Standard Conditions for Development Applications and Planning Proposals

Version 10 – January 2025

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Endeavour Energy

POWER together

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Purpose

The following Standard Conditions are based on Endeavour Energy's experience dealing with numerous development applications and planning proposals. It provides an overview of Endeavour Energy believes are the issues affecting the electricity distribution network that need to be considered by authorities in determining and conditioning consents.

These Standard Conditions should be referred to for advice about:

- Development Application Referral to Endeavour Energy required under *State Environmental Planning Policy (Transport and Infrastructure) 2021* (NSW), Division 5 'Electricity transmission or distribution', Subdivision 2 'Development likely to affect an electricity transmission or distribution network', Section 2.48 'Determination of development applications—other development'.

2.48 Determination of development applications—other development

(1) This section applies to a development application (or an application for modification of a consent) for development comprising or involving any of the following—

(a) the penetration of ground within 2m of an underground electricity power line or an electricity distribution pole or within 10m of any part of an electricity tower,

(b) development carried out—

(i) within or immediately adjacent to an easement for electricity purposes (whether or not the electricity infrastructure exists), or

(ii) immediately adjacent to an electricity substation, or

(iii) within 5m of an exposed overhead electricity power line,

(c) installation of a swimming pool any part of which is—

(i) within 30m of a structure supporting an overhead electricity transmission line, measured horizontally from the top of the pool to the bottom of the structure at ground level, or

(ii) within 5m of an overhead electricity power line, measured vertically upwards from the top of the pool,

(d) development involving or requiring the placement of power lines underground, unless an agreement with respect to the placement underground of power lines is in force between the electricity supply authority and the council for the land concerned.

(2) Before determining a development application (or an application for modification of a consent) for development to which this section applies, the consent authority must—

(a) give written notice to the electricity supply authority for the area in which the development is to be carried out, inviting comments about potential safety risks, and

(b) take into consideration any response to the notice that is received within 21 days after the notice is given.

(3) Subsection (2) does not apply to development specified in subsection (1)(b) if the development involves only one or more of the following—

(a) internal alternations to a building,

(b) a change of use of an existing building,

(c) a change to the hours of operation specified in the development consent,

(d) a subdivision that does not involve construction work.

- *Environmental Planning and Assessment Act 1979* (NSW) requires Councils:
    - in the Local Environmental Plan (LEP) making process (including LEP amendments through a planning proposal for rezoning) to consider the environmental, social and economic impact on the site and surrounds and ability to be accommodated within the capacity of the current and/or future infrastructure and services. When an LEP is made or amended through the planning proposal, it must demonstrate site-specific merit by having regard to this criteria;
    - in development control plan (DCP) to have regard to requirements or standards in respect of the provision of services, facilities and amenities demanded by development; and

- advise adjoining and nearby occupiers/owners of proposals lodged with Council, in the Council's opinion, the enjoyment of the adjoining or neighbouring land may be detrimentally affected.

- Under the *Environmental Planning and Assessment Act 1979* (NSW), development may be declared State significant development (SSD). This declaration may be made by a State Environmental Planning Policy (SEPP) or by the Minister for Planning (the Minister) and is generally based on the scale, nature, location and strategic importance of the development to the State.

  The Environmental Planning & Assessment Regulation 2021 (EP&A Regulation) requires certain SSD documents to be prepared having regard to the State Significant Development Guidelines and includes requirements for addressing infrastructure requirements and utilities. The following is an extract of a request for Secretary's Environmental Assessment Requirements (SEARs) for State Significant Development.

25. Infrastructure Requirements and Utilities • In consultation with relevant service providers: ○ assess the impacts of the development on existing utility infrastructure and service provider assets surrounding the site. ○ identify any infrastructure upgrades required on-site and off-site to facilitate the development and any arrangements to ensure that the upgrades will be implemented on time and be maintained. ○ provide an infrastructure delivery and staging plan, including a description of how infrastructure requirements would be co-ordinated, funded and delivered to facilitate the development. ○ identify potential impacts to existing utility infrastructure, as a result of the development.	• Infrastructure Delivery, Management and Staging Plan. • Evidence of consultation with providers

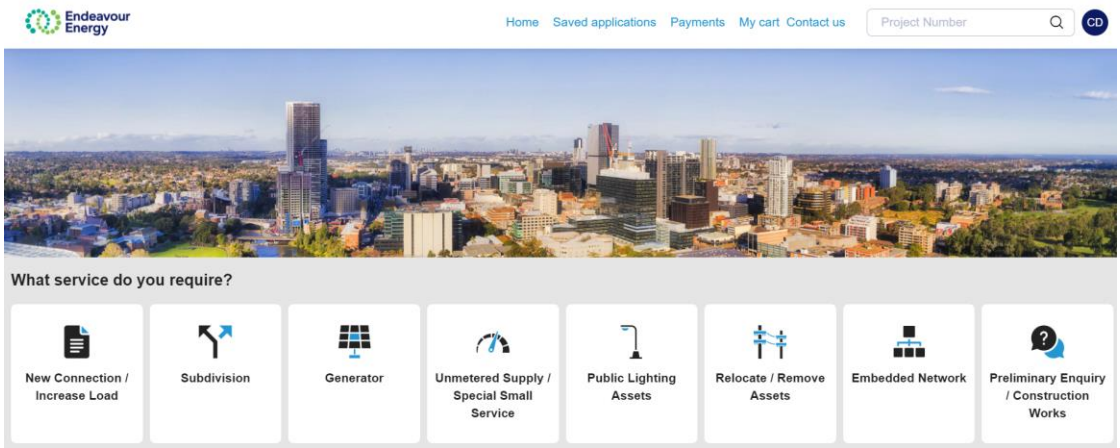
It is not intended as an exhaustive list of matters for consideration. Further advice is available via Endeavour Energy's:

- Website http://www.endeavourenergy.com.au which contains information for customers as well as in relation to the electricity distribution network and electrical safety.

- Connections Portal for new enquiries or work requests. After signing up, applicants can sign in and submit requests by clicking on the relevant tile for the service required shown below. Hovering over the tiles provides a preview of the services provided or please refer to the quick reference guides:

  - Connections Portal User Guide for Construction Works Services - a step by step guide for the new application process.

  - User registration, log in and password reset guide .



1 Adjoining Sites

Endeavour Energy has a freehold property portfolio made up of network property required for the supply of electricity ie. for major assets such as transmission substations, zone substations and switching stations where security of tenure is paramount. It also holds non-network property which is not directly required for the supply of electricity but needed to provide accommodation for support services, ie. field service centres (FSC), pole yards and telecommunication sites.

Endeavour Energy's network properties being non-habitable buildings / sites are less sensitive and comparatively less impacted by development of adjoining or nearby properties. Accordingly, as an adjoining or nearby owners and occupiers, where compatible development is proposed Endeavour Energy generally leaves the determination regarding the environmental impact and the appropriate development controls to Council. The responses to Development Applications and Planning Proposals are therefore more focused on Endeavour Energy's role as an electricity supply authority.

Endeavour Energy's non-network sites are managed by the company in order to provide an environment that is liveable, sustainable and productive. In order to fully support the core objectives of the company, any development of adjoining or nearby properties which will have a detrimental effect on the foregoing objectives will be opposed by Endeavour Energy. The majority of the non-network sites are field service centres being essentially an industrial use are also comparatively less impacted but conversely may impact on the adjoining or nearby development.

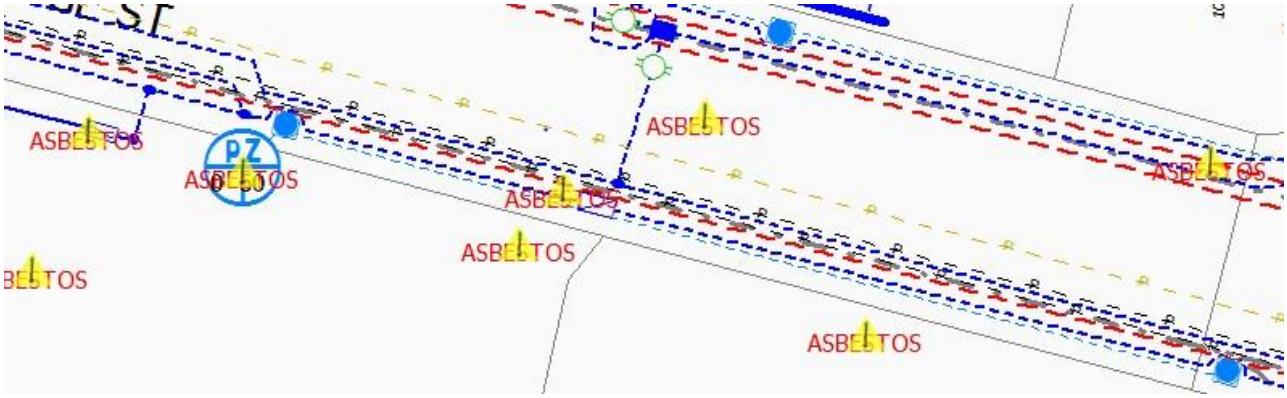
Endeavour Energy is generally opposed to any sensitive development in close vicinity of its properties which could potentially limit its ongoing operations from the site. As the electricity network is operational 24/7/365 ie. all day, every day of the year (please refer to Section 26 'Prudent Avoidance'), likewise so potentially are the FSCs.

Accordingly there is noise, vehicle emissions, light glare etc. associated with the FSC operations which are not compatible to having nearby sensitive uses eg. traffic or persons accessing or working on the site during emergencies at night etc. Endeavour Energy's experience is that despite being a long standing existing use, when surrounding areas are subsequently redeveloped, the new occupants (sometimes supported by councils) seek to restrict the ongoing use of its sites. Given the essential nature of Endeavour Energy's operations such a situation arising is unacceptable. Endeavour Energy is not responsible for any amelioration measures for any emissions that may impact on the nearby proposed development.

Endeavour Energy's Parramatta Field Service Centre located at 84-86 Macarthur Street North Parramatta has had operational issues due to the later adjoining medium density residential development. Source: Google Maps Street View.

2 Asbestos

Endeavour Energy's HxGN NetWorks Core NetViewer master facility model shows locations identified or suspected of having asbestos or asbestos containing materials (ACM) present. This is usually in older parts of the electricity network where ACM was used for strengthening, insulation, lightness and cost saving.



Endeavour Energy's HxGN NetWorks Core NetViewer master facility model indicates that the site is a location identified or suspected of having asbestos or asbestos containing materials present.

The potential locations of asbestos to which construction / electricity workers could be exposed include:

- customer meter boards;
- conduits in ground;
- padmount substation culvert end panels; and
- joint connection boxes and connection pits.

Works on or in the vicinity of Endeavour Energy's electricity network which has the potential to impact asbestos or ACM must be carried out by the appropriately licenced Contractors in accordance involving with Safe Work NSW requirements and Endeavour Energy company procedures / requirements. Asbestos or ACM must be identified by a competent person employed by or contracted to the applicant and an asbestos management plan, including its proper disposal,.

Further details are available by contacting Endeavour Energy's Electrical and Public Safety Branch via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718.

This is an example of ACM cable ducts found in Endeavour Energy's electricity network during excavation for underground works.

3 Asset Planning

Power plants typically generate electricity a long way from homes and businesses. It is transported at high voltages to bulk supply points over the transmission system operated by Transgrid to Endeavour Energy's transmission substations at 132,000 volts / 132 kilovolts (kV).

From here Endeavour Energy transports electricity to our sub-transmission and zone substations, which usually service entire suburbs, transform electricity to mid voltage levels (11,000 / 11 kV or 22,000 volts / 22 kV). When electricity arrives at the location where it is required, distribution substations further transform the electricity to 400 or 230 volts. Underground cables and/or overhead power lines then carry this low voltage electricity to the customer connection points located on the customer's premises to service their electricity load.

Distribution substations are divided into:

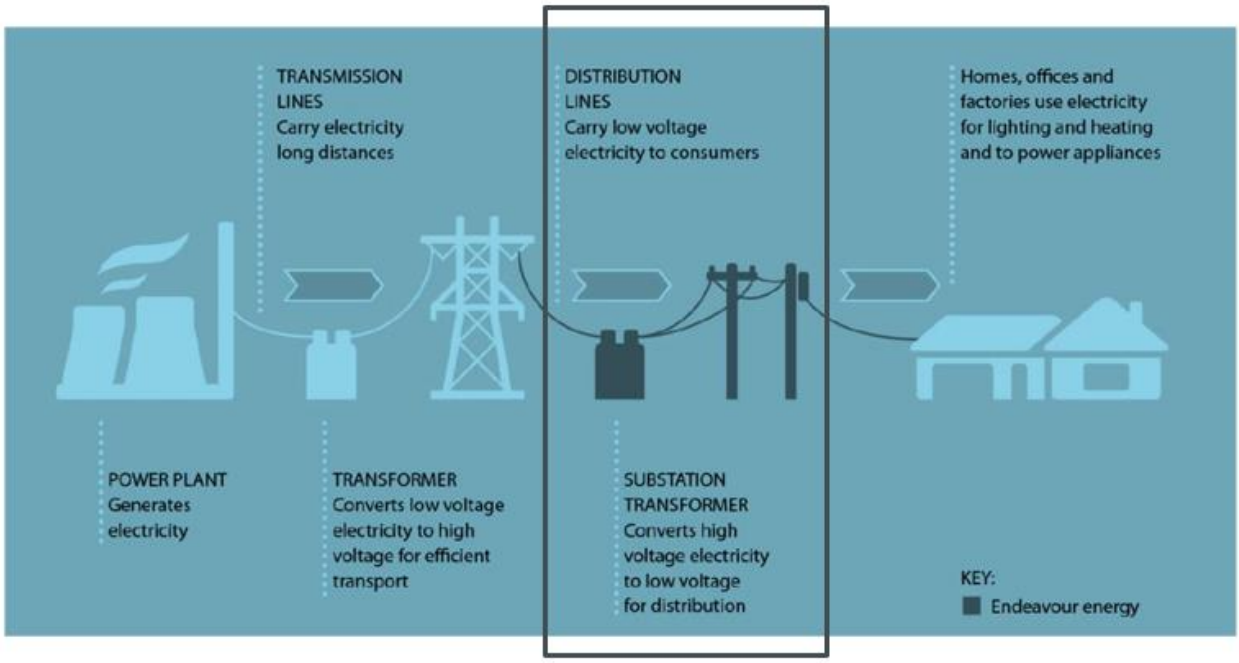
- ground mounted substations most commonly being a padmount substations installed a complete unit on a concrete foundation / plinth and usually associated with underground distribution (indicated by the symbol PS on the site plan from Endeavour Energy's HxGN NetWorks Core NetViewer master facility model) can accommodate loads from 315 kilovolt amperes (kVA) up to 1,500 kVA (typically 500 kVA).

- pole mounted substations where there is overhead distribution (indicated by the symbol on the site plan from Endeavour Energy's HxGN NetWorks Core NetViewer master facility model) and the substation equipment is outdoor type, mounted above ground level on a pole, have comparatively limited capacity of 16 kVA up to a maximum of 400 kVA.

Accordingly there is a significant variation in the number and type of premises able to be connected to a substation ie. a single distribution substation may serve one large building, or many homes.

As well as transforming voltage from high to low in a controlled manner, distribution substations also make it possible to perform the necessary switching operations in the grid (energizing and de-energizing of equipment and lines) and provide the necessary monitoring, protection and control of the network using the Supervisory Control and Data Acquisition (SCADA) system which is supported by an independent telecommunication network.

The following diagram from Endeavour Energy's Distribution Annual Planning Report December 2020 illustrates how the electricity distribution network operates in a traditional, 'one-way' service.



Source: Endeavour Energy Distribution Annual Planning Report December 2020

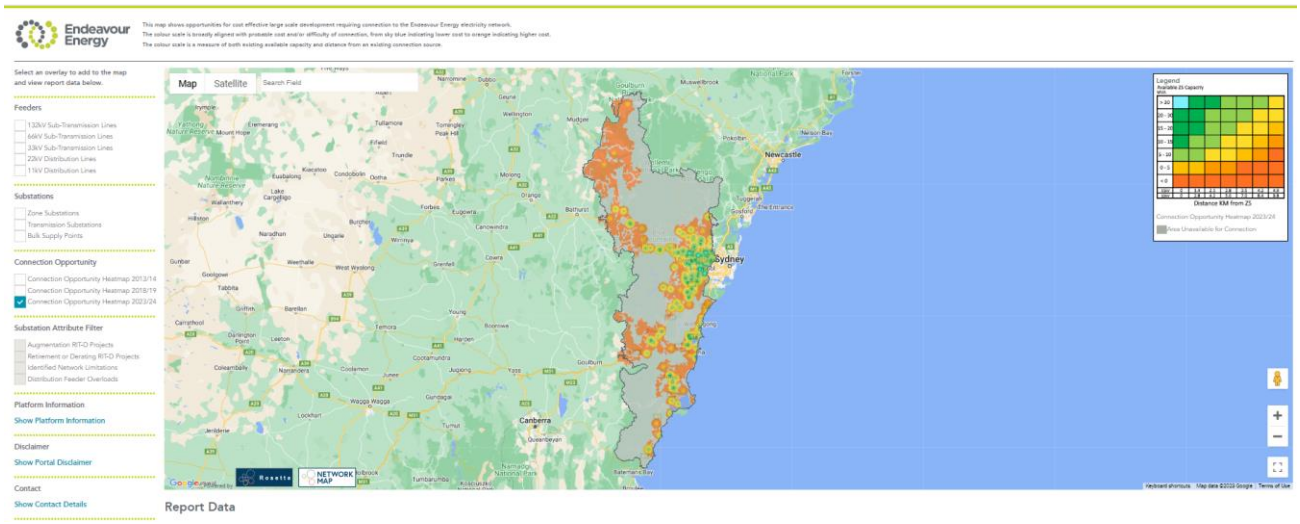
The electricity distribution network also provides a 'two way' service which enables customers with renewable energy resources such as solar photovoltaic panels to export electricity generated into Endeavour Energy's network for supply to other customers for which the customer is credited / paid a solar feed-in tariff as determined by the Independent Pricing and Regulatory Tribunal (IPART).

3.1 Distribution Annual Planning Report Map

The DAPRM (Distribution Annual Planning Report Map) is an interactive geospatial map that has been developed to provide indicative information regarding Endeavour Energy's high voltage electricity network topology, forecast loads and capacities, and network constraints. The DAPRM does not show details of the low voltage electricity distribution network. The DAPRM is an information service available to the public via the following link to Endeavour Energy's website:

https://dapr.endeavourenergy.com.au/connections/# .

This map shows opportunities for cost effective large scale development requiring connection to the Endeavour Energy high voltage electricity network. By loading a marker of the proposed connection location, a line will be generated between the marker and the nearest zone substation. By selecting the Connection Opportunity Heatmap the colour scale shown is broadly aligned with probable cost and/or difficulty of connection, from sky blue indicating lower cost to orange indicating higher cost. The colour scale is a measure of both existing available capacity and distance from an existing connection source.



Endeavour Energy Distribution Annual Planning Report Map includes a Connection Opportunity Heatmap providing an indication of probable cost and/or difficulty of connection.

4 Asset Relocation

To facilitate development, some existing electricity infrastructure may need to be decommissioned / relocated or undergrounded. Planning Proposals often entail significant transport and pedestrian facilities involving the widening and upgrade of the roadways and installation of traffic signals. These works within the 'Public Domain' should similarly have regard to Endeavour Energy URD and asset relocation policies and a method of supply will need to be determined to service all other existing customers.

Enquiries for an asset relocation / removal should be made to Endeavour Energy's Customer Network Solutions Branch who can be contacted via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or on Endeavour Energy's website under 'Home > Connections > Remove or Relocate Our Equipment' or via the following link:

https://www.endeavourenergy.com.au/connections/remove-or-relocate-our-equipment .

The developer is encouraged to approach a Level 3 Accredited Service Provider (ASP) to obtain preliminary details of the assets and discuss possible solutions to the developer's requirements. The developer must provide as much detail as possible concerning the Endeavour Energy assets that the developer wishes to relocate / remove' (including the addressing of alternative supply arrangements for any other customers supplied by the asset proposed to be removed). For details of the ASP scheme please refer to Section 24 'Network Connection'.

5 Before You Dig

Before commencing any underground activity the applicant is required to obtain advice from the ***Before You Dig*** service in accordance with the requirements of the *Electricity Supply Act 1995* (NSW) and associated Regulations.

The applicant must obtain plans not only to identify the location of any underground electrical or other utility infrastructure across the site, but also to identify them as a hazard and to properly assess the risk. Therefore, Duty of Care must be exercised when working around any infrastructure assets.

The plans DO NOT pinpoint the exact location of the infrastructure asset and only the presence. NEVER assume the depth or alignment of pipes and cables. Consider using cable location technologies, potholing and non-destructive digging techniques.

The expiry date of the plans can vary from each asset owner and therefore it is important to note the variations. If plans have expired, a new enquiry must be lodged to ensure current plans are always onsite.

The plans provided by the utility owners must be kept in a legible format either as a hard copy or an electronic copy so they can be easily read and understand.

If help is needed in reading plans and / or information provided, please contact the utility owners directly.

Further details are available on the Before You Dig website via the following link (lodging enquiries by phone is no longer available):

https://www.byda.com.au/ .

6 Bush Fire

Bush fire prone land (BFPL) is land that has been identified by local council which can support a bush fire or is subject to bush fire attack. BFPL maps are prepared by local council and certified by the Commissioner of the NSW Rural Fire Services (RFS). All development on BFPL must satisfy the aim and objectives of RFS Planning for Bush Fire Protection 2019 (PBP). Further information is available via the following link to the RFS website.

https://www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area/planning-for-bush-fire-protection/bush-fire-prone-land .

PBP contains development standards / specifications for bush fire protection measures for land use planning and designing and building of new development to ensure that is not exposed to high bush fire risk. Chapter 5 Residential and Rural Residential Subdivisions includes the following specific recommendations related to electricity services (with similar provisions also applying to Chapter 6 Special Fire Protection Purpose Developments (SFPP) and Chapter 7 Residential Infill Development).

5.3.3 Services – Water, electricity and gas

Intent of measures: *to provide adequate services of water for the protection of buildings during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building.*

Table 5.3c

Performance criteria and acceptable solutions for water, electricity and gas services for residential and rural residential subdivisions.

