WEST LAKE ILLAWARRA AREA PLAN



August 2022



• Version Control and Approvals

- This document is updated annually, or more frequently as revised data is received. Table 1 below is updated datailing key changes made between versions. The table is perjulated in descending order.
- updated detailing key changes made between versions. The table is populated in descending order.

Table 1 – Version Control

Version #	Date of Issue	Description
2	8 August 2022	Release of revised precinct lot forecasts, total mature load, and network project approvals.
1	17 March 2016	Original version.

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Executive Summary

- In March 2016 the original West Lake Illawarra Area Plan was released which defined the preferred supply
- strategy for the West Lake Illawarra geographic area. This 2022 revision of the original Area Plan is based
- on updated precinct lot forecasts, total mature load, and network project approvals. The process of revising the original Area Plan has confirmed there are no material changes required to the original recommended supply strategy and actions.

This report outlines the investment needs and strategy to accommodate the development of an estimated 28,226² residential dwellings together with 3.1 square kilometres (km²) of employment lands in West Lake Illawarra precincts. The development area is bounded by the Moss Vale to Unanderra Railway Line to the north, the Illawarra Escarpment to the West, the Illawarra Highway to the South and the eastern boundary by Brownsville, Dapto, Lake Illawarra at Tallawarra, Albion Park Rail and Albion Park.

When fully developed beyond 2051, it is expected that the West Lake Illawarra area will result in approximately 130MVA of load which will be added to the Endeavour Energy network.

This strategy aims to maximise the use of the existing infrastructure currently in place within the development area, which consists mostly of 132kV and 33kV construction. Consideration is given to staging the implementation of the ultimate network with immediate existing network utilisation and short to medium-term network configurations proposed for supplying the land that is currently zoned or is being planned for development. The ultimate network that is proposed to supply the long-term load comprises of three newly constructed Endeavour Energy (EE) zone substations (ZS) along with a private high voltage customer (HVC) substation.

The need to continue engagement with various stakeholders, including the NSW Department of Planning & Environment (DPE), Councils, TransGrid, developers and landowners, is highlighted as critical for the acquisition of line corridors and zone substation sites.

In summary, the Area Plan recommends the following actions:

- The proposed Ultimate Network Topology (long-term combined 132kV and 33kV transmission solution) outlined within this Plan be carried forward as the basis for further planning within the West Lake Illawarra area. Individual projects based on the principles outlined in this report will be developed separately and funding sought for each of these projects at the appropriate level and time. Additionally, Endeavour Energy is working on following individual projects in the Area:
 - Case for Investment (CFI) NPR-0000013 New West Dapto ZS estimated commissioning late FY28 / early FY29 and,
 - CFI NPR-000063 New Calderwood ZS (permanent) estimated commissioning late FY28 / early FY29.
- 2. Continue Joint Planning with TransGrid for the additional load required to be supplied by 330/132kV Dapto Bulk Supply Point (BSP) and potential N-1 backup security from Marulan BSP.
- 3. Continue in collaborative working relationships with Developers and the Department of Planning and Environment to ensure that zone substation sites and line corridors are included in the development of master plans for West Lake Illawarra precincts.
- 4. Continue discussions with the with the Illawarra Urban Development Committee chaired by NSW Department of Planning and Environment, Wollongong City Council and Shellharbour City Council on an ongoing basis to ensure that Endeavour Energy's staging for the establishment of major infrastructure is in line with projected development timing.

² Based on NSW DPE data from March 2022: Source



Purpose

- The purpose of this document is to establish a supply plan for the West Lake Illawarra precincts.
- The West Lake Illawarra is the development area located within the boundaries of Wollongong and Shellharbour local government areas. The development area is bounded by the Moss Vale to Unanderra Railway Line to the north, the Illawarra Escarpment to the West, the Illawarra Highway to the South and the eastern boundary by Brownsville, Dapto, Lake Illawarra at Tallawarra, Albion Park Rail and Albion Park. The West Lake Illawarra release area incorporates West Dapto (North & South), Calderwood and Tallawarra as illustrated in Figure 1.



Figure 1 – West Lake Illawarra Precincts Overlay

The area has an expected ultimate yield of 28,226 residential lots and 3.1km² of employment lands – most of the land in these areas is already zoned and additional planning proposals are being considered.



Scope

The scope of this document includes:

- A description of the area and linkages to related area plans.
- The **network need** based on triggers for growth in the service area and **opportunities** across the network to facilitate the development of network and non-network options.
- An **overview of proposed network topology** and available capacity to inform the potential augmentation projects to service the growth.
- A recommended supply strategy and list of augmentation projects over a rolling 10-year period.

