Case For Investment(CFI): Lowes Creek Maryland Capacity Constraints

September 2022

Endeavour Energy

Version	Date	Comments
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Investment Title	**Lowes Creek Maryland Capacity Constraints**
NPR-000044 (PR423)	Lowes Creek Zone Substation (ZS) Establishment
Portfolio	Augex
CFI Date	September 2022
Pre RIT-D	☒
Final CFI	☐
Other	☐

1. Executive Summary

This Executive Summary sets out an overview of the proposed investment, including the underlying need, our recommended solution, a discussion of the key drivers, and the options considered to address the identified need. These aspects are covered in detail in the body of the CFI.

1.1 Need / Background

The planned development precincts are comprised of Lowes Creek Marylands, Pondicherry and South Creek West (1-5), located within the Sydney's South West Growth Area, within the Camden Local Government Area (LGA). These precincts will ultimately account for approximately 40,000 new residential dwellings by 2051 and ancillary loads consisting of town centres, schools, community facilities and future commercial spaces. Based on connection enquiries received, the precincts of Lowes Creek Marylands, Pondicherry and one of the five South Creek West precincts, known as Cobbitty South Creek West (5), will account for 13,500 lots by 2031.

These precincts are expected to require approximately 86 MVA capacity by FY51 and 36 MVA by 2031 in the Marylands precinct. This growth in new demand forms the basis for this case of investment. This CFI only includes options for investments for precincts that have submitted connection enquiries as described above. The remaining development area stages will likely be required after 2030 and will be covered in a separate CFI when the need or trigger arises.

The area is currently supplied by Oran Park Zone Substation (ZS), which has a total capacity of 90 MVA and a firm capacity of 45 MVA. The largely residential densification of the area will result in load at risk from 2024, when the firm capacity of Oran Park ZS is exceeded. From then, there will be a large amount of load at risk and ultimately sustained involuntary load shedding. This will result in customers not being able to connect to the network, which contravenes Endeavour Energy's obligation to provide connection services. A project is required to service future customers in the areas surrounding the Oran Park ZS.

Figure 1 below describes the decision rule from Endeavour Energy's growth servicing strategy to determine the approach required to address the trigger and need. Based on the decision rule, the identified need is such that it is sub-optimal for Endeavour Energy to do nothing because:

- Based on characteristics of growth, this investment is classified as **greenfield**.
- Identified need based on consequence of no action for the greenfield development is **reliability corrective action**[1].

[1] Refer to Growth Servicing Strategy for definitions of greenfield and brownfield sites.

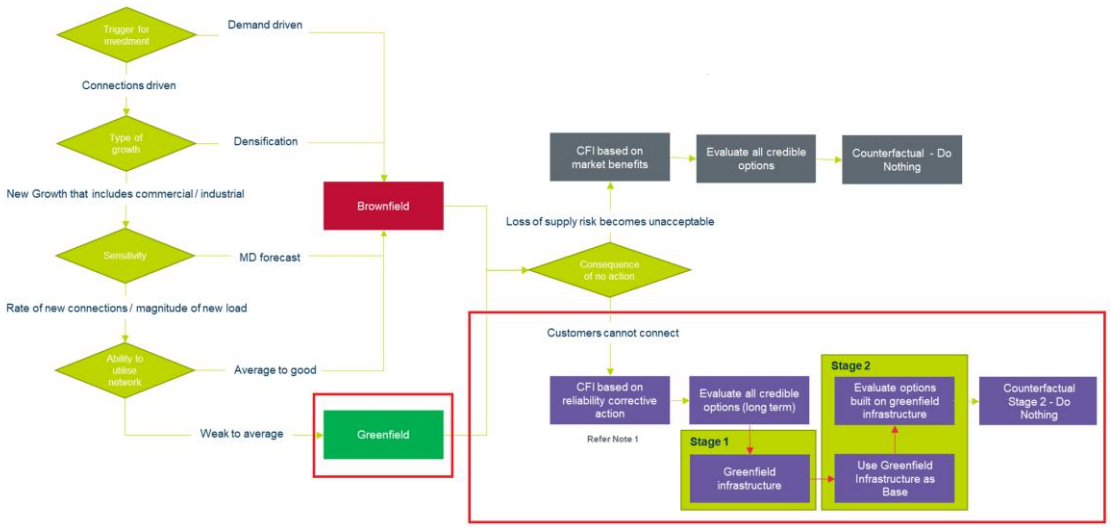


Figure 1 - Decision Rule from Endeavour Energy's Growth Servicing Strategy

1.2 Options Considered

1.2.1 Long Term Network Options

Based on gathered credible growth information, there is a definite need for increased capacity in the abovementioned precincts to connect future customers from the proposed developments. Increasing the electrical capacity requires investment in infrastructure, which

- finds the right balance between short-term and long-term needs, and
- provides the choices (network or non-network) for future growth of electricity infrastructure investment is not constrained.

As a result, various network topologies based on the ultimate demand were tested and the costs and benefits of these ultimate configurations were compared over a sensible time horizon (i.e., what is likely demand within 10-15 years). Table 1 below summarises the network options that were considered to address the identified need of supplying the new connections in the precincts.

Based on the performed quantitative and qualitative analysis, the preferred ultimate option is **Option 2** (establishment of a Lowes Creek ZS with 2 x 132/11kV 45MVA TX) as it has the most significant economic benefit being NPV positive **$565.3 Million.** This option provides the greatest benefit by providing the most significant reduction in unserved energy allowing the greatest number of customers to connect.

Option 2 which proposes establishment of a new Lowes Creek ZS will provide more long-term benefits than all other options considered. However, we note that Option 2 has a marginally higher NPV than Option 1 ($558.7 Million), which proposes establishment of a third transformer at Oran Park ZS in the first stage of the project. There is additional qualitative justification for selecting Option 2 over Option 1, despite it not being the least cost solution.

These would be:

- Lowes Creek ZS will be located within the heart of the load centre signalling the strength of future development in this area which can draw interest and facilitate residents' uptake/interest in later stages.
- Cable congestion from Oran Park ZS to supply Lowes Creek ZS. Once the existing ducts are constrained, expensive augmentation would be required to uprate the cables to suit future growth in these areas.

- The mismatched Tx at Oran Park ZS could cause an operational constraint on the network which limits solar export from customers which does not align with EE's Distributed Energy Resources (DER) enablement strategy.
- Establishing Lowes Creek ZS will shift load off Oran Park ZS and could defer future network investment of the existing substation.

For these reasons, **Option 2** (establishment of 2 x 132/11kV 45MVA TX at Lowes Greek ZS) represents the preferred ultimation solution to supply the region.

Table 1 - List of Long-Term Network Options

Option	Description	Solution Type	NPV [1] $M	Rank	Assessment
1	Install 3rd TX at Oran Park ZS in 2027 and Lowes Creek ZS with 1 x 132/11kV 45MVA TX in 2035	Network solution	$558.7M	2	Several technical limitations expected.
2	**Establish Lowes Creek ZS with 2 x 132/11kV 45MVA TX in 2027**	**Network solution**	**$565.3M**	**1**	**Greatest Net Benefits, Preferred Long Term Option**

Notes:
1: The NPV is based on the central scenario.

1.2.2 Phasing of the Preferred Network Option

To ensure that the proposed headwork infrastructure represents the minimum network infrastructure required to service the step-change in new load, Endeavour Energy compared Option 2 against Option 3, which defers the installation of the 2nd transformer by four years.

Option 3 has a slightly higher value of NPV ($566.2M) than Option 2 ($565.3M) over the study period (30 years). To compare the options, a comparative NPV analysis was completed, which baselines Option 3 against Option 2 (preferred long-term solution). The results of the comparison are outlined in Table 2.

Table 2 shows that Option 3 is NPV positive when baselined against Option 2, in which the benefits of deferring the 2nd transformer do outweigh the quantified cost of unserved energy. **For these reasons, Option 3 is the preferred network option.**

Table 2 - Comparative NPV Analysis

Option	Description	Solution Type	Relative PV Cost[1] $M	Relative PV Benefits[2]	Relative NPV [3] $M	Comments
3	Establish Lowes Creek ZS with 2 x 132/11kV 45MVA TX - Staged Build 4-year deferral of 2nd Transformer (FY31 commissioning year)	Network solution	-0.12	+0.63	+0.51	Technically feasible, greater relative benefits compared to Option 2 (Long Term Network Solution

Notes:
1: The PV cost relative to Option 2 (Highest NPV long term solution)
2: The PV benefits relative to Option 2 (Highest NPV long term solution)
3: The breakdown of PV is based on the central demand forecast scenario

1.2.3 Non-Network Options

The New Technology Master Plan (NTMP) tool was used to evaluate credible non-network options against the constraints in the existing distribution network. The NTMP tool and the subsequent qualitative analysis found following credible non-network solutions which could potentially defer network investment:

- Grid Scale Storage – a possible non-network solution that can potentially defer network investment by 1 year
- Small Scale Demand Response – a possible non-network solution (new development) that can potentially defer network investment by 3 years

1.3 Recommendation and Next Steps

Based on the Endeavour Energy's RIT-D process (Figure 2), it is recommended that:

- A Non-Network Options Report be issued seeking submissions for non-network options prior to proceeding to the Draft Project Assessment Report (DPAR), given that there are credible non-network options available.
- If a feasible non-network option submission is received, the economic evaluation for this project will be revised to assess whether the non-network option will defer the preferred network option.
- The CFI will be finalised at the completion of the RIT-D process and a final approval will then be submitted to the confirm if the scope will include a non-network option and if the recommended timing of investment of the preferred network option will change.
- If a feasible and cost-effective non network option is not received, the best NPV network solution is the establishment of a new **132/11kV 90MVA zone substation** (**Option 3**) in a staged manner to supply the Lowes Creek Marylands, Cobbitty South Creek West and Pondicherry precincts (prior to 2027). Currently, this option represents a highest value (economic benefit) being NPV positive **$566.2 Million** and represents the best option to connect customers. Stage 1 of this option is estimated to cost **$13.3 Million** and is expected to be spread over three years from 2025 to 2027.
- It is recommended that the project value of **$13.3 Million** be approved for consideration in the FY25-FY29 regulatory period.

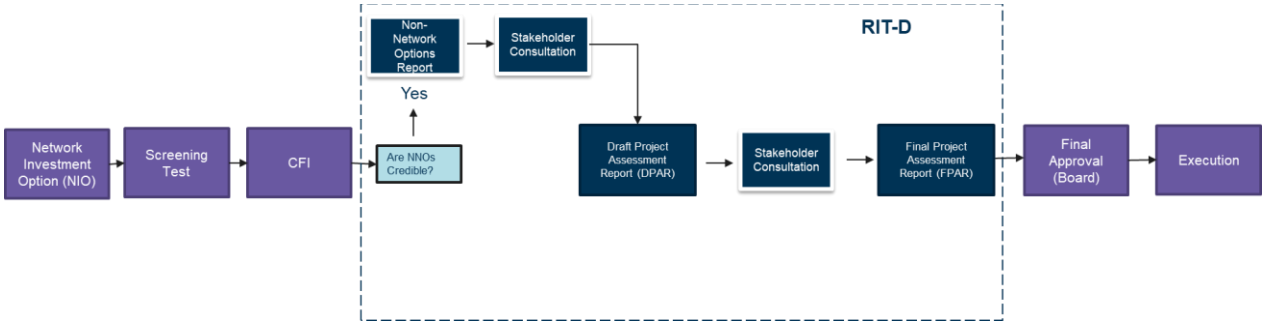


Figure 2 - Endeavour Energy's RIT-D Process

2. Project Proposal

2.1 Identified Need or Opportunity

The CFI within this area has arisen due to the need to service the planned development precincts of Lowes Creek Marylands, South Creek West and Pondicherry, which are located within the central-west portion of Sydney's South West Growth Area (SWGA), within the Camden LGA.

Identified by the NSW Department of Planning and Environment (DPE) for future urban development, these three precincts will ultimately account for approximately 40,000 new residential dwellings, as well as ancillary loads consisting of town centres, schools, community facilities and future commercial spaces.

As shown in Figure 2 below the breakdown of the new precinct loads are as follows:

- Lowes Creek Marylands precinct is expected to accommodate 7,000 new residential lots, a new school and community facilities.
- South Creek West is the largest remaining precinct west of South Creek and is expected to contribute approximately 30,000 new dwellings and community facilities. South Creek West 5 (also known as Cobbitty) is expected to contribute approximately 3,800 new dwellings and community facilities.
- Pondicherry is expected to accommodate 2,700 new dwellings, community facilities, schools, centres, and a variety of outdoor recreational type spaces.

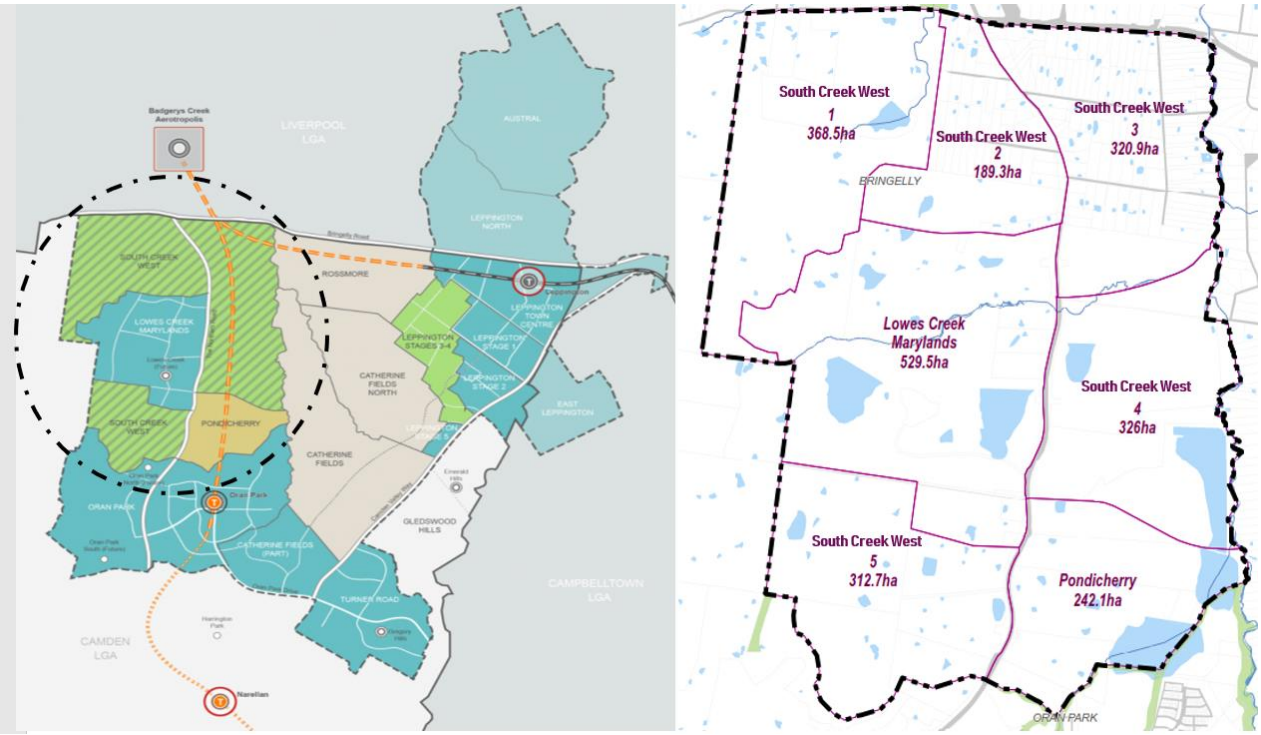


Figure 3 - South West Growth Area showing precinct development boundaries [1][2]

Furthermore, whilst DPE has released a high-level overview of how many lots they are preparing to release, Endeavour Energy's customer networks solutions and planning sections have received several connections enquires relating to the supply of electricity to these associated developments, accounting for a total of approximately 14,000 residential lots, town centres, schools, and other ancillary loads. Off these

new 14,000 dwellings; 7000 will be from Lowes Creek Marylands, 3731 from Cobbitty South Creek West (South Creek West 5) and 2700 lots from Pondicherry, as shown in

Figure 4. Combined, these precincts account for a maximum demand of 85.9 MVA by 2051which forms the need for this CFI.

