Final Project Assessment Report: Lake Cathie Zone Substation Supply area.

Essential Energy

April 2023

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Glossary

Acronym	Full name
AEMO	Australian Energy Market Operator.
AER	Australian Energy Regulator.
BESS	Battery Energy Storage System.
Capex	Capital Expenditure.
DPAR	Draft Project Assessment Report.
EOL	End of life.
EV	Electric vehicle.
FPAR	Final Project Assessment Report.
FRMP	Financially Responsible Market Participant.
NEB	Net Economic Benefit.
NEM	National Electricity Market.
NER	National Electricity Rules.
NMI	National Metering Identifiers.
NPV / C	Net Present Value / Cost.
OPEX	Operational Expenditure.
RIT-D	Regulated Investment Test for Distribution.
STPIS	Service Target Performance Incentive Scheme.
ZS	Zone substation.

Executive summary

This final project assessment report has been prepared in accordance with the Regulatory Investment Test for Distribution (RIT-D) requirements of the National Electricity Rules (the Rules).

Essential Energy's notice of its determination that there are no credible non-network options to address the identified need at Lake Cathie zone substation (LC) has been published in April 2023. Essential Energy's determination was made under clause 5.17.4(c) of the National Electricity Rules and was published pursuant to clause 5.17.4(d). In accordance with those provisions, Essential Energy will not be publishing a non-network options report in relation to the proposed works at Bonny Hills zone substation to rectify the Lake Cathie zone substation constraints.
In summary, our reasons for this conclusion are:

- There is no opportunity to reduce the required assets and associated works for the Lake Cathie zone substation by partially reducing peak load through demand management.
- An embedded generation or demand response option will not be a feasible or cost-effective long-term solution.

1.1 About Essential Energy.

Essential Energy is a state-owned electricity infrastructure company which owns, maintains, and operates the electrical distribution networks for much of New South Wales, covering 95 percent of the state's geographical area. It also owns the reticulated water network in Broken Hill through Essential Water, formerly Australian Inland Energy and Water.

1.2 Identified need.

The primary driver for this investment is a significant whole of site end of life asset condition constraint. A secondary driver exists with a near term zone substation capacity constraint at the existing Lake Cathie zone substation. The investment also supports forecast growth in new connections, existing customer load and the adoption of EVs aligning with Essential Energy's corporate strategy.

The primary identified need is to rectify the Lake Cathie zone substation asset condition and to a smaller degree solve the site capacity constraint issue to achieve compliance with regulatory requirements.

We understand that where the objective is compliance rectification, it comes within the meaning of "identified need" for the RIT-D test. We also understand that work undertaken for either Network Option 1 at the proposed new Bonny Hills zone substation or Network Option 2 Rebuild Lake Cathie zone substation is for Capex, and there cannot be a disaggregation of capex costs when considering whether a RIT-D is required.

The National Electricity Rules (NER) requires that, subject to certain exclusion criteria, network business investments for meeting service standards for a distribution business are subject to a Regulatory Investment Test for Distribution (RIT-D). Essential Energy has determined that network investment is essential in this case for it to comply with the regulatory requirements as no exemptions listed in the NER clause 5.17.3(a) apply. Accordingly, Essential Energy has decided that this investment is subject to a RIT-D.

1.3 Possible solutions to address the identified need.

The possible solutions to address the identified need are:

- Establish Bonny Hills zone substation.
- Rebuild the existing Lake Cathie zone substation.

Essential Energy is now publishing this final project assessment report in relation to the Bonny Hills zone substation project.

1.4 Submissions

Any questions or submissions regarding this FPAR or requests for further information should be directed to:

Email: reginvestment@essentialenergy.com.au

Essential Energy
Buller Street
Port Macquarie 2444
Attention: Tim Ronan

2 Background

2.1. Location

The existing Lake Cathie zone substation is located on the main coastal road (Ocean Drive) that runs from Port Macquarie to Laurieton via Lake Cathie and Bonny Hills.

The site is situated 500m from the ocean, with a small creek adjacent to the north and a medical centre to the west. The ZS was commissioned circa early 1970's.

