Prepared for
Star of the South Wind Farm Pty Ltd as trustee for Star of the South Trust
ABN: 68 239 717 297

AECOM

Technical Report W: Noise and Vibration

Star of the South Offshore Wind Farm

10-Mar-2026
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ABN: 68 239 717 297

Prepared by

AECOM Australia Pty Ltd
Wurundjeri and Bunurong Country, Tower 2, Level 10, 727 Collins Street, Melbourne VIC 3008, Australia
T +61 1800 868 654 www.aecom.com
ABN 20 093 846 925

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Executive Summary

Overview

Star of the South is Australia's most advanced offshore wind project. Located off the south coast of Gippsland, the project comprises an offshore wind farm and supporting transmission infrastructure to transfer energy to the existing electricity network.

A delegate of the Commonwealth Minister for the Environment decided that the project is a controlled action (as set out in notice dated 2 June 2020) and is required to be assessed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) through preparation of an Environmental Impact Statement (EIS) and the Victorian Minister for Planning determined that an Environment Effects Statement (EES) is required (as set out in notice dated 11 May 2020) under the *Environment Effects Act 1978* (EE Act).

Noise and vibration context

Noise produced during the construction and operation of large infrastructure projects has the potential to impact nearby noise sensitive receptors if not adequately understood and subsequently managed in accordance with relevant legislation and guidelines. Impacts from noise can reduce human amenity when produced at levels that are annoying, disruptive or, in some cases, physically harmful to people.

The risk of adverse impacts to human amenity produced by vibration can be similar to those described for noise. However, the risk of impacts from vibration is usually only an issue for sensitive receptors located closer to an activity when compared to impacts from noise. Vibration can also cause damage to utilities (gas or water cable systems, electrical infrastructure etc.) and buildings (dwellings, heritage listed structures etc.) when exposed to repetitive or excessive vibration.

Without proper assessment and appropriate mitigation, the proposed activities and operations for this project risk producing noise and vibration that could result in adverse environmental impacts. This assessment addresses these specific environmental matters in response to the scoping requirements for this EES and by providing evidence that the potential impacts of the project can be managed to achieve the desired outcomes outlined by the Minister for Planning, including the General Environmental Duy (GED).

Noise and vibration impact to fauna and the underwater environment have not been assessed in this report but are covered in EES/EIS Technical Report G - Onshore Ecology for onshore and Attachment I - Underwater Noise Modelling. Airborne noise from port-related activities is not assessed as it is outside the scope of the EES.

Existing conditions

The study area for the assessment has defined so as to include sensitive receptors that are at risk of being impacted during the construction, operation and decommissioning phases of the project.

The noise and vibration sensitive receptors identified within the study area is generally classified as rural residential.

Baseline noise levels were measured to describe the existing noise environment throughout the project study area. This information is used to explain the existing noise environment, including the presence of existing industry or other environmental noise sources, support the development of the project criteria and assess the potential change to the noise environment if the project was constructed.

The ambient levels were influenced by distant and local road traffic, wildlife, insects, noise induced by wind blowing through trees and surf.

Relevant legislation, policy and guidelines

Construction

The key policy, legislation and guidelines relevant to the assessment of airborne construction noise impacts include:

- EPA Victoria – *Civil construction, building and demolition guide*, Publication 1834.2
- The *Environment Reference Standard* (ERS)
- The *General Environmental Duty* (GED)
- Concrete batching plants associated with the project have been assessed in accordance with EPA Victoria Publication 1826 (the Noise Protocol).

EPA Victoria Publication 1834.2 classifies working hours and defines applicable noise criteria for the following times:

- Normal working hours (7am to 6pm weekdays and 7am to 1pm Saturdays)
- Evening/weekend hours and public holidays (6pm to 10pm weekdays, 1pm to 10pm Saturdays and 7am to 10pm Sundays)
- Night hours (10pm to 7am every day).

Commonwealth, state and local-level documents do not currently have legislative requirements or guidance limits to govern vibration originating from construction activities. Standards used for this project are consistent with those adopted on other major infrastructure projects in Victoria:

- British Standard BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting*
- German Standard DIN 4150-3:2016 *Structural vibration in buildings – Effects on structures*.

Operation – Onshore fixed infrastructure

Operational noise criteria were established using EPA Victoria Publication 1826.5 – *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (the Noise Protocol).

For '*commercial, industrial and trade premises'*, the *Environment Protection Regulations* (Part 5.3, Division 3 for commercial, industrial and trade premises) set noise limits that apply in '*noise sensitive areas'*, above which noise is prescribed to be unreasonable (Regulation 118). The Regulations also stipulate relevant factors (such as frequency content) that should be considered under the definition of unreasonable noise. The noise limits are determined using the Noise Protocol, and the noise limits are set by the *Environment Protection Regulations*.

The method for deriving the limits is contained within the Noise Protocol and not the Regulations, therefore the limits have been described as the "*Noise Protocol Limits*" through-out this document.

If noise from operations could lead to an impact on "*natural areas*" (as defined in the ERS) then the residual risk to the environmental value of "*human tranquillity and enjoyment outdoors, in natural areas*" is considered relevant in these cases.

Operation – Offshore wind energy

New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010) is used to assess wind farm noise as required by the *Environment Protection Amendment (Wind Turbine Noise) Regulations 2021*.

Assessment findings

An iterative assessment was undertaken to evaluate potential impacts associated with the project, considering the existing environment within the study area and associated construction, operational and decommissioning activities.

The following issues have been assessed:

- Airborne construction noise both onshore and offshore.
- Airborne offshore operational noise
- Airborne Decommissioning noise both onshore and offshore.

Each issue is described further in the sections that follow.

Key findings – Construction noise

Construction activities

The noise and vibration produced during the construction of the following facilities may result in amenity effects for the nearby sensitive receptors:

Onshore transmission infrastructure

- Shore crossing, which includes offshore support vessels and associated noise
- High voltage AC underground cable system

Offshore infrastructure

- Offshore foundation
- Fixed bottom (monopile) wind turbines
- Fixed bottom offshore substation platforms (steel jacket foundations)
- Offshore cable installation
- Offshore export cables.

Construction impact assessment

The construction impact assessment has assessed the noise impacts associated with the activities listed above and the following impacts have been identified:

- General construction works along the onshore cable system alignment causes an increase in noise that affects the amenity of sensitive receptors (ONV-I001).
- Out-of-hours work causes an increase in noise that affects the amenity of sensitive receptors (ONV-I002)
- Construction traffic causes an increase in noise that affects the amenity of sensitive receptors (ONV-I003)
- Vibration from construction works causes human disturbance (ONV-I004)
- Vibration from construction works cause structural damage to buildings and underground services (ONV-I005).

Construction noise will be reduced as far as is reasonably practicable at all times. This intention has been captured in the application of the practices included within the initial mitigation measures listed in **ONV-M001**. The term "initial" is intended to describe items that are considered to be minimum and then these are refined as the assessment and project progresses.

The proposed temporary batching plants required during the construction phase are commercial, industrial and trade premises and therefore, their noise has been assessed under Part 5.3, Division 3 of the EP Regulations.

Noise modelling scenarios have been developed to determine where there was the potential for the project noise criteria to be exceeded. This assessment has found that compliance with the noise criteria is expected with the inclusion of the mitigation measures detailed in **ONV-M004**.

Avoidable works outside of EPA Victoria normal working hours are not proposed for construction. Should they be required, the application of additional noise management measures (**ONV-M002**) will be implemented.

Unavoidable works (as defined by EPA Victoria Publication 1834.2) associated with the construction of the project include:

- Horizontal directional drilling (HDD) works for the shore crossing.
- Trenchless crossing of roads or sensitive infrastructure (two locations)
- Offshore works - The construction of the turbines and offshore substations requires piles to be driven into the seabed. Installation of the piles can only be carried out under calm sea conditions and relatively low wind speeds, and so to minimise construction periods, piling would be undertaken whenever weather conditions allow. Pausing or stopping the piling process can lead to the loss of progress and the failure for the foundation to reach the required depth. This would require the partly installed pile to be removed and scrapped. The continuation of construction during optimal weather conditions also avoids the issues associated with mobilising and de-mobilising equipment out at sea.
- Nearshore works – utilisation of shore crossing support vessels
- Offshore cable installation.

These works will implement additional out of hours noise management measures (**ONV-M002**).

Night works associated with drilling the shore crossing is predicted to have the greatest impact without the implementation of additional mitigation measures. On site mitigation, such as noise walls and/or enclosures is recommended for this activity to reduce the noise output from the site (**ONV-M005**).

In addition, it is recommended that noise monitoring be undertaken at noise sensitive receptors in the vicinity of the shore crossing site (**ONV-M008**).

Uncertainty remains when making predictions of offshore noise over large distances where variance in wind speed, wind direction and atmospheric stability have the greatest impact on the propagation of sound. . To address this, it is advisable to monitor noise from offshore piling during construction. Given that piling would only occur when weather conditions permit, and variations in weather conditions and seabed geology can result in very different onshore noise levels, it can be difficult for a short-term survey to capture typical piling noise levels. As such, mitigation at the source in combination with long-term monitoring is recommended, as provided in **ONV-M006** and **ONV-M008**.

Clear communication to nearby receptors of the expected duration and times of operation for any out-of-hours work would assist in alleviating community concerns during unavoidable works (**ONV-M001, SOC-M003**).

<u>Construction traffic</u>

It is considered reasonable to assume that all noise sensitive receptors within 500 metres of a new or existing access track (as opposed to an arterial road, for example) could be impacted.

Therefore, the good practice methods provided in Section 4.3.1 of EPA 1834.2 (**ONV-M001**) will be applied and notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 for noise sensitive receptors within 500 metres of a new or existing access track (**ONV-M001**).

Key findings - Construction vibration

Potential impacts from vibration were assessed using known safe working distances from equipment that cause high levels of vibration. Maintaining these distances would be sufficient during construction to avoid human disturbance and potential damage to vibration sensitive structures.

The nearest structures to the cable construction are within the human response and structural damage safe working distance for the largest expected item of vibration generating plant (19t vibratory roller). Therefore, additional mitigation will be required in certain locations as captured in **ONV-M003**.

Mitigation measures

Potential impacts due to noise and vibration from the project will be avoided, minimised or managed to required standards through the recommended mitigation measures.

This assessment has identified risks and proportional mitigation measures to address the General Environmental Duty as required under the *Environment Protection Act 2017*. Nevertheless, the mitigation measures detailed herein are intended to form the basis of a framework to ensure, across all stages of the project, relevant considerations and assessments will be made to ensure that noise and vibration will be minimised so far as is reasonably practicable, consistent with the GED.

These measures are to be implemented pro-actively, wherever it is reasonably practicable to do so, and are not to be contingent on predicted exceedances of nominated criteria.

The mitigation measures for the construction phase are:

- ONV-M001 Managing noise and vibration from construction activities
- ONV-M002 Out of hours construction noise mitigation measures
- ONV-M003 Vibration safe working distances
- ONV-M004 Transmission system construction – batch locations – noise control
- ONV-M005 Unavoidable works - Shore crossing drilling – noise control
- ONV-M006 Unavoidable works - Offshore piling – noise control
- ONV-M008 Noise and vibration monitoring

Key findings – Onshore operational noise

The underground cable system and shore crossing are not expected to generate any noise. There are no other permanent onshore operational components associated with the project.

An onshore substation is required to connect the wind farm to the national electricity market. The VicGrid connection hub will include provision for approach cable easements, substations and associated infrastructure required to connect any approved wind farms in Bass Strait to the national electricity market and is subject to a separate assessment and approval process. The VicGrid connection hub and associated infrastructure are therefore not assessed as a part of this EIS/EES.

Key findings – Offshore operational noise

The project may construct up to 147 wind turbines in the offshore wind farm area.

The key objective of this assessment is to investigate noise levels at surrounding noise sensitive receptors and to demonstrate that noise limits can be practically achieved, taking into consideration typical noise emissions levels that are representative of the turbines that may be used for the project.

Three-dimensional noise models of two indicative layout options for the project were created: a scenario comprising 113 of the largest proposed wind turbines, and one comprising 147 of the smallest proposed wind turbines. These models were developed to predict noise levels from the wind turbines at five representative noise sensitive locations near the offshore site. Victorian legislative requirements with respect to noise are applicable at noise sensitive locations within Victorian jurisdiction.

Offshore operational noise

No exceedances of the high amenity area limit or the base noise limit of 40 dB L_{A90} are predicted across all hub height wind speeds.

Therefore, as exceedances of the base noise limit are not predicted, background noise monitoring would not need to be carried out to determine site specific wind farm noise limits.

The predicted worst case wind farm noise levels are below the outdoor low frequency noise thresholds provided by EPA Victoria Publication 1996. This indicates that low frequency noise is unlikely to be significant at receptors onshore.

The potential for human disturbance because of noise generated by the operation of the offshore substations is considered to be very low. Accordingly, operational noise from the offshore substations has not been assessed.

Offshore operational noise mitigation measures

The final turbine model(s) selected for use by the project would need to comply with planning approval requirements and other relevant criteria as they relate to noise levels at surrounding sensitive locations. An updated noise compliance assessment would also typically be required once final turbines for the project are selected. This will be carried out prior to construction of the project.

Wind turbines would need to be properly maintained by the wind farm operator to ensure that the noise emission of the turbines is not adversely affected by turbine wear, resulting in audible tonality. Similarly, should amplitude modulation be detected upon commissioning, the wind farm operator would be required to alter the operating parameters of some turbines to remove this effect.

No permanent offshore operational noise mitigation is proposed at this time. The completion of a post-construction noise assessment within 12 months of commencement of operations (**ONV-M009**) is required by the *Environment Protection Amendment (Wind Turbine Noise) Regulations 2021*, and mitigation will be applied, if required.

The mitigation measures for the offshore operational phase are:

- ONV-M009 Offshore commissioning measurements

Offshore cumulative operational noise

One potential project within the zone of influence of the project, the Great Eastern Offshore Wind Farm was assessed as Tier 2 (medium certainty)and included in the assessment due to the proximity to the Star of the South project.

If both projects are constructed, then it is estimated that this could add up to 5 dB to the predicted operational wind turbine noise levels presented herein. In which case, compliance with the high amenity noise limit of 35 dB L_{A90} would still be expected to be achieved. Mitigation measures may be required if these projects are to operate together. This would be addressed as the design (for each project) progresses.

Key findings – Operational vibration

The potential for human disturbance because of ground vibration generated by the operation of the project is considered to be very low. This is because:

- The major onshore operational items have no moving parts
- The project components nearest to receptors would be the cable systems, which do not generate any vibration.
- The distance between any project source and the nearest receptor is extremely large, in vibration terms.

Consequently, operational vibration has not been assessed.

Key findings – Decommissioning

The works associated with decommissioning may cause an increase in noise or vibration affecting amenity of nearby sensitive receptors.

Noise from the decommissioning works is expected to be adequately managed by the application of standard noise controls (**ONV-M001**). The application of additional noise management measures (**ONV-M002)** and the general principles provided in **ONV-M008** will be implemented to address impacts, if required.

For the purposes of this assessment, it is assumed that decommissioning would be undertaken in line with current standards. However, different standards may be in place, and this will be assessed further at the time.

The mitigation measures for the decommissioning phase are:

- ONV-M010 Decommissioning Environmental Management Plan - noise impacts
- ONV-M011 Decommissioning review and establishment of noise framework

Abbreviations

Abbreviation	Title
AECOM	AECOM Australia Pty Ltd
CEMP	Construction Environmental Management Plan
dB	Decibel
EES	Environment effects statement
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EPA Victoria	Environment Protection Authority Victoria
EPA Victoria Publication1826.5	Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues
ERS	Environmental Reference Standard
GED	General environmental duty
GIS	Geographic Information System
HAA	High Amenity Area
ICNG	Interim Construction Noise Guideline (NSW Government)
IMO	International Maritime Organization
MLC	Maritime Labour Convention
OSOM	Oversize Overmass
PPV	Peak particle velocity
SEMP	Stakeholder Engagement Management Plan
Soundscape	Soundscape refers to the acoustic environment as perceived, experienced and/or understood by a person or people, in context. This differs from the acoustic environment which is the sound at the receptor from all sound sources as modified by the environment.
UGB	Urban growth boundary
VDV	Vibration dose value

Glossary

Term	Definition
'A' Weighted	Frequency filter designed to adjust the absolute sound pressure levels to correspond to the subjective response of the human ear. The A-weighting filter emphasises frequencies in the speech range (between 1 kHz and 4 kHz) which the human ear is most sensitive to.
Ambient noise	The A-weighted equivalent continuous sound pressure level L_{Aeq}, is typically the descriptor used to describe ambient noise.
Background level (*L_{90} or L_{A90}*)	The L_{90} sound pressure level is used to quantify the background level. For a day, evening or night period means the arithmetic average of the L_{A90} levels for each hour of that period for which the commercial, industrial or trade premises under investigation normally operates. The background level shall include all noise sources except noise from commercial, industrial or trade premises which appears to be intrusive at the point where the background level is measured.
CONCAWE	Conservation of Clean Air and Water in Europe
Decibel [dB]	The measurement unit of sound.
Decibel scale	A three decibel increase in the sound pressure level corresponds to a doubling in sound energy. An increase or decrease of three decibels is typically considered to be the smallest change in sound level that a listener can detect. A change of five decibels, however, is clearly noticeable. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. This increase is typically perceived to sound twice as loud. The table below shows the sound pressure level that would be typically experienced when exposed to different sources: 0 dB – Threshold of human hearing 40 dB – Whisper in a library 50 dB – Open office space 70 dB – Inside a car on a freeway 80 dB – Outboard motor 90 dB – Heavy truck pass-by 100 dB – Pneumatic hammer 110 dB – Rock concert 120 dB – 747 take off at 250 metres
Effective Noise Level (L_{eff})	In accordance with the Noise Protocol, adjustments to the measured noise level are applied to account for the effects of duration, tonality, intermittency and impulsiveness of the noise. The adjusted 30-minute noise level is called the '*Effective Noise Level'*, which is assessed in relation to the noise limits.
Emergency	Means an emergency due to the actual or imminent occurrence of an event which in any way endangers or threatens to endanger the safety or health of any person in Victoria or which destroys or damages, or threatens to destroy or damage, any property in Victoria or endangers or threatens to endanger the environment or an element of the environment in Victoria including, without limiting the generality of the foregoing:

Term	Definition
	a) An earthquake, flood, windstorm or other natural event; and b) A fire; and c) An explosion; and d) A road accident or any other accident; and e) A plague or an epidemic or contamination; and f) A warlike act of terrorism, whether directed of Victoria or at any other State or Territory Commonwealth; and g) A hi-jack, siege or riot; and h) A disruption to an essential service.
Frequency [f]	Frequency is measured in Hertz (Hz). The frequency corresponds to the pitch of the sound: a high frequency to a high-pitched sound and a low frequency to a low-pitched sound.
Insertion loss	The reduction in sound pressure level at a receptor by inserting a barrier between the source and considered receptor.
Impulsiveness	A noise is more annoying when it has an impulsive component (such as banging noise). Where a noise source is impulsive, an adjustment is made to allow for the additional annoyance caused by the impulses.
Leq	Equivalent (energy averaged) noise level measured over a time period. This noise descriptor is commonly used in environmental noise policies and assessments. The time period the measurement is averaged over is included in the subscript, i.e. $L_{Aeq,\ 30min}$.
L90	The noise level exceeded 90% of the measurement period. This descriptor is used to represent the background noise level. The time period the measurement is averaged over is included in the subscript, i.e. $L_{A90,\ 30min}$
Lmax	The maximum sound pressure level measured over the measurement period. The A-weighted form is denoted as 'L_{Amax}'.
Noise sensitive area	Noise Protocol limits are set at noise sensitive areas. These are mainly residential dwellings, but can include, for example, motels and tourist establishments. Noise is assessed at the property boundary unless the boundary is greater than 10 m from the dwelling, in which case the assessment point is within 10 m of the dwelling.
Octave band	The International Standards Organisation has agreed upon preferred frequency bands for sound measurement and the octave band is the widest band for frequency analysis. The upper frequency limit is approximately twice the lower frequency limit, and each band is identified by its band centre frequency.
One-third octave band	Where more detailed information about a noise is required, standardised one-third octave band analysis may be used. There are three one-third octave bands for each octave band. (e.g. 25Hz, 31.5Hz, 40Hz one-third octave bands cover the same frequency range as the 31.5Hz octave band).
Peak particle velocity (PPV)	The maximum speed of a vibrating particle, in mm/s. In buildings, these are the maximum levels measured at the foundation, or the maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor.

Term	Definition
Sensitive receptor	Areas where the occupants, buildings or land use are potentially susceptible to the adverse effects of exposure to noise and vibration.
Sound power level	The total sound emitted by a source.
Sound pressure level	The amount of sound at a specified receiving point.
Special audible characteristics	An audible characteristic of wind turbine noise that is not considered a normal characteristic and has the potential to increase annoyance. Special audible characteristics are defined by NZS 6808:2010 to include tonality, excessive amplitude modulation and impulsivity.
Tonality	Noise is subjectively more annoying when it has a tonal component (a perceptible hum or whine). Tonality can be determined by subjective assessment or from one-third octave band analysis of the noise. Where a noise is tonal, an adjustment is made to allow for the additional annoyance caused by the tone.
Vibration dose value (VDV)	The VDV is a parameter that combines the magnitude of vibration and the duration for which it occurs to cumulatively quantify the level over an 8-hour or 16-hour period.

1.0 Introduction

The Star of the South Offshore Wind Farm (the project) is Australia's most advanced offshore wind farm. The project is located in Commonwealth waters off the coast of Gippsland, and will connect to the electricity network via the proposed VicGrid connection hub in Giffard.

The project represents a significant opportunity to diversify Australia's energy resources. As Australia's ageing coal fleet retires, new sources of power are needed to address the anticipated gap in electricity generation. The project will address this gap, by harnessing Bass Strait's strong, consistent winds and delivering significant amounts of clean, reliable power to the grid starting in 2032. With a capacity of up to 2.2 gigawatts (GW), the project can meet approximately 20 per cent of Victoria's current electricity demand, enough to power around 1.2 million homes annually.

The project is located within both Commonwealth and Victorian jurisdictions and is subject to planning and environmental assessment and approval under Commonwealth and Victorian legislation.

A delegate of the Commonwealth Minister for the Environment and Water has determined the project is a controlled action (as set out in a notice dated 2 June 2020) and must be assessed and approved under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) through an Environmental Impact Statement (EIS). The Victorian Minister for Planning has determined the project requires an Environment Effects Statement (EES) (as set out in a notice dated 11 May 2020) under the *Environment Effects Act 1978* (Vic) (EE Act).

This report provides a noise and vibration impact assessment to inform the preparation of the EIS and EES required for the project.

1.1 Why understanding noise and vibration is important

Evidence of the health risks associated with exposure to prolonged or excessive noise has been documented by scientific bodies including the World Health Organisation (World Health Organisation, 2009). Potential human responses to noise include:

- Annoyance (i.e. stress, poor concentration)
- Fatigue caused by sleep disturbance.
- Negative health effects due to long term exposure
- Productivity loss and/or inability to continue to operate a business.

An individual's sensitivity to noise is commonly influenced by factors such as the type and duration of the noise, community expectations, and the existing noise environment (for example, a busy urban setting compared to a quiet rural area).

Ground-borne vibration can also adversely impact the community and the built environment: excessive vibration can result in human annoyance and responses similar to those caused by excessive noise exposure.

High levels of vibration can potentially also result in cosmetic (such as minor cracks) or structural damage to buildings and infrastructure, as well as interfere with the function of vibration-sensitive equipment.

There are sensitive receptors including residential areas and community facilities near the proposed project area that could be impacted by noise and/or vibration during the construction and operation of the project.

Without proper assessment and appropriate mitigation, the proposed activities and operations for this project could produce noise and vibration that could result in adverse environmental impacts. This assessment addresses these specific environmental matters in response to the scoping requirements for this EES and by providing evidence that the potential impacts of the project can be managed to achieve the desired outcomes outlined by the Minister for Planning, including the General Environmental Duy (GED).

2.0 Project description

Section 2.0 provides a high-level overview of the project in its entirety. Detailed descriptions of project components and construction processes are provided in Chapter 4 - Project description of the EIS for the whole of project assessment across the Commonwealth jurisdiction, and in Chapter 4 – Victorian works project description of the EES for the Victorian jurisdiction. Specific project parameters that have informed the noise and vibration impact assessment are detailed in Section 8.0 of this report.

2.1 Project overview

The offshore wind farm will be installed within a 586-square-kilometre offshore wind farm area, located approximately 10 to 40 kilometres off the coast of Gippsland, as shown in Figure 2-1.

The project comprises an offshore wind farm and supporting transmission infrastructure to generate and transfer power to the grid. The offshore infrastructure extends from the shore crossing at Reeves Beach, to the offshore wind farm area.

The onshore infrastructure primarily comprises of an underground cable system that will connect the project to the proposed VicGrid connection hub in Giffard (also referred to as ‘proposed Giffard terminal station area’). . The onshore transmission infrastructure is located in Central Gippsland, extending approximately 30 kilometres from Reeves Beach to the proposed VicGrid connection hub.

This technical report focusses on potential noise and vibration impacts associated with construction, operation and decommissioning of offshore wind farm and transmission components and the onshore transmission system, within the offshore and onshore project area, as shown in Figure 2-3.

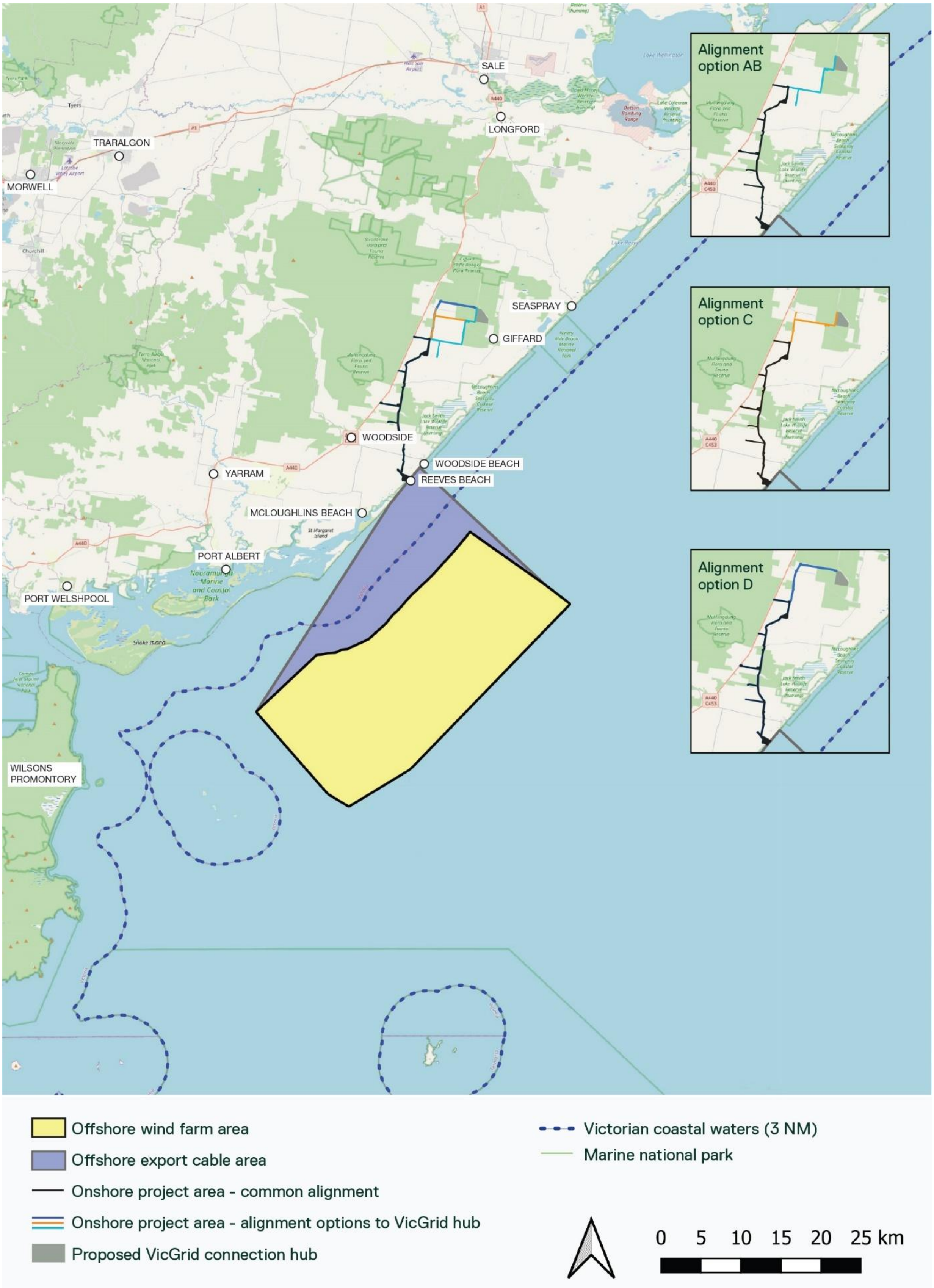

Figure 2-1 Project location

2.2 Project development

Over several years of project development, opportunities to avoid and minimise environmental impacts have been realised in accordance with the mitigation hierarchy shown in Figure 2-2. The assessment framework has also enabled the identification and adoption of further avoidance and minimisation measures as part of the planning and environmental approvals process.

This approach addresses the general environmental duty (GED) as required under the *Environment Protection Act 2017*, as it involves minimising risk of harm to human health and the environment from pollution and waste by adopting controls that are proportionate to identified risks.

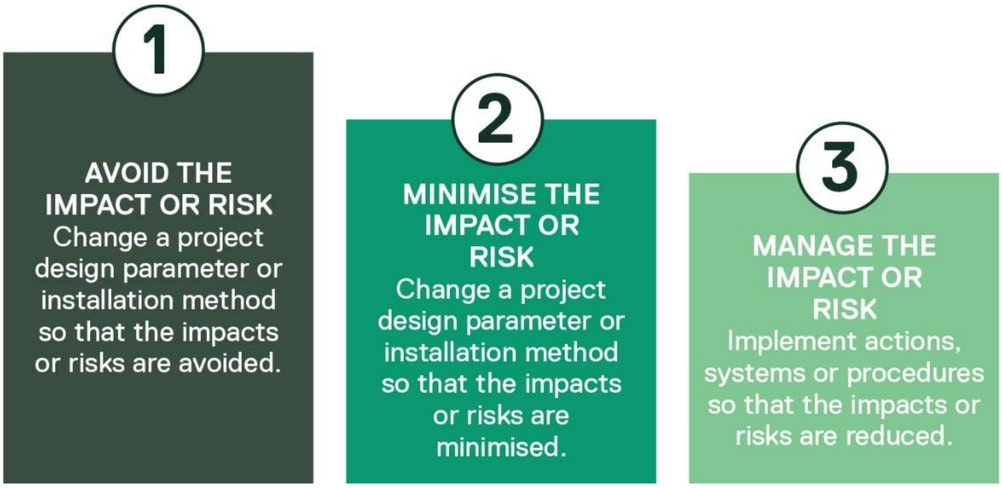

Figure 2-2 Mitigation hierarchy

Avoidance and minimisation of social and environmental impacts is central to the project's decision making and as such, the project would continue to be refined in response to technical requirements and potential environmental and social impacts identified during the development phase.

This was considered in the preparation of a project description which is found in Chapter 4 – Project description for the whole of project assessment across the Commonwealth jurisdiction, and Chapter 4 – Victorian works project description for the Victorian jurisdiction. A description of how avoidance of impact has informed the design in relation to noise and vibration can be found in Section 6.10.

Examples of this include the decision to design the shore crossings without directly impacting coastal areas, utilising existing roads for construction site access wherever possible and adopting construction techniques which avoid impacts on sensitive receptors.

Once avoidance and minimisation measures are exhausted, residual impacts and risks are managed. In the case of risks, mitigation measures can be applied both before and after an event occurs. Residual impacts and risks are then evaluated against the assessment criteria to ensure they are at an acceptable level.

The mitigation measures (**ONV-M001 – ONV-M011**) include a framework to ensure that opportunities to avoid and minimise noise and vibration impacts, so far as reasonably practicable, will be taken throughout the project development and operation.

2.3 Project area

The project area is shown in Figure 2-3 has been broken down into three main sections - offshore, shore crossing, and onshore areas.

1. Offshore project area, comprising:
   - Offshore wind farm area: A 586 square kilometre area extending approximately 10 to 40 kilometres offshore from the shore crossing. Includes offshore wind turbines installed on foundations, offshore substations and offshore transmission cables. This area is in Commonwealth waters.

- Offshore export cable area: A 232 square kilometre area extending from the offshore wind farm area to the shore crossing. Includes offshore export cables to connect the wind farm to land. This area traverses Commonwealth waters and Victorian coastal waters.

2. Shore crossing: Located at Reeves Beach, this is where the offshore export cables will transition to land and connect to the underground cable system onshore.
3. Onshore project area: An approximately 30 kilometre corridor extending from the shore crossing to the proposed VicGrid connection hub. Includes an underground cable system within a (common) alignment to Giffard West, at which point there are three alignment options (AB, C and D) to reach the proposed VicGrid hub in Giffard.

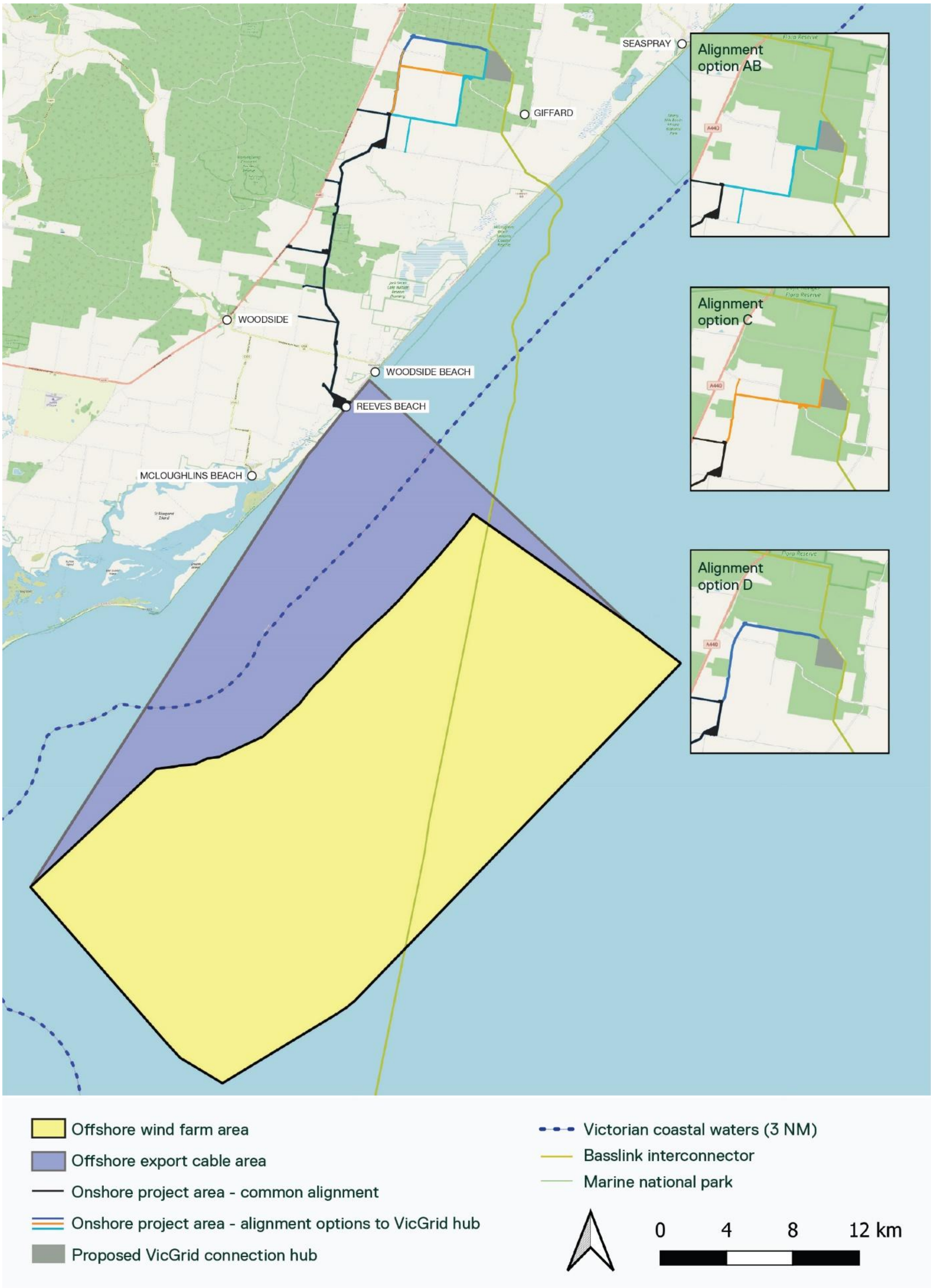

Figure 2-3 Project overview

2.4 Key project components

The key components that make up the project are the offshore wind farm, transmission infrastructure (inter-array cables, offshore substations and offshore export cables) the shore crossing infrastructure and onshore transmission infrastructure. These are shown in Figure 2-4 and described below.

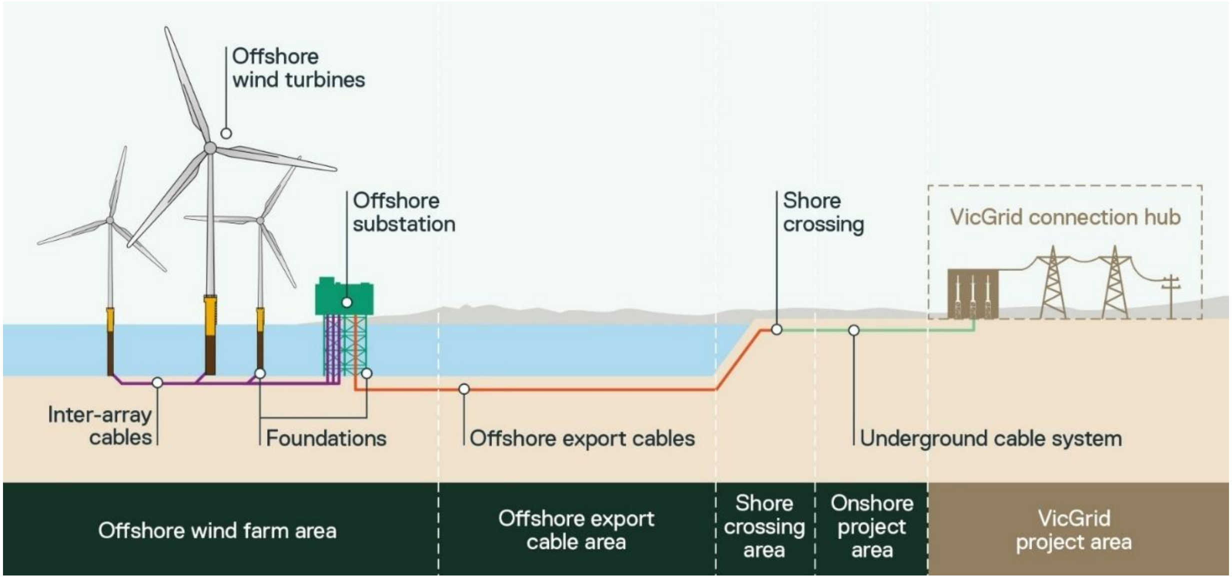

Figure 2-4 Project components

Key components are shown in Figure 2-4 and include:

- Offshore wind farm and transmission infrastructure:
  - Up to 147 offshore wind turbines installed on foundations with connecting inter-array cables
  - Up to five offshore substations and three interlink cables
  - Up to eight offshore export cables.
- Shore crossing infrastructure:
  - Up to eight trenchless crossings containing the offshore export cables.
- Onshore transmission infrastructure, which consists of:
  - An underground cable system connecting to the proposed VicGrid connection hub

2.5 Construction approach

The offshore components of the project are likely to be constructed according to the general sequence below:

- Site preparation activities
- Offshore export cable installation
- Foundation installation
- Offshore substation topside installation
- Inter-array and interlink cable installation
- Wind turbine installation.

Construction of the shore crossing involves 2 main activities and phases:

- Drilling and duct installation

- Cable pulling.

The construction of the shore crossing and onshore transmission system would involve the following key activities:

- Site establishment
- Cable system construction (including trenching, installation and jointing)
- Pre-commissioning and commissioning of the cable system
- Demobilisation and rehabilitation of areas disturbed by construction

2.6 Project timeline

The project has been under development for approximately seven years. If approvals are obtained in the next few years, construction could start around 2030 and electricity generation from 2032. The operational life of the project is approximately 30 years, with the possibility of repowering to extend its life, if deemed appropriate by Star of the South and regulators closer to the time.

Figure 2-5 Project timeline

2.7 Construction schedule

The project is expected to take up to seven years to construct, if built to its full capacity in a single stage. The project could also be built in two stages, depending on energy market and government requirements and timing. Figure 2-6 shows the order and maximum duration of construction for key components.

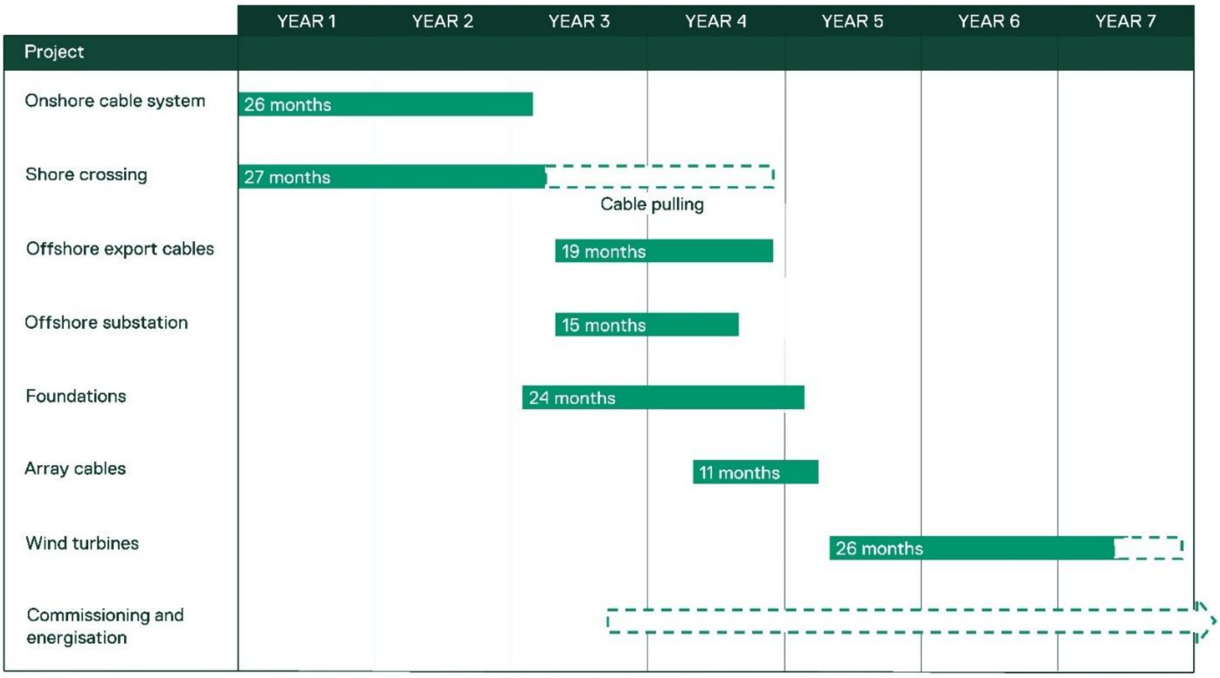

Figure 2-6 Indicative project construction schedule

2.8 Operational requirements

The project is expected to have an operational life of approximately 30 years. The offshore wind turbines will be available to operate continuously during the operations phase. Infrastructure will be monitored and operated remotely from a local O&M facility located at either Barry Beach Marine Terminal or Port Anthony, supported by a service operation vessel (SOV) and/or crew transfer vessel (CTV) logistics strategy.

O&M activities will be both preventative (planned) and corrective (unplanned). Preventative activities are carried out as part of regular scheduled services, such as removing marine growth. Corrective maintenance covers unexpected repairs, component replacement and breakdowns

The underground cable system will be remotely monitored through control and condition monitoring systems. Routine access will be minimal, with testing required once or twice a year at the link pits located at each joint bay.

A small workforce will undertake periodic inspections and routine maintenance of the cable system using light service vehicles, including cable easement inspections to monitor and control vegetation and confirm compliance with easement terms.

2.9 Decommissioning

Key principles that will apply to decommissioning offshore include:

- Planning and budgeting for decommissioning, as required under the Offshore Electricity Infrastructure Act 2021 (Cth)
- Considering environmental conditions and stakeholder interests when developing decommissioning plans

- Returning the seabed to baseline conditions as far as reasonably practicable.

Decommissioning is expected to involve similar types and numbers of vessels and equipment as the construction phase. Requirements at the time will determine the scope of decommissioning activities and impacts. The anticipated duration is up to three years. Indicative activities include:

- Removing offshore substation topsides and foundations to just below the seabed
- Removing offshore wind turbines, transition pieces and monopiles to just below the seabed
- Removing scour protection where reasonably practicable and appropriate to do so
- Retaining offshore cables in situ.

Decommissioning of onshore components will be planned and carried out in accordance with regulatory and landholder requirements current at the time. The decommissioning approach is expected to be agreed with regulators before project operations cease. The assessment of the project assumes current industry practices will be adopted.

To minimise disturbance, most below-ground infrastructure is expected to be left in place, with cable ends cut, sealed and securely buried. Surface infrastructure such as signage, markers, link and fibre pits may be removed if required by landholders or if environmental impacts arise.

3.0 Scoping

3.1 Study objective

The study objective is to assess, avoid and minimise adverse effects for community health and amenity arising from noise and vibration associated with construction, operation and decommissioning of the project.

This objective has guided the assessment methods and the identification of measures for the avoidance and minimisation of potential impacts.

3.2 EIS guidelines

The Guidelines for the Content of a Draft Environmental Impact Statement for the Star of the South Offshore Wind Farm Project ('the guidelines') set out the requirements to allow the Commonwealth Minister for the Environment to make an informed decision on the approval of the project under the EPBC Act.

The aspects of the guidelines relevant to the noise and vibration assessment are shown in Table 3-1 as well as where these items have been addressed in this report.

Table 3-1 Relevant EIS requirements

Requirement	Sections addressed
Section 2.1.7: Identify the source of potential impacts, e.g. ship-movements, artificial lighting, noise.	Section 8.0

3.3 EES evaluation objectives and scoping requirements

The Scoping Requirements for Star of the South Offshore Wind Farm Environment Effects Statement ('scoping requirements') by the Minister for Planning, set out the specific environmental matters the project must address in order to satisfy the Victorian assessment and approval requirements.

The scoping requirements include a set of evaluation objectives. These objectives identify the desired outcomes to be achieved in managing the potential impacts of constructing and operating the project in accordance with the *Ministerial guidelines for assessment of environmental effects* under the EE Act.

The following evaluation objective is relevant to the noise and vibration impact assessment:

> *To avoid, or minimise where avoidance is not possible, adverse effects for community amenity, health and safety, with regard to noise, vibration, dust, the transport network, fire risk management and electromagnetic radiation.*

The aspects from the scoping requirements relevant to the evaluation objective are shown in Table 3-2 as well as the location where these items have been addressed in this report.

Table 3-2 Scoping requirements relevant to noise and vibration

Aspect	Scoping requirement	Section addressed
Key issues	Potential for adverse effects resulting from project-related noise or vibration at sensitive receptors during construction and operation.	Sections 6.5 and 9.0
Priorities for characterising the existing environment	Characterise the ambient noise environment in and adjacent to the project area of interest in established residential, farming, commercial and	Section 7.0

Aspect	Scoping requirement	Section addressed
	open space areas and at other sensitive land use and high amenity locations.	
	Identify sensitive receptors that could be affected by noise, dust or electromagnetic radiation from project construction or operation.	Section 7.1
Design and mitigation measures	Describe and evaluate both potential and proposed design responses and/or other mitigation measures (e.g. staging/scheduling of works) which could minimise noise and vibration during construction and operation.	Section 13.6
Assessment of likely effects	Assess the potential effects of the project on noise and vibration amenity at sensitive receptors, including through consideration of relevant EPA Victoria publications.	Sections 9.14 and 10.5
Approach to manage performance	Describe proposed measures to manage and monitor effects on community amenity, health and safety, the transport network, fire risk management and electromagnetic radiation and identify likely residual effects, including compliance with standards and proposed levels for initiating contingency measures.	Section 13.4
	Describe contingency measures for responding to unexpected impacts to community amenity, health and safety, the transport network, fire risk management and electromagnetic radiation resulting from the project during construction and operation of the project.	Section 13.5

In the context of this report, ‘effects’ includes all potential direct, indirect, on site and off site environmental impacts resulting from the project. The description and assessment of effects is not confined to the immediate area of the project but also considers the potential of the project to impact on adjacent or other areas that could be affected, in the context of a systems-based approach.

4.0 Evaluation framework

The assessment will consider legislation, policy and standards relevant to noise and vibration along with specific assessment criteria that have been derived for the purposes of the study.

4.1 Legislation, policy, guidelines and standards

The key legislation, policy and guidelines/standards relevant to this noise assessment are summarised in Table 4-1.

Table 4-1 Key legislation, policy and standards for noise

Document title	Summary	Relevance to the project
Legislation		
Environment Protection Act 2017 ***(EP Act)***	The *Environment Protection Act* aims to protect Victoria's air, water and land by adopting the 'general environment duty' (GED) which requires all individuals to take proactive steps to reduce the risk of harm to human health and the environment from pollution or waste. The Environment Protection Authority administers the *Environment Protection Act* and subordinate legislation. Section 166 of the *Environment Protection Amendment Act 2018* provides the obligation not to emit unreasonable noise or allow unreasonable noise to be emitted.	Provisions under the EP Act include the GED and an obligation to not emit or permit to emit 'unreasonable noise'. Meeting the regulatory noise limits does not mean the GED has been met. The GED requires all reasonably practicable steps be taken to eliminate or reduce the risk of harm due to from noise from the construction and operation of the project. Even if the GED is met, the noise may still be considered unreasonable if it exceeds the noise limits set by the *Environment Protection Regulations 2021* or considering the factors in the definition of unreasonable noise in section 3(1) the EP Act.
Environment Protection Regulations 2021 (**Environment Protection Regulations**)	The *Environment Protection Regulations* give effect to the EP Act. The Noise Protocol (see below) is encompassed within the Regulations.	The Environment Protection Regulations set out the obligations to comply with the Noise Protocol and the 2010 Standard, as relevant, as well as additional obligations and requirements relating to wind turbine noise.
Subordinate legislation		
EPA Victoria Publication 1826.5: Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues: September 2025 **(Noise Protocol)**	The Noise Protocol specifies how to determine operational noise criteria for new and existing commercial, industrial and trade premises and entertainment venues as defined by The Regulations. The Noise Protocol is subordinate legislation and is required to be adhered to by law.	The Noise Protocol provides assessment criteria, including noise limits, for commercial, industrial and trade premises. This includes concrete batching plants and other operational machinery, but it does not set noise levels or assessment criteria for construction noise and wind turbine noise. The criteria apply at all nearby sensitive receptors during the operation of the project. Meeting the regulatory noise limits does not mean the GED has been met. In addition to setting noise limits for industry, the EP Act 2021 requires that industry would take all reasonably practicable steps to eliminate or reduce

Document title	Summary	Relevance to the project
		the risk of harm to human health and the environment from noise.
The Environment Reference Standard **(ERS)**	The ERS is made under Section 93 of the EP Act to support the protection of human health in Victoria. It sets out the environmental values of the ambient air, ambient sound, land and water environments that are sought to be achieved or maintained in Victoria and standards to support those values. Environmental values are the uses, attributes and functions of the environment that Victorians value. Standards for the environmental values are comprised of objectives for supporting different uses. The ERS sets out objective noise levels based on Victoria's planning zones. The noise levels outlined in the ERS are objectives and are neither noise limits nor noise design criteria.	Identifies environmental values to support the following: sleep at night, child learning and development and human tranquillity and the enjoyment of outdoors in natural areas. Operators are required to consider residual risks from noise due to construction and operation on the environmental reference values (once all reasonably practicable measures have been taken to eliminate or otherwise minimise the risk of harm) with priority given to maintaining environmental values of "*natural areas*" for human tranquillity and enjoyment outdoors. Direct regulation prevails over the ERS. However, the ERS is relevant when considering noise that is not assessed using the EP regulations, for example construction noise, or noise that affects to 'natural areas' (as defined in the ERS) which are not 'noise sensitive areas' as defined in the Regulations.
Guidance		
EPA Victoria Publication 1820.1: Guide to preventing harm to people and the environment	Includes information about how to manage risks, including examples of how this can be done using a simple four-step process.	Applies to all phases of the project.
EPA Victoria Publication 1834.2 Civil construction, building and demolition guide	Provides guidance with respect to construction working hours for various types of development.	Construction
EPA Victoria Publication 1856 - Reasonably Practicable	Provides guidance on the methods used to define what is *Reasonably Practicable*.	Applies to all phases of the project.
EPA Victoria Publication 1992 – Guide to the Environment Reference Standard	Provides information about how the ERS would be applied to support decision making, and how the environmental values, indicators and objectives for each element of the environment would be interpreted.	Applies to all phases of the project.
EPA Victoria Publication 1996 – Noise Guideline, Assessing low frequency noise	Provides guidance on the assessment of low frequency noise (10 to 160 Hertz (Hz))	The assessment methods and guidance set out in this guideline only applies to noise emitted from commercial, industrial and trade premises. This guideline does not apply to noise from wind turbines.
EPA Victoria Publication 1997 - Technical guide: Measuring and	Assists in the assessment of noise including measurement, prediction, analysis and reporting conducted in	Applies to onshore operational noise.

Document title	Summary	Relevance to the project
analysing industry noise and music noise	accordance with Part 5.3 of the *Environment Protection Regulations* (Victorian Government, 2021). Provides guidance for the assessment and management of cumulative noise from multiple industrial premises (existing and planned).	
EPA Victoria Publication 3011 - Technical guide: Wind Energy Facility Turbine Noise	Provides information about the general environmental duty (GED) relating to noise pollution from wind energy facilities. Note that the document specifically highlights that it is not a substitute for legal advice about the effect of the Regulations. Wind energy facility operators should obtain legal and acoustic advice about their specific circumstances.	Applies to offshore operational noise.
Danish Executive Order BEK nr 135	Describes a calculation method for sound propagation for offshore Wind Turbine Generators (WTGs). This is the only methodology which is approved for noise modelling of offshore WTGs. The method includes a correction for multiple reflections which accounts for increased received downwind noise levels at long distances over water.	Applies to offshore operational noise.
German Standard DIN 4150-3:2016 *Structural Vibration in Buildings – Effects on Structures* (**DIN 4150-3**)	German Standard DIN 4150-3:2016 provides guidance on the assessment of building exposure and structural damage due to vibration.	There is no specific policy or guideline for the assessment of vibration in Victoria. These international standards are widely used for the assessment of vibration resulting from the construction and operation of major projects in Victoria.
British Standard BS6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting* (**BS6472-1**)	British Standard BS6472-1:2008 provides guidance on the assessment of human exposure to vibration in buildings	
New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (**NZS 6808:2010**).	The New Zealand Standard is used to assess wind farm noise as required by the *Environment Protection Amendment (Wind Turbine Noise) Regulations 2021*.	Applies to noise from wind turbines at noise-sensitive receptors within Victorian jurisdiction.
Wind energy facility turbine noise regulation guidelines	This guideline provides an overview of the wind turbine noise regulations in the Environment Protection Regulations.	Wind turbine noise

4.2 General Environmental Duty

In Victoria, the EP Act came into effect in 2021 and is designed to prevent harm to human health and the environment from pollution and waste. At the centre of the EP Act is the general environmental duty (GED).

The GED requires that:

> *any person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.*

The GED applies at all times, during construction and operation of the project in Victoria, for any activities posing a risk of harm to human health and the environment from pollution and waste (including noise and vibration). Meeting the regulatory noise limits (e.g. the Noise Protocol criteria) does not mean that the GED has been met.

The following sections of the EP Act apply to the GED:

- Section 25 (4) of the EP Act provides, without limiting subsection (1), that a person who is conducting a business or an undertaking contravenes that subsection if the person fails to do any of the following in the course of conducting the business or the undertaking, so far as reasonably practicable—

  (a) use and maintain plant, equipment, processes and systems in a manner that minimises risks of harm to human health and the environment from pollution and waste

  (b) use and maintain systems for identification, assessment and control of risks of harm to human health and the environment from pollution and waste that may arise in connection with the activity, and for the evaluation of the effectiveness of controls

  (c) use and maintain adequate systems to ensure that if a risk of harm to human health or the environment from pollution or waste were to eventuate, its harmful effects would be minimised

  (d) ensure that all substances are handled, stored, used or transported in a manner that minimises risks of harm to human health and the environment from pollution and waste

  (e) provide information, instruction, supervision and training to any person engaging in the activity to enable those persons to comply with the duty under subsection (1).
- Section 6 of the EP Act states that minimising risks of harm to human health and the environment requires the duty holder to eliminate risks of harm to human health and the environment so far as reasonably practicable and, if it is not reasonably practicable to eliminate those risks, then reduce those risks as far as reasonably practicable.
- Section 6(2) of the EP Act states factors to give regard to when determining what is reasonably practicable in relation to the minimising of risks to harm to human health and the environment.
- EPA has published guidelines to help apply and interpret these factors, which are addressed in Section 4.3 below.

4.3 Reasonably practicable

The EP Act sets out the matters that must be considered in determining what is reasonably practicable in relation to the minimisation of risk of harm to human health and the environment. EPA Publication 1856: *Reasonably Practicable* provides guidance when considering these matters.

EPA Victoria Publication 1856 Reasonably Practicable reflects the factors provided in Section 6(2) of the EP Act and provides guidance as to the factors to consider when defining proportionate controls to minimise harm, as follows:

- Eliminate first: Can you eliminate the risk?
- Likelihood: What's the chance that harm would occur?
- Degree (consequence): How severe could the harm be on human health or the environment?

- Your knowledge about the risks: What do you know, or what can you find out, about the risks your activities pose?
- Availability and suitability: What technology, processes or equipment are available to control the risk? What controls are suitable for use in your circumstances?
- Cost: How much does the control cost to put in place compared to how effective it would be in reducing the risk?

The items above have been considered when assessing the suitability of mitigation measures for the project.

4.4 Unreasonable noise

The *Environment Protection Regulations* describes unreasonable (Section 166) and aggravated noise (Section 168) from a commercial, industrial and trade premises in Regulation 118, as follows.

> *For the purpose of paragraph (b) of the definition of unreasonable noise in section 3(1) of the Act, noise emitted from commercial, industrial and trade premises is prescribed to be unreasonable noise if the effective noise level of the noise exceeds-*
>
> *a. The noise limit that applies at the time the noise is emitted; or*
>
> *b. the alternative assessment criterion that applies at the time the noise is emitted if the assessment of an effective noise level is conducted at an alternative assessment location in accordance with the Noise Protocol.*

Regulation 118 also sets noise limits that apply in '*noise sensitive areas'*, above which noise is prescribed to be unreasonable.

The *Environment Protection Regulations* also prescribes a frequency spectrum (Regulation 120) as a prescribed factor to consider when assessing unreasonable noise for the purpose of part (a) of the definition.

Under section 166 of the EP Act, noise can be assessed as unreasonable based on the factors in paragraph (a) of the definition of unreasonable noise (Section 3(1) of the EP Act). This applies to any noise including:

- when the noise limits are met and the factors remain relevant to noise being unreasonable, such as short-term loud events and low frequency noise.