	PERFORMANCE CRITERIA	ACCEPTABLE SOLUTIONS
	The intent may be achieved where:	
ELECTRICITY SERVICES	› location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings.	› where practicable, electrical transmission lines are underground; › where overhead, electrical transmission lines are proposed as follows: › lines are installed with short pole spacing of 30m, unless crossing gullies, gorges or riparian areas; and › no part of a tree is closer to a power line than the distance set out in ISSC3 *Guideline for Managing Vegetation Near Power Lines*.

Although industrial uses are not covered by Chapters 5 to 7 of NSW Rural Fire Service 'Planning for Bush Fire Protection 2019' (PBP), the aim and objectives of PBP still need to be considered and a suitable package of bush fire protection measures should be proposed commensurate with the assessed level of risk to the development.

The following is an extract of Endeavour Energy's Company Policy 9.1.1 Bushfire Risk Management.

1. Policy Statement

The company will apply prudent asset management strategies to:

- reduce the risk of bushfires caused by network assets and aerial consumer mains to as low as reasonably practicable (ALARP) level;
- mitigating the associated risk to network assets and customer supply reliability during times of bushfire whilst achieving practical safety, reliability, quality of supply, efficient investment and environmental outcomes; and
- ensure compliance with relevant acts, regulations and codes.

Accordingly the electricity network required to service the proposed development must be fit for purpose and meet the technical specifications, design, construction and commissioning standards based on Endeavour Energy's risk assessment associated with the implementation and use of the network connection / infrastructure for a bushfire prone site.

In assessing bushfire risk, Endeavour Energy has traditionally focused on the likelihood of its network starting a bushfire, which is a function of the condition of the network. Risk control has focused on reducing the likelihood of fire ignition by implementing good design and maintenance practices. However the potential impact of a bushfire on its electricity infrastructure and the safety risks associated with the loss of electricity supply are also considered.

Particular attention is given to the design of electrical assets in areas which are susceptible to bushfire to minimise the risk of both normal and foreseeable abnormal operation or failure of the assets initiating a bush fire.

Endeavour Energy crews replacing a burnt timber pole with a concrete pole after the September 2013 bush fire at Winmalee NSW.
Source: Everyday Endeavours, Staff Newspaper November 2013

Endeavour Energy's network is designed to minimise the risk of its assets initiating a bushfire. The asset management actions are focused on identifying and rectifying network defects that may result in faults that could cause fuel ignition. Endeavour Energy has well established processes for identifying such defects, for assessing the likelihood of such faults occurring and prioritising rectification. Endeavour Energy's vegetation management program and pre-summer bushfire inspection program are both examples of this commitment.

However, ultimately the vegetation management work done within easements is primarily to maintain the safe and reliable operation of the electrical network rather than providing a defendable space / Asset Protection Zone (APZ) for an adjoining development / dwelling the easement area is not owned by Endeavour Energy and the slashing and low cut grass would not necessarily be part of Endeavour Energy's vegetation management work.

It is every landholder's responsibility to manage the bush fire hazards on their property. It is also for this reason that any required bushfire protection measures should be contained within the overall development and not on adjoining lands. NSW Rural Fire Service 'Planning for Bush Fire Protection 2019' indicates that a fundamental premise for APZs is that they are provided within the property in such a way that the owner / occupant will be able to maintain the area in perpetuity.

Further details of Endeavour Energy's bushfire / vegetation management policies are available on Endeavour Energy's website under 'Home > Safety > Vegetation management' or via the following link:

https://www.endeavourenergy.com.au/safety/vegetation-management .

The following is an extract of Endeavour Energy Directions Paper for Consultation 1 July 2019 – 30 June 2024.

Bushfire Risk

Over 85 per cent of Endeavour Energy's franchise area is bushfire prone as identified by the NSW Rural Fire Service. Endeavour Energy's franchise area includes the Blue Mountains which has been identified as one of the highest areas of bushfire risk in NSW. As a result, vegetation management is a substantive and critical activity in providing a safe and reliable service.

If we fail to properly maintain safe clearances there is an increased risk of bushfire and outages from trees coming in to contact with, or falling on, powerlines. This can have catastrophic consequences for customers and increase the strain on essential government services like Fire and Rescue NSW and the NSW Rural Fire Service who have previously noted our important role in vegetation management.

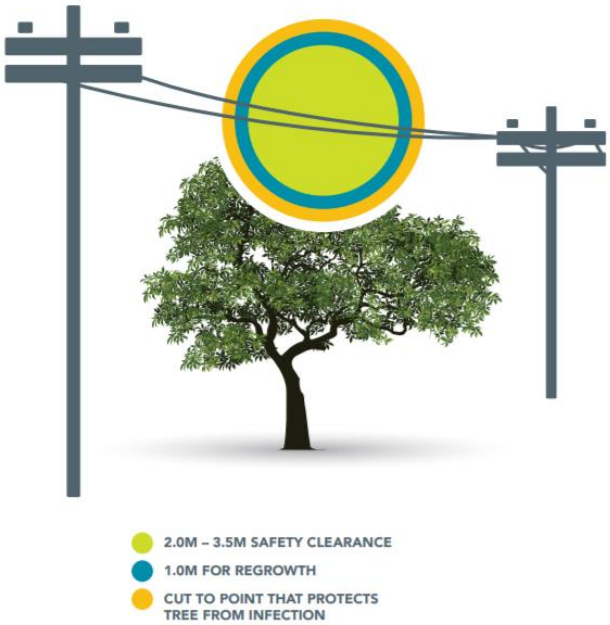
> *"Vegetation management around electricity poles, wires and infrastructure is a critical bushfire mitigation measure. Historically the NSW Rural Fire Service (NSW RFS) has been satisfied that electricity distribution businesses have been appropriately addressing bush fire risks"*
>
> – Commissioner NSW Rural Fire Service – December 2014

We have a comprehensive program of works to manage the risk of bushfires being initiated by the network. We employ leading edge radar based technology to accurately identify vegetation that is too close to the network. Our pre-summer program includes annual inspections of our assets in bushfire prone areas and associated maintenance work, vegetation management, and capital works to target specific high risk assets.

This program is one of Endeavour Energy's largest operating costs at approximately $60 million per year. To ensure we deliver value for money services we externally source this function.

Councils and customers may have different views about the frequency, the impact on streetscapes and the cost-benefit trade-off of tree-trimming. However, we are required to trim trees according to mandatory industry standards (Industry Safety Steering Committee Guideline 3 for managing vegetation near power lines). The ongoing use of the latest technology allows us to better target vegetation management programs in order to strike the right balance between the frequency, impact on streetscapes and compliance of tree-trimming.

Tree-trimming clearance requirements



14 Directions Paper for consultation

1 July 2019 – 30 June 2024

7 Construction Management

As part of the construction management plan the applicant must satisfactorily address any impacts of the proposed works on Endeavour Energy's electricity infrastructure located on the site as well as to the adjoining properties. In this regard the following issues should be considered and addressed by the applicant:

- Maintenance of the structural integrity / weather tightness of the substation building / chamber.
- Access to the substation must be available 24/7/365 ie. all day, every day of the year and must not be impeded by temporary fencing, hoardings, the storage of materials etc.
- The electricity infrastructure may be impacted by vehicle / plant operation, excessive loads, vibration, dust or moisture penetration.

Endeavour Energy expects the applicant will need to prepare a dilapidation report to assess of the current condition of any adjoining building before any construction is done around the area and after the new building's completion to determine if any damage was caused by the excavation, demolition, or construction work.

8 Contamination

Endeavour Energy has noted that Contamination Assessments generally do not appear to identify the electricity infrastructure on or in vicinity of the site which is likely to become redundant assets as a result of the proposed development (which is dealt with by Endeavour Energy's Customer Network Solutions Branch as part of the application for the connection of load for the new development – please refer to Section 24 'Network Connection') as potential areas of environmental concern (AEC) and associated contaminants of potential concern (COPC).

Due to the potential variability in both the nature and extent of any contamination, it is difficult to define specific remedial strategies for potential contamination associated with electricity infrastructure. As a guide only, Endeavour Energy's Sustainability and Environment Branch have advised the remediation of soils or surfaces impacted by various forms of electricity infrastructure is not uncommon but is usually not significant eg. transformer oil associated with leaking substations, pole treatment chemicals at the base of timber poles etc.

The method of remediation is generally the removal of the electricity infrastructure, removal of any stained surfaces or excavation of any contaminated soils and their disposal at a licensed land fill.
The overall Environmental Management System (EMS) for the project should include an unexpected finds protocol to deal with potential contaminated land or asbestos that was not previously identified in the Contamination Assessments. In most cases this should be able to deal with any contamination related to electricity infrastructure. Nonetheless Endeavour Energy's recommendation is for appropriate consideration to be given to electricity infrastructure in the Contamination Assessments.

If the applicant has any concerns over the remediation works related to redundant electricity infrastructure they should contact Sustainability and Environment Branch via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718.

8.1 Contamination from Endeavour Energy Sites

Endeavour Energy's management and / or remediation measures for its sites are implemented based on the presence of contaminants of potential concern that from a contamination perspective would make a site unsuitable for its required use as part of the electricity network. Based on current and historical use of a site, Endeavour Energy may undertake targeted intrusive site investigations to identify or assess concentrations of contaminants of potential concern.

Should the site require significant augmentation or redevelopment, investigations would be undertaken to determine whether environmental management or remediation is required on the site. If that occurs, the site would be assessed under the appropriate land use scenario, which based on the site's current and ongoing use for electricity distribution would be for a commercial or industrial type use. If the use of the site is proposed to change, it would be assessed under the then relevant scenario.

9 Demolition

Demolition work is to be carried out in accordance with Australian Standard AS 2601—2001: 'The demolition of structures' as updated from time to time. All electric cables or apparatus which are liable to be a source of danger, other than a cable or apparatus used for the demolition works shall be disconnected ie. all electrical apparatus shall be regarded as live until isolated and proved de-energised by approved means.

Depending on the extent of the demolition works, the low voltage service conductor and customer connection may need to be isolated and/or removed during demolition. If required the applicant will need to engage and ASP of an appropriate level and class of accreditation to undertake the electrical works. For details of the ASP scheme please refer to Section 12 'Earthing'.

If the entire existing premises are planned for demolition, removal or relocation resulting in the permanent disconnection of a customer connection point, please refer to Section 28 'Removal of Electricity Supply' for further information.

Appropriate care must be taken to not otherwise interfere with any electrical infrastructure on or in the vicinity of the site eg. streetlight columns, power poles, overhead power lines and underground cables etc.

10 Dispensations

In instances where an applicant's proposal is not compliant with Endeavour Energy's engineering documents or standards, where all other options have been exhausted and compliance cannot be achieved, the applicant must request a dispensation in accordance with Endeavour Energy's Company Procedure GAM 0114 'Granting Dispensations for Engineering Documents' which states:

2.0 SCOPE

This procedure applies to all dispensation requests for proposed deviation from the company's engineering documents. This includes dispensations from, but is not limited to, Accredited Service Provider (ASP) designs, the company's designs, and failed acceptance testing results for new and existing equipment.

The dispensation request must outline the risk to the company's ability to provide a safe, reliable and sustainable electricity supply at an optimal whole of life cost when proposing to deviate from engineering documents. The validity of the risk will be assessed and the request will be approved only if the risk is deemed acceptable. The request will be rejected if the risk is deemed unacceptable or substantial evidence is not provided to justify deviating from the company's engineering documents.

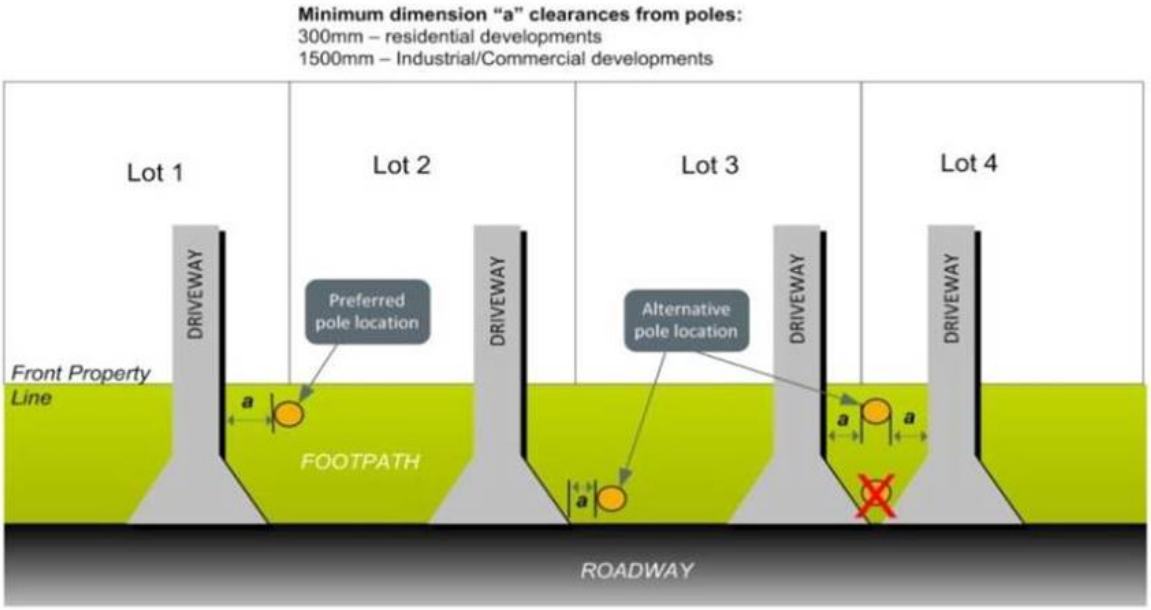
The request should be made to the relevant Endeavour Energy stakeholder eg. if it relates to an easement management matter to the Easement Officers, for an application for connection of load to Customer Network Solutions Branch etc.

11 Driveways

For public / road safety and to reduce the likelihood / protect electricity infrastructure from vehicle impact or loads, Endeavour Energy requires adequate separation distances of driveways that would be acceptable / safe for anyone properly using the driveway. Preference is to have the maximum reasonably possible separation distances from driveways and electricity infrastructure.

However with increased density achieved with smaller, narrower, battle-axe lots and where built to side boundary development is allowed this can sometimes be difficult to achieve. The widening of landscaping provided along the side boundary and the curving of the driveway away can provide additional clearance.

NSW Streets Opening Coordination Council 'Guide to Codes and Practices for Streets Opening' which is available via their website http://www.streetsopening.com.au/resources/ in Section 5.10. 'Vehicular Footpath Crossing' includes the following diagram.



The minimum separation to the skirting of the proposed driveway is regarded as the minimum that would be acceptable / safe for anyone properly using the driveway (and for which depending on the circumstances appropriate protective devices may be required) and failing the foregoing an asset relocation may be required.

Notwithstanding the 300 millimetre possible minimum, Endeavour Energy's preference is for a minimum of 1 metre separation. This is also in keeping with many Councils' development controls which requires driveways to be at least 1 metre from side boundaries ie. often poles are located in line with the boundaries.

The separation required depends on the type, extent and voltage of the electricity infrastructure (some poles may have multiple overhead power lines ranging from low voltage to 132,000 volt / 132 kilovolt (kV) high voltage); setback of the electricity infrastructure from the roadway / kerb and gutter; curve of the road; the traffic type, volume and speed etc. Essentially this requires the completion of a risk assessment.

For new underground subdivisions driveways should be located a minimum of:

- 500 millimetres from low voltage pillars.
- 1500 millimetres from streetlight columns.

In regard to the relevant parts of Australian Standard 2890 'Parking Facilities' as updated from time to time, whilst there is no direct reference in the Standard to power poles or streetlight columns as a 'permanent sight obstruction', provision needs to be made to allow for turning movements, reversing, safety aspects such as sight distances to both pedestrians and other vehicles should not be compromised. Also, as a 'fixed object', if adequate separation cannot be provided, protective devices to protect the power pole or streetlight column from vehicle impact may be required.

Under the provision of the *Electricity Supply Act 1995* (NSW), a driveway constructed too close to electricity infrastructure may under Section 49 'Obstruction of electricity works' be regarded as interfering with electricity works eg. in the event that a pole needs to be replaced and excavation of the surrounding ground is required part of the driveway would need to be removed.

Driveways need to be appropriately located in relation to poles. Poles with transformers (pole mounted substations) may have an additional earth mat surrounding the pole and should be provided with greater separation to driveways. Repairs and maintenance to poles can occur over extended periods of time blocking driveway access. Source: Google Maps Street View.

12 Earthing

Earth wires are a person's life-lines, conveying electricity from a faulty appliance or equipment through the wire to earth and back to the source through the neutral wires rather than through the person's body. If a fault occurs, power will flow to the earth by the shortest and easiest path. So, if appliances or equipment are not properly earthed, the power could flow through it and then through any person touching or using it, causing serious injury or even a fatality. All electrical infrastructure is therefore earthed.

Inadequate connection to the earth to allow a leaking / fault current to flow into the grounding system and be properly dissipated places persons, equipment connected to the network and the electricity network itself at risk from electric shock, fire and physical injury. The earthing system is usually in the form of an earth electrode consisting of earth rods or mats buried in the ground.

Endeavour Energy is committed to ensuring that its activities and assets conform to all relevant International and Australian Standards, Energy Networks Association (ENA) Standards and NSW legislation. Endeavour Energy's Company Policy, Network Asset Management, 9.2.5 'Network Asset Design' which states the following.

5.10 System earthing

The company's network must generally be effectively earthed. However, in order to improve safety for customers and the public (by reducing earth fault current and magnitude of earth fault potential rise in the distribution systems and zone substations) consideration must be given through the planning process to the limitation of the earth-fault levels on the distribution network.

Metal structures and equipment in some cases will be livened to dangerous voltage levels as a result of an earth fault. For this reason depending on access, location and exposure levels, metal structures and equipment must be bonded to earth by permanent connections to electrodes in contact with the general mass of the earth. The hazard to human beings of electric shock means all earthing systems must be designed so that acceptable levels of safety are maintained to electrical employees and the public.

Substations have an 'earth grid' specifically designed for the site considering such factors as ground resistance etc. Depending on the situation, Endeavour Energy may need to seek the imposition of restrictions on land adjoining its electrical infrastructure, particularly in areas of high risk to the public such as:

- aquatic centres, swimming pools (in the vicinity of a zone or transmission substation the required clearance distance is typically 15-30 metres);
- schools; pre-schools and day care centres;
- play grounds;
- conductive concrete or steel poles (near bus stops, pedestrian walkways, etc); and
- conductive boundary fencing.

For this reason, the construction of any building or structure (including fencing, signage, flag poles, hoardings etc.) whether temporary or permanent that is connected to or in close proximity to Endeavour Energy's electrical network is required to comply with AS/NZS 3000:2018 'Electrical installations' as updated from time to time. This Standard sets out requirements for the design, construction and verification of electrical installations, including ensuring there is adequate connection to the earth. Inadequate connection to the earth to allow a leaking/fault current to flow into the grounding system and be properly dissipated places persons, equipment connected to the network and the electricity network itself at risk from electric shock, fire and physical injury.

Copper thieves cutting and taking earths from power poles means there is inadequate connection to the earth placing persons and the electricity network at risk. This example occurred in Prospect NSW part of Endeavour Energy's franchise / network area. Crime Stoppers is urging anyone with information about copper theft in their area to report it anonymously to Crime Stoppers on 1800 333 000.

Earthing systems should be designed by a suitably qualified electrical engineer / Accredited Service Provider (ASP) following a site-specific risk assessment having regard to the potential number of people could be simultaneously exposed, ground resistivity etc. For details of the ASP scheme please refer to Section 24 'Network Connection'.

In particular appropriate consideration should be provided to the conductivity of the fencing near electricity infrastructure or within the easement where there is a possibility it could act as a conductor of electricity and dangerous currents may be carried along the fence. Where conductive / metal fencing is used it must be appropriately earthed eg. the by the use of isolation panels where the fence enters or exits the easement created by the use of timber posts and/or earth electrode installed adjacent to the electricity infrastructure or easement.

12.1 Special Locations

Endeavour Energy's 'Design certification checklist for ASP L3' the design must comply with Endeavour Energy's 'Earthing Design Instruction EDI 001 – Earthing design risk assessment' in which schools, pre-schools, day care centres are regarded as a 'special location' – please see the following extract of EDI 001.

> The representative contact scenarios for any risk event are as follows:
>
> e) *Special*: implies an area within close proximity to or within a premise where there is a high likelihood that shoes will not be worn and/or the risks associated with the earthing system has the potential to be exposed to a number of people simultaneously through contact with affected metalwork. Examples include schools, pre-schools, day care centres, aquatic centres, recreational swimming areas and beaches. This classification must be assessed on a case-by-case basis and may not involve a societal assessment depending on the scenario.

Applicants should check with their ASP responsible for the network connection to the site that any existing or future padmount substations required to facilitate the proposed development that the earthing has been designed to comply with the 'special location' requirements under EDI 100.

13 Easement Management

Whilst the electricity distribution network is held under various forms of property tenure, the most common is an easement which is an encumbrance on the title of land (which may be limited in width and height above or below the land) conferring a right to inspect, construct, operate, maintain, repair, renew, replace or upgrade electrical infrastructure.

Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights' deals with easements and covers:
This instruction covers:

- The rights Endeavour Energy has within its own easements;
- The determination of the minimum easement size for an asset;
- The definition of controls for the safe operation of activities within easements; and,
- The definition of activities which are prohibited within easements.

The following is a summary of the usual / main terms of Endeavour Energy's electrical easements requiring that the landowner:

- Not install or permit to be installed any buildings, structures or services within the easement site.
- Not alter the surface level of the easement site.
- Not do or permit to be done anything that restricts access to the easement site without the prior written permission of Endeavour Energy and in accordance with such conditions as Endeavour Energy may reasonably impose.

Endeavour Energy's preference is for no activities or encroachments to occur within its easements. Most activities are prohibited within the padmount substation easement. However, if any proposed works or activities (other than those approved / certified by Endeavour Energy's Customer Network Solutions Branch as part of an enquiry / application for load or asset relocation project) will encroach / affect Endeavour Energy's easements, contact must first be made with the Endeavour Energy's Easements Officers, via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or email Easements@endeavourenergy.com.au .

Details of all the proposed works or activities within or affecting an easement, restriction or protected works (even if not part of the Development Application) must be referred to Endeavour Energy's Easements Officer for assessment and possible approval provided it meets the minimum safety requirements and controls. However please note that this does not constitute or imply the granting of approval by Endeavour Energy to any or all of the proposed encroachments and / or activities within the easement.

