Liverpool Range Wind Farm

Fact Sheet
14
October 2021

Transmission Line Fact Sheet

The Liverpool Range Wind Farm project proposes to build approximately 100 km of overhead transmission line from within the wind farm site to the proposed network connection point at Ulan, generally parallel to Ulan Road. No major changes are proposed to the route proposed by the Approved Project.

Given the varied and complex topography of the wind farm site and along the external transmission line route, it is likely that the transmission line infrastructure will be a combination of poles and towers, which are typically constructed of galvanised steel to a height of approximately 30-50 m. Towers can be as tall as around 70 m.

We are aware that TransGrid is currently undertaking investigations into delivering new transmission line infrastructure in the area that will service the NSW Government's Central-West Orana Renewable Energy Zone (REZ). We understand that there may be some confusion about how the Liverpool Range Wind Farm and TransGrid's Central-West Orana Transmission Line projects relate.

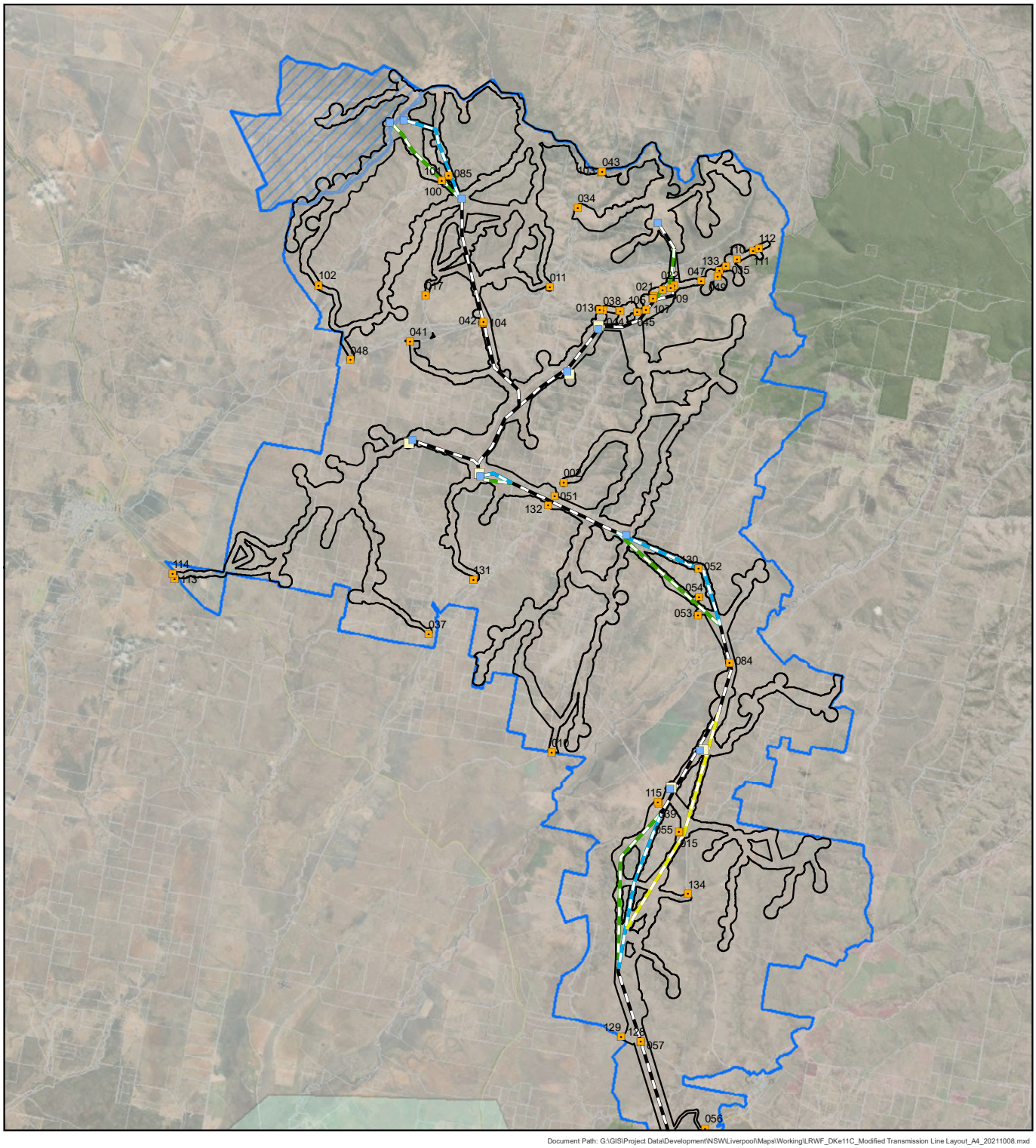
The Liverpool Range Wind Farm project does not depend on the TransGrid proposal to connect into the national grid. The Liverpool Range Wind Farm project is at a much more advanced stage in terms of design resolution, environmental investigations and approvals, and delivery strategy, and is therefore currently being progressed on the basis that it will connect into the grid at Ulan via the transmission line route that was approved in 2018.