The following is not within the scope or intent of this document:

- Precinct specific load forecast. These are included in demand forecasts.
- Options for investments. Options for specific precincts and network needs are included in the individual Case for Investment documents. document does not include optioneering for investments as they are included in the individual CFIs.

Throughout this report there are occasions where Endeavour Energy may use the term "transmission" to describe some sub-transmission assets due to internal naming convention, however it does not own and operate "transmission" network assets as per the definition in the National Electricity Rules (NER).

3.1 Asset Management System

A critical input to the Regulated Asset Base (RAB) Strategies is a series of detailed Area Plans developed for areas that are expected to require significant investment in the future. The purpose of these Area Plans is to outline an overarching view of the network infrastructure that will be required to service the identified growth area.

The Area Plans aim to assess the state of the network, identify the critical external influences to determine the likely future network requirements, and identify the high-level needs and opportunities to be refined and options (external to the Area Plan process) through the investment governance process.

The relationship between the Area Plans and the other artefacts within Endeavour Energy's asset management system is illustrated in **Figure 2**.



Figure 2 – Endeavour Energy Asset Management System artefact hierarchy

A detailed description of Endeavour Energy's asset management system and its constituent parts is available in the Asset Management System Manual and the Asset Management System Guidelines.



• Description of the area

• 4.1 Geographic characteristics of the area

 Set against the Illawarra Escarpment and a landscape of riparian valleys, the West Lake Illawarra Growth Area has the capacity for 28,226 new dwellings in the Tallawarra, West Dapto and Calderwood urban release areas and 3.1km² of employment lands.

The West Lake Illawarra growth area is approximately 5,500 hectares of mostly rural land across Wollongong and Shellharbour local government areas. It will ultimately accommodate an estimated 28,226 residential dwellings and comprise 3.1km² of employment lands. Based on the total number of dwellings and employment lands, the ultimate imposed network demand is estimated at 130MVA.

There are four main development precincts in the area. These are Calderwood, West Dapto, Tallawarra and Avondale as illustrated in **Figure 3**. The main West Lake Illawarra development precincts (West Dapto and Calderwood) are sandwiched between the Illawarra escarpments (west) and existing suburbs of Horsley and Dapto (east). The northern boundary is the existing Kembla Grange employment lands, and the southern boundary is the Illawarra Highway west of Albion Park. The Tallawarra precinct is located on the western shore of Lake Illawarra.

Current developer activity within the Calderwood precinct is driven by a single large developer whereas the larger West Dapto precinct comprises fragmented land ownership with small developments. Initial development activity has commenced in the Avondale precinct, but there is presently no activity in the Tallawarra precinct.

The NSW Government through the Wollongong office co-ordinates the Illawarra Shoalhaven Development Program. It aims to manage continued land and housing supply in the Illawarra and Shoalhaven through implementation of regional strategies.

During a five-year period starting from 1 July 2019 Endeavour Energy plans to invest approximately \$52m on growth projects to ensure continuing connection capacity is available in the West Lake Illawarra Growth Area. Further investment will be required as development matures.





Figure 3 - West Lake Illawarra Growth Area³ – Geographic View

4.2 Informing of the Area Plan

The West Lake Illawarra Area Plan is developed from a range of inputs. Principally the data is informed by officiated NSW Government Department of Planning and Environment (DPE) documents such as Precinct Plans, Structure Plans and Planning Policies.

³ Illawarra Shoalhaven Regional Plan 2041: source



- In addition to published information sources, Endeavour Energy is actively engaged further with DPE
 - through routine Technical Working Group (TWG) meetings as appointed through DPE's Chief Engineer
- Office and the Utilities Collaboration Group (UCG).
- Endeavour Energy also holds direct engagement meetings and routine written correspondence with all
 major developers and land holders in the region. This collaboration informs ultimate long-term needs of
 the precincts as well as near term servicing arrangements and investment timing.

4.3 Overview of the Area Plan

Figure 4 provides an overview of the area plan detailed within this document. The key features include:

- the ultimate requirement for additional three zone substations (West Dapto, Calderwood, and Avondale) along with a private HVC substation,
- the combined use of spare capacity in existing 132kV and 33kV feeders.





4.4 Related Area Plans

This Area Plan does not share common elements of the network strategy with any other Area Plan.



• Network Need

• 5.1 Dwellings and employment lands

The NSW Government Department of Planning and Environment (DPE) has identified three precincts within the subject of the West Lake Illawarra Growth Area. The locations of these precincts are shown in Figure 3 and their expected dwelling numbers and employment land yields are shown in the

Table 2 below. The number of dwellings forecast in each precinct has been updated based on the latest information available from NSW DPE.

