Glen Innes

12

Safety Aspects

12. Safety Aspects

This chapter of the Environmental Assessment provides a description of potential impacts of the project on human health and safety and the measures to mitigate those impacts.

12.1 Introduction

The principal safety issues identified in connection with the proposed wind farm development relate to:

- aviation
- physical safety associated with the turbines themselves
- bushfire risk
- electrical safety
- road safety
- use of plant and equipment on steep slopes on the site
- shadow flicker
- noise

The project will be implemented in accordance with the relevant safety requirements to ensure the safety of the workforce at the site and the local community. Consideration of the specific aspects listed above is provided in the following sections.

12.2 Air safety

The development of the Glen Innes Wind Farm involves the construction of up to 27 wind turbine structures that each has a maximum height of between 124 and 130 metres to the top of the turbine blades. Due to the height of the structures the potential implications for aviation safety have been examined and consultation with relevant stakeholders undertaken. Air safety issues that have been assessed for the proposed project include:

- proximity of the proposed wind farm to landing fields
- potential intrusion into air traffic zones and regulatory requirements
- potential effects on activities such as aerial spraying of agricultural areas

These issues are described in the sections below.

12.2.1 Proximity to aircraft landing fields

Landing fields may be classified according to whether instrument landings are available. The nearest air fields providing commercial services are a significant distance from the wind farm site and will not be affected by its development.

Airfields within the local area surrounding the wind farm include:

- Glen Innes aerodrome about 10 kilometres to the north east of the wind farm site
- Six privately operated airfields are located on properties surrounding the wind farm site (Figure 12.1)
- Inverell airfield is about 50 kilometres to the west of the wind farm site. Its operations will not be affected by the development and it is not discussed further.

Glen Innes aerodrome and the six airfields on land surrounding the wind farm site are shown on Figure 12.1. Glen Innes aerodrome is also described further in Section 12.2.3 while the smaller airfields closer to the wind farm are described below.

Minor airfields are located on various properties throughout the region, many of which are marked on topographic maps. Based on a review of the Glen Innes and Stonehenge 1:25,000 map sheets the six closest airfields are within about 4.5 kilometres of the wind farm as shown in Figure 12.1 and Table 12.1.

Table 12.1 - Details of the closest airfields to the wind farm site

Ref. No.	Approximate Location		Height (m AHD)	Distance from wind farm (km)	Air Strip Orientation
	Easting	Northing			
1	363,350	6,703,000	980	2.5 west	north-south
2	363,000	6,710,100	975	1.5 west	SW - NE
3	365,800	6,714,900	1045	4.4 north	SW - NE
4	367,300	6,709,700	1055	2.5 east	SW - NE
5	371,200	6,705,500	1070	3.0 east	east - west
6	369,750	6,704,350	1075	2.0 east	north - south

Whether or not the proposed turbine structures would constitute a hazard to the local aircraft using these air fields depends on:

- the orientation of the approaches for the air strips
- the distance and relative height differences between the air strip and the top of the relevant turbine structures
- the local knowledge of the pilot flying to or from the air field

The operations at airfields which are closest to the wind farm site and have approaches passing over the proposed turbine structures have the most potential to be impacted by the wind farm development. Only airfields no. 4 and 5 have an orientation toward the wind farm site and these airfields are 2.5 and 3 kilometres from the nearest turbine. In the case of airfield no. 4 this is on a wind farmer property.

It is expected that usage of the local air fields by the relevant property owners or persons familiar with the respective properties will mean that the location of the wind farm relative to respective air strip will be well known and as such aircraft movements can avoid the wind turbine structures. Also, the small planes that could use the local air strips will use visual rather than instrument based landings and the turbines are readily identified at close distance. Overall, it is expected that the light planes using the local air fields are relatively manoeuvrable and, with knowledge of the turbine locations, these aircraft will be able to continue use the local airfields without any increase in air safety risks.

12.2.2 Civil Aviation Safety Authority requirements

Under Civil Aviation Safety Regulations any person who proposes to construct a structure, the top of which will be greater than 110 metres above ground level, must inform the Civil Aviation Safety Authority (CASA) of that intention and the proposed height and location of the structure.