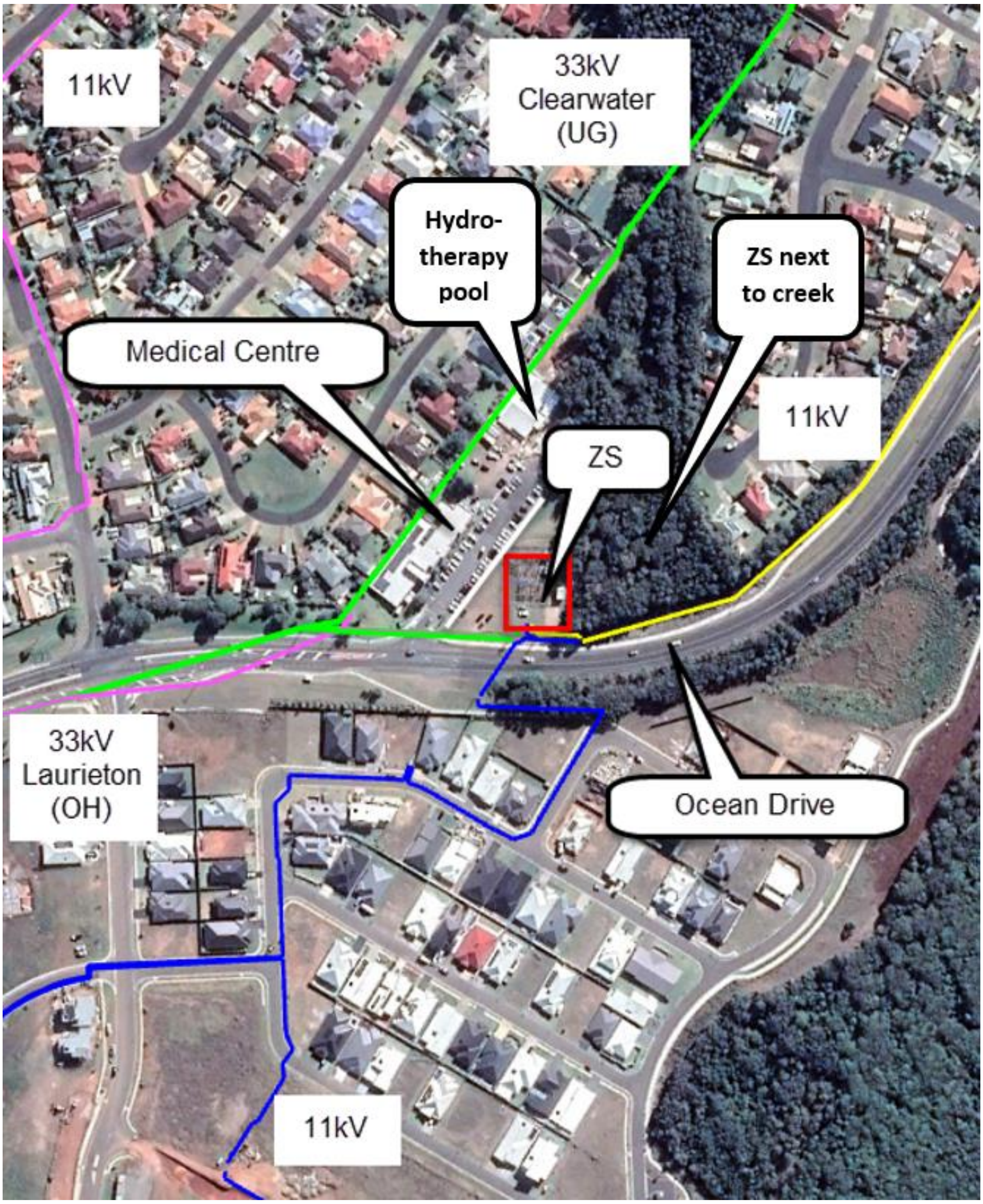

Figure 1: Lake Cathie zone substation location.

2.2. Configuration

Lake Cathie zone substation has two 33/11kV transformers (No.1 8MVA and No.2 10/16MVA), along with three outgoing 11kV feeders as shown in Figure 1.

The 33kV and 11kV infrastructure is outdoor, with two 33kV reclosers protecting the transformers and three 11kV reclosers protecting the feeders. A small shed contains protection and control equipment.

The normal 33kV supply into Lake Cathie ZS comes from Clearwater Crescent 33/11kV ZS in Port Macquarie via 17km of 33kV feeder that is all overhead, except for 1km of underground cable at both ends.

The backup 33kV supply into Lake Cathie ZS originates from Laurieton 66/33/11kV ZS via 14km of overhead conductor. There are limitations with utilising this backup arrangement from Laurieton due to complexities with feeding from the incoming 66kV onto the 11kV bus, then back up through the 33/11kV transformer (step up) and then onto the 33kV line to Lake Cathie.

Both the 33kV normal and backup supplies are connected to form a 'tee' arrangement 200m away from Lake Cathie ZS, and a single section of line enters the ZS. The backup 33kV supply is normally open via a 33kV circuit breaker at Laurieton ZS. This network configuration makes faults in the ZS, or the 33kV lines between Port Macquarie, Lake Cathie, and Laurieton difficult to identify and find.

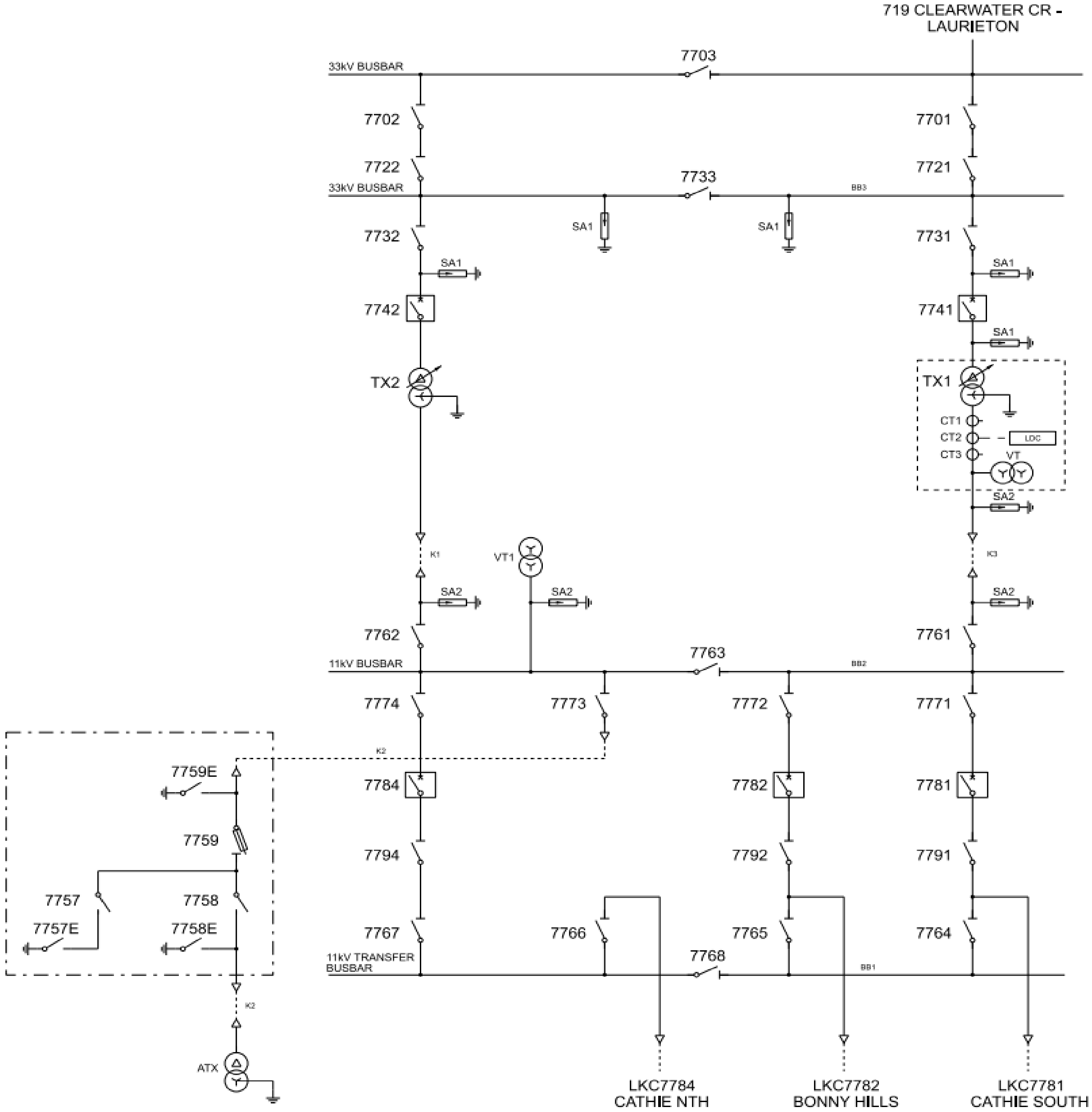

Figure 2: Lake Cathie zone substation single line diagram.

