Plant Community Types (PCTs) and Threatened Ecological Communities. As mapped, 2 vegetation communities exist within the Stringybark PV area (PCT 510 (g) & PCT 568 (g)). Four plots were completed within PCT 510 and seven within PCT 568. The number of plots completed within each vegetation zone is greater than the number of plots required as described within the BAM (OEH, 2017). Targeted surveys for threatened plants were completed by ELA ecologists from 25 to 28 February 2019 in accordance with the NSW guide to surveying threatened plants (OEH, 2016). The GPS recorded tracks of the ecologists undertaking the targeted threatened flora surveys are mapped on Figure 8 of the BDAR (Appendix A to the SEE). Bluegrass (*Dichanthium setosum*) populations were identified in the eastern portion of the Development Envelope in two discrete clusters (approximately 10 and 30 plants respectively – see Figure 9 of the BDAR). Based on the environmental conditions and presentation of the species at the time of survey, there is no evidence to suggest that the species occurs more widely than in the locations where it was identified.

		2. Concern regarding the effects of drought at the time of assessment.	The biodiversity assessment was undertaken in accordance with seasonal survey requirements as mandated in the BAM. The BAM considers long-term records to determine potential candidate species based on the PCT present, and has been developed to be robust to seasonal and climatic variability, including periods of drought. Despite drought conditions at the time of survey, *Dichanthium setosum* was readily identifiable; as demonstrated by the confirmed records in the eastern portion of the Site. No other threatened flora or fauna species were identified during extensive, targeted surveys. This is attributed to prior land management practices at the Site (clearing, grazing and pasture management), rather than dry weather conditions.
		3. Concern about removal of trees, potential impacts to remnant vegetation and the capacity for biodiversity offsets to compensate for the loss.	Refer to the BDAR (Appendix A to the SEE). The Site does not contain hollow bearing trees and predominantly consists of poor condition grassland. No trees will be removed for the installation of the PV array. Only exotic trees within the Substation Location Area will be cleared. The design has minimised vegetation clearing through strategic design and placement of infrastructure in already cleared areas. In designing the development, the aim was to conserve the more intact peripheral vegetation whilst centring development in the most cleared portions of the study area. Ecologically sensitive tree clearing methods are identified in the BDAR, and shall be implemented to ensure minimal impacts to surrounding flora and fauna. Biodiversity offset requirements are determined in accordance with the BAM, which has been developed to compensate for impacts to biodiversity in a scientifically robust and intergenerationally equitable manner.
		4. Concern that the Proposal may impact on wildlife corridors.	The Proposal has been located to avoid potential impacts to wildlife corridors. Through the strategic avoidance of woodland vegetation, the Proposal will not significantly impact on potential wildlife corridors. The extensively cleared paddocks that characterise the Array Area do not provide resources or habitat associated with effective wildlife corridors. However, the sensitive siting of the Proposal maintains intact, semi-continuous woodland habitat to the north, west and south of the Site associated with the Waterfall Way road corridor, the intersecting vegetated ridgeline, and riparian vegetation associated with Commissioners Waters and the Gara River. While perimeter security fencing will create a barrier to the movement of terrestrial fauna, potential for migration around the paddock scale PV array area remains viable.
		5. Concern that the Proposal may impact Koalas.	Potential impacts to Koalas associated with the Proposal are considered within the SEE and the BDAR, and conclude that there is no evidence of Koala core habitat or breeding activity within the Site. The site is not located within a recognised Koala movement corridor, however, the Northern Tablelands Recovery Koala Strategy identifies revegetation and rehabilitation priorities within a potential population corridor located to the west of the site connecting Dangar Falls to areas north east and north west of Armidale (Envirofactor, 2016).
		6. Concern that the Proposal involves clearing of trees and	Through actively targeting previously disturbed areas, tree clearing and groundcover disturbance is minimised within the Proposal.

