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Appendix 15 - Air Quality Assessment

Bullawah Wind Farm Project

Air Quality Assessment

Project Number.: 0120

Date: 14 June 2024

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ABBREVIATIONS AND DEFINITIONS

Term / Acronym	Description
Approved Methods	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
Construction boundary	Where all construction activities would be undertaken, allowing space to construct the road formation, fencing, ancillary facilities and temporary and permanent sediment basins
IAQM	UK Institute of Air Quality Management
PM_{10}	Particulate matter with an equivalent aerodynamic diameter of 10 microns or less
$PM_{2.5}$	Particulate matter with an equivalent aerodynamic diameter of 2.5 microns or less
SEARs	Secretary Environmental Assessment Requirements
TSP	Total Suspended Particulate

EXECUTIVE SUMMARY

Zephyr has completed a risk assessment of the dust generating activities involved in the construction, operation and decommissioning of the Bullawah Wind Farm Project (SSD-50505215). The assessment involved the application of a risk-based approach following the guidance developed by the UK Institute of Air Quality Management and adapted by Zephyr Environmental to be more representative of local conditions in the vicinity of the Project.

The assessment indicated that the pre-mitigated risks to the host residences within the Project Area were high, but that these could be managed with best-practice mitigation measures. Suitable recommendations have been provided to reduce residual impacts to low.

Methodology

The construction assessment methodology involved the application of a semi-quantitative risk-based approach following the guidance developed by the UK Institute of Air Quality Management and adapted by Zephyr Environmental to be more representative of local conditions in the vicinity of the Project. The approach was also tailored according to the nature of the Project. The assessment involved the following main steps:

- The identification of the construction activities that would be likely to occur in relation to the Project.
- The division of activities according to their different potential to cause impacts: demolition, earthworks, construction and vehicle track-out. Risks were assessed in relation to the size of the Project, the volume of traffic on unsealed roads, and the locations of sensitive receptors.
- The identification of project-specific management/mitigation measures to minimise the risk of any potential impacts.

Assessment Overview

Risk of construction and decommissioning impacts on air quality were assessed using the IAQM method. Taking into account the level of dust generating activity, and the proximity and sensitivity of receptor areas; a corresponding level of risk of impact was determined and relevant mitigation measures provided. These results are summarised in the table below.

Summary of risk assessment for the four construction activities

Type of activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area			Step 2C: Risk of dust impacts		
		Dust soiling	Human health	Ecological	Dust soiling	Human health	Ecological
Demolition	Large	Medium	Low	Medium	Medium	Low	Medium
Earthworks	Large	Medium	Low	Medium	Medium	Low	Medium
Construction	Large	Medium	Low	Medium	Medium	Low	Medium
Track-out	Large	Medium	Low	Medium	Medium	Low	Medium

Recommendations

A Dust Management Plan (DMP) should be produced for the construction of the Project. This would contain details of the site-specific mitigation measures to be applied.

The main recommended mitigation measures are summarised in Section 6.

1 INTRODUCTION

Bullawah Wind Farm Pty Ltd (BWF) proposes to develop the Bullawah Wind Farm (the Project), located approximately 36 km south east of Hay, within the South West Renewable Energy Zone (REZ). The Project Area is located within the Hay Shire, Murrumbidgee and Edward River Local Government Areas (LGAs). The Project will include the installation, operation, maintenance and decommissioning of up to 143 wind turbine generators (WTGs), battery storage, ancillary infrastructure and temporary facilities associated with construction of the Project. The Project design incorporates up to 143 wind turbines, with a maximum blade-tip height of 300 m above ground level, and an installed capacity of up to 815.1 megawatts (MW).

Zephyr Environmental (Zephyr) has been engaged by Umwelt (Australia) Pty Ltd (Umwelt) to prepare this air quality assessment for inclusion within the Environmental Impact Statement (EIS) for the Project. This air quality assessment has considered construction, operational and decommissioning phases of the Project; however the focus of this assessment is the construction phase as impacts during operations are limited (if any at all) and impacts during decommissioning are broadly consistent with construction.

1.1 Project description

The key components of the Project include:

The key components of the Project include:

- up to 143 (three (3) blade) WTGs, with a maximum blade-tip height of 300 metres (m) above ground
- a 359 MW / 718 MWh battery energy storage facility
- permanent ancillary infrastructure including internal roads, hardstands, main and collector substations, switchyards, operations and maintenance facilities, underground and overhead electricity transmission lines and poles, telecommunications facilities and utility services, permanent meteorological masts and water storage tanks
- temporary facilities including temporary workforce accommodation (if required), site offices, amenities, construction compounds and laydown areas, on-site borrow pits, rock crushing facilities, concrete or asphalt batching plants, minor 'work front' construction access roads, environmental management and monitoring and signage
- off-site road works, involving upgrades to the proposed local transport route and establishment of site access points to facilitate delivery of wind turbine components to the Project Area as required.

Project construction and grid connection will occur in stages. The conceptual staging plan for the Project involves:

- Stage 1 (South), located mostly south of North Boundary Road, connecting to the existing 220 kV transmission line which runs through the Project Area
- Stage 2 (North) located north of North Boundary Road, connecting to the approved (but not yet constructed) 330 kV Eastern Section of Project Energy Connect, which will also run through the Project Area.

The proposed Project layout is presented in Figure 1-1.