The *Environment Protection Amendment (Wind Turbine Noise) Regulations 2021* describes unreasonable noise (Regulation 131H) from wind turbines as follows:

> *For the purposes of paragraph (b) of the definition of unreasonable noise in section 3(1) of the Act, wind turbine noise is unreasonable noise if it exceeds—*
>
> *a. The noise limit set out in the relevant noise standard; or*
>
> *b. the applicable alternative monitoring point criteria if the assessment of the wind turbine noise is conducted at an alternative monitoring point.*

4.5 Environment Reference Standard

The ERS is made under Section 93 of the EP Act. It sets out the environmental values of the ambient air, ambient sound, land and water environments that are sought to be achieved or maintained in Victoria and standards to support those values.

Information about how the ERS would be applied to support decision making, and how the environmental values, indicators and objectives for each element of the environment would be interpreted is provided in the *Guide to the Environment Reference Standard* (EPA Victoria Publication 1992).

Environmental values are the uses, attributes and functions of the environment that Victorians value. Some examples are water that is safe to drink; air quality that sustains life, health and wellbeing; land that is suitable for production of food; and an ambient sound environment that supports sleep at night.

The ERS applies to both the construction and operation phases of the project and is a reference tool, it does not set compliance limits.

In addition, it does not apply in situations where specific regulations apply to that part of the environment or activity. For example, those noise sources assessed under Part 5.3, Division 3 of the EP Regulations. This is because noise limits and other requirements are clearly set by these regulations.

As such, for the purposes of this assessment, the ERS has been applied to noise from:

- Construction to noise sensitive areas as defined in the ERS
- Both construction and operations of the batching plants and the wind turbines impacting on "*natural areas*" (as defined in the ERS). The residual risk to the environmental value of "*human tranquillity and enjoyment outdoors, in natural areas*" is considered relevant in these cases.

From a noise perspective, the ERS provides a framework, based on environmental values, for assessing the ambient sound environment over a period of time for different categories of land use, as shown in Table 4-2.

Table 4-2 ERS land-use categories

Land use category	General description	Planning Zones
Category I	An urban form with distinctive features or characteristics of taller buildings, high commercial and residential intensity and high site coverage.	Industrial Zone 1 (IN1Z) Industrial Zone 2 (IN2Z) Port Zone (PZ) Road 1 Zone (RDZ1) Capital City Zone (CCZ) Docklands Zone (DZ)
Category II	Medium rise building form with a strong urban or commercial character. Typically contains mixed land uses including activity centres and larger consolidated sites, and an active public realm.	Industrial Zone 3 (IN3Z) Commercial 1 Zone (C1Z) Commercial 2 Zone (C2Z) Commercial 3 Zone (C3Z) Activity Centre Zone (ACZ) Mixed Use Zone (MUZ) Road 2 Zone (RDZ2)
Category III	Lower rise building form including lower density residential development and detached housing typical of suburban residential settings or in towns of district or regional significance.	Residential Growth Zone (RGZ) General Residential Zone (GRZ) Neighbourhood Residential Zone (NRZ) Urban Floodway Zone (UFZ) Public Park and Recreation Zone (PPRZ) Urban Growth Zone (UGZ)

Land use category	General description	Planning Zones
Category IV	Lower density or sparse populations with settlements that include smaller hamlets, villages and small towns that are generally unsuited for further expansion. Land uses include primary industry and farming.	Low Density Residential Zone (LDRZ) Township Zone (TZ) Rural Living Zone (RLZ) Green Wedge A Zone (GWAZ) Rural Conservation Zone (RCZ) Public Conservation and Resource Zone (PCRZ) Green Wedge Zone (GWZ) Farming Zone (FZ) Rural Activity Zone (RAZ)
Category V	Unique combinations of landscape, biodiversity and geodiversity. These natural areas typically provide undisturbed species habitat and enable people to see and interact with native vegetation and wildlife.	Natural areas are classified as land within Category V irrespective of the planning zones that apply to that land.
Category I, II, III or IV	Depending on surrounding land uses and the intent of the specific planning zone (which may have a diversity of uses) as specified in a schedule to the planning zone	Comprehensive Development Zone (CDZ) Priority Development Zone (PDZ) Special Use Zone (SUZ) Public Use Zone (PUZ)

The environmental values of the ambient sound environment are set out in Table 3.1 of the ERS, as reproduced below in Table 4-3.

Table 4-3 Environmental values of the ambient sound environment

Environmental value	General description
Sleep during the night	An ambient sound environment that supports sleep at night
Domestic and recreational activities	An ambient sound environment that supports recreational and domestic activities in a residential setting
Normal conversation	An ambient sound environment that allows for a normal conversation indoors without the need to raise voices
Child learning and development	An ambient sound environment that supports cognitive development and learning in children
Human tranquillity and enjoyment outdoors in natural areas	An ambient sound environment that allows for the appreciation and enjoyment of the environment for its natural condition and the restorative benefits of tranquil Soundscapes in natural areas.
Musical entertainment	An ambient sound environment that recognises the community's demand for a wide range of musical entertainment

EPA Victoria Publication 1992 provides the following context with respect to the indicators and objectives for the ambient sound environment:

> *The objectives vary with the time interval for the relevant time of day. The lower night-time objectives compared to the day/evening objective for the same category apply to the environmental value of sleep during the night. For example, in category III, the objective for the* $L_{Aeq,8\,hr}$ *from 10 pm to 6 am is 40 dB(A), whereas for the same category the objective for the outdoor* $L_{Aeq,16hr}$ *during the day and evening (6 am to 10 pm) is 50 dB(A). This is sufficient to maintain the environmental value of sleep for most people during the night, even with bedroom windows open.*
>
> *The ERS objectives also differ based on the land use category. The objectives for developed areas are based on the Australian standard for design sound levels within buildings AS/NZS 2107:2016. These levels were adjusted to the outdoor environment (in free-field conditions) based on the typical noise reduction provided by the building envelope within the corresponding land use setting. For example, the difference in noise level from outdoors to indoors with the window open is generally understood to be 10 dB(A). Similarly, for typical older Australian dwellings without additional noise control, a reduction of 15 dB(A) can reasonably be expected when windows are closed. Greater noise reduction, around 20 dB(A), can be achieved in contemporary constructions that include thermal efficiency measures (such as thermal double glazing for the prevention of air leakage). Even higher noise reduction can be expected where specific acoustic treatments have been incorporated.*
>
> *The ERS objectives for sound in the ambient environment are designed to achieve and maintain the environmental values that relate to the intended use of buildings in specific land use categories. The differences in objectives recognise the reality of current ambient sound levels that can reasonably be expected in developed areas. In some land use settings, such as category I, some modification to living arrangements or building design is expected (such as closed windows or improved acoustic attenuation). In the more urbanised ERS land use categories (I and II), additional noise attenuation above standard contemporary energy-efficient construction may be required to achieve internal noise levels equivalent to those observed in other land use categories*.

The ERS indicators and objectives are set out in Table 4-4. It is noted that for land classified as Category 5, the qualitative indicator and objective apply irrespective of the planning zones that apply to that land.

Table 4-4 Indicators and objectives for the ambient sound environment

Land use category	Indicators	Objectives
Category I	Outdoor $L_{Aeq,8h}$ from 10 pm to 6 am	55 dB
	Outdoor $L_{Aeq,16h}$ from 6 am to 10 pm	60 dB
Category II	Outdoor $L_{Aeq,8h}$ from 10 pm to 6 am	50 dB
	Outdoor $L_{Aeq,16h}$ from 6 am to 10 pm	55 dB
Category III	Outdoor $L_{Aeq,8h}$ from 10 pm to 6 am	40 dB
	Outdoor $L_{Aeq,16h}$ from 6 am to 10 pm	50 dB
Category IV	Outdoor $L_{Aeq,8h}$ from 10 pm to 6 am	35 dB
	Outdoor $L_{Aeq,16h}$ from 6 am to 10 pm	40 dB
Category V	Qualitative	A sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural Soundscape

Table 5.1 of EPA Victoria Publication 1992 provides further guidance as to the interpretation of the ERS environmental values described in Table 4-5.

Table 4-5 Derivation and interpretation of objectives for ambient sound environmental values

Environmental value	Indicator type	Derivation	Interpretation
Sleep during the night	Decibel level as an outdoor $L_{Aeq,8\ hour}$ (in free field conditions)	Decibel level objectives are derived from standards for design of building interiors suitable for sleep (AS/NZS 2107:2016). The objectives are adapted based on expected building attenuation in the land use setting and whether the occupant is more likely to sleep with their windows opened or closed. In category I, the night-time objective is consistent with the levels suggested by enHealth (2018) as evidence-based limits outdoors and the interim target in the World Health	Not meeting the decibel level objectives outdoors in the ambient sound environment indicates that there is an increased risk of sleep disturbance due to noise (difficulty falling asleep, awakening, poor quality sleep). An increased potential risk of sleep disturbance can be expected when the levels are exceeded: • even if windows are closed in the

Environmental value	Indicator type	Derivation	Interpretation
		Organization Night noise guidelines for Europe (WHO, 2009).	more urbanised areas in categories I and II • when windows are open in categories III and IV.
Domestic and recreational activities	Decibel level as an outdoor $L_{Aeq,16\ hour}$ (in free field conditions)	Decibel level objectives for domestic and recreational activities are derived from standards for design of building interiors suitable for living areas of residential buildings in different land use settings (AS/NZS 2107:2016). The objectives are adapted, based on expected building attenuation in the land use setting and whether the occupant is more likely have windows opened or closed. In category I, the day-time objective is consistent with the level suggested by enHealth (2018) as evidence-based limits outdoors.	The objectives are set at levels above which there is an increased risk of disturbance by noise. Not meeting the decibel levels outdoors can affect domestic and recreational activities that people conduct at home and other residences. Noise can be expected to interfere with reading and other tasks that require concentration or sustained attention, such as working from home, watching television, listening, rest and recreation. An increased risk of disturbance to domestic and recreational activities can be expected when the levels are exceeded: • for categories I and II, outdoors and indoors, even if windows are closed, • for categories III and IV, • outdoors and indoors when windows are open.
Normal conversation	Decibel level as an outdoor $L_{Aeq,16\ hour}$ or an outdoor $L_{Aeq,8\ hour}$ (in free-field conditions)	Ambient sound can interfere with speech intelligibility (the ability of speech to be heard and understood). The objectives are based on evidence of speech intelligibility at different ambient sound levels.	The risk of interference to normal conversation increases when ambient sound levels exceed the day-evening objectives for categories I and II. This risk increases as the distance between the

Environmental value	Indicator type	Derivation	Interpretation
			speaker and the listener increases. In category I, if sound levels increase above the level of the day-evening objective, the ability to hold a normal conversation indoors can be affected when the windows are open. In category I and II, conversations outdoors can require a higher vocal effort as sound levels increase above the level of the day-evening objective.
Child learning and development	Decibel level as $L_{Aeq,16\ hour}$ (in free- field conditions)	Decibel level objectives for child learning and development are derived from standards for design of building interiors suitable for teaching spaces and classrooms in educational buildings. (AS/NZS 2107:2016) In categories I, II and III, the objectives are based on having the classroom windows closed on the facade most exposed to the sound. The objectives do not apply to spaces inside buildings used for sleeping during daytime, as may occur in childcare centres.	Ambient sound levels exceeding the objectives pose a risk to children being able to hear and understand complicated spoken messages in classrooms and learning areas. In categories I and II, additional building attenuation may be warranted to achieve acceptable internal sound levels. For example. AS/NZS 2107:2016 recommends a range of 35 to 45 dB(A) for teaching spaces and single classrooms. Above this range, most people would be dissatisfied with the level of intruding sound.
Human tranquillity and enjoyment outdoors in natural areas	Qualitative	This objective is based the World Health Organization Guidelines for community noise (WHO, 1999) recommendations to protect the outdoors in parkland and conservation areas from disruption of tranquillity. WHO (1999) states:	Introducing non-natural sounds into natural areas poses a potential risk to visitor experience, disruption of tranquillity and loss of enjoyment of the natural area.

Environmental value	Indicator type	Derivation	Interpretation
		'existing quiet outdoor areas would be preserved and the ratio of intruding noise to natural background sound would be kept low'.	
Musical entertainment	None	Recognises the importance of musical entertainment to Victoria's culture and economy. It carries over the policy goal of SEPP N-2 (Victorian Government, 1989b)	Decisions that introduce sounds into the environment where musical entertainment is performed pose a risk to this value.

4.6 Construction noise

The obligation of Section 166 (unreasonable noise) of the EP Act applies to any place or premises that are not residential premises, which includes construction sites. However, there are no statutory noise limits which apply to construction work in Victoria.

However, EPA Victoria provides recommendations for managing construction noise in Publication 1834.2.

4.6.1 EPA Victoria Publication 1834.2

EPA Victoria Publication 1834.2 "*Civil construction, building and demolition guide*" provides guidance with respect to construction working hours for various types of development.

For the purposes of this assessment the project has been classified as a "*commercial and industrial construction and demolition site*".

Section 4.3 "*Managing noise and vibration during working hours*" provides normal working hours and noise management measures that would be adopted at all times whilst Section 4.4 "*Managing noise and vibration outside normal working hours*" provides additional requirements for noise management outside of those hours.

This is presented in Table 4-6.

Table 4-6 Working hours defined in EPA Victoria Publication 1834.2

Period	Recommendations
Normal working hours Monday to Friday; 7am – 6pm Saturdays; 7am – 1pm	General noise at any time during the day might still be considered unreasonable, depending on the work practices and circumstances in which the noise is emitted. Assessment must consider the attributes of the noise and the time, place and circumstances in which it is emitted.
Weekend/evening work hours Monday to Friday; 6pm – 10pm Saturdays; 1pm – 10pm Sundays and Public Holidays; 7am – 10pm	Noise levels at any residence must not exceed the background (L_{A90}) noise at the time of impact by: • 10 dB or more for up to 18 months after project commencement • 5 dB or more for 18 months or more after project commencement
Night period Monday to Sunday; 10pm – 7am	Noise is to be inaudible within a habitable room at any residential premises. If audible, this is considered unreasonable noise under the EP Act. However, provision is made for circumstances of unavoidable works, low-noise or managed-impact works.

Blasting is not proposed to be part of the construction methodology for this project and therefore has not been assessed.

Page 39 of EPA Publication 1834.2 provides the following guidance:

> *The construction noise should be assessed as an L_{Aeq} and compared to the background noise at the time of impact. If the noise presents tonal or impulsive character, apply the following adjustments to the measured L_{Aeq}:*
>
> - *+2 dB for a tone just detectable by the observer and +5 dB for a tonal component prominently audible; and*

- *+2 dB for an impulsiveness just detectable by the observer and +5 dB if it is readily detectable.*

Where relevant, these corrections have been added to the predicted construction noise levels.

4.7 Construction vibration

There are no existing statutory requirements or guidelines for assessing or managing vibration from the construction of major infrastructure in Victoria. However, the GED and Section 166 of the *Environment Protection Amendment Act 2018* apply to vibration.

Recent major impact assessments in Victoria have instead used criteria from British or German standards or from the International Standards Organisation (ISO). Accordingly, the human amenity criteria adopted herein are based on British Standard BS6472-1:2008 and the German Standard DIN 4150-3:2016 is adopted when considering potential structural damage impacts.

Note that blasting is not expected to be part of the construction methodology for this project and therefore has not been discussed in this report.

4.7.1 British Standard BS6472-1:2008

British Standard BS6472-1:2008 "*Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting*" (BS6472-1:2008) includes Vibration Dose Value (VDV) ranges for workshops, offices, residences (daytime and evening).

These ranges highlight the values where adverse vibration impacts for most persons could be expected. The vibration dose values for these building types are presented in Table 4-7. For offices and workshops, multiplying factors of two and four respectively would be applied to the VDV ranges for a 16-hour day.

Table 4-7 Vibration dose value ranges for residential buildings (BS6472-1:2008)

Place and time	Low probability of adverse comment $ms^{-1.75}$	Adverse comment possible $ms^{-1.75}$	Adverse comment probable $ms^{-1.75}$
Residential buildings 16-hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8-hour night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Offices	0.4 to 0.8	0.8 to 1.6	1.6 to 3.2
Workshops	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

See section 4.7.3 for further information about the applicability of the dose values presented in Table 4-7 when managing vibration from construction.

4.7.2 DIN4150-3:2016

German Standard DIN 4150-3 "*Structural vibration in buildings – Effects on structures*" (DIN 4150-3) outlines 'safe limits' as Peak particle velocity (PPV) levels up to which no damage due to vibration effects have been observed for particular classes of buildings. Damage is defined as anything from minor non-structural effects such as superficial cracking in cement render to the separation of partitions or intermediate walls from load bearing walls. Safe limits applied to vibration levels of a short duration are summarised in Table 4-8.

Table 4-8 Structural damage 'safe limits' for construction short-term vibration on structures (DIN 4150-3)

Group	Type of structure	Peak particle velocity (PPV) in mm/s		
		At foundation at a frequency of:		
		Less than 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. heritage-listed)	3	3 to 8	8 to 10

1 For frequencies above 100 Hz, the higher values in the 50 Hz to 100 Hz column would be used.

The more stringent values shown in Table 4-9 can be applied when evaluating the effects of long-term or continuous vibration on structures.

Table 4-9 Structural damage 'safe limits' for construction vibration for long-term vibration impacts on structures

Group	Type of structure	Guideline values for velocity (mm/s) of Vibration at horizontal plane of highest floor (All frequencies)
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	10
2	Dwellings and buildings of similar design and/or occupancy	5
3	Structures that, because of their sensitivity to vibration, cannot be classified under lines 1 and 2 and are of intrinsic value (e.g. Heritage buildings)	2.5

4.7.3 Vibration descriptors relevant to construction

The dose values outlined in in 4.7.1 are a measure of the weighted spectral vibration experienced over a specified period whereas construction vibration is often measured as a PPV.

Peak particle vibration criteria are generally preferable as they allow for an immediate review of discrete events that exceed a pre-determined threshold. The PPV can be described as the rate at which a particle of ground is moving, i.e. a measure of ground vibration, in millimetres per second.

Furthermore, PPV is considered the simplest indicator of both perceptibility and the risk of damage to structures.

British Standard BS5228-2:2009 suggests that:

> *…..for construction it is considered more appropriate to provide guidance in terms of the PPV (peak particle velocity), since this parameter is likely to be more routinely measured based upon the more usual concern over potential building damage, Furthermore, since many of the empirical vibration predictors yield results in terms of PPV, it is necessary to understand what the consequences might be of any predicted levels in terms of human perception and disturbance.*

A reasonable approach that has been adopted for other projects in Victoria is to convert the human amenity vibration dose values to a representative PPV value.

By setting criteria that are readily understood and measurable, the communications between stakeholders can be quickly advanced leading to prompt adjustments to construction practices if required.

4.7.4 Underground assets

Vibration from construction works has the potential to cause structural damage to underground services. Consultation with asset owners will be required to define specific criteria for individual asset types.

4.8 Operational noise – onshore fixed infrastructure

The following sections provide an overview of the relevant documents with respect to noise form onshore infrastructure.

4.8.1 EPA Victoria Publication 1826 – the Noise Protocol

The Noise Protocol provides noise assessment procedures (including statutory noise limits) to protect people from operational industrial noise that may affect normal domestic and recreational activities, including sleep at night.

For '*commercial, industrial and trade premises'*, the *Environment Protection Regulations* (Part 5.3, Division 3 for commercial, industrial and trade premises) set noise limits that apply in '*noise sensitive areas'*, above which noise is prescribed to be unreasonable (Regulation 118). The noise limits are determined using the Noise Protocol, and the noise limits are set by the EP Regulations.

However, the lay reader is unlikely to be aware of this distinction. Therefore, since the method for deriving the limits is contained within the Noise Protocol and not the Regulations, the limits have been described as the "*Noise Protocol Limits*" through-out this document.

There are two methods provided to determine the noise limits depending on the location of the site: the urban method and the rural method. The relevant method depends only on the location of the noise sensitive area, regardless of whether the premises investigated is within a major urban boundary or in a rural area.

In addition, EPA Victoria provides classification of major urban boundaries for large conurbations outside of Melbourne (such as Mildura, for example).

The site is in a rural area and so the relevant noise limits have been defined in accordance with Section 2 of the Noise Protocol "*Noise limits – Rural areas method*".

A detailed derivation of the Noise Protocol Limits is presented in Appendix B.

4.8.2 Assessment of noise using the Noise Protocol

EPA Victoria provide guidance for the assessment of noise from industrial and commercial operations. Key considerations for an assessment using the Noise Protocol are summarised below:

- Meeting the regulatory noise limits does not mean the GED has been met. The GED requires all reasonably practicable steps be taken to eliminate or reduce the risk of harm due to from noise from the operation of the project.
- Even if the GED is met, the noise may be unreasonable if it exceeds the noise limits or considering the factors in the definition of unreasonable noise in Section 3(1) the EP Act.
- Industry is expected to take reasonable opportunities to reduce noise from site operations. Not exceeding the Noise Protocol Limits that apply to noise from industry within the approved area of application is part of these obligations.
- The Noise Protocol Limits derived for a noise sensitive area apply at the area of land which is within 10 metres of the facade. The calculated or measured noise levels from an industrial site is compared to the relevant Noise Protocol Limits at this location to determine compliance.
- Adjustments are to be applied to the measured or modelled output of an industrial site to account for the duration of noisy activities over a 30-minute period and the potential annoyance associated with noise characteristics such as tonality, intermittency and impulsiveness (See Section 6.8).
- Noise sources that are not assessed under Part 5.3, Division 3 of the EP regulations include:
  - Road and rail corridors
  - Noise from construction or demolition activities on building sites
  - Residential noise
  - Non-commercial vehicles, on or off the site, except for maintenance activities, or
  - Noise from audible intruder, safety or emergency alarms

All industry is encouraged to design and operate below the Noise Protocol Limits at nearby sensitive receptors to achieve the intentions of the GED.

4.8.3 Cumulative noise

Regulation 119 of the EP Act provides that:

(1) *If 2 or more commercial, industrial and trade premises (whether existing or proposed) emit, or are likely to emit, noise that contributes to the effective noise level, a person in management or control of one or more of those premises must take all reasonable steps to ensure that the contribution from each of the premises, when combined, does not exceed the noise limit for the noise sensitive area.*

(2) *For the purposes of subregulation (1), what constitutes a reasonable step must be determined in accordance with the Noise Protocol.*

Clause 62 of the Noise Protocol provides that:

> *The value of a specific alternative assessment criterion is determined from the relevant noise limit, the difference between the sound paths from the industry being assessed to the noise sensitive area, and the sound paths to the alternative assessment location. It may also be influenced by the character of the noise. However, to ensure that meeting an alternative assessment criterion is consistent with complying to the relevant noise limit that applies within the considered noise sensitive area, an alternative assessment criterion is not subject to the base noise limits set out in Regulation 118(2) or to the maximum value of 55 dB(A) for the night period set out in Regulation 118(3).*

In accordance with Section 3.3.1 of EPA Victoria Publication 1997, major new sources of noise would apply the equal contribution principle. This is the new noise source is abated to the Noise Protocol Limit minus $10\times\log^{10}(N)$, where N is the total number of existing and likely contributing industrial plant installations. For example, where N = 2, a reduction of three decibels is applied to the Noise Protocol Limits.

It is noted however that the equal contribution principle is not applicable in the case that an existing industry already exceeds the noise limits at the nearest noise sensitive area. In this case then:

> *each industry must take all reasonable steps to ensure that the individual contributions, when combined, do not exceed the noise limit for the noise sensitive area for each of the day, evening or night period.*
>
> *In other words, the noise limit must be 'shared' between all premises contributing to the noise within the noise sensitive area. To achieve this, the noise emissions of each individual industry should be controlled to meet noise levels lower than the noise limits.*

Applying this lower noise criterion allows for multiple facilities to assess and manage noise from their individual sites.

4.9 Operational noise – offshore wind energy facility

The following sections provide an overview of the relevant documents with respect to noise form offshore infrastructure.

4.9.1 Environment Protection Amendment (Wind Turbine Noise) Regulations 2021

In 2021, the *Environment Protection Act 2017* (EP Act) and *Environment Protection Regulations 2021* (the Regulations) established a new regulatory framework for wind turbine noise in Victoria. Prior to this, wind farms were regulated solely under the Planning and Environment Act 1987 (PE Act).

Noise from wind turbines was regulated through conditions of planning approval. Planning and construction phases are still regulated by planning permits, or other approvals, but turbine noise during the operational phase is regulated by EPA Victoria under the EP Act and Regulations.

Operational noise limits applicable to wind energy facilities (WEFs) in Victoria must be determined in accordance with the relevant noise standard subject to regulation 131BA(2) and (3) of the Regulations.

Where a high amenity noise limit does not apply, the wind turbine noise limit is the higher of 40dB(A) and 5dB above background sound level, at all wind speeds. This noise limit must be achieved at a noise sensitive location, which encompasses 20m on any side of a building which contains habitable or education spaces that is not on the wind farm site, and land that is zoned for residential use.

From 18 October 2022 amendments to the *Environment Protection Regulations* (Division 5 of Part 5.3) introduced new, ongoing wind turbine noise obligations, which include:

- Ongoing compliance with the relevant noise standard - New Zealand Noise Standard NZS 6808 2010.
- Implementation of a noise management plan, including a complaints management plan.
- Introduction of maximum allowable noise limit of 45 L_{A90}, dB or background plus 5 dB (for properties subject to stakeholder agreements)
- Providing an annual statement detailing the actions that have been taken to ensure compliance.
- Completing a post-construction noise assessment within 12 months of commencement of operations
- Conducting noise monitoring every five years from 1 January 2024.

New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010) is used to assess wind farm noise for those projects with an authorising document issued on or after 1 January 2011, as required by the *Environment Protection Amendment (Wind Turbine Noise) Regulations 2021*.

4.9.2 EPA Victoria Publication 3011

EPA Publication 3011 supports the technical measurement and assessment of wind turbine noise emissions under the Regulations made under the EP Act. It is intended to assist WEF operators to meet their obligations under the Regulations.

4.9.3 High amenity areas

Clause 5.3 of the 2010 Standard provides for a high amenity area (HAA) noise limit, being the higher of 5dB above background and 35dB(A), during evening and night times at wind speeds below 6m/s. The Standard envisages that a HAA limit should only be applied where the relevant planning instrument, such as a planning scheme, 'promotes a higher degree of protection of amenity related to the sound environment in a particular area.'

In Victoria, the EPA has provided guidance in EPA Publication 3011 that the HAA limit:

- Should apply to a dwelling located in the following zones predominantly intended for residential development: Low Density Residential Zone (LDRZ), Township Zone (TZ), Rural Living Zone (RLZ), Green Wedge A Zone (GWAZ) and Rural Conservation Zone (RCZ)
- Should not apply to the Farming Zone (FZ)
- Should not be applied in any location where background sound levels are already affected by other specific sources such as road traffic noise
- Only applies for WEF wind speeds up to and including 6 m/s
- Is applicable only when there is no agreement made in accordance with regulation 131A.

Above 6 m/s the base wind turbine noise limit is 40 dB(A) (that is, the standard acceptable noise limit).

Where an HAA noise limit does not apply, the 'standard' wind turbine noise limit discussed in Section 4.9.1 (i.e. the higher of 5dB above background and 40 dB(A)) applies at all wind speeds.

4.10 EPA Publication 1996 - Low frequency noise

The EPA publication 1996: *Noise guidelines: assessing low frequency noise (* sets out a procedure to assess low frequency noise.

EPA Victoria Publication 1996 is a guideline for acoustic consultants and other qualified professionals who assess low frequency noise (10 to 160 Hertz (Hz)). Table 1 of EPA Victoria Publication 1996 provides a list of the types of activities and equipment that could give rise to low frequency noise.

Table 4-10 Sources of low frequency noise – EPA Victoria Publication 1996

Type	Noise source	
Commercial/Industrial/Trade	• Aircraft	• Loading and unloading
	• Blasting	• Metal thudding
	• Boilers	• Motors
	• Cooling towers	• Power stations
	• Cooling fans	• Pumps
	• Compressors	• Shipping
	• Diesel engines	• Steam releases
	• Electrical installations	• Shakers
	• Extraction fans	• Transformers
	• Heavy machinery	• Ventilation plant
	• Large generators	• Vibratory screens

Type	Noise source	
Residential	• Air conditioners • Electric appliances • Fish tank pumps	• Heat pumps • Refrigerators • Spa bath pumps
Natural causes	• Sea, including surf • Seismic activity • Thunder	• Wind • Wind effects on structures

EPA Victoria Publication 1996 does not apply to:

- Music noise from entertainment venues
- Noise from residential premises
- Noise from wind turbines.

In addition, EPA Victoria Publication 1996 provides the following guidance with respect to predicting low frequency noise:

> *Predicting expected noise levels at noise sensitive receptors may be compared against the relevant low frequency threshold levels (Table 2 for indoor or Table 3 for outdoor measurements). However, noise level calculations in the low frequency range can be problematic and of limited accuracy.*
>
> *The use of noise calculations would be restricted to indicative estimations only. Due to this, calculations would only be used as a screening tool to assess the risk of low frequency noise from the proposed development and/or extension of existing commercial, industrial and trade premises.*
>
> *Other factors you would consider:*
>
> - *Noise data provided by equipment manufacturers and suppliers of noise control solutions may not be available at low frequencies. The frequency range of most acoustic testing standards doesn't extend below one-third octave band 50 Hz.*
> - *Equipment noise levels from measurements conducted at other facilities can be used as an input for noise calculations. However, the uncertainty associated with using data from another site needs to be considered.*
> - *Engineering calculation methods for the outdoor propagation of sound would be used with caution. The procedures such as those within ISO 9613-2:1999 or CONCAWE (1981), can be based on empirical data in octave bands rather than one-third octave bands, meaning the value of attenuation factors at low frequencies may not be documented.*
>
> ***Using extrapolation in low frequency noise calculations***
>
> *It may be acceptable to use extrapolation to estimate noise emission levels in the low frequency range if the trend is known from:*
>
> - *Measurement*
> - *Verifiable literature references, for example, Bies, Hansen & Howard (2018) and Joint Departments of the Army and the Air Force USA (1995).*

The outdoor noise threshold criterion to be used for outdoor assessments is provided in Table 3 of EPA Victoria Publication 1996, as follows in Table 4-11.

Table 4-11 One-third octave low-frequency noise thresholds, EPA Victoria Publication 1996

Hz/dB(Z)	One-third octave band threshold level, $L_{Zeq,15min}$ dB												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The threshold levels are not set limits. Rather, they are levels that indicate a potential risk of problematic low frequency noise.

As noted in EPA Publication 1996, the thresholds are derived from two research papers prepared by the Acoustics Research Centre at the University of Salford on behalf of the Department of the Environment, Food and Rural Affairs (DEFRA) in the UK, as follows:

- *Proposed criteria for the assessment of low frequency noise disturbance* (2005)[1].
- *A procedure for the assessment of low frequency noise complaints* (2011)[2].

The summary of the 2005 DEFRA Paper provides the following context:

> *In the laboratory tests, a set of 'thresholds of acceptability' were established by asking 18 subjects to set the level of various low frequency sounds to a just-acceptable level for imagined day and night situations. The sounds presented consisted of a set of tones across the low frequency range, 'real' low frequency noise extracted from field test recordings, and synthesized tones with varying degrees of fluctuation.*

The thresholds of acceptability from Table 9 of the 2005 DEFRA Paper have been adopted as the indoor thresholds provided in Table 2 of EPA Publication 1996. The outdoor thresholds, presented in Table 3 of EPA Publication 1996, are from the same source but include a correction to account for the noise insulation performance of a typical dwelling.

The concluding remarks from the 2005 DEFRA paper provides that:

> *It is suggested that the proposed criterion be used not as a prescriptive indicator of nuisance, but rather in the sense of guidance to help determine whether a sound exists that might be expected to cause disturbance. <u>Some degree of judgement by the EHO is both desirable and necessary in deciding whether to class the situation as a nuisance</u>, and is likely to remain so. One of the main reasons is that, from the control cases, it is clear that <u>problems do not necessarily arise when the criteria are exceeded</u>. Indeed, we can conjecture that genuine LFN complaints occur only in a few such cases.*

Noise is regarded as a statutory nuisance (meaning "to harm or injure") under UK law if it does one of the following:

- Unreasonably and substantially interferes with the use or enjoyment of a home or other premises.
- Injures health or is likely to injure health.

In which case, the term nuisance, as used in the 2005 DEFRA Report, is considered to be broadly equivalent to the concept of harm as provided in the *Environment Protection Act 2017*.

It is considered appropriate to take the outdoor thresholds provided in Table 3 of EPA Publication 1996 as the criteria for deciding whether there is a risk of harm due to low frequency noise for the following reasons:

- The research that led to the definition of the EPA Publication 1996 outdoor thresholds indicates that noise below these levels would not be expected to cause disturbance.
- Noise levels above the thresholds could lead to disturbance but do not necessarily constitute a nuisance (i.e. an adverse effect). Some degree of judgement is required. In other words, an exceedance of the EPA 1996 thresholds indicates a higher risk of problematic low frequency noise.

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[1] Moorhouse, AT, Waddington, DC and Adams, MD
[2] Moorhouse, AT, Waddington, DC and Adams, MD

The degree of risk would require further analysis, noting that harm is defined in section 4 of the EP Act, as '*an adverse effect on human health or the environment (of whatever degree or duration)*'.

- Therefore, the inference can be drawn that nuisance would not be expected to occur in the absence of disturbance.
- Hence, if a disturbance is not expected (because the measured or predicted levels are below the EPA Publication 1996 thresholds) then neither would nuisance (i.e. harm) be expected.

5.0 Consultation and engagement

Star of the South has undertaken extensive engagement with a broad range of stakeholders and communities throughout the project's development phase and preparation of the EIS/EES to communicate project information; obtain, understand and discuss feedback; and identify potential issues and opportunities for consideration in the EIS/EES. A summary of this engagement is documented in Attachment II: EIS/EES Consultation Report.

Consultation specific to 'onshore noise' has also been undertaken with identified stakeholders to inform this report. A summary of this engagement is provided below.

Engagement activities

Key activities undertaken between 2019 and 2025 to engage with identified stakeholders include:

- Discussions with community members through phone calls, emails or visits to the Gippsland office.
- Direct engagement with landholders along the project's proposed transmission route; including phone calls, emails and meetings
- Direct engagement with relevant stakeholders through phone calls, emails and meetings
- Community information sessions
- Presence at community events and pop-up stalls across Gippsland.

Stakeholders

Key stakeholders identified and engaged on this report include:

- Gippsland community
- Landholders along the project's proposed transmission alignment
- Parks Victoria
- Wellington Shire.

Table 5-1 Stakeholder engagement undertaken

Stakeholder/partner and type of response	Issues raised	Response to issues raised and/or where considered within this report or associated appendices.
General community	Level of noise heard from drilling and construction activity at Reeves Beach and potential impact on campers and local residents	The assessment is provided in Section 9.7. Mitigation measures are provided in Section 13.4 and 13.5.
	Management of noise and vibration from offshore piling and where would it be heard or felt from on land	The assessment is provided in Section 9.9. Mitigation measures are provided in Section 13.4 and 13.5.
	Potential for night-time construction noise, (onshore and/or offshore) affecting residents	The assessment is provided in Section 9.7, 9.8, 9.9
	Ability to hear operational turbines from shore	Operational noise levels of the wind turbines and offshore substation and potential impact on the surrounding

Stakeholder/partner and type of response	Issues raised	Response to issues raised and/or where considered within this report or associated appendices.
	Potential noise or amenity impacts from operational turbine blades	soundscape and noise receptors are assessed in Section10.2.3, 10.2.7, 10.2.11 and 10.5.1. Section 10.5.1
Landholders	Concern about daytime construction noise on liveability or farming operations	The assessment is provided in Section 9.5 and 9.6.
Parks Victoria	Level of audible construction noise from Reeves Beach Campground	The assessment is provided in Section 9.0

6.0 Methodology

As context to the assessment approach, the Star of the South Offshore Wind Farm is a large project that covers a wide geographic area and has the potential for significant influence across Commonwealth waters and Victorian coastal waters, the state of Victoria and in particular the central Gippsland region. Accordingly, the impacts (both positive and negative) of the project are assessed in terms of their materiality at the scale of Commonwealth waters and Victorian coastal waters, the state of Victoria and the central Gippsland region.

This report is limited to surface noise and vibration impacts to humans. Underwater and terrestrial noise impacts to flora and fauna from project construction and operation activities would be presented separately.

6.1 Overview of assessment framework

This section describes the framework used to assess potential environmental issues associated with the proposed project.

The assessment has been guided by an evaluation framework that comprises applicable legislation, policy, guidelines and standards, the Commonwealth EIS guidelines and the EES scoping requirements and study-specific assessment criteria. The approach generally aligns with guidance issued by the Australian National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for the Environmental Assessment of Major Offshore Infrastructure (Reference: *Environment Management Plan Content Requirement, 16/12/12022)* and the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (OPGGS Regulations).

An overview of the assessment framework is presented in Figure 6-1.

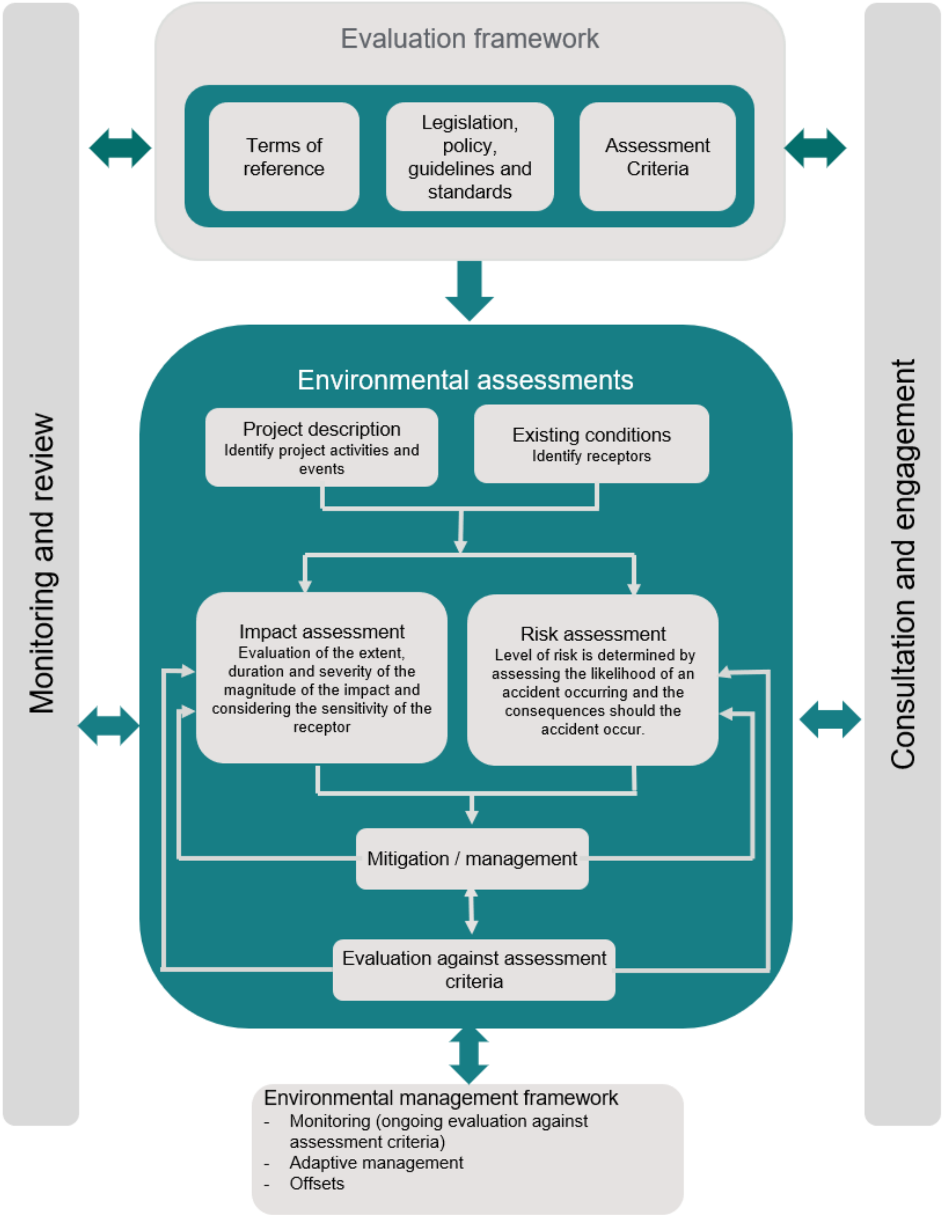

Figure 6-1 Overview of assessment framework

The environmental assessment in relation to Onshore Noise and Vibration were undertaken according to the following steps:

- **Existing conditions:** Characterisation of existing (baseline) environmental conditions and identification of sensitive assets, values and uses that may be affected by construction, operation and decommissioning of the project
- **Project description:** Review of the key project components and proposed construction, operation and decommissioning activities to identify potential project interactions with sensitive receptors (i.e. events). This includes identification of the maximum design scenario for the purposes of impact and risk assessment, taking into account the parameter range within the project design envelope as outlined in Chapter 4 – Project description for the whole of project assessment across the Commonwealth jurisdiction Chapter 4 – Victorian works project description of the EES for the Victorian jurisdiction and selection of the parameter value with potentially greatest impact or risk.
- **Impact assessment:** Assessment of consequences based on the predicted magnitude of the impacts and the sensitivity of potentially affected receptors, taking into account proposed mitigation

measures and their likely effectiveness. The impact assessment methodology is described in Section 6.4.

- **Risk assessment**: Assessment of likelihood and consequences of accidents (i.e. events that are not certain to occur). The risk assessment methodology is described in Section 6.9.
- **Avoid, mitigate and manage:** Identification of mitigation measures to avoid, minimise and manage impacts or risks and to address the GED as required under the EP Act.
- **Evaluation against assessment criteria:** Evaluation of predicted residual impacts or risks against assessment criteria set out in Section 6.5 and Section 6.6. If the impact or risk assessment indicates that the criteria are not met, then changes to the project design are made or further mitigation measures are introduced. Residual impacts and risks are those that remain following the implementation of all mitigation measures committed to by the project, taking into account their expected effectiveness.
- **Monitoring and review:** Continual checking for changes to legislation, policy, guidelines and standards and the project description and subsequent refinement and updating of assessments as required.
- **Consultation and engagement:** Consideration of feedback from community, stakeholders and regulators to ensure that concerns and expectations are met. Stakeholder consultation and engagement will continue throughout the life of the project.

For impacts (expected events) the likelihood of the event is considered to be certain, therefore only an evaluation of consequence is required. For risks (accidental events) both likelihood and consequences need to be considered. The evaluation of consequences for both impacts and risks takes into consideration the nature and scale of the effects, the predicted extent, severity and duration, the likely effectiveness of mitigation measures to reduce consequences as well as the sensitivity of the receptor.

As an example, ‘project activity’ is construction piling, and in this case the ‘event’ is underwater noise, and the ‘consequence’ would be injury or disturbance to marine mammals. Underwater noise is an expected event as the generation of underwater noise is a planned part of construction that cannot be avoided as part of the activity. Underwater noise would be detectable within and beyond the activity area. It is expected that marine fauna would encounter the underwater noise due to their known presence in the activity area. An example of an accidental event is where the ‘project activity’ is vessel presence, and in this case the ‘event’ is ‘collision with marine fauna’ and the ‘consequence’ would be injury or disturbance to marine mammals. This event is unlikely to occur but is still possible.

6.2 Study area

The study area is defined as all locations that may potentially be impacted by project activities.

6.2.1 Offshore

Noise levels due to offshore operations have been assessed at the nearest representative noise sensitive receptors onshore which is located at least 10 kilometres from the offshore licence area and export cable corridor (refer to Figure 2-3). This noise assessment is based on the onshore study area, as described in Section 6.2.2.

6.2.2 Onshore

Most of the land located adjacent to the project corridor is sparsely populated rural land. This type of land use is typically quieter than suburban areas meaning that the introduction of a new noise source may cause changes to the noise environment at distances of more than one or two kilometres. An onshore study area up to 2 kilometres from the project was therefore considered appropriate for capturing noise impacts for the activities (including construction, operation and associated traffic) outlined in the project description.

The propagation of ground vibration is dependent on the type of activity and attenuation characteristics of the medium that the vibration is travelling through. Vibration impacts associated with civil infrastructure are typically limited to distances of up to approximately 50 metres for structural damage and between 100 and 200 metres for human disturbance. The study area adopted for the assessment of noise impacts is therefore considered also to be adequate for determining impacts from ground vibration.

Figure 6-2 shows the study area for this noise and vibration impact assessment. This figure shows a 2-kilometre area beyond the project that applies to the assessment.

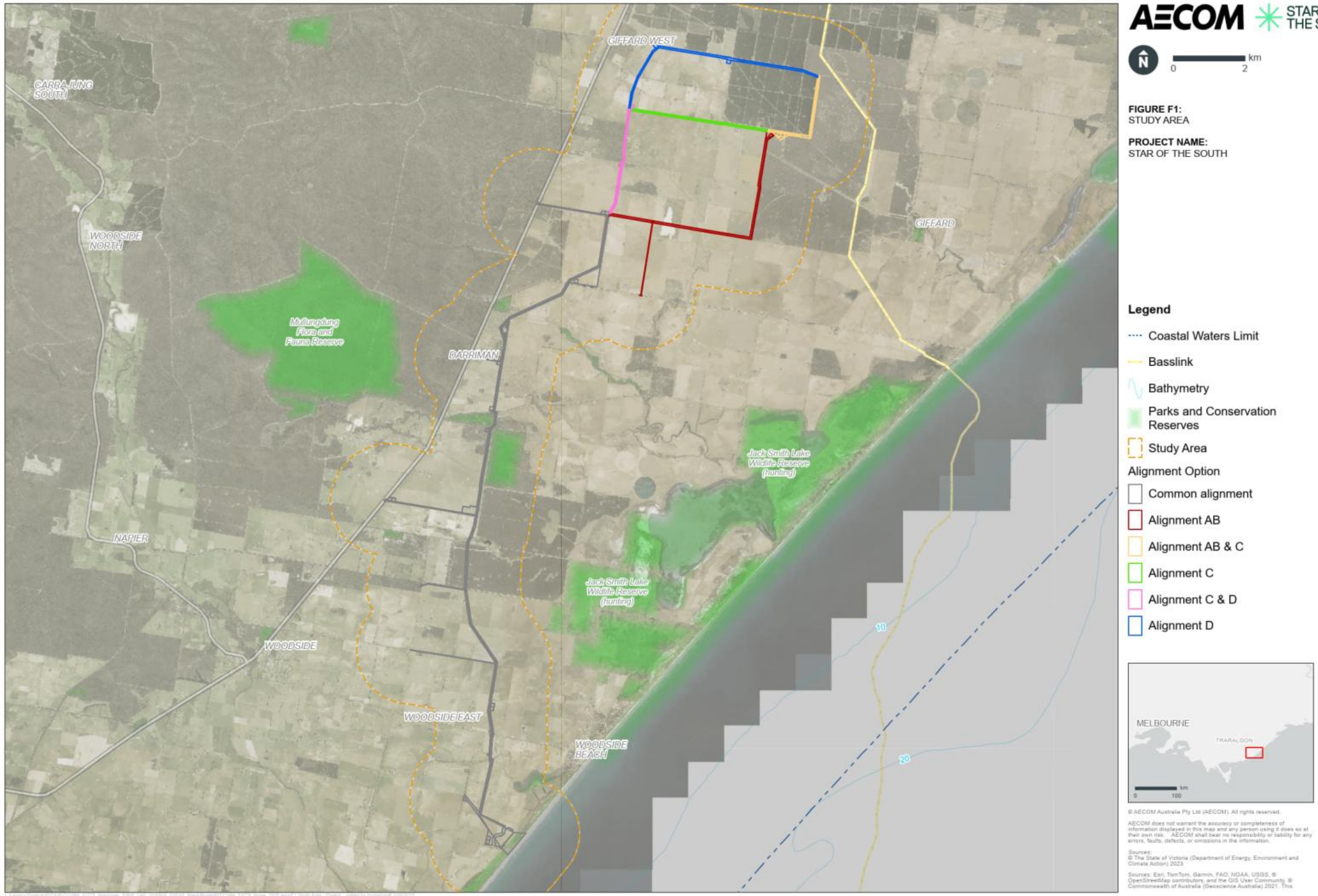

Figure 6-2 Study area for the onshore noise and vibration impact assessment

6.3 Methods to determine the existing environment

A comprehensive literature review and an extensive field program were undertaken to identify relevant receptor groups to inform the environmental impact assessment of the project on Onshore Nosie and Vibration. The aim of the existing conditions assessment is to identify where noise and vibration sensitive receptors are located relative to the proposed project footprint and develop an understanding of the existing noise environment.

Baseline noise levels were measured to describe the existing noise environment throughout the project study area. This information is used to describe the existing environment, including the presence of existing industry or other environmental noise sources, support the development of the project criteria and assess the potential change to the noise environment if the project was constructed.

Suitable noise monitoring locations were identified in areas where there was the potential for sensitive receptors to be affected by construction and operational activities. Available aerial images of the area, site investigations, and engagement with key stakeholders and the community were used to refine these locations based on priority and access.

The methodology used to conduct noise measurements is provided below:

6.3.1 Unattended noise monitoring:

- Noise measurement equipment was deployed to a suitable location and measured noise levels continuously throughout the logging period.
- Noise measurements were undertaken using a Rion class 1 precision integrating sound level meter (NL-32 or NL-52) with the microphone mounted on a pole.
- All noise monitoring was undertaken in free field, with the microphone at least 3.5 metres from all reflecting surfaces at a height of 1.5 metres. This height is representative of the centre of a typical ground floor window.
- Equipment was set up in locations to minimise the impacts of extraneous noise sources, such as insects, air conditioners, pool pumps and so forth.
- Each noise monitor was checked with a field calibrator at the start and completion of the monitoring period.
- Meteorological conditions from the closest BOM weather station were collected to identify periods unsuitable for measurements.

6.3.2 Short term attended noise monitoring

- Noise measurements were undertaken using a Bruel & Kjaer class 1 precision integrating sound level meter (Type 2270) mounted on a tripod.
- The operator measured noise at a location for 15 minutes.
- The existing ambient environment, specific noise events and weather conditions were observed and recorded.

Existing noise levels were monitored and reported with reference to the following descriptors:

- **Background noise level (L_{A90} dB)**: The noise level that is exceeded for 90 per cent of a specified period. Background noise levels are used to determine limits for fixed plant and equipment under the Noise Protocol. Background noise levels are also used to determine non-statutory construction noise criteria under EPA Victoria Publication 1834.2.
- **Ambient noise level (L_{Aeq} dB)**: Commonly used to describe continuous sound pressure level for all sound occurring during the measurement period. The ambient noise level is used to quantify industrial noise, and to assess environmental noise impacts.
- **Maximum noise level (L_{Amax} dB)**: The maximum instantaneous noise level occurring during the measurement period. The maximum noise level is typically used to describe the highest noise level produced by very short peaks or spikes of sound.

Monitoring results and locations are summarised in Section 7.0.

6.4 Impact assessment method - overview

An impact is where a project activity or activities in any of the project phases (construction, operation or decommissioning) results in a change in the existing environment.

The impact assessment has been based on a maximum design scenario which enables a realistic and conservative approach to considering possible impacts that could occur due to the construction, operation or decommissioning of the project. Impacts can be positive or negative, direct or indirect. Impacts are described following the application of mitigation measures (residual impact).

Whether an impact results in a consequence to environmental receptors depends on the sensitivity of receptors and the magnitude of the impact.

- **Sensitivity**: the intolerance of a species or habitat to damage from an external factor and the time taken for its subsequent recovery
- **Magnitude**: the severity, extent and duration of an impact.

As environmental assets, values and uses are interconnected, sometimes an impact will give rise to a follow-on (secondary or indirect) impact which has also been considered as part of the assessment.

The impact assessments have involved identifying the magnitude of changes to the environment, positive or negative, that the project may have on the existing conditions. The method used has been specific to each individual technical study in accordance with relevant guidelines and standards. The technical reports each contain a section that describes their impact assessment method in detail, in particular the modelling or analysis that has been undertaken to predict the changes that may occur due to the implementation of the project.

The factors that have been considered when assessing the consequences of the project are as follows:

- Severity, extent, and duration
- Sensitivity of the affected receptors
- Assessment criteria
- The principles of ecologically sustainable development as defined in the Ministerial guidelines for assessment of environmental effects (DTP 2023) and in section 3A of the EPBC Act
- Stakeholder input and feedback
- The likely effectiveness of measures to avoid, minimise and manage impacts
- Assumptions and uncertainties associated with the assessment.

The impact assessments have considered the potential for combined impacts generated by the project on the one receptor but resulting from different actions. For example, shorebirds and seabirds are potentially affected by the loss of habitat within the transmission corridor, together with bird strike associated with the operation of the wind farm (referred to as inter-related impacts in the technical reports). The combined impact of these changes is assessed within the shorebird and seabird assessment. The approach to cumulative impact assessment is outlined in Section 6.12.

For the purposes of the impact assessment the project description defined a project design envelope (PDE). The PDE comprises ranges for certain design parameters (for example, an upper and lower limit for wind turbine generator heights). This allows for flexibility in the eventual design for the project that is necessary within an evolving industry where technology is rapidly changing.

The assessment has been based on a Maximum Design Scenario (MDS) which enables a realistic and conservative approach to considering possible impacts and risks that could occur due to the construction, operation or decommissioning of the project. The MDS consists of a defined set of project parameters from within the PDE that represent the greatest potential impact to an identified sensitive receptor or receptor group.

As the MDS is defined based on specific impacts, the MDS assessed will vary between the impacts and risks assessed. See Section 9.1 and Section 10.1 for the MDS used for this assessment.

6.4.1 Assigning a sensitivity level

To assign a sensitivity level, the existing environment is described and 'receptors' are identified. For example, receptor in the marine environment could include whales and on land, residential areas or native vegetation.

A sensitivity level of high, medium or low is assigned to the receptors based on specific criteria developed by the specialist undertaking the assessment.

A sensitivity level is assigned to the receptors that have been identified in the baseline characterisation presented in Section 7.0. The sensitivity of each of the receptors has been determined to be either high, medium or low according to the descriptions relevant to noise and vibration and are presented in Table 6-1.

Table 6-1 Receptor sensitivity

Sensitivity (to impact)	Description
High	Residential uses
Medium	Commercial or educational uses, natural areas
Low	Industrial or agricultural uses

6.4.2 Assigning a magnitude level

The magnitude of the impact on the environment includes consideration of the following factors:

- Extent – site, local, regional or widespread
- Duration – short, medium or long term (also considering frequency and permanence)
- Severity – degree of change from existing condition

The magnitude of a specific impact is based on clear criteria determined by the specialist undertaking the assessment and are defined relevant to noise and vibration in Table 6-2. Magnitude is assigned for the maximum credible consequence with consideration of mitigation and management measures according to the levels presented in

Table 6-3.

Table 6-2 Magnitude criteria

Terms		Description
Extent	Localised	Within one kilometre
	Medium scale	Within 10 kilometres
	Large scale	Within 20 kilometres
	Regional	Not applicable to noise and vibration
Duration	Short-term	Weeks to months
	Medium-term	Less than 5 years
	Long-term	Greater than 5 years
Severity	Unlikely to be detectable	Changes are within natural variability
	Reversible	Changes are reversible once the activity has ceased,
	Permanent	Not applicable to noise and vibration

Table 6-3 Magnitude description

Magnitude	Description
Negligible	Noise is not easily discernible and vibration is not perceptible
Low	The impact is localised and short-term, and results in reversible changes to the receptor once the activity has ceased
Medium	The impact is medium scale and is medium-term, and results in reversible changes to the receptor once the activity has ceased
High	The impact is large scale and is medium-term, and results in reversible changes to the receptor once the activity has ceased
Very high	The impact is large scale and long-term, and results in reversible changes to the receptor once the activity has ceased

6.4.3 Assigning a consequence level

Consequence is the potential outcome of an event affecting a receptor. It is determined by combining magnitude of the impact and sensitivity of the receptor. The consequence level is assigned based on the receptor sensitivity level and magnitude level using the matrix in Table 6-4.

Consequences are assigned based on the maximum credible impact for each pathway. Where uncertainty exists, a conservative approach to assessing consequence is adopted.

Table 6-4 Consequence level matrix

Magnitude	Sensitivity		
	Low	Medium	High
Negligible	Negligible	Negligible	Minor
Low	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
High	Moderate	Major	Severe
Very high	Not applicable to noise and vibration		

Table 6-5 Guide to consequence levels

Consequence	Qualitative description	
	Noise	Vibration
Negligible	Not applicable	Not applicable
Minor	Construction • noise is not easily discernible. Operation • no increase in noise level.	Construction • vibration is within applicable limits • no damage to structures. Operation • vibration is within applicable limits • no damage to structures.
Moderate	Construction • noise could be perceptible but within project noise criteria. Operation • noise could be perceptible but within project criteria.	Construction • isolated exceedances of project limits • no damage to structures. Operation • isolated exceedances of project limits • no damage to structures.
Major	Construction • noise is occasionally above project criteria. Operation • noise levels increase and are greater than project criteria.	Construction • extended periods of exceedances of project limits • superficial damage to structures. Operation • extended periods of exceedances of project limits • superficial damage to < three structures

Consequence	Qualitative description	
	Noise	Vibration
Severe	Construction • noise levels above project criteria for extended periods of time. Operation • noise levels significantly increase and are greater than project criteria.	Construction • long-term exceedances of project limits • structural damage. Operation • long-term exceedances of project limits • superficial damage to >three structures • structure damage to < three structures • damage to heritage structures.

6.4.4 Residual impacts

While there are clear steps in the assessment process, it may not always follow a linear progression. Typically, assessment requires multiple iterations of impact evaluation considering the assessment criteria and application of mitigation measures as the technical studies progress and additional information becomes available. The completed impact assessments are based on the final mitigation measures that will be implemented and therefore describe the residual impacts.

The residual impacts constitute the predicted consequences following the implementation of the mitigation measures and taking into account the expected effectiveness of these measures.

6.5 Impact assessment method – Construction noise

Overall, the project comprises of a variety of onshore and offshore construction scopes. Each component of the project requires different construction installation techniques and associated equipment and machinery. The following construction scopes are described:

Onshore transmission infrastructure

- Shore crossing, which includes offshore support vessels and associated noise
- High voltage AC underground cable system

Offshore infrastructure

- Offshore foundation, including substructures
- Fixed bottom wind turbines
- Fixed bottom offshore substation platforms
- AC inter-array cables connecting strings of wind turbines together and connecting the wind turbines to the offshore substations
- Offshore export cables.

A number of construction scenarios are currently being considered including 'all construction within one construction stage' and 'construction phased over two stages'. The duration of the construction phase varies depending on the scenario however for indicative purposes, and for the scenario that all construction would take place within one stage, the offshore construction is anticipated to take up to no more than 59 months and the onshore construction up to 26 months.

These staging principles would be evolved based on investigations into technical feasibility and commercial viability and would continue to be refined in response to information gathered, the potential environmental and social impacts identified, and as a result of the consultation process.

Infrastructure may be constructed simultaneously, such as wind turbines being installed on foundations that are already completed while foundation installation is continuing at other locations within the site.

