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White Rock Solar Farm

Environmental Noise Assessment

Prepared For

Goldwind

S4834C1
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INTRODUCTION

The White Rock Solar Farm is planned to occupy an area of approximately 50 hectares, south of Matheson, New South Wales (NSW), with a generating capacity of up to 20 MW. The solar farm is a part of the White Rock Renewable Energy Precinct which would comprise of a 175 MW wind farm and 20 MW solar farm.

This assessment has been conducted in accordance with the Secretary's Environmental Assessment Requirements (SEARs), dated 3 February 2016.

There are two dwellings within 1km of the proposed solar farm, as shown in Appendix A. The coordinates of all dwellings in the vicinity of the solar farm and their association to either the solar or wind farms is provided in Appendix B.

The preliminary solar farm layout includes 8 arrays of solar panels with an SMA SC2500 inverter/transformer module generally at the centre of each array. Appendix C provides the coordinates assumed for the assessment and Appendix D provides an indicative layout. Each of the inverters and transformers are within an enclosure with cooling fans for temperature regulation. The inverters and cooling fan assembly comprise the major noise source for a solar farm and generate a sound power level which is comparable with a small commercial air conditioning system.

The assessment compares the predicted noise levels at the closest noise sensitive receivers from the operation of the solar farm with the *NSW Industrial Noise Policy 2000* (INP), and noise from construction activity with the Department of Environment & Climate Change *Interim Construction Noise Guideline 2009* (ICN Guideline). The assessment has been based on:

- UGL 'White Rock Solar PV Nugent Site Fixed PV Layout Plan' drawing, numbered TC-10411-DP1-100, and dated 9 February; and,
- SMA "White Paper BU-U-019: Sunny Central" sound power measurements on SC 2200 (-US), SC 2500-EV central inverters.

The report also addresses the cumulative noise level from both the solar and wind farms operating simultaneously.

CRITERIA

Solar Farm

The *NSW Industrial Noise Policy 2000* (the INP) establishes objective criteria based on the existing ambient noise environment ("intrusiveness") and the envisaged amenity of the area ("amenity"). The more stringent of the intrusiveness and amenity based criteria are used.

Intrusiveness

The INP requires that noise sources should not exceed the Rating Background Level (RBL) by more than 5 dB(A). The RBL is used to characterise the existing ambient noise environment and effectively represents the noise level during "lulls" in the environment.

The INP enables the RBL to be set at 30 dB(A) in quiet environments.

Amenity

From an amenity perspective, the INP establishes a goal noise criterion of 40 dB(A) for a rural environment.

RBL

Long term background noise monitoring has previously been conducted for the White Rock Wind Farm and has been used to calculate the RBL.

The noise monitoring was carried out at seven residences in the vicinity of the wind farm. The most relevant location at which monitoring was conducted was R1 which is the closest to the proposed solar farm.

The RBL is determined from the lower tenth percentile of the L_{A90} noise level in the environment. The RBL for each of the day, evening and night time periods is provided in Table 1 below.

Table 1: RBL at Background Monitoring Location R1

Day	33
Evening	31
Night	25

Based on the solar farm only operating during daylight hours, the lowest relevant RBL is during the evening, 31 dB(A).

Assessment Criteria

Based on an RBL of 31 dB(A) the relevant assessment criteria in accordance with the INP is 36 dB(A).

Annoying Characteristics

If the noise source has a character that has the potential to be annoying, such as tonality, modulation or dominant low-frequency content, then a modifying correction factor is applied. The inverter/transformer modules have the potential to exhibit audible tonality, although this potential is diminished by the masking effect of the fan systems. Notwithstanding the influence of the fans, a 5 dB(A) correction has been used in the assessment as a conservative approach, which effectively reduces the criterion to 31 dB(A).

Therefore, in order to achieve the INP, noise from the combined operation of the 8 units must not exceed a level of 31 dB(A) at any nearby dwelling.

Construction

The construction of a solar farm comprises activities such as road construction, civil works, excavation, foundation construction, and electrical infrastructure works. These require processes such as heavy vehicle movements, piling, crushing and screening, concrete batching, loaders, excavators, generators, cranes and, subject to local conditions, possibly blasting.

