EnergyCo

Central-West Orana Renewable Energy Zone Transmission project

Amendment Report

Appendix A: Updated project description

March 2024

energyco.nsw.gov.au

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A1 Project description

A1.1 Overview

A summary of the project is provided in Table A-1 and shown on Figure A-1. Section A1.2 provides a greater level of detail about each of the key components of the project and Section A1.3 describes the operational and maintenance aspects of the project. Land access and acquisition requirements for the project are discussed in Section A1.4, and an overview of the key construction features and construction activities of the project is provided in Section A1.5.

Table A-1 Project summary – operation

Project element	Summary	Figure reference
Project location	The project is located within the Warrumbungle, Mid-Western Regional, Dubbo Regional and Upper Hunter local government areas (LGAs) and generally extends north to south from Cassilis to Wollar and east to west from Cassilis to Goolma.	Figure A-1
Operation area	The operation area of the project would comprise the following permanent infrastructure: • a transmission line easement which would provide a right of access to maintain and operate the 500 kilovolts (kV) and 330 kV transmission lines and other operational assets • an operation area for the energy hubs at Merotherie (incorporating a maintenance facility next to the Merotherie Energy Hub) and Elong Elong • an operation area for the New Wollar Switching Station • an operation area for the 330 kV switching stations at Cassilis, Coolah, Leadville, Merotherie, Tallawang, Dunedoo, Cobbora and Goolma • access tracks along and to the transmission line easements • an operation area for the new microwave repeater sites at Botobolar and Cope. The operation area of the project is around 2,700 hectares but is subject to ongoing investigation and refinement and would be finalised as part of continued design development. In particular, the operation area is expected to increase at the Elong Elong Energy Hub due to the configuration of the initial 330 kV operation.	Figure A-2
Transmission lines	The transmission line network infrastructure that would be provided as part of the project would include: • twin double circuit 500 kV transmission lines and towers, which extend for around 90 kilometres, to connect the Merotherie and Elong Elong energy hubs to the National Electricity Market (NEM) via the New Wollar Switching Station. The Merotherie Energy Hub — Elong Elong Energy Hub connection would be built as part of this project to operate at 500 kV; however, would initially operate at 330 kV until a time when 500 kV operations at the Elong Elong Energy Hub commence • 330 kV network infrastructure around 150 kilometres in length, connecting selected renewable energy generation projects within the Central-West Orana Renewable Energy Zone (REZ) to the Merotherie Energy Hub and Elong Elong Energy Hub. This includes single circuit and double circuit 330 kV transmission lines and towers, extending from the Merotherie and Elong Elong energy hubs to nearby renewable energy generation projects • access tracks along and to the transmission line easements. These would be established initially to facilitate construction and retained for operational purposes. In some locations the 500 kV network would run alongside the 330 kV network.	Figure A-2, Figure A-3, Figure A-4 and Figure A-11

Project element	Summary	Figure reference
Energy hubs	Energy hubs are proposed at Merotherie and Elong Elong to connect 330 kV transmission lines from selected renewable energy generation projects within the Central-West Orana REZ to the project's 500 kV network infrastructure. An energy hub operating at 500 kV would typically comprise 330 kV and 500 kV switchyards, with power transformers, synchronous condensers, maintenance facility (at Merotherie only), and other supporting equipment and infrastructure including access roads, fencing and lighting. At Elong Elong, all of the earthworks, pads, foundations and access roads would be constructed to facilitate operation at both 330 kV and 500 kV, though initially, the energy hub would only be fitted out for 330 kV operation. The configuration for the initial 330 kV operation is expected to increase the operational area at the energy hub as shown in Figure 3-2 and Appendix B. Fit out of the 500 kV switchyard would only occur when demand within the Central-West Orana REZ is met. The Merotherie Energy Hub would operate at 500 kV but not all 500 kV infrastructure would be constructed and operated until demand within the REZ is met. All earthworks, pads, foundations and access roads would be constructed to facilitate operation of the Merotherie Energy Hub at full capacity. The operation of both the temporary and full-build configurations of the energy hubs form part of this project.	Figure A-2, Figure A-6 and Figure A-7
Switching stations	Fifteen switching stations located along the 500 kV and 330 kV network infrastructure comprising: • a new 500 kV switching station at Wollar (the New Wollar Switching Station) to connect the project to the existing 500 kV electricity network • fourteen 330 kV switching stations along the 330 kV network infrastructure at Cassilis, Coolah, Leadville, Merotherie, Tallawang, Dunedoo, Cobbora and Goolma. These switching stations would transfer the energy generated from renewable energy generation projects within the Central-West Orana REZ onto the project's 330 kV network infrastructure. The switching stations along the 330 kV network may in some cases allow multiple renewable energy generation projects to have an aggregated connection to the 330 kV network infrastructure, reducing the overall length of generator connections, and would also allow for potential future connections to additional renewable energy generation projects within the Central-West Orana REZ (subject to the outcomes of the competitive tender process for rights to access the new transmission infrastructure). Each switching station site would typically comprise a switchyard and other support equipment and infrastructure, including auxiliary service buildings, roads, drainage, fencing and lighting.	Figure A-2, Figure A-5 and Figure A-8
Communications infrastructure	Underground fibre optic communications cables would be provided to monitor and control the network infrastructure and generator performance, and would generally be located within the transmission line easement between: • the New Wollar Switching Station and the existing Transgrid Wollar Substation • the New Wollar Switching Station and energy hubs • the energy hubs and renewable energy generation projects, including the connecting switching stations and the 330 kV network infrastructure. A new microwave network would be established to provide a secondary communications link between the project and the existing electricity transmission and distribution network. New microwave repeater structures would be installed at two sites within the operation area at Botobolar and Cope, and additional microwave repeater infrastructure would be installed at two existing microwave repeater sites at Kandos and Galambine.	Figure A-9 and Figure A-10
Watercourse crossings	Communications infrastructure would cross around 28 watercourses through conduits installed below the watercourses. The project would not require any permanent watercourse crossings for access roads or access tracks. Temporary watercourse crossings may be required during construction where alternative vehicle access routes are impractical.	N/A

Project element	Summary	Figure reference
Operational maintenance facility	A maintenance facility would be located at the Merotherie Energy Hub to support the operational requirements of the project. The maintenance facility would be used as a base for the operation of the project and would include an office building, stores, workshop facilities, parking areas, water storage tanks, firefighting equipment and septic tank.	Figure A-6
Commencement of operation	Initial operations are projected to commence in late 2027 (subject to approvals and other factors).	N/A
Operational workforce	Variable with a peak operational workforce of up to 60 personnel, comprising a combination of office- and site-based roles.	N/A

The project would continue to be refined as part of continued design development. An overview of the project is shown in Figure A-1.

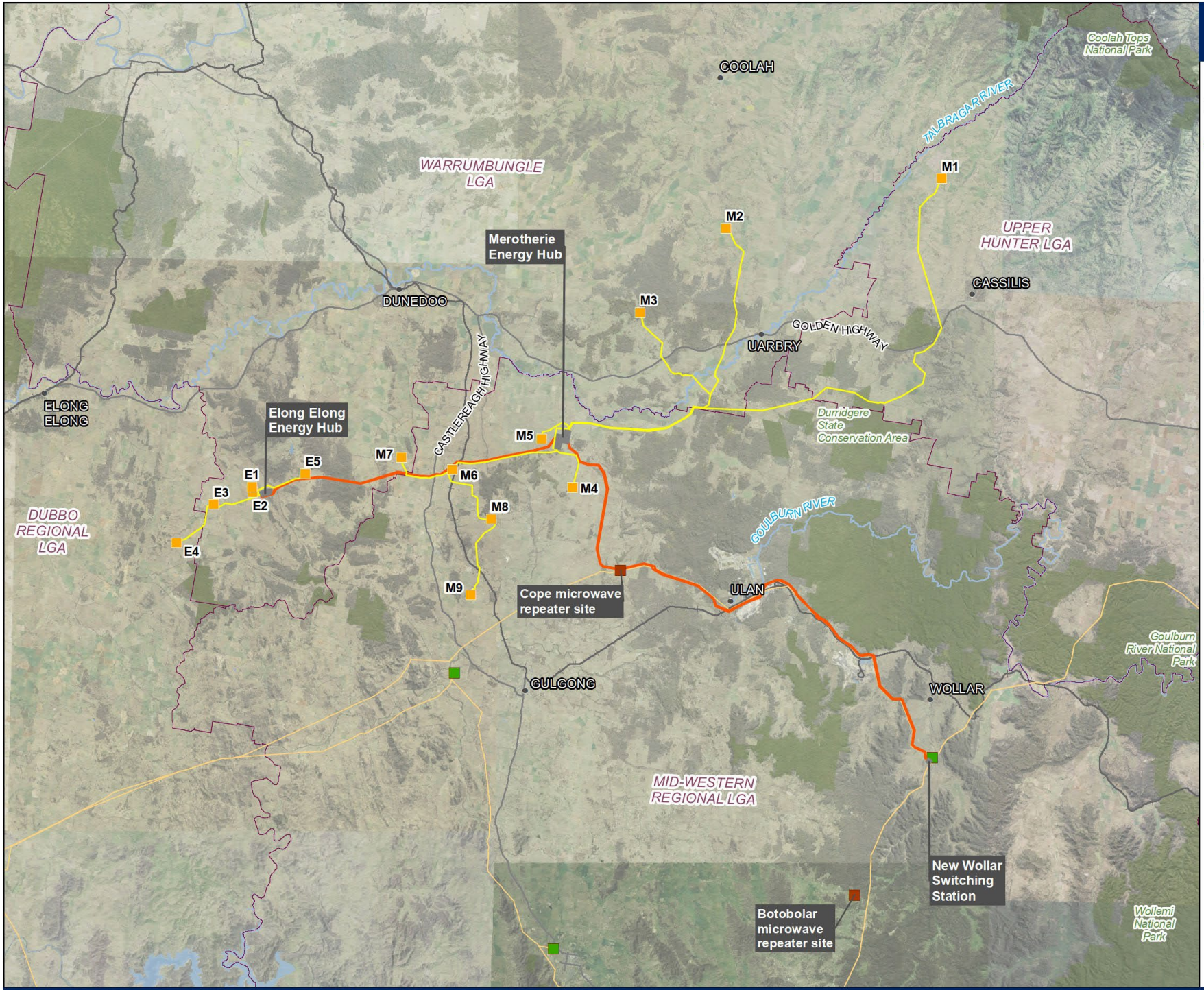
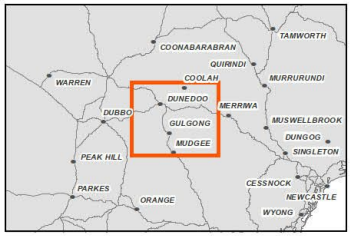


Figure A-1
The Project

Legend

- Energy hub / 500 kV switching station
- 330 kV switching station
- 500 kV transmission line and easement
- 330 kV transmission line and easement
- Existing substation
- Microwave repeater site
- Existing transmission line
- State road
- Railway
- Watercourse
- Water body
- Local government area
- NPWS estate



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GDA 2020

Data sources: WSP 2023, EnergyCo, NSWSS

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A1.2 Components of the project

The project would require the construction and operation of a series of double and single circuit transmission lines, energy hubs and switching stations to collect and transform power for transmission on to the existing electricity network. The permanent infrastructure of the project is described in detail in Section A1.2.1 to Section A1.2.5.

A1.2.1 Transmission line alignment

The project includes a series of transmission lines, referred to as the 500 kV network infrastructure and the 330 kV network infrastructure.

The alignment of the transmission lines has been developed to avoid and/or minimise impacts on important environmental, land use and social values, where practical to do so (refer to Chapter 2 (Strategic context) for more information on project development). This has resulted in the selection of an alignment which is located next to existing transmission line easements and travels through as much previously disturbed land where practicable, including co-locating project infrastructure with areas used for mining. A coordinated approach to transmission line connections has been adopted to minimise the number of transmission line easements between the project and renewable energy generation projects, where practicable.

An overview of the proposed transmission line alignment is shown in Figure A-2. Additional project mapping is also provided in Appendix B (Updated project description mapping).

500 kV network infrastructure

The 500 kV network infrastructure would comprise twin double circuit 500 kV transmission lines that would form a transmission backbone. The 500 kV network infrastructure would connect to the existing transmission network (as part of the NEM) at Wollar via the New Wollar Switching Station. Two energy hubs along the 500 kV network infrastructure at Merotherie and Elong Elong would connect renewable energy generation projects within the Central-West Orana REZ to the 500 kV network infrastructure. The nominal length of the 500 kV network infrastructure would be around 90 kilometres and the alignment would include:

- Twin double circuit 500 kV transmission lines between the New Wollar Switching Station and the Merotherie Energy Hub (the New Wollar Switching Station — Merotherie Energy Hub connection). These transmission lines would extend from the New Wollar Switching Station for around 60 kilometres in a northwesterly direction, passing along the western edge of the Goulburn River National Park, as well as traversing the Wilpinjong, Moolarben and Ulan coal mining operations and the Sandy Hollow/Gulgong Railway. North of the mining operations, the New Wollar Switching Station to the Merotherie Energy Hub connection would mainly pass though cleared agricultural lands. The transmission lines would generally be located parallel to Transgrid's existing 330 kV transmission line (Transmission Line 79) from the existing Wollar Substation, for a distance of around 40 kilometres.
- Twin double circuit 500 kV transmission lines from the Merotherie Energy Hub to the Elong Elong Energy Hub (the Merotherie Energy Hub — Elong Elong Energy Hub connection). The Merotherie Energy Hub – Elong Elong Energy Hub connection would extend for around 30 kilometres in a westerly direction from Merotherie passing predominantly though cleared agricultural lands midway between the towns of Gulgong and Dunedoo. This section of the 500 kV transmission line alignment would cross a number of local roads, the Castlereagh Highway, and the Wallerawang – Gwabegar Railway Line. It would also extend through an area of bushland adjacent to the Tuckland State Forest on its approach to the Elong Elong Energy Hub. This portion of the 500 kV network infrastructure would initially operate at 330 kV, and would ultimately operate at 500 kV when generation from renewable energy generation projects requires it.

330 kV network infrastructure

The project would include around 150 kilometres of 330 kV network infrastructure, and would comprise a combination of single, double circuit and twin double circuit 330 kV transmission lines. The 330 kV network infrastructure would provide a connection between the energy hubs and 330 kV switching stations. The switching stations along the 330 kV network infrastructure would be designed to connect and aggregate the energy generated from renewable energy generation projects onto the 330 kV transmission line network.

The 330 kV network infrastructure from the Merotherie Energy Hub would include:

- 330 kV transmission lines extending for around 90 kilometres to the northeast to provide connections to the proposed Valley of the Winds wind farm and approved Liverpool Range Wind Farm. The transmission lines would initially extend in an easterly direction as twin transmission lines for around 14 kilometres before deviating to form the following connections:
  - a 330 kV transmission line extending for around 44 kilometres (referred to as the Cassilis connection), terminating at switching station M1
  - a 330 kV transmission line extending for around 20 kilometres (referred to as the Coolah connection), terminating at switching station M2
  - a 330 kV transmission line extending for around 12 kilometres (referred to as the Leadville connection), terminating at switching station M3
- a 330 kV transmission line extending for around five kilometres in a southerly direction (referred to as the Merotherie south connection) to connect to switching station M4. This would initially provide a connection to the proposed Narragamba solar farm
- a 330 kV transmission line extending to the northwest and west of the Merotherie Energy Hub for around four kilometres (referred to as the Merotherie west connection) to connect to switching station M5. This would initially provide a connection to the proposed Birriwa solar farm
- 330 kV transmission lines extending around 17 kilometres to the west of the Merotherie Energy Hub (referred to as the Tallawang west connection). The Tallawang west connection would extend west for around 11 kilometres to switching station M6 in Tallawang before continuing to switching station M7 further west. This would initially provide a connection to the eastern cluster of the proposed Orana wind farm. The majority of the Tallawang west connection would be located alongside the project's 500 kV network infrastructure
- a 330 kV transmission line extending around 17 kilometres south from switching station M6 at Tallawang (referred to as the Tallawang south connection). The connection would extend for around eight kilometres to switching station M8 to provide a connection to the proposed Barneys Reef wind farm. From switching station M8, the Tallawang south connection would continue further south to switching station M9 to provide a connection to the proposed Tallawang solar farm.

The 330 kV network infrastructure from the Elong Elong Energy Hub would include:

- a 330 kV transmission line extending for around one kilometre to the north (referred to as the Cobbora north connection) to switching station E1, to provide a connection to the proposed Cobbora solar farm
- a 330 kV transmission line extending for around 970 metres in a northwesterly direction (referred to as the Cobbora west connection) to switching station E2, to provide a connection to the proposed Sandy Creek solar farm
- a 330 kV transmission line extending for around 11 kilometres in a southwesterly direction (referred to as the Goolma connection). The connection would extend for around five kilometres to switching station E3, to provide a connection to the proposed Dapper solar farm. From switching station E3, the Goolma connection would continue southwest to switching station E4, to provide a connection to the proposed Spicers Creek wind farm
- a 330 kV transmission line extending for around seven kilometres in an easterly direction (referred to as the Dunedoo connection) to switching station E5, to provide a connection to the western cluster of the proposed Orana wind farm.

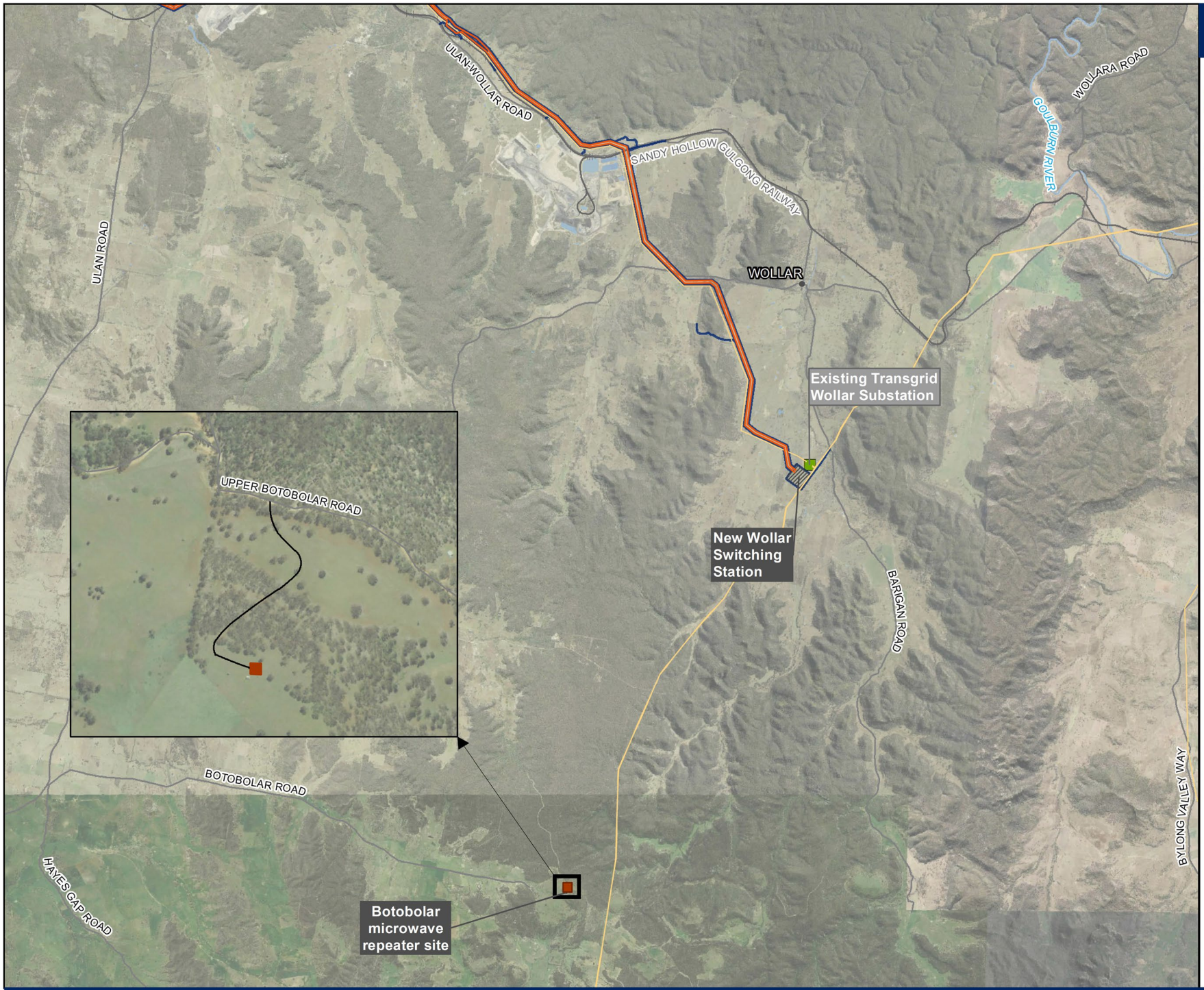
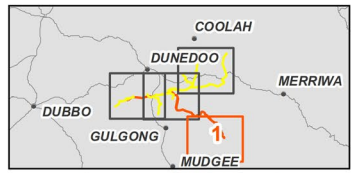


Figure A-2
Operational features of the project
Page 1 of 4

Legend

- Operation area
- Energy hub / 500 kV switching station
- 500 kV transmission line and easement
- Microwave repeater site
- Microwave repeater access road
- Existing substation
- Existing transmission line
- State road
- Railway
- Watercourse
- Water body



