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CHAPTER 13

AERONAUTICAL IMPACTS

13 Aeronautical Impacts

13.1 Introduction

Aviation Projects Pty Ltd (Aviation Projects) was commissioned by UFWA to assess the aeronautical and obstacle lighting impacts arising from the project. The full aeronautical impact and night-lighting assessment report is found at **Appendix 9**.

Under the Civil Aviation Safety Regulations, the owner of a structure (or proponents of a structure) that will be 110 m or more above ground level must inform the Civil Aviation Safety Authority (CASA). This is to allow CASA to assess the effect of the structure on aircraft operations and determine whether or not the structure will be hazardous to aircraft operations.

13.2 Methodology

Evaluation of the potential aeronautical impact and obstacle marking and lighting has been undertaken in accordance with relevant safety regulations.

The methodology for the aeronautical impact assessment was as follows:

- the scope and deliverables were discussed with and agreed by the UFWA Project Manager;
- a site visit was conducted on 4 April 2011;
- a desktop review of the supplied materials was conducted;
- the relevant regulatory requirements and sources of information were reviewed;
- an assessment of the Procedures for Air Navigation Services – Aircraft Operations and Obstacle Limitation Surfaces (PANS-OPS and OLS) was prepared and forwarded to Airservices Australia, Bathurst Regional Council (Bathurst Airport), CASA, Goulburn Mulwaree Council (Goulburn Airport), Oberon Council (Oberon aerodrome), and Upper Lachlan Shire Council (Crookwell aerodrome) for consideration;
- other stakeholders, including the Aerial Agriculture Association of Australia, Commonwealth Department of Defence and NSW Rural Fire Service were consulted in writing and/or by telephone;
- interviews were carried out with stakeholders as required; and
- a report was prepared and finalised.

13.3 Results

13.3.1 Cumulative impacts

The project is relatively remote from other existing or approved wind farms, including the proposed Golspie Wind Farm, the closest wind farm to the site, approximately 25 km south-west. Accordingly, Aviation Projects concluded that there will be no significant cumulative impact arising from the Project and nearby existing or approved wind farms.

13.3.2 Obstacle lighting and marking

The need for obstacle marking and lighting of wind turbines, wind monitoring towers and transmission lines was assessed.

It was assessed by Aviation Projects that if the turbine model ultimately selected has a blade tip height of less than 150 metres there will be no requirement for the turbines to be lighted. However, Aviation Projects determined that if the turbine model ultimately selected has a blade tip height of in excess of 150 metres then the turbines are considered obstacles and selected turbines will therefore require obstacle lighting. An aeronautical study of the requirement for obstacle lighting should be prepared once the final model is selected and the final turbine layout and design has been determined.

If lighting is required, lights are recommended for turbines 1, 5, 6, 9, 11, 15, 17, 20, 21, 23, 24, 30, 31, 35, 36, 39, 42, 44, 47, 49, 51, 52, 55, 58 and 60. This lighting design is subject to confirmation of the final turbine layout. Refer to **Figure 51 – Indicative turbine lighting layout**.

If obstacle lighting is required, installed lights should be designed according to the criteria set out in the applicable regulatory material, which includes:

- two flashing red medium intensity obstacle lights should be provided;
- the light fixtures should be mounted sufficiently above the surface of the nacelle so that the lights are not obscured by the rotor hub, and at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction;
- both lights should flash simultaneously; and
- the characteristics of the obstacle lights should be in accordance with the applicable standards in MOS 139.

If obstacle lighting is required, medium intensity lighting will be used regardless of the final turbine height.

To minimise the visual impact on the environment, some shielding of the obstacle lights is recommended by Aviation Projects. Shielding may be provided to restrict the downward component of light to either, or both, of the following:

- such that no more than 5% of the nominal intensity is emitted at or below 5 degrees below horizontal; and
- such that no light is emitted at or below 10 degrees below horizontal.

All obstacle lights on a wind farm should be synchronised so that they flash simultaneously.

Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be marked in accordance with CASA Manual of Standards (MOS) 139 Section 8.10 Obstacle Markings.

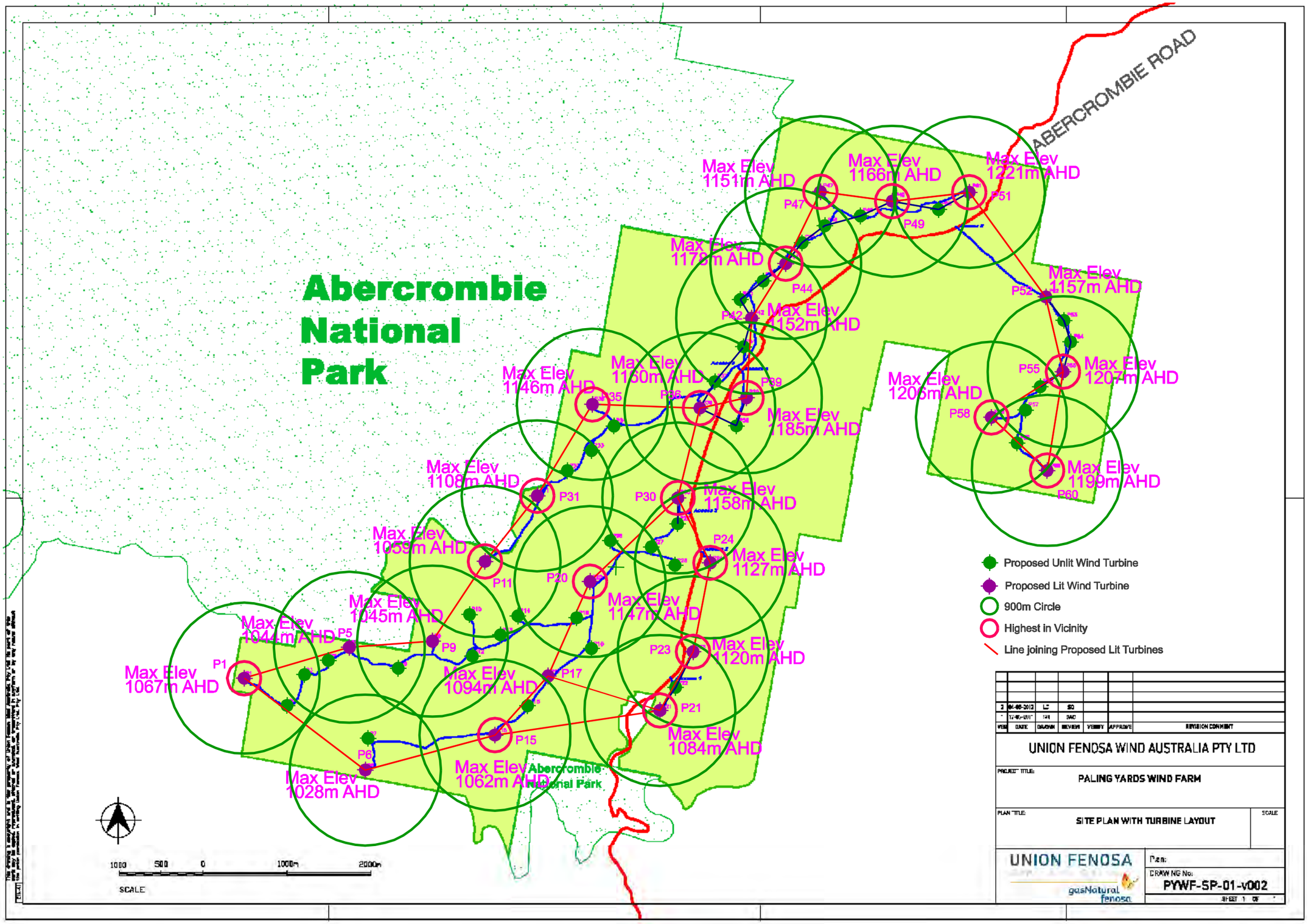

Figure 51 Indicative Turbine Lighting Layout

Source: UFWA

13.3.3 Aeronautical impacts

Aviation Projects assessed that "*the proposed development does not impose any significant risk to normal flying operations, provided aircraft are operated in compliance with applicable regulatory and operational control requirements and with the application of good airmanship".*

In relation to nearby aerodromes and aircraft landing areas, Bell ALA agricultural operation remains operational. The current aerial agriculture operator Mr. Fred Fahey has said that he would not be prepared to operate fixed wing aircraft on the property once turbines are installed. Rotary wing aircraft therefore remain a valid option for aerial agriculture operations. The aeronautical assessment acknowledged that the project will most likely prevent fixed wing aerial agricultural operations on the wind farm site; however, Aviation Projects conclude that safe aerial application operations would be possible on properties neighbouring the proposed wind farm, subject to final turbine locations, and subject to a case-by-case assessment.

In the event the immediate neighbouring landowner(s) would require aerial agriculture spraying of their land adjacent to the wind farm and there is an increase in cost associated with the proximity to turbines, the proponent will cover the reasonable cost increase for the aerial agriculture activity. The landowner seeking compensation for the cost increase must demonstrate and justify this increase with previous records.

There are a number of larger aerodromes at distances greater than 30km from the site, none of which will be impacted.

The project is not anticipated to have an adverse impact on obstacle limitation surfaces, PANS-OPS surfaces, radar interference, communication systems, defined air traffic routes, navigation aids, or electric or magnetic fields.

For operating aircraft, in order to avoid the wind farm, aircraft will have to fly at a higher altitude or divert around it.

In relation to fire-fighting methods, any fire-fighting activities in the vicinity of the proposed wind farm by either fixed or rotary wing aircraft would need to be conducted in consideration of the location of the wind turbines and monitoring masts. Therefore, the location of the wind turbines and monitoring masts should be made available to New South Wales Rural Fire Service (RFS) and aerial agriculture operators.

While aerial fire-fighting operations may potentially be restricted in the vicinity of the proposed wind farm, Aviation projects note that there is still a valid ground-based means of fighting bushfires.

Consultation with the Rural Fire Service (RFS) Development Assessment and Planning Officer, NSW (Mr. Doug Stevens) was undertaken. Mr. Stevens considered wind farms to be an advantage to RFS operations generally, because they required a cleared area, a water supply, and provided improved access to the property.

Further consultation with local fire authorities will occur prior to construction of the project.

13.4 Mitigation

The report recommends that the following actions be implemented to mitigate the aeronautical impacts of the project:

Notification of tall structures:

- Final (approved) turbine coordinates and elevations should be provided to RAAF Aeronautical Information Service (AIS) via the online vertical obstruction database.

Marking of turbines:

- The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white, off-white or a light grey colour.