		ground cover during a period when natural vegetation is struggling to withstand changing climate patterns.	All remaining impacts to native vegetation are assessed within the BDAR. All impacts to biodiversity associated with the project would be offset in accordance with the Biodiversity Offsets Scheme (BOS) under the BC Act, which will require in-perpetuity management of 'like for like' biodiversity values.
		7. Suggestion that the site would benefit from tree planting noting that preservation of remnant vegetation has been undertaken by other landholders in the area.	Through actively targeting previously disturbed areas, tree clearing and groundcover disturbance is minimised within the Proposal. The establishment of vegetation screening utilising appropriate local native species will provide additional biodiversity outcomes and reduced stocking rates will benefit local ecology. The Proposal has avoided the large portion of remnant vegetation to the north of the Development Envelope.
		8. Concern about the 'Lake Effect' and that this might lead to effects on local bird life.	On the topic of 'Lake Effect', a comprehensive literature review by Taylor, Conway, Gabb & Gillespie (2019), stated that '*Media and grey literature reports indicate that water birds may confuse large solar arrays with water bodies; and of collisions with solar panels at large-scale PV solar parks. A study by Bernath et al. (2001) observed birds such as black kite and swallow attempting to drink from plastic sheets which led the authors to the hypothesis that these birds were attracted to sources of polarised light. It has been suggested that birds that drink on the wing, such as swallows, could be at risk of collision with solar panels (which also reflect polarised light), while there is unlikely to be a risk to birds that drink from a perched position (Harrison et al. 2017)'.* However, they go on to say that '*Very few relevant research papers were found during the data search for this review that substantiated these contentions'.*
		9. Concern that the Proposal has the potential to lead to an increase in invasive species at the Site.	Weed and pest control at the Site is the responsibility of the Proponent. The Proposal is unlikely to increase any invasive flora or fauna and the risk from priority weeds and pests is low, but would be subject to ongoing monitoring and management (Section 7.2 and 7.3). Herbicides will be used to control weeds at the site if necessary. Good management practices will be implemented to ensure that herbicide use is minimised (including the potential use of sheep to graze between and below the panel rows to manage vegetation loads). The application of any herbicides will be in accordance with the NSW *Pesticides Act 1999*, such that only registered products would be used based on label instructions that are designed to minimise impacts on surrounding land. The distance from neighbouring properties means the potential conflict is assessed as low. Mitigation measures to manage invasive species will be included in the Environmental Management Plans and include targeted control measures for pest vertebrate species that may occur within the Site. The mitigation measures reduce the risk of potential impact to '*very low*'.

		10. Concern about straying livestock potentially accessing the Solar Farm.	Straying livestock will not be able to access the solar farm. A new perimeter security fence up to 2.5 m high will be constructed around the entire Proposal. All fences will be maintained to avoid the possibility of livestock straying onto the Site from the Landholding or any adjoining properties.
		11. Concern regarding the establishment of tree screening plantings due to adverse conditions.	Specifications and performance criteria for the screening will be developed as part of the Construction Environmental Management Plan (CEMP) and its ongoing maintenance guided through commitments in the Operational Environmental Management Plan (OEMP). Climatic conditions in the vicinity of the Proposal may present challenges in tree establishment from time to time. However, the site for the proposed vegetative screens is well suited to this undertaking, being mid-slope, well drained and sunny locations. Prior to development, the Proponent shall liaise with recognised local experts in regard to species selection, site preparation, planting and maintenance of these screens. Furthermore, both the CEMP and OEMP will include auditable performance indicators to gauge the ongoing success of the plantings. Should the screening not meet these expectations, a suite of remedial actions will be implemented to investigate and resolve issues associated with any mortality, slow growth or non-suitability of selected species. Potential considerations include use of alternative species or installation of irrigation systems, etc.
Water Supply	• Section 7.8 (Water)	1. Where will water for the Proposal be sourced and will this have any impact on local water resources?	It should be noted that no water for the Proposal will be sourced from Commissioners Waters, Gara River or from local groundwater resources. Most water required to support the construction, operation and decommissioning of the Proposal will be sourced offsite from contractors who hold an appropriate water licence. A small volume of water will be reused onsite from dewatering activities during construction for example, when onsite dams are filled in. Water will be required for: • Non potable water for dust suppression (construction); • Non potable water for general construction activities (for example cleaning of machinery); • Water for fire protection (construction and operation); • Watering for the establishment of the onsite vegetation screens (construction/operation); • Potable water for onsite amenities (construction and operation); and • Panel cleaning. Panels can be cleaned using water, a combination of air and water, or air alone (operations).
		2. Concern that there would be a water license request to draw water from Commissioners Waters potentially impacting the	The Proposal is not seeking a water license to draw water from Commissioners Waters. Any water sourced offsite would be under agreement with existing water access licences.