In conjunction with council and developers, via their consultants and Accredited Service Providers (ASP) during their enquiries, Endeavour Energy has been able to produce a high-level forecast of when these lots and associated loads are expected to be delivered[2].

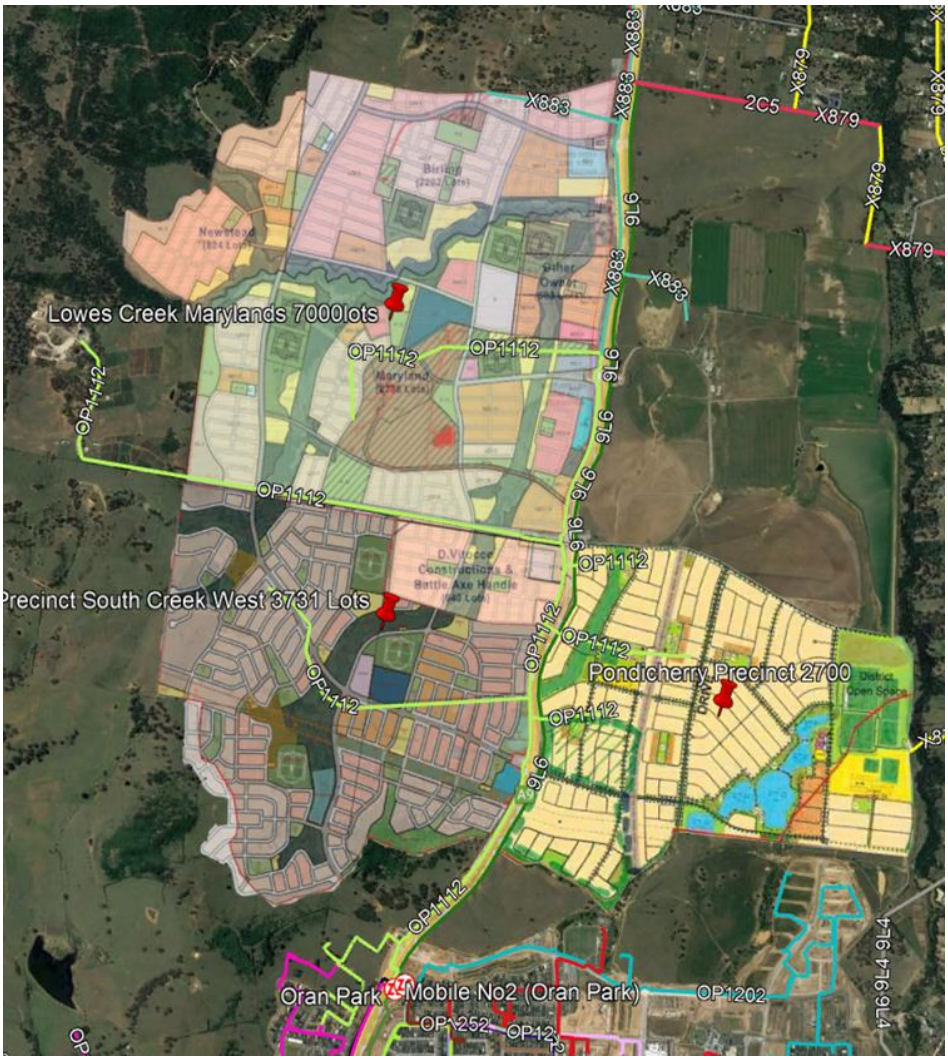


Figure 4 - Connection Enquiries received by Endeavour Energy

[2] Since no lot release information has been provided to Endeavour Energy for the South Creek West Precincts (1-4) at this time, it has not been included in the demand forecast used to produce this CFI.

2.2 Existing Infrastructure

2.2.1 Initial load growth

Endeavour Energy is currently supplying the South Creek West Precincts 1-3 mainly from Bringelly ZS. The remaining load is serviced from Oran Park ZS in the interim before new infrastructure can be established at Lowes Creek Marylands.

This area is currently being serviced from Oran Park ZS via two 11kV distribution feeders, OP1112 and OP1122, which extend into, or near, the three precincts and will be able to provide some capacity to service the residential lots.

Oran Park ZS has two 45 MVA 132/11 kV transformers and is supplied via two 132 kV feeders (9L3 and 9L6). Total installed capacity of Oran Park ZS is 90 MVA with a firm (N-1) capacity of 45 MVA. A Single line diagram (SLD) of Oran Park ZS and the surrounding network is shown on Figure 5.

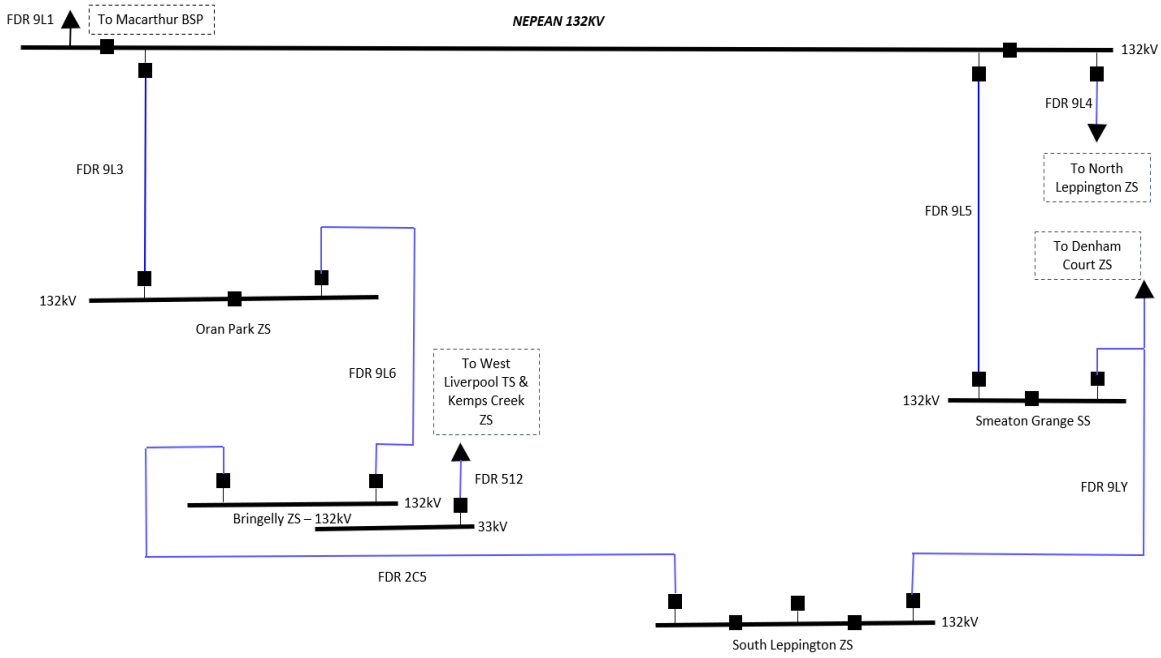


Figure 5 - SLD of Oran Park ZS including relevant surrounding network

2.2.2 Limitations of existing infrastructure

Following two limitations of existing infrastructure that will result in unserved energy due to the insufficient load transfer potential from neighbouring zone substation and feeders have been identified:

- **Insufficient capacity of Oran Park ZS:** This is the main constraint in the area. Oran Park ZS has a total capacity of 90 MVA and a firm (N-1) capacity of 45 MVA under a contingency event such as a transformer failure. When the forecasted load is greater than the firm capacity, it will lead to load at risk leading to unserved energy.
- **Constrained surrounding 11kV network:** Initial capacity for the new growth in the Lowes Creek Marylands, Cobbitty South Creek West and Pondicherry precincts was assessed to approximately 6 MVA via four 11kV distribution feeders from Oran Park ZS (two existing, two future). Through organic growth within the existing Oran Park precinct, the two future feeders are expected to run slightly north in the direction of these precincts. Since these feeders will be initially run to service the loads derived from the Oran Park precinct, it is expected that ultimately a capacity of approximately 6 MVA will be available to these three new precincts, through feeder

extensions, before new feeders will be required. This consideration also accounts for the offloading of 11kV Feeder OP1122, shown in Table 3 below, and is based on a typical backup capacity of 1.5MVA per feeder.

Table 3 - Existing Oran Park Distribution Feeder Loads

Zone Substation	Feeder	Design Rating (MVA)	Load S2021 (MVA)
Oran Park	OP1112	4.57	0.85
	OP1122	4.57	4.74

In summary, the primary constraint in the Oran Park network is the capacity available from Oran Park ZS. The secondary constraint is the limited capacity available within existing 11kV distribution feeders. For this CFI, only the primary constraint has been considered in the technical and economic assessment.

2.2.3 New Load Growth

The new load growth can be summarised into the following developments based on information provided by South West Growth Area, Camden Council area plans, and developer technical enquiries:

- Lowes Creek Marylands precinct – approximately 7000 lots in total, starting from 2027
- Cobbitty South Creek West (South Creek West 5) precinct – approximately 3731 lots, starting from 2024
- Pondicherry precinct – approximately 2700 lots, starting from 2027

These precincts combined account for a maximum demand of 85.9 MVA by 2051. Assumptions related to the estimation of maximum demand are as follows:

- Straight line growth for residential load (same as DPIE)
- Growth rate is 2.5%
- 5.4kVA/lot for all residential blocks
- Local centre loads appear 1/3 into the development timeline
- 1 MVA of load for schools in each precinct
- Local centre loads are 500kVA (Woolworths, McDonald's, Service Stations etc.)
- 3 MVA of load for major town centre

The developments are well progressed as shown in Table 4 which shows the status of the three important criteria to determine the timing of the investment. The table shows the growth is likely in the short term which will require investment.

Table 4 - Criteria for Investment Timing

Criteria	Low or later growth time frame	Moderate growth in medium term expected	High growth likely in shorter term
Zoning status	Not part of any official release area and not rezoned	Part of official release area but not rezoned yet	Yes rezoned

Criteria	Low or later growth time frame	Moderate growth in medium term expected	High growth likely in shorter term
Development status	No current activity	First stages already planned /committed to	construction commenced for initial stages
Supporting infrastructure (water/sewer, roads, transport)	Lack of other infrastructure commitment	Planned/committed initial stages of other infrastructure	Significant progress on roads and transport and water/sewer infrastructure already

2.2.4 Demand Forecast

The expected demand forecast at Oran Park ZS is shown in Table 5 below and covers central, high, and low forecast cases. The high forecast case represents 110% of central forecast case while low forecast case represents 90% of central forecast case. The following load components were considered for the demand forecast at Oran Park ZS:

- Load growth surrounding Oran Park area which was captured in the November 2021 Summer Demand Forecast (SDF)
- Several new applications within the Oran Park area
- The load forecast for new precincts of Lowes Creek Marylands, Pondicherry and Cobbitty South Creek West 5.

The expected demand forecast for each of these components individually is detailed in Appendix A.

A diversity of 80% was used when summating all loads. Endeavour Energy believes this forecast is a conservative forecast to strengthen the case for this CFI. This load forecast is used for business as usual (BAU) base case (“No proactive Intervention”).

These developments will result in load at risk from 2024, when the firm capacity of Oran Park ZS is exceeded (Figure 6). From then, there will be a large amount of load at risk and ultimately sustained involuntary load shedding, resulting in considerable unserved energy and loss of supply. This will result in customers not being able to connect to the network, which contravenes Endeavour Energy’s obligation to provide connection services. An investment into additional electrical capacity in this area is required to meet these requirements. Consequently, this investment is considered a reliability corrective action under Section 5.2.3(d) of the NER.

The other network options involving establishment of a new zone substation at Lowes Creek Marylands Precinct (Option 1, 2 & 3). For these options, the demand forecast was split into two sub-forecasts:

- a forecast for what Oran Park ZS will ultimately supply, and
- a forecast for what Lowes Creek ZS would ultimately supply

This forecast is shown in Table 6 below, with the proposed substation supplying Lowes Creek Marylands, Pondicherry and a third of Cobbitty South Creek West 5. The remaining load is supplied by the existing Oran Park ZS. Option 1 proposes establishment of a new Lowes Creek ZS in 2035 implicating that before 2035, the load will be entirely supplied by upgraded Oran Park ZS as shown in Table 8. Option 2 and 3 propose establishment of a new Lowes Creek ZS in 2027, after which the load will be split between existing Oran Park ZS and a new Lowes Creek ZS (Table 12).

Table 5 - Load Forecast at Oran Park ZS for BAU case

Oran Park ZS- Demand Forecast (DF) (MVA)	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2036	2041
Oran Park ZS - November 2021 SDF	36.4	39.0	43.2	46.2	48.8	51.4	53.1	54.8	57.1	57.0	65.5	74.1
Current CAMS/Additional Oran Park Load	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2
Oran Park ZS - DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Total Oran Park ZS DF Central	37.4	40.0	44.2	47.3	49.9	52.5	54.2	55.9	58.2	58.1	66.6	75.3
Total Oran Park ZS DF Low	33.7	36.0	39.8	42.5	44.9	47.2	48.8	50.3	52.4	52.3	60.0	67.8
Total Oran Park ZS DF High	41.2	44.0	48.7	52.0	54.9	57.7	59.6	61.5	64.0	63.9	73.3	82.8
New Load – DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Oran Park - Commercial Load	0.0	0.0	0.4	0.9	1.3	1.7	2.0	2.4	2.8	2.8	2.8	2.8
Oran Park - Industrial Load	0.0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.1	1.1	1.1
LC Marylands Precinct - Residential Load	0.0	0.0	0.0	0.0	0.0	1.6	3.2	4.9	6.5	8.1	16.2	24.3
LC Marylands Precinct - Commercial Load	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	3.8
Pondicherry Precinct - Residential Load	0.0	0.0	0.0	1.1	2.2	3.2	4.3	5.4	6.5	7.6	13.0	14.6
Pondicherry Precinct - Commercial Load	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	0.8	1.5	1.5	1.5
Cobbitty Precinct - Residential Load	0.0	0.0	1.6	3.2	4.9	6.8	8.6	10.5	12.4	14.3	20.1	20.1
Cobbitty Precinct - Commercial Load	0.0	0.0	0.0	0.0	0.3	0.3	0.6	0.6	0.6	0.6	1.5	1.5
New Load - DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Total New Load - Diversified (80%) - Central	0.0	0.0	1.7	4.5	7.3	11.4	16.0	20.4	24.4	28.7	46.7	55.8
Total New Load - Diversified (80%) - Low	0.0	0.0	1.5	4.0	6.6	10.2	14.4	18.3	22.0	25.8	42.0	50.2
Total New Load - Diversified (80%) - High	0.0	0.0	1.9	4.9	8.0	12.5	17.6	22.4	26.9	31.6	51.3	61.3
Total BAU Load - DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Total BAU Load Forecast Central	37.4	40.0	46.0	51.7	57.1	63.8	70.2	76.3	82.7	86.8	113.3	131.1
Total BAU Load Forecast Low	33.7	36.0	41.4	46.5	51.4	57.5	63.1	68.6	74.4	78.2	102.0	118.0
Total BAU Load Forecast High	41.2	44.0	50.6	56.9	62.9	70.2	77.2	83.9	90.9	95.5	124.6	144.2
Capacity (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Oran Park ZS Total Capacity	90	90	90	90	90	90	90	90	90	90	90	90
Oran Park ZS Firm Capacity	45	45	45	45	45	45	45	45	45	45	45	45
Load at Risk (LAR)	-	-	1.0	6.7	12.1	18.8	25.2	31.3	37.7	41.8	68.3	86.1