Lighting of turbines:

- If the wind turbines to be installed will have a blade tip height lower than 150 m AGL, no obstacle lighting is necessary.
- If the wind turbines to be installed will have a blade tip height of 150 m or more AGL, obstacle lighting may be required.
- An aeronautical study to determine the requirement for obstacle lighting, in the form of a detailed and thorough risk assessment using internationally recognised standards, should be prepared once the final approved turbine layout and design turbine height are known.
- UFWA may consider other factors in its decision as to whether obstacle lights should be installed.
- If lighting is required, lights are recommended for turbines 1, 5, 6, 9, 11, 15, 17, 20, 21, 23, 24, 30, 31, 35, 36, 39, 42, 44, 47, 49, 51, 52, 55, 58 and 60.
- Obstacle lighting should be designed in accordance with the characteristics specified in ICAO Annex 14 Vol 1 Chapter 6 and MOS 139 Chapter 9, while minimising visual impact.

Marking of wind monitoring towers

- Consideration should be given to marking the wind monitoring towers according to the requirements set out in MOS 139 Section 8.10.

Marking of electricity transmission lines:

- Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be marked in accordance with MOS 139 Section 8.10.
- Alternatively, consideration could be given to installing the AAAA endorsed power line marker reportedly developed in conjunction with Country Energy.

Other measures to mitigate the visual impacts of night lighting include vegetation screen planting, as detailed in **Chapter 9 – Landscape and Visual Impacts.**

The need for night lighting is under review given recent wind farm decisions. If CASA determine the wind farm does require night lighting it would comply with these specifications and recommendations contained in the aeronautical report.

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CHAPTER 14

TRANSPORT IMPACTS

14 Transport Impacts

14.1 Introduction

URS Australia Pty Ltd (URS) was commissioned by UFWA to assess the transport related impacts arising from the project. The full transport impact assessment (TIA) prepared by URS is found at **Appendix 10**.

The report identifies and considers the traffic impact of the project both during the construction and operational phases. It also identifies the likely measures required to improve conditions of the access routes to the site.

The report has been prepared in accordance with the scope agreed between URS and UFWA and focuses on the public roads defined as the preferred transportation routes between the site and the Port of Newcastle and Port Kembla.

14.2 Methodology

In order to establish the traffic conditions and likely traffic impacts arising out of the project, site investigations were undertaken by URS on 4 and 5 April 2011. Detailed observations were recorded during the inspection and photographs taken to supplement the observations.

The following key steps were undertaken for the assessment:

- A site inspection of the surrounding network and site access points was undertaken;
- The road network surrounding the site and the site access points was defined;
- The additional traffic generated during construction and operation phases of the project was defined.
- The impact of the additional construction and operational traffic was investigated using SIDRA analysis.

Based on an assessment of the existing road network conditions during the site visit and using the RTA's Travel Restrictions Vehicle Route maps, the most appropriate route options were detailed for use by construction and transport vehicles including Over Dimensional Vehicles, heavy vehicles and cars/personnel.

Management and mitigation measures were developed in order to minimise any traffic impacts from the project.

14.3 Results

Given the findings of the assessment, URS concludes that the "*traffic generated by this proposal is not considered to have a significant impact on the existing transport network, with current operation anticipated to remain at an acceptable Level of Service for key roads*".

14.3.1 Access to the site

The site is divided by the Goulburn-Oberon (Abercrombie) Road. There are six access points proposed to access the site from Abercrombie Road. The first access point is located approximately three kilometres north of the Abercrombie River and the remaining five access points are positioned within a distance of 7.5 kilometres from the first access.

The access points are shown on **Figure 12 – Indicative Access & Infrastructure Plan**. These access points have been selected due to the topographic features of the land and to avoid vegetation removal where possible.

Access to the site is provided via a number of roads and highways in the area.

Goulburn-Oberon (Abercrombie) Road is a classified two-lane, two-way road of approximately 150 km between the Hume Highway, Goulburn in the south and O'Connell Road, Oberon in the north. The condition of the road's surface varies considerably in the vicinity of the site. On the northern side the road's surface condition is excellent, and on the southern section the road has winding parts with diminishing surface condition.

In relation to existing traffic conditions, the Level of Service thresholds indicate that Goulburn-Oberon Road currently operates at a Level of Service B, which is the highest performance rating possible for Rolling Terrain.

The Great Western Highway, known as the National Route 32 in the vicinity of the site, provides access to the area from Sydney. Key access routes to Paling Yards and the site are also provided by Bells Line of Road (National Route 40), Jenolan Caves Road, Duckmaloi Road and O'Connell Road.

14.3.2 Over Dimensional Vehicles and Transport Routes

Over dimensional vehicles (OD vehicles) are required for the transportation of certain wind farm components. The full report by URS outlines haulage requirements for the construction of wind turbines, route options and OD vehicles swept paths.

For the purpose of this assessment, URS adopted a 'worst-case-scenario' whereby the greatest width, height and turning circle requirements are taken into account based on the transport requirements of each wind turbine manufacturer for the assessed wind turbine options.

The transport requirement for the identified 'worst-case scenario' for OD vehicle movements, taking into account the requirements of all assessed wind turbine manufacturers, is therefore defined as follows:

- Maximum OD vehicle length: 64.4 metres
- Minimum height clearance required: 6.6 metres
- Minimum road width required: 5.5 metres
- Maximum slope gradient permitted: 6%
- Maximum slide inclination permitted: 2%

A number of haulage route options have been identified for OD vehicles between Port Kembla and the site, and between the Port of Newcastle and the site.

Two feasible route options exist from Port Kembla to the site. These are shown on **Figure 15 – OD Vehicle Route Options Port Kembla**. The first route progresses north from Port Kembla to the Westlink M7, continues west from here and then travels south along Abercrombie Road to connect to the site. The length of this route is 328km and the estimated travel time in 5 hours. B-Double vehicles using this route must not be longer than 19 metres in length and must weigh less than 50 tonnes.

The second route is slightly longer in length than the first option, connecting to O'Connell Road in the north before progressing onto Abercrombie Road. The length of this route is 372km and the estimated travel time is 5.5 hours. B-Double vehicles using this route must be no longer than 26 metres in length.

Two feasible route options exist from the Port of Newcastle to the site. These are shown on **Figure 16 – OD Vehicle Route Options Port of Newcastle**. The routes follow the same path between the port and Bells Line of Road heading south-west.

Two route options are available when crossing the Blue Mountains to the site. The first option follows the same path as route option 1 from Port Kembla, and the second option follows the same path as route option 2 from Port Kembla.

B-Double vehicles using the first option must not be longer than 19 metres in length and must weigh less than 50 tonnes. The length of this route is 381km and the estimated travel time is 6 hours.

B-Double vehicles using the second option must be no longer than 26 metres in length. The length of this route is 425km and the estimated travel time is 6.5 hours.

The proponent will be required to apply to the NSW Roads & Maritime Services Department (RMS) for a special load carrying permit for the selected route that the Over Dimensional Vehicles take.

14.3.3 Impact of Traffic Generation

Construction Phase

The forecasted construction vehicle volumes generated by the project are based on the traffic generation estimates for Ryan Corner Wind Farm in Victoria, which is a similar project to Paling Yards, with 68 wind turbines. Therefore the following assumptions have been adopted for the project in this assessment:

- 18 month construction program,
- 11 hour (7am to 6pm) working weekday,
- 24 working days per month, and
- The eighth month being the peak construction month.

The total number of peak one-way vehicle movements generated by the project is estimated to be 120 vehicle movements per day, of which 3 are OD vehicles, 27 are heavy vehicles and 90 are light vehicles.

Two preferred site access routes have been chosen to analyse the performance of the existing road network and model traffic characteristics at the intersections during the peak construction phase of the project. The two chosen intersections are:

- East side of T-intersection on Abercrombie Road.
- West side of T-intersection on Abercrombie Road.

SIDRA modelling package was used in this analysis. Four scenario models were developed to determine the worst-case scenario impacts:

- Scenario 1: All construction vehicles enter and exit the site via one access point forming a T-intersection with Abercrombie Road on the eastern side of the site during AM peak;
- Scenario 2: All construction vehicles enter and exit the site via one access point forming a T-intersection with Abercrombie Road on the western side of the site during AM peak;
- Scenario 3: All construction vehicles enter and exit the site via one access point forming a T-intersection with Abercrombie Road on the eastern side of the site during PM peak;
- Scenario 4: All construction vehicles enter and exit the site via one access point forming a T-intersection with Abercrombie Road on the western side of the site during PM peak;

The results of this modelling indicated that:

- no major increases in Degree of Saturation or queue lengths will occur to the road network during the peak construction period of the project.
- minor impacts may occur during the PM peak hour; however these result in a negligible increase in queue lengths (i.e. one car length or less).
- roads operating at a Level of Service of C or better are generally considered to have acceptable flow conditions.
- the performance of each of the proposed access point intersections is well within acceptable performance criteria.

Operational and Decommissioning Phases

In relation to potential traffic impacts during the operating life of the wind farm, the TIA notes that the number of vehicles generated by the project during the operational phase will be *"insignificant relative to that experienced during the construction phase"*.

The impact predicted by the TIA of the project's construction traffic on the existing Degree of Saturation and Queue Lengths of all intersections modelled were found to be 'minimal, if non-existent'.

Therefore, it is anticipated that the traffic impact during the operational and decommissioning phases will also be insignificant.

14.4 Mitigation

URS advises that a detailed Transport Management Plan, in consultation with local councils and RMS, should be developed to outline the finalised transport details and include management and mitigation measures for the project. URS recommends that this document be prepared before the construction phase of the project, to form the foundations for all traffic related activities for the project.

This Transport Management Plan should include:

- Confirmation of the route selection;
- Define RTA approvals for OD vehicles;
- Further consultation with the RTA and local Council;
- Define operating hours and speed limits for construction vehicles;
- Develop traffic control signage plans where required at site access points and other intersections;
- Recommend and provide concept designs of vehicles swept paths at site access points for OD vehicles at key intersections along the defined OD vehicle route between Port and site;
- Outline a program for collecting a baseline assessment of the surrounding road network and a program of regular inspections;
- Detail any roadworks required and when these are required; and
- Details of measures to control soil erosion and dust generated by traffic volumes.