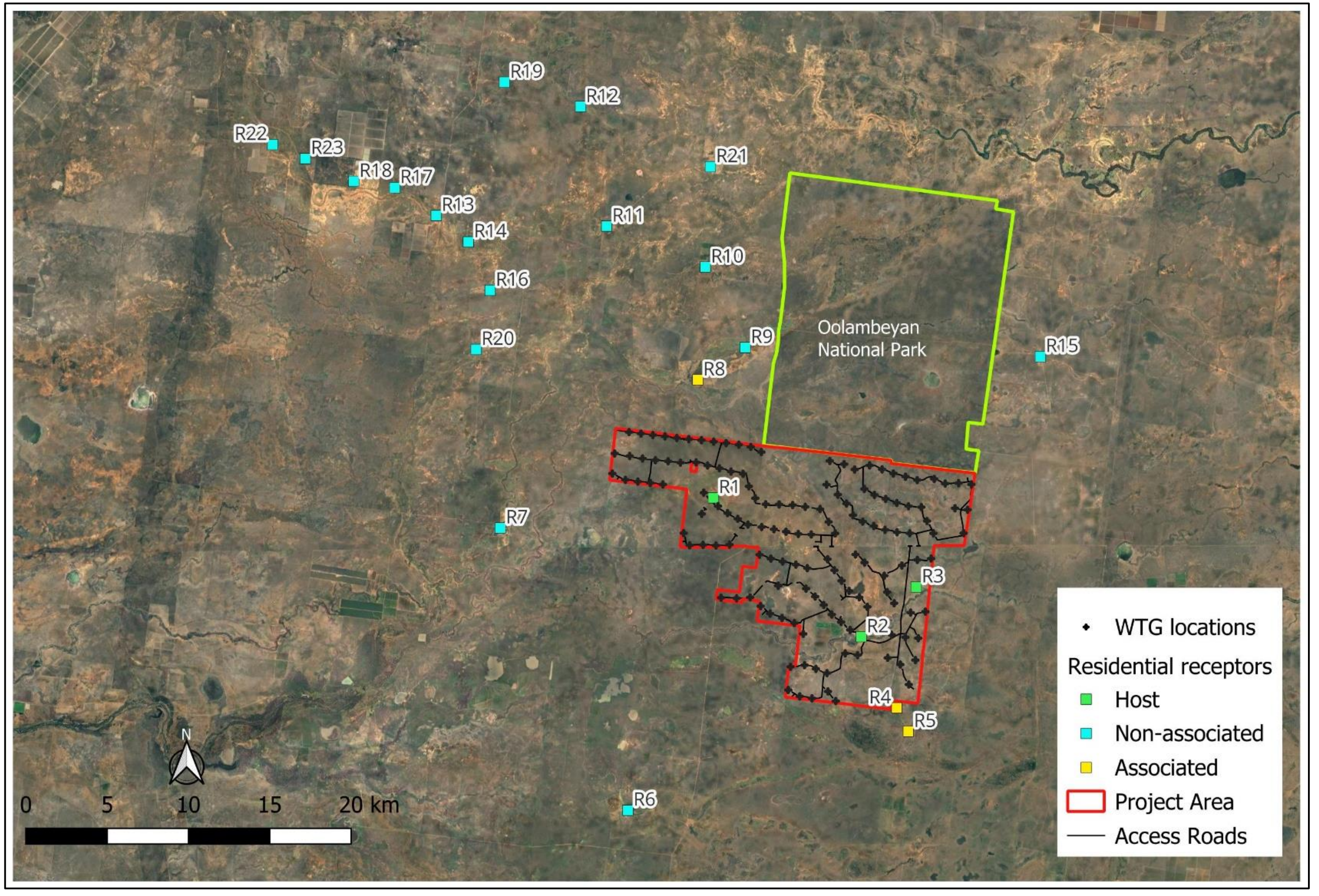


Figure 1-1: Project layout

2 LEGISLATION AND POLICY

2.1 Secretary's Environmental Assessment Requirements (SEARs)

The SEARs for the Project (SSD-50505215) were issued on 12 December 2022. This assessment has been completed in order to address the SEARs that relate to air quality impacts. This assessment will form part of the Environmental Impact Statement (EIS) for the Project.

The SEARs addressed in this assessment are provided in Table 2-1.

Table 2-1: SEARs requirements – air quality

Requirement	Report section
An assessment of risks of dust generation and propose mitigation measures designed in accordance with the Approved Methods and Guidelines for the Modelling and Assessment of Air Pollutants in New South Wales (DECC, 2005).	Section 5 assesses the risk of air quality impacts due to dust generation. Section 6 provides recommended mitigation and management measures.

2.2 Approved methods

The *"Approved Methods for the Modelling and Assessment of Air Pollutants in NSW"* (Approved Methods) (Environment Protection Authority (EPA), 2022) lists the methods for modelling and assessing air quality impacts in the state of NSW. The document was developed for stationary sources, but the general assessment principles outlined in the documentation can be applied to other types of emission sources and non-modelling scenarios.

The original version published in 2005 has been noted in the SEARs, however this has been updated twice since then. The most recent version, published in 2022 includes updated air quality assessment criteria for several pollutants including particulates. These are discussed further in Section 2.3 and referred to here for context when defining the receiving environment in the vicinity of the Project.

2.3 Air quality assessment criteria

The Approved Methods specifies air quality criteria relevant for assessing impacts from air pollution (EPA, 2022). These criteria are health-based and for PM_{10} and $PM_{2.5}$ are consistent with the revised National Environment Protection Measure for Ambient Air Quality (referred to as the Ambient Air-NEPM). Table 2-2 presents the air quality criteria for concentrations of particulate matter (PM) that that are relevant to this study.

Table 2-2: NSW EPA impact assessment criteria for PM_{10} and $PM_{2.5}$

Pollutant	Averaging period	Criterion
PM_{10}	Annual	25 µg/m^3
	24-hour	50 µg/m^3
$PM_{2.5}$	Annual	8 µg/m^3
	24-hour	25 µg/m^3

Airborne PM also has the potential to cause nuisance dust effects when it deposits on surfaces. Larger particles do not tend to remain suspended in the atmosphere for extended periods of time and will fall out relatively close to the source. Dust fallout can soil materials and generally degrade the aesthetic environment and is therefore assessed for nuisance or amenity impacts. Table 2-3 shows the maximum acceptable increase in deposited dust levels (due to the Project alone) and the maximum total deposited dust level (including both existing dust levels in combination with dust generated by the Project). These criteria for deposited dust levels are set to protect against nuisance and amenity impacts (EPA, 2022).

Table 2-3: NSW EPA impact assessment criteria for deposited dust

Pollutant	Averaging period	Maximum increase (due to the Project)	Maximum total level (cumulative)
Deposited dust (insoluble solids)	Annual	2 g/m^2/month	4 g/m^2/month

3 CONSTRUCTION ASSESSMENT METHODOLOGY

It is difficult to quantify dust emissions from construction activities (demolition, earthworks, construction and decommissioning, and track-out, refer Section 3.1 below) and dispersion modelling is therefore not always the best method for assessing potential impacts.

Dust emissions can vary substantially from day to day depending on the level of activity, the operations being undertaken, and the local weather conditions (which may result in dust generation even when there is no construction activity at a site). It is difficult to predict what the weather conditions would be when specific construction activities are undertaken, and it is therefore very difficult to accurately quantify dust emissions from construction using a model. Any effects of construction on PM concentrations would also tend to be temporary and relatively short-lived.

Additionally, due to the nature and types of infrastructure required for windfarm development, windfarms typically have a small disturbance footprint and inherently lower potential for dust emission relative to other large scale infrastructure projects.

The assessment and control of construction-related air quality therefore focused on identifying and managing risk.

The construction assessment methodology involved the application of a semi-quantitative risk-based approach following the guidance developed by the UK Institute of Air Quality Management (IAQM, 2024), and adapted by Zephyr Environmental to be more representative of local conditions in the vicinity of the Project. The approach was also tailored according to the nature of the Project. The assessment involved the following main steps:

- The identification of the construction activities that would be likely to occur in relation to the Project.
- The division of activities according to their different potential to cause impacts: demolition, earthworks, construction and vehicle track-out. Risks were assessed in relation to the size of the Project, the volume of traffic on unsealed roads, and the locations of sensitive receptors.
- The identification of project-specific management/mitigation measures to minimise the risk of any potential impacts.

The main air pollution and amenity issues at construction sites are:

- Annoyance impacts due to visible dust plumes and soiling of surfaces (including dust settling on cars, washing, swimming pools, roofs and rainwater tanks etc.).

- Elevated PM_{10} concentrations due to dust-generating activities.
- Exhaust emissions from diesel-powered construction equipment.

Exhaust emissions from on-site plant and site traffic are unlikely to have a significant impact on local air quality, and in the majority of cases they will not need to be quantitatively assessed, which is the circumstance for the Project. Other potential impacts need to be considered on a site-by-site basis (IAQM, 2024).

The IAQM methodology noted above and discussed in more detail in Section 3.1, is predominantly concerned with dust emissions during the construction phase of the Project and the potential impacts on both human and ecological receptors. In addition, this report also discusses the operational phase in Section 5.2, but in a more general context and not using this specific methodology. The decommissioning phase is also noted in Section 5.3, with potential impacts identified and mitigation provided that is comparable to that discussed for construction, due to the similar nature of activities.

Dust emissions can occur during the preparation of the land (e.g. earth moving) and during construction itself and can vary substantially from day to day depending on the level of activity, the specific operations being undertaken, and the weather conditions. A significant portion of the emissions result from site plant and road vehicles moving over temporary unsealed roads and open ground or disturbed areas. If dirt or mud is tracked onto public roads, dust emissions can occur at some distance from the construction site (IAQM, 2024). Other sources will include land clearing, crushing and screening rock, wind erosion, crushing and screening as well as excavating and loading spoil material.

The risk of dust impacts from construction causing loss of amenity and / or health or ecological impacts is related to the following:

- the nature of the activities being undertaken
- the duration of the activities
- the size of the site and area disturbed
- the meteorological conditions (wind speed, wind direction and rainfall). Adverse impacts are more likely to occur downwind of the site and during drier periods.
- the proximity of receptors to the activities
- the sensitivity of the receptors to dust
- the adequacy of the mitigation measures applied to reduce or eliminate dust.

Figure 3-1 shows the layout of the Project Area in relation to the nearest residences. There are three (3) properties within the Project boundary and BWF has agreements in place with each of these landholders to host Project infrastructure. It is anticipated that these will remain as residences for the duration of the construction and operation of the Project. In addition to the Oolambeyan National Park immediately adjacent to the north boundary, there are also ecological receptors within the Site Boundary, as discussed below.