Table 2 – West Lake Illawarra Precinct dwellings & employment land estimates from March 2022

West Lake Illawarra Precinct	Local Government Area (LGA)	Number of Dwellings ⁴	Employment land (km²) ⁵
Calderwood	Shellharbour	6,900	-
Calderwood	Wollongong	800	0.500
Tallawarra	Wollongong	1,400	0.668
West Dapto	Wollongong	19,126	1.932
	Total	28,226	3.100

5.2 Required capacity

Based on the total number of dwellings and employment land area provided in Table 2, Endeavour Energy have established an ultimate demand profile for the West Lake Illawarra region. The load of the residential dwellings was estimated based on the provisions from National Institute of Economic Industry Research (NIEIR) report where 3.76kVA per lot was adopted for residential lots in new release areas for the Illawarra in April 2020. The load of the employment lands, comprising of a combination of industrial and commercial developments, was based on the provisions from the Network Capability Planning Standards document (NCP 1104 section 5.9 Load Density Figures) where 6MVA per km² was adopted for industrial load and 12MVA per km² for commercial load. The employment lands will have 67% of industrial load and 33% of commercial load.

The total forecast demand for the West Lake Illawarra area is shown in Table 3 below.

Table 3 - Ultimate demand forecast f	for the West Lake Illawarra area
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Load type	Number of dwellings/ Employment land (km²)	MVA/dwelling or MVA/km ²	MVA
Dwelling's development	28,226 dwellings	0.00376 MVA/dwelling	106.0 MVA
Industrial development (67%)	2.077 km ²	6 MVA/km²	12.5 MVA
Commercial Development (33%)	1.023 km²	12 MVA/km ²	12.3 MVA
		Total	130.8 MVA

⁴ Based on NSW DPE data from March 2022: <u>Source</u>

⁵ Obtained from developer enquiry applications to Network Connections prior to 2016



5.3 Study considerations

- The existing electricity infrastructure in the study area is of a light, rural nature and is limited in its ability to
- supply any substantial load arising from development in the West Lake Illawarra precincts.
- Augmentation of existing infrastructure where possible will be undertaken to provide supply to initial phases of developments. This will provide some lead time to undertake detailed network investment option studies prior to committing to capital investment in new infrastructure.

Due to the difficulties in establishing overhead electricity infrastructure and obtaining line corridors and easements the following basic design considerations have been used in the determination of a suitable network topology:

- The use of standard capacity overhead feeders will allow standard underground installations where required.
- Existing 132kV and 33kV lines which traverse the development area, associated corridors, and easements they occupy should be utilised wherever practicable. The 132kV lines have spare capacity with only some of the 33kV lines having limited spare capacity.
- The use of 11kV as the distribution voltage although a majority of the existing 11kV in the area is of light, rural design, there are enough assets in place to make any conversion to an alternative distribution voltage difficult, involving complex changeover procedures and possibly lengthy and multiple interruptions to customers.

5.4 Relationship within Growth Servicing Strategy

A key component of our investment approach for augmentation expenditure is servicing growth in "stages" to defer significant network investment until it is self-evidently necessary. Broadly, these stages entail utilisation of the existing network and/or minor network extensions, non-network solutions and network augmentation. Endeavour Energy is committed to selecting the most efficient option and staging approach that best addresses the strategic objectives outlined in our Growth Strategy.

Investments within West Lake Illawarra area must be carefully timed particularly the existing rural setting, a general lack of widespread infrastructure (for example, 11kV distribution feeders), and the level and frequency of load application and enquiry. In most precincts the establishment of a Zone Substation will be required in advance of most development to avoid a lack of infrastructure resulting in a deterrent or slowing of growth.



• 5.5 Electrification and our customers changing energy needs

- Customer energy needs continue to evolve within the wider context of the energy transition. There is a
- growing bias from both customer groups and developers to transition or move away from gas, increase
- energy efficiency (e.g., building standards and heat pump heating systems), adopt low emission
- transportation options, and increase the penetration and capability of distributed energy resources (DERs) such as solar generation and storage.

Endeavour Energy continues to adapt to changing needs. The extended roll out of distributed automation, latest technology substation control systems, the provision for grid scale storage on many zone substation sites, amongst other initiatives provides enabling options in this transition. The deployment of the Advanced Distribution Management System (ADMS), continued developments in Distributed Energy Resource Management System (DERMS), TimeScale Databases, and Next Generation Planning Systems (NGPS) will provide data platforms to underpin an ability to inspect, understand and forecast changing customer behaviours and continue to adapt.