In order to ensure safety and reduce the impact of the development on the local road network, URS recommend the following commitments be included in the Statement of Commitments for the project:

Task	Notes
Prepare detailed management plan	To be completed prior to the construction phase of project
Finalise traffic generation numbers and proposed routes	To be included in Transport Management Plan
Confirm haulage contractor and prepare Haulage Transport Plan	To be completed prior to finalisation of Transport Management Plan
Liaise with appropriate road authorities	To be undertaken during Transport Management Plan tasks
Finalise design of access points	To be included in Transport Management Plan following finalisation of preferred site accesses
Finalise design of internal site tracks network	To be completed prior to construction phase of project
Undertake existing conditions assessment and roadside vegetation assessment	Any additional assessments required specific to the site to be included in Transport Management Plan
Intersection and road upgrades along OD route to safely accommodate the manoeuvrability of these vehicles	To be recommended in the Transport Management Plan and completed prior to the construction phase of the project

In addition, the following measures will also be undertaken for the project:

- Carry out a pre-construction road survey to determine existing conditions of local roads.
- Carry out any necessary upgrades and strengthening works along the access road network to provide safe construction access for the project.
- Prepare and implement a traffic management plan to ensure local roads are not adversely impacted by heavy vehicles.
- Notify the local community of changed traffic conditions and proposed road works via a newsletter or information line.

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CHAPTER 15

ELECTROMAGNETIC INTERFERENCE IMPACTS

15 Electromagnetic Interference Impacts

15.1 Introduction

Garrad Hassan Pacific Pty Ltd (Garrad Hassan) was engaged by UFWA to assess the electromagnetic interferences arising from the project. The full report undertaken by Garrad Hassan appears as **Appendix 11**.

Radiocommunications is used as a broad term in the report to encompass all services that rely on electromagnetic or radio waves to transfer information.

The report notes that "If not properly designed, wind farms have the potential to cause interference to analogue television broadcast signals and microwave signals". However, it is possible to design around these issues.

Two services that are most likely to be affected include analogue television broadcast signals and fixed point-to-point microwave signals. Analogue broadcast signals are still commonly used to transmit domestic television, while microwave links are used for line of sight connections for data, voice and video. The interference mechanisms are different for each of these, and hence, there are different ways to avoid interference.

For analogue television broadcast signals (point to point), large scale interference can generally be avoided by placing the wind turbines at an appropriate distance from the broadcast tower, at a recommended clearance of at least 1 km.

The assessment reviewed and considered the *Draft NSW Wind Farm Guidelines* (Draft Guidelines) in relation to electromagnetic interference.

15.2 Methodology

The methodology for assessing the potential radiocommunications interference in this assessment undertaken included identifying the telecommunications towers located within 75 km of the site boundary and investigating the telecommunication licenses attached to these towers.

The Draft Guidelines recommend a radial distance of 50-60km from the centre of the wind farm would normally capture all of the potentially affected services in the area.

Therefore, the approach used in this report meets (and exceeds) the requirements of the Draft Guidelines regarding electromagnetic interference.

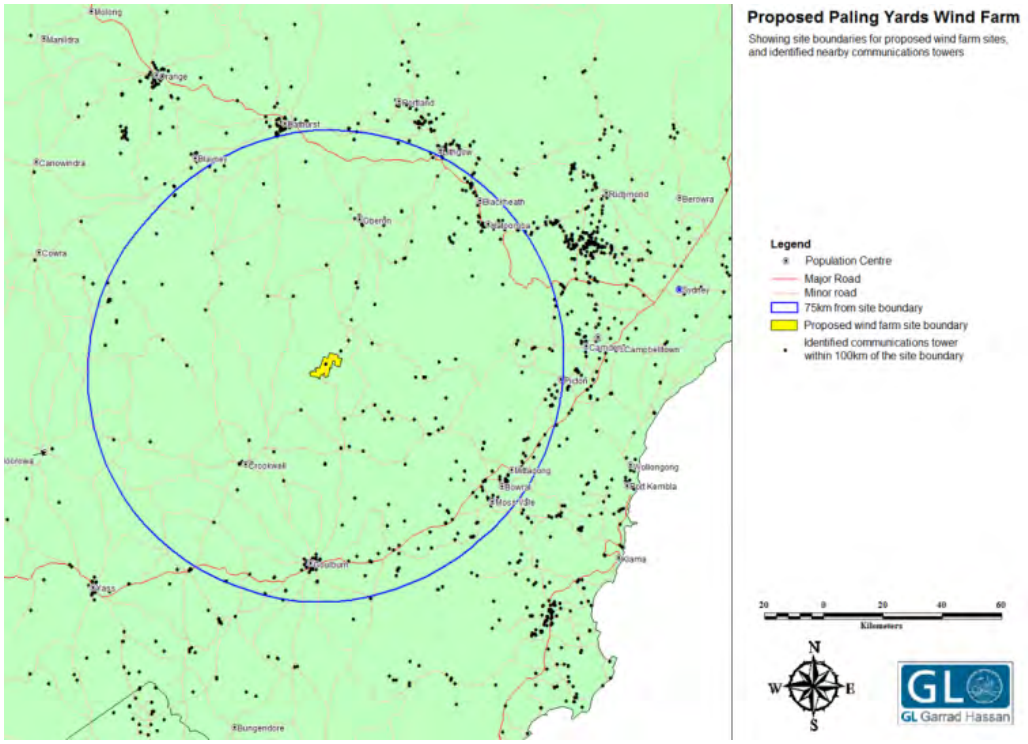
Other services with the potential to experience interference from the project were also identified, and the potential for interference to those services reported.

15.3 Results

Telecommunications Towers

An image of the ACMA database dated June 2012 was used for this assessment. From the database, there are 417 telecommunication towers within a nominal 75 km of the wind farm. The locations of these telecommunication towers are shown in **Figure 52**.

Figure 52 Location of identified proximate radio communication sites



The assessment identified several point-to-point microwave links with a path over, or near to the site boundary. Of these links, two links (involving six fixed licences in total) were identified as passing through wind turbine locations.

The interference zones around these point-to-point links have been identified and it has been found that five turbines from the project have the potential to cause interference to the links. Refer to **Figure 53**.

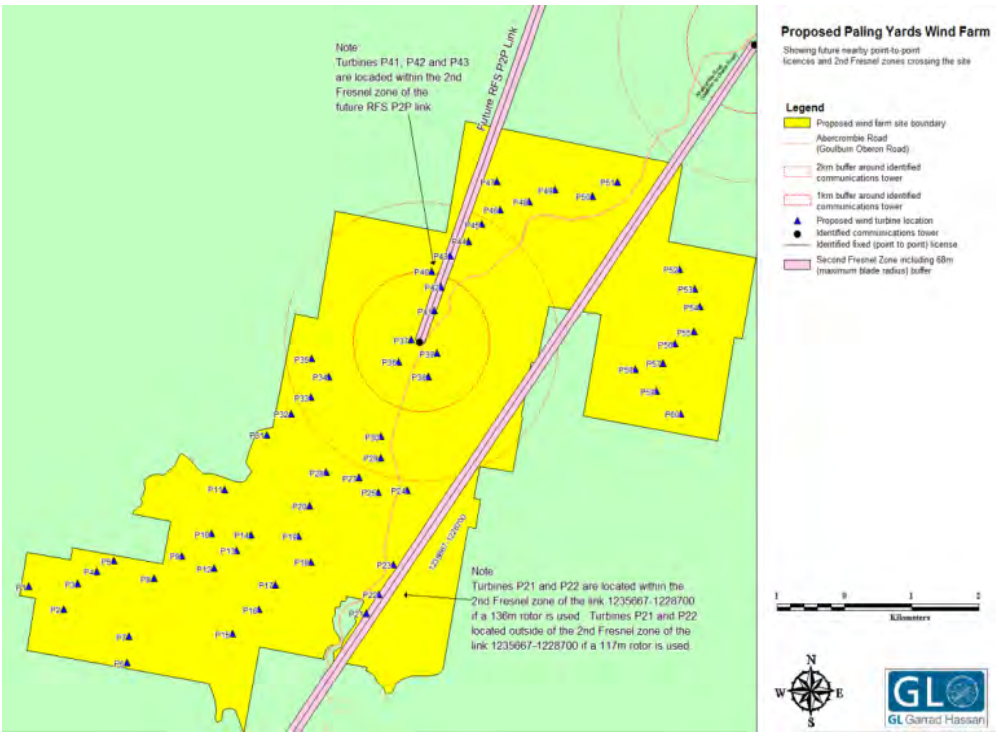
For the first link, operated by Telstra, two turbines may interfere with the link when a rotor diameter of 136 m is considered. However UFWA has indicated that they intend to reduce the rotor diameter of these turbines to 117 m, resulting in an unlikely interference with the link.

For the second link, a future NSW RFS P2P link, three turbines may interfere with the link, being turbines P41, P42 and P43.

A number of mitigation options may be available, including moving the three turbines in question outside of the exclusion zone or relocating the communications tower. When further clarity on potential interferences to this link due to the project is provided, the appropriate mitigation measures will be put forward and implemented. As discussed with NSW RFS, the preferred option would be to relocate the communications tower. NSW RFS understand that UFWA would be willing to contribute to costs associated with the relocation.

The proponent will resolve this issue through further consultation with NSW RFS.

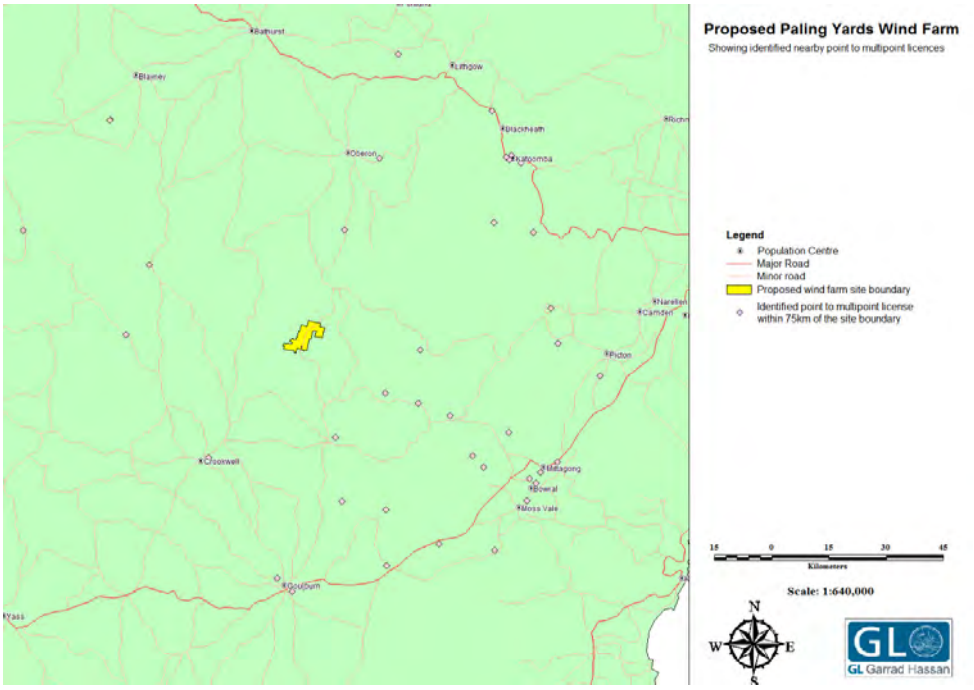
Figure 53 Proposed telecommunication vectors and 2nd Fresnel zones plus 58.5 m buffer



In relation to point-to-multi-point microwave links, there are no point-to-multipoint base stations listed in the ACMA database within 20km of the site boundary (refer to **Figure 54**). It is unlikely that stations at this distance will be servicing customers in the vicinity of the site.