The 250 m buffer around the Project Boundary is shown to indicate there are no other residential receptors within this distance for the purposes of the construction assessment. Outside the Project Boundary, the closest residence is R4, an associated residence situated approximately 300 m from the Project Boundary, and beyond the above-mentioned 250 m buffer. The 250 m buffer distance is defined in Step 1 of the IAQM methodology as the distance within which a detailed assessment should be undertaken for residential receptors.

The buffer distance for the screening assessment for ecologically sensitive receptors is 50 m. The boundary of the Oolambeyan National Park is within this buffer and has therefore been considered.

There are also sensitive areas to be considered within the Project Boundary.

Of the 642 ha that will be disturbed, approximately 638 ha consists of native vegetation. An assessment of potential impacts to flora (and fauna) has been undertaken in the form of a 'Biodiversity Development Assessment Report' (BDAR). The BDAR provides an assessment of the biodiversity within the Project Area, documents the application of an avoid, minimise and offset framework and assesses the likely biodiversity impacts of the Project. This BDAR has been prepared as part of the EIS documentation and in accordance with the BC Act and Biodiversity Assessment Method (BAM) (NSW DPIE 2020a) under the NSW Biodiversity Offset Scheme (BOS).

Regardless, and to provide a precautionary assessment of potentially sensitive ecological receptors, these onsite receptors have been considered in this assessment.

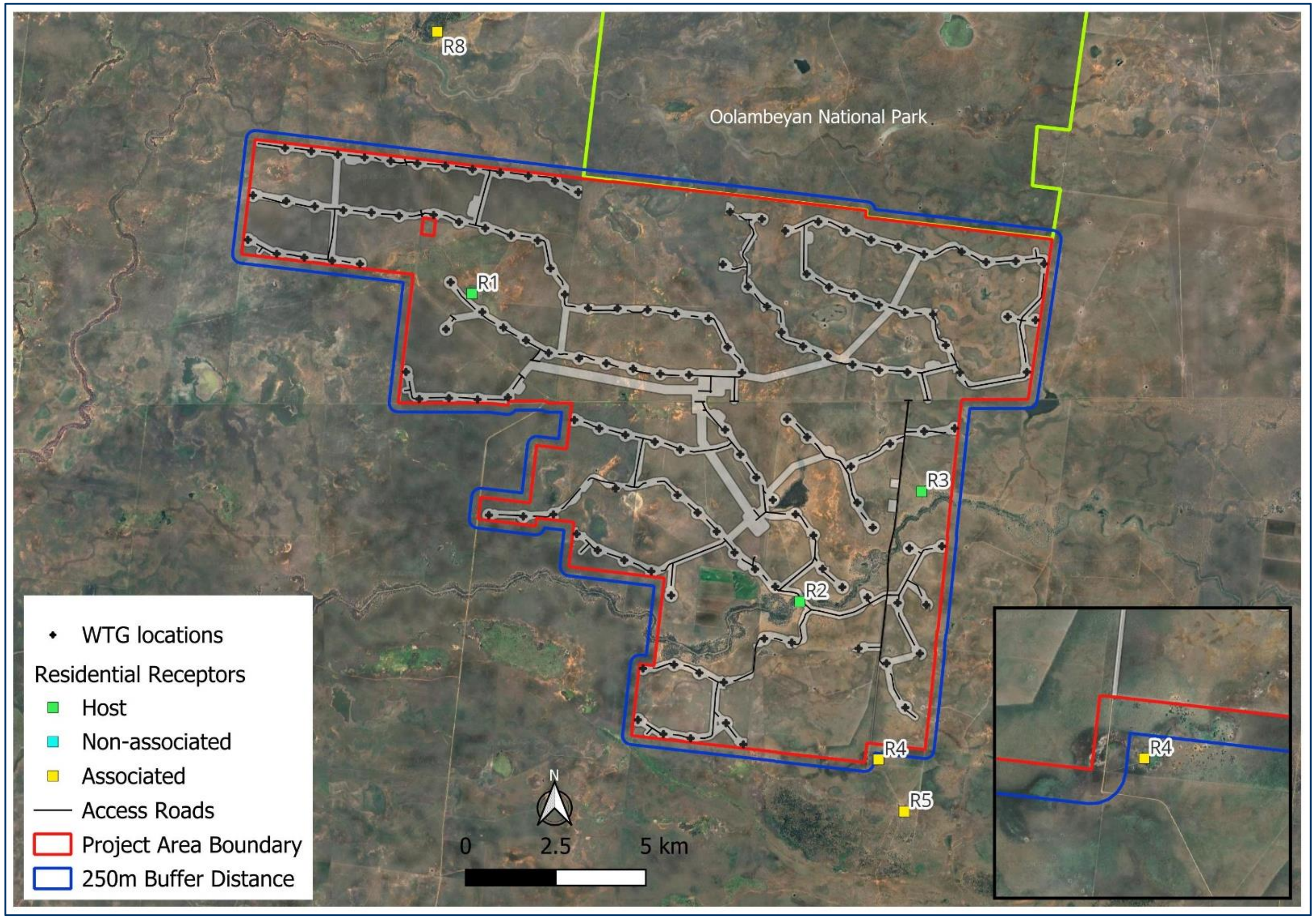


Figure 3-1: Buffer distance and residences

3.1 Overview of the method

The IAQM assessment procedure for assessing risk is shown in Figure 3-2. Professional judgement is required in some steps, and where justification cannot be given a precautionary approach is adopted. Given that there are three (3) Host receptors and ecological receptors within the Project Boundary and adjacent ecological receptors, the screening assessment (Step 1) notes the need for a detailed assessment for the construction phase.

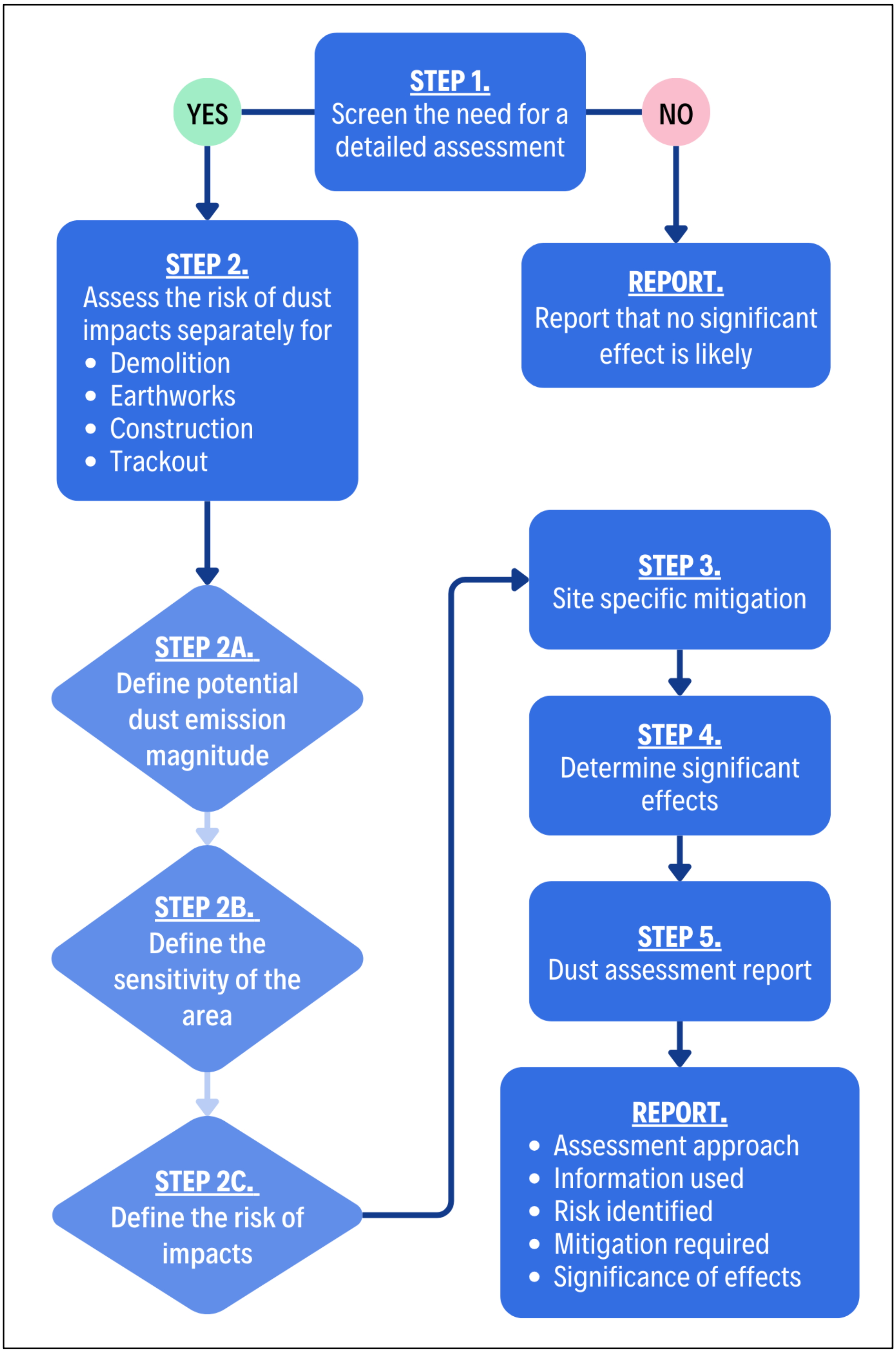
Activities on construction sites can be divided into four (4) types to reflect their different potential impacts, and the potential for dust emissions is assessed for each activity that is likely to take place. These activities are:

- **Demolition** – this refers to any activity that involves the removal of existing structures. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time. In the context of a windfarm development, this assessment has considered potential demolition activities for the decommissioning phase.
- **Earthworks** - this covers the processes of crushing and screening, clearing, soil stripping, ground levelling, excavation and landscaping. Earthworks will primarily involve excavating material, haulage, tipping and stockpiling.
- **Construction** - this is any activity that involves the provision of new structures (including roads), modification or refurbishment.
- **Track-out** - this involves the transport of dust and dirt by Heavy Duty Vehicles (HDVs) from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

The assessment methodology considers three (3) separate dust impacts:

- Annoyance impacts due to dust deposition.
- The risk of health effects due to an increase in exposure to PM_{10}.
- Harm to ecological receptors.

The assessment is used to define appropriate mitigation measures to minimise the risk of any potential impacts. The assessment steps, as they have been applied to the Project, are described in Appendix A.



Source: adapted from IAQM (2024)

Figure 3-2: Steps in the assessment of construction dust

4 EXISTING ENVIRONMENT

4.1 Meteorology

The closest meteorological station to the Project is the Bureau of Meteorology (BoM) Automatic Weather Station (AWS) located in Hay, approximately 60 km north west of the Project. The Deniliquin AWS is located approximately 75 km to the south of the Project and provides additional information on the meteorological conditions of the broader region.

An annual wind rose for the six years from 2018 – 2023, for each meteorological station, is presented in Figure 4-1 and Figure 4-2. Conditions between the two (2) locations are reasonably similar, with the most notable difference being a higher prevalence of northerlies at Hay.

As Hay is in closer proximity to the Project Area, these data were analysed in further detail. Given the relatively flat terrain in the area these conditions are likely to be broadly representative of the Project Area and its surrounds. Annual wind roses for each year from 2018 – 2023 are presented in Figure 4-3 and seasonal and monthly variations in Figure 4-4.

Wind speed and direction do not vary substantially from year to year, except for 2022 which was a strong la Niña year with atypical meteorological conditions. On an annual basis for the other years, winds are predominantly from the southwest quadrant, with northerlies also prominent. Winds in autumn and spring follow this annual trend, while summer has a greater prevalence of southerly winds than other seasons, and winter has a greater prevalence of northerly winds.

Stronger winds are predominantly from the south west through to the north, with maximum hourly average speeds reaching 16.5 metres per second (m/s). The seasonal windroses show that these stronger winds occur more frequently in spring and summer. There is generally a low frequency of calm conditions, where wind speeds are less than 0.5 m/s.

Most of the closest residences are to the north west of the Project, and as such, are not in the direction of the dominant winds. They are also situated at a substantial distance from the Project Area (see Figure 1-1). There are three (3) host residences within the Project Area and so these may be impacted by any wind direction. The National Park is directly north of the Project Boundary and so winds from the southwest would blow particulates towards this receptor.