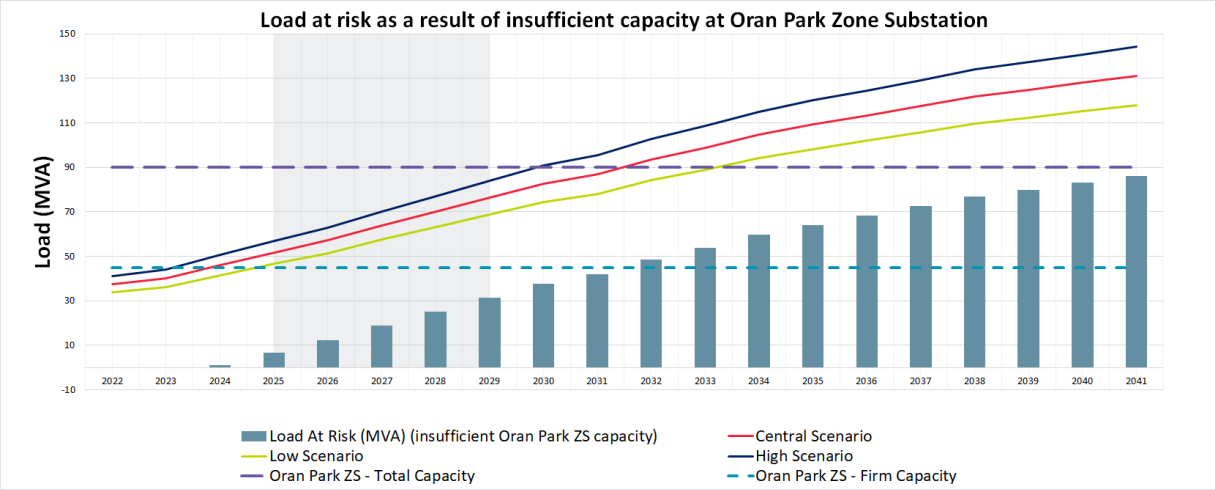


Figure 6 - Load at Risk because of insufficient capacity at Oran Park ZS

Table 6 – Proposed load split between existing Oran Park ZS and new Lowes Creek ZS (load forecast for network options)

Oran Park ZS DF (MVA)	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2036	2041
Oran Park ZS - November 2021 SDF	36.4	39.0	43.2	46.2	48.8	51.4	53.1	54.8	57.1	57.0	65.5	74.1
Current CAMS/Additional Oran Park Load	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2
Oran Park ZS DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Total Oran Park ZS only DF Central	37.4	40.0	44.2	47.3	49.9	52.5	54.2	55.9	58.2	58.1	66.6	75.3
Total Oran Park ZS only DF Low	33.7	36.0	39.8	42.5	44.9	47.2	48.8	50.3	52.4	52.3	60.0	67.8
Total Oran Park ZS only DF High	41.2	44.0	48.7	52.0	54.9	57.7	59.6	61.5	64.0	63.9	73.3	82.8
New Load DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Oran Park - Commercial Load	0.0	0.0	0.4	0.9	1.3	1.7	2.0	2.4	2.8	2.8	2.8	2.8
Oran Park - Industrial Load	0.0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.1	1.1	1.1
Cobbitty Precinct - 2/3 of Residential Load	0.0	0.0	1.1	2.2	3.2	4.5	5.8	7.0	8.3	9.5	13.4	13.4
Cobbitty Precinct - Commercial Load	0.0	0.0	0.0	0.0	0.3	0.3	0.6	0.6	0.6	0.6	1.5	1.5
Total New Load DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Total New Load - Diversified (80%) - Central	0.0	0.0	1.3	2.7	4.3	5.7	7.3	8.7	10.1	11.2	15.0	15.0
Total New Load - Diversified (80%) - Low	0.0	0.0	1.1	2.5	3.8	5.1	6.6	7.9	9.1	10.0	13.5	13.5
Total New Load - Diversified (80%) - High	0.0	0.0	1.4	3.0	4.7	6.2	8.0	9.6	11.2	12.3	16.5	16.5
Total Oran Park ZS DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Total Oran Park ZS DF Central	37.4	40.0	45.5	50.0	54.1	58.2	61.5	64.6	68.4	69.3	81.7	90.3
Total Oran Park ZS DF Low	33.7	36.0	41.0	45.0	48.7	52.3	55.4	58.2	61.5	62.4	73.5	81.3
Total Oran Park ZS DF High	41.2	44.0	50.1	55.0	59.5	64.0	67.7	71.1	75.2	76.2	89.8	99.4
New Load (Lowes Creek ZS) DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**

LC Marylands Precinct - Residential Load	0.0	0.0	0.0	0.0	0.0	1.6	3.2	4.9	6.5	8.1		16.2	24.3
LC Marylands Precinct - Commercial Load	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		2.1	3.8
Pondicherry Precinct - Residential Load	0.0	0.0	0.0	1.1	2.2	3.2	4.3	5.4	6.5	7.6		13.0	14.6
Pondicherry Precinct - Commercial Load	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	0.8	1.5		1.5	1.5
Cobbitty Precinct - 1/3 Residential Load	0.0	0.0	0.5	1.1	1.6	2.3	2.9	3.5	4.1	4.8		6.7	6.7
Total New Load (Lowes Creek ZS) DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**		**2036**	**2041**
Total New Load - Diversified (80%) - Central	0.0	0.0	0.4	1.7	3.0	5.7	8.7	11.6	14.3	17.6		31.6	40.7
Total New Load - Diversified (80%) - Low	0.0	0.0	0.4	1.6	2.7	5.1	7.8	10.5	12.9	15.8		28.5	36.7
Total New Load - Diversified (80%) - High	0.0	0.0	0.5	1.9	3.3	6.3	9.5	12.8	15.7	19.3		34.8	44.8

2.2.5 Related Projects

NLP-000031 (PR737) Lowes Creek ZS Site purchase is expected to occur within FY22.

3. Options Considered

Based on the decision rule from the Endeavour Energy's Growth Servicing Strategy outlined in the Executive summary, the characteristics of the area are as follows:

- **Investment is classified as greenfield.**
- Identified need based on consequence of no action for the greenfield development is **reliability corrective action**[3].

Figure 7 below (subset of the decision rule included in the Growth Servicing Strategy) has been utilised to outline the options.

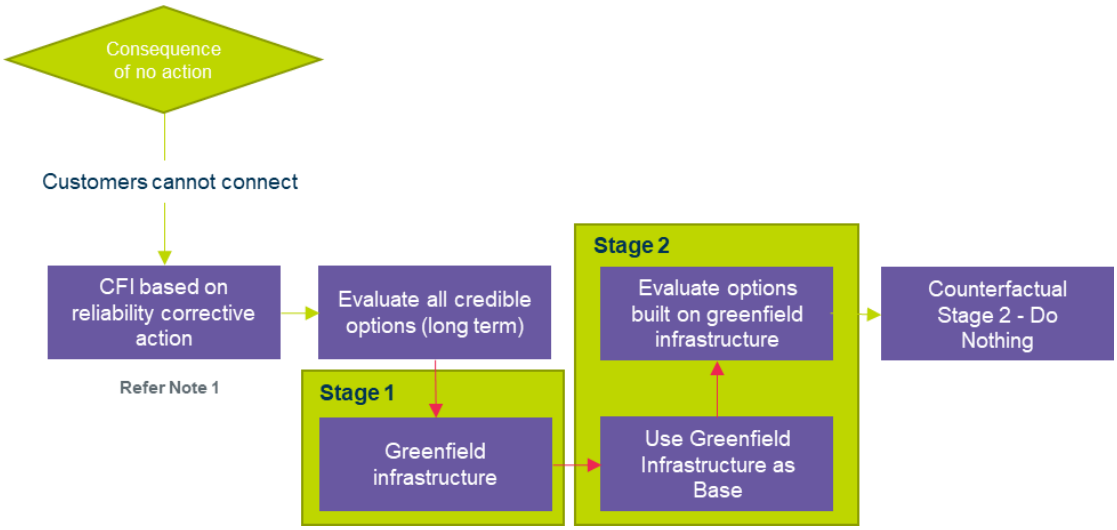


Figure 7 - Decision Rule from Endeavour Energy's Growth Servicing Strategy

3.1 BAU Base Case - 'No proactive intervention'

This chapter examines the risks and benefits of undertaking a non-proactive intervention. Figure 5 above shows the current network configuration with Oran Park ZS as the main source of the supply to meet the capacity of Lowes Creek Marylands, Cobbitty South Creek West and Pondicherry precincts.

The consequence of not proceeding with any investment in these precincts will result in significant unserved energy due to the existing supply network being constrained and incapable of supplying the forecast demand for the area. Most of the Expected Unserved Energy (EUE) is result of the insufficient capacity available from Oran Park ZS

Table 7 and Figure 8 shows the amount and value of EUE. The "No Proactive Intervention" approach will result in significant expected unserved energy in all precincts from 2024 onwards and increased Service Target Performance Incentive Scheme (STPIS) penalties. Without proactive intervention, a risk of unserved energy will remain as shown on Figure 8 and Table 7, and Endeavour Energy may be unable to provide supply security for future developments in the growth area. There are also substantial reputational risks and stakeholder dissatisfaction if Endeavour Energy cannot meet supply requirements for this area.

In terms of Risk Cost assessment, the "No Proactive Intervention" option provides a base case where the risks are valued by applying a Value of Customer Reliability (VCR) to the forecast expected unserved

[3] Refer to Growth Servicing Strategy for definitions of greenfield and brownfield sites.

energy. The VCR values used by Endeavour Energy in its modelling are the same as those published by AER. This approach was endorsed by the AER during the determination process.

It is noteworthy that there is a significant increase in EUE between 2031 (43 MWh) and 2036 (1,222 MWh). This is the based on known information at the time of this CFI (June 2022) and there are several factors that may bring forward (likely) or defer the growth (unlikely). Some of these factors include:

- Incentives from government to fast track the development to recover from the COVID-19 economic downturn.
- Increase in demand with the opening of the Western Sydney Airport and job opportunities in the Western Sydney growth corridor.

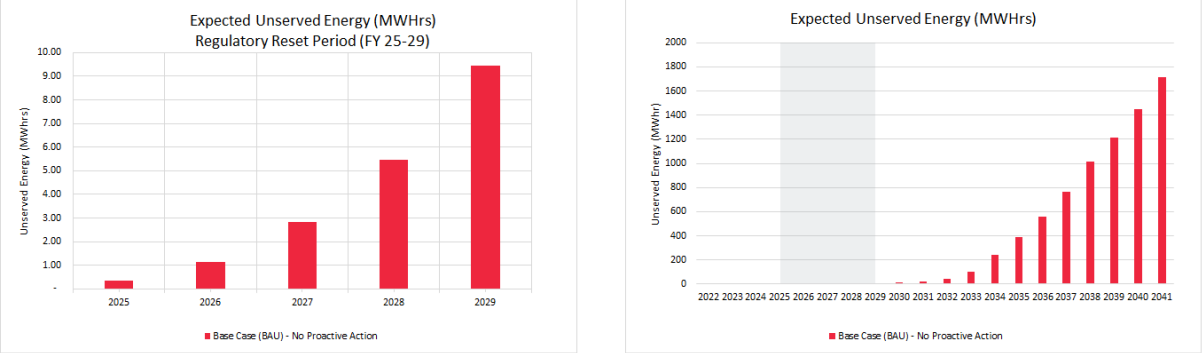


Figure 8 - Expected Unserved Energy as a result of "no proactive intervention"

Table 7 - Value of Expected Unserved Energy as a result of "no proactive intervention"

EUE	2024	2025	2026	2027	2028	2029	2030	2031		2036	2041
EUE (MWh)	0.00	0.33	1.14	2.84	5.46	9.46	15.85	21.41		558.6	1716.9
Value of EUE ($M)	0.00	0.01	0.03	0.07	0.14	0.25	0.41	0.56		14.5	44.7

3.2 Credible Network Options

The National Electricity Objectives (NEO) as stated in the National Electricity Law (NEL) require Endeavour Energy to operate the networks in the long-term interests of consumers. The options in this section sets out the ***credible options*** that were considered, together with a counterfactual option: "*no proactive intervention"* to assist the overall comparison. These include all substantially differing commercially and technically credible options, including non-network solutions. Credible options (or a group of options) are those that meet the following criteria:

- addresses the identified need
- is (or are) commercially and technically feasible
- can be implemented in sufficient time to meet the identified need

Each credible network option is further elaborated in the subsequent chapter.

3.2.1 Option 1 – Establish 3rd transformer at Oran Park ZS in 2027 and 132/11kV 45MVA Zone Substation at Lowes Creek Marylands Precinct in 2035

3.2.1.1 Scope

Stage 1 of this option proposes to install a third 132/11kV 45MVA transformer at Oran Park ZS in 2027, resulting in the zone substation having a firm capacity of 90MVA and a total installed capacity of 135MVA. Stage 1 meets all requirements for medium term network capacity needs, as well as provides the capacity to respond to the additional precincts within the SWGA, namely Catherine Fields North and Catherine Park.

The proposed scope of works include:

Zone Substation:

- 132/11kV 1 x 45 MVA low noise transformer
- Transformer bund and firewall
- 132kV Bus Section Circuit Breaker
- 3 x 132 kV disconnection/earth switches
- 1 x 132kV transformer Circuit Breaker
- 1 x 11kV transformer Circuit Breaker
- 2 x 11 kV Bus Sections (5 feeders on each section)
- 10 x Feeders Circuit Breakers
- New Bus Truck or relocation of existing bus trunk and protection and control panels
- Potential relocation of security fence (minor)

Distribution:

- Establish 8 x 11kV feeders (new) into the existing 11kV network heading north.

Stage 2 of this option proposes to establish a new 132/11kV Lowes Creek ZS with one 45MVA transformer in 2035. This substation would be located on The Northern Road, 3km north of Oran Park ZS and 3.5km south of Bringelly ZS (Figure 9). Supply would be established to the new substation from a single tee-off connection from existing 132kV feeder 9L6 between Oran Park ZS and Bringelly ZS, via a new 132kV underground cable ideally on Pole 814346, and 80m of new 132kV cable which crosses The Northern Road, as shown in Figure 9 below.

Figure 9 - Potential Lowes Creek ZS site shown in shaded in Grey

Using the new standard substation layouts, which makes use of modular buildings, and provides the base design for a 132kV/11kV, 3 x 45MVA, 24 x 11kV FDR indoor substation on an 8280sqm site, this Option's scopes of works are as follows and the ultimate configuration is shown below in the single line diagram in Figure 10.

Zone Substation:

- 132/11kV 1 x 45 MVA low noise transformer
- 1 x 132kV switchroom which includes a modular GIS switchboard with:
  - 1 x Transformer circuit breaker
  - 1 x Busbar
  - 1 x Feeder Bay
  - 1 x Transmission Bay and
  - 1 x Bus Tie Bay (spare for future)
- 1 x 11kV switchroom with:
  - 2 x 11kV Bus Sections
  - 8 x Feeder Circuit Breakers
  - 1 x Bus Tie (2 x 11kV legs for each TX) and
  - 2 x Transformer Circuit Breakers

Transmission Lines:

- Establish one underground 132kV feeder linkage teeing off 132kV feeder 9L6 loop via a new 132kV UGOH ideally on Pole 814346.

Distribution:

- Additional costs to establish 11kV feeders into the existing 11kV network.