The scope of the project construction noise and vibration assessment process steps considered for minimising the risk of harm from construction noise and vibration so far as is reasonably practicable, consistent with the GED and with EPA Publication 1834.2, includes the following:

- Identify sensitive receptors in the vicinity of the works
- Use background noise measurements to establish construction noise criteria
- Determine the location, duration and timing of each construction activity
- Preliminary screening assessment of the risk of harm from noise, allowing the identification of areas for which it is justified that noise will not be an issue
- Review work schedules and locations of noise sources, amend wherever possible to minimise noise
- Consider options for quieter equipment and processes, including alternative methods to minimise noise at source (for example bored piling rather than percussive hammers, chemical rock-breaking agents rather than rock breakers or blasting)
- Consider options for mitigation of noise during propagation, for examples barriers along the construction site boundary
- Calculate the potential noise levels associated with construction works at the nearest sensitive receptors in reference to the project construction noise criteria relevant for the proposed construction activity working hours
- Reconsider measures for reducing noise, including those deemed impracticable in previous iterations, which may in fact be effective in addressing the residual risk of harm
- Reassess noise levels once all reasonably practicable options to minimise noise at source and during its propagation have been considered
- Establish set back distances for activities anticipated to generate high levels of vibration
- Develop management and mitigation strategies for construction noise and vibration impacts based on the proposed construction methods.

The iterative process laid out above is difficult to undertake for a construction assessment at this stage given the large number of variables that will be dependent on the specific contractor that is ultimately engaged. For those works where the methodology is well defined, the assessment (including the ERS assessment) looks at the residual risk (as far as is possible at this stage of the project). For other works, that are not well defined at this stage, a worst-case assessment has been carried out. An example of this would be the offshore piling. The methodology is unlikely to change in future, noting that the specific equipment to be used has yet to be defined, whereas details of the onshore cable system construction will change when the contractor is engaged.

The full construction methodology and program used to develop the following sections can be found in Sections 4.7, 4.13 and 4.18 of EIS Chapter 4 – Project description. Construction scenarios have been developed based on the above information to assess impacts when noise or vibration is expected to be greatest (i.e. maximum design) at surrounding receptors.

Accordingly, these maximum design scenarios have been developed based on all fixed and mobile plant equipment operating simultaneously over the relevant assessment period. The construction noise and vibration impact assessment is presented in Section 9.0.

6.5.1 Construction noise assessment criteria

The construction noise criteria adopted for this assessment have been derived using the methodology outlined in Section 4.6.

No noise sensitive educational, community or health facilities have been identified within the study corridor. Accordingly, criteria have not been presented for these receptors.

EPA Victoria Publication 1834.2

Table 6-6 presents the construction noise criteria derived on the basis of the noise monitoring in accordance with EPA Victoria Publication 1834.2. The derivation of the criteria is provided in Appendix B.

Table 6-6 Construction noise criteria

Target area	Construction noise criteria L_{Aeq} dB
EPA Victoria normal working hours	
Residential	Application of all practicable and reasonable work practices to reduce levels of noise
Classrooms in schools and other educational institutions	
Parks and recreational areas	
Outside of EPA Victoria normal working hours[1]	
Rural Residential - Evening and weekend (<18 months)	31
Rural Residential - Evening and weekend (> 18 months)	26
Rural Residential – Night (avoidable works)	Avoidable works at night are not proposed.
Coastal Residential - Evening and weekend (<18 months)	37
Coastal Residential - Evening and weekend (> 18 months)	32
Coastal Residential – Night (avoidable works)	Avoidable works at night are not proposed.
Campgrounds - Night	Noise reduction measures apply with reference to the relevant ERS objective and environmental values. Noting that the ERS objectives are not levels one can pollute up to, or design targets.
All – Unavoidable night works	Application of all practicable and reasonable work practices to reduce levels of noise.

Table notes:

1 Projects should aim to constrain works to normal working hours and it is noted that works undertaken outside of normal working hours are required to be justified on the basis that it is not reasonably practicable to undertake them during normal working hours and of being “low impact”, “managed impact” or unavoidable works (as defined in EPA Publication 1834.2).

Noise Protocol Limits – batching plants

The proposed batching plants are commercial, industrial and trade premises and therefore, their noise has been assessed under Part 5.3, Division 3 of the EP Regulations.

Table 6-7 Noise Protocol Limits – batching plants

Location	Noise Protocol Limits ($L_{eff,30min}$ dB)		
	Day	Evening	Night
Batching Plants	46	41	36

6.5.2 Proposed construction working hours

The proposed construction working hours are:

Onshore transmission infrastructure

- 7am – 6pm weekdays, 7am – 1pm Saturdays for:
  - Onshore cable system
  - Batching plants
  - Shore crossing (except the drilling works)
  - Decommissioning.
- Drilling of the shore crossing, as required, via HDD, or similar will require uninterrupted 24-hour works for safe completion.
- The onshore trenchless crossings of roads and watercourses could be undertaken on day works only if suitable ground conditions are confirmed during the site geotechnical investigations.

Offshore infrastructure

- Offshore works may require 24-hour working.

6.5.3 Out-of-hours works

Projects would aim to constrain works to normal working hours. Where it can be justified that it is not reasonably practicable to constrain the works to normal hours, then, works or activities outside normal working hours may occur for:

- **Low-noise impact works** – these are inherently quiet or unobtrusive, for example, manual painting, internal fitouts, and cabling. Low-noise works do not have intrusive characteristics such as impulsive noise or tonal movement alarms. The authority relevant to noise must be contacted, and any necessary approvals sought.

  The only works (other than unavoidable works) that are proposed during night hours are likely to include the arrival of staff to construction compounds, staff briefings and works preparation (between the night hours of 6 am to 7 am). This activity is unlikely to cause noise that could be clearly heard by residents.

- **Managed-impact works** – works where the noise emissions are managed through actions specified in a noise and vibration management plan (may be part of a broader environmental management plan), to minimise impacts on sensitive receptors. Managed-impact works do not have intrusive characteristics such as impulsive noise or tonal movement alarms.

  The project must contact the relevant authority for noise and vibration regulations at the time of works, which may change over the course of the project, and seek any necessary approvals. A noise and vibration management plan may need to be prepared or reviewed by a suitably qualified acoustic consultant or practitioner.

- **Unavoidable works** – are works which cannot be done at another time or cannot be halted because they would pose an unacceptable risk to life or property or a major disruption and can therefore be justified. Includes an activity which has commenced but cannot be stopped. In these instances, it is necessary to demonstrate that planned unavoidable works cannot be reasonably moved to normal work hours. This requires additional consideration of potential noise and vibration generating activities and controls to minimise noise and vibration. These arrangements can be set out within the noise and vibration management plan (or within a broader environmental management plan).

The relevant authority for noise must be consulted and provide any necessary approvals for unavoidable works. Sensitive receptors will be notified of the intended work, its duration and times of occurrence.

6.5.4 Unavoidable works

The definition of "*Unavoidable works*" in EPA Victoria Publication 1834.2 includes those works that cannot practicably meet the schedule requirements because the activity involves continuous work This type of work does not need to comply with the requirements of the schedule however the project is not exempt from developing noise reduction measures in accordance with the GED and the preparation of a noise management plan.

Example unavoidable works provided by EPA Victoria Publication 1834.2 include:

- The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- Tunnelling works including mined excavation elements and the activities that are required to support tunnelling works (i.e. spoil treatment facilities) rail occupations or works that would cause a major traffic hazard
- Works where a proponent demonstrates and justifies a need to operate outside normal working hours such as work that once started cannot practically be stopped until completed such as concrete pouring or construction of diaphragm walls.

Unavoidable works for the project that can be anticipated and planned for in advance are as follows:

- Drilling of shore crossing (which includes offshore support vessels and associated noise) and other trenchless crossing works will utilise trenchless drilling technology that must keep continual progress to maintain the integrity of the drilled hole. Pausing or stopping of drilling works has the potential for borehole collapses which would require additional construction durations and land to drill additional holes.
- Cable pulling for the shore crossing involves the floating and pulling in of the offshore export cables which are susceptible to tide and current movements. Once the export cable has commenced pulling in it must continue so that the cable can be lowered to the seabed and secured in a timely manner. Pausing the activity would leave the cable susceptible to bending damage from tide and wave, this would require this portion of cable to be scrapped, preventing completion of the wind farm as planned.
- Offshore piling works require the installation of piles into the seabed. Pausing or stopping the piling process can lead to the loss of progress and the failure for the foundation to reach the required depth. This would require the partly installed pile to be removed and scrapped.

Unavoidable works could also include works required as the result of an emergency. An emergency is defined as bush fire, flood, accident, spillage or anything else listed in the definition provided by the Emergency Management Act 2013.

A qualified specialist, with skills and expertise in health, safety and the environment as relevant, will be appointed to review all planned and unplanned night work (10:00 pm to 7:00 am) activities to ensure that the works have been reviewed and justified in accordance with Section 4.4 of EPA 1834, that all reasonably practicable work practices have been considered, and that community engagement has been undertaken.

6.5.5 Character of construction noise

Section 4.1.3 of EPA Victoria Publication 1834.2 notes that:

> *Noise and vibration can pose a risk of harm to human health and the environment if it is too loud, continues too long, recurs frequently, suddenly increases in level, or includes disturbing sounds such as:*
>
> - *Impulses (banging, hammering)*
> - *Tones (squealing, screeching, humming)*
> - *Low frequency sound. This can be more intrusive than high frequency sound as it is less attenuated during propagation and when transmitting into buildings. Noise abatement measures are less effective at low frequencies.*

Therefore, commentary on the likelihood of construction activities displaying any of the characteristics listed above has been included.

6.5.6 Environment Reference Standard – indicators and objectives

The project area is considered to be:

- Expansive with a wide variety of Soundscapes throughout
- Generally, located in areas designated as Farming Zone
- Generally, in the vicinity of existing roads, existing recreational activities (campgrounds) or within low-density residential areas.

It is anticipated that ERS Category 4 is appropriate to the project area since it best fits the majority of the land uses in the vicinity, as follows:

> *Lower density or sparse populations with settlements that include smaller hamlets, villages and small towns that are generally unsuited for further expansion. Land uses include primary industry and farming.*

The exceptions are Category 5 areas, as follows:

- Reeves Beach Campground
- McLoughlins Beach - Seaspray Coastal Reserve
- Woodside H27 Bushland Reserve
- Woodside H28 Bushland Reserve
- Kangaroo Swamp
- Mullungdung State Forest
- Warrigal Creek Streamside Reserve
- Darriman H33 Bushland Reserve
- Jack Smith Lake Wildlife Reserve
- Giffard Flora Reserve
- Giffard H30 Bushland Reserve
- Giffard H31 Bushland Reserve.

The approach taken herein is that the ERS sets noise objectives for those sources that are not governed by existing legislation or guidance.

Nevertheless, the potential impact of noise to people working from home is considered by reference to the interpretation provided in Table 5.1 of EPA Victoria Publication 1992 against the Environment Value of "*Domestic and recreational activities",* as follows:

> *The objectives are set at levels above which there is an increased risk of disturbance by noise. Not meeting the decibel levels outdoors can affect domestic and recreational activities that people conduct at home and other residences. Noise can be expected to interfere with reading and other tasks that require concentration or sustained attention, such as working from home, watching television, listening, rest and recreation.*

All reasonably practicable mitigation is applied with the aim of meeting the objective, in accordance with the GED. If it is the case that the ERS objectives are likely to not be met by an activity the commentary as to the implications is included.

In this way the project achieves the intent of the ERS.

6.5.7 Noise modelling methodology - onshore construction

Predicted noise levels for mobile onshore construction activities such as the cable system installation have been calculated assuming simple geometric spreading of sound from each noise source. This method highlights if there are sensitive receptors within the impacted distances from the activity so that adequate levels of mitigation can be recommended.

For static construction works at the shore crossing, a three-dimensional computer noise model of the site and surrounds was developed to predict likely noise levels due to the project. The following information was incorporated into the model:

- Proposed locations and layouts of the construction works
- Assumed sound power level information for the various noise-emitting plant and equipment items.
- Terrain based on contour lines of the project area available from VicMap
- Ground absorption assumptions:
  - 60% acoustically soft ground within general residential areas
  - 60% acoustically soft ground within rural / undeveloped areas
- Single storey residential buildings modelled at 4.5 metres and receivers at 1.5 metres in height
- Sources are modelled at 1.5 metres in height unless they are elevated.

The noise model allows for targeted noise mitigation to be defined for specific construction activities.

In addition, ISO 9613–2 provides a method for calculating noise attenuation with the influence of meteorological effects under *downwind propagation* conditions. These conditions favour the propagation of sound from the source to the receptor, with ISO 9613-2 assuming propagation conditions for wind speeds between approximately 1 m/s and 5 m/s or a ground-based temperature inversion.

6.5.8 Noise modelling methodology - offshore construction

The wind farm is proposed to be at least 10 kilometres offshore and therefore most aspects of the development would not be expected to generate high levels of noise onshore. The exception is offshore piling which, depending on weather conditions, could potentially be audible onshore.

There is considerable uncertainty in the prediction of noise over such large distances because of meteorological conditions, and the variability of these. Therefore, for the purposes of this assessment, predictions have been made based on standard meteorological conditions which are known to alter the attenuation of noise. The modelled effects that alter the propagation of noise over long distances are listed below:

- Temperature
- Humidity
- Wind speed and direction
- Atmospheric stability (temperature inversions or lapses).

Of these effects, wind speed and direction and atmospheric stability have the greatest impact on the propagation of sound. CONCAWE was chosen as the preferred algorithm for the prediction of offshore construction noise because it was developed for the prediction of environmental noise levels over large distances (as is the case for the project).

CONCAWE provides a method for calculating noise attenuation due to meteorological effects under *downwind propagation* meteorological conditions. Conditions can be set to favour the propagation of sound from the source to the receptor. The wind speed has been set to three metres per second within the CONCAWE algorithm to simulate conditions most favourable to noise propagation.

Note that CONCAWE has been used for different meteorological conditions to give a 'range' of noise levels for offshore construction activities. The worst-case offshore piling noise predictions (i.e. the higher value in the range of predicted levels given) are conservative because they take into account distance attenuation only, without considering ground effects, absorption or any shielding under wind conditions that are favourable to the propagation of noise. This is an unlikely scenario for rural environments where some ground absorption would be expected. The lower predicted noise levels in the range given account for air absorption whilst the wind speed has been set to three metres per second within the CONCAWE algorithm to simulate conditions least favourable to noise propagation.

6.5.9 Noise modelling tolerance

In practice the noise models are based on noise data provided by the manufacturer or reference data such as that provided by British Standard 5228 and are generally considered to be conservative because the assumption is that all of the plant operates at full duty, in the same location at the same time. This does not typically happen in reality.

The margin for error in the SoundPLAN modelling is compounded by the inherent tolerance that was accepted during the development of, amongst other things, the software algorithms, software coding, publicly available terrain data, manufacturers noise data, etc. These items are out of projects control.

Nevertheless, the margin for error has been minimised as far as possible by:

- Using construction noise input data from a verifiable resource (such as BS5228, AS2436 or manufacturer supplied data)
- Using operational noise input provided by the manufacturer and/or verified by the project team
- Developing an in-house standard procedure for noise modelling
- Not manipulating data taken from verifiable sources (such as BS5228 or VicMap terrain data)

Therefore, whilst the margin of error cannot be directedly quantified it has been reduced as far as is possible using industry standard approaches that have been tested by independent bodies.

6.5.10 Onshore construction plant and equipment

Sound power levels for the proposed construction equipment have been obtained from construction noise standards, databases and, where reasonably practicable, from manufacturers data for specific equipment that would be used on the project.

The indicative sound power levels of construction equipment were based on the following references:

- AS2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*
- BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites* – Part 1: Noise
- Department of Environment, Food and Rural Affairs (DEFRA) – *Update of noise database for predictions of noise on construction and open sites* - 2006
- Manufacturers' noise data

The data presented in Table 6-8 shows the equipment and their indicative associated sound power levels that have been used to predict noise from the project construction activities.

Table 6-8 Key construction equipment and associated indicative sound power levels

Equipment	Sound Power Level, dB(A)	Equipment	Sound Power Level, dB(A)
Articulated dump truck (up to 25T)	109	Generator, diesel (500kw)	102
Articulated dump truck (up to 41T)	116	Grader (up to 73T)	114
Backhoe loader (12-15T)	95	Hydrovac excavation truck	114
Cable winch	84	Loader	113
Cable pusher	97	Lorry	107
Chain wheel trencher	115	Mobile crane	98
Chainsaw	114	Mulcher	113
Compressor	103	Pump	103
Concrete mixer	104	Reach stacker	99
Concrete pump	106	Road reclaimer	117
Concrete truck	110	Rock crusher	124
Dewatering plant	114	Rock saw	120
Directional drill unit	111	Roller (up to 19T)	109
Dozer (up to 70T)	108	Roller, padfoot	111
Drop hammer piling rig	97	Rotary drill, waterbores	119
Excavator, (up to 100T)	117	Scraper	114
Excavator, (up to 29T)	104	Skid steer loader	105
Excavator, (up to 10T)	96	Telehandler (up to 11T)	107
Excavator with breaker	104	Tractor	108
Fencing equipment	96	Truck and dog (up to 20T)	108
Forklift (up to 18T)	99	Ute 4x4	101
Franna crane	105	Water cart 20,000L	102
Front end loader (up to 36T)	113	Wheeled tractor/scraper (up to 54T)	116
Generator, diesel (30kw)	93		

6.5.11 Offshore construction plant and equipment

Images of typical offshore vessels are presented in Table 6-9 and are based on preliminary estimates that will be subject to change as planning progresses and methodology is proposed by contractors.

Table 6-9 Typical equipment for offshore operations

Equipment	Image
Platform support vessel (indicative)	
Cable lay vessel (indicative)	
Multi-purpose dry cargo vessel (indicative)	

<table>
<tr><th>Equipment</th><th>Image</th></tr>
<tr><td>Vessel installing a monopile foundation (https://renews.biz/56552/solar))</td><td></td></tr>
<tr><td>Jack-up vessel installing a wind turbine</td><td></td></tr>
<tr><td>HDD vessel</td><td></td></tr>
<tr><td>Offshore substation substructures and foundation installation / wind turbine monopile installation</td><td>The sound power level used to represent the offshore piling rig (Stage 1 and Stage 2 of the offshore construction assessment) is from an Institute of Acoustics[3] paper for a similar offshore piling arrangement and a spectrum based on attended measurements of a large percussive piling rig (Kobelco BM800HD).
<table>
<tr><th rowspan="2">Sound power level (dBA)</th><th colspan="7">Octave band centre frequency, Hz</th></tr>
<tr><th>63</th><th>125</th><th>250</th><th>500</th><th>1000</th><th>2000</th><th>4000</th></tr>
<tr><td>145</td><td>143</td><td>148</td><td>148</td><td>142</td><td>138</td><td>136</td><td>131</td></tr>
</table></td></tr>
</table>

The major offshore construction is limited to piling and vessel movements. The assembly of the turbines would also require vessels but given that they are at least 10km offshore, they are likely to be inaudible

[3] A Leiper: Bang, Bang, Beep – Non-Operational Airborne Sound from Offshore Windfarms, IOA, 2024

onshore. Tools used for turbine assembly are also likely to be inaudible onshore. Therefore, these items have not been assessed.

6.5.12 Low frequency noise – construction

Generally, 1/3rd octave band data is not available for construction equipment. Therefore, a qualitative judgement as to the likelihood of the nominated construction equipment exhibiting low frequency noise content was made on the basis of:

- The equipment listed in Table 1 of EPA Victoria Publication 1996
- Previous project experience.

Further, the ISO 9613-2 algorithm is a 1/1 octave band prediction methodology, rather than a 1/3rd octave band methodology.

Therefore, the assessment has been undertaken by taking the predicted 1/1 octave band levels and applying them to the adjacent 1/3rd octave bands.

For example, the predicted noise level in the 63Hz 1/1 octave band has been applied to each of the 50Hz, 63Hz and 80Hz octave bands. This is conservative as, in reality, the 1/1 octave band level will be the logarithmic sum of the levels in the three adjacent 1/3rd octave bands (i.e. lower).

6.5.13 Construction vibration

Specific information about the equipment being used, geological conditions and the condition of structures near the proposed construction works is generally limited during the planning phase of a project. Consequently, a risk-based approach is usually adopted at this stage of a project to allow for vibration management measures to be developed for locations, structures or assets that are closer than calculated safe working distances.

The assessment of vibration-induced impacts during construction has been undertaken by:

- Identifying the location and distance to occupancies, structures and assets in relation to the construction works.
- Determining the safe working distances for relevant construction activities using relevant guideline values for protecting occupancies, structures and assets. The safe working distances have been determined using typical levels of ground vibration[4] and the guideline values documented in BS 6472-1:2008 (human annoyance) and DIN 4150-3 (structural damage to structures and utilities).
- Highlighting areas where occupancies, structures and assets are closer than the safe working distances.
- Propose mitigation measures aimed at managing the risk of vibration-induced damage.

For most receptors, the most stringent vibration criterion is normally the human comfort criterion. Separate objectives are not normally required in relation to the effect of construction vibration on typical building contents.

6.6 Impact assessment method – onshore operational noise

Consistent with the preventative approach implied by the GED, consideration should be given first to actions and measures to minimise the risk of harm due to noise so far as reasonably practicable (e.g. consider best practice in the first place, then also consider what can be done better or differently to eliminate or minimise noise emissions), and then assess the residual noise once these actions have been taken. The following approach has been adopted to assess operational noise:

- Identify sensitive receptors likely to be affected by operational noise from the project.
- Establish the applicable operational noise limits for sensitive receptors, using background noise measurements, where required.
- Determine the location and likely operation of noise sources associated with the project.

---

[4] NSW Roads and Maritime Services - Construction Noise and Vibration Guideline – August 2016

- Locate any industrial sites not associated with the project which may contribute to the noise environment at nearby sensitive receptors and, where reasonably practicable, quantify the expected noise levels from those sites.
- Incorporate initial mitigation measures that have been included as part of the initial design for the project.
- Use the above information to develop a noise model of the proposed operation to predict the potential noise impact at the nearest sensitive receptors with reference to the project noise criteria.
- Reconsider measures for reducing noise, including those deemed impracticable in previous iterations, which may in fact be effective in addressing the residual risk of harm
- Reassess noise levels once all reasonably practicable options to minimise noise at source and during its propagation have been considered
- Recommend best practice techniques and in principle methods to mitigate the effects of operational noise with consideration of any cumulative impacts.

The term "initial" is intended to describe items that are considered to be minimum and then these are refined as the assessment and project progresses.

The methodology for predicting operational noise impacts due to onshore equipment is further discussed in the following sections.

6.6.1 Noise Protocol Limits

The only onshore project element that will be subject to the Noise Protocol is the batching plants

For '*commercial, industrial and trade premises'*, the *Environment Protection Regulations* (Part 5.3, Division 3 for commercial, industrial and trade premises) set noise limits that apply in '*noise sensitive areas'*, above which noise is prescribed to be unreasonable (Regulation 118). The noise limits are determined using the Noise Protocol, and the noise limits are set by the EP Regulations.

The method for deriving the limits is contained within the Noise Protocol and not the Regulations, therefore the limits have been described as the "*Noise Protocol Limits*" through-out this document.

Section 4.8 describes the method for determining the Noise Protocol Limits for the project, which are summarised in Table 6-10. The derivation of the applicable Noise Protocol Limits is presented in Appendix B.

Table 6-10 Noise Protocol Limits

Address	Noise Protocol Limits (dB, Leff,30min)		
	Day	Evening	Night
Batching Plant Site 1			
[redacted] Giffard West Road, Giffard West	46	41	36
Batching Plant Site 2			
[redacted] South Gippsland Highway, Giffard West	46	41	36
Batching Plant Site 3			
[redacted] Dewars Road, Woodside	46	41	36

Address	Noise Protocol Limits (dB, Leff,30min)		
	Day	Evening	Night
Batching Plant Site 4			
[redacted] Woodside Beach Road, Woodside	46	41	36
Batching Plant Site 5			
Adjacent to the Shore Crossing site	46	41	36

It is assumed that if compliance with the Noise Protocol Limits is achieved at the locations detailed in Figure 6-3, then compliance would also be achieved at sensitive receptors further away since they are located within the same planning zone.

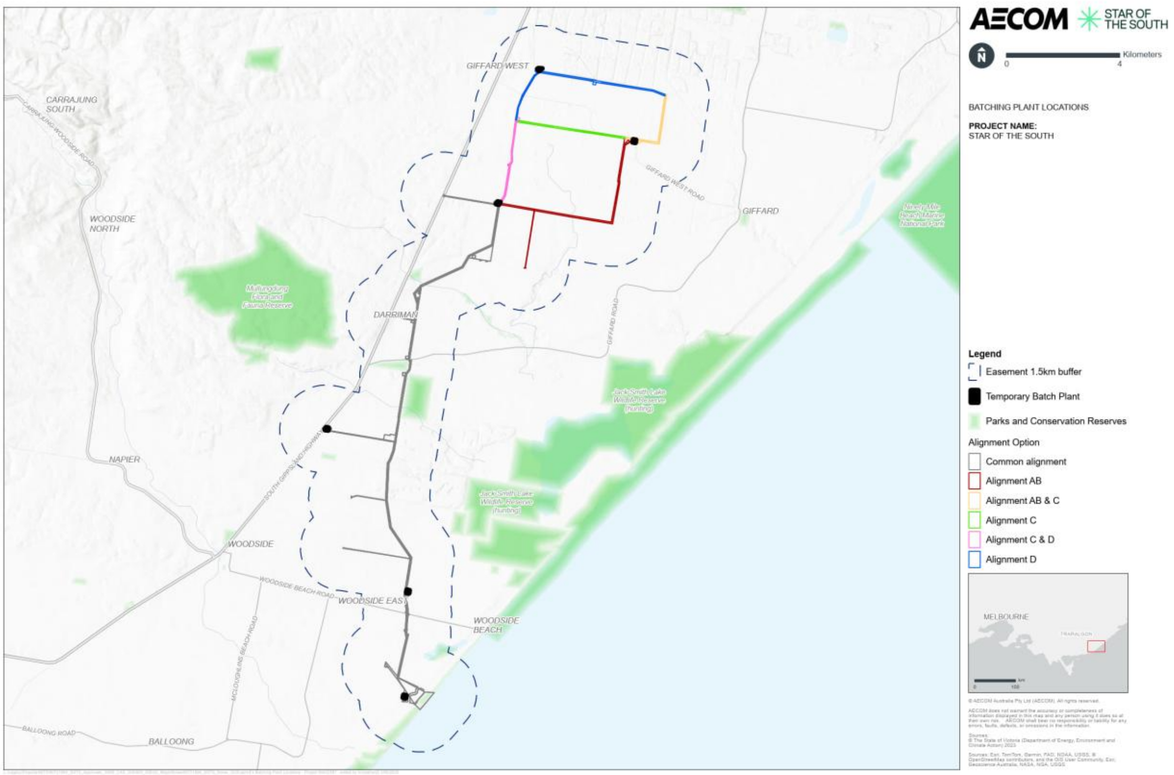

Figure 6-3 Batching Plant locations

6.6.2 Environment Reference Standard – indicators and objectives

The ERS indicators and objectives are laid out in Section 6.5.6.

The ERS does not apply in situations where specific regulations apply to that part of the environment or activity, for example, those noise sources considered by the *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*. This is because noise limits and other requirements are clearly set by these regulations.

As such, for the purposes of this assessment, the ERS has been applied to noise from:

- Construction to noise sensitive areas
- Construction, the batching plants and the wind turbines impacting on "*natural areas*" (as defined in the ERS). The residual risk to the environmental value of "*human tranquillity and enjoyment outdoors, in natural areas*" is considered relevant in these cases.

6.6.3 Noise modelling scenarios – onshore

The modelled scenarios have been developed to represent times when all fixed and mobile plant is operating at the same time during weather conditions that would be expected to promote the propagation of sound.

6.6.4 Noise modelling methodology – onshore

Onshore operational noise levels were predicted using SoundPLAN version 9.0 environmental noise modelling software and the implementation of ISO 9613-2: 2024 '*Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors'*.

ISO 9613-2 describes a method for calculating the attenuation of sound from industrial sources and is used to predict noise levels at noise sensitive receptors. ISO 9613-2 assumes downwind propagation from the sound source to the receptor.

The following inputs were included in all operational noise models:

- Terrain based on contour lines of the project area available from VicMap
- Ground absorption assumptions:
  - 60% acoustically soft ground within general residential areas
  - 60% acoustically soft ground within rural / undeveloped areas
- Single storey residential buildings modelled at 4.5 metres and receivers at 1.5 metres in height
- Sources are modelled at 1.5 metres in height unless they are elevated
- Structures digitised from site layout plans and aerial images of the project area
- Noise sources modelled using the dimensions provided and located using the site plans.

A range of comparative studies AECOM has previously been involved in have been investigated to determine appropriate ground absorption for each area. EES studies with similar ground absorption values include:

- Gas Import Jetty and Pipeline project "*EES Technical Report H: Noise and vibration impact assessment*", June 2020.
- Golden Beach Gas project "*EES Technical Report F: Noise and vibration impact assessment*", October 2020.

6.6.5 Noise modelling tolerance

In practice the noise models are based on noise data provided by the manufacturer and are generally considered to be conservative.

Further details are provided in Section 6.5.9.

6.6.6 Low frequency noise – onshore operation

Generally, 1/3rd octave band data is not available for the nominated operational equipment. Therefore, a simplified version of the approach provided by EPA Victoria Publication 1996 has been adopted based on the available 1/1 octave band data, and:

- The equipment listed in Table 1 of EPA Victoria Publication 1996
- Previous project experience.

Further, the ISO 9613-2 algorithm is a 1/1 octave band prediction methodology, rather than a 1/3rd octave band methodology.

Therefore, the assessment has been undertaken by taking the predicted 1/1 octave band levels and applying them to the adjacent 1/3rd octave bands.

For example, the predicted noise level in the 63Hz 1/1 octave band has been applied to each of the 50Hz, 63Hz and 80Hz octave bands. This is conservative as, in reality, the 1/1 octave band level will be the logarithmic sum of the levels in the three adjacent 1/3rd octave bands (i.e. lower).

Additional mitigation measures are discussed, as required.

6.6.7 Operational vibration

Given the distances between vibration sensitive receptors and project infrastructure (i.e. at least 500 metres), operational vibration impacts are considered to be negligible. Operational vibration has therefore not been considered further.

6.7 Impact assessment method – offshore operational noise

The methodology for predicting operational noise impacts due to offshore equipment is discussed in the following sections.

6.7.1 WEF noise limits

Noise sensitive locations considered in this assessment are all within the Township Zone established under the Wellington Planning Scheme.

Five representative dwellings within the assessment area of 16 kilometres from the offshore wind farm site were selected for the purpose of demonstrating compliance with the noise limits. Additional non-residential receptors were included for Reeves Beach Campground (as required by the Regulations) and the McLoughlins Beach - Seaspray Coastal Reserve (a natural area in accordance with the ERS).

Compliance at these locations indicates that compliance at all other noise sensitive locations within the study area is likely to be achieved. The locations of the noise sensitive receptors assessed are shown in Figure 10-2 and Figure 10-3.

Section 5.2 of the Standard specifies the following outdoor noise levels at noise sensitive locations:

> *"As a guide to the limits of acceptability at a noise sensitive location, at any wind speed wind farm sound levels ($L_{A90(10\ min)}$) would not exceed the background sound level by more than 5 dB, or a level of 40 dB $L_{A90(10\ min)}$, whichever is the greater."*

However, under EPA Publication 3011 a HAA noise limit applies to all of these receptors during the evening and night periods, which means that the applicable WEF noise limit for the project is:

- Below 6 m/s wind speed at hub height the wind turbine noise limit is the higher of 35 dB(A) and 5dB above the background level; and
- Above 6 m/s the base wind turbine noise limit is the higher of 40 dB(A) and 5dB above the background level..

It should be noted however, that this preliminary assessment does not rely on background noise measurements to demonstrate compliance with NZS:6808:2010.

The NZS 6808:2010 requirement is that background noise should be undertaken where the predicted noise levels at 95% rated power are above 35 dB (so within 5 dB of the noise limit). However, the standard allows this not to be carried out if the wind farm predictions at noise sensitive receptors are below 35dB (as is the case here – see Tables 10-9 and 10-10 and Figures 10-4 and 10-5), the wind farm operator adopts a 40dB limit at all wind speeds or agrees to conduct On / Off testing. On / Off testing is unlikely to be practical for a WEF of this capacity.

Because no noise sensitive receptors are modelled to experience wind turbine noise above 35dB, background noise measurements have not been undertaken under NZS6808:2010, although background measurements for other purposes have been used to evaluate the intrusiveness of turbine noise later in this report.

Moreover, background noise measurements will be undertaken at a range of representative locations in order to enable post-construction compliance measurements to be carried out in accordance with Section 7 of the Standard.

6.7.2 NZS 6808:2010 – Section 1.7 - Offshore wind farms

The Standard is the appropriate document to use for assessing potential operational noise impacts associated with the Star of the South project.

The Standard provides guidance for the prediction, measurement and assessment of sound from wind turbines for land base and offshore facilities. The Standard states that it "*may be applied to offshore wind farms if there are onshore effects on people and communities*".

Further, Section 1.7 of the Standard states that:

> *Offshore wind farms are likely to have limited noise effects within the immediate coastal marine area but may be close enough to shore to have some noise effects on people and communities on land. In this Standard special consideration is not given to offshore wind farms, but the same prediction, measurement, and assessment methods, with appropriate modification, can be used for planning and management of wind farm sound received onshore."*

6.7.3 NZS 6808:2010 – Section 5.4 - Special audible characteristics

Section 5.4.2 of the standard requires the following:

> *"Wind turbine sound levels with special audible characteristics (such as, tonality, impulsiveness, and amplitude modulation) shall be adjusted by arithmetically adding up to +6 dB to the measured level at a noise sensitive location"*

No penalty for special audible characteristics (tonality, impulsiveness, low frequency, and amplitude modulation) was applied (i.e. 0 dB penalty). It is worth noting that the Standard states:

> *"Wind farms shall be designed so that wind farm sound does not have special audible characteristics at noise sensitive locations. However, as special audible characteristics cannot always be predicted, consideration shall be given to whether there are any special audible characteristics of the wind farm sound when comparing measured levels with noise limits."*

It is expected that tonality will not be an audible feature because of the distances separating the turbines from the nearest noise sensitive locations. However, it will be a requirement of the manufacturer of the selected turbine model that the measured noise levels resulting from the operation of the wind turbines do not exhibit tonal characteristics. In accordance with EPA Publication 3011, if the turbine source data reveals special audible characteristics (e.g. tonality) that are likely to be assessable when measured at the noise sensitive locations, then those turbines cannot be used for the WEF development.

It would also be required that the wind turbines are properly maintained by the wind farm operator to ensure that the noise emission of the turbines is not adversely affected by turbine wear, resulting in audible tonality. Similarly, should amplitude modulation be detected upon commissioning, the wind farm operator would be required to alter the operating parameters of some turbines to remove this effect.

6.7.4 IoA Supplementary Guidance Note No.6

The Institute of Acoustics (IoA) Supplementary Guidance Note No.6 (SGN6) specifically recommends that cylindrical geometric divergence be included (in addition to spherical divergence) in the prediction of wind turbine noise over large bodies of water and explains that:

> "*an under prediction of the propagation effects can occur over water due to a combination of refraction and reflection effects which results in cylindrical rather than spherical geometric divergence*".

It is noted that although SGN6 mentions in Section 1.2.2 that it "*does not cover noise propagation for offshore wind farms*" it does however mention in section 2.2.3 that "*Where the body of water is at least 700m in extent (or the turbine is offshore), the following formula would be used*

$L = L_s - 20\log r - 11 + r - \Delta L_a + 10\log(\frac{r}{700})$"

The $10\log(\frac{r}{700})$ term corresponds to the transition from spherical geometric divergence to cylindrical divergence at 700 metres from a wind turbine. The 700-metre transition distance was derived based on measurements in the Kalmar Strait between mainland Sweden and the island of Öland.

Although SGN6 recommends 700 metres, the document acknowledges that it is:

> "*just a modelling parameter*" and that "*In reality there is of course no sudden change in the attenuation law at some well defined distance. The effective changeover distance would vary, at least as a function of wind shear and sea state*".

A review of noise assessment reports for UK offshore wind farms has shown that cylindrical divergence does not appear to have been applied, at least not in any publicly available documents.

In the absence of further research into this and the fact that there is no existing offshore wind farms located in the southern hemi-sphere, this assessment does not adopt the cylindrical divergence term in the prediction of wind farm noise.

6.7.5 Noise modelling methodology – offshore

A three-dimensional computer noise model of the project site was created in SoundPLAN Version 9.1, industry standard acoustic modelling software, to predict operational noise levels at five representative noise sensitive locations in the vicinity of the project site.

The BEK nr 135 algorithm was utilised as it the most recent development of wind turbine noise modelled procedures and is specifically designed to examine the multiple reflections which account for increased received downwind noise levels at long distances over water.

Reference is also made to the procedures provided in ISO 9613.2:2024 *Acoustics – Attenuation of Sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors* as implemented within the SoundPLAN software package and allowed by the Standard.

The primary equation for the sound pressure level taken from the Danish Propagation model is given in Equation 1.

Equation 1:

$$L_{pA} = L_{wA} - 10\log(l^2 - h^2) - 11 \text{ dB} + \Delta L_g + \Delta L_a + \Delta L_m$$

Where:

L_{pA} = Sound pressure level

L_{wA} = Sound power level

l = Distance between the base of the wind turbine and the receptor

h = Wind turbine hub height

ΔL_g = Ground absorption (1.5 dB for onshore and 3 dB for offshore turbines)

ΔL_a = Air absorption (per ISO 9613-1:1993)

ΔL_m = Multiple reflections correction.

The sound power levels for the turbines have been provided by the proponent. The sound power level for the smallest turbine has been sourced from manufacturer's data whilst the sound power level for the largest turbine has been derived by analysing the relationship between sound power and rated power of other globally prevalent wind turbines (up to 16MW) and applying that relationship to the smaller turbine data to extrapolate a sound power level for the larger turbine.

6.7.6 Offshore substations

The potential for human disturbance because of noise generated by the operation of the offshore substations is considered to be very low due to the distance between source and receptor. Accordingly, operational noise from the offshore substations has not been assessed.

6.8 Soundscape assessment method

The requirement for a Soundscape assessment comes from the ERS and only applies to Natural Areas (as defined in the ERS). EPA Victoria Publication 1992[5] provides that:

> *The indicator for category V land use is qualitative. This is because numerical criteria, such as sound levels measured as $L_{Aeq,}$ are limited in their ability to represent the values of natural areas. This is related to how the experience of natural areas is affected by the presence of non-natural sounds intruding into the natural Soundscape. Rather than the loudness or quietness of a sound, it is the audibility, noticeability and whether it fits with the environment that either enhances or detracts from the experience and disrupts people's tranquillity and enjoyment.*
>
> *The audibility and noticeability of introduced sounds in the presence of other ambient environment sound depends on the loudness, temporal variation and the frequency of both the existing sound and the introduced sound (or noise signal). Regardless of its decibel level, an introduced sound can be audible during quieter times, as the natural sounds vary temporally, seasonally and in frequency, such as with bird calls or leaf rustling. For this reason, the objective for category V areas is 'a sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural Soundscape'.*

Soundscape refers to the acoustic environment as perceived, experienced and/or understood by a person or people, in context. This differs from the acoustic environment which is the sound at the receptor from all sound sources as modified by the environment.

6.8.1 Background

There is a difference between the sound environment and the Soundscape.

The sound environment means all the sounds that may be heard in a particular place, at a particular time. This is the element of the environment that is assessed throughout this report.

Soundscape refers to how the sound environment is perceived or experienced by the people in it. The quality or appropriateness of the Soundscape is determined by three elements: the sounds, the people hearing those sounds, and the context in which the sounds are heard.

Like individual noises, some Soundscapes can be detrimental to people's physical and mental health, causing sleep disorders, stress, and reduced cognitive capabilities amongst other deleterious effects, affecting both children and adults.

Good Soundscape design is not necessarily a question of how loud certain sounds are, but rather what sounds are appropriate to, or belong to a place at a particular time. There is no one ideal sound environment, and what is deemed an appropriate Soundscape can change over time to reflect the evolving needs and/or uses of an area. Moreover, the starting point of a Soundscape assessment does not assume that loudness is going to be the primary factor of concern, even if it is likely to be.

A comprehensive review of Soundscape assessments was undertaken by The University of Salford in 2007[6], which noted in its summary that:

> *Only a few case studies, involving the modification and designing of Soundscapes, have been reported for the UK and the rest of the world, and of those available, their success has often not been formally evaluated. The presented examples range from artistic interventions (e.g. Harmonic Bridge, Musical roads), through council, policy and consultancy interventions (e.g. Gainesville, Neville Street), to experimental studies (e.g. Mount Ontake). The underlying rationale behind most of the case studies' focus on or consideration of sound was to improve a Soundscape that was negatively affected by the sound of traffic.*

From this it could be surmised that Soundscape design is less about the introduction of positive sounds and more about identifying elements that would cause a certain noise to be detrimental to the people that can hear it. That is, the assessments reviewed are concerned with improving an already

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[5] EPA Publication 1992: Guide to the Environment Reference Standard
[6] Research into the Practical and Policy Applications of Soundscape Concepts and Techniques in Urban Areas: Sarah R. Payne, Dr. William J. Davies, Dr. Mags D. Adams. 2007

compromised Soundscape rather than the introduction of a new noise source to an otherwise pristine environment, as is the case herein.

Further, there are a number of research papers available in the public domain which seek to cast doubt on the concept of investigating the acoustic quality of an environment based on measured noise levels. For example:

> *For the most part, identification of quiet areas has, inadequately, been based on low levels of integrated sound, with no distinction between sound sources. Whilst a low level of sound may be a characteristic of some areas that are of high acoustic quality, quiet is not the antithesis of noisy. Many areas that people might judge to be of high acoustic quality are not quiet, and areas that have low levels of sound may not necessarily be preferred (for example, where the sources are low levels arising from distant motorway traffic).*[7]

The implication here is that the quality of the acoustic environment is dependent on the composition of that environment as opposed to its absolute level. This much is obvious. However, statements of this type do not, in and of themselves, preclude the investigation of a Soundscape using traditional acoustic metrics. What they indicate is that more care is required in the observation of the relative contributions that make up the existing environment rather than attending to the overall levels as would be the case in purely compliance-based approach. This is achieved herein by undertaking attended measurements and observations at the locations under investigation.

There are also statements in the literature that seek to cast doubt on the instrumentation and methods that acousticians typically use:

> *Most of the currently used sound-level meters do not have the capacity to separate the sound-pressure levels of noise sources from the sound-pressure levels of wanted sounds. Consequently, detailed measurement of sound-pressure levels of noise sources in a quiet area of an agglomeration may be practically impossible. The solution is to rely entirely on calculated sound-pressure levels based on noise mapping, which is not at all the same as actual in situ measurement. This supports the observation that there is a need for new approaches towards measuring the acoustic quality of quiet areas, which move beyond sound-pressure levels. Soundscape is one such new approach.*[8]

This statement is partially true, but it does indicate a broad lack of understanding as to what it is that acousticians actually do. In other words, the limitations of the instrumentation are well understood, are regularly avoided by utilising attended measurements and do not, ultimately, imply that a new approach is required. This general sentiment is evident in several papers in the public domain, including Brown and Muhar (2004); the idea that an assessment of a Soundscape needs to be separate from the environmental noise impact side of an assessment.

This is not so, it would be impossible to undertake a Soundscape assessment of a noise source that does not exist without first undertaking all the steps that are required for the impact assessment. The two are intrinsically linked so it is necessary to find a way for the two approaches to co-exist.

The root of this challenge is elaborated by Brown and Muhar[9], as follows:

> *The Soundscape of a place is simply its sonic, or acoustic, environment, with the receptor, or listener, at the centre of the sonic landscape (Porteous and Mastin, 1985). Schafer (1977) argued, amongst other matters, that Soundscapes are amenable to analysis and design. To him, acoustic design meant discovering the principles by which the aesthetic qualities of the acoustic environment may be improved.*
>
> *These principles could include elimination or restriction of certain sounds through noise abatement, the preservation of sounds that give character or sense of place to a location (soundmarks as the acoustical equivalent of visual landmarks) or imaginative placement of sounds to create attractive and stimulating environments. In Hellström's (2002) translation of Pascal Amphoux's work on the sonic identity of European cities, these three approaches are described as:* ***defensive****, protecting*

[7] Soundscape planning as a complement to environmental noise management, Brown AL, 2014
[8] Good practice guide on quiet areas, European Environment Agency, Technical Report No.4/2014
[9] Background to the Acoustic Design of Outdoor Space, Brown and Muhar, 2004

the sonic environment from acoustic pollution; ***offensive****, consolidating the acoustic milieu and;* ***creative****, composing the sonic landscape.*

All of the quotations given in this section are concerned with an offensive (such as maintaining the vibrancy of a busy city plaza by loosening restrictions on the noise levels that cafes or bars in the vicinity can generate) or creative (such as adding sounds that enhance or mask the existing environment so as to improve it in some way) approach. In these cases, the various psychoacoustic terms that have been adopted in the field of Soundscape assessment become relevant because they are used to articulate the qualities of the existing environment that are to be enhanced. In other words, they are attempting to translate the lived experience of an area into terms that can be recognised by a broad section of people and then converted into actions.

It is the defensive approach that is relevant in this case since the project looks to introduce a new noise source in the vicinity of areas that have been hitherto, pristine. Therefore, the primary interest of the Soundscape assessment becomes where those existing elements sit in the frequency and time domain so as to reduce the influence of the new noise source in those areas.

Consequently, the target of this Soundscape assessment is to consider how to avoid the risk of noise from the project having a detrimental effect on its surroundings by making observations of the information content (i.e. frequency content) of the existing Soundscape and then comparing the predicted noise spectrum to measurements of the existing frequency spectrum.

The assessment will not assess construction noise in detail, because the works are temporary and the initial predicted noise levels are significantly higher than the existing environment measured at the nearby noise monitoring locations, and will focus, primarily, on operational noise from the wind turbines to McLoughlins Beach - Seaspray Coastal Reserve and Reeves Beach Campground.

6.8.2 Assessment context

The context may influence Soundscape through, the auditory sensation, the interpretation of auditory sensation and the responses to the acoustic environment. Examples, that may influence this are:

- **Auditory Sensation**, besides the acoustic environment, include meteorological conditions (which vary by the season), hearing impairments and hearing aids
- **Interpretation of Auditory Sensation** include attitude to the sound source and to the producer of the sound, experience and expectations (including cultural background, intentions or reason for being at a place), as well as other sensory factors, like visual impression and odour
- **Acoustic Environment** include time of day, lighting and weather; emotional state, psychological and physiological resources to deal with the situation, perceived ability to control one's exposure to sounds, as well as personal activities and those of others.

Figure 6-4 provides a summary of the conceptual framework used in Soundscape design and the interrelationships between person and activity and place, in space and time.

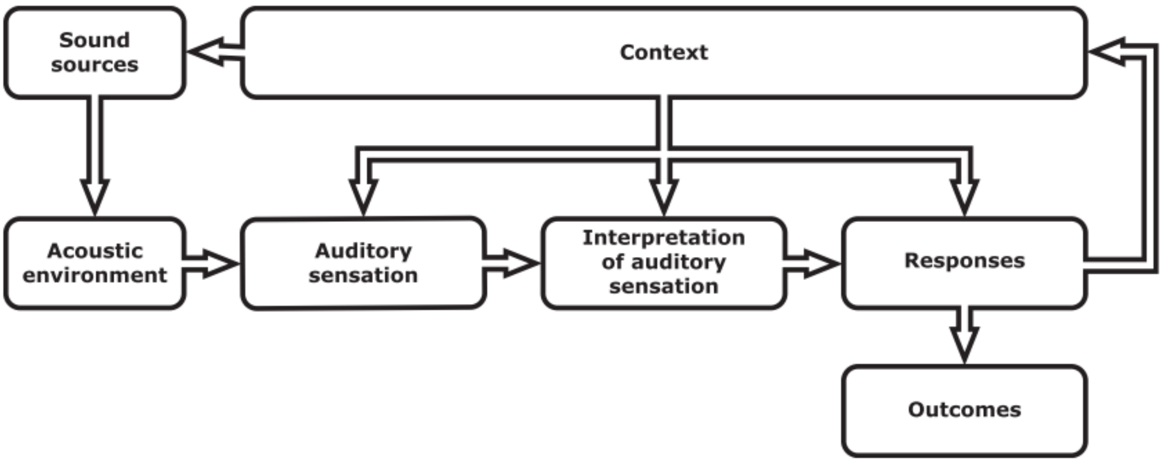

Figure 6-4 Conceptual Framework for Soundscape Design

6.8.3 ISO 12913 – Acoustics – Soundscape

In practice, there is a disparity between the descriptors and indicators used in measuring Soundscapes by individuals and the data collected by instruments (i.e. Sound Level Meters). To maximise the potential of the Soundscape approach in delivering a successful outcome, it is crucial to integrate psychoacoustic, ecological, landscape and acoustic methods to bridge the gap between personal experiences and broader societal needs.

ISO 12913 – Acoustics – Soundscape aims to bridge this disparity and provides methodology for the collection of data, reporting and analysis of Soundscapes. Steps for the assessment generally include:

- Collection of qualitative and quantitative data (Questionnaire, Soundwalk or Guided Interview)
- Acoustic measurements
- Analysis of data

This information may be used to inform the Soundscape assessment.

It is considered that the purpose of the questionnaire survey detailed in the ISO would be to collect data from local residents to gain an understanding of how they perceive the existing sound environment, its value to them and how it affects their daily lives.

A survey of residents is not proposed to be undertaken because the ERS requirement relates to natural areas only and the natural areas nearest to the project have no permanent dwellings. As such, the assessment is focussed on the effect of the Soundscape on visitors.

6.8.4 Adopted approach

The stages adopted for the Soundscape assessment include:

Stage 1: Soundwalk

Soundwalk is a walk with a focus on listening to the environment and is used to observe the masking, spectral contents, temporal patterns, and spatial distribution of the existing sources in the sound environment under investigation.

The data gathered should take account of any diurnal, seasonal or other temporal variation, where this is relevant. For this reason, the Soundwalk was carried out in February 2025 under conditions that could be reasonably assumed to attract visitors (i.e. during the summer, warm, not raining).

Step 2: Gather acoustic data

A general distinction can be made between research assessing Soundscapes in situ (where the person assessing the Soundscape is listening within the actual location) or in a laboratory (where the person assessing the Soundscape is listening to a previously recorded signal being played back in a listening room or laboratory).

The latter approach would involve the use of a calibrated binaural measurement system (artificial head).

Step 3: Data analysis

EPA Victoria has advised that the use of the ambient noise level (L_{Aeq}) is problematic when considering the tranquillity of an environment, as follows:

> *An L_{Aeq} measurement can provide information on the average loudness of the ambient sound environment and of introduced sounds, but not how these sounds are experienced by visitors to a natural area or whether the pre-existing environment or introduced sound will affect the tranquillity and enjoyment of the area.*[10]

[10] The Victorian Environment Reference Standard and how it has been considered and applied in noise assessments, Buret, Just and Mosely, 2024

Research undertaken by The University of Salford[11] with respect to the appropriate noise monitoring metric to apply indicated that none of those typically used in noise assessments are particularly effective for a Soundscape assessment.

Of the metrics typically used, the L_{A50} and L_{A90} gave the nearest correlation to individual respondent's subjective impressions. Other metrics, such as the ambient level (L_{Aeq}) or maximum level (L_{Amax}) were deemed to be less useful.

No consensus appears to have been reached but it should be restated that the scenarios tested in the research differ from the project in that they are primarily concerned with an existing Soundscape that is in some way compromised and are therefore not directly comparable.

The approach taken herein is to compare the measured 1/3rd octave band levels on the Soundwalk to the predicted levels from the wind turbines at an equivalent location to investigate whether there is likely to be a change in the frequency content (and hence information) of the sound within the areas under investigation. Given that noise from the turbines is likely to be relatively constant with time, it is proposed that the 1/3rd octave band measured background (L_{90}) levels be used for comparison to the predicted levels.This is based on observations made by Brown and Muhar[12], as follows:

> *Most of the Proposed Acoustic Environments require that wanted sounds not be masked by the unwanted sounds (or in some cases this is more appropriately described as ensuring that the wanted sounds mask the unwanted sounds). Masking occurs when the sounds we wish to hear are rendered inaudible by other sounds. Masking is a very complex phenomenon determined not only by the relative levels of the masking and masked sounds (the so-called wanted signal S to unwanted noise N ratio S/N), but by the frequency spectrum of both the wanted and unwanted sounds, and by the temporal variation of both (Webster, 1984).*

A difference of 3 dB or more between the existing and predicted noise sources in each one-third-octave band indicates a noticeable change in perception for the user, suggesting a potential Soundscape impact. This is based on observations made during the "*Sonic Gathering Place*" (SGP) project in Melbourne, which looked to ameliorate a polluted Soundscape by introducing recordings of natural sounds, as follows:

> *The sounds introduced by the SGP were natural water sources, vegetation, birdsong and other wildlife from the four different national park biomes where the vegetation used in the SGP was native. These SGP-on levels have a similar, though slightly larger, dynamic range to the existing background levels. There is increased eventfulness, and higher level of maxima, in the introduced-sound trace - due primarily to the bird song and water movement sounds introduced to the site by the SGP recording. The median values of most of the metrics of the levels with the SGP sound playback operating were only marginally greater than those with the SGP sound playback switched off –by about 1 dB.*
>
> *This corresponds to what Brown and Rutherford (1994) described, in their examination of the interaction between the sounds from a water structure and the background sounds of road traffic noise in an urban park, as being in an area of transition from a "zone of detection" of the introduced sounds (being able to detect the sounds of the water structure in the lulls between the peaks of the road traffic noise signal) to a "zone of influence" (the water structure generating sufficiently loud sounds that it would be considered to be the influential source of sound at the location, even though road traffic noise peaks might still be heard).*
>
> *In later work on the interpositioning of water structure sounds and road traffic noise, Calarco & Galbrun (2024) redefine Brown & Rutherford's (1994) zone of influence as an "optimum zone" in which introduced water sound levels should be similar to, or no more than 3 dB below, the road traffic noise levels.*[13]

[11] Research into the Practical and Policy Applications of Soundscape Concepts and Techniques in Urban Areas: Sarah R. Payne, Dr. William J. Davies, Dr. Mags D. Adams. 2007
[12] Background to the Acoustic Design of Outdoor Space, Brown and Muhar, 2004
[13] The Sonic Gathering Place Installation, Melbourne: User Experience and Post-Hoc Assessment of Sound Levels, Brown, Lacey and Neudorfl, 2024

The method adopted herein assumes that the opposite is also true, that if the introduced sounds can be kept below the existing by more than 3 dB within the frequency ranges of interest then that should allow the existing sounds to dominate[14].

If frequency analysis identifies a potential impact, then commentary is provided on the specific effects. For example, the introduction of a new noise at 4 kHz might affect the perception of wildlife, a Soundscape feature valued by the community.

6.9 Risk assessment

The risk assessment is not applicable to noise and vibration since a risk, as it is defined herein, is where a project activity or activities could result in an unexpected (accidental) event in any of the project phases (construction, operation or decommissioning) that causes a change to the existing environment.

The level of risk is determined by combining the likelihood of an accident occurring and the consequences should the accident occur. The assignment of consequence level follows the process outlined above.

The following steps were undertaken to identify, analyse and evaluate risks:

- Develop a risk matrix based on the likelihood of an accident occurring and the consequences, should the accident occur
- Identify controls and requirements to mitigate identified risks
- Assign likelihood and consequence ratings for each risk to determine risk ratings considering design, proposed activities and mitigation.

6.9.1 Assigning a likelihood level

Likelihood is the probability of an unexpected (accidental) event occurring. The likelihood criteria range from ‘rare’ where the event may occur only in exceptional circumstances to ‘almost certain’ where the event is expected to occur in most circumstances.

Likelihoods are assigned with consideration of mitigation and management measures according to the levels presented in Table 6-11.

Table 6-11 Guide to likelihood levels

Level	Description
Rare	The event may occur only in exceptional circumstances
Unlikely	The event could occur but is not expected
Possible	The event could occur
Likely	The event will probably occur in most circumstances
Almost certain	The event is expected to occur in most circumstances

6.9.2 Risk matrix

Risk is defined as combination of the likelihood of an event occurring (using Table 6-11).

A risk rating is then determined by these factors using the risk matrix, presented in Table 6-12.

The level of detail of the assessment undertaken for each risk pathway is proportionate to the identified level of risk (i.e. risk ranking).

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[14] Table 1 of Sound mapping design of water features used over road traffic noise for improving the Soundscape, Calarco, 2024

Table 6-12 Risk matrix

Likelihood rating	Consequence				
	Negligible	Minor	Moderate	Major	Severe
Rare	Very low	Very low	Low	Medium	Medium
Unlikely	Very low	Low	Low	Medium	High
Possible	Low	Low	Medium	High	High
Likely	Low	Medium	Medium	High	Very high
Almost certain	Low	Medium	High	Very high	Very high

6.10 Avoidance and minimisation through design

The impact assessment process is iterative, and the design of the transmission alignment has been informed by earlier versions of environmental assessments in order to avoid and minimise potential impacts, including during:

- Pre-referral corridor selection
- Post-referral corridor selection
- Post feasibility license award
- Post VicGrid establishment corridor selection.

At each decision point, the project, where reasonably practicable has sought to avoid and minimise impacts to a suite of environmental, heritage, socio-economic and landholder values. Avoid and minimise principles have materialised through reduced construction footprints and re-routing where sensitive values have been identified. These strategic considerations, informed by site validation, have resulted in the footprint under which the onshore project is being assessed.

Relevant to this topic, the following measures have been adopted in relation to the design, construction and operation of the project to avoid and minimise impacts:

- Placing wind turbines a large distance from dwellings
- Reduction in the number of turbines
- Refinement of onshore transmission alignment to avoid impacts on native vegetation.

6.11 Avoidance, mitigation and management

Once avoidance and minimisation measures have been exhausted, the next step is management of the residual impacts and risks. In the case of risks, the mitigation measures can be applied prior to the event occurring and/or after the event. The residual impacts and risks are evaluated against the assessment criteria to ensure impacts and risk are of an acceptable level.

The assessments describe the impacts and risks with all the mitigation measures implemented i.e. with both initial and final mitigations. Initial mitigation measures are defined as the standard suite of mitigation measures that will be implemented by the project such as measures required under legislation, national or international standards and standard measures implemented on similar projects. Final mitigation measures are any additional mitigation measures adopted to address the findings of impact/risk assessments to further reduce impacts and risks to acceptable levels. The completed impact and risk registers for this technical report are presented in Appendix A and show the reduction in impact/risk that occurs between the initial rating and final rating due to the application of final mitigation measures.

6.12 Cumulative impact assessment

Cumulative impacts arise when the effects of a single project on a single receptor are considered alongside the effect of other projects on the same receptor. The project has considered the potential for cumulative impacts associated with other proposed projects. It is noted that projects that are operational are considered as part of the baseline environment, and the cumulative impact assessment focuses on proposed or future actions.

A staged approach to cumulative impact assessment has been adopted. This approach is split into four stages:

- Stage 1 Identifying potentially cumulative projects or actions
- Stage 2 Shortlisting identified projects or actions
- Stage 3 Gathering information
- Stage 4 Assessment

This approach is focused on the assessment of potential adverse cumulative effects on receptors or similar groups of receptors, as relevant. The availability of information necessary to conduct a cumulative impact assessment depends on the status of the proposed project or action within the planning and approval regulatory steps. Therefore, a level of certainty reflecting the availability of detail and information necessary for the assessment is assigned to each proposal:

- Tier 1 High certainty – Project planning application/EIS/EES has been submitted to regulators, or the project has been approved, or the project is under construction.
- Tier 2 Medium certainty – Project referrals have been submitted to the regulators.
- Tier 3 Low certainty – Project is in the proposal stage and little information is publicly available.