As the proposed wind turbine structures may have a height in the range of 124 to 130 metres consultation was initiated with CASA and details of the initial layout of the wind farm have been provided. The response of CASA is provided in Appendix B of this Environmental Assessment and includes the requirement to consult with the operator of the Glen Innes aerodrome (see section 12.2.3).

Details of the final turbine locations and their elevations and height of the structures will be provided to CASA prior to their erection of the turbines so that relevant databases and maps can be updated.

CASA assesses the potential for the proposed structures to represent hazardous objects due to location, height or lack of lighting and has also issued guidelines for the lighting on wind turbines, should it be required. The proponent believes that a wind farm without lighting will have reduced visual impact at night times and that avoidance of the monitoring and maintenance requirements for the wind farm lighting present a significant cost saving. Nevertheless, any lighting requirements required by CASA will be implemented by Glen Innes Wind Power. Consultation with CASA will be continued to confirm any lighting requirements for the wind farm. Despite the uncertainty as to whether lighting will be required this assessment has considered the impact should lighting be installed on the nacelles.

12.2.3 Glen Innes Aerodrome and the Obstacle Limitation Surface (OLS)

Glen Innes aerodrome is about ten kilometres north east of the proposed wind farm site (Figure 12.1) and is operated by the Glen Innes Severn Shire Council. There is no regular commercial airline servicing the airport and there is accordingly, minimal daily air traffic. Each aerodrome has an Obstacle Limitation Surface (OLS) surrounding the wind farm and proposed tall structures surrounding the aerodrome must be assessed to determine whether they impinge the OLS.

Obstacle Limitation Surfaces (OLS) are conceptual (imaginary) surfaces associated with a runway, which identify the lower limits of the aerodrome airspace above which objects are regarded as potential obstacles to aircraft operations and must be reported to the Civil Aviation Safety Authority (CASA). The operator of a certified aerodrome must monitor the airspace around the aerodrome to ensure that buildings and structures do not infringe the OLS.

The Glen Innes Shire Council has been notified of the proposed turbine locations and their height. A copy of Council's letter of response and attached figure dated 31st July 2007 is provided in Appendix B2-1. Figure 12.1 shows the relevant aircraft approaches to Glen Innes aerodrome and the location of components of the OLS as advised by Council in the abovementioned correspondence and relative to the proposed wind farm. The OLS includes the inner horizontal surface and outer conical surface. Council's response stated that the wind farm is clear of the obstacle restriction area and the proposed structures will not infringe the Glen Innes Obstacle Limitation Surface (OLS).

12.2.4 Aerial agricultural operations

The wind turbine structures are not considered to be safety hazards to aerial agriculture operations as the structures are readily visible and the pilots can readily avoid them. It is noted that where the aircraft undertaking the aerial agriculture operations are reloading at a local airfield close to the wind farm that their take off with a full load will involve a more gradual ascent than would otherwise be the case. Also, they may not be quite as manoeuvrable under full load conditions and some variation to their normal pattern of aerial spreading may be needed.

In some cases the turbines could limit the areas of paddock that can be treated using aerial based methods. Discussions will be held between affected landowners and Glen Innes Wind Power to identify and provide compensation for any additional costs associated with alternative treatment methods. However, as the extent of individual turbine sites is limited and there needs to be reasonable spacing of turbines it is likely that aerial fertilizing can still be undertaken.

The Aerial Agricultural Association of Australia (AAAA) has been provided with details of the proposed wind farm and invited to comment on the proposal. Prior consultation with the AAAA and individual members in relation to Crookwell, Blayney, Gunning and Capital wind farms has obtained positive support for the wind farm developments.

12.2.5 Recreational activities

Recreational use of air space can involve hot air balloons, micro-light and ultra -light aircraft, gliders and parachuting. While these activities could occur within the locality no such activities have been observed during site visits. The wind farm will be readily apparent to participants in such activities who will be able to avoid the turbines.