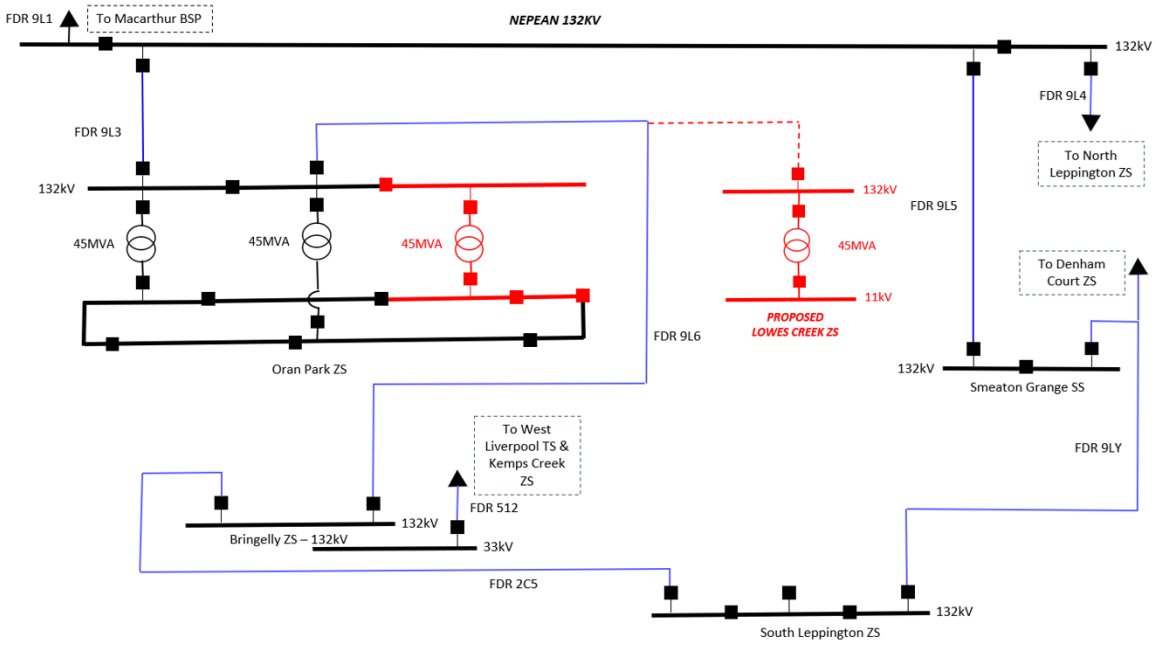


Figure 10 – 132/11kV 45MVA Zone Substation at Lowes Creek Marylands SLD

Figure 11 presents how this option will reduce the expected unserved energy when compared to the BAU base case ("no proactive intervention"). Notably, the load for all three scenarios exceeds the firm capacity (N-1) in 2024 under the central demand scenario. The expected unserved energy consists of the following categories:

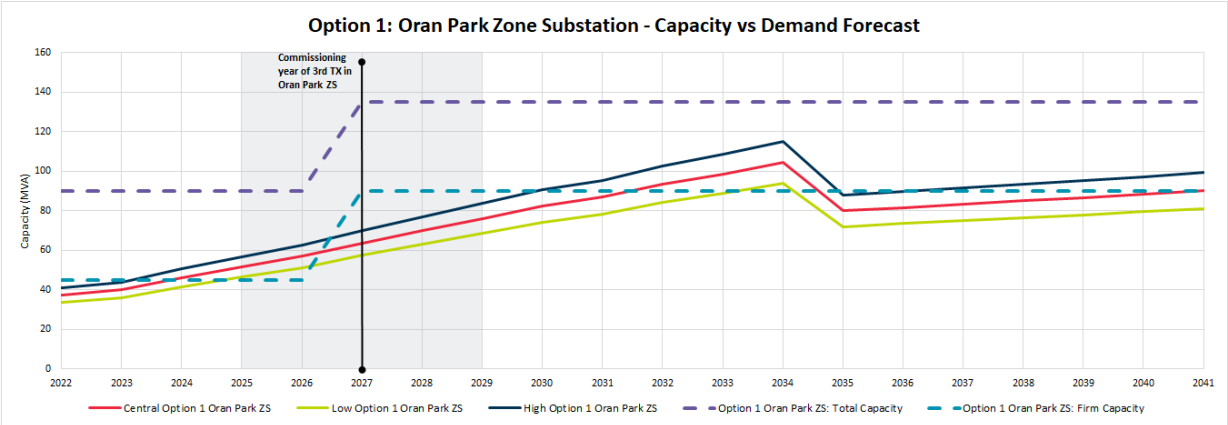
- Unserved Energy due to load at risk at Oran Park ZS based on the demand forecast in Table 8.
- Unserved Energy due to precinct load at Lowes Creek ZS based on the demand forecast in Table 8

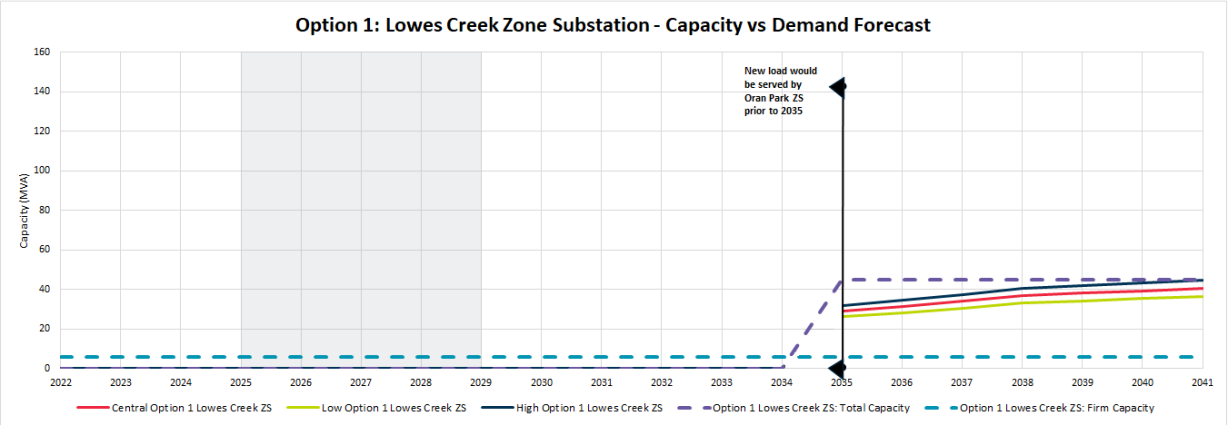
The split of unserved energy between the different substations can be found in Figure 11, Figure 12 and Table 9 which shows that from 2029 onwards, a majority of the expected unserved energy is a result of the limited firm capacity of Lowes Creek ZS.

Table 8 - Load forecast in Option 1 - at upgraded Oran Park ZS and new Lowes Creek ZS (commissioned in 2035)

Oran Park ZS DF (MVA)	2022	2023	2024	2025	2026	2027[1]	2028	2029	2030	2031		2036[2]	2041
Total Oran Park ZS - Option 1 - DF Central	37.4	40.0	46.0	51.7	57.1	63.8	70.2	76.3	82.7	86.8		81.7	90.3
Total Oran Park ZS - Option 1 - DF Low	33.7	36.0	41.4	46.5	51.4	57.5	63.1	68.6	74.4	78.2		73.5	81.3
Total Oran Park ZS - Option 1 -DF High	41.2	44.0	50.6	56.9	62.9	70.2	77.2	83.9	90.9	95.5		89.8	99.4
Total Lowes Creek ZS DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**		**2036**	**2041**
Total Lowes Creek ZS - DF Central	-	-	-	-	-	-	-	-	-	-		31.6	40.7
Total Lowes Creek ZS - DF Low	-	-	-	-	-	-	-	-	-	-		28.5	36.7
Total Lowes Creek ZS - DF High	-	-	-	-	-	-	-	-	-	-		34.8	44.8

Notes:
1: The capacity of Oran Park ZS will be increased by installing a third transformer in 2027 to support the load growth until Lowes Creek ZS is established.
2: The reduction in load at Oran Park ZS in 2035 is due to the proposed commissioning of Lowes Creek ZS. The new precinct load will be shifted from Oran Park ZS to the new Lowes Creek ZS.





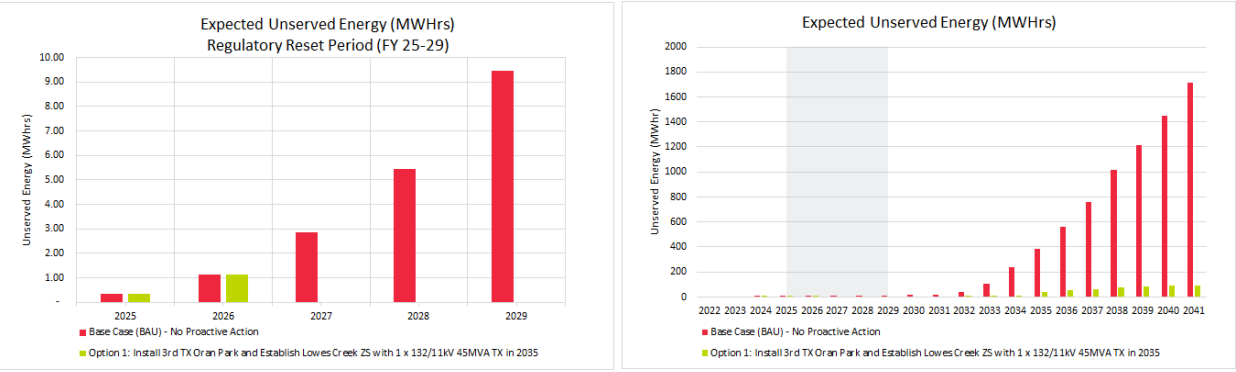


Figure 11 - Summary of Option 1 - Expected Unserved Energy based on central case demand forecast

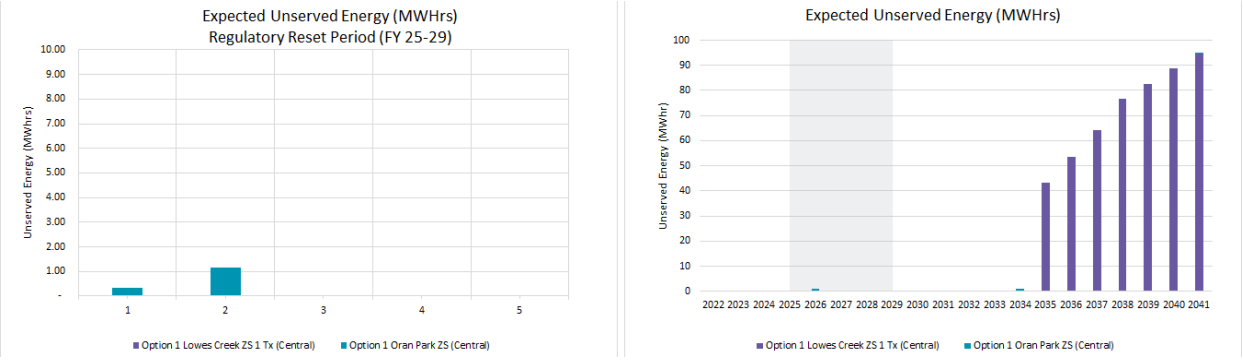


Figure 12 - Breakdown of Expected Unserved Energy for Option 1 based on the central case demand forecast

Table 9 - Breakdown of Expected Unserved Energy for Option 1

EUE (MWh)	2024	2025	2026	2027	2028	2029	2030	2031	2036	2041
Upgraded Oran Park ZS	0.005	0.334	1.139	0.000	0.000	0.000	0.000	0.000	0.000	0.000
New Lowes Creek ZS (1x Tx)	-	-	-	-	-	-	-	-	53.38	94.73

3.2.1.2 Cost

Total estimated capital cost of Option 1 is **$27.3 M**. The cost is spread over three years to align with construction timelines, and it is based on estimates provided by Endeavour Energy's estimating team. Commissioning of the 3rd transformer at Oran Park ZS is planned for FY27 while commissioning of a new Lowes Creek ZS with 1 x Tx 45MVA is planned for FY2035. A summary of the capital cost can be found in Table 10.

The cost of establishing 8 x 11kV feeders (new) into the existing 11kV network heading north is estimated to be approximately $7.2M.

The total present value of costs for Option 1 is $20.09M.

Table 10 - Option 1 - Capital cost summary

Option 1	2025	2026	2027	2033	2034	2035
Stage 1 (3rd Tx at Oran Park ZS)	$1.88M	$5.64M	$5.01M			
Stage 2 (1 Tx at Lowes Creek ZS)				$2.22M	$6.65M	$5.91M

3.2.1.3 Benefits & Net Present Value (NPV)

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the following section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The involuntary load shedding was utilised by the Houston Kemp model (HK model) along with a VCR to calculate a market benefit.

There were no other identified risks that were included in the costs and benefits analysis.

The assumptions used in the HK model are:

- A study period of 30-years.
- The commercial discount rate was set to 3.26% based on the pre-tax real WACC for the 2025-29 determination period and 1.04% for low and high sensitivities.
- A composite VCR of $26,008 was used based on 81% residential and 19% commercial. which is a conservative estimate of the load profile in this area.
- The benefits of options are based on the avoided unserved energy.
- NPV based on the central scenario.

Summary of HK model's output is given in Table 11 below.

Table 11 – Summary of Option 1

Option	PV "Market Benefits" ($M)	PV Costs ($M)	NPV ($M)
1	$578.77M	$20.09M	$558.68M

3.2.2 Option 2 – Establish 132/11kV 90MVA Zone Substation at Lowes Creek Marylands Precinct in 2027

3.2.2.1 Scope

This option proposes to establish a new 132/11kV zone substation with two 45MVA transformers in 2027. Supply would be established to the new substation from existing 132kV feeder 9L6 between Oran Park ZS and Bringelly ZS, via two new 132kV UGOHs ideally on Poles 814345 and 814356, and 170m of new 132kV cable which crosses The Northern Road

Using a standard substation design and establishing a 90MVA 132/11kV zone substation, this option meets all requirements for the medium-long term network capacity needs and provides a local zone substation site closer to the precincts it will service, including the future precinct of South Creek West 4.

Using the new standard substation layouts, which makes use of modular buildings, and provides the base design for a 132kV/11kV, 3 x 45MVA, 24 x 11kV FDR indoor substation on an 8280sqm site, this Option's scopes of works are as follows:

Zone Substation:

- 132/11kV 2 x 45 MVA low noise transformers
- 2 x 132kV switchrooms which includes a modular GIS switchboard with:
    - 2 x Transformer circuit breakers
    - 2 x Busbars
    - 2 x Feeder Bays
    - 2 x Transmission Bays and
    - 2 x Bus Tie Bays (spare for future)
- 2 x 11kV switchrooms with:
    - 4 x 11kV Bus Sections
    - 16 x Feeder Circuit Breakers
    - 2 x Bus Ties (2 x 11kV legs for each TX) and
    - 4 x Transformer Circuit Breakers.

Transmission Lines:

- Establish two underground 132kV feeder linkages looping into adjacent 132kV feeder 9L6 via two new 132kV UGOHs ideally on Poles 814356 and 814346.

Distribution:

- Additional costs to establish 11kV feeders into the existing 11kV network.

The ultimate configuration is shown below in the single line diagram in Figure 13.

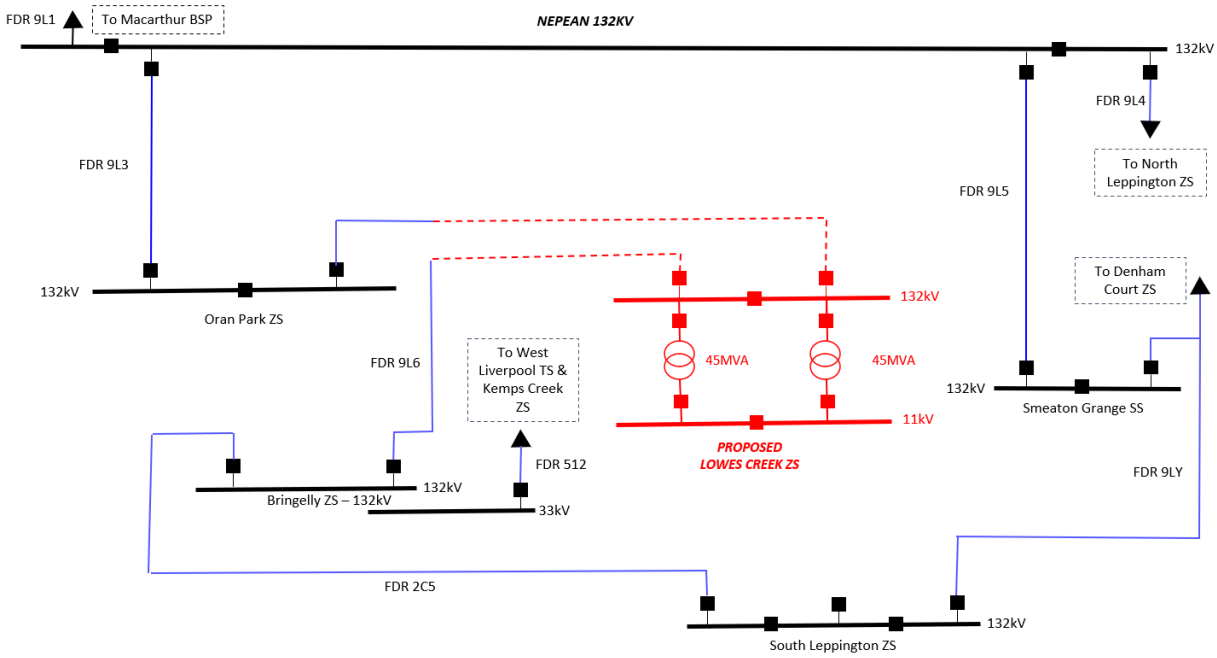


Figure 13 – 132/11kV 90MVA Zone Substation at Lowes Creek Marylands SLD

This option involves the establishment of the Lowes Creek ZS with two 45MVA transformer with supporting 11kV feeders, resulting in a substation with a firm capacity of 45 MVA and total capacity of 90 MVA.