Continuously investigating alternative, smart non-network options and integrating these into the network planning process represent important enablers of energy transition. Endeavour Energy applies an innovative method to provide capacity for the first stages of new release areas. This has traditionally been addressed by establishing mobile zone substations. Nowadays, a grid scale Battery Energy Storage System (BESS) allows modular and rapid deployment of additional network capacity which can reduce or defer the need for networks to invest in new capacity. In support of the role our network will play in shaping the future electricity landscape, Endeavour Energy have been conducting battery energy storage trials across its network, including the West Lake Illawarra region.

Mainly consisting of rural lands that are to be converted to urban and industrial use, the West Lake Illawarra region represents an appropriate site to test peak demand reduction and islanding. A 11kV trial 1.5MWh BESS was commissioned on feeder 35590 in the West Lake Illawarra area in April 2020. The battery charges during low load times and discharges during high load times, such as afternoons and evenings. The project's main intent was to augment the grid in times of peak load anticipated during the summer months resulting in major capital expenditure (CAPEX) deferral which otherwise would be required to increase the capacity of the local substation. The BESS of this size positively affected staging of network augmentation, however it cannot be applicable for the ultimate long-term supply strategy for the West Lake Illawarra Area Plan. A much larger and more complex BESS would be required to cater for the estimated load growth of West Lake Illawarra precincts.



• Existing Supply Arrangements

• 6.1 Overview

Endeavour Energy is supplied in this region at 132kV from the TransGrid owned BSP (Dapto BSP). Both 132kV feeders 981 (Dapto BSP to Bellambi TS) and 988 (Dapto BSP to Fairfax Lane TS) traverse major parts of the development area. In addition, 33kV feeders 7341 (Kembla Grange ZS to Dapto ZS), 7041 (Mt Terry TS to Dapto ZS), 7123 (Albion Park ZS to Avon Colliery) and 7099 (Springhill TS to Wongawilli) also traverse the development.

The existing West Lake Illawarra development area is predominately serviced by a rural overhead 11kV feeder network beyond the existing mature suburbs. The existing Zone Substations (ZS) are located geographically to far from the proposed load centre to be able to support the required capacity in the development area. Therefore, the existing 11kV network cannot service the significant step change in load which will ultimately materialise.

The existing transmission and sub-transmission network within the West Lake Illawarra precinct is illustrated in **Figure 5**.



Figure 5 - Existing Network & Development Area (sketch not to scale)

It should also be noted that Endeavour Energy purchased a block of land (30 July 2010) in the West Dapto North area with the intention of establish a zone substation when required. The parcel owned by Endeavour Energy is Lot 1 DP 818199 on West Dapto Rd Kembla Grange.



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- Since publication of the original West Lake Illawarra Area Plan in 2016 the following land acquisition and
 project approvals gained are:
- An 11kV trial 1.5MWh Battery Energy Storage System (BESS) commissioned on feeder 35590 from Kembla Grange ZS at Lot 1 DP 818199 West Dapto Rd, Kembla Grange.
 - Major Project PR499 Calderwood Mobile ZS approved August 2019, with commissioning scheduled May 2023.
 - Alternate West Dapto ZS site purchase December 2020 Lot 99 DP1269057 West Dapto Rd.
 - Calderwood ZS site acquired April 2021 Lot 10 DP1237642 Calderwood Rd.

6.2 Capacity of existing sub-transmission feeders

Table 4 shows each sub-transmission line in the area along with the contingency demand and the associated rating.

Existing 132kV feeders 980 and 981 (Dapto BSP to Bellambi TS) and 988 (Dapto BSP to Fairfax Lane TS) presently do not supply any load in the development area. These feeders along with Dapto BSP have ratings that can support additional load in the West Lake Illawarra precinct. The feeder ratings include emergency ratings where available.

Presently existing 33kV feeders 7012 & 7016 (Springhill TS to Unanderra ZS), 7017 & 7117 (Springhill TS to Kembla Grange ZS), 7041 (Mt Terry TS to Dapto ZS), 7054 & 7058 (Mt Terry TS to Albion Park ZS), 7099 (Springhill TS to Wongawilli), 7120 (Unanderra ZS to Dapto ZS), 7123 (Albion Park ZS to Avon Colliery 'not in service') and 7341 (Kembla Grange ZS to Dapto ZS) supply load within and adjacent to the development area. The feeder ratings are shown in Table 4 and include emergency ratings where available.