		availability of water for surrounding landowners.	
Alteration of climate	• Not addressed	1. Concern that the Proposal of the Proposal would change local climatic conditions and exacerbate drought conditions.	There is little conclusive evidence that solar farms significantly alter the local climate surrounding where they are located, by means of a heat island effect. While there are very localised changes caused by heating of the panels, significant changes are limited to within array areas, with localised heating between 1.9°C and 4°C recorded in studies (see Barron-Gafford et al., 2016; Fthenakis Yuanhao, 2013). Of studies which illustrate the potential for a 'heat island effect', heat generated '*completely dissipates to the environment at heights of 5 to 18 m*', above the arrays and rapidly dissipates laterally (Fthenakis Yuanhao, 2013). Other effects include convection based changes in wind speed directly above the panels, averaging less than 2 m/s but not beyond an elevation of approximately 3m above panels (Hassanpour Adeh *et al*., 2018). It has also been found that arrays with no groundcover vegetation could contribute to further heat increases due to the bare earth re-radiating heat beneath the panels (Hassanpour Adeh *et al*., 2018), however Section 7.2.4 in the SEE demonstrates the Proponent's commitment to ensure that there is vegetative ground cover across the Site.
Planning Policies	• Section 5 (Statutory and Planning Framework) • Section 7.2 (Land) • Section 2 (Strategic Justification)	1. Concern that that Proposal contravenes the intent of either Ru1 land, on which it is sited, or Ru4 land from which it is visible.	Clause 34.7 of the State Environmental Planning Policy (Infrastructure) 2007 (SEPP) states that the development of a solar energy system with a generation capacity greater than 100 kW, may be carried out by any person with consent on any land, other than in a prescribed residential zone. The Proposal is located on land zoned as 'Ru1 Primary Production. The objectives of Ru1 land are described in the Armidale Dumaresq LEP (2012) as: • To encourage sustainable primary industry production by maintaining and enhancing the natural resource base. • To encourage diversity in primary industry enterprises and systems appropriate for the area. • To minimise the fragmentation and alienation of resource lands. • To minimise conflict between land uses within this zone and land uses within adjoining zones. • To allow for non-agricultural land uses that will not restrict the use of other land in the locality for agricultural purposes. The Proposal may be visible from areas of both Ru1 and Ru4 zoned land in proximity to the Site. The objectives of Ru4 land within the Armidale Dumaresq LEP (2012) are: • To enable sustainable primary industry and other compatible land uses. • To encourage and promote diversity and employment opportunities in relation to primary industry enterprises; particularly those that require smaller lots or that are more intensive in nature. • To minimise conflict between land uses within this zone and land uses within adjoining zones.

			The Proposal is demonstrated to be permissible and in accordance with the objectives of Ru1 in Section 5.1 of the SEE. Furthermore, the Proposal is compatible with the objectives of nearby Ru4 land. It is noted that, despite smaller minimum lots sizes (40 ha) and historic subdivision, nearby Ru4 does not constitute residential land, nor is residential amenity an objective of the Ru4 zoning.
		2. Concern that the Proposal conflicts with the primary goals of the NSW Government regional plan for New England and the North West (2036).	The Proposal is well matched to the primary goals of the New England-North West Regional Plan, these being: • A strong and dynamic regional economy • Healthy environment and pristine waterways • Strong infrastructure and transport networks for a connected future • Attractive and thriving communities The Proposal will provide investment and job opportunities to help bolster the local and regional economy, providing a range of opportunities across traditional and emerging industries, while promoting the regions reputation for technological innovation. The Proposal will help to bring prosperity and growth, essential to allow communities to thrive and to invest in improved, housing, public infrastructure and transport options. The Proposal has been developed to minimise impacts to biodiversity and the natural environment. Potential impacts to biodiversity shall be offset under the BOS, while the transition from traditional grazing enterprises to managed pastures provides the opportunity to reduce land and water degradation. The Proposal is strongly aligned to the Armidale Region's character; defined by a prosperous economy, diverse community, outstanding natural assets and access to high level services. Furthermore, the identification and promotion of wind, solar and other renewable energy production opportunities is identified as a priority for the Armidale Region within the New England-North West Regional Plan.
Drainage, Runoff and Erosion	• Section 7.2 (Land) • Section 7.8 (Water)	1. Concern regarding the adequacy of the water assessment that supports the SEE.	Within the Australian context, the development of PV solar farms has generally been shown to have a very small and easily managed impact on rainfall runoff and downstream hydrology. This is because the vast majority of infrastructure associated with PV solar farms is located above the ground on posts which are driven into the ground with minimal disturbance to the surface or existing groundcover vegetation. The panels themselves are generally well above the natural ground level and accordingly do not impede surface water flows across the PV array area. Ancillary infrastructure such as invertors, substations and on-site buildings, are usually located away from water flow paths and/or areas of inundation that occur during flooding. Access tracks, which make up the majority of impervious areas within a solar farm can be located in areas of inundation, provided suitable mitigation measures are incorporated into the design to ensure there are negligible effects on surface water flows. This low risk of adverse impacts matches the practical experience of Eco Logical Australia (ELA), who have undertaken a number of hydrological assessments for solar farms within the New England region and more

