1.1 INTRODUCTION

The information provided below responds to the request received from the City of Wagga Wagga 7th February 2018. Nomenclature used in Council's correspondence has been retained for ease of cross referencing.

1.2 AGRICULTURAL LAND QUALITY

1.2.1 QUALITY AND HISTORIC USE

The development site is productive agricultural land. It has a long established history of both successful cropping and grazing; principally the latter.

The Land and Soil Capability (LSC) scheme developed by OEH maps the bulk of the development footprint (over 95%) as Class 3 land. Class 3 land is category high capability land, with only moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation. Across the Wagga Wagga LGA there is a mapped 153,524 ha of Class 3 land. The temporary removal of 0.04% of Class 3 land in the Wagga Wagga LGA will not occupy

A small part of the land to be occupied by the solar farm (0.3 ha) is mapped as Biophysical Strategic Agricultural Land (BSAL). The location and extent of this BSAL land is shown on Figure 8 of the SEE; noting that mapping is at a state/regional scale with varying accuracies and degrees of confidence.

The (then) NSW Agriculture's *Agricultural Land Classification* (ALC) ceased in 2000 and Wagga Wagga was not covered in the areas where ALC was completed.

Simarly, the Important Agricultural Land (IAL) mapping being prepared by the Derpartment of Primary Industries has not yet been completed for Wagga Wagga and the following caveats are noted. IAL mapping focusses on the range of factors important to the predominant or leading agriocultural industries rather than docussing entirely on the biophysical factorsd such as soils. Further, due to scale limitaitons IAL mapps are not suitable for assessing development proposals or for property specific planning purposes.

Notwithstanding the comments above, the solar farm will be temporary in nature and the land will be returned to the pre-existing agricultural value as proposed in the SEE.

1.2.2 ABILITY TO BE FARMED IN FUTURE

Given that solar farms are a relatively recent development there is no example of a decommissioned farm being returned to agricultural use. Notwithstanding, it is reasonable to conclude that there is the ability for this land to be farmed in the future and returned to primary production. The soil resource will not be degraded and, subject to the removal of farm infrastructure, the land will be able to be farmed without constraints.

The ability to farm is linked to the capacity to physically work the country (ie. sow and harvest) and the soil resource. Working the country in preparation for cropping will only require the removal of solar infrastructure, inclusive of cabling shallower than 500 mm below ground level, to permit paddock preparation for sowing. Obstacles for machinery manoeuvrability will be removed and, with the exception of internal access tracks which may be retained for convenience, full and complete access to the site to farm will be available.

The soil resource will not be degraded whilst the solar farm exists and there is no associated impact that would compromise its ability to return to cropping or pasture. The productivity and health of the soil resource will not be subject to any additional pressures. To the contrary, there will be less soil compaction which can only protect soil structure; there will be an enhanced ability to retain groundcover over the site which can only reduce erosion potential and improve soil organic carbon levels; there will be less nutrient removal; there will be less ground disturbance and there will be less fertiliser/herbicide application. Grazing and farming is an active land use that draws on the soil resource, while a solar farm is a passive land use that will effectively rest the soil resource.

Removal of infrastructure and access to a rested soil resource will enable the land to be farmed in the future. The solar farm does not incur any irreversible impact in terms of a future ability for the land to be farmed.

1.3 VISUAL IMPACT

The viewshed analysis provided in the SEE does account for the site topography, including the higher portion of the site, to accurately show what parts of the solar farm would be visible from residences up to 2.3 km from the site: and does so with the extremely conservative assumption that no intervening stands of vegetation or structures between the solar farm and the curtilages of these homes obstruct views.

The presence of parts the solar farm in the landscape at distances further than 2.3 km from some sections of public roads and different parts of peoples' properties is not dismissed. Notwithstanding, it is considered highly unlikely that a significant vista enjoyed from the curtilage of any home further than 2.3 km from the development site will be fundamentally changed. The solar farm becomes a smaller percentage of the observed space as distance from the solar farm increases, meaning that the solar farm will not be omnipresent or dominate the landscape for longer range locations.