12.2.6 Defence Force low altitude flights

The Department of Defence operates low level flights at various rural locations and needs to be aware of the locations of any tall structures. The Department has been advised of the proposed location of the wind farm and its response is provided in Appendix B2 with a summary of key points set out below.

The Department of Defence has assessed the proposal with respect to any possible impact on the safety of military flying operations and possible interference to Defence communications. It advised that the proposed development is outside any areas affected by the Defence (Areas Control) Regulations (DACR) and that the proposal will not affect existing Defence communications. The Department also requested that the colour used for the wind turbines ensures that they are conspicuous and does not allow the turbines to blend into the ground.

The Department of Defence will be advised of the final locations for the turbines both prior to and following their construction.

12.2.7 Records of data relating to wind turbine structures.

CASA, Airservices Australia and the Department of Defence (Royal Australian Air Force (RAAF)) all maintain databases and or maps of objects or structures that may be relevant to the safety of flying operations.

Prior to construction of the proposed wind farm, Glen Innes Wind Power will provide a plan of the final locations of the wind turbines and details of the height of each wind turbine to CASA, Airservices, RAAF and AAAA so that these organisations can record the details in their databases and on relevant maps. The “as constructed” details will also be provided to these organisations once construction is complete.

Having regard to the foregoing, it is considered that the proposed development will not present a hazard to aviation.

12.3 Physical safety

As with any tall structure, the safety implications of structural or mechanical failure need to be addressed in the design and installation of the wind turbines.

The issue of physical safety will be addressed primarily through ensuring that all plant and equipment meets the relevant Australian and/or overseas standards. In particular, the turbine structures will be designed and constructed in accordance with the following Standards:

- ASNZS 1170.2 - Structural Design Actions, including earthquake load considerations
- AS 2550 - Cranes - Safe Use
- AS 3600 - Concrete Structures
- AS 4100 - Steel Structures (except tower)
- Steel Tower – DIN 18 800
- IEC 61400-1 Wind Turbine Generator Systems - Safety Requirements

In addition, construction works will be carried out in accordance with all relevant requirements of the WorkCover Authority and other statutory requirements.

Other physical safety issues which may be relevant in relation to wind turbines include potential for tower failure, blade separation, ice throw and contact with moving blades. These issues are discussed below.

World wide, rare instances of tower failure and blades being separated from turbines have been reported. Damage may occur as a result of storms, materials fatigue, poor maintenance practices or lightning. However, the risk of such an event occurring is extremely low for the following reasons:

- Catastrophic structural failures of major turbines very rarely occur and when they do it is usually for a very specific reason. For example, a 500 kW Mitsubishi turbine collapsed in Portugal largely as a result of a blade being wrongly installed during routine maintenance (International Energy Association, 2005)

- In Australia, wind turbines are sited in rural areas away from built up areas. Siting turbines in less densely populated areas means there will be less visitation to the wind farms, which reduces the likelihood of a person being present in the highly unlikely event of turbine failure. It is noted that Sinclair Lookout is close to Turbine No 1. However, as it is on private land access to the turbine site will not be provided but visitors will be afforded a view of the turbine from a safe distance at the lookout.

- During storm events it is very unlikely that a member of the general public will be in the exposed areas of land where wind turbines will be located. There would have to be exceptional circumstances for people to be in the vicinity of a turbine during a storm event. The people who would be at most risk would be the landowners, their visitors and maintenance personnel. During periods of high wind speeds the turbines are designed to shut down to avoid damage that might otherwise occur.

Risks are further reduced by a number of design features of modern turbines. For example, the potential for damage due to lightning is reduced by fitting the blades with metal lightning strips and the risk of blade separation is reduced through built in detection systems that warn of impending failure and shut the equipment down for maintenance.

In cold climates, ice may be thrown from the blades. In these instances a distance equal to the maximum turbine height is generally accepted as the extent of the area that could be affected.