The cumulative impact assessment has followed a staged approach (as shown in Figure 6-5 and described in detail in EIS Chapter 6 - Assessment Framework and EES Chapter 6 – Assessment Framework).

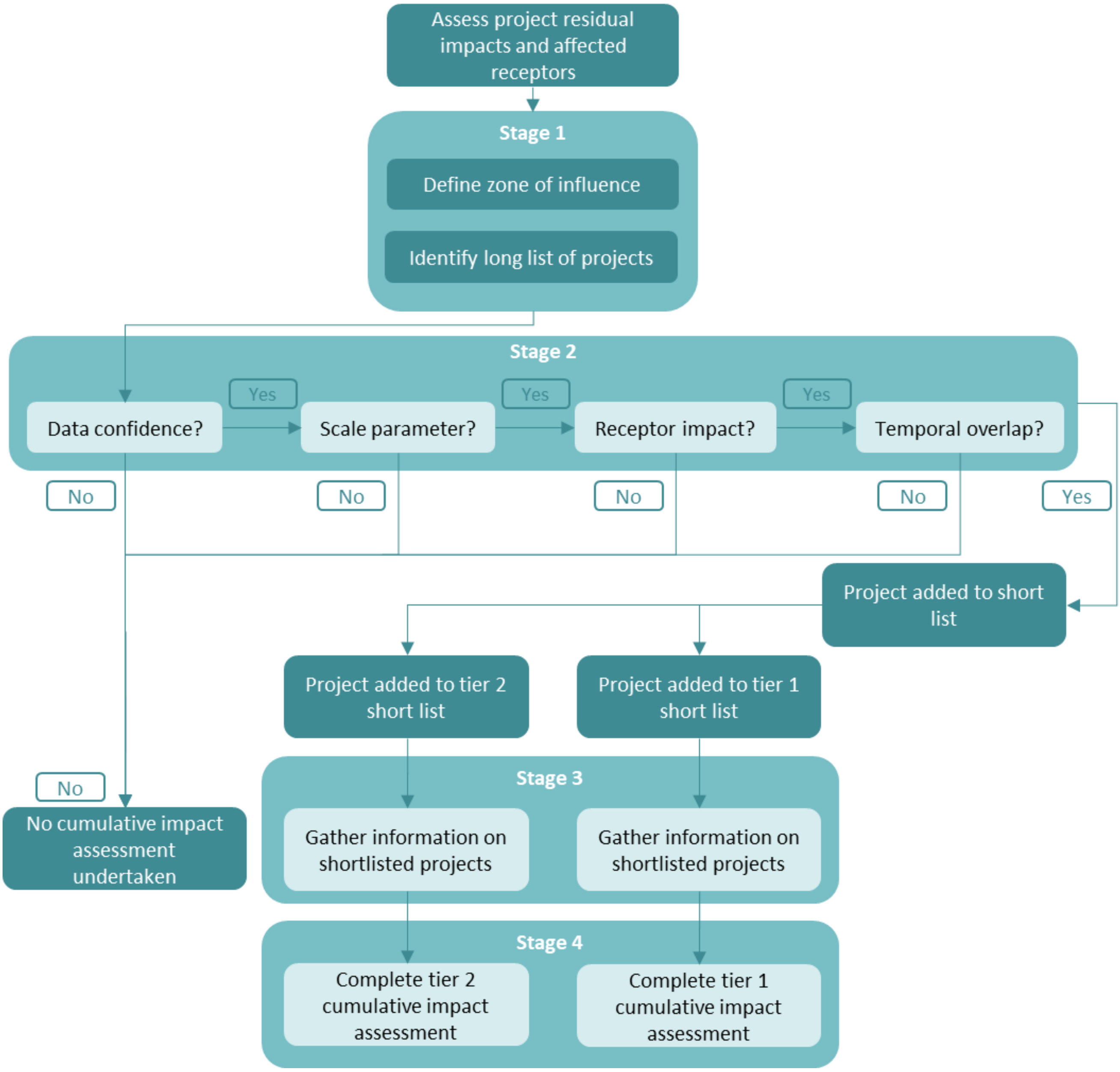

Figure 6-5 Cumulative impact assessment process

6.13 Describing noise and vibration

The types of noise and vibration and their character are accounted for in the assessment, as these can influence the level of disturbance to the nearby community. For example, noise that has notable tonal, impulsive or intermittent characteristics is generally perceived to be more annoying than a noise heard without these characteristics (i.e. steady-state noise). As a result, noise with these qualities would typically be penalised by adjusting a measurement result to account for the additional disturbance due to one or more of these characteristics.

Table 6-13 outlines the types of noise that may be present during the construction and/or operation of projects of similar scale and nature as the project.

Table 6-13 Characteristics of Industrial Noise

Type	Definition[1]	Examples	Penalty where relevant[2]
Steady-state	Noise with very little fluctuation in sound pressure level within the period of observation. (Note that steady-state noise could also be tonal)	• Pumps • Electric motors • Gearboxes • Conveyers	0 dB
Intermittent	Noise for which the level significantly drops several times during the period of observation. The time during which the level remains at a constant value different from that of the ambient background noise must be one second or more.	• Air compressors • Mobile machinery • Manual work • Grinding • Welding	+3 dB or +5dB
Impulsive	Impulse noise can be defined as having a high peak of short duration or a sequence of such peaks (bangs, clicks, clatters, or thumps).	• Automatic press • Pneumatic drill • Riveting hammer blow • Material handling • Punch press • Gunshot	+2 dB or +5dB
Tonal	Tonal noise can be defined as having a prominent frequency and characterised by a defined pitch.	• Reverse beepers • Bells • Buzzers • Grinding metal	+2 dB or +5dB

Table notes:

1 Definitions as per *World Health Organisation – fundamentals of acoustics*

2 Undertaken in accordance with the Noise Protocol.

The types of vibration that can affect a structure can be continuous, intermittent, or impulsive. A penalty for different vibration characteristics has not been considered in this report, however the application of criteria would depend on the type of vibration.

Construction and demolition activities typically result in intermittent or impulsive types of vibration (short-term). Short-term vibration events during construction can be described by activities that decay significantly before the next event (e.g. blasting, pile driving (non-vibratory), most rock breaking).

Sources like fixed machinery, vibratory rolling or vibratory piling would be considered continuous. Continuous vibration can have a greater impact on structures if the frequency of the source results in large vibration amplitudes (resonance). Consequently, the criteria may be more stringent for these activities to reduce the likelihood that resonance would occur.

Definitions on the types of vibration discussed in this report are outlined in Table 6-14.

Table 6-14 Types of vibration

Type	Definition[1]	Examples
Continuous	Continuous uninterrupted for a defined period (usually throughout daytime and/or night-time).	Normally generated by fixed plant items such as generators and fans, where the vibration continues uninterrupted (usually throughout the daytime or night-time period).
Intermittent	Defined as interrupted periods of continuous vibration or repeated periods of impulsive vibration.	Can be defined as interrupted periods of continuous vibration (e.g. vibratory rolling, heavy truck pass-bys or rock breaking) or continuous periods of impulsive vibration (e.g. impact pile driving).
Impulsive	A rapid build-up to a peak followed by a decay. The duration is typically less than 2 seconds.	A typical example would be ground compaction by dropping a large mass.

Table notes:

1 Definitions as per *BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings*

6.14 Limitations, uncertainties and assumptions

Assumptions and limitations relating to the noise and vibration impact assessment are provided below:

- This report is limited to surface noise and vibration impacts to humans. Underwater and airborne noise impacts to flora and fauna from project construction and operation activities would be presented separately (refer to Technical Report B - Benthic Ecology, Technical Report G - Onshore Ecology and Attachment I - Underwater Noise Modelling).
- Noise monitoring was undertaken at selected locations where approval was provided by the landholder or on public land near the project. The number of locations at which noise was monitored is considered to be sufficient to characterise the existing noise environment in the vicinity of the project
- The sensitive receptors in the study area have been identified using available GIS information.
- Inputs used to develop the project construction and operational noise models are based on available program and operational information at the time of reporting. Changes to these may impact the predicted noise levels.
- Key items outlined in the project description and provided by this operational noise assessment would be revisited if the specified equipment changes during detailed design to ensure that the noise is appropriately accounted for in the model.
- Specific information about the equipment being used, geological conditions (including the seabed) and the condition of structures near the proposed construction works is generally limited during the planning phase of a project. Consequently, a risk-based approach is usually adopted at this stage of a project to allow for vibration management measures to be developed for locations, structures or assets that fall within calculated safe working distances.
- It has not been possible to obtain noise data for individual equipment items or overall levels for the offshore and nearshore vessels. Therefore, the assessment has been based on a maximum allowable sound power level for the vessels.

6.15 Linkage to other Technical Reports

The noise and vibration impact assessment would be read in conjunction with other relevant technical reports forming part of the EES. Table 6-15 outlines the noise and vibration interdependencies with other technical reports.

Table 6-15 Noise and vibration interdependencies

Technical report	Noise and vibration interdependencies
Technical report Q - Business and tourism	Uses the results and analysis from this report as a basis for characterising business and tourism impacts due to noise and vibration.
Technical report T – Land use and planning	Uses the results and analysis from this report as a basis for characterising land use and planning impacts due to noise and vibration.
Technical report G – Onshore Ecology	Uses the results and analysis from this report as a basis for characterising noise and vibration impacts to flora and fauna.
Technical report R - Social	The noise models generated to investigate offshore construction and operational noise from the project at receptors onshore were altered to represent receptors who frequent the offshore area (i.e. recreational fishers and boaters). Note that these data are not presented in detail in this report as they are not relevant to the assessment presented herein.

Other technical reports are considered and referenced, where relevant.

7.0 Existing environment

The following sections describe the measurements that have been undertaken throughout the project area to define the existing noise environment.

7.1 Sensitive receptors

A review of the types of sensitive receptors that may be impacted by noise and from the project construction and operation was undertaken using maps and site investigations.

All the receptors in the vicinity of the project are residential except for:

- Reeves Beach Campground, which is a public campground in Reeves Beach, approximately 80 metres away from the shore crossing site.
- McLoughlins Beach-Seaspray Coastal Reserve, approximately 300 metres away from the shore crossing site.
- Woodside H27 Bushland Reserve
- Woodside H28 Bushland Reserve
- Kangaroo Swamp – 0-5,000 visitors per year – Kangaroo Swamp Nature Conservation Reserve Management Statement, DSE, 2005
- Mullungdung State Forest – no camping, no dogs, no fires, no firearms, no drones – otherwise accessible
- Warrigal Creek Streamside Reserve
- Darriman H33 Bushland Reserve
- Jack Smith Lake Wildlife Reserve – accessible for hunting and camping but may have restrictions at some times of the year
- Giffard Flora Reserve
- Giffard H30 Bushland Reserve
- Giffard H31 Bushland Reserve

It is understood that all of the reserves in the vicinity are publicly accessible but that some are significantly more popular than others. Apart from the campground and the beach, the only reserve that is understood to receive regular visitors is Mullungdung State Forest, which includes Kangaroo Swamp.

7.2 Monitoring locations

The locations of the noise monitoring are shown in Figure 7-1.

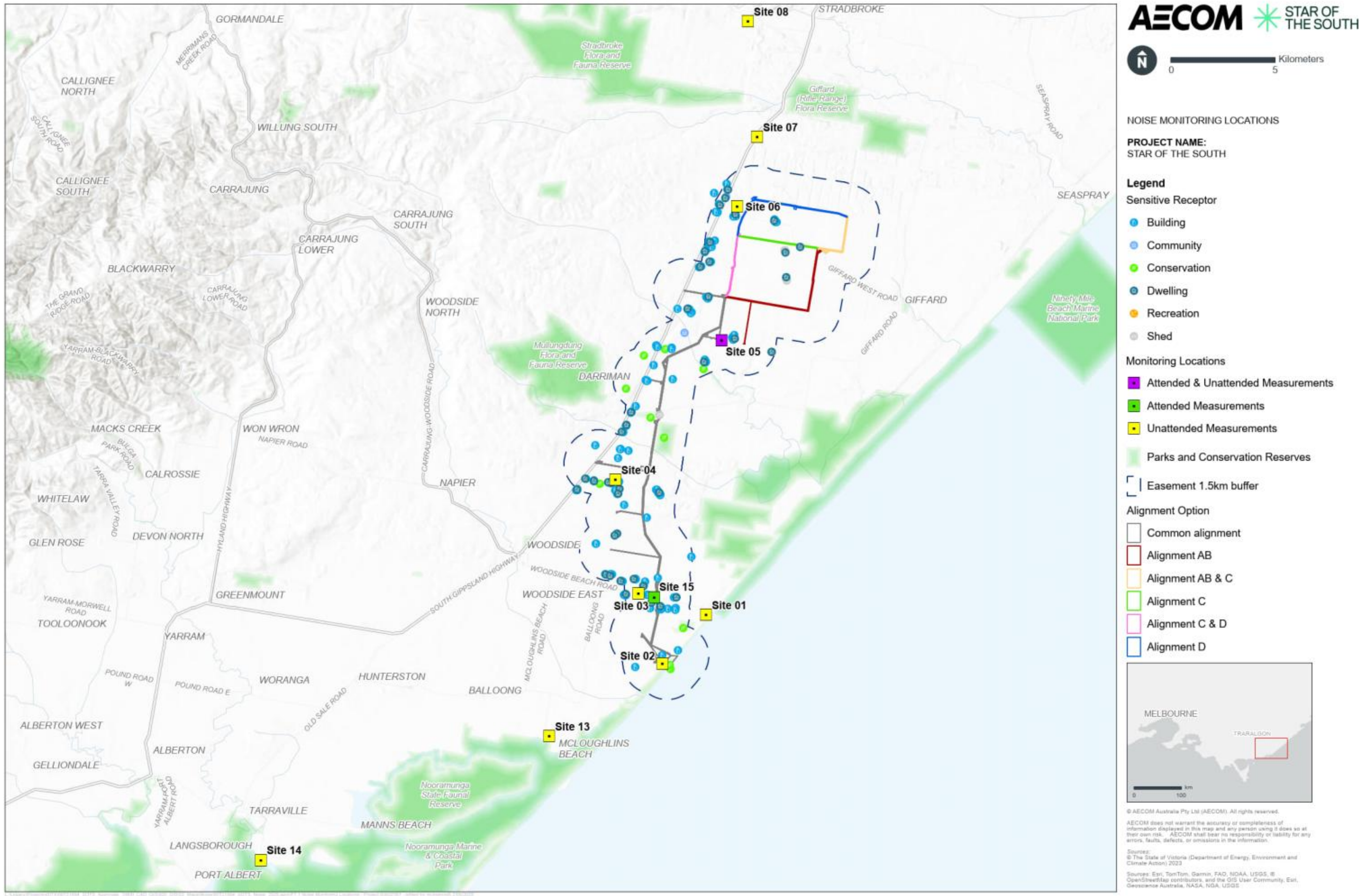

Figure 7-1 Noise monitoring locations

7.3 Unattended noise monitoring

Unattended background noise monitoring was undertaken at thirteen locations between 12 August and 3 September 2021 and at four additional locations between 27 September and 6 October 2022. The locations were selected to provide an understanding of the existing conditions at various locations within the study area.

The scope of the project has been reduced in the interim, so some of the monitoring locations are noted as being no longer relevant.

All measurements have been conducted in free-field locations and the results presented have not been adjusted to account for positioning. A summary of locations, equipment details and the duration of the monitoring is shown in Table 7-1.

Table 7-1 Measurement locations, duration and equipment details for unattended noise monitoring

Site ID	Address	GPS coordinates		Noise monitoring			Laboratory calibration expiry
		Latitude	Longitude	Serial number	Start	End	
01	[redacted]Rebecca Street, Woodside Beach, 3874	-38.551750°	146.975303°	947012	12/08/21	19/08/21	21/05/22
02	Reeves Beach Road, Woodside, 3874	-38.572795°	146.951154°	865769	27/08/21	03/09/21	15/01/22
03	[redacted] Woodside Beach Road, Woodside, 3874	-38.542544°	146.937932°	409174	12/08/21	19/08/21	23/07/23
04	[redacted] Dewars Road, Woodside, 3874	-38.493042°	146.925246°	765699	12/08/21	19/08/21	12/11/22
05	Four Mile Creek Road, Giffard West, 3851	-38.432647°	146.983948°	465445	12/08/21	27/08/21	18/11/22
06	[redacted] Giffard West Road, Giffard West, 3851	-38.374492°	146.992536°	409167	12/08/21	19/08/21	23/07/23
07	[redacted] South Gippsland Highway, Giffard West, 3851	-38.344337°	147.003570°	1273093	12/08/21	19/08/21	15/01/22

Site ID	Address	GPS coordinates		Noise monitoring			Laboratory calibration expiry
		Latitude	Longitude	Serial number	Start	End	
08	[redacted] Gormandale–Stradbroke Road, Stradbroke, 3851	-38.294192°	146.998479°	1273093	19/08/21	25/08/21	15/01/22
					27/08/21	03/09/21	
13	[redacted] McLoughlins Road, McLoughlins Beach, 3874	-38.604330°	146.888529°	947012	27/08/21	03/09/21	21/05/22
14	[redacted] Sarena Parade, Robertsons Beach, 3971	-38.657897°	146.728816°	409174	19/08/21	03/09/21	23/07/23

Table notes:

1 Noise measured at locations 9,10,11,12, 15 16, 17 and 18 are not reported in this assessment report, due to changes in project scope.

All noise monitoring equipment had current laboratory calibration status at the time of the measurements. Each noise monitor was checked with a field calibrator at the start and completion of the monitoring period. No significant drifts in calibration were noted.

Further details of the monitoring methodology and results are provided in Appendix A.

7.3.1 Weather conditions

Meteorological data was obtained from the Bureau of Meteorology weather station at Yarram Airport to identify periods where the measured noise levels could have been affected by adverse weather conditions. Adverse weather conditions were considered where wind speeds were noted to be greater than 5 m/s and/or rainfall was observed. Noise data was omitted where affected by adverse weather conditions. This is shown graphically in Appendix A.

7.3.2 Average background noise levels (L_{A90})

The measured background level from each monitoring location was calculated for each time period (Day, Evening and Night) for each day.

The lowest of those averages taken during the day and evening have been selected to represent the background level for the purpose of deriving criteria for those periods. The lowest measured hourly background has been selected for the purpose of deriving construction criteria for avoidable works during the night.

Table 7-2 Background noise monitoring results

Site	Address	Lowest Average Measured L_{A90}, dB			Lowest Measured $L_{A90,\ 1\ hr}$ dB
		Day	Evening	Night	Night
01	[redacted] Rebecca Street	39	39	36	34
02	Reeves Beach Road	35	42	41	37

Site	Address	Lowest Average Measured $L_{A90,}$ dB			Lowest Measured $L_{A90, 1\ hr}$ dB
		Day	Evening	Night	Night
03	[redacted] Woodside Beach Road	31	26	25	23
04	[redacted] Dewars Road	30	32	22	18
05	Four Mile Creek Road	27	24	22	19
06	[redacted] Giffard West Road	36	30	29	27
07	[redacted] South Gippsland Highway	30	27	20	17
08	[redacted] Gormandale–Stradbroke Road	29	22	22	19
13	[redacted] McLoughlins Road	37	35	35	26
14	[redacted] Sarena Parade	29	27	26	25

Table notes:

1 Noise levels measured at locations 9,10,11,12, 15 16, 17 and 18 are not reported in this assessment report, due to changes in project scope.

7.3.3 Average ambient noise levels (L_{Aeq})

The measured ambient noise level at each unattended monitoring location is shown in Table 7-3.

Table 7-3 Ambient noise monitoring results

Site	Address	Lowest Average Measured $L_{Aeq,}$ dB		
		Day	Evening	Night
01	[redacted] Rebecca Street	45	44	40
02	Reeves Beach Road	46	45	46
03	[redacted] Woodside Beach Road	55	49	42
04	[redacted] Dewars Road	47	40	35
05	Four Mile Creek Road	45	35	37
06	[redacted] Giffard West Road	47	39	35
07	[redacted] South Gippsland Highway	54	47	45
08	[redacted] Gormandale–Stradbroke Road	46	28	34
13	[redacted] McLoughlins Road	50	38	43
14	[redacted] Sarena Parade	41	31	35

Table notes:

1 Noise levels measured at locations 9,10,11,12, 15 16, 17 and 18 are not reported in this assessment report, due to changes in project scope.

7.3.4 Observations

Key observations from the existing conditions noise monitoring include:

- Background noise levels throughout the project study area are typically low.
- Background noise in the vicinity of the coast was typically higher than in rural areas.
- The evening background noise levels are marginally greater than the day-time background levels at some locations. This is likely due to extraneous noise sources such as cicadas or surf.
- Night-time background noise levels are typical for rural areas and areas of low residential density. It is noted that there is significant variation in the night-time background noise levels between monitoring locations. This is to be expected when the measured levels are less than 30 dB L_{A90}.

7.4 Attended noise measurements

Attended noise measurements were conducted:

- On Friday 3 September 2021 for a period of approximately 15 minutes during the day

These locations were selected in areas that may not have been available or suitable for unattended monitoring.

Table 7-4 Attended noise measurements

Site	Location	Start time	Measured noise level, dB			Observations
			L_{Aeq}	L_{Amax}	L_{A90}	
5	Four Mile Creek Road (2021)	03/09/2021 12:31	45	53	37	Distant traffic, bird noise

Table notes:

1 Noise measured at locations 12, 15, 19 and 20 are not reported in this assessment report, due to changes in project scope.

The equipment and calibration details for the attended measurements are presented in Table 7-5.

Table 7-5 Attended measurement equipment details

Monitoring location	Equipment details	Laboratory calibration expiry
All (2021)	Brüel & Kjær Type 2270, Serial No. 30029627	14/01/2022

All noise monitoring equipment had a current laboratory calibration certificate at the time of the measurements. Each noise monitor was checked with a field calibrator at the start and completion of the monitoring period. No significant drifts in calibration were noted.

8.0 Issues for assessment

The issues for assessment were identified by reviewing the project description for interactions between the key project components and the proposed construction, operations and decommissioning activities and sensitive receptors. These cause-and-effect pathways were designated as either impacts or risks based on whether the issues relate to situations that are expected or accidental.

The identified issues are presented in Table 8-1 and for each, a maximum design scenario has been defined as the basis for the assessments presented in Section 9.0, Section 10.0 and Section 11.0.

The table also includes the residual impact and risk levels arising from the assessment undertaken, following incorporation of mitigation measures

Table 8-1 Noise and vibration assessment issues

Impact or risk ID	Impact or risk pathway	Residual impact rating	Residual risk rating
Construction			
ONV-I001	General construction works along the onshore cable system alignment causes an increase in noise that affects the amenity of sensitive receptors.	Moderate	N/a[1]
ONV-I002	Out-of-hours work causes an increase in noise that affects the amenity of sensitive receptors There are no avoidable out-of-hours works proposed so this relates to unavoidable works associated with the shore crossing, trenchless crossings and offshore works.	Moderate	N/a[1]
ONV-I003	Construction traffic causes an increase in noise that affects the amenity of sensitive receptors.	Moderate	N/a[1]
ONV-I004	Vibration from construction works causes human disturbance.	Minor	N/a[1]
ONV-I005	Vibration from construction works cause structural damage to buildings and underground services.	Minor	N/a[1]
Operation			
ONV-I006	The 24-hour operation of the offshore wind turbines leads to an increase in noise affecting the amenity of nearby sensitive receptors.	Minor	N/a[1]
ONV-I007	Vibration at sensitive receptors generated by the operation of project infrastructure causes human disturbance.	Minor	N/a[1]

Impact or risk ID	Impact or risk pathway	Residual impact rating	Residual risk rating
Decommissioning			
ONV-I008	Infrastructure decommissioning causes an increase in noise or vibration affecting amenity of nearby sensitive receptors.	Moderate	N/a[1]

Table notes:

1 The risk assessment is not applicable to noise and vibration since a risk, as it is defined herein, is where a project activity or activities could result in an unexpected (accidental) event in any of the project phases (construction, operation or decommissioning) that causes a change to the existing environment.

9.0 Construction assessment

The assessment of impacts and risks associated with the project construction considers the potential changes to the noise environment within the study area and whether this could adversely affect human amenity or sensitive structures and/or exceed the proposed criteria.

As planning progresses and the construction methodology for design evolves, the project must meet the General Environment Duty, which requires proactive approaches to noise mitigation so as to minimise impacts as far as is reasonably practicable.

9.1 Project parameters that form the basis of impact assessment

Table 9-1 specifies the maximum design scenario that has been assessed for construction. The scenario depicted is the set of project parameters from ranges specified in the project design envelope that results in the greatest potential impact to an identified sensitive receptor or receptor group. (See Section 6.4 for more information on maximum design scenarios).

Table 9-1 Maximum design scenario - construction

Issue	Key parameter values	Justification

ONV-I001 – ONV-I006	The works and infrastructure are located within the onshore construction project area, which is defined by the area required for construction of the following:
	• Onshore Wind Farm transmission system infrastructure:
	  ▪ Up to 8 underground cable circuits with the following upper limit footprints:
	    ♦ Temporary construction corridor width between shore crossing and VicGrid connection hub: 60 m width.
	  ▪ Joints and bays at one-kilometre (approx.) intervals with upper limit joint footprints of 5 m x 15 m x 3 m (W/L/D)
	  ▪ Other temporary construction infrastructure including access roads
	• Shore crossing infrastructure:
	  ▪ Trenchless shore crossing approaches with maximum length of 1400 m and depth of up to 35 m
	  ▪ Transition joints and bays with upper limit footprints of 10 m x 30 m x 5 m (W/L/D)
	  • Temporary construction compounds with an upper limit footprint of 100 m x 100 m (W/L)
		The onshore and offshore construction project area defines the area within which construction activities would be occurring for the project.

	Details of the offshore piling are as follows: • Up to 152 monopiles requiring piling (147 WTG monopiles and 5 OSS monopile or jackets) • Maximum hammer energy of 4,000 kJ • Approximate soft start energy (% of maximum hammer energy)% of 20% • Maximum duration of per pile (to reach target depth) (per monopile) of 4 hours • Cumulative duration of active piling of 608 hours • No more than one pile would be constructed concurrently.	

Issue	Key parameter values	Justification
	Maximum foundation installation duration (cumulative) 24 months	

To assess potential impacts associated with the project, the assessment has also considered the following assumptions and indicative construction techniques:

- Trenching construction techniques across each waterway that will take between two to three days to complete and could be constructed during dry periods with minimal impacts on flow regime.

9.2 Initial mitigation measures

The construction noise and vibration mitigation measures for the project are based on the legislation, policy and guidelines discussed in Section 4.0, the methodology and assumptions outlined in Section 6.5 and the existing baseline levels and observations captured for the existing conditions assessment in Section 7.3.

9.2.1 ONV-M001 – Managing noise and vibration from construction activities

EPA Victoria Publication 1834.2 does not provide construction noise criteria or guideline levels for works that are undertaken during normal working hours.

The project will reduce construction noise as far as is reasonably practicable to avoid unnecessary noise impacts upon sensitive receptors in accordance with the EPA Victoria Publication 1834.2, the ERS and the GED.

This intention has been captured in the application of the practices included within the initial mitigation measures listed in **ONV-M001**. The term "initial" is intended to describe items that are considered to be the minimum and then these are refined as the assessment and project progresses.

This includes the following general good practice techniques taken from EPA Victoria Publication 1834.2:

- Adopting all reasonably practicable mitigation measures to minimise the impact on the receptors
- Inform potentially noise-affected neighbours about the nature of construction stages and noise reduction measures.
- Give notice as early as possible for periods of noisier works such as excavation. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress.
- Appoint a principal contact person for community queries.
- Provide 24-hour contact details through letters and site signage. Record complaints and follow a complaint response procedure suitable to the scale of works.
- Within normal working hours, where it is reasonable to do so:
  - schedule noisy activities for less sensitive times, (for example, delay a rock-breaking task to the later morning or afternoon)
- Provide respite offers that reflect the level of impact, for example, movie tickets. The weekend/evening work hours in the schedule (including Saturday afternoon or Sunday) are more sensitive times and have noise requirements consistent with quieter work.
- The weekend/evening periods are important for community rest and recreation and provide respite when noisy work has been conducted throughout the week. Accordingly, work will not usually be scheduled during these times.
- Using the lowest-noise work practices and equipment that meet the requirements of the job.
- Locating site buildings, access roads and plant will be positioned such that the minimum disturbance occurs to the locality.

- Installing broadband reversing alarms on construction vehicles and machinery in preference to 'beeper' reversing alarms. The site will also be planned to minimise the need for reversing of vehicles.
- Turning off plant and vehicles when not being used.
- Taking care not to drop spoil and construction materials that cause peak noise events
- All mechanical plant is to be silenced by the best reasonably practicable means using current technology. Mechanical plant, including noise-suppression devices, will be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair.
- Fitting all pneumatic tools operated near a residential area with an effective silencer on their air exhaust port.
- Scheduling noisy works to EPA Victoria normal construction hours (i.e. Monday to Friday 07:00 am to 6:00 pm, and Saturday 07:00 am to 1:00 pm).
- Appointing a suitably qualified project representative to manage and approve unavoidable night work (10:00 pm to 7:00 am) applications.

In addition, the communication and offsite mitigation approaches taken from Section 4.3.2 and 4.3.5 of EPA Victoria Publication 1834.2 are included in **ONV-M001**.

9.2.2 ONV-M002 – Out of hours construction noise mitigation measures

The application of additional noise management measures (**ONV-M002**) will be implemented to address impacts if out of hours works are required.

Avoidable works outside of EPA Victoria normal working hours are not proposed for the onshore construction. If this changes as the project progresses, then **ONV-M002** also provides for the development of a framework to justify the necessity of avoidable out-of-hours works.

Projects should aim to constrain works to normal working hours and it is noted that works undertaken outside of normal working hours are required to be justified on the basis that it is not reasonably practicable for the works to be undertaken during normal working hours and of being "low impact", "managed impact" or "unavoidable works" (as defined in EPA Publication 1834.2).

Where the construction works are required to occur outside of EPA Victoria normal working hours (i.e. unavoidable works in this case as avoidable works at night are not proposed), all reasonably practicable mitigation measures will be implemented to minimise the impact on the receptors.

9.2.3 ONV-M003 – Vibration safe working distances

Additional management measures will be required where occupancies, structures and assets are closer than the safe working distances derived using the values in the following standards:

- British Standard BS 6472-1:2008: Table 1 – *Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings*
- German Standard DIN4150-3:2016-12: Table 1 – *Guideline values for vibration velocity for evaluating the effects of short-term vibration on structures*
- German Standard DIN4150-3:2016-12: Table 3 – *Guideline values for vibration velocity for evaluating the effects of short-term vibration on buried pipework*
- An asset owner's utility standards.

9.2.4 ONV-M004 - Cable system construction – batch locations – noise control

Adoption of noise reduction measures to be installed to the batching plant locations as follows:

- For Site 1, a noise barrier will be installed, wherever reasonably practicable to do so.
- For Site 2 to 6, a noise shall be installed to allow compliance with the noise protocol.

- Any noise barrier will be installed to the site boundary at a height of 2.4 metres or 500 millimetres greater than the highest point on a static noise source within the site, whichever is the higher.
- Any access gates will be solid and generally kept closed.
- Adopting engineering noise controls for ancillary equipment (e.g. silencer, mufflers, enclosures) by all reasonably practicable means using current technology.
- Where reasonably practicable, the quietest available equipment or process should be selected.
- The impacts and the design of site-specific mitigation will be determined prior to construction works via noise modelling and confirmed during construction via on site monitoring.

9.2.5 ONV-M005 – Unavoidable works - Shore crossing drilling – noise control

Adoption of noise reduction measures to be installed adjacent to the shore crossing site as follows:

- A noise barrier will be installed to the site boundary at a height of 2.4 metres.
- Any access gates will be solid and generally kept closed, especially at night.
- Where reasonably practicable, installation of enclosures or localised noise barriers around the shore crossing drilling equipment to provide a noise barrier between any particularly noisy construction works and the residences.
- Adopting engineering noise controls for ancillary equipment (e.g. silencer, mufflers, enclosures) by all practical means using current technology.
- Where reasonably practicable, the quietest available equipment or process should be selected.
- Stationary equipment such as bentonite treatment, generators and pumps will be stored within shipping containers or suitable acoustic enclosures.

9.2.6 ONV-M006 - Unavoidable works - Offshore piling – noise control

Initial mitigations for the offshore piling that have been considered in the design included:

- Where reasonably practicable, the quietest available equipment or process should be selected.
- Reduced number of turbines
- Reduced monopile size, depth and blows from initial assessment
- Exploring options for vibration hammer and other lower energy hammers
- Monitoring and reporting mechanisms as part of management plan.

9.3 Mitigation measures from other technical reports

Initial mitigation measures that have been recommended within other technical reports that are relevant to this assessment are referenced below.

Separate to this technical assessment, an assessment is being undertaken for underwater noise (Attachment I: Underwater Noise Modelling). The sensitivities around underwater noise are anticipated to be more onerous than those for airborne noise although this assessment has not been finalised. Underwater noise mitigations will be considered once finalised, as they are likely to benefit airborne noise.

9.3.1 SOC-M003 Stakeholder Engagement Management Plan

A Communications & Stakeholder Engagement Management Plan will be implemented to facilitate ongoing consultation with relevant stakeholders (including Councils, authorities, businesses, residents and community groups) throughout the project to ensure that all stakeholders have access to complete information regarding the nature of the proposed project activities and their likely impacts. Advanced notice will be given to affected residents, business or industries prior to commencement of works.

9.4 Construction working hours

Table 9-2 summarises the proposed construction activity working hours.

Table 9-2 Proposed construction activity working hours

Activity	Construction hours
Cable system and batching plants	7am – 6pm weekdays 7am – 1pm Saturdays
Shore crossing	7am – 6pm weekdays 7am – 1pm Saturdays
Shore crossing drilling	Note that the shore crossing drill is exposed to failure if drilling activities are suspended with bore hole collapse being the greatest risk. It is therefore assumed that once drilling activities commence, 24/7 unavoidable works would be required until the drilling scope is completed. Similarly a cable pull could start at any time and would be continuous.
Trenchless (HDD) crossings	7am – 6pm weekdays 7am – 1pm Saturdays Unavoidable works during the night may be required but they would not occur continuously and would be for less than a week.
Offshore installations	24hrs, seven days a week
Onshore decommissioning	7am – 6pm weekdays (onshore) 7am – 1pm Saturdays (onshore)
Offshore decommissioning	24hrs, seven days a week

Staff may arrive between 6am and 7am (during night hours) at construction compounds. This activity is unlikely to cause noise that could be clearly heard by residents.

Whilst it is the intention to undertake works during daytime, some unavoidable works are anticipated outside of the daytime period. The anticipated unavoidable works considered for this assessment are presented in Table 9-3.

Table 9-3 Unavoidable works summary

<table>
<tr><th>Works</th><th>Activity</th><th>Justification</th></tr>
<tr><td>Drilling or micro-tunnelling works within the shore crossing site</td><td>Shore crossing drill and cable system insertion</td><td rowspan="2">The drill works require continuous drilling to avoid bore hole collapse which would prolong the construction activities.
Similarly, the pullback process that is part of this construction method does not allow for stopping the activity, as this could also cause bore hole collapse.</td></tr>
<tr><td>Onshore cable system construction</td><td>Trenchless crossings</td></tr>
</table>

Works	Activity	Justification
Emergency	Unknown	Emergency or directed activities would be carried out if required to prevent an imminent loss of life or environmental damage as directed by the relevant authority for noise and vibration regulations at the time of works. The definition of an emergency is taken from the Emergency Management Act 2013.
Nearshore works	Shore crossing support	The shore crossing support is required at stages of drilling and for the cable system insertion. During nearshore construction, vessel(s) would operate close to the shoreline to install the cable system and umbilical and to stabilise both onto the seabed. The work is based on a 24hr operation to optimise weather windows, as operating conditions for vessels in shallow water are very sensitive to wave, current and wind conditions.
Offshore installation	All	The construction of the turbines and offshore substations requires piles to be driven into the seabed. Installation of the piles can only be carried out under calm sea conditions and relatively low wind speeds, and so to minimise construction periods, piling would be undertaken whenever weather conditions allow. The work is based on a 24hr operation because pausing or stopping the piling process can lead to the loss of progress and the failure for the foundation to reach the required depth. This would require the partly installed pile to be removed and scrapped. In such a case the pile may need to be completed outside of normal hours. However, there will not be a case where a pile is commenced out of hours as there are other factors, such as marine wildlife monitoring which mean that this cannot happen. The continuation of construction during optimal weather conditions avoids the potential delays associated with mobilising and de-mobilising piling equipment out at sea.

The proposed construction activity hours and works described in Table 9-2 and Table 9-3 would be referenced in the relevant sections throughout the construction noise and vibration impact assessment.

9.5 Construction noise from the onshore cable system (ONV-I001)

Onshore wind farm transmission (dedicated transmission system) – Approximately 30 kilometres of onshore transmission project area extending from the shore crossing at Reeves Beach, Woodside and the proposed VicGrid connection hub, Giffard. The area would contain the onshore transmission system, consisting of underground cables, fibre and joints as well as infrastructure to access and maintain the system during operations. The underground transmission system is to be contained within a nominally 40-metre-wide cable easement, with a nominal 60-metre-wide temporary footprint during construction. Substations and associated infrastructure required to connect to the VicGrid connection hub is subject to assessment under a separate Environment Effects Statement process for these works.

A review of the proposed cable system construction methods has been undertaken to determine the scenarios with the greatest potential for noise impacts. Although the cable system works would occur over several months, the activities required for installation are expected to move past each cluster of sensitive receptors in days only, in most cases, or weeks for each activity.

Construction stages are generally likely to follow sequentially but may be separated by weeks or months so receptors are likely to experience each of the stages at different times. Also, note that between each node (which means a primary laydown or batching plant) location, plant and vehicles are likely to access a specific node continually while work is being undertaken, possibly despite no work being undertaken in the immediate vicinity of that node.

The batching plants are commercial, industrial and trade premises and therefore, their noise has been assessed under Part 5.3, Division 3 of the EP Regulations in Section 9.6.

Where the transmission corridor traverses areas of sensitivity, such as native vegetation, efforts would be made to minimise potential impacts, such as decreasing construction footprint widths, micro-siting and in some cases using trenchless construction methods. Trenchless crossings are addressed in Section 9.8.

9.5.1 Construction scenarios

The construction scenarios for the cable system works are presented in Table 9-4. A construction noise model was not developed due to the large extent of the works.

Table 9-4 Assessment scenarios – Onshore cable system construction works

Scenario reference	Construction phase	Rate/duration of works	Description of construction activities
P1	Site establishment	Rolling along alignment as new work fronts opened up.[1]	Clearing of foliage within a 50-60 metre construction corridor along cable system route. A 30-40 metre easement is cleared and graded along the cable system route.
P2	Civil works – Access track construction	Rolling along in front of trenching works as new work fronts opened up [1]	Access tracks constructed along cable system.
P3	Civil works Pad/Bench Construction for Laydown Areas & Batch Plants	Approximately 2.5 weeks per laydown or batch plant site.	Establishment of laydowns and batch plant areas.
P4	Civil Works - Batch Plant Erection		Construction of a batching plant site.
P5	Civil works – Excavation and conduit installation	Approximately 120 m per trench per day per work crew (4 crews). Expected duration is approximately 10 months[1]	A trench is dug for the cable system to be laid in, conduits are laid and trench is back filled.
P6	Cable joint bay and ancillary pit installation	12 days per double circuit joint bay per crew (7 crews).[1]	Transmission system cable joint bays and ancillary pits are installed.

Scenario reference	Construction phase	Rate/duration of works	Description of construction activities
P7	Cable pulling	1 length of cable per day per crew, therefore 6 cables per week per crew. (3 crews) [1]	Transmission system cables are pulled through laid conduits[2]
P8	Cable jointing activities	12 days per double circuit joint bay + additional setup time (6 crews).[1]	Cables are joined by cable jointers[2]
P9	Commissioning activities	Expected duration is approximately 5 months[1]	The cable system is tested[2]
P10	Civil works – Reinstatement	Reinstatement works ongoing though-out construction (>12 months)	Temporary access tracks, temporary buildings, drainage, etc is removed. Re-seeding is undertaken and permanent fencing is installed.
Total duration		Approximately 26 months of construction.	

Table notes:

1 Construction scenario rates per day are approximate/preliminary

2 Work tasks P6-P8 will generally be undertaken in the vicinity of joint bays which are expected to be spaced at 1000 metre intervals (subject to design variables and procurement). At these locations, there will be extended periods of works.

9.5.2 Onshore cable system - Construction plant and equipment

The construction plant and equipment proposed for the onshore cable system are presented below. All activities are currently proposed to occur during normal working hours.

It is anticipated that different cable system construction activities, such as trenching and lowering in, would be separated by a buffer period to allow for any delays in construction.

The plant listed in Table 9-5 is based on preliminary estimates and will be subject to change as planning progresses and methodology is proposed by contractors.

Table 9-5 Onshore cable system – proposed construction plant and equipment

Equipment	Sound Power Level, dB (A)	Operation time in a 15-minute period	Transmission system construction scenarios									
			P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Articulated dump truck (up to 25T)	109	100%	1		1		2					3
Articulated dump truck (up to 41T)	116	100%			2		2	1				
Backhoe loader (12-15T)	95	100%			2		2					
Cable winch	84	100%							1			
Cable pusher	97	100%							2			
Chain wheel trencher	115	100%					1					
Chainsaw	114	50%	3									
Compressor	103	100%				2						
Concrete mixer	104	100%					1					
Concrete pump	106	100%										
Concrete truck[1]	110	100%				1	1					
Dewatering plant	114	100%					1					
Directional drill unit	111	100%					2					
Dozer (up to 70T)	108	100%	2	1	3		3					1
Drop hammer piling rig	97	100%									1	
Excavator, (up to 100T)	117	100%			1		1					
Excavator, (up to 29T)	104	100%	1		1		1	1				2
Excavator, (up to 10T)	96	100%	1		1		1					1
Excavator with breaker	104	100%						1				
Fencing equipment	96	100%	1									
Forklift (up to 18T)	99	100%			2	2						
Franna crane	105	100%			1		1	1				
Front end loader (up to 36T)	113	100%					1					
Generator, diesel (30kw)	93	100%				1	1	1	1	1		
Generator, diesel (500kw)	102	100%									1	
Grader (up to 73T)	114	100%		1	2		2					
Hydrovac excavation truck	114	10%					1	1				
Loader	113	100%			3	2						
Trucks[1]	107	100%				1	1	1	1	1	1	
Mobile crane	98	50%			1	2			2			

Equipment	Sound Power Level, dB (A)	Operation time in a 15-minute period	Transmission system construction scenarios									
			P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Mulcher	113	100%	1									
Pump	103	100%										
Reach stacker	99	100%			1							
Road reclaimer	117	100%			1		1					
Rock crusher	124	50%					1					
Rock saw	120	10%					1					
Roller (up to 19T)	109	100%		1	2		2					
Roller, padfoot	111	100%	1	1	2		2					
Rotary drill, water bores	119	100%			1							
Scraper	114	100%			2							
Skid steer loader	105	100%			1		1					
Telehandler (up to 11T)	107	10%	1		1							
Tractor	108	100%					3					3
Truck and dog (up to 20T)[1]	108	100%	1		1		1					1
Ute 4x4	101	100%	1		2		2					
Water cart 20,000L	102	100%		1	1							2
Wheeled tractor/scraper (up to 54T)	116	100%		1	2		2					
Activity Sound Power Level, dB(A)[2]			**120**	**120**	**128**	**118**	**128**	**117**	**108**	**107**	**109**	**118**

Table notes:

1. There will be several trucks operating to, amongst other things, deliver product from the TSB to the work fronts, it has been assumed that there would typically be up to one of each type of truck on site at any one time.
2. The overall sound power levels for each scenario is the sum of the noise level from each individual item. This is a conservative approach.

9.5.3 Nearest noise sensitive receptors

The nearest noise and/or vibration sensitive receptors potentially impacted by the cable system construction works are shown in Table 9-6.

Table 9-6 Nearest noise sensitive receptors for the onshore cable system construction works

Receptor type	Approximate distance from works (m)	Number of receptors
Residential buildings	Within 250	35
	250-500	33
	500-1000	65
	1000-1500	40
	Total	**206**
Community buildings	250-2000	0
Outdoor recreation and public open spaces	250-2000	5 reserves within 1000m of the cable alignment.

9.5.4 Construction noise levels at distance

The calculated noise levels from onshore cable system construction activities at distances from each construction scenario are summarised in Table 9-7.

Table 9-7 Construction noise set back distances

Scenario reference	Combined sound power level, dB(A)	Calculated construction noise levels at offset distances from cable system, $L_{Aeq\ (15\ min)}$ dB[1]				
		250m	500m	1000m	1500m	2000m
P1	120	69	63	57	54	51
P2	120	69	63	57	53	51
P3	128	77	71	65	61	59
P4	118	67	61	55	51	49
P5	128	77	71	65	62	59
P6	117	67	60	54	51	48
P7	108	57	51	45	42	39
P8	107	56	50	44	41	38
P9	109	58	52	46	42	39

Scenario reference	Combined sound power level, dB(A)	Calculated construction noise levels at offset distances from cable system, $L_{Aeq\ (15\ min)}$ dB[1]				
		250m	500m	1000m	1500m	2000m
P10	118	67	61	55	52	49

Table notes:

1. Includes a +5 dB correction for tonality and/or impulsiveness on the basis that static equipment could be tonal and that mobile equipment could be impulsive but that they may not operate at the same time or that the mobile equipment, which is louder, may mask the tonality of the fixed equipment

9.5.5 Assessment against ERS

In all cases, the measured existing noise levels presented in Section 7.3.3 are above the relevant ERS objective during the daytime.

In addition, it is noted that the integrating periods for assessment against EPA Victoria Publication 1834.2 (15 mins) and the ERS (16 hours during the day and 8 hrs overnight) are different, however, since the assessment period for the ERS is longer, the predictions made for comparison with EPA Victoria Publication 1834.2 (Table 9-7) represent a conservative approach.

Commentary with respect to the predicted construction noise and the ERS objectives is presented in Table 9-8.

Table 9-8 Assessment against the ERS – Onshore cable system construction

Approximate distance to works	Objective, L_{Aeq}, dB		Environmental Value
	Day	Night	
Up to 2000m from the works	40[1]	N/a – Avoidable night works are not proposed. Unavoidable works have their own section.	**Sleep during the night** N/a – Avoidable night works are not proposed for the bulk of the works. Early morning operations associated with the batching plants are assessed in Section 9.6.
			Domestic and recreational activities Construction noise may interfere with domestic and recreational activities at noise sensitive receptors less than 2000 metres from mobile works for approximately four weeks. Therefore, notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 for noise sensitive receptors within 2000 metres (**ONV-M001**).
			Normal conversation Construction noise may interfere with normal conversation at noise sensitive receptors less than 2000 metres from mobile works for approximately four weeks Therefore, notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**).
			Child learning and development N/a – there are no learning institutions in the vicinity of the transmission system construction.

Approximate distance to works	Objective, L_{Aeq}, dB		Environmental Value
	Day	Night	
			Human tranquillity and enjoyment outdoors in natural areas A high-level Soundscape assessment has been carried out and is detailed in Section 9.5.6.
			Musical entertainment N/a – There are no musical entertainment venues within the study area.

Table notes:

1. *In all cases, the measured existing noise levels presented in Section 7.3.3 are above the relevant ERS objective during the daytime. However, the predicted levels are generally above the existing measured levels and, therefore, the ERS is still a relevant consideration.*

9.5.6 Soundscape

Apart from Reeves Beach Campground and McLoughlins Beach - Seaspray Coastal Reserve, which are addressed in the assessment for the shore crossing, the following reserves are in the vicinity of the transmission system construction footprint.

It is noted that some of the reserves listed are very large, so the distance stated is intended to reflect the nearest point of the reserve to the construction works.

Table 9-9 Nearest Natural Areas to the onshore cable system construction

Name	Distance (m)
McLoughlins Beach - Seaspray Coastal Reserve	550
Woodside H27 Bushland Reserve	1500
Woodside H28 Bushland Reserve	Adjacent
Mullungdung State Forest	550
Warrigal Creek Streamside Reserve	800
Darriman H33 Bushland Reserve	100
Jack Smith Lake Wildlife Reserve	3200
Giffard Flora Reserve	4200
Giffard H30 Bushland Reserve	5500
Giffard H31 Bushland Reserve	5800

It is understood that all of the reserves in the vicinity are publicly accessible but that some are significantly more popular than others. The only reserve that is understood to receive regular visitors is Mullungdung State Forest, which includes Kangaroo Swamp.

Predicted construction noise levels to the nearest reserves to the works are of the order of 76 L_{Aeq} dB. However, these levels are taken as the nearest point of the reserve and could be lower at the nearest publicly accessible location. In addition, the works are expected to be in the vicinity of the reserve for a short duration.

A high-level assessment based on the data collected as part of the sound walk at Reeves Beach Campground indicates that noise may interfere with human tranquillity and enjoyment outdoors in natural areas in the vicinity of the onshore cable system construction.

Notification and consultation will be undertaken with Parks Victoria and relevant user groups in reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**).

9.5.7 Character of construction noise

Commentary on the risk of harm in the event that cable system construction activities display any of the characteristics listed in Section 4.1.3 of EPA Victoria Publication 1834.2, is provided in Table 9-10.

Table 9-10 Potential construction noise characteristics – Transmission system

Activity	Potential noise character	Factors that influence the risk of harm (EPA Victoria Publication 1834.2)
Chainsaw	Tonal	In accordance with EPA 1834, the following corrections have been added to the predicted construction noise levels: • +2 dB for a tone • +2 dB for an impulsiveness. **<u>Proximity to people</u>** The nearest cable system works are within 250 metres from residential dwellings. However, most residents in the vicinity are between 250 and 1500 metres from the works. **<u>Time of day</u>** Daytime only. **<u>Duration of exposure</u>** For mobile works: Approximately four weeks in most locations For static works: Up to 25 months. **<u>Background noise levels</u>** The existing measured ambient levels are generally representative of rural environments. The predicted noise levels are above the measured existing ambient levels in most locations along the cable system construction corridor. **<u>Low frequency noise</u>** A high-level screening assessment of low frequency noise has been carried out for the highest noise source (Road reclaimer) for this construction scope. The results indicate that the EPA Publication 1996 thresholds could be exceeded in the 50Hz and 63Hz 1/3rd octave bands at distances of up to 2000m. this indicates a risk of problematic low frequency noise. **<u>Construction fatigue</u>** There are no other known works ongoing in the vicinity at present. **<u>Summary</u>** Notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 for noise sensitive receptors within 2000 metres from mobile works (**ONV-M001**).
General earthworks	Impulsive	
Heavy machinery	Low frequency noise	
Reverse beepers	Tonal	
Rock breaker	Impulsive, tonal	
Rock crusher	Impulsive	
Rock saw	Tonal	

9.6 Construction noise – batching plants (ONV-I001)

A batch plant is equipment that combines various ingredients to form concrete or other mixed products such as thermally stable backfill (TSB) for the cable system. Batch plants can be permanent structures or temporary, mobile plants used to service a section of a site then be moved.

Batch plants are preferably located in areas accessible to the wider road network for delivery of raw product from external sources, and efficiently supply the mixed product to the work sites. The plants are ideally located away from sensitive receptors.

Each batch plant would be erected on a temporary hardstand that includes an engineered surface suitable for managing the expected loads, traffic volumes and contain runoff from the materials being stored.

On completion of the section of works, the batch plant would be demobilised, and the temporary hardstand removed.

It is anticipated that the project may utilise up to three batch plants at any one time to supply TSB for the cable system. The batch plants would be expected to be in operation for up to seven months at each location before being demobilized. A schematic overview of a batch plant is provided in Figure 9-1 below.

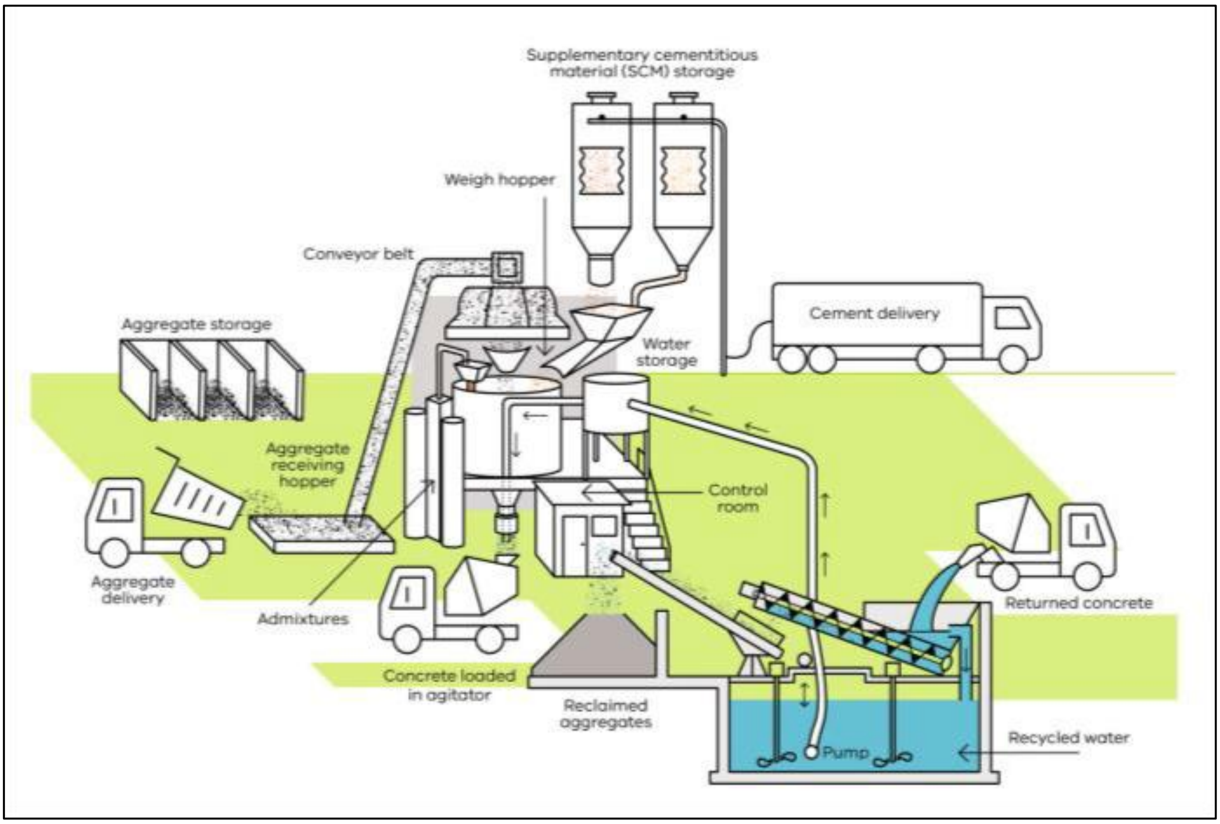

Figure 9-1 Typical batch plant components (Source EPA Victoria)

Batching plants will only be utilised as a part of the construction operation. However, they are commercial, industrial and trade premises and therefore, their noise has been assessed under Part 5.3, Division 3 of the EP Regulations.

A batching plant has a number of components that work together to produce high quality product, including:

- **Aggregate feeders** – Bins located side by side, which each hold different coarse aggregates and sand, feeding them into the batching plant.

- **Aggregate weigh conveyor** – Materials move from the feeders to a conveyor or bin that weigh aggregates before they are put in the mixing unit. Other bins also weigh water received from the water pump and any other additives. This process ensures the exact proportions of ingredients are dispatched into the mixer.
- **Cement silo** – Holds large volumes of cement. A screw conveyor of suitable diameter and length is at the bottom, enabling transfer of cement into the cement weigh hopper.
- **Mixing unit** – This is where all the ingredients are received and thoroughly mixed together until homogenous before discharging contents into a transit mixer or concrete pump
- **Air compressor** – This controls essential pneumatic operations of the batching plant like the feeder gates, butterfly valves fitted with weigh hoppers, opening and closing of the mixing unit gate, etc.
- **Control panel** – Modern batching plants allow you to control the entire system easily with an electronic control panel and display system.

An indicative batching plant layout is provided in **Figure** 9-2

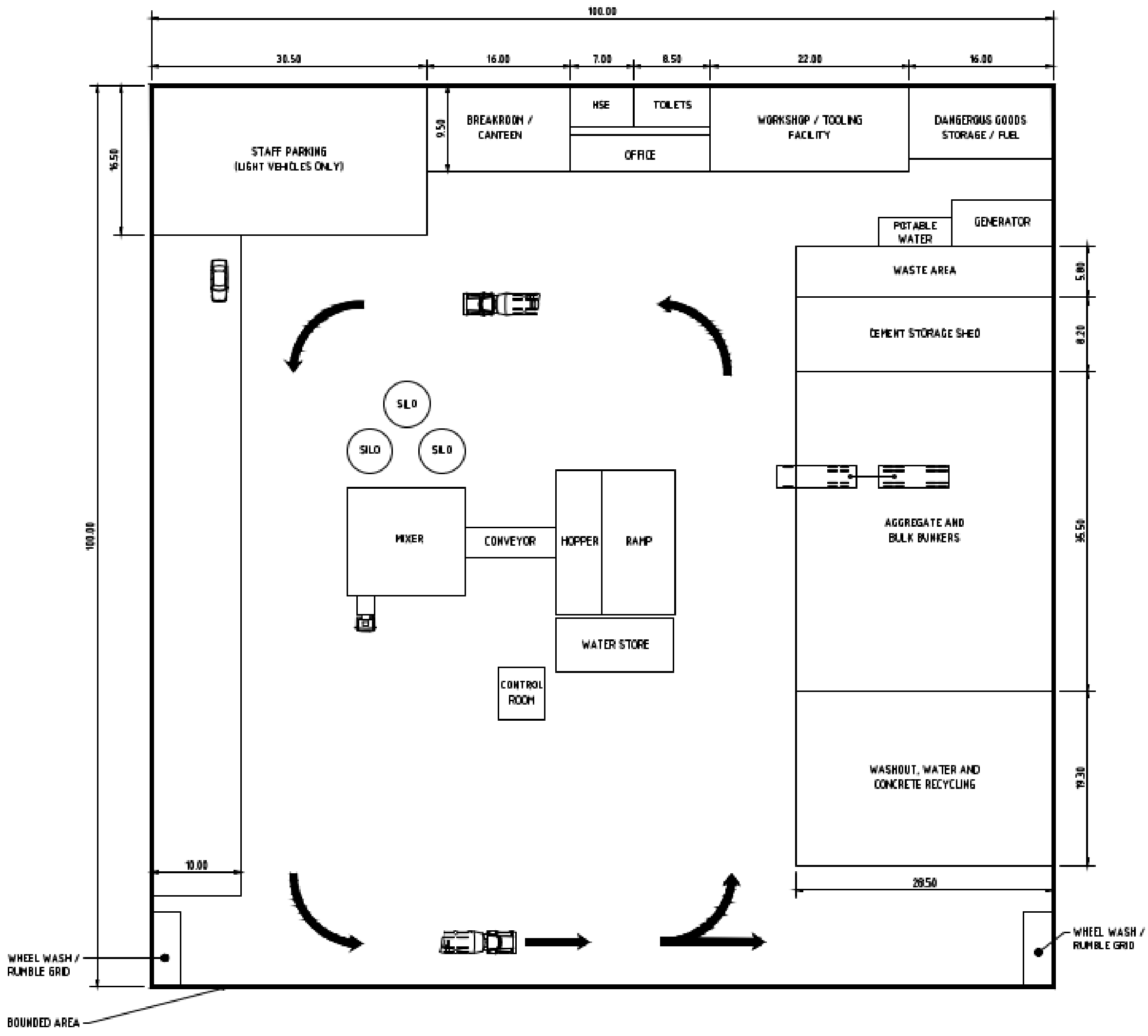

Figure 9-2 Typical batch plant arrangement

9.6.1 Exclusions from the noise model

The initial constructions of the batch plants and the demobilisations are assessed under the onshore cable system construction noise assessment in Section 9.5.