It is noted that maintaining the rural landscape is one of the seven (7) objectives for RU1 zoned land in the Wagga Wagga LGA, and that solar farm infrastructure is not associated with a conventional appreciation of what constitutes a rural landscape. The changing landscape of the industrial area was not meant to be interpreted as a justification; but rather a statement that the future landscape in this locality has and is planned to change.

The proposed solar farm does not exacerbate the potential for land use conflict between land uses in the RU1 zoned land. A recurring theme mentioned in comments about visual impact was concern about glare. To this end a glare assessment has been undertaken to validate the conclusion in the SEE that this will not be an issue.

Glare analysis for the proposed Wagga Wagga Solar Farm (WWSF) has been undertaken using the ForgeSolar 'GlareGauge' glare analysis tool. GlareGauge uses the Solar Glare Hazard Analysis Tool (SGHAT) technology developed by Sandia National Laboratories and meets the United States Federation Aviation Administration (FAA) standards and guidelines. GlareGauge computes the potential for glare for flight paths and receptor points (https://www.forgesolar.com/tools/glaregauge/).

GlareGauge has also been used and accepted by the Civil Aviation Safety Authority (CASA) for assessing potential glare impacts of solar farms in proximity to airports in Australia.

GlareGauge is a web-based interactive tool that provides a quantified assessment of when and where glare will occur throughout the year for a prescribed solar installation. The tool employs an interactive Google map where the user can locate a site, identify the proposed PV arrays, and specify observer locations or paths. Coordinates and elevation are automatically recorded through the Google interface, providing necessary information for sun position and vector calculations. Additional information regarding the orientation and tilt of the PV panels, reflectance, environment, and ocular factors are entered by the user.

Significantly, GlareGauge does not account for the mitigating effects of physical obstructions between the solar arrays and the receptor. These obstructions include buildings and vegetation and as such, the assessment provides more conservative results than would actually occur.

The analysis produces a report that identifies whether there is glare potential for any given receptor. If glare is predicted the model output provides the following information:

- Whether the glare is 'potential' or 'low potential' glare.
- A plot showing on what days of the year, at what times during those days, and for how long each day (to minute accuracy) that glare is predicted.
- A plot of glare reflections on the solar farm footprint showing the location that glare is predicted to be visible.

It is also noted that the GlareGauge analysis is based on a 1 minute interval. This allows the sun's position to be determined as it changes throughout the year and produces high resolution results (refer Sandia National Laboratories (2016) *Solar Glare Hazard Analysis Tool User's Manual* v. 3.0).

Parameters provided in **Table 1** are those used for modelling the WWSF. Explanatory descriptions for each parameter are also provided (Sandia National Laboratories 2016).

Table 1 PV Array Input Data

Parameter	Input
Axis tracking *Single axis tracking allows for the PV panels to rotate over one dimension in order to track the apparent movement of the sun over time.*	Single axis tracking (east to west)
Tracking axis tilt *The panels rotate about the tracking axis; the tracking axis can be tilted towards the north direction or placed horizontal. Not tilted means tracking axis tilt is 0 degrees (i.e. tracking axis is parallel with flat ground). A tilt of 90 degrees is perpendicular to the ground, facing the horizon.*	0 degrees *Axis is not tilted towards the north direction.*
Tracking axis orientation *This is the orientation of the tracking axis clockwise from due north (0 degrees).*	9 degrees *Axis is aligned 9° from true north, clockwise (i.e. towards the east)*
Module offset angle *This is the angle between the tracking axis and the panel if there is a vertical offset between them.*	0 degrees *No vertical offset between the panel and tracking axis*
Maximum tracking angle *This is the maximum angle the panel will rotate in both the clockwise and counter-clockwise directions from the zenith (upward) position.*	60 degrees *Tracks 60° towards east and west, from the horizontal*
Resting angle *This is the angle the solar panels rest after the maximum angle has been reached each day. For the WWSF, the maximum angle at the end of each day is 60º towards the west. The panels return to 60º towards the east when there is no incident sunlight on the solar farm. Therefore, 60º towards the east is the resting angle.*	60 degrees *Facing towards the east*
Module surface material *This is the type of material comprising the PV modules. The reflectivities of the material choices have been characterised by GlareGauge to generate scaled values for each time step (1 minute analysis intervals).*	To provide a conservative basis for assessment, it has been assumed that the panels are are smooth glass with no anti-reflective coating (ARC)
Height of panels above ground	2.6 metres for receptors 1.3 metres for motorists on East Bomen Road