			broadly throughout NSW. Of relevance to the current study are findings associated with the Metz Solar Farm (located approximately 9 km north-east of the Proposal), where modelling of the potential hydrological effects of the (approximately 3 times larger) development indicated negligible impacts to downstream flows (ELA, 2017). Furthermore, the installation of the PV solar farm does not significantly decrease the amount of pervious area within the Development Footprint (less than 0.5% of the contributing catchment would potentially change from pervious to impervious). This is because the panels are located above the ground, allowing any intercepted rainfall to be shed from the panel area to the undisturbed ground below, which absorbs water, reducing energy and runoff volumes. The initial water assessment prepared for the Stringybark Solar Farm SEE did not include detailed hydrological flood modelling as it is generally considered more appropriate to be completed post consent as part of the detailed design process. However, in recognition of community concerns regarding potential flooding and/or erosion impacts as a consequence of the Proposal, the Applicant has commissioned preliminary hydrological modelling to demonstrate that the solar farm is appropriately located and that potential impacts can be effectively mitigated. This preliminary modelling augments information presented in the SEE and provides: • Preliminary calculations of water depths and velocities across a range of rainfall durations and intensities (i.e. different storm events) for both current conditions and post-development scenarios; and • Identifies key locations where stormwater management features may need to be considered. The results justify the approach taken in the SEE and illustrate that the proposed Site is well-suited for the purposes of a solar farm. The majority of the Site is free from potential flooding and the predicted changes in hydrology as a consequence of the Proposal can be readily mitigated (Appendix E). Preliminary modelling indicates that the only hydrological changes that will occur (as a consequence of the establishment of the proposed solar farm) would be minimal changes to flow characteristics within the existing drainage lines when compared to current conditions. For example, for the 1 in 100 year flood event, with all existing dams removed from within the PV Array area (as detailed in the SEE), the unmitigated peak flow leaving the Site would potentially increase from 28.6 m3/s to 31.6 m3/s. These relatively small volumes of water predicted for the 1 in 100 year flood event, both pre and post development reflect the small catchment area within which the Proposed Development is located. As such, the difference between pre and post-development flows is not considered significant.

			The implementation of mitigation measures, such as drop structures and detention ponds, as outlined in Managing Urban Stormwater: Soils and Construction (the Blue Book), would be used to mitigate effects, resulting in negligible downstream impacts as a result of the Proposed Development.
		2. Concern that slope on Site presents an unmanageable erosion risk.	The slope contours of the Development Envelope show an average and consistent 3%-4% gradient from north to south. Across the Development Envelope (i.e. perpendicular to overall fall) the average gradient is negligible. Locally steeper areas are located near the two drainage lines running through the Development Envelope. As discussed above, hydrological modelling indicates that the Site is well suited for solar farm development being located within a small catchment area with limited potential for localised flooding and manageable stream flows. Hydrological modelling (Appendix E) shows that the majority of the Site is not prone to erosion, as there is no sheet flow. Within the drainage lines themselves, modelling indicates some potential for erosion, however, aerial photography and site inspections indicate good groundcover vegetation (as discussed in other points) and a lack of erosion under current management practices. The removal of farm dams within the drainage lines may result in localised changes in flow velocity resulting in potential erosion, however this would be mitigated for example, through the installation of drop structures and downstream sediment basins (within the Development Envelope). Based on these findings it is concluded that the slope associated with the Site does not present an unmanageable erosion risk.
		3. Suggestion that an Erosion and Sediment Management Strategy should be provided as a condition of approval.	Erosion and sediment control plans are site specific recommendations and strategies that are routinely prepared post-consent during detailed design, and prior to the commencement of construction to ensure that effective on ground actions are taken to manage erosion and sedimentation during the construction, operation and decommissioning phases of a development. As such, it is not considered appropriate to prepare erosion and sediment control plans prior to consent. Nonetheless, strategies have been built into the concept design to minimise potential for erosion and sedimentation. These include: • The retention of existing groundcover vegetation throughout the Site is prioritised; • There is a commitment to rehabilitate any disturbed ground cover as soon as practical; • Hydrological modelling will be used to identify areas at risk of scouring and used to assess and test stormwater management structures and mitigation strategies to prevent and/or control any potential areas of erosion and prevent potential off-site impacts; • Access roads will be designed to minimise impacts to flow pathways, and appropriate drainage will be employed to ensure runoff volumes and velocity are controlled; and • Detailed Erosion and Sediment Controls Plans will be prepared and provided to Council for all phases of the Proposal.