9.6.2 Batch plants operational components and sound power levels

The following equipment has been identified as the static operational components of the batch plants, and their sound power levels.

Table 9-11 Octave band sound power data for plant and equipment

Equipment	Number	Sound power level (dBA)	Equipment	Number	Sound power level (dBA)
Batching Plants					
Concrete Trucks	2[1]	110	Pump	1	106
Compressor	1	103	Mixer	1	104
Conveyor motor	1	97	Diesel generator	1	93
Hopper	1	94	Stirrer Motor	1	79
Loader (up to 36T)	1	113	Wash out	1	91
Delivery truck	1[2]	108			

Table notes:

1. There will be up to six concrete trucks operating to deliver product from the TSB to the work fronts, it has been assumed that there would be a maximum of two trucks on the TSB site at any one time.
2. There will be up to three delivery trucks operating to deliver raw materials to the TSB sites, it has been assumed that there would be a maximum of one truck on the TSB site at any one time.

9.6.3 Predicted noise levels with recommended mitigation

Table 9-12 shows the modelled noise levels at the nearest residential receptors based on the assumptions outlined in the sections above. The purpose of the assessment is to determine if additional mitigation would be required to achieve the EPA Noise Protocol.

Table 9-12 Predicted noise levels – Batch plant operation with noise mitigation (within 10 m of the building)

Receptor address	Noise Protocol Limits ($L_{eff,30min}$ dB)	Distance to nearest receptor (m)	Predicted noise level $L_{eff,30min}$ dB[1]	Compliance achieved?
	Day			
Batching Plant Site 1				
[redacted] Giffard West Road, Giffard West	46	1100	35	✓
Batching Plant Site 2				
[redacted] Giffard West Road, Giffard West	46	2500	<30	✓
Batching Plant Site 3				
[redacted] South Gippsland Highway, Giffard West	46	800	38	✓
Batching Plant Site 4				
[redacted] Dewars Road, Woodside	46	800	38	✓
Batching Plant Site 5				
[redacted] Woodside Beach Road, Woodside	46	700	40	✓
Batching Plant Site 6				
Reeves Beach Campground	46	550	43	✓

Table notes:

1. includes a +5 dB penalty to account for potential tonality from batching plant equipment and potential impulsive noise from mobile plant.

9.6.4 Assessment against ERS

As noted in Section 6.6.2, the ERS does not apply in situations where specific regulations apply to that part of the environment or activity.

As such, for the purposes of this assessment, the ERS has been applied to noise from:

- Batching plant operations impacting on "*natural areas*" (as defined in the ERS). The residual risk to the environmental value of "*human tranquillity and enjoyment outdoors, in natural areas*" is considered relevant in these cases.

Commentary with respect to the predicted batching plant noise and the ERS objectives for natural areas is presented in Section 9.6.5.

9.6.5 Soundscape

The following reserves are in the vicinity of the batching plant sites. It is noted that some of the reserves listed are very large, so the distance stated is intended to reflect the nearest point of the reserve to the batching locations.

Table 9-13 Nearest Natural Areas to the Batching Plant Sites

Name	Distance from a batching location (m)
Reeves Beach Campground	500
McLoughlins Beach - Seaspray Coastal Reserve	800
Woodside H27 Bushland Reserve	800
Woodside H28 Bushland Reserve	2900
Mullungdung State Forest	2000
Warrigal Creek Streamside Reserve	3300
Darriman H33 Bushland Reserve	3600

A high-level assessment based on the data collected as part of the sound walk at Reeves Beach Campground indicates that noise may interfere with human tranquillity and enjoyment outdoors in natural areas less than 1000 metres from the batching plants.

This applies only to Reeves Beach Campground and the Woodside H27 Bushland Reserve, since the sound walk measurements taken at McLoughlins Beach - Seaspray Coastal Reserve in February 2025 indicate that noise due to the surf is significantly higher than the predicted levels from the batching plants.

Therefore, notification and consultation will be undertaken with Parks Victoria and relevant user groups in reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**) for reserves less than 1000 metres away.

9.6.6 Batch plants - low frequency noise

The outdoor noise threshold criteria for outdoor assessments provided in Table 3 of EPA Victoria Publication 1996 are used here to indicate whether or not low frequency noise is likely to be a significant component of the overall noise level at the nearest receptors ([redacted] Dewars Road, Woodside, and [redacted] South Gippsland Highway, Giffard West) as follows in Table 9-14.

Table 9-14 One-third octave low-frequency noise – batch plants

	One-third octave band centre frequency (Hz)												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
EPA Victoria Publication 1996 outdoor thresholds, dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44
[redacted]Dewars Road, Woodside dB(Z)	-	-	-	-	-	-	-	44	44	44	34	34	34
Difference	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-6**	**-6**	**-4**	**-14**	**-12**	**-10**

It can be seen that the highest predicted noise levels are below the outdoor thresholds provided by EPA Victoria Publication 1996. This indicates that low frequency noise is unlikely to be significant at receptors in the vicinity of the batch plants.

9.7 Unavoidable night-time construction – Shore Crossing (ONV-I002)

The shore crossing would be performed by either HDD or micro tunnelling, and a shore crossing foundation area would be constructed and located behind the shoreline sand dune.

Further details of the shore crossing installation are provided in Section 4.13 of EIS Chapter 4 – Project description and Section 4.10 EES Chapter 4 – Victorian works project description.

9.7.1 Construction scenarios

Installation of the main components of the shore crossing is described in Table 9-15.

Table 9-15 Shore crossing drilling – Construction activities

Scenario reference	Activity	Rate/duration of works	Construction activity
HDD1	Site establishment	Two weeks	Clearing of foliage, erecting fences, etc.
HDD2	Civils - construction of onshore Access tracks and Work Pads	1-month per stage	Access tracks and work pads are constructed.
HDD3	Duct assembly	In parallel to HDD works	The ducts are assembled ready for installation in parallel to the HDD works.
HDD4	Shore crossing drilling and duct installation	A typical installation timeframe would be approximately 40 days per single crossing, dependent on final number of crossings and number of HDD rigs employed.	The HDD crossings would be installed sequentially. Similarly, the installation of the offshore cables would occur one at a time. There may be a period between the HDD works being completed before the export cables would be installed as well as a potentially for only some of the export cables being installed. The location where the construction will take place is likely to be in a 40 x 40 m area positioned at the entry point of each borehole. All the equipment will be setup in this area approximately. 400 m from the beach. There will also be marine support vessels and equipment in an area approximately 700m from the high-water line. Marine support vessels are discussed separately in this section.
HDD5	Transition joint bay installation	12 days per double circuit joint bay per crew	Cable joint bays and ancillary pits are installed.
HDD6	Cable pulling		To facilitate the cable pulling operation, a bell mouth is fitted to the duct entry offshore. The bell mouth and duct would be buried under the seabed for later recovery during the offshore export cable pulling activities. It may be a number of weeks or months before the export cables

Scenario reference	Activity	Rate/duration of works	Construction activity
			arrive and cable pulling operations commence.
HDD7	Reinstatement	Reinstatement works ongoing though-out construction	Temporary access tracks, temporary buildings, drainage, etc is removed. Re-seeding is undertaken, and permanent fencing is installed.
Total duration		Approximately 27 months of construction in total plus two months (of total activity) for the cable pulling.	

9.7.2 Marine support activities

Shore crossing installation would be supported by marine vessels and associated equipment. Once the shore crossing ducts have been installed, the offshore cable installation vessel would be positioned near the offshore exit point (duct entry point), to undertake installation of the subsea export cables.

A winch cable from shore would be pulled through the duct and connected to the subsea cable on the vessel. The subsea cable then would be pulled ashore through the duct.

Once onshore, the subsea cables are pulled through an open trench and positioned into the pre-prepared transition joint bays and anchored. The cable laying vessel then heads off towards the wind farm laying the subsea export cable. The process is then repeated for each crossing.

Figure 9-3 Typical cable shore crossing installation vessel

Marine survey equipment including a remote operated vehicle (ROV) and air diving facilities may be required to be positioned directly over the exit point for survey, inspections and activities such as fitting of the bell mouths.

A summary of the durations for the marine support works is shown in Table 9-16.

Table 9-16 Marine support works

Description	Duration

Cable pulling activity	The onshore export cable pulling activity at the shore crossing typically takes one day per cable, excluding preparation activities and downtime (due to weatheror mechanical failure).
Entire marine support works associated with pulling activity (start to finish)	Up to 2 months total activity. The cable pulling window is noted as being up to 19 months. In practice this will be short windows of days where a cable vessel will be stationed off Reeves Beach (making noise) whilst the pulling is occurring before heading off towards the wind farm.

9.7.3 Shore crossing drilling plant and equipment - onshore

Plant and equipment for the shore crossing drilling are described in Table 9-17 and are based on preliminary estimates that will be subject to change as planning progresses and methodology is proposed by contractors.

Table 9-17 Shore crossing drilling – Proposed construction plant and equipment

Equipment	Equipment sound power level, dB (A)	Operation time (% of a 15-minute period)	HDD construction scenario						
			HDD1	HDD2	HDD3	HDD4	HDD5	HDD6	HDD7
Articulated dump truck (up to 25T)	109	100%							3
Articulated dump truck (up to 41T)	116	100%					1		
Cable wnch	84	100%						1	
Cable pusher	97	100%						2	
Directional drill unit	111	100%				1			
Dozer (up to 70T)	108	100%							1
Excavator, (up to 29T)	104	100%		2	2	2	1		2
Excavator, (up to 10T)	96	100%							1
Excavator with breaker	104	100%					1		
Fencing equipment	96	100%	1						
Franna crane	105	100%					1		
Generator, diesel (30kw)	93	100%			1	2	1	1	
Grader (up to 73T)	114	100%		1					
Hydrovac excavation truck	114	10%					1		

Equipment	Equipment sound power level, dB (A)	Operation time (% of a 15-minute period)	HDD construction scenario						
			HDD1	HDD2	HDD3	HDD4	HDD5	HDD6	HDD7
Lorry	107	100%	1						
Mud system	114	100%				1		2	
Roller (up to 19T)	109	100%		2					
Tractor	108	100%							3
Truck and dog (up to 20T)	108	100%							1
Water cart 20,000L	102	100%							2
Activity SWL[1,2]			**107**	**117**	**107**	**116**	**117**	**117**	**118**

Table notes:

1 SWL = Sound Power Level in dB (A)

2 The overall sound power levels for each scenario is the sum of the noise level from each individual item. This is a conservative approach.

9.7.4 Nearest noise sensitive receptors

The nearest noise sensitive receptors potentially impacted by these works are outlined in Table 9-18.

Table 9-18 Nearest noise sensitive receptors for construction works

Receptor type	Location	Approximate distance from works (m)
Residential	South-west of the shore crossing facility	6500
	North of the shore crossing facility	2400
Community building	None identified	N/a
Outdoor recreation and public open spaces	Reeves Beach Campground and McLoughlins Beach - Seaspray Coastal Reserve, adjacent to the shore crossing site	80 / 300

9.7.5 Predicted noise levels – onshore shore crossing activities

The predicted results at the nearest sensitive receptors are presented in Table 9-19.

Table 9-19 Predicted levels at nearest noise sensitive receptors

Assessment location	Applicable period	Criteria	Predicted noise level, L_{Aeq} dB[3]						
			HDD1	HDD2	HDD3	HDD4	HDD5	HDD6	HDD7
Residential									
North of shore crossing	Day	N/a[1]	37	46	37	46	46	47	47
	Evening/ Weekend	N/a[2]	<30	-	-	46	-	47	-
	Night	N/a[2]	<30	-	-	46	-	47	-
Community buildings									
N/a	-	-	-	-					
Outdoor recreation and public open spaces									
Reeves Beach Campground	When in use	N/a[1]	66	76	66	75	76	76	77
McLoughlins Beach - Seaspray Coastal Reserve			55	64	55	64	65	65	66

Table notes:

1 Noise reduction measures apply with reference to the relevant ERS objective and environmental values

2 Unavoidable works - Noise reduction measures apply with reference to the GED and relevant ERS objective and environmental values

3 Includes a +5 dB correction for tonality and/or impulsiveness on the basis that static equipment could be tonal and that mobile equipment could be impulsive but that they may not operate at the same time or that the mobile equipment, which is louder, may mask the tonality of the fixed equipment.

9.7.6 Nearshore noise levels at distance

Figure 9-4 shows the indicative exit location of the shore crossing drilling relative to the shore and the area within which the support vessel would most likely be located. The vessel is anticipated to be a minimum of 350 metres from the high-water line.

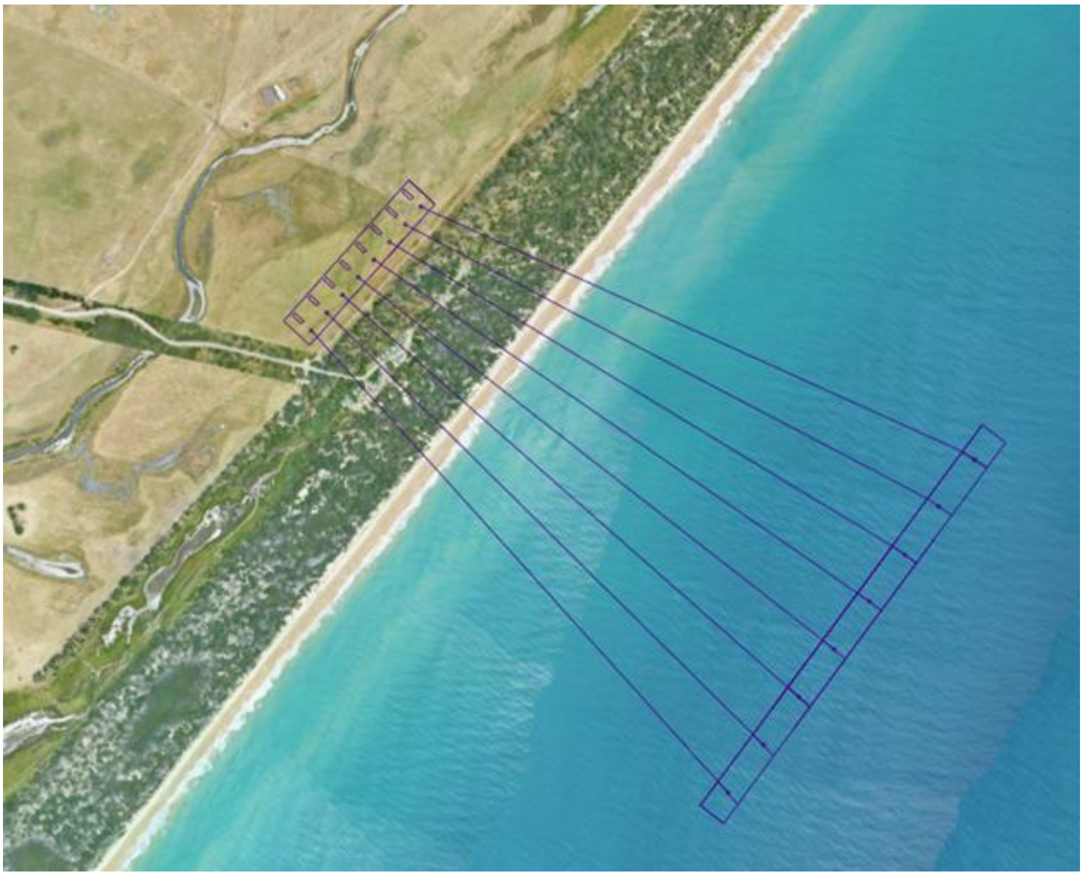

Figure 9-4 Indicative shore crossing offshore works area

The calculated noise levels from nearshore activity, which are summarised in Table 9-20, have been calculated based on the spectrum of a large diesel generator and equate to the expected sound power levels for three operating conditions[15]:

- A vessel idling for the full 15-minute assessment period
- A vessel cruising for the full 15-minute assessment period
- A vessel accelerating for the full 15-minute assessment period.

The nearest receptors have been identified as the McLoughlins Beach-Seaspray Coastal Reserve, Reeves Beach Campground, which is located near to the beach, Woodside Beach approximately 2.4 kilometres to the north, and McLoughlins Beach approximately six kilometres to the south.

[15] Oriel Windfarm Project: Environmental Impact Assessment Report Appendix 25-2: Noise Modelling Methodology, RPS, March 2024

Table 9-20 Estimated nearshore noise levels

Location	Unavoidable works at night?	Minimum distance from works (m)	Predicted noise level, $L_{Aeq\ (15\ min)}$ dB, based on the sound power level of the activity, dB L_{wA}		
			100 (idling)	105 (cruising)	110 (accelerating)
Reeves Beach Campground	Yes[1]	500	38	42	47
McLoughlins Beach-Seaspray Coastal Reserve	Yes[1]	350	41	46	51
McLoughlins Beach	Yes[1]	6000	<30	<30	<30

Table notes:

1 Unavoidable works - Noise reduction measures apply with reference to the relevant ERS objective and environmental values

9.7.7 Assessment against ERS

In all cases, the measured existing noise levels presented in Section 7.3.3 are above the relevant ERS objective during the day and night periods at receptors on the coast.

Commentary with respect to noise from shore crossing and the ERS objectives is presented in Table 9-21.

Table 9-21 Assessment against the ERS – Shore Crossing drilling works

Location	Objective, L_{Aeq}, dB		Environmental Value
	Day	Night	
McLoughlins Beach-Seaspray Coastal Reserve, Woodside Beach to the north and Reeves Beach Campground to the east.	40[1]	35[1]	**Sleep during the night** The works may interfere with sleep during the night at Reeves Beach Campground since the predicted levels due to the shore crossing drilling are above the existing ambient levels measured within to it. Notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**). Additional mitigation for the Shore Crossing works is included in **ONV-M005**.
			Domestic and recreational activities Construction noise is not expected to interfere with domestic and recreational activities at noise sensitive residential receptors in the vicinity. However, the highest predicted levels due to the works are at Reeves Beach Campground, which is addressed below.

Location	Objective, L_{Aeq}, dB		Environmental Value
	Day	Night	
			Normal conversation Construction noise is not expected to interfere with normal conversation at noise sensitive residential receptors in the vicinity. However, the highest predicted levels due to the works are at Reeves Beach Campground, which is addressed below.
			Child learning and development N/a – there are no learning institutions in the vicinity of the Shore Crossing.
			Human tranquillity and enjoyment outdoors in natural areas A high-level Soundscape assessment has been carried out and is detailed in Section 9.7.8
			Musical entertainment N/a – there are no musical entertainment venues within the study area.

Table notes:

1. *In all cases, the measured existing noise levels presented in Section 7.3.3 are above the relevant ERS objective during the daytime and night-time at the receptors nearest to the site. However, the predicted levels are generally above the existing measured levels and, therefore, the ERS is still a relevant consideration.*

9.7.8 Soundscape

The following reserves are in the vicinity of the shore crossing site.

Table 9-22 Nearest Natural Areas to the Shore Crossing Site

Name	Distance from the Shore Crossing (m)
Reeves Beach Campground	80
McLoughlins Beach - Seaspray Coastal Reserve	300

The predicted levels due to the shore crossing drilling are above the existing ambient levels measured adjacent to Reeves Beach Campground.

This applies only to Reeves Beach Campground, since the sound walk measurements taken at McLoughlins Beach - Seaspray Coastal Reserve in February 2025 indicate that noise due to the surf is significantly higher than the predicted levels from the shore crossing works.

Therefore, there is a there is a risk that construction noise would interfere with Human tranquillity and enjoyment outdoors in natural areas.

Notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**).

Additional mitigation for the shore crossing works is included in **ONV-M005**.

9.7.9 Character of construction noise

Commentary on the likelihood of harm in the event that cable system construction activities display any of the characteristics listed in Section 4.1.3 of EPA Victoria Publication 1834.2, is provided in Table 9-23.

Table 9-23 Potential construction noise characteristics – shore crossing drilling works

<table>
<tr><th>Activity</th><th>Potential noise character</th><th>Factors that influence the risk of harm (EPA Victoria Publication 1834.2)</th></tr>
<tr><td>Heavy machinery</td><td>Low frequency noise</td><td rowspan="2">In accordance with EPA 1834, the following corrections have been added to the predicted construction noise levels:
• +2 dB for a tone
• +2 dB for an impulsiveness.

<u>Proximity to people</u>
The nearest works are approximately 2400 metres from residential dwellings. Reeves Beach Campground is approximately 80 metres from the nearest shore crossing drilling location.

<u>Time of day</u>
All

<u>Duration of exposure</u>
Up to 27 months, including approximately 6 months of site establishment, 18 months of duct installation using HDD construction, and 3 months for demobilisation. However, works during the night would not occur continuously.

<u>Background noise levels</u>
The existing measured ambient levels are generally representative of rural environments. The predicted noise levels are above the measured existing ambient levels at Reeves Beach Campground and residents to the north.

<u>Low frequency noise</u>
A high-level screening assessment of low frequency noise has been carried out for the highest noise source (Grader) for this construction scope. The results indicate that the EPA Publication 1996 thresholds could be exceeded at Reeves Beach Campground. This indicates a risk of problematic low frequency noise.

<u>Construction fatigue</u>
There are no other known works ongoing in the vicinity at present.

<u>Summary</u>
Applies to Reeves Beach Campground only.

Notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (ONV-M001).</td></tr>
<tr><td>Reverse beepers</td><td>Tonal</td></tr>
</table>

Activity	Potential noise character	Factors that influence the risk of harm (EPA Victoria Publication 1834.2)
		Additional mitigation for the shore crossing works is included in **ONV-M005**.

9.8 Unavoidable night-time construction – trenchless crossings (ONV-002)

Over its length, the transmission systems cables and construction activity cross existing infrastructure and natural features, including waterways, roads and third-party infrastructure.

For most locations open trenched crossings are likely to be suitable. Open trenching is selected where the project crosses infrastructure with relatively low sensitivity, such as minor watercourses, minor roads, tracks and service roads.

Where required, traffic management will be used to allow work on alternate halves of the road while maintaining the flow of traffic. After excavating the first half, steel plates will be placed across the trench for traffic to pass while the second half of the road is excavated. A section of pipe will then be threaded through the trench under the steel plates. The trench will then be backfilled and the road re-surfaced.

Most minor watercourse crossings are anticipated to be suitable to cross using open cut trench methods. If needed, dry open cut methods could be used, where water flow is maintained by damming and bypass pumping. Alternately, temporary pipes that extend on each side of the trench can be installed in the bed of the watercourse.

Star of the South has identified several candidate locations where trenchless crossings will likely be required. This requirement is either to limit disruption to the community or to protect a natural feature.

Currently, trenchless crossing locations, along with the primary impact mitigator include:

- Reeves Beach waterway to reduce ecological impacts.
- Woodside Beach Road to reduce disruption to the Woodside Beach township and avoid roadside vegetation impacts.

Further crossing consideration is ongoing as part of the transmission system design. A key challenge with trenchless crossings is their potential negative impact on cable ratings, which means they are not a feasible technical solution in all scenarios.

There are a number of trenchless methods suitable for the onshore system construction including:

- HDD
- Micro-tunnelling, and
- Auger-boring.

Further details of the trenchless crossing methodologies are provided in Section 4.13 of EIS Chapter 4 – Project description and Section 4.10 of EES Chapter 4 – Victorian works project description.

9.8.1 Construction scenarios

Installation of the main components of the trenchless crossings is described in Table 9-24.

Table 9-24 Trenchless crossings drilling – Construction activities

Scenario reference	Activity	Rate/duration of works	Construction activity
TC1	Site establishment	Two weeks	Clearing of foliage
TC2	Civils - Construction of onshore Access tracks and Work Pads		Access tracks and work pads are constructed.

Scenario reference	Activity	Rate/duration of works	Construction activity
TC3	Duct Assembly	In parallel to trenchless crossing works	The ducts are assembled ready for installation in parallel to the trenchless crossing works.
TC4	Drilling	The average duration per conduit (crossing <100m) is approximately four days in soil (not rock). The average duration per conduit (crossing >100m) ~10 days in soil (not rock)	The crossings would be installed sequentially.
TC5	Cable Pulling	One length of cable per day per crew, therefore 6 cables per week per crew.	The cable installation would occur after the conduits are installed and backfilled and would involve transporting the drums in advance for preparation of pulling work.
TC6	Reinstatement	Reinstatement works ongoing though-out construction	Temporary access tracks, temporary buildings, drainage, etc is removed. Re-seeding is undertaken and permanent fencing is installed.
Total duration		Up to a month in each location. However, works during the night would not occur continuously and would be for less than a week, if required	

9.8.2 Trenchless crossing drilling plant and equipment

Plant and equipment for the shore crossing drilling are described in Table 9-25 and are based on preliminary estimates that will be subject to change as planning progresses and methodology is proposed by contractors.

Table 9-25 Trenchless crossings – proposed construction plant and equipment

Equipment	Equipment sound power level, dB (A)	Operation time (% of a 15-minute period)	Trenchless construction scenario				
			TC1	TC2	TC3	TC4	TC5
Articulated dump truck (up to 25T)	109	100%					3
Articulated dump truck (up to 41T)	116	100%					
Cable winch	84	100%					
Cable pusher	97	100%					
Directional drill unit	111	100%				1	
Dozer (up to 70T)	108	100%					1
Excavator, (up to 29T)	104	100%		2	2	2	2
Excavator, (up to 10T)	96	100%					1
Excavator with breaker	104	100%					
Franna crane	105	100%					
Generator, diesel (30kw)	93	100%			1	2	
Grader (up to 73T)	114	100%		1			
Hydrovac excavation truck	114	10%					
Lorry	107	100%	1				
Mud system	114	100%				1	

Equipment	Equipment sound power level, dB (A)	Operation time (% of a 15-minute period)	Trenchless construction scenario				
			TC1	TC2	TC3	TC4	TC5
Roller (up to 19T)	109	100%		2			
Tractor	108	100%					3
Truck and dog (up to 20T)	108	100%					1
Water cart 20,000L	102	100%					2
Activity SWL[1]			**107**	**117**	**107**	**116**	**118**

Table notes:

1 SWL = Sound Power Level in dB (A)

2 The overall sound power level for each scenario is the sum of the noise level from each individual item. This is a conservative approach.

9.8.3 Nearest noise sensitive receptors

The nearest noise sensitive receptors potentially impacted by these works are outlined in Table 9-26.

Table 9-26 Nearest noise sensitive receptors for trenchless construction works

Receptor type	Location	Approximate distance from works (m)
Residential	North-east of the waterway at Reeves Beach	2500
	[redacted] Woodside Beach Road	350
Community building	None identified	N/a
Outdoor recreation and public open spaces	Reeves Beach Campground and McLoughlins Beach-Seaspray Coastal Reserve	300 / 500

9.8.4 Predicted noise levels – trenchless crossings

The predicted noise levels due to the trenchless crossings at the nearest sensitive receptors are presented in Table 9-27.

Table 9-27 Predicted levels at nearest noise sensitive receptors

Assessment location	Applicable period	Criterion	Predicted noise level, L_{Aeq} dB[3]				
			TC1	TC2	TC3	TC4	TC5
Residential							
North-east of the waterway at Reeves Beach	Day	N/a[1]	36	46	36	45	47
	Evening/ Weekend	N/a[1]	-	-	-	45	-
	Night[2]	N/a	-	-	-	45	-
[redacted] Woodside Beach Road	Day	N/a[1]	54	63	54	63	64
	Evening/ Weekend	N/a[1]	-	-	-	63	-
	Night[2]	N/a	-	-	-	63	-
Community buildings							
N/a	-	-	-	-	-	-	-
Outdoor recreation and public open spaces							
Reeves Beach Campground	When in use	N/a[1]	55	64	55	64	66
McLoughlins Beach-Seaspray			50	60	50	59	61

Assessment location	Applicable period	Criterion	Predicted noise level, L_{Aeq} dB[3]				
			TC1	TC2	TC3	TC4	TC5
Coastal Reserve							

Table notes:

1 Normal working hours - Noise reduction measures apply with reference to the relevant ERS objective and environmental values

2 Unavoidable works - Noise reduction measures apply with reference to the relevant ERS objective and environmental values

3 Includes a +5 dB correction for tonality and/or impulsiveness on the basis that static equipment could be tonal and that mobile equipment could be impulsive but that they may not operate at the same time or that the mobile equipment, which is louder, may mask the tonality of the fixed equipment.

9.8.5 Assessment against ERS

In all cases, the measured existing noise levels presented in Section 7.3.3 are above the relevant ERS objective during the day and night periods at receptors on the coast.

Commentary with respect to noise from shore crossing and the ERS objectives is presented in Table 9-28.

Table 9-28 Assessment against the ERS – Trenchless crossing drilling works

Location	Objective, L_{Aeq}, dB		Environmental Value
	Day	Night	
Residential properties in the vicinity **McLoughlins Beach-Seaspray Coastal Reserve to the north, east and south, Woodside Beach to the north and Reeves Beach Campground to the east of the waterway at Reeves Beach**	40[1]	35[1]	**Sleep during the night** In all cases the predicted levels are above the ERS objective in the case that works for TC3 are required to continue into the night period. Therefore, the works may interfere with sleep during the night since the predicted levels are above the measured existing ambient levels. Notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**). Additional on site mitigation has not been considered due to the anticipated duration of works during the night, if required.
			Domestic and recreational activities With the exception of [redacted] Woodside Beach Road, construction noise is not expected to interfere with domestic and recreational activities at noise sensitive residential receptors in the vicinity as the predicted levels are either below the ERS daytime objective or the existing measured ambient noise level.

Location	Objective, L_{Aeq}, dB		Environmental Value
	Day	Night	
			However, the highest predicted levels due to the works are at Reeves Beach Campground, which is addressed below.
			Normal conversation With the exception of [redacted] Woodside Beach Road, construction noise is not expected to interfere with domestic and recreational activities at noise sensitive residential receptors in the vicinity as the predicted levels are either below the ERS daytime objective or the existing measured ambient noise level. However, the highest predicted levels due to the works are at Reeves Beach Campground, which is addressed below.
			Child learning and development N/a – there are no learning institutions in the vicinity of the trenchless crossings.
			Human tranquillity and enjoyment outdoors in natural areas A high-level Soundscape assessment has been carried out and is detailed in Section9.8.6
			Musical entertainment N/a – there are no musical entertainment venues within the study area.

Table notes:

1. *In all cases, the measured existing noise levels presented in Section 7.3.3 are above the relevant ERS objective during the daytime and night-time at the receptors nearest to the crossing sites. However, the predicted levels are generally above the existing measured levels and, therefore, the ERS is still a relevant consideration.*

9.8.6 Soundscape

Applies to Reeves Beach Campground and McLoughlins Beach - Seaspray Coastal Reserve only.

A soundwalk was conducted at these locations in February 2025. The Soundscapes at these locations were observed to include contributions from local fauna (predominantly birds), surf and wind. During the soundwalk, acoustic measurements were conducted, and ambient noise levels were measured to be 40dB L_{Aeq} within Reeves Beach Campground and 70dB L_{Aeq} within McLoughlins Beach - Seaspray Coastal Reserve.

The predicted levels due to the nearest trenchless crossing works are up to 24 dB above the existing ambient levels measured within Reeves Beach Campground.

Therefore, there is a there is a risk that construction noise associated with the trenchless crossings would interfere with human tranquillity and enjoyment outdoors in this area.

Notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**).

9.8.7 Character of construction noise

Commentary on the likelihood of harm in the event that cable system construction activities display any of the characteristics listed in Section 4.1.3 of EPA Victoria Publication 1834.2, is provided in Table 9-29.

Table 9-29 Potential construction noise characteristics – trenchless crossing drilling works

<table>
<tr><th>Activity</th><th>Potential noise character</th><th>Factors that influence the risk of harm (EPA Victoria Publication 1834.2)</th></tr>
<tr><td>Heavy machinery</td><td>Low frequency noise</td><td rowspan="2">In accordance with EPA 1834, the following corrections have been added to the predicted construction noise levels:
• +2 dB for a tone
• +2 dB for an impulsiveness.

<u>Proximity to people</u>
The nearest works are between 350 and 2500 metres from residential dwellings. Reeves Beach Campground is approximately 300 metres from the Reeves Beach waterway drilling location.

<u>Time of day</u>
All

<u>Duration of exposure</u>
Up to a month in each location. However, works during the night would not occur continuously and would be for less than a week, if required.
In general:
- average duration per conduit (crossing <100m) ~4 days in soil (not rock).
- average duration per conduit (crossing >100m) ~10 days in soil (not rock)

<u>Background noise levels</u>
The existing measured ambient levels are generally representative of rural environments. The predicted noise levels are above the measured existing ambient levels.

<u>Low frequency noise</u>
A high-level screening assessment of low frequency noise has been carried out for the highest noise source (Grader) for this construction scope. The results indicate that the EPA Publication 1996 thresholds could be exceeded at Reeves Beach Campground and [redacted] Woodside Beach Road. This indicates a risk of problematic low frequency noise.

<u>Construction fatigue</u>
There are no other known works ongoing in the vicinity at present. However, trenchless, open trench and cable pulling activities could happen in close proximity to each other, at the same time. The trenchless crossing bore construction needs to be completed before that section of cable can be pulled through it.

<u>Summary</u></td></tr>
<tr><td>Reverse beepers</td><td>Tonal</td></tr>
</table>

Activity	Potential noise character	Factors that influence the risk of harm (EPA Victoria Publication 1834.2)
		Notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**).

9.9 Unavoidable night-time construction - offshore works (ONV-I002)

There are two offshore construction elements to be considered; nearshore construction works and offshore construction works.

9.9.1 Wind turbine foundations

The turbines are supported by foundations and substructures. The turbines for this project would be supported by monopile foundations. An example of the foundation design is provided in Figure 9-5.

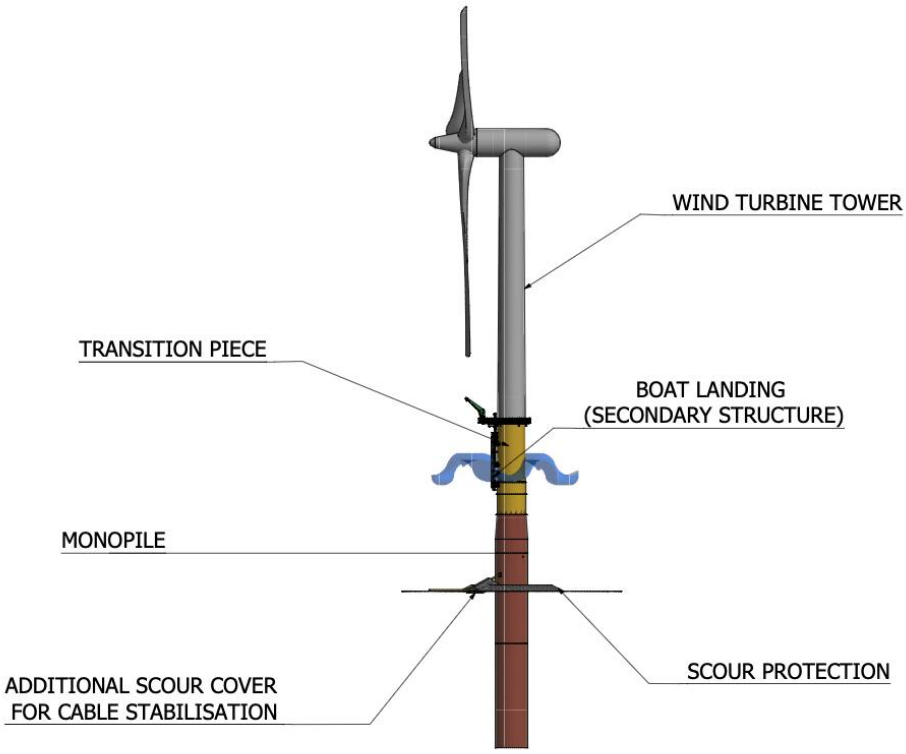

Figure 9-5 Monopile foundation illustration

Monopile foundations are large steel tubes that are driven into the seabed by an impact hammer from an installation vessel to provide a stable footing for the equipment to be installed above.

Monopile footings typically consist of two key components. The monopile and a transition piece that provides the stable interface between the pile and component it is supporting. Further details are provided in Section 4.7 of EIS Chapter 4 – Project description.

9.9.2 Offshore substations

Offshore substations collect and transform the power generated by the offshore wind turbines to an appropriate voltage for export through subsea export cables. The stations also provide other power system, control and support functionality. They are an essential component of offshore wind farms, in particular at large, multi-megawatt sites. An illustration of a typical offshore substation is provided in Figure 9-6. Further details are provided in Section 4.7 of EIS Chapter 4 – Project description.

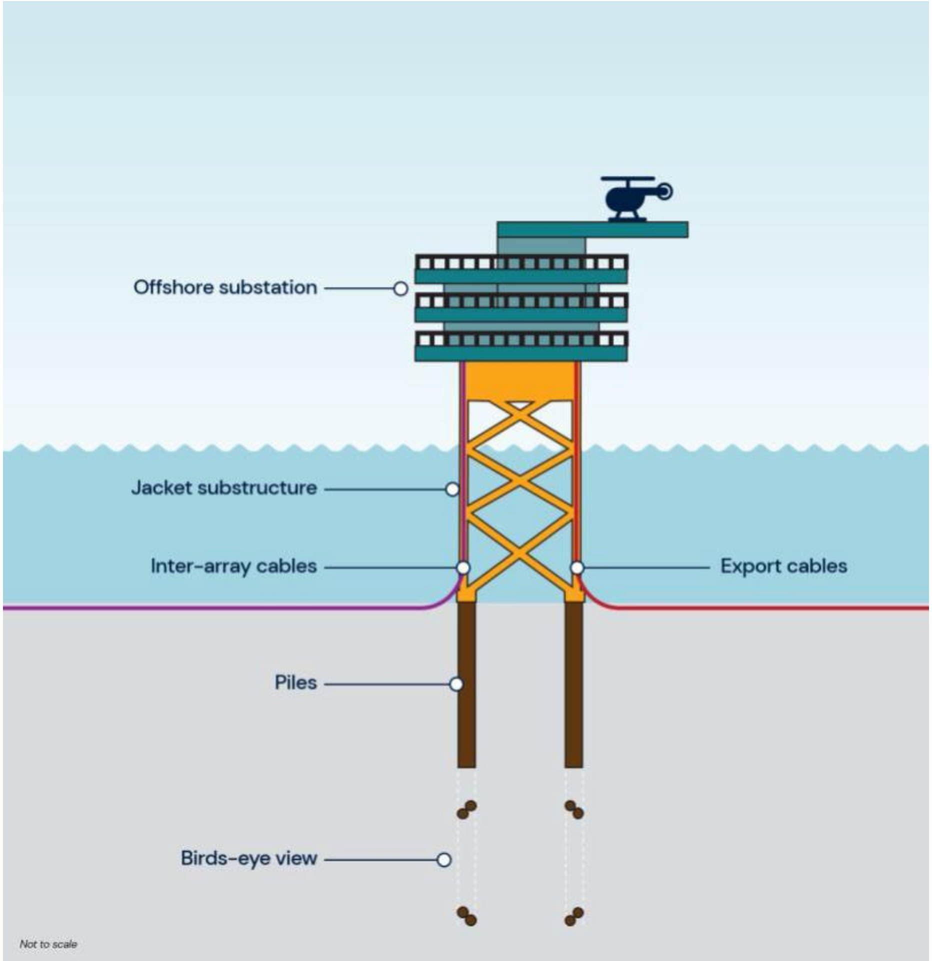

Figure 9-6 Offshore substation and foundation illustration

Piled jacket foundations are typically multi tube steel frames, built with a lattice construction (typically with tubular steel members and welded joints) fixed to the seabed by a number of legs. The jacket frame is anchored to the seabed with piles which may be driven or suction.

9.9.3 Work stages

Work stages associated with the offshore activities are described in Section 4.7 of EIS Chapter 4 – Project description and comprise the following key elements:

- Offshore substation substructures and foundation installation
- Monopile foundation installation
- Inter-array cable installation
- Scour protection installation
- Wind turbine installation
- Offshore substation installation
- Subsea export cable installation.

Vessel logistics

Several vessels would be required for the installation of the offshore wind infrastructure. A typical installation spread for the project could include two vessels for wind turbine installation, two for foundation installation, five for inter array cables installation, three for subsea export cables installation and two for offshore substation installations.

9.9.4 Offshore works duration

An outline summary of the durations for the offshore works is shown in Table 9-30.

The final vessel numbers are dependent on vessel availability, the installation contractor, project economics and other factors.

These numbers include only heavy lift/installation vessels. Secondary vessels, such as transfer vessels or support tugs are not considered. This example is illustrative only.

Table 9-30 Stages of offshore works – duration

Stage	Description	Duration
Stage 1	Offshore substation substructures and foundation installation	Up to 608 hours of piling plus 570 vessel movements
Stage 2	Monopile foundation installation	
Stage 3	Inter-array cables installation	280 vessel movements
Stage 4	Scour protection installation	Included in foundations installation
Stage 5	Wind turbine installation	480 vessel movements
Stage 6	Offshore substation installation (Phase 1)	Five vessel movements
Stage 7	Offshore substation installation (Phase 2)	
Stage 8	Subsea export cable installation	Included in inter-array cable installation

9.9.5 Offshore works noise levels at distance

The calculated noise levels from the offshore works, which are based on the estimated spectrum of a large offshore piling rig (Stage 1 and 2, refer Table 6-9) and in the case of vessels, the spectrum of a large diesel generator (Stages 3-8), are summarised in Table 9-31.

Calculated noise levels for vessels equate to the expected sound power levels for three operating conditions[16]:

- A vessel idling for the full 15-minute assessment period
- A vessel cruising for the full 15-minute assessment period
- A vessel accelerating for the full 15-minute assessment period.

The nearest receptors have been identified as the McLoughlins Beach-Seaspray Coastal Reserve, Reeves Beach Campground, which is located near to the beach, Woodside Beach to the north and McLoughlins Beach and Robertsons Beach, to the west. The minimum distance between the nearest receptor and the works is estimated to be approximately 10 kilometres.

Table 9-31 Estimated noise levels – offshore works

Activity	Unavoidable works at night?	Minimum distance from shore (m)	Predicted noise level, $L_{Aeq\ (15\ min)}$ dB, based on the sound power level of the activity, dB L_w			
			Vessels			Piling
			105[4] (idling)	110[4] (cruising)	115[4] (accelerating)	145
Stage 1 and Stage 2	Yes[2]	10000	-	-	-	44 - 62[1,3]
		15000	-	-	-	41 - 59[1,3]
		20000	-	-	-	37 - 56[1,3]
		25000	-	-	-	35 - 54[1,3]
		30000	-	-	-	34 - 53[1,3]
		35000	-	-	-	33 - 51[1,3]
		40000	-	-	-	33 - 50[1,3]
Stage 3	Yes[2]	10000	<30	<30	<30	-
Stage 4	Yes[2]	10000	<30	<30	<30	-
Stage 5	Yes[2]	10000	<30	<30	<30	-
Stage 6	Yes[2]	10000	<30	<30	<30	-
Stage 7	Yes[2]	10000	<30	<30	<30	-
Stage 8	Yes[2]	10000	<30	<30	<30	-

[16] Oriel Windfarm Project: Environmental Impact Assessment Report Appendix 25-2: Noise Modelling Methodology, RPS, March 2024

Table notes:

1 There is considerable uncertainty in the prediction of noise over such large distances because of meteorological conditions, and the variability of these. Therefore, for the purposes of this assessment, predictions have been made based on standard meteorological conditions which are known to alter the attenuation of noise. A range of noise levels is presented so as to address this uncertainty. The lower range of the predicted levels (before adding corrections) is broadly in line with a series of measurements taken from a boat during piling for Rampion Offshore Windfarm, which is approximately 10 kilometres off the coast of West Sussex in the UK[17].
2 Unavoidable works - Noise reduction measures apply with reference to the relevant ERS objective and environmental values.
3 Includes a +5 dB correction for impulsiveness.
4 Oriel Windfarm Project: Environmental Impact Assessment Report Appendix 25-2: Noise Modelling Methodology, RPS, March 2024

An indicative number of piles for the layout for the largest turbines in each of the offset bands provided in Table 9-31 for each of the receptor areas assessed in the offshore operational noise assessment is provided in Table 9-32.

Table 9-32 Offshore works – Number of piles in each offset band

Receptor	Number of piles in each offset band (Largest turbine layout)						
	0-10km	10-15km	15-20km	20-25km	25-30km	30-35km	35-40km
Robertsons Beach	0	0	16	18	39	30	10
Manns Beach	0	2	19	32	41	19	0
Mcloughlins Beach	0	10	25	36	28	12	2
Sunday Island	0	3	11	14	23	36	19
Port Albert	0	0	12	14	29	39	16
McLoughlins Beach Reserve	0	15	26	39	21	12	0
Reeves Beach Campground	0	12	18	32	22	15	14

The majority of the piles are at least 25 kilometres from the nearest onshore receptor.

9.9.5.1 Offshore construction noise to receptors offshore

The noise models generated to investigate offshore construction and operational noise from the Project at receptors onshore were altered to represent receptors in the sea (i.e. recreational fishermen and the like) for inclusion in *Technical Report R*: *Social.*

Noise levels due to piling are expected to be of the order of 100 dB L_{Aeq} at 50 metres from the pile, and approximately 80 dB L_{Aeq} at 500 metres.

9.9.6 Assessment against ERS

In all cases, the measured existing noise levels presented in Section 7.3.3 are above the relevant ERS objective during the day and night periods and receptors on the coast.

Commentary with respect to noise from offshore works and the ERS objectives is presented in Table 9-33.

[17] Rampion Offshore Wind Farm, ES Section 27 Noise: Appendix 27.2 - 27.3, December 2012, RSK Environmental

Table 9-33 Assessment against the ERS – offshore works

Location	Objective L_{Aeq}, dB		Environmental Value
	Day	Night	
McLoughlins Beach-Seaspray Coastal Reserve, Woodside Beach to the north and McLoughlins Beach, Robertsons Beach and Reeves Beach Campground.	40	35	**Sleep during the night** Noting that piling is not proposed to occur at night, there may be occasions when piling takes longer than four hours, and extends into night time. If this occurs, and wind is blowing towards sensitive receptors there is a risk offshore works may interfere with sleep during the night at noise sensitive receptors on the coast. This risk may never eventuate as piling may never occur at night. If night time piling does eventuate, onshore winds are only anticipated 5% of the time (around 30 hours), therefore the duration of exposure would be expected to be considerably less than the 608 hours of piling activity. Given that piling only occurs when weather conditions permit, and variations in weather conditions or seabed geology can result in very different onshore noise levels it is recommended that piling sections that are anticipated to generate higher levels of noise because of seabed geology, for example, be identified before works commence and a notification strategy be developed specifically for those works at least 3 months in advance (**ONV-M001**). Additional mitigation for the offshore piling works is included in **ONV-M006**.
			Domestic and recreational activities Offshore works may interfere with domestic and recreational activities at noise sensitive receptors on the coast for short periods.
			Normal conversation Offshore works may interfere with domestic and recreational activities at noise sensitive receptors on the coast for short periods.
			Child learning and development N/a – there are no learning institutions in the vicinity of the offshore works.
			Human tranquillity and enjoyment outdoors in natural areas A high-level Soundscape assessment has been carried out and is detailed in Section 9.9.7.
			Musical entertainment N/a – there are no musical entertainment venues within the study area.

9.9.7 Soundscape

Applies to Reeves Beach Campground and McLoughlins Beach - Seaspray Coastal Reserve only.

A soundwalk was conducted at these locations in February 2025. The Soundscapes at these locations were observed to include contributions from local fauna (predominantly birds), surf and wind. During the soundwalk, acoustic measurements were conducted, and ambient noise levels were measured to be 40 dB L_{Aeq} within Reeves Beach Campground and 70dB L_{Aeq} within McLoughlins Beach - Seaspray Coastal Reserve.

It is expected that, for much of the construction period, noise from the piling would not be experienced as a significant disturbance from the shore.

Therefore, there is a there is a low risk that offshore construction noise would interfere with human tranquillity and enjoyment outdoors in this area at night.

Notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 (**ONV-M001**).

Additional mitigation for the offshore piling works is included in **ONV-M006**.

9.9.8 Character of offshore construction noise

Commentary on the likelihood of harm in the event that the offshore construction activities display any of the characteristics listed in Section 4.1.3 of EPA Victoria Publication 1834.2, is provided in Table 9-34.

Table 9-34 Potential construction noise characteristics – Offshore

<table>
<tr><th>Activity</th><th>Potential noise character</th><th>Factors that influence the risk of harm (EPA Victoria Publication 1834.2)</th></tr>
<tr><td>Piling</td><td>Impulsive</td><td rowspan="3">In accordance with EPA 1834, the following corrections have been added to the predicted construction noise levels:
• +5 dB for an impulsiveness.

<u>Proximity to people</u>
The nearest offshore works are at least 10km from the nearest receptor.

<u>Time of day</u>
Works are planned to occur during the day but may extend into night-time. A conservative worse case assumption of 24/7 working is adopted.
<u>Duration of exposure</u>
Up to 608 hours of piling activity is proposed, however as onshore winds are only anticipated 5% of the time (around 30 hours), the duration of exposure would be expected to be considerably less.

<u>Background noise levels</u>
The existing measured ambient levels (Locations 1, 2, 13 and 14) are generally representative of coastal environments and the average existing ambient levels (from Appendix B) range between 44 and 51 dB L_{Aeq} during the day, 40 and 50 dB L_{Aeq} during the evening and 39 and 47 dB L_{Aeq} during the night. The predicted noise levels for the offshore piling are given as a range (33 – 62 $L_{Aeq,\ 15\ mins}$ dB).

For the reasons set out below, noise levels would generally be expected to be at the lower range of the estimates, however, in the case that onshore noise levels due to the piling are at the upper end of the range (which only applies to two pile locations)</td></tr>
<tr><td>Vessels</td><td>Low frequency noise</td></tr>
<tr><td></td><td></td></tr>
</table>

<table>
<tr><th>Activity</th><th>Potential noise character</th><th>Factors that influence the risk of harm (EPA Victoria Publication 1834.2)</th></tr>
<tr><td></td><td></td><td>then they will be above the measured existing ambient levels at all receptors.

Despite this, due to the spread of receptors relative to the pile locations and because piling will be undertaken sequentially, not all receptors will be impacted at once.

The predicted levels are influenced by:
• Wind direction: Wind has the greatest influence on noise levels at receptors. Noise levels would generally be expected to be at the lower range of the estimates. This is because less than 5 per cent of winds are from the south-east (i.e. the case where the wind is blowing from the source towards the receptor). Analysis of data taken from the BOM station at Wilsons Promontory Lighthouse (presented in Section 10.2.10) indicates that the prevailing wind conditions for all seasons are from the west with the next most prevailing from north-north east. As the wind turbines are generally south-east of the nearest noise sensitive receptors, the piling locations are expected to be generally down wind of the receptors.
• Distance: The nearest pile to the shore is a very significant distance, in noise terms, from the shore. This is balanced by the high source noise level of the equipment. However, the result is that, under the wind conditions that are expected for most of the time, the noise from the piling at onshore receptors is likely to be comparable to or below the existing ambient noise level for most of the time. As the piling moves further away from the shore, it is expected that piling noise at the onshore receptors will diminish, noting that differences in wind direction and speed are expected to create greater variations in noise levels than would changes in distance. As a rule of thumb, noise would be expected to be attenuated by 6 dB for every doubling of distance. This means that, with all things being equal, piling for a turbine 10 kilometres offshore could be expected to be 9 dB louder (three times) than the same activity at 30 kilometres offshore.
• Seabed conditions: Detailed geotechnical investigations have been carried out and, consequently, the geology of the area is well known. This means that the piling assumptions used as input to the assessment are likely to be typical. In other words, unforeseen higher piling noise levels due to obstacles are unlikely to occur.

As a result, it is expected that, for much of the construction period, noise from the piling would not be experienced as a significant disturbance from the shore

Offshore vessels are not expected to generate significant levels of noise onshore.

<u>Low frequency noise</u></td></tr>
</table>

Activity	Potential noise character	Factors that influence the risk of harm (EPA Victoria Publication 1834.2)
		A high-level screening assessment of low frequency noise has been carried out for the offshore piling rig for this construction scope. The results indicate that the EPA Publication 1996 thresholds could be exceeded at receptors that are within 20km of a piling location. This indicates a risk of problematic low frequency noise. **Construction fatigue** There are no other known works ongoing in the vicinity at present. **Summary** Additional mitigation for the offshore piling works is included in **ONV-M006**.

9.10 Construction traffic noise (ONV-I004)

Primary access routes will be constructed within the site, to gain access to the cable construction corridor, providing access for construction vehicles and to connect construction vehicles to the local public road network. Haul roads along the corridor would be used to connect primary access, enabling construction loops to be utilised.

Primary access roads used during construction are considered to be either ‘new’ or ‘existing’. Access roads that are new are those that require some works to be undertaken such as vegetation removal, where appropriate access does not currently exist or is not suitable. Existing private, local and regional road infrastructure will be used wherever possible, and may require maintenance, vegetation trimming and in some cases upgrades or modification depending on their use. Access to the cable corridor is assumed to be obtained at most locations where the construction corridor crosses a road, via that corridor.

The temporary access tracks will be formed using appropriate materials and will be maintained for the duration of the construction period as required. Following construction, the temporary surface will be removed and the previous land use reinstated. Tracks are not required to be maintained for access to the cable route over the operations period.

Project access would be designed to minimise impacts on the local road network as far as possible. Traffic figures have been generated for the onshore construction works (refer to EES Chapter 17 – Traffic and Transport). A Traffic Assessment has been prepared in support of the approval and provides greater detail on access routes to the site and potential impacts of construction and operation traffic (Technical report X - Traffic and Transport).

Trucks will stay on arterials as long as possible, pass-by noise events will be of short duration and not generally at night. Those receptors nearby to access tracks are sparse, therefore a practical and effective approach to noise management will be consultation with individual land holders. The project is already in dialogue with many nearby potentially-affected stakeholders in relation to other matters through their existing stakeholder engagement activities.

The nearest residences to the proposed primary access routes are as follows in Table 9-35.

Table 9-35 Nearest residences to a primary access route

Address	Distance to the nearest primary access track (m)
[redacted] Woodside Beach Road, Woodside	1200
[redacted] Stringy Bark Lane, Woodside	1000 to the north
	750 to the south
[redacted] Dewars Road, Woodside	600
[redacted] South Gippsland Highway, Darriman	35
[redacted] South Gippsland Highway, Darriman	350
[redacted] South Gippsland Highway, Giffard West	800
[redacted] Carstairs Road, Giffard West	100
[redacted] Four Mile Creek Road, Giffard West	450

9.10.1 Assessment against ERS

It is likely that noise due to construction traffic associated with the cable system construction, such as hauling TSB from the batching locations to the work fronts, would be significant at individual noise sensitive receptors for short periods as the work site progresses.

It is considered reasonable to assume that all noise sensitive receptors within 500 metres of a new or existing access track (as opposed to an arterial road, for example) could be impacted.

Therefore, commentary with respect to noise from construction traffic and the ERS objectives is presented in Table 9-36.

Table 9-36 Assessment against the ERS – construction traffic

Location	Objective, L_{Aeq}, dB		Environmental Value
	Day	Night	
Noise sensitive receptors within 500 metres of a new or existing access track	40[1]	N/a – Avoidable night works are not proposed	**Sleep during the night** N/a – Heavy vehicle traffic movements, including OSOM and B-Double heavy vehicles, to occur Monday to Friday, evenly distributed throughout the day between 0700 and 1700 hrs (refer Technical Appendix X: Traffic and Transport).
			Domestic and recreational activities Construction traffic may interfere with domestic and recreational activities at noise sensitive receptors within 500 m of a new or existing access track (as opposed to an arterial road, for example). Therefore, the good practice methods provided in Section 4.3.1 of EPA 1834.2 (**ONV-M001**) will be applied and notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 for noise sensitive receptors within 500 metres of a new or existing access track (**ONV-M001**).
			Normal conversation Construction traffic may interfere with normal conversation at noise sensitive receptors within 500 metres of a new or existing access track (as opposed to an arterial road, for example). Therefore, the good practice methods provided in Section 4.3.1 of EPA 1834.2 (**ONV-M001**) will be applied and notification and consultation will be undertaken with reference to Section 4.3.2 of EPA Victoria Publication 1834.2 for noise sensitive receptors within 500

Location	Objective, L_{Aeq}, dB		Environmental Value
	Day	Night	
			metres of a new or existing access track (**ONV-M001**).
			Child learning and development N/a – there are no learning institutions in the vicinity of the access tracks. Woodside Primary School is not within the study area but is located on a potential access route. Refer to Technical Report X: Traffic and Transport **(TTP-M002)** for further information on noise impacts associated with traffic.
			Human tranquillity and enjoyment outdoors in natural areas The assessment against the ERS for natural areas is as described in Section 9.5.5.
			Musical entertainment N/a – there are no musical entertainment venues within the study area.

Table notes:

1. *In all cases, the measured existing noise levels presented in Section 7.3.3 are above the relevant ERS objective during the daytime at the nearest receptors.*

9.11 Vibration from construction works leading to human disturbance (ONV-I004)

Ground vibration caused by construction activities has the potential to cause an adverse response at sensitive receptors within the project study area.

9.11.1 Nearest vibration sensitive receptors

The nearest vibration sensitive receptors potentially disturbed by ground vibration during construction are outlined in Table 9-37.

Table 9-37 Vibration sensitive receptors – human comfort

Receptor type	Location	Approximate distance from works (m) to nearest receptor	Receptors within 100 metres of works[1]
Residences located next to the cable system alignment	Rural	20 to cable system works corridor	33
	Coastal	2400 to shore crossing works	Nil
Other buildings	None identified	N/a	Nil
Other infrastructure	None identified	N/a	Nil

Table notes:

1 Measured from the nearest point of the construction corridor

9.11.2 Safe working distances

Works outside of the safe working distances presented in Table 9-38 would be considered to comply with the criteria presented in Section 4.7.1.

Table 9-38 Ground vibration safe working distances from plant

Plant	Rating / description	Human response safe working distances (m)
Drop hammer	3t Enclosed (30kJ per blow assumed)	100
	25 kJ per blow	100
	5 kJ per blow	35
Excavation	-	Avoid contact with structures
Hydraulic jacking rig	-	Avoid contact with structures
Jackhammer	Handheld	Avoid contact with structures
Large hydraulic hammer	(1,600 kg – 18-34t excavator)	73
Medium hydraulic hammer	(900 kg – 12-18t excavator)	23

Plant	Rating / description	Human response safe working distances (m)
Pile boring	≤ 800 mm	N/a
Small hydraulic hammer	(300 kg – 5-12t excavator)	7
Vibratory rig	50 kJ per cycle	100
Vibratory rig	10 kJ per cycle	100
Vibratory roller	< 50 kN (typically 1-2t)	15-20
	< 100 kN (typically 2-4t)	20
	< 200 kN (typically 4-6t)	40
	< 300 kN (typically 7-13t)	100
	> 300 kN (typically 13-18t)	100

9.11.3 Discussion – human response

The nearest structures to the cable construction are within the Human response safe working distance for the largest expected item of vibration generating plant (19t vibratory roller). Therefore, additional mitigation would be required in certain locations as captured in **ONV-M003**.

9.12 Vibration from construction works leading to structural damage to buildings and underground services (ONV-I005)

Construction activities have the potential to cause vibration that affects the structural integrity of buildings. The activities with the greatest potential for causing vibration impacts on sensitive receptors are rolling or compaction activities at the facilities.