The results of the glare analysis for the WWSF indicate that there is no potential for any of the receptors located within 2 km of the solar farm, or for motorists on East Bomen Road, to experience adverse glare impacts. The results of this analysis supports the findings in the SEE that the use of single-axis tracking significantly mitigates the potential for glare and, accordingly, visual impact. The results of the model output is attached (refer **Appendix A**): noting OP refers to a receptor, green glare refers to 'low potential' glare and yellow glare is 'potential' glare.

1.4 NOISE IMPACT

A detailed response is provided by AMG (refer **Appendix B**). By way of summary:

- In accordance with the "*Implementation and transitional arrangements for the Noise Policy for Industry"* (NSW EPA, 2017), where the environmental assessment commenced before release of the new policy, the application can be determined based on NSW Industrial Noise Policy (2000) for a period of up to one (1) year from the date of release of the Noise Policy for Industry (2017).

  The Noise Impact Assessment was originally completed on 10th October 2017, prior to the release of the updated Policy on 27th October 2017. Hence, in this case, assessment of the development against the Industrial Noise Policy 2000 is considered appropriate.

  Regardless, a review of the noise criteria considered in the assessment has confirmed that the outcomes of the assessment would remain unchanged were it to be undertaken in accordance with the Noise Policy for Industry 2017.
- Noise emissions from the tracking motors occur for approximately one minute out of each 15-minute period (providing for up to five degrees rotation per hour) during sunlight hours. Where these tracking motors are assumed to operate continuously throughout the 'night' periods, receptor noise levels are predicted to be less than 20 dB(A) at all receptors. This level of noise is significantly lower than the 35 dB(A) noise criterion during night periods.
- The noise levels presented in Table 11 are Sound Power Levels (SWL), which are a logarithmic quantification of energy released from the equipment. When sound waves travel, the energy emitted is dissipated through absorption (air and ground), distance attenuation and diffraction from obstacles such as terrain variation, barriers and buildings. As a result, the predicted noise levels at the receptors will always be below the SWL.

  The noise modelling undertaken considers the sound power level for each noise source along with information regarding its acoustical usage (how often it emits noise at that level), the distance between noise source and receptor, terrain height variation, the type of ground cover in the area and the effect of meteorological conditions to predict receptor noise levels. Hence the difference between the results presented in the impact assessment and the sound power levels in Table 11 represents the cumulative effect of these components.

1.5 EARTHWORKS

1.5.1 EARTHWORKS

Some earthworks will be required to construct the solar farm. Specific detail on these can not be provided until a detailed design is undertaken. It is for this reason that specific hold points have been incorporated into the development proposal to provide confidence that appropriate checks will be undertaken when the information to do so is available.

Notwithstanding, the extent of earthworks proposed is expected to be modest. Site levelling (if required at all) would be limited to localised spots where ground clearance is needed for the panels. The extent and location of site levelling is dependent on the tracker technology selected. For example, some trackers require a slope less than 6.1% in the north-south direction which the majority of the site can accommodate. However some micro-levelling may also be required if the existing undulation of the land exceeds equipment tolerances. For example, for some trackers the clearance between the tracker and the ground can't be less than 0.93 m or greater than 1.52 m. As a detailed design has not yet commenced and final equipment has not been selected, Terrain Solar is unable to provide specific details of the grading and site levelling that may be required.

The internal access tracks may require earthworks. If so, this would be restricted to stripping topsoil to expose the natural subgrade, to then be infilled with a compacted road base gravel finished at grade. Alternatively, a contractor may opt to provide a layer of graded quarry rubble on top of the natural soil to assist trafficability during construction in wetter months.

It is highly unlikely that any contour banking will be required to dissipate flow velocities. In general site drainage will be designed to and maintain and improve surface run-off and ponding adjacent to any building footings or adjacent to access roads. Typically this is achieved by grading the ground surface away from building footings and hardstand areas and providing swales or surface V drains to direct surface waters to suitable areas, at suitable velocities.

