White Rock Wind Farm - Project Approval MP10_160

Modification Application No. 4 - Alternative Grid Connection

Appendix 2

Noise Impact Assessment – Prepared by Sonus, September 2016

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White Rock Wind Farm

Modification Application 4

Environmental Noise Assessment

Prepared for

White Rock Wind Farm Pty Ltd

S3486C9

September 2016

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1 INTRODUCTION

White Rock Wind Farm Pty Ltd has engaged Sonus to conduct an environmental noise assessment associated with Modification Application No.4 of the White Rock Wind Farm (WRWF) project approval[1].

The current project approval involves a grid connection to the existing Glen Innes to Inverell 132kV transmission line. The modification involves an alternative grid connection which will connect to an existing 330kV transmission line approximately 13km west of WRWF.

Components of the modification will include the construction and operation of:

- a double circuit 132kV transmission line between WRWF and the 330kV line;
- a 132kV/330kV substation located adjacent the 330kV line, comprising a single 132/330kV transformer rated at 320MVA; and
- temporary construction facilities for the construction of the 330kV grid connection facilities.

The location of the components of the modification and the closest residences are detailed in Appendix A.

This assessment considers the environmental noise at the nearest residences from the construction and operation of the proposed alternative grid connection. Specifically, the noise from the construction of the substation and transmission line towers; the operation of the substation; and the corona and aeolian effects of the transmission lines have been assessed against the relevant conditions of the current project approval.

[1] Project Approval MP 10_0160 MOD 3, approved on 1 April 2016 (Modification Application No. 3).

2 PROJECT APPROVAL CONDITIONS

Conditions of the current project approval (MP 10_0160 MOD 3) which are relevant to noise from the construction and operation of the alternative grid connection are provided below:

Overhead Transmission Lines

C17: Any overhead transmission line associated with the project shall be designed, constructed and operated to minimise the generation of corona and aeolian noise as far as reasonable and feasible at the nearest existing non-associated residences.

Construction or Decommissioning Hours

E5. The Proponent shall only undertake construction or decommissioning activities between:
(a) 7:00am to 6:00pm Mondays to Fridays;
(b) 8:00am to 1:00pm Saturdays; and
(c) at no time on Sundays or NSW public holidays.
The following construction activities may be undertaken outside these hours:

- *activities that are inaudible at any non-associated residence;*
- *activities approved under an out-of-hours (OOHW) work protocol (see condition E22(b)(vi));*
- *the delivery of materials as requested by the NSW Police Force or other authorities for safety reasons; or*
- *emergency work to avoid the loss of lives, property and/or prevent environmental harm.*

Construction Environmental Management Plan

E22. As part of the Construction Environmental Management Plan for the project required under condition E21 the Proponent shall prepare and implement:

..

*b) a **Construction Noise and Vibration Management Plan** to detail how construction noise and vibration impacts will be minimised and managed. The Plan shall be consistent with the guidelines contained in the Interim Construction Noise Guidelines (DECC, 2009) and shall include, but not necessarily be limited to:*

(i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the project;

(ii) details of construction activities and an indicative schedule for construction works; including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas;

(iii) identification of reasonable and feasible measures proposed to be implemented to minimise and manage construction noise and vibration impacts (including construction traffic noise impacts);

(iv) *procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast management program, applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/ vibration dampeners or alternative construction methodology, and pre- and post- construction dilapidation surveys of sensitive structures where blasting and/ or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria); and*

(v) *a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be conducted, the locations where monitoring would take place, how the results of this monitoring would be recorded and reported, and, if any exceedance is detected, how any non-compliance would be rectified;*

(vi) *an out-of-hours work (OOHW) protocol for the assessment, management and approval of works outside of standard construction and decommissioning hours as defined in condition E5 , including a risk assessment process under which an Environmental Representative may approve out-of-hour construction activities deemed to be of low environmental risk and refer high risk works for the Secretary's approval. The OOHW protocol shall detail standard assessment, mitigation and notification requirements for high and low risk out-of-hour works, and detail a standard protocol for referring applications to the Secretary; and,*

(vii) *mechanisms for the monitoring, review and amendment of this plan.*

Operational Noise Criteria - Ancillary Infrastructure

E23. The Proponent shall ensure that the noise generated by the operation of ancillary infrastructure does not exceed 35 dB(A) $L_{Aeq(15\ minute)}$ at any non-associated residence.

Noise generated by the project is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy (as may be updated from time-to-time), as modified by the provision in Appendix 3.

