Chapter 24
Cumulative effects

24.1 Overview

Cumulative impacts are positive or negative, direct or indirect, long-term or short-term impacts arising from a range of activities throughout an area or region, where each individual effect may not be significant if taken in isolation. However, in combination with one or more other proposed or existing activities in the area or region, there may be overall significant effect on a specific environmental factor. This chapter describes potential cumulative impacts from all components and stages of the project, and measures that were taken to avoid and minimise these impacts.

Key areas for the cumulative assessment include listed threatened species and communities of flora and/or fauna, in particular Brolga (*Grus rubicunda*) and Southern Bent-wing Bat (*Miniopterus orianae bassanii*), as well as social and amenity values, such as landscape and visual impacts and noise, and traffic and transport. The assessment of cumulative impacts has also included Aboriginal cultural heritage, geoheritage and electro-magnetic interference, given their social value to people in the area.

Cumulative visual impacts may result in changes to the perceptions of the local community or a visitor to the region due to the presence of more wind turbines (than were already there before the project was built). Visual impacts can occur in two ways: sequential views to multiple wind farms, and simultaneous views to multiple wind farms from a single location. Viewers travelling along highways and local roads within the area would likely experience views that take in the project and other wind farms sequentially (i.e., one after another), impacting the viewer's perception of the landscape. Cumulative visual impacts from individual dwellings involving simultaneous views of Willatook and other wind farm wind turbines would also be possible. Irrespective of whether there was a cumulative impact, landscape screening would be offered for residential dwellings within 6 kilometres where there are views of one or more Willatook wind turbines.

Cumulative noise was assessed on nearby dwellings. There are four wind farms within 15 kilometres of the project site that are either operating or have received planning approval. The project was predicted not to result cumulative noise levels for the yet-to-be-constructed Ryan Corner, Hawkesdale and Woolsthorpe wind farms. The Macarthur Wind Farm is about 7 kilometres north from the closest proposed project wind turbines and there is the potential for noise levels at residences between the two wind farms to increase as a result of the project. Noise predictions indicate that the noise level at non-stakeholder dwellings between the two wind farms would be less than 40 dB(A) when applying a conservative modelling assumption of dwellings being downwind of both wind farms, which would never occur. This means the noise criteria for all wind speeds at all dwellings between the Macarthur and Willatook wind turbines would be achieved.

With each project added to the landscape there is land disturbance and some vegetation clearance. These areas of vegetation clearance are required to be offset in accordance with *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP, 2017b). During the operation of wind farms, some birds and bats are known to collide with turbine blades. If the project was constructed there would be expected to be some bird and bat deaths from collisions with wind turbines, as would other operating wind farms in the region. Given that those species predicted to be impacted by turbine collisions have been shown to be widely distributed species that are not threatened, the impact of these collisions was assessed to be low.

Species most at risk of cumulative impacts are those that are rare or threatened fauna. As the Southern Bent-wing Bat has been recorded in the project site and other wind farm sites, there is a risk that it may collide with operating turbines. Based on the very low activity levels of Southern Bent-wing Bat recorded on the project site, the lack of records in locations and heights of proposed wind turbines, and the distance to the closest maternity roosting site, there is a very low likelihood of a collision by this species with project turbines. As such, the project is unlikely to contribute to cumulative impacts on the species.

The social and economic, and landscape and visual assessments concluded that there may be cumulative impacts associated with broader regional and landscape changes associated with the increasing number of wind farms within the south-west of Victoria. For some people this may be negative perceptions of the region becoming concentrated with wind farms, which could alter the character of the region and people's sense of place. However, there would also be a range of benefits associated with employment opportunities, particularly during construction, and broader economic benefits to the region.

While there is the potential for some cumulative impacts for other aspects, such as cultural heritage and electromagnetic interference, these impacts were assessed to either be low or unlikely to occur.

24.2 EES objectives and key issues

The scoping requirements identify '*effects from a cumulative perspective, including on threatened flora and fauna, social and amenity values, with particular consideration of the currently operating and already approved wind farm projects in the region*' as a key matter to be addressed by the EES.

The EES scoping requirements specify the draft evaluation objective and key issues to a broad range of matters. Two aspects (biodiversity and habitat, and landscape and visual) specifically note cumulative impacts, as outlined in Table 24.1, which have guided this assessment. For other aspects, while cumulative impacts are not specifically noted in the scoping requirements, they have also been considered in this assessment where relevant.

Table 24.1 Relevant draft evaluation objectives

Draft evaluation objective	
Biodiversity and habitat: *To avoid or minimise potential adverse effects on biodiversity values within and near the site including native vegetation, listed threatened species and ecological communities, and habitat for these species. Where relevant, offset requirements are to be addressed consistent with state and Commonwealth policies.* **Landscape and visual:** *To minimise and manage potential adverse effects for the community with regard to landscape and visual amenity.*	
Key issues	• Potential cumulative effects on relevant listed threatened species and communities of flora and/or fauna, in particular Brolga and Southern bent-wing bat, from the project in combination with the construction and operations of other energy facilities. • Potential cumulative impacts of other operating and approved wind farms on landscape values of the region.

24.3 Method

The potential for cumulative impacts was considered by technical specialists in relation to their respective discipline. Some specialists could rule out the potential for cumulative impacts, such as shadow flicker for example, where there is no potential for shadow to be cast by wind turbines from more than one project onto the same dwelling. Other specialists were required to investigate the potential for cumulative impacts in more detail, using information collected and produced for the project in combination with publicly available information about other projects.

Other projects considered as part of the cumulative impact assessment varied between specialists since distance to neighbouring projects could have varying degrees of influence on the combined impact. For example, cumulative noise impacts can only occur when projects are sufficiently close enough to result in a combined noise at a specific location that is louder than that from just one project alone. Alternatively, impacts on Southern Bent-wind Bat need to be considered more broadly since only a small impact on this threatened species can have a broader (cumulative) impact on the population.

Timing of other projects relative to the Willatook project also influenced the scope of some assessments. Nearby projects that have not yet started construction have the potential to overlap in construction timeframes or involve only short time gaps between projects. This could result in both positive and negative effects in the project area and region.

Acknowledging that the Willatook project is located between the Macarthur Wind Farm to the north, and approved Ryan Corner Wind Farm to the south, as well as to the west of both the approved Hawkesdale and Woolsthorpe wind farms, these projects have all been considered in the assessment of cumulative impacts by technical specialists. The full list of projects considered for the cumulative assessment can be found in Section 24.4.

For a description of methods used to assess cumulative impacts refer to the following technical supporting studies:

- Geoheritage (Appendix A)
- Brolga (Appendix C1)
- Biodiversity (Appendix D)
- Noise and vibration (Appendix E1)
- Landscape and visual (Appendix F1)
- Traffic and transport (Appendix G)
- Aboriginal cultural heritage (Appendix J)
- Electromagnetic interference (Appendix N).

At a high level the key steps involved in assessing cumulative impacts involved:

- determining what other projects have the potential to interact with the project
- a quantitative and/or qualitative assessment of predicted impacts and their potential overlap with of other projects
- proposing mitigation strategies, where possible
- assessing the residual cumulative impacts and describing their significance.

24.4 Nearby projects and infrastructure

Infrastructure projects that were included in the cumulative assessment include those adjacent to or near the project site that have received planning approval, are in construction, are in the process of being commissioned or are in operation. The assessment of other projects was based on publicly available information.

