APPENDIX H

AERONAUTICAL IMPACT ASSESSMENT

G.9 AVIATION

Aeronautical Impact Assessment

Modification
Rye Park Wind Farm, NSW

Client

Rye Park Renewable Energy Pty Ltd

LB00300

Final V5
26 March 2020

Landrum & Brown Worldwide (Aust) Pty Ltd, 2020

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Version No.	Basis of issue	Author	Date	Reviewers
Draft 001	Draft report for submission to Client	PW	14 February 2019	JW
Draft 002	Updated Draft following client comments	PW	21 February 2019	
Draft 003	Updated Draft with 80 WTG layout	PW	2 May 2019	CA
Final V1	Final Report	PW	11 December 2019	
Final V2	Updated followed client comments	PW	13 March 2020	
Final V3	Updated client name - RPRE	PW	13 March 2020	
Final V4	Further updates	PW	16 March 2020	
Final V5	Updated following Airservices Australia report	PW	26 March 2020	

Contents

1 Introduction

1.1 The Development

Rye Park Renewable Energy Pty Ltd (RPRE), a solely owned subsidiary of Tilt Renewables, has tasked Landrum & Brown Worldwide (Australia) Pty Ltd to prepare an Aeronautical Impact Assessment (AIA) for the proposed modification of the Rye Park Wind Farm located approximately 55km north of Canberra. This report assesses the modification of the current Development Consent as sought by RPRE.

Development consent was issued for the Rye Park Wind Farm based on a layout comprising 126 WTGs with a maximum height of 157 m AGL.

The modified Rye Park Wind Farm will comprise 80 Wind Turbine Generators (WTGs) with the maximum height from ground level to the tip of an upright vertical WTG blade of 200 m above ground level (AGL) and 6 Met Masts. When considering terrain elevations, the elevations of the WTG blade tips varies from 860 m AHD to the maximum height of 971 m AHD. The met masts vary from 763 m AHD to 911 m AHD.

A previous Aeronautical Impact Assessment was provided to Tilt Renewables in 2014. Air routes and navigation aid infrastructure have changed since that report was compiled. This assessment considers the aeronautical information contained in Aeronautical Information Publication effective 27 February 2020 and on Aeronautical Charts effective 7 November 2019.

The boundary of the modified wind farm remains similar to the original layout assessed in 2014.

The general location of the wind farm and the ATC Radar location at Bobbara Mountain are shown in Figure 1.

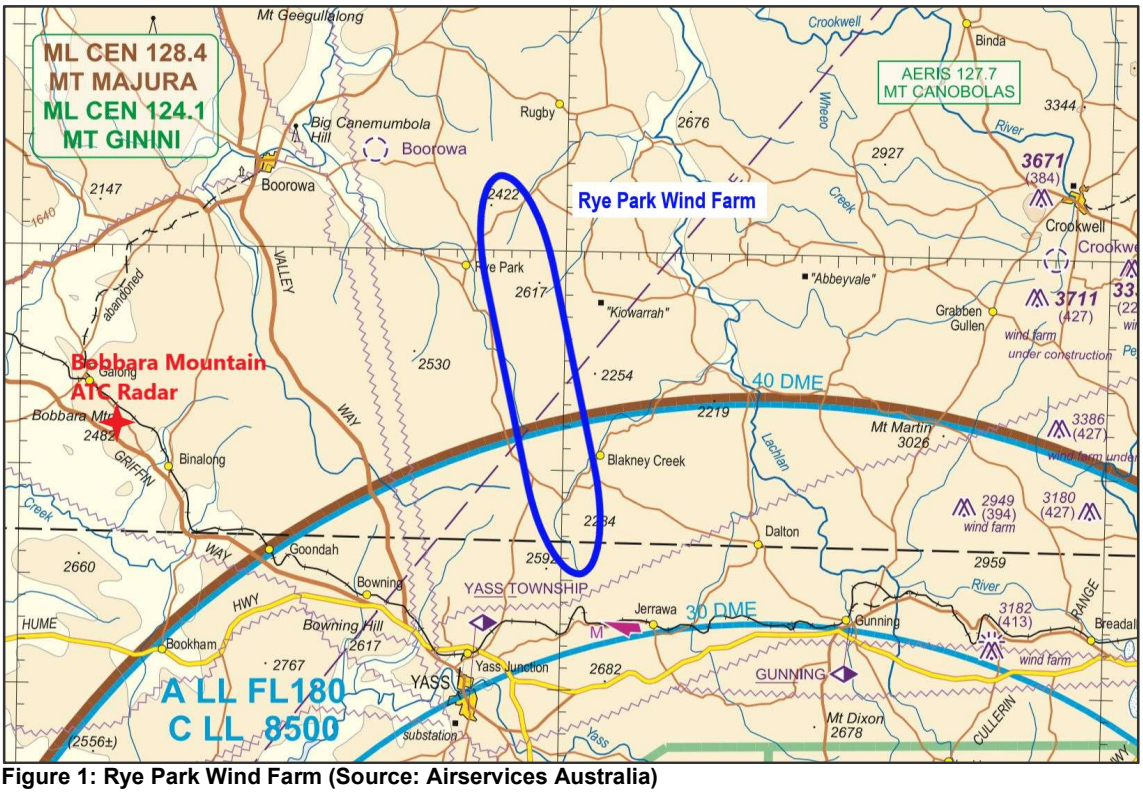

Figure 1: Rye Park Wind Farm (Source: Airservices Australia)

Goulburn Airport and Cowra Airport are the nearest certified airports and have published instrument approach procedures.