However, these criteria do not apply if the Proponent has an agreement with the owner/s of the relevant residence or land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.

Note:

Appendix 3 provides the Applicable Meteorological Conditions for Noise Compliance Assessment of non-wind turbine noise sources (other facilities), which excludes the following conditions:

a) wind speeds greater than 3m/s at 10m above ground level; or
b) temperature inversion conditions between 1.5ºC and 3ºC/100m and wind speeds greater than 2m/s at 10m above ground level; or
c) temperature inversion conditions greater than 3ºC/100m.

3 ASSESSMENT CRITERIA

3.1 Construction Noise

The project approval includes conditions that restrict the hours for construction activities (Condition E5) and require a Construction Noise and Vibration Management Plan (CNVMP) to be prepared and implemented (Condition E22), consistent with the Interim Construction Noise Guidelines[2] (ICNG).

Although the noise impact from construction activities and its compliance with the project approval will be managed through the CNVMP, an assessment at this stage will provide an indication of the potential construction activities that will need noise reduction measures, as required by the ICNG.

The ICNG provides an emphasis on implementing feasible and reasonable noise reduction measures and does not set mandatory standards or objective criteria during standard hours. However, the ICNG does establish a quantitative approach, whereby a goal level is used as a "trigger" for the construction site to implement all feasible and reasonable work practices and measures.

The ICNG goal level is based on the existing rating background level (RBL) at noise-sensitive locations, determined from the monitored background noise level (L_{A90}) in the environment. For construction activity occurring within the defined standard hours (also as specified by Condition E5), the ICNG provides a goal noise level of 10 dB(A) above the RBL. Construction activity that exceeds this level will need to implement all reasonable and feasible measures to reduce the noise.

The ICNG also recommends an upper limit, or maximum criterion, of 75 dB(A), which should only be exceeded "in exceptional circumstances and for short periods of time (for example up to two days)", acknowledging that construction activity is intermittent and for some processes, the application of noise reduction measures may not be reasonable or feasible.

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[2] Released by the NSW Department of Environment and Climate Change in July 2009.

For the purposes of this assessment, the ICNG goal noise level has been based on the indicative daytime RBL derived from the background noise monitoring conducted in the area.

Long term background noise monitoring has previously been conducted for the White Rock Wind Farm assessment (summarised in the Sonus report S3486C4, dated August 2011) at seven residences in the vicinity of the wind farm. The noise data from the location that result in the lowest derived RBL (for the allowable hours of Condition E5) have been considered. This results in an RBL of 29 dB(A) but in accordance with the Industrial Noise Policy (INP), the level has been set to the minimum of 30 dB(A). Therefore, the resultant ICNG goal noise level is 40 dB(A).

It is noted that this goal noise level is extremely conservative (low) for construction noise activity in that it is significantly less than the average noise level already in the environment.

Where the goal noise level is achieved, no specific noise mitigation measures are required. Where the goal noise level is exceeded, then all feasible and reasonable work practices and measures will need to be implemented.

3.2 Operation Noise

Condition E23 provides the relevant criterion to assess noise from the operation of the substation. That is 35 dB(A) $L_{Aeq(15\ minute)}$ at any non-associated residence when measured and adjusted in accordance with the INP.

3.3 Corona and Aeolian Noise

Condition C17 requires corona and aeolian noise generation by the overhead transmission lines be considered and be minimised as far as reasonable and feasible at the nearest existing non-associated residences.

4 ASSESSMENT

The assessment has been made based upon the following:

- the alternative grid connection route and the substation location as indicated on the figure in Appendix A;
- the nearest existing residences within 3.2km of the alternative grid connection route and the substation, as identified on the figure in Appendix A;
- predicted noise levels using the CONCAWE propagation model[3] in the SoundPlan noise modelling software, with the following input and assumptions:

Table 1: Noise prediction model input and assumptions.

Model Parameter	Input and Assumptions
Receiver height	1.5m above ground elevation
Topography	Local ground topography taken in 10m intervals
Ground type	Soft ground
Temperature	10°C
Relative humidity	70%
Wind	2 m/s in the worst case direction (ie. all receivers are downwind from the noise source)
Meteorological conditions	CONCAWE Category 6 (worst case that results in the highest noise level)

4.1 Construction Noise

In the absence of specific information on the construction techniques and equipment, the assessment has been based on typical construction activities, equipment types and numbers that may be expected to be used. The sound power levels for construction equipment have been based on manufacturer's data, Sonus database of noise sources, and the Australian Standard *AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites*, as summarised in the Table 2.