To assess construction noise in accordance with the SEARs, the Department of Environment & Climate Change *Interim Construction Noise Guideline 2009* (the ICN Guideline) is used.

The ICN Guideline provides an emphasis on implementing "feasible" and "reasonable" noise reduction measures and does not set mandatory objective criteria. However, the ICN Guideline does establish a quantitative approach, whereby "management levels" are defined based on the existing RBL of the environment, in this case 33 dB(A) for daytime construction activity. The management levels as defined by the ICN Guideline are provided in Table 2.

Table 2: The ICN Guideline management levels.

Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

OPERATIONAL NOISE

The proposed solar farm layout has a proposed capacity of 20MW.

The assessment is based on the indicative layout of 8 blocks of solar panels with 2.5MW SMA inverter/transformer units being located as shown in the UGL drawing, included as Appendix D.

Sound Power Levels

The sound power level to be used for the assessment is based on the following:

- Sound Power measurements of the 2.5MW SMA Sunny Central 2500-EV inverter/transformer unit detailed in *SMA "White Paper BU-U-019: Sunny Central" Sound Power Measurements on SC 2200 (-US), SC 2500-EV central inverters* and octave band frequency data from a range of publically available data for similar inverter systems. The sound power level for each 2.5MW inverter/transformer unit is summarised in the below table;

Table 3: Assumed sound power spectrum for inverter/transformer units

Inverter/Transformer Rating	SWL (dB) for each Octave Band Centre Frequency							Total SWL (dB(A))
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
2.5 MW	86	90	96	89	85	81	73	92

The above sound power level data has been used for indicative purposes to show that the current proposal can achieve compliance with the project criteria. Variations to the indicative layout are unlikely to increase operational noise at the nearest residence, as it is understood that movement would most likely be away from the closest residence. Notwithstanding, a final assessment will be required prior to the commencement of construction to confirm compliance with the project criteria based on the final inverter/transformer selection and locations.

Noise Predictions

Noise Model

The prediction of environmental noise has been made using the Conservation of Clean Air and Water in Europe (CONCAWE)[1] noise propagation model and SoundPLAN noise modelling software. The sound propagation model considers the following influences:

- sound power levels and locations of noise sources;

[1] CONCAWE, The oil companies' international study group for conversation of clean air and water – Europe, '*The propagation of noise from petrochemical complexes to neighbouring communities*', May 1981.

- separation distances between noise sources and receivers;
- topography of the area;
- influence of the ground hardness;
- air absorption; and,
- meteorological conditions.

The CONCAWE system divides meteorological conditions into six separate "weather categories", depending on wind speed, wind direction, time of day and level of cloud cover. Weather Category 1 provides the weather conditions associated with the "lowest" propagation of noise, whilst Weather Category 6 provides "worst-case" (i.e. highest noise level) conditions. Weather Category 4 provides "neutral" weather conditions for noise propagation (that is, conditions which do not account for the effects of temperature inversion or wind on propagation).

The INP defines the applicable weather category for noise predictions as follows:

Where temperature inversions are predicted for more than 30 per cent of the total night-time during winter, these are considered to be significant and should be taken account of in the noise assessment.

Where there is less than a 30 percent occurrence of wind of up to 3 m/s (source-to-receiver component), wind is not included in the noise-prediction calculation.

As the White Rock Solar Farm does not operate outside of daylight hours, temperature inversions will not occur at the site for more than 30 per cent of the total operational time. As such, the INP does not require the prediction methodology to account for the influence of temperature inversions.

The INP provides *"two ways to assess wind effects"* as follows;

- *Use a wind rose to determine whether wind is a feature based on the frequency of occurrence and wind speed. In doing this, take care to assess the source-to-receiver components of wind that are relevant.*
- *Simply assume that wind is a feature of the area (foregoing the need to use a wind rose) and apply a 'maximum impact' scenario.*

Based on the above, the assessment has been based on the assumption that wind is a feature and the wind speed set to 3 m/s.

These meteorological conditions are represented by CONCAWE Weather Category 5 noise propagation, and therefore weather category 5 has been used for the assessment in accordance with the INP.