The unlicenced airfields at Boorowa and Crookwell, shown on the chart at Figure 1, are far enough away from the wind farm that aircraft operations will not be affected.

There may be other privately-owned airstrips in the area that are not published in the Aeronautical Information Publication (AIP). The owners of these airstrips and the pilots that use them are responsible for ensuring that the condition of the airstrip and the surrounding terrain and obstacle environment are suitable for the safe operation of the aircraft using them.

Some Instrument Flight Rules (IFR) air routes exist in the vicinity of the proposed Rye Park Wind Farm. These routes and the clearances are discussed in detail later in this report.

2 Airspace Protection

2.1 Overview

Protected airspace for an airport is the airspace above any part of either an Obstacle Limitation Surface (OLS), a PANS OPS (Procedures for Air Navigation Services – Aircraft Operations) surface, or the Radar Terrain Clearance Chart (RTCC) protection surfaces.

All of the local airports with OLS are in excess of 15 km from the wind farm and therefore their OLS are not infringed.

Airspace within the lateral navigation tolerances of an air route, and the vertical allowance is also protected from terrain or obstacle intrusion to ensure safe flight operations during IFR flight on those routes.

Infringement by an infrastructure development or crane into protected airspace requires the approval of the aerodrome operator or Airservices Australia, and the Civil Aviation Safety Authority (CASA).

Infringement of PANS OPS protection surfaces are not supported by the aviation authorities.

2.2 PANS OPS Surfaces

Goulburn and Cowra airports are the nearest airports with published instrument approach procedures. They are located at 65 km and 69 km respectively from the nearest boundary of the Rye Park Wind Farm and are therefore beyond the maximum limit of the PANS OPS surfaces of 56 km from the airport.

The modified layout of the Rye Park Wind Farm will not infringe any existing PANS OPS surface. Any future PANS OPS developments will need to consider the wind farm when determining related PANS OPS protection surfaces.

Airservices Australia has provided the following advice following their assessment of the Rye Park Wind Farm:

"With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 971m (3185ft) AHD, the wind farm will not affect any sector or circling altitude, nor any instrument or departure procedures at any airport,…" (Airservices Response: NSW-WF-038 P3)

2.3 Air Routes

The air route structure north of Yass has changed since the last report. Each air route has an associated Lowest Safe Altitude (LSALT) which is the lowest altitude that an IFR aircraft can fly on that route, without visual reference to the ground or water.

The LSALT for each route is determined by assessing the highest terrain or obstacle within each route segment protection area, usually 7nm laterally either side of the route centreline. A minimum obstacle clearance (MOC) margin of 1000 ft is applied to the highest point and then rounded up to the next 100 ft interval.

The highest WTG in the Rye Park Wind Farm, at 971 m (3186 ft) AHD would cause a minimum LSALT for any air route whose protection area overlaps it, to be 4186 ft (1276 m) which would be rounded up to 4200 ft.

Five air routes, listed in Table 1, have LSALTs less than 4200 ft. Airservices Australia will need to assess all of the WTG elevations against their protection area diagrams and data to determine which of these air routes would require amendment up to a LSALT of 4200 ft.

The relevant Grid LSALTs, based on a whole 1-degree longitude x 1-degree latitude square, are above 4200 ft and would not require amendment.

Air Route and Segment	LSALT (ft/ m AHD)	Infringement of development at maximum WTG Elevation + 1000 ft 1275 m AHD	Likely LSALT Result
W137 Cowra to AVBEG	4100 ft / 1250 m	25 m	4200 ft
W683 UGVER to ISNOL	4100 ft / 1250 m	25 m	4200 ft
W762 Narrandera to ISNOL	3800 ft / 1158 m – westbound 4100 ft / 1250 m – eastbound	117 m – westbound 25 m - eastbound	4200 ft
W478 ASUMU to ISNOL	3900 ft / 1188 m	87 m	4200 ft
W836 Griffith to ISNOL	3800 ft / 1158 m – westbound 3900 ft / 1188 m – eastbound	117 m – westbound 25 m - eastbound	4200 ft

Table 1: Air Routes LSALT Impact

Airservices Australia has provided the following advice following their assessment of the Rye Park Wind Farm:

The wind farm *"…will affect local air routes as follows:*

W137:

WTG50 (36ft penetration), WTG61 (1ft penetration), WTG62 (1ft penetration), WTG80 (37ft penetration), WTG84 (47ft penetration), WTG86 (4ft penetration), WTG120 (1ft penetration), WTG139 (83ft penetration), WTG143 (24ft penetration), WTG145 (6ft penetration) and WTG150 (34ft penetration).

The largest penetration of 83ft (WTG139) will require the Lowest Safe Altitude (LSALT) to be raised to 4200ft.

W478:

WTG01 (52ft penetration).