Feeder	Voltage (kV)	Rating (S) (MVA)	TNPR N-1 (S) 2031 (MVA)	SPARE Capacity (MVA)
980	132	163	80	83
981	132	163	80	83
988	132	133	90	43
7012	33	44.4	19.5	24.9
7016	33	33.2	19.6	13.6
7017/7117	33	33.2	19.1	14.1
7099	33	32.9	N only, 0.4	32.5
7120	33	33.2	14.3	18.9
7341	33	32.1	9.4	22.7
7041	33	27.4	25.9	1.5
7054	33	45.7	36.9	8.8
7058	33	45.7	20.5	25.2
7123	33	16.8	N only, 0.0	16.8



- Table 4 shows spare capacity of 83MVA under N-1 scenarios for both feeders 980 & 981. Either of these
- e feeders will support a standard firm 45MVA 132/11kV ZS in the West Dapto North development area as
- show in Figure 4 and Figure 5. There is spare capacity of 43MVA under an N-1 scenario for feeder 988. It
- is considered that 988 should have sufficient capacity for a firm 45MVA to be installed and 988 would only
- need to be augment when the load on the proposed Avondale ZS materialises.

Table 4 shows the maximum spare capacity under N-1 on 33kV feeders from Springhill TS is 24.9MVA on 7012 and from Mount Terry TS is 25.2MVA on 7058. There is extremely limited 33kV feeder capacity to support three new 33/11KV ZS's and one 33kV HV Customer substation in the development area.

6.3 Capacity of existing substations

Table 5 below shows the transmission substations that supply the area in subject, their voltage levels, their firm nameplate capacities, expected ultimate demand and spare capacity.

Substation	Voltage (kV)	Firm transformer capacity (MVA)	Winter 2020 Load (MVA) Undiversified	SPARE Capacity (MVA)
Dapto BSP	330/132	750	764.7 ⁶ /334.7 ⁷	-14.7 ⁶ / 415.3 ⁷
Springhill TS	132/33	240	154.1	85.9
Mount Terry TS	132/33	120	96.1	23.9

Table 5 - Existing Substations' Capacities

Table 5 shows Springhill TS has sufficient capacity for maximum two new 33/11kV ZS's. However, together Mount Terry TS and Springhill TS would be stretched to support three 33/11kv ZS's and one 33kV HV Customer Substation. Given Tallawarra generation -430MW, Dapto BSP could easily support two 132/11kV ZS's.

6.4 Renewal needs

The existing zone and transmission substations that provide supply in the area and their age and renewal needs of is summarised below in Table 6. The table shows that there are limited renewal needs in the area and these needs have minimal impact on determining the ultimate supply strategy for increased capacity. As there is little scope for installing new capacity based on the condition of the existing assets, at least in the short to medium term, the installation of new assets is anticipated to be driven by capacity constraints.

⁷ This ultimate load is with Tallawarra Generator -430MVA



⁶ This ultimate load is without Tallawarra Generator -0.0MVA

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Table 6 - Summary of Renewal Needs

Substation	Current age of the asset (years)	Condition comments
Mount Terry TS	47	Currently no renewal needs
Springhill TS	7	Currently no renewal needs
Tallawarra SS	7	Currently no renewal needs
Unanderra ZS	52	 Renewal needs which are included in the Strategic Asset Renewal Plan (SARP) 2014/15 for consideration within the next 10 years include: TS163 – Renewal: Control Building, New 11kV switchboard, auxiliaries, P&C, TS005 – Replace: 33kV CBs, TS600 – Replace: VT & CT
Albion Park ZS	47	 Renewal needs which are included in the SARP 2014/15 for consideration within the next 10 years include: TS610 – No 2 33/11kV Transformer - completed 2020 TS611 – No 3 33/11kV Transformer - completed 2020
Dapto ZS	53	Currently no renewal needs.
Kembla Grange ZS	16	Currently no renewal needs



Recommended Ultimate Supply Strategy

feeder connection works.

- It was previously determined that it will be possible to service the development of the West Lake Illawarra
 precincts through the following two solutions:
 - Option 1: Combined 132kV and 33kV Transmission Solution: establish two 132kV 45MVA ZS's, one 33kV 25MVA ZS and one 33kV 15MVA private HV Customer substation along with the required
 - **Option 2: 33kV Transmission Solution:** Establish requiring three 33kV (1 x 50MVA, 1 x 35MVA & 1 x 25MVA) ZS's and one 33kV 15MVA private HV Customer substation along with the required feeder connection works. This would also require significant feeder augmentation works along with new 33kV feeders establish to both West Dapto & Avondale ZS's.

Both the original report from 2016 and this revised report from 2022 confirms Option 1 remains as the long-term preferred network strategy. Option 2 will not be considered further. Under Option 1, all envisaged future major projects will be tested and developed through Network Planning's, Network Opportunity Statements (NOS) and CFI processes.