Figure 14 presents how this option will reduce the unserved energy when compared to the base case ("no proactive intervention"). The expected unserved energy consists of the following categories:

- Unserved Energy due to load at risk at Oran Park ZS based on the demand forecast in Table 12 which is not addressed by this option.
- Unserved Energy due to precinct load at Maryland ZS based on the demand forecast in Table 12.

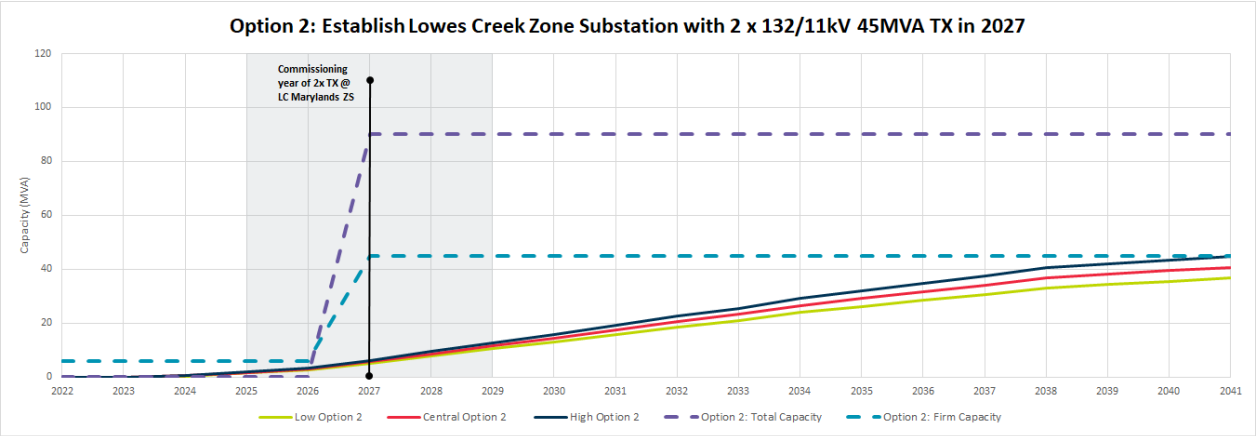
The split of unserved energy between the different substations can be found in Figure 14, Figure 15 and Table 13 which shows that the expected unserved energy is due to the load at risk at Oran Park ZS which is not addressed by this option.

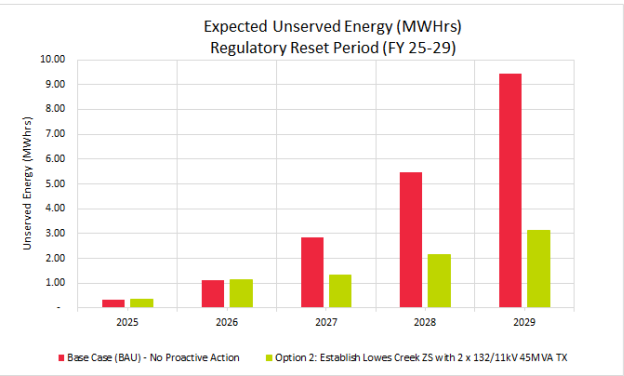
Table 12 - Load forecast at existing Oran Park ZS and new Lowes Creek ZS (commissioned in 2027) - Option 2 & 3

Oran Park ZS DF (MVA)	2022	2023	2024	2025	2026	2027[1]	2028	2029	2030	2031	2036	2041
Total Oran Park ZS - Option 2&3 - DF Central	37.4	40.0	46.0	51.7	57.1	58.2	61.5	64.6	68.4	69.3	81.7	90.3
Total Oran Park ZS - Option 2&3 - DF Low	33.7	36.0	41.4	46.5	51.4	52.3	55.4	58.2	61.5	62.4	73.5	81.3
Total Oran Park ZS - Option 2&3 -DF High	41.2	44.0	50.6	56.9	62.9	64.0	67.7	71.1	75.2	76.2	89.8	99.4
Total Lowes Creek ZS DF (MVA)	**2022**	**2023**	**2024**	**2025**	**2026**	**2027[2]**	**2028**	**2029**	**2030**	**2031**	**2036**	**2041**
Total Lowes Creek ZS - DF Central	-	-	-	-	-	5.7	8.7	11.6	14.3	17.6	31.6	40.7
Total Lowes Creek ZS - DF Low	-	-	-	-	-	5.1	7.8	10.5	12.9	15.8	28.5	36.7
Total Lowes Creek ZS - DF High	-	-	-	-	-	6.3	9.5	12.8	15.7	19.3	34.8	44.8

Notes:
1: The existing Oran Park ZS will supply the load growth until Lowes Creek ZS is established in 2027.

2: After establishment of Lowes Creek ZS in 2027, the new precinct load will be shifted from Oran Park ZS to the new Lowes Creek ZS.





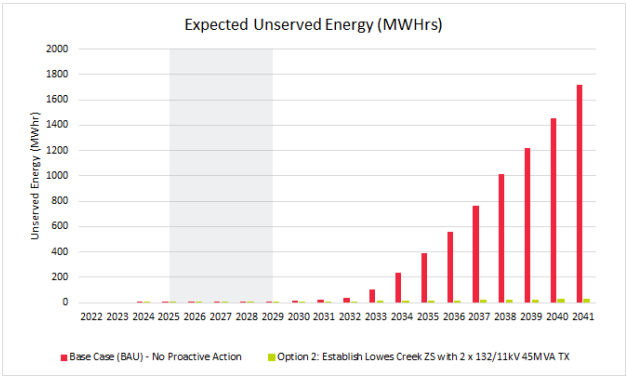
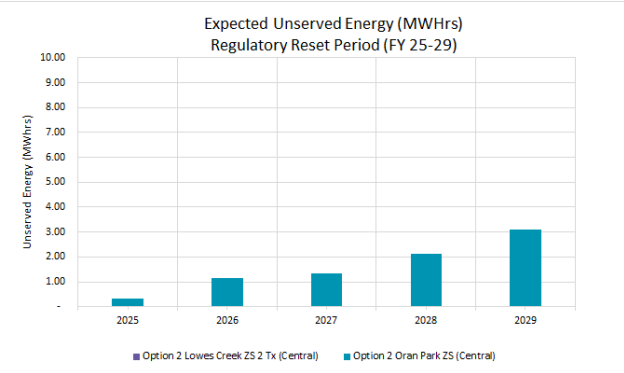


Figure 14 - Summary of Option 3 - Expected Unserved Energy based on central case demand forecast



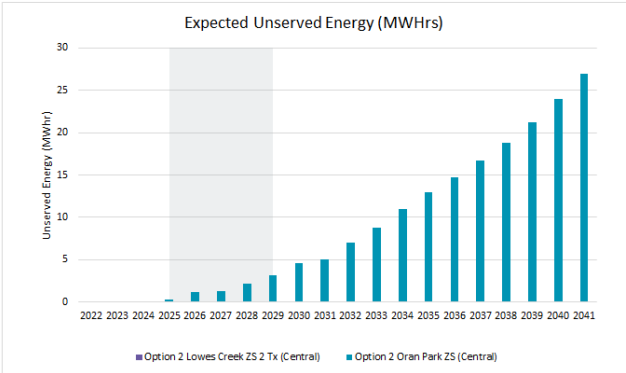


Figure 15 - Breakdown of Expected Unserved Energy for Option 3 based on the central case demand forecast

Table 13 - Breakdown of Expected Unserved Energy in Option 3

Expected Unserved Energy (MWh)	2027	2028	2029	2030	2031	2036	2041
Existing Oran Park ZS	1.339	2.134	3.113	4.593	5.022	14.722	26.950
Lowes Creek ZS (2x Tx)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

3.2.2.2 Cost

The total estimated capital cost of Option 2 is $21.8 M. The cost is spread over three years to align with construction timelines and is based on estimates provided by Endeavour Energy's estimating team.

Commissioning of new equipment from Option 2 is planned for FY27. A summary of the capital cost can be found in Table 14.

The total present value of costs for Option 3 is $16.01M.

Table 14 - Option 3 - Capital cost summary

Option	2025	2026	2027
2	$3.27M	$9.8M	$8.1M

3.2.2.3 Benefits & NPV

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the following section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The involuntary load shedding was utilised by the HK model along with a Value of Customer Reliability to calculate a market benefit. No other identified risks were included in the costs and benefits analysis.

The assumptions used in the HK model are the same as in the case of Option 1. A Summary of HK model's output is given in Table 15 below.

Table 15 – Summary of Option 2

Option	PV "Market Benefits" ($M)	PV Costs ($M)	NPV ($M)
2	$581.26M	$16.01M	$565.25M

3.3 Recommended Long Term Network Option

Table 16 below sets out the credible options that were considered, together with a counterfactual option: "no proactive intervention" to assist the overall comparison. Option 2 represents the highest value (economic benefit), being NPV positive of $565.25 Million compared to other options, even with the sensitivity & scenarios considered in Section 3.6.

Option 2 which proposes establishment of a new Lowes Creek ZS will provide more long-term benefits than all other options considered. However, we note that Option 2 has a marginally higher NPV than Option 1 ($558.7 Million), which proposes establishment of a third transformer at Oran Park ZS in the first stage of the project. There is additional qualitative justification for selecting Option 2 over Option 1, despite it not being the least cost solution.

These would be:

- Lowes Creek ZS will be located within the heart of the load centre signalling the strength of future development in this area which can draw interest and facilitate residents' uptake/interest in later stages.
- Cable congestion from Oran Park ZS to supply Lowes Creek ZS. Once the existing ducts are constrained, expensive augmentation would be required to uprate the cables to suit future growth in these areas.
- The mismatched Tx at Oran Park ZS could cause an operational constraint on the network which limits solar export from customers which does not align with EE's Distributed Energy Resources (DER) enablement strategy.
- Establishing Lowes Creek ZS will shift load off Oran Park ZS and could defer future network investment of the existing substation.

For these reasons, **Option 2** (establishment of 2 x 132/11kV 45MVA TX at Lowes Greek Marylands) represents the preferred ultimation solution to supply the region.

Table 16 – Detailed Summary of Credible Options

Option	Description	Solution Type	PV residual risk[1] $M	PV Cost[2] $M	PV Benefits[3]	NPV [45] $M	Rank	Assessment Description
BAU	No proactive intervention	Base case / counterfactual	605.6	-	-	-605.6	4	Non-preferred as will lead to unacceptable risk or higher cost for customers if opportunity not captured
1	Install a third 132/11kV 45MVA transformer at Oran Park ZS and establish 132/11kV 45MVA ZS with 1 x sub transmission tee connection at Lowes Creek Marylands	Network solution	-	20.1	578.8	558.7	2	Technically feasible, lower net benefits
2	**Establish 132/11kV 90MVA ZS with 2 x sub transmission connections at Lowes Creek Marylands**	**Network solution**	**-**	**16.0**	**581.3**	**565.3**	**1**	**Greatest Net Benefits, Preferred Long Term option**

Notes:
1: PV residual risk cost (or savings for opportunities) post the investment.
2: PV of total costs, both Capex and Opex. See Section 3 for further details.

3: PV of total quantified benefits, both risks mitigated, and any forecast decrease in Capex or Opex arising as a result of undertaking the investment (opportunities).
4: PV Benefits less PV Investment Costs
5: The breakdown of PV is based on the central demand forecast scenario

3.4 Phasing of the Preferred Network Option

Based on descriptions of Option 2 from Section 3.2.2 and the consequence of no proactive intervention detailed in Section 3.1, it is likely that the servicing the future growth in the area will require the ultimate establishment of Lowes Creek ZS with a firm capacity of 45 MVA. To ensure that the proposed headwork infrastructure represents the minimum network infrastructure required to service the step change in new load, Endeavour Energy has considered the following:

- Option 3: Deferred 2nd 45 MVA Transformer at Lowes Creek ZS
    - Two staged implementation of Lowes Creek ZS where the 2nd Transformer is deferred by four years (FY31)

3.4.1 Option 3 – Staged Built 132/11kV 90MVA Zone Substation at Lowes Creek Marylands

3.4.1.1 Scope

Option 3 would establish a staged 132kV/11kV 90 MVA zone substation at Lowes Creek Marylands.

Under Stage 1, the scope of works is the same as Option 1 in which a new 132/11kV Lowes Creek ZS with one 45MVA transformer would be established with a tee-off connection from existing 132kV feeder 9L6. Under Stage 2, to be undertaken 4 years later, an additional 132/11kV 45 MVA transformer, 132kV bus bar, 132kV transmission feeder bay and 11kV busbar with another 8 x 11kV circuit breakers would be installed to provide the substation with firm 45 MVA capacity.

Using the new standard substation layouts, which makes use of modular buildings, and provides the base design for a 132kV/11kV, 3 x 45MVA, 24 x 11kV FDR indoor substation on an 8280sqm site, this Option's scopes of works are as follows and the ultimate configuration is shown below in the single line diagram in Figure 18.

Stage 1:

Zone Substation:

- 132/11kV 1 x 45 MVA low noise transformer
- 1 x 132kV switchroom which includes a modular GIS switchboard with:
    - 1 x Transformer circuit breaker
    - 1 x Busbar
    - 1 x Feeder Bay
    - 1 x Transmission Bay and
    - 1 x Bus Tie Bay (spare for future)
- 1 x 11kV switchroom with:
    - 2 x 11kV Bus Sections
    - 8 x Feeder Circuit Breakers
    - 1 x Bus Tie (2 x 11kV legs for each TX) and
    - 2 x Transformer Circuit Breakers

Transmission Lines:

- Establish one underground 132kV feeder linkage teeing off 132kV feeder 9L6 loop via a new 132kV UGOH ideally on Pole 814346.

Distribution:

- Additional costs to establish 11kV feeders into the existing 11kV network.

Stage 2:

Zone Substation:

- 132/11kV 1 x 45 MVA transformer
- 1 x Transmission Feeder bays
- 1 x 132kV busbars
- 1 x 11kV busbar with 8 x 11kV circuit breakers

This option results in a total capacity of 45 MVA and 6 MVA firm capacity from 2027 to 2031. From 2031 onwards, Lowes Creek ZS has a total capacity of 90 MVA with 45 MVA firm capacity. Figure 16 presents how this option will reduce the expected unserved energy when compared to the BAU base case ("no proactive intervention"). The expected unserved energy consists of the following categories:

- Unserved Energy due to load at risk at Oran Park ZS based on the demand forecast in Table 12 which is not addressed by this option
- Unserved Energy due to precinct load at Lowes Creek ZS based on the demand forecast in Table 12.