The penetration will require the LSALT to be raised to 4000ft.

In order to not affect any local air routes the maximum tip elevations are as follows:

WTG01:	*899m/2950ft*	*WTG50:*	*960m/3150ft*
WTG61:	*944m/3100ft*	*WTG62:*	*944m/3100ft*
WTG80:	*944m/3100ft*	*WTG84:*	*944m/3100ft*
WTG86:	*944m/3100ft*	*WTG120:*	*944m/3100ft*
WTG139:	*944m/3100ft*	*WTG143:*	*944m/3100ft*
WTG145:	*944m/3100ft*	*WTG150:*	*944m/3100ft"*

(Airservices Response: NSW-WF-038 P3)

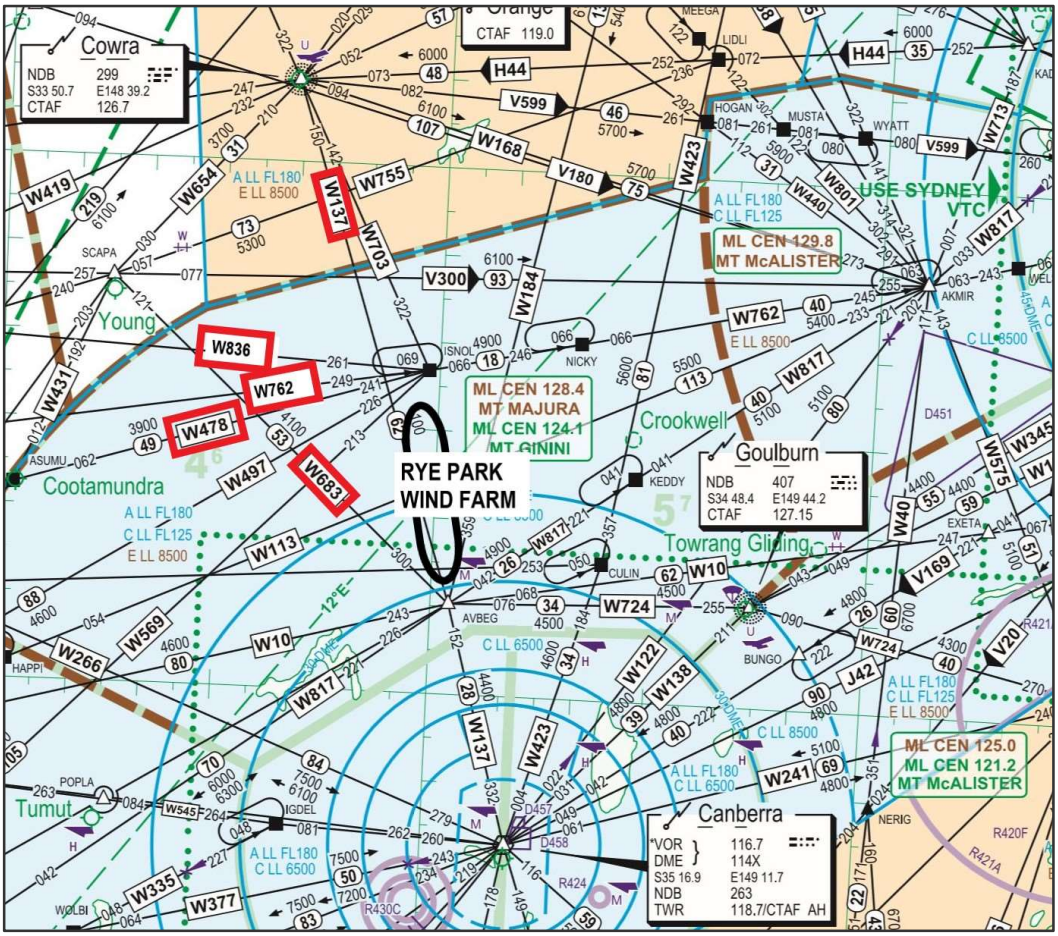

Figure 2: Air Routes and development site (AIP ERC L2 – 7 November 2019)

The modified layout of the wind farm, with higher WTGs causes an additional increase of 100 ft to the LSALTs for these air routes above what the original layout imposed. An increase to 4100 ft was shown in the previous report.

This is considered a minimal impact and should be approved by Airservices Australia.

3 ATC Surveillance Systems and Navigation Aids

Wind farms have the potential to cause both electro-magnetic and reflective type interference to ATC radar surveillance systems and to the accuracy of aeronautical navigation aids.

The nearest ATC surveillance system is located at Bobbara Mountain, shown in Figure 1, and approximately 35 km from the western boundary of the Rye Park Wind Farm. Another ATC surveillance system is located at Mt Majura, 54.5 km south of the wind farm boundary.

The Bobbara Mountain Monopulse Secondary Surveillance Radar (MSSR) is located beyond the 16 km Eurocontrol–Guide 0130 Zone 4 and no assessment is required. A 0.5 degree clearance plane commencing at the antenna exists at 1108 m above the closest point of the wind farm, well above the maximum height of the wind farm WTGs.

Mt Majura Primary Surveillance Radar (PSR) is also located beyond 16 km but a possible line of sight condition may be present.