The physical safety of the Glen Innes Wind Farm installation will be further enhanced by:

- its location generally distant from public roads
- provision of signage at Sinclair Lookout warning people not to enter the private land and approach the turbine
- the incorporation of a design feature whereby the turbine automatically shuts down when maximum wind speeds for safe operation are exceeded

Another potential physical safety issue is that associated with contact with the moving turbine blades. During operation, there will be at least 30 metres clearance between the turbine blades and the ground below and, accordingly, the risk of people or equipment coming into contact with the moving blades will be negligible.

12.4 Electrical safety

Because of the well known dangers inherent in the use of electricity, electrical safety will be a key design consideration. As with mechanical and structural considerations, electrical safety will be achieved through ensuring that plant, equipment and the overall installation are in accordance with the relevant standards or, where necessary, that approval is obtained for an alternative specification. The standards considered will include:

- AS 3000 - SAA Wiring Rules – Some components are pre-wired (eg Nacelle and Control Cabinets) and where non-compliance has been identified they are being re-designed such that they either abide with AS 3000 or approval for any exemptions is obtained via the relevant Electricity Authority
- IEC 61024-1 (1990-04) - Protection of Structures against lightning – Part 1: General Principles
- Specific lightning standards may also apply for the selected wind turbine
- IEEE STD 80 - Guide for Safety in AC Substation Grounding
- IEC 60034 - Rotating Electrical Machines
- BS 4999 - General Requirements for Rotating Electrical Machines.
- BS 5000 - Specification for Rotating Electrical Machines of Particular Types or for Particular Applications Compliance with BS 5000 subject to review.
- IEC 60076 –1 (2000-04) - Power Transformers - Part 1 General
- IEC 60146.1.1 Semiconductor converters - General requirements and line commutated converters.
- IEC 62271.100 - HV Alternating Current Circuit Breakers
- IEC 60282.1 - HV Fuses (for Rated Voltages greater than 1,000 volts)
- IEC 62271.200 - AC Metal Enclosed Switchgear & Control Gear greater than 1,000 volts
- IEC 60529 - Degrees of Protection Provided by Enclosures
- IEC 60947 (2001-12)- Low Voltage Switchgear & Controlgear
- IEC 60439.1 - Low Voltage Switchgear & Control Gear Assemblies
- IEC 60269.1 - Low Voltage Fuses - General Requirements

In addition to addressing the above Standards, protective equipment will be installed to detect faults and disconnect the faulted equipment from the system.

The proposed substation will be equipped with an underground earth grid which will extend for a distance of one metre beyond the perimeter fence. Public access to the live electrical equipment within the substation will be prevented by the perimeter fence which will be of chain wire construction some 2 metres high surmounted by four strands of barbed wire.

As with any tall structure in an exposed location it can be anticipated that, from time to time, the wind turbines could be struck by lightning and lightning protection is a standard design feature of all modern wind turbines including:

- metallic conductors running throughout the turbine blades and electrically connected to the metalwork of the structure
- supporting structures sufficiently well earthed to limit the voltage rise during a lightning strike
- internal electrical equipment protected against voltage rises due to lightning

In addition, the 33,000/66,000 (or 132,000) volt substation will be protected by surge diverters, lightning masts and an underground earth grid.

12.4.1 Electric and Magnetic Fields (EMF)

Wherever electrical equipment operates, electric and magnetic fields (EMFs) are created in the surrounding environment. Over the past 30 years the question has been raised as to whether or not these fields may be harmful to human health. Despite extensive research and numerous public inquiries, adverse health effects have not been established but the possibility has not been ruled out. In these circumstances, a prudent approach is warranted in designing and siting new facilities.

The main sources of EMFs that will be associated with the proposed wind farm will be the electrical equipment within the turbine structures, the substation and the interconnecting underground cables and any overhead wiring. The fields associated with all of these items will be quite localised.

The Glen Innes Wind Farm will be located on ridge tops along Waterloo Range that are only occasionally visited by landowners and farm workers. The substation will be approximately one kilometre from the Gwydir Highway and on private land at about 500 metres from Sinclair lookout. All equipment will be constructed according to industry accepted practices. The EMFs associated with the proposed wind farm will be well within the relevant health standards and in many cases will be localised to areas not often frequented by people. On this basis, the possibility of human health effects due to EMF is not considered to be an issue for the project.