The earthworks required will be localised, subject to detailed design and submitted to Council for approval before construction can commence. With these checks in place there is no likelihood of disruption of, or any detrimental effect on, existing drainage patterns and soil stability in the locality.

1.5.2 EROSION

Maintenance of groundcover over the site is the way in which soil erosion will be avoided. A Soil and Water Management Plan to be submitted for approval prior to works commencing will detail the controls and measures to be employed during construction to prevent erosion. An Operations Environmental Management Plan to be submitted for approval prior to the farm becoming operational that will detail the measures that will be implemented on an ongoing basis to prevent erosion.

The Land and Soil Capability (LSC) scheme developed by OEH maps the bulk of the development footprint (over 95%) as Class 3 land. The LSC assessment scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. Each hazard is given a rating between 1 (best, highest capability land) and 8 (worst, lowest capability land), and the final LSC class of the land is based on the most limiting hazard.

Class 3 land is high capability land, with only moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices.

A solar farm is not a high impact land use.

Mitigation of potential soil and water impacts associated with the WWSF can be achieved through establishing several hold points, at which time specific information will be prepared and submitted to WWCC and/or DPI – Water for approval.

Drainage Design

Subject to securing Development Consent and ‘locking in’ detailed design parameters, a Stormwater Management Plan (SMP) will be prepared and submitted to WWCC and DPI – Water for approval. This SMP will include hydrologic and hydraulic modelling of overland flow paths to validate the sites pre and post development peak discharge volumes and flow velocities.

Soil and Water Management Plan

Erosion and sedimentation impacts associated with construction can be minimised by undertaking works in accordance with Managing Urban Stormwater: Soils and Construction series. Prior to construction commencing a SWMP will be prepared and submitted to WWCC and DPI – Water for approval.

Operations Environmental Management Plan

Prior to commencing operations an OEMP will be submitted to WWCC for approval. A key element of the OEMP will be the procedures for monitoring and maintaining a groundcover across the farm. This would include a protocol for undertaking regular inspections across the site to identify any localised scouring, and undertaking remedial works if required.

1.5.3 WEED CONTROL

The application of herbicide to treat any noxious weeds would be undertaken by appropriately accredited contractors, using proprietary products and applied strictly in accordance with product labels – including rainfast instructions.

The application of herbicide under these circumstances would not generate run-off.

A procedure would be included in the OEMP that would record any spray application, with detail on the chemical applied, rate, the location where it was sprayed, the mode of application (spot or micro-boom), the name of the contractor and the weather conditions.

1.6 BIODIVERSITY

NGH Environmental, the consulting ecologists who undertook the biodiversity assessment has confirmed the following:

- The paddock trees are native, and were considered as such in the impact assessment. The sentence referenced in Council's correspondence was incomplete.
- There are 17 isolated paddock trees (not 14) and the sentenced referenced in Council's correspondence is simply a typographical error.

1.7 OTHER

1.7.1 SOUTHERN OPTION

The southern portion of the land was initially considered, however, further engineering investigations of the site topography, geology and hydrology made it less suitable and less economically viable as a solar farm site. For this reason the northern part of the site was selected as this provided the greatest potential for the project to be economically viable.

1.7.2 CONSULTATION

The approach to consultation prior to lodgement was to contact and consult with immediately adjoining neighbours, where possible. The rationale was to focus on and consult with those that lived in the immediate area and could, as a neighbour, be impacted by the development. It was deliberately targeted as such and then checked against the findings of the noise impact assessment to ensure any potentially impacted neighbour was consulted.

Broader consultation was not undertaken for two reasons. Firstly, beyond being able to see parts of the solar farm in the landscape, at distance, no other landowner was judged to be potentially personally impacted by the development. Secondly, because it was judged that the public exhibition period, and the scope of the supporting Statement of Environmental Effects, would provide accurate and meaningful information to those in the community that wanted to comment on the proposal.

TERRAIN SOLAR

Amanda Gray
Senior Town Planner
Wagga Wagga City Council

Via: Email
Date: 6th July 2018

Dear Amanda,

Capacity Increase – Wagga Solar Farm

When optimising the Wagga Solar Farm for the Southern Joint Regional Planning Panel (SJRPP) requests, our engineers took the opportunity to revisit solar module availability, timing, and price changes that have occurred since November last year when the application was lodged. Over this time there has been a significant fall in solar module pricing, particularly due to the recent announcement by the Chinese government enacting policies on June 1, 2018, that ultimately slowed down Chinese domestic growth in their solar industry.