Due to the high elevation of the Mt Majura PSR it has a slightly downward tilted antenna to improve the coverage of aircraft at low levels around Canberra. It is probable that under optimum conditions the wind farm may generate radar plots. However, the radar filters are likely to restrict false plots from generating false tracks that would appear on the radar controller's display. Strict criteria is applied to the radar data to restrict false track outputs to the air traffic controller.

The probability of the radar “seeing” some of the higher WTGs and producing plots is considered MEDIUM. The likelihood of these plots generating a false track to the radar controller, through sophisticated filtering processes within the radar system is considered minimal.

No significant adverse effect to the performance of the radars is anticipated due to the distances of the radars from the wind farm and the lack of any known adverse effects caused by existing wind farms in the region.

Airservices Australia’s radar engineers will need to make their own assessment of the wind farm to officially determine if any adverse impact to ATC surveillance services may exist or not.

The wind farm will be located in Class G airspace below Class E airspace with a Lower Limit (LL) of 8500 ft. Class G airspace is uncontrolled. Both IFR and VFR flights operate there and do not require an ATC clearance. Class E airspace is not infringed by any of the WTGs.

The nearest aeronautical navigation aids are located at Goulburn airport, 65 km from the development. The windfarm is located outside the clearance zones associated with all navigation aids. Navigation aids detailed in the previous report have been removed from service. Class E airspace is mid-level enroute controlled airspace open to both IFR and VFR aircraft. IFR aircraft require an ATC clearance and therefore must communicate with ATC.

Details of the wind farm will be provided to Airservices Australia to enable their engineers to confirm that the wind farm does not interfere with ATC communications, surveillance or navigations systems.

Airservices Australia has provided the following advice following their assessment of the Rye Park Wind Farm:
“The wind farm will not affect the Canberra Radar Terrain Clearance Charts (RTCC).

This wind farm, to a maximum height of 971m (3185ft) AHD, will not adversely impact the performance of Precision/Non-Precision Navigational Aids, HF/VHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

ATC has no objections to this development.” (Airservices Response: NSW-WF-038 P3)

4 Aviation Activity in the Vicinity of the Wind Farm

4.1 VFR operations

It is difficult to assess the level of aviation activity in the vicinity of the proposed Rye Park Wind Farm due to the lack of reporting requirements for VFR flights in this area.

VFR transit type flights between airports normally operate at a comfortable altitude above terrain for their transit to their destinations. They are required to navigate by visual reference to the ground or water at all times which therefore requires a minimum standard of “good weather” to enable their operations.

VFR scenic and local flights might operate at lower altitudes, but the prominent WTGs will be readily identifiable and avoidable, as well as serving as a navigation feature. The existence of other wind farms in the region will have already influenced pilot behavior due to an increased level of awareness of their presence, size and contrast to the surrounding environment.

Glider flying training and cross-country soaring activity occurs around the Australia. Glider flights are conducted by day only and in good weather conditions using either thermal or mountain wave type updrafts to conduct cross-country flights away from their airfield. Glider flights will either be at an altitude well above the wind farm or be landing in paddocks if they cannot get back to an airfield. Either way, the wind farm is a prominent feature that will enable pilots to avoid it if they need to land nearby or use it as a prominent navigation feature.

4.2 Low level operations

Pilots undertaking authorised low level operations such as crop dusting, aerial firefighting, aerial cattle mustering, search and rescue, power line survey, gas pipe line monitoring and military low level flying in the area undergo specialised training and are required to take account of obstacles when planning and conducting low level operations.

Depiction of the wind farm on aeronautical charts will provide sufficient information for pilots planning to operate in the vicinity of it, to be aware of its presence and to plan their flights in order to either avoid the location altogether or consider its impact upon their proposed flight operations.

4.3 IFR Operations

IFR pilots operating in the area are required to maintain minimum altitudes published on aeronautical charts and instrument approach charts. Section 2.3 of this report details the impact upon LSALTs in the area.

4.4 Contingency Procedures – Engine Inoperative Flight Paths

In the context of the aircraft and airport operations in the vicinity of the proposed development of the Rye Park Wind Farm and the physical environment, it is considered to be sufficiently distant from nearby airports to have no impact on contingency procedures and engine inoperative flight paths in the area.

The modified layout and height of the wind farm is unlikely to create any additional impact to aviation activity in the area. When the layout is finalise, approved and published in aeronautical publications and charts, pilots will consider that layout in their flight planning and operational activities.

5 Obstacle Marking and Lighting

CASA have indicated that obstacle marking, usually white or a conspicuous colour against the local background, and lighting of very high wind turbine generators is likely to be required due to the WTGs exceeding the minimum altitude for VFR flight, 500 ft/ 152 m AGL and the need to ensure that such low level flights are able to identify the WTGs in time to be able to avoid them.

CASA would issue advise to the relevant planning authority that would indicate that the wind farm is likely to, or would, cause a hazard to aviation safety without appropriate marking or lighting.

If CASA or the Department of Defence (DoD) require obstacle lighting for the Rye Park Wind Farm, shielding of the lights to avoid distraction to residents may be installed, however the lights must remain visible above a horizontal plane.