9.12.1 Nearest vibration sensitive structures or assets

The nearest vibration sensitive receptors potentially impacted by ground vibration that could cause structural damage are outlined in Table 9-39.

Table 9-39 Vibration sensitive receptors – structural damage

Receptor type	Location	Approximate minimum distance from works (m) to nearest building	Structures within 50 metres[1]	Structures within 25 metres[1]
Residences located next to the cable system alignment	Rural dwelling	20 to cable system works	8	1
	Rural building	10 to cable system works	22	10
	Coastal	2400 to shore crossing works	Nil	Nil
Other buildings	None identified	N/a	N/a	Nil

Receptor type	Location	Approximate minimum distance from works (m) to nearest building	Structures within 50 metres[1]	Structures within 25 metres[1]
Other surface infrastructure	None identified	N/a	N/a	Nil

Table notes:

1 Measured from the nearest point of the construction corridor

9.12.2 Safe working distances

Table 9-40 presents the safe working distances which relate to cosmetic/structural damage for vibration-intensive construction equipment, in relation to the vibration criteria outlined in Section 4.7.2.

Table 9-40 Structural damage set back distances

Plant	Rating / description	Cosmetic damage safe working distances (m)[1]		
		Heritage	Residential	Industrial
Drop hammer	3t Enclosed (30kJ per blow assumed)	40	23	6
Drop hammer	25 kJ per blow	40	23	6
Drop hammer	5 kJ per blow	17	10	3
Excavation	-	2 [1]	1 [1]	<1
Hydraulic jacking rig	-	3	1.5	<1
Jackhammer	Handheld	1 [1]	1 [1]	<1
Large hydraulic hammer	(1,600 kg – 18-34t excavator)	34	22	7
Medium hydraulic hammer	(900 kg – 12-18t excavator)	12	7	2
Pile boring	≤ 800 mm	3	2	<1
Small hydraulic hammer	(300 kg – 5-12t excavator)	4	2	<1
Vibratory rig	50 kJ per cycle	50	30	8
Vibratory rig	10 kJ per cycle	23	15	3.5
Vibratory roller	< 50 kN (typically 1-2t)	8	5	2
	< 100 kN (typically 2-4t)	10	6	2
	< 200 kN (typically 4-6t)	20	12	3

Plant	Rating / description	Cosmetic damage safe working distances (m)[1]		
		Heritage	Residential	Industrial
	< 300 kN (typically 7-13t)	25	15	4
	> 300 kN (typically 13-18t)	30	20	6

Table notes:

1 Nominal distance

9.12.3 Discussion – structural damage

The nearest structures to the cable construction are within the structural damage safe working distance for the largest expected item of vibration generating plant (19t vibratory roller). Therefore, additional mitigation would be required in certain locations as captured in **ONV-M003**.

9.13 Risk assessment

There are no "risks" associated with the noise and vibration assessment, as all of the works, and their associated noise sources, are planned.

The only exception to this would be in the case of a machine failure, which could mean that works have to be paused for a period in order for the machine to be repaired. This has been addressed as follows:

- Those works that can be stopped and restarted would be delayed.
- Those works that cannot be stopped, such as the offshore piling or the shore crossing drilling, have been assessed as "unavoidable' works to cover such an eventuality in the respective impact assessment sections of this report.

9.14 Summary of residual impacts

Residual impacts are those that remain once mitigation measures have been implemented. This section describes potential residual impacts during the construction phase of the project, once mitigation measures have been considered and applied.

A comparison of the measured background levels and the predicted construction noise levels was undertaken to determine if there would be a deterioration in acoustic amenity during this phase of the project. It was found that noise-generating construction activities are likely to be audible at sensitive receptors for short periods during normal hours, consequently ongoing consultation with those affected be a key element of the projects noise management measures.

Although there is not a specific noise limit that would apply during normal hours, all reasonably practicable mitigation measures will be applied to noise-generating construction activities in accordance with the GED. Mitigation would aim to reduce disturbance caused by construction noise and maintain the existing acoustic amenity where reasonably practicable. Additional mitigation has been provided in in **ONV-M002, ONV-M004, ONV-M005** and **ONV-M006**.

The assessment has indicated that there is no potential residual impact due to out of hours works for the construction of the onshore cable system since there are none proposed.

The impact assessment has indicated that the potential impact due to unavoidable out of hours works for the shore crossing drilling works and offshore piling is moderate. This is predominantly due to the continuous nature of the shore crossing drilling works and the size of the equipment required for the offshore piling activities. Specific mitigation measures are to be applied to these works as detailed in **ONV-M002**, **ONV-M005** and **ONV-M006** to reduce the residual impact as far as is reasonably practicable.

10.0 Operation assessment

The assessment of impacts from the project operation considers the potential changes to the noise environment within the study area and whether this could adversely affect human amenity or sensitive structures and/or exceed the proposed criteria.

10.1 Project parameters that form the basis of impact assessment

Table 10-1 specifies the maximum design scenario that has been assessed for operation.

Table 10-1 Maximum design scenario - operation

Risk	Key parameter values	Justification

ONV-I007 and ONV-I008	The works and infrastructure are located within the onshore operation project area, which is defined by the area required for the following:
	• Onshore transmission infrastructure:
	  ▪ Up to 8 underground cable circuits with the following upper limit easement footprints:
	    ♦ Operation easement width between shore crossing and VicGrid Connection hub: 40 m width
		The onshore operation project area defines the area within which noise-generating infrastructure would be operating for the project.

ONV-I009	Two scenarios have been developed to inform assessment; scenario one comprising the maximum number of smallest turbines, and scenario two comprising the maximum number of the largest turbines: • Smaller WTGs – 147 of the smallest WTG, with a rotor diameter of up to 236 metres. • Larger WTGs – 113 of the largest WTG, with a rotor diameter of up to 285 metres.	Largest number of turbines represent the greatest noise generated, and therefore greatest potential impacts to noise receptors.

To assess potential impacts associated with the project, the operational assessment has also considered the following assumptions:

- Following construction, all cable trenches will be covered with topsoil and seeded with appropriate groundcover. Similarly, all joint bays will be covered with topsoil and seeded, leaving just the link pit lids above ground.
- Permanent infrastructure sites may also include a co-located storage of a wide range of polluting material including fuels, chemicals and wastes.

10.2 Operational noise – offshore wind energy (ONV-I006)

The project would include up to 147 wind turbines in the offshore wind farm area. The wind turbines would have a three-blade rotor design and horizontal rotor axis similar in appearance to onshore wind turbines used in Australia. More than one turbine size may be selected to be used within the offshore area.

The wind turbines consist of three key components:

- Blades
- Hub and nacelle, and
- Tower.

A schematic of a wind turbine is provided in Figure 10-1. Further details are provided in Section 4.6 of EIS Chapter 4 – Project description.

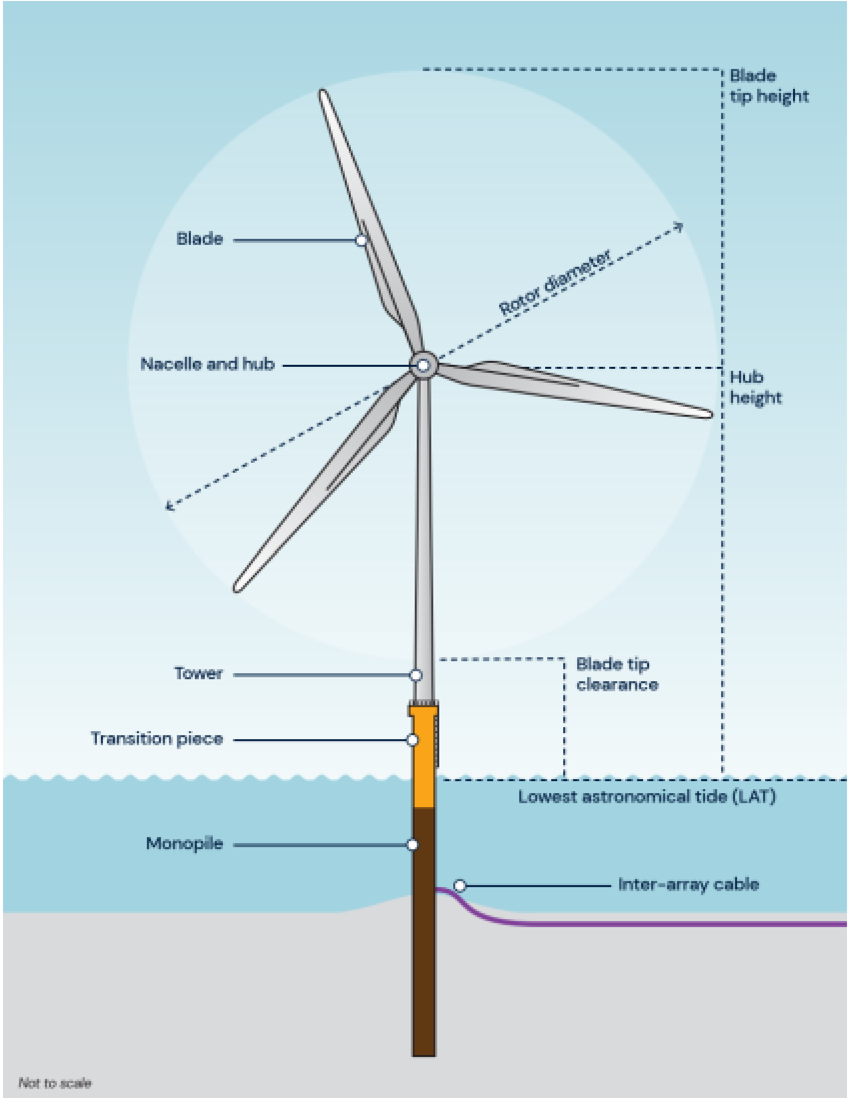

Figure 10-1 Wind turbine schematic

10.2.1 Wind turbine specification

This assessment has been prepared using two likely wind turbine scenarios that are representative of the smallest and largest turbine sizes being considered by the project. The scenarios are based on feasible smallest and largest turbine sizes that are anticipated be suitable to be installed for the project.

The project will decide on final wind turbine(s) configuration to be used for the project following planning approvals being obtained and subsequent detailed design work, as well as a tender process to procure the preferred turbine(s).

Notwithstanding, the final turbine(s) that are selected for use by the project would need to comply with planning approval requirements and other relevant criteria, as they relate to noise levels at surrounding noise sensitive locations. An updated noise impact assessment would also typically be required once final turbines for the project are selected. This would be carried out prior to construction of the project.

The key objective of this assessment is to investigate noise levels at surrounding noise sensitive receptors and to demonstrate that noise limits can be practically achieved, taking into consideration typical noise emissions levels that are representative of the turbines that may be used for the project.

The two turbine scenarios selected for the assessment represent two different layouts with a different number of turbines. The general specification of these reference turbines is set out in Table 10-2.

It is understood that all technical data provided is subject to change and as such any significant changes to the wind turbine technical specifications as reproduced in Table 10-2 as well as noise emission details would require reassessment of the impacts of noise of this proposed wind energy facility.

Table 10-2 Wind turbine technical specifications

Component	Largest wind turbine	Smallest wind turbine
Manufacturer	Generic	Vestas
Model	Generic 19MW offshore wind turbine	Vestas V236-15 MW
Type	3-bladed, horizontal axis	
Scenario hub height	207.5 m	153 m
Scenario rotor diameter	285 m	236 m
Scenario rotor tip height	350 m	285 m
Number of turbines	113	147

Table notes:

1. Adopted from a generic suitable reference wind turbine specification.

10.2.2 Exclusions from the noise model

The following sections describe items that are not included in the noise modelling.

10.2.2.1 Offshore substations

The potential for human disturbance because of noise generated by the operation of the offshore substations is considered to be very low. Accordingly, operational noise from the offshore substations has not been assessed.

10.2.2.2 Access and vessel movements

The offshore wind infrastructure could typically be accessed either from the sea via a boat landing or a stabilised gangway via the substructure, or by air via hoisting from a helicopter to a heli-hoist platform on the nacelle. Any helicopter access would be designed in accordance with relevant Civil Aviation Authority (CASA) guidance and standards.

10.2.3 Noise sensitive receptors

The receptors used in the assessment are detailed in Table 10-3.

Table 10-3 Noise sensitive receptors – Offshore wind energy

Receptor	Address	Associated property?	Distance from nearest turbine (largest wind turbines), m	Distance from nearest turbine (smallest wind turbines), m
1	Sarena Parade, Robertsons Beach Victoria 3874	No	15300	15000
2	David Street, Manns Beach Victoria 3971	No	15600	14900
3	McLoughlins Road, McLoughlins Beach Victoria 3874	No	11700	11500
4	Sunday Island, Port Albert Victoria 3971	No	14600	15000
5	North Street, Port Albert Victoria 3971	No	15700	15400
6	Reeves Beach Campground	No	10400	12000
7	McLoughlins Seaspray Reserve	No	10400	10200

10.2.4 Turbine site layout scenarios

Three-dimensional noise models were developed to predict the noise levels for two indicative layouts of the project, one consisting of 113 of the 19 MW wind turbines, and one consisting of 147 of the 15 MW wind turbines.

A different layout may ultimately be installed; however, the modelled scenarios are considered to represent the design scenario in terms of noise impacts at the closest onshore receptors.

The layout of the turbines relative to receptors onshore is shown in Figure 10-2 and Figure 10-3.

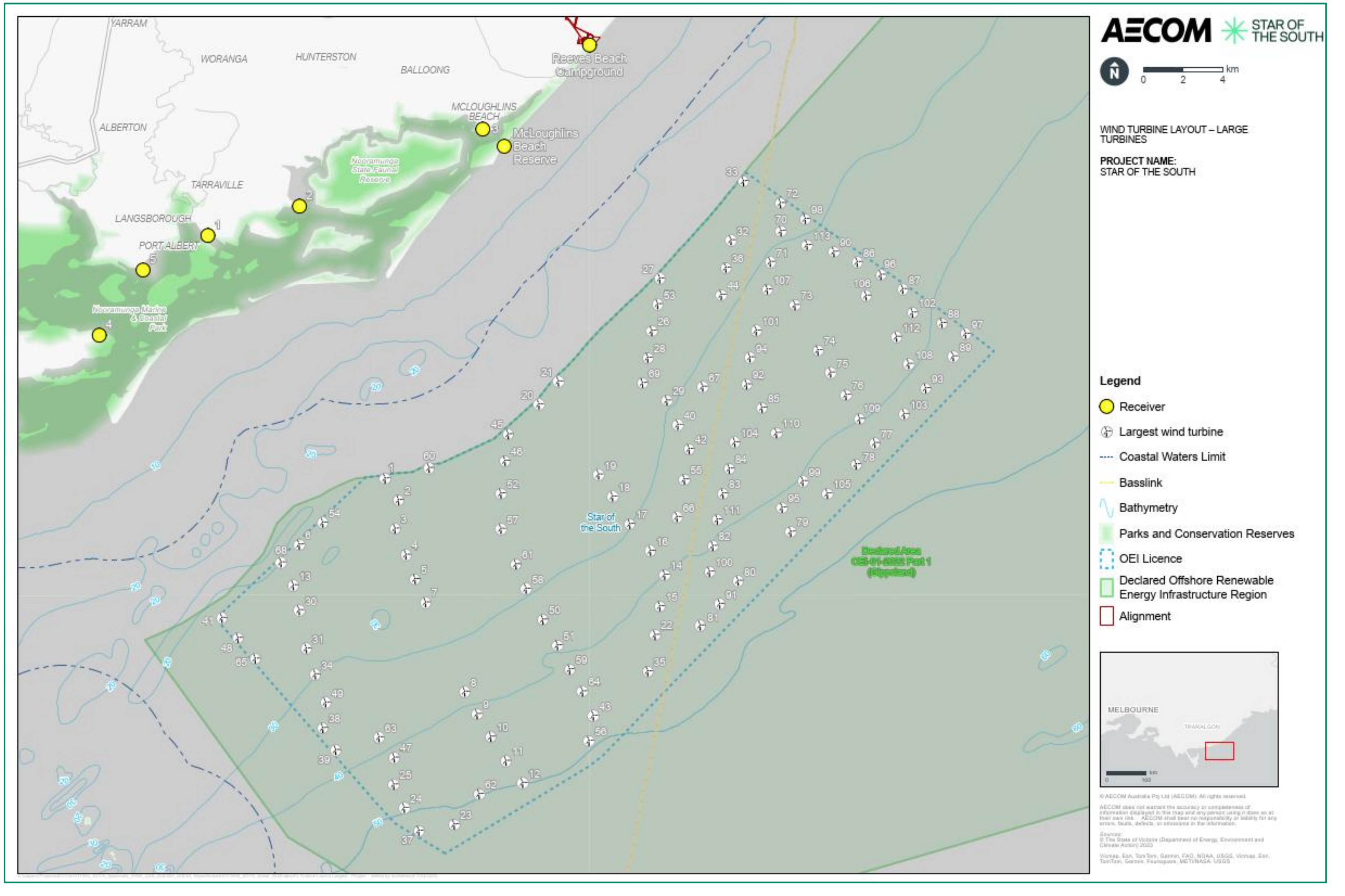

Figure 10-2 Indicative largest wind turbine site layout

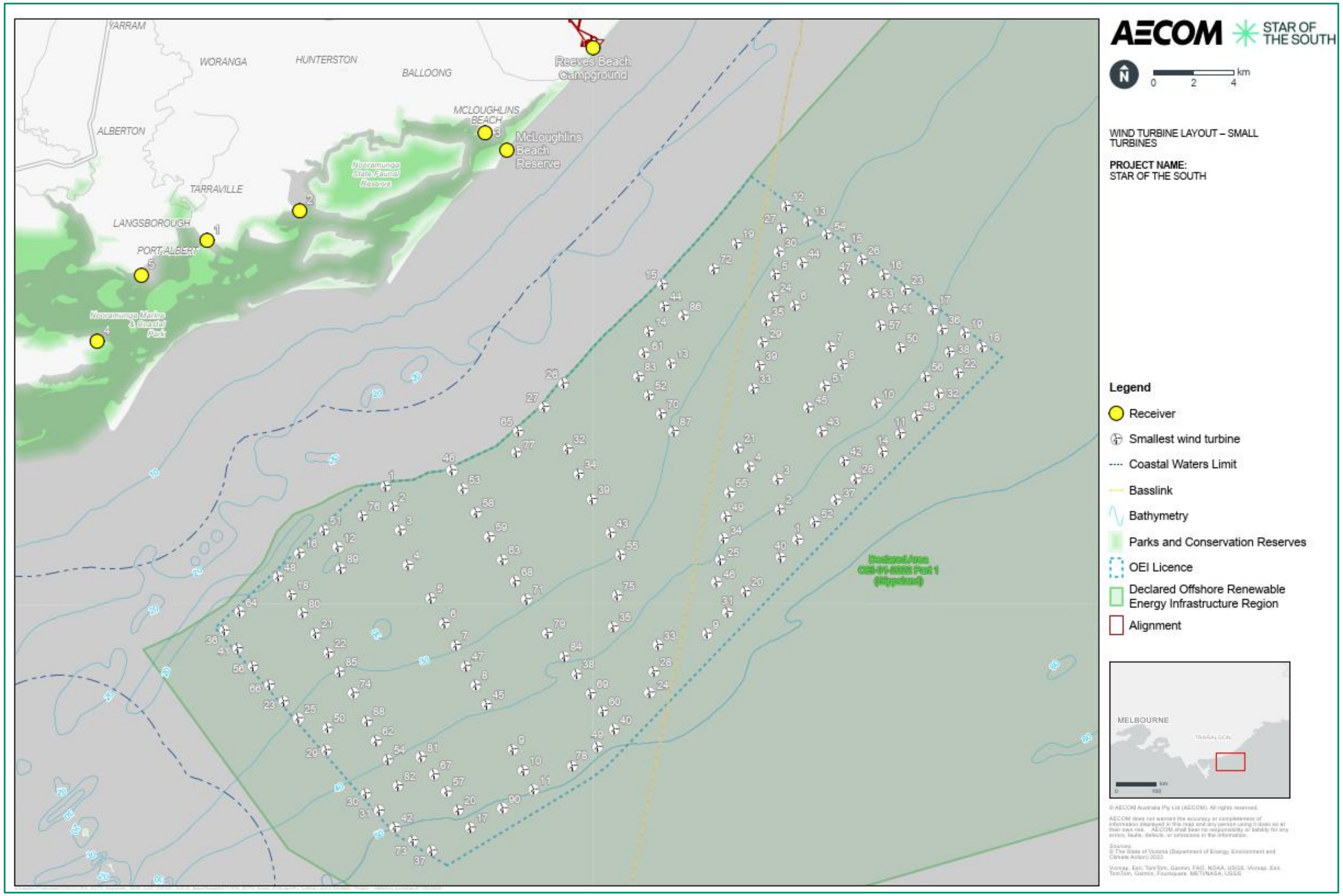

Figure 10-3 Indicative smallest wind turbine site layout

10.2.5 Wind turbine sound power levels

Sound power levels for different hub height wind speeds are provided in Table 10-4 and Table 10-5, whilst the 1/3 octave band sound power levels used in the noise modelling are provided in Table 10-6 and Table 10-7.

For the purposes of this assessment a +2 dB correction to the sound power levels have been made to convert the provided sound power levels to declared sound power levels (Lwd) in the absence of uncertainty or test reports available for the wind turbines as recommended by IoA Wind Turbines 2013.

Table 10-4 Sound power levels and declared sound power levels for the largest wind turbines at different hub height wind speeds

Sound power level, dB	Wind speed, m/s										
	4	5	6	7	8	9	10	11	12	12.5 (Rated power)	Up to cut-out (30)
Largest wind turbine	106	107	109	113	117	120	121	122	122	122	122
Largest wind turbine (Declared)	108	109	111	115	119	122	123	124	124	124	124

Table 10-5 Sound power levels and declared sound power levels for the smallest wind turbines at different hub height wind speeds

Sound power level, dB	Wind speed, m/s									
	4	5	6	7	8	9	10	11	11.1 (Rated power)	Up to cut-out (30)
Smallest wind turbine	103	104	106	110	113	116	118	118	118	118
Smallest wind turbine (Declared)	105	106	108	112	115	118	120	120	120	120

Table 10-6 Sound power level spectra for the largest wind turbine at different hub height wind speeds

Hub height wind speed m/s	Overall dB(A)	1/3 octave frequency band (Hz) sound power level, dB																																
		6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
4	106	109	109	108	107	107	106	105	105	105	105	104	104	104	104	103	103	102	102	101	100	99	97	96	95	93	91	89	87	85	82	80	77	74
5	107	111	110	109	108	108	107	107	106	106	106	106	106	105	105	105	104	103	103	102	101	100	98	97	96	94	92	90	88	86	83	80	78	75
6	109	113	113	112	111	111	110	109	109	109	108	108	108	107	107	107	106	106	105	104	103	102	100	99	98	96	94	92	90	87	85	82	79	76
7	113	117	116	115	115	114	114	113	112	112	112	112	112	111	111	111	110	109	109	108	107	105	104	103	101	99	98	95	93	91	88	85	82	79
8	117	120	120	119	118	118	117	116	116	116	116	115	115	115	114	114	114	113	112	111	110	109	108	106	105	103	101	99	97	94	91	88	85	83

Hub height wind speed m/s	Overall dB(A)	1/3 octave frequency band (Hz) sound power level, dB																																
		6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
9	120	120	119	122	121	121	120	120	119	119	119	119	118	118	118	117	117	116	115	114	113	112	111	109	108	106	104	102	100	97	94	91	88	85
10	121	121	121	124	123	123	122	121	121	121	120	120	120	120	119	119	118	118	117	116	115	114	112	111	109	108	106	103	101	98	96	93	90	87
11	122	121	121	124	123	123	122	122	121	121	121	121	120	120	120	119	119	118	117	116	115	114	113	111	110	108	106	104	102	99	96	93	90	88
12	122	121	121	124	123	123	122	121	121	121	121	121	120	120	120	119	119	118	117	116	115	114	113	111	110	108	106	104	102	99	96	93	90	88
13 Up to cut-out (30)	122	121	121	124	123	123	122	122	121	121	121	121	121	120	120	120	119	118	117	117	115	114	113	111	110	108	106	104	102	99	96	93	90	87

Table 10-7 Sound power level spectra for the smallest wind turbine at different hub height wind speeds

Hub height wind speed m/s	Overall dB(A)	1/3 octave frequency band (Hz) sound power level, dB																													
		12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
4	103	106	106	105	104	104	103	102	102	102	101	101	101	101	100	100	100	99	98	98	97	96	94	93	92	90	88	86	84	82	79
5	104	107	107	106	105	105	104	103	103	103	103	102	102	102	102	101	101	100	99	99	98	97	95	94	93	91	89	87	85	82	80
6	106	110	109	109	108	107	107	106	106	105	105	105	105	104	104	104	103	102	102	101	100	99	97	96	94	93	91	89	87	84	81
7	110	113	113	112	111	111	110	110	109	109	109	108	108	108	107	107	107	106	105	104	103	102	101	99	98	96	94	92	90	87	85
8	113	117	116	116	115	115	114	113	113	113	112	112	112	111	111	111	110	110	109	108	107	106	104	103	101	99	98	96	93	91	88
9	116	120	119	119	118	118	117	116	116	116	115	115	115	115	114	114	113	113	112	111	110	109	107	106	104	102	101	98	96	93	91
10	118	121	121	120	119	119	118	118	117	117	117	117	116	116	116	115	115	114	113	112	111	110	109	107	106	104	102	100	98	95	92
11	118	121	121	120	120	119	119	118	118	117	117	117	117	116	116	116	115	115	114	113	112	111	109	108	106	104	103	100	98	95	93
12 Up to cut-out (30)	118	121	121	120	119	119	118	118	117	117	117	117	117	116	116	116	115	115	114	113	112	111	109	108	106	104	103	101	98	95	93

10.2.6 Noise model inputs

The following data was used to create the computer model:

- Ground elevations for the onshore receptor area was obtained from VicMap Terrain data.
- Two proposed project layouts containing 113 large and 147 small wind turbines respectively.
- The coordinates of the wind turbines are presented in Appendix D.
- Seven representative noise sensitive locations, which are intended to represent the worst-case noise-sensitive receptor in each of the nearby townships or noise-sensitive areas.

The following parameters were entered in the computer model, in accordance with IoA Wind Turbines 2013:

- Atmospheric conditions at 10 degrees Celsius temperature and 70 per cent relative humidity.
- 50 per cent acoustically hard ground and 50 per cent acoustically soft ground (i.e. ground factor (G) = 0.5). Acoustically hard ground (G = 0) used for water. It is acknowledged that there is a large amount of vegetation and farming land onshore in vicinity of the wind energy facility and nearby noise sensitive locations, however IoA Wind Turbines 2013 specifically recommends the use of G = 0.5. Additionally, NZS 6808:2010 states that "*By default for 'soft' ground a ground factor of 0.5 would be used. Values above 0.5 would generally not be used*".
- Barrier attenuation of no greater than 2 dB.
- Four-metre receptor height as recommended by IoA Wind Turbines 2013. It is acknowledged that 1.5 metres is a more realistic representation of single storey receptor heights, however IoA Wind Turbines 2013 explains that the 4-metre receptor height "*has the effect of reducing the potential over-sensitivity of the calculation to the receptor region ground factor compared to lower receptor heights*".
- Application of a 3 dB correction where a concave ground profile exists between a wind turbine and a receptor. This was applied to areas where it is observed that $h_m \geq (1.5 \times |h_s - h_r| \times 0.5)$ where h_m is the mean height above ground of the direct line of sight from the receptor to the source (as defined in ISO 9613-2) and h_s and h_r are the heights above the local ground level of the source and receptor respectively.
- The 1/3 octave sound power spectrum sound power levels were provided by Star of the South from 4 m/s to 20 m/s hub height wind speeds for a slightly smaller model (18MW).
  - It was instructed by Star of the South that this reference spectrum would be used for the large turbine where it would be scaled according to the overall sound power levels for this turbine.
  - Similarly, the cut-in, cut-out, and rated power hub high wind speeds for the largest turbine are all assumed to be the same as the suitable reference turbine.
  - The rated power hub height wind speed for the largest turbine was represented by 13 m/s as sound power data was only available for integer windspeed values.
- The 1/3 octave sound power spectrum for the smallest wind turbine generator was provided by Star of the South for hub height wind speeds from 4 m/s to 20 m/s. This was for a Vestas 236-15 MW turbine.
- It is acknowledged that for both wind turbines used in the assessment, the cut-in wind speed is 3 m/s and the cut-out wind speed is 30 m/s however, due to limitations in measurement data, sound power spectra are not available for hub height wind speeds outside of the 4 to 20 m/s range. However the highest overall sound power level is constant from 11 m/s to 30 m/s for the largest turbine and 10 m/s to 30 m/s for the smallest turbine. The rated power wind speed is reached at approximately 12.5 m/s for the largest turbine and 11.1 m/s for the smallest turbine. This is in accordance with the Standard which states "*A set of overall levels shall be predicted covering the wind speed range for which sound power level data are available from the manufacturer. As a minimum, the wind speed range shall include the range specified by IEC 61400-11 and the wind speed corresponding to the highest sound level generated by the turbine*".

Table 10-8 NZS 6808:2010 sound level prediction documentation summary

Documentation	Parameters	
A map showing the topography in the vicinity of the wind farm, the position of the wind turbines, and noise sensitive locations	Shown in Figure 10-2 and Figure 10-3.	
Noise sensitive locations for which wind farm sound levels are calculated	Shown in Figure 10-2 and Figure 10-3.	
Wind turbine sound power levels at rated power hub height windspeed	**Largest wind turbine (12.5 m/s)**	**Smallest wind turbine (11.1 m/s)**
	Overall sound power level of L_w = 121.7 dB(A)	Overall sound power level of L_w = 118 dB(A)
	Declared overall sound power level of: L_w = 123.7 dB(A)	Declared overall sound power level of: L_w = 120 dB(A)
The make and model of the wind turbines	Generic	Vestas V236
The hub height of the wind turbines	207.5 m	153 m
Distance of noise sensitive locations from the nearest wind turbine	Between 11 and 16 km	
Calculation procedure used	BEK nr 135 (2019) as implemented in SoundPLAN Version 9.1.	
Meteorological conditions assumed	10 degrees Celsius temperature, 70 per cent relative humidity and 1013.3 mbar	
Air absorption parameters used	As per ISO9613.2:2024	
Ground attenuation parameters used	G = 0.5 for land G = 0 for water	
Topography/screening assumed	Barrier attenuation of no greater than 2 dB	
Predicted far-field wind farm noise levels	Refer to Table 10-9 and Table 10-10	

10.2.7 Offshore predicted noise levels

Table 10-9 and Table 10-10 present the results from the assessment for the proposed largest and smallest wind turbine layout using the candidate turbines described in Table 10-8.

Table 10-9 Noise prediction for largest wind turbines assessed against the hub height wind speeds noise limit

Receptor ID	Stakeholder	Predicted noise level at different hub height wind speeds (m/s), from cut-in to rated power wind speeds, $L_{A90(10\ min)}$ dB										Complies?
		4	5	6(1)	7	8	9	10	11	12	12.5 (rated power)	
Noise limit, $L_{A90(10\ min)}$ dB		35	35	35	40	40	40	40	40	40	40	
1	No	<20	<20	<20	<20	23	27	28	29	29	30	**Yes**
2	No	<20	<20	<20	<20	24	28	30	30	30	31	**Yes**
3	No	<20	<20	<20	23	27	30	32	33	33	33	**Yes**
4	No	<20	<20	<20	<20	23	27	29	29	30	30	**Yes**
5	No	<20	<20	<20	<20	23	26	28	29	29	29	**Yes**
6	No	<20	<20	<20	23	27	30	32	33	33	33	**Yes**
7	No	<20	<20	<20	23	27	30	31	32	32	32	**N/a**

Table notes:

1. 6 m/s is the threshold below which a high amenity noise limit of (35 $L_{A90,\ 10\ mins}$ dB) applies.

Table 10-10 Noise prediction for smallest wind turbines assessed against the hub height wind speeds noise limit

Receptor ID	Stakeholder	Predicted noise level at different hub height wind speeds (m/s), from cut-in to rated power wind speeds, $L_{A90(10\ min)}$ dB									Complies?
		4	5	6[1]	7	8	9	10	11	11.1(rated power)	
Noise limit, $L_{A90(10\ min)}$ dB		35	35	35	40	40	40	40	40	40	
1	No	<20	<20	<20	<20	23	26	28	29	29	**Yes**
2	No	<20	<20	<20	<20	23	27	29	29	29	**Yes**
3	No	<20	<20	<20	<20	26	29	31	32	32	**Yes**
4	No	<20	<20	<20	<20	23	26	28	29	29	**Yes**
5	No	<20	<20	<20	<20	22	26	27	28	28	**Yes**
6	No	<20	<20	<20	<20	26	29	31	31	31	**Yes**
7	No	<20	<20	<20	<20	24	26	28	29	29	**N/a**

Table notes:

1. 6 m/s is the threshold below which a high amenity noise limit (35 $L_{A90,\ 10\ mins}$ dB) applies.

10.2.8 Offshore predicted noise contours

Contours of the predicted noise level from the wind turbines at receptors onshore are presented in Figure 10-4 and Figure 10-5.

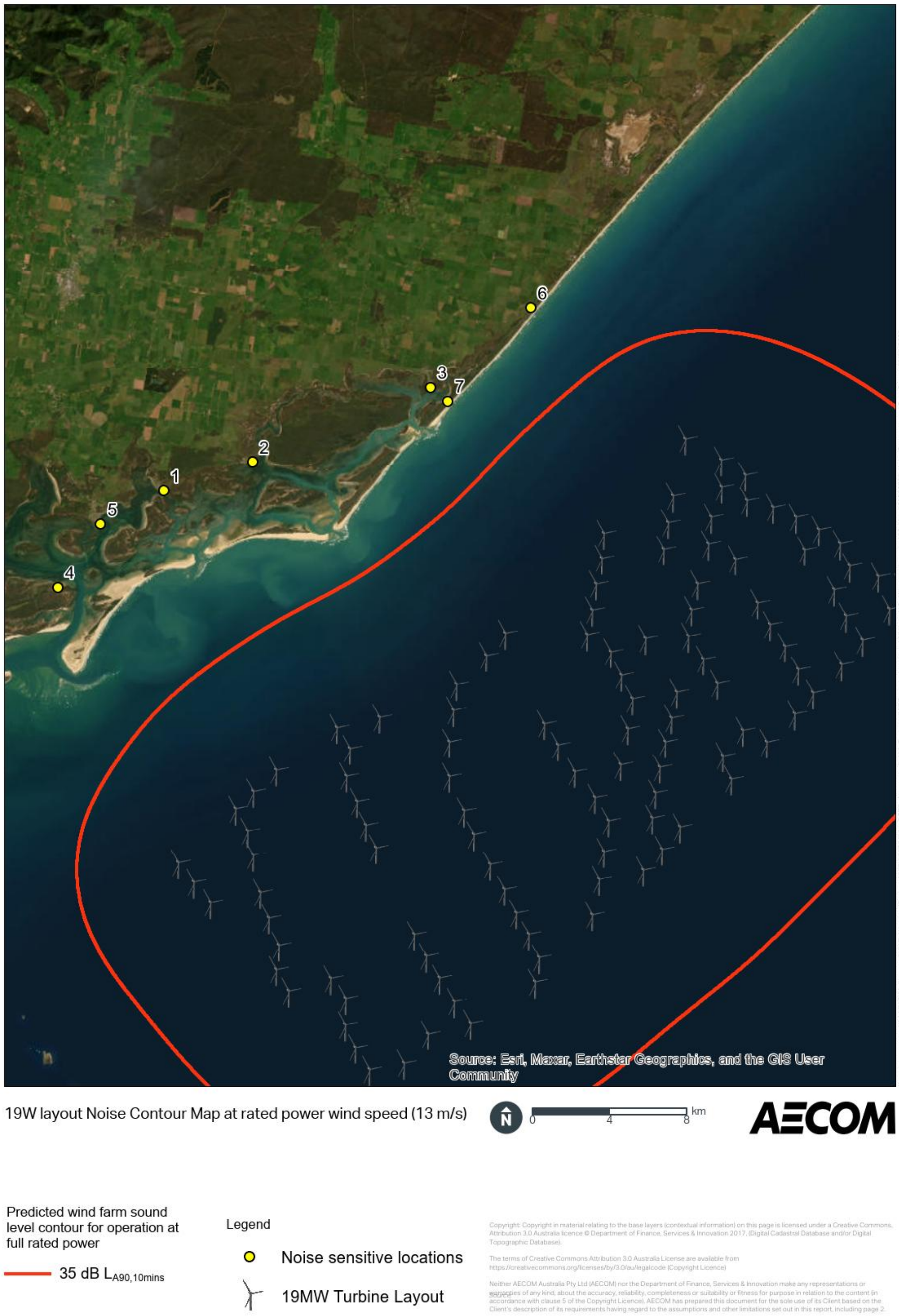

Figure 10-4 Noise contours for the largest turbines

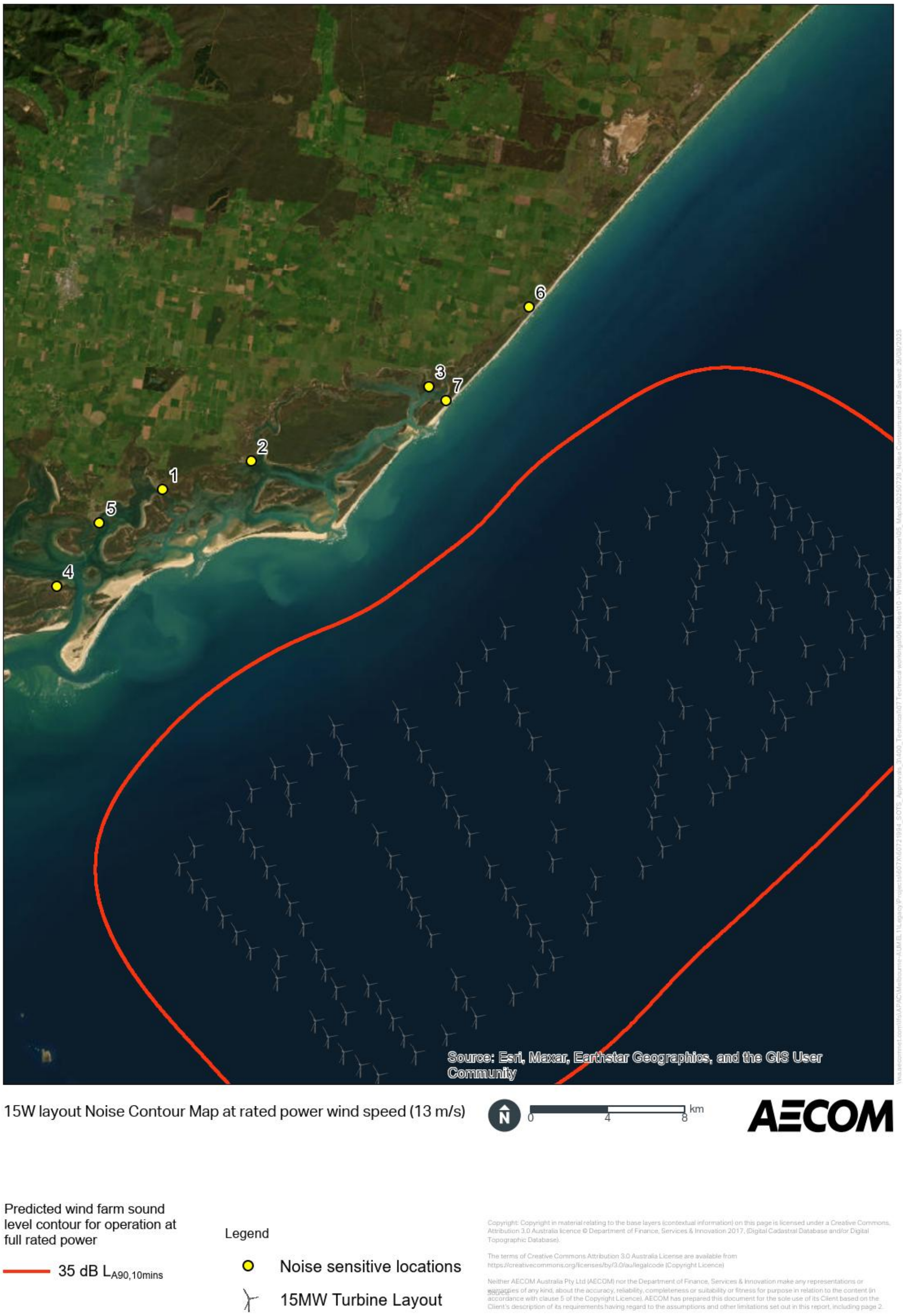

Figure 10-5 Noise contours for the smallest turbines

10.2.9 Offshore operational - low frequency noise

The outdoor noise threshold criteria for outdoor assessments provided in Table 3 of EPA Victoria Publication 1996 do not apply to noise from wind turbines.

10.2.10 Wind Rose – Wilsons Promontory Lighthouse

An analysis of existing meteorological conditions was also carried out to determine prevailing wind conditions. Seasonal wind roses for Wilsons Promontory Lighthouse BOM weather station (085096) were generated and are presented in Figure 10-6 and includes wind data from 2010-2021.

Wilsons Promontory Lighthouse is considered the most representative BOM dataset for the wind farm location. The wind roses show that the prevailing wind conditions for all seasons are from the west with the next most prevailing from north north-east. Less than 5 per cent of winds are from the south-east.

As the wind turbines are generally south-east of the nearest noise sensitive receptors, the predicted offshore noise levels are considered to be conservative as the calculation algorithm assumes downwind propagation from the sound source to the receptor.

The Institute of Acoustics Good Practice Guide to the Application of ETSU-97, states the following with respect to the wind direction:

> *"[…] current practice suggests that for a range of headings from directly downwind (0°) up to 10 degrees from crosswind (80°), there may be little to no reduction in noise levels; once in crosswind directions (90°) then the reduction maybe around 2 dB(A); and when at sufficient distance upwind the reduction would be at least 10 dB(A)."*

Additionally, due to the size of the proposed wind farm and the how spread out the noise sensitive receptors are, it is highly unlikely for downwind propagation from wind turbines to receptors to occur between every wind turbine and receptor at the same time i.e. what the predicted noise levels represent.

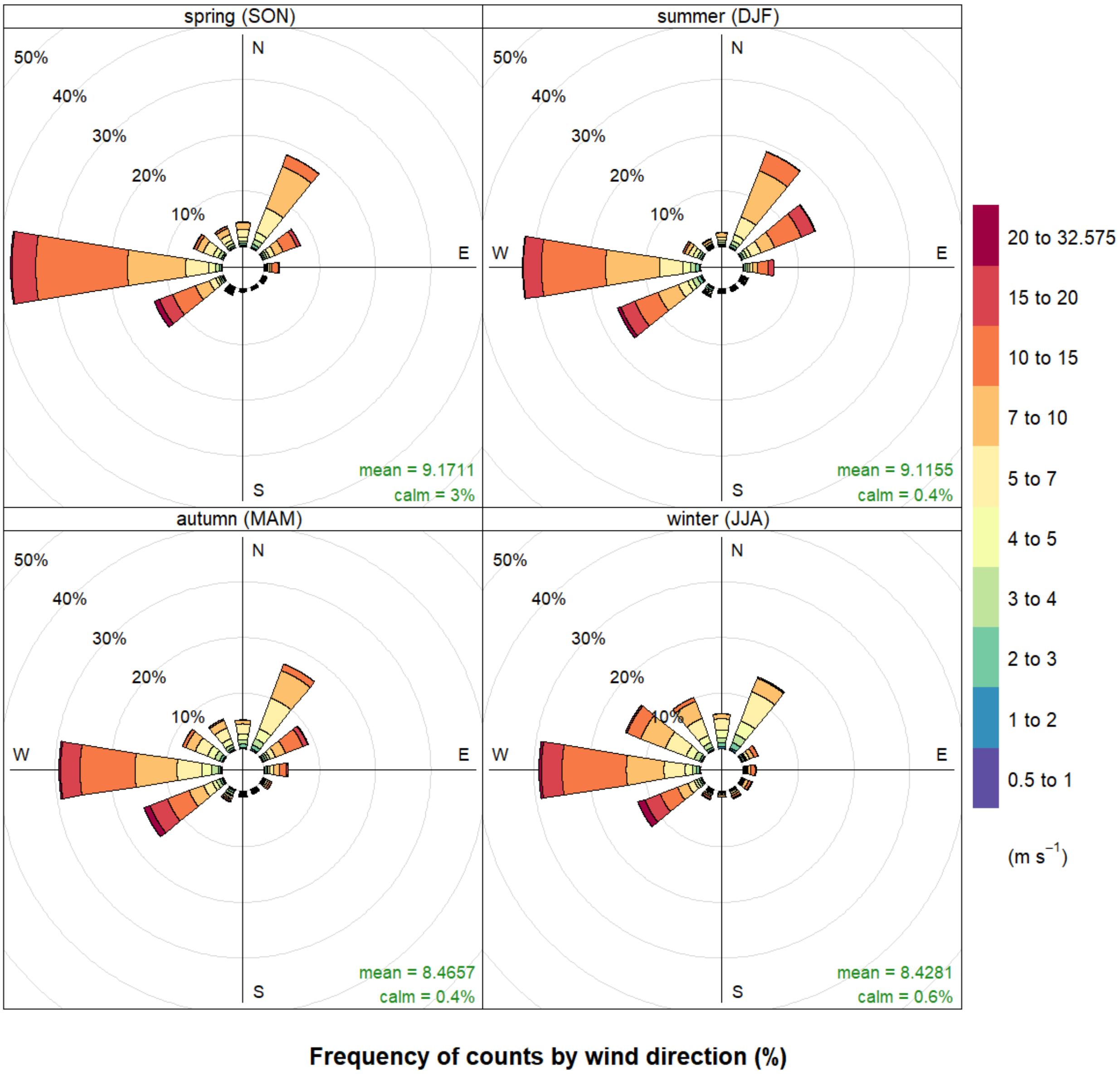

Figure 10-6 Seasonal wind roses at Wilsons Promontory Lighthouse BOM station between 2010-2021

10.2.11 Soundscape

The requirement for a Soundscape assessment comes from the ERS and only applies to Natural Areas (as defined in the ERS). EPA Victoria Publication 1992. Under the Environment Reference Standard Reeves Beach Campground is a Natural Area (category V) stating:

> *The audibility and noticeability of introduced sounds in the presence of other ambient environment sound depends on the loudness, temporal variation and the frequency of both the existing sound and the introduced sound (or noise signal). Regardless of its decibel level, an introduced sound can be audible during quieter times, as the natural sounds vary temporally, seasonally and in frequency, such as with bird calls or leaf rustling. For this reason, the objective for category V areas is 'a sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural Soundscape'.*

In this instance the operational wind turbine noise is the introduced sound and the loudness, temporal variation and the frequency of both the existing sound and the introduced sound should be examined to maintain the tranquillity and enjoyment of the area. The following sets out the Soundscape assessment per the methodology defined in Section **6.8**.

In the absence of a questionnaire and interview survey, acoustic data was gathered during a soundwalk on Wednesday 12th February 2025 at the campground and the beach reserve. The existing environment during the soundwalk was observed to be as follows:

Reeves Beach Campground

- The existing Soundscape is rugged and pristine with high variations in level that are driven by the surf and the wind. These two components, whilst they will vary from day to day, will be a permanent feature and are likely to dominate at all times of the day and night. Slight seasonal variations in wind and tide patterns would not be expected to alter their contributions significantly. The primary information in the environment was driven by magpies and cicadas.
- Surf and occasional breezes were generally dominant in the range below around 1000 Hz.
- Cicadas were observed throughout the grounds and were generally dominant in the range 8 KHz – 14 kHz.
- Magpies were observed throughout the grounds and their calls were generally dominant in the range 1 KHz – 2 kHz, when they occurred.
- No industrial or commercial noise sources were observed.
- Noise from campsites and campers was observed to be minimal.

McLoughlins Beach - Seaspray Coastal Reserve

- The existing Soundscape is rugged and pristine with high variations in level that are driven by the surf and the wind. These two components, whilst they will vary from day to day, will be a permanent feature and are likely to dominate at all times of the day and night. Slight seasonal variations in wind and tide patterns would not be expected to alter their contributions significantly.
- The surf and wind was generally dominant in the range below around 1000 Hz.
- It was noted that the wind was constant and significantly stronger on the shore than within the campgrounds (i.e. behind the dunes). In this location the wind was a significant component of the noise environment and could not be separated by noise due to the surf. Given that the turbines would only generate noise when the wind is blowing, it is considered that measurements taken under windy conditions are appropriate for comparison.
- No other sounds were audible.

Third octave noise levels for this measurement have been compared to one-third octave noise levels calculated from the turbines at Reeves Beach Campground (Figure 10-7) and McLoughlins Beach - Seaspray Coastal Reserve (Figure 10-8).

A difference of 3 dB or more between adjacent one-third-octave bands indicates a noticeable change in perception for the user, suggesting a potential Soundscape impact.

If frequency analysis identifies a potential impact, then commentary is provided on the specific effects. For example, the introduction of a new noise at 1-2 kHz might affect the perception of wildlife, a Soundscape feature valued by the community.

The analysis has been based on the predicted levels for the largest turbines noise levels at 12.5 m/s and smallest turbines at 11 m/s.

It can be seen that the predicted levels at all frequencies, apart from very low frequencies, are at least 3 dB below the measured existing background levels. It is considered therefore that noise from the turbines will be hard to discern from background noise and in general the existing noise sources in natural areas in the vicinity will remain dominant within the Soundscape.

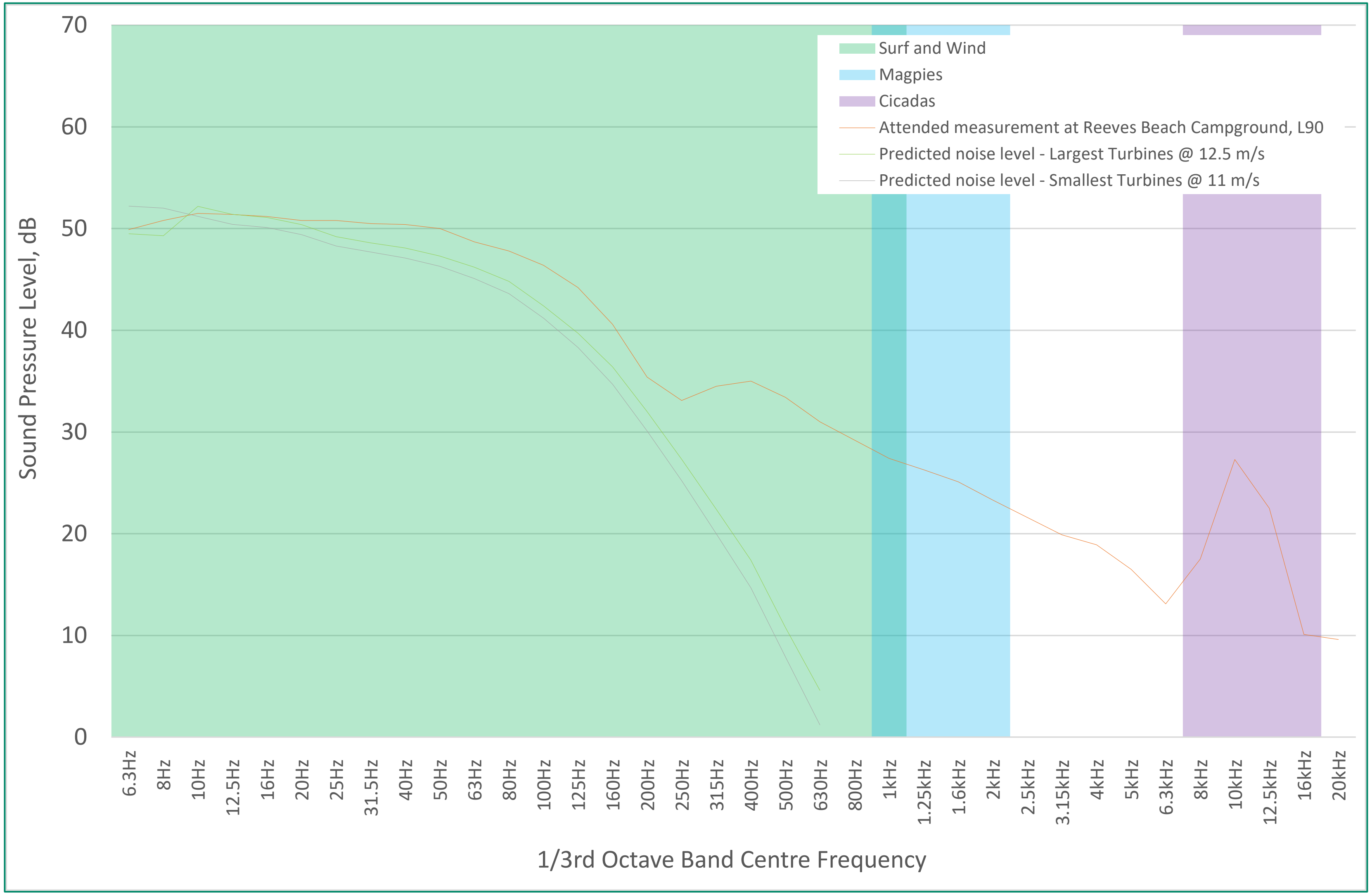

Figure 10-7 One-third octave Soundscape analysis – Reeves Beach Campground

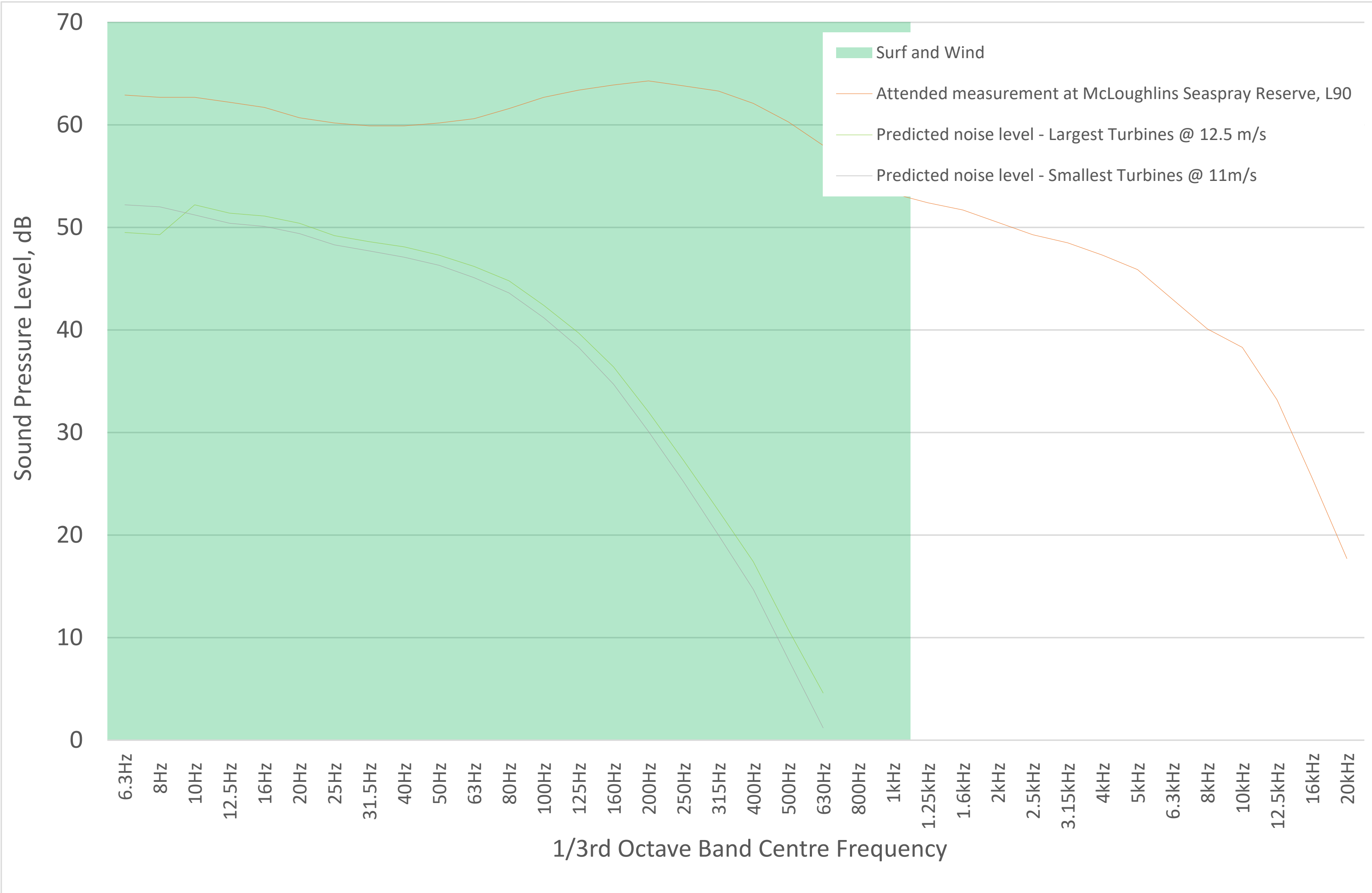

Figure 10-8 One-third octave Soundscape analysis – McLoughlins Beach - Seaspray Coastal Reserve

10.2.12 Discussion

The final turbine model that is selected for use by the project would need to comply with planning approval requirements and other relevant criteria as they relate to noise levels at surrounding sensitive locations. An updated noise impact assessment would also typically be required once final turbines for the project are selected. This would be carried out prior to construction of the project.

No exceedances of the high amenity area limit or the base noise limit of 40 L_{A90}, dB are predicted across all hub height wind speeds.

Therefore, background noise monitoring would not need to be carried out to determine site specific wind farm noise limits.

10.3 Operational vibration (ONV-I007)

The potential for human disturbance because of ground vibration generated by the operation of the project is considered to be very low. This is because:

- The major onshore operational items have no moving parts and, therefore, do not generate vibration
- The project components nearest to receptors would be the cable systems, which do not generate any vibration
- The distance between any project source and the nearest receptor is extremely large, in vibration terms.

Accordingly, operational vibration has not been assessed.

10.4 Risk assessment

There are no “risks” associated with the noise and vibration assessment, as all of the noise sources, are planned.

10.5 Summary of residual impacts

Residual impacts are those that remain once mitigation measures have been implemented. This section describes potential residual impacts during the construction phase of the project, once mitigation measures have been considered and applied.

10.5.1 Operation - offshore

The modelled noise levels from both of the candidate turbines comply with the NZS6808:2010 noise limit.

Further, analysis of background noise levels shows that noise due to the turbines is expected to be difficult to measure in the field. By extension, the turbines are not expected to make a significant contribution to the noise environment on shore.

This indicates that noise due to the wind turbines would not be expected to compromise the environmental values that relate to existing uses in the vicinity and therefore, that a residual impact is not expected to occur.

The audibility or otherwise of the turbines from the shore is dictated by, amongst other things, the prevailing wind conditions, the background noise level onshore at the time and the condition of the listeners hearing. Consequently, whilst the audibility of the turbines is a subjective judgement that would vary between individuals and time periods, the assessment indicates that noise onshore due to the turbines would be difficult to discern.

Background noise levels are expected to be variable and influenced by natural phenomena such as wind and surf. Nevertheless, inspection of the graphs in Appendix A particularly for noise monitoring Site 14 (Receptor 1 in the wind turbine assessment) for which there is more data available, shows that the background noise level on the coast is regularly below 30 $L_{A90,\ 1hr}$ dB during the night.