As a result, the market has seen a global oversupply of solar modules, and prices have significantly fallen and will continue to fall for the rest of 2018 and into 2019. Bloomberg New Energy Finance (BNEF) expects a 35% decline in module prices as stated in the following quote:

"BNEF provides a benchmark monocrystalline module price of US$0.37 per watt for the fourth quarter of 2017, and expects this to fall to only $0.24/watt by the end of the year."

This has enabled the Wagga Solar Farm to utilise a higher efficiency module for the same CIV as what was originally anticipated. As a result, we are able to increase the wattage of the project and generate up to 30MW of electrical power without changing the footprint of the solar farm. The physical size and number of the modules would remain the same, therefore, there would not be any additional environmental impact.

Terrain Solar would like to use this moment to request a variation to the wattage of the proposed solar farm up to, but not more than, 30 megawatts.

Kind Regards,

Simon Ingram
Managing Director – Terrain Solar P/L

TERRAIN SOLAR

Amanda Gray
Senior Town Planner
Wagga Wagga City Council

Via: Email
Date: 6th July 2018

Dear Amanda,

Response package – Southern Joint Regional Planning Panel Key Issues

Thank you for providing the Southern Joint Regional Planning Panel (SJRPP) Record of Briefing Meeting to Terrain Solar on the 13th of June.

Terrain Solar have compiled this response package that addresses the key issues discussed during your briefing meeting with the SJRPP on the 7th of June 2018.

In addressing the requests from the SJRPP, Terrain Solar have included the following:

1. A table providing reposes to the key issues raised by the SJRPP.

2. A Drawing set that has been updated (Version 2) to replace those in the November 2017 Statement of Environmental Effects to provide ease of referencing. The updated set includes:
   - Dimensioned and scaled plans of the solar farm layout (refer Drawing EV05 and EV06) as requested by the SJRPP; and
   - Inclusion of the Riparian Protection Measures (refer Drawing EV07) as approved by Department of Industry – Water in issuance of its General Terms of Approval.

3. A Visual Impact Assessment including a:
   - Landscape concept plan
   - Landscape concept sections
   - Plant list & landscape notes
   - Photomontages from the north, east and south of the site.

4. A clarification email from NGH providing verification of tree removal.

5. A summary of results from an ambient temperature monitoring study on a South East Queensland solar farm.

Table 1: Key Issues and Responses

Item	Key Issues	Response
1.	Reference to lack of detail in Panel meeting held at neighbouring Council – when this report is presented to the Panel it must have all required details or a determination cannot be made.	Noted
2.	Details of plans – require suitably scaled detail of individual and rows of panels, landscaping, access roads and maintenance building. The current plans cannot be scaled from and show no dimensions.	The requested plans are included in this response package.
3.	Visual Impact Assessment – the site is very open and the visual impact will be significant. The application should include photo montages taken from various view points from the north, east and south with and without the solar farm imposed onto the photos to be able to assess the impact.	Visual Impact Assessment including Landscape Plans & Cross Sections are included in this response package.
4.	Vegetation retention and clearance – provide a clear plan that identifies what trees stay and what trees are to be removed. Report should back up the plan with detail as to why trees are being removed and their quality and value.	Appendix B of the SEE Figure 4.4 provides detail on what trees stay and what trees are to be removed including information on their quality and value. Clarification on the removal of trees, from NGH Environmental, is included in this response package.
5.	Anticipate the need for a vegetation buffer to all sides that experience a visual impact – the required APZ and fencing should be behind the buffer within the site. Noted that this may require an amendment to the number of panels or panel layout on site but this is a critical matter. Detailed planting plan to be provided.	The vegetation buffer has been informed through the Visual Impact Assessment and presented in the included site drawings, landscape plan and screening cross sections.