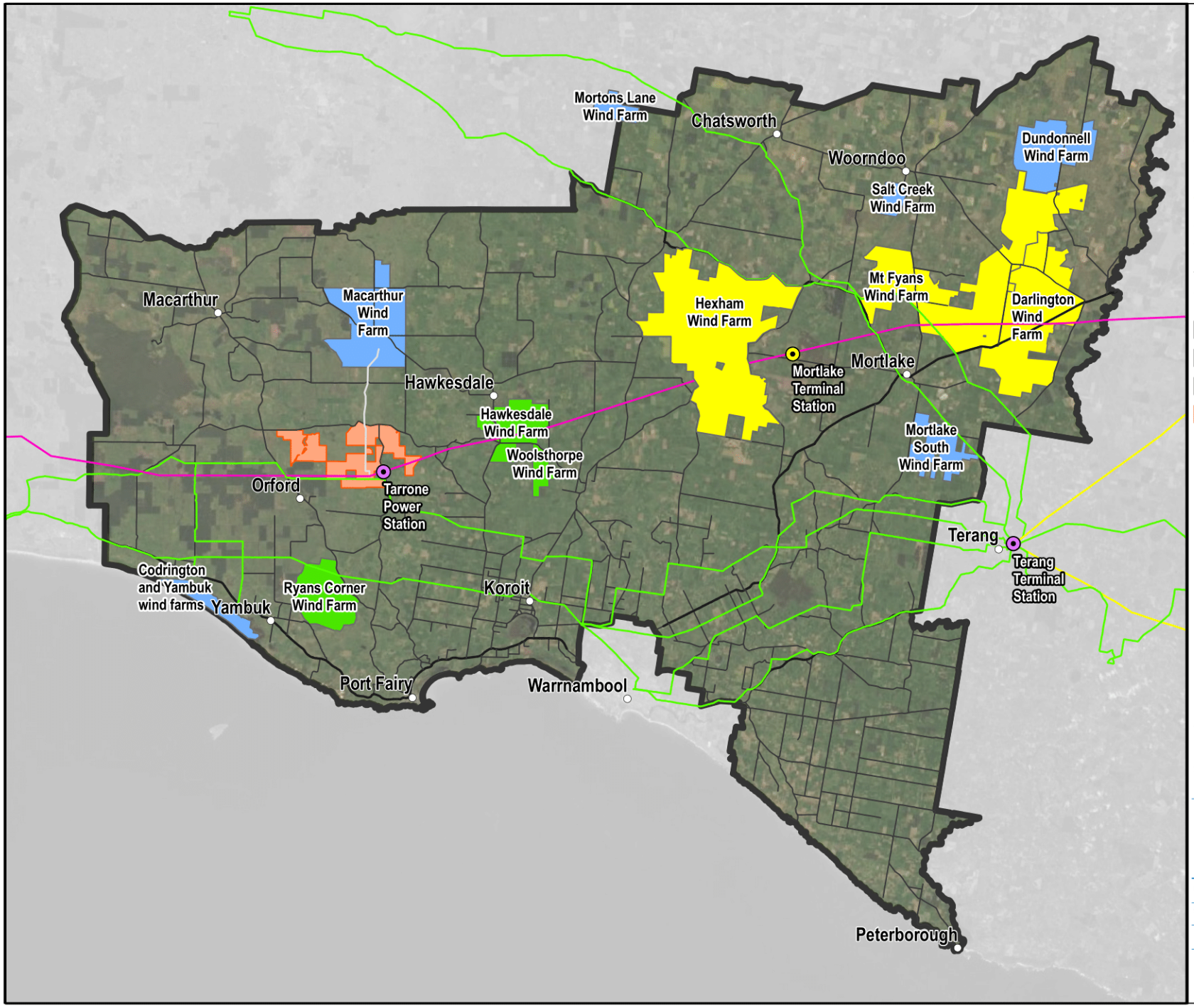
Wind farm projects within Moyne Shire included in the cumulative impact assessment are shown in Figure 24.1 and described in Table 24.2. The indicative development schedules are shown in Figure 24.2, based on the most recent publicly availability information. Other projects outside Moyne Shire have been considered if relevant for a particular technical aspect, for example biodiversity where a species range extends beyond the Moyne Shire boundary.

Two gas fired power stations have been proposed in proximity to the project and were approved via planning scheme amendments. AGL (the proponent of the Tarrone Gas-fired Power Station) have stated they have “no immediate plans to begin construction on this project” [1]. Nonetheless, this power station has been considered from a cumulative perspective, primarily cumulative noise.

The Shaw River Gas-fired Power Station was proposed to be constructed to the south-west of the project site, with Amendment C036 for site gazetted on 1 November 2010. The incorporated document for the power station has expired and it is understood the proponent (Santos) is no longer progressing with the project. As such, this power station has not been considered as part of the cumulative assessment.

Other existing infrastructure considered in the cumulative impact assessment included high voltage transmission lines as shown in Figure 24.1.

[1] AGL Tarrone Power Project: https://www.agl.com.au/content/aglenergy/nsw/en/about-agl/how-we-source-energy/tarrone-power-project (accessed 27 April 2022)



LEGEND

- Locality
- Operational gas power station
- Permitted gas power station
- 500KV transmission line
- 220KV transmission line
- 66KV transmission line
- 123KV transmission line
- Highway
- Major road

Wind farms

- Operating
- Approved - not constructed
- No permit / proposed
- Willatook Wind Farm boundary

SOURCE:
Willatook Wind Farm boundary, turbine locations and site infrastructure from Wind Prospect.
Roads and watercourses from Vicmap.
Mines from Geoscience Australia.
Imagery from ArcGIS Online (various capture dates).

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PROJECTION:

WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 24.1

Regional developments

DATE: 25.03.22 PROJECT: 754-MELEN287657 FILE: 287657_01_F007_GIS DOC REFERENCE: 287657_02_FIGS_B.APRX_V03

Table 24.2 Relevant wind farm projects in the Moyne Shire

Project	Status (at March 2022)	Location	Relationship to Willatook Wind Farm	Description
Macarthur Wind Farm	Operating	Approximately 10 kilometres east of the township of Macarthur and 14 kilometres south-west of Penshurst, Victoria.	The furthest southern turbines are approximately 7 kilometres north of the most northerly project turbines.	The wind farm consists of 140, 3 MW wind turbines. Each wind turbine has a 84 metre tower and a blade tip height of 135 metres. The project also involved the development of a 15 kilometre 132 kV transmission line between the wind farm and Tarrone Terminal Station.
Salt Creek Wind Farm	Operating	Approximately 40 kilometres east of Hamilton and 5 kilometres south of Woorndoo.	Approximately 55 kilometres north-east of the project.	The wind farm consists of 15, 3.5 MW turbines. Each wind turbine has a 100 metre tower and a blade tip height of 150 metres. The project also involved the development of a 50.5 kilometre 66 kV overhead transmission line, owned and operated by AusNet Services.
Dundonnell Wind Farm	Operating	Approximately 23 kilometres north-east of Mortlake, in the Western District of Victoria, Australia.	Approximately 70 kilometres north-east of the project.	The wind farm consists of 80, 4.2 MW wind turbines. Each wind turbine has a 114 metre tower and a blade tip height of 189 metres. The project also includes a 38 kilometre 220 kV overhead transmission line and a new substation at the Mortlake Gas Fired Power Station.
Mortlake South Wind Farm	Operating	Approximately 5 kilometres south of the Mortlake township.	Approximately 55 kilometres north, north-east of the project.	The wind farm consists of 35, 4.5 MW wind turbines. Each wind turbine has a 105 metre tower and a blade tip height of 186 metres.
Codrington Wind Farm	Operating	Approximately 25 kilometres west of Port Fairy.	Approximately 18 kilometres south, south-west of the project.	The wind farm consists of 14, 1.3 MW wind turbines. Each wind turbine has a 50 metre tower and a blade tip height of 81 metres.
Yambuk Wind Farm	Operating	Approximately 20 kilometres west of Port Fairy.	Approximately 16 kilometres south, south-west of the project.	The wind farm consists of 20, 1.5 MW wind turbines. Each wind turbine has a 70 metre tower and a blade tip height of 106 metres.
Mortons Lane Wind Farm	Operating	Approximately 25 kilometres east of Hamilton.	Approximately 40 kilometres north-west of the project.	The wind farm consists of 13, 1.5 MW wind turbines. Each wind turbine has a 105 metre tower and a blade tip height of 150 metres.