Besides describing the preferred long-term network strategy, this section outlines network configurations that will allow for the staged implementation of the preferred network strategy and cater for the expected immediate and near-term network needs and solutions.

The existing network is presented as well as additional works for each option to modify the network to meet the network need. Note that the strategy for the distribution network (11kV) is not discussed within this document as it will be planned for and established as part of individual developments through the normal customer application for load process administered by the Customer Connections Branch.

7.1 Initial supplies and short-term network configuration

It was previously determined in the original report from 2016 that the immediate network solution to enable continued staged development within the West Lake Illawarra development area is through providing limited capacity from the existing distribution network. This capacity will be made available prior to capital investment projects leading to the eventual ultimate network strategy described in the Section 7.2.

To date the demand growth has been slower than forecast from the original 2016 report. The existing distribution feeders along with project works undertaken to increase and keep pace with the actual load and precinct load growth from firm applications for load include:

West Dapto - North Precinct

- Existing Dapto ZS 11kV feeders DP1243, DP1284 & DP1236/B continue to provide initial capacity,
- Existing Kembla Grange 11kV feeder 25449 continues to provide initial capacity,
- Augmented the rural backbone of feeder 25449 between Sheaffes Rd and Wongawilli Rd to increase capacity, completed early 2020,
- Developed existing 11kV feeder 35590 from Kembla Grange ZS (HVC manufacturing customers closed) to provide a second 11kV feeder to West Dapto North, completed May 2019,
- An 11kV trial 1.5MWh Battery Energy Storage System (BESS) commissioned on feeder 35590 to peak shave morning and evening peak loads, commissioned April 2020.

Calderwood Precinct

- Existing Albion Park ZS 11kV feeders APC2/A and APE2 continue to provide initial capacity,
- Developed new 11kV feeder APF2 (completed February 2019) to off load APC2/A,



- Converted energised and unused 33kV feeder 7123 to 11kV to enable Dapto ZS 11kV feeder
 DP1284 to provide contingency supply to Albion Park ZS feeder APE2, completed early 2021,
- Decommissioning the AFIC at Albion Park ZS (PR770) to enable full capacity of the 3 x 11kV bus sections and enable offloading of feeder APC2/A to APF2, completion scheduled for October 2022,
 - Establish Calderwood Mobile Substation (PR657) with 4 x 11kV feeders, approved 2019 with commissioning scheduled for May 2023.

The interim supply capacity and availability from the existing distribution network in FY23 is estimated and shown in Table 7.

Precinct	Spare Lot Capacity (No.)	Spare Load Capacity (MVA)	Existing Zone Substation
Calderwood	250	1.0	Albion Park
West Dapto – North	625	2.5	Kembla Grange
West Dapto – South & Tallawarra	750	3.0	Dapto
Total	1,625	6.5	-

Table 7 - Estimated Interim Supply Capacity FY23

7.2 Long-term supplies

The dwelling yield expected to materialise in the long-term has been based on historical and forecast dwelling completions provided by NSW Government DPE through the Urban Development Program Dashboard Illawarra-Shoalhaven. There is more uncertainty surrounding the development of the employment lands. As a result, this has not been allowed for within this timeframe. The expected remaining precinct yields (aggregated for all years starting from FY23) are shown in Table 8.

Precinct	Number of dwellings	Employment land (km²)	Expected load (MVA)	Planning Status
Calderwood (part)	5,995	0	22.54	Partially Rezoned and Released for planning
West Dapto – North & South	17,469	0	65.68	Partially Rezoned and Released for planning
Tallawarra	900	0	3.38	Released for planning
Total	24,364	0	91.6	-

It can be seen in the dwelling yield provided in Table 8 that demand is greater than the spare capacity available in the existing distribution network for all precincts. The estimated load is significantly greater than the existing spare capacity of 6.5MVA shown in Table 7.

To service the development within the Calderwood precinct it is proposed that consideration be given to redeveloping Calderwood ZS as a traditional ZS with 2 x 25MVA transformers and a 33kV busbar to facilitate two incoming and two outgoing 33kV feeders. Potentially the 33kV to 11kV packaged substations installed as part of the short-term plan would become redundant. Load flow modelling has been carried out for contingency tables. Load flow modelling indicates no existing 33kV line augments would be required on the Mt Terry TS system.



- To service the increasing West Dapto North & South load the establishment a permanent 132/11kV ZS
- with 2 x 45MVA transformers would be required. This new ZS along with existing Dapto and Kembla
- Grange ZS's are likely to provide sufficient capacity. This will ultimately hinge on economic conditions at
- the time driving demand. Load flow modelling carried out for the ultimate load confirms availability of capacity
- capacity.