12.5 Bushfire risk

A bushfire risk management plan will be prepared by the project contractor in consultation with the local Rural Fire Service and NSW Fire Brigade. The plan will be incorporated in the project EMP. Issues associated with the bushfire risk may involve:

- the potential for the construction activities to initiate a bushfire
- the potential for operational facilities to initiate a bushfire
- the impacts on the facility from a bushfire affecting the site, whether originating from the site or elsewhere and potential for impact on human safety or the facilities

These issues are reviewed in the following sections.

12.5.1 Bush fire risks associated with construction activities

Fires may eventuate from 'hot work' activities, fires within engines or from sparks from friction igniting dry-grass. Accordingly, during the construction phase the following measures will be implemented to manage any bushfire risk:

- The contractor will be required to comply with all relevant sections of the Bush Fires Act and the Fire Brigade Act and all Regulations thereto and will be required to liaise with the Rural Fire Service
- Where necessary, access tracks and work sites will be slashed to remove vegetation in excess of 100 mm high
- All construction vehicles will use diesel fuel
- A mobile 1,000 litre tanker unit complete with motor-driven pump, hose and nozzle will remain at the site during construction work
- Knapsack sprays and McLeod tools will be kept on hand at each actual work site
- In the event of welding, flame cutting or grinding being carried out in the open during periods of fire danger, an observer holding a knapsack spray will be on hand
- The contractor will be required to maintain the exhaust systems of all vehicles on site in sound condition and to avoid any build up of dry vegetation under vehicles
- The use of explosives will not be allowed during periods of high bushfire risk

12.5.2 Bush fire risks associated with operational activities

The potential fire risk associated with electrical failure will be managed by the following measures:

- Use of fully enclosed electrical equipment on turbine structures and padmount transformers
- Extensive use of underground cabling between turbines
- Design of any overhead lines in accordance with industry standards
- Exclusion of vegetation from within the substation enclosure
- Use of circuit breakers and fuses to interrupt any electrical fault
- Adoption of the lightning protection measures described in 12.4 above

12.5.3 Bush fire risk for installed facilities

The risk of damage to the facilities in cleared grazing land is low. For the proposed development, all wind turbine locations are in mostly cleared grazing land or in areas with sparse or scattered tree cover and are considered to have a low risk of bushfire damage. The assessment of low risk is based on a low frequency of bushfire events on Waterloo Range. A Glen Innes Severn Councillor who lives near to Waterloo Range indicated that bushfires at the location are rare. Additionally, there are few signs of bushfire effects in the nearby remnant woodland.

Despite the low overall risk, where turbines are located adjacent to steep slopes that have considerable vegetation cover, there can be a greater risk than those further distant from slopes covered by woodland. The following table provides a ranking of the turbine sites to indicate those that may present a greater risk of damage than others.

Table 12.2 – Relative risk of individual turbine being damaged by bushfire

Relative risk of damage from bushfire	Turbines in risk category
Least	2, 3, 4, 5, 7, 8, 9, 10B, 12B, 12C, 16B, 16C, 21B
Intermediate	1, 6, 15, 17, 19, 22B
Most	10, 11, 11B, 14B, 13, 13B, 18, 20B

Where practicable, suitable buffers between vegetation and installed equipment will be maintained as part of the ongoing facility maintenance. Due to the conservation status of the remnant woodland in the vicinity of Waterloo Range, no clearing is proposed to reduce the risk to turbines. The proponent will consider the risks amongst other matters in reaching its decision to proceed with the project and individual turbines.

The buildings at the substation will be within a cleared compound that is set back from the adjacent remnant woodland. It is also proposed that it be located on relatively flat land. Being at the northern end of the site and close to the main access route to and from the site there is suitable access and egress to the substation. The construction site office, if located adjacent the highway, will easily satisfy the requirement for safe access and egress. Alternative access routes are also available including Rose Hill Road and Hillside Road should they be required.