Please note Endeavour Energy's Easement Officers do not have access to the NSW Planning Portal. To resolve the easement management matters direct contact with the Easement Officer should be made.

13.1 Padmount Substation Fire Rating Restriction

If part of a building encroaches the fire rating restriction for a padmount substation, the applicant will need to provide Endeavour Energy's Easements with an engineer's certificate identifying that all external surfaces of the building within the fire rating zone meet the appropriate fire rating as per Endeavour Energy's terms for the restriction and in accordance with Australian Standard AS 1530 'Fire Test to Building Material – Standard'. The engineer must also specify the materials to be utilised and the fixing instructions for those materials in order to meet the stated fire rating.

Alternatively, if it can be demonstrated that the entire building (including the fascia, down pipes and guttering) is a minimum of 3 metres away from the substation plinth, then Endeavour Energy would have no objection to the proposed development. Failing the foregoing, the location / design of the part of the building encroaching the restriction area would need to be amended to be outside of the restriction area or be protected by a fire screen / wall.

Figure 46 from Endeavour Energy's Mains Construction Instruction MCI0006 'Underground distribution: Construction standards manual' explains the fire restriction and the use of screen walls.

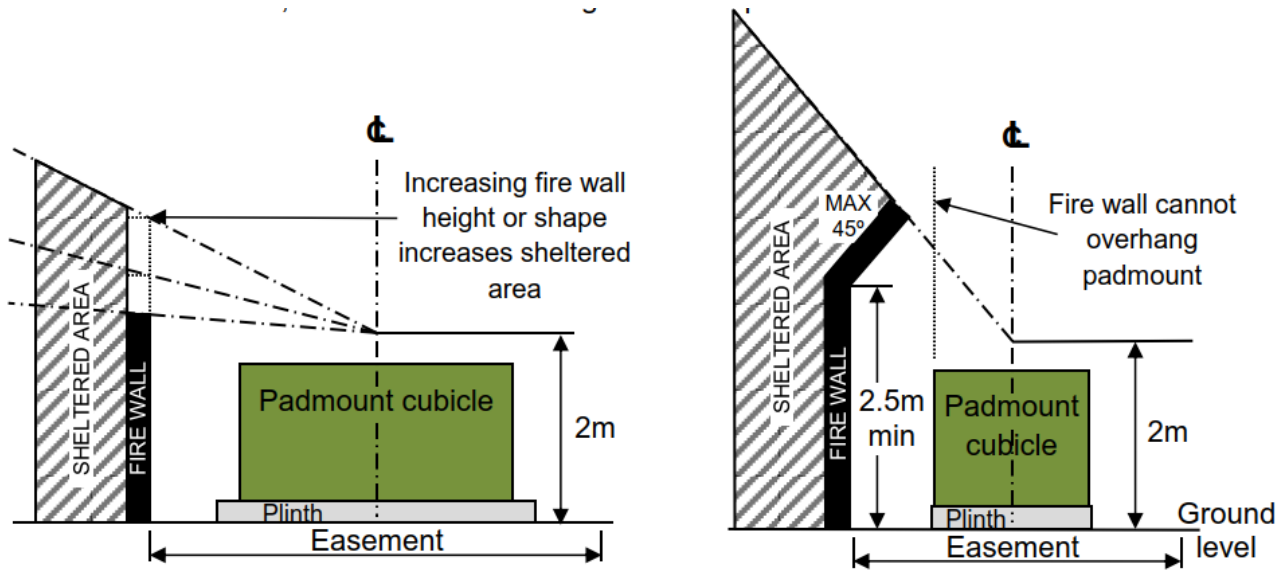
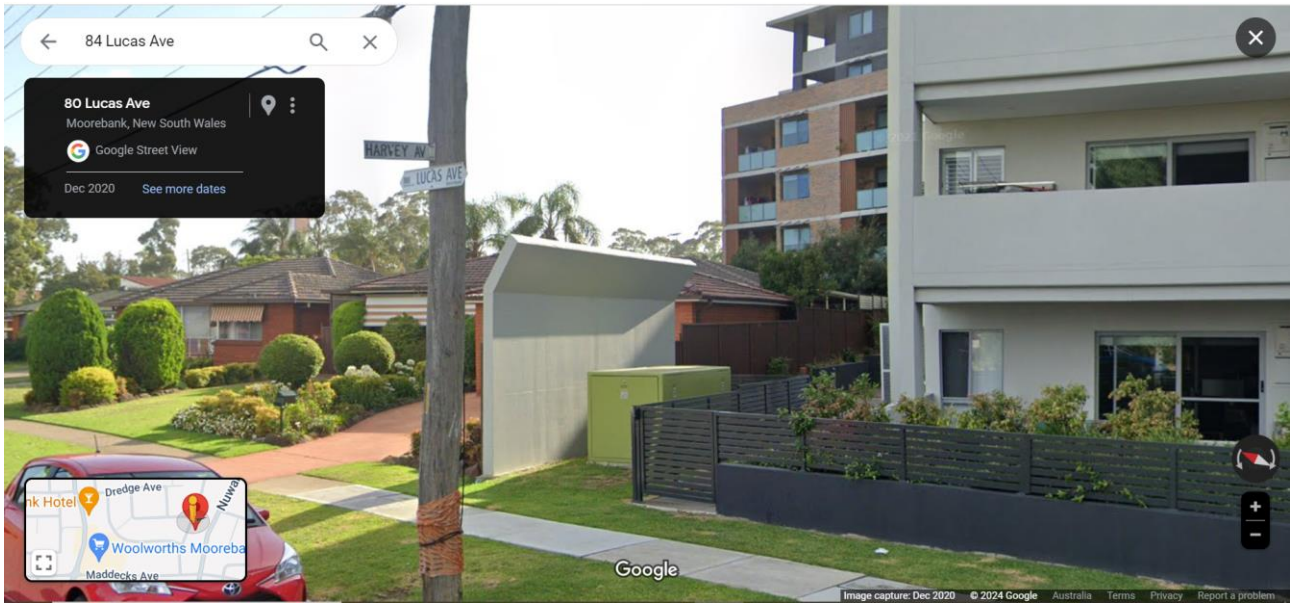


Figure 46 - Screen wall examples

This is also outlined in Endeavour Energy's Mains Design Instructions MDI0028 'Underground distribution network design' and the Australian Standard AS2067: 2016 'Substations and high voltage installations exceeding 1 kV a.c.' which provides common rules for the design and the construction of electrical power installations and also addresses a range of issues including fire risk related to substations within or near buildings (which excludes any constructions with non-fire rated materials being allowed within the fire clearance zone) and recognises requirements of the National Construction Code.



Fire screen wall to padmount substation no. 36553 in Lucas Avenue, Moorebank used to avoid the fire rating restriction encroaching the adjoining property. Source: Google Maps Street View.

It is Endeavour Energy's experience in dealing with the fire restriction areas for padmount substations that any form of glazing (in particular opening windows) cannot achieve the required rating. In regard to the Building Code of Australia (BCA) is the grading period in minutes is for three criteria: structural adequacy, integrity and insulation. For glazing the structural stability of the product and the capacity it has to resist fire, while still acting as a support for its structure (since windows are generally not structural elements) is difficult to achieve. The issue with any openings is that if they are left open, the internal surfaces are also exposed to fire. For this reason both openings and glazing within the fire restriction site is best avoided.

Partly for this reason the Terms of Restriction on the Use of Land for Fire Rating of Buildings was amended in 2022 to include the following additional requirement.

> *No doors or opening windows are permitted to be erected within the restriction site on the external surface of a building within 3 metres from the substation footing.*

Although this additional requirement is not included in the restriction registered on title to all properties, given the problem in achieving the required fire rating, it essentially will apply.

In addition the following matters also need to be considered in regard to the fire rating restriction:

- Personnel access doors and fire exit doors to a building are not permitted within the fire restriction area.
- Gas mains/pipes shall not pass through the fire restriction area.
- A 10 metre clearance distance shall be maintained between substation and fire hydrants, booster valves, and the like in accordance with AS2419.1 'Fire hydrant installations System design, installation and commissioning' as updated from time to time.
- Any landscaping that potentially could transfer / provide connectivity for flame or radiant heat from a fire in the substation to a dwelling or building should be avoided.
- The storage of and / or use of flammable, combustible, corrosive or explosive material within the fire restriction should be avoided.

An electrical transformer caught alight in Sydney's south-west today. (9News)

At least 18 people were evacuated from nearby units. (9News)

Whilst fires in padmount substations are relatively rare they do occur and can represent a risk to the nearby buildings and occupants. The required fire clearances / ratings must be complied with. Above are photographs from 9 News coverage of 'Fire erupts between two apartment blocks in Sydney's south-wests' regarding a padmount substation fire at Guildford which occurred on 25 October 2021. Source: https://www.9news.com.au/national/guildford-fire-apartment-block-electrical-new-south-wales-sydney-south-west/46ff15ed-84f7-4442-9884-dc206cb6e7d0

13.2 Site Specific Conditions

Land interests benefitting Endeavour Energy must be provided where any part of the distribution system is or will be located on land that is not a dedicated public road or reserve. Depending on the type of development and the location of electricity assets being installed, there are different pathways to providing land interests for contestable works. All land interest requirements are outlined in Endeavour Energy's 'Land Interest Guidelines for Network Connection Works'.

Although land interests are still created by registration of the approved Endeavour Energy, there are also unregistered land interests in the form of Site Specific Conditions, which may be appropriate for certain types of distribution network assets, where the connection assets are positioned on the public road frontage within the land parcel being supplied and with direct access from the public road. Endeavour Energy's Customer Network Solutions Branch maintain a register of the Site Specific Conditions and will apply for the life of the 'Premises Connection Assets'.

These Site Specific Conditions are imposed in lieu of the customer creating a registered Land Interest in the form of an easement. Essentially the Conditions are the same as that for the easement for the type of distribution network asset and the assets are managed on the same basis as if an easement is in place.

Further details of the land interest requirements are available by contacting Endeavour Energy's Customer Network Solutions Branch via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or on Endeavour Energy's website under 'Home > Connections > Land interest for contestable works' or via the following link:

https://www.endeavourenergy.com.au/connections/land-interest-for-contestable-works.

14 Easement Release

Under Endeavour Energy's Company Policy 9.2.3 (Network) 'Property Tenure for Network Assets', the company will assess all applications for the release of easements to identify and manage risks to its network, commercial and community interests. The company may seek compensation for the extinguishment of property tenure. No easement is considered to be redundant or obsolete until it is released under this policy.
Applications for the release / extinguishment of an easement can only be made by the registered landowners of the encumbered property and are usually done either:

- As part of an application for connection of load or capital works project for a development project eg. where alternative / new network arrangements are to be put in place, which is managed by Endeavour Energy's Customer Network Solutions Branch. Endeavour Energy's Customer Network Solutions Branch will make the applicant or their ASP aware of Endeavour Energy's requirements for the release of easement. Please refer to Section 24 'Network Connection'..

- At the request of landowners where the electrical assets within the easement have been removed or it has become apparent that the easement has possibly become redundant to Endeavour Energy's future network requirements eg. no electrical assets have ever been installed in the easement. Further details are available by contacting Endeavour Energy's Property Services Section via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or email network_property@endeavourenergy.com.au (underscore between 'network' and 'property'). The greater amount of detail provided will assist in the assessment of the application.

In some circumstances the release of easement may be for nil compensation eg. the affected land is subject to dedication as public road or as part of an asset relocation / capital works project where the alternative network arrangements occur at the same voltage and level of easement affectation. Otherwise the release will be subject to monetary compensation paid by the applicant having regard to the potential increase in value of the land as a result of the easement release / reduction in the extent of easement affectation (with appropriate consideration given to the applicant's alternative network arrangements).

15 Easement Subdivision

Endeavour Energy's preference is to have continuity of all easement types over the most direct and practicable route affecting the least number of lots as possible. Therefore, Endeavour Energy generally does not support the subdivision of easements and their incorporation into multiple / privately owned lots.

The incorporation of electricity easements into privately owned lots is generally problematic for both Endeavour Energy and the future landowners and requires additional easement management to ensure no uncontrolled activities / encroachments occur within the easement area.

Accordingly, Endeavour Energy's recommendation is that whenever reasonably possible, easements be entirely incorporated into public reserves and not burden private lots (except where they are remnant lots or not subject to development). In some Council areas this is a requirement for subdivisions as shown in the following extract of Camden Council's development control plan.

C7.2 Neighbourhood and Subdivision Design		
Electricity easements are to be incorporated in public road reserves and shall not burden private lots.	The proposed electricity easements are located within the public road reserve. No electricity easements burden the private lots.	✔

Endeavour Energy's experience is that regardless of the easement, inevitably some property owners will seek to maximise the utilisation of their land and will encroach or undertake prohibited activities within the easement. The following aerial photograph shows part of easement within the public reserve being clear but that within the private lots having prohibited buildings and swimming pools.

Overlay of approximate location of easement for 132,000 volt / 132 kilovolt Feeders No. s 930 & 931 Baulkham Hills to Carlingford from Endeavour Energy's HxGN NetWorks Core NetViewer master facility model onto aerial photograph from SIX Maps of properties located on the southern side of McGiff Avenue, North Rocks NSW. The part of the easement to the west within Hunts Creek Reserve show no encroachments. To the east within privately owned lots there are encroachments of the easement by buildings / structures and swimming pools.

Where subdivisions of property are proposed for land in which Endeavour Energy has an easement, the following requirements must be met:

- Subdivision of the easement parallel to overhead power lines or underground cables which effectively reduce the easement width must be avoided.
- The number of crossings of easements must be minimised and crossings should be or close to perpendicular to the overhead power lines or underground cables and must be at least half the easement width beyond any pole or structure. Contiguous / ready access along the easement can be difficult not only due to fencing but also retaining walls and changes in levels which may preclude physical access.
- Unrestricted access to structures such as poles and towers or cable pits must be retained. Where subdivisions incorporate easements to the rear of the lots, if buildings are constructed from side boundary to side boundary, access to the easement is extremely restricted.
- Easements for other types of electricity infrastructure such as padmount substations or switching stations shall not be subdivided but any associated restriction or right of access etc. may encumber and adjoining lot.

Poor subdivision of easements restricts access and working area around the structures. Source: Google Maps Street View.

If a subdivision results in the incorporation of Endeavour Energy's easement into new or multiple lots, the easements, rights and restrictions, covenants etc. must be retained over the affected lots and in accordance with the requirements of NSW Land Registry Services (LRS).

Depending on the age of the existing easement terms and the intended use of the site, Endeavour Energy may need to include additional requirements / restrictions to be registered on titles to each of the lots to ensure it can reasonably access and manage its existing electricity infrastructure within the easement. This may apply in situations where the terms of easements reflected the use at the time of large lot non-urban changing to a multiple lot urban use. For example, old terms of easement may only provide access to the site via the easement itself compared to being able to enter the (entire) lot burdened using the most practical route to the easement.

16 Emergency Contact

In case of an emergency relating to Endeavour Energy's electrical network, the applicant should note the Emergencies Telephone is 131 003 which can be contacted 24 hours / 7 days. Endeavour Energy's contact details should be included in any relevant risk and safety management plan.

If someone seriously injured or in need of urgent medical help call the Triple Zero (000) service which is the quickest way to get the right emergency service to help you. It should be used to contact Police, Fire or Ambulance service in life threatening or emergency situations.

17 Excavation

Section 49A 'Excavation work affecting electricity works' of the of *Electricity Supply Act 1995* (NSW) covering the carrying out or proposed carrying out of excavation work in, on or near Endeavour Energy's electrical infrastructure.

Electricity Supply Act 1995 No 94

Current version for 1 August 2018 to date (accessed 4 September 2018 at 08:54)

Part 5 > Division 2 > Section 49A

49A Excavation work affecting electricity works

(1) This section applies if a network operator has reasonable cause to believe that the carrying out or proposed carrying out of excavation work in, on or near its electricity works:

(a) could destroy, damage or interfere with those works, or

(b) could make those works become a potential cause of bush fire or a potential risk to public safety.

(2) In those circumstances, a network operator may serve a written notice on the person carrying out or proposing to carry out the excavation work requiring the person:

(a) to modify the excavation work, or

(b) not to carry out the excavation work, but only if the network operator is of the opinion that modifying the excavation work will not be effective in preventing the destruction or damage of, or interference with, the electricity works concerned or in preventing those works becoming a potential cause of bush fire or a potential risk to public safety.

If any excavation work affects Endeavour Energy's electricity infrastructure, prior contact must be made with Endeavour Energy's Field Operations Branch via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or alternately email Construction.Works@endeavourenergy.com.au .

With the increased number of developments incorporating basements often being constructed to the property boundaries or immediately adjacent to easements, the integrity of the nearby electricity infrastructure can be placed at risk.

This excavation for a basement at 6 Sorrell Street Parramatta NSW for a mixed use 8 storey development in 2015 was identified by Endeavour Energy's Regional Services North as being unsafe due to the integrity of padmount substation 7858 located on the adjoining lot being compromised and access not being available. This resulted in the 'switching out' of the substation from the network until the site conditions were again deemed to be safe.

However even relatively minor excavation works may affect the integrity of the nearby electricity infrastructure.

Crews from Endeavour Energy's Moss Vale Field Service Centre in March 2024 had to attend site as this excavation by a drainage contractor resulted in the striking of the earthing system for a pole mounted substation and compromised the support of the poles.

18 Flooding

Particular attention must be given to the design of electrical assets in areas which are susceptible to flooding. The network required to service an area / development must be fit for purpose and meet the technical specifications, design, construction and commissioning standards based on Endeavour Energy's risk assessment associated with the implementation and use of the network connection / infrastructure for a flood prone site. Risk control has focused typically on avoiding the threat, but where this is not possible, reducing the negative effect or probability of flood damage to assets by implementing good design and maintenance practices.

Endeavour Energy's System Control Branch Procedure NCB 0615 'Flood Response Plan' is based on electricity supply being maintained as long as practicable consistent with the safety of employees' general public and emergency services personnel. It involves rearranging the network having regard to a substation prioritisation ranking, comprised of flood risk and damage potential, to focus the flood response efforts toward areas and resources in order of highest importance.

In regard to the flood susceptibility of electricity infrastructure, overhead power lines which can be damaged by flying or floating debris, falling trees and branches, inundation by floodwater and in colder parts of the network, collected ice and snow. The main guide to the construction of overhead power lines is Australian/New Zealand Standard AS/NZS 7000:2016 'Overhead line design' which has specific as well as general guidance in regard to design of overhead power lines in flood prone land.

Underground cables are less likely to be damaged from storm events but are still susceptible to flooding and tidal surges. Saltwater, which is a very good conductor and causes electrolysis reactions with the metal conductors and can result in accelerated corrosion to the underground cables and associated infrastructure. With appropriate design electrical cables are commonly run underwater and in other hostile environments and likewise can also take into consideration potential flood events.

The main guide to the construction of overhead power lines used by Endeavour Energy is its:

- Mains Design Instruction MDI 0028 'Underground distribution network design'.
- Mains Construction Instruction MCI 0006 'Underground distribution construction standards manual'.

These documents have specific as well as general guidance applicable to the design and construction of underground cables in flood prone land.

Distribution substations should not be subject to flood inundation or stormwater runoff ie. the padmount substation cubicles are weatherproof not flood proof and the cable pits whilst designed to be self-draining should not be subject to excessive ingress of water. Section 7 'Substation and switching stations' of Endeavour Energy's Mains Construction Instruction MCI 0006 'Underground distribution construction standards manual' provides the following details of the requirements for flooding and drainage in new distribution substation locations.

> *7.1.6 Flooding and drainage*
>
> Substations are to be located such that the risk of flooding or stormwater damage is minimal.
>
> As a minimum the level at the top of the transformer footing, HV and LV switchgear, shall not be lower than the 1:100 year flood level.
>
> All drains within the substation site area or in the vicinity shall be properly maintained to avoid the possibility of water damage to Endeavour Energy's equipment.
>
> In areas where, as determined by the Network Substation Manager, there is a high water table or a heightened risk of flooding, indoor substations will not be permitted.
>
> All materials used in the construction below the substation (ground level) shall be capable of withstanding prolonged immersion in water without swelling or deterioration.

Figure 51 - Example substation raised above 1:100 flood level

18.1 Building in flood hazard areas

The Australian Building Codes Board (ABCB) National Construction Code Standard 2012.3 'Construction of buildings in flood hazard areas' includes the following requirements.

2.9 Requirements for utilities

2.9.1 General

(a) Utilities and related equipment, other than an electrical meter for the building, must not be placed below the *FHL* unless they have been designed specifically to cope with flood water inundation.

Note: The location of electrical meters is regulated by the electrical authority.

(b) Buried systems must be placed at a depth sufficient to prevent damage due to scour and erosion during the *DFE*.

(c) Exposed systems must be designed to withstand the flood related actions (buoyancy, flow, debris and wave).

2.9.2 Electrical

Unless the electrical supply authority determines otherwise:

(a) Electrical switches must be placed above the *FHL*.

(b) Electrical conduits and cables installed below the *FHL* must be waterproofed or placed in waterproofed enclosures.

(DFE: Defined Flood Event; FHL: Flood Hazard Level)

19 Hazardous Environment

Endeavour Energy is aware that the provisions of State Environmental Planning Policy Resilience and Hazards (Resilience and Hazards SEPP) Chapter 3 'Hazardous and offensive development' in the preparation of a preliminary hazard assessment electricity infrastructure is not defined / regarded as sensitive land use. However, in these situations Endeavour Energy has sought further advice from the consultants preparing the preliminary hazard assessment on the basis that, although not a sensitive land use in the traditional / environmental sense, if the electricity infrastructure on or in proximity of the site (which also may be a potential ignition source) is damaged, the resulting outage could leave many properties / customers without power.

In these situations the applicant's consultants have been requested to specifically address the risks associated with the proximity of the electricity infrastructure ie. detail design considerations, technical or operational controls etc. to demonstrate as required by the Resilience and Hazards SEPP that the proposed business / development is suitably located and can be built and operated with an adequate level of safety and pollution control.

Irrespective of the class / division and the quantities, any dangerous goods whether combustible and / or flammable should not be stored near electricity infrastructure and increasing the separation distance as far as reasonably possible is recommended.

Figure 4: Service Station Facility Following Fire

Extract of Statement of Environmental Effects for a Development Application notification received by Endeavour Energy in July 2023 for the rebuilding of a service station at Campbelltown following a fire in February 2023 which was near low voltage and 11,000 volt / 11 kilovolt high voltage overhead power lines. Note the fire damage to the pole.