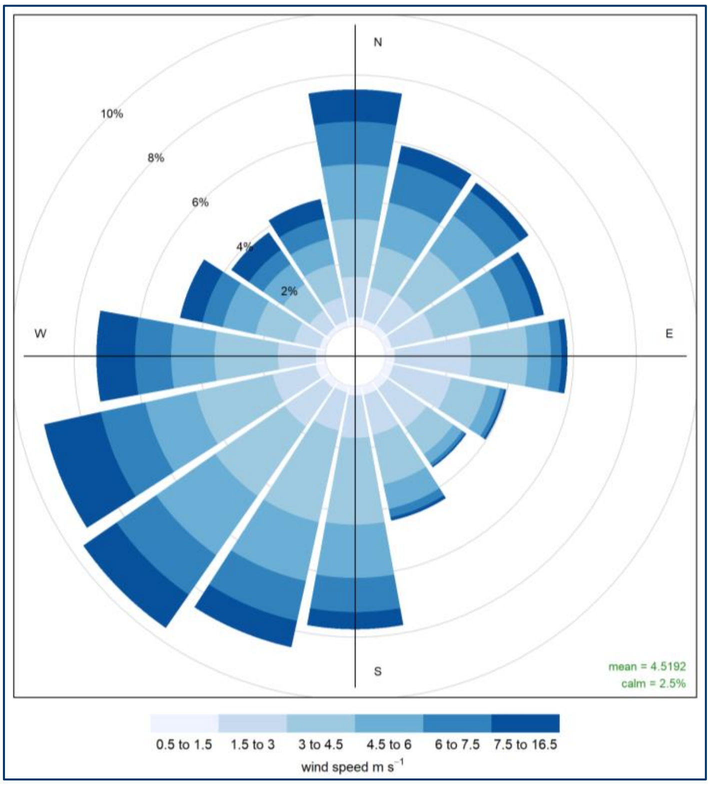


Figure 4-1: Wind rose for all data from 2018 – 2023 at Hay AWS

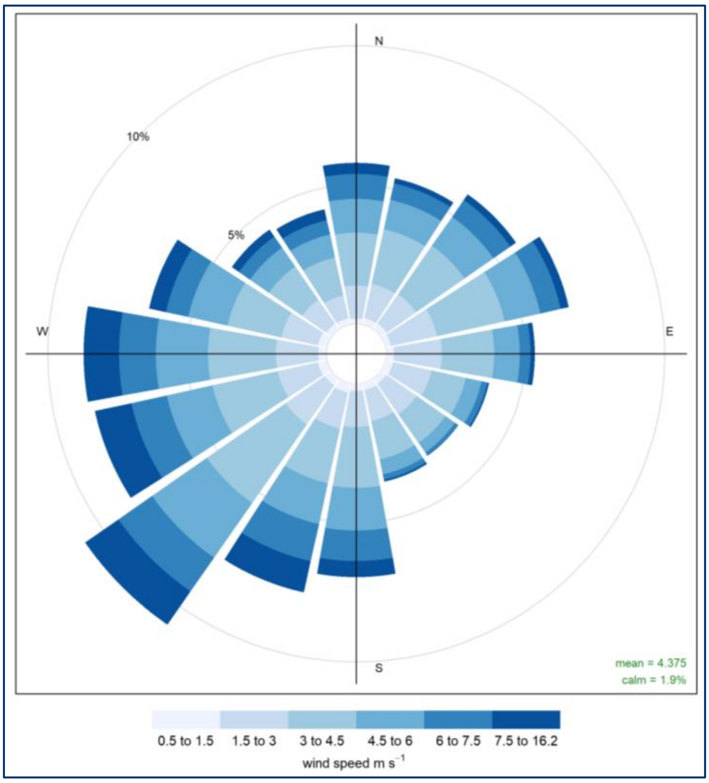


Figure 4-2: Wind rose for all data from 2018 – 2023 at Deniliquin AWS

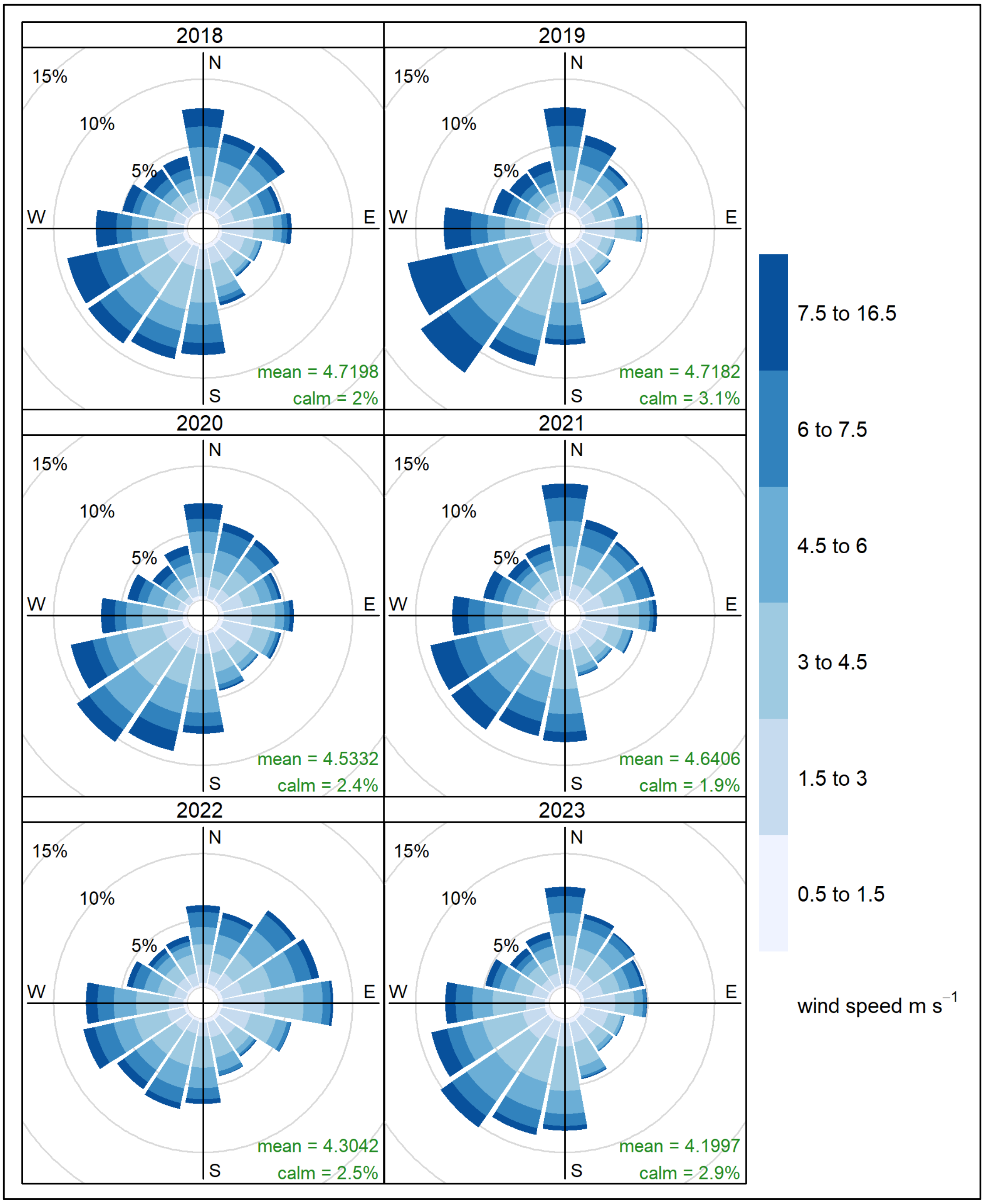


Figure 4-3: Annual windroses for 2018-2023 at Hay AWS

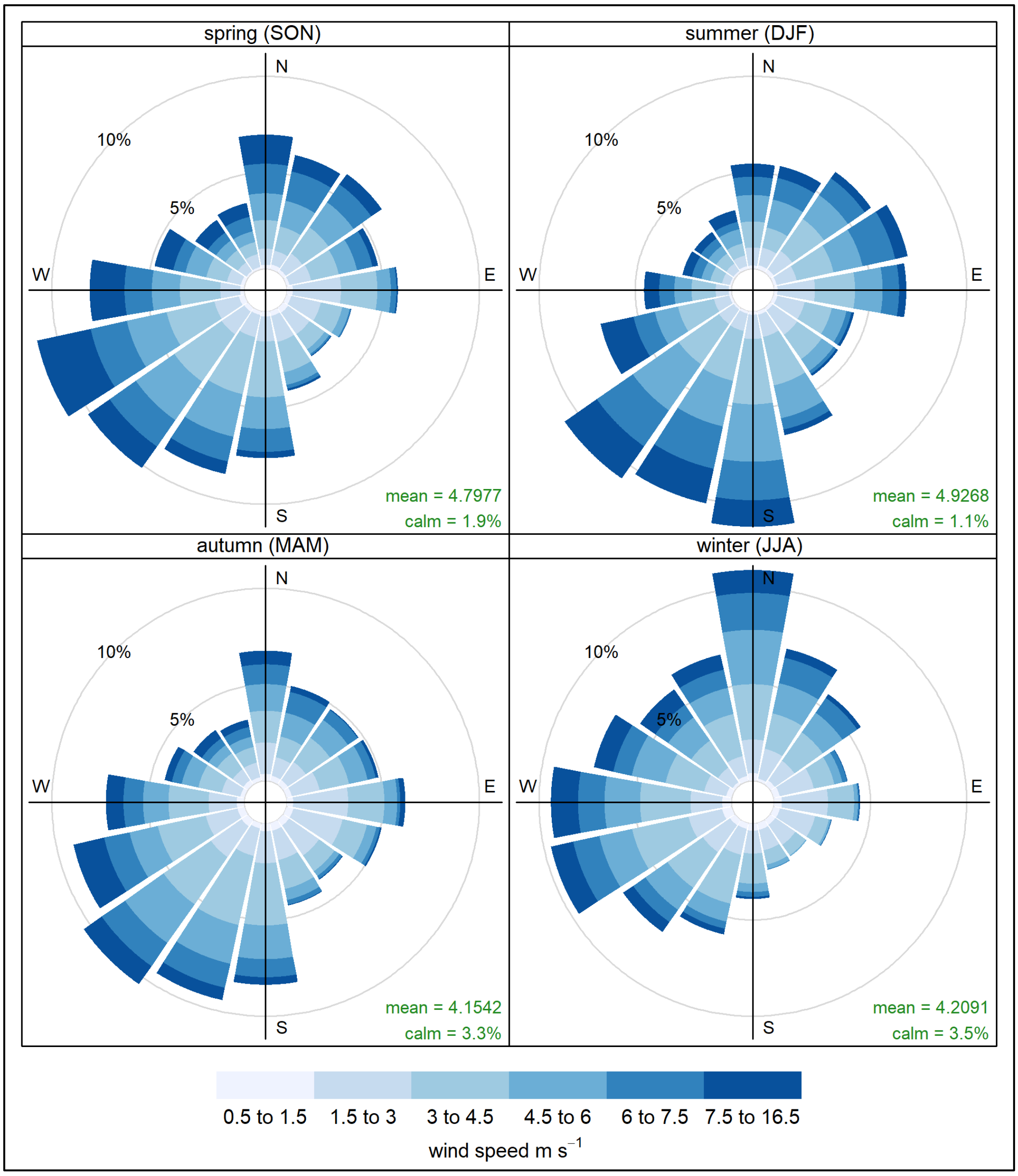


Figure 4-4: Seasonal windroses from data collected 2018 – 2023 at Hay AWS

4.2 Existing air quality

The NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) (formerly the Department of Environment and Planning, DPE) operates several air quality monitoring sites across NSW. The closest air quality monitoring station to the Project Area is a station in Hay, approximately 35 km to the north west. Other nearby stations which provide information regarding the wider NSW regional area, are located in Deniliquin (75 km to the southwest), Griffith (90 km to the northeast), and Narrandra (120 km to the east).