Project	Status (at March 2022)	Location	Relationship to Willatook Wind Farm	Description
Ryan Corner Wind Farm	Permitted	Approximately 12 kilometres north-west of Port Fairy.	Approximately 9 kilometres south of the project. Construction period may overlap.	The wind farm would consist of 52, 4 MW wind turbines. Each wind turbine would have a 110 metre tower and a blade tip height of 180 metres. Planning permit granted 2017. Construction planned to commence in 2022.
Hawkesdale Wind Farm	Permitted	Several kilometres south of Hawkesdale township.	Approximately 7 kilometres east of the project. Construction period may overlap.	The wind farm would consist of 23 wind turbines. Each wind turbine would have a 110 metre tower and a blade tip height of 180 metres. Planning permit granted 2017 and an extension of time to complete the development was granted in 2020. Construction planned to commence in 2022.
Woolsthorpe Wind Farm	Permitted	Approximately 4 kilometres west of Woolsthorpe.	Approximately 12 kilometres east of the project. Construction period may overlap.	The wind farm would consist of 20 wind turbines. Each wind turbine would have a 98 metre tower and a blade tip height of 168 metres. Planning permit granted in 2008. Construction start date is unknown, however it is anticipated to be no earlier than 2023.
Mt Fyans Wind Farm	Application submitted	Approximately 5 kilometres north of Mortlake.	Approximately 45 kilometres east of the project. Construction period may overlap.	The wind farm as most recently anticipated consists of 85 wind turbines. Each wind turbine would have a 125 metre tower and a maximum blade tip height of 200 metres. Planning permit granted in 2008. A revised planning permit application is pending a final decision. Construction start date is unknown, however it is anticipated to be no earlier than 2022.
Hexham Wind Farm	EES referral submitted	Approximately 15 kilometres west of Mortlake and 15 kilometres north-east of Woolsthorpe	Approximately 25 kilometres east of the project	The proposed wind farm would consist of up to 108 wind turbines with a maximum blade tip height of 250 metres and minimum blade ground clearance of 40 metres. The project submitted an EES Referral in March 2022 and if planning approval was to be achieved construction would anticipated no earlier than 2026.

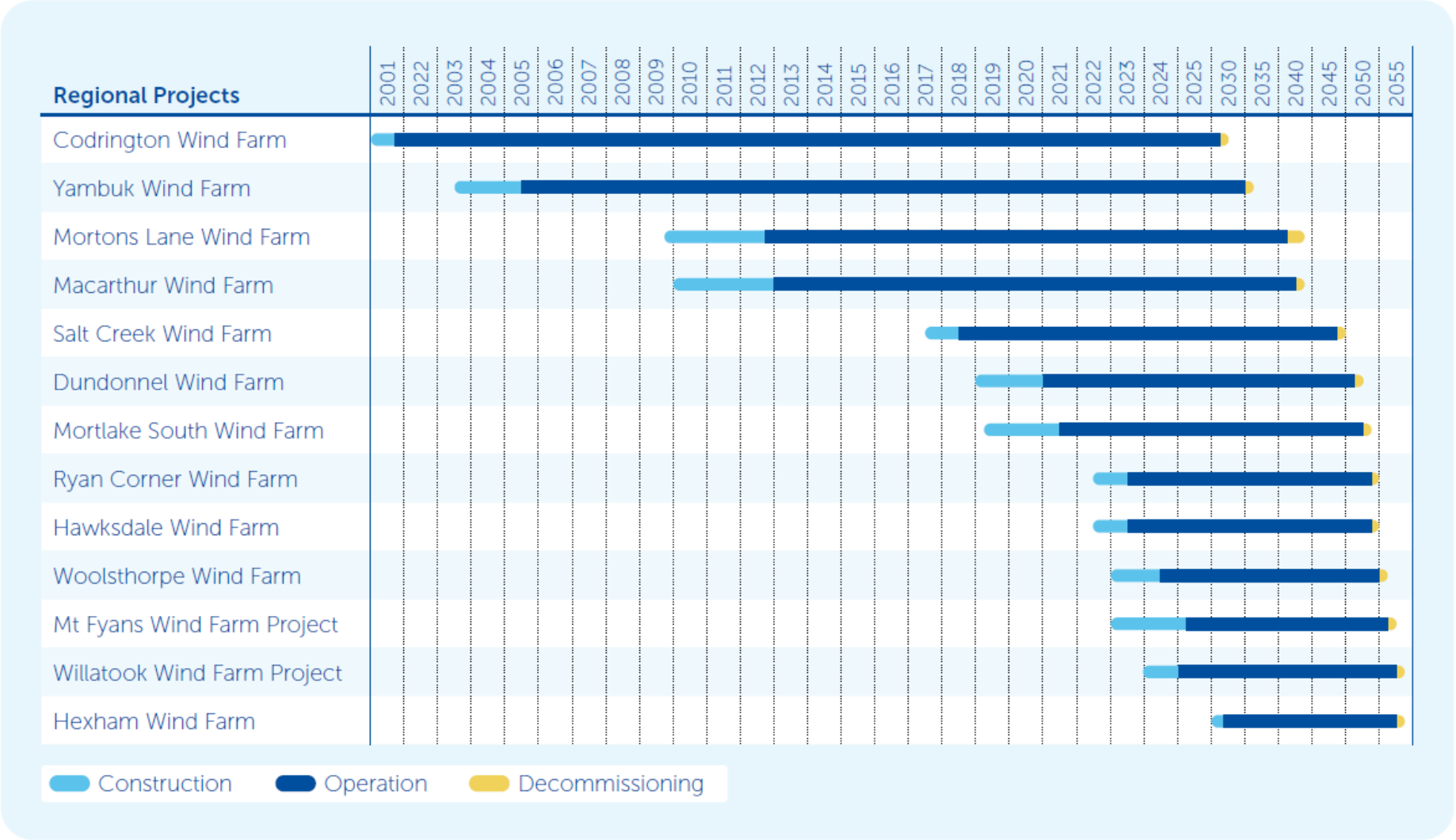


Figure 24.2 **Indicative development schedules of regional projects**

24.5 Cumulative impacts

This section discusses cumulative impacts of the project with respect to other infrastructure projects or developments that are planned, or currently being constructed, adjacent to or near the project site.

24.5.1 Landscape and visual

Appendix F1 – *Landscape and visual* discusses the cumulative impacts on the landscape and people's views within the landscape and visual investigation area. This investigation area is defined by the distance where project wind turbines would comprise 5% of the vertical field of view (i.e., 28.6 kilometres). At this distance, the wind turbines would be visually insignificant but noticeable on clear days with good visibility.

The assessment of landscape and visual impacts is subjective as the change in visual amenity is influenced by how the change is perceived by the viewer. Factors that can influence viewer perceptions of the landscape character includes viewer location, type (e.g., resident or visitor), the importance of the view, and the presence of wind farms or other energy infrastructure in the landscape.

Cumulative visual impacts may result due to the presence of multiple power-generating infrastructures (e.g., wind turbines), transmission lines, and/or substations in the project region. These cumulative impacts can occur either as a result of sequential views or simultaneous views. These impacts are discussed in the following sections.

Photomontages from representative locations that include views of the project and other wind farms are presented in Appendix F1 – *Landscape and visual* and the project Map Book (Attachment III).

Sequential views

Viewers travelling along highways and local roads within the investigation area may experience sequential visual impacts from the project – that is, views along the route journey may take in a number of wind farms sequentially (one after another), impacting the viewer's perception of the landscape they are travelling through.

Sequential views may include the operating or approved wind farms within the landscape and visual investigation area, but could also include other wind farms outside this area (e.g., Mortons Lane, Mortlake South and Portland wind farms (Cape Nelson, Cape Sir William Grant, Cape Bridgewater)).