Discussion notes regarding the lighting of wind farms can be found in Appendix C.

As the Rye Park Wind Farm turbine tip heights will exceed 110m AGL, formal notification to CASA and DoD is required in accordance with:

- CASA Advisory Circular AC 139-08(0) “Reporting of Tall Structures” to enable inclusion of the wind farm location and height of turbines in relevant aeronautical information publications; and
- CASA Form 406 – “Operational Assessment of Existing and Proposed Structures”.

This aeronautical impact assessment and review of obstacle marking and lighting requirements supports this formal notification requirement.

Meteorological Monitoring Masts should be marked in accordance with NASAG Guideline D and their position notified to the RAAF and Airservices.

Formal notification of the intention to develop the Rye Park Wind Farm should also be provided to local aviation parties and relevant aviation stakeholders.

As part of corporate responsibility and duty of care undertakings, it is considered appropriate for the proponent to formally advise all relevant stakeholders of:

- The locations and heights of the WTGs and Meteorological Masts and when they would be constructed and decommissioned; and
- The developer’s intentions regarding marking and lighting of these components.

The increased height of the WTGs may cause CASA to consider that the wind farm will require some form of lighting due to the increased height.

6 Conclusion

The modifications to the proposed Rye Park Wind Farm development to the north of Yass, to a maximum height of 971 m AHD:

- will not infringe any OLS;
- will not infringe the PANS OPS surfaces of any airport;
- will not impact on contingency procedures;
- will not affect ATC surveillance systems or infringe the Canberra RTCC;
- will infringe the LSALT protection surfaces for five air routes. (Airservices Australia will make the minor adjustment to some air route LSALTs);
- does not infringe the Grid LSALTS in the area;
- is outside the clearance zones associated with any aeronautical navigation aids;
- will have little or no impact upon local flying activities; and
- will provide a significant visual navigation feature in the region.

The modification to the layout and height of the Rye Park Wind will not have any significant impact upon local aviation activity or procedures. The additional height will require a 100 ft height increase to the LSALTs of the local air routes and may cause CASA to further consider that lighting will be required.

Construction crane activity below 971 m AHD will not infringe any of the above surfaces.

Details of the Rye Park Wind Farm will be provided to CASA and the Department of Defence, for assessment of the need for obstacle lighting.

CASA will receive the details of the wind farm from the relevant local planning authority. They will not assess or comment on any wind farm until then.

Vertical Obstacle Notification

As soon as construction commences, the proponent must complete the Vertical Obstacle Notification Form for tall structures and submit the completed form to VOD@airservicesaustralia.com .

For further information regarding the reporting of tall structures, please contact (02) 6268 5622, email VOD@airservicesaustralia.com or refer to the web link below:

http://www.airservicesaustralia.com/services/aeronautical-information-and-management-services/part-175/

Appendix A: WTG Coordinates and Terrain Elevations

WTG ID	Latitude GDA94	Long GDA94	Ground Elevation m AHD	Tip Elevation m AHD
1	-34.4464	148.9226	715	915
2	-34.4498	148.921	714	914
3	-34.4534	148.9194	695	895
4	-34.4569	148.9195	680	880
5	-34.4587	148.9357	710	910
7	-34.4616	148.9324	722	922
9	-34.465	148.9313	716	916
11	-34.4685	148.9301	731	931
12	-34.4726	148.9308	720	920
17	-34.4816	148.975	723	923
20	-34.4849	148.9717	743	943
21	-34.4885	148.9449	693	893
22	-34.4881	148.9554	691	891
25	-34.4917	148.9537	705	905
26	-34.492	148.9442	698	898
28	-34.4955	148.944	730	930
30	-34.4993	148.9498	740	940
31	-34.5017	148.9646	755	955
32	-34.5023	148.9451	740	940
34	-34.5058	148.9487	722	922
36	-34.5049	148.9633	738	938
37	-34.5093	148.9498	710	910
39	-34.5114	148.9619	716	916
41	-34.5139	148.961	707	907
42	-34.5146	148.9717	695	895
43	-34.5141	148.9503	710	910
48	-34.5253	148.9777	760	960
49	-34.5265	148.9825	720	920
50	-34.5287	148.9762	771	971
51	-34.532	148.9761	741	941
58	-34.5401	148.9877	720	920
61	-34.5387	148.972	745	945
62	-34.5418	148.9706	745	945
63	-34.5448	148.9868	711	911
64	-34.5458	148.999	695	895
65	-34.5468	149.0141	660	860
66	-34.5477	148.9877	705	905
67	-34.5489	148.9646	695	895
68	-34.5498	149.0108	668	868
69	-34.5508	148.9869	716	916
71	-34.568	148.9861	729	929
72	-34.5718	148.9851	730	930
73	-34.5747	148.9745	706	906
74	-34.5778	148.9772	720	920
75	-34.5811	148.9776	730	930
76	-34.5824	148.9674	711	911
78	-34.5847	148.9711	705	905
79	-34.589	148.97	695	895
80	-34.5933	148.9847	756	956
82	-34.5975	148.9847	741	941
83	-34.6012	148.9827	733	933
84	-34.6175	148.9783	759	959
85	-34.6201	148.9843	723	923
86	-34.6248	148.9824	746	946
87	-34.6282	148.9803	731	931
18	-34.4839	148.9439	699	899
119	-34.7511	149.0064	742	942
120	-34.7503	149.0209	745	945
122	-34.7546	149.0056	731	931
124	-34.7554	149.0223	728	928
125	-34.7559	149.0146	740	940
127	-34.76	149.0138	720	920
128	-34.7632	149.0011	700	900
129	-34.7638	149.0149	720	920
131	-34.7696	148.9997	704	904
135	-34.5026	148.953	740	940
136	-34.4894	148.9691	735	935
137	-34.4931	148.9675	722	922
138	-34.4966	148.9671	730	930
139	-34.5266	148.9714	770	970
141	-34.5445	148.9669	738	938
142	-34.7528	149.0167	733	933
143	-34.6139	148.9787	752	952
130	-34.7666	149.001	698	898
146	-34.5558	149.0074	690	890
147	-34.5594	149.0105	714	914
148	-34.5633	149.0108	709	909
150	-34.5885	148.985	755	955
145	-34.7372	149.0328	719	919
151	-34.4551	148.9304	690	890