Garrad Hassan has contacted operators of the majority these stations to assess any potential impact that the wind farm could have on their service, and has not been informed of any potential impacts by these parties. Garrad Hassan has endeavored to contact the remaining stations. The proponent will endeavour to contact the remaining stations; however due to the lack of responses from these parties, potential impacts to these remaining stations are not anticipated.

Figure 54 Location of point-to-multipoint stations within 75 km



A review of other licences within 75 km of the site was conducted. Many of the licences identified can broadly be described as base to mobile station style communication, and include radio broadcasting, commercial and private mobile telephony.

Garrad Hassan highlight that these license types are generally not affected by the presence of wind turbines any more than other effects such as terrain, vegetation and other forms of signal obstruction. Should reception difficulty be encountered, the user may move a short distance to receive a clearer signal.

Garrad Hassan found that the project is unlikely to unreasonably impact emergency services, meteorological radar, trigonometrical stations, Citizens Band Radio, wireless internet, satellite television, internet or AM radio.

A review of the mobile GSM and NextG network coverage found that the general area around the site has marginal network coverage and in some areas, turbines may potentially cause some interference to the signal. In such cases, the installation of an external antenna or moving a short distance until the signal strength improves will help to improve the signal quality.

An examination of the potential impact of the wind farm on radio broadcasting found that FM signals may be susceptible to interference from wind turbines, resulting in hissing and distortion of the signal. This can be mitigated by the installation of a high quality antenna.

An assessment of the potential impact of the project on broadcast towers found that interference to analogue television could potentially occur at:

- 11 houses, when tuned to the Canberra transmitter at Black Mountain,
- 16 houses if tuned to the Central Tablelands transmitter at Mount Canobolas,
- 10 houses if tuned to the Gore Hill transmitter in Sydney, and
- 6 houses if tuned to the Knights Hill transmitter at Illawarra.

However, Garrad Hassan note that analogue television is being phased out across Australia. The transmissions from most of the analogue transmitters whose signals can be received in the vicinity of the site may have been ceased by the time the wind farm is constructed.

If digital reception is marginal, residents in the vicinity of the site may be eligible to receive access to the Government-funded satellite television service to view free-to-air television.

15.4 Mitigation

The electromagnetic interference mitigation measures proposed throughout the report include:

- For any interference with fixed point-to-point links, either the relevant turbines or the communications tower may be slightly relocated, where possible.
- Realigning or relocating the householder's TV antenna.
- The installation of an external antenna or more directional and/or higher gain antenna at the affected household;
- The installation of cable/satellite TV at the affected household; and
- Installation of a TV relay station.
- A person with portable device moving a short distance to a new or higher location until the signal strength improves.

Garrad Hassan note that as television interference from wind turbines is readily identifiable, appropriate mitigation measures can be readily taken if required.

In the event that TV interference is an issue during wind farm construction or after wind farm commissioning, the following options are recommended, in approximate order of increasing cost:

1. Realigning the householder's TV antenna more directly towards their existing transmitter;
2. Tuning the householder's antenna into alternative sources of the same or suitable TV signal;
3. The installation of more directional and/or higher gain antenna at the affected house;
4. Relocating the antenna to a less affected position;
5. The installation of a digital set top box (and UHF antenna if required);
6. The installation of cable/satellite TV at the affected house; and
7. Installation of a TV relay station.

In the event that digital TV does not provide an acceptable amelioration option, satellite television represents another potential option.

In relation to the NSW RFS proposed P2P link, further discussion will be undertaken with RFS to confirm actual interference and whether the P2P tower or interfering turbines should be relocated.

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CHAPTER 16

FIRE IMPACTS

16 Fire Impacts

16.1 Introduction

A wind farm in a rural area, as with many large scale developments, can increase the risk of bushfire to nearby people and property. This includes fire caused by the turbines (and associated components) themselves, impacts on the turbines caused by fire sparked elsewhere, and impacts on the ability to fight fires in and around a wind farm site.

This chapter draws on current literature to describe and detail the risk and outlines a range of mitigation measures designed to reduce the risk. The potential risk to people and property depends on a number of factors, including the inherent flammability of the turbine generators, the landscape in which the turbines sit, and the capability and methods used by local fire services to fight fires in the area.

The Draft NSW Wind Farm Guidelines specify that assessment must detail bushfire hazards and risk, including recommending consultation with the NSW Rural Fire Service.

As a result of increased wind farm development in Victoria and NSW, the Victorian Country Fire Authority (CFA) and the RFS have extensively studied the implications of wind farms on fire, and the possible mitigation measures to reduce the risk.

16.2 General Risk

Local communities have expressed concern that wind turbines may increase the risk of bushfires due to the introduction of electrical devices and mechanical components on site (NSW Legislative Council 2009). In addition, residents are concerned that bushfires may be started through lighting strikes on the turbines, leading to combustion and the commencement of a wider fire (NSW Legislative Council 2009).

Wind turbines manufactured today incorporate the highest quality and safety standards (CFA 2012). Despite this, *"the risk of fire always exists when electronics and flammable oils and hydraulic fluids exist in the same enclosure"* (CFA 2012). The risk of fire at a wind farm can be associated with nacelle fires, electrical faults during construction or from connection lines, fire fighting limitations within and adjoining the wind farm footprint, access to water sources and air fields, operation of winches and machinery during maintenance tasks, and impacts from downwind air turbulence on fire behaviour (CFA 2012).

The CFA considers that "the risk of wildfire resulting from the wind farm operations is not unduly greater than that resulting from other agricultural and industrial practices which operate within the country area" (DPCD 2009, McArthur 2006 Panel Report). Furthermore, the risk of fire is considered to be in fact minimised by wind farm developments and their associated permit conditions because they introduce more intensive fire planning (DPCD 2009, Mt Mercer 2006 Panel Report).

The NSW Legislative Council (No.5, 2009) concluded in their report that wind farms do not significantly increase the risk of bushfires in rural areas. Wind farm developers are aware of the potential risks and implement appropriate management measures to prevent bushfires from occurring (NSW Legislative Council 2009). It is also important to note that no bushfires have been started through wind farm activity in NSW (NSW Legislative Council 2009).

The potential impacts of wind farm activities on fire is considered lower in comparison to normal power generation sites, as power transmission is located within the turbine towers and underground to the transformers (CFA 2012). Due to modern day manufacturing, the risk of fire at wind farms is 'very low' (AusWind 2007), in terms of

both fire damage to wind turbines and fire caused by the turbines. This is because modern turbines are equipped with safety devices to reduce the risk of fire. It is also because:

- *the flammable components are located high above the ground;*
- *there is normally no vegetation around the base of the turbine towers;*
- *medium-voltage connections are underground;*
- *access tracks act as fuelbreaks and provide fire fighting access;*
- *comprehensive lightning protection devices are installed on every wind turbine, including internal lightning conductor rods running all the way to the blade tips; and*
- *dedicated monitoring and control systems shut down the wind turbines when the threshold temperatures of critical components are reached (AusWind 2007).*

Additionally, wind turbines must comply with the Building Code of Australia and Australian Standards, and vegetation around transformers are generally kept below 100 mm (NSW Legislative Council 2009). While it is possible for an electrical failure to cause fire within a wind turbine, the system is designed to contain fire rather than spread it to the surrounding area (Fenwick 2009). The wind farm can also be shut down in the event of a fire situation.

Applications for approval under Part 3A are assessed against *Planning for Bush Fire Protection* 2006, to ensure that the required measures have been incorporated into the project. The ability for the project to comply with *Planning for Bush Fire Protection* is the key objective of this assessment (NSW Rural Fire Service 2007).

An additional fire risk is the possible lack of experience of the local RFS staff and volunteers, who may have little experience in fighting fires in wind farms. This may include unfamiliarity with the wind farm layout, location of water sources, and internal operational mechanisms of the turbines. This risk can be reduced though training and education.

In relation to fire-fighting methods, any fire-fighting activities in the vicinity of the project by either fixed or rotary wing aircraft would need to be conducted in consideration of the location of the wind turbines and monitoring masts. Therefore, the location of the wind turbines and monitoring masts should be made available to RFS and aerial agriculture operators.

While aerial fire-fighting operations may potentially be restricted in the vicinity of the project, there is still a valid ground-based means of fighting bushfires. Further discussion on the implications of wind farm on aerial fire fighting in the vicinity of the site is found in **Chapter 13 – Aeronautical Impacts**.

16.3 Local Risk

Oberon Council considers that the whole of the Rural 1(a) zone in Oberon is susceptible and or liable to bush fires, including the subject site. The presence of dense areas of native vegetation to the west (Abercrombie National Park) and to the east on private land, combined with the steep topography to the south of the site, increase the risk of bushfire in this region.

However, several site factors assist in reducing the potential for fire or enhance the ability to control existing fires. These include a ready supply of water through the Abercrombie River, local dams, and smaller waterways, and the fact that the majority of the turbine locations are cleared of treed native vegetation. The taller native

vegetation has been replaced by lower pasture grasses which present much lower flammability.

A further factor reducing the risk of fire is the accessibility of the majority of the site from the sealed Abercrombie Road and the internal network of farm tracks. Properly constructed, these allow the free passage and direct access to the turbines and all parts of the site. All these factors are likely to reduce the severity and duration of any fire.

An 'Abercrombie River National Park Fire Management Strategy' has been prepared for the adjacent land by the NSW Parks and Wildlife Service (2005). It provides direction for fire management activities within the park to fulfil the Service's obligations under various legislation and Government policy. It aims to protect from bushfires, persons and property on, or immediately adjacent to the park through strategies such as fuel management and trail maintenance.