2.3. Asset condition and capacity issues

Lake Cathie ZS has the following asset condition and capacity issues:

- The structures supporting the outdoor busbar equipment and reclosers are heavily corroded.
- Corrosion is occurring on the upper and lower sections of the 33kV and 11kV insulators fitted to isolators. This increases the risk of the units failing whilst an Essential Energy employee is operating the device.
- The insulators are subjected to regular heavy salt build up which causes tracking and increases likelihood of failure.
- There are reduced phase-to-phase safety clearances between outgoing feeders. ZS technicians need to isolate two feeders to allow safe access to maintain one feeder recloser.
- The ZS has a chain wire mesh fence that provides a lower standard of security than required and is in poor condition. A formal risk assessment has raised concerns with its ability to prevent unauthorised access to the ZS. It is in an area of expanding residential and commercial development with increased foot and vehicle traffic nearby and is in a highly visible location. It also does not meet Essential Energy's CECP7029 Physical Security Framework.
- The transformers are protected by 33kV reclosers, not circuit breakers, and the protection scheme does not meet the requirements of Essential Energy's protection policy CEOP 8002.01 which recommends that transformers with a rating >8MVA to have differential protection.
- Transformer bunds and oil containment are not to standard or sufficiently sized, creating an environmental risk of transformer oil leaking into an adjacent creek.
- The outgoing 11kV feeders cannot provide adequate 11kV redundancy for ultimate demand.
- 33/11kV transformers (No.1 8MVA and No.2 10/16MVA) cannot provide N-1 capacity for the forecast growth.
- No. 1 and No. 2 transformers cannot be paralleled due to voltage tap incompatibility.
- The normally in service No.1 transformer is forecast to have its cyclic capacity exceeded in four years.
- No.2 transformer has a non-standard secondary nominal voltage and limited tapping range that results in high customer voltages, so it is not normally used. It has an 11.66kV nominal voltage with limited buck taps, so it regularly sits on top tap and cannot maintain the distribution voltage within the required acceptable range and is rarely put into service.
- The existing incoming 33kV tee arrangement and present protection systems require a manual changeover to the backup 33kV supply which takes time as line and ZS patrols are also needed.

Lake Cathie ZS presents significant asset condition, safety, capacity, and operational issues that need to be addressed.

2.4. Development area population growth

Area 14 is one of three key development areas within the Port Macquarie Hastings Council area and is currently supplied from the existing Lake Cathie zone substation. The development areas are Area 13 – Thrumster / Sovereign Hills, Area 14 - Lake Cathie/Bonny Hills and Area 15 - Camden Haven.

The three development areas were endorsed by the NSW Dept of Urban Affairs and Planning in 2001 via Council's 'Hastings Urban Growth Strategy'. The Council's strategy has been further reinforced in the 2011 and 2017 'Urban Growth Management Strategy'.

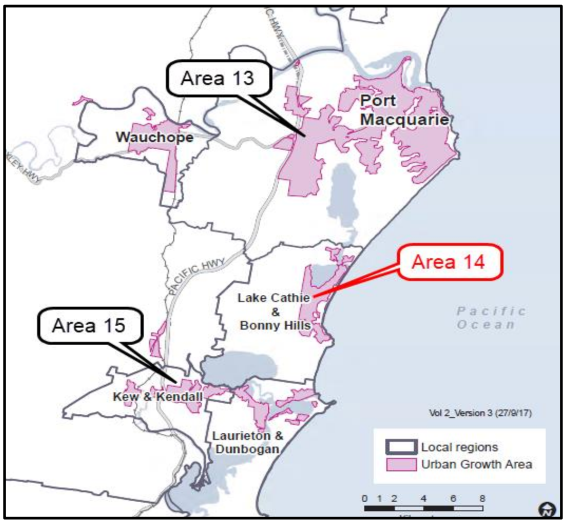

Figure 3: Port Macquarie Hastings Council development areas

Area 14 population is anticipated to increase from the current 6,000 to 9,000 residents by 2036. Significant portions of the future development will be located along the coast between Lake Cathie and Bonny Hills, including the master planned Rainbow Beach area, which has capacity for 1,300 dwellings, primary schools, playing fields and village centre providing retail and community facilities. The ultimate long-term peak demand in the area is expected to exceed 14MVA (approx. 2037). The medium-term demand forecast is shown below in Figure 4 / Table 1.

In conjunction with the Hastings Urban Growth Strategy, Hastings Council have a committed plan to establish a new water treatment plant at Cowarra Dam (2027 completion) and provide N-1 security for the WTP. The preferred option is to provide primary supply for the Cowarra Dam WTP from Bonny Hills zone substation with backup available from Rocks Ferry Zone Substation. The POE50 forecast below includes a step change in 2026/2027 that includes the new WTP load. There is also an opportunity to place conduits for the future 66kV ring alongside the new Cowarra Dam 11kV supply conduits and Lake Cathie Bonny Hills pipeline being constructed along Houston Mitchell Drive over the next 4 years.

2.5. Forecast demand.

Lake Cathie ZS is forecast to remain a winter peaking zone substation. The load is significantly residential with over 80% of customers in this category and most of the remaining demand is from commercial customers being the next largest category at 18%.

It has been identified that by the end of 2026 there will be 2.3 MVA of load at risk and there are 216 hours for which it will not be able to supply all customers from the zone substation if there is a failure of the normally in service No.1 transformer at Lake Cathie ZS. That is, it would not be able to supply all customers during high load periods following the loss of transformer 1. No.2 transformer has a non-standard nominal voltage and limited tapping range that results in high customer voltages, so it is not normally used. It has a 11.66kV nominal secondary voltage with limited buck taps, so it regularly sits on top tap and cannot maintain the distribution voltage within the required acceptable range and is rarely put into service due to it delivering voltage outside the acceptable range that may cause power quality issues for Essential Energy customers.