Predictions

The predicted noise levels at the residences in the vicinity of the solar farm from the 8 inverter/transformer units are tabulated below, and illustrated on a noise contour map in Appendix E. The table includes residences where a level of 15 dB(A) or greater is predicted.

Table 4: Predicted

Residence ID	Predicted Noise Level (dB(A))	Residence Status
R1	24	Non Associated
R5	16	Wind & Solar Farm Host Landowner
R49	23	Non Associated

The predicted noise levels comply with the criteria conservatively established in accordance with the NSW *Industrial Noise Policy 2000*, without any specific acoustic treatment.

Based on the above, the proposed design and layout of the project is predicted to result in noise levels at nearby sensitive receivers which are within acceptable limits.

Cumulative Assessment

The cumulative effect of noise from both the solar and wind farms has been considered. The most onerous criterion for the wind farm is 35 dB(A), and the wind farm Stage 1 layout has been assessed to be compliant. The predicted noise from the solar farm is more than 10 dB(A) below this criterion and therefore will not result in the total noise level exceeding 35 dB(A). That is, *24 dB(A) + 35 dB(A) = 35 dB(A)*.

- For dwellings which marginally achieve the wind farm criteria, the solar farm noise will not increase/significantly contribute to the predicted level; and,
- For dwellings which have predicted noise levels which are similar for the solar and wind farm components, the combined level will be approximately 3 dB(A) higher.

CONSTRUCTION NOISE

The equipment and activities on site will vary throughout the project, depending on various stages of construction. The predicted noise from construction activity is presented as a worst case (highest noise level) scenario, where it is assumed all equipment is present, and each piece of equipment operates for one third of the assessment period.

The weather conditions used for the predictions are the most conducive for the propagation of noise, comprising an overcast day with a breeze from the construction activity to the receiver. Other weather conditions would result in lower noise levels than those predicted for day-time construction.

The separation distance of the closest dwelling (R01) to any proposed construction activity (either at the solar farm or an access track) is approximately 550m. Table 5 below provides the separation distance between each of the dwellings in the vicinity of construction activity.

Residence	Distance to construction activity[2] (m)
R1	550
R4	2000
R5	1800
R12	2600
R42	2400
R49	770
R57	2000

The results of noise predictions from construction activity at 550m are provided below in Table 6. A separation distance greater than 550m will result in lower noise levels than presented. The required separation distance in order to achieve the ICN Guideline's 43 dB(A) criterion, 10 dB(A) above the RBL, is also provided in Table 6.

[2] The distance between a dwelling and the closer of either a solar array or an access track.

Table 5: Predicted construction noise levels.

Phase	Main Plant and Equipment	Predicted Noise Level at 550m	Separation to Achieve 43 dB(A) Criterion
Site Preparation, Clearing & Demolition	Excavator Bulldozer Chainsaw Tree Mulcher Light Vehicle Dump Truck	53 dB(A)	1800m
Establishment Site Compound, Access Roads & Delivery of Materials	Hand Tools Excavator Light Vehicles Delivery Truck Bulldozer Plate Compactor Grader Roller Asphalt Paver Bobcat Bored Piling Rig Mobile Crane	54 dB(A)	2000m
Installation of Foundations	Piling Rig Mobile Crane Bobcat Excavator Concrete Vibrating Needle Concrete Truck	57 dB(A)	2500m
Installation of Underground Cabling	Bobcat / Trencher Tractor & Cable Trailer Loader	44 dB(A)	600m
Assembly of Panel Frames, Mounts & Transformer Units	Truck Compressor Hand Tools Generator Ratchet Gun Mobile Crane	51 dB(A)	1400m
Site Rehabilitation / Removal of Temporary Construction Facilities	Light Vehicles Excavator Bulldozer Loader Dump Truck Truck	51 dB(A)	1400m

Based on the predicted noise levels, it is expected that at some times, the construction noise will be greater than 43 dB(A) at a distance of 550m. The predicted noise levels are significantly less than the 75 dB(A) upper limit provided in the ICN Guideline.