Whilst the site is susceptible to bushfire, the risk of either the wind farm igniting a fire, or that the wind farm significantly affecting the ability to control a fire started elsewhere, is considered low.

16.4 Mitigation

The mitigation measures that will be implemented as part of this project will be detailed in a Fire Management Plan, prepared in consultation with State and local RFS, and the State Planning Department, in accordance with *Planning for Bushfire Protection 2006*. This would address safety, communication, site access and emergency response protocols.

Other mitigation measures proposed by this Environmental Assessment which are to be implemented as part of the project include:

- Consultation and training with the NSW Rural Fire Service in regard to the adequacy of bushfire prevention measures to be implemented on site during construction, operation and decommissioning.
- Consultation with the NSW PWS on the management of bushfires in the adjacent National Park
- Consult with the RFS during periods of high fire danger
- Inform RFS and any aerial agriculture operators on the location of the wind turbines, transmission lines and monitoring masts.
- Development of workplace health and safety protocols to minimise the risk of fire for workers during construction and during maintenance in the control room and amenities.
- On-site vegetation management during construction and operation to minimise potential sources of fuel.
- Re-organisation of construction activities during periods of high fire danger, including ceasing use of explosives, and management of hot work activities such as welding or cutting.
- Use of materials and equipment during operation that minimise the likelihood of fire.
- Maintenance of vehicles to minimise sparking from exhaust systems.
- Automatic shutdown of any overheating turbine mechanism.
- Shut down of turbines during a bush fire in the area.

- Lightning protection on each turbine.
- Under-grounding of electrical and communication cables where practicable.
- Access to adequate water supply, with water access points be located in safe, easily identifiable areas and accessible in all weather conditions by equipment up to 15 tonnes
- A turning circle with a minimum radius of 10 metres will be provided for fire appliances at all water access points.
- The location and number of tanks or other water supply points will be determined in consultation with the NSW RFS.
- Careful storage and handling of flammable materials and ignition sources brought onto the site, as per manufacturer's instructions.
- Storage of appropriate fire fighting equipment onsite during the construction phase, ensuring that a minimum of one person on site is trained in its use.
- Periodical inspection of overhead transmission easements to monitor any regrowth of encroaching vegetation.
- Vehicle turn-around facilities to be provided at every turbine tower site.
- At least 5-metres wide internal access tracks to be provided that are driveable and permanently clear of vegetation for heavy fire-fighting equipment up to 15 tonnes
- Provision of wind turbine access tracks that continue onto adjacent paddocks and are not dead-ended.
- Implementing a wide fuel break in accordance with RFS, Council and State Government recommendations to slow the spread of fire.
- Any vegetation plantings to have low fire resistance.

Micro-siting of the turbines following approval will consider bushfire risk.

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CHAPTER 17

SHADOW FLICKER IMPACTS

17 Shadow Flicker Impacts

17.1 Introduction

Garrad Hassan Pacific Pty Ltd (Garrad Hassan) was engaged by UFWA to assess the potential impact of shadow flicker arising from the proposed wind turbines, which are part of the project on surrounding view locations. The results of the shadow flicker assessment are summarised in Chapter 11 of the Landscape Visual Impact Assessment (LVIA) report by Green Bean Design, and a copy of the detailed shadow flicker assessment is found in the LVIA at **Appendix 6**.

The assessment describes the shadow flicker effect as follows:

"Due to their height, wind turbines can cast shadows on surrounding areas at a significant distance from the base of the wind turbine tower. Coupled with this, the moving blades create moving shadows. When viewed from a stationary position, the moving shadows appear as a flicker giving rise to the phenomenon of 'shadow flicker'. When the sun is low in the sky the length of the shadows increases, increasing the shadow flicker affected area around the wind turbine".

17.2 Methodology

Garrad Hassan utilised the following methodology in assessing the impact of the project:

"The number of hours of shadow flicker experienced annually at a given location can be calculated using a geometrical model which incorporates the sun path, topographic variation over the wind farm site and wind turbine details such as rotor diameter and hub height".

The report further suggests that this modelling makes the following assumptions:

- *that there are clear skies every day of the year;*
- *that the turbines are always rotating;*
- *that the sun can be represented as a single point;*
- *that the blades of the turbines are always perpendicular to the direction of the line of sight from the specified location to the sun; and*
- *that the sun is modelled as a point source.*

The above assumptions have not been applied to the shadow flicker duration results, meaning that the results should be regarded as conservative.

The shadow flicker assessment adopted the Victorian Planning Guidelines, *Policy and planning guidelines for development of wind energy facilities in Victoria*, (Sustainable Energy Authority Victoria, 2009), which recommend a shadow flicker limit of 30 hours per year in the immediate area of a dwelling. This recommendation is also reflected in the *Draft NSW Planning Guidelines Wind Farms Guidelines* (Draft Guidelines), which also recommend a shadow flicker limit of 30 hours per year to be experienced at any dwelling as a result of the operation of a wind farm. The Draft Guidelines also recommend assessment of the impact of shadow flicker on all houses within 2km of a proposed wind turbine.

The likelihood and duration of the shadow flicker effect depends upon a number of variable factors as follows:

- *Direction of the property relative to the turbine.*
- *Distance from turbine (the further the observer is from the turbine, the less pronounced the effect would be).*
- *Wind direction (the shape of the shadow would be determined by the position of the sun relative to the blades, which would be oriented to face the wind).*
- *Turbine height and rotor diameter.*
- *Time of year and day (the height of the sun in the sky).*
- *Weather conditions (cloud cover reduces the occurrence of shadow flicker).*

17.3 Results

17.3.1 Shadow Flicker

Garrad Hassan has assessed the impacts of shadow flicker arising from the project on surrounding view locations. Refer to **Figure 55 – Theoretical annual shadow flicker duration at 2 metres (Option 1)** and **Figure 56 – Theoretical annual shadow flicker duration at 2 metres (Option 2)**.

The shadow flicker assessment takes into account the impact of shadow flicker on all houses within 2km of the turbines as recommended by the Draft Guidelines.

The results of the of the shadow flicker assessment for the project determined that the following seven residential view locations may be subject to levels of shadow flicker above the recommended limit of 30 shadow flicker hours per year:

- House ID 7,
- House ID 7A,
- House ID 8,
- House ID 8A
- House ID 9,
- House ID 9A, and
- House ID 9B.

The residences listed above are project-involved landowners, and UFWA will negotiate an agreement with the owners of these dwellings.

The predicted flicker impacts from the worst-case scenario turbine option are summarised in the table below.

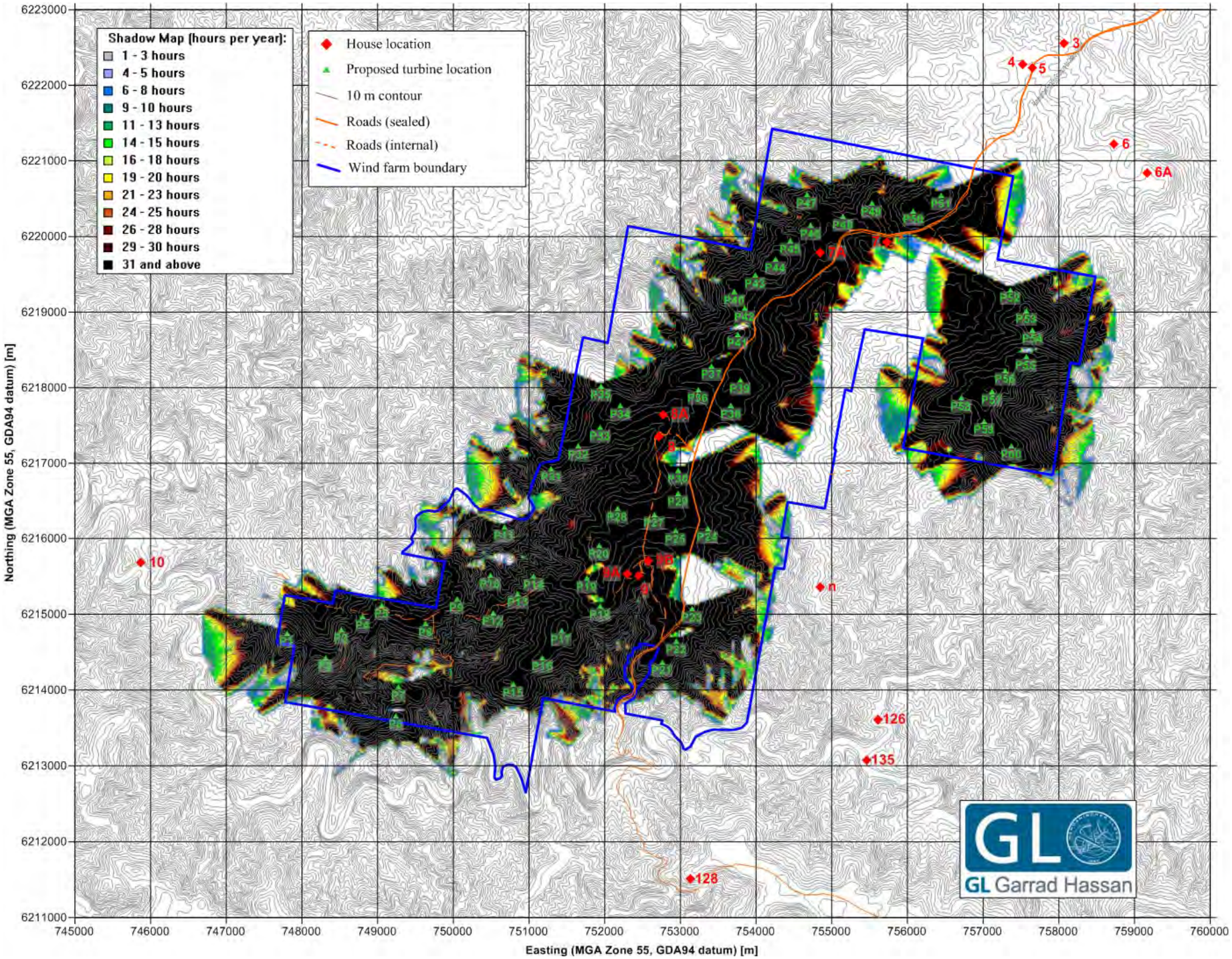

Figure 4. Map of proposed Paling Yards Wind Farm showing turbines, house locations and theoretical shadow flicker duration at 2 m for Turbine Option 1.
(13 turbines with an 100 m rotor diameter and an 80 m hub height, and 46 turbines with an 117 m rotor diameter and a hub height of 91 m)