In the event that construction and commissioning timeframes align, opportunities to connect the Liverpool Range Wind Farm project into TransGrid's Central-West Orana Transmission Line will be explored further.

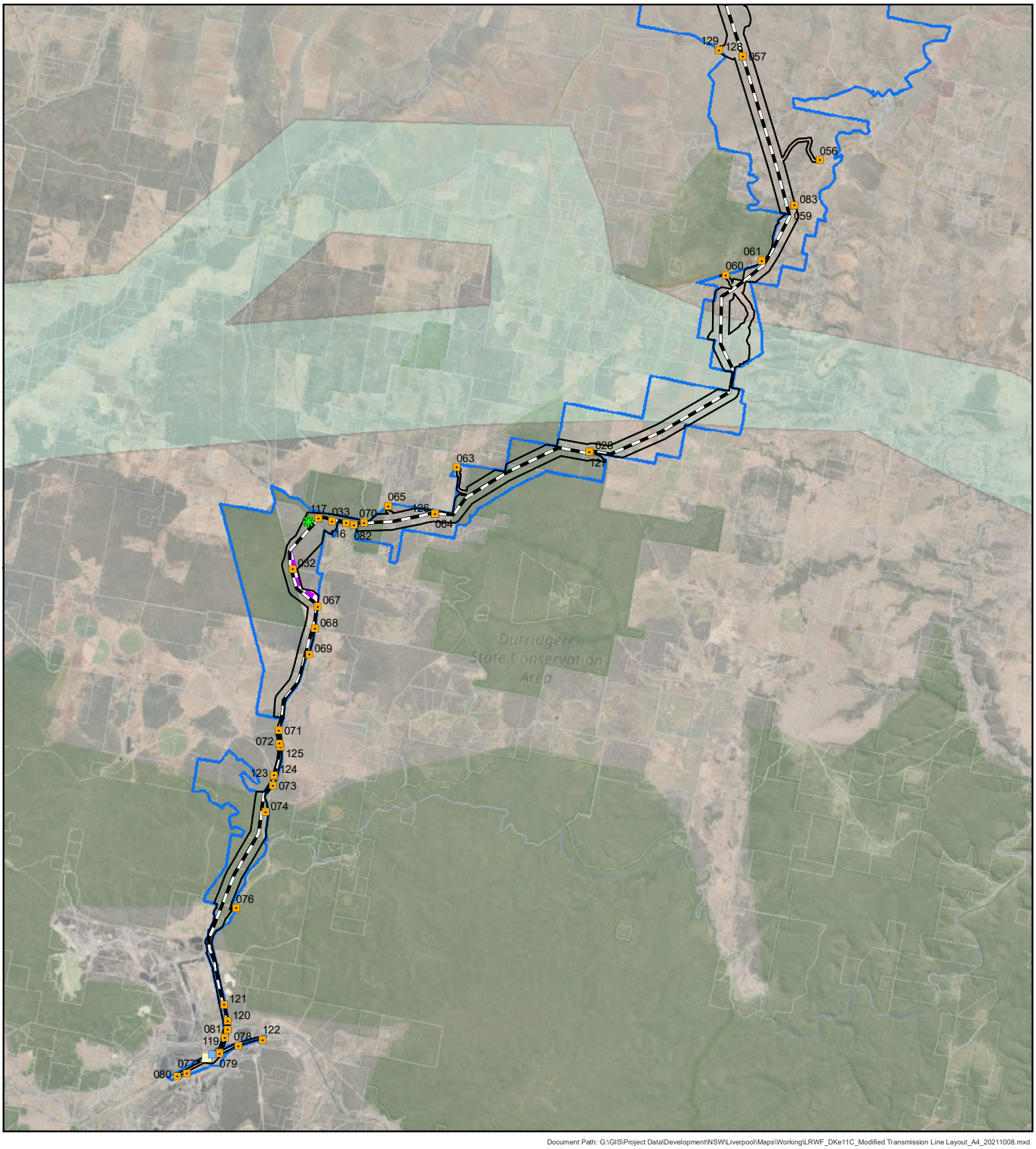
Flat top strain tower

Double circuit strain pole

Modified Transmission Line layout



Modified Transmission Line Layout



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Legend

- Modified Site Boundary
- Modified Development Corridor
- Cadastral Boundary
- TransGrid Central West Orana Transmission Line Study Corridor
- Potential Bench Location
- Potential Site Access Points
- Potential Battery (BESS) Locations
- Potential Substation Locations
- Transmission Line
- Alternate Transmission Line (under negotiation - to be confirmed)

N

Date: 08/10/2021
Version: C

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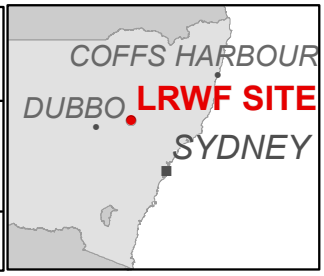
Kilometres

GCS GDA 1994
1:157,390



Transmission line design considerations

Construction of transmission lines through steep terrain is extremely difficult and Tilt Renewables has engaged a specialist overhead line designer to come up with with viable project design solutions for the Liverpool Range Wind Farm.

Access tracks will be required to construct the transmission line and just like wind farm access tracks, there are key parameters that these access tracks must meet so that the structures can be accessed safely and efficiently by concrete trucks and cranes. One of the most important parameters is that access tracks should generally be no steeper than a 17% gradient. Between the ridge lines at the Project site, the gradient of the land in most places is significantly higher than 17%, meaning that in many locations it is extremely difficult to design access tracks to the transmission line directly from these ridge lines. Therefore, towers must be installed at some of these locations to cover the expansive distance between the two ridges. In some locations, helicopters may be required to install the towers to replace the need for access tracks.