In similar situations the consultants have been requested to specifically address the risks associated with the proximity of the electricity infrastructure ie. detail design considerations, technical or operational controls such as equipotential bonding between the earth, concrete driveway and fuel tanks etc. to demonstrate as required by the Resilience and Hazards SEPP that the proposed business / development is suitably located and can be built and operated with an adequate level of safety and pollution control.

Irrespective of the class / division and the quantities, any dangerous goods whether combustible and / or flammable should not be stored near electricity infrastructure and increasing the separation distance as far as reasonably possible is recommended.

Endeavour Energy's Mains Design Instruction MDI 0028 'Underground distribution network design' includes the following advice regarding substations near hazards.

> *6.3.7 Substation near hazards*
>
> Substations contain HV and LV electricity, oil, plastics, concrete and other materials. In some situations, a substation can be regarded as a hazardous source, or be susceptible to hazardous sources.
>
> Therefore, substations in or near hazardous areas will be dealt with strictly in accordance with Australian Standards and statutory requirements. The minimum distances to be maintained from hazardous locations are set out in AS 60079.10:2009. Reference will be made to AS 60079.10:2009 and any relevant statutory authority, in determining the siting of a substation when in hazardous locations. Padmount substations in or near hazardous areas, will have stainless steel cubicles as long as they comply with EDI 100 for earthing.

19.1 Fire Risk

Endeavour Energy's electricity infrastructure is potentially a source of ignition for fires. Endeavour Energy's risk control has focused on reducing the likelihood of fire ignition by implementing good design and maintenance practices. However there is still the potential for fires to occur as a result of fault currents, flashovers, fallen conductors, vehicle impacts etc.

With oil-filled equipment used in the substations there is the possibility of fires occurring eg. with padmount substations this is the reason for the inclusion of a fire restriction area. The appropriate selection, installation, maintenance and condition monitoring of the equipment used in substations is undertaken to reduce the possibility of fires and their containment.

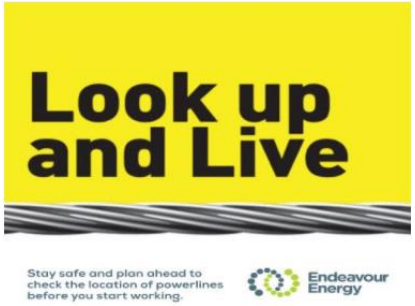
Although the risk cannot be eliminated entirely, Endeavour Energy's aim is to reduce the residual risk of these potential hazardous events to 'As Low As Reasonably Practicable'.

Whilst, Endeavour Energy has traditionally focused on the likelihood of its network starting a fire, conversely Endeavour Energy believes that Councils (and applicants) should consider the safety risks associated with inappropriate development in proximity of electricity infrastructure that may result in damage to the network and the loss of electricity supply.

19.2 Air Quality / Dust

Although Endeavour Energy's electricity infrastructure is not a 'sensitive receptor' in the traditional sense of being a habitable / residential use, the electrical equipment / operation of the site would be affected by excessive / cumulative dust emissions. Although unlikely in normal circumstances and the risk is considered low, it could cause a flashover to occur on the insulators on the overhead power lines or start a fire in the substation. From Endeavour Energy's perspective it is imperative that the appropriate air quality management measures are implemented and adhered to in order to minimise any impact on the electricity infrastructure on or in the vicinity of the site.

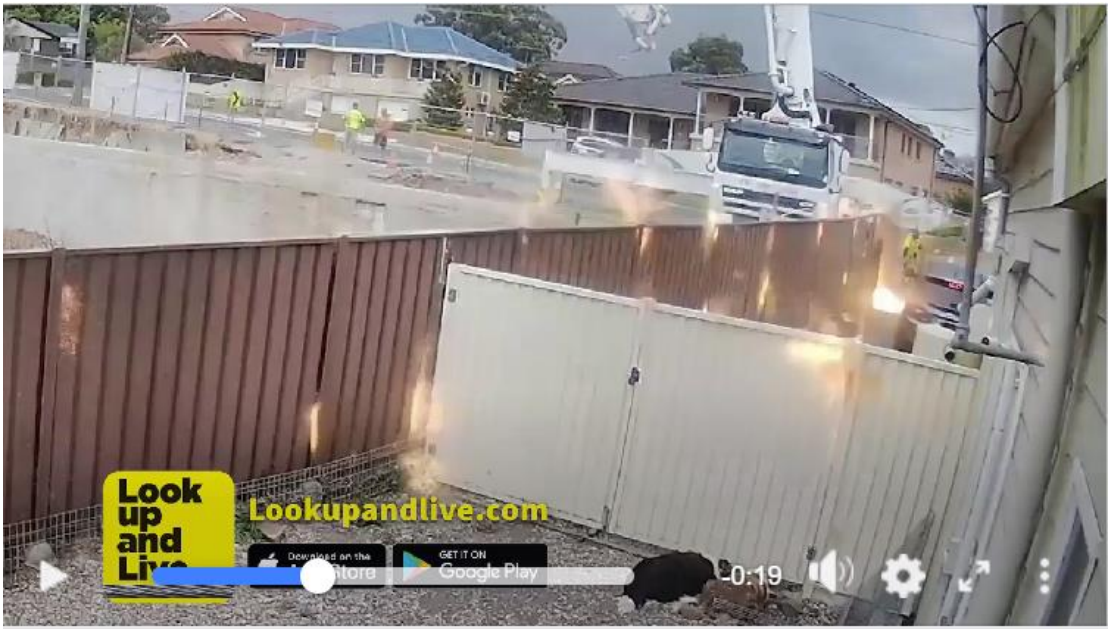
20 Look Up and Live



Before undertaking work on a site with overhead power lines, the location of powerlines can be checked with the free Look up and Live app which is available via the following link:

www.lookupandlive.com.au .

The Look up and Live map is an interactive geospatial map that has been developed to display the electricity networks of various distributors including Endeavour Energy. It is a simple worksite planning tool which provides information on powerline safety and allows specific information to be obtained from Endeavour Energy concerning how to minimize the risk of contact while working in proximity to the electricity network.

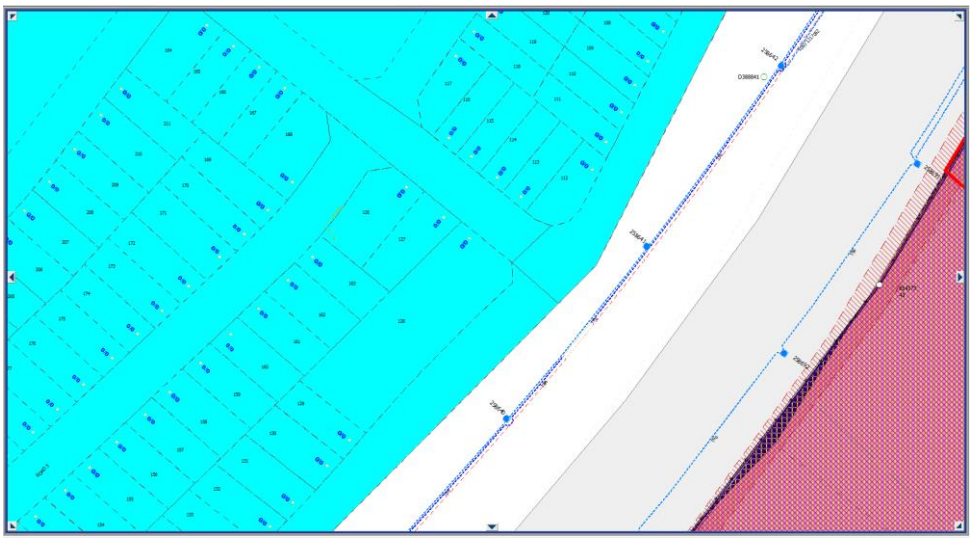


In December 2022 a concrete boom truck in Western Sydney came into contact with 33,000 volt / 33 kilovolt high voltage overhead powerlines causing an electrical explosion that energised the immediate area with potentially fatal consequences. Thankfully no one was killed or seriously hurt. Source: Too often Endeavour Energy (NSW) is... - Endeavour Energy | Facebook

21 Modifications

Endeavour Energy's HxGN NetWorks Core NetViewer master facility model shows enquiries and applications for contestable works projects with Endeavour Energy's Customer Network Solutions Branch for electricity supply by either:

- 'Work Polygon' indicated by the coloured highlighting and/or hatching of the lot.
- 'Developer Area' indicated by a proposed road / lot layout for a proposed subdivision.



Extract of Endeavour Energy's HxGN NetWorks Core NetViewer master facility model showing 'Work Polygon' and 'Developer Area'.

As such, Endeavour Energy's Customer Network Solutions Branch are managing the conditions of supply with the proponent and their Accredited Service Provider (ASP). However the applicant will need to contact Endeavour Energy's Customer Network Solutions Branch via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 if the Development Application:

- Includes any contestable works projects that are outside of any existing approved / certified works.

- Results in an electricity load that is outside of any existing Supply / Connection Offer requiring the incorporation of the additional load for consideration. This is due to load often being based on a desktop assessment using an After Diversity Maximum Demand (ADMD) where demand is aggregated over a large number of customers providing an ADMD for the site / per lot. Depending on the actual development proposed for the site, the ADMD provided may not be sufficient ie. the increase in the number of premises or in the developable area may result in the creation of additional load; requirement for another separate customer connection point etc.

22 Network Access

It is imperative that the access to electrical infrastructure be maintained at all times. To ensure that the supply electricity is available to the community, access to the electricity infrastructure may be required at any time. Restricted access to electricity infrastructure by electricity workers causes delays in power restoration and may have severe consequences in the event of an emergency.

If Endeavour finds that a structure impedes access or presents an unacceptable level of risk, Endeavour Energy reserves the right to have the structure removed, or to remove it at the owner's expense. To ensure suitable access is available to electricity infrastructure the *Electricity Supply Act 1995* (NSW) includes the following Section 49 'Obstruction of electricity works'.

Electricity Supply Act 1995 No 94

Current version for 1 July 2019 to date (accessed 7 April 2020 at 10:49)

Part 5 > Division 2 > Section 49

49 Obstruction of electricity works

(1) This section applies if a network operator has reasonable cause to believe that any structure or thing situated in, on or near its electricity works:

(a) could destroy, damage or interfere with those works, or

(b) could make those works become a potential cause of bush fire or a potential risk to public safety.

(2) In those circumstances, a network operator:

(a) may serve a written notice on the person having control of the structure or thing requiring that person to modify or remove it, or

(b) in an emergency, may, at its own expense, modify or remove the structure or thing itself.

This is particularly important where there are poles or structures and changes in direction to a line route. In the event of fallen conductors or faults in underground cables, access to the poles or cable pits to restring or pull cables will be required by electricity workers with heavy vehicles, machinery and materials and is essential for restoring electricity supply.

The equipment required for pole replacements can include up to a 60 ton crane, franna crane, large elevating work platform and lifter borer.

23 Network Asset Design

Endeavour Energy's Company Policy, Network Asset Management, 9.2.5 'Network Asset Design' as one of its purposes is to establish the design principles and standards to be applied consistently across the network. The Company Policy includes the following:

5.11 Reticulation policy

5.11.1 Distribution reticulation

In order to improve the reliability performance of and to reduce the operating expenditure on the network over the long term the company has adopted the strategy of requiring new lines to be either underground cables or where overhead is permitted, to be predominantly of covered or insulated construction. Notwithstanding this strategy, bare wire overhead construction is appropriate and permitted in some situations as detailed below.

In areas with the potential for significant overhanging foliage, CCT is used to provide increased reliability as it is less susceptible to outages from wind-blown branches and debris than bare conductors. CCT must only be used in treed[2] areas as the probability of a direct lightning strike is low. In open areas where the line is not shielded from a direct lightning strike, bare conductors must generally be used for 11kV and 22kV reticulation.

Non-metallic Screened High Voltage Aerial Bundled Cable (NMSHVABC) must be used in areas which are heavily treed and where it is not practicable to maintain a tree clearing envelope around the conductors.

[2] A "treed" area is one with a substantial number of trees adjacent to the line, in each span. In these situations CCT is used to provide increased reliability as it is less susceptible to outages from wind-blown

For urban areas it provides the following additional detail.

5.11.1.1 Urban areas

Reticulation of new residential subdivisions will be underground. In areas of low bushfire consequence, new lines within existing overhead areas can be overhead, unless underground lines are cost justified or required by either environmental or local council requirements.

Where underground reticulation is required on a feeder that supplies a mixture of industrial, commercial and/or residential loads, the standard of underground construction will apply to all types of load within that development.

Where ducting is used, adequate spare ducts and easements must be provided at the outset to cover the final load requirements of the entire development plan.

Extensions to the existing overhead 11kV/22kV network must generally be underground. Bare wire will be used for conductor replacements and augmentations except in treed areas where CCT or NMSHVABC must be used.
Extensions to the existing overhead LV network and augmentations must either be underground or ABC. Conductor replacements greater than 100m in route length must utilise aerial bundled cable.

Overhead power lines are progressively undergrounded as subdivisions progress. Source: Google Maps Street View.

For non-urban areas it includes the following.

5.11.1.2 Non-urban areas

Extensions to the existing overhead 11kV and 22kV network and conductor replacements / augmentations must be underground. Where underground reticulation is not practical overhead construction can be used. The choice of overhead construction must be bare wire for the following circumstances:

- areas that are not substantial treed;
- long gully crossings;
- SWER lines;
- joint use 132, 66 or 33kV lines; and
- distribution lines with transmission construction and located in an easement.

All other overhead constructions must be CCT or NMSHVABC.

Extensions to the existing overhead LV network and augmentations must either be underground or utilise ABC. Conductor replacements greater than 100m route length must utilise ABC.

5.11.2 Transmission and sub-transmission

Transmission and sub-transmission lines will be must overhead construction unless environment, community and/or planning instrument considerations require an underground solution.

The Company Policy also indicates that 'Customers may elect or may be required by local council to install underground reticulation'. Councils may seek the enforcement of underground cables policy as part of their detailed planning and design guidelines in their Development Control Plans to support the planning controls in the Local Environmental Plan.

As well as improving the reliability of supply, and improved aesthetics a major consideration for increasing the proportion of underground power is the reduction of traffic hazards with poles traditionally placed in close to the kerb lines which increases the risk of vehicular impacts and potential road fatalities.

24 Network Connection

Applicants should not automatically assume that the presence of electricity infrastructure in the locality and / or nearby similar development means that adequate supply is immediately available to facilitate their proposed development.

Generally, customers wishing to connect a typical low voltage load up to 100 amps single phase or 63 amps three phase in an existing urban area will be offered to connect under a low voltage (LV) basic connection service even though out minimal extensions or augmentation works may need to be carried out to the network in order to facilitate the connection.

Many other types of LV connections, such as loads in non-urban locations or loads above 100 amps single phase or 63 amps three phase, may also be offered a LV basic connection service if it is assessed that the connection can be supported by the network without the need to extend or enhance the network.

In cases where the non-urban or larger LV loads are deemed to be requiring enhancement or extension works to the network, the offer will be in the form of a standard connection service.

When considering applications, Endeavour Energy will determine which areas are urban and rural based on the criteria specified within the definition of rural and urban below and the local government planning instruments.

Applications for new connection services need to be completed online. Further details of the entire range of connection services including high voltage installations; temporary builder's supply; asset relocation and removal; multi occupant developments; subdivisions; meeting the requirements of development approval etc; are available by contacting Endeavour Energy's Customer Network Solutions Branch via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or on Endeavour Energy's website under 'Home > Connections > Connect online > Connection of load > Connecting to our network' or via the following link:

https://www.endeavourenergy.com.au/connections/connect-online/connection-of-load .

To ensure an adequate connection, the applicant may need to engage an Accredited Service Provider (ASP) of an appropriate level and class of accreditation to assess the electricity load and the proposed method of supply for the development. The ASP scheme is administered by Energy NSW and details are available on their website via the following link or telephone 13 77 88:

https://energy.nsw.gov.au/government-and-regulation/legislative-and-regulatory-requirements/asp-scheme-and-contestable-works .

There are currently 3 levels of accreditation:

- Level 1: Construction of electricity distribution network assets ('poles and wires' or underground)
- Level 2: Construction or change of service lines between the electricity distribution network and the point of connection of the property/premises and for energising new or altered connections
- Level 3: Design of electricity distribution network assets underground or overhead.

The availability of additional electricity supply to a development is based on a wide range of factors eg. the age and design of the network; the number and type of distribution substations required to transform high to low voltage to supply customers / developments; other development in the locality utilising previously spare capacity within the local network; the progress of nearby / surrounding sites including electricity infrastructure works; the size and rating / load on the conductors and voltage drop (which can affect the quality of supply particularly with long conductor runs) etc.

Depending on these factors, in some circumstances the electrical infrastructure may need to be extended or upgraded to accommodate additional electrical load resulting from a development. However the extent of any works required will not be determined until the final load assessment is completed. Any work required to enable supply of the load in line with the requirements of the *Electricity Supply Act 1995* (NSW) is deemed to be 'contestable works' and should be undertaken by an ASP of an appropriate level and class of accreditation.

As part of the application for connection of load Endeavour Energy's Customer Network Solutions Branch as well as determining the method of supply requirements will also determine the funding arrangements. Depending on the circumstances not all the works may be customer funded or constructed and Endeavour Energy may supply materials, fund or construct works, make a capital contribution or seek reimbursements from the customer eg. for the use of spare ducts which Endeavour Energy has made a capital contribution as part of other nearby works.

For more complex connections, advice on the electricity infrastructure required to facilitate the proposed development can also be obtained by submitting a Technical Review Request to Endeavour Energy's Customer Network Solutions Branch who can be contacted via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or by completing an online application on Endeavour Energy's website under 'Home > Connections > Speak to an engineering expert' or via the following link

https://www.endeavourenergy.com.au/connections/speak-to-an-engineering-expert .

The response to these enquiries is based upon a desktop review of corporate information systems, and as such does not involve the engagement of various internal stakeholders in order to develop a 'Connection Offer'. It does provide details of preliminary connection requirements which can be considered by the applicant prior to lodging a formal application for connection of load.

Endeavour Energy is urging applicants /customers to engage with an Electrical Consultant / ASP prior to finalising plans to in order to assess and incorporate any required electricity infrastructure. In so doing the consideration can also be given to its impact on the other aspects of the proposed development. This can assist in avoiding the making of amendments to the plan or possibly the need to later seek modification of an approved development application.

Questions about connections services can be made by completing Enquiry Form available via the following link and submitted to CWAdmin@endeavourenergy.com.au or speak to a Customer Service Representative on 133 718.

https://www.endeavourenergy.com.au/contact-us/general-enquiry .

24.1 Facilitating Subdivision

As a facilitating subdivision for the orderly subdivision and development of land the usual requirement to provide a separate customer connection point for each lot within the subdivision may be waived with the resulting lots to be identified / released as residue lots.

Accordingly the notification of arrangement letter issued by Endeavour Energy's Customer Network Solutions Branch will identify the lots as residues and are being released unsupplied.

The further proposed subdivision to create developable lots will be subject to Endeavour Energy's normal customer connection procedure and policies.

24.2 High Voltage Customer

As a high voltage customer the 'High Voltage Operational and Maintenance Protocol' between Endeavour Energy and the customer regarding the provision of high voltage supply to the site will specify a 'Load of Customers Installation' which is adequate for the then / Customer's current requirements. The Protocol generally also states the following:

> *'Should any further increase in loads be required, contact should be made with Endeavour Energy's Customer Network Solutions Branch, who will inform you of the requirements in this regard'.*

The Protocol also identifies where Endeavour Energy's responsibility terminates (normally at the pole or pillar on the road verge from which supply is taken) in respect of:

- ownership of high voltage equipment;
- switching operations; and
- maintenance of equipment.

However, high voltage customer connections must be a single customer site. Multiple occupant developments such as subdivisions, shopping centres, factory units, distribution centres, etc. are not entitled to high voltage connections. Accordingly, should this change, the site will no longer be eligible for a High Voltage Connection Service.

24.3 Distribution Substations

As distribution substations require incoming supply at 11,000 volts / 11 kilovolts (kV), in areas with only low voltage supply the 11 kV high voltage supply will need to be extended from the closest existing feeder to the site. However, feeders are also limited in capacity and in some instances a new dedicated feeder/s from the closest zone substation to the site will be required.

Although there are numerous diversity factors applicable for any given type of connection, installation (ie. residential, commercial, industrial) and other factors, for typical installations and usual equipment loads are provided in the Australian / New Zealand Standard AS / NZS 3000:2018 Electrical Installations (known as the Electrical Wiring Rules) as updated from time to time.

Any required distribution substation will need to be located within the property (in a suitable and accessible location) and be protected (including any associated cabling not located within a public road / reserve) with an appropriate form of property tenure as detailed in the attached copy of Endeavour Energy's 'Land Interest Guidelines for Network Connection'.

Endeavour Energy's general requirements is for distribution substation to be at ground level and have direct ready access from a public street (unless provided with appropriate easements for the associated underground cables and right of access) and must not be located within 6 metres of road intersections or bends to reduce the risk of possible vehicle impact damage.

Generally it is the Level 3 Accredited Service Provider's (ASP) responsibility (engaged by the developer) to make sure that the substation location and design complies with Endeavour Energy's standards the suitability of access, safety clearances, fire ratings, flooding etc. As a condition of the Development Application consent Council should request the submission of documentary evidence from Endeavour Energy confirming that satisfactory arrangements have been made for the connection of electricity and the design requirements for the substation, prior to the release of the Construction or Subdivision Certificate / commencement of works.

Endeavour Energy's distribution substations in newer / urban / underground areas consist mostly of padmount substations (also known as kiosk substations). Typically, they are a green or brown coloured box to blend into their surroundings, these structures are connected by underground cables. They can accommodate loads from 315 kVA up to 1,500 kVA (typically 500 kVA) ie. there is a significant variation in the number and type of premises able to be connected to a substation.

Padmount substations are converters of electricity, reducing the high voltages for street lighting and to the end user whilst low voltage pillar boxes are distribution junction points. These structures also mean underground cables are nearby. Digging activities and planting of trees or shrubs should not occur near them.

As an example of the type of development that may require the provision of a padmount substation, Endeavour Energy's Mains Design Instruction MDI 0028 'Underground distribution network design' includes the following requirement for substations in urban residential development.