Total Suspended Particulates (TSP) is measured at each of these four (4) rural monitoring stations. Table 4-1 presents an annual average of these TSP concentrations for each station, from 2018 to 2023. Concentrations fluctuate year to year, tending to be higher in drier years when drought conditions prevail, such as in 2019 – 2020. Conditions were much wetter in 2021 – 2023 and all stations recorded concentrations substantially lower.

Table 4-1: Annual average TSP concentration at rural DCCEEW monitoring stations 2018-2023

Year	Hay (µg/m^3)	Deniliquin (µg/m^3)	Griffith (µg/m^3)	Narrandera (µg/m^3)	EPA Assessment criterion (µg/m^3)
2018	7.4	7.9	9.3	7.7	90 (TSP) 25 (PM_{10})
2019	13.2	8.6	15.1	16.9	
2020	12.4	12.5	16.4	16.1	
2021	5.0	10.7	16.6	13.7	
2022	5.1	10.3	9.0	9.6	
2023	5.5	9.3	7.5	10.4	

No monitoring data for PM_{10} are available near the Project Area. However, historically for sites in rural NSW, PM_{10} concentrations have generally been found to be approximately 40% of TSP concentrations (NSW Mineral Council, 2000). Under this assumption, existing PM_{10} concentrations in the region would be relatively low, ranging from 2 – 6.8 µg/m^3 based on the TSP concentrations in Table 4-1. These are well below the annual average EPA assessment criterion of 25 µg/m^3. Furthermore, if it is conservatively assumed that 100% of TSP constituted PM_{10}, these concentrations would also not exceed the 25 µg/m^3 annual criterion.

For the purposes of this assessment, it is assumed that TSP is all PM_{10}, and therefore the annual average PM_{10} concentration used is 13.2 µg/m^3 (maximum value for Hay). These are highly conservative assumptions, both in using the maximum value over the six (6) years and also that all TSP is PM_{10}.

5 POTENTIAL AIR QUALITY IMPACTS

5.1 Construction impacts

The Project Boundary covers an area of approximately 20,600 hectares. Project construction and grid connection will occur in stages over a period of approximately 3.5 years.

The conceptual staging plan for the Project involves:

- Construction of Stage 1 (South) commencing in late 2025 and concluding in late 2027 (indicative).
- Construction of Stage 2 (North) commencing in early 2027 and concluding in mid-2029 (indicative).

Temporary construction facilities will include temporary workers accommodation (if required), site offices, amenities, construction compounds and laydown areas, on-site borrow pits, rock crushing facilities, concrete or asphalt batching plants, minor 'work front' construction access roads and temporary meteorological masts.

Risk of construction impacts on air quality were assessed using the method described in Section 3.1. Taking into account the level of dust generating activity, and the proximity and sensitivity of receptors; a corresponding level of risk of impact was determined and relevant mitigation measures provided. These results are summarised in Table 5-1. It is noted that there is no demolition as part of the construction phase of this Project but this activity could be required during decommissioning, and hence has been considered in the risk assessment. Note also that the ecological receptors have been divided into two categories, those outside the Project Boundary and those inside. The full process is detailed in Appendix A.

Table 5-1: Summary of risk assessment for each activity

Type of activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area				Step 2C: Risk of dust impacts			
		Dust soiling	Human health	Ecological		Dust soiling	Human health	Ecological	
				Outside	Inside			Outside	Inside
Demolition	Large	Medium	Low	High	High	Medium	Low	Medium	High
Earthworks	Large	Medium	Low	High	High	Medium	Low	Medium	High
Construction	Large	Medium	Low	High	High	Medium	Low	Medium	High
Track-out	Large	Medium	Low	High	High	Medium	Low	Medium	High

5.1.1 Significance of risks from onsite disturbance

Based on the large amount of bulk earthworks and associated activity, the potential for particulate emissions during the construction phase of the Project is large. Given the sensitivity of the receptors and their distances from the Project Boundary, there is a risk of dust impacts including dust soiling of property and sensitive ecological areas. These risk profiles have been determined in the absence of dust mitigation measures.

These risks can be managed through the implementation of mitigation measures at the point of emission. Due to inherent difficulties in managing controlled surfaces, there is potential for dust impacts to persist, however, as evidenced by other large infrastructure projects, these are likely to be temporary and unlikely to result in a greater risk of adverse impact.

Any mobile concrete or asphalt batching plants that may be required will also need to be managed to ensure the delivery of raw materials and product is done in a way that contains any dust emissions. These operations do not generally represent significant sources of dust.

Based on the above, recommendations for suitable environmental management measures are provided within Section 6 of this report.

5.1.2 Impacts due to offsite disturbance

Potential impacts associated the proposed upgrades to the local area road network were also considered as part of this assessment specifically, the widening of North Boundary Road and the intersection upgrade at the corner of Cobb Highway and Jerilderie Road.

Given the type of infrastructure proposed to be installed, the construction activities associated with minor works and the substantial distance offset to nearby receptors, there is limited or no potential for dust annoyance of amenity impacts to occur with normal mitigation measures being implemented.

Based on the above, the same recommendations for environmental management measures (provided within Section 6 of this report) should be implemented for the offsite disturbance areas.

5.2 Operational impacts

Potential air quality impacts during the operational phase of the Project would be limited to:

- operational vehicle movements
- maintenance works on Project infrastructure including access tracks, hardstands and laydown areas.

During operations, the lowermost blade tip for the WTGs will be approximately 100 m above the ground. While turbine rotation does cause some downstream wake effects (a type of turbulence) for a distance beyond the WTG, the effect is very high above ground, such that it is not likely to be noticeable at ground level.

The primary source of dust emissions during operations will be emissions from vehicle movements along access roads. However, the risk will be much lower than for construction given the much lower intensity of vehicle movements and can be mitigated via effective road maintenance and vehicle speed management.

Based on the above, there are no recommendations for environmental management measures that apply to the operational phase of the Project.

5.3 Decommissioning impacts

Equipment and activities during decommissioning are expected to be similar to those required during the construction stage, however, decommissioning would occur over a shorter duration of time and not require the clearing of vegetation for site preparation. There is the potential for demolition to be required, which has been considered in this assessment.

Based on the above, the same recommendations for environmental management measures (provided within Section 6 of this report) should be implemented for decommissioning.

5.4 Cumulative impacts

NSW Government – EnergyCo seeks to maximise opportunities created by the transformation of the NSW electricity system by coordinating investment in Renewable Energy Zones (REZs) across NSW. A REZ is the equivalent of modern-day power stations, combing new renewable energy infrastructure, including generators (such as solar and wind farms), storage (such as batteries and pumped hydro) and then high-voltage transmission infrastructure. Five (5) dedicated REZs have already been identified in NSW.

The Project is located wholly within the South West REZ. Because of this, and the REZ benefits anticipated by NSW Government – EnergyCo, the South West REZ has the potential to see strong interest for renewable energy development.