6.	Weed management and grazing beneath panels – have the impacts of this been fully addressed for this land?	Section 17.6.3 of the SEE provides detail on weed management and approaches to managing ground cover via grazing: The long term performance measure is to establish a healthy, self-sustaining, noxious weed free groundcover over the solar farm that does not create a fuel hazard. How this can best be achieved, and maintained, through a combination of mechanical slashing and/or periodic crash grazing will require monitoring and implementation of adaptive management principles. Specifically, this will entail adapting the frequency, duration and intensity of crash grazing, and the timing of any mechanical slashing to suit and accommodate the prevailing seasonal conditions. It will also require regular inspection across the site following intense rainfall events to check that drainage is stable and localised scouring hot-spots are not appearing.
7.	Run-off from the panels onto the land – has the potential erosion been considered? How is this to be managed?	Section 11 of the SEE provides information on potential erosion and details how this would be managed during detailed design, construction and operation.
8.	Micro-climate – does the solar farm result in local ambient temperatures changing? What are the impacts of this?	An experimental study on a solar farm, with no ground cover, located in a desert biome in Tucson Arizona, detected a change in ambient temperatures resulting from the solar farm, that became unmeasurable at 30 meters from the site. It was noted in this study that the heat gain was attributed to unvegetated soil cover. Considering the Wagga Solar farm exists in a temperate climate and will establish a healthy, self-sustaining, noxious weed free groundcover, any potential change to ambient local temperatures will be avoided. In order to verify this Terrain Solar undertook a study on local ambient temperatures in a temperate climate in South East QLD with grass cover. The study concluded that the solar farm was not having an effect on the local ambient temperatures. This study brief is included in the response package.
9.	Is noise from the motors turning the panel significant – clarity about how many motors are required to turn how many panels.	Appendix C of the SEE provides a Noise and Vibration Assessment that clarifies up to 1,295 NexTracker tracking motors will be installed and demonstrates through modelling that the noise impact is not significant.
10.	Restoration of the site – need to know the detail of how the land will be restored. If the development is not maintained for 25 years the site cannot be left covered in un-used infrastructure. Provide some detail on how this will work.	Section 2.9 of the SEE states: It is proposed that no later than 12 months before the intent to decommission the WWSF the owner of the WWSF will provide a Decommissioning Management Plan (DMP) to WWCC for approval. The DMP would detail what decommissioning would entail and how it would be conducted. All above ground infrastructure would be removed from the site and sold as scrap metal, recycled or otherwise disposed of at approved facilities." The primary objective of the DMP would be to restore the land capability to its pre-existing agricultural value and use. Further detail on how the solar farm would be decommissioned is provided in Section 17.8 of the SEE. The design life of the PV modules will be at least 30 years. At the end of their useful life modules and electrical equipment will be either replaced and the farm re-commissioned, or the farm will be decommissioned and the site returned to agricultural land use. This will be a commercial decision based on the relative economics of solar PV generation compared to alternatives at the time (i.e. year 2047). In all likelihood the economics will be favourable because the farm

		infrastructure, including network connection, underground cabling, foundations, and access tracks will continue to be serviceable and the cost of replacing modules and inverter stations favourable compared to competing generating technologies. Further, the technology available in 30 years' time is likely to have much higher efficiency factors than today's modules. Decommissioning would include initially disconnecting the solar farm from the TransGrid network. The overhead interconnecting cable (if used) and substation equipment would be removed and disposed of off-site, reusing and recycling wherever possible. Foundations would be broken up and removed off site. Modules and the racking system would be removed and it could be expected that a significant amount of the support structure could be reused or recycled off-site. Piles will be lifted out of the ground and recycled wherever possible. In general, cables are likely to be worth removing and recycling. However underground cables which are deeper than 300 mm below ground level may be left buried to avoid excessive ground disturbance. The site control room and facilities would be lifted off their foundations and transported off site on flatbed trucks. The ground would be then be worked, stabilised and returned to agricultural use. In addition to the commitments in the SEE, the contracts that are in place with the landholder require decommissioning to be undertaken in a similar way to the process outlined in the SEE. This creates an additional legal obligation for decommissioning between the Solar Farm owner and landholder.
11.	Noted significant objection – be sure that all matters raised in objection have been answered and addressed.	Noted
12.	Further information to be requested from applicant as soon as possible.	Noted

We look forward to working with you as we approach the SJRPP meeting to determine the application.