Based on the above, it is possible that a dwelling located between 550m and up to 2500m from the site may be defined as “noise affected” but not “highly noise affected” by the ICN Guideline.

Noise Mitigation

Where residences are classed as “noise affected” by the ICN Guideline, the developer is required to apply all feasible and reasonable work practices, and to inform the residents of the proposed construction work.

“Feasible and reasonable” noise control strategies to minimise noise during construction may include engineering measures such as the construction of temporary acoustic barriers, the use of proprietary enclosures around machines, the use of silencers, the substitution of alternative construction processes and the fitting of broadband reversing signals. It may also include administrative measures such as inspections, scheduling and providing training to establish a noise minimisation culture for the works.

A Draft Noise Management Plan has been prepared and is detailed in Sonus report “S4834C2”. The report provides mitigation measures to be implemented for the construction works and provides the framework for a final Construction Management Plan once the final construction methods, timing, locations and equipment have been determined.

Construction Traffic

Construction activity will incorporate passenger vehicle and heavy vehicle movements to and from the site along the Gwydir Highway to the north of the solar farm. These vehicles will include semi-trailers, low loaders, haulage trucks, mobile cranes, water tankers, four-wheel-drive vehicles and passenger vehicles. The direct access from a state highway mitigates the potential impacts compared with access via local roads.

The day-time criterion provided by the NSW Road Noise Policy is an equivalent ($L_{Aeq, 1hour}$) noise level of 55 dB(A) during any given hour. It is predicted that a distance of 10m from the road side the criterion can be achieved for 10 passenger vehicle movements and 3 heavy vehicle movements in one hour. The number of vehicle movements can double for every doubling of distance from the roadside and continue to achieve the 55 dB(A) criterion. That is, 20 passenger vehicles and 6 heavy vehicle movements could be accommodated in an hour at a dwelling that is 20m from the roadside. It is noted that care should be taken to avoid excessive acceleration of trucks and the use of truck engine brakes in close proximity to dwellings.

In accordance with the general principles of dealing with temporary construction noise impacts as compared to permanent operational noise, where the NSW Road Noise Policy is exceeded, the following mitigation measures should be employed to reduce construction traffic noise:

- Communicate with the affected community in accordance with the provisions above;
- Establish and maintain a route into the site so that heavy vehicles do not enter noise sensitive areas for access where practicable;
- Incorporate information regarding the route to all drivers prior to accessing the site and the need to minimise impacts through driver operation at certain locations;
- Schedule construction traffic deliveries such that it is as evenly dispersed as practicable;
- Restrict construction to the day-time operating hours for the construction site, subject to the scheduling caveats in the Construction Noise Management Plan.

These measures are repeated in the Draft Noise Management Plan.