Highways

The approved turbines within the Ryan Corner Wind Farm would be highly visible for viewers travelling along the Princes Highway. However, the turbines located within the operating Macarthur Wind Farm are not visible, and it is anticipated that the turbines of the approved Hawkesdale and Woolsthorpe Wind Farms would also not be visible. There may be locations where the project turbines may be noticed by a viewer travelling along the Princes Highway, but the turbines would not be dominant visual features due to the distance to the nearest wind turbine. As such, the cumulative visual impact from sequential views along the Princes Highway was assessed to be nil – negligible.

A photomontage (VP H2) was completed from the edge of Princes Highway looking north towards the project (approximately 16 kilometres northeast) and approved Ryan Corner Wind Farm (shown as a wireframe simulation) and is provided in Attachment III – *Map Book*.

Connector roads

Road users travelling north-south along the Hamilton-Port Fairy Road take in views of the operating Codrington and Yambuk wind farms towards the south and views of the Macarthur Wind Farm where topography and gaps in roadside vegetation allow views towards the north. There would be locations along this road with views of the approved Ryan Corner, Hawkesdale and Woolsthorpe wind farms in the distance. These views would be transient and limited as there are no formal roadside stops or locations where drivers are encouraged to stop and take in the view of the landscape. Road users travelling along the Penshurst-Warrnambool Road would experience similar views.

As the landscape contains several operating and approved wind farms, and the addition of the project to these views would not significantly alter a viewer's perception of the landscape, the cumulative visual impact from sequential views along the connector roads was assessed to be low.

Local roads

Sequential views to the project may occur from a few locations within the local road network, such as along Kangertong Road where the Macarthur Wind Farm is also visible. The major impact on views would be from the immediately adjacent project wind turbines, and the additional impact from views to the Macarthur Wind Farm would be negligible. As such, the cumulative visual impact from sequential views to wind farms from local roads was assessed to be to be low – negligible.

Simultaneous views

Simultaneous views to wind turbines are experienced from publicly accessible viewpoints or private viewing locations where two or more wind farms may be visible at the same time from one location. These views can be in the same or opposing directions.

Simultaneous views would be limited to wind farms that are close enough to the project so that both are discernible visual features from specific location (e.g., Macarthur, Ryan Corner and Hawkesdale wind farms).

Photomontage (VP H13) from the edge of Woolsthorpe-Heywood Road east of the project shows the predicted views of the proposed Willatook turbines with the closest turbine approximately 5 kilometres away, the modelled Hawkesdale wind farm turbines approximately 3 kilometres away, Ryan Corner Wind Farm approximately 17 kilometres away and Macarthur wind farm approximately 9 kilometres away, and is provided in Attachment III – *Map Book*.

Photomontage (VP T2) from a local road on the outskirts of Hawkesdale shows turbines modelled for Hawkesdale wind farm approximately 2 kilometres away and visible turbines at Macarthur wind farm approximately 10 kilometres away. The Willatook turbines are shown central to the view with the closest turbine approximately 10.6 kilometres south-west, and is provided in Attachment III – *Map Book*.

There are few locations where simultaneous views of the project and another wind farm may be possible due to the topography and vegetation screening that partially filter views for road users. However, the overlap of multiple view of operating or approved projects would occur along a section of the Princes Highway, inland connector roads and a number of local roads. In these instances, the nearest wind farm is the most obvious contributor to views and the impact from another wind farm in the distance does not alter the level of impact. As such, the simultaneous visual impact of the project was assessed to be negligible – medium.

Cumulative visual impacts from individual dwellings involving simultaneous views of Willatook and other wind farm turbines would be possible. Irrespective of whether there was a cumulative impact, landscape screening would be offered for residential dwellings within 6 kilometres where there are views of one or more Willatook wind turbines.

24.5.2 Noise

Appendix E1 – *Noise and vibration* discusses the cumulative noise and vibration impacts on nearby dwellings. The greatest potential for cumulative impacts to result in non-compliance is where the noise level contribution from one of the wind farms marginally achieves the criterion at a dwelling (i.e., being 40 dB(A) or background plus 5 dB(A)). In this situation, the contribution from a second wind farm may then cause a higher cumulative noise level, increasing the total noise level above the criterion.

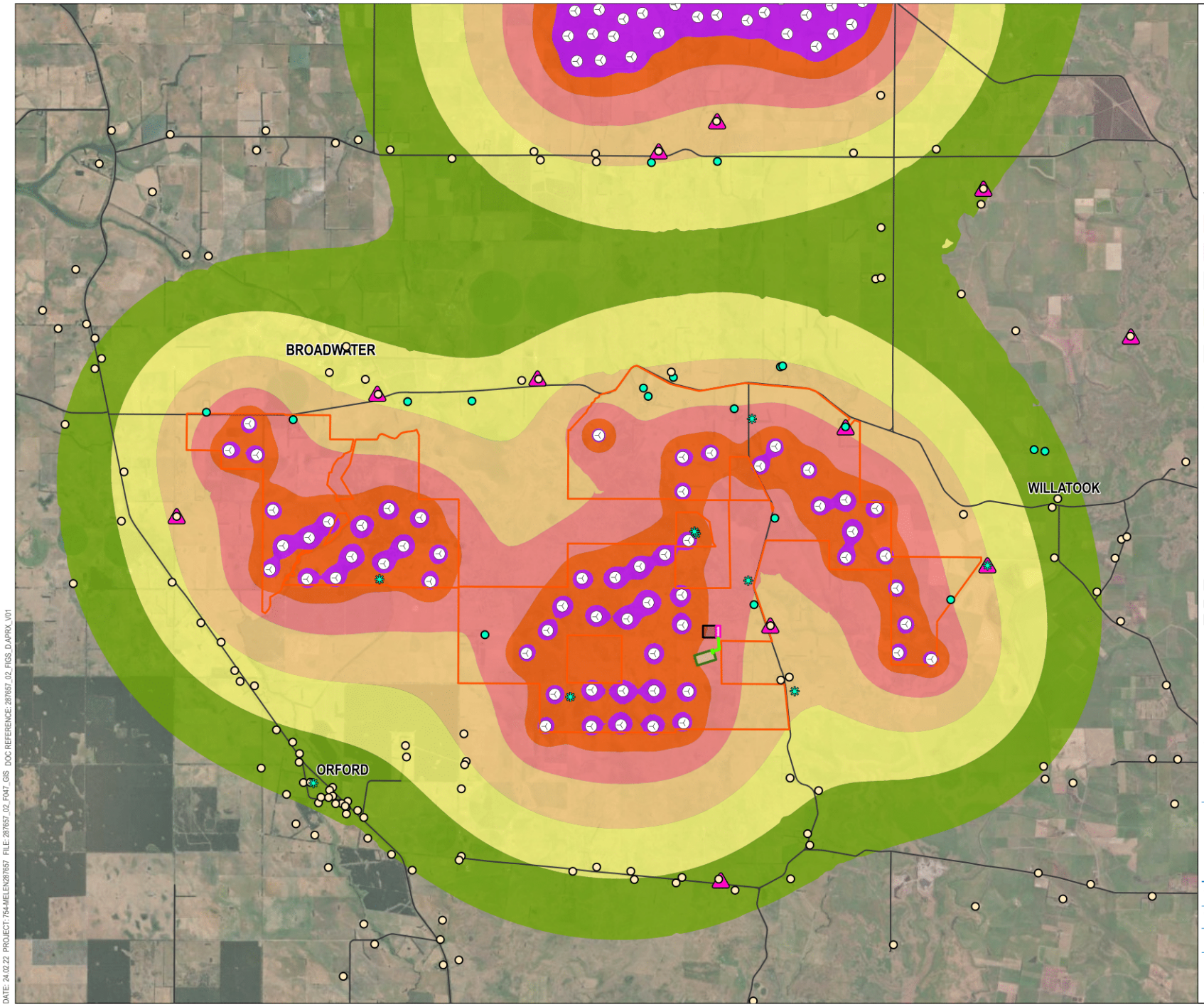
There are four wind farms within 15 kilometres of the project site that are either in operation or have received planning approval (i.e., Ryan Corner, Hawkesdale, Woolsthorpe and Macarthur Wind Farms). Based on the distance between the project and these wind farms no cumulative noise impacts are predicted. Nonetheless, the closest operating wind farm to the project (the Macarthur Wind Farm, located approximately 6 kilometres north from the closest proposed project wind turbines) was assessed quantitatively.