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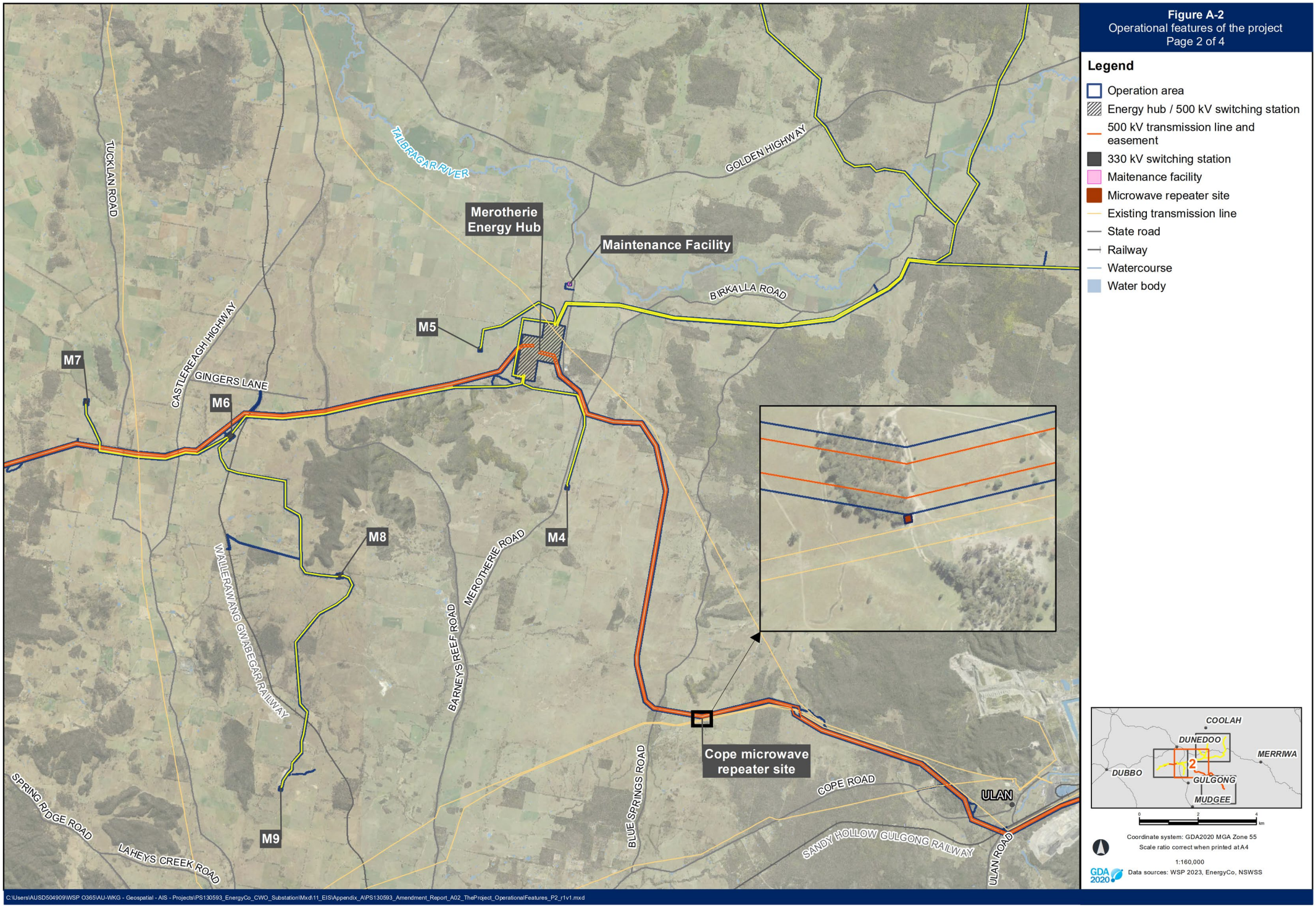
TUCKLAN ROAD
TALBRAGAR RIVER
GOLDEN HIGHWAY
Merotherie Energy Hub
Maintenance Facility
BIRKALLA ROAD
M5
M7
CASTLEREAGH HIGHWAY
GINGERS LANE
M6
M8
M4
WALLERAWANG GWABEGAR RAILWAY
MEROTHERIE ROAD
BARNEYS REEF ROAD
BLUE SPRINGS ROAD
Cope microwave repeater site
COPE ROAD
ULAN
SPRING RIDGE ROAD
LAHEYS CREEK ROAD
M9
SANDY HOLLOW GULGONG RAILWAY
ULAN ROAD
Figure A-2
Operational features of the project
Page 2 of 4
Legend
Operation area
Energy hub / 500 kV switching station
500 kV transmission line and easement
330 kV switching station
Maitenance facility
Microwave repeater site
Existing transmission line
State road
Railway
Watercourse
Water body
COOLAH
DUNEDOO
MERRIWA
DUBBO
GULGONG
MUDGEE
2
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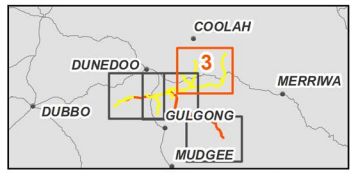
Figure A-2
Operational features of the project
Page 3 of 4

Legend

- Operation area
- 330 kV switching station
- State road
- Watercourse
- Water body



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Data sources: WSP 2023, EnergyCo, NSWSS

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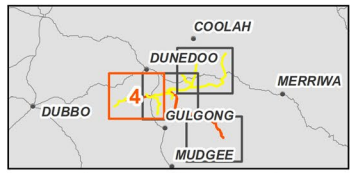
Figure A-2
Operational features of the project
Page 4 of 4

Legend

- Operation area
- Energy hub / 500 kV switching station
- 500 kV transmission line and easement
- 330 kV switching station
- Potential future expansion
- Existing transmission line
- State road
- Railway
- Watercourse
- Water body



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GDA 2020

Data sources: WSP 2023, EnergyCo, NSWSS

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Connections to the switching stations would be provided to renewable energy generation projects in the Central-West Orana REZ that are successful in their bids to access the transmission infrastructure through the Consumer Trustee's competitive tender process. The development of renewable energy generation projects in the Central-West Orana REZ does not form part of the project and those generation projects are subject to separate planning and environmental approvals (refer to Section 1.4 of the EIS). Renewable energy generators are responsible for connecting their projects to the closest switching station in accordance with their own planning approvals.

A1.2.2 Transmission line towers

The 500 kV and 330 kV transmission lines would be supported on a series of transmission line towers, except for a section of the 330 kV transmission line along the Cassilis connection. This section would be supported by a combination of towers and poles, to be as consistent as practicable with the transmission line design proposed at this location when it formed part of the approved Liverpool Range wind farm project.

The final location and specification of each transmission line tower would be dependent on a range of factors such as distance between each structure, structure loading, required ground clearances, transmission line voltage, changes in direction of the transmission line route, local geotechnical conditions, topography and local environmental constraints (such as the need to avoid specific areas of biodiversity value or to span watercourses).

The type and arrangement of the transmission line towers would continue to be refined as part of the finalisation of the project design, with a view to further minimising environmental impacts within the identified transmission line easement, wherever practicable.

The transmission line tower type for the 500 kV network infrastructure would consist of free-standing steel lattice towers, comprising:

- suspension towers. This tower type is typically used for straight sections of the transmission line. It would have a typical permanent base footprint area of around 20 metres by 20 metres (or around 400 square metres)
- tension towers. This tower type is typically used where there is a change in direction along the transmission line alignment but can also be used between long runs of suspension towers. These towers typically have a wider base than suspension towers, with a base footprint of around 25 metres by 25 metres (or around 625 square metres).

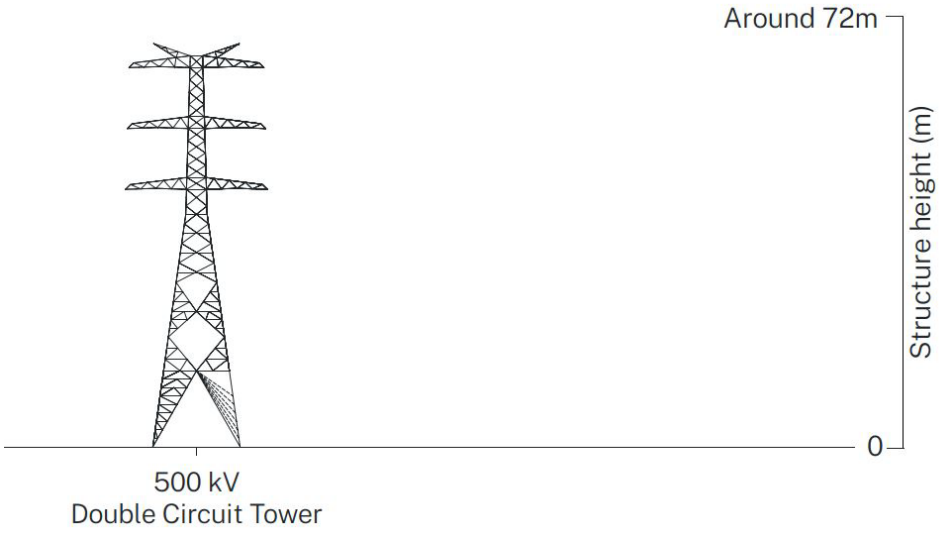
Transmission line towers for the 330 kV network infrastructure would be similar to those for the 500 kV network infrastructure, though they would have a slightly smaller footprint. Suspension towers would have a permanent base footprint of around 15 metres by 15 metres (or around 225 square metres), with the tension towers around 20 metres by 20 metres (or around 400 square metres). The final permanent base footprint would be confirmed as part of continued design development. Where poles are used along the 330 kV network infrastructure, these would typically be monopoles with a similar height to lattice towers but with a reduced base operational footprint of around three metres diameter. An 80 metre by 80 metre area around each transmission line tower (around 6,400 square metres) would be required for construction and would be permanently cleared of vegetation for operational maintenance and safety requirements.

Depending on local circumstances, the height of the transmission line towers would typically be around 75 metres (and up to around 85 metres in isolated locations) for the 500 kV network infrastructure and up to around 65 metres for the 330 kV network infrastructure (and up to around 55 metres for monopoles). The transmission line towers would be typically spaced at around 450 metres to 550 metres apart for the 500 kV network infrastructure and 250 metres to 450 metres apart for the 330 kV network infrastructure, though this would increase or decrease depending on constraints present along the corridor.

The number, location and type(s) of towers required would be confirmed as part of the continued development of the project design.

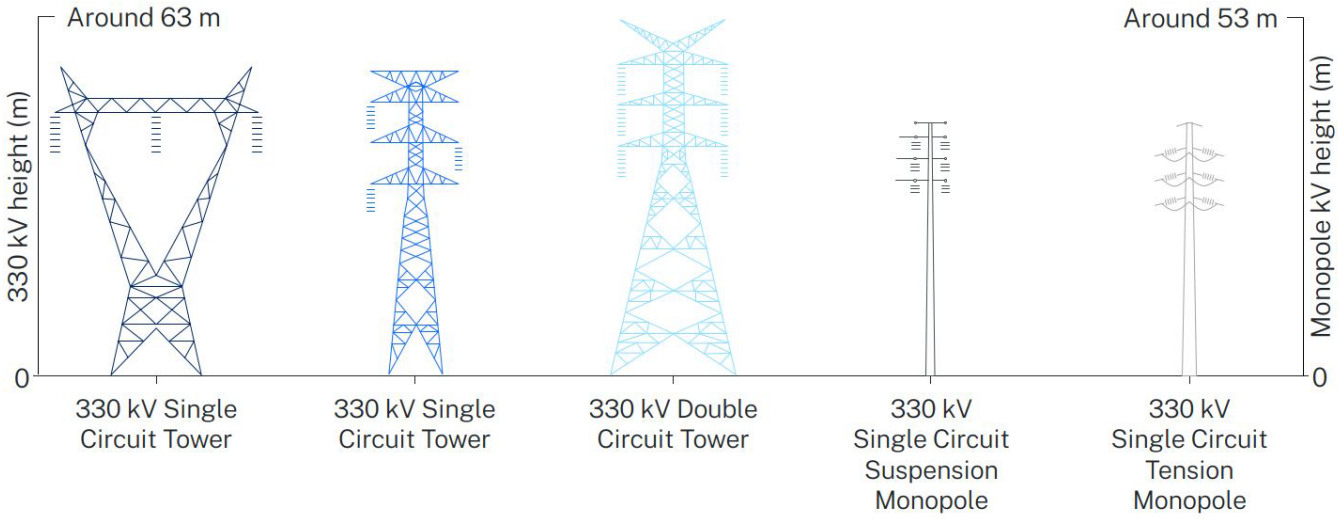
Transmission line towers will also include communications infrastructure, including optical ground wires.

The indicative concept designs for the 500 kV and 330 kV transmission line towers are shown in Figure A-3 and Figure A-4 respectively.



Note: Tower heights are indicative and subject to detailed design across the alignment; however, it should be noted tower heights would be up to around 85 metres in isolated locations

Figure A-3 Indicative concept design for the 500 kV transmission line towers



Note: Tower heights are indicative and subject to detailed design across the alignment

Figure A-4 Indicative concept design for the 330 kV transmission line towers

A1.2.3 Transmission line access

Access to the proposed transmission line easements for operational maintenance would be via access tracks, running to and along the easements, and existing public and private roads.

Maintenance of and improvements to existing access tracks and new access tracks would be required to provide appropriate access to construction areas. Access tracks would be retained as necessary for operational purposes. Access tracks would be used by a range of heavy and light vehicles. Access tracks proposed for the project are shown in Figure B-2 in Appendix B (Updated project description mapping).

Existing access tracks would be used, where practicable, in order to minimise vegetation clearing and construction works (i.e. widening or grading). Where access is across open spaces, particularly in cultivated areas, pasture improved grazing land or native grasslands, care would be exercised to ensure that minimum damage is caused to the surface by confining movement, as far as practicable, to one route.

New access tracks and improvements to existing access tracks would be required in areas where there are no existing access tracks that are fit for purpose, or where existing conditions (such as terrain) prevent continuous access along the transmission line easement between road crossings.

Improved or new access tracks would typically be between four to eight metres wide and would generally follow the natural contour of the land as far as practicable to minimise the amount of cut and fill material and soil disturbance. New constructed access tracks would be sited to minimise vegetation clearance as far as practicable. In the case of cultivated land, it may be necessary to position new access tracks along existing fence lines or otherwise in accordance with landowner requirements.

The project would not require any permanent watercourse crossings for access tracks. Temporary watercourse crossings in the form of culverts, causeway, bridges or fords may be required during construction where alternative vehicle access routes are impractical. All watercourse crossings would be designed and installed in accordance with relevant Department of Primary Industries (DPI) guidelines for watercourse crossings including:

- *Why do fish need to cross the road? Fish Passage Requirements for Waterway Crossings* (NSW DPI, 2003)
- *Guidelines for Controlled Activities on Waterfront Land* (NSW DPI, 2012)
- *Policy and Guidelines for Fish Habitat and Conservation and Management* (NSW DPI, 2013).

Access points to access tracks would be established along public roads, where required, and retained for the duration of construction and operation. These are shown on Figure B-2 in Appendix B (Updated project description mapping).

A1.2.4 Energy hubs and switching stations

The project would include two energy hubs and 15 switching stations. An energy hub is a substation where energy exported from renewable energy generation projects is aggregated, transformed to 500 kV (where required), and exported to the transmission network. A switching station is a facility used to connect two or more distinct transmission lines of the same designated voltage.

A 500 kV switching station at Wollar (the New Wollar Switching Station) would transfer electricity from the project onto the existing transmission network (as part of the NEM).

Energy hubs along the 500 kV transmission network would connect the project's 330 kV transmission lines from renewable energy generation projects within the Central-West Orana REZ to the project's 500 kV network infrastructure.

Fourteen 330 kV switching stations would connect and aggregate the energy generated from the renewable energy generation projects onto the 330 kV transmission line network.

The locations of the energy hubs and switching stations are described in Table A-2 and shown in Figure A-1. Indicative layouts of the energy hubs and switching stations are shown in Figure A-5 to Figure A-8.

Table A-2 Location and details of energy hubs and switching stations

Energy hub/ switching station	Description
New Wollar Switching Station (refer to Figure A-5)	A new switching station along the 500 kV network, located around six kilometres south of the township of Wollar, and 320 metres southwest of the existing Transgrid Wollar Substation off Barigan Road. It is located in the Mid-Western Regional LGA. The New Wollar Switching Station would provide a connection point between the project and the existing transmission network.
Merotherie Energy Hub (refer to Figure A-6)	The Merotherie Energy Hub is located next to Merotherie Road, Merotherie in the Mid-Western Regional LGA. The nearest town is Dunedoo, located around 17 kilometres to the northwest of the energy hub. The energy hub would provide a connection between the 330 kV network infrastructure from renewable energy generation projects in the Central-West Orana REZ to the project's 500 kV network infrastructure.
Elong Elong Energy Hub (refer to Figure A-7)	The Elong Elong Energy Hub is located next to Dapper Road, Cobbora in the Warrumbungle LGA. The nearest town is Dunedoo, around 22 kilometres to the northeast. The energy hub would provide a connection between the 330 kV network infrastructure from renewable energy generation projects in the Central-West Orana REZ to the project's 500 kV network infrastructure.
330 kV switching stations (refer to Figure A-8)	Switching stations along the 330 kV network infrastructure would connect and aggregate the energy generated from the renewable energy generation projects onto the 330 kV transmission line network. Switching stations would be located along and at the end of 330 kV transmission lines at the following locations: • Cassilis (M1) • Coolah (M2) • Leadville (M3) • Merotherie (M4, M5) • Tallawang (M6, M8 and M9) • Dunedoo (M7 and E5) • Cobbora (E1, E2 and E3) • Goolma (E4). The connection from the renewable energy generation projects to the switching station is the responsibility of each generator, and would form part of a separate planning approval(s).

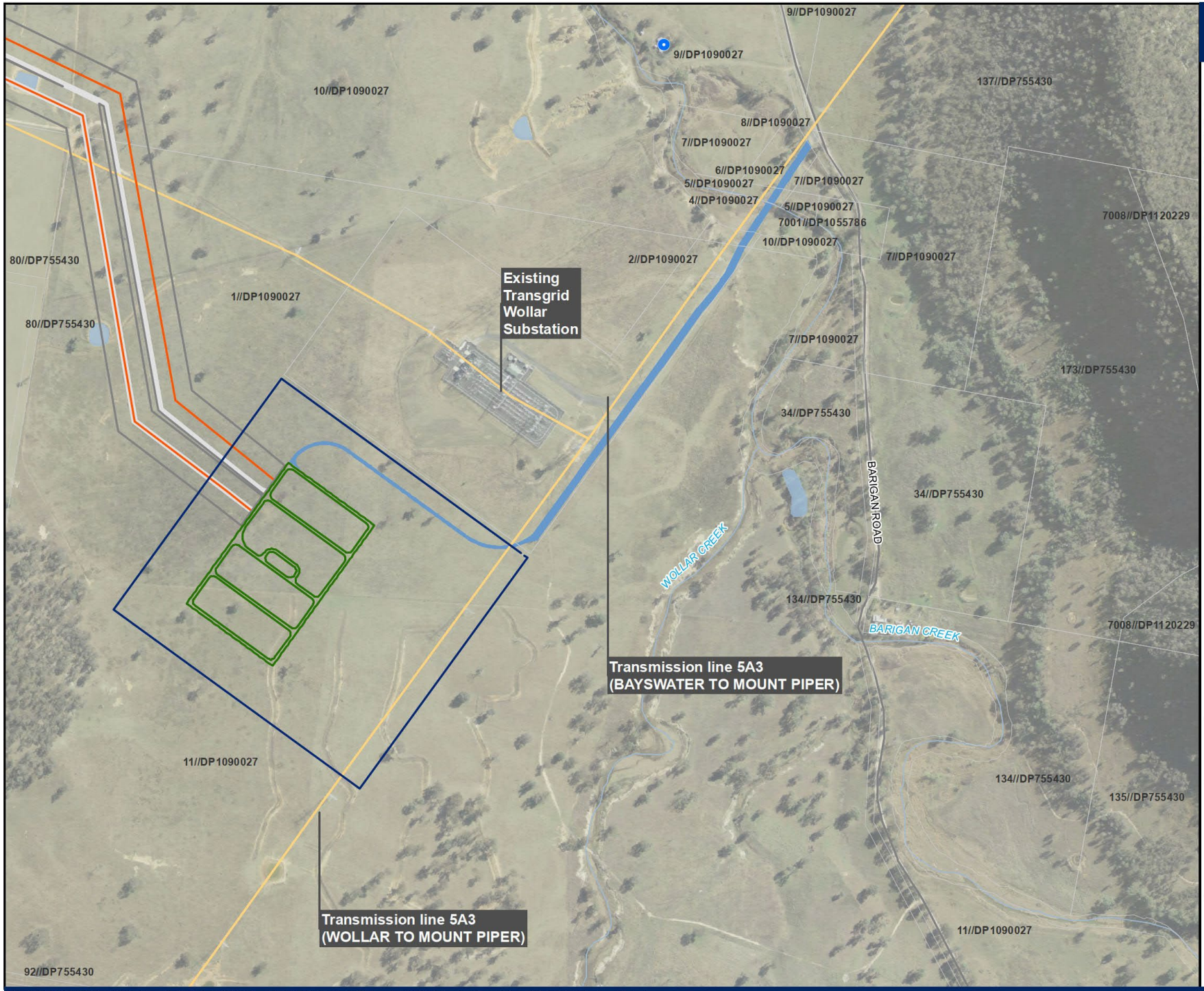


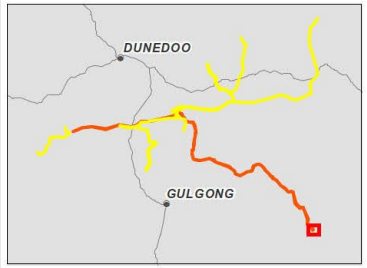
Figure A-5
Indicative layout
of New Wollar Switching Station

Legend

- Fenceline
- 500 kV switching station infrastructure
- Access road
- 500 kV transmission line
- Access track
- Easement
- Existing transmission line
- State road
- Watercourse
- Water body

Sensitive receivers

- House



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Data sources: WSP, EnergyCo, NSWSS

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Figure A-6
Indicative layout of
Merotherie Energy Hub

Legend

- Fenceline
- Energy hub infrastructure
- Maintenance facility
- Access road
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Easement
- Access track
- State road
- Watercourse
- Water body

Sensitive receivers

- House

Coordinate system: GDA2020 MGA Zone 55
Scale ratio correct when printed at A4

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GDA 2020

Data sources: WSP 2023, EnergyCo, NSWSS

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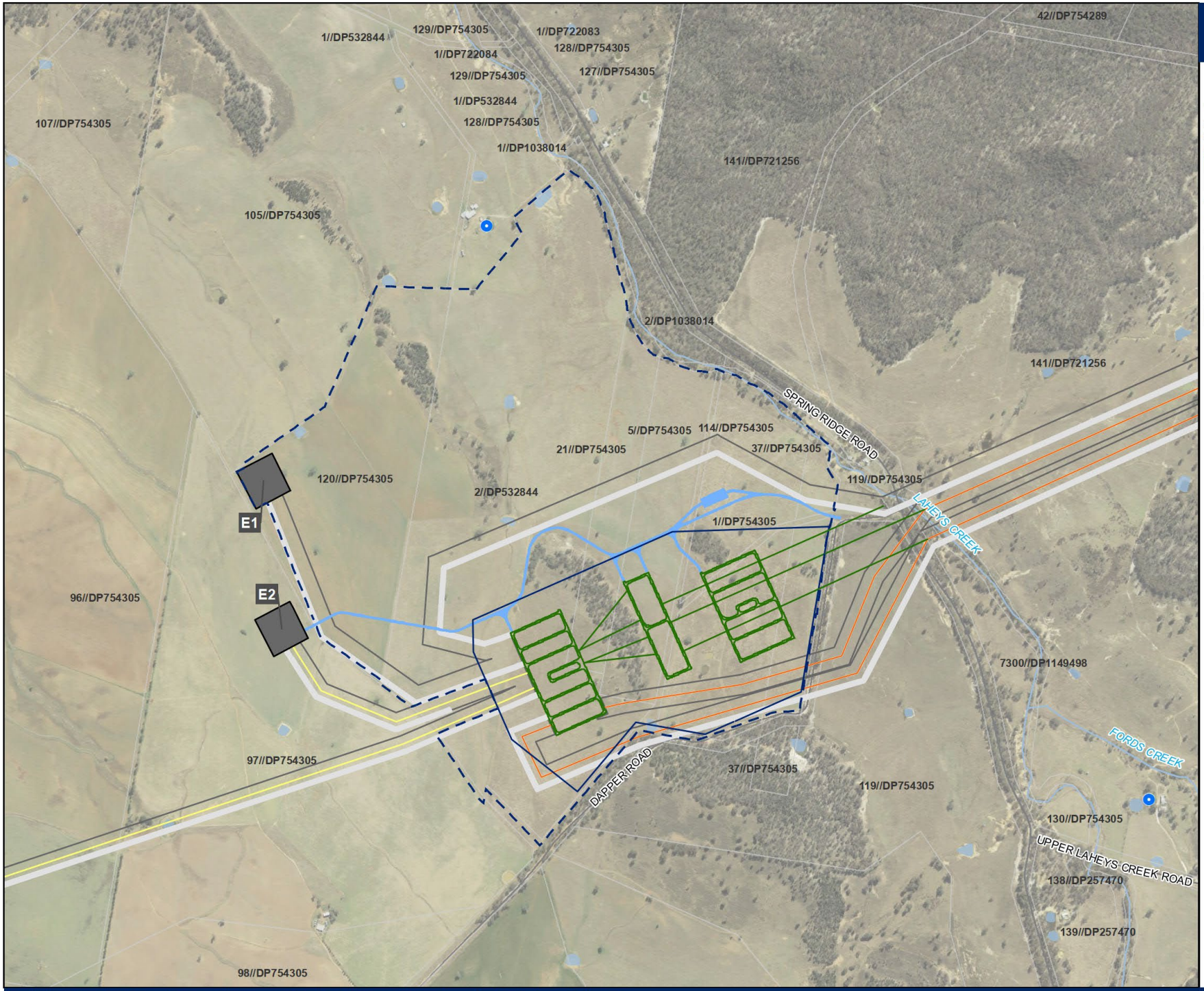


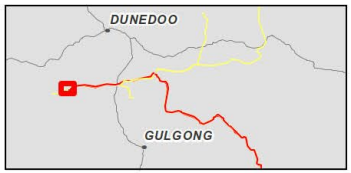
Figure A-7
Indicative layout of
Elong Elong Energy Hub

Legend

- Fenceline
- 500 kV energy hub infrastructure
- Potential future expansion
- Access road
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Easement
- Access track
- State road
- Watercourse
- Water body

Sensitive receivers

- House



0 250 500 Meters

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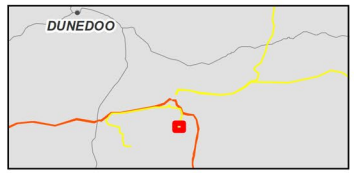
Figure A-8
Indicative layout of a typical 330 kV switching station

Legend

- 330 kV switching station
- 330 kV transmission line
- Easement
- Access track
- State road
- Watercourse
- Water body

Sensitive receivers

- House



0 100 200 Meters

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Data sources: WSP 2023, EnergyCo, NSWSS

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Key components

New Wollar Switching Station

The New Wollar Switching Station would occupy an area of around 35 hectares (inclusive of the required bushfire asset protection zone (APZ) buffer and access road) (refer to Figure A-5). The typical infrastructure and equipment that would be installed would include:

- a 500 kV switchyard that would provide connections to:
  - the Merotherie Energy Hub via the 500 kV network infrastructure
  - Transgrid's existing Wollar Substation via the existing Transgrid 500 kV transmission lines 5A3 and 5A5 and underground fibre optic communications cabling
- auxiliary transformers that would provide low voltage alternating current for auxiliary loads for equipment within the switching station
- a range of supporting electrical components including circuit breakers, overhead conductors, busbars and gantries
- noise mitigation structures, including buildings and noise walls, if required
- control and protection systems (including relays, metering and disturbance recorder)
- control buildings to accommodate protection for switchgear and fixed portions of secondary systems (such as fire protection, security system, and air conditioning)
- oil containment system (including bunding and containment tank)
- water supply, drainage and sewer infrastructure
- a parking area.