CONCLUSION

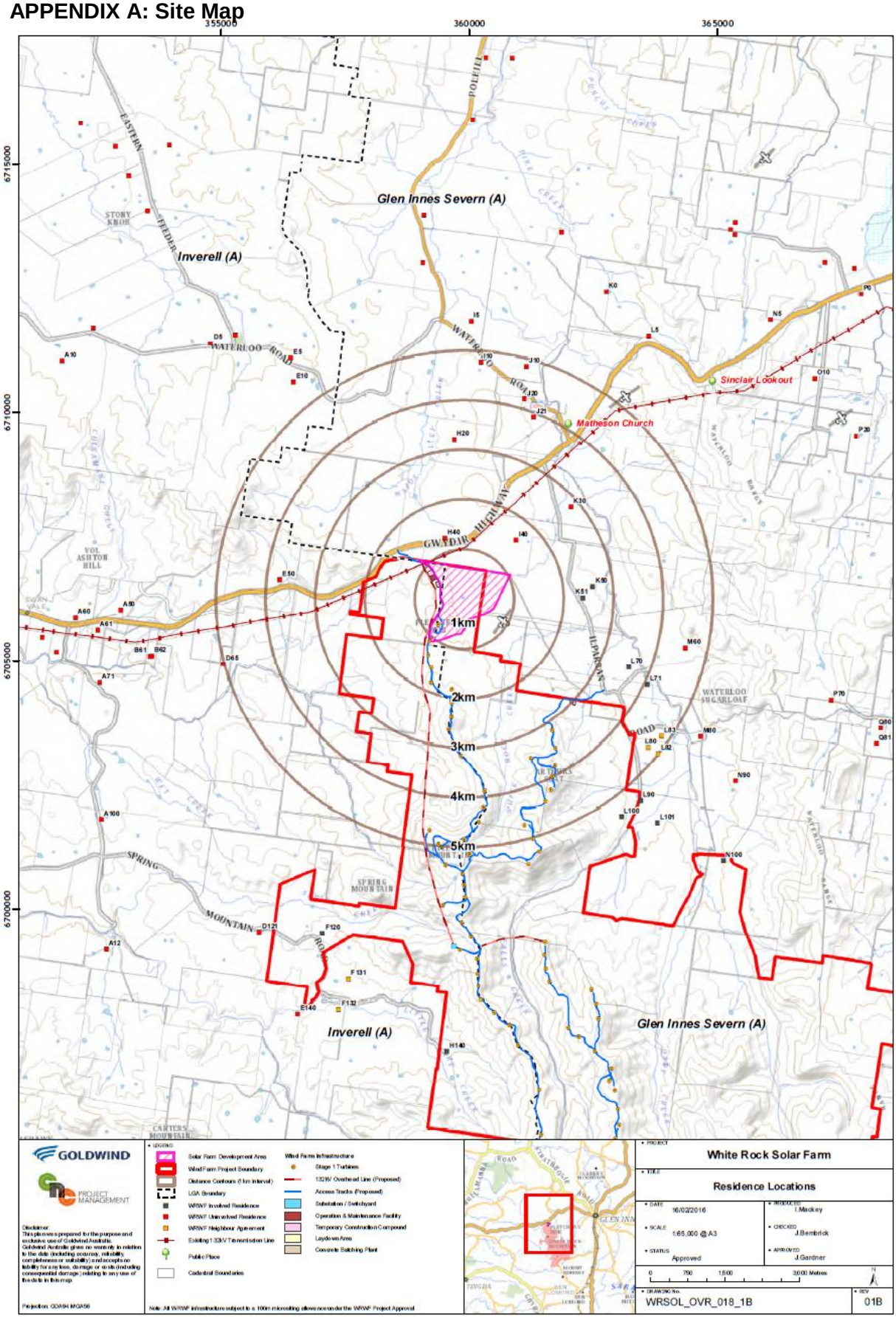
An environmental noise assessment has been conducted for the proposed White Rock Solar Farm as a part of the White Rock Renewable Energy Precinct. The assessment has addressed the Secretary's Environmental Assessment Requirements by predicting the noise levels from the preliminary design and comparing them against the *NSW Industrial Noise Policy 2000* (INP) for the purposes of confirming compliance.

Under conservative assumptions, the predicted noise levels for operation of the solar farm achieve the assessment criterion provided by the INP at all dwellings without any specific acoustic treatment.

In addition, construction noise from establishing the solar farm has been considered and a Draft Noise Management Plan has been prepared.

Based on the above, it is considered that the relevant noise criteria will be achieved. Notwithstanding, a final assessment will be undertaken prior to construction work commencing, once final locations and selections of the inverters and transformers are known, to ensure that the noise from the project achieves the relevant criteria. If necessary, the Construction Noise Management Plan will be updated prior to implementation to address the final project construction methodology.