The cumulative noise assessment was based on Vestas ‘V112-3.0’ wind turbines for the Macarthur Wind Farm, with a hub height of 84 metres above ground level. Predictions were made for high wind speeds using both the ISO 9613 and CONCAWE noise models for sensitive receptors downwind of both wind farms. This is a conservative modelling approach as it considers the highest noise levels from both the project and Macarthur Wind Farm turbines.

The results for both models are shown in the noise prediction contours for the highest predicted noise level wind speed (11 metres per second) (see Figure 24.3 (CONCAWE) and Figure 24.4 (ISO 9613)). Modelling predictions indicate that the noise level at high wind speeds at non-stakeholder dwellings between the two wind farms would be less than 40 dB(A). As such, the baseline noise criteria of 40 dB(A) for all wind speeds at all dwellings between the Macarthur and the project wind turbines would be achieved.

There may be instances where a residence becomes downwind of turbines more often, resulting in wind farm noise being audible more often. For example, at a given dwelling, the noise from project may be more audible under a southerly wind direction and the noise from the Macarthur Wind Farm may be more audible under a northerly wind direction. The wind rose for the area near the wind farm indicates that southerly conditions occur more often during summer, resulting in the highest noise levels from the project, while northerly conditions are more common during winter and would result in the highest noise levels occurring from the Macarthur Wind Farm. However, the cumulative noise assessment has considered the residences being downwind of both windfarms, and determined that the objective noise criteria under the New Zealand Standard NZS6808:2010 *Acoustics - Wind Farm Noise* would still be satisfied at all times.

Noise modelling for ancillary infrastructure, such as the project on-site substation and battery energy storage system, also considers the noise from the existing substations associated with the nearby Macarthur Wind Farm. This modelling demonstrated compliance of the relevant noise criteria of EPA Victoria Publication 1826.4 (Noise Protocol), including the 34 dB(A) night time criteria.



LEGEND

- Noise monitoring location
- Turbine location
- Non-involved stakeholder dwelling
- Involved stakeholder dwelling
- Dilapidated dwelling
- Major road
- Willatook Wind Farm boundary
- Substation 33kV/220kV
- Battery energy storage system
- Transmission line and grid connection infrastructure
- Tarrone Terminal Station

Noise level (db(A))

- >= 25
- >= 30
- >= 35
- >= 40
- >= 45
- >= 50

Noise (dBA) modelled using Vestas V162 model at a wind speed of 11m/s at a hub height of 149 meters.

SOURCE:
Willatook Wind Farm boundary, dwellings, noise contours and noise monitoring locations from Wind Prospect.
Roads and watercourses from Vicmap.
Imagery from ArcGIS Online (various capture dates).

N

0 1 2 km

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PROJECTION: **GDA 1994 MGA Zone 54**

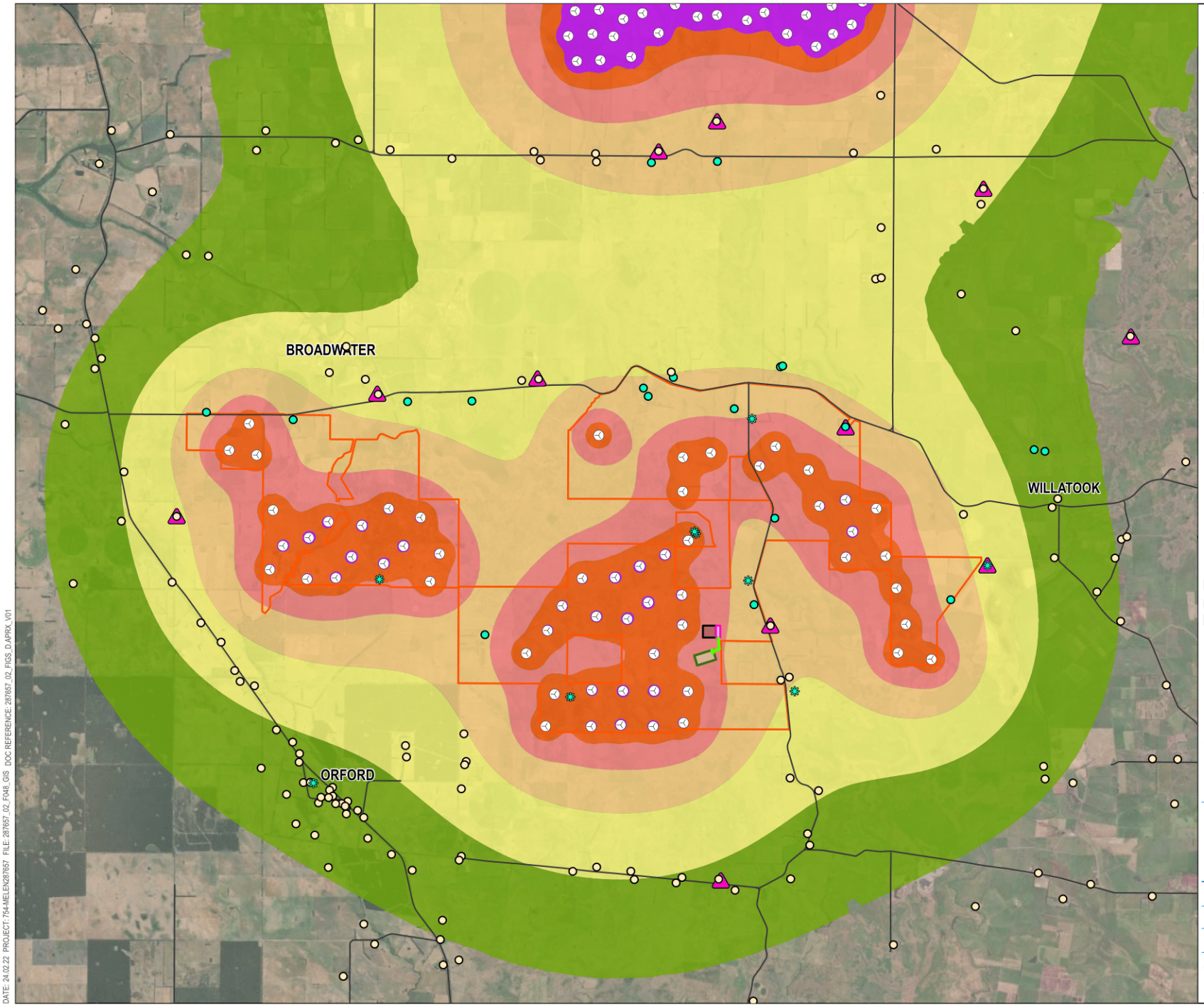
WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 24.3

CONCAWE cumulative noise prediction contours

DATE: 24.02.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F047_GIS DOC REFERENCE: 287657_02_FIGS_D.APRX_V01



LEGEND

- Noise monitoring location
- Turbine location
- Non-involved stakeholder dwelling
- Involved stakeholder dwelling
- Dilapidated dwelling
- Major road
- Substation 33kV/220kV
- Battery energy storage system
- Willatook Wind Farm boundary
- Tarrone Terminal Station
- Transmission line and grid connection infrastructure

Noise level (db(A))

- >= 25
- >= 30
- >= 35
- >= 40
- >= 45
- >= 50

Noise (dBA) modelled using Vestas V162 model at a wind speed of 11m/s at a hub height of 149 meters.

SOURCE:
Willatook Wind Farm boundary, dwellings, noise contours and noise monitoring locations from Wind Prospect.
Roads and watercourses from Vicmap.
Imagery from ArcGIS Online (various capture dates).