The network augmentation required in the long-term strategy presented below will be subject to individual business case approval and the timing of projects will depend on the actual pace of development.

7.3 Proposed long-term network topology

Given the anticipated load of the West Lake Illawarra development area and the geographical spread of this load across the various precincts, a network topology has been developed to service the growth area by best utilising the existing assets. Further, the proposed network is broadly based on the design requirements of Section 5.0 and Endeavour Energy's Substation Design Instruction (SDI) 501 Network Configuration Standard.

Figure 6 below provides the overview of the long-term network topology foreseeable for the West Lake Illawarra.

Assuming a combined 132kV and 33kV transmission utilisation solution indicates a credible solution may involve establishing the following number of firm Endeavour Energy Zone Substations (source: SDI 501 – Network Configuration) and a private High Voltage Customer (HVC) substation (Illawarra International Health Precinct):

- Two 132/11kV 45MVA firm Zone Substations (West Dapto ZS & Avondale ZS)
- One 33/11kV 25MVA firm Zone Substation (Calderwood ZS)
- One 33kV 15MVA capacity HVC substation

The installed ZS firm capacity would equal 115MVA plus a 15MV HVC provides a total capacity of 130MVA.

Options for 33/11kV zone substations will include package substations as well as conventional substation design.





Figure 6 - West Lake Illawarra Long-Term Area Plan - Geographic

To determine whether the existing TS's and BSP have sufficient capacity to supply the long-term needs of the West Lake Illawarra precinct, the additional substation capacity can be compared to the expected ultimate demand on the network. Table 9 below shows the expected demand on Mount Terry TS slightly exceeds the firm rating by 21%. Typically, the diversity between all substations supplied by Mount Terry TS may reduce the actual load to less than the firm rating. Overall, the Dapto BSP (with Tallawarra Generation), Springhill TS and Mount Terry TS have sufficient capacity to support the solution requiring two 132kV 45MVA ZS's, one 33kV 25MVA ZS and one 33kV 15MVA private HV Customer in the West Lake Illawarra development area.



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Table 9 - Ultimate Load Forecast for combined 132kV and 33kV long-term solution

Substation	Voltage (kV)	Firm capacity (MVA)	W 2030 & S 2031 (MVA) Undiversified	Expected Ultimate Load (MVA) Undiversified
Dapto BSP	330/132	750	842 ⁸ /412 ⁹ & 785 ⁸ / 355 ⁹	956 ^{8,10} / 630 ⁹
Springhill TS	132/33	240	164& 156	206
Mount Terry TS	132/33	120	112& 110	136 ¹⁰
West Dapto ZS	132/11	proposed 45	N/A	45
Avondale ZS	132/11	proposed 45	N/A	45
Calderwood	33/11	proposed 25	N/A	25
I.I. Health Precinct	33/11	proposed 15	N/A	15

In summary, provisions from Table 4 and Table 5 along with Table 9 clearly demonstrate that proposed long-term solution requires minimal augmentation projects to sub transmission lines and either the BSP or TS's minimising capital expenditure.

 $^{^{\}rm 10}$ Diversity in actual load may prevent load at risk at Mt Terry TS



 $^{^{\}rm 8}$ This ultimate load is without Tallawarra Generator -0.0MVA

⁹ This ultimate load is with Tallawarra Generator -430MVA

7.4 Indicative timing of investment and cost estimates

Timing of individual projects will be based on principles outlined in the area plan and will be developed separately with funding sought for each project at the appropriate time. This will be in line with evidence based (actual committed load) approach, which will ultimately determine the network requirement date.

The cost of implementing the preferred, long-term network solution has been estimated along with the specification of the associated works and is shown in Table 10. The estimates estimate of 33kV line works associated with Illawarra International Health Precinct.

Asset	Cost per unit (\$/Sub or \$/km)	Works	Estimated Cost
33kV feeder Bay ZS	\$2.5m	2	\$5.0m
45MVA 132/11kV ZS	\$19.5m	2	\$39.0m
15MVAr Reactive Support	\$2.0m	1	\$2.0m
132kV Line Works	\$0.92m	6.5km	\$6.0m
25MVA 33/11kV ZS	\$17.0m	1	\$17.0m
33kV Line Works	\$0.99m	35.7km	\$35.3m
33kV Line 7017 & 7120 Reconfiguration Works	\$0.25m	1	\$0.25m

Total

Table 10 - Indicative cost estimate of the preferred long-term solution



\$104.6m

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Stakeholder engagement and challenges

• 8.1 TransGrid joint planning

TransGrid are the Transmission Network Provider in NSW. They provide the main grid injection points in the form of Bulk Supply Points that supply Endeavour Energy's network, and, as such, the two organisations conduct joint planning in relation to these connection points. The estimated 128MVA of load in the West Lake Illawarra development area will impact TransGrid's network. TransGrid's Dapto BSP will ultimately be required to provide the capacity the development area and the Marulan BSP may be required to provide support under an N-1 contingency should Avondale ZS be connected as a 132/11kV ZS. The issues concerning this option will be progressively explored in future joint planning meetings between the two organisations.