[3] CONCAWE The oil companies' international study group for conservation of clean air and water – Europe "The propagation of noise from petrochemical complexes to neighbouring communities". The model takes into account geometrical spreading, topography, ground absorption, atmospheric absorption and meteorological conditions.

Table 2: Sound power levels (dB(A)) of construction equipment.

Equipment	Overall Sound Power Level (dB(A))
Front end loader	118
Excavator	118
Roller	115
Concrete mixer truck	112
Truck	120
Truck mounted boring machine	120
Crane	115
Forklift	115
Generator for welding	113
Semi trailer	115

The stages of construction activities that were considered during the construction of the substation and the transmission line towers include the following:

- site preparation;
- foundation works;
- infrastructure construction;
- equipment/tower installation; and/or,
- site rehabilitation / removal of temporary construction facilities.

The two nearest residences to the substation location are approximately 2.4km and 3km away (AGC-R5 and AGC-R6, respectively), whilst the two nearest residences to the transmission line route are approximately 300m and 830m away (AGC-R7 and AGC-R8, respectively). Noise predictions have been made to these residences, which are representative of the others (the predicted noise levels at the other residences will be lower than the two closest residences).

The equipment considered during each stage of construction of the substation and transmission line towers are provided in Table 3 and Table 4, respectively. The predicted noise levels at the two nearest residences with all the equipment operating continuously and simultaneously are also provided in the tables.

Table 3: Predicted noise level from the construction of the substation.

Construction Stage	Considered Scenario		Predicted Noise Level (dB(A))	
	Expected Equipment	Quantity	AGC-R5 (2.4km buffer)	AGC-R6 (3km buffer)
Site preparation	Front end loader Excavator Roller Truck	1 1 1 1	37	33
Foundation works	Front end loader Roller Truck Concrete mixer truck Crane	1 1 1 2 1	37	33
Building construction	Truck Crane Forklift Concrete mixer truck Generator for welding	1 1 1 2 1	36	32
Equipment installation	Semi trailer Crane Forklift Generator for welding	2 1 1 1	36	33
Site rehabilitation / removal of temporary construction facilities.	Forklift Semi trailer Excavator Loader Truck	1 2 1 1 1	38	35

Table 4: Predicted noise level from the construction of the transmission line towers.

Construction Stage	Considered Scenario		Predicted Noise Level (dB(A))	
	Expected Equipment	Quantity	AGC-R7 (300m buffer)	AGC-R8 (830m buffer)
Site preparation	Front end loader Excavator Truck	1 1 1	63	51
Foundation works	Truck mounted boring machine Excavator Concrete mixer truck Crane	1 1 1 1	64	52
Tower construction	Crane Truck Generator for welding	2 1 1	62	51

Based on Table 3, the predicted noise levels at the nearest residences from construction activities associated with the substation are less than the ICNG goal noise level of 40 dB(A) and therefore will not require specific acoustic measures to be implemented.

Based on Table 4, the predicted noise levels at the nearest residences to the transmission line construction activities will be greater than the 40 dB(A) goal noise level of the ICNG, however, less than the 75 dB(A) upper limit. The noise from the construction activity is predicted to achieve the 40 dB(A) criterion when a separation distance of at least 2km is provided. Hence, for any construction activity that occurs within 2km of a residence, all feasible and reasonable work practices and noise reduction measures will need to be implemented.

The extent of all feasible and reasonable work practices and noise reduction measures to be implemented will be identified and detailed in the CNVMP for the project.

4.2 Operational Noise

The only significant noise source associated with the operation of the alternative grid connection is the 320MVA transformer at the substation. The noise from this single transformer has been predicted to the nearest residence (AGC-R5) located approximately 2.4km away.

Given that the transformer is yet to be procured at this stage of the development, the prediction has been based on an overall sound power level derived in accordance with the *Australian/New Zealand Standard AS/NZS 60076.10:2009 Power transformers – Part 10: Determination of sound* (AS/NZS 60076.10:2009), and octave band sound power levels derived from measurements of a similar transformer conducted by Sonus. The sound power levels are provided in Table 5.

Table 5: Sound power levels (dB(A)) of a 320MVA rated transformer.

Octave Band Centre Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	Total
SWL (dB(A))	80	88	96	98	90	88	80	76	101

The final transformer selection should be specified to have sound power levels no greater than those derived by the AS/NZS 60076.10:2009.

Based on the prediction, the noise level at the nearest residence from the operation of the transformer is 16 dB(A), therefore easily achieving the criterion of 35 dB(A).