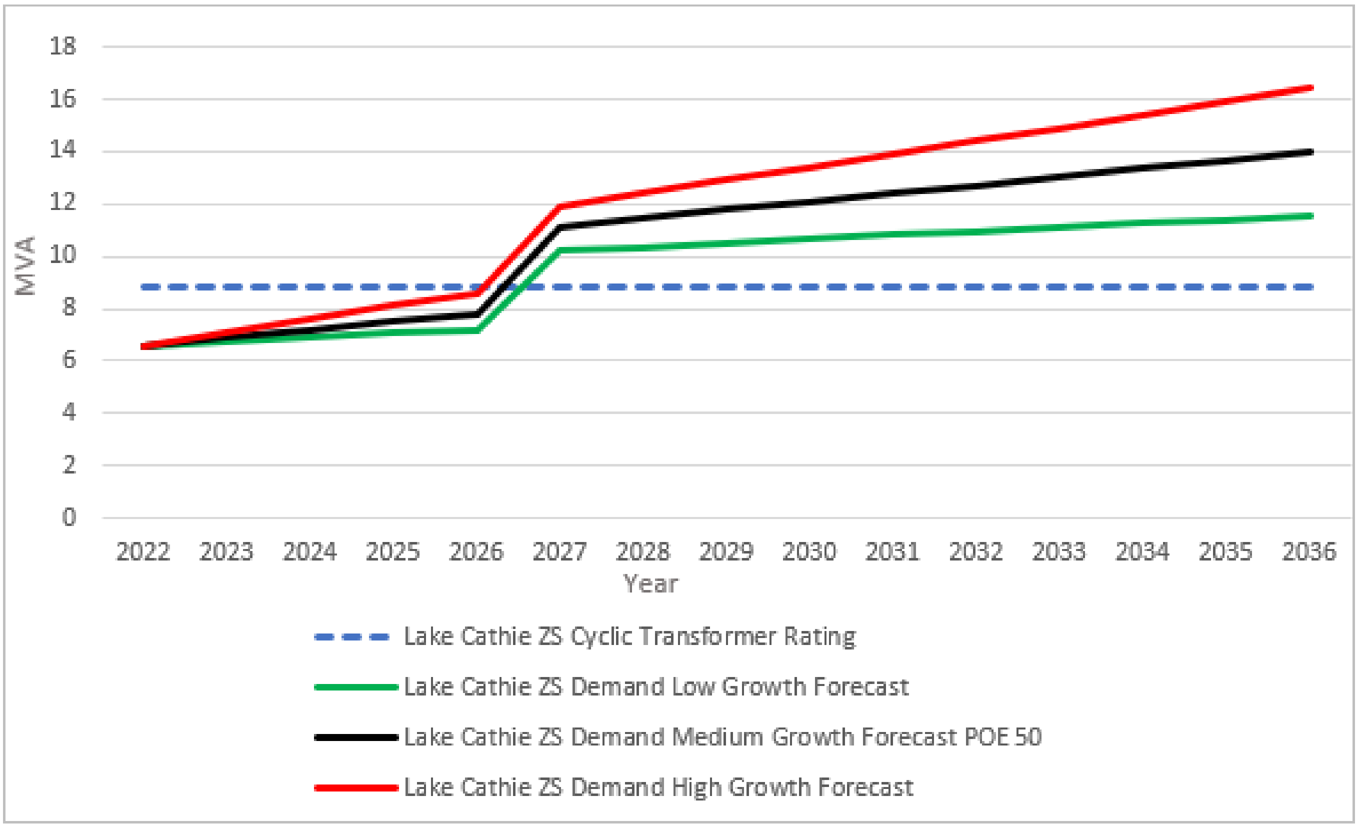

Figure 4: Lake Cathie zone substation demand forecast & N-1 cyclic transformer rating.

LAKE CATHIE ZS FORECAST PEAK MVA #															
Forecast Scenario	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Low Growth	6.6	6.8	6.9	7.1	7.2	10.2	10.4	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6
Medium Growth #	6.6	6.9	7.2	7.5	7.8	11.1	11.4	11.8	12.1	12.4	12.7	13.0	13.4	13.7	14.0
High Growth	6.6	7.1	7.6	8.1	8.6	11.6	12.1	12.6	13.1	13.6	14.1	14.6	15.1	15.6	16.1

Table 1: Forecast demand # Winter POE50

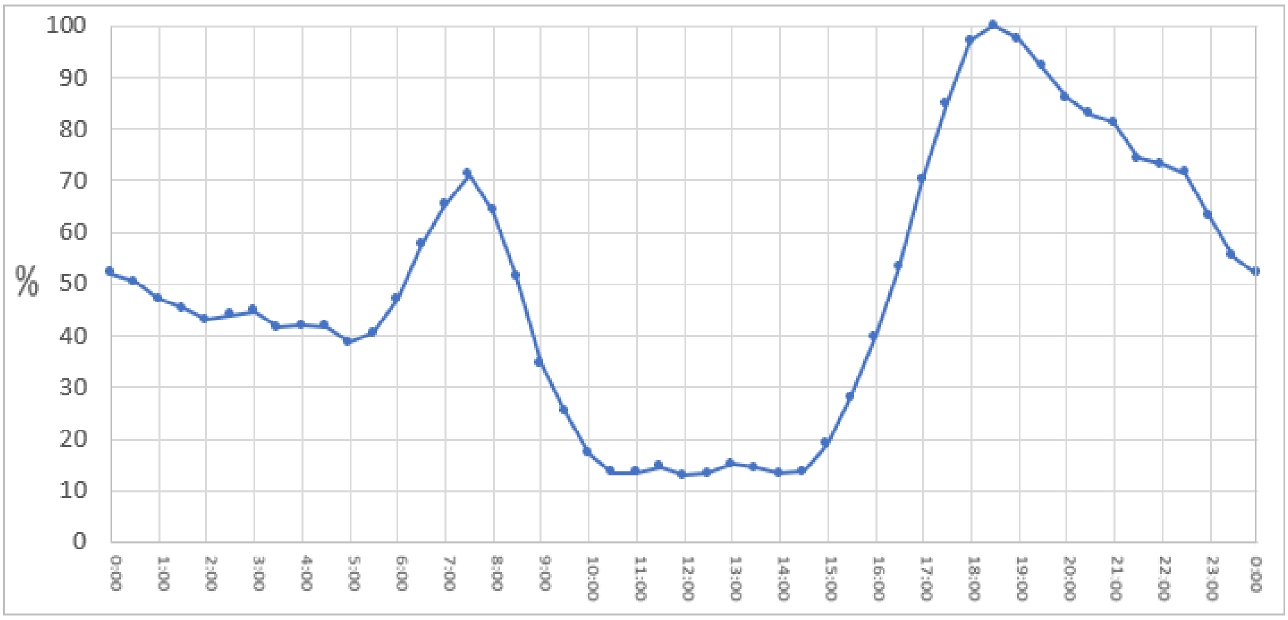

Figure 5: Lake Cathie zone substation peak winter load cycle

2.6 Load transfer capacity from the adjacent zone substations

There is limited transfer capacity available to the existing 11 kV network. During peak demand an estimated maximum transfer capacity of 0.7 MVA is available from the adjacent 11kV network supplied from Laurieton ZS via 11kV Feeder LRN3B1 Alma Street located south of the Bonny Hills / Lake Cathie supply area with no 11kV network link available from Port Macquarie. Due to voltage and thermal constraints the available transfer capacity can only supply a small section of the network in the Bonny Hills area.

3 Identified Need

3.1 Description of the Identified need.

Essential Energy has prepared this non-network options screening notice to assess whether the safety, reliability and demand requirements of the Lake Cathie Zone Substation could be achieved either fully, or in part through non-network options. To assess whether the non-network options could be beneficial, it is important firstly to define the identified need for this location. Lake Cathie zone substation asset condition and near-term capacity issues require rectification because:

- Lake Cathie zone substation was installed in the 1970s and is in poor condition. If the identified poor asset condition zone substation components (Full list in background), remain in service, there is an increased likelihood that a number of these assets will fail in future years, which could result in fires and oil spills that present a high risk to those in the immediate vicinity, and potentially the wider area which includes a medical centre and environmentally sensitive creek located next to the zone substation.
- The zone substation is at near capacity with existing in-service transformer 1 unable to carry the forecast future load within 5 years without thermal overload. Alternate Transformer 2 has a secondary nominal tap of 11.6kV and is only used as an emergency backup due to lack of buck taps creating power quality issues. Essential Energy has identified the Lake Cathie Zone Substation as a priority for investment based on two key needs:
    - Firstly, the need to protect power sector workers and members of the public from harm caused by equipment failure (Safety); and,
    - Secondly, the need to maintain a reliable power supply to the residences and businesses that are dependent on the supply from this distribution network (Reliability).