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SCALE 1:100,000
PAGE SIZE: **A4**
PROJECTION: **GDA 1994 MGA Zone 54**

WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 24.4

Cumulative ISO 9613 prediction model noise contours

DATE: 24.02.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F048_GIS DOC REFERENCE: 287657_02_FIGS_D.APRX_V01

24.5.3 Biodiversity

As discussed in Chapter 12 – *Biodiversity and habitat*, the key impact pathways with the potential to impact biodiversity relate to land disturbance during construction, and collision of birds and bats with operating wind turbines.

With each project added to the landscape there is land disturbance and some vegetation clearance. These areas of vegetation clearance are required to be offset in accordance with *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP, 2017b).

During the operation of wind farms, some birds and bats are known to collide with turbine blades. Some species are more susceptible based on their flying behaviour, for example, high flying species and those that are less manoeuvrable (see Chapter 12 – *Biodiversity and habitat*). Monitoring of bird and bat deaths from turbine collisions is now routine for operating wind farms. Modelling of this data collected from ten operating wind farms in western Victoria has predicted that the rate of bird deaths for large turbines is likely to between 5 and 7 bird and 7 and 11 bat mortalities per turbine per year (Symbolix, 2020). If the project was constructed there would be expected to be some bird and bat deaths from collisions with wind turbines, as would other operating wind farms in the region.

Bird species

Bird species likely to be affected are typically common and broadly distributed species that are not threatened. Moloney et al. (2019) showed that the most frequently recorded bird species that died from collisions at 15 Victorian wind farms between 2003 to 2018 were the Australian Magpie and Wedge-tailed Eagle, followed by the Nankeen Kestrel, Brown Falcon and Eurasian Skylark. Nature Advisory concluded that bird deaths as a result of collisions with operating turbines was very low to low. Species at higher collision risk, such as high-flying species or those that are less manoeuvrable (e.g., raptors), were not predicted to experience greater impacts since they were either unlikely to regularly occur or may occur irregularly in low numbers (see Chapter 12 – *Biodiversity and habitat*).

While each wind farm would be expected to have an impact on the local bird population, given distances between wind farms, the cumulative impact is predicted to be **low**.

Bat species

Bat species likely to be affected by collision deaths include the White-striped Freetail Bat, Gould's Wattled Bat and Eastern False Pipistrelle. Moloney et al. (2019) identified these bat species accounted for 83% of all recorded deaths in post-construction monitoring of bat deaths for 15 Victorian wind farms. These species are susceptible as they typically fly higher than most other species of Victorian bats. Each of these species are common species that are widely distributed in Australia and none are considered threatened. As bat activity in the project site is comparatively lower than for other wind farm sites in the region, the cumulative impact to the bat community generally from the project is assessed as **low**.

As the Southern Bent-wing Bat has been recorded in the project site there is a risk that it may collide with operating turbines. Based on post-operation monitoring of bat collision deaths, eight known records of Southern Bent-wing Bat collisions are known to have occurred (Symbolix, 2020). Two deaths were recorded from the Macarthur Wind Farm and the remainder from a coastal location.

The *National Recovery Plan for the Southern Bet-wing Bat Miniopterus orianae bassanii* (DELWP, 2020) states that the impacts from wind farms on the population are unclear at this stage, however, it is possible that any wind farm built close to a significant roosting site could have a major impact on that population. This risk increases the closer the wind farm is to a maternity site or migratory route. Risks include cave destruction during construction, mortalities due to collisions and altered access to foraging areas (DELWP, 2020).

Utilisation rates of Southern Bent-wing Bat within the project site are far lower than other approved wind farms and minimum blade height is higher than the Macarthur Wind Farm (where Southern Bent-wing Bat collisions have occurred), which suggests that the cumulative impact will be lower than for other approved wind farm projects (Appendix D – *Biodiversity*). Given the very low activity levels of Southern Bent-wing Bat recorded on the project site, the lack of records in locations and proposed heights of project wind turbines, the lack of suitable foraging habitat where project wind turbines are proposed and the distance to the closest maternity roosting site, there is a very low likelihood of a collision by this species with turbines in the Willatook Wind Farm over the life of the project. As such, additional cumulative impacts as a result of the project were assessed to be low.

24.5.4 Brolga

The *Interim Guidelines for the Assessment, Avoidance, Mitigating and Offsetting of Potential Wind Farm Impacts on the Victorian Brolga Population* (Interim Brolga Guidelines) (Department of Sustainability and Environment, 2012) state that there is a requirement to avoid cumulative impacts of the wind farm industry on the Victorian Brolga population. The specific objective of these guidelines is to manage each wind farm development to achieve a zero net impact on the Brolga population, with an overall objective to avoid cumulative impacts of multiple wind farms operating independently within the Brolga range in Victoria.

There are 20 wind farms within the Brolga range (i.e., within roughly 100 kilometres of the project site) that are either operating, approved or have started their public development approval process.

It is possible that these wind farms could lead to an increased risk of collision as an individual Brolga ranges across the area that includes these projects. This may be particularly pertinent to the Brolga as during the non-breeding season they may fly up to 100 kilometres in a short time between habitats (Appendix C1). However, to date, there have been no reported collisions of Brolga associated with wind farm infrastructure.

As each wind farm has been assessed for its impacts on the Brolga in different ways, it is not possible to combine quantitative estimates of Brolga impacts and arrive at a definitive number of Brolgas affected. This is primarily because most of the information available on the impacts of these wind farms was prepared before the development of the consistent assessment method in the Interim Brolga Guidelines. Similarly, Maloney et al. (2019) note that “before the cumulative effect [on Brolga] of a newly proposed wind farm can be considered, it is first necessary for the effects of all other relevant wind farms to be quantified to a consistent standard and to be available. At present they are not readily available”.

The project has been assessed in accordance with the Interim Brolga Guidelines, using an approach agreed with DELWP. This assessment has used all available techniques in the guidelines to understand and mitigate the potential impact of the project on the Victorian Brolga population. Nature Advisory concluded that with the implementation of proposed design, management and compensatory measures, the project is not expected to lead to a significant incremental contribution to the cumulative impact of wind farms within the Brolga’s range in Victoria. These findings were supported by Biosis, who conducted a peer review of Nature Advisory’s assessment and concluded that it is unlikely the project would result in an impact on the Victorian population of the species.

24.5.5 Social and economic

Ethos Urban (Appendix I) note the potential impacts to the community’s cultural connections to the land, particularly to intangible values, due to the presence of new wind turbines within a largely agricultural setting. Cumulative impacts could be associated broader transition from one that was largely agricultural in character to one that is characterised by a mix of wind farms and agricultural uses on a regional scale. There may also be negative perceptions of the region becoming concentrated with wind farms. Associated with this would be a sense that there is continual development in the region with progressive wind farms being built.

Ethos Urban also note that as more wind farms become operational in the region there may be changes to character and sense of place. These impacts were rated to be of medium social significance (see Chapter 17 – *Socio-economic*).

The economic assessment concluded that because of the development of the Willatook Wind Farm there would be a range of economic benefits associated with:

- employment opportunities during construction and to a lesser extent operations (both direct and indirect jobs), resulting in increased spending within the region
- significant capital investment, of which 15% was predicted to be retained in the region
- ongoing economic stimulus associated with the operation of the project through the financial returns to stakeholders (host landowners), local wage spending, community fund payments and Council financial returns.

Similar economic benefits, dependent on the scale of other developments, would be expected. These would therefore provide cumulative economic benefits across the region.

24.5.6 Cultural heritage

Aboriginal cultural heritage

The Aboriginal cultural heritage assessment (Appendix J) considered the potential cumulative impacts to Aboriginal cultural heritage.