Figure 55 Theoretical Annual Shadow Flicker Duration At 2 Metres (Option 1)

Source: *GL Garrad Hassan*

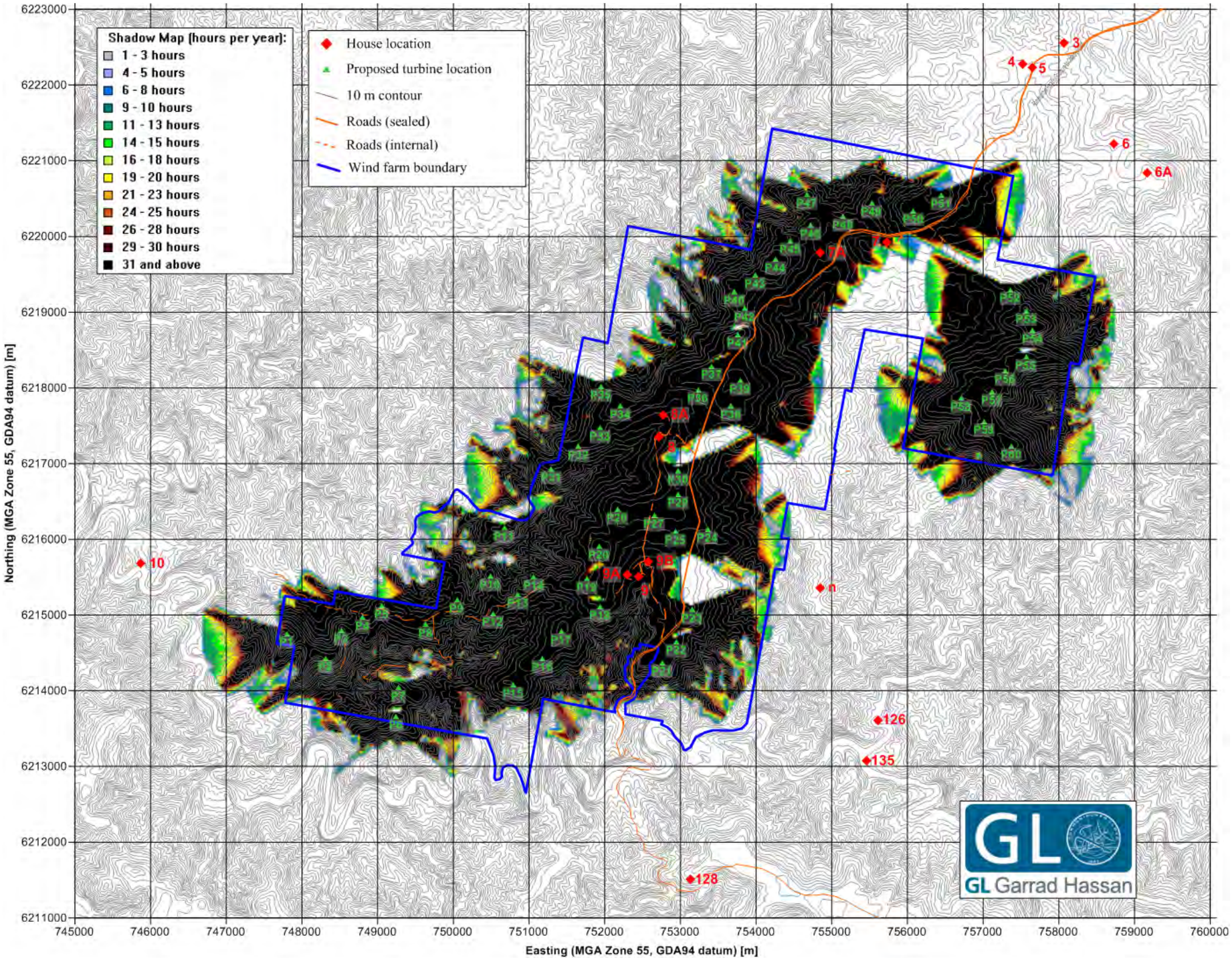

Figure 6. Map of proposed Paling Yards Wind Farm showing turbines, house locations and theoretical shadow flicker duration at 2 m for Turbine Option 2.
(15 turbines with an 100 m rotor diameter and an 80 m hub height, and 44 turbines with an 136 m rotor diameter and a hub height of 107 m)

Figure 56 Theoretical Annual Shadow Flicker Duration at 2 Metres (Option 2)

Source: *GL Garrad Hassan*

Table 25 Flicker assessment for worst-case scenario turbine option

House ID	Theoretical				Predicted Actual			
	At Dwelling [hr/yr]		Max Within 50m of Dwelling [hr/yr]		At Dwelling [hr/yr]		Max Within 50m of Dwelling [hr/yr]	
	At 2m	At 6m	At 2m	At 6m	At 2m	At 6 m	At 2m	At 6m
7	36	34	90	83	13	12	25	23
7A	151	153	180	180	55	55	63	63
8	51	50	71	70	18	17	25	25
8A	186	187	197	197	56	57	58	58
9	68	66	81	81	23	23	28	28
9A	84	82	141	141	24	24	43	43
9B	120	117	156	156	31	31	41	41

Note: the number of hours in this table represents the worst-case scenario at each dwelling for turbine design Options 1 and 2 investigated in the shadow flicker assessment.

To assist UFWA to reach an agreement with these dwellings, detailed time-of-day theoretical shadow flicker durations have been prepared.

It is important to note that the shadow flicker assessment may overestimate the actual number of annual hours of shadow flicker at a particular location due to a number of reasons including:

- *The probability that the wind turbines would not face into or away from the sun all of the time.*
- *The occurrence of cloud cover.*
- *The amount of particulate matter in the atmosphere (moisture, dust, smoke etc) which may diffuse sunlight.*
- *The presence of vegetation.*
- *Periods where the wind turbine may not be in operation due to low winds, or high winds or for operational or maintenance reasons.*

17.3.2 Photosensitive Epilepsy

Garrad Hassan also acknowledges the potential issue of 'photosensitive epilepsy', which is defined by the Canadian Epilepsy Alliance as *"a sensitivity to flashing or flickering lights, usually of high intensity, which are pulsating in a regular pattern – and people with photosensitive epilepsy can be triggered into seizures by them"*. The assessment notes that both the Canadian Epilepsy Alliance and Epilepsy Action Australia estimate that less than 5% of people with epilepsy are photosensitive.

An assessment of these sources found that;

"Given the low flicker frequency associated with the Paling Yards wind turbines, which falls below the range suggested by Epilepsy Action Australia as a potential trigger for

photosensitive epileptic seizures, it is unlikely that the Paling Yards wind turbines would present a risk to people with photosensitive epilepsy".

17.3.3 Motorists

There is the potential for motorists to experience shadow flicker sensations whilst driving as a result of shadows cast on the road from roadside or overhead objects such as trees, poles, or buildings, including turbines.

It is possible that the sensation of shadow flicker may cause annoyance and may impact on a driver's ability to operate a motor vehicle safely. The report considered the potential of shadow flicker associated with wind turbines to road uses, and concluded that;

"As the potential flicker frequency for the Paling Yards wind turbines is likely to be around 1Hz, it is unlikely that the flicker effect would cause annoyance or impact on a driver's ability to operate a motor vehicle safely whilst travelling along local roads surrounding the wind farm".

The figure below presents a typical situation where shadow flicker may be experienced whilst driving along a road where trees cast shadows.

Figure 57 Potential shadow flicker created by trees filtering sunlight across road

Source: Shadow Flicker Impact Assessment, Garrad Hassan Pacific Pty Ltd, Appendix 6

17.3.4 Blade Glint

The assessment also addresses 'blade glint', which is described as a *"phenomenon that results from the direct reflection of sunlight (also known as specular reflection) from a reflective surface that would be visible when the sun reflects off the surface of the wind turbine at the same angle that a person is viewing the wind turbine surface"*.

Glint usually results in a 'low impact' due to the infrequency of occurrence and environmental factors including cloud cover.

The assessment notes that the potential for blade glint from a wind farm is reduced by the turbines' surfaces, including the towers and blades, as they are *"largely convex, which will tend to result in the divergence of light reflected from the surfaces, rather than convergence toward a particular point which will also reduce the potential for blade glint"*.

Blade glint can also be further mitigated through the use of matt coatings.

As no non-project involved, identified dwellings are located within 2km of the site, the assessment of blade glint, coupled with the proposed mitigation measures is considered acceptable in accordance with the Draft Guidelines.

17.4 Mitigation

The report concluded that several options are available for mitigation of shadow flicker and blade glint on the view locations such as the noted dwellings, based on the owner's approval. These options are as follows:

- Use of non-reflective paint on turbine blades;
- Installation of screening structures or planting of trees to block shadows cast by the turbines; and
- Use of turbine control strategies which shut down turbines when shadow flicker is likely to occur.

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CHAPTER 18

HERITAGE IMPACTS

18 Heritage Impacts

18.1 Introduction

Anderson Environmental Consultants Pty Ltd (Anderson Environmental) was commissioned by UFWA to undertake an indigenous and non-indigenous cultural heritage impact assessment of the project. The full report prepared by Anderson Environmental is found at **Appendix 12a**. Following the preparation of Anderson Environmental's report, Environmental Management Resources Australia Pty Ltd (ERM) was engaged by UFWA to undertake an assessment of the significance of heritage sites referred to in the Anderson Environmental report and prepare a supplementary heritage impact assessment report in November 2013 to address the adequacy review comments from DoPI dated 24 June 2013. The heritage impact assessment report by ERM can be found at **Appendix 12b**. These reports should be read in combination, and where the same issues are addressed, the ERM report should be considered as the most up to date information which has informed the mitigation measures.

The purpose of the ERM report was to identify the archaeological/scientific and cultural/social values of sites identified during Anderson Environmental's field survey and assess their significance. ERM notes that 'Archaeological (or scientific) significance' refers to *"the potential of a site to contribute to current research questions"*, and that 'Cultural/social significance' concerns *"the value of a place, feature or site to a particular community group, in this case the local Aboriginal communities*".

The Anderson Environmental report outlines the results of a heritage investigation of the project in relation to the potential impact of the proposed activity on indigenous, non-indigenous and cultural heritage values, including the results of the 2005 surveys by Heritage Concepts. The assessment also outlines recommendations to mitigate the potential heritage impacts of the project.

18.2 Methodology

Anderson Environmental's assessment was conducted in two parts being:

- a desktop assessment; and
- field assessment and surveys.