Indicative WTG Coordinates and Terrain Elevations. Source: Tilt Renewables

Appendix B: Assessment Methodology

In preparing aeronautical impact assessments associated with airport safeguarding and protection, it is necessary to observe the requirements of the relevant aviation authorities including:

- The Department of Infrastructure, Regional Development and Cities (DIRDC);
- The Civil Aviation Safety Authority of Australia (CASA);
- Airservices Australia (ASA);
- Airport Operators; and
- Department of Defence where appropriate.

Relevant Acts and Regulations applicable to developments near airports and air traffic routes were referenced during this assessment.

The major relevant documents include:

- The Airports Act 1996, Airports (Protection of Airspace) Regulations 1996;
- Civil Aviation Safety Regulation (CASR) Part 139 Manual of Standards – Aerodromes;
- Aeronautical Information Publication (AIP);
- Airservices Australia's Airways Engineering Instruction – Navigation Aid Building Restricted Areas and Siting Guidance (BRA);
- International Civil Aviation Organisation (ICAO) DOC 8168 Procedures for Air Navigation – Aircraft Operations (PANS OPS).

A Glossary of Aeronautical Terms and Abbreviations is shown at Appendix D.

Appendix C: Discussion of Obstacle Lighting Requirements

The aeronautical requirements for marking and lighting of wind farms are currently undergoing review by the International Civil Aviation Organization (ICAO), the Department of Infrastructure, Regional Development and Cities (DIRDC) and CASA.

DIRDC recently issued a Discussion Paper "Safeguards for Airports and The Communities Around Them" that implies an amendment to the criteria for wind turbine reporting heights from 110m to 152m AGL being applicable to wind farms in the vicinity of aerodromes. In addition, CASA is currently reviewing its withdrawn Advisory Circular AC139-181 "Obstacle Marking and Lighting of Wind Farms".

The outcomes of these various reviews may result in:

- Revised criteria for reporting of wind farms; and
- Wind farms that are in remote locations, away from aerodromes, not requiring obstacle lighting, depending on the findings of a qualitative risk assessment to be undertaken by the proponent.

While the DIRDC Discussion Paper applies specifically to wind farms within the vicinity (generally accepted as 30km) of aerodromes, CASA is also currently reviewing the requirements for marking and lighting of obstacles and hazards remote from aerodromes. CASA has informally advised the renewable energy industry that a qualitative risk assessment approach to the potential hazards, as presented by wind farms, may be considered.

CASA's current position on obstacle lighting of wind farms that are remote from an aerodrome (which is the situation for the Rye Park Wind Farm) is summarised as:

- CASA cannot mandate obstacle lighting for wind farms that are not within the vicinity of an aerodrome;
- provision of obstacle lighting is the responsibility of the proponent;
- any associated requirements placed on proponents by planning authorities, insurers or financiers are beyond CASA's scope;
- a wind farm proponent may have a duty of care to the aviation industry and local operators in terms of ensuring obstacles are made conspicuous; and
- obstacle marking and lighting requirements in relation to Obstacle Limitation Surfaces, etc, as specified in the CASA Manual of Standards Part 139, Chapters 8 and 9 applies.

CASA Manual of Standards (MOS) 139, Chapter 9, Section 9.4 indicates that for structures more than 110m AGL, the proponent should expect that obstacle lighting will be required unless there are unusual circumstances. The turbines to be installed at Rye Park Wind Farm will have a maximum height of 200 m AGL. However, there have been situations where CASA has acknowledged non-provision of obstacle lighting of wind farms in Australia where the turbine height exceeds 110m AGL. Such installations have been the subject of a hazard risk assessment that takes into account such factors as location of the wind farm with respect to nearby airfields and air routes, potential impact on navigable airspace, surrounding terrain, local aviation activity in the area, and environmental considerations.

The wind farms concerned are sited in mountainous area are remote from regulated airports and were assessed as not presenting a hazard to aircraft operations.