An underground fibre optic communications connection between the New Wollar Switching Station and the existing Transgrid Wollar 500 kV Substation would be provided to support communication requirements.

The building pads that would be constructed at the New Wollar Switching Station would allow for additional switchyard infrastructure and connections for two additional 500 kV transmission lines in the future. The construction and operation of any additional 500 kV transmission network infrastructure would be subject to separate environmental assessment and approval.

Energy hubs

The energy hubs at Merotherie and Elong Elong would occupy an area of around 200 hectares and 75 hectares respectively, inclusive of the required APZ buffers, but excluding the maintenance facility at the Merotherie Energy Hub. As discussed in Section A1.1, the Elong Elong Energy Hub would initially be fitted out in a temporary arrangement to reflect the initial operation of the Elong Elong – Merotherie connection at 330 kV. Fit out and operation of 500 kV switchyard infrastructure at Elong Elong would occur when demand within the REZ network has been met (refer to Section A1.5.3). The operational area at the Elong Elong energy hub is expected to increase due to the configuration of the initial 330 kV operation. The operation area of the project more generally is subject to ongoing refinement and would be finalised as part of continued design development.

The construction and operation of both the temporary and full-build configurations of the Elong Elong and Merotherie energy hubs form part of this project.

The key electrical components of the Merotherie Energy Hub at full-build include:

- one 500 kV switchyard that would provide connections to the New Wollar Switching Station and Elong Elong Energy Hub (when operated at 500 kV), via the 500 kV network infrastructure
- two 330 kV switchyards that would provide connections between the energy hub and switching stations via the project 330 kV network infrastructure
- two equipment yards containing the power transformers and synchronous condensers
- four synchronous condensers, which would provide system stability and regulation of the energy collected at the energy hubs
- four transformers. The transformers would also provide connection for auxiliary transformers which would provide low voltage alternating current for auxiliary loads for equipment within the energy hub.

The final number and configuration of each of the components would be confirmed during the detailed design phase.

The key electrical components of the Elong Elong Energy Hub at full-build include:

- one 500 kV switchyard that would provide a connection to the Merotherie Energy Hub when operating at 500 kV
- one 330 kV switchyard that would provide connections between the energy hub and switching stations via the project 330 kV network infrastructure, as well as the Merotherie Energy Hub when operating at 330 kV
- one equipment yard, containing power transformers and synchronous condensers
- three transformers. The transformers would also provide connection for auxiliary transformers which would provide low voltage alternating current for auxiliary loads for equipment within the energy hub
- three synchronous condensers, which would provide system stability and regulation of the energy collected at the energy hubs.

The final number and configuration of each of the component types would be confirmed during the detailed design phase.

The typical infrastructure and equipment that would be installed at each energy hub would include:

- a range of supporting electrical components including shunt reactors, circuit breakers, overhead conductors, busbars and gantries
- noise mitigation structures, including noise insulated buildings to enclose the synchronous condensers, if required
- control and protection systems (including relays, metering and disturbance recorder)
- communications equipment, including microwave infrastructure
- auxiliary services and control buildings to accommodate protection for switchgear and fixed portions of secondary system (such as fire protection, security system and air conditioning)
- a backup diesel powered generator to charge batteries for the control systems
- oil containment system (including bunding and containment tank) and oil water separation facility
- water supply, drainage and sewer infrastructure
- amenities for maintenance and operational personnel
- laydown area
- workshop area
- storage for spare equipment
- a parking area.

The energy hub building pads that would be constructed as part of the project would allow for additional switchyard, transformers and/or synchronous condensers infrastructure should they be required in the future to provide additional capacity or resilience within the network. The construction and operation of the additional infrastructure would be subject to separate approvals.

Both the temporary and full-build configurations of the Elong Elong Energy Hub and Merotherie Energy Hub form part of this project.

The internal configuration of each energy hub differs according to local conditions and the type and size of renewable energy generation projects proposed to be connected to the project (refer to Figure A-6 and Figure A-7). The final configuration would be confirmed during detailed design.

Maintenance facility

A maintenance facility would be established near the Merotherie Energy Hub (refer to Figure A-6), which would support the operation and maintenance of the transmission lines, switching stations and energy hubs (refer to Section A1.3) during operation of the project. Maintenance staff and personnel would be based at this maintenance facility. The single storey maintenance facility would occupy an area of around two hectares and include:

- an office, which would accommodate maintenance personnel, staff amenities, training/meeting and first aid rooms. The building would occupy and area of around 60 metres by 16 metres, and 5.5 metres in height
- storage facilities, including a climate controlled electronic storeroom and storage facilities for spare parts, equipment, fleet and plant
- workshop facilities comprising a sheet metal shed occupying an area of around 600 square metres (around 30 metres by 20 metres, and eight metres in height)
- parking areas
- water storage tanks with a combined capacity of approximately 80,000 litres (including for firefighting purposes)
- firefighting equipment
- septic tank.

The Elong Elong Energy Hub may also include containerised workshop and storage that would be used for maintenance works and breakdown activities.

Generally, the maintenance facility would be used during standard working hours; however, 24 hour access would be provided to allow for the use of the facility during an emergency event or incident. Parking would be provided at the maintenance facility for operational personnel, and no additional off-site parking would be required.

Wastewater from the maintenance facility would be stored in a septic tank and collected and transported to a council wastewater treatment plant as required.

330 kV switching stations

Fourteen switching stations would be installed along the 330 kV network infrastructure and would range in size from about two hectares to seven hectares, (inclusive of the required APZ buffer surrounding the switching stations), depending on the size and generation capacity of the renewable energy generation projects they connect to. A typical arrangement is provided in Figure A-8. The typical infrastructure and equipment that would be installed at each switching station would include:

- one 330 kV switchyard that would provide connection(s) to the 330 kV transmission line(s)
- auxiliary transformers that would provide low voltage alternating current for auxiliary loads for equipment within the switching station

- a range of supporting electrical components including circuit breakers, overhead conductors, busbars and gantries
- control and protection systems (including relays, metering and disturbance recorder)
- communication equipment, including microwave infrastructure
- auxiliary services and control buildings to accommodate protection for switchgear and fixed portions of secondary systems (such as fire protection, security system and air conditioning)
- a backup diesel powered generator to charge batteries for the control systems
- amenities for maintenance and operational personnel
- water supply, drainage and sewer infrastructure
- storage for spare equipment.

Auxiliary power

Auxiliary power for the energy hubs and switching stations would be accessed from Essential Energy's existing electrical distribution network. This would be supplied to the energy hub and switching station sites from connection points on the existing 66 kV (or below) distribution network, for which approval is sought under the CSSI application, and which would be delivered as part of the project.

The exact connection points would be determined following detailed studies undertaken by the electricity service provider. It would involve the potential construction of an above ground electrical distribution line (poles and wires) or underground electrical distribution line to accommodate the connection. The final routes for auxiliary power connections would be subject to detailed construction planning and determined in consultation with Essential Energy. Where practicable, the new transmission lines would be located within Essential Energy's existing easement. It is also anticipated that some augmentation works would be required to the distribution line in accordance with the information included in the 'Adjustments and augmentation to existing transmission infrastructure' section below.

Safety and security

Security fencing would be installed at the energy hubs, maintenance facility and switching stations. At relevant locations within the operation area, the following safety equipment would be provided:

- closed-circuit television security cameras
- motion sensors
- temperature monitors
- outdoor lighting
- anti-climbing barriers to all transmission towers
- safety and public information signage at energy hubs, switching stations, maintenance facility and transmission line towers.

To manage the risk of fire to and from the energy hub and switching station sites and maintenance facility, a bushfire APZ would be implemented and maintained around each site (refer to Chapter 16 (Hazard and risk) and Technical paper 10 – Bushfire, for further detail on the APZ).

Lighting

Operational lighting would be provided at the energy hubs, maintenance facility and switching stations for site security and worker safety. Lighting would operate from dusk until dawn, seven days a week. The external lighting would be installed to maintain an even distribution across the sites. The lighting would be designed to minimise light spill to areas beyond the site boundary, including potential light spill on passing traffic along local roadways, sensitive receivers and local fauna. Lights would incorporate Light Emitting Diode (LED) technology, mounted on poles or buildings and would be controlled via a daylight sensor.

Exterior lighting would primarily be designed in consideration of the *Dark Sky Planning Guidelines* (NSW DPE, 2023a) and *Australian and New Zealand Standard AS/NZS 4282:19 Control of the obtrusive effects of outdoor lighting* (Standards Australia, 2019a). Other guidelines that would inform exterior lighting design include the *Australian Standard AS1158.3.1:2005 Lighting for roads and public spaces* (Standards Australia, 2005) and *Australian Standard AS2067:2016 Substations and high voltage installations exceeding 1 kV a.c* (Standards Australia, 2016).

A lighting study would be completed as part of continued design development to determine the most appropriate outdoor lighting design at energy hubs and switching stations.

The following general specifications have been assumed and are subject to further design development:

- lighting masts typically at a height of 15 metres with standard flood lights fitted to each mast, comprising a LED light of about 300 watts that would emit 52,000 lumens
- 20 lux for lighting around cubicles and marshalling boxes/kiosks, in proximity of all operating points and around the areas of control buildings
- 10 lux along access roads
- 2.5 lux within general open areas where lighting would be required.

Access roads and tracks

Access to the energy hubs, maintenance facility and switching stations would be via new and/or upgraded access roads or access tracks from private access points from the nearest public road. Access roads are private roads to provide access to the energy hubs at Merotherie and Elong Elong, the maintenance facility at Merotherie, New Wollar Switching Station and switching station E2 from the nearest public road.

The existing access road to the existing Transgrid Wollar Substation would be extended to provide access to the New Wollar Switching Station. The existing access road to the existing Transgrid Wollar Substation would only be upgraded if this was determined to be required during detailed design.

Any new access roads would be sealed and designed to accommodate the expected vehicle movements along these roads during both construction and operation. All access roads would generally be wide enough to accommodate a traffic lane in each direction, with lanes typically between 2.5 and 3.5 metres in width.

Road drainage provisions to cater for run-off from the road surface and the immediate road corridor areas would be designed for up to a 10 per cent Annual Exceedance Probability (AEP) flood event, where practicable.

The project would not require any new permanent watercourse crossings for access roads or access tracks. Temporary watercourse crossings in the form of culverts, causeway, bridges or fords may be required during construction where alternative vehicle access routes are impractical. All watercourse crossings would be designed and installed in accordance with relevant DPI guidelines, as discussed in Section A1.2.3. Where practicable, the switching stations have been located with infrastructure from the renewable energy generation projects and, where suitable, the access road network provided under these projects would be utilised. Alternatively, switching stations would be accessed via access tracks from the access points, that run mostly within the transmission line easements, as described in Section A1.2.3.

Access points for the switching station sites (except switching station E2) would not require any adjustments to the public roads. Access points for the energy hub sites and maintenance facility would require upgrades to public roads and intersections (refer to Section A1.5.6).

Site access points for the New Wollar Switching Station, the energy hubs at Merotherie and Elong Elong and the maintenance facility at the Merotherie Energy Hub are summarised in Table A-3.

The location, type and extent of any additional access tracks and points required on the construction routes will be confirmed during detailed construction planning in consultation with the affected landowner and the relevant roads authority. Any impacts additional to those identified in the EIS and Amendment Report will be subject to further assessment, if required.

Table A-3 Site access points

Site	Site access point
New Wollar Switching Station	The switching station would be accessed from Barigan Road via a new extension and a potential upgrade of the existing Transgrid Wollar Substation access road (if required) (refer to Figure B-1 in Appendix B (Updated project description mapping)).
Merotherie Energy Hub and maintenance facility	Access to the Merotherie Energy Hub and maintenance facility would be via two new private access points off Merotherie Road (refer to Figure B-1 in Appendix B (Updated project description mapping)).
Elong Elong Energy Hub	Access to the Elong Elong Energy Hub would be via one new private access point off Dapper Road (refer to Figure B-1 in Appendix B (Updated project description mapping)).

Parking

The energy hubs, switching stations and access roads would be configured to provide adequate parking areas for workforce personnel during construction and operation of the project.

Water supply

Refer to Section A1.3.4 for a discussion on water supply to the energy hubs and switching stations.

Stormwater and drainage

Drainage infrastructure would be installed along the perimeter of each energy hub and switching station site and the maintenance facility to capture and divert runoff from the surrounding catchment away from the project infrastructure. Intercepted runoff would be diverted to existing natural watercourses or overland flow paths using appropriate dispersion/dissipation structures or drainage systems.

At energy hubs, a system of kerb and guttering and drains and stormwater pits and pipes would collect and discharge stormwater. On-site detention basins may be provided where required to provide slow controlled release to the nearest watercourse, and to maintain the water quality objectives established during construction as part of the construction water quality monitoring program (refer to Section 19.1 (Hydrology, flooding and water quality)). The bench drainage system would cater for runoff from the bench surface, including switchyard and access road areas. Drainage would be provided in the bench grading to prevent inundation of the switchyard areas under a one per cent AEP flood event.

Energy hubs and switching stations would be placed on a level surface and would include a bunded oil containment system around transformer yards. Oil containment systems would be isolated from the stormwater drainage collection system to prevent cross contamination and have a capacity of at least 130 per cent of the largest oil volume within the oil containment system or provide a minimum of 54 kilolitres storage (whichever is greater).

Adjustments and augmentation to existing transmission infrastructure

The project would require the adjustment and augmentation of existing Transgrid and Essential Energy transmission and distribution lines at crossing points with the new 500 kV and 330 kV transmission lines. Adjustments and augmentation would include changes to tower pole heights at locations along the following transmission and distribution lines:

- Transmission Line 5A3 (Bayswater to Mount Piper) and Transmission Line 5A5 (Wollar to Mount Piper) (Transgrid 500 kV)
- Multiple 12.7 kV, 22 kV and 66 kV distribution lines (Essential Energy)
- Transgrid Transmission Line 79 (Wollar to Wellington).

Details of the adjustments will be confirmed through detailed design in consultation with the individual asset owners.

Transgrid transmission lines 5A3 (Bayswater to Mount Piper) and 5A5 (Wollar to Mount Piper)

Transgrid's 500 kV transmission lines 5A3 (Bayswater to Mount Piper) and 5A5 (Wollar to Mount Piper) would be adjusted to provide a connection between the New Wollar Switching Station and the existing transmission network. This would require a 500 kV suspension transmission line tower and four 500 kV tension transmission line towers to connect to the Transgrid network along the eastern frontage of the New Wollar Switching Station. Two existing towers that form part of the Transgrid network would be removed. The configuration of the transmission line towers would cater for additional future twin 500 kV transmission lines to connect to the New Wollar Switching Station (refer to the New Wollar Switching Station section above).

Essential Energy 12.7 kV, 22 kV and 66 kV distribution lines

The project alignment, including the proposed brake and winch sites, would intersect the easements of a number of existing 12.7 kV, 22 kV and 66 kV distribution lines that form part of the Essential Energy network. At these locations, the Essential Energy distribution lines may have to be relocated above ground or below ground, to maintain minimum vertical and horizontal clearances from the proposed transmission lines, or avoid clashes with areas required for construction. In addition, the Essential Energy network would be augmented or extended to provide auxiliary power connections to the energy hubs and switching stations. These connections are discussed in the 'Auxiliary power' section above.

A1.2.5 Communications infrastructure

Fibre optic cabling

Underground fibre optic communication cables would be provided to monitor and control the network infrastructure and generator performance. The communication cables would be installed along the entire 500 kV and 330 kV transmission line easement, where practicable.

Microwave repeaters

A new microwave network would be established as part of the project to provide a secondary communications link between the project and the existing electricity transmission and distribution network. It would provide a connection to an existing microwave network that has been established by other electricity distribution providers. Two new microwave towers would be established at the following locations within the operation area:

- on Crown Land near Botobolar, around 14 kilometres southwest of the New Wollar Switching Station (refer to Figure A-9)
- along the New Wollar Switching Station — Merotherie Energy Hub connection in Cope, around 13 kilometres southeast of the Merotherie Energy Hub (refer to Figure A-10).

The new microwave towers would comprise an antenna on a pole or lattice tower, up to around 20 metres in height (dependent on line-of-sight requirements). The antenna would be powered by a new solar site which would be established around the base of the tower.

Additional infrastructure (antennas) would also be installed at two existing microwave repeater sites, at Baldy Peak in Kandos and at Magpie Hill in Galambine.

The preliminary locations and details of the microwave repeater sites are subject to further design development.

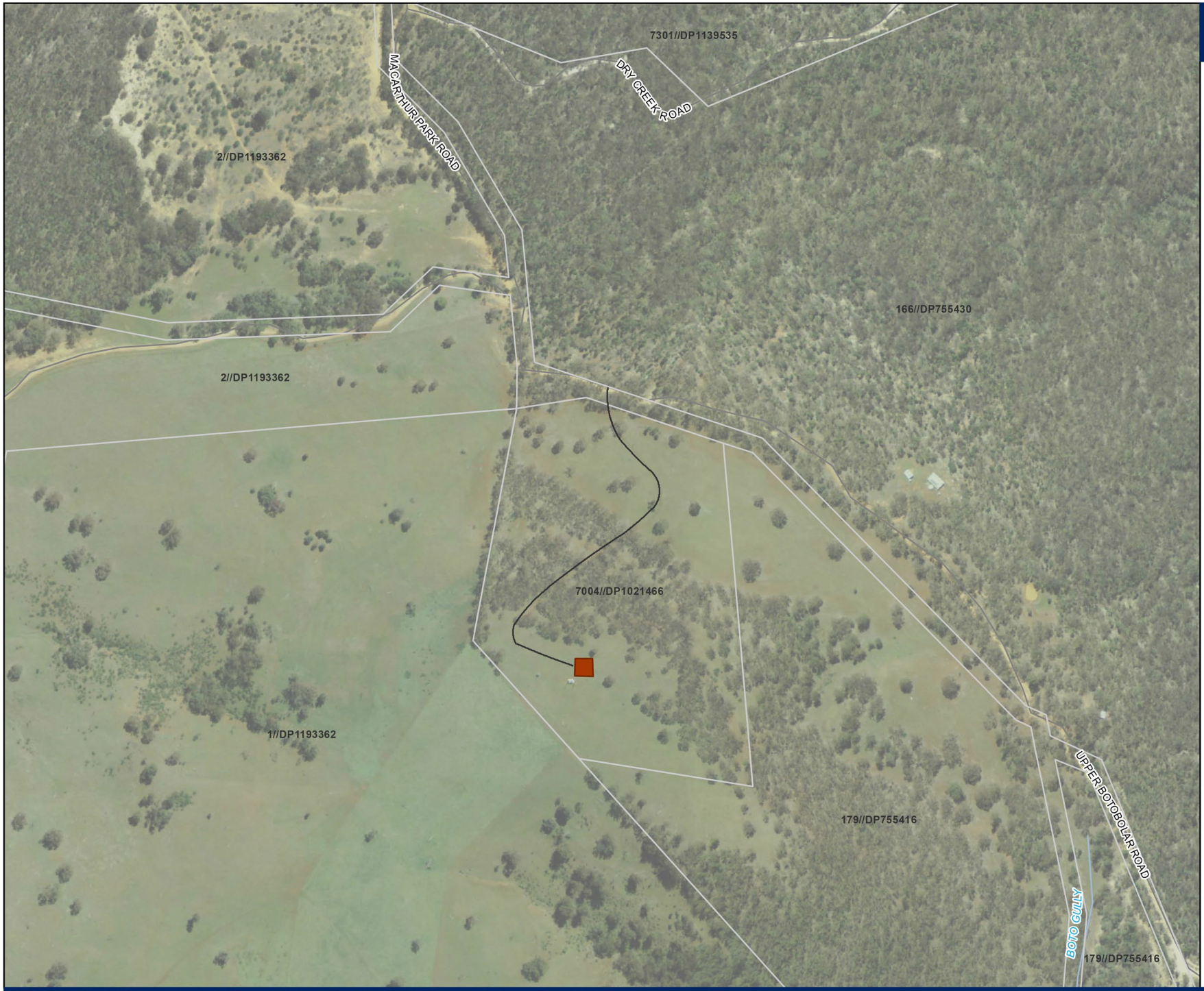
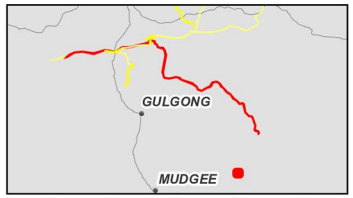


Figure A-9
Microwave repeater site – Botobolar

Legend

- Microwave repeater site
- Microwave repeater access road
- State road
- Watercourse