APPENDIX A: Site Map



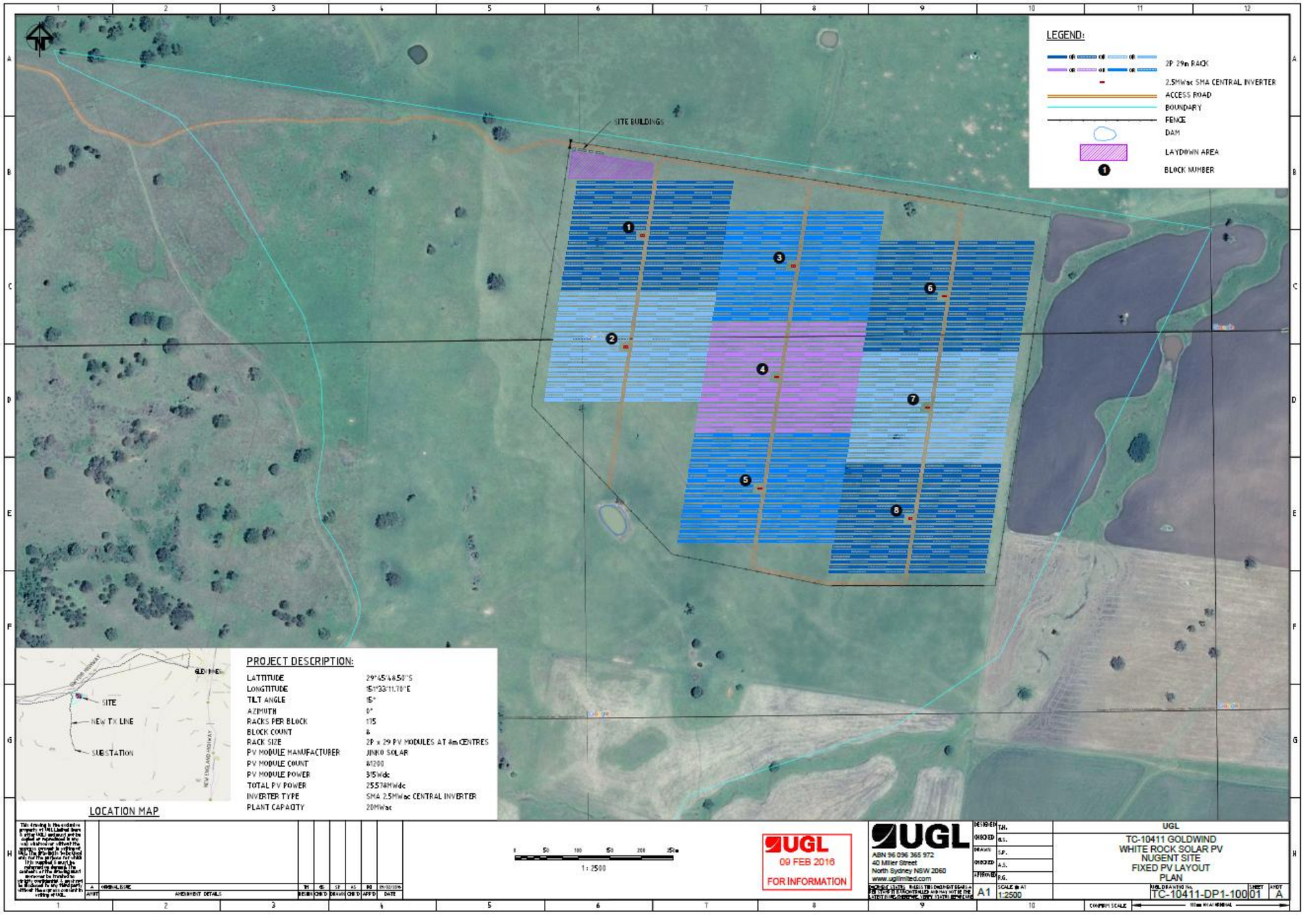
APPENDIX B: Residence Locations

ID	Wind Farm ID	Coordinates (UTM WGS84 H55)		Association to White Rock Solar and Wind Farms
		Easting	Northing	
R01	H40	359518	6707472	Non-Associated
R04	K50	362492	6706495	Wind & Solar Farm Host Landowner
R05	K51	362295	6706272	
R12	H20	359709	6709459	Non-Associated
R42	E50	356197	6706634	Non-Associated
R49	I40	360953	6707433	Non-Associated
R57	K30	362059	6708102	Non-Associated

APPENDIX C: Indicative Inverter/Transformer Locations used in Assessment

Location	Coordinates (UTM WGS84 J56)	
	Easting	Northing
1	359936	6706729
2	359909	6706554
3	360173	6706682
4	360147	6706506
5	360123	6706331
6	360411	6706632
7	360384	6706460
8	360358	6706281

APPENDIX D: Solar Farm Layout



APPENDIX E: Grid Noise Map