			Such an approach is consistent with solar farm development in NSW and a would normally be provided as a condition of consent. It should be noted that the hydrological modelling undertaken (Appendix E) indicates that any potential for erosion and sedimentation can be managed at the Site using standard erosion and sediment control measures.
		4. Concern regarding increased erosion and or sedimentation impacts moving off-site and impacting downstream receivers.	Preliminary hydrological modelling indicates no significant additional risk of erosion and/or sedimentation as a result of the Proposal, as there is insufficient flow to cause erosion across the majority of the Site. The installation of solar panels does not increase erosion. Although rainfall may be intercepted by the surface of the solar panel before hitting the ground, this has little effect on rainfall energy and due to the relatively sparse spacing of the proposed tracking solar arrays (minimum row spacing of 5.5m, see Section 4.1.5 of the SEE), the intercepted rainfall is spread over a relatively large area for infiltration. Further minimising local impacts is the fact that the PV panels track the sun throughout the day and hence will distribute runoff across a broader footprint than would be the case if a fixed array was installed. Given the large vegetated surface area below each panel and between rows that will absorb rainfall and minimise runoff potential, it is considered that surface water runoff velocities associated with the PV panel array are no more likely to generate erosion and sedimentation than the existing land management processes associated with the Site. Potential changes to impervious surfaces associated with access tracks, invertors, buildings and areas of hardstand would be mitigated through the application of appropriate erosion and sediment control measures to be developed during detailed design. Preliminary modelling indicates that the establishment of the proposed solar farm would result in minimal changes to flood characteristics within the existing drainage lines. When compared to current conditions the unmitigated peak flows leaving the Site are predicted to increase from 28.6 m3/s to 31.6 m3/s for the 1 in 100 year flood event. This low potential to generate broad-scale erosion across the Site, and relatively small increases in unmitigated stream flows, suggests limited capacity for increased erosion and or sedimentation impacts moving off-site and impacting downstream receivers. Further reducing the likelihood for impacts to downstream receivers is the capacity to manage flow velocities using flow detention basins and/or other mitigation structures before the flows leave the Site. Effective design and location of these structures during detailed design would ensure that effluent flows would not differ significantly from current conditions.
		5. Concern that the Proposal will not be able to maintain/establish ground cover effectively at the Site exacerbating erosion issues.	The Proposal will be designed and constructed to minimise impacts to existing groundcover. Where groundcover is disturbed during construction, these areas shall be sown with a suitable species mix in order to re-establish groundcover quickly (Appendix A). Routine inspection and response actions for erosion shall be incorporated into the CEMP.

			During operation of the solar farm, groundcovers will be actively managed to maintain their capacity to slow surface runoff and promote infiltration. Please refer to the Graz Ag Report (Appendix A) that discusses suitable species selection and how groundcover can be maintained across the Site during the operation of the Proposal.
		6. Concern there could be an increased risk of flood on adjacent properties.	As discussed above, the installation of a PV solar array does not increase potential downstream flooding, as it does not meaningfully alter the amount of permeable ground within the Array Area. As such, any rainfall intercepted by the PV array is returned to the ground surface and is either absorbed or generates runoff in a similar manner to the undeveloped state. Features that will increase runoff, and hence flood volumes, are changes to areas from permeable land to non-permeable features, such as access tracks, areas of hardstand or buildings, if located in areas subject to flooding or overland flow. Under these conditions, and in the absence of mitigation, these features may divert flow pathways and increase runoff velocities, which may increase potential flood risk. Preliminary modelling indicates that the establishment of the proposed solar farm would result in minimal changes to flood characteristics when compared to current conditions. The unmitigated peak flow leaving the Site is predicted to increase from 28.6 m3/s to 31.6 m3/s for the 1 in 100 year flood event. The minimal changes for peak flow rates also reflect minimal changes to water depths, and hence negligible potential flood impacts. Further flood modelling, undertaken post consent as part of detailed design, would be used to refine mitigation such as flood detention structures, to ensure potential off-site impacts are fully mitigated. These flood mitigation structures will be designed in accordance with relevant water management legislation to ensure that they do not unnecessarily retain water on site, to the detriment of downstream ecosystems and water users.
Fire Risk	• Section 7.10 of the SEE	1. Concern bushfire risk has not been adequately considered in the design of the Proposal.	Bushfire risk was considered as an integral part of the location and design of the Proposal (See Section 7.10 of the SEE), for example none of the Development Envelope or Substation Location Area is mapped as Bushfire Prone Land on the Planning Portal, ePlanning Spatial Viewer Bushfire Prone Land Map. Furthermore, risk assessments were carried out for the construction and operation periods and documented in the SEE supporting the Proposal (See Section 7.10). In response to concerns raised on bushfire in submissions, a Bushfire Risk Analysis (**Appendix F** to this document) has been prepared post-submission, in consultation with the RFS to provide further details in relation to risks associated with fire at the Site and justify the approach taken in the SEE. This Risk Assessment will be used to inform the final design of the Proposal in further consultation with the RFS, which will then lead to the development of a Bushfire Management Plan (which would be required as a condition of consent).