POLES VS TOWERS

When designing a transmission line, it is beneficial to take the most direct route between two points and minimise any direction changes in the line. Direction changes increase the forces on the structures. Often, two structures are required to support the line on a significant bend. This increases the number of required structures and the overall cost.

Poles are suitable for alignments in simple terrain where access is easy and mechanical loading is low. Poles do best when used for alignments with regularly spaced spans of up to **450 m**.

Towers are suitable for alignments in complex terrain where access is either difficult or not possible and mechanical loading is high. Towers do not need to be spaced at regular intervals and can be used to span distances of up to **1500 m** with minimal issues.

The use of towers allows for longer spans to be achieved, which in-turn results in a number of key benefits:

- Longer spans means that fewer structures can be used for the same distance.
- Fewer structures mean fewer access tracks, significantly reducing ground disturbance and impacts to vegetation.
- Fewer access tracks also offer security benefits as there are fewer locations for the public to access and traverse the site.
- Towers can be strategically located along and between ridges at points that are easily accessible from the planned wind farm access tracks – resulting in long, straight sections of transmission. This contrasts with a standard pole construction that requires regular spacing and smaller spans, resulting in more direction changes in complex terrain where suitable locations are sparse.
- Having a greater degree of flexibility with tower span length means less vegetation removal. Where towers can span over greater distances there is the potential to reduce impacts to sensitive areas such as lower height native vegetation, watercourses and associated riparian zones, and recorded cultural heritage artefacts and places.