As indicated above, Australian policy, standards and recommended practices for obstacle marking and lighting of wind farms are currently under review. A current proposal includes a change to the criterion height of 110m (361ft) to 152m (500ft) AGL for wind farms within the vicinity of a certified or registered aerodrome.

Appendix D: Glossary of Aeronautical Terms and Abbreviations

To facilitate the understanding of aviation terminology used in this report, the following is a glossary of terms and acronyms that are commonly used in aeronautical impact assessments and similar aeronautical studies.

Advisory Circulars (AC) are issued by CASA and are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the *Regulations*.

Aeronautical Information Publication (AIP) is a publication promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. It contains details of regulations, procedures and other information pertinent to flying and operation of aircraft within the applicable country. AIP Australia is produced by Airservices Australia under contract to CASA.

Aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria are appropriate.

Air routes exist between navigation aids or waypoints to facilitate the regular and safe flow of aircraft operating under the IFR.

Airservices Australia (ASA) is the Australian government-owned corporation Air Navigation Service Provider (ANSP) providing safe, secure, efficient and environmentally sound air traffic management and related airside services including telecommunications, aeronautical data, navigation services and aviation rescue and firefighting services to the aviation industry within the Australian flight information region.

Air Traffic Control (ATC) service is a service provided in controlled airspace for the purpose of preventing collisions between aircraft and between aircraft and obstructions on the manoeuvring area of controlled aerodromes whilst maintaining an expeditious and orderly flow of air traffic.

Altitude is the vertical distance of a level, a point or an object, considered as a point, measured from mean sea level.

Area navigation (RNAV) A method of navigation which permits aircraft operation on any desired flight path within the coverage of the station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

Circling approach An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.

Civil Aviation Safety Authority (CASA) is the Australian government authority responsible under the *Civil Aviation Act 1988* for developing and promulgating appropriate, clear and concise aviation safety standards. As Australia is a signatory to the ICAO *Chicago Convention,* CASA adopts the standards and recommended practices established by ICAO, except where a difference has been notified.

Civil Aviation Safety Regulations (CASR) are promulgated by CASA and establish the regulatory framework *(Regulations)* within which all service providers must operate.

Civil Aviation Act 1988 (the Act) establishes the CASA with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes.

Decision altitude (DA) or decision height (DH) A specified altitude or height in a 3D instrument approach operation at which a missed approach must be initiated if the required visual reference to continue the approach has not been established. *Note— Decision altitude (DA) is referenced to mean sea level and decision height (DH) is referenced to the threshold elevation.*

Elevation The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.

Height The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

Instrument Flight Rules (IFR) are rules applicable to the conduct of flight under IMC. IFR are established to govern flight under conditions in which flight by outside visual reference is not available due to cloud cover or restricted visibility. IFR flight depends upon a qualified instrument rated pilot flying by reference to instruments located in the flight deck. Navigation is accomplished by reference to electronic signals. It is also referred to as, "a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying," such as an IFR or VFR flight plan. IFR flights can and do regularly operate in VMC but remain an IFR flight for rule and ATC requirements. Regular Public Transport flights are required to file an IFR flight plan, irrespective of the weather conditions.

Instrument Meteorological Conditions (IMC) are meteorological conditions that are less than the minimum specified for visual meteorological conditions.

International Civil Aviation Organization (ICAO) is an agency of the United Nations which codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. The ICAO Council adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference, and facilitation of border-crossing procedures for international civil aviation. In addition, the ICAO defines the protocols for air accident investigation followed by transport safety authorities in countries signatory to the Convention on International Civil Aviation, commonly known as the *Chicago Convention*. Australia is a signatory to the *Chicago Convention.*

Lowest Safe Altitude (LSALT) are published for each low level air route segment. Their purpose is to allow pilots of aircraft that suffer a system failure to descend to the LSALT to ensure terrain or obstacle clearance in IMC where the pilot cannot see the terrain or obstacles due to cloud or poor visibility conditions. It is an altitude that is at least 1,000 feet above any obstacle or terrain within a defined safety buffer region around a particular route that a pilot might fly.

Manual of Standards (MOS) comprises specifications (Standards) prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation in relation to a particular segment of the aviation regulations. For example, MOS 139 relates to CASR Part 139 – Aerodromes.

Minimum descent altitude (MDA) or minimum descent height (MDH) A specified altitude or height in a 2D instrument approach operation or circling approach operation below which descent must not be made without the required visual reference. Note: Minimum descent altitude (MDA) is referenced to mean sea level and minimum descent height (MDH) is referenced to the aerodrome elevation or to the threshold elevation if that is more than 2 m (7 ft) below the aerodrome elevation. A minimum descent height for a circling approach is referenced to the aerodrome elevation.

Minimum Obstacle Clearance (MOC) is the minimum distance above an obstacle or terrain that aircraft conducting instrument approach or departure procedures are not allowed to fly below in IMC. The MOC varies depending on the distance from the runway or in mountainous areas.

Notices to Airmen (NOTAMs) are notices issued by the NOTAM office containing information or instruction concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.

Obstacles. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

Obstacle assessment surface (OAS) is a defined surface intended for the purpose of determining those obstacles to be considered in the calculation of obstacle clearance altitude/height for a specific APV or precision approach procedure.