			The Site covers approximately 94 ha of rural land, all of which has been cleared for grazing pasture. In the wider area, due to historic clearing for agriculture, vegetation cover is generally low except along ridgetops, within road reserves, along the banks of the Commissioners Waters, in isolated patches in paddocks and gullies and within gardens surrounding the homesteads which are scattered across the landscape. Ground cover adjacent to the Site is dominated by grazed pastures and while managed, it could be susceptible to grass fires in hot, dry and windy conditions. These areas are not classified as Bushfire Prone Land. Grass fire spread can be held up or stopped where continuous cured grass cover is broken up by local roads, green creek lines, arterial public roads, firebreaks, fully eaten-out areas and farm breaks/tracks. Such features occur in the landscape surrounding the site, and include: • Drainage lines and rivers; • Screening, ornamental or wind break plantings of non-native tree species; • Residential houses, sheds and other infrastructure required for agricultural activity; • 132kV powerline easement which passes between the Substation Location Area and the Development Envelope of the Site; • The Armidale Regional Landfill and its access road; • Waterfall Way which runs along the northern boundary and Gara Road along the southern boundary; and • Farm access tracks in all adjoining properties. There are no woodland fragments across the Development Envelope, which is covered in a combination of native and introduced pastures. Exotic trees that occur within the Substation Location Area will be removed prior to the construction of the Substation. Grass fires within the Site are considered a potential risk, however, it is considered that this risk can be effectively managed through mitigation measures to reduce the fuel load within the Site. The final design will be appropriately engineered, and infrastructure (for example cables and wiring) required for the Proposal will be selected and installed in line with relevant Australian Standards. While the connection cable easement will pass through Bushfire Prone Land, the cable itself will be buried, therefore risks only apply to a limited period during the construction phase. A suite of mitigation measures to reduce and manage the risk and impact of fire are provided in Section 7.10.4 of the SEE. These include safety protocols embodying staff training, the use of firefighting equipment, Work Health Safety procedures and daily fire risk assessment, and will be incorporated into the CEMP, OEMP and DMP. Continuous monitoring systems, coupled with routine site inspections, will provide opportunities to identify potential fire hazards associated with faulty equipment during the operational phase of the project. All equipment used on site will require regular inspection to ensure that they do not create additional fire risk.

		2. Concern regarding fire response.	As outlined in the SEE (Section 7.10), a Bushfire Management Plan shall be prepared in consultation with relevant fire authorities for the Site post-consent and prior to commencing construction activities, acknowledging specific risks associated with the Site, Proposal and surrounding influences. This plan will consider firefighting issues including access, static water supply requirements and safety. In addition, the CEMP will provide safety protocols to ensure all staff and contractors are aware of the bushfire risk on site and the mitigation measures required to reduce this risk Risks associated with firefighting responses include the presence of energised panels and potential for toxic fumes and smoke from plastics and other decomposed parts of the panels. Prior to construction, contact should be made by the site operator with the Local Emergency Management Committee to establish an Emergency Management Plan, documenting procedures for the management of safety hazards presented by the Site. In the unlikely event that a fire should occur, Site remediation work would be the responsibility of the Proponent and would be carried out in accordance with statutory requirements and guidelines.

APPENDIX LIST

Appendix A: Agronomy Report

Appendix B: Slope Suitability

Appendix C: Landscape and Visual Impact Assessment – Response to submissions

Appendix D: Traffic and Transport Assessment – Response to submissions

Appendix E: Stringybark Solar Farm Hydrology Assessment

Appendix F: Bushfire Risk Analysis

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