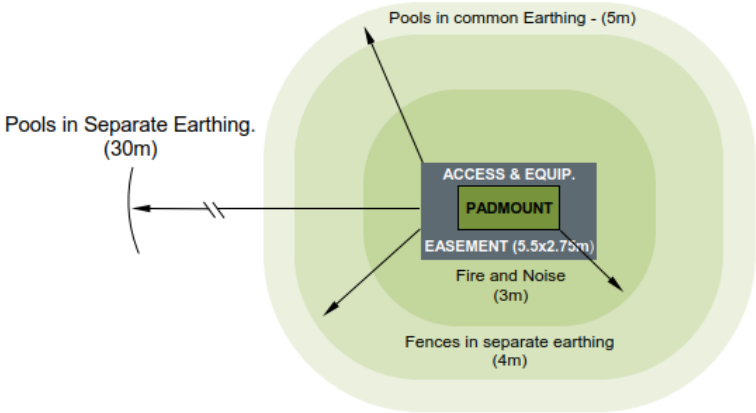
> **4.4 SUBSTATIONS FOR URD**
>
> Substations in URD's must be padmounts, 500 kVA must be the standard size for transformers. 315 kVA transformers must be installed where the capacity of a 500 kVA transformer cannot be adequately utilised by this and adjacent developments and the deferment of expenditure is economical.

From Endeavour Energy's Mains Design Instruction MDI 0030 'Method of calculating voltage drop in low voltage mains', the After Diversity Maximum Demand (ADMD) Schedule for new URD development areas in Western Sydney in a gas area 6.5 KVA with 90 % of the transformer capacity allows for a maximum of 69 small dwellings for a 500 kVA padmount substation (or 43 for a 315 kVA).

The majority of Endeavour Energy's padmount substations are held under easement. As shown in the following extract of Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights', Figure A4.3 'Padmount easements and clearances', padmount substations require:

- Easement with a minimum size of 2.75 x 5.5 metres (single transformer).
- Restriction for fire rating which usually extends 3 metres horizontally from the base of the substation footing / plinth.
- Restriction for swimming pools which extends 5 metres from the easement (which may not be required for non-residential development).

A4.3 - Padmount easements and clearances



The easement should not cross property boundaries but the restriction/s may affect any adjoining property provided they are able to be registered on the title to that property.

The restrictions for padmount substations were introduced on a case for case basis from 2003 before becoming standard in 2009. Whilst some existing padmount substations may not have these restrictions, in the redevelopment of any site with an existing padmount substation, for safety reasons the new restrictions should also be applied.

Older / non-urban / above ground areas of the network utilising pole mounted substations have comparatively limited capacity of 16 kilovolt amperes (kVA) up to a maximum of 400 kVA. Pole mounted substations need to be located in an area that is clear of overhead obstructions and the immediate area surrounding the pole should provide a firm, level base with sufficient space to safely erect an extension ladder.

Pole mounted substation no. 914 in Blaxcell Street, Guildford NSW has 79 customer connection points servicing 119 premises in an urban context which is at the upper end of the number of premises able to be serviced. In contrast pole mounted substation no. 26132 in Baaners Lane Little Hartley NSW in a non-urban context only services a single rural property. Source: Google Maps Street View.

24.4 Indoor Substations

Traditionally Endeavour Energy's preference has been for the utilisation of padmount substations. The reasons for this included ready access and no reliance on the building owners to provide / maintain the building required to house an indoor substation. Padmount substations are regarded as a 'plug and play' system without the need for a physical building which allows for easier reconfiguration and less involvement with a building owner to resolve any issues / conflicts.

Developers have consistently opposed the imposition that such indoor substations place on their developments, but indoor substations have usually taken up development space equivalent to a few car parking spaces and in comparison to padmount substations, being integrated into the building they are an aesthetic improvement and also address issues related to fire rated construction and avoiding the need for the use of fire / screen walls.

For new developments particularly within central business districts where zero and minimal building setbacks are allowed (and which given their size makes the provision of the easements and restrictions for a padmount substation difficult to achieve on site), Endeavour Energy's recommendation is for the distribution substation to be an indoor substation (also known as a chamber substation).

Whilst indoor substations are predominantly utilised for commercial / office type development, in May 2017 Endeavour Energy's Mains Design Instruction MDI 0028 'Underground distribution network design' was amended to allow certain types of urban multi residential load (UML) developments to utilise indoor substations where a padmount substation is not practicably possible.

As with the installation of underground reticulation, Councils may seek the enforcement of an indoor substations policy as part of their detailed planning and design guidelines in their Development Control Plans to support the planning controls in the Local Environmental Plan.

As shown in the following extract of Google Maps Street View this site at 32 Castlereagh Street Liverpool utilises an indoor substation due to the zero building setback with the low voltage overhead power lines also having been undergrounded to provide the required safety clearances to the building.

Indoor substation at 32 Castlereagh Street Liverpool. Source: Google Maps Street View.

In comparison, as shown in the following extract of Google Maps Street View is of a site at 18 Copeland Street Liverpool required the installation of a fire wall next to the padmount substation to avoid the creation of restrictions on the adjoining site the development. Whilst meeting the fire rating requirements etc. from an aesthetics perspective this is not an attractive outcome.

Fire wall constructed for padmount substation at 18 Copeland Street Liverpool. Source: Google Maps Street View.

25 Protected Works

In cases where Endeavour Energy does not have an easement over electricity infrastructure on a site, they are usually protected assets and deemed to be lawful for all purposes under Section 53 'Protection of certain electricity works' of the *Electricity Supply Act 1995* (NSW). Essentially this means the owner or occupier of the land cannot take any action in relation to the presence in, on or over the land of electricity works ie. the electricity infrastructure cannot be removed to rectify the encroachment.

These protected assets are managed as if an easement is in place (please refer to Section 13 'Easement Management') and in accordance with the minimum easement widths specified in Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights',

For overhead power lines, this easement width in some circumstances may not be warranted ie. depending on the span (the longer the span the greater the sag and blowout of the overhead power lines), type of conductor, access, property type and use etc. However if the easement width cannot be reasonably provided, as a minimum any building or structure (including fencing, signage, flag poles etc.) whether temporary or permanent must comply with the minimum required safe distances / clearances (please refer to Section 29 'Safety Clearances').

Protected works often occur in non-urban / rural areas (where in the past the policy was not to obtain easements due to the lower number of customers and the associated network risks)

The applicant should note the following requirements of Endeavour Energy's 'Land Interest Guidelines for Network Connection Works, Provision of Network Connection Services'.

5.0 REGISTERED LAND INTERESTS REQUIRED WHEN SUBDIVIDING LAND

5.1 Urban Requirements

Endeavour Energy will require the registration of Land Interests for:

a) all new transmission, high voltage and low voltage Network Assets; and
b) all existing transmission, high voltage and low voltage Network Assets located within the Customer's land.

5.2 Non-urban Requirements

Endeavour Energy will require the registration of Land Interests for:

a) all new transmission, high voltage and low voltage Network Assets;
b) all existing transmission Network Assets located within the Customer's land;
c) all existing high voltage Network Assets located within the Customer's land; and
d) all existing low voltage Network Assets that will be used to supply any adjoining land outside the subdivision.

6.0 REGISTERED LAND INTERESTS REQUIRED WHEN NOT SUBDIVIDING LAND

6.1 Urban Requirements

Endeavour Energy will require the registration of Land Interests for:

e) all existing Network Assets that will be used to supply a new Network Asset.

26 Prudent Avoidance

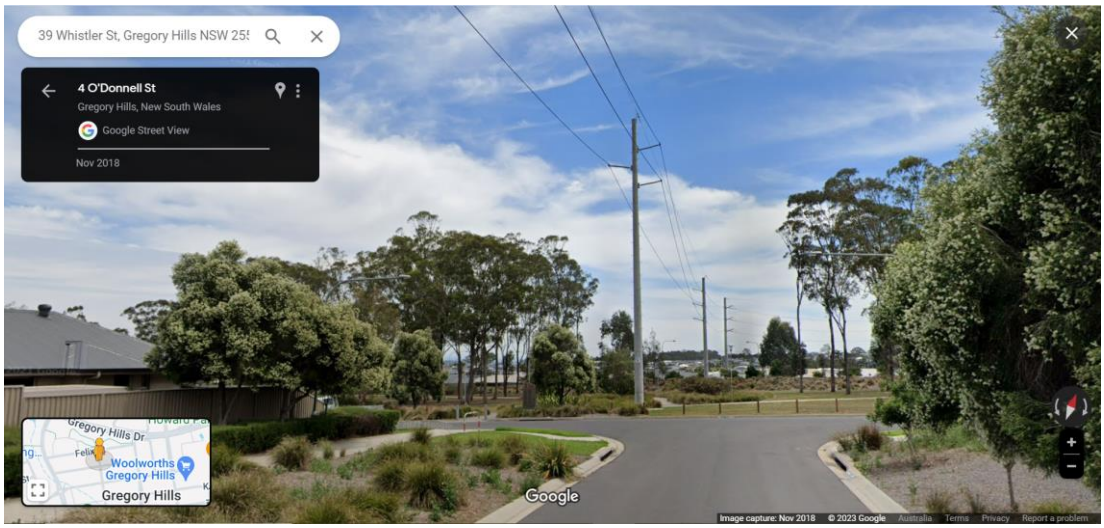
The electricity industry has adopted a policy of prudent avoidance by doing what can be done without undue inconvenience and at modest expense to avert the possible risk to health from exposure to emissions form electricity infrastructure such as electric and magnetic fields (EMF) and noise which generally increase the higher the voltage ie. Endeavour Energy's network ranges from low voltage (normally not exceeding 1,000 volts) to high voltage (normally exceeding 1,000 volts but not exceeding 132,000 volts / 132 kV).

In practical terms this means that when designing new transmission and distribution facilities, consideration is given to reducing exposure and increasing separation distances to more sensitive uses such as residential or schools, pre-schools, day care centres or where potentially a greater number of people are regularly exposed for extended periods of time.

These emissions are usually not an issue but with Council's permitting or encouraging development with higher density, reduced setbacks and increased building heights, but as the electricity network operates 24/7/365 (all day, every day of the year), the level of exposure can increase.

Endeavour Energy believes that irrespective of the zoning or land use, applicants (and Council) should also adopt a policy of prudent avoidance by the siting of more sensitive uses eg. the office component of an industrial building, away from and less susceptible uses such as garages, non-habitable or rooms not regularly occupied eg. storage areas in a commercial building, towards any electricity infrastructure – including any possible future electricity infrastructure required to facilitate the proposed development.

Where development is proposed near electricity infrastructure, Endeavour Energy is not responsible for any amelioration measures for such emissions that may impact on the nearby proposed development.



Incorporating the easement for 132 kilovolt (kV) overhead transmission lines at Gregory Hills into the public road reserve and parks is in keeping with a policy of prudent avoidance and also assists with easement management associated with the subdivision of easements.

Please refer to the Appendices for a copy of Energy Networks Association's 'Electric & Magnetic Fields – What We Know' which can also be accessed via their website at https://www.energynetworks.com.au/electric-and-magnetic-fields and provides the following advice:

> *Electric fields are strongest closest to their source, and their strength diminishes rapidly as we move away from the source.*
>
> *The level of a magnetic field depends on the amount of the current (measured in amps), and decreases rapidly once we move away from the source.*

Typical magnetic field measurements associated with Endeavour Energy's activities and assets given the required easement widths, safety clearances etc. and having a maximum voltage of 132,000 volt / 132 kV, will with the observance of these separation distances not exceed the recommended magnetic field public exposure limits. As a guide, reference should be had to Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights' Table 1 – 'Minimum easement widths'.

26.1 Special / Sensitive Uses

Regarding the proximity of sensitive / special uses such as schools, pre-schools, day care centres etc. near electricity infrastructure, Endeavour Energy's Sustainability & Environment Branch has provided the following advice.

> *As far as Network Environment Assessment Section is aware there are no restrictions in legislation that stop schools, pre-schools, day care centres being placed next to electricity infrastructure.*
>
> *In regard to the NSW Planning & Environment 'Child Care Planning Guideline' August 2017, besides Part 3.6 'Noise and air pollution' referring to substations as a 'noisy environment', there is no specific requirement under the site selection and location criteria to consider proximity to electricity infrastructure, although arguably a child care centre and electricity infrastructure are not a compatible use.*
>
> *Prudent avoidance measures must however be implemented. Prudent avoidance was a policy recommended by former Chief Justice of the High Court of Australia, Sir Harry Gibbs, as a result of an inquiry he conducted into community needs and high voltage transmission lines including issues in relation to EMF back in 1991. The findings in the Gibbs report are consistent with subsequent inquiries and are still relevant today.*
>
> *Prudent avoidance is defined as doing what can be done without undue inconvenience and at modest expense to avert the possible risk to health from exposure to new high voltage transmission facilities. In practical terms, this means designing new transmission and distribution facilities having regard to their capacity to produce EMFs, and siting them having regard to the proximity of houses, schools and the like.*
>
> *Although the Gibbs report was particularly aimed at electricity distributers to consider when placing their infrastructure, and bearing in mind that there are schools, pre-schools, day care centres adjacent to our infrastructure in various locations right across our franchise area, it is nonetheless Endeavour Energy's recommendation it that such 'sensitive uses' are not built adjacent to major electricity infrastructure.*
>
> *Should such a development proceed, the design of the schools, pre-schools, day care centres should also consider prudent avoidance measures such as any rooms which the children will occupy (class rooms, play areas, sleeping rooms, eating areas) be arranged such that they are on the side of the site/building which is furthest away from the electricity infrastructure.*
>
> *There is scientific consensus that health effects have not been established but that the possibility cannot be ruled out. Accordingly, if there are any concerns regarding the location of the schools, pre-schools, day care centres in proximity to the electricity infrastructure, in order to make an informed conclusion, the applicant may need to commission an independent review to provide an overall assessment including electric and magnetic field measurement and advice. Applying a precautionary approach early on in the design process will hopefully result in the adoption of prudent avoidance principles benefitting the eventual development of the site.*

Endeavour Energy is able to provide estimated EMF levels from comparable electricity infrastructure and having regard to concept designs which can then be used to model the possible impact. Further details are available by contacting Endeavour Energy's Substation Primary Design Section via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or email earthingenquiry@endeavourenergy.com.au.

Although not part of Endeavour Energy's electricity network, the applicant should consider wiring the new building and locating high electricity consuming devices away from areas occupied by children.

26.2 Noise

The transformers in substations may emit a hum – especially when under heavy load say in the summer peak when use of air conditioning is at its highest. Overhead power lines can produce an audible sound or buzz as a side effect of carrying electricity. The sound can be louder if there is increased moisture (during rain, fog, frost etc.) or pollutants in the air. The sound usually occurs at the poles at the insulators supporting the power lines and increase at higher voltages.

Endeavour Energy's substations are not a 'scheduled premises' under the *Protection of the Environment Operations Act 1997* (NSW) and the holding of a licence under that Act for operations at the site is not required ie. a substation is generally located and designed to not result in the emission of offensive noise. As guide / target Endeavour Energy's substations nominally meet the Environmental Protection Authority 'NSW Industrial Noise Policy' with the overall aim to allow the need for its network operations to be balanced with the desire for quiet in the community.

The Environment Protection Authority EPA 2013/0127 Noise Guide for Local Government, in Part 3 Noise management principles, includes a reference to *State Environmental Planning Policy (Infrastructure) 2007* (NSW). Whilst not directly applicable to 'Division 5 Electricity transmission or distribution', the similar standard as that required for rail corridors and roads and traffic should be imposed on any new development.

> *If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
>
> *(a) in any bedroom in the building—35 dB(A) at any time between 10 pm and 7 am,*
>
> *(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.*

Acoustic assessments should consider substations required to facilitate the proposed development as a potential mechanical / plant noise source.

26.3 Electronic and Magnetic Fields (EMF)

Endeavour Energy recognises that a causal link between EMF exposure and demonstrated health effects has not been established, even after much scientific investigation throughout the world. There are no state or federal exposure standards for 50/60- hertz (Hz) EMF based on demonstrated health effects. Nor are there any such standards world-wide. Among those international agencies that provide guidelines for acceptable EMF exposure to the general public, the International Commission on Non-Ionizing Radiation Protection in 2010 established a level of 2,000 milligauss (mG). Endeavour Energy recognises that timely additional research is unlikely to prove the safety of power-line EMF to the satisfaction of all.

Endeavour Energy is committed to ensuring that its activities and assets conform to all relevant International and Australian Standards, National Health and Medical Research Council (NH&MRC) Standards, Energy Networks Association (ENA) Standards and NSW legislation. As mentioned above, this includes a commitment to a policy of prudent avoidance as endorsed by the ENA with regard to the location of assets and electric and magnetic fields.

27 Public Safety

Workers involved in work near electricity infrastructure run the risk of receiving an electric shock and causing substantial damage to plant and equipment. Please find attached copies of Endeavour Energy's public safety training resources, which were developed to help general public / workers to understand why you may be at risk and what you can do to work safely. The public safety training resources are also available via Endeavour Energy's website under 'Home > Safety' or via the following link:

https://www.endeavourenergy.com.au/safety .

Endeavour Energy provides safety advice to the building industry, councils or any other organisation or individuals working near our overhead or underground network. Enquiries for parts of the network which are not subject to easements can be made by completing the attached Request for Safety Advice form and emailing it to Construction.Works@endeavourenergy.com.au . Enquiries related to electricity infrastructure located within an easement should be directed to Endeavour Energy's Easements Officers by email Easements@endeavourenergy.com.au .

SafeWork NSW provides key safety information on how to protect persons from the risks arising when working or undertaking activities near overhead power lines and underground cables including:

- SafeWork NSW 'Work Near Underground Assets – Guide 2007'; and
- WorkCover (now SafeWork NSW) 'Work Near Overhead Power Lines Code of Practice 2006'.

These documents as well as other useful resources are available via the following link to the SafeWork NSW website.

https://www.safework.nsw.gov.au/your-industry/construction/safety-topics/electrical .

NSW GOVERNMENT | SafeWork

Electrical

The most common electrical risks include hitting overhead and underground powerlines, working on live equipment, and arc flashes. Consult with the supply authority and de-energise equipment before working near electricity. Don't do electrical work without a licence.

28 Removal of Electricity

Approval for the permanent disconnection and removal of supply and meters eg. when premises are planned for demolition, removal or relocation, or the replacement of a temporary builder's supply with a permanent connection, must be obtained from Endeavour Energy's Customer Network Solutions Branch (contact via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718) and the works completed by Accredited Service Providers (ASP) with the relevant class of Authorisation for the type of work being carried out. For details of the ASP scheme please refer to Section 24 'Network Connection'.

The work could involve:

- The disconnection and removal of an underground service cable or overhead service line,
- Removal of metering equipment.

The Authorised Level 2 ASP will complete an online application on Endeavour Energy's website for Removal of All Gear Notification of Service Works (NOSW) for approval to undertake the works. The ASP must also follow the Retailer / Meter Providers' process for the permanent removal of supply.

29 Safety Clearances

As a minimum any building or structure (including fencing, signage, flag poles etc.) whether temporary or permanent must comply with the minimum safe distances / clearances for voltages up to and including 132,000 volts (132 kV) as specified in:

- Australian/New Zealand Standard AS/NZS 7000 – 2016: 'Overhead line design' as updated from time to time.

- 'Service and Installation Rules of NSW' which can be accessed via the following link to the NSW Climate and Energy Action website:

  https://energy.nsw.gov.au/government-and-regulation/legislative-and-regulatory-requirements/service-installation-rules .

These distances must be maintained at all times and regardless of the Council's allowable building setbacks etc. under its development controls. As a guide only please find attached a copy of Endeavour Energy Drawing 86232 'Overhead Lines Minimum Clearances Near Structures'. Factors such as the span (the longer the span the greater the sag and blowout of the overhead power lines), type of conductor, access, property type and use etc. will impact on the minimum clearances.

Different voltages are kept at different heights, the higher the voltage, the higher the wires are positioned on the pole. Similarly, the higher the voltage, the greater the required building setback.

Overhead powerlines with high voltage, low voltage and service connections at different levels on the poles. This example is in Marayong NSW part of Endeavour Energy's franchise / network area. Source: Google Maps Street View.

If there is any doubt whatsoever regarding the safety clearances to the overhead power lines, the applicant will need to have the safety clearances assessed by a suitably qualified electrical engineer / Accredited Service Provider (please refer to Section 24 'Network Connection'). This will require the provision of a detailed survey plan showing the location of the conductors to enable the assessment / modelling of the clearances for which there are software packages available. If the safety clearances are inadequate, either the parts of the building encroaching the required clearances or the overhead power lines will need to be redesigned to provide the required clearances.

Even if there is no issue with the safety clearances to the building or structure, ordinary persons must maintain a minimum safe approach distance of 3.0 metres to all voltages up to and including 132,000 volts / 132 kV. Work within the safe approach distances requires an authorised or instructed person with technical knowledge or sufficient experience to perform the work required, a safety observer for operating plant as well as possibly an outage request and/or erection of a protective hoarding.

Endeavour Energy's recommendation is that whenever reasonably possible buildings and structures be located and designed to avoid the need to work within the safe approach distances for ordinary persons eg. not having parts of the building normally accessible to persons in close proximity of the overhead power lines; the use of durable / low maintenance finishes. Alternatively, in some instances the adoption of an underground solution may be warranted ie. particularly for low voltage which can be more readily (in shorter distances) and comparatively economically be undergrounded.

Consideration must be given to WorkCover (now SafeWork NSW) 'Work Near Overhead Power Lines Code of Practice 2006' which includes the following requirements for work near low voltage overhead power / service lines.

TABLE 4

Approach distances for work near low voltage overhead service lines

Ordinary Persons (m)				
Hand held tools	Operation of crane or mobile plant	Handling of metal materials (Scaffolding, roofing, guttering, pipes, etc)	Handling of non-conductive materials (Timber, plywood, PVC pipes and guttering, etc)	Driving or operating vehicle
0.5	3.0	4.0	1.5	0.6

In addition the developer / builder should consider 'tiger tailing'/matting the low voltage overhead service lines to provide a distinct visual of the location of overhead construction ie. these are still not regarded as insulated conductors and safe approach distances need to be maintained. as shown in the following photograph.

'Tiger Tails' are used primarily as a visual indicator or for mechanical protection from electrical wires. They are not to be used as insulating material and will not provide full protection from live electricity. This example is of tiger tails installed by Endeavour Energy on overhead power lines at Ermington NSW as part of a risk management for work on a nearby Distribution Substation No. 20981.