A noise prediction contour of the noise from the transformer at the substation is provided in Appendix B.

4.3 Corona and Aeolian Noise

Corona and aeolian noise can be generated from the transmission lines. Corona noise is electrically-induced and occurs under specific meteorological conditions when the transmission lines are operational, whereas aeolian noise is wind-induced and occurs under specific conditions regardless of whether the transmission lines are operational or not.

Corona noise is infrequent and typically occurs in specific conditions of rain or high humidity when the air adjacent to a conductor of high voltage lines is ionised and becomes a conductor of electricity. The noise that is produced is typically a low level of hissing that is rarely a problem at distances greater than 100m from the transmission lines.

Aeolian noise is infrequent and only occurs at times when there is a specific wind speed and direction to generate the mechanism of air passing over thin structures. Aeolian noise generally only occurs on rare occasions and at times when there are high wind speeds and high background noise levels. There are mitigation measures available to reduce aeolian noise if necessary.

Given that the separation distance between the transmission lines and the nearest residence along the transmission line route is approximately 300m (ie., AGC-R7), the potential noise impact from corona and aeolian noise generation by the transmission lines is insignificant.

CONCLUSION

An environmental noise assessment has been made of Modification Application No. 4, associated with the proposed alternative grid connection for the White Rock Wind Farm.

The assessment considered the noise from:

- the construction of the substation and transmission line towers;
- the operation of the substation; and,
- the Corona and Aeolian effects of the transmission lines;

against the relevant conditions of the current project approval (MP 10_0160 MOD 3, issued 1 April 2016), which are Conditions E5, E22, E23 and C17.

Condition E5 limits the hours of construction activities to the standard hours of the ICNG, whilst Condition E22 requires a Construction Noise and Vibration Management Plan (CNVMP) consistent with the ICNG to be prepared and implemented. With a CNVMP that limits the hours of noisy construction activities to within the standard hours of the ICNG and implements all feasible and reasonable noise reduction measures where practicable, particularly for construction activities that occur within 2km of a residence, Condition E5 and E22 will be satisfied.

The noise at residences from the operation of the substation has been predicted for worst-case meteorological conditions. The predicted noise level at the residences is 16 dB(A), therefore easily achieving the 35 dB(A) criterion of Condition E23.

The nearest residence to the transmission line route is approximately 300m away. Given this separation distance, the noise impact at the residence from corona and aeolian noise generation by the transmission lines will be insignificant and therefore satisfy Condition C17.

Based on the above, the noise from the proposed alternative grid connection will achieve the relevant conditions of the current project approval.

APPENDIX A: ALTERNATIVE GRID CONNECTION AND NEAREST RESIDENCES

Coordinates of the Transmission Line Route:

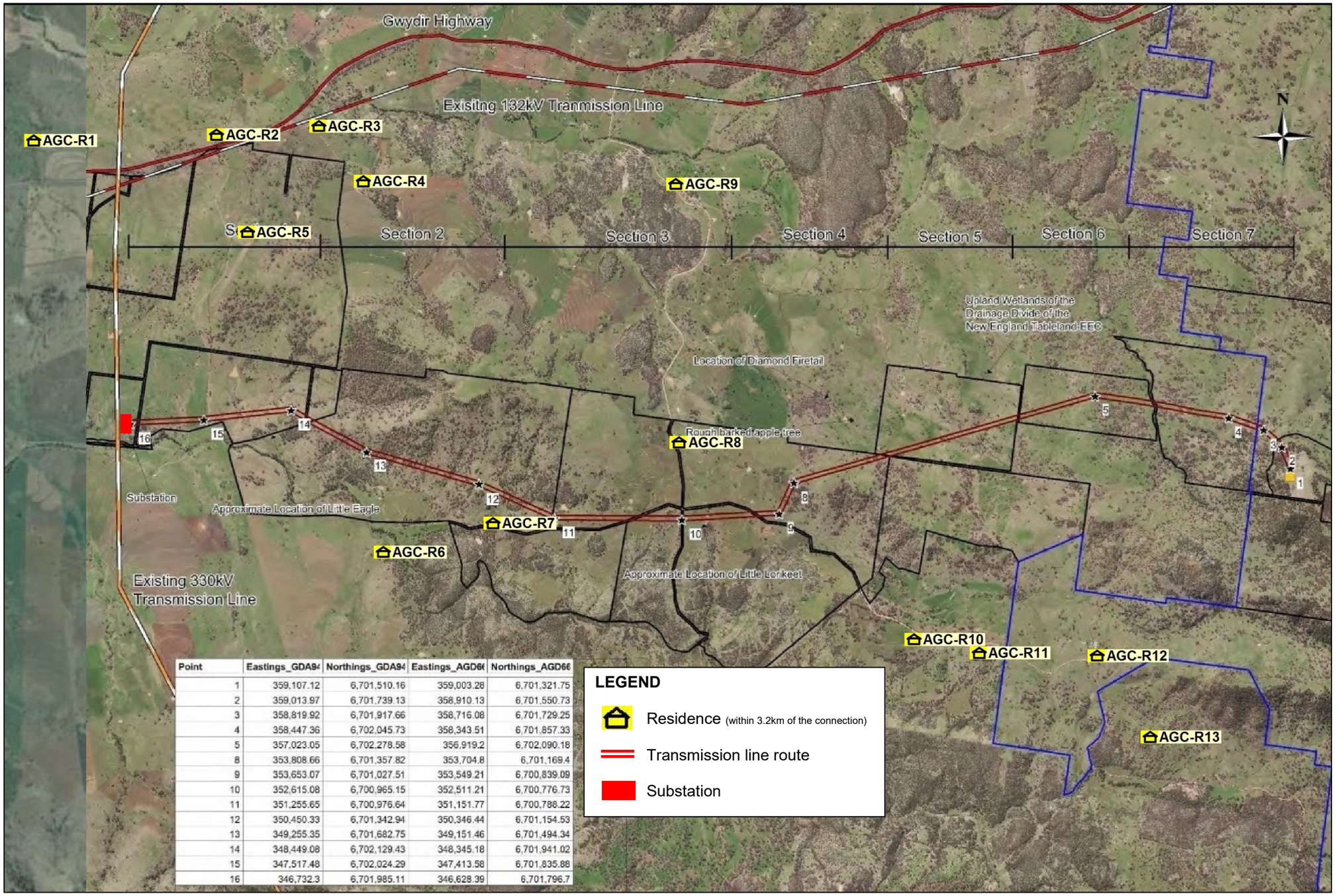
Transmission Line Route Point	Coordinates (MGA94 Z56)	
	Easting	Northing
1	359107	6701510
2	359014	6701739
3	358820	6701918
4	358447	6702046
5	357023	6702279
6	354782	6702638
7	354247	6701711
8	353809	6701358
9	353653	6701028
10	352615	6700965
11	351256	6700977
12	350450	6701343
13	349255	6701683
14	348449	6702129
15	347517	6702024
16	346732	6701985

Coordinates of the Substation:

Substation	Coordinates (MGA94 Z56)	
	Easting	Northing
320MVA transformer	346682	6701982

Coordinates of the Nearest Residences:

Residence ID	Coordinates (MGA94 Z56)	
	Easting	Northing
AGC-R1	345695	6705022
AGC-R2	347648	6705086
AGC-R3	348740	6705175
AGC-R4	349215	6704588
AGC-R5	347976	6704041
AGC-R6	349427	6700629
AGC-R7	350598	6700935
AGC-R8	352588	6701799
AGC-R9	352553	6704557
AGC-R10	355094	6699696
AGC-R11	355791	6699549
AGC-R12	357054	6699519
AGC-R13	357619	6698654



Point	Eastings_GDA94	Northings_GDA94	Eastings_AGD66	Northings_AGD66
1	359,107.12	6,701,510.16	359,003.28	6,701,321.75
2	359,013.97	6,701,739.13	358,910.13	6,701,550.73
3	358,819.92	6,701,917.66	358,716.08	6,701,729.25
4	358,447.36	6,702,045.73	358,343.51	6,701,857.33
5	357,023.05	6,702,278.58	356,919.2	6,702,090.18
8	353,808.66	6,701,357.82	353,704.8	6,701,169.4
9	353,653.07	6,701,027.51	353,549.21	6,700,839.09
10	352,615.08	6,700,965.15	352,511.21	6,700,776.73
11	351,255.65	6,700,976.64	351,151.77	6,700,788.22
12	350,450.33	6,701,342.94	350,346.44	6,701,154.53
13	349,255.35	6,701,682.75	349,151.46	6,701,494.34
14	348,449.08	6,702,129.43	348,345.18	6,701,941.02
15	347,517.48	6,702,024.29	347,413.58	6,701,835.88
16	346,732.3	6,701,985.11	346,628.39	6,701,796.7

APPENDIX B: PREDICTED NOISE LEVEL CONTOUR FROM OPERATION OF THE SUBSTATION