3.2 Quantification of the identified need.

3.2.1 Condition of plant, safety / operational clearances, and security fencing.

The investment is driven by the deteriorating condition of the busbar structures, switchgear insulators, transformer insulators, unacceptable busbar safety clearances, transformer bunding and security fencing which are at risk of failure and pose a serious safety risk.

- The structures supporting the outdoor busbar equipment and reclosers are heavily corroded and ZS technicians have made several ad-hoc repairs over the years without fully completing substantive repairs.
- The switchgear and transformer insulators are subjected to regular heavy salt build up which causes tracking.
- Corrosion is occurring on the upper and lower sections of the 33kV and 11kV insulators fitted to isolators. This increases the risk of the units failing whilst an Essential Energy employee is operating the device.
- There are reduced phase-to-phase safety clearances between outgoing feeders. ZS technicians need to isolate two feeders to allow safe access to maintain one feeder recloser with a loss of reliability as a result.
- Transformer bunds and oil containment are not to standard or sufficiently sized, creating an environmental risk of transformer oil leaking into the adjacent creek.
- The ZS has a chain wire mesh fence that provides a lower standard of security than required for an urban area and is in poor condition. A formal risk assessment has raised concerns with its ability to prevent unauthorised access to the ZS. It is in an area of expanding residential development with increased foot and vehicle traffic nearby and is in a highly visible location. It also does not meet Essential Energy's CECP7029 Physical Security Framework.
- There is an increased likelihood that a number of these assets will fail in future years, which could result in projectiles, fires and oil spills that present an intolerable risk to those in the immediate vicinity, and potentially the wider area.

The identified need, therefore, is to address the increasing risks to safety, reliability of supply associated with the deterioration and capacity of the assets at Lake Cathie zone substation. This ensures we continue to comply with our obligations in the following regulations:

- Electricity Supply (Safety and Network Management) Regulation 2014 [1]
- The Reliability And Performance Licence Conditions For Electricity Distributors.[2]

1. Section 5 Network operators to ensure safety of distribution and transmission systems.
   A network operator must take all reasonable steps to ensure that the design, construction, commissioning, operation and decommissioning of its network (or any part of its network) is safe.

2. Section 15. Network overall reliability standards

15.1 A licence holder must not, when excluded interruptions are disregarded, exceed in a financial year the SAIDI average standards that apply to its feeder types.

15.2 A licence holder must not, when excluded interruptions are disregarded, exceed in a financial year the SAIFI average standards that apply to its feeder types.

3.2.2. Creditable solution requirements

Credible solutions would be required to allow the decommissioning of the Lake Cathie Zone Substation to ensure the safety of staff and the public and enable supply for the load detailed in Table 1 and Figure 5.

3.3 Assumptions in relation to identified need.

In accordance with the NER requirements, we also noted this reasoning is not dependent on any assumptions or methodologies.

4 Potential Credible Options

Table 2 provides a description of the credible network options that address the identified need. These options are compared to a 'business as usual' (BAU) option, where the existing assets at Lake Cathie zone substation remain in service and maintenance is undertaken consistent with the condition and age of the assets. Minor capital works will also occur as is essential to keep the substation operational on a 'like for like' basis.

Option	Description	Notes	Opex	Capex	Net Economic Benefit ($M)	Ranking
BAU	Business as usual "Do Nothing" option.	• Increased safety risk of EOL plant failure over time • Compromised level of Reliability. • Ongoing operational Safety Risk. • Increased operating and maintenance costs including ongoing repair. • Compromised protection not meeting current standards. • Compromised power quality when Txr 2 is in service.	$0.282M*	$0.0M	-$5.28	3
1	Establish Bonny Hills zone substation.	• Lower cost. • Simple construction. • Site well located/hidden. • Improved Reliability.	$0.1M	$10.69M	$1.45	1
2	Rebuild the existing Lake Cathie zone substation.	• Brownfield site. • Increased customer outages during construction. • Construction safety. • Poor location/public presence. • Elevated corrosion due to location.	$0.1M	$10.94M	$1.17	2

Table 2: Network options

*Section 6 contains detail of Economic Analysis including Net Economic Benefit that provides Ranking.

4.1 Preferred option

The preferred option is Network Option 1: Establish Bonny Hills zone substation. This option has an NPB of $1.45M positive and includes the establishment of a new 33/11kV zone substation at an existing site (Bonny Hills) on Houston Mitchel Drive, 2km southwest of the existing Lake Cathie ZS.

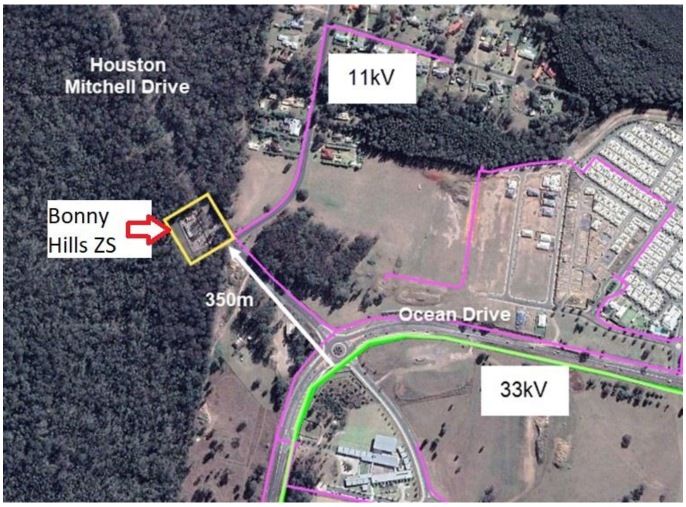

Figure 6: Bonny Hills zone substation site

The site is 2.5km from the ocean in an area that is screened and buffered by State Forest which will provide more salt corrosion protection than the existing Lake Cathie ZS site. The surrounding State Forrest ensures that dwellings and other developments cannot be built around the ZS. The site was cleared some time ago and it is presently used as a storage area.

The site is well located with respect to connecting into Essential Energy electrical infrastructure, being only 350m from the 33kV line and adjacent to the 11kV network. The overall location is ideal to service the existing loads back to the north towards Lake Cathie township and the developing areas directly east and south of the ZS site.

The new ZS would have a control / switch room containing a 12 panel 11kV switchboard (10 x feeders), two new 33/11kV 16/20MVA transformers, 66kV outdoor switchyard and equipment to allow for future conversion to 66kV (except for 33kV VTs).