The split of unserved energy between the different substations can be found in Figure 17 and Table 17 which shows that between 2027-2031, most of the expected unserved energy is a result of the limited firm capacity of Maryland ZS. From 2031 onwards, the EUE is the same as Option 2 with the central scenario. Table 18 compares the EUE between Option 2 and Option 3 from 2027 to 2031 (deferral period of the 2nd transformer) and a high level SLD can be found on Figure 18.

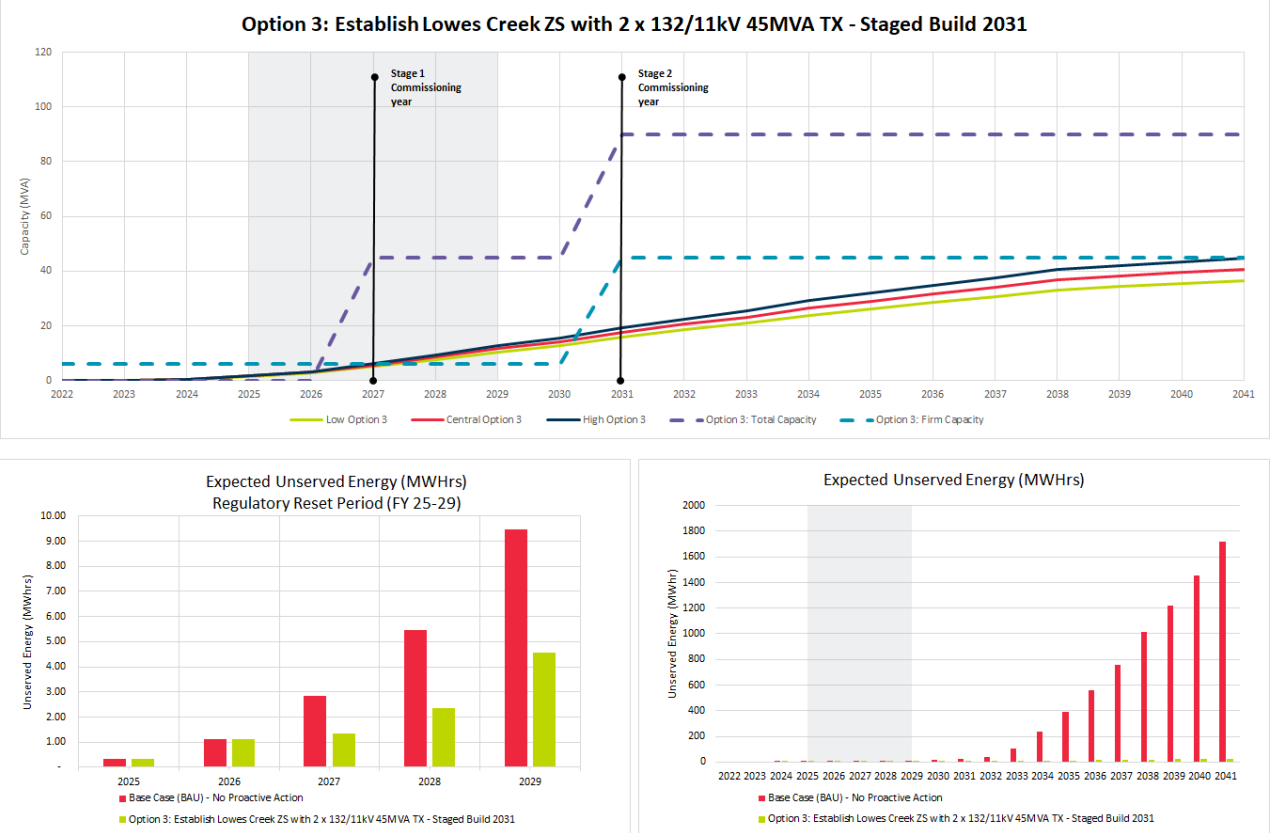


Figure 16 - Summary of Option 3 - Expected Unserved Energy based on central case demand forecast

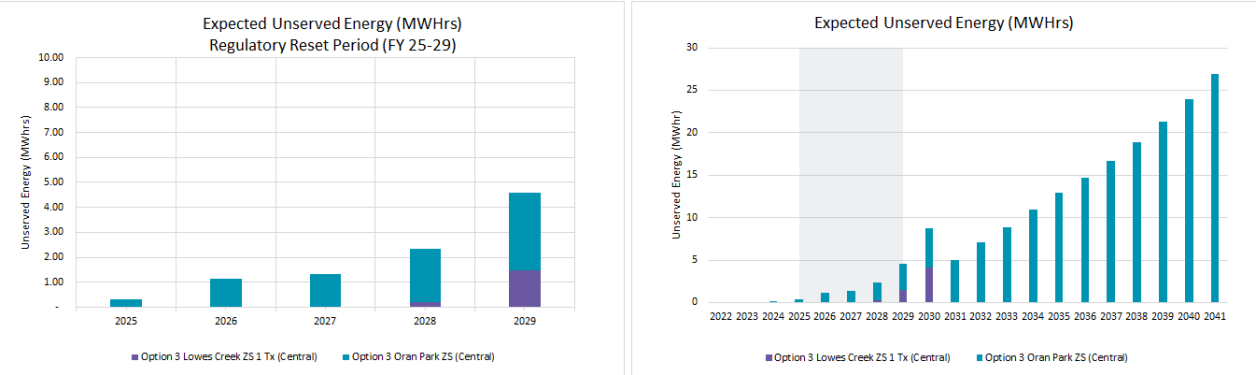


Figure 17 - Breakdown of Expected Unserved Energy for Option 3 based on the central case demand forecast

Table 17 - Breakdown of Expected Unserved Energy in Option 3

EUE (MWh)	2027	2028	2029	2030	2031	2036	2041
Existing Oran Park ZS	1.339	2.134	3.113	4.593	5.022	14.722	26.950
Lowes Creek ZS (2x Tx)	0.000	0.214	1.460	4.128	0.000	0.000	0.000

Table 18 – Comparison of Expected Unserved Energy between Option 2 and Option 3 between 2027-31

EUE (MWh)	2027	2028	2029	2030	2031
Option 2	0.000	0.000	0.000	0.000	0.000
Option 3	0.000	0.214	1.460	4.128	0.000

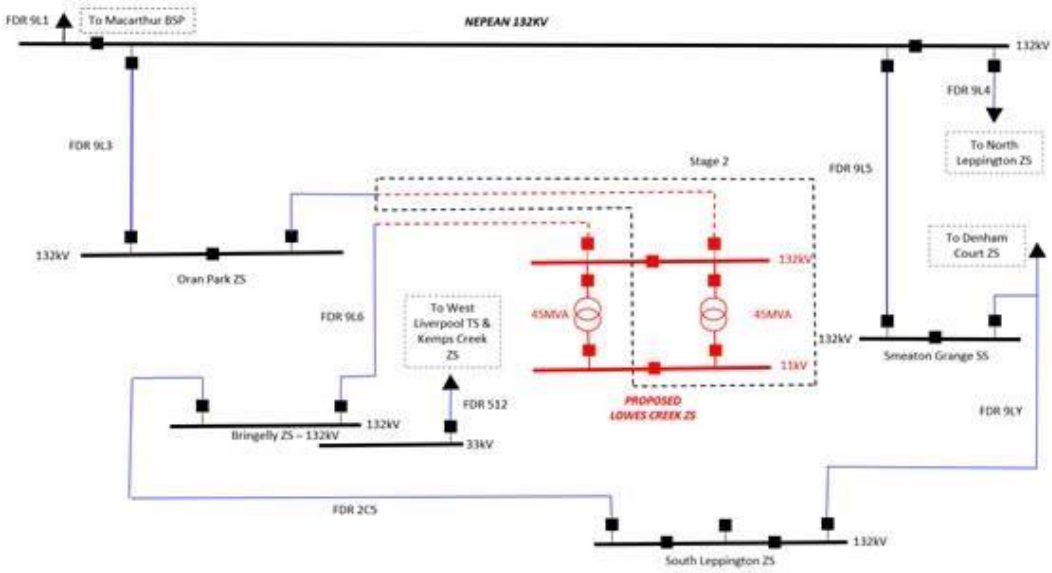


Figure 18 - High Level SLD (Left) for Option 3

3.4.1.2 Cost

The total estimated capital cost for the first phase of Option 3 is $13.3M and $9.2M for the 2nd stage. The cost is based on estimates provided by Endeavour Energy's estimating team. Commissioning of new equipment from Stage 1 is planned for 2027 while commissioning of new equipment from Stage 2 is planned for 2031. A summary of the capital cost can be found in Table 19.

The total present value of costs for Option 4 (both stages combined) is $14.98M.

Table 19 - Option 3 - Capital cost summary

Option 3	2025	2026	2027	2031
Stage 1	$1.99M	$5.98M	$5.32M	-
Stage 2	-	-	-	$9.18M

3.4.1.3 Benefits & NPV

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the following section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The HK model utilised the involuntary load shedding along with a Value of Customer Reliability to calculate a market benefit. No other identified risks were included in the costs and benefits analysis.

The assumptions used in the HK model are stated in Section 3.2.1.3. The NPV summary is provided in the Table 20 below.

Table 20 - NPV Summary - Option 3 (Central Scenario)

Option	PV "Market Benefits" ($M)	PV Costs ($M)	NPV ($M)
3	$581.14	$14.98	$566.16

3.5 Recommended Network Option

Option 3 which defers part of the network investment, have a slightly higher NPV ($566.16M) as Option 2 ($565.25M) over the study period[4], even with the sensitivity & scenarios considered in Section 3.6. This is because Option 3 is a subset of Option 2, with the only change being between 2027-31 in Option 3, where the installation of the 2nd transformer is deferred.

A comparative NPV analysis was completed to compare these options, which baselines Option 3 against Option 2 (preferred long-term solution). The comparative NPV analysis was based on the following inputs and assumptions and is summarised in Table 21.

- A study period from 2022-2031
  - After 2031, both options are the same
- The commercial discount rate was set to 3.26% and a composite VCR of $26,008/MWh was used
  - Same inputs defined in Section 3.2.1.3.
- Comparative PV Costs
  - The relative cost for deferring the 2nd transformer in Option 3 is the increase in expected unserved energy from only having one transformer relative to Option 2
- Comparative PV Benefits
  - The relative benefits of deferring the 2nd transformer for Option 3 are:
    - Deferred capital expenditure of the 2nd transformer
    - Reduced maintenance cost by only having one transformer compared to two transformers in Option 2.

[4] 30 years is the length of the study period

Table 21 shows that Option 3 is NPV positive when baselined against Option 2, in which the benefits of deferring the 2nd transformer do outweigh the quantified cost of unserved energy. **For these reasons, Option 3 is the preferred network option.**

Table 21 - Comparative NPV Analysis

Option	Description	Solution Type	Relative PV Cost[1] $M	Relative PV Benefits[2]	Relative NPV [3,4] $M	Comments
3	Establish Lowes Creek ZS with 2 x 132/11kV 45MVA TX - Staged Build 4-year deferral of 2nd Transformer (FY31 commissioning year)	Network solution	-0.12	+0.63	+0.51	Technically feasible, greater relative benefits compared to Option 2 (Long Term Network Solution

Notes:
1: The PV cost relative to Option 2 (Ultimate long-term solution)
2: The PV benefits relative to Option 2 (Ultimate long-term solution)
3: The breakdown of PV is based on the central demand forecast scenario
4: The breakdown of PV is based on the central demand forecast scenario

3.6 Sensitivity and Scenario Analysis

3.6.1 Sensitivity Analysis

Sensitivity tests and analysis have been applied to the economic evaluation in the Houston Kemp model and results are shown in Figure 19 below.

To confirm the robustness of the economic evaluation and to demonstrate the results over a range of variation in some of the key variables, the sensitivity analysis was conducted on all of the credible network options.

The key variables included in the sensitivity analysis and shown below in Figure 19 below were:

- Discount rate used for the discounted cashflow in the evaluation.
- Capital cost estimates.
- Value of customer reliability
- Risk costs, for this project, essentially the value of the expected unserved energy.

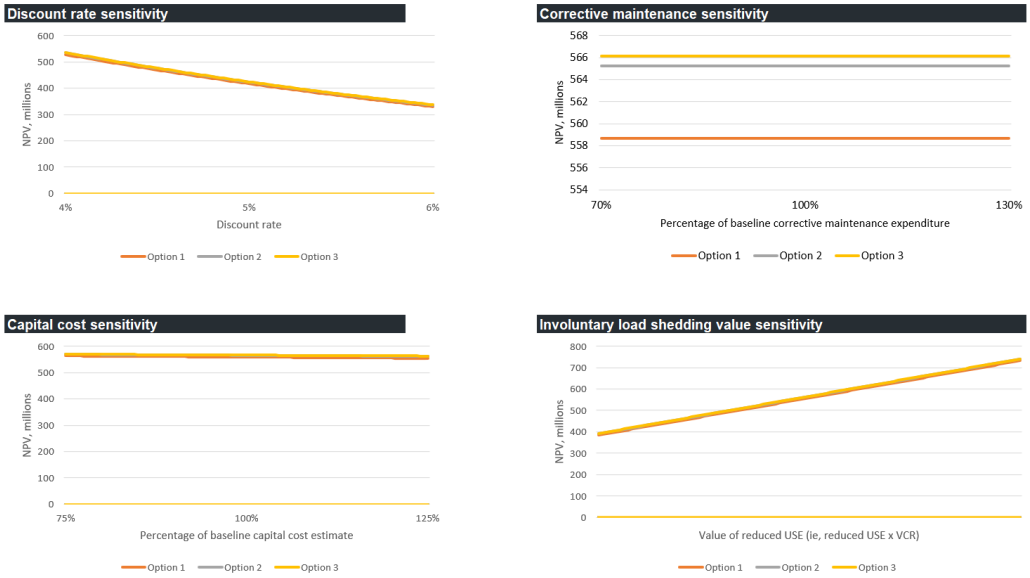
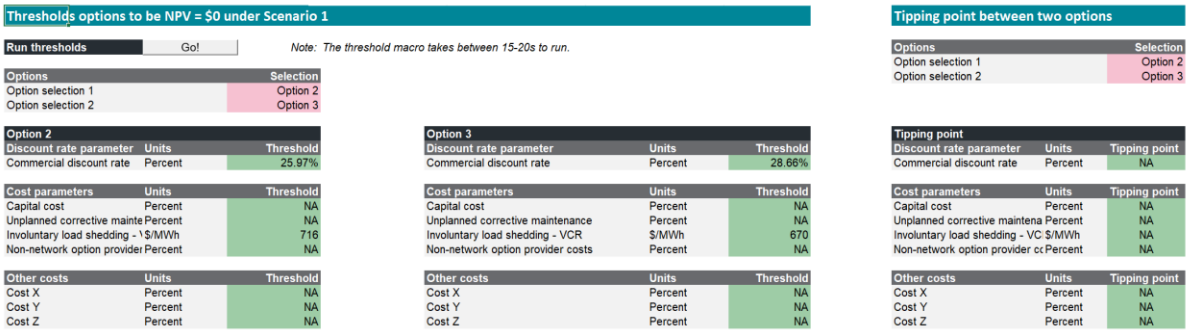


Figure 19 - Sensitivity analysis

The results show that Option 3 remains the most favourable option in all sensitivity tests as there was no tipping point found between the options as shown in



Thresholds options to be NPV = $0 under Scenario 1

Run thresholds | Go! | *Note: The threshold macro takes between 15-20s to run.*

Options	Selection
Option selection 1	Option 2
Option selection 2	Option 3

Option 2

Discount rate parameter	Units	Threshold
Commercial discount rate	Percent	25.97%

Cost parameters	Units	Threshold
Capital cost	Percent	NA
Unplanned corrective mainte	Percent	NA
Involuntary load shedding - \	$/MWh	716
Non-network option provider	Percent	NA

Other costs	Units	Threshold
Cost X	Percent	NA
Cost Y	Percent	NA
Cost Z	Percent	NA