In complex terrain, such as within the wind farm site generally north of the Golden Highway, it is likely that tower structures will be required at many locations.

Further detailed design work is required on the section of the transmission line generally between the Golden Highway and Ulan to understand whether poles or towers (or a combination of both) will be used. Typically, ownership and management of transmission lines between the last on-site collector substation within the wind farm site and the point of connection into the grid are transferred to the Transmission Network Service Provide (TNSP). As such, detailed design of this section of the transmission line will be undertaken in consultation with TransGrid to determine the infrastructure that will ultimately be constructed.

Where will the Liverpool Range Wind Farm connect to the grid?

The wind farm is currently being designed to connect to the National Electricity Market via TransGrid's existing 330 kV Wellington-Wollar transmission line at Ulan. A new transmission line between the wind farm and point of connection at Ulan is required. The proposed transmission line will be approximately 100 km in length: approximately 50 km external to the wind farm and 50 km internal of the wind farm site.

Are there changes to the Transmission Line under the proposed Modified Project?

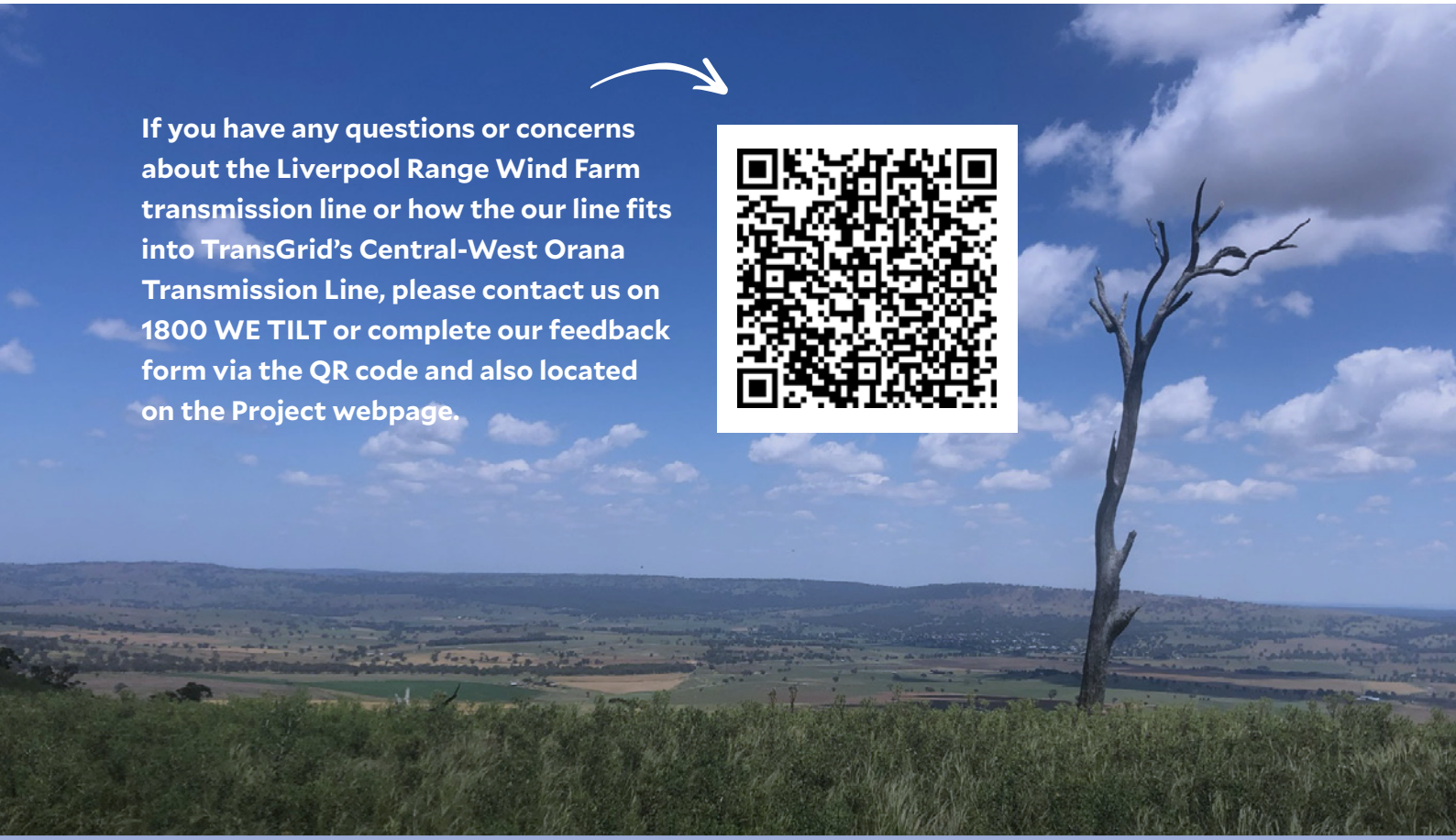
The design review and layout optimisation work undertaken since 2019 has identified changes to the Approved Project that would allow the Project to be built and operated more efficiently.