Construction of the new ZS will be straight forward as it is on a greenfield site. The 33kV and 11kV connections along Houston Mitchell Drive will be mostly underground. The existing 11kV feeder along Houston Mitchell Drive will be rebuilt with compact 66kV overhead construction, and the other 33kV connection will be underground.

Required commissioning date to meet the identified need is December 2026.

Network Option 1 has NPC of $10.69M an NMB of $12.14M and is NEB positive $1.45M.

4.2 Other network options considered.

Network Option 2 – Rebuild Lake Cathie ZS

This option requires rebuilding Lake Cathie ZS at its present location. The Lake Cathie ZS site is 50m x 50m and the ZS footprint is 30 x 30m. The ZS is in the northwest corner of the site, away from Ocean Drive to the south and the creek to the east.

A new control/switch room would be constructed in the only available area, which is to the south of the existing footprint, close to Ocean Drive and away from the creek. The new building would contain an 11kV indoor switchboard and control/protection equipment. Temporary 11kV connections would be made from the new switchboard to the existing 33/11kV transformers to allow staged connections of the 11kV feeders. Existing 11kV outdoor infrastructure would then be dismantled to allow for construction of two new transformer bunds for the new 16/20MVA transformers.

The primary side of the ZS would be built to 66kV standards, including all equipment except for 33kV VTs, in preparation for the long-term future network conversion to 66kV.

To build the new outdoor yard, temporary 33kV connections would be needed to the new transformers. This would then allow removal of the existing transformer bunds and 33kV outdoor equipment. A new high security fence and earthing grid would be installed, and existing oil containment system upgraded.

The existing 33kV tee connection outside of the ZS would be removed by rearranging the 33kV line from Clearwater Crescent to enter UG into the ZS and connect to the new outdoor switchgear.

Rebuilding on a brownfield site is normally more expensive and complex that a greenfield site. There are additional safety risks related to working around live high voltage that is not present with a greenfield build. Retaining this site would have negative community and reputational impacts.

The adjacent medical centre and therapy aquatic centre have expressed concerns with their proximity to the ZS. There are environmental concerns related to the ZS's oil filled transformers not meeting today's design standard and being adjacent to a creek. The location of the site will continue to be in a highly visible residential and commercial area, subject to nearby vehicle and foot traffic, and salt corrosion from the nearby ocean.

As per Network Option 1 the required commissioning date to meet the identified need is December 2026.

Network Option 2 has NPC of $10.94M an NMB of $12.14M and is NEB positive $1.17M.

5 Consideration of Non-Network Options

In the case of the identified need at the Lake Cathie zone substation, we have concluded that there are no credible non-network options for the following reasons:

- there is no opportunity to reduce the required assets and associated works to replace the EOL Lake Cathie zone substation by partially reducing peak load through demand management.
- embedded generation incorporating the use of batteries would not be cost effective in this location given the estimated capital cost and amount of land purchase required to cater for the December 2026 peak load requirement with connection of the committed Water Treatment Plant at Cowarra Dam.
- the cost of embedded generation exceeds the cost of the preferred network option, and there is in any event, limited space for implementing a local generation option large enough to meet current and forecast demand within the area.

In considering the feasibility of generation and storage options, Essential Energy investigated an indicative estimate for the non-network options listed in Table 3 that would provide a level of supply reliability comparable to the network options. It was found that:

- the high-level annualised capital cost of a stand-alone gas fired generation option was higher.
- There is no gas pipeline to supply the standalone gas generator in the area.
- the high-level annualised capital cost of a stand-alone renewable generation / battery option was higher.

These non-network options are unfavourable when compared to the network options. A non-network solution within the lake Cathie area would be cost prohibitive and not be able to meet all the criteria to satisfy the identified need.

Table 3 below is a summary of the non-network options considered with respect to meeting the identified need, technical, commercial, and timing to enable full consideration of these non-network options as credible.

Rating	Colour Coding
Does not meet the criterion	[orange]
Does not fully meet the criterion (or uncertain)	[yellow]
Clearly meets the criterion	[green]

Options	Assessment against Criteria			
1.0 Generation and Storage	**Meets Need**	**Technical**	**Commercial**	**Timing**
1.1 Gas turbine power station	[green]	[orange]	[orange]	[orange]
1.2a Generation (Solar) including battery storage	[orange]	[orange]	[orange]	[orange]
1.2b Generation (Wind) including battery storage	[orange]	[orange]	[orange]	[orange]
1.3 Dispatchable generation (large customer)	[orange]	[yellow]	[orange]	[orange]
1.4 Large customer energy storage	[orange]	[yellow]	[orange]	[orange]
1.5 Community Battery	[orange]	[orange]	[orange]	[orange]
2.0 Demand management				
2.1 Customer power factor correction	[orange]	[green]	[green]	[orange]
2.2 Customer solar power systems	[orange]	[yellow]	[yellow]	[yellow]
2.3 Customer energy efficiency	[orange]	[orange]	[orange]	[orange]
2.4 Demand response (curtailment of load)	[orange]	[yellow]	[orange]	[orange]

Table 3: Non-network options summary

5.1 Required Demand Management Characteristics

Generation and Storage

The assessment commentary for each of the non-network generation and storage options to address the identified need is:

5.1.1 Gas turbine power station

Identified need – Reduces safety risks of running old plant beyond life. Capable of meeting identified need through provision of multiple gas generators. (Fully met).

Technical: Significant constraints and barriers to deployment of equipment to generate the energy required in the Lake Cathie / Bonny Hills area (e.g., obtaining planning permits, local community objections, adequately managing the environmental impacts). In addition, there is no availability of a suitable high pressure gas pipeline in the immediate vicinity that is essential for this type of generation. (Closest HP Gas main is in Newcastle) (Not met)

Commercial: Costs of this type of generation appear much higher that the network alternatives. For example, the minimum scenario of installing a suitably sized gas fired generator including provision of a high-pressure gas main to supply the generator have an estimated cost of $45M plus network connections dependent upon location. It is noted that non-network proponents rather than Essential Energy would bear the cost of these additions and they would recoup these costs through selling power generated at market prices. It should also be noted that this costing includes an estimate of revenue raised from generation and sold at market rates.

The scale of estimated capital costs illustrates the quantum of additional capital costs compared to a network solution and this will lead to a much higher cost compared to the preferred network solution. (Not met).

Timing: Planning process and nature of the investment and likely objectives, together with design requirements both for the generator and any required connections to the network supplied from Lake Cathie ZS mean this is unlikely to be completed by 2026. (Not met)

Overall: Not a potentially credible option

5.1.2 Generation using renewables solar energy combined with suitable BESS.

Identified need: Reduces safety risks of running old plant beyond life. This NNO option is unlikely to solve the identified need. It is estimated that a suitably sized generator using solar is likely to require 165 acres of land.