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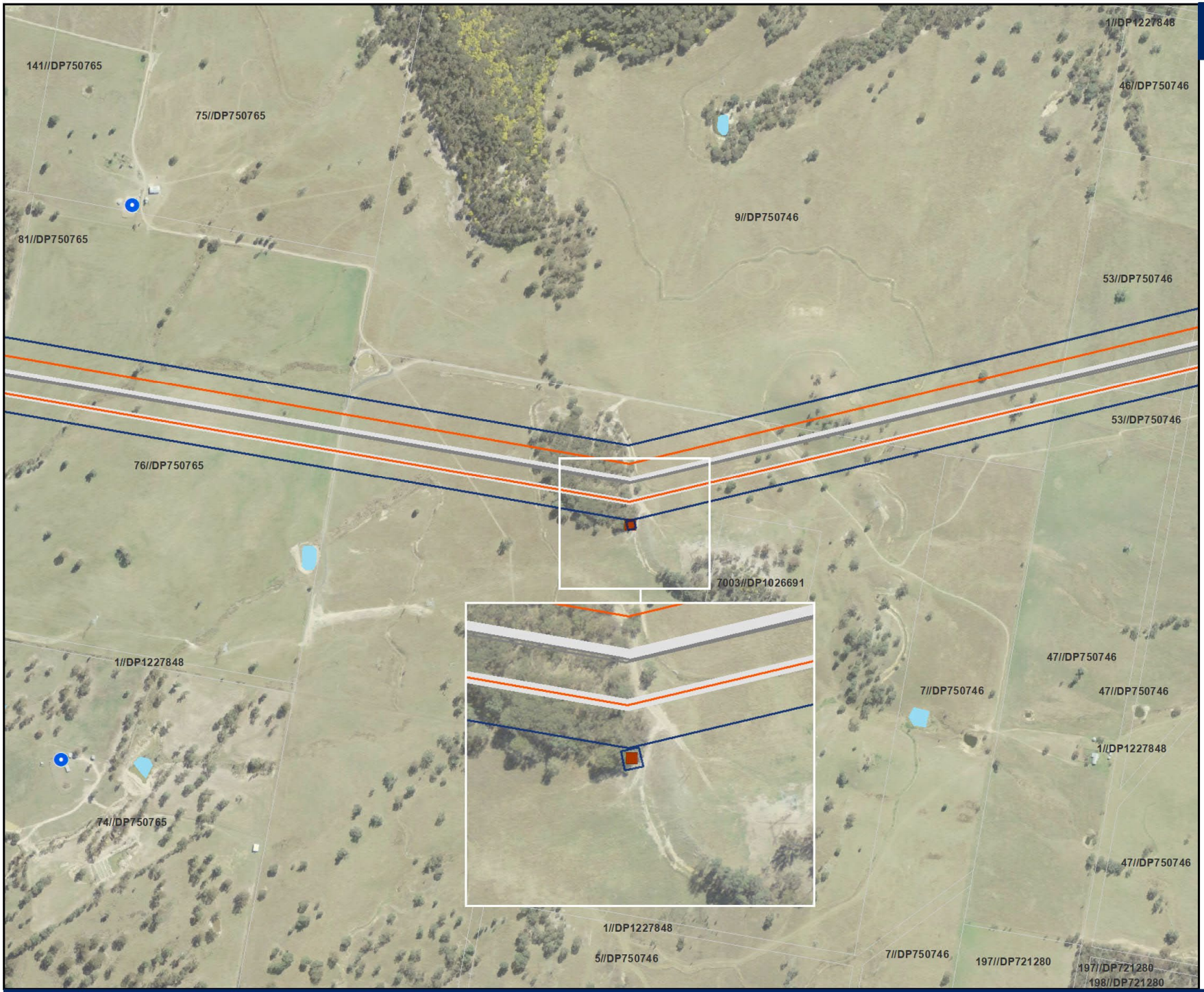


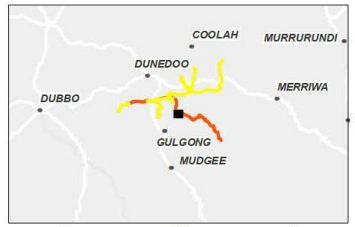
Figure A-10
Microwave repeater site – Cope

Legend

- Access track
- Microwave repeater site
- Operation area
- 500 kV transmission line
- Easement
- Access track
- Water body

Sensitive receivers

- House



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A1.3 Operation

Operation of the project would provide for the transmission of electricity generated from renewable energy generation projects within the Central-West Orana REZ onto the existing transmission network.

During operation, the transmission lines and towers, energy hubs and switching stations would be inspected by field staff and contractors on a regular basis and subject to maintenance activities. Other operational activities in the event of an emergency would also occur as required. These activities would be completed by the future Network Operator.

A1.3.1 Energy transmission

Operation of the project would provide for the transmission of electricity generated from renewable energy generation projects within the Central-West Orana REZ onto the existing transmission network.

It is anticipated that electricity generation within the Central-West Orana REZ would gradually ramp up to the intended network capacity over time as generators gain access to the network and deliver their projects (subject to the outcomes of the Consumer Trustee's competitive tender process for rights to access the new transmission infrastructure). Because of this, the operation of the Elong Elong – Merotherie connection and the Elong Elong Energy Hub would commence at 330 kV, rather than 500 kV, up until a point when the demand within the REZ requires this portion of the project to operate at 500 kV. Further, the Merotherie Energy Hub would operate at 500 kV but not all 500 kV infrastructure would be required until demand within the REZ is met.

There is therefore the potential that some project infrastructure would initially be constructed in a temporary arrangement to suit 330 kV operation, and then augmented at a point when the demand with the Central-West Orana REZ requires 500 kV operations.

A1.3.2 Transmission line maintenance

Regular maintenance activities would be required for the transmission lines during operation of the project. Likely maintenance activities would include:

- regular inspection and maintenance of all network infrastructure (ground and aerial), including transmission lines, towers and poles, that would typically involve:
  - annual aerial inspection of the transmission lines, easements, vegetation and access tracks as part of seasonal bushfire prevention surveys
  - ground based light detection and ranging (LiDAR) and thermographic inspection of lines
  - vehicle-based patrol of access tracks and roads
  - ground based asset inspection including foundation inspections. This would typically involve two to three maintenance crews driving light vehicles along the easement (accessed from public roads and access tracks), inspecting each transmission line tower from the ground and by personnel climbing the tower
  - maintenance of transmission lines to address defects identified from inspections, using a light vehicle(s), an elevated work platform and a medium sized truck involving multiple maintenance crews to rectify any defects found from routine inspections
  - earth testing at each line structure
  - vegetation removal required to maintain appropriate electrical safety clearances to the transmission lines

- an aerial inspection and LiDAR data gathering exercise of transmission
- fault and emergency response (unplanned maintenance), that would typically involve ad hoc fault and emergency fly over(s) to assess infrastructure condition should an unplanned outage occur (for example through a weather event or other failure of infrastructure). This maintenance would occur as required. The number of maintenance personnel and/or crews required to repair any damaged infrastructure would depend on the extent of repairs required.

Vegetation management

Vegetation within the operation area with growth heights of two metres and above (largely trees and shrubs) would be removed prior to and during operation, whereas native vegetation (including Derived Native Grasses and Derived Native Shrublands) with growth heights less than two metres would be retained. Where practicable, native vegetation would be retained throughout the operation area in accordance with project operational safety requirements (including bushfire risk management).

Hazard/high risk trees located inside and outside the transmission line easement would be removed. Hazard/high risk trees are defined as any tree or part of a tree that if it were to fall would infringe on the vegetation clearance requirements at maximum conductor sag of the transmission lines.

Hazard/high risk trees would be confirmed based on the final design (considering the transmission line conductor profile) and following qualified arborist assessment of the tree. All hazard/high risk trees confirmed as posing a risk to the corridor would be removed. To enable adequate assessment of future potential impacts on hazard/high risk trees beyond the easement the following parameters have been established for both the 330 kV and 500 kV transmission lines:

- 330 kV transmission line – hazard/high risk tree height is greater than 30 metres at the outer edge of the easement and 39.7 metres at 10 metres beyond
- 500 kV transmission line – hazard/high risk tree height is greater than 20 metres at the outer edge of the easement and 29 metres at 10 metres beyond.

Trees located outside the easement that exceed or have potential to exceed these defined hazard/high risk tree parameters include trees occurring in certain taller growing vegetation communities as defined in Section 4.2 of Technical paper 4 – Biodiversity development assessment report.

A1.3.3 Energy hub and switching station maintenance

Likely operational maintenance activities at the energy hub and switching station sites would include:

- ground and vegetation management, weed spraying and inspections of fire systems and synchronous condensers
- vermin management
- inspections of switchyards and buildings, power transformers and oil filled equipment, oil water separator, protection of secondary system assets (including supervisory control and data acquisitions systems) and thermographic survey of electrical equipment
- operational exercise for electrical equipment function and minor service of 50 and 120 volts battery systems
- minor service of electrical equipment
- major service of 50 and 120 volt battery systems
- maintenance of equipment protection and control systems
- major service of electrical equipment
- ad hoc attendance by switching operators to undertake switching of infrastructure for planned and unplanned works and fault and emergency personnel to respond to equipment status alarms.

Routine infrastructure inspection activities would require around two to four personnel, and routine/planned maintenance would require around four to 12 maintenance personnel.

Ad hoc maintenance may also arise from fault and emergency works (for example through a weather event or unexpected failure of an asset). This maintenance would occur as required. The number of maintenance personnel and/or crew required to repair any damaged infrastructure would depend on the extent of repairs required.

These activities are likely to require access via light vehicles or small to medium sized plant. Any waste generated during operation would be minimal and disposed of on an 'as needed' basis to a licensed waste facility by the attending maintenance personnel.

The energy hubs would include laydown areas which would support the maintenance operations.

Equipment is expected to have a service life of around 40 to 50 years. Maintenance would be undertaken regularly for the different infrastructure components and plant items such as transformers. These components would be replaced/refurbished towards the end of their serviceable life, allowing the service life of the sites to be extended.

A1.3.4 Resource use

Materials expected to be required for the operation of the project would be limited to those necessary for ongoing maintenance activities, and the operation of the energy hubs and switching stations. Resources used during operations would be associated with:

- replacement materials for electrical components at the energy hubs and switching stations such as inverters, transformers and electric cabling as required
- maintenance of access tracks and roads
- maintenance activities and use of machinery and vehicles (e.g. fuels, lubricants and metals)
- potable and non-potable water requirements
- electricity for the operation of the energy hubs, switching stations and communications facilities.

Materials

The materials described in Table A-4 are expected to be required annually as part of continued operation and maintenance of the project. Other materials may also be required to aid in general operation and maintenance activities, and these would be confirmed as part of continued development of the project's operational requirements.

Table A-4 Annual operational materials requirements

Material	Description/activity	Tonnes per year
Road base	Access track/road maintenance	50
Crushed sandstone (or similar)	Access track/road maintenance	50
Blue metal	Energy hub/switching stations	15
Transformer mineral oil	Maintenance	2.5
Silica gel	Transformer/oil breather	0.1

Water

During operation of the project, about 1.7 megalitres of water per year would be required for maintenance activities, on-site staff facilities and testing of firefighting systems and services, comprising:

- around 430 kilolitres for on-site staff facilities and maintenance activities at the energy hubs (potable water)
- around 1,100 kilolitres for vegetation management (potable or non-potable water), subject to development of a detailed vegetation management plan for the project as part of continued design development
- around 170 kilolitres for fire systems testing and fire services training (potable or non-potable water).

Measures to minimise water use, particularly of potable water, would be investigated during detailed design.

Potable water would preferentially be sourced from council owned potable water supplies in Dunedoo and Coolah (in the Warrumbungle LGA) and Gulgong (in the Mid-Western Regional LGA). Other sources would be investigated If these council owned supplies are not able to supply water to the project. Non-potable water would be sourced from rainwater harvesting and existing unregulated surface water sources, including the Upper Talbragar River Water Source, Lower Talbragar River Water Source and Upper Goulburn River Water Source, under water access licences for the project. The available water in each water source is dependent on conditions in each water source, which are dependent on the climate.

Water would be purchased and transported to the energy hubs, maintenance facility and switching stations as required, where it would be stored in water tanks.

A1.4 Land requirements

The project has been designed and developed to minimise impacts on private landowners, however private land is required for the following purposes:

- temporary use of land during construction
- permanent acquisition of freehold land for the energy hubs, switching stations, maintenance facility and temporary workforce accommodation camps
- easements for transmission lines infrastructure.

Where appropriate or available, land may be acquired on the market. Acquisitions of all other interests in land would be carried out in consultation with the relevant landowner in accordance with the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW) (Just Terms Act) and preferably resolved by negotiated agreement.

To the extent that subdivisions are required to facilitate acquisitions of part-lots, the project would also incorporate subdivisions.

Additional detail about potential impacts of the project on property during construction and operation are included in Chapter 7 (Land use and property).

A1.4.1 Freehold land access and acquisition arrangements

Freehold interests in land would be permanently acquired for the energy hubs (including the maintenance facility at the Merotherie Energy Hub) and the New Wollar Switching Station, prior to construction commencing.

Land for the temporary workforce accommodation camp at Neeleys Lane, Turill has been acquired by EnergyCo.

Freehold interests in land required for the 330 kV switching stations would be temporarily leased for the duration of construction, before the land is permanently acquired for operation, based on the final footprint of the constructed infrastructure.

EnergyCo has commenced the acquisition process to acquire any construction leases, together with the underlying land required for the project, in accordance with the Just Terms Act.

The freehold land that would be permanently acquired for the project is listed in Table A-5. The need for any further freehold land would be determined during finalisation of the project design and in consultation with relevant landowners (as required).

The proposed microwave repeater sites at Botobolar and Cope is located on Crown Land and private land, respectively.

Table A-5 Freehold land requirements

Project component	Lot/DP		Partial/full acquisition
New Wollar Switching Station	Lot 11 DP 1090027		Partial
Merotherie Energy Hub and maintenance facility	Lot 1 DP 854876 Lot 52 DP 750755 Lot 4 DP 750761 Lot 1 DP1064927		Full
Elong Elong Energy Hub	Lot 1 DP 754305 Lot 5 DP 754305 Lot 21 DP 754305	Lot 37 DP 754305 Lot 120 DP 754305 Lot 2 DP 532844	Full
330 kV switching stations	Lot 5 DP 883170 (M1) Lot 85 DP 750745 (M2) Lot 32 DP750745 (M2) Lot 12 DP 750768 (M3) Lot 47 DP 750761 (M4) Lot 34 DP 750755 (M5) Lot 51 DP 1215895 (M6) Lot 62 DP 754334 (M7)	Lot 47 DP 750767 (M8) Lot 148 DP 750762 (M9) Lot 105 DP 754305 (E1) Lot 97 DP 754305 (E2) Lot 15 DP 753405 (E3) Lot 17 DP 753405 (E3) Lot 1 DP 134329 (E3) Lot 30 DP 754302 (E4)	Partial
Neeleys Lane temporary workforce accommodation camp	Lot 61 DP 750771 Lot 62 DP 750771 Lot 72 DP 750771		Full

A1.4.2 Easements

The project would require access to land for the construction and permanent operation of transmission lines. Where the transmission alignment traverses private land, access would predominately be achieved by:

- a construction easement, including temporary access and brake and winch sites
- an easement for the permanent alignment of the transmission lines, together with any accesses required to support operations.

The easements would set out how each party use the land affected by the relevant easement. The terms of the easement would, among other things, allow ongoing access and maintenance of the transmission lines to authorised entities. Landowners can typically continue to use most of the land within transmission line easements, subject to some restrictions for safety and operational reasons.

The project would also require an easement through the Durridgere State Conservation Area which would be secured in accordance with the requirements of the *National Parks and Wildlife Act 1974*.

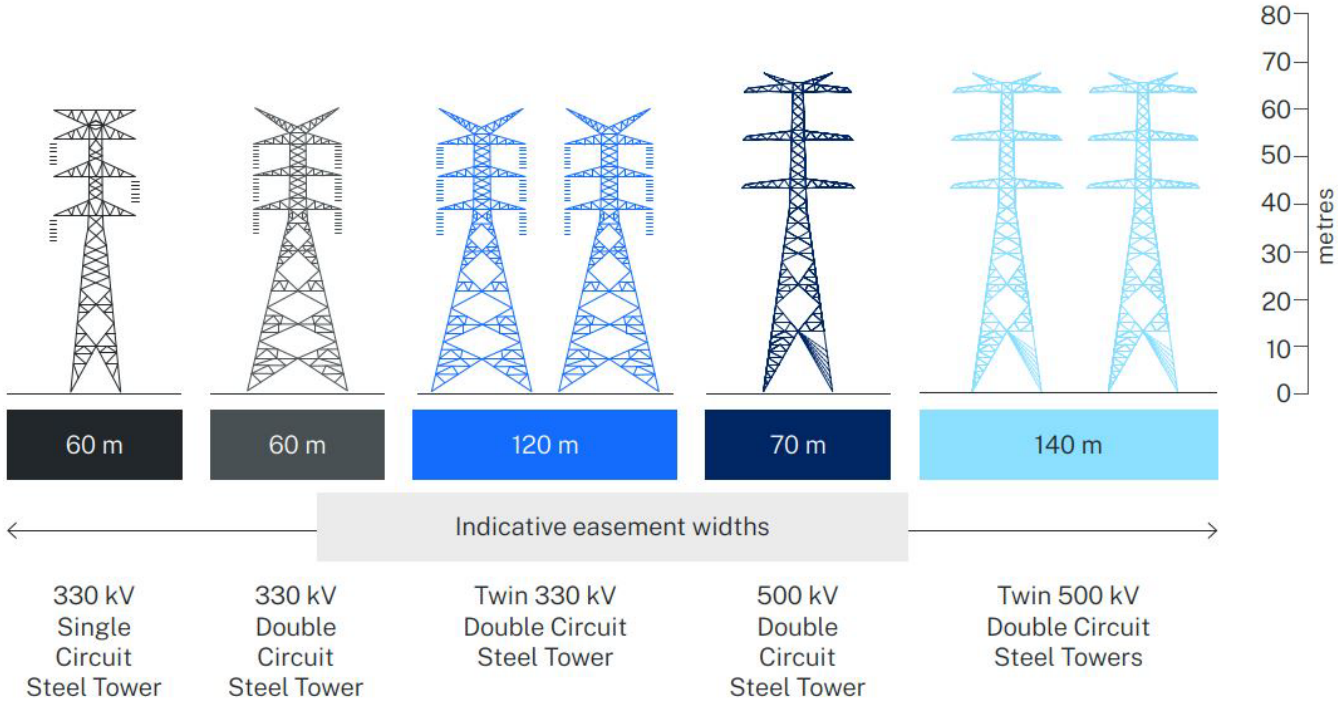
Typical permanent easement widths include:

- 70 metres for a single 500 kV transmission line
- 60 metres for a single 330 kV transmission line.

Where the 500 kV and 330 kV networks are located in the same easement, or immediately next to each other, a permanent easement width of up to around 240 metres would be required. This is expected to occur for two sections about seven and four kilometres between the Merotherie and Elong Elong energy hubs.

Figure A-11 shows typical permanent transmission line easements for the 500 kV and 330 kV network infrastructure.

Easements on land would be established and acquired in accordance with the Just Terms Act.



Note: Figure not to scale and represents indicative maximum tower heights and minimum easement widths which are subject to detailed design across the alignment. It should be noted 500 kV transmission line tower heights would be up to around 85 metres in isolated locations. A maximum easement width of around 240 metres would occur where a 330 kV easement (60 metres) is located alongside a twin 500 kV transmission line easement (140 metres) and include gaps between the 330 kV and 500 kV networks.

Figure A-11 Typical transmission line easements for the 330 kV and 500 kV network infrastructure

A1.4.3 Operational access requirements

Access to the transmission line easement during operation would be via existing public and private roads and access tracks, and access tracks established as part of the project during construction.

In some cases, access easements may be required to allow operational access to the transmission line easement from the nearest public road. These access easements would be negotiated with landowners as necessary. Where access arrangements are in place, the future Network Operator may install lockable and signed access gates should the landowner not have a suitable nearby access gate.

A1.5 Construction of the project

A1.5.1 Construction overview

Key construction activities for the project would occur in the following phases:

- enabling works, being activities that are required to facilitate the commencement of substantial construction
- construction works associated with the energy hubs and switching station sites
- construction works associated with the transmission lines
- pre-commissioning and commissioning of the project
- demobilisation and rehabilitation of areas disturbed by construction activities.

These key phases would not necessarily take place in the order stated above and some phases may take place concurrently. The key phases are further discussed in Section A1.5.6. An overview of project construction is provided in Table A-6, with key features shown in Figure A-12.