Numerous archaeological investigations of the volcanic plain of western Victoria have found the area to be sensitive for Aboriginal cultural heritage. However, unlike residential subdivisions surrounding Melbourne metropolitan regions, which are more likely to experience blanket-like disturbance and resulting impacts to sites of Aboriginal cultural heritage, most developments in the south-west region of the volcanic plains have tended to be linear in nature, such as fibre-optic cable routes, pipelines, electricity transmission lines and wind farms. These developments have greater flexibility to avoid areas of cultural heritage sensitivity and disturbance is limited in any one location.

Smaller artefact scatter sites and low density artifact distributions of low significance are common across the wider Victorian landscape and are often destroyed, either under an approved CHMP or Cultural Heritage Permit. The cumulative impacts from development-related disturbance to this type of site both within the wider region and more locally is likely to be reasonably high. However, within the geographic region of the project, archaeological reports have identified a sparse range of low density artefact scatters or isolated artefacts, with a small number of earth features being recorded. Investigations for the project identified one stone artefact scatter within the investigation area in addition to a previously recorded earth feature (mound). Design measures resulted in these areas of known Aboriginal cultural heritage being avoided.

A CHMP (no. 11090) has been prepared for the project and will be finalised, in consultation with the Registered Aboriginal Parties, and submitted to First Peoples – State Relations Group for evaluation once the Minister for Planning has made an assessment on this EES. The approved CHMP will contain conditions for the management of known Aboriginal heritage places, and contingency plans for the unexpected discovery of Aboriginal cultural heritage and human remains. These conditions would ensure that any potential impacts are avoided or minimised.

The cumulative impact from the project to Aboriginal cultural heritage is low.

Historic cultural heritage

The historic cultural heritage assessment (Appendix K) concluded that with design avoidance measures implemented, no impacts on listed sites of historical heritage value are anticipated. Impact to a dry stone wall would be minimised, but could not be completely avoided.

Cumulative impacts to historic cultural heritage are predicted to be negligible.

24.5.7 Geoheritage

There are existing and proposed wind farms on other parts of the Mount Rouse lava flows, and on other stony rises (young lava flows) in the Newer Volcanic Province of Victoria. As such, there is a potential cumulative impact of existing and proposed wind farms on the geoheritage features of the Newer Volcanic Province.

The DELWP wind energy projects website[2] lists a total of 52 wind energy facilities in Victoria (as at 29 August 2021) in various stages. Of these, 27 occur on parts of the Newer Volcanic Province. Within the Newer Volcanic Province, a total of 15 wind farms are operating, four are under construction, four are approved but not yet constructed, and four have a planning permit application lodged or planning process underway.

As noted in Appendix A – *Geoheritage*, some of these wind farms have completed detailed geoscience studies to assess individual impacts, and presumably informed the design of each project to some degree. These include Macarthur, Cape Bridgewater, Crowlands, Dundonnell, Stockyard Hill and Mt Fyans wind farms. The degree to which geoheritage/geoscience features were considered for the remainder of the wind farms is not clear and as such a thorough standardised assessment across the region was not possible.

The total project construction footprint is estimated to be up to 222.3 hectares (or 5.4% of the site). This includes an area of up to 99.5 hectares (or 2% of the site) that would be used for the life of the project and 122.8 hectares that would be rehabilitated once construction is complete. As noted in Appendix A – *Geoheritage*, the construction and operation of the proposed Willatook Wind Farm would not significantly compromise the high level of geoscience significance of the site and the broader aspects of Mount Rouse and associated lava flows exposed at the project site. While there are residual effects on specific areas within the site (see Chapter 8 – *Geoheritage*), in the context of cumulative impacts within the broader Newer Volcanic Province of Victoria these are unlikely to be significant.

24.5.8 Groundwater and surface water

Residual impacts to groundwater and surface water following the implementation of design measures and management controls were assessed to be very low to low, with impacts being temporary (i.e., during the construction of the project) and localised within the project site. While the construction of other approved wind farms such as Ryan Corner, Hawkesdale and Woolsthorpe wind farms are likely to experience similar groundwater and surface water impacts these were not predicted to interact or become cumulative.

24.5.9 Traffic

As described in the traffic and transport impact assessment report (Appendix G), the key phase of project development that would affect traffic and roads is during construction. As such, a key determining factor for potential cumulative traffic and transport impacts is overlapping construction periods. As noted in Section 24.3, it is likely that construction of the Hawkesdale and Ryan Corner wind farms would be completed by the time that construction of the Willatook project commences. Based on publicly available information regarding the proposed timing of construction of the Woolsthorpe and Mount Fyans wind farms there is the possibility of some overlap with the Willatook project.

The other determining factor that influences cumulative traffic and transport impacts would be the overlap (sharing) of key transport routes by other wind farm projects under construction. As such, site access for the neighbouring wind farms yet to be constructed was considered in the traffic and transport cumulative impact assessment.

A summary of the cumulative traffic and transport impact assessment, which considered other wind farm projects within the region that may have overlapping construction periods with the Willatook Wind Farm is presented in Table 24.3.

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2 https://www.planning.vic.gov.au/permits-and-applications/specific-permit-topics/wind-energy-facilities/wind-energy-projects-planning (accessed 29 August 2021)

Table 24.3 Cumulative traffic and transport impact assessment

Wind farm	Proposed site access	Interaction with Willatook Wind Farm
Ryan Corner	Youls Road and Hamilton-Port Fairy Road	The project is proposing to use the Tyrendarra-Ettrick Road north and then Woolsthorpe-Heywood Road in an easterly direction. As such, there would be minimal potential traffic route overlap, except for both using the Princes Highway which, as a major highway, could accommodate the expected traffic volumes of both projects.
Hawkesdale	Primarily via Penshurst-Warrnambool Road, and from Woolsthorpe-Heywood Road shortly after the intersection with Penshurst-Warrnambool Road	The Willatook Wind Farm project is not proposing to use Penshurst-Warrnambool Road as a main access route. Both projects would use the Woolsthorpe-Heywood Road, however, the Hawkesdale Wind Farm would only use a short section (approximately 3 kilometres) around 10 kilometres east of the project site. Woolsthorpe-Heywood Road is an arterial C class road.
Woolsthorpe	Princes Highway, northbound along Warrnambool-Caramut Road to Woolsthorpe-Heywood Road, and then into the site via Slatterys Road	Should construction activity for both the Willatook project and Woolsthorpe Wind Farm project overlap, traffic volumes on Woolsthorpe-Heywood Road, west of the Penshurst-Warrnambool Road and past the Willatook project site would be as follows • Hamilton-Port Fairy Road to Point A: 118 vehicles per day (4% heavy vehicles or over size/over mass vehicles) – this is 11 vehicles more than estimated for the project alone • Point A to Tarrone North Road: 177–195 vehicles per day (12–21% heavy vehicles or over size/over mass vehicles) – this is 11–12 vehicles more than estimated for the project alone • From Tarrone North Road to the east: 310–370 vehicles per day (19–33% heavy vehicles or over size/over mass vehicles) – this is 11–13 vehicles more than estimated for the project alone. These traffic volumes represents a minor increase in expected traffic volumes above those generated to Woolsthorpe-Heywood by the Willatook project and would not require additional mitigation to what is proposed (see Chapter 15 – *Traffic and transport*).
Mount Fyans*	Port of Portland, approaching from the north via Lake Bolac	There is little potential for overlap with the Willatook Wind Farm construction and staff traffic.

* The traffic impact assessment for Mount Fyans Wind Farm has not been publicly released. As such, the proposed site access for this project has been assumed based on the approach used for the nearby Dundonnell and Salt Creek wind farms.

While each individual wind farm project would increase construction-related traffic, cumulative impacts because of concurrent construction activities are not predicted based largely on the projects being separated in time, but also differences in proposed site access routes and being geographically separated by six kilometres or more. On a broader regional scale, communities may see continual construction related traffic and heavy vehicles, for example while using regional arterial roads. Therefore, at this scale there may be a perception of continual construction development over a longer time period, compared to the construction period of a single project.