29.1 Scaffolding

For any scaffolding, depending on the width of the working platform and the distance of the conductors from the boundary, consideration may need to be given to the 'Work Near Overhead Power Lines Code of Practice 2006', Section 6.5 'Control measures for erection and dismantling of scaffolding near overhead power lines up to and including 33kV' an extract of which follows.

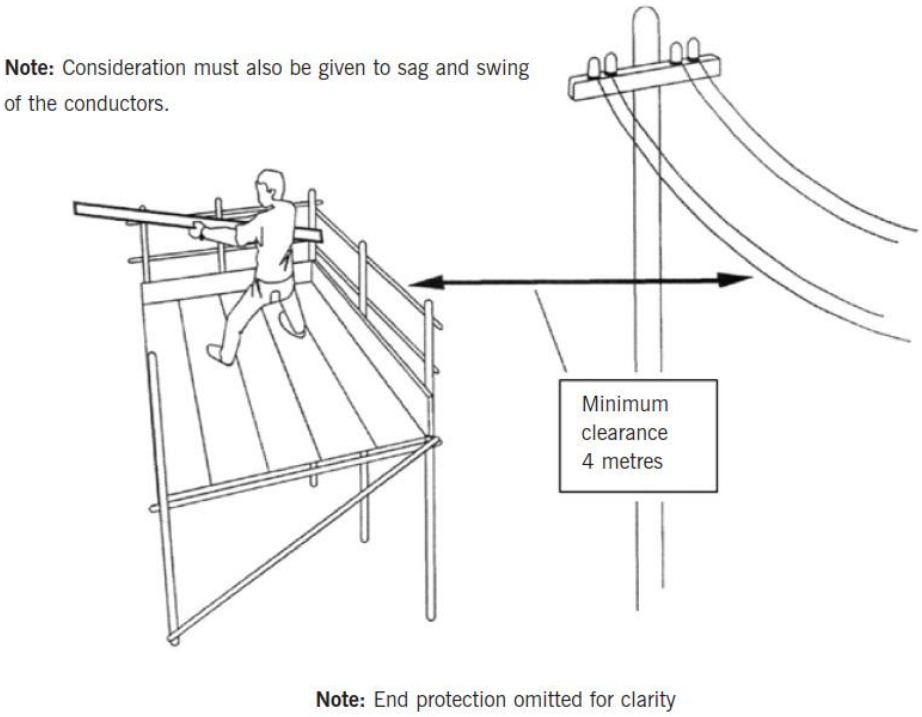
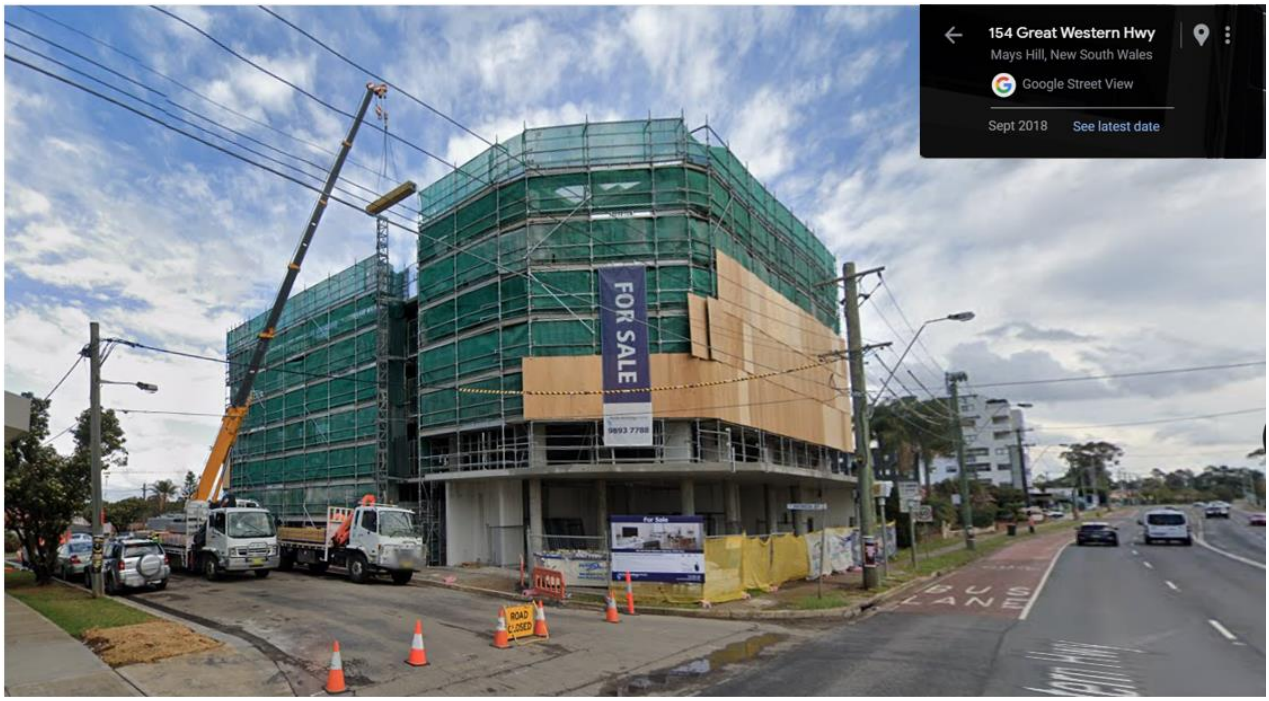


Figure 10 – A 4 metre approach distance applies in any direction where metallic scaffold is erected, used or dismantled near overhead power lines.

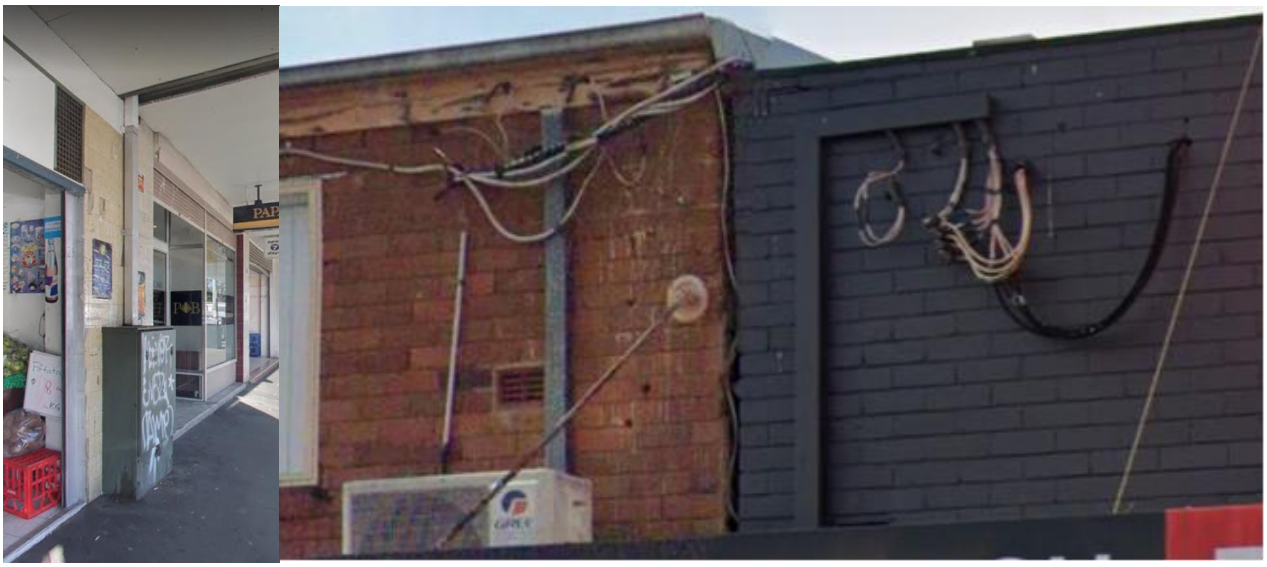
The use of scaffolding near overhead power lines may require the isolation of the network and the use of a hoarding which can be a significant cost and time to organise.



Hoarding erected on scaffolding near overhead powerlines for construction of a mixed use development at the Great Western Highway, Westmead. Source: Google Maps Street View.

29.2 'Awning' Overhead Power Lines

In some older urban areas of the electricity distribution network may have low voltage overhead 'awning' power lines where the conductors are in troughs / ducts fixed to the awnings / shop fronts.



Example of 'awning' overhead power lines coming from a low voltage pillar on the road verge rising to through a duct and then through or above the awnings to the customer connection points for the premises. Source: Google Maps Street View.

With the low voltage overhead 'awning' power lines, before commencing any activity their exact location must be identified. If any of the foregoing external works involves the exposing of the power lines within the awning and the undertaking of works within the safe approach distances, it requires an electrically authorised (500 mm) or instructed person (1,000 mm) with technical knowledge or sufficient experience to perform the work required. The applicant may need to seek advice from an Accredited Service Provider (ASP) of an appropriate level and class of accreditation for the undertaking of any such works. For details of the ASP scheme please refer to Section 24 'Network Connection'.

29.3 Pole Mounted Substations

Endeavour Energy Mains Design Instruction MDI 0031 'Overhead line design' includes the following clearance zone for pole mounted substations.

9.0 SUBSTATIONS, AUTO-RECLOSERS, SECTIONALISERS, VOLTAGE REGULATORS AND ENCLOSED SWITCHES

9.1.2 Equipment hazard and fire zone

As part of the design, allowance is to be made for a three metre horizontal clearance zone around pole mounted substations, regulators, reclosers, sectionalisers and enclosed switches to minimise the effects of failure of any equipment and manage ongoing noise in accordance with Figure 13.

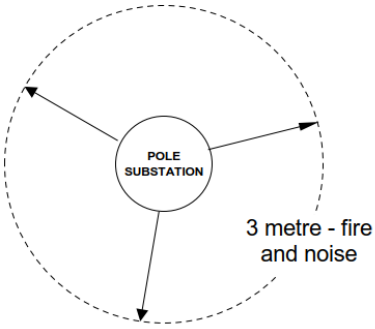


Figure 13 – Fire and noise separation

Pole mounted substations, regulators, reclosers, sectionalisers and enclosed switches may contain hazardous materials. Additional requirements apply to environments containing explosive gas atmospheres. Where applicable these provisions must comply with the requirements of AS/NZS 60079.

29.4 Ground or Pole Stays

The turning / angle of overhead power lines or at a termination pole / structure creates an 'unbalanced load' and means it is necessary for the pole to be stayed to stop it from leaning or tipping over from the forces of the conductors turning or terminating. This is done with tensioned wires going to a bollard pole, concrete block or embedded into ground with an anchor rod and plate or concrete footing. Stay poles are generally best avoided ie. the use of an un-stayed higher strength pole is preferable to a lower strength pole that is stayed.

Endeavour Energy Mains Design Instruction MDI 0031 'Overhead line design' includes the following

3.12 Stays

Where it is necessary to stay a pole in an urban area, a bollard pole must be used. Ground stays are permitted in non-urban areas where a trip hazard is deemed unlikely, otherwise a bollard pole must be used.

Stay poles at Riverstone Ground stay at Menangle which with the urban residential subdivision may need to be replaced with a bollard pole.

When previously non-urban / rural areas become urban area, existing ground stays may not only become a trip hazard due to the increase in pedestrian traffic but may also impact on the location of driveways and the clearances to the stay wires which could be damaged by vehicle impacts.

29.5 Building Setbacks

As the electricity distribution network partially relies on the retention of appropriate building setbacks relative to the use / zoning of the land to the road frontages to provide safety clearances to overhead power lines on the road verge / roadway, the encroachment of building setbacks is generally not supported by Endeavour Energy.

Particular regard needs to be had to secondary road frontages or where overhead power lines are located near side or rear boundaries where lesser building setbacks apply. Multi-dwelling development with subsequent subdivision should assess building setbacks based on the proposed subdivision layout. Consideration must be given in rezonings reducing building setbacks and subdivisions changing the primary road frontage to secondary road / side or rear boundaries to which reduced building setbacks usually apply under the councils' Development Control Plans. Even if there is no existing electricity infrastructure, the encroachment of building setbacks may affect future required line routes. This may also apply to underground cables.

As a guide, the minimum easement widths in Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights', Table 1 – 'Minimum easement widths', should be considered. Although the safety clearances to a building or structure are less than the minimum easement width, the greater separation will assist in addressing issues for ordinary persons maintaining a minimum safe approach distance; prudent avoidance etc.

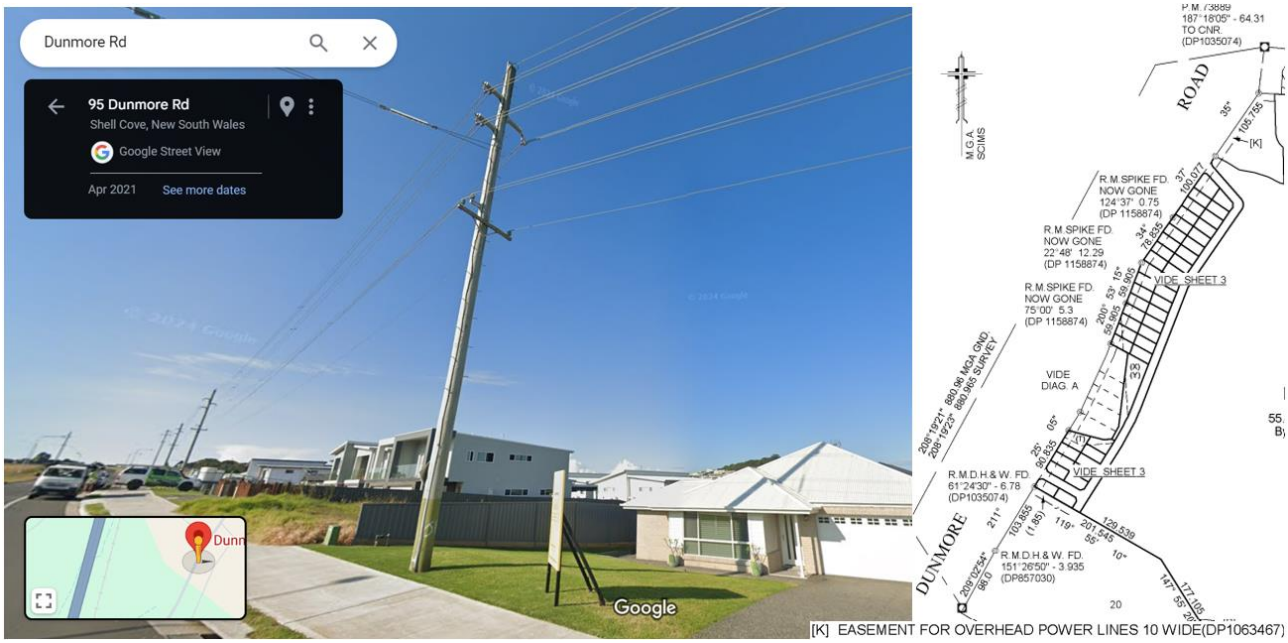
The encroachment of building setbacks by dwellings, structures etc. may also result in the encroachment of safety clearances to overhead power lines on the road verge / roadway or on the site itself. In this example located in The Hills Shire Local Government Area (LGA), there are both low voltage and 11,000 volt / 11 kilovolt high voltage overhead power lines. Source: Google Maps Street View.

In areas where the electricity network is designed on the basis of low density residential development with typically minimum front building setbacks ranging from 4.5 to 10 metres, a rezoning to increases density / dwellings per hectare is often achieved by allowing for reduced and sometimes zero setbacks, as well as then encroachments / projections of balconies and awnings into the front building setback (or in some mixed-use developments the awnings extent over the footpath), the required clearances cannot be maintained and causes issues with the network.

The following shows two examples of rezonings of rural land with 33,000 volt / 33 kilovolt (kV) overhead transmission lines to the road frontages which under Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights' require a minimum 18 metre wide easement.
At Fifteenth Avenue, Austral which is to become a major road with restricted vehicle access, as part of the Indicative Layout Plan the local roads run parallel to the major road and are located within the notional easement fully incorporated into the public road reserve and not impacting the developable lots.

33,000 volt / 33 kilovolt (kV) overhead power lines at Fifteenth Avenue, Austral Source: Google Maps Street View. Inset Austral & Leppington North Precincts Indicative Layout Plan.

At Dunmore Road, Shell Cove where the fronts of the low density residential lots are subject to an easement for overhead power lines 10 metres wide ie. Although there was no existing easement over the land, as part of the application for connection of load for the new urban residential subdivision the easements were required to be created to ensure the future dwellings did not encroach the minimum required safety clearances etc.



Easement for 11,000 volt / 11 kilovolt (kV) and 33,000 volt / 33 kV overhead power lines at Dunmore Road, Shell Cove. Source: Google Maps Street View. Extract of Deposited Plan DP 1113813.

30 Security / Climb Points

Endeavour Energy's Substation Design Instruction SDI524 'Fencing and Perimeter Security at Zone and Transmission Substations, and Switching Stations' states the following requirement in relation to the prevention of unauthorised access by any person to a substation by the creation of 'climb points'.

5.11 Perimeter management

Consideration shall be given to the balance between screening with manufactured objects or plants, and the security benefits of uninhibited visibility to staff and the general public.

To prevent people from concealing themselves or aiding their activities, vegetation shall not screen the entire length of the substation perimeter.

Vegetation that could provide a climbing point, and all objects, including equipment and stores, shall not be located within 2000mm of either side of the intruder resistant perimeter fence or intruder resistant barrier.

Accordingly, Endeavour Energy's usual requirement is to have a minimum clear area / buffer of 2 metres from the fence with 3 metres preferred, and then depending on what the climb point is, it could increase to 4 metres. Where a permanent structures / object is constructed within these clearances, Endeavour Energy may raise the height of the substation fence.

Zone substations typically have a security weldmesh fence, the height and finish eg. may be topped with razor wire, depending upon the nearby existence of climb points and the clearance of vegetation within 3m of the fence. Whilst Endeavour Energy has no control over the development on the adjacent land, the construction of a structure that constitutes a 'climb point' would require an increase in the height of the substation fence.

Endeavour Energy's Seven Hills Zone Substation is an 'outdoor' design. Note height of fencing due to adjacent 'climb point' created by the seating and awning.

31 Service Conductors

A component of Endeavour Energy's electricity distribution system are the service lines from the street to the customer's connection point / electrical installation dedicated to the supply of electricity to the site. In older / above ground areas of the network this is typically an overhead service line coming from a pole on the road verge going to a point of attachment where the mains are terminated on a customer's building, pole or structure.

Low voltage overhead service conductors encroaching adjoining properties in older / above ground parts of the network can be an issue for the redevelopment of 'brownfield' areas. These service mains are generally 'legacy assets' but are also 'Protected Works' and cannot be removed to rectify the encroachment – unless it is done so with the agreement of the benefited property owner and an alternative low voltage customer service is provided at the applicant's cost. Conversely, if the adjoining site were to be redeveloped, the encroachment would need to be rectified by and at the cost of the adjoining owner.

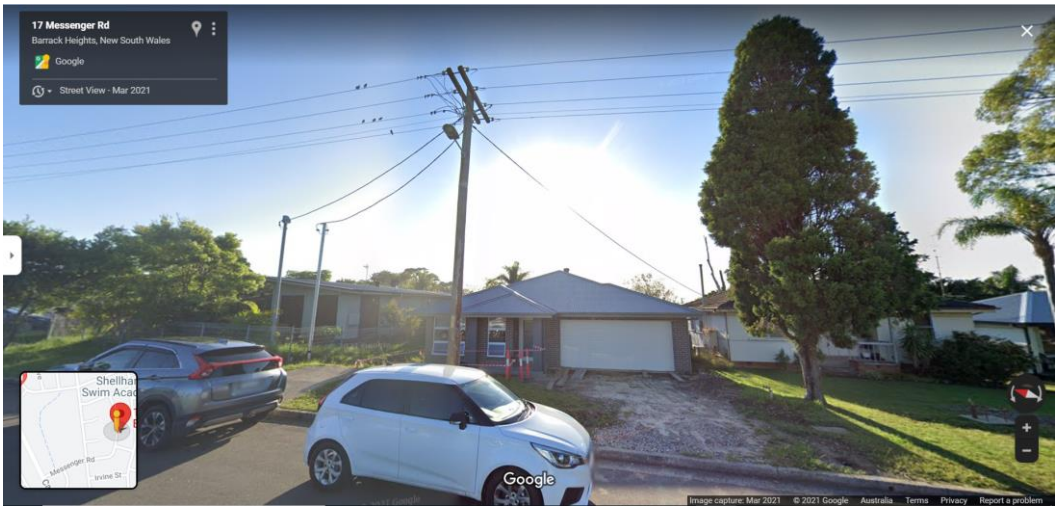
Clauses 2.2.2 'Service Route' and 3.2.4 'Crossing of Adjoining Property' of the Service and Installation Rules of NSW state that service mains or consumer's mains crossing an adjoining property must have a suitable easement. Endeavour Energy generally requires this easement to adopt the standard terms in Schedule 8 of the *Conveyancing Act 1919* (NSW) and benefit the lot being serviced (an inter-allotment easement appurtenant to the land). As Endeavour Energy's HxGN NetWorks Core NetViewer master facility model only shows easements benefiting Endeavour Energy, these are not shown on the site plan from Endeavour Energy's HxGN NetWorks Core NetViewer master facility model. To verify the existence of such an easement a title search would be required.

Whilst Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure' requires a minimum easement width of 9 metres for low voltage overhead power lines ie. 4.5 metres to both sides of the centreline of the conductors, for certain types of conductors and in some circumstances a lesser easement width may be allowed – usually 6 metres.

Given the difficulty in obtaining easements, the solution to the encroachment is usually the adoption of an alternative network design involving either an underground solution or a customer owned / private pole. In accordance with the Service and Installation Rules of NSW, Clause 3.7.2.1 'Private Posts/Poles' a private post/pole must be installed within 1 metre of the front property street alignment.

The Service and Installation Rules of NSW can be accessed via the following link to the NSW Climate and Energy Action website:

https://energy.nsw.gov.au/government-and-regulation/legislative-and-regulatory-requirements/service-installation-rules .



The low voltage overhead service conductor to the older dwelling on the right encroaches the adjoining property. The newer dwelling to the left utilises a private pole to avid encroaching the adjoining property. The newly constructed dwelling also utilises a private pole possibly also utilised for temporary builder's supply and as cables will not impede the front building setback and also avoid the need for a point of attachment bracket usually required to be fixed to a rafter or fascia. Source: Google Maps Street View.