Kind Regards,

Simon Ingram
Managing Director – Terrain Solar P/L

Terrain Solar Pty Ltd
ACN 616 856 172, PO Box 1113, Manly, NSW, 2095

Assured Monitoring Group

TEMPERATURE MONITORING OVERVIEW
TERRAIN SOLAR
Reference: 11428

R_0
DATE OF RELEASE: 3/07/2018

Terrain Solar
PO Box 1113
Manly
NSW 2095

Attn: Simon Ingram [simon@terrainsolar.com]

Dear Simon,

The Assured Monitoring Group was commissioned by Terrain Solar to undertake ambient temperature monitoring. The monitoring was undertaken to identify if a solar farm was contributing to an increase in ambient temperature in the area surrounding the facility.

This letter provides a summary of the results of monitoring undertaken between 6 April 2018 to 13 April 2018.

1 TEMPERATURE MONITORING

1.1 Monitoring Approach and Equipment

Unattended monitoring was undertaken at distances of 1 m, 10 m, 30 m and 100 m from the outer most edge of an existing solar farm operating in regional Queensland. In undertaking the monitoring, two alternate monitoring instruments were utilised. Each temperature sensor consisted of a calibrated thermocouple connected to a data logging system with measurements were set to be taken at 5-minute intervals.

2 TEMPERATURE MONITORING RESULTS

2.1 Overview

Prior to analyses, any invalid measurements were removed from the dataset. The remaining 5-minute average information was summarised into hourly averages.

It is noted that minor variations have been identified in the monitoring datasets during the middle of the day when temperatures are highest. Review of the data indicates that this apparent variation is the result of differences in the responsiveness of the two monitoring instrument types utilised for the monitoring. As a result, the different instruments types cannot be directly compared to each other and are analysed independently.

2.2 Statistical Variation

A T-test was undertaken to analyse the significance of any potential variation between the monitoring datasets. For each t-test, where the calculated t-value is less than t-critical, the data demonstrates that there is no significant variation between the datasets.

In Table 1 a T-test was conducted between measured temperature data to identify if there was any significant temperature variation between instruments located at distances of 1 m and 30 m from the solar panels.

Table 1: T-test for Temperature Variation at 1 m and 30 m

Source of Variation	1m	30m	Variation analysis
Mean	22.4	22.5	
Variance	44.5	47.8	
Observations	165.0	163.0	
Pooled Variance			46.1
Hypothesized Mean Difference			0.0
Df			326.0
t-Statistic			-0.2
P(T<=t) one-tail			0.4
t Critical one-tail			1.6
P(T<=t) two-tail			0.9
t-Critical two-tail			2.0

As -0.2 > -2 and -0.2 < 2, the results of the T-test indicate that there is no significant temperature variance from 1 m to 30 m from the solar farm.

Similarly, in Table 2 a T-test was conducted to identify if there was any significant temperature variation between instruments located at distances of 10 m and 100 m from the solar panels.

Table 2: T-test for Temperature Variation at 10 m and 100 m

Source of Variation	10m	100m	Variation analysis
Mean	22.5	22.0	
Variance	32.1	33.2	
Observations	165.0	165.0	
Pooled Variance			32.7
Hypothesized Mean Difference			0.0
Df			328.0
t-Statistic			0.6
P(T<=t) one-tail			0.3
t Critical one-tail			1.6
P(T<=t) two-tail			0.5
t-Critical two-tail			2.0

As $0.6 > -2$ and $-0.6 < 2$, the results of the T-test indicate that there is no significant temperature variance from 1 m to 30 m from the solar farm.

3 CONCLUSIONS

As demonstrated in the above results, no statistically significant impact on temperatures in the local area from the solar farm was observed. Hence, it appears highly unlikely that heat radiating from the solar farm is having a significant impact on temperatures in the local area.

4 DOCUMENT CONTROL

Table 3: Document Approval

	Name	Position Title	Signature	Date
Author	Craig Beyers	Consulting Services Manager		3/07/2018

Table 4: Revision Register

Revision	Date	Name	Issued to	Comment
R_0	3/07/2018	Craig Beyers	S. Ingram	Initial release