24.5.10 Land use

The use of the land for a wind farm is compatible with the farming and agricultural land use of the location. Through collaboration with stakeholders the project has been sited to allow the land to be maintained and continued for farming. Stakeholders would have more impacts than non-stakeholders as the construction and operation activities would occur on their land. However, agreements with stakeholders have been established to manage construction impacts, including how construction workers are to access and manage land. These agreements and management measures would reduce potential land use impacts.

Once in operation, the project would take around 100 hectares of land out of direct agricultural production and farming activities can continue around the infrastructure, representing approximately 2.4% of the project site. Other wind farms and infrastructure projects are likely to have a similar effect within their site boundaries.

Cumulative impacts to land use were assessed as negligible.

24.5.11 Air quality

The scale of potential impacts described in the air quality assessment (Appendix L) are not predicted to interact with other projects in the region.

No cumulative impacts to air quality are predicted.

24.5.12 Shadow flicker

As described in the shadow flicker assessment (provided in Appendix M), the maximum length of a shadow cast by a wind turbine blade that is likely to cause annoyance due to shadow flicker above a 'moderate level of intensity' was assumed to be 1,900 metres (i.e., 10 times the rotor diameter), based on the UK wind industry guidelines (Office of the Deputy Prime Minister, 2004). Beyond this distance the shadow is diffused such that the variation in light levels is not likely to cause annoyance.

Given the distance to other approved or operating wind farms is more than 6 kilometres, no cumulative shadow flicker impacts are predicted.

24.5.13 Electromagnetic interference

The electromagnetic interference assessment (Appendix N) concluded that it is possible that some radiocommunication services could experience cumulative impacts from the project. DNV conducted a high-level review for the potential for cumulative impacts based on the relative locations of neighbouring operating and approved wind farms.

Table 24.4 summarises the predicted electromagnetic interference-related cumulative impacts of the project in conjunction with neighbouring wind farms. For services where impact from the project itself was assessed to be either unlikely or non-existent, it is expected that no cumulative impacts would occur.

Table 24.4 Potential for cumulative electromagnetic interference

Licence or service type	Potential for cumulative impact from the project and neighbouring wind farms
Radiocommunication towers	No cumulative impact predicted.
Fixed point-to-point links	No cumulative impact predicted, as the link path does not cross neighbouring wind farms.
Fixed point-to-multipoint links	No cumulative impact predicted, based on consultation responses.
Emergency services	Very low potential for cumulative impact.
Meteorological radar	Low potential for cumulative impact.
Trigonometrical stations	Very low potential for cumulative impact.
Citizen's band radio	Very low potential for cumulative impact.

Licence or service type	Potential for cumulative impact from the project and neighbouring wind farms
Mobile phones	Potential for cumulative impact where there are multiple turbines between the tower and the user.
Wireless internet	Potential for cumulative impact to services provided by mobile phone networks where there are multiple turbines between the tower and the user. No cumulative impact to NBN fixed wireless signals as the signal lines of sight do not cross multiple wind farms.
Satellite television and internet	No cumulative impact predicted.
Radio broadcasting	Potential for cumulative impact where there are multiple wind turbines between the tower and the user.
Television broadcasting	Potential for cumulative impact to signals from the Warrnambool, Portland and Western Victoria towers received at dwellings located between the Macarthur Wind Farm and the project.

The greatest potential for cumulative electromagnetic interference-related impact is to broadcast digital television signals received at nearby dwellings. Given the proximity of the Macarthur Wind Farm and the locations of broadcast towers servicing the area, there is potential for increased interference to signals received from the Warrnambool, Portland and Western Victoria towers at dwellings located between the Macarthur Wind Farm and the project. However, feedback from BAI Communications (who are responsible for broadcasting of national public television services in Australia) indicates that cumulative impacts are likely to be minimal.

There is also some potential for increased interference to other point-to-area services including mobile phone and FM radio signals, specifically in areas with marginal coverage or where there may be multiple wind turbines between the user and the transmission tower. Cumulative impacts to other services, including point-to-point links and NBN fixed wireless internet signals, are not expected.

As described in Chapter 22 – *Electromagnetic interference*, the project would conduct a pre-construction signal survey of the average television, FM radio and point-to-area reception strength around the project. This would assist in refining the predictions for cumulative impacts. Where interference to television services is not eliminated through turbine design and siting, a mitigation strategy would be developed and implemented in consultation with homeowners and service providers to restore the affected service to at least the quality determined in the pre-construction Signal Strength Survey.

24.5.14 Aviation

The aviation impact assessment, prepared by Chiron Aviation Consultants (provided in Appendix O), concluded that the potential for the project to impact aviation operations is low and would not pose a hazard to aircraft safety following the implementation of design measures. These design measures include establishing buffers around local airstrips, incorporating the recommendations of the Country Fire Authority (2022) *Design Guidelines and Model Requirements Renewable Energy Facilities* for aerial and ground-based firefighting, and committing to marking the meteorological monitoring masts in accordance with the *National Airports Safeguarding Framework Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation* to improve visibility of these structures for low-flying aircraft.

With each additional wind farm that is constructed, there are more large structures (i.e., wind turbines) that pilots (primarily those flying Visual Flight Rules, i.e., clear weather) must avoid.

24.6 Conclusions

Cumulative impacts arise from activities throughout an area or region where each individual effect may not be significant if taken in isolation, but when combined may be significant. The potential for cumulative impacts was considered by technical specialists in relation to their respective discipline.

Cumulative visual impacts may result due to the presence of multiple power-generating infrastructures (e.g., wind turbines), transmission lines and/or substations in the project region. These cumulative impacts can occur either as a result of sequential views or simultaneous views. Viewers travelling along highways and local roads within the area would likely experience views that take in the project and other wind farms sequentially. There are few locations where simultaneous views of the project and another wind farm may be possible due to the topography and vegetation screening that partially filter views for road users. Cumulative visual impacts from individual dwellings involving simultaneous views of Willatook and other wind farm turbines would also be possible.

The project would not increase the noise levels or result in non-compliance with the noise criteria when the Ryan Corner, Hawkesdale or Woolsthorpe wind farms are also considered as they are too far away. The potential cumulative impacts of the closest operating wind farm to the project, the Macarthur Wind Farm, were conservatively modelled approach (i.e., with the noise receiver being downwind of both the Macarthur and project wind farms). This modelling predicted that noise levels at non-stakeholder dwellings would be less than 40 dB(A), which would achieve regulated noise criteria for all wind speeds at all dwellings between the Macarthur and the project wind turbines.

Cumulative impacts to flora and fauna were considered greatest during operation of the project due to collisions of birds and bats with wind turbine blades. If the project was constructed some bird and bat deaths from collisions with wind turbines would be expected, as would other operating wind farms in the region. Species predicted to be impacted are widely distributed and not threatened. As such, the impact of these collisions is assessed as low. The species most at risk of cumulative impacts is the Southern Bent-wing Bat, which has been recorded in the project site and other wind farm sites. Based on the very low activity levels of the species at Willatook, including no records at heights of the proposed wind turbines, the project is unlikely to result in cumulative impacts to the species.

In terms of social and economic aspects, there may be cumulative impacts associated with the broader transition from a landscape primarily agricultural in character to one that is characterised by a mix of wind farms and agricultural uses. For some people this may be negative and could alter their sense of place. For others this may be positive. There would also be a range of benefits associated with employment opportunities, particularly during construction, and broader economic benefits to the region.

Cumulative traffic impacts would be most significant during the construction phase. Should construction activity for both the project and Woolsthorpe Wind Farm overlap, a minor increase in traffic volumes on Woolsthorpe-Heywood (of around 11 to 13 vehicles per days) are anticipated. Additional management measures above what are proposed for the project are not required.

While cumulative impacts for most aspects were assessed as unlikely to occur or have the potential for a low or negligible effect to environment and amenity, cumulative visual impacts from individual dwellings involving simultaneous views of Willatook and other wind farm turbines would be possible, and changes to character and the community's sense of place may occur as more wind farms become operational in the region.