Table A-6 Project summary – construction

Project element	Summary	Figure reference
Construction		
Construction area	Around 4,000 hectares comprising the area that would be directly impacted by the construction of the project, including all project infrastructure elements (including, but not limited to, the transmission lines and towers, energy hubs, switching stations, access roads to switching stations and energy hubs, access tracks to and along easements, communications infrastructure, workforce accommodation camps, construction compounds, brake and winch sites and laydown and staging areas).	Figure A-12
Construction program	Anticipated to commence in the second half of 2024 and be completed in the first half of 2028 (subject to approvals and other factors).	Figure A-13
Construction workforce	Variable with a peak construction workforce of up to around 1,800 personnel.	N/A

Project element	Summary	Figure reference
Construction compounds	Construction compounds to support the construction of the project would be located at: • New Wollar Switching Station • Merotherie Energy Hub • Elong Elong Energy Hub • Neeleys Lane workforce accommodation camp. The construction compounds would accommodate a range of facilities including (but not limited to) staging and laydown areas, concrete batching plant and cement silo (except at the Neeleys Lane compound), aggregate storage, crushing, grinding and screening plant (except at the Neeleys Lane compound), parking areas, equipment and materials storage, maintenance sheds, generators, chemical and fuel stores, firefighting equipment, waste bins and stockpile areas, potable water tanks, wastewater treatment plants, staff facilities (office, lunch room and amenities), and helicopter landing pad and support facilities, including refuelling tanks.	Figure A-18, Figure A-19, Figure A-20 and Figure A-21
Workforce accommodation camps	Workforce accommodation camps to cater for the construction workforce would be located at: • Merotherie Road, Merotherie • Neeleys Lane, Turill. The workforce accommodation camps would provide accommodation for up to around 1,800 staff. Each workforce accommodation camp would include (but not limited to) demountable accommodation and office buildings, workforce amenities, utilities, refuelling tank, parking area and bus stop, equipment, materials and gas storage, generators, firefighting equipment and wastewater treatment plant.	Figure A-19 and Figure A-21
Other ancillary construction support facilities	The following ancillary construction support facilities would be required at the switching stations: • staging and laydown areas • crushing, grinding and screening plant (only at switching station M1) • vehicle, equipment and materials storage, maintenance sheds, generators, chemical and fuel stores, firefighting equipment, waste bins and potential stockpile areas • staff facilities (office and amenities) • parking areas • potable water tanks. Workforce amenities (including temporary bathroom facilities) would also be located within the construction area, typically along the transmission line alignment. Staging and laydown areas would be located along the transmission line and at each transmission line tower site to minimise vehicle movements to and from the construction compounds, where practicable.	N/A

Project element	Summary	Figure reference
Water management	Construction of the project would require a total demand of around 700 megalitres of water across the construction period, comprising of a mix of potable and non-potable water required for: • workforce accommodation camps and ancillary facilities • construction activities (such as concrete batching, dust suppression, vehicle washdown, earthworks and pavement compaction and landscaping). Non-potable water is proposed to be sourced from rainwater harvesting, reuse of construction water, treated water sources (including wastewater from the workforce accommodation camps and mine water (subject to further investigations during continued design development), existing unregulated surface water sources or regulated groundwater sources (from two new groundwater bores located at the Merotherie and Elong Elong construction compounds). Potable water is proposed to be sourced from existing regulated and unregulated surface water sources. Wastewater treatment plants would be provided at the workforce accommodation camps.	Figure B-1 in Appendix B (Updated project description mapping)
Construction routes	Construction routes to and from construction work areas, energy hubs, switching stations and workforce accommodation camps would use the public road network. These are depicted in Appendix B (Updated project description mapping) and discussed in Section A1.5.10. Non-standard or oversized loads would be transported from the Port of Newcastle (Newcastle) via gazetted oversize and overmass (OSOM) routes.	Figure B-1 and Figure B-3 in Appendix B (Updated project description mapping)
Local road, and intersection upgrades	A number of local roads and intersections would be upgraded to enable safe and reliable access to the construction compounds and energy hub sites, including: • upgrading the Golden Highway/Merotherie Road intersection • upgrading (road widening and sealing) Merotherie Road • installing a new bridge on Merotherie Road at its crossing of the Talbragar River to replace the existing crossing • upgrading the intersection of Merotherie Road and the access road to the Merotherie Energy Hub • upgrading (road widening) of Spring Ridge Road, near the intersection with Dapper Road • installing a new bridge on Spring Ridge Road at its crossing of Laheys Creek to replace the existing causeway • upgrading Dapper Road to tie into the upgraded Spring Ridge Road • upgrading the Spring Ridge Road/Dapper Road intersection to tie into the upgraded Dapper Road and Spring Ridge Road • upgrading Neeleys Lane (if required) and the Neeleys Lane/Ulan Road intersection • upgrading the Golden Highway/Ulan Road intersection • upgrading drainage infrastructure.	Figure A-12 and Figure B-1 in Appendix B (Updated project description mapping)
Stringing of transmission lines	Stringing of transmission lines would be completed in sections along the alignment. Insulators would be pre-assembled at each transmission line tower site and installed on the transmission line towers using winches before stringing commences. Brakes and winches would be used within brake and winch sites to install the conductors (when the use of drones to string transmission lines is not practicable). Helicopters and/or drones (if available and practicable) would be used for stringing of the transmission lines where ground pulled draw wire cannot be used in ecologically sensitive areas or areas with access constraints. Helicopter landing pads and support facilities, including refuelling tanks, would be located at each of the three main construction compounds at the Elong Elong Energy Hub, Merotherie Energy Hub and New Wollar Switching Station. Refuelling tanks would also be located at laydown areas along the transmission line easement.	Figure A-16

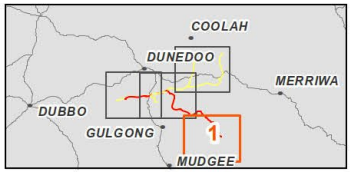
Project element	Summary	Figure reference
Utility adjustments	Adjustments to existing utilities would be required where new infrastructure would interface with existing utilities. This would include protection or relocation works to utilities including communications, gas mains and energy transmission.	N/A
Helicopter use during emergencies	Helicopters may be used during emergencies to transfer sick or injured personnel, assist with firefighting during bushfires or provide access during flood events. Helicopter landing pads and support facilities, including refuelling tanks, would be located at three of the main construction compounds at the Elong Elong Energy Hub, Merotherie Energy Hub and New Wollar Switching Station.	Figure A-18, Figure A-19 and Figure A-20

Figure A-12
Overview of the project construction
Map 1 of 4

Legend

- Construction area
- Construction compound
- Energy hub / 500 kV switching station
- 500 kV transmission line
- Microwave repeater site
- Existing substation
- Existing transmission line
- State road
- Railway
- Watercourse
- Water body

Note: Location of construction features are indicative and would be confirmed during detailed design



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Scale ratio correct when printed at A4

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Data sources: WSP, NSWSS, EnergyCo

GDA 2020

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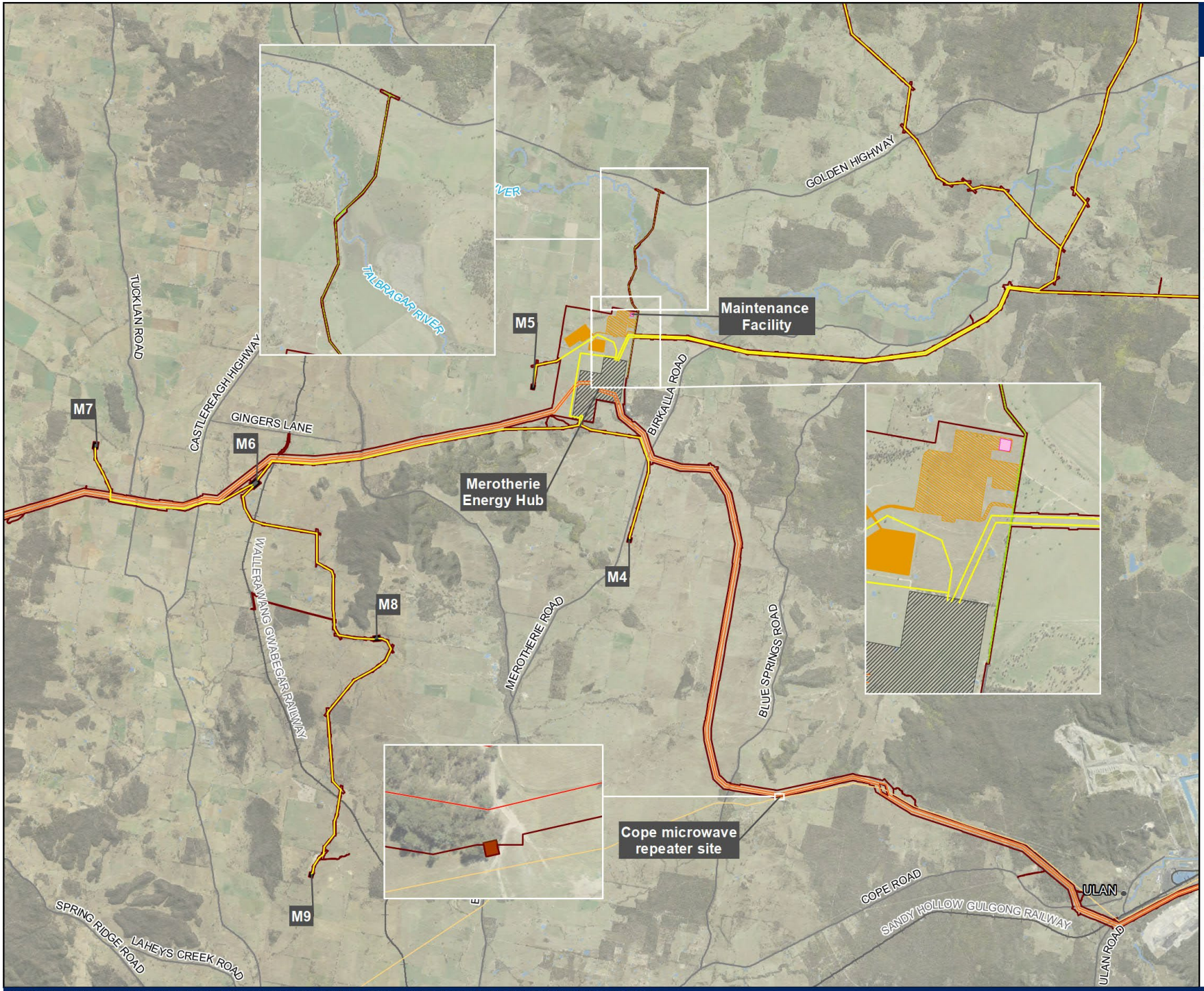
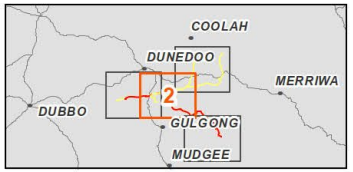


Figure A-12
Overview of the project construction
Map 2 of 4

Legend

- Construction area
- Construction compound
- Workforce accommodation camp
- Energy hub / 500 kV switching station
- Maintenance facility
- Public road upgrade
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Microwave repeater site
- Existing transmission line
- State road
- Railway
- Watercourse
- Water body

Note: Location of construction features are indicative and would be confirmed during detailed design



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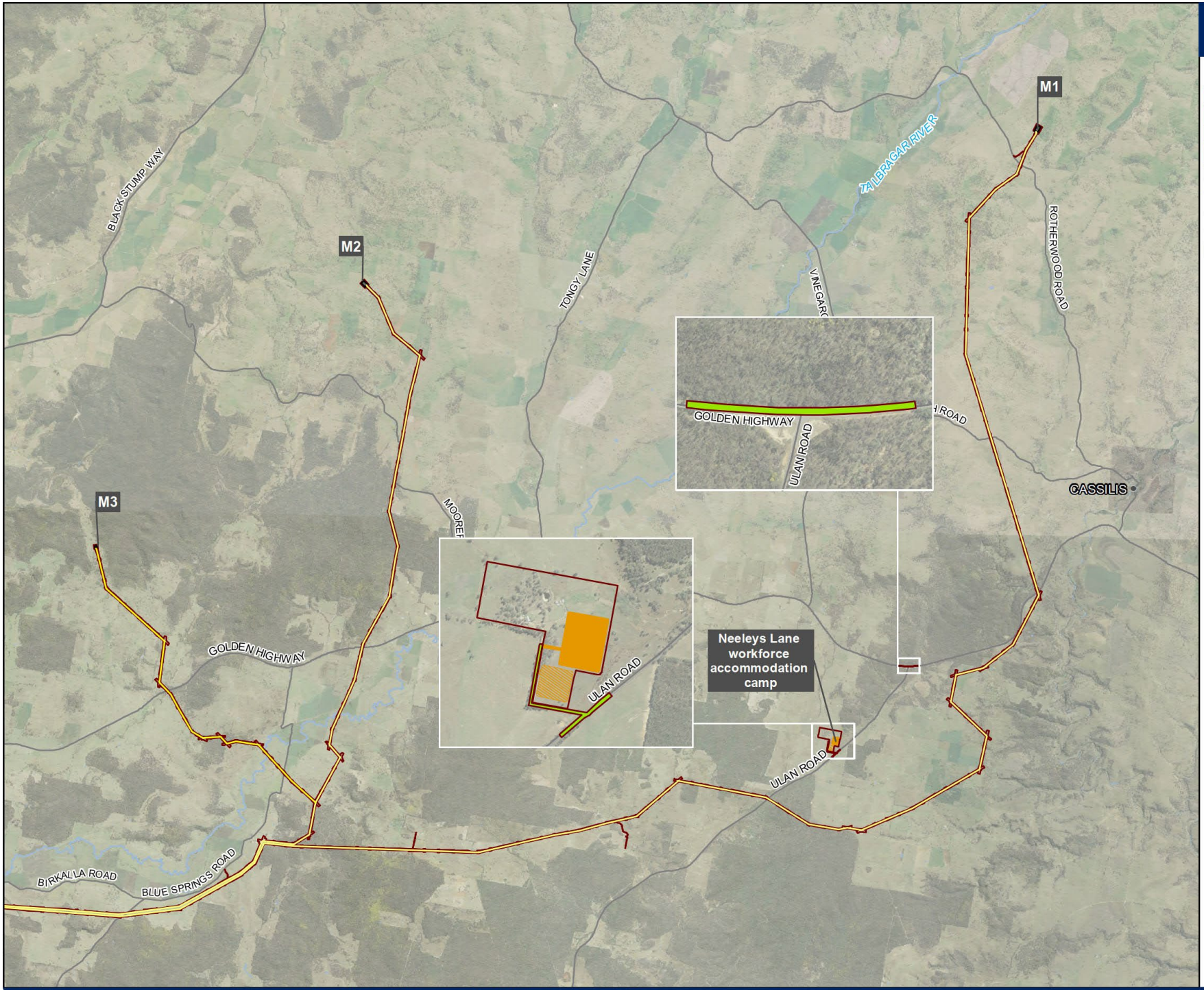
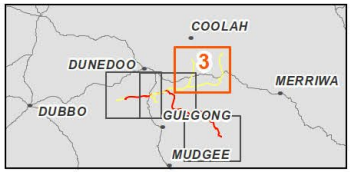


Figure A-12
Overview of the project construction
Map 3 of 4

Legend

- Construction area
- Construction compound
- Workforce accommodation camp
- Public road upgrade
- 330 kV switching station
- 330 kV transmission line
- State road
- Watercourse
- Water body

Note: Location of construction features are indicative and would be confirmed during detailed design



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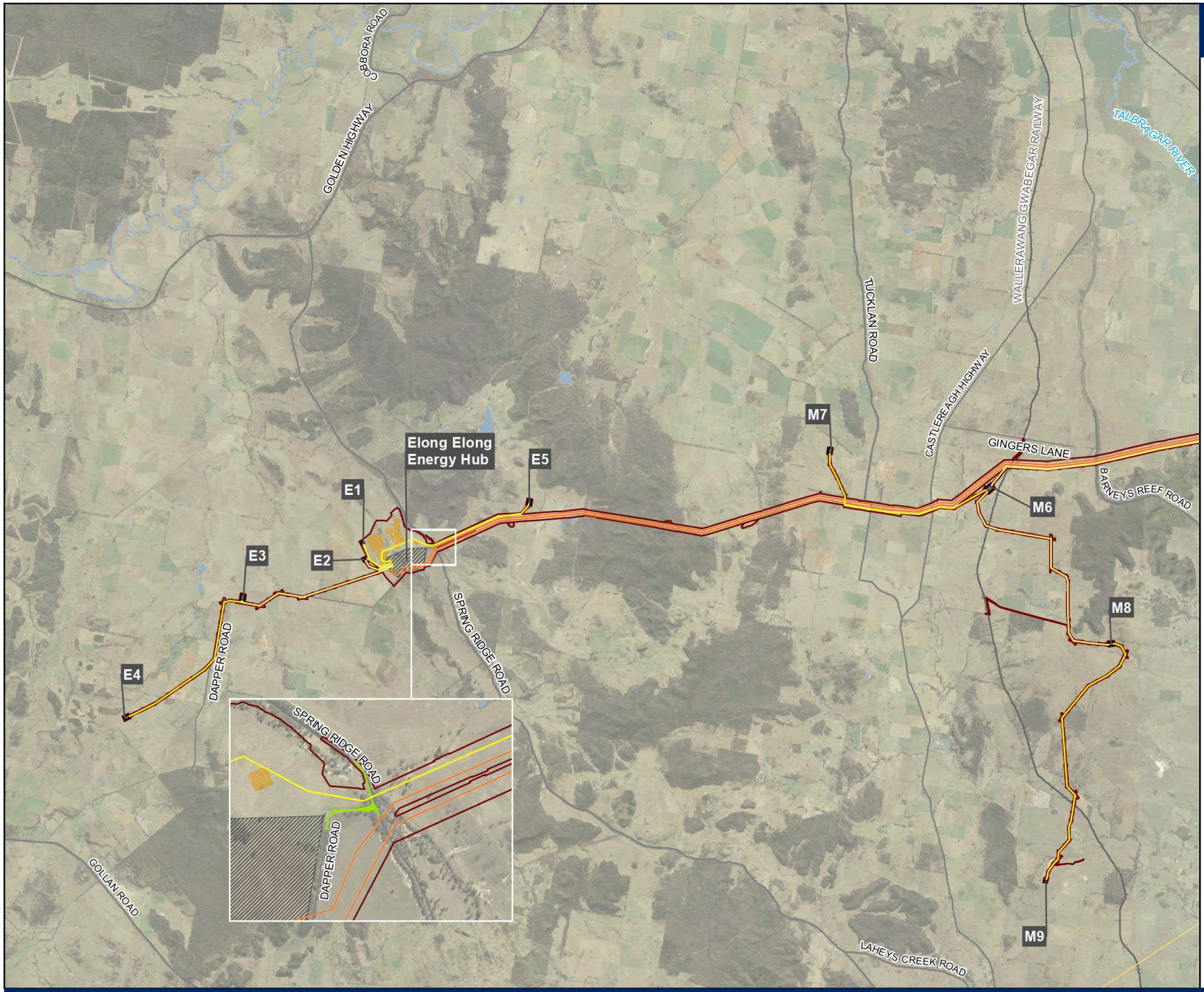
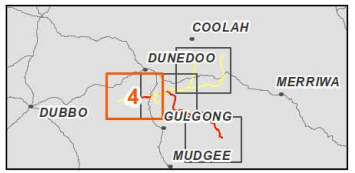


Figure A-12
Overview of the project construction
Map 4 of 4

Legend

- Construction area
- Construction compound
- Energy hub / 500 kV switching station
- Public road upgrade
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Existing transmission line
- State road
- Railway
- Watercourse
- Water body

Note: Location of construction features are indicative and would be confirmed during detailed design



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Data sources: WSP, NSWSS, EnergyCo

GDA 2020

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A1.5.2 Indicative construction program

The indicative timeframe for the project is for construction to commence in the second half of 2024, for a period of around four years, with initial operations to commence by late-2027, subject to NSW Government and Commonwealth planning approvals. Construction site decommissioning and rehabilitation is expected to extend until the first half of 2028 (refer to Figure A-13).

Figure A-13 Indicative construction program

A1.5.3 Construction sequencing

Construction of the project is planned to occur concurrently across multiple work fronts. This would mean that at any one time, construction activities are likely to be occurring at several locations within the construction area at the same time. The sequencing of construction activities and phases would be confirmed as part of detailed construction planning.

As detailed in Section A1.2, the Elong Elong Energy Hub and the Merotherie Energy Hub — Elong Elong Energy Hub connection would initially operate at 330 kV. However, as more demand is placed on this portion of the transmission line infrastructure, it is envisaged that both the Elong Elong Energy Hub and the Merotherie Energy Hub — Elong Elong Energy Hub connection would operate at 500 kV.

To facilitate this, the following sequencing of the project's construction is planned to occur:

- Initially, all foundations, pads and hardstand areas required for 500 kV operation of the Elong Elong Energy Hub would be constructed within the energy hub site; however, only the equipment in the two 330 kV switchyards would be fitted out with equipment. At a later date, the 500 kV switchyard within the energy hub would be fitted out with equipment. It is anticipated that the 500 kV switchyard would be fitted out with equipment and be operational to align with the timing of when the demand on the REZ network reaches a point where 500 kV operation of the energy hub is required.
- Initially, all foundations and hardstand areas required for 500 kV operation of the Elong Elong – Merotherie connection would be constructed within the Merotherie Energy Hub site; however, only the equipment for 330 kV operation would be installed, except for the infrastructure that connects to the New Wollar Switching Station — Merotherie Energy Hub connection. It is anticipated that these works would be constructed and operational to align with the timing of when the demand on the REZ network reaches a point where 500 kV operation of the Elong Elong Energy Hub is required.

- The Merotherie Energy Hub—Elong Elong Energy Hub connection would be constructed to the specifications required for 500 kV operation; however, would be operated at 330 kV until a time when 500 kV operations commence. No augmentations of this transmission line are expected as part of the transition of operations from 330 kV to 500 kV, except within the Merotherie and Elong Elong energy hub sites, where the transmission lines would need to be adjusted.

A1.5.4 Construction phases

Enabling work

Enabling works are activities that are required to facilitate the commencement of substantial construction (and may incorporate investigations and other works that can be undertaken prior to CSSI approval) to:

- prepare for construction
- to manage specific features or issues
- collect additional information required to finalise aspects of the design and construction methodology.

To be considered enabling works, these works must be considered of minor or low impact, and typically must not involve impact on features of high environmental or heritage conservation significance, or significant amenity impacts to nearby receivers.

Enabling works for the project would include:

- installation of fencing, gates, barricades, exclusion zones and other access controls
- property adjustment work, including adjustments to existing property fencing. Any property adjustment work would occur in consultation with the affected landowner and in accordance with the Property Management Plan for that property
- establishment of permanent and temporary environmental controls and monitoring equipment, where required
- minor clearance of vegetation (excluding threatened species and ecological communities) to facilitate other enabling works, and the relocation of salvaged habitat features
- establishment of construction compounds, interim workforce accommodation camps and laydown areas, including:
  - surface preparation required to establish construction compounds, interim workforce accommodation camps (which would be at the same location as the workforce accommodation camps) and laydown areas
  - installation/erection of site sheds, storage containers, interim workforce accommodation camps, office and associated amenities facilities. The interim workforce accommodation camps would be required to temporarily house the construction workforce (particularly early work contractors) to carry out the establishment of the final workforce accommodation camps, pre-construction works activities and early work activities. These camps would be located within the same areas identified for the construction compounds and final workforce accommodation camps (refer to Figure A-12) and would be supported by temporary infrastructure such as portable generators, toilets and ablutions and water trucks for potable water
  - establishment of concrete batching plants
- biodiversity, heritage and other investigations, including test excavation (as required), protection, salvage, environmental monitoring and recordings
- establishment of new access tracks, maintenance of and upgrades to existing access tracks where required, including widening and/or grading of existing access tracks

- utility works, connections, adjustments, augmentations, relocations, and protection. This includes connections to construction compounds and/or workforce accommodation camps, where practicable
- delivery of construction plant and equipment to site and delivery of materials at laydown areas
- additional geotechnical and contamination investigations
- other survey work, such as road dilapidation surveys, and surveys of the general alignment and existing utilities, installing survey controls (including installation of global positioning systems (GPS)), installing repeater stations, carrying out surveys of existing and future utilities
- removal of waste from the construction area and remediation of contaminated land (if present and required)
- works to enable installation of microwave communication towers.

Transmission line construction

Construction of the transmission lines, including the towers and stringing activities, would take place within a temporary easement typically about 220 metres wide, but around 280 metres wide where the 500 kV and 330 kV networks are located immediately next to each other. This easement would then be permanently reduced for operation of the project in accordance with the widths described in Section A1.4.2. Each transmission line tower would require the following key steps:

- site preparation, including survey, access, vegetation clearance and earthworks
- construction of transmission line tower foundations and earthing grids
- transmission line tower assembly and installation
- stringing.

Based on the final construction sequencing of the multiple crews working across multiple work fronts, there may be periods of inactivity between the abovementioned key construction activities for each transmission line tower.

Energy hub, maintenance facility and switching station site construction

Following a period of enabling and site establishment works, as described above, the construction methodology for the energy hub, maintenance facility and switching station sites would typically consist of the following key activities (depending on the site-specific electrical infrastructure requirements):

- establishment of suitable access
- earthworks and site preparation, including:
  - removal of vegetation and topsoil
  - bulk earthworks to form the energy hub, maintenance facility or switching station pad, including excavation, and leveling of the site, placement and compaction of fill, and preparation of the site for concrete foundations
  - blasting, depending on geotechnical conditions (to be confirmed as part of continued design development, and subject to further assessment)
- civil construction works, including:
  - construction of hardstand areas
  - construction of access roads
  - installation of reinforced concrete and piled foundations for the electrical equipment
  - installation of protective walls around transformer areas
  - trenching of electrical equipment conduits and general site drainage works

  - bund construction
  - construction of prefabricated ancillary buildings, equipment control buildings and acoustic sheds, as required
- mechanical and electrical fitout, including:
  - erection of galvanised steel towers to support electrical equipment, using cranes
  - installation of electrical equipment on foundations, including transformers and synchronous condensers (at energy hubs)
  - installation of site wiring and electrical control equipment within the control buildings
  - installation of trenches and cabling
  - at New Wollar Switching Station, installation of an underground communications cable between the new switching station and the existing Transgrid Wollar 500 kV Substation
- finishing works, including:
  - erection of the boundary security fence, including site access gates
  - surfacing and stabilising works for access roads
- commissioning.

Pre-commissioning

The pre-commissioning process would commence in the final phases of construction. Pre-commissioning is required to ensure construction has been undertaken in accordance with the design and statutory requirements and is safe to operate.