Based on information available within the public domain, the following developments are identified in the vicinity of the Bullawah Project:

- Pottinger Solar Farm (SSD-59254709) – adjoining, the boundaries touch.
- Pottinger Wind Farm (SSD-59235464) – adjoining, the boundaries touch.
- Dinawan Wind Farm (SSD-50725708) – 16 km from the centre of Bullawah to the closest edge of boundary.
- Dinawan Solar Farm (SSD-50725959) – 47.65 km from the centre of Bullawah to the closest edge of boundary.
- Argoon Wind Farm (SSD-64935522) – 41.15 km from the centre of Bullawah to the closest edge of boundary
- Yanco Delta Wind Farm (SSD-41743746) – 26.25 km from the centre of Bullawah to the closest edge of boundary
- The Plains Solar Farm BESS (SSD-51219280) – 39.68 km from the centre of Bullawah to the closest edge of boundary
- The Plains Wind Farm (SSD-50629707) – 20 km from the centre of Bullawah to the closest edge of boundary
- Romani Solar Farm (SSD-67105475). – 57 km from the centre of Bullawah to the closest edge of boundary
- Tchelery Wind Farm – 78.27 km from the centre of Bullawah to the closest edge of boundary
- Hay Sun Farm – 49.63 km from the centre of Bullawah to the closest edge of boundary
- Hay Solar Farm – 50 km from the centre of Bullawah to the closest edge of boundary
- Hay 1A and 2A solar farm – 52.23 km from the centre of Bullawah to the closest edge of boundary.

Based on the proximity of the above-mentioned developments to the Project, the limited potential for dust impacts to occur outside the Project Area, cumulative impacts are considered highly unlikely to occur.

No further recommendations for environmental management measures are provided as a result of potential cumulative impacts to those already documented within Section 6 of this report.

It is noted that because of the development activity in the South West REZ the above list may not address all potential sites being privately developed and not yet in the public domain and so any of these are excluded for this study.

6 MITIGATION MEASURES

A Dust Management Plan (DMP) should be produced for the construction of the Project. This would contain details of the site-specific mitigation measures to be applied.

The main recommended mitigation measures are summarised in Table 5-1. Additional guidance on the control of dust at construction sites in NSW is provided as part of the NSW EPA Local Government Air Quality Toolkit.

Table 5-1: Summary of mitigation measures

Aspect	Mitigation reference	Description
General air quality impacts	AQM01	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
	AQM02	Display the name and contact details of person(s) accountable for air quality and dust issues on the Project Boundary.
	AQM03	Develop and implement a Dust Management Plan (DMP) which details the air quality control measures and procedures to be undertaken during construction, including: ▪ air quality and dust management objectives that are consistent with relevant regulatory authority guidelines ▪ identification of potential sources of dust ▪ mitigation measures to minimise dust impacts on sensitive receptors and the environment (including but not necessarily limited to AQM04 to AQM11 below) ▪ a dust monitoring program to assess compliance with the identified objectives ▪ contingency plans to be implemented in the event of non-compliances and/or complaints about dust.
Impacts on local air quality during construction	AQM04	Areas of exposed surface are to be minimised throughout the construction site planning and programming, to reduce the area of potential construction dust emission sources.
	AQM05	Control measures, such as compaction stabilisation or covering will be implemented in order to minimise dust from stockpile sites.
	AQM06	Dust suppression measures, such as the use of water carts or soil binders, will be used in any unsealed surfaces and other exposed areas as required.
	AQM07	Further stabilisation should be considered for high-use access tracks, particularly those in closer proximity to sensitive receptors such as residential premises. Stabilisation may include sealing or the use of lower silt content material such as gravel.
	AQM08	All trucks must cover their loads when transporting materials that are potential sources of wind blown dust, to and from the Project.
	AQM09	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
	AQM10	Activities that generate dust will be avoided or modified during high wind periods.
	AQM11	Work activities will be reviewed if the dust suppression measures are not adequately restricting dust generation.
	AQM12	Ensure rumble grids and wheel washes are placed at all site exit points and that gravel or sealed surfaces are maintained between the wheel wash and the exit to avoid recontamination of tyres.
Exhaust emissions	AQM13	Impose and signpost a maximum-speed-limit of 15 km/h on unsealed haul / access roads and work areas
	AQM14	Construction plant and equipment will be maintained in good working condition to limit impacts on air quality.
	AQM14	Where practicable, vehicles will be fitted with pollution reduction devices and switched off when not in use.

7 CONCLUSIONS

Zephyr has completed a risk assessment of the dust generating activities involved in the construction, operation and decommissioning of the Project. The assessment involved the application of a risk-based approach following the guidance developed by the UK Institute of Air Quality Management and adapted by Zephyr Environmental to be more representative of local conditions in the vicinity of the Project.

The assessment indicated that the pre-mitigated risks to the host residences within the Project Area were high, but that these could be managed with best-practice mitigation measures. Suitable recommendations have been provided to reduce residual impacts to low.

Construction dust is unlikely to represent a serious ongoing problem. Any effects would be temporary and relatively short-lived and would likely arise during dry weather with the wind blowing towards a receptor, at a time when dust is being generated and dust suppression measures are not being fully effective. In these circumstances, it is recommended that dust generating activities be reviewed and avoided or modified where necessary.

It is recommended that a Dust Management Plan (DMP) be produced to cover the construction of the Project, and recommendations for elements of this plan have been provided. Because decommissioning activities are anticipated to be similar the DMP would also need to apply during that later phase of the Project.

The risk of operational impacts is very low. The main source would be vehicle movements along internal access roads which can be effectively managed through good road maintenance.

There is limited potential for interactions with other projects to occur with respect to dust nuisance and amenity, and so the risk of cumulative impacts occurring is also considered very low. No additional mitigation and management measures are recommended for cumulative impacts.

8 REFERENCES

EPA (2022) Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. NSW Environment Protection Authority – August 2005, minor revisions November 2016, minor revisions August 2022

IAQM (2024) Guidance on the assessment of dust from demolition and construction, January 2024 (Version 2.2), Institute of Air Quality Management https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf

NSW Mineral Council (2000) Particulate Matter and Mining Interim Report. Technical Paper. Sydney, NSW

Appendix A

Steps involved in the assessment of construction dust

Step 1: Screening

A construction dust assessment will normally be required, where:

- There are human receptors within 250 m of the boundary of the Project Boundary and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s).
- There are ecological receptors within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s).

In this screening stage the assessment area was assumed to be limited to the Project Area. It can be seen from Figure 3-1 that of the sensitive residential receptors outside the Project Boundary, none are within 250 m of the boundary. However, there are three (3) residential properties within the Project Boundary and these will be exposed to the construction activities for the duration of the Project. This is a conservative assumption as there are unlikely to be multiple work fronts open at any given time to permanently generating dust within 250 m of a residential property.

Regarding sensitive ecological receptors, the Oolambeyan National Park (or simply, 'the Park') is adjacent to the northern boundary of the Project. For the purposes of this assessment, it has been conservatively assumed that there are ecologically sensitive receptors within the Park within 50 m of the Project Boundary. There are some ecologically sensitive areas within the Project Boundary which are also considered.

Step 2: Risk Assessment

In Step 2 the risk of dust arising in sufficient quantities to cause annoyance and/or health effects was determined for each of the four activities (demolition, earthworks, construction, and track-out). Risk categories were assigned to the site based on two factors:

- The scale and nature of the works, which determines the magnitude of potential dust emissions. This is assessed in Step 2A.
- The sensitivity of the area. The proximity of sensitive receptors (i.e. the potential for effects). This is assessed in Step 2B.

These factors are combined in Step 2C to give the risk of dust impacts. Risks are described in terms of there being a low, medium or high risk of dust impacts for each of the four separate potential activities. Where there is risk of an impact, then site-specific mitigation will be required in proportion to the level of risk.

Step 2A: Potential for dust emissions

The criteria for assessing the potential scale of emissions based on the scale and nature of the works are shown in Table A-1.

Table A-1: Site categories criteria (scale of works)

Type of activity	Site category		
	Large	Medium	Small
Demolition	Building volume >75,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >12 m above ground level.	Building volume 12,000–75,000 m^3, potentially dusty construction material, demolition activities 6-12 m above ground level.	Building volume <12,000 m^3, construction material with low potential for dust release (e.g. metal cladding, timber), demolition activities <6 m above ground and during wetter months.
Earthworks	Site area >110,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth-moving vehicles active at any one time, formation of bunds >6 m in height.	Site area 18,000-110,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 3-6 m in height.	Site area <18,000 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <3 m in height.
Construction	Total building volume >75,000 m^3, piling, on site concrete batching; sandblasting.	Building volume 12,000-75,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching.	Total building volume <12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
Track-out	>50 HDV (>3.5t) OUTWARD movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m.	20-50 HDV (>3.5t) OUTWARD movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50–100 m.	<20 HDV (>3.5t) OUTWARD movements in any one day, surface material with low potential for dust release, unpaved road length <50 m.