Drawing on updated knowledge and experience with wind farm construction, we are proposing several changes to the approved transmission line alignment, the large majority of which are contained within the wind farm site.

Internal to the wind farm site, the proposed changes in transmission line alignment are largely driven by the generally complex topography, revised turbine layout and collector substation locations, and recommended separation distances between the transmission line and turbines along the steep ridge lines. Given the complex topgraphy, it is likely that a combination of transmission line poles and towers will be required within the wind farm site, which is consistent with the Approved Project.

External to the wind farm site between Cassilis and Ulan, the proposed transmission line generally follows the approved alignment.

We are investigating an optional realignment of a short section of the transmission line to avoid a portion of the Durridgere Conservation Area (subject to landowner negotiations). In addition, we have attempted to negotiate with relevant landholders to achieve greater separation distance from the Hands on Rock cultural heritage site along Ulan Road, however those negotiations have not been successful to-date.



If you have any questions or concerns about the Liverpool Range Wind Farm transmission line or how the our line fits into TransGrid's Central-West Orana Transmission Line, please contact us on 1800 WE TILT or complete our feedback form via the QR code and also located on the Project webpage.

Frequently asked questions

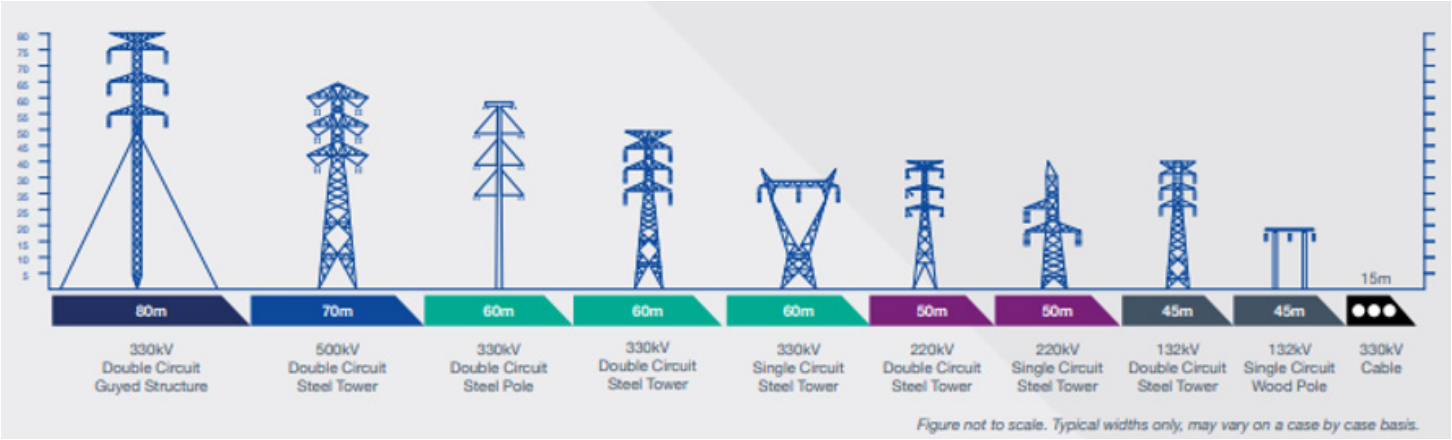
WHAT IS A TRANSMISSION LINE EASEMENT?