The desktop assessment reviewed historical databases and heritage lists to ascertain the level of potential for archaeological and historical value within the site and to establish a statutory process for further work under the legislative framework. The previous survey undertaken in 2005 was also reviewed as background for the current survey.

Areas were identified in which indigenous and non-indigenous cultural heritage objects or artefacts were predicted to be located, based on the lands topographical, vegetation, sheltering and historical hunting resources. Once the areas in which object or artefacts were predicted to be located were determined, indigenous and non-indigenous cultural heritage field surveys were undertaken by foot. The areas surveyed included all of the sites for potential turbine locations as well as all the transmission line route options. Other areas where there was a high potential to find objects or artefacts were also assessed. The specific surveys for non-indigenous heritage involved surveying the site for European artefacts and signs of early European settlement and farming/land management practices

The site had previously been well surveyed by Heritage Concepts during 2005, during which the drought was at its height and as such the soil exposure was high compared to the current surveys which followed good rain and so had reduced visibility.

Surveys for non-indigenous heritage involved surveying the site for European artefacts and signs of early European settlement and farming/land management practices.

ERM's review of the fieldwork and assessment components of the project undertaken by Anderson Environmental confirms that the requirements of the *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH 2010) were incorporated in the methodology, and that the project has been conducted in accordance with the OEH 2010 *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*.

In undertaking the supplementary heritage impact assessment, ERM has not undertaken any additional field work or had any direct consultation with Aboriginal parties.

Seven key criteria have been used by ERM to examine the scientific significance of a site. These are based on the legislative guidelines (OEH 2010 and NPWS 1999). These are:

1. *rarity: whether any or all aspects of a site (type, location, integrity, content and archaeological potential) can be considered common or rare within a local, regional or national context;*
2. *representativeness: the comparative rarity of the site when considered and contrasted against other similar sites conserved at the local and/or regional level;*
3. *archaeological landscapes: the study of the cultural sites relating to Aboriginal peoples within the context of their interactions in the wider social and natural environment they inhabited. Landscapes can be large or small depending upon specific contexts (i.e. local or regional conditions); they may also may be influenced by Aboriginal social and demographic factors (which may no longer be apparent);*
4. *connectedness: whether a site can be connected to other sites at the local or regional level through aspects such as type, chronology, content (i.e. materials present, manufacturing processes), spatial patterning or ethno-historical information;*
5. *integrity & condition: integrity refers to the level of modification a site has been subject to (the cultural and natural formation process) and whether the site could yield intact archaeological deposits, which could be spatially meaningful. Condition takes into account the state of the material, which is especially relevant for organic materials;*
6. *complexity: the demonstrated or potential ability of a site to yield a complex assemblage (stone, bone and/or shell) and/or features (hearths, fire pits, activity areas); and*
7. *archaeological sensitivity: the potential to yield information (from sub-surface materials which retain integrity, stratigraphical or not) that will contribute to an understanding of contemporary archaeological interest, or which could be saved for future research potential.*

Each site is designated a significance rating by ERM as either 'High', 'Moderate', 'Low/Moderate' or 'Low' based on the above criteria.

ERM's assessment of the cultural/social significance involved an analysis of the consultation process that was undertaken with local Aboriginal stakeholders. ERM confirms that in accordance with the consultation guidelines, Aboriginal representatives, stakeholder groups or individuals who hold information concerning the significance of Aboriginal cultural heritage and wished to be consulted were identified and consulted with. Refer to **Chapter 22** of this report for further details on the consultation process.

18.3 Results

18.3.1 2005 Heritage Concepts assessment

An indigenous and non-indigenous cultural heritage survey and draft impact assessment was previously undertaken by Heritage Concepts in June 2005. This report is not available for publication due to its draft format and potential copyright restrictions; however the proponent has been granted permission to use and reference the results of the surveys. The 2005 assessment found 14 Aboriginal Archaeological sites and 5 historic cultural sites across the landscape. For the detailed results of the 2005 survey refer to 'Appendix C Aboriginal Archaeological Sites (June 2005)' and 'Appendix D Historic Cultural Sites (June 2005)' in the Anderson Environmental Heritage Impact Assessment at **Appendix 12a**. Prior to the 2005 assessment, no other indigenous cultural heritage surveys had been undertaken and therefore no Aboriginal Archaeological sites had previously been identified.

The following three sites which were found in the 2005 surveys occur near proposed turbines and/or infrastructure and therefore have the potential to be impacted (refer to **Figure 58 – Aboriginal Archaeological and Historic Cultural Heritage Sites**):

- Site PYWF A11 located near Turbine P47.
- Site PYWF A10 located near access track between turbines P45 and P46.
- Site PYWF A7 located near access track between turbines P54 and P55.

It may be possible to avoid these sites through the micro-siting of turbines and access tracks; however, a range of options will be explored in the future Cultural Heritage Management Plan prior to the construction phase. If impact cannot be avoided due to terrain restrictions, then the heritage sites would be salvaged and relocated nearby as instructed by the relevant agency.

In the supplementary heritage impact assessment, ERM notes that *"of the 14 sites recorded in the Heritage Concepts 2005 Report, A7, A10 and A11 contain a moderate archaeological sensitivity and scientific significance, whilst also having a high Aboriginal cultural significance"*. ERM recommends that direct impact upon these three sites be avoided through micro-siting and through effective construction management as part of a CHMP.

18.3.2 Indigenous cultural heritage

The indigenous cultural heritage survey by Anderson Environmental detected eight additional Aboriginal Archaeological sites distributed on both the eastern and western sides of the site. The additional areas surveyed were designed to include the new proposed development footprint that was outside the 2005 survey scope. Refer to **Figure 58 – Aboriginal Archaeological and Historic Cultural Heritage Sites** for the locations of the sites.

Anderson Environmental found that none of the sites detected would likely be impacted by the project.

The targeted surveys revealed that indigenous artefacts were not at high levels within the site. The artefacts that do exist within the landscape are distributed generally near the ridge lines and small rises in the country (refer to **Figure 58**).

Sites 1, 2, 3 and 4 are considered to be of low significance and will not be impacted by the project.

Site 5 is considered to be of moderate significance. Based on the current indicative layout, this site will not be impacted by the project. However, the impact on this site will be revised once the final layout is determined.

Site 6 is considered to be of moderate to high significance based on its location within the landscape. Based on the current layout, this site will not be impacted by the project. However, the impact on this site will be revised once the final layout is determined.

Site 7 is considered to be of moderate significance. Based on the current indicative layout, this site will not be impacted by the project. However, the impact on this site will be revised once the final layout is determined.

Site 8 is a moderately significant site due to a high number of artefacts found in this location. The site is near the proposed turbine location 31. However, any impacts on this site may be able to be avoided as the proposed turbines and access road do not currently fall within the Site 8 area. Therefore, based on the current indicative layout, this site will not be impacted by the project. However, the impact on this site will be revised once the final layout is determined.

A summary of the eight identified sites and artefacts detected is provided in the table below.