Devoting this amount of land to energy production in the Lake Cathie / Bonny Hills environment is improbable given the proximity of available land and the required network connections. In addition, the generation profile of solar power does not align to the consumption profile of consumers and will not satisfy the identified need with asset condition of the existing Lake Cathie ZS being the primary driver even with the inclusion of battery energy storage. (Not met)

Technical: While it is technically feasible to use this well understood and applied technology for this type of power generation, there are significant constraints to the deployment of a solar facility to generate the energy required in this locality. These include zoning, planning and environmental constraints given the land requirements and the lack of evidence of the availability of approximately 165 acres for this type of purpose. (Not met).

Commercial: Costs of this type of generation are unlikely to be commercially viable or comparable with the costs of network alternatives. Based on required generation & BESS unit rates, a conservative cost is likely to be $30M plus network connection costs. There is limited availability of land for such a development close enough to service the Lake Cathie supply area and the cost / lease for the required land would be prohibitive. This costing includes an estimate of revenue raised from generation and sold at market rates. This NNO is unlikely to be cost effective when compared to the network alternatives. (Not met)

Timing: planning process and nature of the investment and likely objectives, together with design requirements (both for the generators, battery storage and any required 11 kV connections to Lake Cathie ZS network) mean this is unlikely to be completed by 2026. (Not met).

Overall: Not a potentially credible option.

5.1.2b Generation using renewables wind energy combined with suitable BESS

Identified need: Reduces safety risks of running old plant beyond life. Unlikely to meet the identified need.

A suitably sized wind turbine/farm would require 150 acres which includes a buffer area, suitable spacing to ensure that there are obstructions to the air flow and to meet local planning standards. Devoting this amount of land to energy production in the Lake Cathie / Bonny Hills area is unlikely to be feasible with the amount of public consultation required with the highly visible nature of wind turbines. (Not met).

Technical: It is unclear whether there is an adequate site available in terms of elevation, wind conditions for wind generation. The planning constraints and environmental factors involved in securing planning permission for using land for this purpose are significant and the use of land required for this purpose unlikely to be allowed. (Not met)

Commercial: As for commercial solar generation, the cost of acquiring land or finding a suitable parcel of land to lease and installing wind turbines is likely to significantly exceed the costs of the preferred network solution and means this form of generation is unlikely to be viable. A conservative estimate for installation of a suitably sized WF including a suitable BESS would exceed $38M approx. This estimate includes revenue raised from generation and sold at market rates.

This relatively small-scale installation is likely to be more expensive per MW in a semi urban / rural environment. (Not met)

Timing: planning process and nature of the investment and likely objectives, together with design requirements (both for the generators and any required 11 kV connections to Lake Cathie ZS) mean this is unlikely to be completed by 2026. (Not met)

Overall: Not a potential credible option.

5.1.3 Dispatchable generation (large customer)

Identified need: Reduces safety risks of running old plant beyond life. There are a small number of commercial customers consuming 1.3 peak MVA. There are also a limited number of industrial customers with small level maximum demands of 0.5 MW and 0.3 MW. It's unlikely that the small number of industrial and commercial customers is consuming sufficient energy for this type of generation to provide a viable non-network option. The practical difficulties of coordinating generation efforts for a large number of small consumers are too great for this non network option to be viable. (Not met).

Technical: This type of generation is technically feasible within existing Commercial and industrial sites but would face planning and technical constraints. (Not fully met).

Commercial: There are only a small number of commercial and industrial large-scale customers in the Lake Cathie supply area that would have a generator or have the need to install one. This is unlikely to be commercially viable compared to solving the identified need using a network solution. (Not met).

Timing: Planning processes, the nature of the investment and likely obstacles, together with design requirements (both for generators and any required network connections to Lake Cathie ZS) mean this is unlikely to be completed by 2026. (Not met).

Overall: not a potentially credible option.

5.1.4 Large customer energy storage

The responses to this option are similar to option 5.1.3. The overall finding that this is not a potentially credible option is driven by the relatively small power requirements per commercial / industrial customer and the need to coordinate efforts across many power users this is likely to be time consuming and difficult to achieve. In addition, the costs associated with battery storage to manage peak demand and therefore reduce the scope of the non-network project are likely to be higher than costs for a network solution.

Overall: not a potentially credible option.

5.1.5 Community Battery energy storage

Identified need: This NNO is unlikely to meet the identified need. It is estimated that use of suitably sized community batteries to support the Lake Cathie supply area load using 250kW units (match for average distribution transformer), would require a significant number of community batteries suitably located in the Lake Cathie and Bonny Hills areas.

The community batteries would generally be located adjacent to existing distribution and LV infrastructure. In the Lake Cathie / Bonny Hills area this would be difficult given the proximity of available land and the required connections and is not feasible. Although beneficial it will not satisfy the identified need with asset condition of the existing Lake Cathie ZS being the primary driver. (Not met)

Technical: While it is technically feasible to use this this type of community battery storage, there are significant constraints to the deployment of a batteries to meet the Lake Cathie supply area load required in this locality. These include finding suitable locations generally near to existing infrastructure in the streets throughout the urban areas. Given the land requirements for this type of NNO including the requirement to find the large number of sites makes it difficult to achieve and not potentially feasible. (Not met)

Commercial: Costs of this type of generation are unlikely to be commercially viable or comparable with the costs of network alternatives. Based on required battery capacity to support the area power requirements the cost is likely to be $20M plus network connection costs.

This is unlikely to be cost effective when compared to the network alternatives. (Not met)

Timing: With the planning process, nature of the investment and likely objectives, together with design requirements (for the battery storage and any required 11 kV connections to Lake Cathie ZS network) mean this is unlikely to be completed by 2026. (Not met).

Overall: not a potentially credible option.

5.2 Demand management Option considered.

The assessment commentary for the demand management/efficiency options is:

5.2.1 Customer power factor correction

Identified need: Reduces safety risks of running old plant beyond life. This option is unlikely to meet the identified need because of the absence of enough large industrial power users where this type of action could result in significant power savings. (Not met)

Technical: This type of saving is technically feasible for commercial / industrial users on a certain type of contract and is achievable. (Fully met)

Commercial: This could be cost-effective. (Fully met).

Timing: This option is unlikely to be completed by the end of 2026. (Not met).

Overall: Not a potentially credible option.

5.2.2 Customer solar power systems

Identified need: Reduces safety risks of running old plant beyond life. Solar household installations in Australia is on average 30%.

Satellite imagery suggests that the proportion for the Lake Cathie / Bonny Hills catchment is unlikely to exceed this average figure. Currently, as noted in Section 5, solar installations in Lake Cathie / Bonny Hills area have a maximum connected capacity of 5 MW. The rate of take up required to meet the ultimate forecast POE50 load is not considered to be achievable. (Not met).

Technical: This option is technically feasible, and the technology well understood and tested. (Not fully met)

Commercial: Achieving a greater than average solar take up would require a financial incentive and to achieve the level of take up for this option to be potentially credible would require a very high subsidy. (Not fully met).