Easements are formally acquired interests, registered on property titles and are in place to:

- Protect the safety of people living, working or playing near electricity infrastructure by controlling activities under or near the network.
- Provide the Operator (TransGrid) with the right to safely access, operate, maintain and upgrade the network.
- Enable the Operator to undertake vegetation maintenance to prevent bush fire hazards and protect the transmission infrastructure from being damaged.

HOW WIDE ARE TRANSMISSION LINE EASEMENTS?

The width of transmission line easements vary depending upon the operating voltage, design of the transmission line, the length of the conductor span between structures and local terrain. The figure below shows typical easement widths recommended by TransGrid. Generally, the higher the voltage the wider the easement required. The specific location and size of the easement across property is identified on the registered plan of title.



Photomontage 15 - section of Yarrawonga Rd, Cassilis (Modified Project view)

WHY NOT PUT THE TRANSMISSION LINE UNDERGROUND?

Underground lines have a much larger construction footprint than overhead lines. Laying underground cables requires digging wide and deep trenches and directional drilling, and still requires above-ground infrastructure. It also requires significant excavation and truck movements during construction compared to overhead lines. This would result in significantly more land disturbance, resulting in a much greater environmental, cultural heritage and land use impact, along with resulting in higher costs and a much less flexible alignment.

There are also a number of temperature/electrical performance, ongoing maintenance, fault identification and resolution issues associated with underground 330 kV cabling. Most importantly, and different to 33 kV underground cabling with the wind farm, if there is a fault along the 330 kV line, the entire wind farm is unable to export electricity to the grid, which would cause significant disruption to consumers, whereas a fault internal to the wind farm on the 33 kV lines would only affect that particular turbine cluster.

WHAT IS THE DIFFERENCE BETWEEN TRANSMISSION LINES AND DISTRIBUTION LINES?

Transmission lines generally transport electricity at high voltages (typically between 132 kV and 500 kV), between a power plant and a terminal substation where voltage is normally stepped down and connects into the distribution system. Transmission lines are always built with sets of three conductors with an optional small wire or two at the top of the structure to serve as lightning protection and telecommunications. Transmission lines can be supported by poles or towers, depending on topographic and ground conditions. While a typical residential service may only include a single phase, the electricity grid itself is a three-phase system and the transmission lines are meticulously balanced so that an equal amount of current flows on each of the three phases. Transmission line poles and towers typically do not have additional equipment such as fuses, switches, or transformers, attached to them.

Distribution lines, which consist of smaller, lower-voltage lines (under 33 kV in most situations), deliver power to homes and businesses. The number of energy-carrying wires on them is three or fewer and they tend to hold other equipment on them as well, such as transformers, fuses, switches, and even telephone and cable lines.

ARE THERE HEALTH IMPACTS FROM LIVING NEAR TO TRANSMISSION LINES?

According to the Australian Cancer Council and to the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), scientific evidence **does not** establish that exposure to extremely low frequency (ELF) electric and magnetic fields (EMF) found around the home, the office or near powerlines and other electrical sources is a hazard to human health.

ARPANSA maintains continual oversight of emerging research into the potential health effects of the EMF exposure from powerlines and other electrical sources in order to provide accurate and up-to-date advice. ARPANSA further asserts that although numerous studies have been done, there is no conclusive evidence that ELF causes cancer. Studies show either weak or no association with adverse health effects.

GOODS AND SERVICES REGISTER

To register interest in providing goods or services for the Project, please visit www.liverpoolrangewindfarm.com.au and complete the linked form under the Employment section.

SIGN UP & STAY INFORMED

If you haven't already, please subscribe to our newsletter to ensure you receive all Project updates and information. We understand that not everyone uses email, so we will be working with local businesses to host Project information packs such as the newsletter, fact sheets and maps. Subscribe to receive the newsletter by email or post, by contacting us at: liverpoolrangewindfarm@tiltrenewables.com

For more information, please visit the website below
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