Key activities undertaken during pre-commissioning include:

- testing and commissioning of the equipment at the energy hubs, maintenance facility and switching stations
- point to point testing of the connections of the transmission lines, energy hubs, maintenance facility and switching stations
- earthing testing
- high voltage testing
- high voltage equipment operational checks
- connection to the existing NSW transmission network
- protection, control, and metering system and communication system testing
- operational readiness and safety checks.

Commissioning

Following all testing, operational readiness checks and connection of the New Wollar Switching Station to the existing NSW transmission network, the commissioning of the project would commence. Commissioning is planned to start a year prior to the commencement of operation and would be a staged process. This would include:

- connecting the New Wollar Switching Station to the existing NSW transmission network
- commissioning of the New Wollar Switching Station
- energisation of the New Wollar Switching Station — Merotherie Energy Hub connection 500 kV transmission lines
- progressive commissioning of the Merotherie Energy Hub

- progressive commissioning of the 330 kV network infrastructure connecting Merotherie Energy Hub to the surrounding renewable energy generation projects
- energisation of the Merotherie Energy Hub — Elong Elong Energy Hub connection 500 kV transmission lines (operating at 330 kV initially)
- progressive commissioning of the Elong Elong Energy Hub
- progressive commissioning of the 330 kV network infrastructure connecting Elong Elong Energy Hub to the surrounding renewable energy generation projects
- supporting the connected renewable energy generation projects to undertake their own test and commissioning activities
- end to end testing of communication and control systems between the Central-West Orana REZ and the REZ control room, AEMO control room and Transgrid control rooms
- audible noise, thermographic imaging and electric and magnetic field (EMF) testing.

Operation would commence when all infrastructure is energised and operating within the NSW transmission network.

Demobilisation and construction site rehabilitation

Following infrastructure completion, demobilisation and construction site rehabilitation would be carried out progressively along sections of the transmission lines, including tower locations, and at energy hubs, the maintenance facility and switching stations. This phase of work would include:

- removal of all construction plant and equipment, and all materials not required during operation, including any remaining waste material
- removal and/or handover of construction compounds and workforce accommodation camp sites to EnergyCo
- removal of any temporary site buildings and temporary environmental controls
- rehabilitation works, including rehabilitation of construction areas, compounds and workforce accommodation camps, irrigation and water infrastructure facilities, natural drainage in areas where temporary facilities were provided, fences, gates and other agricultural infrastructure which may have been damaged during construction. Land subject to a temporary lease agreement would be rehabilitated to its pre-existing condition where feasible and reasonable
- in other non-operational locations, site restoration would be undertaken to make good any disturbances caused during project activities.

A1.5.5 Construction hours and workforce

Construction of the project would generally be carried out during recommended standard hours as defined by the *Interim Construction Noise Guideline* (NSW Department of Environment and Climate Change (DECC), 2009) (ICNG):

- Monday to Friday between 7 am and 6 pm
- Saturday between 8 am and 1 pm
- no work on Sundays or public holidays.

Construction of the project would also be undertaken outside of the recommended standard hours (out of hours work), as detailed below.

Out of hours work

Due to the remote nature of the work, and the requirement to accommodate a rostered fly-in fly-out and drive-in drive-out workforce, construction hours would be extended across a seven-day work week between 7 am and 7 pm (extended construction hours) where necessary and appropriate. To support construction activities during these extended hours, operation of the main construction compounds would also be required.

Where sensitive receivers are noise affected during extended construction hours (that is, where construction noise is above the noise management level (refer to Chapter 15 (Noise and vibration)), and the works cannot be undertaken during standard work hours, mitigation measures would be implemented through an out of hours work protocol.

The workforce accommodation camps would be operational 24 hours a day, seven days a week to provide accommodation for the workforce.

In addition, the following out of hours work would be required at certain locations within the construction area to satisfy third party or safety requirements or to accommodate specific long lead items:

- stringing of transmission lines across a main road or railway
- transmission line construction within areas currently forming part of mining operations, to coordinate works with 24/7 mining operations
- where road occupancy licences are required
- transmission line cutover or commissioning
- the delivery of equipment or materials as requested by police or other authorities for safety reasons (such as the delivery of transformer units)
- oil filling of the transformers at energy hubs
- emergency work to avoid the loss of lives and/or property and/or to prevent environmental harm
- work timed to correlate with system planning outages (likely 24-hour operations when required to minimise impact to electrical supply services)
- situations where agreement is reached with affected receivers
- potential utilities adjustment works (in consultation with the requirements of asset operators)
- large concrete pours (including concrete batching plant operation which may require commencement before 7 am for early pours)
- any works that do not exceed the applicable noise management levels in accordance with the ICNG.

During detailed construction planning, a program would be developed to identify the required night work periods (including dates and durations). Except for emergencies, out of hours works would be carried out in accordance with an out of hours protocol and would not take place outside construction hours without prior notification in line with that protocol (refer to Chapter 15 (Noise and vibration)).

Construction workforce

The construction workforce would vary depending on the stage of construction and associated activities. During the peak construction period, it is expected around 1,800 full time equivalent construction workers would be employed. The peak construction workforce is expected to occur in the second half of 2025. This is attributed to concurrent construction works being completed for civil construction and electrical construction works across three key construction phases (the enabling works, energy hubs and switching stations, and transmission line construction activities).

A1.5.6 Construction methods

Site preparation

Site preparation works would be required at the energy hub, maintenance facility and switching station sites and at each transmission line tower site. Typically, site preparation activities would include:

- vegetation clearing and mulching, where required
- earthworks (including blasting, if required) for levelling of the ground surface, bench sites (including the laydown and storage area), drainage and/or grading and construction of access tracks from public roads to the easements (where required). Earthworks activities would also include placement and compaction of fill, and preparation of the site for concrete foundations.

Vegetation clearance

The approach to vegetation clearance within the construction area has been adopted to provide as realistic an assessment as possible and avoid a 'worst case' approach, as doing so for this environmental aspect would result in a substantial overestimation of the likely biodiversity impacts of the project. The approach to the assessment of potential biodiversity impacts and a detailed description of the vegetation clearance strategy that has been applied to the project is provided in Chapter 6 (Approach to impact assessment).

Vegetation clearance within the construction area would be confirmed during finalisation of the project design and construction methodology and would be developed with the aim of avoidance and minimisation of potential impacts to biodiversity, where practicable.

Earthworks

Excavation and the establishment of hardstand areas would be required to provide a level platform for equipment setup, and/or the erection of the tower and other construction activities. This would require the use of earth moving equipment such as graders, excavators, dozers, dump trucks and rollers.

Where excavation is required for hardstands, pads and access roads, excavations would typically be up to around 1.5 metres below ground level (bgl) (subject to site topography and geotechnical conditions). In areas where groundwater is shallow, alternative construction methodologies and designs may be implemented to limit interaction with groundwater during excavation and to avoid or minimise the need to dewater. If groundwater is encountered during excavation, dewatering would be undertaken and managed as appropriate.

The construction area traverses land within the Wilpinjong Coal Mine (owned by Peabody), including an area known as Pit 4. Pit 4 has been previously mined and backfilled with materials potentially containing high carbon material (HCM), and low-level coal, which carries a risk of spontaneous combustion if not handled appropriately. HCM is likely to be encountered at a depth of greater than one metre below the ground surface. Once excavated, HCM cannot be used as surface fill material and cannot be capped with topsoil and rehabilitated. It must be buried within the mine within specific areas in accordance with the Spontaneous combustion management plan for the Wilpinjong Coal Mine (refer to Section 19.2 (Soils and contamination)). Prior to excavation in these areas, soil testing would be carried out to confirm the presence of HCM. Appropriate safeguards and management measures as outlined in Chapter 21 (Environmental management) would be implemented to ensure the appropriate handling and treatment of HCM on-site.

Excavated material that does not contain HCM would be stockpiled and tested to determine its waste classification and potential beneficial reuse. Excavated material suitable for reuse would be used for backfill around the transmission line tower foundations and embankment filling at the tower site from which it was excavated. Topsoil would be stripped and stored separately from the excavated material to assist in site rehabilitation. Any excess excavated material would be spread evenly around the site after completion of the foundation backfilling (if suitable) or removed from the site and disposed of in accordance with its waste classification.

Blasting

Controlled blasting may be required in areas of shallow bedrock or hard geological conditions, to loosen and break up existing rock. There is the potential for this to be required at the Merotherie and Elong Elong energy hubs, switching stations and small areas along the transmission line alignment. This would most likely include the Cassilis, Coolah, Leadville and Merotherie Energy Hub — Elong Elong Energy Hub connections, based on the current understanding of geotechnical conditions. Areas requiring blasting would be confirmed during detailed construction planning.

Controlled blasting typically involves pre-drilling a series of closely spaced holes which are loaded with a small amount of explosives that are then detonated to break the rock into removable pieces. Following controlled blasting, rock material would be excavated using standard construction plant and equipment. The controlled blasting technique to be used would be confirmed during detailed construction planning and may be adjusted during construction, depending on the success of the initial blasting activities.

Where practicable, the excavated material from blasting would be reused to construct the pads for the energy hubs, maintenance facility, switching stations, transmission tower foundations or aggregates road base to be used on the project, to minimise the volume of imported fill material required.

Construction of transmission line tower foundations

Transmission line tower foundations would typically consist of pile foundations along the transmission line alignment. Alternative foundation designs would be required at some locations due to the anticipated geotechnical conditions. An example of this would include the foundation for a tower base in a rehabilitated open cut mining area, comprising uncontrolled backfill.

Transmission line tower piles would typically consist of bored, cast in situ piles with reinforced concrete. Pile depth would typically range from between five metres bgl to 20 metres bgl, though this would vary significantly based on the depth at which rock is encountered. Piles would typically range in diameter between 600 millimetres and 1,800 millimetres, though this would depend on the type of tower and the geotechnical conditions encountered (e.g., greater piling depths would be required where soft soil types are present), and the type of transmission tower required.

Monopole foundations would generally comprise bored piles, up to four metres in diameter, which would be socketed into rock, depending on geotechnical conditions. Where rock is encountered at shallow depths, alternative foundation designs may be utilised that include rock and strand anchors.

If groundwater is encountered during piling, dewatering would be undertaken and managed as appropriate. Dewatering may also be required during the concrete pour process. Concrete would be poured into the excavated pile, and water removed from the pile as it is displaced by the concrete.

Tower foundations in mining rehabilitation and mine subsidence areas

The transmission line easement would traverse the Moolarben, Ulan and Wilpinjong mining leases. The New Wollar Switching Station — Merotherie Energy Hub connection that forms part of the 500 kV network infrastructure would require the construction of tower foundations within the three mining areas, including rehabilitated areas, as well as areas of potential mine subsidence within the Mudgee Mine Subsidence District.

An assessment of predicted subsidence has been completed for the areas of the project that traverse the Mudgee Mine Subsidence District. This assessment has indicated that subsidence within the Mudgee Mine Subsidence District is not expected to impact or affect the project's infrastructure during construction and/or operation. Consultation with the Subsidence Advisory NSW has been undertaken as part of this process. Consultation with Subsidence Advisory NSW will continue throughout the detailed design and construction phases if any significant design changes are proposed for the portion of the alignment through the Mudgee Mine Subsidence District.

The main issues associated with transmission tower foundations on infilled pits in rehabilitated mining areas relate to differential settlement and constructability, as pits are typically filled with highly variable soil and rock materials derived from mining. These materials are generally not placed or compacted in a controlled manner and may contain voids and boulders. In addition, some areas may have also been used as tailings dams.

Within the rehabilitated open cut mining areas, the design of the project has considered the potential impacts of settlement on project infrastructure. For towers over areas previously subject to mining it is possible that cruciform foundations may be adopted in some areas rather than piles (refer to Figure A-14). This would be further investigated and confirmed as part of continued design development. The design of project infrastructure within these areas would continue to be refined as part of continued design development. The location of the 500 kV network infrastructure relative to the Mudgee Mine Subsidence District and areas of mine subsidence risk associated with the Moolarben, Ulan and Wilpinjong mining operations are shown in Figure A-15.

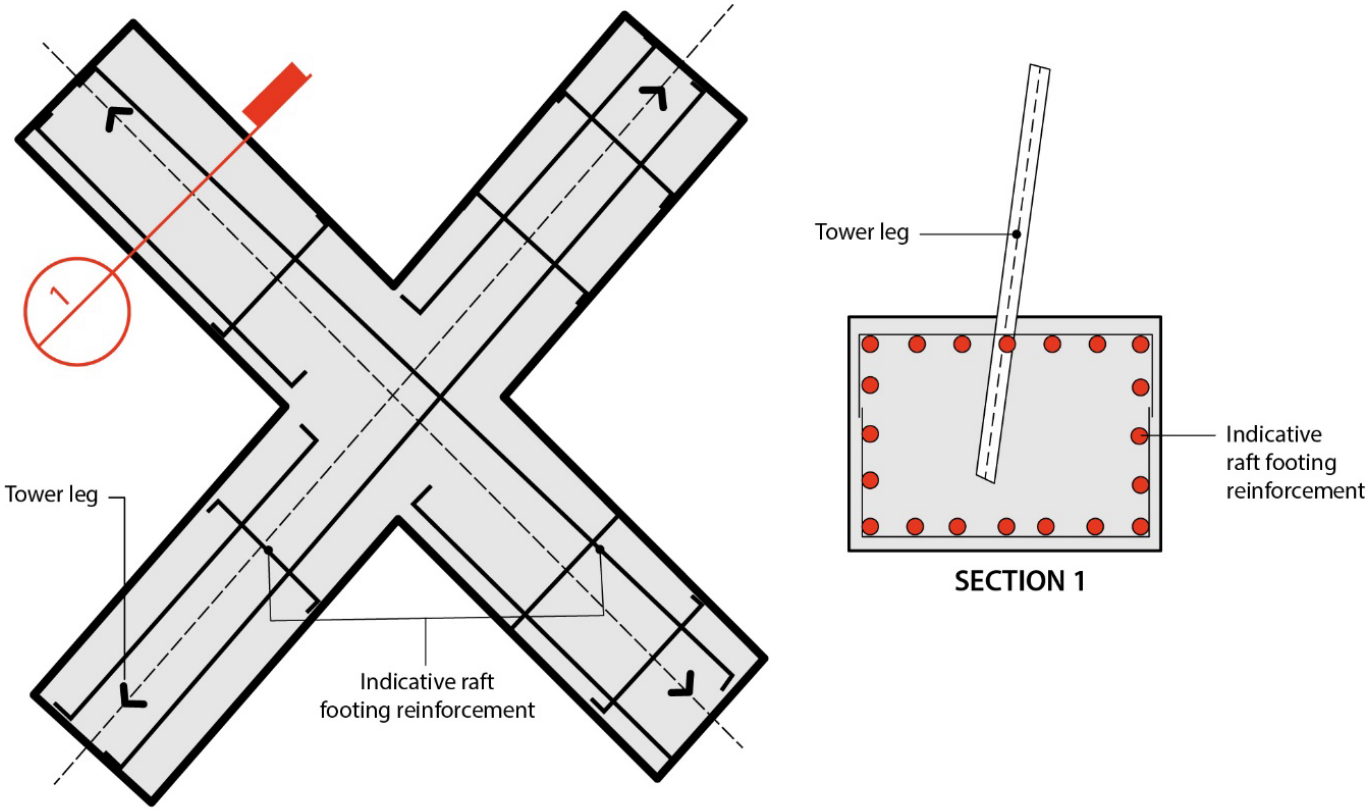


Figure A-14 Cruciform foundation design for rehabilitated open cut mining areas

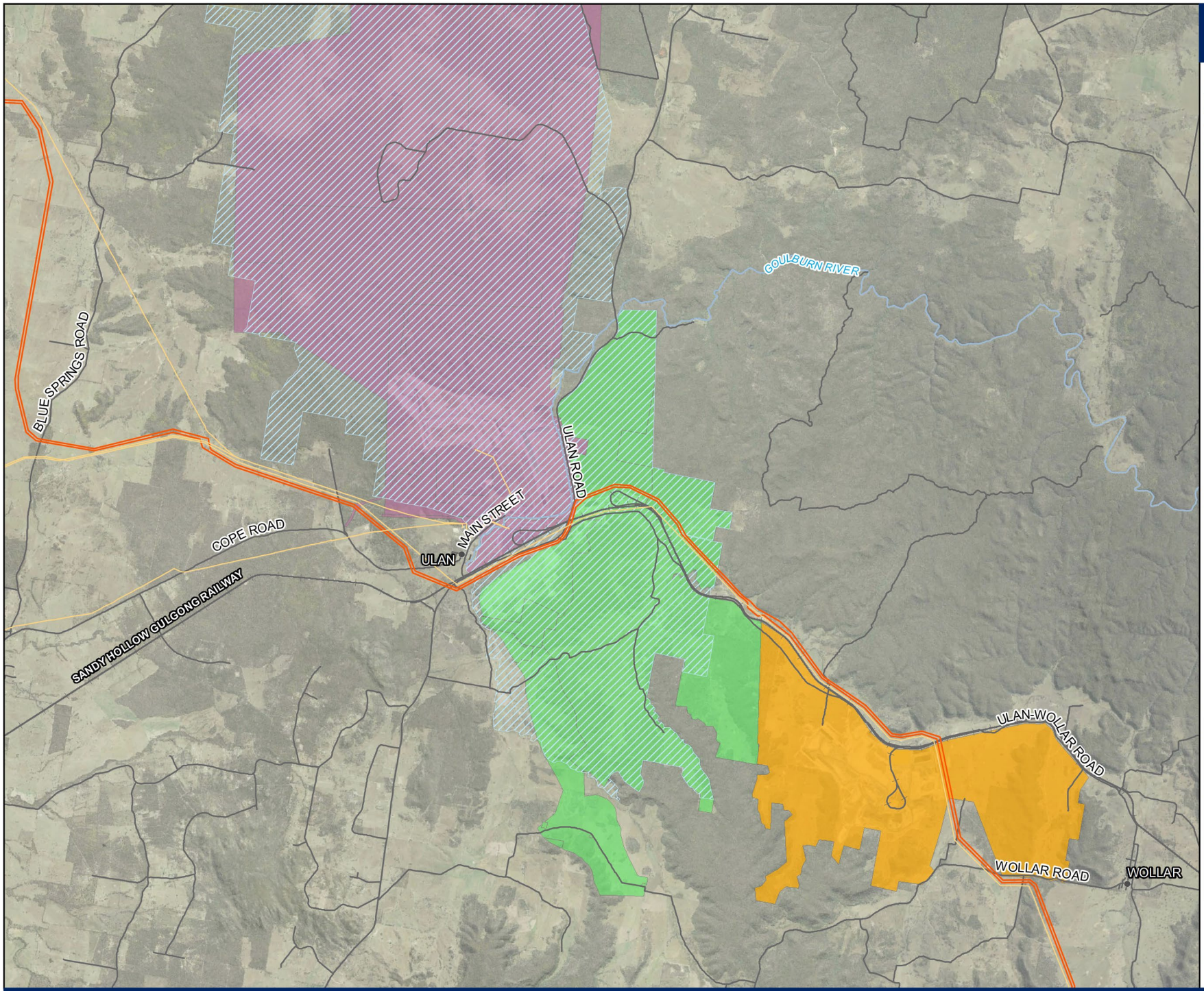


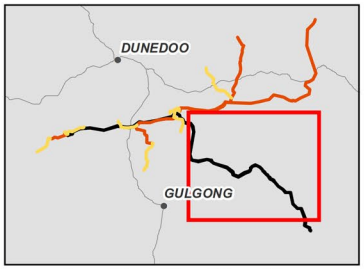
Figure A-15
Mine subsidence district areas in the vicinity of the project

Legend

- Construction area
- 500 kV transmission line
- Existing transmission line
- Mudgee Mine Subsidence District
- State road
- Railway
- Watercourse

Mining lease area

- Wilpinjoing mine
- Moolarben mine
- Ulan mine



0 1,000 2,000 3,000 4,000 Meters

Coordinate system: GDA2020 MGA Zone 55
Scale ratio correct when printed at A4

1:150,000

Data sources: WSP 2023

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Assembly of transmission line towers

Transmission line towers are typically erected by assembling them in sections on the ground and hoisting or lifting successive sections into place using cranes. Assembly of towers on the ground is generally done using Franna cranes or similar, and once a transmission line tower section is of sufficient size, it's lifted into place using a larger crane, though this varies depending on specific site constraints.

These towers would include infrastructure such as step bolts, climbing attachment plates, ladders, platforms, climbing barriers, identification plates, warning plates, other fixtures and fittings for the attachment of earth wires and insulators.

Construction of each transmission line tower would require access for tower assembly and stringing works. Crane pads may be required for erecting each tower, depending on geotechnical conditions. At a typical site, this would include a temporary area of around 80 metres by 80 metres for the 330 kV and 500 kV transmission line towers (inclusive of where monopoles are to be installed). These sizes are indicative only and would vary depending on specific constraints at each tower location.

Stringing of the transmission lines

Stringing of transmission lines includes all activities associated with the installation of the primary conductors onto the transmission line towers at insulated connection points. Insulators would be pre-assembled at each transmission line tower site and installed on the transmission line towers using winches before stringing commences.

Rollers would be installed at the peak of the towers for stringing overhead earth wire and optical ground wire.

In locations where the transmission line alignment includes a direction change, a larger area would be required to allow for brake and winch sites. A brake and winch site would be temporarily cleared to provide an area for plant and equipment to be located, and for the purposes of spooling and winching a conductor into place on an erected transmission line tower. Brake and winch sites would generally be around 150 metres in length and 70 metres wide, though they vary significantly based on the height of the adjacent tower and the existing topography.

Stringing would be completed in sections along the alignment. The method utilised for the installation of the draw wire would depend on a number of site-specific constraints including topography and the length of the pull.

Use of drones/helicopters

In ecologically sensitive areas or areas with access constraints, the stringing of transmission lines would use aerial methods, such as a line stringing drone or a helicopter, to pull the draw wire if available and practicable, and subject to noise impact restrictions and weather conditions (refer to Figure A-16). This method is expected to minimise disturbance and vegetation clearance, and reduce assembly, erection and stringing timeframes.

The coordination of aerial activities would be completed in consultation with local landowners, Airservices Australia and Civil Aviation Safety Authority to minimise any potential air traffic conflicts, as required.

Use of ground pulled draw wire

When the use of drones or helicopters to string transmission lines is not practicable (due to inclement weather, not being available or due to noise restrictions), a small bulldozer would be used to ground pull the draw wire (refer to Figure A-17).

At each tower, the draw wire would be pulled over a pulley assembly which would be pre-installed on the tower. The draw wire is then connected to a winch set up at the end of the stringing route. Tensioners would be set up in the brake site, between the first tower and cable drum, with the conductors winched into position. When the end of the conductor drum is reached, the conductor would be clamped in place after tensioning, and a new drum set up and fed through the tensioner. The ends of the conductor would be jointed and the pull restarted until the full length of the run has been achieved.