8.2 Developers

To obtain the appropriate land to build each zone substation and the corridors for the connecting feeders, it is important that Endeavour Energy is involved in the subdivision planning stage of developments. The way developments take place is important from a land acquisition and corridor development perspective. It is critical that the following issues be considered and addressed where appropriate based on learnings from experience:

- Endeavour Energy must actively support NSW Planning and Environment in their efforts to coordinate development in areas of fragmented land ownership.
- Early discussions must be held to determine options for incorporating existing and future infrastructure into precinct master plans (involving the NSW Department of Planning and Infrastructure). This should incorporate the need for relocation and the identification of feasible options where required.
- Zone substation sites and line corridors should be identified on precinct master plans from the outset where appropriate.
- Early strategic acquisition of zone substation sites and sub-transmission line corridors can be advantageous due to lower land prices (pre-rezoning) and fewer environmental constraints (not surrounded by existing residential dwellings). However, the Foreign Investment Review Board (FIRB) mandates a maximum holding period between acquisition and development of land by Endeavour Energy. This limitation must be carefully considered during the planning process.
- Transmission line design and construction has a longer lead time than zone substations due to the ability to secure appropriate line routes. Consideration should be given to lead times and final commissioning dates when issuing projects with significant sub-transmission line design and easement acquisition.

There is a need to have a consistent process by which the necessary properties and line easements can be acquired. The preferred option would be suitable substation locations and line corridors are identified at an early stage and these included on precinct master plans. As design work on the development proceeds, final details of sites and corridors can be determined in discussions between developers and Endeavour Energy.

8.3 Environmental impacts

The construction and upgrading of zone substations and the connecting lines will be assessed under the Environmental Planning and Assessment Act (1979) (the Act). Reviews of Environmental Factors (REFs) will be prepared for all activities and depending on the impacts of the proposals, Environmental Assessments may be required for some of the works and therefore extensive community involvement and community consultation would be required. Depending on the complexity of a project, the Environmental Assessment process can take between 12 - 24 months before environmental approval is obtained and construction of a project can commence. Allowance of sufficient forward planning time is therefore



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- essential. The planning process needs to ensure that electrical infrastructure can be installed in strategic
- locations and be located adjacent to suitable compatible land uses to minimise the impacts to the
- environment and the community.



Recommendations

- In conclusion, the revision endorses the original recommendations of this Area Plan in full as follows:
 - The proposed Ultimate Network Topology (long-term combined 132kV and 33kV transmission solution) outlined within this report be carried forward as the basis for further planning within the West Lake Illawarra area. Individual projects based on the principles outlined in this report will be developed separately and funding sought for each of these projects at the appropriate level and time. Additionally, Endeavour Energy is working on following individual projects in the Area:
 - Case for Investment (CFI) NPR-0000013 New West Dapto ZS estimated commissioning late FY28 / early FY29 and,
 - CFI NPR-000063 New Calderwood ZS (permanent) estimated commissioning late FY28 / early FY29.
 - 2. Continue Joint Planning with TransGrid for the additional load required to be supplied by 330/132kV Dapto Bulk Supply Point (BSP) and potential N-1 backup security from Marulan BSP.
 - 3. Continue in collaborative working relationships with Developers and the Department of Planning and Environment to ensure that zone substation sites and line corridors are included in the development of master plans for West Lake Illawarra precincts.
 - 4. Continue discussions with the with the Illawarra Urban Development Committee chaired by NSW Department of Planning and Environment, Wollongong City Council and Shellharbour City Council on an ongoing basis to ensure that Endeavour Energy's staging for the establishment of major infrastructure is in line with projected development timing.

It is noted that demand management initiatives and changes in electricity demand may modify the ultimate load of the West Lake Illawarra development area as well as the timing of the required infrastructure. It has, however, been shown that the recommended ultimate network strategy along with the immediate and near-term network strategy's is flexible enough to cater for the uncertainty in the greenfield West lake Illawarra development area.



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