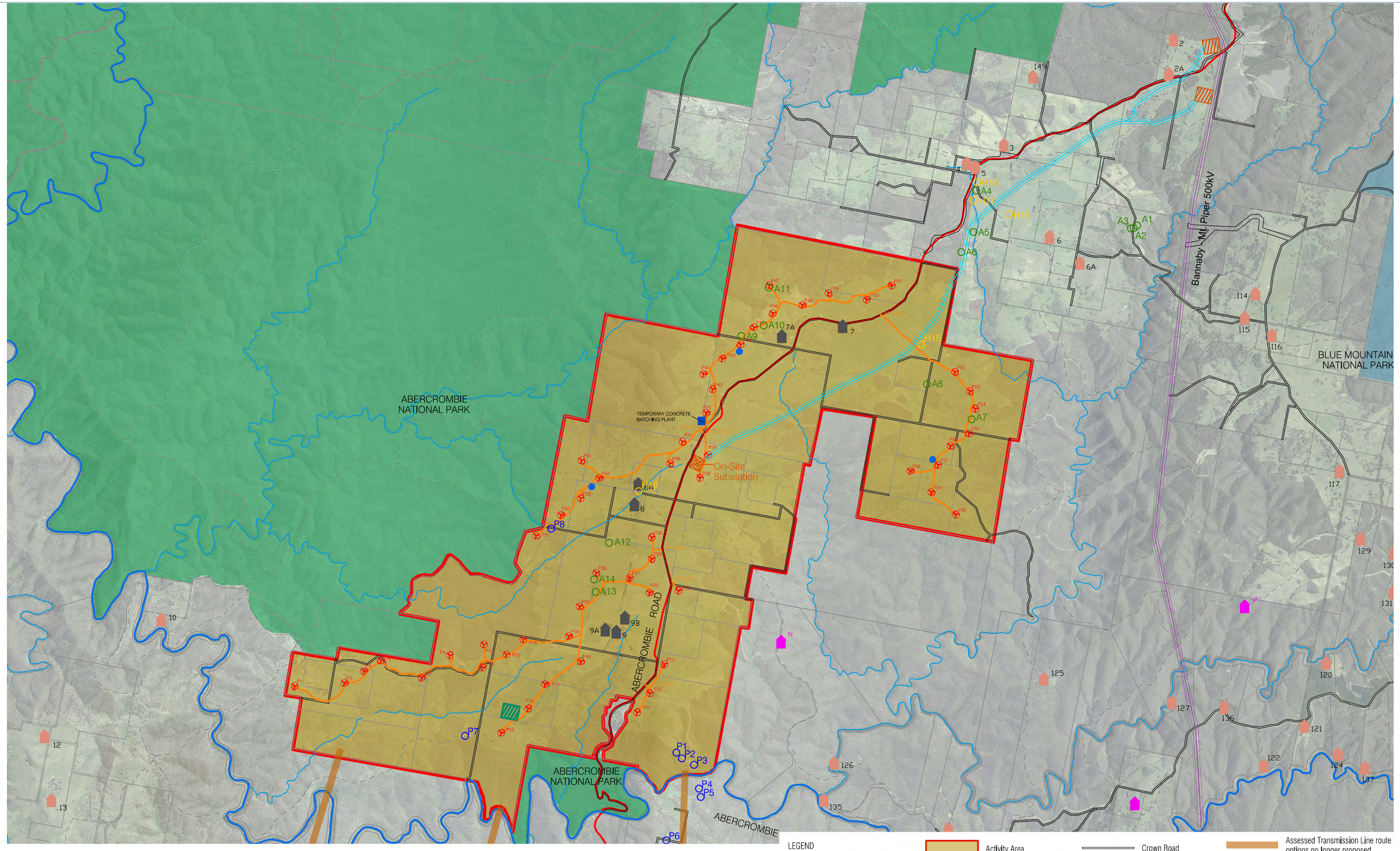

Figure 58 Aboriginal Archaeological & Historic Cultural Heritage Sites

Source: *Tract Consultants*

Table 26 Survey results of indigenous artefacts found on site

Site No. and contents	Heritage Type	Location	Impact Significance
Site 1 8 stone fragments	Indigenous	Towards the south-east boundary of the site, adjacent to a fenceline.	Low significance. Pejar LALC agrees with this assessment of significance.
Site 2 4 artefacts	Indigenous	Downhill from site 1 along the cleared fenceline area.	Low significance. Pejar LALC agrees with this assessment of significance.
Site 3 6 artefacts	Indigenous	This site is present further downslope along the fenceline from Site 2.	Low significance. Pejar LALC agrees with this assessment of significance.
Site 4 5 artefacts	Indigenous	Top of a rise on the southern side of the Abercrombie River, outside the site boundary.	Low significance. Pejar LALC agrees with this assessment of significance.
Site 5 1 core and five flakes and two larger artefacts	Indigenous	On the southern side of the Abercrombie River on the lower eastern knoll near to "the racecourse", outside the site boundary.	Moderate significance. Pejar LALC agrees with this assessment of significance.
Site 6 35 various flakes and cores	Indigenous	Top of a hill approximately 800 metres south-west from Site 5.	Moderate to high significance. Pejar LALC agrees with this assessment of significance.
Site 7 1 core and backblade artefact	Indigenous	Towards the south-western side of the site boundary.	Moderate significance. Pejar LALC agrees with this assessment of significance.
Site 8 55 artefacts	Indigenous	Approximately 3km north of Site 7, in the west side of the site.	Moderate significance. Pejar LALC agrees with this assessment of significance.

The project remains subject to detailed design, particularly in relation to the location of the access tracks, underground cabling and overhead electrical connections. As such, it may be possible to avoid these sites through the micrositing of turbines and access tracks. A range of options will be explored in the future Cultural Heritage Management Plan prior to the construction phase.

Additional surveys will be required once the project is approved and the final locations of access tracks, cabling, and powerlines are determined and pegged. This would allow for minor changes to the final design if required.

Further assessment is not deemed to be required in most paddock areas as there is a long history of soil disturbance and pasture improvement.

Significant consultation has taken place with relevant parties in particular with the Pejar Local Aboriginal Land Council (Pejar LALC) regarding the identified heritage sites. However, prior to construction further consultation relating to the preparation of the Cultural Heritage Management Plan should be undertaken in collaboration with Pejar LALC and other stakeholders (collectively referred to as 'Registered Aboriginal Parties') that have registered their interest for participation in the consultation process for this development project.

18.3.3 Non-indigenous cultural heritage

In relation to non-indigenous heritage, Anderson Environmental found that a number of non-indigenous cultural heritage items are located within the site, including Mingary Park Airstrip, Quobleigh basalt chimney and plantings, Steam Boiler, Stockyards and Stillwell burial ground. However, none of the non-indigenous cultural heritage items located within the site would be disturbed as part of the project.

Furthermore, none of the non-indigenous sites are considered to be significant and none are listed under any heritage register or recorded in the Local Environmental Plan (LEP) for Oberon and Upper Lachlan Shires, or the recent Cultural Heritage Study of the Upper Lachlan Shire.

18.4 Assessment of significance

18.4.1 Archaeological significance

ERM Pty Ltd evaluated the significance of the archaeological sites and landscapes identified in the surveys and assessment undertaken by Anderson Environmental. ERM acknowledges that a total of 22 Aboriginal sites are recorded within the project site (14 recorded in 2005 by Heritage Concepts and eight recorded by Anderson Environmental in 2012).

ERM assessed the eight sites recorded in the recent survey and designated each site with a scientific significance ranking in terms of rarity, representativeness, archaeological landscape, connectedness, integrity and condition, complexity, and archaeological sensitivity, in accordance with the legislative guidelines (OEH 2010 and NPWS 1999). Refer to the methodology at **Chapter 18.2** for the determination of the ranking.

The table below summarises the archaeological sensitivity and scientific and aboriginal cultural significance of the landscapes and the eight identified archaeological sites (P1-P8) within the project site.

Table 27 Summary of Heritage Significance Assessment

Landscape units and sites	Archaeological sensitivity	Scientific significance	Aboriginal cultural significance	Overall ranking
Head of gullies	Moderate	Moderate	Moderate	Moderate
Low rises (near water)	Moderate	Moderate	Moderate	Moderate
Slight slope areas (near water)	Moderate	Moderate	Moderate	Moderate
Site P1	Moderate	Low	High	Low
Site P2	Moderate	Low	High	Low
Site P3	Low	Low	High	Low
Site P4	Low	Low	High	Low
Site P5	Low/ Moderate	Moderate	High	Moderate
Site P6	Low/ Moderate	Moderate	High	Moderate
Site P7	Low/ Moderate	Moderate	High	Moderate
Site P8	Moderate	Moderate	High	Moderate

Following an assessment of the significance of the sites, ERM concludes that:

- All sites identified within the project site are common site types at a local and regional level
- Stone artefact scatters are the only site type represented in the region
- Four of the artefact scatters within the project site (Sites P1, P2, P3 and P4) have been assessed as having 'Low' archaeological significance, as these sites have not demonstrated a significantly greater diversity or complexity in comparison to other known sites within the region
- The remaining four sites (Sites P5, P6, P7 and P8) have been allocated a 'Moderate' archaeological significance rating based on the larger number of artefacts present and the sites' potential to reveal in situ sub-surface deposits

In terms of actual impacts caused by the project, ERM found that any real risks associated with turbine placements and construction is associated with site P8. Therefore, ERM recommends that *"sub-surface investigation may be warranted associated with any turbines proposed within 100m of site P8, which could occur post development consent"*. ERM also recommends that a minimum distance or separation buffer of 100 metres should be maintained from any turbine and site P8.

18.4.2 Cultural significance

ERM acknowledges that *"landscapes or locations within a landscape may hold special significance to Aboriginal communities as places where traditional lifestyles have occurred and where sacred or symbolic significance places exist"*. Accordingly, ERM notes that Aboriginal cultural significance is determined by the Aboriginal community.

In response to the consultation process undertaken (including the newspaper advertisements in 2010 and expression of interest (EOI) in community participation and consultation letters in 2010 and 2013, which are outlined in more detail in **Chapter 22**,

registrations of interest were received from three Aboriginal Parties. These parties were:

- Luke Burges (Pejar Local Aboriginal Land Council)
- Lance Syme (Warrabinga Native Title Claimants Aboriginal Corporation)
- Bill Allen (Muri Clan Group of the Wiradyri People)

The registered stakeholders were provided with written information regarding the scope of the proposed project and the methodology for the proposed cultural heritage assessment process. Mr Luke Burges of the Pejar Local Aboriginal Land Council replied to the request to participate in the project and provide feedback on the proposed methodology.

During the fieldwork component of this study and in accordance with the relevant Aboriginal consultation guidelines, Mr Burges was asked about the cultural significance (to individuals and the community more broadly) of the project site and the identified heritage sites. Mr Burges responded that:

- *"the project site holds a high level of cultural significance to Aboriginal people as it is situated within areas that were used for hunting, gathering and camping by past Aboriginal groups and therefore represents Aboriginal occupation of the region, a past way of life and a direct link to their ancestors*
- *the wider landscape, particularly the flora, fauna and water courses associated with the study area are significant to them and other past and present Aboriginal people as they formed part of an economic resource environment"*.

In response to the identification of the project site as holding a high level of Aboriginal cultural significance, the layout of the project components has been carefully designed to minimise impact on the identified archaeological sites, and mitigation measures have been developed to further minimise impacts on archaeological and cultural heritage (refer to **Chapter 18.5** below). This includes the preparation of a Cultural Heritage Management Plan for the project and consultation and collaboration with the Registered Aboriginal Parties.

In accordance with the DGRs for this project, the heritage assessments have been developed in consultation with Aboriginal stakeholders who hold cultural knowledge or responsibility for the land within the project site.

18.5 Mitigation

The report recommends the following actions in order to preserve areas of cultural heritage significance and amelioration of potential impacts;

- Avoid, as far as practicable, impacts on the known archaeological sites.
- A comprehensive Cultural Heritage Management Plan should be prepared in consultation and collaboration with the Registered Aboriginal Parties to reduce and mitigate the impacts of the project on any artefacts which may be detected within disturbance zones. If it is not practicable to locate infrastructure so as avoid objects / artefacts then cooperation with Registered Aboriginal Parties should be undertaken to determine the management option for these objects / artefacts (i.e. collection for education purposes or moving the objects / artefacts slightly to outside the zone of disturbance).

- The movement of identified objects is considered to be a suitable mitigation measure in most cases as the distances involved would not be significant, and many of the objects may have been moved in the past via water movement, erosion or vehicle/tractor movements such as road grading and cultivation of the ground.
- The Cultural Heritage Management Plan should also outline management strategies for the management of any potential unrecorded sites which are identified within the site during construction of the project. In accordance with the Draft NSW Wind Farm Planning Guidelines, the construction program control measures should include provision to temporarily halt the excavation of a specific site in the event that a previously unidentified Aboriginal object(s) and historic relic is uncovered. All works likely to affect the object/relic should cease and the OEH officers and the Registered Aboriginal Parties notified. Works should not recommence at the specific site until an appropriate strategy for managing the object/relic has been determined in consultation with OEH and the Aboriginal stakeholders and a permit or written authorisation has been obtained from OEH.
- If impacts to any further sites which are identified cannot be avoided then further investigation would be required in consultation with Registered Aboriginal Parties and OEH. This would include sub-surface digs and analysis.
- As the detailed design of the proposed access tracks and electrical connections were not available at the time the field surveys were conducted, potential deviations to the surveyed routes may be made during detailed design to reduce impact(s) on the land.
- Once the proposed access track locations and other disturbance areas are pegged on the ground, additional targeted surveys of these areas should be undertaken. Where these additional targeted surveys identify any further sites, test pits should be undertaken in order to determine the extent of significance of any sites which would be potentially impacted.
- The final micrositing of the proposed infrastructure should be undertaken in consideration of utilising and upgrading as much as possible the existing farm access tracks where possible to achieve an overall site plan which minimises unnecessary new soil disturbance.
- A minimum distance or separation buffer of 100 meters to be maintained from any turbine and site P8. If the separation distance is not practical, then a sub-surface investigation should be undertaken for any turbine proposed within 100m of site P8.