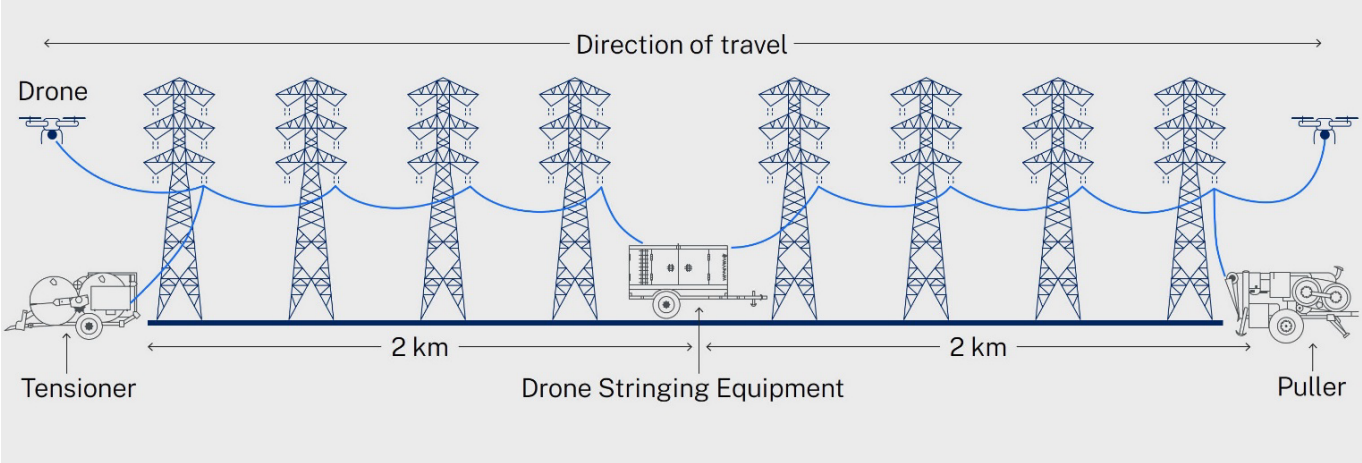


Figure A-16 Diagram of how conductor stringing operations could occur using a drone

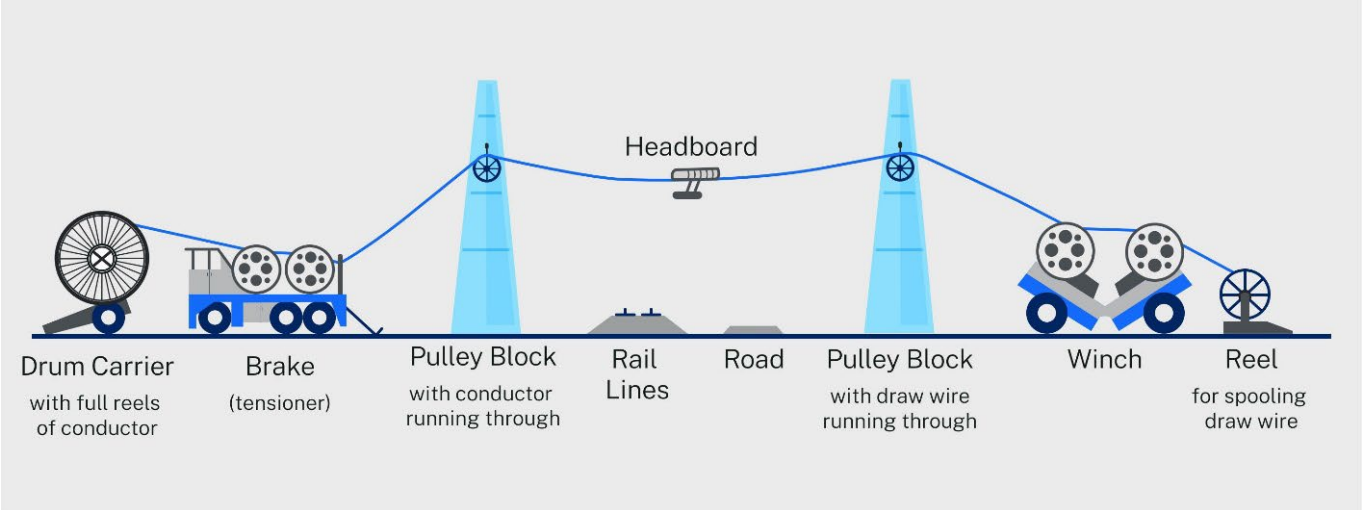


Figure A-17 Diagram of how conductor stringing operations could occur using a ground pulled draw wire

Transmission line crossing points

Watercourse crossings

The transmission lines (both 500 kV and 330 kV network infrastructure) would require spanning of 28 watercourses, including the Talbragar River and smaller ephemeral watercourses.

Generally, to limit the potential for impacts to and disturbance of these watercourses, the design of the transmission lines would include a transmission line tower on either side of the watercourse, located as far away as practicable from the watercourse. In instances where a temporary watercourse crossing cannot be used (refer to Section A1.2.3), a drone or helicopter would be used to take the draw wire over the watercourse during stringing to allow cables to then be pulled and strung tower to tower. In some circumstances it may be impractical to use a drone or helicopter, and in such cases alternative methods, such as the use of watercraft, would be investigated.

There would be some temporary works at the base of the transmission line tower on both sides of the watercourse to allow for the construction of the transmission line tower foundations and tower assembly, however it is likely that these would be located as far as practicable from the bank of the watercourse with appropriate environmental controls (such as erosion and sediment controls) implemented.

Road, rail and other infrastructure crossings

The project would cross a number of roads, railways lines, existing transmission lines, and existing mining infrastructure.

Key roads that would be crossed by the project include:

- Upper Cumbo Road
- Wollar Road
- Wipinjong Road
- Ulan-Wollar Road
- Ulan Road
- Lagoons Road
- Cope Road
- Highett Road
- Blue Springs Road
- Birkalla Road
- Castlereagh Highway (B55)
- Birriwa Bus Route South
- Merotherie Road
- Ross Crossing South Road
- Golden Highway (B84)
- Moorefield Road
- Cliffdale Road
- Turill Bus Route Road
- Summerhill Road
- Coolah Road
- Rotherwood Road
- Tucklan Road
- Barneys Reef Road
- Puggoon Road
- Upper Laheys Creek Road
- Spring Ridge Road
- Dapper Road
- Sandy Creek Road.

Key railway line crossings would include:

- three crossings of the Sandy Hollow/Gulgong Railway, which is operated by the Australian Rail Track Corporation and is referred to as the Ulan Line. The crossings are located along Ulan Road and the Ulan-Wollar Road adjacent to the existing mining operations
- three crossings of the Wallerawang/Gwabegar Railway, two crossings around five and seven kilometres south of the rail line's intersection with the Castlereagh Highway and one crossing around two kilometres northeast of switching station M9.

Key crossings of existing transmission network and other infrastructure crossings would include:

- Transgrid Transmission Line 79 at a number of locations between the New Wollar Switching Station and Merotherie Energy Hub
- 12.7 kV, 22 kV, 66 kV and 132 kV Essential Energy distribution lines near the Merotherie and Elong Elong energy hubs and Moolarben, Ulan and Wilpinjong coal mines.

Where the new transmission lines cross above the 12.7 kV, 22 kV and 66 kV Essential Energy distribution lines, undergrounding or relocation of these utilities may be required.

Where undergrounding is not required, including at locations where the transmission lines would cross Transgrid Transmission Line 79 and other infrastructure, temporary hurdles with netting may be required. The hurdles and netting would be installed above the existing infrastructure and act as protection during the stringing operation. These hurdles with netting would protect the existing infrastructure, allowing continued use during the stringing operation. A similar approach may be adopted for road and railway crossings.

Local road and intersection upgrades

Local road and intersection upgrades are proposed to enable safe and reliable access to construction compounds and energy hub sites, including:

- upgrading (road widening and sealing) Merotherie Road
- installing a new bridge on Merotherie Road at its crossing of the Talbragar River to replace the existing crossing
- upgrading the intersection of Merotherie Road and the access road to the Merotherie Energy Hub
- upgrading the Golden Highway/Merotherie Road intersection to tie into the upgraded Merotherie Road
- upgrading (road widening) Spring Ridge Road, near the intersection with Dapper Road
- installing a new bridge on Spring Ridge Road at its crossing of Laheys Creek to replace the existing causeway
- upgrading Dapper Road to tie into the upgraded Spring Ridge Road
- upgrading the Spring Ridge Road/Dapper Road intersection to tie into the upgraded Dapper Road and Spring Ridge Road
- upgrading Neeleys Lane from the Neeleys Lane (if required to access the construction compound and workforce accommodation site)/Ulan Road intersection to the entrance of the Neeleys Lane workforce accommodation camp
- upgrading the Neeleys Lane/Ulan Road intersection
- upgrading the Golden Highway/Ulan Road intersection
- upgrading drainage infrastructure.

The location of the local road and intersection upgrades are shown in Figure A-12. Detailed figures showing the extent of these works are provided in Figure B-1 in Appendix B (Updated project description mapping).

The need for and extent of local road and intersection upgrades will be confirmed during detailed construction planning. Any impacts additional to those identified in the EIS and Amendment Report will be subject to further assessment, if required.

Communications infrastructure

The fibre optic communication cables would be installed alongside access tracks within the transmission line easements. The communication cables would be laid within conduits or direct buried in trenches around 600 millimetres wide and 1,000 millimetres deep within the transmission line easement.

Horizontal directional drilling would be used (where feasible) to install communications infrastructure across watercourses to avoid channel disturbance, the creation of in-stream barriers and impacts on water quality and aquatic fauna and flora. Detailed hydrogeological information (e.g. bore data) will be used to inform the most suitable underboring construction method that would minimise the need for dewatering.

Directional drilling would require a launch pit for the drill entry and a receival pit. A vertical borehole would be drilled at the launch pit to the target depth below the ground surface, from where horizontal drilling would proceed.

Drilling fluids would be circulated and then recovered to remove cuttings and provide formation stability and to lubricate the drilling rod and head. Management of excess drilling mud would either be on-site through beneficial reuse in accordance with the Environment Protection Authority general exemption for treated drilling mud or disposed at an appropriately licenced facility.

Crushing, grinding and screening

Crushing, grinding and screening plant would be located at the New Wollar Switching Station, Merotherie Energy Hub and Elong Elong Energy Hub construction compounds and switching station M1 to process material extracted from these sites (refer to Section A1.5.7). Indicative quantities of material that would be subject to crushing, grinding and screening activities are provided in Table A-7. The project is expected to exceed the threshold quantity that would trigger the need for an Environment Protection Licence (EPL) for this activity (refer to Appendix D of the Amendment Report). The final quantity of material that would be subject to crushing, grinding and screening activities would be confirmed as part of detailed construction planning.

Table A-7 Indicative crushing, grinding and screening quantities

Construction compound location	Anticipated quantity	Expected duration
New Wollar Switching Station	40,000 tonnes (t)	6 months
Switching station M1	62,000 t	8 months
Merotherie Energy Hub	19,000 t	6 months
Elong Elong Energy Hub	9,000 t	3 months

A1.5.7 Construction facilities

Construction compounds

To support the construction of the project, four main construction compounds would be required, one at each of the energy hubs, one at the New Wollar Switching Station, and one at the Neeleys Lane workforce accommodation camp. The main construction compounds would be established as enabling work and demobilised at the completion of construction.

Construction compounds would include the following:

- staging and laydown areas
- concrete batching plant (except at the Neeleys Lane compound)
- cement silos (except at the Neeleys Lane compound)
- crushing, grinding and screening plant (except at the Neeleys Lane compound)
- aggregate bins (except at the Neeleys Lane compound)
- water tanks
- staff facilities (office, lunch room and amenities)
- parking areas
- construction support facilities including vehicle, equipment and materials storage, maintenance sheds, generators, chemical and fuel stores (such as petroleum, diesel, liquefied natural gas, herbicide, pesticide and mineral oils), firefighting equipment, waste bins and stockpile areas. Hazardous and dangerous good storage would be secured in purpose-built bunded and secure areas
- helicopter landing pad and support facilities (except at the Neeleys Lane compound), to allow for the use of helicopters during the stringing of transmission lines (refer to Section A1.5.6) and during emergencies (refer to Section A1.5.11)
- testing laboratory
- potable water tanks
- wastewater treatment plant. If a wastewater treatment plant is not established, wastewater would be transported to a licenced treatment facility
- fencing.

Upon completion of works, the construction compounds would be cleared of any temporary infrastructure and equipment, and rehabilitated.

New Wollar Switching Station

The construction compound at the New Wollar Switching Station would be located along the southwestern boundary of the switching station and accessed via Barigan Road. Access to the construction compound would be via the existing access road for the Transgrid Wollar Substation and an extension of this access road to the construction compound.

The construction compound would provide primary support for the construction of the New Wollar Switching Station and the New Wollar Switching Station — Merotherie Energy Hub connection.

An indicative location for the construction compound is shown in Figure A-18. The layout of the site would be determined prior to commencement of construction.

Merotherie Energy Hub

The construction compound at the Merotherie Energy Hub would be located to the north of the energy hub and accessed via the Golden Highway, Merotherie Road and Birriwa Bus Route South (that runs east-west through the Merotherie Energy Hub site). Access to the construction compound would be via Merotherie Road.

The construction compound would provide primary support for the construction of the Merotherie south connection, Merotherie west connection, Merotherie Energy Hub – Elong Elong Energy Hub connection, Tallawang west connection and Tallawang south connection.

An indicative location for the construction compound is shown in Figure A-19. The layout of the site would be determined prior to commencement of construction.

Elong Elong Energy Hub

The construction compound at the Elong Elong Energy Hub would be located along the northern boundary of the energy hub and accessed via the Golden Highway, Spring Ridge Road and Dapper Road. Access to the construction compound would be via Dapper Road.

The construction compound would provide primary support for the construction of the Elong Elong Energy Hub, Merotherie Energy Hub – Elong Elong Energy Hub connection, Cobbora north connection, Cobbora west connection, Goolma connection and Dunedoo connection.

An indicative location for the construction compound is shown in Figure A-20. The layout of the site would be determined prior to commencement of construction.

Neeleys Lane workforce accommodation camp

The construction compound at the Neeleys Lane workforce accommodation camp would be located along the southern boundary of the workforce accommodation camp and accessed via the Golden Highway and Ulan Road. Access to the construction compound would be via Neeleys Lane.

The construction compound would provide primary support for the construction of the Cassilis connection, Coolah connection and Leadville connection.

An indicative location for the construction compound is shown in Figure A-21. The layout of the site would be determined prior to commencement of construction.

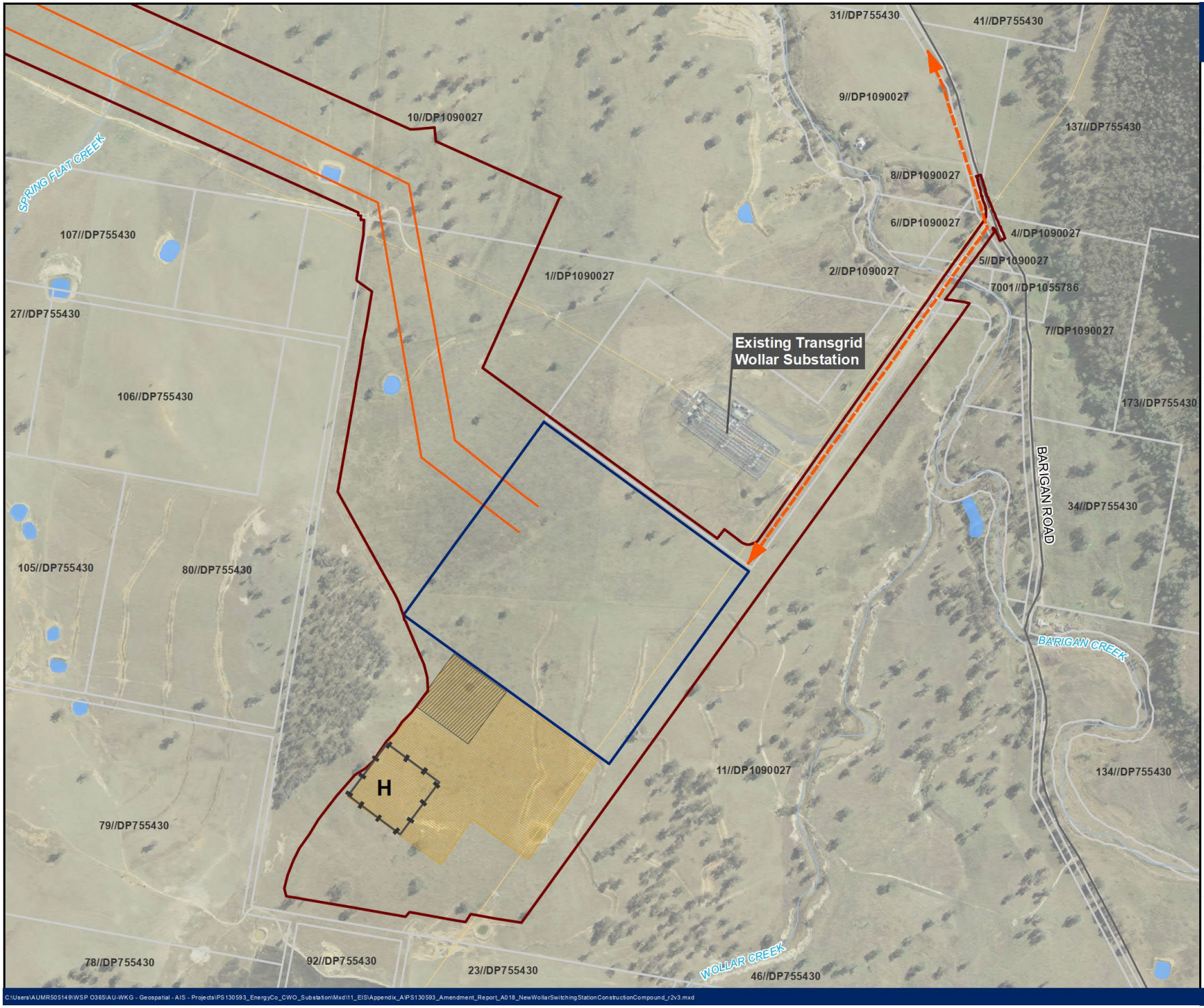


Figure A-18
Indicative construction layout
at New Wollar Switching Station

Legend

Construction

- Construction area
- Construction compound
- Helipad
- Concrete batch plant
- Access in/out

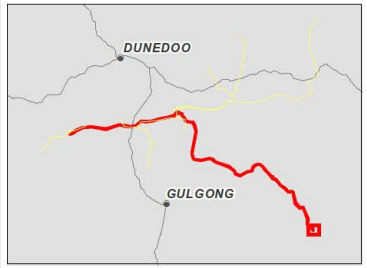
Note: Location of construction features are indicative and would be confirmed during detailed design

Operation

- 500 kV switching station
- 500 kV transmission line

Other features

- Existing transmission line
- Road
- Watercourse
- Water body



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Coordinate system: GDA2020 MGA Zone 55
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Data sources: WSP, EnergyCo, NSWSS

GDA 2020

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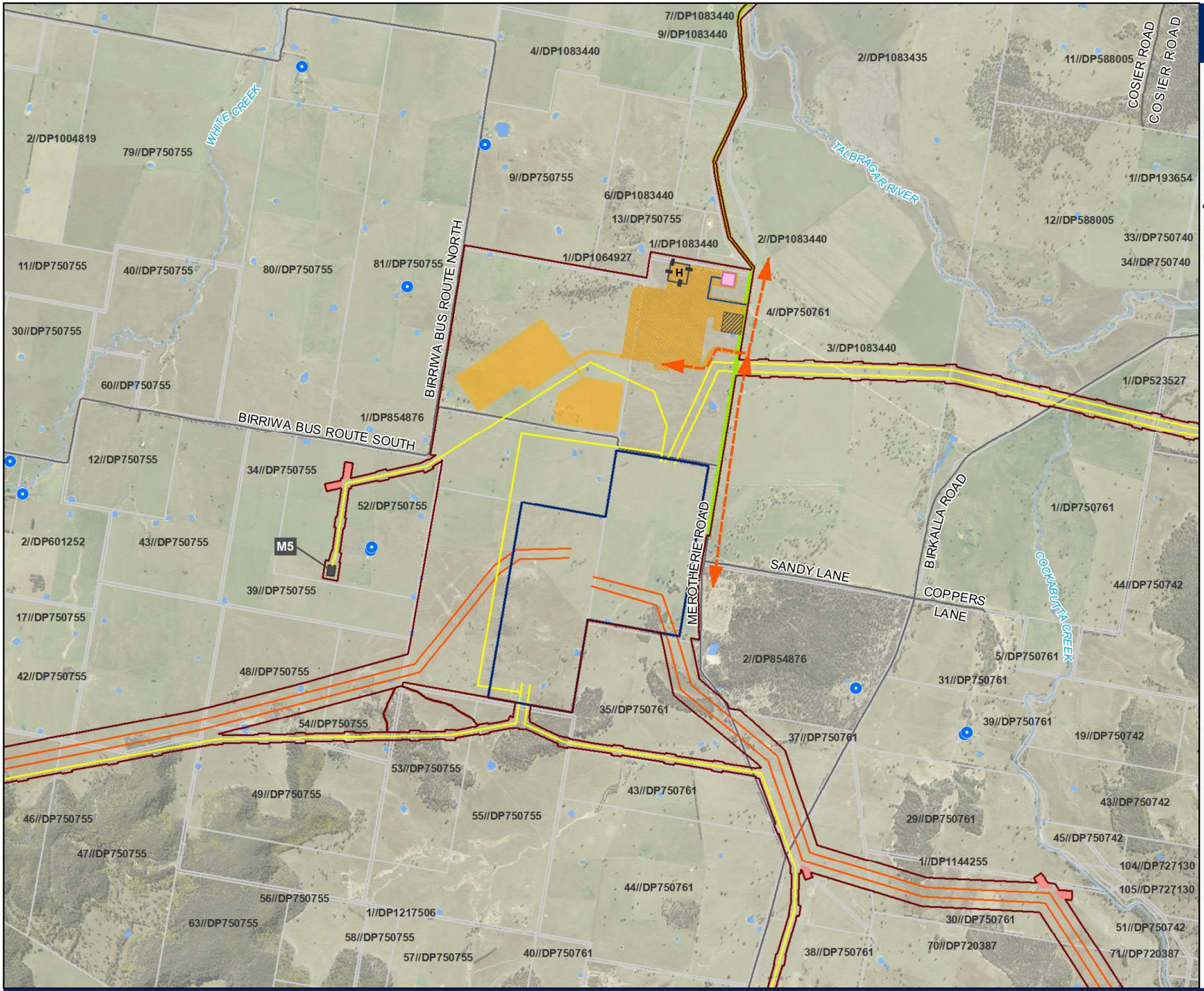


Figure A-19
Indicative construction layout at Merotherie Energy Hub

Legend

Construction

- Construction area
- Brake and winch site
- Construction compound
- Workforce accommodation camp
- Helipad
- Concrete batch plant
- Public road upgrade
- Access in/out

Note: Location of construction features are indicative and would be confirmed during detailed design

Operation

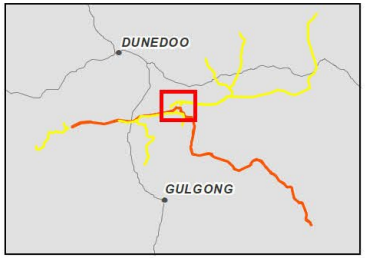
- 500 kV energy hub
- Maintenance facility
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line