Source: IAQM, 2024

Based on the criteria outlined in Table A-1, the classifications that have been applied for the Project in this assessment are listed in Table A-2.

As demolition activities are limited to the decommissioning phase of the Project, and specific details regarding actual on site building (and any demolition methods) are unknown, a precautionary approach has been taken adopting a ‘large’ site category.

Table A-2: Site categories (scale of works)

Activity	Site category
Demolition	Large
Earthworks	Large
Construction	Large
Track-out	Large

Step 2B: Sensitivity of Area

The sensitivity of the area takes account of the specific sensitivities of local receptors, the proximity and number of the receptors, and the local background PM_{10} concentration. Dust soiling, health impacts and ecological impacts are each treated separately.

The sensitivity of the area takes account of a number of factors, including the specific sensitivities of receptors in the area; the proximity and number of those receptors; in the case of PM_{10}, the local background concentration; and site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust. For the sensitivity of people and their property to soiling, the IAQM recommends that professional judgement is used to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account general principles.

A high sensitivity receptor is defined by surrounding land where: users can reasonably expect enjoyment of a high level of amenity; or the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, schools, museums and other culturally important collections, medium and long term car parks and car showrooms.

Sensitivity of area to dust soiling effects on people and property

The criteria for determining the sensitivity of an area to dust soiling effects are shown in Table A-3. Based on the IAQM guidance[1] the receptor sensitivity was classified as 'high'.

The number of receptors and their distance from the Project Area is based on data supplied by Umwelt. The exact counting of the number of 'human receptors' is not required by the IAQM guidance.

The numbers of receptors and the resulting outcomes are shown in Table A-4. These receptors are all residential. Based on high receptor sensitivity and < 20 m distance from the Project site, sensitivity to dust soiling effects is categorised as 'medium'.

Table A-3: Criteria for sensitivity of area to dust soiling effects

Receptor sensitivity	Number of receptors	Distance from source (m)			
		< 20	< 50	< 100	< 250
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Source: IAQM, 2024

Table A-4: Results – sensitivity to dust soiling effects

Activity	Receptor sensitivity	Distance from source (m)				Sensitivity of Area
		< 20	20 – 50	50 – 100	100 – 250	
Demolition	High	3	0	0	0	Medium
Earthworks	High	3	0	0	0	Medium
Construction	High	3	0	0	0	Medium
Track-out	High	3	0	0	0	Medium

[1] Professional judgement is used to identify where on the spectrum between high and low sensitivity a receptor lies. High sensitivity receptors can reasonably expect enjoyment of a high level of amenity. The appearance, aesthetics or value of their properties would be diminished by soiling, and the people or properties would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.

Sensitivity of area to human health impacts

The criteria for determining the sensitivity of an area to human health impacts caused by construction dust are shown in Table A-5. Based on the IAQM guidance[2] the receptor sensitivity was assumed to be 'high'.

The numbers of receptors for each activity, and the risk outcomes are shown in Table A-6. Based on high receptor sensitivity and annual PM_{10} concentration of 13.2 µg/m³ (Section 4.2), sensitivity to health impacts is categorised as 'low'.

Table A-5: Criteria for sensitivity of area to health impacts

Receptor sensitivity	Annual mean PM_{10} conc. (µg/m3)	Number of receptors	Distance from source (m)			
			< 20	20 – 50	50 – 100	100 – 250
High	> 20	>100	High	High	High	Medium
		10-100	High	High	Medium	Low
		1-10	High	Medium	Low	Low
	17.5 – 20	>100	High	High	Medium	Low
		10-100	High	Medium	Low	Low
		1-10	High	Medium	Low	Low
	15 – 17.5	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	< 15	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
Low	-	>1	Low	Low	Low	Low

Source: IAQM, 2024

Table A-6: Results – sensitivity to health impacts

Activity	Receptor sensitivity	Annual mean PM_{10} conc. (µg/m³)	Distance from source (m)				Sensitivity of area
			< 20	20 – 50	50 – 100	100 – 250	
Demolition	High	< 15	3	0	0	0	Medium
Earthworks	High	< 15	3	0	0	0	Medium
Construction	High	< 15	3	0	0	0	Medium
Track-out	High	< 15	3	0	0	0	Medium

[2] The sensitivity of people to the health effects of PM_{10} is based on exposure to elevated concentrations over a 24-hour period. High sensitivity receptors relate to locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.

Sensitivity of ecological impacts – Oolambeyan National Park

The criteria for determining the sensitivity of an area to ecological impacts caused by construction dust are shown in Table A-7. Based on the IAQM guidance, ecological receptors within the Park are determined to be of high sensitivity, as it is an important habitat for threatened species.

The results for sensitivity of ecological impacts are shown in Table A-8. Due to high receptor sensitivity and 20-50 m distance from the Project site, sensitivity was categorised as 'medium".

Table A-7: Criteria for sensitivity of ecological impacts at the Park

Receptor Sensitivity	Distance from source (m)	
	< 20	20 – 50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Source: IAQM, 2024

Table A-8: Results – sensitivity of ecological impacts at the Park

Activity	Receptor sensitivity	Distance from source (m)	Sensitivity of area
Demolition	High	20-50	Medium
Earthworks	High	20-50	Medium
Construction	High	20-50	Medium
Track-out	High	20-50	Medium

Sensitivity of ecological impacts – within the Project Boundary

The criteria for determining the sensitivity of an area to ecological impacts caused by construction dust are shown in Table A-9. To provide a precautionary assessment of the potentially sensitive ecological receptors within the Project Boundary, their sensitivity is determined to be high.

The results for sensitivity of ecological impacts are shown in Table A-10. Due to high receptor sensitivity and <20 m distance from the Project site (inside the Project Boundary), sensitivity was categorised as 'high'.

Table A-9: Criteria for sensitivity of ecological impacts within the Project Boundary

Receptor Sensitivity	Distance from source (m)	
	< 20	20 – 50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Source: IAQM, 2024

Table A-10: Results – sensitivity of ecological impacts within the Project Boundary

Activity	Receptor sensitivity	Distance from source (m)	Sensitivity of area
Demolition	High	< 20	High
Earthworks	High	< 20	High
Construction	High	< 20	High
Track-out	High	< 20	High

Step 2C: Risk of dust impacts

The dust emission potential determined in Step 2A is combined with the sensitivity of the area determined in Step 2B to give the risk of impacts with no mitigation applied. The criteria are shown in Table A-11.

The final results for the Step 2 risk assessment are provided in Table A-12. Track-out, earthworks and construction are all deemed to have a 'medium' risk of dust soiling impacts, a 'low' risk of impacting human health, and a 'low' risk of ecological impacts.

Table A-11: Criteria for sensitivity of area to impacts

Receptor sensitivity	Sensitivity of area	Dust emission risk (by scale)		
		Large	Medium	Small
Earthworks	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Construction	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Track-out	High	High	Medium	Low
	Medium	Medium	Low	Negligible
	Low	Low	Low	Negligible

Source: IAQM, 2024

Table A-12: Summary of risk assessment for each activity

Type of activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area				Step 2C: Risk of dust impacts			
		Dust soiling	Human health	Ecological		Dust soiling	Human health	Ecological	
				Outside	Inside			Outside	Inside
Demolition	Large	Medium	Low	High	High	Medium	Low	Medium	High
Earthworks	Large	Medium	Low	High	High	Medium	Low	Medium	High
Construction	Large	Medium	Low	High	High	Medium	Low	Medium	High
Track-out	Large	Medium	Low	High	High	Medium	Low	Medium	High