Option 3

Discount rate parameter	Units	Threshold
Commercial discount rate	Percent	28.66%

Cost parameters	Units	Threshold
Capital cost	Percent	NA
Unplanned corrective maintenance	Percent	NA
Involuntary load shedding - VCR	$/MWh	670
Non-network option provider costs	Percent	NA

Other costs	Units	Threshold
Cost X	Percent	NA
Cost Y	Percent	NA
Cost Z	Percent	NA

Tipping point between two options

Options	Selection
Option selection 1	Option 2
Option selection 2	Option 3

Tipping point

Discount rate parameter	Units	Tipping point
Commercial discount rate	Percent	NA

Cost parameters	Units	Tipping point
Capital cost	Percent	NA
Unplanned corrective maintena	Percent	NA
Involuntary load shedding - VC	$/MWh	NA
Non-network option provider co	Percent	NA

Other costs	Units	Tipping point
Cost X	Percent	NA
Cost Y	Percent	NA
Cost Z	Percent	NA

Figure 20 - Tipping points

Scenarios	
Scenario selection	
Scenario	Scenario 1

Scenario weighting	Scenario 1	Scenario 2	Scenario 3
Weighting	0.33	0.33	0.33

General inputs							
General	Unit	Value	Selection	Scenario 1	Scenario 2	Scenario 3	User defined
Commercial discount rate	Percent	3.26%	Central	Central	High	Low	Central

Cost inputs							
Cost	Unit	Value	Selection	Scenario 1	Scenario 2	Scenario 3	User defined
Capital cost	Percent	100%	Central	Central	High	Low	Central
Planned routine maintenance and refurbishment	Percent	100%	Central	Central	Low	High	Central
Unplanned corrective maintenance	Percent	100%	Central	Central	Low	High	Central
Decommissioning costs	Percent	100%	Central	Central	Central	Central	Central
Non-network option provider costs	Percent	100%	Central	Central	High	Low	Central
Cost X	Percent	100%	Central	Central	Central	Central	Central
Cost Y	Percent	100%	Central	Central	Central	Central	Central
Cost Z	Percent	100%	Central	Central	Central	Central	Central

Benefit inputs							
Avoided 'risk cost' benefits	Unit	Value	Selection	Scenario 1	Scenario 2	Scenario 3	User defined
Reliability and security risk costs	Scenario	NA	Central	Central	Low	High	Central
Safety and health risk costs	Scenario	NA	Central	Central	Low	High	Central
Environmental risk costs	Scenario	NA	Central	Central	Low	High	Central
Legal/regulatory compliance risk costs	Scenario	NA	Central	Central	Low	High	Central
Financial risk costs	Scenario	NA	Central	Central	Low	High	Central

Market benefits	Unit	Value	Selection	Scenario 1	Scenario 2	Scenario 3	User defined
Involuntary load shedding - VCR	$/MWh	26,008	Central	Central	Low	High	Central
Involuntary load shedding - MWh	Scenario	NA	Central	Central	Low	High	Central
Difference in timing of unrelated expenditure	Scenario	NA	Central	Central	Low	High	Central
Difference in timing of unrelated expenditure	Percent	100%	Central	Central	Low	High	Central
Voluntary load curtailment - VCR	$/MWh	26,008	Central	Central	Low	High	Central
Voluntary load curtailment - MWh	Scenario	NA	Central	Central	Low	High	Central
Costs for non RIT-D proponent parties	Percent	100%	Central	Central	Central	Central	Central
Electricity energy losses	$/MWh	100	Central	Central	Central	Central	Central
Change in load transfer capacity and the capacity for embedde	Percent	100%	Central	Central	Central	Central	Central
Other classes of market benefits	Percent	100%	Central	Central	Central	Central	Central

Figure 21 - Houston Kemp model scenario parameters

Table 10 – Summary of scenarios investigated

Variable	Scenario 1 - baseline	Scenario 2 – low benefits	Scenario 3 – high benefits
Capital cost	Estimated network capital costs	25% increase in the estimated network capital costs	25% decrease in the estimated network capital costs
Value of customer reliability (VCR)	$26/kWh (from AER VCR report)	$18.2/kWh 30% lower than baseline	$33.8/kWh 30% higher than baseline
Discount rate	3.26% (WACC)	2.22% (WACC - 2%)	4.3% (WACC + 2%)
Maintenance costs	Estimated network maintenance costs	25% decrease in the estimated network maintenance costs	25% increase in the estimated network maintenance costs
Scenario weighting	50%	25%	25%

The scenarios have been weighted as 50% for Scenario 1 being the subject of this CFI with Scenarios 2 and 3 being given a weighting of 25% with the purpose to “inform” and “test” our thinking. The weighted NPV for each option is shown below. The scenario assessment shows that Option 3 evidently has a higher NPV under scenario 1 and is therefore the preferred option.

Table 11 – Weighted net present value of options

Option	Scenario 1 NPV ($M)	Scenario 2 NPV ($M)	Scenario 3 NPV ($M)	Weighted NPV ($M)	Option ranking
Option 1	558.7	126.6	1,757.7	750.4	1
Option 2	565.3	137.9	1,719.9	747.1	3
Option 3	566.2	139.3	1,720.3	747.9	2

3.7 Proposed Investment Timing

The optimal timing where the value of unserved energy from the ‘No Proactive Intervention’ scenario exceeds investment costs for Option 3 is 2033 as per Figure 22.

In accordance with the National Electricity Rules, Endeavour Energy has an obligation to connect customers to the network. As such the timing of this investment (FY2027 for Stage 1 and FY2031 for Stage 2) is driven by network need and not the optimal timing from the economic modelling. This aligns

with Endeavour Energy adopts a “just in advance” principle to design and deliver the infrastructure to meet the growth needs of those areas identified for greenfield development.

Annualised option cost and optimal timing for Option 3

Option name	Annualised cost	Optimal commission date
Option 3	917,234	2033

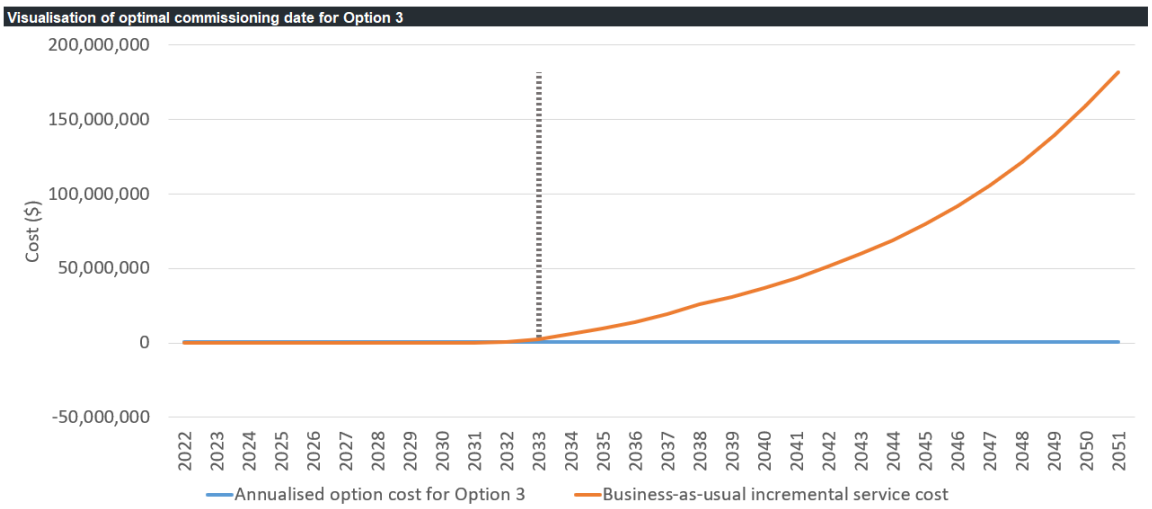


Figure 22 - Houston Kemp optimal timing output for Option 3

3.8 Non-Network Solutions to defer network investment

3.8.1 Scope

Electricity Distributors in NSW operate under the licence requirement (under the *NSW Electricity Supply Act 1995*) to investigate non-network alternatives to network augmentation for specific capital expenditure projects. The National Electricity Rules (NER) require Distribution Network Service Providers (DNSP) to investigate non-network options by utilising a consultation process as part of planning for major network augmentations.

The New Technology Master Plan (NTMP) tool was used to evaluate credible non-network options with the primary constraint of the existing Oran Park ZS. Figure 23 shows the comparison of non-network solutions and network solutions against the base case ("no proactive intervention"), while Figure 24 compares non-network solutions against the network solution.

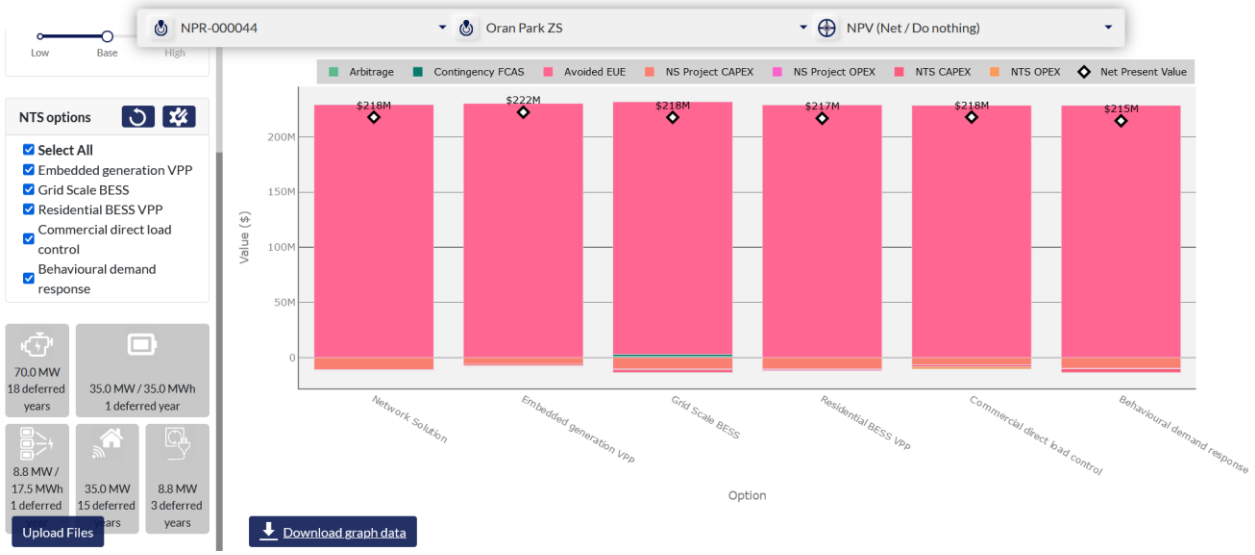


Figure 23 - NTMP Output for Non-Network Options when compared to the Base Case ("no proactive intervention")

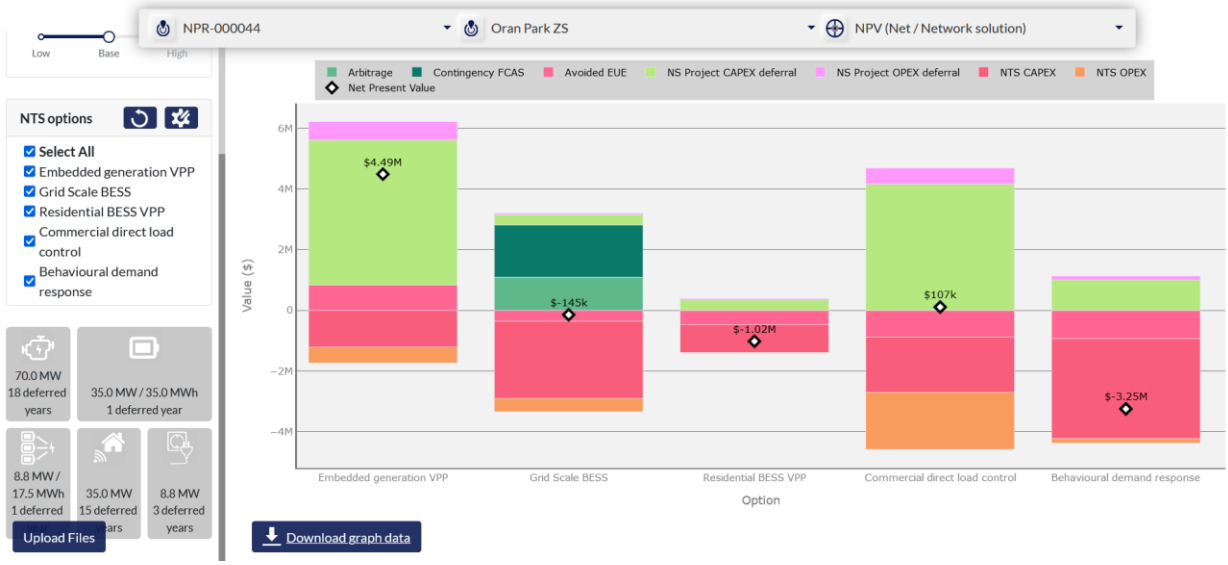


Figure 24 - NTMP Output for Non-Network Options when compared to the Network Solution

Table 22 provides an overview of the outputs from the NTMP tool and overlays with qualitative assessment.

Table 22 - Non-Network / New Technology Options

Non-Network Options	Outcomes	Qualitative Assessment	Comments
Grid-Scale Storage (35MW /35 MWh)	Potentially defer the network investment by 1 year	✔	Grid Scale storage can potentially be explored and connected to existing feeder infrastructure. However, this option is marginally NPV negative and provides minimal deferral when compared to the network option which would need to be evaluated in further assessment.
VPP (70.0 MW)	Potentially defer the network investment by 18 years	✘	Not a feasible as the proposed capacity is large for a new technology and this uptake exceeds the forecasted load up until 2038.
Residential BESS VPP (8.5 MW /17.5 MWh)	Potentially defer the network investment by 1 year	✘	Not a feasible option as this is a new development. Additionally, it is NPV negative when compared to the network option and provides minimal deferral of network investment
Commercial Direct Load Control (35.0 MW)	Potentially defer the network investment by 15 years	✘	Not feasible as, it would require a large uptake from commercial/industrial load in this region as it represents ~60% of the total load in 2027.
Behavioural Demand Response (8.8 MW)	Potentially defer the network investment by 3 years	✔	Unlikely but feasible option. However, this option is NPV negative when compared to the network option which would need to be evaluated in further assessment.

3.8.2 Summary

The NTMP tool and the subsequent qualitative analysis found at least two credible non-network options (BESS & Behavioural Demand Response). These options need to be further evaluated using the screening test in the RIT-D process. As part of the RIT-D process, Endeavour Energy will issue a non-network options report before progressing with the Draft Project Assessment Report (DPAR)

4. Detailed description and costs of preferred option

High level cost estimate:

Table 23 - Option 3 - 132/11kV 90MVA Zone Substation at Lowes Creek Marylands

Description	Cost ($M)
New Modular Build Substation 132/11kV, 1 x 45MVA, 1 x TR feeder bays, 8 x 11kV CB's	11.3
Additional cost of 1 x Low Noise Transformer Units	0.15
Additional cost of 1 new 132 kV UGOH	0.164
132kV cable IN (90m)	0.185
Distribution Feeders establishment	1.5
STAGE 1 Total	**13.299**
STAGE 2 – Install 45MVA TX in 2031 + 1 x TR Feeder Bay, 8 x 11kV CBs	**6.7**
Additional cost of 1 x Low Noise Transformer Units	0.15
132kV cable OUT (80m)	0.165
Additional cost of 1 new 132 kV UGOH	0.164
Distribution Works	1.5
Staged Contingency	0.5
STAGE 2 Total	9.179
TOTAL	**22.478**

Note: Substation Primary Design and Transmission Mains groups to confirm the above and further scope during full proper budget estimate.