Other features

- Road
- Watercourse
- Water body

Sensitive receivers

- House



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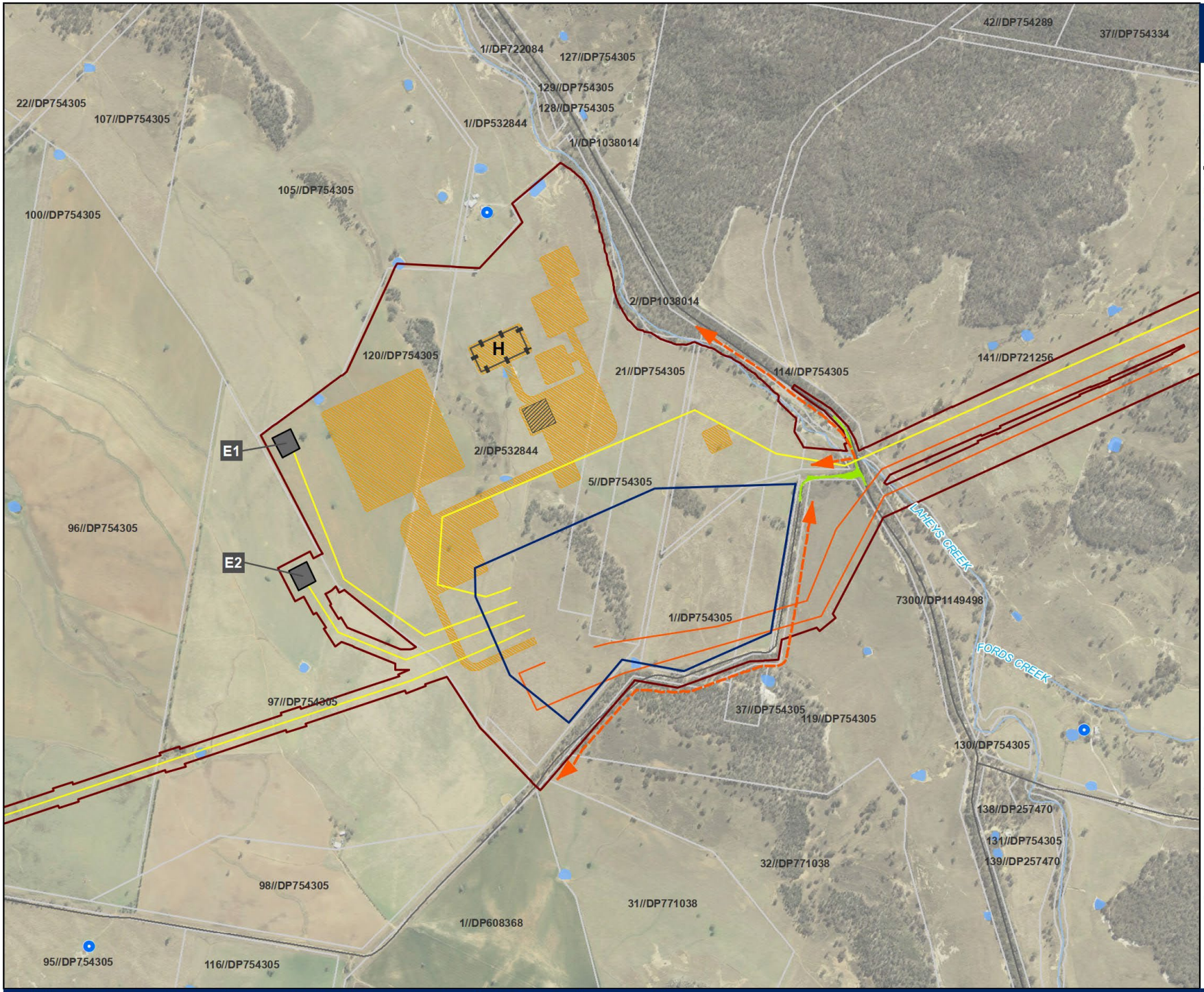


Figure A-20
Indicative construction layout at Elong Elong Energy Hub

Legend

Construction

- Construction area
- Construction compound
- Helipad
- Concrete batch plant
- Public road upgrade
- Access in/out

Note: Location of construction features are indicative and would be confirmed during detailed design

Operation

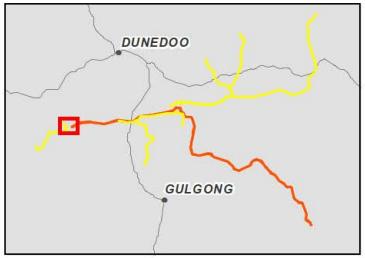
- 500 kV energy hub
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line

Other features

- Road
- Watercourse
- Water body

Sensitive receivers

- House



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Data sources: WSP 2023

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Figure A-21
Indicative layout of the construction compound at Neeleys Lane workforce accommodation camp

Legend

- Construction area
- Construction compound
- Workforce accommodation camp
- Public road upgrade
- Access in/out

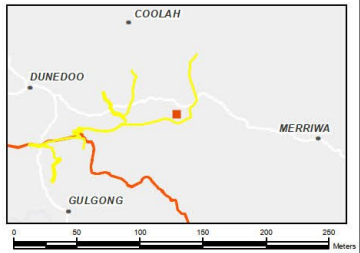
Sensitive receivers

- House

Other features

- Road
- Watercourse

Note: Location of construction features are indicative and would be confirmed during detailed design



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Data sources: WSP, 2023, EnergyCo, NSWSS

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Other ancillary construction support facilities

In addition to the proposed main construction compounds, ancillary construction support facilities would be required at the 330 kV switching station sites, along the transmission line easement (including at each transmission line tower site).

The 330 kV switching station sites would include the following construction support facilities:

- staging and laydown areas
- construction support facilities including vehicle, equipment and materials storage, maintenance sheds, generators, chemical and fuel stores (such as petroleum, diesel, liquefied natural gas, herbicide, pesticide and mineral oils), firefighting equipment, waste bins and potential stockpile areas. Hazardous and dangerous good storage would be secured in purpose-built bunded and secure areas
- staff facilities (office and amenities)
- parking areas
- potable water tanks.

The switching station M1 site would also include crushing, grinding and screening plant, which would be demobilised prior to construction of the switching station.

Workforce amenities (including meal and bathroom facilities) would also be located within the construction area, typically along the transmission line alignment.

Staging and laydown areas would be located along the transmission line and at each transmission line tower site for the temporary storage of materials, plant and equipment required to construct the various elements of the project, and to facilitate assembly of the transmission line towers and stringing of the conductors.

Although every endeavour has been made to identify the land areas likely to be required for construction, the construction contractor(s) may require additional compounds and/or support facilities. Alternative or additional sites (if required outside the construction area) may be added, and would be subject to further assessment and approval.

The following criteria would be considered for any additional compounds and/or support facilities:

- ready access to the road network – located to minimise the need for heavy vehicles to travel on local roads
- located on relatively level land
- separated from the nearest residences by at least 200 metres, unless feasible and reasonable noise and light spill mitigation measures are implemented
- not requiring native vegetation clearing beyond that already required
- minimise impacts (e.g. noise and dust) on any adjacent properties, in particular residential dwellings
- above the 20-year average recurrence interval flood level, unless a contingency plan to manage flooding is prepared and implemented
- sufficient space to store construction materials to minimise the number of deliveries required.

Workforce accommodation camps

Two temporary workforce accommodation camps would be required to cater for the construction workforce. The workforce accommodation camps would be located at the main construction compound at Merotherie Road, Merotherie on land adjacent to the Merotherie Energy Hub, and at Neeleys Lane in Turill. The workforce accommodation camps would be established as enabling work and demobilised at the completion of construction.

The workforce accommodation camps would include a range of facilities, potentially including:

- demountable accommodation and office buildings
- workforce amenities, including food and catering, fitness and recreational (such as indoor and outdoor recreational spaces, gymnasium areas), laundry, bathroom and first aid facilities
- utilities, including telecommunication services, electricity and water (including water tanks) (refer to Section A1.5.9 and Section A1.5.12)
- waste bins
- firefighting equipment
- refuelling tank
- parking area and bus stop
- equipment, materials and gas storage
- generators
- wastewater treatment plant
- water treatment plant
- fencing.

The components and layout of the workforce accommodation camps would be finalised during detailed construction planning.

During the operation of the workforce accommodation camps, a range of general activities would be undertaken to support the functions of the facility and minimise its impacts, such as general grounds maintenance, deliveries and waste removal, and worker movements. Where practicable, workers would be transported between the construction areas and the workforce accommodation camps via shuttle buses, to minimise potential traffic impacts of the project on local roads. This would mainly occur at the start and end of the working day.

The workforce accommodation camps would provide sufficient accommodation for all construction workers, including during the peak construction period. Food and recreation facilities, first aid facilities and a full-time medical practitioner or paramedic would be provided at the camps, to minimise impacts of the construction workforce on local and regional health services.

The workforce accommodation camps are expected to operate for the duration of construction. At the end of construction, the workforce accommodation camps would be demobilised and the sites would be cleared of any temporary infrastructure and equipment, and rehabilitated.

Merotherie Road, Merotherie

The main construction workforce accommodation camp at Merotherie Road, Merotherie would be located next to the Merotherie Energy Hub main construction compound, about six kilometres south of the intersection of Merotherie Road with the Golden Highway and access to the site would be provided via these roads. The location of the workforce accommodation camp is shown in Figure A-19. The workforce accommodation camp site is about 41 hectares in size and would accommodate up to 1,200 people.

This workforce accommodation camp would be used for the duration of construction, and would primarily house workers undertaking construction along the 500 kV network infrastructure and the remaining 330 kV network infrastructure connections.

Neeleys Lane, Turill

A satellite workforce accommodation camp would be located at 118 Neeleys Lane, Turill, about 11 kilometres southwest of Cassilis. The location of the workforce accommodation camp is shown in Figure A-21.

This workforce accommodation camp would primarily service the construction workforce undertaking works along the 330 kV network infrastructure, particularly the Cassilis, Coolah and Leadville connections. Access to the site would be provided via Neeleys Lane, Ulan Road and Golden Highway. The workforce accommodation camp site is about seven hectares in size and would accommodate up to 600 people. The Neeleys Lane/Ulan Road intersection would require upgrades to ensure safe access, as discussed in Section A1.5.6.

Additional workforce accommodation

It is anticipated that at the commencement of construction, prior to the operation of the workforce accommodation camps, a small number of construction workers would utilise existing local hotel, motel and rental accommodation. The workforce required to utilise existing accommodation facilities would generally be limited primarily to those required for the establishment of workforce accommodation camps only, as well as a small number of project management personnel.

A1.5.8 Plant and equipment

An indicative list of construction plant and equipment likely to be required for the key construction elements is provided below. Not all the equipment identified below would be required for all phases of construction.

- air compressors
- backhoes
- bulldozers
- buses
- boom lift
- cable tensioner/puller
- cable hauling winch
- cable drum stands
- chainsaws
- concrete batch plants
- concrete agitator
- concrete vibrator
- concrete pump
- cranes (various sizes)
- crushing plants
- drill and blast units and associated support plant/ equipment
- drones
- dump trucks
- elevated work platform
- excavators (various sizes)
- explosives for blasting
- flatbed trucks
- forklift
- fuel trucks
- generators
- graders
- helicopter and associated support plant/equipment
- knuckle boom
- mulcher
- piling rigs
- plate compactor
- pneumatic jackhammers
- rigid tippers
- rollers
- scrapers
- screening plants
- semi-trailers
- skid steer/positrack loaders
- telehandler
- tilt tray trucks
- transport trucks and trailers
- trench roller
- trenchers
- watercarts.

A1.5.9 Resources and materials

Excavation volumes

Excavation would be required for activities such as transmission line tower construction, preparation of the energy hub and switching station sites to provide level surfaces, trenching for drainage, earthing, and electrical conduits and grading and levelling of access tracks. Excavation works would be carried out using earth moving equipment such as excavators, dozers, piling rigs and rock breakers, and blasting equipment (where required).

The construction methodology for the project has been developed with the aim of providing balanced cut (excavation) and fill (embankment) volumes at the energy hubs to reduce the amount of excavated material requiring off-site disposal at appropriately licenced facilities. Excavated spoil from the construction area would be reused on-site wherever feasible. Any on-site reuse would be within the construction area (unless otherwise agreed with adjacent landowners), and would not substantially alter the landform or drainage near the transmission line towers or other associated network infrastructure.

Table A-8 provides an indicative estimate of earthworks quantities required for the project.

Table A-8 Indicative earthworks quantities

Project component	Approximate fill requirements (m^3)	Approximate cut volume (m^3)	Approximate cut volume to be taken off-site (m^3)	Approximate fill volume to be imported
Transmission lines	0	61,000	61,000	0
New Wollar Switching Station	77,000	52,000	3,000	28,000
Merotherie Energy Hub and workforce accommodation camp	410,000	310,000	5,000	105,000
Elong Elong Energy Hub	250,000	200,000	5,000	55,000
330 kV switching stations	129,000	95,000	13,000	47,000
Access roads and access tracks	123,000	123,000	0	0
Neeleys Lane workforce accommodation camp and construction compound	10,000	10,000	0	0
Local road and intersection upgrades	1,000	11,000	11,000	1,000

Water supply

Water would be required during construction for:

- dust suppression on construction work areas and access tracks through the use of a water spray attached to a tanker vehicle
- on-site concrete batching
- earthworks and pavement compaction
- wetting backfill material (if it is too dry for effective compaction)
- general worker facilities at the construction compounds and workforce accommodation camps
- irrigation for landscaping.

It is estimated that around 700 megalitres of water would be required for construction per year, comprising:

- around 250 megalitres of non-potable water for:
  - dust suppression
  - earthworks and pavement compaction
  - landscaping
- around 450 megalitres of potable water for:
  - accommodation camps and ancillary facilities
  - concrete batching activities.

The actual water usage during construction is expected to vary during the construction period depending on the nature and extent of construction activities taking place. Opportunities to minimise water demand would be identified during detailed construction planning and implemented where feasible.

The use of non-potable water over potable would be preferred, however this is dependent on the location and nature of the water use activity as well as the quantity and quality of available water at the time. Water for construction of the project would be sourced according to the following hierarchy, where feasible and reasonable, and where water quality and volume requirements are met:

- rainwater harvesting (non-potable water)
- reuse of construction water (non-potable water)
- reuse of treated wastewater (discussed in section below) and/or groundwater inflows (non-potable water), where practicable
- reuse of treated mine water (non-potable water), if practicable. The potential reuse of treated mine water would be investigated during continued design development (refer to Section 19.1 (Hydrology, flooding and water quality))
- existing unregulated surface water sources (non-potable water), including the Upper Talbragar River Water Source, Lower Talbragar River Water Source and Upper Goulburn River Water Source, under water access licences for the project. The available water in each water source is dependent on conditions in each water source, which are dependent on the climate. The water quality of these water sources would be tested to determine the need for treatment prior to use in construction activities (refer to Section 19.1 (Hydrology, flooding and water quality)
- extraction from regulated groundwater sources via new groundwater bores (non-potable water), primarily for dust suppression. Two new bores would be established, one at each of the energy hubs at Elong Elong and Merotherie as shown in Figure B-1 in Appendix B (Updated project description mapping), to source the groundwater. Around 125 megalitres of groundwater would be taken over the construction period from each of the Lachlan Fold Belt Murray-Darling Basin (MDB) Groundwater Source and Gunnedah-Oxley Basin MDB Groundwater Source under water access licences for the project
- existing regulated and unregulated surface water sources (potable water). Potable water would be sourced from council owned potable water supplies in Dunedoo and Coolah (in the Warrumbungle LGA) and Gulgong (in the Mid-Western Regional LGA) where possible. Other sources would be investigated if these council owned supplies are not able to supply water to the project.

Water would be transported from water sources, water suppliers and/or groundwater extraction points via tanker truck and stored in storage tanks located at the workforce accommodation camps, construction compounds and switching stations.

EnergyCo has commenced discussions with a number of water suppliers within the broad region within which the project would be located, to identify the sources and availability of the volume of water (potable and non-potable) required for the project from existing facilities. Further investigation of options for the provision and storage of construction water would be undertaken during continued development of the project design and detailed construction planning, in consultation with local councils, water utility companies, licence holders and mine operators. The preferred sources of construction water and the method of construction water storage would be confirmed prior to the start of construction.

The construction water balance, and the potential impacts of the proposed approach to supplying construction water on water availability, environmental flows and water dependent ecosystems, are considered in Section 19.1 (Hydrology, flooding and water quality) and Section 19.3 (Groundwater).

On-site wastewater management

Wastewater treatment facilities would be established at the construction compounds and workforce accommodation camps to manage effluent and greywater. The systems would be designed to collect wastewater from construction activities (including concrete washout), showers, kitchens, laundries and toilets, with toilet and kitchen facilities located both at the workforce accommodation camps and the office areas.

Wastewater produced during the initial establishment of the workforce accommodation camps would be collected and transported to a council wastewater treatment plant. This process would be in place during the site establishment works for the project and would cease once the main wastewater treatment facilities are operational.

The proposed wastewater treatment plants would be a generally contained system and would include biological and chemical treatment, filtration and disinfection. The most suitable treatment processes and plant configuration would be finalised as part of detailed construction planning.

The wastewater treatment system would be designed, maintained and monitored in accordance with *Onsite domestic wastewater management, Designing and Installing On-Site Wastewater Systems* (WaterNSW, 2019), *AS/NZS 1547:2012 On-site domestic wastewater management* (Standards Australia, 2012) and the *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1)* (National Resource Management Ministerial Council, Environment Protection and Heritage Council and Australian Health Minister's Conference, 2006).

All wastewater treatments plants produce sludge that requires disposal on regular intervals. Liquid waste sludge would be transported to a facility licensed to accept the waste.

The wastewater treatment facilities would be designed to produce effluent that meets the water quality requirements for dust suppression and use for other construction activities within the construction area.

The volume of water to be treated at the workforce accommodation camps would depend on the number of personnel at each accommodation camp at any given time. The water treatment plant would be designed with a capacity able to treat the estimated peak construction workforce at each accommodation camp site and would assume up to 240 litres of water would be used per day, per person. On this basis, an EPL for sewage treatment in accordance with clause 36 of Schedule 1 of the *Protection of the Environment Operations Act 1997* is not anticipated to be required.

At construction work areas outside the workforce accommodation camps, bathroom facilities would be installed to provide amenity to workers at these locations. All liquid waste generated from these locations would be removed and transported to a licensed facility.

Energy and fuel use

Construction of the project would require the use of energy and fuels to power plant, equipment and transport vehicles. Fuels would likely include non-renewable sources such as petroleum, diesel, natural gas and liquefied natural gas.

Electricity supply would be required throughout construction at the main construction compounds, workforce accommodation camps and switching station sites. Electricity needs on site would likely be provided by connection of the construction site offices and workforce accommodation camps to the local power grid. Generators would be used where it is not practicable to obtain power from the local grid or through the use of solar panels, at the construction compounds and workforce accommodation camps. Electricity would be supplied to the 330 kV switching station sites via portable generators.

The estimated annual construction electricity demand for the main construction compounds and workforce accommodation camps is 9,925 megawatts per hour.

Other resources and materials

A range of other materials and resources would also be required during the construction of the project. The project design has included careful consideration of the construction methodology and selection of materials and resources to ensure fit for purpose and to minimise resource consumption, in accordance with the *Waste Avoidance and Resource Recovery Act 2007*. Indicative quantities and the potential sources of construction materials are provided in Table A-9. All quantities have been estimated based on the current project design and would be subject to further refinement during further design development.

Construction materials would be sourced locally, where practicable, to benefit the local economy. Materials that are not available locally would be sourced from other locations within NSW, or within Australia if not available in NSW. Some project components are not produced in Australia and would have to be sourced from overseas, such as synchronous condensers, steel reinforcement and electrical switchgear.

Consistent with the principles of the circular economy, opportunities for reuse and the use of recycled and sustainable materials would be identified during the subsequent phases of the project design and construction, for example, supplementary cementitious material content in concrete, recycled aggregate products and recycled steel. Material selection would be undertaken with consideration to optimising durability (thus reducing the frequency or need for replacement) and minimising embodied energy and carbon footprint.

Table A-9 Indicative quantities and sources of resources required for construction

Material/project component	Estimated quantity required	Anticipated source/origin.(including entry point to Australia for imported components)
Quarry products	418,000 tonnes	Central West
Concrete (comprising cement, aggregate and sand)	1,100 cubic metres	Central West
	97,000 cubic metres	On-site from concrete batching plants at the main construction compounds. It is anticipated that cement and fine aggregates would be sourced from Newcastle, and coarse aggregates from within the Central West region.
Steel	57,980 tonnes	Sydney
Reinforcement	21,750 tonnes	Newcastle
Drainage pipes (consisting of a range of standard materials such as polyvinyl chloride (PVC) and concrete)	4,838 metres	Sydney

Material/project component	Estimated quantity required	Anticipated source/origin.(including entry point to Australia for imported components)
Bituminous materials (spray seal)	570,000 square metres	Central West and Newcastle
Transformers and synchronous condensers	16 units	Newcastle
Electrical switchgear and other electrical materials	7,075 containers	Sydney
Pre-fabricated buildings (ancillary buildings, equipment control buildings and acoustic sheds at energy hubs and switching stations)	24 units	Newcastle
Pre-fabricated buildings (temporary) for accommodation and offices.	1,060 units	Sydney

A1.5.10 Construction routes and traffic volumes

Construction vehicle movements would occur on the public road network to travel to and from the construction area on a daily basis. Vehicle movements would comprise both heavy and light vehicles and the volume of movements would vary across the road network depending on the construction activity being undertaken across the construction period.

The majority of movements on public roads would comprise heavy vehicles transporting project infrastructure, equipment and plant, construction materials, waste, water and buses associated with workforce personnel travelling on public roads to and from workforce accommodation camps and construction areas. A smaller proportion of vehicle movements would comprise light vehicles associated with workforce personnel travelling on public roads to and from workforce accommodation camps and construction areas.

Non-standard or OSOM loads would also be required for the energy hubs (such as the delivery of transformer units and synchronous condensers), switching stations and transportation of transmission line tower materials. These loads would be transported to the construction compounds via the public road network.

The selection of the energy hub locations considered their access and their relative proximity to major roads (State roads or highways) alongside other site selection criteria. Additionally, construction routes have been developed to minimise impacts on local roads as far as practicable, while providing the most direct route to the road network and meeting specific road requirements (such as specified routes for the movement of heavy vehicles).

General construction routes and volumes

Construction routes that would be used on a daily basis to facilitate construction and the maximum number of movements to and from construction areas (during peak hour during the peak construction period) along these roads (including workforce accommodation camps), are shown in Figure B-3 in Appendix B (Updated project description mapping). Deliveries from the wider region would use the regional public road network to link with these routes. These construction routes would be reviewed during detailed construction planning.

Oversize and overmass haulage routes

Non-standard or oversized loads would have to be transported to the construction compounds from shipping ports in NSW. It is anticipated the delivery of large specialist equipment would originate from the Port of Newcastle (Newcastle) to the construction compounds via pre-approved OSOM routes.

The final construction routes for OSOM vehicle movements would be determined during detailed construction planning in accordance with the heavy vehicle haulage guidelines and in consultation with the National Heavy Vehicle Regulator and relevant local councils and government agencies, where required. Access to construction compounds from the pre-approved OSOM routes would be provided using access roads which, if required, would be upgraded (refer to Section A1.5.6).

Construction workforce parking

Parking for the construction workforce would be mainly located within the construction compounds and workforce accommodation camps. Given the transient nature of construction works along the transmission line alignments, and potentially long distances between these construction areas and the workforce accommodation camps and construction compounds, it is expected that workers would typically be transported by bus (or other type of crew vehicle) between construction work areas and their relevant workforce accommodation camp. Workers travelling in light vehicles from accommodation camps to transmission lines, such as stringing crews, would park in designated areas within the transmission line easement that are outside of areas of active construction work.

A1.5.11 Helicopter use during emergencies

Helicopters may be used during emergencies to transfer sick or injured personnel, assist with firefighting during bushfires or provide access during flood events. Helicopter landing pads and support facilities, including refuelling tanks, would be located at three of the main construction compounds at the Elong Elong Energy Hub, Merotherie Energy Hub and New Wollar Switching Station.

A1.5.12 Utilities

Construction of the project would require adjustments to a number of existing utilities during works associated with the energy hubs, maintenance facility, switching stations and transmission lines. This would include protection or relocation works to utilities, including communications, gas mains and energy transmission.