12.6 Road safety

The principal road safety issues associated with the proposed development relate to the construction period and include:

- increased traffic on roads surrounding the wind farm
- presence of over-size/heavy loads at certain times during construction

- site entry point from Gwydir Highway used by long loads associated with delivery of turbine equipment

Traffic and transport issues have been assessed and reported in Appendix I and a summary of the related issues, including road safety, is provided in Section 9 of the EA.

The various traffic safety authorities already regulate the transport of materials and equipment over public roads and Glen Innes Wind Power and its contractors will observe all relevant safety requirements of such authorities. In addition, a Traffic Management Plan will be established for the construction stage of the wind farm development. The Plan will be prepared in consultation with the local Traffic Management Committee.

At other wind farm sites consideration has been given to motorists stopping along busy local roads to view the wind farm from an unsafe vantage point or being distracted by it. The Glen Innes Wind Farm is generally more than one kilometre from public roads and the local roads have low to moderate small traffic volumes. The Sinclair Lookout will provide a suitable vantage point for people to safely park and view the wind turbines. The potential for the wind farm to be a distraction to local traffic and to impact on road safety is considered to be low.

12.7 Use of vehicle or plant and equipment on steep slopes

At some turbine sites and for parts of some access tracks located on or close to steep slopes there is a risk of accidents for mobile plant or vehicles leaving the track or work area and descending the slope. All such areas will be identified and measures implemented to mitigate the risk. This may include induction relevant to the risk, installation of barriers, warning signs, tapes to alert drivers to the hazard and in some cases observers to watch for and warn drivers of proximity to steep slopes. Access tracks on steep slopes will also be benched into the slopes to provide safe trafficable passage. The risk is reduced by the conduct of construction activities during daylight hours but poor weather, ice, snow and low cloud could increase the risk. Working conditions will be taken into account for the safe management of the works.

12.8 Shadow flicker

Shadow Flicker is a visual effect that occurs when rotating turbine blades cause intermittent shadowing as the blades momentarily pass between the sun and the observer. The effect will occur under circumstances where the turbine location is such that at certain times of the day the sun's rays pass through the blades and affect the viewpoint.

There has been concern in the past that shadow flicker may induce seizures in people with photosensitive epilepsy. The turbines that would be used in the Glen Innes Wind Farm will rotate at between 8 and 18 revolutions per minute. With three blades, this corresponds to a maximum flicker frequency of 1 cycle per second (1 Hz). It is uncommon for epileptics to be photosensitive at frequencies less than 5 Hz (The National Society for Epilepsy (UK), 2005). Therefore, the risk of shadow flicker inducing seizures is considered to be insignificant.

Appendix D provides a review of the potential for shadow flicker effects at the Glen Innes Wind Farm and indicates that it is not a significant issue for the development. Consequently, health risks posed by shadow flicker on residents or passing motorists within the project area are considered minimal.

12.9 Noise

The noise impacts of the development have been assessed in Appendix H and a summary of the results and the proposed mitigation measures is provided in Chapter 10 of the EA.

The assessment of the operational noise impacts of the wind farm indicates that it can be designed and operated such that it will comply with the relevant noise criteria. This has included assessment of the noise impacts under various conditions of atmospheric stability. The assessment showed that the unconstrained operation of the wind farm comprising turbines with the highest sound power level noise specification would result in exceedance of criteria for a short period of the time they are operational. The exceedance is predicted to be greatest at times of stable atmospheric conditions when the wind farm is operating. Options to avoid exceedance include selection of a turbine with lower sound power levels or constrained operation of selected turbines that contribute to the exceedance.

A post commissioning performance review will assess the wind farm noise compliance. Consultation with neighbours will also provide a measure of any whether the wind farm operation has been associated with any disturbance. The main transformer(s) at the substation have potential to generate noise levels that at close range could be disturbing. As the closest residences to the substation are distances of about two kilometres it is not expected that any noise impact will occur for the substation.

Construction noise will occur over the construction period and involve a range of noise impacts from a variety of equipment at various distances. At any neighbouring location any impact is likely to be of a temporary nature as works progress across the site. Additionally, construction work will occur predominantly during the day and controls will be incorporated to limit noise impacts.