The background level is a statistical measure which represents the underlying noise level at a point in time once all transient noises (e.g. traffic, birds) are removed. Effectively, it gives an indication of the lowest likely noise levels that would be experienced in the environment under investigation. If noise from the turbines is predicted to be below the background level then this indicates that it would be difficult to discern in the environment. This is because the existing ambient (overall environmental noise from all sources in the area, like traffic, industry, and natural sounds like wind or insects) would likely be dominant.

Background measurements in accordance with NZS 6808:2010 have not been taken at this time because predicted noise levels from both modelled turbines are well below the 35dB threshold at 95% rated power and therefore this requirement under NZS 6808:2010 is not triggered.

11.0 Decommissioning assessment (ONV-I008)

Decommissioning activities would be further refined as part of ongoing project development. Infrastructure decommissioning would be reviewed in discussion with the transmission system operator and the regulator in the light of any other existing or proposed future use.

11.1 Offshore wind infrastructure decommissioning

At the end of the operation phase of the project, it is envisaged that offshore structures above the seabed (within Commonwealth jurisdiction) would be removed. The decommissioning activities would principally be a reverse of the construction sequence (except for the piling, which is not required) and involve similar types and numbers of vessels, equipment and management measures.

11.2 Offshore transmission infrastructure decommissioning

Offshore cabling, either buried or protected, would likely be left in-situ to avoid impacts to the environment.

11.3 Onshore transmission infrastructure decommissioning

Onshore underground cables would potentially be left in the ground with the cable ends cut, sealed and securely buried as a precautionary measure.

11.4 Decommissioning timing and duration

The duration of decommissioning works is anticipated to take 2-3 years.

Onshore decommissioning works are anticipated to be undertaken during EPA Victoria normal working hours. Offshore decommissioning would require 24/7 working.

11.5 Work phases

Noise model scenarios have been developed to assess the noise impact from the key works associated with decommissioning. The activities for this scenario are presented in Table 11-1.

Table 11-1 Decommissioning work phases

Construction scenario	Relevant activity	Summary of work
D1	Offshore wind farm decommissioning	As noted in Section 9.9.5, piling is the major noise source associated with the offshore construction works. Therefore, noise due to wind farm decommissioning is not expected to be significant at receptors onshore because there would be no requirement for piling. As such, noise due to the wind farm decommissioning has not been assessed further.
D2	Offshore transmission infrastructure decommissioning	The offshore transmission infrastructure decommissioning works would be addressed in accordance with the ERS assessment for the offshore works, as provided in Section 9.9.5.1.
D3	Onshore transmission infrastructure decommissioning	• Lifting out of heavy equipment • Drill out / remove chemical anchor stud bolts

Construction scenario	Relevant activity	Summary of work
		• Welding • Hard standing removal, if required.

11.6 Proposed construction plant and equipment

The proposed equipment and associated noise levels included within the noise model have been summarised in Table 11-2.

Table 11-2 Decommissioning – Proposed construction plant and equipment

Equipment	Equipment sound power level, dB (A)	Operation time (% of a 15-minute period)	Decommissioning scenario		
			D1	D2	D3
All terrain crane (up to 300T)	105	100%	-	-	1
Franna crane	105	100%	-	-	1
Generator, diesel	93	100%	-	-	1
Truck	107	100%	-	-	5
Activity SWL[1]			-	-	**115**

Table notes:

1 SWL = Sound Power Level in dB (A)

11.7 Nearest noise sensitive receptors

The nearest noise and/or vibration sensitive receptors potentially impacted by the onshore decommissioning works are the dwellings near the substations. These are outlined in Table 11-3.

Table 11-3 Nearest noise sensitive receptors for the onshore decommissioning works

Receptor type	Location (m)	Approximate distance from works (m)
Residential buildings	Within 250	35
	250-500	33
	500-1000	65
	1000-1500	40
	Total	**206**
Community buildings	250-2000	0
Outdoor recreation and public open spaces	250-2000	5 reserves within 1000m of the cable alignment.

11.8 Decommissioning noise levels at distance

Calculated noise from decommissioning activities at distances from each decommissioning scenario is summarised in Table 11-4. As noted above, on the basis of the construction phase assessment, noise due to the decommissioning of the offshore infrastructure (D1 and D2) is not expected to generate a significant amount of noise and has therefore not been assessed further.

Table 11-4 Decommissioning noise set back distances

Scenario reference	Combined sound power level, dB(A)	Calculated construction noise levels at offset distances from cable system, $L_{Aeq\ (15\ min)}$ dB[1]				
		250m	500m	1000m	1500m	2000m
P4	-	-	-	-	-	-
P5	-	-	-	-	-	-
P6	115	64	57	52	48	45

11.9 Assessment against ERS

The decommissioning works would be addressed in accordance with the ERS assessment for the onshore cable system construction works, as provided in Table 9-8.

12.0 Cumulative Assessment

This section provides an assessment of cumulative impacts, taking into consideration other proposed developments in the region. The method to consider cumulative impacts has been described in Section 6.12 and Chapter 6 – Assessment Framework within both the EIS and EES.

12.1 Projects within zone of influence

For the purpose of evaluating cumulative impacts, this assessment has identified other projects that are located within the zone of influence of this study. The zone of influence for this study has been defined as the project area and areas within two kilometres of the project area.

The long list of projects that fall within the zone of influence for noise and vibration is presented in Table 12-1. The listed projects are also shown inFigure 12-1.

Each of the projects in Table 12-1 have been evaluated against the cumulative assessment criteria to determine whether there is the potential for cumulative impacts with the project and sufficient information available to undertake a meaningful assessment.

In assessing the potential cumulative impacts for the Star of the South project it is important to consider that some developments, predominately those ‘proposed’ (referred) or identified in development plans, may not actually be taken forward, or fully built out.

There is therefore a need to build in some certainty (or uncertainty) with respect to the potential impacts that may arise from such proposals, which is done by allocating projects into ‘tiers’. This approach allows appropriate weight to be given to each tier when considering the potential cumulative impacts.

The long list of identified projects, relevant to noise, is provided in Table 12-1.

Table 12-1 Cumulative impacts – projects in zone of influence

Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
Aurora Green Offshore Wind	Tier 3 – project announced, in the public realm	Yes	Not considered further due to a lack of information.	Yes	Screened out due to a lack of information.
Blue Mackerel North Offshore Wind	Tier 3 - project announced, in the public realm.	Yes	Not considered further due to a lack of information.	Yes	Screened out due to a lack of information.
Gippsland Offshore Wind Farm 1	Tier 2 – Seeking approval	Yes	Unlikely to be an issue due to distance	Yes	Screened out due to distance.
Gippsland Offshore Wind Farm 2	Tier 2 – Seeking approval.	Yes	Unlikely to be an issue due to distance	Yes	Screened out due to distance.
Gippsland Skies Offshore Wind	Tier 3 – project announced, in the public realm.	Yes	Unlikely to be an issue due to distance	Yes	Screened out due to distance.
Great Eastern Offshore Wind Farm	Tier 2 – Seeking approval	Yes	Possibly. The imagery available on the website suggests that as this project is nearby there is the potential for cumulative noise impacts.	Yes. The operational phases of the two projects are likely to overlap.	Screened in.
High Sea Wind Offshore Wind	Tier 3 – project announced, in the public realm.	Yes	Not considered further due to a lack of information.	Yes	Screened out due to a lack of information.

Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
Kent Offshore Wind	Tier 3 – project announced, in the public realm.	Yes	Unlikely to be an issue due to distance.	Yes	Screened out due to distance.
Kut-Wut Brataualung Offshore Wind	Tier 3 – project announced, in the public realm.	Yes	Unlikely to be an issue due to distance.	Yes	Screened out due to distance.
Navigator North Offshore Wind	Tier 3 – project announced, in the public realm.	Yes	Unlikely to be an issue due to distance.	Yes	Screened out due to distance.
Gippsland Offshore Wind Transmission 2GW Project	Tier 2 – Seeking approval	Yes	Not considered further due to a lack of information.	Yes	Screened out due to a lack of information.

One potential project within the zone of influence of the project the Great Eastern Offshore Wind Farm was assessed as Tier 2 (certainty) andincluded in the assessment due to the proximity to the Star of the South project.

The potential for the project to result in cumulative impacts when combined with these projects has been considered in the following sections with respect to severity, extent and duration.

All other identified projects were screened out due to distance, and lack of information.

Table 12-2 describes the projects screened in to be taken forward for the cumulative impact assessment.

Table 12-2 Projects assessed for cumulative impacts

Project or action	Stage	Project description	Relevance to this assessment	Certainty	Assessment assumptions
Great Eastern Offshore Wind Farm	Received feasibility licence.	Up to 2.5GW fixed-bottom offshore wind farm approximately. 22 km off the central Gippsland coast.	Spatial relevance: located adjacent to the Star of the South Offshore Wind Farm Area. Temporal relevance: According to the project lifecycle depicted on the project website it is possible that the construction and operations phase of the project may overlap with those of the Star of the South project.	Tier 2 (Medium)	If both projects are constructed, then it is estimated that this could add up to 5 dB to the predicted operational wind turbine noise levels presented herein. In which case, compliance with the noise limit would still be expected to be achieved. Consequently, mitigation measures are unlikely to be required if these projects are to operate together. This would be addressed as the design (for each project) progresses.

Based on the assumptions in Table 12-2, cumulative impacts due to noise would be unlikely to occur.

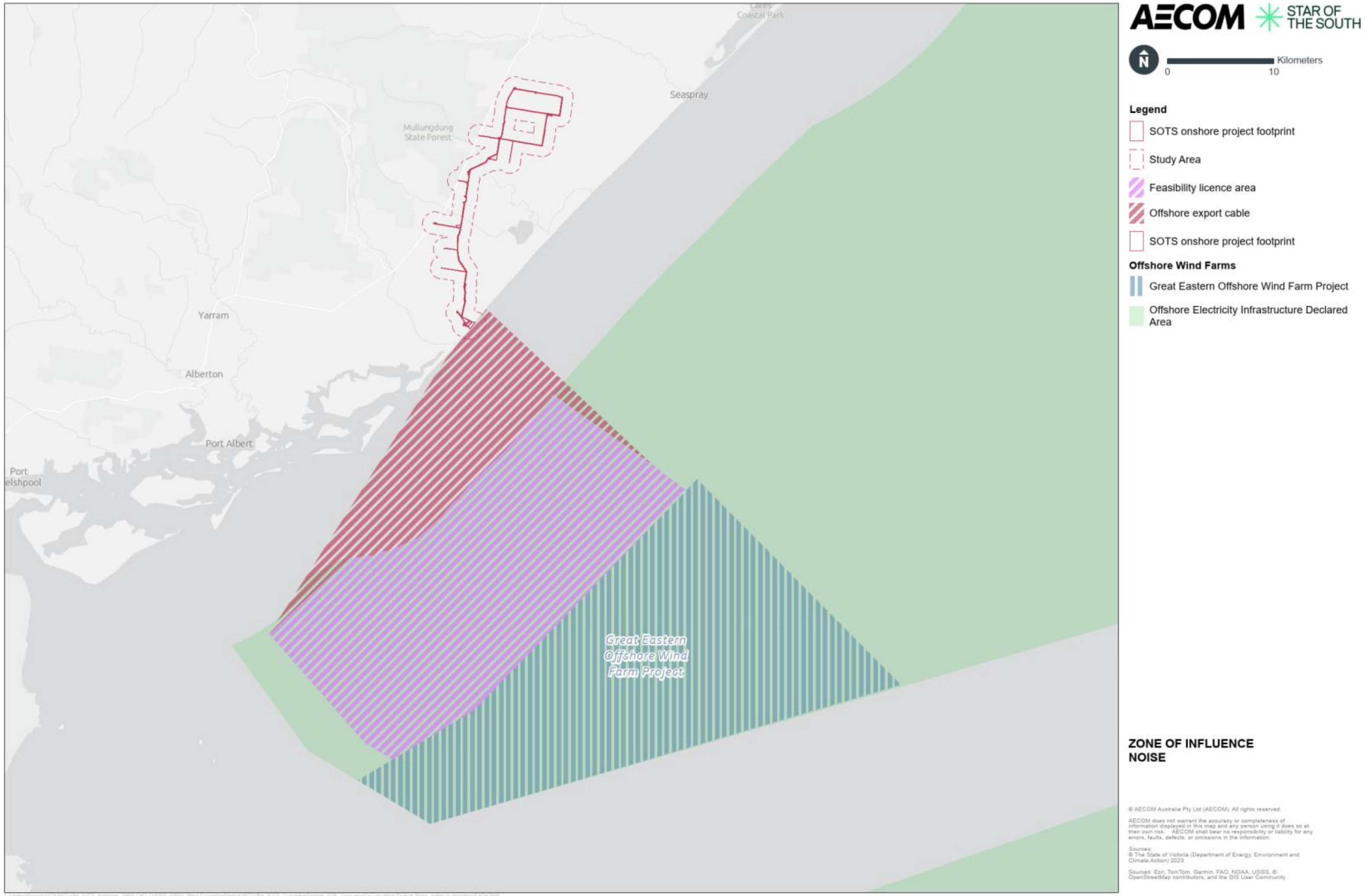

Figure 12-1 Cumulative impact zone of influence and projects further assessed

13.0 Summary of mitigation, monitoring and contingency measures

The following section discusses the effectiveness of the initial mitigation measures and provides detail of additional mitigation measures required to reduce noise and vibration impacts.

13.1 Construction noise and vibration

The following section provides discussion on potential noise and vibration impacts due to the construction of the project.

13.1.1 Work during EPA Victoria normal working hours

The project will reduce construction noise as far as is reasonably practicable at all times. This intention has been captured in the application of the practices included within the initial mitigation measures listed in **ONV-M001**.

Residents will also have access to information about the construction staging (**ONV-M001 and SOC-M003**) and be able to contact the project if their individual circumstances mean that they are more sensitive to noise during EPA Victoria normal working hours.

Additional mitigation is recommended to reduce noise in the vicinity of the cable system batching areas (**ONV-M004**).

13.1.2 Work outside of EPA Victoria normal working hours

At present it is anticipated that avoidable works will not be required to occur outside of EPA Victoria normal working hours. Where it can be justified that it is not reasonably practicable to constrain the works to normal hours then, works or activities outside normal working hours may occur. It is noted that works undertaken outside of normal working hours are also required to be justified on the basis of being “low impact”, “managed impact” or unavoidable works. Avoidable works at night are not anticipated to be required.

Therefore, additional mitigation measures, which will be applied wherever reasonably practicable have been discussed in **ONV-M002** should works outside of EPA Victoria normal working hours be identified as a requirement as the design development progresses.

It will be important that the general good practice techniques included within **ONV-M001** are observed at all times. The community will also be provided with information about the duration and intensity of works prior to commencing (**ONV-M001 and SOC-M003**) and have a complaints management system available so that the project can be contacted when disturbance is unacceptable.

Accordingly, off site noise management measures will be adopted to provide residents with works notifications, individual briefings and respite offers that reflect the level of impact, for example, movie tickets.

13.1.3 Unavoidable out-of-hours work – Trenchless crossings

It will be important that the general good practice techniques included within **ONV-M001** are observed during periods of noisy work. The community will also be provided information about the duration and intensity of works prior to commencing (**SOC-M003).**

As a minimum, the mitigation measures prescribed in **ONV-M001** and **ONV-M002** will be employed.

In addition, it is recommended that noise monitoring be undertaken at sensitive receptors in the vicinity at the start of any new activity for the purposes of assessing the scope of the noise mitigation in use and any improvements that could reasonably be made, or following a complaint (**ONV-M008**).

13.1.4 Unavoidable out-of-hours work – Shore crossing drilling

It is recommended that the mitigation measures outlined in **ONV-M005** are adopted during the shore crossing drilling works, on the basis that they could be required to occur at night.

In addition, it is recommended that noise monitoring be undertaken at sensitive receptors in the vicinity of the shore crossing drilling site at the start of any new activity for the purposes of assessing the scope of the noise mitigation in use and any improvements that could reasonably be made, or following a complaint (**ONV-M008**).

Specific consultation will be carried out with Parks Victoria and relevant user groups for Reeves Beach Campground.

13.1.5 Unavoidable out-of-hours work – Offshore and nearshore works

Significant uncertainty remains when making predictions of offshore noise over large distances where variance in wind speed, win direction and atmospheric stability have the greatest impact on the propagation of sound. To address this, it is advisable to monitor noise from offshore piling during construction. Given that piling only occurs when weather conditions permit, and variations in weather conditions and seabed geology can result in very different onshore noise levels, it can be difficult for a short-term survey to capture typical piling noise levels. As such, mitigation at source in combination with long-term monitoring is recommended for the offshore piling works, as provided in **ONV-M006** and **ONV-M008**.

In addition, the current state of the art with respect to the piling method will be reviewed as the design progresses. This may lead to a quieter construction method being selected

The final equipment has not been selected at this stage. However, noise reduction measures (which have not been included in the noise modelling at this stage) for the offshore piling equipment could include:

- A hydraulic cushion positioned between pile driving hammer and sleeve, which damps the impact and noise. The volume in the cushion can be filled with water which controls the impact characteristic reducing noise at the source. The expected reduction in airborne noise is up to 10dB.
- An enclosure at the point of impact and bellows around the pile as shown in Figure 13-1. The expected reduction in airborne noise is up to 15dB.

Figure 13-1 Example noise reduction bellows (www.ihciqip.com)

13.1.6 Ground vibration

The nearest structures to the cable construction are within the human response and structural damage safe working distance for the largest expected item of vibration generating plant (19t vibratory roller). Therefore, additional mitigation will be required in certain locations as captured in **ONV-M003**.

13.2 Operational noise and vibration

Recommended noise mitigation measures have been incorporated into the batching plant noise model to show that compliance with the Noise Protocol Limits is possible (**ONV-M004**) and Section 13.4 provides a detailed commentary as to other noise mitigation measures that have been considered.

Mitigations measures for the offshore components have not been proposed or modelled at this time (refer Section 13.6.4).

It is recommended that commissioning measurements (**ONV-M009**) of both permanent onshore (if any) and offshore noise sources be undertaken and further mitigation be applied, if required.

13.3 Decommissioning noise and vibration

Noise from the decommissioning works is expected to be adequately managed by the application of standard noise controls (**ONV-M001**) and a decommissioning noise and vibration noise management plan will be developed once the approach to decommissioning is confirmed. Should mitigation measures specific to decommissioning be identified, these will be designed, documented and implemented as soon as is reasonably practicable in accordance with this plan.

The application of additional noise management measures (**ONV-M002**) will be implemented to address impacts, if required.

a decommissioning noise and vibration noise management will plan be developed in due time, that will assess whether mitigation measures specific to decommissioning are likely to be needed, these will then be designed, documented and implemented as soon as reasonably practicable.

13.4 Mitigation measures

The mitigation measures that are proposed to avoid, mitigate or manage noise and vibration impacts associated with the project are summarised in Table 13-1. In addition to the proposed mitigation measures, additional controls were considered and assessed for practicability. An assessment of practicability on additional control measures not adopted for the project is included in Section 13.6.

Table 13-1 Mitigation measures

ID	Mitigation measures	Work area	Phase
ONV-M001	**Managing noise and vibration from construction activities** Construction noise will be managed in accordance with EPA Victoria Publication 1834.2. This includes the development of a Construction Noise and Vibration Management Plan (CNVMP) to ensure, across all stages of the project, the relevant considerations and assessments will be made to ensure that noise (including from construction traffic) and vibration impacts will be minimised as far as reasonably practicable, consistent with the General Environment Duty (in accordance with Section 6(1) of the EP Act). These measures are to be implemented pro-actively, wherever it is reasonably practicable to do so, and are not to be contingent on predicted exceedances of nominated criteria. Prior to commencement of project works, develop a CNVMP that complies with the Environment Protection Act 2017 and subordinate legislation, including the general environmental duty, and with reference to the Civil construction, building and demolition guide (EPA Publication 1834.2, as amended from time to time) and Construction – guide to preventing harm to people and the environment (EPA Publication 1820.1, as amended from time to time). The CNVMP must be informed by noise and vibration modelling of Project works. The CNVMP must include: • Identification of noise and vibration sensitive receivers, including consideration of sensitive receivers that may be more sensitive during Normal Working Hours such as shift workers or agricultural operations or community events that are more sensitive at specific time of year. • Unattended noise monitoring, undertaken no more than six months prior to construction commencing, at the nearest noise sensitive area for a period of not less than seven days. Noise monitoring will be undertaken by a qualified acoustic consultant • Details of the measured period background levels to include the lowest period average, the highest period average and comment on the variability of the background level across the noise survey. • Construction noise and vibration reference levels and criteria derived using the background at the time of impact. Any applicable criteria shall be set using the lowest	All	Construction

ID	Mitigation measures	Work area	Phase
	period average taken during the survey. In other words, if the survey collected data over several days (i.e. several day ($L_{A90,\ 11hr}$), evening (integrating period depends on the day) and night ($L_{A90,\ 9hr}$) period averages), then select the lowest period average for the purposes of setting the criteria • Details of relevant construction activities and an indicative schedule for construction works, including identification of the activities that have the potential to generate noise and/or vibration impacts at sensitive receivers. • A noise and vibration risk assessment for the operation of laydown areas • Batching locations are to be assessed against EPA Publication 1826.5, as amended from time to time. • How the risks of construction noise and vibration will be minimised as far as is reasonably practicable at all times. • Consideration of low frequency noise • Consideration of the Environment Reference Standard • A program for monitoring and inspections to: - Validate construction noise and vibration predictions. - Assess the effectiveness of management measures - Assess whether noise and vibration levels are being minimised so far as reasonably practicable - Verify the noise predictions for Unavoidable Works and Managed-Impact Works. - The general traffic management measures taken from Section 4.3.1 of EPA Victoria Publication 1834.2 - Offsite mitigation will be considered, where appropriate, in accordance with Section 4.3.5 of EPA Victoria Publication 1834.2 - The general communication steps taken from Section 4.3.2 of EPA Victoria Publication 1834.2 - The general good practice techniques taken from Section 4.3.3 of EPA Victoria Publication 1834.2 • Processes for reviewing and updating the modelling, plan and implemented controls in response to Project changes, changes to conditions, monitoring results or enquiries/complaints. • A process for unavoidable works, including: - Identification of unavoidable works that would be undertaken, including their location, timing and duration		

ID	Mitigation measures	Work area	Phase
	- A clear rationale for defining works as being unavoidable works, including a justification as to why it is not reasonably practicable to undertake them during normal working hours - Response strategies to mitigate the impacts of unavoidable works, consistent with EPA Publication 1834.2 (as amended from time to time). • A process for consideration of avoidable works outside of normal working hours: - These should be avoided unless a clear justification is provided as to why it is not reasonably practicable to undertake them during normal working hours. A typical justification could be safety or environment related but must not be due to the schedule or the budget. - Where these works are justified, the activities must adhere to the definitions of “Low Impact” or “Managed Impact” works consistent with EPA Publication 1834.2 (as amended from time to time). - Unless a construction delivery is justified to be unavoidable (per the definition provided in EPA 1834.2), deliveries will not be scheduled to arrive on site outside of EPA 1834.2 normal working hours. - If a delivery is delayed for any reason (for example traffic, breakdown or accident) such that it arrives at site outside of normal working hours then this will be noted in a log, along with the reason for the delay. The log will be reviewed at regular intervals to establish whether or not the current scheduling process is adequate to avoid deliveries arriving out of hours. The CNVMP must be a sub plan to the CEMP and implemented during construction. Specific consultation will be carried out with: • Parks Victoria and relevant user groups for Reeves Beach Campground and Natural Areas in the vicinity of the project. • Noise sensitive receptors within 1500 metres of the static cable system work sites (batching locations). • Noise sensitive receptors within 500 metres of a new or existing access track. • Noise sensitive receptors on the coast that could potentially be impacted by the offshore piling sections that are anticipated to generate higher levels of noise, such as sections containing adverse seabed geology. All employees, contractors and subcontractors are to receive an environmental induction.		

ID	Mitigation measures	Work area	Phase
	The induction will include: • All relevant project specific and standard noise mitigation measures. • Relevant licence and approval conditions. • Permissible hours of work. • Any limitations on noise generating activities with special audible characteristics. • Location of nearest sensitive receptors. • Construction employee parking areas. • Designated loading/unloading areas and procedures. • Site opening/closing times (including deliveries). • Environmental incident procedures.		
ONV-M002	**Out of hours construction noise mitigation measures** Where it can be demonstrated that it is not reasonably practicable to carry out the works during normal hours, construction works undertaken outside of EPA Victoria normal working hours, will implement all reasonably practicable mitigation measures to minimise the impact on nearby receptors, including the following: • Adopting engineering noise controls at the source (e.g. silencer, mufflers, enclosures) by the best reasonably practicable means • Installing on site barriers such as hoardings or temporary enclosures to provide a noise barrier between any particularly noisy construction works and the residences • Limiting works in proximity to receptors to the arrival of staff on site and toolbox meetings between 6 am and 7 am. The use of loud equipment, generation of unnecessary noise and the movement of vehicles on the construction footprint will be minimised, where reasonably practicable. • Provide respite offers that reflect the level of impact, and which are consistent with the projects community engagement commitments, for example, provision of movie tickets. It is noted that works undertaken outside of normal working hours are required to be justified and be managed on the basis of being “low impact”, “managed impact” or “unavoidable works” (as defined in EPA Publication 1834.2). **Avoidable works**	Shore crossing and onshore cable system works, if required	Construction

ID	Mitigation measures	Work area	Phase
	For avoidable works during the evening or weekend periods, the construction noise risks will be assessed based on the variation in the measured background level (dB $L_{A90,\ 1hr}$) during the relevant period(s). For avoidable works during the night, the construction noise risks will be assessed based on the lowest measured background level (dB $L_{A90,\ 1hr}$) during the night. Unavoidable works will be identified and managed as either planned or unplanned activities. **Planned Unavoidable works** All unavoidable works that are planned for will be detailed in the Construction Environment Management Plan (CEMP), which will be reviewed and approved by a qualified specialist in advance of the project commencing. **Unplanned Unavoidable or Unplanned out of hours works** A list or rationale as to what defines acceptable unplanned unavoidable or unplanned out of hours work will be contained within the CEMP. The rationale will include the requirements for such works to occur and the required measures that will be considered to ensure the impacts will be effectively managed. This will include the requirement for the preparation of a construction noise and vibration management plan for unplanned out-of-hours works. A qualified specialist, with skills and expertise in health, safety and the environment as relevant, will be appointed to review all planned and unplanned night work (10:00 pm to 7:00 am) activities to ensure that the works have been reviewed and justified in accordance with Section 4.4 of EPA 1834, that all reasonably practicable work practices have been considered, and that community engagement has been undertaken.		

ID	Mitigation measures	Work area	Phase
ONV-M003	**Vibration safe working distances** The project will reduce construction vibration as far as is reasonably practicable to avoid unnecessary noise impacts upon sensitive receptors in accordance with the EPA Victoria Publication 1834.2 and the General Environment Duty. Additional management measures will be implemented where occupancies, structures and assets are within the safe working distances derived using the values in the following standards: • British Standard BS 6472-1:2008: Table 1 – *Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings* • German Standard DIN4150-3:2016-12: Table 1 – *Guideline values for vibration velocity for evaluating the effects of short-term vibration on structures* • German Standard DIN4150-3:2016-12: Table 3 – *Guideline values for vibration velocity for evaluating the effects of short-term vibration on buried pipework* • An asset owner's utility standards in consultation with the asset owners.	Shore crossing and onshore cable system works	Construction
ONV-M004	**Transmission system construction – batch locations – noise control** Adoption of noise reduction measures to be installed to the batching plant locations as follows: • A noise barrier will be installed to the site boundary at a height of 2.4 metres or 500 mm greater than the highest point on a static noise source within the site, whichever is the higher. • Any access gates will be solid and generally kept closed. • Where reasonably practicable, installation of enclosures or localised noise barriers around static equipment to provide a noise barrier between any particularly noisy construction works and the residences. • Adopting engineering noise controls for ancillary equipment (e.g. silencer, mufflers, enclosures) by all reasonably practicable means. • Where reasonably practicable, the quietest available equipment should be selected. The impacts and the design of site-specific mitigation will be determined prior to construction works via noise modelling and confirmed during construction via on site monitoring.	Batch locations	Construction

ID	Mitigation measures	Work area	Phase
ONV-M005	**Unavoidable works - Shore crossing drilling – noise control** Adoption of noise reduction measures to be installed adjacent to the shore crossing site as follows: • A noise barrier will be installed to the site boundary at a height of 2.4 metres. • Any access gates will be solid and generally kept closed, especially at night. • Where reasonably practicable, installation of enclosures or localised noise barriers around the shore crossing drilling equipment to provide a noise barrier between any particularly noisy construction works and the residences. • Adopting engineering noise controls for ancillary equipment (e.g. silencer, mufflers, enclosures) by all practical means using current technology. • Where reasonably practicable, the quietest available equipment or process should be selected. • Where reasonably practicable, stationary equipment such as bentonite treatment, generators and pumps will be stored within shipping containers or suitable acoustic enclosures. The impacts and the design of site-specific mitigation will be determined prior to construction works via noise modelling and confirmed during construction via on site monitoring. A qualified specialist, with skills and expertise in health, safety and the environment as relevant, will be appointed to review all planned and unplanned night work (10:00 pm to 7:00 am) activities to ensure that the works have been reviewed and justified in accordance with Section 4.4 of EPA 1834, that all reasonably practicable work practices have been considered, and that community engagement has been undertaken. All planned unavoidable works will be detailed in the CEMP described in ONV-M002.	Shore crossing drilling site	Construction
ONV-M006	**Unavoidable works - Offshore piling – noise control** Noting that the final equipment has not been selected at this stage, there will be continual review of the project state of knowledge, to ensure that best available technology will be used when construction occurs. This will include the relevant considerations and assessments to ensure that noise and vibration impacts will be minimised so far as reasonably practicable, consistent with the General Environment Duty. All planned unavoidable works will be detailed in the CEMP described in ONV-M002.	Offshore piling	Construction

ID	Mitigation measures	Work area	Phase
ONV-M007	**Pre-construction noise assessment** As required by VPP clause 52.32-4, the proponent will provide a pre-construction (predictive) noise assessment report prepared by a suitably qualified and experienced acoustician that: • Reports on a pre-construction (predictive) noise assessment conducted in accordance with *New Zealand Standard NZS6808:2010, Acoustics - Wind Farm Noise*. • Provides an assessment of whether the proposed wind energy facility will comply with the noise limit for that facility under Division 5 Part 5.3 of the *Environment Protection Regulations 2021*. • Is prepared on the basis that the relevant noise standard under Division 5 of Part 5.3 of the *Environment Protection Regulations 2021* will be *New Zealand Standard NZS6808:2010, Acoustics - Wind Farm Noise* and includes an assessment of whether a high amenity noise limit is applicable under Section 5.3 of the standard.	Offshore infrastructure	Planning
ONV-M010	**Decommissioning Environmental Management Plan - noise impacts** A decommissioning environmental management plan that includes noise and vibration impacts will be developed in due time. Should mitigation measures specific to decommissioning be identified, these will be designed, documented and implemented as soon as is reasonably practicable. The general principles provided in **ONV-M001**, **ONV-M002** and **ONV-M003** will be adopted for the decommissioning stage.	All	Decommissioning

13.5 Monitoring and contingency measures

The monitoring and contingency measures that are proposed to assess noise and vibration impacts associated with the project are summarised in Table 13-2.

Table 13-2 Monitoring and contingency measures

ID	Monitoring and contingency measures	Work area	Phase
ONV-M008	**Noise and vibration monitoring** Attended noise and vibration monitoring will be undertaken during construction at the start of any new activity with the potential to produce perceptible noise and vibration at sensitive receiver for the purposes of assessing the scope of the noise mitigation in use or following a complaint, as defined in the construction environment management plan: • The nearest noise sensitive residential property or properties impacted by out-of-hours works to confirm the effective implementation of noise mitigation measures (subject to landholder approval). • The nearest building or assets that are within derived set back distances for structural damage or in response to a complaint (subject to landholder approval). • Where an asset owner’s utility standards are at risk of being exceeded. It should be noted that monitoring should not be limited to verifying compliance with regulations and/or nominated criteria (if relevant); it should also be used pro-actively to validate the effectiveness of mitigation measures and to inform continual improvement. Where reasonably practicable, unattended noise monitors will be installed for the duration of the shore crossing drilling and offshore piling at the nearest affected residences (subject to landholder approval). The scope of the unattended monitoring will be determined by a suitably qualified acoustic consultant in consultation with the relevant authority for noise and vibration regulations at the time of works A response framework will be developed to manage potential impacts if nominated criteria are exceeded, including: • Actions taken to rectify the exceedance • Actions to minimise risk of reoccurrence • Name of person(s) responsible for undertaking the required actions. The duration of the attended monitoring will be determined by a suitably qualified acoustic consultant in consultation with the relevant authority for noise and vibration regulations at the time of works.	Batching locations Shore crossing site All offshore piling works.	Construction

ID	Monitoring and contingency measures	Work area	Phase
ONV-M009	**Offshore commissioning measurements** Implement wind turbine operational noise requirements,generally in accordance with the Environment Protection Regulations (Division 5 of Part 5.3), including: • Ongoing compliance with the relevant noise standard - New Zealand Noise Standard NZS 6808 2010 where applicable to an offshore wind farm or other relevant standard if NZS 6808 2010 is updated or replaced. • Implementation of a noise management framework, including a complaints management plan. • Completing a post-construction noise assessment within 12 months of commencement of operations. • Conducting noise monitoring every five years from commencement of operation.. Background noise measurements will be undertaken at a range of representative locations in order to enable post-construction compliance measurements to be carried out in accordance with Section 7 of the Standard. Wind turbines will be properly maintained by the wind farm operator to ensure that the noise emission is not adversely affected by turbine wear, resulting in audible tonality. Compliance testing will be undertaken once all noise sources associated with the project are in operating mode, i.e. all turbines have been commissioned and are operating correctly. It is noted that there may be difficulty in measuring wind turbine noise in the way that NZS 6808:2010 envisages. A compliance noise monitoring methodology will be developed by a suitably qualified acoustic consultant that recognises the characteristics of a large-scale offshore wind farm.	Offshore operations	Operation
ONV-M011	**Decommissioning review and establishment of noise framework** A review of decommissioning activities will be conducted by the end of life of the project to plan decommissioning and establish the framework to manage noise impacts. It is expected that the general principles provided in **ONV-M010** and **ONV-M008** will be adopted for the decommissioning stage.	All	Decommissioning

13.6 Assessment of Reasonably Practicable mitigation measures

Additional noise mitigation measures have been considered and assessed in the following sections in order to demonstrate that the mitigation measures provided in Sections 13.4 and 13.5 represent the limit of measures that are considered to be reasonably practicable for the project.

13.6.1 Construction – Onshore

Mobile work sites

The construction methodology, and other parameters, are yet to be defined, or confirmed, and may be subject to evolution across the further stages of the project.

Therefore, a framework will be developed to ensure, across all stages of the transmission system construction, relevant considerations and assessments will be made to ensure that noise and vibration impacts will be minimised so far as reasonably practicable, consistent with the GED.

These measures are to be implemented pro-actively, wherever it is reasonably practicable to do so, and are not to be contingent on predicted exceedances of nominated criteria.

Nevertheless, mitigation of mobile work sites at source, for example solid noise barriers adjacent, is not practicable because the major equipment items required are relatively large. This means that, in order to be effective, temporary noise barriers, for example, would become too heavy to move by hand, thus introducing an unnecessary additional noise source in the form of a crane or telehandler.

Therefore, a key consideration for this activity will be minimizing harm by consulting with the community and responding as necessary, as captured in **ONV-M001**.

Static work sites

Additional mitigation has been proposed for all the long-term static onshore construction sites (Shore crossing site) in **ONV-M005**. It is considered that the mitigation measures described herein are the limit of what is achievable in terms of airborne noise reduction for these activities.

Additional mitigation is not proposed for the trenchless crossings due to their duration and the low number of receptors in the vicinity. Therefore, a key consideration for this activity will be minimizing harm through consulting with the community and responding as necessary, as captured in **ONV-M001**.

Access routes

Mitigation of access routes at source, for example noise barriers adjacent, is not practicable for a number of reasons. Therefore, the only options are to carefully consider the schedule of traffic movements and to consult with the community and respond as necessary, as captured in **ONV-M001**.

Off site mitigation will be considered, where appropriate, in accordance with Section 4.3.5 of EPA Victoria Publication 1834.2 (**ONV-M001**).

13.6.2 Construction – Onshore – batching locations

All modelled scenarios are predicted to comply with the Noise Protocol under normal operation at all receptors.

Initial mitigation measures incorporated into the design at the time of the assessment have been identified where relevant. Additional mitigation measures would only be recommended where the initial controls do not adequately manage the risk of an impact.

In addition, the guidance provided in EPA Victoria Publication 1856 has been used to define whether or not additional mitigation measures are reasonably practicable, as described in Table 13-3.

Table 13-3 Onshore operational noise mitigation measures – Assessment of practicability

Mitigation measure	Location	Factor to consider (EPA Victoria Publication 1856)	Commentary on practicability	Effectiveness	Adopted?
Quieter equipment	Batching sites	Elimination	Not possible	High. The input noise levels used in the assessment are based on typical equipment selections. It could be that lower noise equipment is available with little additional cost. In which case, these items would be considered.	To be considered wherever reasonably practicable.
		Likelihood	Low. Noise levels are predicted to be in compliance with the relevant limit based on the input noise levels presented herein.		
		Degree / Consequence	Low. Noise levels are predicted to be in compliance with the relevant limit based on the input noise levels presented herein.		
		Knowledge	High		
		Availability	High		
		Cost	Moderate		
Noise barriers around the site perimeter	Batching sites	Elimination	Not possible	Moderate. The distance between the sites and the nearest receptors is generally large, in noise terms. A noise barrier around the site will provide useful screening for the majority of activities on the site.	Yes
		Likelihood	Moderate		
		Degree / Consequence	Moderate		
		Knowledge	High		
		Availability	High		
		Cost	High		
		Elimination	Not possible		No.

Mitigation measure	Location	Factor to consider (EPA Victoria Publication 1856)	Commentary on practicability	Effectiveness	Adopted?
Enclosures around individual items of equipment	Batching sites	Likelihood	Low. Noise levels are predicted to be in compliance with the relevant limit without the inclusion of enclosures.	Low. There are no elevated receptors in the vicinity. Therefore, there is no justification for enclosing (i.e. putting a roof on) the equipment.	
		Degree / Consequence	Low. Noise levels are predicted to be in compliance with the relevant limit without the inclusion of enclosures.		
		Knowledge	High		
		Availability	High		
		Cost	Moderate		
Shed over the site	Batching sites	Elimination	Not possible	Low. There are no elevated receptors in the vicinity. Therefore, there is no justification for enclosing (i.e. putting a roof on) the equipment. In addition, the cost of constructing a shed over the sites is considered to be prohibitive.	No.
		Likelihood	Low. Noise levels are predicted to be in compliance with the relevant limit without the inclusion of a shed over the site.		
		Degree / Consequence	Low. Noise levels are predicted to be in compliance with the relevant limit without the inclusion of enclosures.		

Mitigation measure	Location	Factor to consider (EPA Victoria Publication 1856)	Commentary on practicability	Effectiveness	Adopted?
		Knowledge	High		
		Availability	High		
		Cost	Very high		
Site orientation	Batching sites	Elimination	Not possible	Low. The distance between the batching locations and the nearest receptors is high compared to the space available within the site footprint. Therefore, altering the layouts to reduce noise would not lead to an appreciable reduction at the receptors. Nevertheless, the design does attempt to place the noisiest equipment as close to the perimeter fence as practical.	No.
		Likelihood	Low		
		Degree / Consequence	Low		
		Knowledge	High		
		Availability	High		
		Cost	High		
Site location	Batching sites	Elimination	Not possible	Potentially high. However, the location of the batching sites is dictated by factors other than noise.	No.
		Likelihood	Low		
		Degree / Consequence	Low		
		Knowledge	High		
		Availability	Low		
		Cost	Very high		

13.6.3 Construction – Offshore and nearshore

The major source of noise due to the offshore and nearshore construction is the piling for the wind turbine and offshore substations. Available mitigation options are limited at the time of writing since the specific equipment is yet to be selected.

The most common method of installing driven piles is to use a hydraulic hammer. Impact piling is presented herein, however alternative piling methods such as vibro-piling, may also be considered as technologies that reduce the source level of underwater noise.

These technologies are relatively new to the market and the suitability of such technologies will be informed by pre-construction surveys and detailed design post approval.

The selection of the foundations is guided by considerations other than noise and therefore, alternative methods of foundation construction have not been considered further. Nevertheless, the current state of the art with respect to the piling method will be reviewed as the design progresses. This may lead to a quieter method being selected.

Each foundation type (small or large) needs a specific hammer size in order to provide sufficient force, therefore the scope for selecting a quieter piece of equipment is limited by the size of the piles. Nevertheless, if in the future there are multiple providers of this type of equipment then the project will account for noise in the selection of the hammer procured.

Other mitigation strategies are described in the literature, such as bubble curtains, cofferdams and the pipe-in-pipe method. It should be noted however that the primary purpose of these approaches is to reduce noise transfer to the water as opposed to the air.

It is considered likely that the mitigation measures described herein are the limit of what is achievable in terms of airborne noise reduction for these activities given size of the turbines and the installation method proposed. Further measures will be investigated at detailed design phase.

13.6.4 Operation – Offshore

There are additional mitigations to offshore noise regarding adding additional blade equipment, however, the primary available mitigation would be to deactivate or reduce the power-generating capability of individual turbines.

Therefore, reference is made to an investigation into the economics of wind farm noise mitigation by power limitation, which was presented to the International Congress on Acoustics (ICA) in 2010.

The study found that:

> *The noise setting has an influence on the power curves only in the partial load area (wind speed between cut-in wind speed and rated wind speed). If the turbine is operated with a lower noise demand, the rotor rpm is reduced and the pitch angle is increased. Together with the noise reduction, also the aerodynamic efficiency decreases; this leads to a lower power curve and an increase of the rated wind speed.*

And:

> *For example, with a wind speed of 12 m/s, the wind turbine output is equal to 759 kW in 104 dB(A) configuration and equal to 688 kW in 100 dB(A) configuration. The percentage reduction in electric power is thus equal to 9 per cent.*

Given that any power reduction would have to be applied to a large number of turbines in order to realise a meaningful reduction in noise due to the significant distance to the receptors, careful consideration of the economic impact of this approach will be required.

This is beyond the scope of this report.

In addition, the assessment detailed herein has been carried out with the best available data at the time of writing and it is not appropriate to provide specific additional mitigation measures at this time. More information, such as measured noise levels, will be required to be considered at detailed design phase.

Nevertheless, the requirement for ongoing noise measurements does allow for the management of offshore operational noise from the project in accordance with the *Environment Protection Regulations*.

14.0 Summary of implications under relevant legislation

This study has assessed the impacts and risks of construction, operation and decommissioning of the project on assets and values to be protected.

The significance of the impacts and risks has been assessed in accordance with the evaluation framework, based on applicable legislation, policy and standards and the evaluation objectives and environmental significance guidelines arising from the government terms of reference established to guide the assessments.

The following sections summarise these identified impacts and risks under the relevant Commonwealth and Victorian legislation.

14.1 Victorian

In relation to the evaluation objectives set out in the project EES scoping requirements under the *Environment Effects Act 1978*, the project will not produce significant noise and vibration for the following reasons:

- The assessment of potential noise and vibration demonstrates that the operational phase of the project will not result in ongoing or widespread adverse noise and vibration with noise levels being in accordance with the Noise Protocol and the *Environment Protection Amendment (Wind Turbine Noise) Regulations 2021*.
- All identified operational noise and vibration associated with the project will be reduced as far as reasonably practicable.
- The outcome of the construction noise and vibration assessment indicates that mitigated noise and vibration will be reduced as far as reasonably practicable.
- With the implementation of the recommended mitigation measures, potential noise and vibration will be minimised during construction and decommissioning activities.

14.2 Commonwealth

There is no applicable Commonwealth legislation as this technical report assesses the potential for the noise generated by the offshore wind farm (during construction, operation and decommissioning) to impact receptors onshore. Therefore, only Victorian legislation applies to this assessment

15.0 Conclusion

The purpose of this report is to assess potential noise and vibration impacts and risks associated with Star of the South Offshore Wind Farm to inform the preparation of the EIS/EES required for the project.

A summary of the key assets, values or uses potentially affected by the project, and an associated assessment of noise and vibration impacts and risks and recommended mitigation measures, are summarised below.

Existing conditions

Monitoring of the existing noise environment throughout the project study area was used to establish background noise levels and develop the criteria.

Night-time background noise levels are typical for rural areas and areas of low residential density. It is noted that there is significant variation in the night-time background noise levels between monitoring locations. This is to be expected when the measured levels are very low (less than 30 dB L_{A90}).This is because, at very low levels of noise, a small change in, for example, wind speed can lead to a change in the measured level that looks to be significant (for example 25 dB L_{A90} versus 30 dB L_{A90}) but should be taken in the context of the very low overall level.

Mitigation and contingency measures

This assessment has identified risks and proportional mitigation measures to address the GED as required under the EP Act. An assessment of practicability on control measures not adopted for the project is included in Section 13.6.

Nevertheless, the mitigation measures detailed herein are intended to form the basis of a framework to ensure, across all stages of the project, relevant considerations and assessments will be made to ensure that noise and vibration impacts will be minimised so far as reasonably practicable, consistent with the GED.

These measures are to be implemented pro-actively, wherever it is reasonably practicable to do so, and are not to be contingent on predicted exceedances of nominated criteria.

Construction noise and vibration impact assessment

On shore construction noise

Construction noise from works that occur during the EPA Victoria normal working hours is not predicted to be significant at nearby sensitive receptors if they are undertaken using good practice construction management techniques.

The construction hours for the works are expected to be 7am – 6pm weekdays, 7am – 1pm Saturdays, unless otherwise stated (e.g. Unavoidable works).

The application of additional noise management measures (**ONV-M002**) will be implemented to address impacts, if works avoidable works outside normal working hours are required.

The highest impact is predicted to occur when the proposed construction working hours are outside of the EPA Victoria normal working hours.

Unavoidable construction works

Unavoidable works associated with the construction of the project include:

- HDD drilling works for the shore crossing
- Trenchless crossings
- Offshore works
- Nearshore works.

Additional mitigation for works outside of EPA normal working hours is defined in **ONV-M002, ONV-M004, ONV-M005** and **ONV-M006.**

Construction vibration

Potential impacts from vibration were assessed using known safe working distances from equipment that cause high levels of vibration. Maintaining these distances would be sufficient during construction to avoid human disturbance and potential damage to vibration sensitive structures.

The nearest structures to the cable construction are within the human response and structural damage safe working distance for the largest expected item of vibration generating plant (19t vibratory roller). Therefore, additional mitigation will be required in certain locations as captured in **ONV-M003**.

Construction traffic

It is considered reasonable to assume that all noise sensitive receptors within 500 metres of a new or existing access track (as opposed to an arterial road, for example) could be impacted.

Therefore, commentary with respect to noise from construction traffic and the ERS objectives is presented in Section 9.10.1.

Batching Plants

The proposed temporary batching plants required during the construction phase are commercial, industrial and trade premises and therefore, their noise has been assessed under Part 5.3, Division 3 of the EP Regulations.

Noise modelling scenarios have been developed to determine where there was the potential for the project noise criteria to be exceeded. This assessment has found that compliance with the noise criteria is expected.

Construction noise mitigation measures

Noise reduction measures (**ONV-M001**) are recommended for all construction works to reduce the impact of construction noise.

The application of additional construction noise management measures (**ONV-M002**) was developed to ensure an acceptable level of amenity to sensitive receptors located adjacent to the project construction areas where standard controls are not sufficient.

The impacts and the design of site-specific mitigation for the batching locations would be further refined prior to construction works via noise modelling and confirmed during construction via on site monitoring to reduce the residual impact as far as is reasonably practicable.

Due to the high predicted impact of shore crossing drilling works and offshore piling works at night on nearby receptors, noise mitigation has been recommended in **ONV-M005** and **ONV-M006.**

Uncertainty remains when making predictions of offshore noise over large distances where variance in wind speed, wind direction and atmospheric stability have the greatest impact on the propagation of sound. To address this, it is advisable to monitor noise from offshore piling during construction. Given that piling only occurs when weather conditions permit, and variations in weather conditions and seabed geology can result in very different onshore noise levels, it can be difficult for a short-term survey to capture typical piling noise levels. As such, mitigation at source in combination with long-term monitoring is recommended for the offshore piling works, as provided in **ONV-M006** and **ONV-M008**.

In addition, it is recommended that monitoring be undertaken at noise sensitive receptors in the vicinity of the shore crossing drilling site (**ONV-M008**).

Residents will be consulted about the project prior to the commencement of particularly high intensity activities, with the highest consideration given to those that are predicted to be most affected as a result of the construction activities.

Operational noise and vibration impact assessment

The underground cable system and shore crossing are not expected to generate any noise. There are no other onshore operational components associated with the project.

An onshore substation is required to connect the Wind Farm to the national electricity market. The VicGrid connection hub will include provision for approach cable easements, substations and associated infrastructure required to connect any approved wind farms in Bass Strait to the national electricity market and is subject to a separate assessment and approvals process. The VicGrid connection hub and associated infrastructure are therefore not assessed as a part of this EIS/EES.

Onshore operational noise

The underground cable system and shore crossing are not expected to generate any noise. There are no other permanent onshore operational components associated with the project.

Onshore operational noise mitigation measures

Recommended noise mitigation measures have been incorporated into the operational noise model to show that compliance with the Noise Protocol Limits is possible**,** and Section 13.4 provides a detailed commentary as to other noise mitigation measures that have been considered. Monitoring and contingency measures are provided in Section 13.5.

It is recommended that commissioning measurements (**ONV-M009**) be undertaken, and further mitigation be applied, if required.

Offshore operational noise

No exceedances of the high amenity area limit or the base noise limit of 40 dB $L_{A90,}$ are predicted across all hub height wind speeds.

Therefore, as exceedances of the base noise limit are not predicted, background noise monitoring would not need to be carried out to determine site specific wind farm noise limits.

The potential for human disturbance because of noise generated by the operation of the offshore substations is considered to be very low. Accordingly, operational noise from the offshore substations has not been assessed.

Offshore operational noise mitigation measures

No permanent offshore operational noise mitigation is proposed at this time. The completion of a post-construction noise assessment within 12 months of commencement of operations (**ONV-M009**) is required by the *Environment Protection Amendment (Wind Turbine Noise) Regulations 2021*, and mitigation will be applied, if required.

Offshore cumulative operational noise

One potential project within the zone of influence of the project, the Great Eastern Offshore Wind Farm has been assessed as Tier 2 . Nevertheless, they were included in the assessment due to their proximity to the Star of the South project.

If both projects are constructed, then it is estimated that this could add up to 5 dB to the predicted operational wind turbine noise levels presented herein. In which case, compliance with the high amenity noise limit of 35 dB L_{A90} would still be expected to be achieved. Mitigation measures may be required if these projects are to operate together. This would be addressed as the design (for each project) progresses.

Operational vibration (onshore and offshore)

The potential for human disturbance because of ground vibration generated by the operation of the project is considered to be very low. This is because:

- The major onshore operational items have no moving parts
- The project components nearest to receptors would be the cable systems, which do not generate any vibration
- The distance between any project source and the nearest receptor is extremely large, in vibration terms.

Accordingly, operational vibration has not been assessed.

Decommissioning noise impact assessment

Noise from the decommissioning works is expected to be adequately managed by the application of standard noise controls (**ONV-M001**).

The application of additional noise management measures (**ONV-M002**) will be implemented to address impacts, if required.

For the purposes of this assessment, it is assumed that decommissioning would be undertaken in line with current standards. However, different standards may be in place, and this will be assessed further at the time.

16.0 References

Legislation

- *Environment Protection Act 1970*.
- *Environment Protection Act 2017, as amended by the Environment Protection Amendment Act 2018*.
- *Environment Protection Amendment Wind Turbine Noise Regulations 2021*
- *Environment Effects Act 1978 (Vic).*
- *Environment Protection and Biodiversity Conservation Act 1999 (Cth).*

Australian Policies and Guidelines

- *Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978*, Victorian Government Department of Sustainability and Environment (June 2006).
- *Civil construction, building and demolition guide,* EPA Victoria Publication 1834.2 (September 2025).
- *Development of Wind Energy Facilities in Victoria, Policy and Planning Guidelines* – Department of Environment, Land, Water and Planning, October 2018
- *Technical guide: Measuring and analysing industry noise and music noise,* EPA Victoria Publication 1997 (June 2021).
- *Noise guideline – assessing low frequency noise,* EPA Victoria Publication 1996 (June 2021).
- *Guide to the Environment Reference Standard,* EPA Victoria Publication 1992 (June 2021).
- *Reasonably practicable,* EPA Victoria Publication 1856 (September 2020).
- *Wind Energy Facility Turbine Noise – a Technical Guideline,* EPA Victoria Publication 3011 (December 2024).
- *Interim Construction Noise Guideline*, Department of Environment and Climate Change NSW, Publication 2009/265 (July 2009).
- Melbourne Metro Rail project – *Residential Impact Mitigation Guidelines for Construction*.

Victorian Regulations

- *Environment Protection Regulations 2021*.
- *General Environmental Duty*
- *The Environment Reference Standard*; May 2021
- *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, EPA Victoria Publication 1826.5 (September 2025).

Australian Standards

- Australian Standard 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*.
- Australian/New Zealand Standard ISO 31000:2009 *Risk Management Process*.

Overseas and International Standards

- New Zealand Standard NZS 6808:2010 – *Acoustics – Wind farm noise*, 2010
- International Standard ISO 9613-2:2024 – *Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors*
- German Standard DIN 4150: Part 3 – *Structural Vibration in Buildings – Effects on Structures* (1999-02).

- British Standards 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting.*
- British Standard 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites* – Part 1: Noise.

Publications

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- *Bies, Hansen & Howard, Engineering Noise Control* (5th Edition) 2018.
- *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* – Institute of Acoustics, UK, May 2013.
- Moorhouse, AT, Waddington, DC and Adams, MD: *Proposed criteria for the assessment of low frequency noise disturbance*, DEFRA (2005).
- Moorhouse, AT, Waddington, DC and Adams, MD: *A procedure for the assessment of low frequency noise complaints*, DEFRA (2009).
- Downey and Parnell, *Assessing low frequency noise from industry – a practical approach*, International Commission on Biological Effects of Noise: Congress on Noise as a Public Health Problem (2017).
- Cotana, Rossi and Filipponi*, Economics on wind farm noise mitigation by power limitation,* Proceedings of 20th International Congress on Acoustics (2010).
- Hansen, Henrys, Hansen, Doolan and Moreau, *Wind farm noise – what is a reasonable limit in rural areas?* Proceedings of Acoustics 2012, Fremantle

Appendix A

Existing Conditions Noise Monitoring

Appendix A Existing Conditions Noise Monitoring

The average measured noise levels by time period are presented at the bottom of each monitoring summary. The methodology for calculating the average, minimum and maximum noise levels for each monitoring location was as follows:

- The average noise level was calculated for each time period (day/evening/night) of the monitoring period and are presented as the minimum average, maximum average and average of the averages in the following summary tables.
- Different averaging times for the assessment periods at the weekend have been considered
- Measurements that were subject to adverse weather conditions have been omitted from the assessment and are highlighted in the graphs
- The background measurements (L_{A90}) were arithmetically averaged whilst the ambient measurements (L_{Aeq}) were logarithmically averaged. Maximum noise levels (L_{Amax}) have not been averaged.

A summary of the measure background levels is presented Table A-1.

Table A-1 Measured background levels

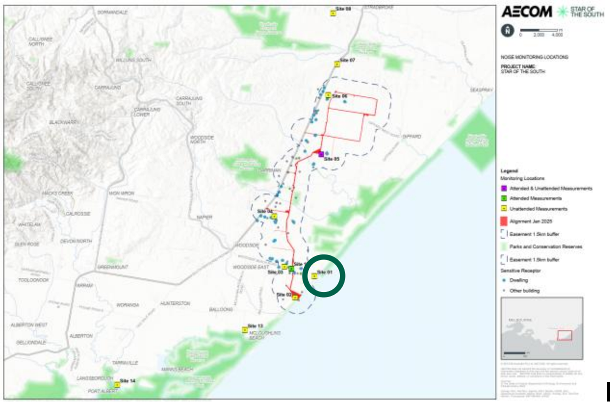
Site	Address	Lowest Average Measured $L_{A90,}$ dB			Lowest Measured $L_{A90, 1 hr}$ dB
		Day	Evening	Night	Night
01	[redacted] Rebecca Street, Woodside Beach, 3874	39	39	37	34
02	Reeves Beach Road, Woodside, 3874	35	42	41	37
03	[redacted] Woodside Beach Road, Woodside, 3874	31	26	25	23
04	[redacted] Dewars Road, Woodside, 3874	30	32	22	18
05	Four Mile Creek Road, Giffard West, 3851	27	24	22	19
06	[redacted] Giffard West Road, Giffard West, 3851	36	30	29	27
07	[redacted] South Gippsland Highway, Giffard West, 3851	30	27	20	17
08	[redacted] Gormandale–Stradbroke Road, Stradbroke, 3851	29	22	22	19
13	[redacted] McLoughlins Road, McLoughlins Beach, 3874	37	35	35	26
14	[redacted] Sarena Parade, Robertsons Beach, 3971	29	27	26	25

Table notes:

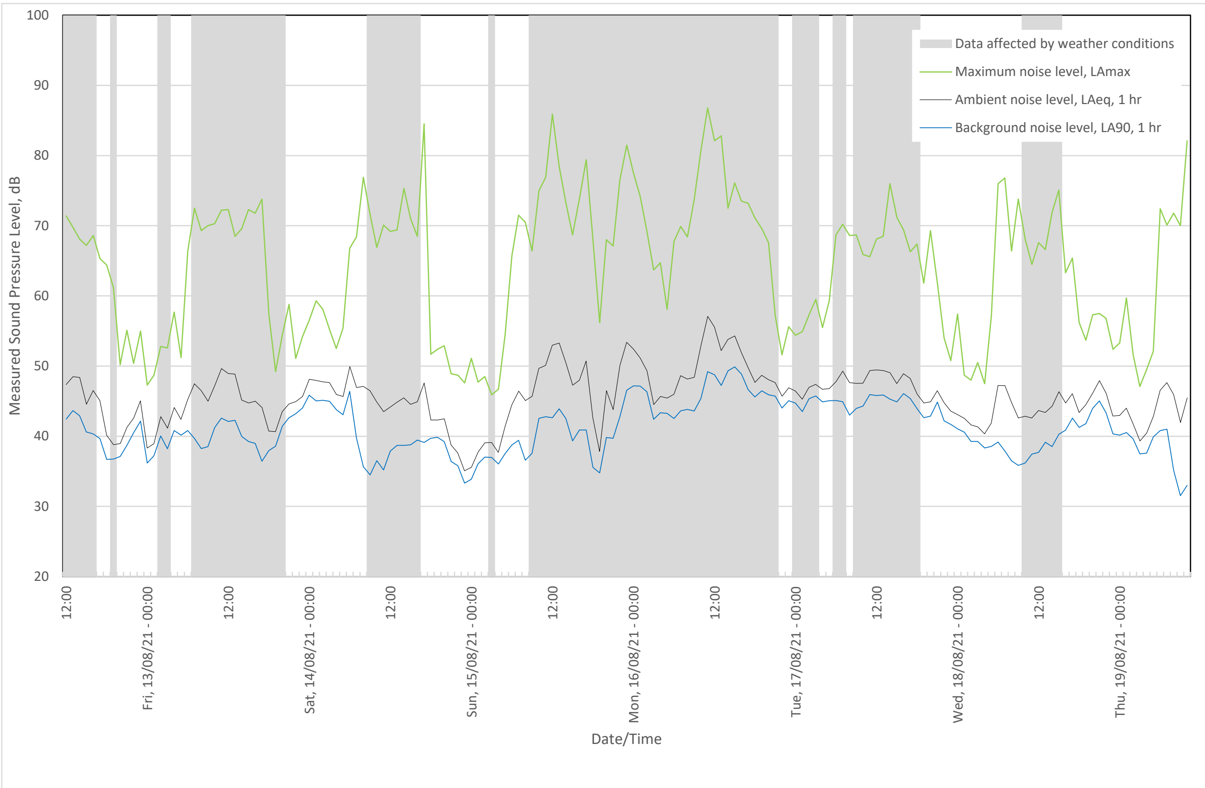
1 Noise levels measured at locations 9,10,11,12, 15 16, 17 and 18 are not reported in this assessment report, due to changes in project scope.