5. Recommendations and Next Steps

It is recommended that:

- A Non-Network Options Report be issued seeking submissions for non-network options prior to proceeding to the Draft Project Assessment Report (DPAR), given that there are credible non-network options available.
- If a feasible non-network option submission is received, the economic evaluation for this project will be revised to assess whether the non-network option will defer the preferred network option.
- The CFI will be finalised at the completion of the RIT-D process and a final approval will then be submitted to the confirm if the scope will include a non-network option and if the recommended timing of investment of the preferred network option will change.
- If a feasible and cost-effective non network option is not received, the best NPV network solution is the establishment of a new **132/11kV 90MVA zone substation** (**Option 3**) in a staged manner to supply the Lowes Creek Marylands, Cobbitty South Creek West and Pondicherry precincts (prior to 2027). Currently, this option represents a highest value (economic benefit) being NPV positive **$566.2 Million** and represents the best option to connect customers. Stage 1 of this option is estimated to cost **$13.3 Million** and is expected to be spread over three years from 2025 to 2027.

- It is recommended that the project value of **$13.3 Million** be approved for consideration in the FY25-FY29 regulatory period.

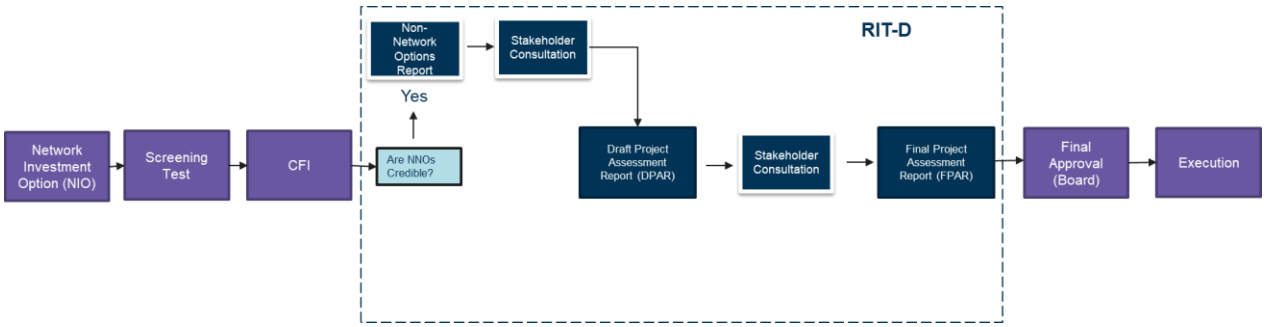


Figure 25 - Endeavour Energy's RIT-D Process

Appendices

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A. Summer Demand Forecasts

The respective expected demand forecasts over the next 12 years at Oran Park Zone Substation (excluding the three precincts) is shown in Figure 26 below.

Summer - Macarthur_132kV

Location		Actual						Forecast												
		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Actual	MVA			4.1	8.7	10.4	16.8													
Smeaton_Grange	MW			3.9	8.7	10.4	16.8	23.3	32.0	41.5	44.3	44.5	44.7	45.0	45.2	45.4	45.4	45.7	45.9	46.1
	MVAr			1.3	0.0	0.4	0.5	7.7	10.5	13.7	14.6	14.6	14.7	14.8	14.9	14.9	14.9	15.0	15.1	15.1
10% POE	MVA			4.1	8.7	10.4	16.8	24.6	33.7	43.7	46.6	46.8	47.1	47.3	47.6	47.8	47.8	48.1	48.3	48.5
	PF			0.950	1.000	0.999	1.000	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
	MW			3.9	8.7	10.4	16.8	23.3	32.0	41.5	44.3	44.5	44.7	45.0	45.2	45.4	45.4	45.7	45.9	46.1
	MVAr			1.3	0.0	0.4	0.5	7.7	10.5	13.7	14.6	14.6	14.7	14.8	14.9	14.9	14.9	15.0	15.1	15.1
50% POE	MVA			4.1	8.7	10.4	16.8	24.6	33.7	43.7	46.6	46.8	47.1	47.3	47.6	47.8	47.8	48.1	48.3	48.5
	PF			0.950	1.000	0.999	1.000	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
Actual	MVA		11.9	22.8	27.0	39.9	32.1													
Oran_Park	MW		11.8	22.4	26.6	39.2	31.5	34.6	37.0	41.0	43.9	46.4	48.8	50.4	52.0	54.2	54.2	56.3	57.8	59.2
	MVAr		1.8	4.2	4.8	7.7	5.8	11.4	12.2	13.5	14.4	15.2	16.0	16.6	17.1	17.8	17.8	18.5	19.0	19.5
10% POE	MVA		11.9	22.8	27.0	39.9	32.1	36.4	39.0	43.2	46.2	48.8	51.4	53.1	54.8	57.1	57.0	59.3	60.8	62.3
	PF		0.989	0.983	0.984	0.981	0.984	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
	MW		11.8	22.4	26.6	39.2	31.5	34.6	37.0	41.0	43.9	46.4	48.8	50.4	52.0	54.2	54.2	56.3	57.8	59.2
	MVAr		1.8	4.2	4.8	7.7	5.8	11.4	12.2	13.5	14.4	15.2	16.0	16.6	17.1	17.8	17.8	18.5	19.0	19.5
50% POE	MVA		11.9	22.8	27.0	39.9	32.1	36.4	39.0	43.2	46.2	48.8	51.4	53.1	54.8	57.1	57.0	59.3	60.8	62.3
	PF		0.989	0.983	0.984	0.981	0.984	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950

Figure 26 - Extended Oran Park Forecast excluding the three precincts

Using a growth rate of 2.5%, this forecast has been extended to 2051 to account for growth surround Oran Park, excluding these three precincts, as shown in the Table 24 below.

Table 24 - Oran Park Forecast excluding the three precincts

Oran Park ZS	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
SDF (MVA)	36.4	39.0	43.2	46.2	48.8	51.4	53.1	54.8	57.1	57.0	59.3	60.8
Oran Park ZS	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Forecast (MVA)	62.3	63.9	65.5	67.1	68.8	70.5	72.2	74.1	75.9	77.8	79.7	81.7
Oran Park ZS	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**						
Forecast (MVA)	83.8	85.9	88.0	90.2	92.5	94.8	-	-	-	-	-	-

Furthermore, several applications which have not yet been reflected in the Oran Park Forecast, excluding the three precincts, are as follows:

Table 25 - Current CAMS/additional Oran Park Load not included in Forecast (excluding three precincts)

Oran Park ZS	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Load (MVA)	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Oran Park ZS	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Load (MVA)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3
Oran Park ZS	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**						
Load (MVA)	1.3	1.3	1.3	1.3	1.4	1.4	-	-	-	-	-	-

The new load forecast for the precincts of Lowes Creek Marylands, Pondicherry and Cobbitty South Creek West, as depicted in Table 26 is as follows:

Table 26 - Precinct Load Forecasts (undiversified) for Lowes Creek Marylands, Pondicherry, Cobbitty South Creek West and new load at Oran Park

Precinct Loads	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Load (MVA)	-	-	2.1	5.6	9.1	14.2	20.0	25.4	30.5	35.9	41.3	45.9

Precinct Loads	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Load (MVA)	51.4	55.2	58.3	61.5	64.9	66.5	68.1	69.7	71.3	73.0	74.6	76.2
Precinct Loads	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**						
Load (MVA)	77.8	79.4	81.1	82.7	84.3	85.9	-	-	-	-	-	-

Summing all the loads together, the total forecast for Oran Park, as depicted in Table 27 is as follows:

Table 27 - Total Load Forecasts (undiversified) for Oran Park (BAU)

Precinct Loads	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Load Central (MVA)	37.4	40.0	46.4	52.8	59.0	66.7	74.1	81.3	88.8	94.0	101.7	107.8
Load High (MVA)	41.2	44.0	51.0	58.1	64.9	73.3	81.6	89.5	97.6	103.4	111.9	118.6
Load Low (MVA)	33.7	36.0	41.7	47.6	53.1	60.0	66.7	73.2	79.9	84.6	91.5	97.0
Precinct Loads	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Load (MVA)	114.9	120.2	125.0	129.8	134.8	138.2	141.6	145.0	148.5	152.0	155.6	159.2
Load High (MVA)	126.4	132.2	137.5	142.7	148.3	152.0	155.7	159.5	163.3	167.2	171.2	175.1
Load Low (MVA)	103.4	108.2	112.5	116.8	121.3	124.4	127.4	130.5	133.6	136.8	140.0	143.3
Precinct Loads	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**						
Load (MVA)	162.9	166.6	170.4	174.2	178.1	182.1	-	-	-	-	-	-
Load High (MVA)	179.2	183.3	187.5	191.7	195.9	200.3	-	-	-	-	-	-
Load Low (MVA)	146.6	150.0	153.4	156.8	160.3	163.9	-	-	-	-	-	-

In determining the unserved energy, the forecast for the business as usual (BAU), the forecast used in Table 27 above was used.

For Option 1, upgrading Oran Park ZS by installing 3rd transformer in 2027 and establishing a 45 MVA Zone Substation at Lowes Creek Marylands in 2035, the BAU forecast was split into two sub-forecasts; a forecast for what Oran Park ZS will ultimately supply, and a forecast for what Lowes Creek ZS would ultimately supply. This is broken down in Table 28 and Table 29 below, with Lowes Creek ZS supplying Lowes Creek Marylands, Pondicherry and a third of Cobbitty South Creek West, and Oran Park ZS supplying the remaining loads.

For Options 2 and 3, establishing a 90 MVA Zone Substation at Lowes Creek Marylands, the BAU forecast was split into two sub-forecasts; a forecast for what Oran Park ZS will ultimately supply, and a forecast for what Lowes Creek ZS would ultimately supply. This is broken down in Table 30 and Table 31 below, with Lowes Creek ZS supplying Lowes Creek Marylands, Pondicherry and a third of Cobbitty South Creek West, and Oran Park ZS supplying the remaining loads. In these options, Option 1 has the firm capacity at Lowes Creek ZS increasing to 6 MVA to account for the distribution feeders from Oran Park ZS and has a total capacity of 45 MVA from 2035. In a similar manner, Option 2 has a firm capacity of 45 MVA in 2027 and a total installed capacity of 90 MVA. On the other hands, Option 3 has a firm capacity of 45 MVA in 2031 and a total installed capacity of 90 MVA. In these two options (2&3), there is not change to the firm and total capacity at Oran Park ZS.

Table 28 - Total Load Forecast (undiversified) at Lowes Creek ZS (Option 1)

Precinct Loads	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Load Central (MVA)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Load Low (MVA)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Load High (MVA)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precinct Loads	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Load (MVA)	0.0	36.4	39.5	42.7	46.1	47.7	49.3	50.9	52.5	54.2	55.8	57.4
Load Low (MVA)	0.0	32.7	35.6	38.4	41.5	42.9	44.4	45.8	47.3	48.7	50.2	51.7

Load High (MVA)	0.0	40.0	43.5	46.9	50.7	52.4	54.2	56.0	57.8	59.6	61.4	63.1
Precinct Loads	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**						
Load (MVA)	59.0	60.6	62.3	63.9	65.5	67.1	-	-	-	-	-	-
Load Low (MVA)	53.1	54.6	56.0	57.5	58.9	60.4	-	-	-	-	-	-
Load High (MVA)	64.9	66.7	68.5	70.3	72.0	73.8	-	-	-	-	-	-

Table 29 -Total Load Forecast (undiversified) at Oran Park ZS (Option 1)

Precinct Loads	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Load Central (MVA)	37.4	40.0	46.1	52.2	57.9	65.3	72.3	79.2	86.2	91.2	98.6	104.5
Load Low (MVA)	33.7	36.0	41.5	46.9	52.1	58.7	65.1	71.3	77.6	82.1	88.7	94.0
Load High (MVA)	41.2	44.0	50.7	57.4	63.7	71.8	79.6	87.1	94.9	100.4	108.5	114.9
Precinct Loads	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Load (MVA)	111.3	80.1	81.7	83.3	85.0	86.7	88.5	90.3	92.2	94.1	96.1	98.1
Load Low (MVA)	100.1	72.1	73.5	74.9	76.5	78.1	79.7	81.3	82.9	84.7	86.5	88.3
Load High (MVA)	122.4	88.1	89.8	91.7	93.5	95.4	97.4	99.4	101.4	103.5	105.7	107.9
Precinct Loads	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**						
Load (MVA)	100.1	102.2	104.4	106.6	108.9	111.2	-	-	-	-	-	-
Load Low (MVA)	90.1	92.0	93.9	95.9	97.9	100.1	-	-	-	-	-	-
Load High (MVA)	110.1	112.5	114.8	117.3	119.8	122.3	-	-	-	-	-	-

Table 30 - Total Load Forecast (undiversified) at Lowes Creek ZS (Option 2 & 3)

Precinct Loads	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Load Central (MVA)	0.0	0.0	0.0	0.0	0.0	7.1	10.8	14.5	17.9	21.9	25.7	29.0
Load Low (MVA)	0.0	0.0	0.0	0.0	0.0	6.4	9.7	13.1	16.1	19.8	23.1	26.1
Load High (MVA)	0.0	0.0	0.0	0.0	0.0	7.8	11.9	16.0	19.6	24.1	28.2	31.9
Precinct Loads	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Load (MVA)	33.2	36.4	39.5	42.7	46.1	47.7	49.3	50.9	52.5	54.2	55.8	57.4
Load Low (MVA)	29.9	32.7	35.6	38.4	41.5	42.9	44.4	45.8	47.3	48.7	50.2	51.7
Load High (MVA)	36.5	40.0	43.5	46.9	50.7	52.4	54.2	56.0	57.8	59.6	61.4	63.1
Precinct Loads	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**						
Load (MVA)	59.0	60.6	62.3	63.9	65.5	67.1	-	-	-	-	-	-
Load Low (MVA)	53.1	54.6	56.0	57.5	58.9	60.4	-	-	-	-	-	-
Load High (MVA)	64.9	66.7	68.5	70.3	72.0	73.8	-	-	-	-	-	-

Table 31 - Total Load Forecast (undiversified) at Oran Park ZS (Option 2 & 3)

Precinct Loads	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Load Central (MVA)	37.4	40.0	46.4	52.8	59.0	59.6	63.3	66.8	70.9	72.1	76.0	78.8
Load Low (MVA)	33.7	36.0	41.7	47.6	53.1	53.6	57.0	60.1	63.8	64.9	68.4	70.9
Load High (MVA)	41.2	44.0	51.0	58.1	64.9	65.5	69.7	73.5	78.0	79.3	83.6	86.7
Precinct Loads	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Load (MVA)	81.7	83.8	85.4	87.1	88.8	90.5	92.3	94.1	96.0	97.9	99.8	101.8
Load Low (MVA)	73.5	75.4	76.9	78.4	79.9	81.4	83.0	84.7	86.4	88.1	89.8	91.6
Load High (MVA)	89.8	92.2	94.0	95.8	97.6	99.5	101.5	103.5	105.6	107.7	109.8	112.0
Precinct Loads	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**						
Load (MVA)	103.9	106.0	108.2	110.4	112.6	115.0	-	-	-	-	-	-
Load Low (MVA)	93.5	95.4	97.3	99.3	101.4	103.5	-	-	-	-	-	-

Load High (MVA)	114.3	116.6	119.0	121.4	123.9	126.5	-	-	-	-	-	-

Note: This CFI is written to address the constraint from only the three precincts mentioned above. The continual growth at Oran Park is planned to be addressed in future CFIs within the area, and currently includes loads forecasted for the growth precincts of Catherine Park and Catherine Fields North. To address these constraints, other CFIs including the establishment of zones substations at the forementioned sites will be explored, with the option of adding a third transformer at Oran Park ZS.

B. Referenced documents and appendices

[1] **Camden Council South West Growth Area**
Camden Council. (2022). South West Growth Area. Available: https://www.camden.nsw.gov.au/strategic-planning/precinct-planning/swga-precinct/. Last accessed 8/03/2022.

[2] **DPIE: South West Growth Area – South Creek West Release Area**
NSW Department of Planning and Environment. (2022). South West Growth Area. Available: https://www.planning.nsw.gov.au/Plans-for-your-area/Priority-Growth-Areas-and-Precincts/South-West-Growth-Area. Last accessed 8/03/2022.

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