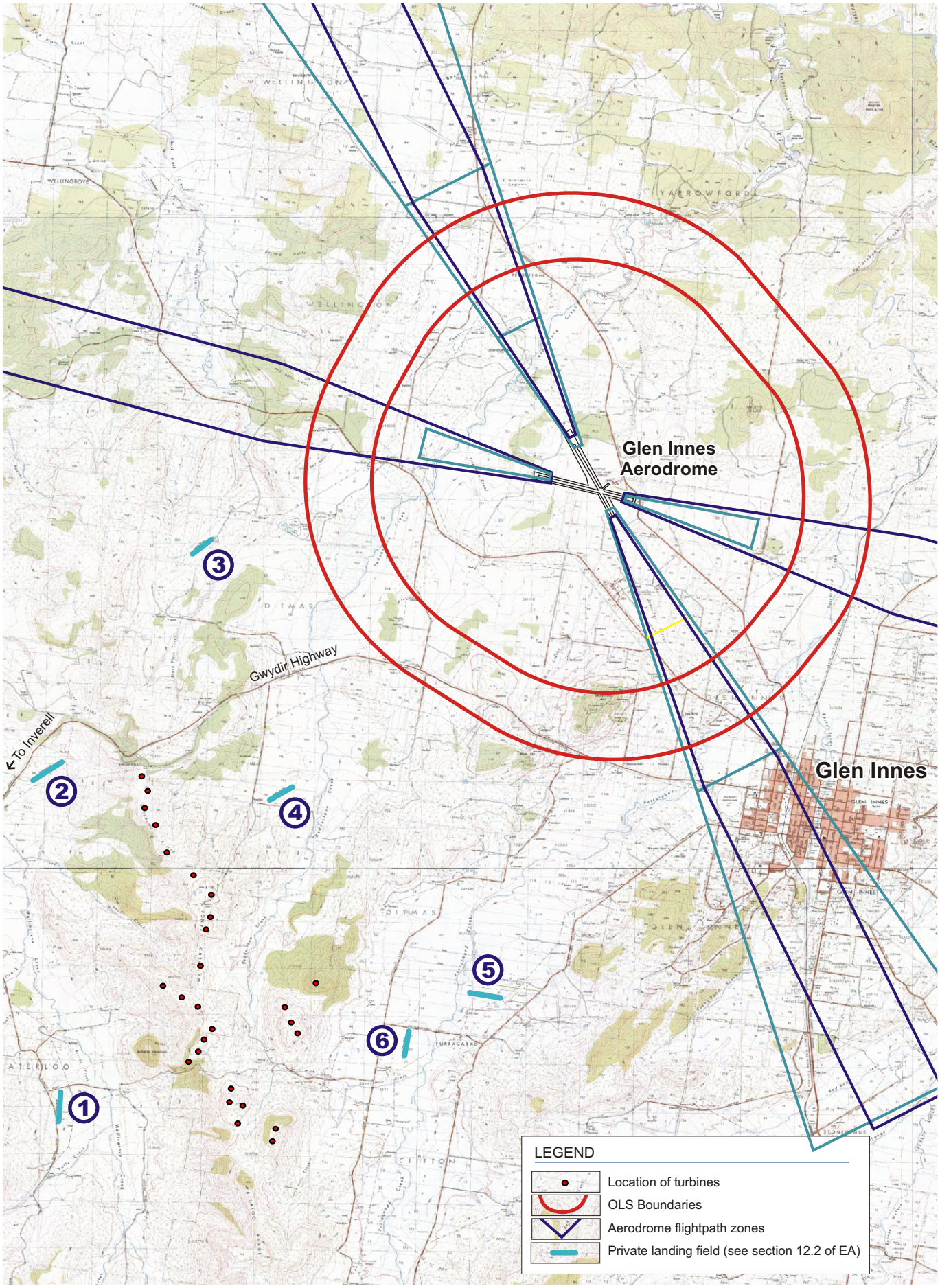

Figure 12.1

Source: Topoview Raster 2006

Glen Innes Aerodrome Obstacle Limitation Surface and Approaches