Site 01 – [redacted] Rebecca Street, Woodside Beach, 3874

Noise monitor in-situ



Full monitoring results

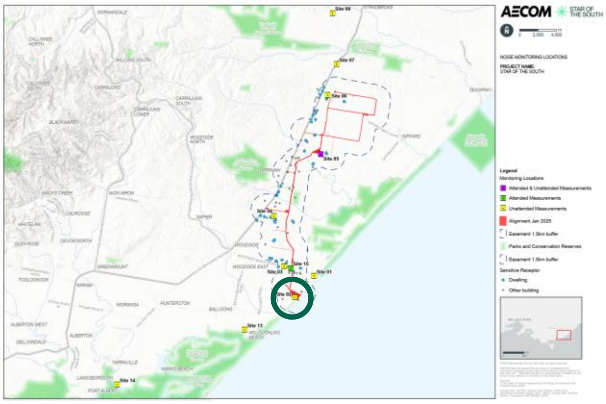


Summary, dB

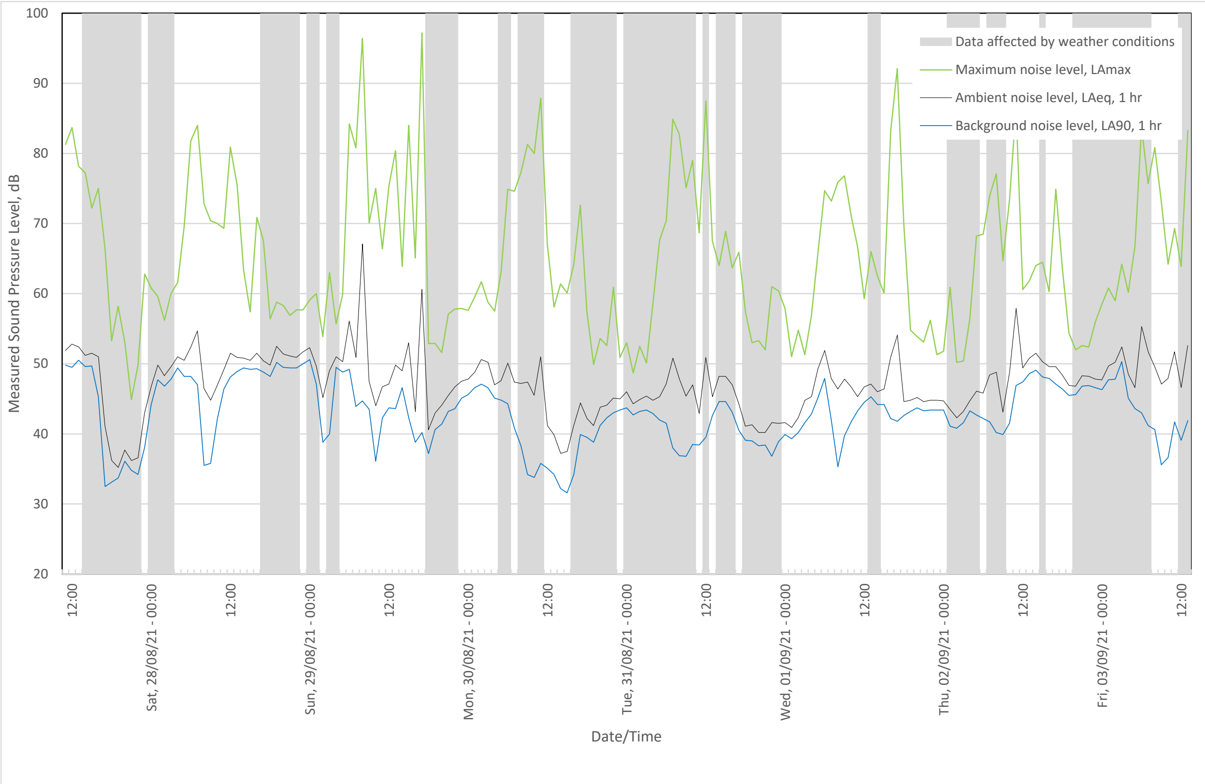
Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	39	39	39	45	45	45	77	77	N/a
Evening	39	43	41	44	46	45	58	85	N/a
Night	37	45	40	40	47	43	66	76	N/a

Site 02 – Reeves Beach Road, Woodside, 3874

Noise monitor in-situ



Full monitoring results

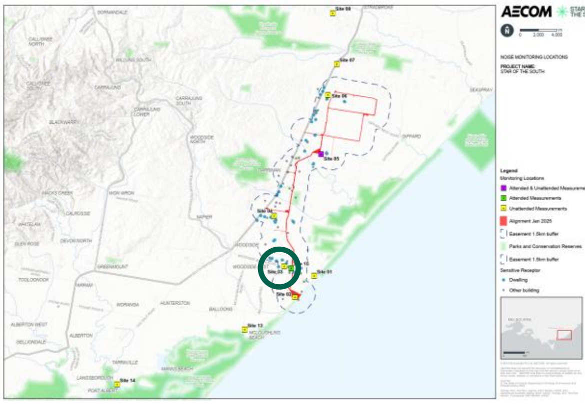


Summary, dB

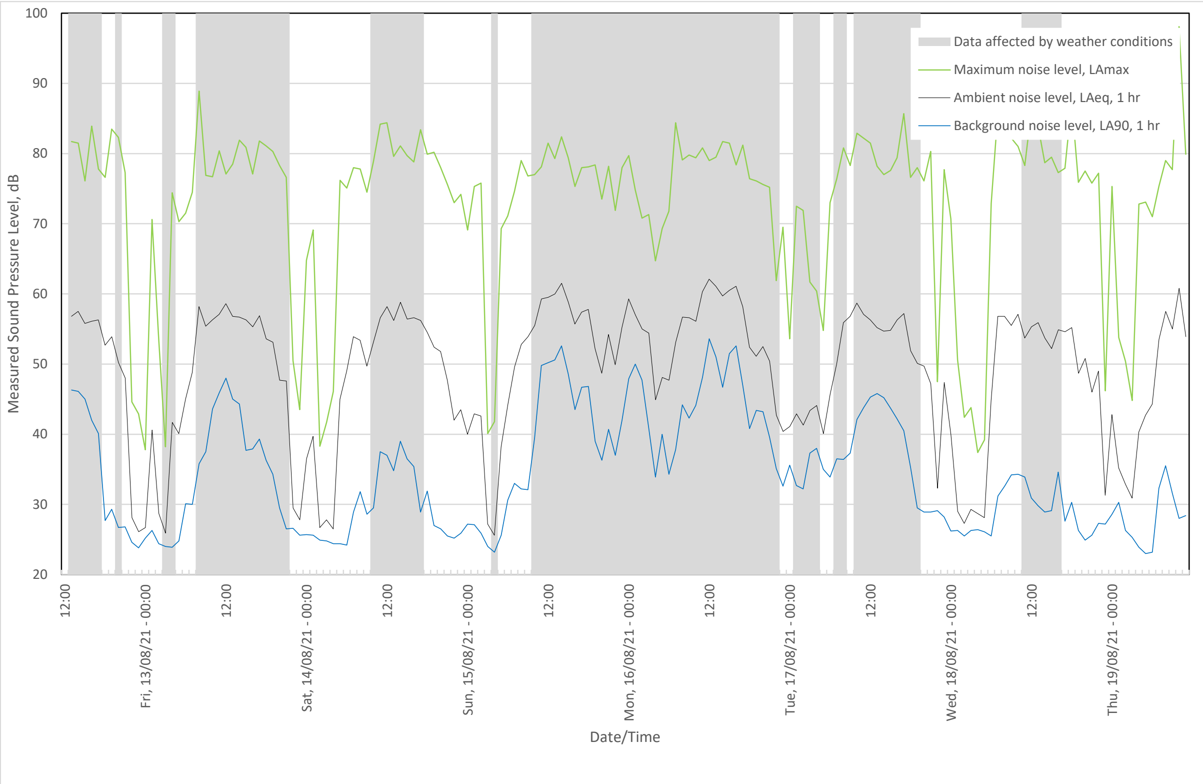
Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	35	45	41	46	51	49	84	92	N/a
Evening	42	49	45	45	57	50	64	97	N/a
Night	41	45	43	46	49	47	75	75	N/a

Site 03 – [redacted] Woodside Beach Road, Woodside, 3874

Noise monitor in-situ



Full monitoring results

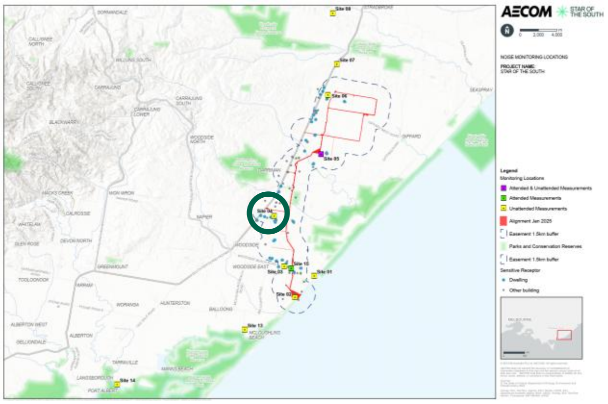


Summary, dB

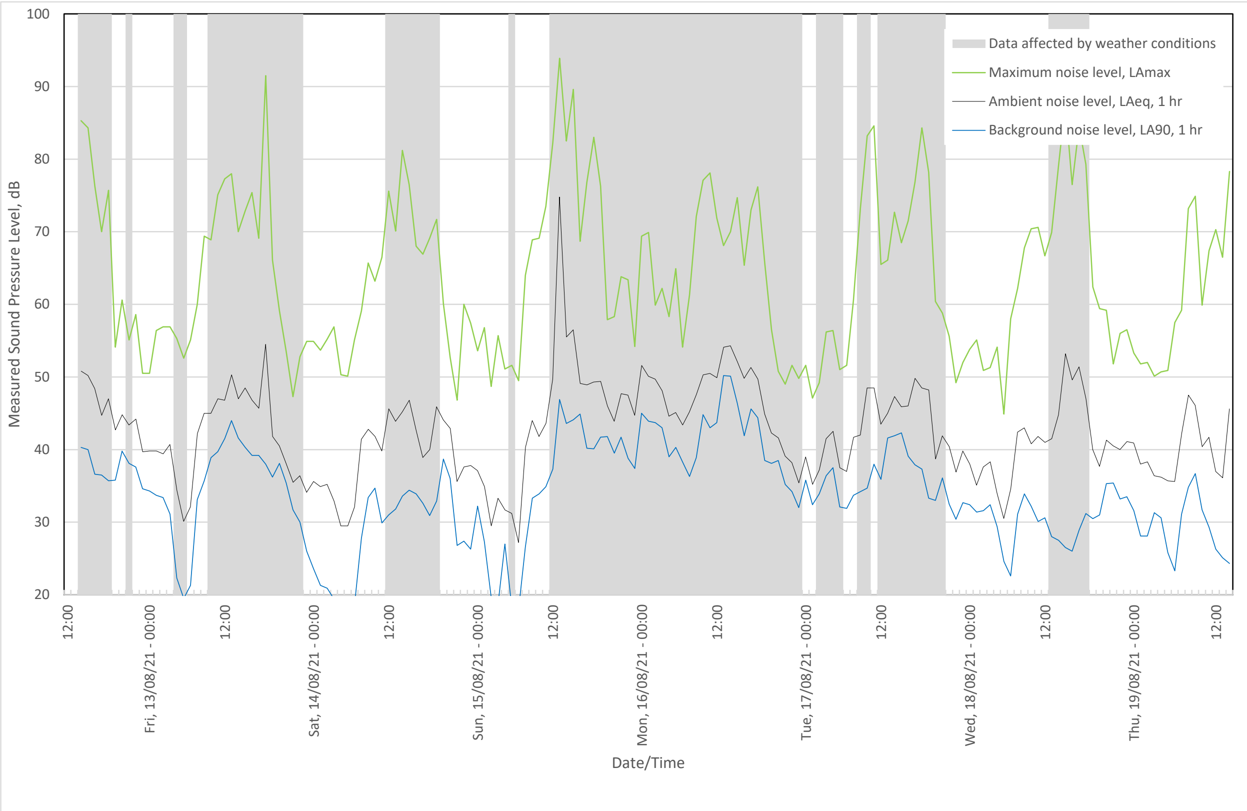
Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	31	31	31	55	55	55	87	87	N/a
Evening	26	31	28	49	55	52	78	83	N/a
Night	25	27	26	42	48	45	75	86	N/a

Site 04 – [redacted] Dewars Road, Woodside, 3874

Noise monitor in-situ



Full monitoring results

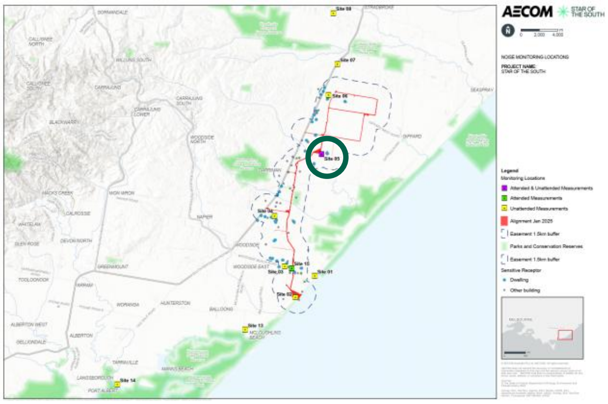


Summary, dB

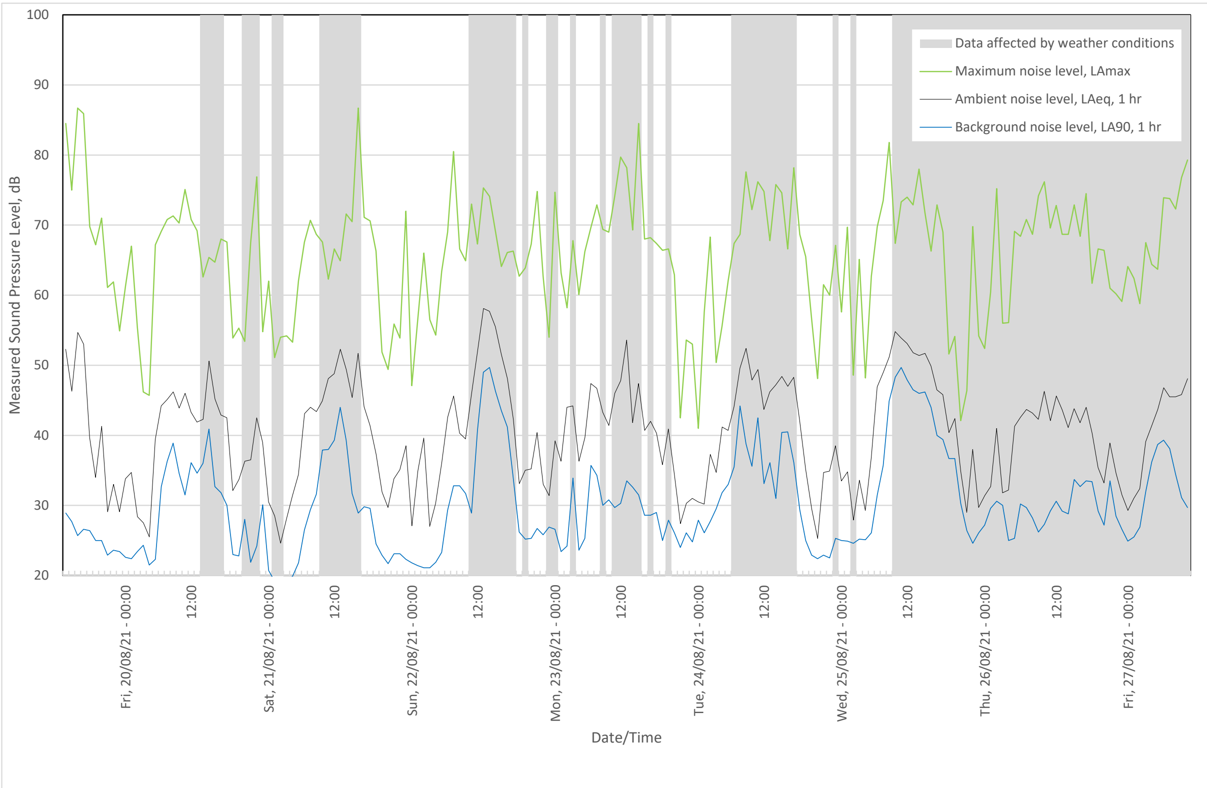
Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	30	38	34	47	67	57	88	94	N/a
Evening	32	34	33	40	41	41	59	60	N/a
Night	22	30	27	35	39	37	59	64	N/a

Site 05 – Four Mile Creek Road, Giffard West, 3851

Noise monitor in-situ



Full monitoring results



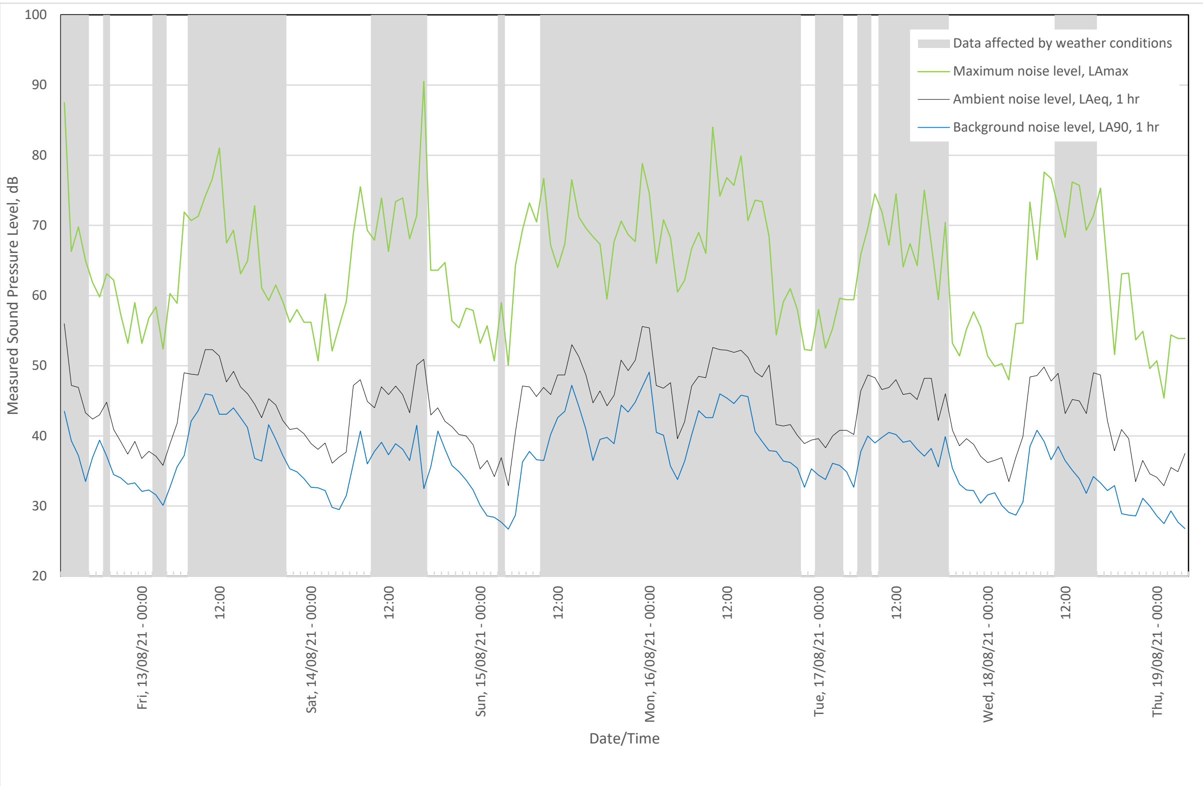
Summary, dB

Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	27	35	31	45	52	49	75	87	N/a
Evening	24	28	26	35	46	39	67	87	N/a
Night	22	29	25	37	42	39	68	77	N/a

Site 06 – [redacted] Giffard West Road, Giffard West, 3851

Noise monitor in-situ

Full monitoring results

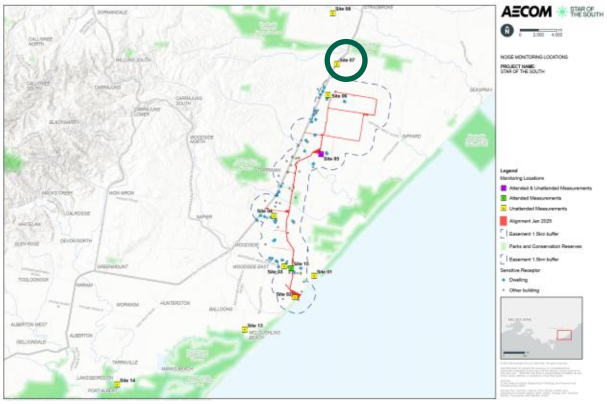


Summary, dB

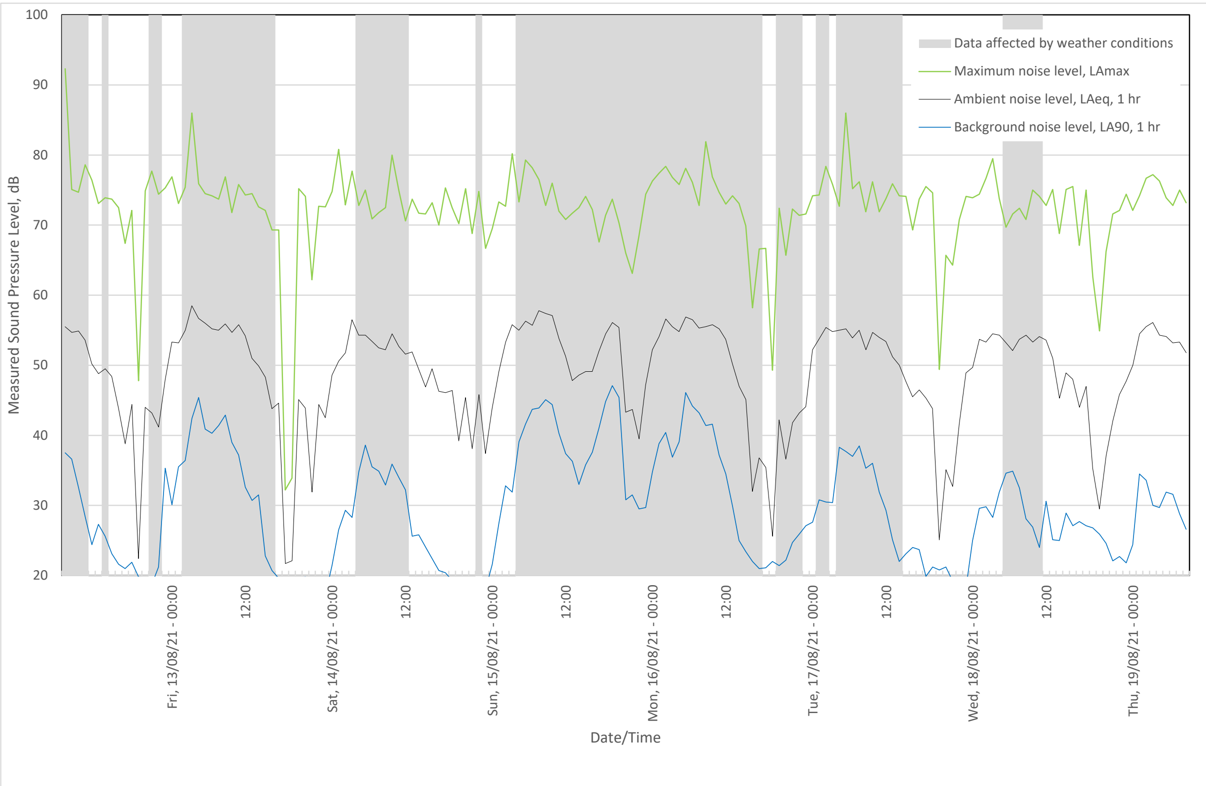
Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	36	36	36	47	47	47	78	78	N/a
Evening	30	37	33	39	46	42	63	91	N/a
Night	29	33	31	35	42	40	55	73	N/a

Site 07 – [redacted] South Gippsland Highway, Giffard West, 3851

Noise monitor in-situ



Full monitoring results

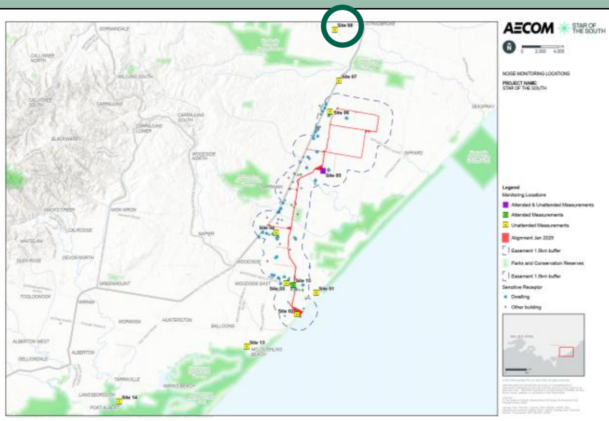


Summary, dB

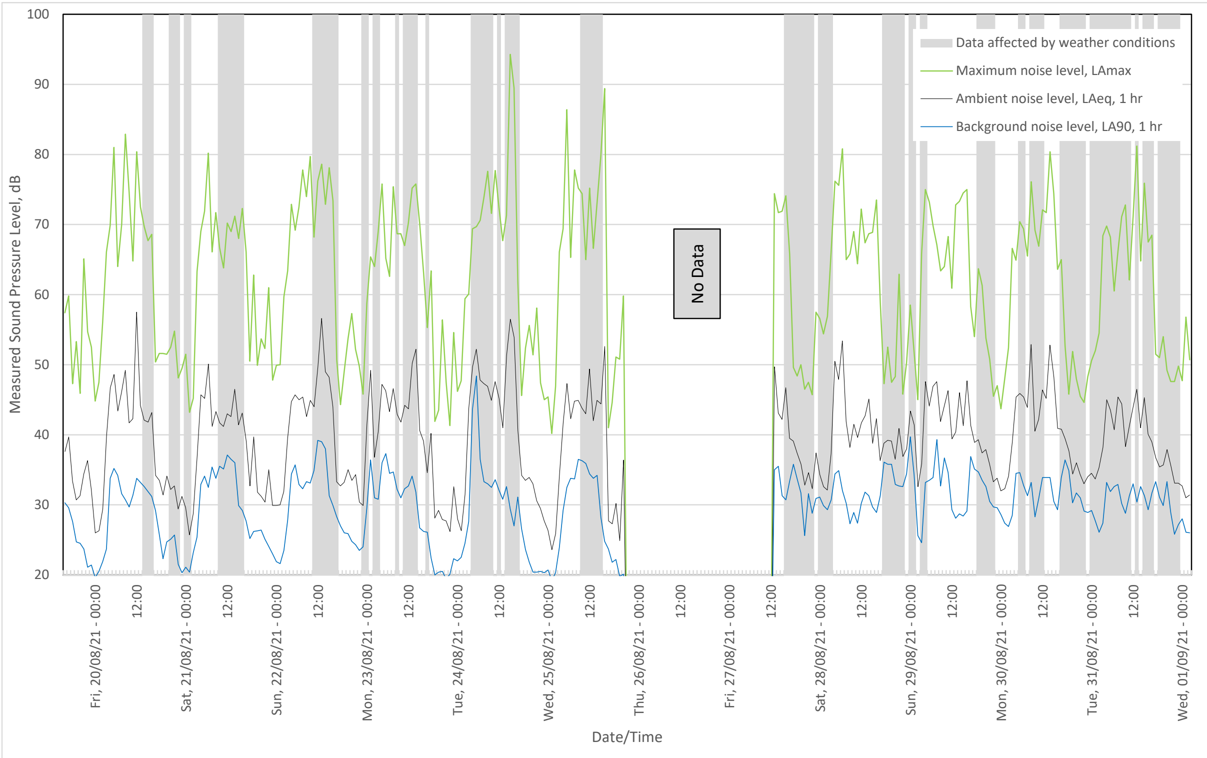
Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	30	30	30	54	54	54	80	80	N/a
Evening	27	28	28	47	51	49	76	80	N/a
Night	20	26	22	45	48	47	75	81	N/a

Site 08 – [redacted] Gormandale–Stradbroke Road, Stradbroke, 3851

Noise monitor in-situ



Full monitoring results

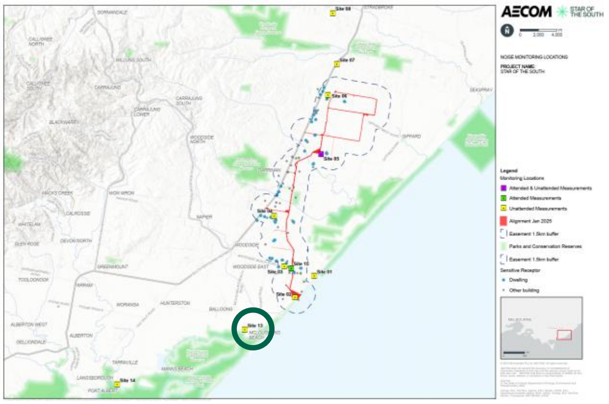


Summary, dB

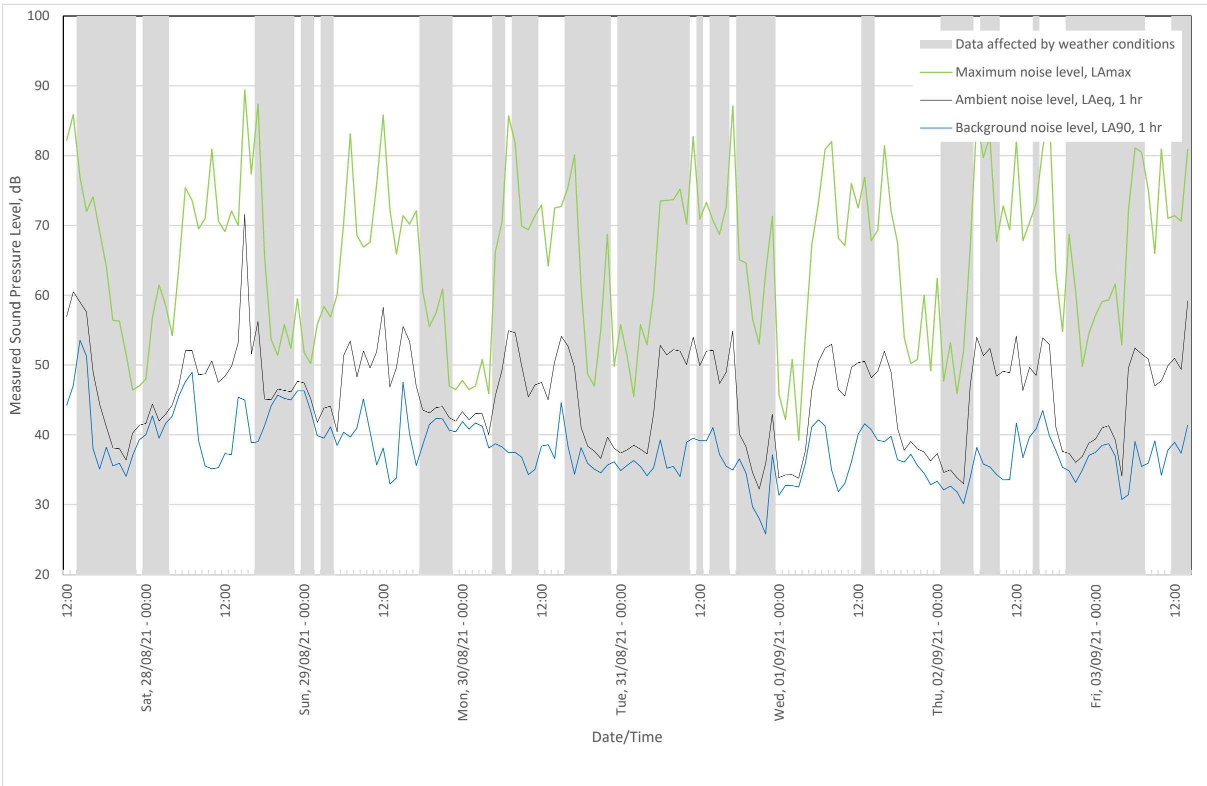
Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	29	33	31	46	55	48	74	98	N/a
Evening	22	34	29	28	48	38	51	80	N/a
Night	22	30	26	34	43	39	60	76	N/a

Site 13 – [redacted] McLoughlins Road, McLoughlins Beach, 3874

Noise monitor in-situ



Full monitoring results

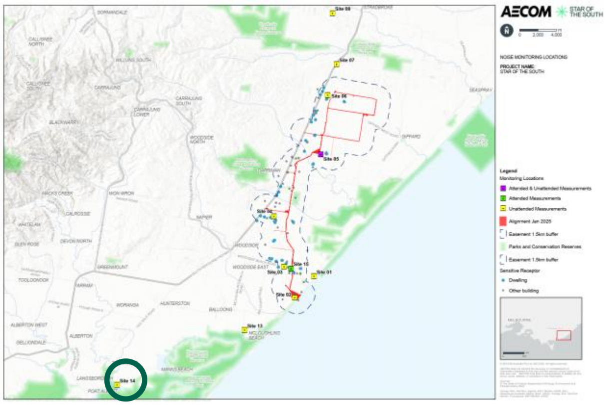


Summary, dB

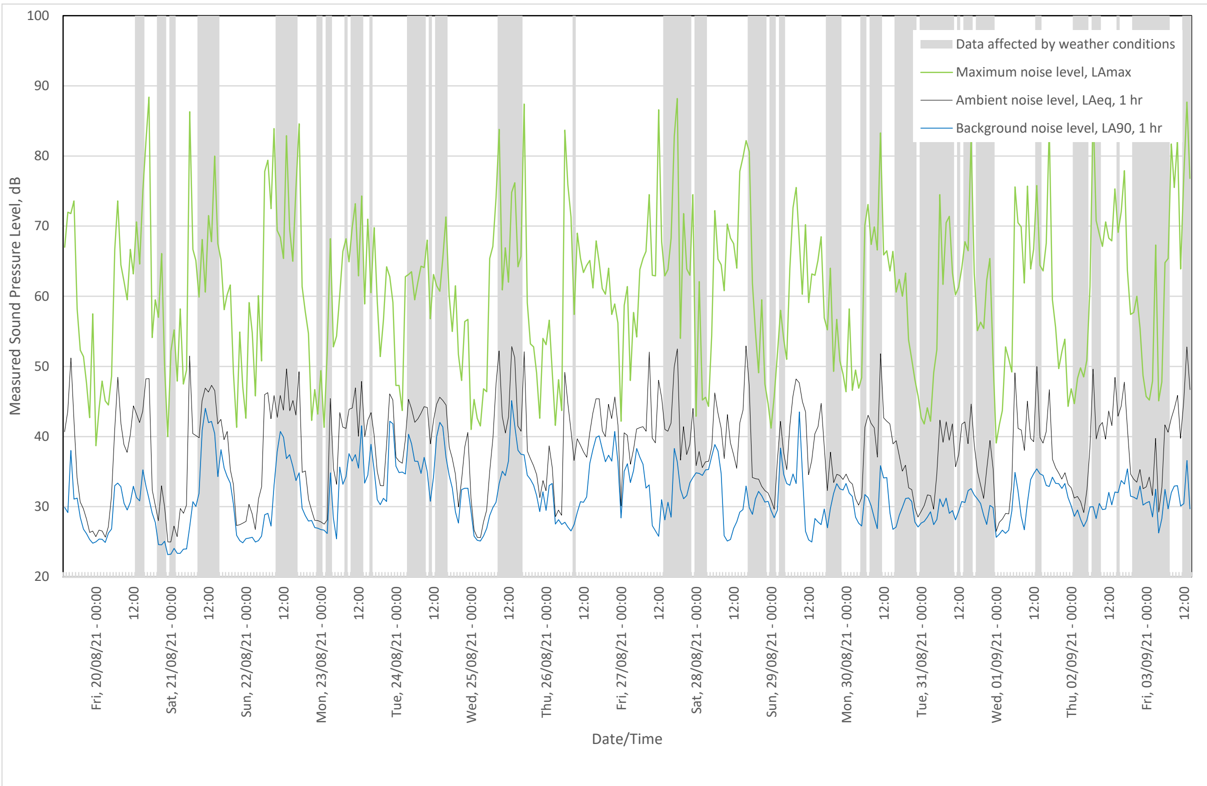
Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	37	39	38	50	51	51	81	87	N/a
Evening	35	42	38	38	62	48	68	89	N/a
Night	35	40	37	43	44	44	71	73	N/a

Site 14 – [redacted] Sarena Parade, Robertsons Beach, 3971

Noise monitor in-situ



Full monitoring results



Summary, dB

Period	Background, L_{A90}			Ambient, L_{Aeq}			Maximum, L_{Amax}		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Day	29	36	32	41	47	44	70	88	N/a
Evening	27	37	32	31	47	40	59	88	N/a
Night	26	38	31	35	43	39	64	84	N/a

Appendix B

Construction and Operational Noise Criteria

Appendix B Construction and Operational Noise Criteria

Construction noise criteria

The construction noise criteria for residential receptors at which monitoring was undertaken are presented in Table B-1 and apply to all construction activities associated with the project.

The lowest of the measured average background levels have been adopted when deriving the residential evening and weekend criteria.

Table B-1 Construction Noise Criteria – specific monitoring locations

Location	Normal working hours	Weekend/evening work hours, L_{Aeq}, dB		Night period (unavoidable works), L_{Aeq}, dB
		For up to 18 months after project commencement	After 18 months from project commencement	
[redacted] Rebecca Street	No specified Guideline Noise Level - noise reduction measures apply with reference to the relevant ERS objective and environmental values	49	44	Application of all practicable and reasonable work practices to reduce levels of noise.
Reeves Beach Road		52	47	
[redacted] Woodside Beach Road		36	31	
[redacted] Dewars Road		42	37	
Four Mile Creek Road		34	29	
[redacted] Giffard West Road		40	35	
[redacted] South Gippsland Highway		37	32	
[redacted] Gormandale–Stradbroke Road		31	26	
[redacted] McLoughlins Road		45	40	
[redacted] Sarena Parade		37	32	

Due to the extent of the project construction corridor, it has been necessary to derive criteria for locations other than those at which monitoring has been undertaken. These locations have been broadly categorised as either rural or coastal and the criteria are based on the lowest measured levels for each, as detailed in Table B-2.

Table B-2 Construction Noise Criteria for the broader project corridor

Target area	Construction noise criteria L_{Aeq} dB
EPA Victoria normal working hours	
Residential	Noise reduction measures apply with reference to the relevant ERS objective and environmental values
Classrooms in schools and other educational institutions	
Parks and recreational areas	
Outside of EPA Victoria normal working hours	

Target area	Construction noise criteria L_{Aeq} dB
Rural Residential – Evening and weekend (<18 months)	31
Rural Residential – Evening and weekend (> 18 months)	26
Rural Residential – Night (avoidable works)	Avoidable works at night are not proposed.
Coastal Residential – Evening and weekend (<18 months)	37
Coastal Residential – Evening and weekend (> 18 months)	32
Coastal Residential – Night (avoidable works)	Avoidable works at night are not proposed.
Campgrounds – Night	Noise reduction measures apply with reference to the relevant ERS objective and environmental values
All – Unavoidable night works	Application of all practicable and reasonable work practices to reduce levels of noise

Operational noise criteria – fixed infrastructure

The following section provides the derivation of the applicable Noise Protocol criteria for all fixed onshore infrastructure, the batching plants and the offshore substations.

For '*commercial, industrial and trade premises*', the EP Regulations set noise limits that apply in '*noise sensitive areas*', above which noise is prescribed to be unreasonable (Regulation 118). The noise limits are determined using the Noise Protocol, and the noise limits are set by the EP Regulations.

There are two methods provided to determine the noise limits depending on the location of the site, the urban method and the rural method. The relevant method depends only on the location of the noise sensitive area, regardless of whether the premise investigated is within a major urban boundary or in a rural area.

In addition, the EPA Victoria provides classification of major urban boundaries for large conurbations outside of Melbourne (such as Mildura, for example).

The site is in a rural area and so the relevant noise limits have been defined in accordance with Section 2 of the Noise Protocol "*Noise limits – Rural areas method*".

Step 1: Zone Levels

Table B-1 of the Noise Protocol is used in conjunction with the planning scheme for the subject sites to determine the applicable zone levels in the following time periods.

Table B-3 Noise Protocol – Assessment periods

Day of week	Period		
	Day	Evening	Night
Monday to Friday	0700-1800hrs	1800-2200hrs	2200-0700hrs
Saturday	0700-1800hrs	1800-2200hrs	2200-0700hrs

Day of week	Period		
	Day	Evening	Night
Sundays and Public Holidays	N/a	0700-2200hrs	2200-0700hrs

The zone levels applicable to the batching locations and nearest receptors are shown in Table B-4.

Table B-4 Noise Protocol – Zone Levels

Generating Zone	Receiving Zone	Zone Level, dB (A)		
		Day	Evening	Night
Batching Plants (all)				
FZ	FZ	46	41	36

Step 2: Distance Adjustment

Clause 20 of the Noise Protocol states that distance adjustments are to be made to the Zone Levels when source and receptor are in different Zone classifications or are separated by another Zone type (other than road or railway line). The distance adjustment is based on the distance between the receptor and the boundary of the Zone in which the source is located.

The adjustment to the Zone Levels for distance is a subtraction of one decibel for every 100 metres from the receptor to the boundary of the land use Zone in which the source is located, up to a maximum of nine decibels.

Table B-5 Noise Protocol – Distance adjustments

Generating Zone	Receiving Zone	Distance Adjustment
Batching Plants (all)		
FZ	FZ	No distance adjustment

The zoning of project infrastructure with reference to the nearest residential properties is shown in **Table B-6.**

Table B-6 Noise Protocol - Distance adjusted Zone Levels

Receptor address	Receiving Zone	Distance to Zone boundary	Distance adjustment, dB	Distance Adjusted Zone Level, dB (A)		
Batching Plant Site 1						
[redacted] Giffard West Road, Giffard West	FZ	N/a	N/a	46	41	36
Batching Plant Site 2						
[redacted] Giffard West Road, Giffard West	FZ	N/a	N/a	46	41	36
Batching Plant Site 3						
[redacted] South Gippsland Highway, Giffard West	FZ	N/a	N/a	46	41	36

Batching Plant Site 4						
[redacted] Dewars Road, Woodside	FZ	N/a	N/a	46	41	36
Batching Plant Site 5						
[redacted] Woodside Beach Road, Woodside	FZ	N/a	N/a	46	41	36
Batching Plant Site 6 and the offshore substations						
Reeves Beach Campground	FZ	N/a	N/a	46	41	36

Step 3: Base Noise Level Check

Regulation 118(2) of the *Environment Protection Act* provides '*base noise levels*', which place lower limits on the distance-adjusted levels and are shown in Table B-7 and Table B-8.

Table B-7 Noise Protocol - Base Noise Level Check

Base Noise Level Check, dB (A)		
Day	Evening	Night
45	37	32

Table B-8 Base noise level check and corrected zone levels

Receptor address	Base noise level check adjustment?	Corrected zone levels, dB(A)		
		Day	Evening	Night
Batching Plant Site 1				
[redacted] Giffard West Road, Giffard West	No	46	41	36
Batching Plant Site 2				
[redacted] Giffard West Road, Giffard West	No	46	41	36
Batching Plant Site 3				
[redacted] South Gippsland Highway, Giffard West	No	46	41	36
Batching Plant Site 4				
[redacted] Dewars Road, Woodside	No	46	41	36
Batching Plant Site 5				

Receptor address	Base noise level check adjustment?	Corrected zone levels, dB(A)		
		Day	Evening	Night
[redacted] Woodside Beach Road, Woodside	No	46	41	36
Batching Plant Site 6 and the offshore substations				
Reeves Beach Campground	No	46	41	36

Step 4: Background Level Check and Adjustment

Clause 21 of the Noise Protocol states that background noise monitoring may be conducted if the nearest receptors are deemed to be in a '*background-relevant area*', which is defined as:

> *'A noise sensitive area within a rural area where background levels may be higher than usual. This includes areas where freeway or highway traffic is a significant audible background noise source. It also includes coastal areas, where representative background levels are elevated by the sound of surf.'*

An assessment of the background level would only either increase the Noise Protocol Limit or leave it unchanged. The distance-adjusted, or base levels are compared to the background levels, and if necessary, a background adjustment is taken, as shown in Table B-9.

Table B-9 Noise Protocol - Background relevant adjustments

Period	Background Adjustment
Day	The greater of: • The distance-adjusted level or base noise level • The daytime background level plus 8 dB
Evening	The greater of: • The distance-adjusted level or base noise level • The evening background level plus 5 dB
Night	The greater of: • The distance-adjusted level or base noise level • The night background level plus 5 dB

No adjustments are required for Step 4.

Step 5: High Traffic Noise Areas

Where a background relevant area is affected by high traffic noise, the Noise Protocol nominates reference levels for consideration against the traffic noise levels. This applies when the residence is not positioned in an industrial, business or special use zone.

These reference values provide a constraint on how loud industry noise can be relative to the background noise levels and provide a 'cap' to industry noise levels compared to traffic noise levels. The reference values for high traffic noise areas are shown in Table B-10.

Table B-10 Noise Protocol - High Traffic Noise Area Reference Values

High Traffic Noise Area Reference Values, dB (A)		
Day	Evening	Night
55	50	45

The procedure for determining the Noise Protocol Limits in high traffic noise areas is detailed in Table B-11.

Table B-11 Noise Protocol - Traffic Noise Level Adjustments

Background-Adjusted Level compared to Reference Value	Figure to apply as Recommended Level
Background-adjusted level is lower than the reference value	Background-adjusted value
Background-adjusted level is equal to or greater than the reference value	Reference value
Background-adjusted level is greater than the reference value, and traffic noise L_{Aeq} equals or is greater than the reference value + 10	The lower of: • Background-adjusted level • The traffic noise L_{Aeq} level minus 10 dB

None of the residential properties identified are affected by traffic noise. Therefore, no adjustment is required for Step 5.

Step 6: Noise Protocol Limits

Noise Protocol Limits have been determined for nearest residential properties in the vicinity of the batching plants and are shown in Table B-12.

Table B-12 Noise Protocol Limits

Receptor address	Noise Protocol Limits (dB, $L_{eff,30min}$)		
	Day	Evening	Night
Batching Plant Site 1			
[redacted] Giffard West Road, Giffard West	46	41	36
Batching Plant Site 2			
[redacted] Giffard West Road, Giffard West	46	41	36
Batching Plant Site 3			
[redacted] South Gippsland Highway, Giffard West	46	41	36

Receptor address	Noise Protocol Limits (dB, $L_{eff,30min}$)		
	Day	Evening	Night
Batching Plant Site 4			
[redacted] Dewars Road, Woodside	46	41	36
Batching Plant Site 5			
[redacted] Woodside Beach Road, Woodside	46	41	36
Batching Plant Site 6 and the offshore substations			
Reeves Beach Campground	46	41	36

Operational noise criteria – offshore wind energy facility

Operational noise limits applicable to wind energy facilities (WEFs) in Victoria must be determined in accordance with the relevant noise standard subject to regulation 131BA(2) and (3) of the Regulations.

Where a high amenity area (HAA) noise limit does not apply, the base wind turbine noise limit should be 40 dB(A) at all wind speeds. In all cases, the relative limit of 'background sound level +5 dB' applies if background sound level is higher than the base wind turbine noise limit.

However, in accordance with the EP Act 2017, a HAA noise limit applies to all of these receptors, which means that the applicable WEF noise limit for the project is:

- Below 6 m/s wind speed at hub height the wind turbine noise limit is 35 dB(A); and
- Above 6 m/s the base wind turbine noise limit is 40 dB(A).

This preliminary assessment does not rely on background noise measurements to demonstrate compliance with the acoustic requirements for wind turbines. However, background noise measurements will be undertaken at a range of representative locations in order to enable post-construction compliance measurements to be carried out in accordance with Section 7 of the Standard.

Appendix C

Impact and Risk Register

Appendix C Impact and Risk Register

The impact and risk pathway summary table is presented in Table C-1.

Table C-1 Impact pathway summary table

Impact ID	Impact or risk pathway	Initial mitigation	Initial impact level			Final mitigation	Residual impact level		
			Receptor sensitivity	Magnitude	Consequence level		Receptor sensitivity	Magnitude	Consequence level
Construction									
ONV-I001	General construction works along the onshore cable system alignment causes an increase in noise that affects the amenity of sensitive receptors.	*ONV-M001*	High	Medium	Major	*ONV-M002*	High	Low	Moderate
ONV-I002	Out-of-hours work causes an increase in noise that affects the amenity of sensitive receptors.	*ONV-M001*	High	Medium	Major	*ONV-M002, ONV-M004, ONV-M005, ONV-M006, ONV-M008*	High	Low	Moderate
ONV-I003	Construction traffic causes an increase in noise that affects the amenity of sensitive receptors.	*Nil*	High	Medium	Major	*ONV-M001*	High	Low	Moderate
ONV-I004	Vibration from construction works	*ONV-M001,*	High	Negligible	Minor	*Nil*	High	Negligible	Minor

Impact ID	Impact or risk pathway	Initial mitigation	Initial impact level			Final mitigation	Residual impact level		
			Receptor sensitivity	Magnitude	Consequence level		Receptor sensitivity	Magnitude	Consequence level
	causes human disturbance.	*ONV-M003*							
ONV-I005	Vibration from construction works cause structural damage to buildings and underground services.	*ONV-M001, ONV-M003*	High	Negligible	Minor	*Nil*	High	Negligible	Minor
Operation									
ONV-I006	The 24-hour operation of the offshore wind turbines leads to an increase in noise affecting amenity of nearby sensitive receptors.	*ONV-M007, ONV-M009*	High	Negligible	Minor	*ONV-M007, ONV-M009*	High	Negligible	Minor
ONV-I007	Vibration at sensitive receptors generated by the operation of project infrastructure causes human disturbance.	*Nil*	High	Negligible	Minor	*Nil*	High	Negligible	Minor
Decommissioning									

Impact ID	Impact or risk pathway	Initial mitigation	Initial impact level			Final mitigation	Residual impact level		
			Receptor sensitivity	Magnitude	Consequence level		Receptor sensitivity	Magnitude	Consequence level
ONV-I008	Works associated with decommissioning cause an increase in noise or vibration affecting amenity of nearby sensitive receptors.	*ONV-M001, ONV-M003*	High	Medium	Major	*ONV-M002, ONV-M010, ONV-M011*	High	Low	Moderate

Appendix D

Wind Turbine Coordinates

Appendix D Wind Turbine Coordinates

Table D-1 Largest wind turbine layout coordinates

Wind turbine ID	Easting(1)	Northing(1)		Wind turbine ID	Easting(1)	Northing(1)
1	485636.2	5708738		33	503706.7	5723719
2	486317.3	5707647		34	482117.5	5698867
3	486135	5706211		35	498879.1	5699023
4	486689.9	5704893		36	502817.1	5719362
5	487148.8	5703669		37	487336.1	5690985
6	481307.9	5705408		38	482498.2	5696161
7	487677.8	5702490		39	483147.5	5695051
8	489651.4	5697995		40	500401.1	5711442
9	490275.4	5696866		41	477412.5	5701709
10	490968.1	5695721		42	500965.8	5710223
11	491730.6	5694507		43	496135.7	5696784
12	492571.5	5693398		44	502588.6	5717990
13	481010.6	5703358		45	491845.6	5710966
14	499733	5703887		46	491685.5	5709626
15	499490	5702298		47	486100.1	5694671
16	499016.4	5705095		48	478221.1	5700699
17	497974.3	5706444		49	482638.2	5697448
18	497104.4	5707828		50	493592.2	5701625
19	496399.7	5708938		51	494327.2	5700334
20	493393	5712475		52	491477.9	5707983
21	494375.4	5713629		53	499378.5	5717523
22	499246	5700853		54	482498.2	5706518
23	489122.2	5691301		55	500726.5	5708690
24	486604.2	5692139		56	495915.9	5695513
25	486074.3	5693313		57	491477.5	5706200
26	499083.4	5716175		58	492743.9	5703181
27	499486.6	5718817		59	494942	5699120
28	498880.5	5714826		60	487855.9	5709267
29	499844.2	5712667		61	492234.8	5704413
30	481305.9	5702102		62	490378	5692837
31	481666.5	5700174		63	485328.4	5695698
32	503076.8	5720745		64	495591.3	5698010

Wind turbine ID	Easting[(1)]	Northing[(1)]
65	479089.1	5699655
66	500352.4	5706795
67	501650.8	5713361
68	480387.2	5704509
69	498618	5713550
70	505595.8	5721209
71	505056.6	5719652
72	505571.6	5722615
73	506301.6	5717477
74	507459.7	5715198
75	508100.3	5714077
76	508874.8	5712949
77	510331.3	5710523
78	509381.3	5709448
79	506087.3	5706056
80	503435.5	5703580
81	501526	5701332
82	502158.4	5705339
83	502673	5707983
84	502988.8	5709231
85	504640.2	5712299
86	509442	5719647
87	511736.8	5718283
88	513710.1	5716573
89	514284.5	5714892
90	508264	5720162
91	502507.5	5702418
92	503863.7	5713480
93	512895.1	5713282
94	504031.3	5714841
95	505653.1	5707267
96	510631.9	5719002
97	514904.1	5716036
98	506820.3	5721820
99	506696	5708604
100	501990.8	5704039
101	504347.6	5716194
102	512227.7	5717099
103	511810.2	5711989
104	503269.5	5710564
105	507935.6	5707975
106	509889.1	5717955
107	504908.5	5718267
108	512036	5714515
109	509566.9	5711739
110	505368.4	5711030
111	502385.7	5706667
112	511423.9	5715878
113	506910.7	5720508

Table notes:

1. Eastings and northings are defined based on the GDA 2020 projection MGA55.

Table D-2 Smallest wind turbine layout coordinates

Wind turbine ID	Easting(1)	Northing(1)		Wind turbine ID	Easting(1)	Northing(1)
1	485589.3	5708739.1		35	496941.6	5701738.4
2	485987.2	5707733.1		36	477554.2	5701547.9
3	486342.4	5706545.4		37	487885.7	5690577.4
4	486716.8	5704811.6		38	495119.1	5699373.2
5	487855.7	5703154		39	495886.2	5708089.4
6	488529.2	5701918.8		40	496988.1	5696625.1
7	489105.2	5700818.6		41	478230.6	5700657.5
8	490093.2	5698825.1		42	486072.9	5691749
9	491928.9	5695617.8		43	496808.7	5706414.1
10	492470.9	5694580.2		44	499485	5717708.9
11	492967.4	5693625.4		45	490628.7	5697867.1
12	483217.1	5705706.6		46	488900.7	5709533.3
13	499807.8	5714846.4		47	489606	5699769.2
14	498727.1	5716454		48	480248.3	5704235.6
15	499393.7	5718792.3		49	496157	5695751
16	481306.1	5705403.3		50	482704.5	5696692.5
17	489823.2	5691724.1		51	482525.4	5706543.4
18	480885.5	5703330		52	498725.1	5713270.1
19	503087.8	5720830.3		53	489449.3	5708608.1
20	489219.3	5692613.4		54	485708.6	5695116.7
21	482102.1	5701396.5		55	497293.5	5705322.1
22	482753.1	5700443		56	478982.8	5699774
23	480517.7	5698015.5		57	488645	5693523
24	498755.9	5698450.9		58	490122.1	5707425.3
25	481246.9	5697180		59	490775.9	5706227.1
26	494470.6	5713859.7		60	496423.5	5697531.8
27	493500.7	5712687.9		61	498490.3	5715389.9
28	498973.9	5699509.9		62	485128.6	5696052.3
29	482636.9	5695591.5		63	491426.1	5705068
30	484605.6	5693424.5		64	478321.7	5702482.5
31	485280.7	5692576.8		65	492211.2	5711487.2
32	494662.3	5710604.4		66	479806.8	5698841.5
33	499173.6	5700832.6		67	488014.6	5694381.9
34	495228.1	5709354.7		68	492061.4	5704003

Wind turbine ID	Easting(1)	Northing(1)		Wind turbine ID	Easting(1)	Northing(1)
69	495816.5	5698409		104	510364.7	5710453.7
70	499336	5712351.2		105	508477.1	5720634.6
71	492624.2	5703102		106	510449.6	5719280.9
72	501969.4	5719564.5		107	512871.1	5717553
73	486955.2	5691089.7		108	515334.8	5715674.4
74	483997.5	5698436.5		109	514470.2	5716368.6
75	497130.6	5703296.9		110	503525.1	5703492.2
76	484444.3	5707263.2		111	503172.5	5710638.1
77	492105.3	5710422.7		112	514140.6	5714379.9
78	494904.5	5694797.1		113	511509.2	5718537.4
79	493674.8	5701418.7		114	504937.6	5718196.4
80	481461.2	5702422.3		115	502277.5	5705061.5
81	487366.8	5695260.1		116	509343.1	5720019.8
82	486213.9	5693817		117	505347.2	5721592.7
83	498211.6	5714205.4		118	509038.3	5709108.9
84	494510.2	5700250.1		119	504390	5715916.5
85	483304.5	5699489.3		120	505204.1	5720420
86	500452.3	5717248.4		121	502640.5	5702462
87	499962.5	5711490.4		122	513163.6	5713362.7
88	484670.7	5697038.3		123	503935.6	5713599.2
89	483365.8	5704631		124	502433.3	5706134.3
90	491431.6	5692692.1		125	504566	5716974.1
91	506132.7	5706080		126	513348.2	5716563.4
92	505244.1	5707580.2		127	508052.7	5708061
93	505147.4	5709086.6		128	513701.7	5715426.7
94	503730.5	5709709.9		129	504234	5714759
95	505006.9	5719296.8		130	505277.9	5705191.8
96	505991	5717746.1		131	510883.8	5717616.4
97	507768.8	5715700.4		132	508454.8	5709998.8
98	508381.8	5714813.4		133	507336.6	5711474.8
99	501609.8	5701393.1		134	506365.2	5719863
100	510070.7	5712872.3		135	506670	5712665.1
101	511242.7	5711363		136	502088.6	5703956.4
102	505564.4	5722702.3		137	508494.2	5719046.1
103	506657.3	5721956.7		138	512083.5	5712240.7

Wind turbine ID	Easting[(1)]	Northing[(1)]		Wind turbine ID	Easting[(1)]	Northing[(1)]
139	502569.4	5707228.7	**Table notes:**			
140	511256.7	5715643.1	1. Eastings and northings are defined based on the GDA 2020 projection MGA55.			
141	507496.1	5713733.7				
142	506978.1	5706953.1				
143	509909.2	5718365.2				
144	507583.8	5721302				
145	502740	5708429.6				
146	512506.3	5714198				
147	510258.2	5716748.5				