31.1 Mid Span - Suspended Service Conductors

The 'Service and Installation Rules of NSW' under Clause 3.2.4 'Crossing of Adjoining Property' indicates 'A private pole should be installed to avoid a suspended service. A mid span / suspended service is only permitted as a last resort'. Mid span / suspended services are also generally 'legacy assets' and not permitted for new development.

Mid span / suspended low voltage overhead service conductor for a dwelling at Rydalmere. Source: Google Maps Street View.

32 Solar / Generation

Endeavour Energy allows connection of up to 8 kilowatts (kW) total panels to a 5 kW inverter or up to 40 kW total panels to a 30 kW inverter. If the applicant's connection requirements are other than these, an application for a micro embedded generator connection service will be required.

The connection of small and medium embedded generators with a capacity of between 30 kilowatts (kW) and 5 megawatts (MW) may affect other Endeavour Energy customers connected to the electricity network. A detailed technical review of endeavour Energy's network's capacity to transfer the generation energy along with analysis of the generator's protection schemes and quality of supply considerations must therefore be undertaken prior to a permission to connect to Endeavour Energy's network being issued. Further details are available by contacting Endeavour Energy's Customer Network Solutions Branch via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or on Endeavour Energy's website under 'Home > Connections > Connect online > Small and medium embedded generator connection service' via the following link:

https://www.endeavourenergy.com.au/connections/connect-online/small-and-medium-embedded-generator-connection-service .

The roof at Bankwest (now CommBank) stadium in Parramatta supports a 100 kilowatt hour (kWh) solar panel system 309 individual solar panels generating renewable energy for the stadium. Source: Bankwest Stadium Sustainability Case Study May 2020.

33 Street Infrastructure

33.1 Streetlighting

Endeavour Energy recognise that lighting roads, pedestrian crossings and pathways helps to keep pedestrians and motorists safe during times of inadequate natural light.

With the increase in both vehicular and pedestrian traffic resulting from the overall development occurring in the area, even if the existing streetlighting is already designed for an urban environment, the streetlighting may need to be reviewed and if necessary upgraded to comply with the series of standards applying to the lighting of roads and public spaces set out in with Australian / New Zealand Standard AS/NZS 1158: 2010 'Lighting for roads and public spaces' as updated from time to time.

Whilst the determination of the appropriate lighting rests with the road controlling authority, Endeavour Energy as a Public Lighting Service Provider is responsible for operating and maintaining the streetlights on behalf of local councils, Roads and Maritime Services and other utilities in accordance with the NSW Public Lighting Code 2019 (Code) as updated from time to time. Endeavour Energy recognises that well designed, maintained and managed Public Lighting offers a safe, secure and attractive visual environment for pedestrians and drivers during times of inadequate natural light.

For any Code implementation and administration / technical matters please contact Endeavour Energy's Substation Mains Assets Section via Head Office enquiries on business days from 9am - 4:30pm on telephone: 133 718 or email mainsenquiry@endeavourenergy.com.au .

Green light for Net Zero Strategy

Kiama Council has given the green light to switch all remaining local street lights to LED, a key element of their Net Zero Strategy. Council has endorsed a proposal by Endeavour Energy to upgrade the remaining 951 non-LED street lights in the municipality.

The completion of light-emitting diode (LED) street lighting upgrade by Kiama Municipal Council will reduce emissions by 310 tonnes of carbon emissions a year [382,225 kilowatt-hours (kWh)].Source: https://www.nationaltribune.com.au/green-light-for-net-zero-strategy/ .

33.2 Street Awnings

With zero building setbacks and street awnings extending over the footpath, consideration must be provided to the possible impacts on the existing streetlights. This may result in the reduction of light levels by having a shadowing effect. To rectify this additional under awning lighting may be required to ensure the visual requirements of pedestrians and motorists are maintained.

The design of the awning must take into consideration the positioning of the existing lighting infrastructure and must facilitate the safe working environment. Streetlight columns and poles must not pass through awnings. As a guide:

- Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights' includes the following requirements.

5.4 Assets within special areas

5.4.1 Assets within the road verge

Assets installed within a road carriageway cannot be provided with an easement. However, overhead assets proposed to be installed within the road verge still require the clearances specified in Table 1 and Clause 5.3.1.

5.3.2 Minimum easement required for network assets

The table below details the minimum easement widths for various network assets. Refer to Annexure 4 for graphical representation for a cable joint system; pole stay and padmount clearances.

Table 1 - Minimum easement widths

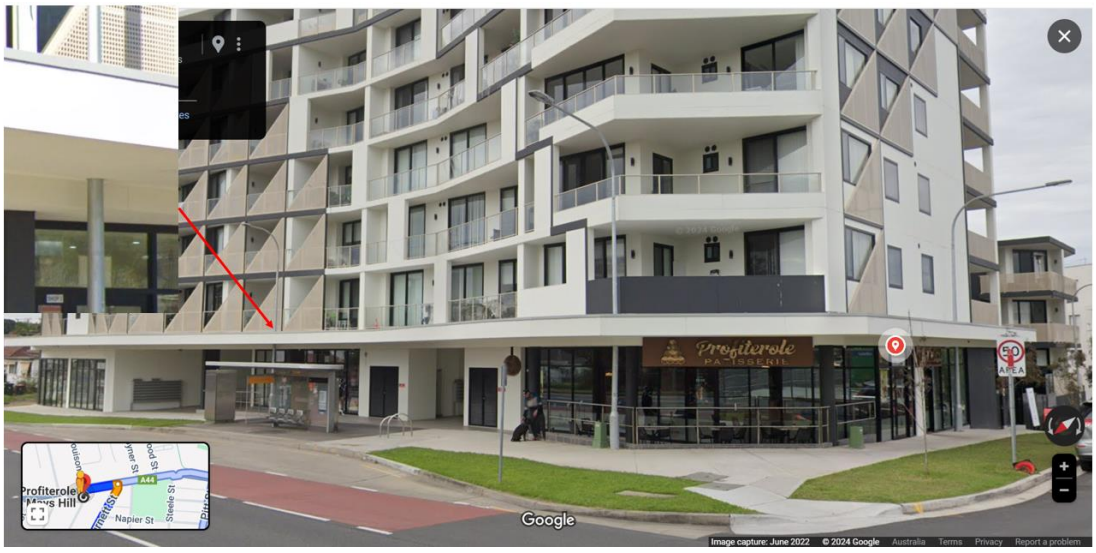
	Voltage	Asset Type	Construction	Minimum Easement (m)
Other		Streetlight Column / Service Pillar		1.0 x 1.0

(The network asset must be positioned in the centre of the easement).

- NSW Streets Opening Coordination Council 'Guide to Codes and Practices for Streets Opening' includes the following:

5.8. SERVICES AROUND POLES

Underground services and other obstructions around poles are to be kept a minimum distance of 300mm from the periphery of the pole to allow inspections by utility/service provider staff and the safe replacement of the pole.



The street awning is inappropriately constructed around three streetlight columns. Source: Google Maps Street View.

The awning may restrict access for the installation and removal of the streetlight column, fixing of streetlight faults for which access will be required for all lighting infrastructure including lamps, columns, supply cabling, pillars and pits. Maintenance staff will require safe access both for themselves and their vehicles and equipment purposes eg. from an elevated work platform (EWP) vehicle to change the lamps. Failing the foregoing, an asset redesign / relocation may be required.

33.3 Public / Pedestrian Obstruction

For public / pedestrian safety and to protect electricity infrastructure from becoming a public obstruction, Endeavour Energy requires adequate consideration to walkway and thoroughfare design where a new or existing electrical asset is likely to pose a hazard. Preference is to ensure electrical infrastructure is not placed or left stranded in public areas.

This may occur with public domain upgrades with footpaths and pavements being redesigned and particularly impact on the low voltage network pillars which provide the connection point to supply residences and businesses is underground distribution areas. Alternatively, assets may need to be relocated where design alternatives are not suitable - please refer to Section 4 'Asset Relocation'. Wall mounted designs are available where building facades are in close proximity to pedestrian footpath areas.

Low voltage pillars should be appropriate to the role and context of the street / footpath. Source: Google Maps Street View.

Conversely it is also important that when designing a new street making changes to an existing street or undergoing maintenance to the public domain (including lighting; landscaping and street furniture etc.) do not interfere with, restrict access for maintenance and repairs or replacements (which may require excavation and result in difficulties in restoration of the finished surfaces) or create a hazard such as climb point, to the electricity distribution infrastructure.

Street furniture such as bus shelters etc. need to be appropriately located. Source: Google Maps Street View.

The foregoing is also in keeping with the processes and design principles set out the NSW Government Movement and Place framework for planning, designing and managing transport networks to maximise benefits for the people and places and which can be accessed via the following link to their website.

https://www.movementandplace.nsw.gov.au/

34 Sustainability

Greenhouse gas emissions from Australia's energy sector continue to decline due to gradual decarbonisation of the grid. Endeavour Energy is also committed to reducing greenhouse gas emissions and helping customers save on their energy consumption and costs through new initiatives and projects to adopt sustainable energy technologies.

This commitment involves network demand management solutions (also known as a non-network option) being investigated and implemented where cost to either permanently defer network investment or temporarily defer investment to achieve the optimal timing and utilisation of network investments whilst meeting regulatory, statutory obligations, stakeholder and customer expectations. This will include consideration and potential adoption of new technologies and innovative approaches that can provide those solutions.

Demand management solutions generally involve a specific or linked network element, such as a zone substation, or broad based targeted solution – where a network area, such as a broader distribution area, has been forecast to exceed network capacity limitations within the area.

Notwithstanding the solutions such as the use of controllable loads, embedded generation and network tariff options that promote the efficient utilisation of network assets by signalling the economic cost of network congestion can also apply to individual customers eg. by saving energy around the home when and how heating or cooling, cooking, lighting etc. that involves the use of smart meters, batteries and solar panels to enable customers to generate, store and sell electricity into the grid as well as integrating electric vehicles into the network.

Accordingly Endeavour Energy encourages all development to adopt sustainable energy initiatives. For details of Endeavour Energy's sustainable energy initiatives or on Endeavour Energy's website under 'Home > Modern grid > Sustainability' via the following link:

https://www.endeavourenergy.com.au/modern-grid/sustainability .

In particular:

- Endeavour Energy has launched a 'Customer EV hub' where further information on electric vehicles and associated infrastructure is available for customers. Please refer to the following link for more information: https://www.endeavourenergy.com.au/modern-grid/electric-vehicles .

- Endeavour Energy's "Flexible Exports" program enables efficient energy usage and supports renewable energy integration (from solar) into the grid. Please refer to the following link for more information: https://www.endeavourenergy.com.au/modern-grid/flexible-exports .

For those working in Western Sydney, the following section of the website provides resources for establishing sustainable growth in the region: https://www.endeavourenergy.com.au/modern-grid/our-work-in-greater-western-sydney .

Endeavour Energy is also working towards a circular economy that recovers resources and protects the planet. This includes aiming to be nature positive by 2025 and waste neutral by 2030 (excluding hazardous and contaminated waste). As such, we encourage the consideration of circular economy practices and habitat protection in development.

35 Swimming Pools

Electricity and water are a potentially dangerous combination and needs to be treated with caution. This is due to parts of the swimming pool having the potential to be a conductor of electricity that can function as a path for stray current which as it seeks to complete the circuit, it could travel through to the water in the swimming pool. This includes but is not limited to coping / paving, rail / decks, steps, diving boards, pumps, filters etc.

Swimming pools potential could occur in any land zone and in addition to private pools on residential lots can be for various other uses eg. as part of an apartment complex / common area, recreation centres, hotels, sales and display etc.

Special consideration needs to be provided to the positioning of swimming pools in:

- Front yards.
- Corner lots with reduced building setbacks to the secondary road frontage.
- Adjoining zone and transmission substations.

The potential risk is reflected in swimming pools being prohibited in all types of easements. The separation / restrictions for swimming pools near padmount substations is detailed in Section 24.3 'Distribution Substations'. For Endeavour Energy's purposes the separation required from electricity infrastructure to a swimming pool includes the 'pool zone' being 'arms reach' or 1.25 metres from the water edge, as referred / defined in Australian/New Zealand Standard AS/NZS 3000:2018 'Electrical installations' as updated from time to time.

As a guide, for electricity distribution infrastructure that is protected works or adjacent to the site in public roadways and other adjoining properties ie. without an easement, the 'pool zone' should be outside of the notional easement provided in Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights' Table 1 – 'Minimum easement widths'.

If there is any doubt whatsoever regarding the safety clearances to any electricity distribution infrastructure, the applicant will need to have the safety clearances assessed by a suitably qualified electrical engineer / Accredited Service Provider (please refer to Section 24 'Network Connection').

Australian/New Zealand Standard AS/NZS 3000:2018 'Electrical installations' in clause 6.3.4.8 'Electricity Distributor's electrical equipment' states:

- Pools and spas shall not be located in areas containing electrical equipment, including connection pits and cabinets, owned by the electricity distributor, that results in such equipment being incorporated into any classified zone. See diagrams 6.15 and 6.16 of the Standard. (Please refer to the Appendices for a copy of the diagrams).

With the 'classified zones' this means no pool or spa can be installed within 3.5 metres of any of Endeavour Energy's electrical equipment and ever further if a 5 metre restriction zone is registered on the title to the property.

The Standard also requires the construction of a bonded earthing system to meet the requirements of equipotential bonding all the metal / conductive components to create substantially the same electrical potential, so that, under fault conditions, the difference in potential between simultaneously accessible exposed and extraneous conductive parts will not cause electric shock.

Before and After. This swimming pool in Endeavour Energy's network area at Middleton Grange NSW had to be modified to comply with the restriction for the padmount substation on the use of land in relation to swimming pools.

36 Telecommunications

Endeavour Energy has significant telecommunications infrastructure between their control centres, substations and other key electricity network infrastructure for Supervisory Control and Data Acquisition (SCADA) applications, communications to our Field Service Centres asset monitoring systems and high-speed protection packages can also be affected. In some cases the infrastructure is shared with telecommunications carriers.

Factors including environmental factors (topography, direct signal strength, radio frequency interference, proposed transmitter type, receiver type etc) affect the operation of the telecommunications systems. Accordingly telecommunications facilities need to be clear of surrounding obstructions such as buildings to reduce 'dead spots' and allow the radio base station to effectively cover its intended range / path (typically a direct line of sight between two radio base stations located on towers or elevated topographical features).

Telecommunications are likely to be affected if a building or development is in the line of sight between sending and receiving antennae or within a zone of the line of sight of these antennae. Where a potential exists for interference to line of sight links, an obstruction analysis will need to be undertaken to ensure that there is no impact on Endeavour Energy's telecommunications facilities.

Mitigation measures may require an establishment of an exclusion zone or relocation or redesign of the development causing the interference. Failure to do so would require Endeavour Energy to modify or relocated its existing telecommunications infrastructure eg. by installation of a directional antennae to reroute the existing signal; installation of an amplifier to boost the signal, and / or utilisation of onsite optical cable to reroute the original signal. All of these will involve a significant impact on Endeavour Energy's telecommunication facilities, cost and potential safety risk until the matter is rectified.

36.1 Telecommunications Carriers

In addition to electricity distribution, telecommunications carriers can apply for a Facilities Access Agreement (FAA) to install their assets on parts of the network, being mostly poles in overhead distribution areas but also on streetlight columns, including:

- cable television (CATV); fibre coaxial, public switched telephone network (PSTN) cables;
- associated telecommunication equipment including antennas, micro cells etc. (and which may have a power supply / electrical connection); and

are the responsibility of the carrier owning the telecommunications system.

Telecommunications cables are typically the lowest wires and located below the overhead power lines. If a telecommunication cable or equipment is encountered, advice should be obtained from the telecommunications network operator and never assume that the operating voltage is harmless.

Telecommunications equipment on the road verge and streetlight column in Bedford Street and Northcliffe Drive, Berkeley. Source: Google Maps Street View.

37 Vegetation Management

Endeavour Energy recognises the importance of plants and vegetation in helping to maintain the environmental balance and mitigate some of the negative impacts and social consequences of urbanisation eg. the creation of 'urban heat islands' and need for green / canopy cover to help offset the absorption and retention of heat. However, as an electricity distributor this also needs to be balanced against the critical need to manage the risks of vegetation intrusion to the electricity network that can cause:

- public safety incidents such as electrocution, or damage to a person's property;
- fire starts and the risk of bushfires that have devastating impacts including loss of human life and large-scale property destruction;
- restrict access for installation maintenance and repair of electricity infrastructure;
- reduce light levels from streetlights which can impact on crime prevention and road and pedestrian safety; and
- electricity supply interruptions which can also impact not only electricity customers but also other critical infrastructures and result in significant economic and social consequences.

Such landscaping may be subject to Endeavour Energy's Vegetation Management program and/or the provisions of the *Electricity Supply Act 1995* (NSW) Section 48 'Interference with electricity works by trees' by which under certain circumstances the cost of carrying out such work may be recovered.

Sydney's weather of storms and high winds can cause trees and branches to touch and short out the network or fall onto and damage overhead power lines. Heavy rain and flooding can also damage the electricity network. Many blackouts are caused from trees and shrubs damaging power lines and other network assets, especially during storms and periods of high winds.

Endeavour Energy's Transmission North had to repair a pole failure in April 2024 as a large tree fell on mains also resulting in damage to some customer switchboards and house fascias. Always treat fallen power lines as 'alive' and keep 8 metres away from them. Any trees, branches or other debris can also become 'alive' if they contact the damaged power lines.

The central activity is to clear vegetation and remove identified hazard trees that are in close proximity to electricity lines and to safely dispose of cut vegetation in accordance with Endeavour Energy's environmental obligations.

Poor tree selection and placement near overhead power lines in Moss Vale NSW in Endeavour Energy's franchise area. Source: Google Maps Street View.

Endeavour Energy regularly inspect and clear vegetation around electricity infrastructure. This not only includes tree trimming to overhead power lines but also ground clearing eg. for underground cable works or access tracks. As well as power, the infrastructure includes earthing cables (to allow a leaking/fault current to flow into the grounding system and be properly dissipated) and pilot cables (carrying protection signals or communications between substations). The poles may also carry data and telecommunications cables for other authorities / carriers.

The cost of vegetation management is a significant cost element in the company's operating budget (and the network charges to its customers). Endeavour Energy is constantly looking to improve its vegetation management practices to enable better maintenance, resulting in fewer faults and fewer outages of shorter duration and reducing costs.

The planting of large trees in the vicinity of electricity infrastructure is therefore not supported by Endeavour Energy. Suitable planting needs to be undertaken in proximity of electricity infrastructure. Only low growing shrubs not exceeding 3.0 metres in height, ground covers and smaller shrubs, with non-invasive root systems (less than 400 millimetres below ground level) are the best plants to use. Larger trees should be planted well away from electricity infrastructure (at least the same distance from overhead power lines as their potential full grown height) and even with underground cables, be installed with a root barrier around the root ball of the plant.

Although the spread of the tree on the opposite side of the road did not encroach safety clearances to the overhead power lines, the height meant that when the tree fell during a storm, it damaged the overhead power lines requiring repairs to restore electricity supply to customers. Source: https://web.yammer.com/main/org/endeavourenergy.com.au

Endeavour Energy's recommendation is that consideration be given to the removal of the existing street trees that are of nil to low ecological value and the trees be replaced with an alternative smaller planting to ensure appropriate clearances are maintained whilst minimising the need for future pruning. Alternatively, the minimum clearances for vegetation as required by the 'Service and Installation Rules of NSW' must be allowed for the details of which can be accessed via the following link to the NSW Climate and Energy Action website:

> https://energy.nsw.gov.au/government-and-regulation/legislative-and-regulatory-requirements/service-installation-rules .

While trees and underground cables often coexist well together, it is also important to keep trees a safe distance away from the cables to prevent the root system from growing around and possibly into the cable ducts the lines. The tree could be seriously damaged if roots have to be cut to dig up and repair underground cables.

38 References

Conveyancing Act 1919 (NSW)
Electricity Supply Act 1995 (NSW).
Electricity Supply Amendment (Protection of Electricity Works) Act 2006 (NSW)
Environmental Planning and Assessment Act 1979 (NSW).
Electricity Supply (Safety and Network Management) Regulation 2014 (NSW)
Protection of the Environment Operations Act 1997 (NSW)
State Environmental Planning Policy (Transport and Infrastructure) 2021 (NSW)
State Environmental Planning Policy (Resilience and Hazards) 2021 (NSW)
ISSC 20 Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure Industry Safety Steering Committee September 2012
Camden Council Development Control Plan 2011
NSW Planning & Environment 'Child Care Planning Guideline' August 2017
NSW Rural Fire Service 'Planning for Bush Fire Protection 2019'
NSW Government 'The Gibbs Report, Inquiry into Community Needs and High Voltage Transmission Line Development 1991'
NSW Streets Opening Coordination Council 'Guide to Codes and Practices for Streets Opening'
Energy Networks Association (ENA) 'Electric & Magnetic Fields – What We Know'
Australian Standard AS 1530 'Fire Test to Building Material – Standard'
Australian Standard AS2067: 2016 'Substations and high voltage installations exceeding 1 kV a.c.'
Australian Standard AS 2601—2001: 'The demolition of structures'
Australian Standard 2890 'Parking Facilities'
Australian/New Zealand Standard AS/NZS 7000: 2016: 'Overhead line design'
Australian/New Zealand Standard AS/NZS 3000:2018 'Electrical installations'
Australian / New Zealand Standard AS/NZS 1158: 2010 'Lighting for roads and public spaces'
Endeavour Energy Company Policy (Network) 9.1.1 – Bushfire Risk Management
Endeavour Energy Company Policy 9.2.3 (Network) 'Property Tenure for Network Assets'
Endeavour Energy Company Policy (Network) 9.2.5 – Network Asset Design
Endeavour Energy Company Procedure GAM 0114 - Granting Dispensations for Engineering Documents
Endeavour Energy's Branch Procedure (System Control) NCB 0615 'Flood Response Plan'
Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights'
Endeavour Energy Mains Design Instruction MDI 0028 'Underground distribution network design'
Endeavour Energy Mains Design Instruction MDI 0031 'Overhead line design'
Endeavour Energy Mains Construction Instruction MCI 0002 'Attachment of communication cables to Endeavour Energy poles'
Endeavour Energy Mains Construction Instruction MCI 0006 'Underground distribution construction standards manual'
Endeavour Energy Substation Design Instruction SDI524 'Fencing and Perimeter Security at Zone and Transmission Substations, and Switching Stations'
Endeavour Energy Earthing Design Instruction EDI 001'Earthing design risk assessment'
Endeavour Energy Drawing 86232 'Overhead Lines Minimum Clearances Near Structures'
Endeavour Energy Form FPJ7006 'Technical Review Request'
Endeavour Energy Form FPJ4015 'Application for the Relocation / Removal of Electrical Network Assets'
Endeavour Energy Form FPJ4603 'Permission to Remove Service / Metering by Authorised Level 2 Accredited Service Provider'
Endeavour Energy 'Alive and Dangerous'
Endeavour Energy 'Directions Paper for Consultation 1 July 2019 – 30 June 2024'
Endeavour Energy 'Distribution Annual Planning Report December 2020'
Endeavour Energy 'High Voltage Operational and Maintenance Protocol'
Endeavour Energy 'Land Interest Guidelines for Network Connection Works, Provision of Network Connection Services'
Energy NSW 'NSW Public Lighting Code 2019'
Energy NSW 'Service and Installation Rules of NSW'
Environment Protection Authority EPA 2013/0127 Noise Guide for Local Government
SafeWork NSW 'Work Near Underground Assets – Guide 2007'
WorkCover (now SafeWork NSW) 'Work Near Overhead Power Lines Code of Practice 2006'

39 Appendices

39.1 Energy Networks Association (ENA) ‘Electric & Magnetic Fields – What We Know’

ena
energy networks association

ELECTRIC & MAGNETIC FIELDS – WHAT WE KNOW

ABOUT EMFS

ELECTRIC AND MAGNETIC FIELDS – OR EMFS – ARE FOUND EVERYWHERE THERE IS ELECTRICITY. THEY ARE INVISIBLE.