Obstacle Limitation Surfaces (OLS) are a series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations may be conducted safely.

Prescribed airspace is an airspace specified in, or ascertained in accordance with, the Regulations, where it is in the interests of the safety, efficiency or regularity of existing or future air transport operations into or out of an airport for the airspace to be protected. The prescribed airspace for an airport is the airspace above any part of either an OLS or a PANS OPS surface for the airport and airspace declared in a declaration relating to the airport.

Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) is an ICAO term denominating rules for designing instrument approach and departure procedures. Such procedures are used to allow aircraft to land and take off under Instrument Meteorological Conditions (IMC) using the Instrument Flight Rules (IFR). ICAO document 8168-OPS/611 (volumes 1 and 2) outlines the principles for airspace protection and procedure design which all ICAO signatory states must adhere to. The regulatory material surrounding PANS-OPS may vary from country to country.

PANS OPS Surfaces. Similar to an Obstacle Limitation Surface, the PANS-OPS protection surfaces are imaginary surfaces in space, below the nominal flight path of the aircraft, which guarantee a certain minimum obstacle clearance above the ground or man-made obstacles. These surfaces may be used as a tool for local governments in assessing building development. Where buildings may (under certain circumstances) be permitted to penetrate the OLS, they cannot be permitted to penetrate any PANS-OPS surface, because the purpose of these surfaces is to guarantee pilots operating in IMC an obstacle free descent or climb path for a given approach, holding procedure or departure.

Regulations (Civil Aviation Safety Regulations)

Threshold (THR). The beginning of that portion of the runway usable for landing.

Visual Flight Rules (VFR) are rules applicable to the conduct of flights that are only permitted in VMC due to aircraft equipment and pilot qualifications. The visual flight rules allow a pilot to operate an aircraft in weather conditions that allow the pilot to navigate by visual reference to the ground or water by maintaining visual contact with the terrain and obstacle environment in order to be able to see and avoid other aircraft, terrain, obstacles or other hazards. Specifically, the weather must be equal to or better than basic VFR weather minima. If the weather is worse than VFR minima, IFR qualified pilots operating an IFR qualified aircraft are able to operate under the IFR.

Visual Meteorological Conditions (VMC) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, equal or better than specified minima.

Visual Segment Surface (VSS) A PANS-OPS design segment of a straight-in instrument approach procedure, which needs to be monitored and kept clear of any penetrations by obstacles.

Abbreviations

Abbreviations used in this report, and the meanings assigned to them for the purposes of this report are detailed in the following table.

Abbreviation	Meaning
AC	Advisory Circular (document support CAR 1998)
ACFT	Aircraft
AD	Aerodrome
ADS-B	Automatic Dependent Surveillance - Broadcast
AHD	Australian Height Datum
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALT	Altitude
AMSL	Above Mean Sea Level
APARs	Airports (Protection of Airspace) Regulations, 1996 as amended
ARP	Aerodrome Reference Point
AsA	Airservices Australia
ATC	Air Traffic Control(ler)
ATM	Air Traffic Management
BARO-VNAV	Barometric Vertical Navigation
BRA	Building Restricted Area
CAO	Civil Aviation Order
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
Cat	Category
DAP	Departure and Approach Procedures (charts published by AsA)
DER	Departure End of (the) Runway
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DIT	Department of Infrastructure and Transport. (Formerly Dept. of Infrastructure, Transport, Regional Development and Local Government and Department of Transport and Regional Services (DoTARS))
DOTARS	See DIT above
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix

Abbreviation	Meaning
FAP	Final Approach Point
FAS	Final Approach Surface of a BARO-VNAV approach
ft	feet
GBAS	Ground Based Augmentation System (satellite precision landing system)
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
LAT	Latitude
LLZ	Localizer
LONG	Longitude
LNAV	Lateral Navigation criteria
m	metres
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MGA94	Map Grid Australia 1994
MOC	Minimum Obstacle Clearance
MOS	Manual of Standards, published by CASA
MSA	Minimum Sector Altitude
MVA	Minimum Vector Altitude
NASAG	National Airports Safeguarding Advisory Group
NDB	Non Directional Beacon
NE	North East
NM	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in nautical miles)
NNE	North North East
NOTAM	NOtice to AirMen
OAS	Obstacle Assessment Surface
OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OHS	Outer Horizontal Surface
OIS	Obstacle Identification Surface

Abbreviation	Meaning
OLS	Obstacle Limitation Surface
PANS OPS	Procedures for Air Navigation Services – Aircraft Operations, ICAO Doc 8168
PBN	Performance Based Navigation
PRM	Precision Runway Monitor
QNH	An altimeter setting relative to height above mean sea level
REF	Reference
RL	Relative Level
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RPA	Rules and Practices for Aerodromes — replaced by the MOS Part 139 — Aerodromes
RPT	Regular Public Transport
RTCC	Radar Terrain Clearance Chart
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
STAR	STandard ARrival
SGHAT	Solar Glare Hazard Analysis Tool
TAR	Terminal Approach Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
VNAV	Vertical Navigation criteria
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range
WAC	World Aeronautical Chart