Electric and magnetic fields - or EMFs - are found everywhere there is electricity. This includes around electrical appliances, equipment and the wiring we use in our homes, workplaces and schools, as well as powerlines and utility facilities. As electricity is so widespread in our society, questions about electricity and health are important to people. Research over more than 40 years has greatly increased our understanding of EMFs. The purpose of this brochure is to inform the public about what we know, and what we are doing about it.

WHAT ARE ELECTRIC FIELDS?

Electric fields are related to the voltage, or the pressure which pushes electricity along wires. The higher the voltage, the higher will be the electric field. Electric fields are present in any appliance plugged into a power point which is switched on. Even if the appliance itself is turned off, if the power point is on, an electric field will be present.

Electric fields are strongest closest to their source, and their strength diminishes rapidly as we move away from the source. The many common materials such as brickwork or metal will block electric fields. Walls, tables and bench tops can act as shields.

WHAT ARE MAGNETIC FIELDS?

Magnetic fields are produced by the flow of electricity, commonly known as current. Unlike electric fields, magnetic fields are only present when electric current is flowing. In other words, if an appliance is operating (even while in 'standby' mode), a magnetic field is produced.

The level of a magnetic field depends on the amount of the current (measured in amps), and decreases rapidly once we move away from the source. While electric fields are shielded by many common materials, this is not the case with magnetic fields. This is one reason why power lines may contribute to magnetic fields in the home and why burying power lines will not eliminate magnetic fields.

EMFS AND HEALTH

Research on EMFs and health has been conducted for over 40 years. This includes over 2,900 studies at a cost of more than $490 million internationally.

The research has generally focused on the magnetic fields with two main areas of research, *epidemiology* and *laboratory* studies. Both areas would need to provide links between EMFs and adverse health effects for causality to be accepted by health authorities.

Epidemiology (population).

This research looks at statistics to see if there are patterns of disease in large groups of people. The difficult with large statistical studies is that they take several years to produce meaningful results and even then, there are different opinions about how the results should be interpreted.

There may be other factors in the study which could complicate the interpretation of the results. Scientists generally agree that epidemiological studies aren't strong enough by themselves to establish that adverse health effects exist.

Laboratory

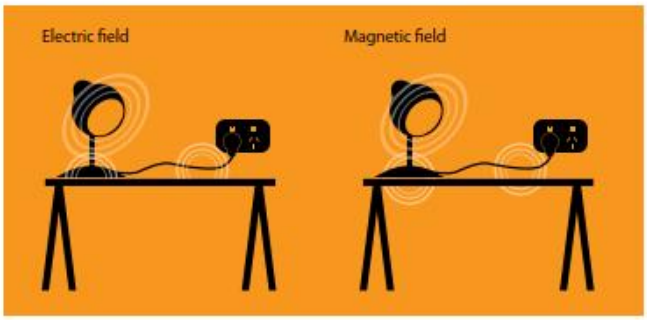
In the laboratory researchers have studied animals cells, as well as human volunteers under controlled circumstances to see if EMFs have any effects.

There have been many hundreds of these studies, and scientists look for results which can be successfully repeated in different laboratories. In over 40 years of research there have been no such consistently reproducible results for exposures below the guidelines.

AUTHORITATIVE REVIEWS

It is well accepted by scientists that no one study considered in isolation will provide a meaningful answer to the question of whether or not EMF can contribute to adverse health effects. In order to make an informed conclusion from all of the research, it is necessary to consider the science in its totality.

All of the research is reviewed periodically by expert panels which are established by national or international bodies with the purpose of trying to determine whether or not human exposure to EMF is related to adverse health effects.



The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is a Commonwealth Government agency charged with the responsibility for protecting the health and safety of people and the environment from EMF. ARPANSA advises that:

"The scientific evidence does not establish that exposure to ELF EMF found around the home, the office or near powerlines and other electrical sources is a hazard to human health".

"There is no established evidence that ELF EMF is associated with long term health effects. There is some epidemiological research indicating an association between prolonged exposure to higher than normal ELF magnetic fields (which can be associated with residential proximity to transmission lines or other electrical supply infrastructure, or by unusual domestic electrical wiring), and increased rates of childhood leukaemia.

However, the epidemiological evidence is weakened by various methodological problems such as potential selection bias and confounding. Furthermore this association is not supported by laboratory or animal studies and no credible theoretical mechanism has been proposed."

These findings are consistent with the views of other credible public health authorities. For example the World Health Organisation (WHO) advises that:

"Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields."

Similarly, the US National Cancer Institute concludes that:

Currently, researchers conclude that there is little evidence that exposure to ELF-EMFs from power lines causes leukemia, brain tumors, or any other cancers in children."

"No mechanism by which ELF-EMFs could cause cancer has been identified. Unlike high-energy (ionizing) radiation, ELF-EMFs are low energy and non-ionizing and cannot damage DNA or cells directly."

"Studies of animals exposed to ELF-EMFs have not provided any indications that ELF-EMF exposure is associated with cancer, and no mechanism has been identified by which such fields could cause cancer."

EMF GUIDELINES FOR ESTABLISHED HEALTH EFFECTS

The two internationally recognised exposure guidelines are:

- International Commission in Non-Ionizing Radiation Protection (ICNIRP) 2010; and
- International Committee on Electromagnetic Safety, Institute of Electrical and Electronics Engineers (IEEE) 2002.

ARPANSA's advice is:

- *"The ICNIRP ELF guidelines are consistent with ARPANSA's understanding of the scientific basis for the protection of the general public (including the foetus) and workers from exposure to ELF EMF".*
- Under the ICNIRP guidelines of 2010 the recommended magnetic field public exposure limit is 200 microtesla.

Under the IEEE Standard of 2002 the recommended magnetic field public exposure limit is 904 microtesla.

FIGURE 1: TYPICAL MAGNETIC FIELD MEASUREMENT RANGES

Magnetic Field Source	Range of Measurements in µT*
Electric stove	0.2 – 3
Refrigerator	0.2 – 0.5
Electric kettle	0.2 – 1
Toaster	0.2 – 1
Television	0.02 – 0.2
Personal computer	0.2 – 2
Electric blanket	0.5 – 3
Hair dryer	1 – 7
Pedestal fan	0.02 – 0.2
Substation	
» substation fence	0.1 - 0.8
Distribution line	
» under line	0.2 – 3
» 10m away	0.05 – 1
Transmission Line	
» under line	1 – 20
» edge of easement	0.2 - 5

* Note: Levels of magnetic fields may vary from the range of measurements shown. Appliance measurements at normal user distance.

Source: ARPANSA, Measuring magnetic fields

GUIDE TO COMMON EMFS

It is possible to measure magnetic fields using a gaussmeter.

The fields are measured in a unit of microtesla (µT) or milligauss (mG). 1 Microtesa (µT) equals 10 milligauss (mG).

To give you an idea of the relative strengths of EMF, the following guide shows the typical magnetic fields close to appliances and under power lines.

Due to variations in the design of electrical appliances / powerlines and the power consumed or transmitted, the levels of magnetic fields will vary.

ENA'S RESPONSE?

Electricity utilities review scientific developments related to EMFs and are guided by relevant health authorities. In Australia, the Energy Networks Association (ENA) recommends that electricity utilities provide balanced and accurate information to the community and design and operate electrical power systems prudently within relevant health guidelines. This includes such actions as:

- providing training to staff;
- informing the community;
- ensuring that fields are within established guidelines set by health authorities; and
- practising "prudent avoidance" when building new electrical facilities.

Prudent avoidance involves reducing magnetic field exposure where this is practicable and can be done at no cost or very low cost.

The industry has followed this reasonable, common sense approach for many years.

INDIVIDUALS RESPONSE

There are some things you can do very easily to reduce exposure to EMF. Since EMFs drop off rapidly as you move away from their source, you can modify your use of electrical appliances such as clock radios. You can locate beds away from a wall that has a switchboard outside and you can switch off your electric blanket before you get into bed. These actions may reduce exposure to EMFs but it cannot be said that doing any of these things will have any health benefit.

For further information about EMFs:

- your local electricity utility or the Energy Networks Association (ENA) www.ena.asn.au;
- the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) - www.arpansa.gov.au
- the World Health Organisation (WHO) – www.who.int

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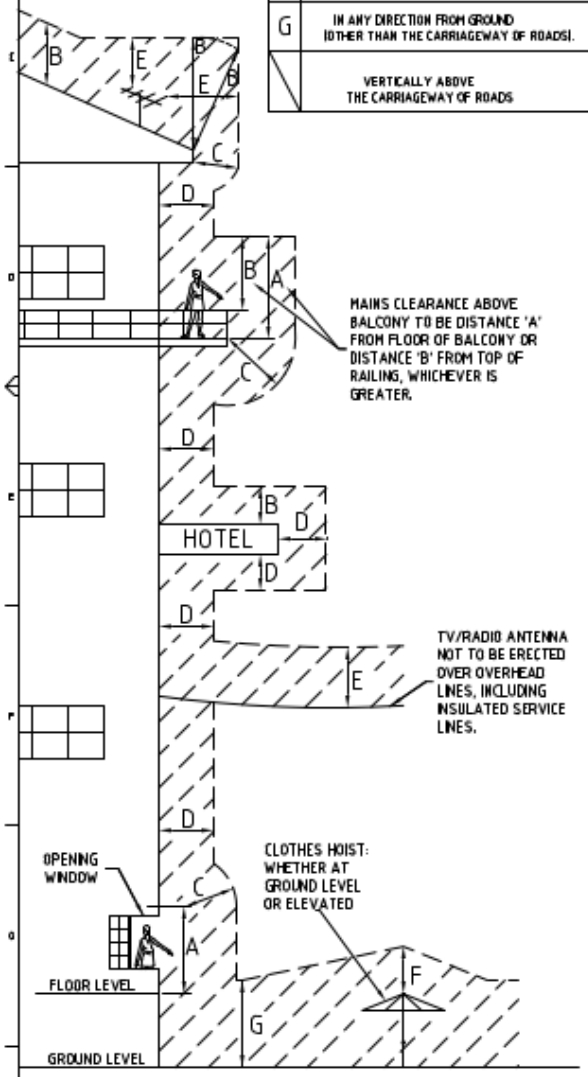
UPDATED DEC 2015 PUBLISHED FEB 2016

39.2 Endeavour Energy Drawing 86232 'Overhead Lines Minimum Clearances Near Structures'

APPLICATION \ NOMINAL VOLTAGE (U) & CONDUCTOR	U < 1000V INSULATED (mm)	U < 1000V BARE NEUTRAL (mm)	U < 1000V BARE ACTIVE (mm)	U > 1000V INSULATED WITHOUT EARTHED SCREEN (mm)	U > 1000V INSULATED WITH EARTHED SCREEN (mm)	1000V < U < 33kV BARE CONDUCTORS (mm)	33kV < U < 132kV BARE CONDUCTORS (mm)
A VERTICALLY ABOVE THOSE PARTS OF ANY STRUCTURE NORMALLY ACCESSIBLE TO PERSONS	2700	2700	3700	3700	2700	4500	5000
B VERTICALLY ABOVE THOSE PARTS OF ANY STRUCTURE NOT NORMALLY ACCESSIBLE TO PERSONS BUT ON WHICH A PERSON MAY STAND	2000	2700	2700	2700	2700 NOTE 4	3700	4500
C IN ANY DIRECTION (OTHER THAN VERTICALLY ABOVE) FROM THOSE PARTS OF ANY STRUCTURE NORMALLY ACCESSIBLE TO PERSONS, OR FROM ANY PARTS NOT NORMALLY ACCESSIBLE TO PERSONS BUT ON WHICH A PERSON CAN STAND	1000	900 NOTE 5 (1000)	1500	1500	1500 NOTE 4	2100	3000
D IN ANY DIRECTION FROM THOSE PARTS OF ANY STRUCTURE NOT NORMALLY ACCESSIBLE TO PERSONS	100 NOTE 2	300 NOTE 2	600 NOTE 2	600	100	1500	2500
E IN ANY DIRECTION FROM ANY PART OF AN OUTDOOR TELEVISION ANTENNA OR PART OF A STAYWIRE	1800	1800	1800	3000	3000	3000	3000
F IN ANY DIRECTION FROM CLOTHES LINE	2000	3000	3000	3000	3000	3000	3000
G IN ANY DIRECTION FROM GROUND (OTHER THAN THE CARRIAGEWAY OF ROADS).	5500 NOTE 6	5500	5500	5500 NOTE 5 (7500)	5500	5500 NOTE 5 (7500)	6700 NOTE 5 (7500)
VERTICALLY ABOVE THE CARRIAGEWAY OF ROADS	5500	5500	5500	6000 NOTE 5 (7500)	5500	6700 NOTE 5 (7500)	6700 NOTE 5 (7500)



GENERAL NOTES

1. THE POINT OF ATTACHMENT IS HERE DEFINED AS THE POINT AT WHICH Endeavour Energy'S AERIAL SERVICE MAINS JOIN ONTO THE CONSUMERS BUILDING OR STRUCTURE OR ELSE THE FIRST POLE PAST THE BOUNDARY OF THE CONSUMERS PREMISES.
2. THIS CLEARANCE MAY BE REDUCED TO ALLOW FOR TERMINATION AT POINT OF ATTACHMENT.
3. FOR CLEARANCE REQUIREMENTS OF INSULATED AERIAL SERVICE MAINS, REFER Endeavour Energy'S DRAWING 011985.
4. HIGH VOLTAGE NON-METALIC SCREENED AERIAL BUNDLED CONDUCTOR (NMS-HV ABC) IS CLASSIFIED AS INSULATED WITH EARTHED SCREEN FOR CLEARANCE PURPOSES, EXCEPT FOR DIMENSIONS B & C.
5. TO KEEP LINES BEYOND THE REACH OF PERSONS, THE DESIGN CLEARANCES (SHOWN IN BRACKETS) REQUIRED BY Endeavour Energy IN THESE SITUATIONS ARE GREATER THAN THOSE REQUIRED BY INDUSTRY GUIDELINES.
6. DOES NOT INCLUDE INSULATED SERVICE LINES.

MINIMUM CLEARANCE REQUIREMENTS

MINIMUM SAFE CLEARANCES ARE SPECIFIED IN ELECTRICITY SUPPLY (SAFETY & NETWORK MANAGEMENT) REGULATION 2008, & GUIDELINES FOR DESIGN & MAINTENANCE OF OVERHEAD DISTRIBUTION & TRANSMISSION LINES (ENA C(b)1-2006).
DETAILS SHOWN ON THIS DRAWING COMPLY WITH ENDEAVOUR ENERGY PRACTICE.

THESE CLEARANCES ARE THE MINIMUM NECESSARY WHEN ANY Endeavour Energy OVERHEAD LINE WILL BE IN ITS CLOSEST POSITION TO THE BUILDING OR OTHER STRUCTURE DURING STRONG WINDS OR MAXIMUM OPERATING TEMPERATURE (EXCLUDING FAULT CURRENTS OR EMERGENCY LOAD CURRENTS). UNDER THESE CONDITIONS, CONDUCTOR MAY SWING OR SAG CONSIDERABLY TOWARDS THE BUILDING OR STRUCTURE COMPARED WITH NORMAL CONDITIONS.
ADEQUATE ALLOWANCE SHOULD BE MADE FOR THIS POSSIBLE SWING OR SAG OF CONDUCTORS.

OVERHEAD LINES MUST NOT COME WITHIN HATCHED AREAS.
MINIMUM CLEARANCES SHOWN ARE FOR Endeavour Energy OVERHEAD LINES UP TO THE POINT OF ATTACHMENT (AS DEFINED IN NOTE 1).
MINIMUM CLEARANCES PAST THE POINT OF ATTACHMENT ARE TO BE IN ACCORDANCE WITH SAA WIRING RULES (AS/NZS3000).

ORIGINAL SCALE NONE	APPROVED C.BROWN	Endeavour Energy	DO NOT SCALE DIMENSIONS IN MILLIMETRES
DRAWN C.R.T.		Endeavour Energy OVERHEAD LINES MINIMUM CLEARANCES NEAR STRUCTURES	REFERENCE DRAWINGS; AUTHORISED W.ISLEY; HOR TRANSMISSION MAINS 16-2-95; A2P 086232 K; SHEET No 1 OF 1 SHEETS
DATE 16-2-95			
CHD			

39.3 Australian/New Zealand Standard AS/NZS 3000:2018 'Electrical installations' Figures 6.15 & 6.16.

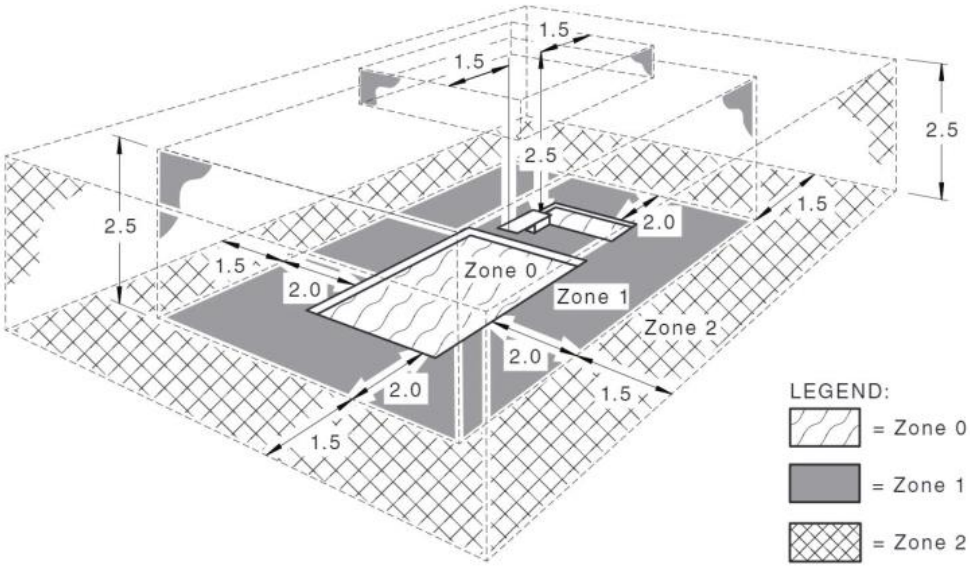


FIGURE 6.15 ZONE DIMENSIONS OF IN-GROUND SWIMMING POOLS

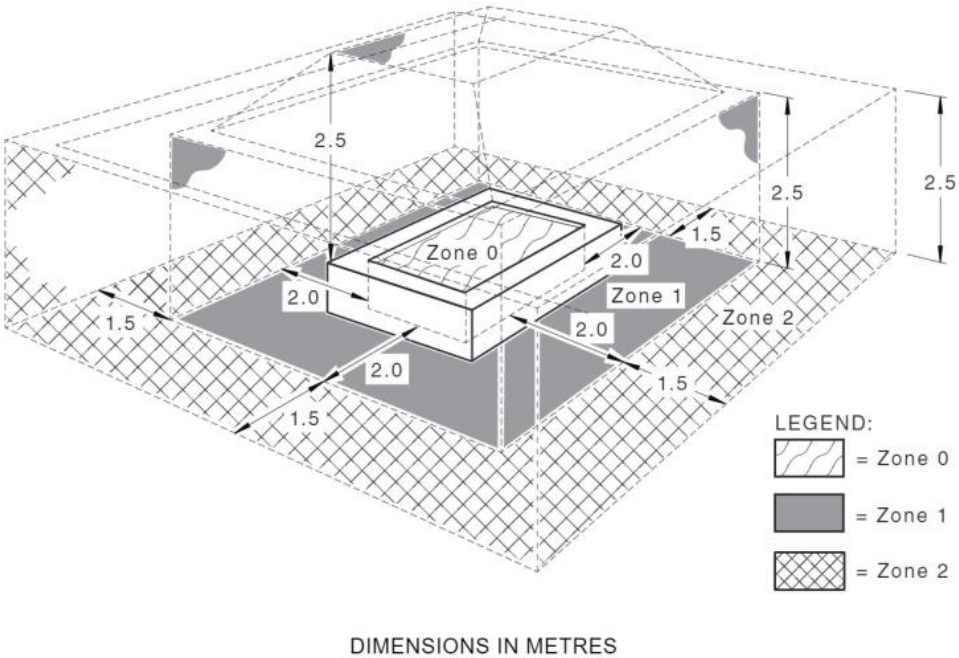


FIGURE 6.16 ZONE DIMENSIONS OF ABOVE-GROUND SWIMMING POOLS

A classified zone is made up of 3 zones:

- Zone 0 being the area of the interior of the water container of the pool .
- Zone 1 being the area limited to zone 0, and a vertical plan 2 metres from zone 0.
- Zone 2 being the area limited by a vertical plane 1.5 metres external of Zone 1.

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