Timing: This option could be completed by 2026 but there is uncertainty given the percentage of customers that would need to install solar. (Not fully met).

Overall: not a potentially credible option.

5.2.3 Customer energy efficiency

Identified need: Considering a major part of the identified need is asset condition of the existing Lake Cathie zone substation reduction in demand alone will not meet the required outcome. (Not met).

Technical: This option is not technically feasible as it not viable to reduce customer demand by 100% (Not met).

Commercial: Not commercially feasible due to the above. (Not met).

Timing: This type of mass action would be difficult to promote and implement by 2026. (Not fully met).

Overall: not a potentially credible option.

5.2.4 Demand response (curtailment of load)

This option has a similar assessment profile to options 5.1.3 and 5.1.4. All essentially rely on the actions of a small number of high consumption users. There is no evidence of a small number of very large users who might be persuaded to curtail load and hence this is unlikely to meet the identified need. We also do not think this is likely to be commercially feasible or achievable within the intended timing of the network solution.

Overall: not a potentially credible option.

6 Economic Assessment

In this section we present the results of our economic assessment of the business as usual and two credible options set out in table 4. The purpose of this assessment is to identify the preferred option, which is then subject to sensitivity analysis and analysis to determine optimum timing.

In identifying the preferred option, the objective is to maximise net economic benefit. Each of the credible options would meet the need as identified in Section 3, in terms of continuing to reliably supply load to the customers who are presently supplied from Lake Cathie zone substation. Therefore, the preferred option can be identified as the one that minimises total net present value cost.

6.1 Methodology

The methodology we have applied in this assessment accords with the approach prescribed in the AER documents "Application guidelines - Regulatory investment test for distribution – August 2022" and "Industry practice application note - replacement planning - January 2020".

Under the methodology, the annual risk cost of an asset (or group of assets) is calculated as the probability of asset failure multiplied by the likelihood of consequence of the asset failure multiplied by the consequence cost of the failure event.

To calculate the annual risk cost of the assets at Lake Cathie zone substation, we have modelled four key failure modes listed in the table below.

Failure mode	Description
1	Catastrophic failure of a transformer (irreparable damage to both transformers)
2	Catastrophic failure of a 33kV CB
3	Disruptive failure of a transformer (irreparable damage to one transformer)
4	Disruptive failure of a 33kV CB (irreparable damage to a 33kV CB)

Table 4: Failure Mode Summary

The analysis has not modelled all failure modes as additional failure modes are not expected to have material impact on the identification of the preferred option. Furthermore, such endeavour will constitute effort that is not commensurate with the costs of the project. This is a conservative assumption as the full risk costs are expected to exceed those calculated in this analysis.

The consequence costs for each failure mode were estimated in each of the following consequence areas:

- involuntary supply interruption.
- safety (i.e., threat to human life).
- operating expenditure (principally for emergency generators).

- capital expenditure associated with the reinstatement or replacement of failed and damaged assets.
- capital expenditure associated with installing alternate assets to restore supply.
- environmental costs such as oil spillage and site clean-up.
- costs associated with disruption to adjacent businesses and residents.

Annual asset failure and consequence probabilities were derived from historical asset performance data and used in analysis modelling.

The probability-weighted cost of each failure mode based on the likelihood that the cost would be incurred was calculated and these were summed to derive an estimate of the total expected annual risk cost. The total present value of the risk cost is calculated and the present value of CAPEX and OPEX costs to implement each of the credible options is also calculated. This provides a basis for comparison between BAU and credible options to determine a preferred option.

In a project where the identified need is for reliability corrective action such as this situation the net economic benefit is typically negative and the preferred option can be identified as the one that minimises total present value costs, avoiding costs associated with an increased probability of failure.

This is defined in NER clause 5.17.1(b) that states that the purpose of the RIT–D is to:

...identify the credible option that maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the National Electricity Market (the preferred option). For the avoidance of doubt, a preferred option may, in the relevant circumstances, have a negative net economic benefit (that is, a net economic cost) where the identified need is for reliability corrective action.

6.2 Key variables and assumptions

Table 5 below lists the key variables and assumptions applied in the economic assessment. The table also sets out the upper and lower bounds of the range of forecasts adopted for each of these variables. We used these ranges to undertake scenario analysis, as explained in section 6.1.

Upper and lower bounds have been selected based on reasonableness estimates and with consideration of the sensitivity analysis results presented in section 6.4. This ensures the modelling considers the variability in parameters that have more significant impact on the results.

Variable / assumption	Lower bound	Central estimate	Upper bound
Cost of involuntary supply interruption	30% reduction in central estimate	Value of Customer Reliability (VCR) of $31,691 per MWh (weighted average by customer class)	50% increase in central estimate
Safety cost	30% reduction in central estimate	Value of statistical life of $4.4M	50% increase in central estimate
Network operating expenditure	20% reduction in central estimate	Cost forecast based on asset operating and maintenance requirements	20% increase in central estimate
Network capital expenditure	20% reduction in central estimate	In-house cost estimates using detailed and high-level project scopes	20% increase in central estimate
Environmental costs	20% reduction in central estimate	In-house cost estimates using detailed and high-level project scopes	20% increase in central estimate
Bushfire Environmental costs	20% reduction in central estimate	In-house cost estimates using detailed and high-level project scopes	20% increase in central estimate
Probability of asset failure	30% reduction in central estimate	Historical asset performance data, plus forecasts based on condition monitoring	30% increase in central estimate
Discount rate (real pre-tax)	3.04% real, being the pre-tax equivalent of the regulated WACC	30% increase in lower estimate	80% increase in lower estimate

Table 5: Key Variables and Assumptions

6.3 Scenarios adopted for option assessment.

NER clause 5.17.1 requires RIT–D proponents to base the RIT–D assessment on a cost benefit analysis that includes an assessment of reasonable scenarios. We have developed five reasonable scenarios to test the economic assessment with different combinations of plausible variations in the input values.

Material uncertainty and risk regarding assumptions of values for input parameters for economic benefit assessment is accounted for through selection of credible scenarios that reasonably reflect potential future states. A further step is to assign a reasonable probability to each of these reasonable scenarios occurring in practice. Regarding this report we consider the central scenario as the most likely and all other scenarios of lower but equal likelihood. Consequently, a higher probability has been assigned to the central scenario and an equal lower probability to the other 4 scenarios as shown in Table 6 below which includes the definition of scenario input parameters.

Scenario	Description	Probability of Occurrence
Central scenario	This scenario adopts the central estimate for each variable in the economic assessment. It represents the most likely outcome.	40%
Scenario A	This scenario represents a combination of variables that assess a high-risk cost and high failure probability	15%
Scenario B	This scenario represents a combination of variables that assess a low-risk cost and low failure probability	15%
Scenario C	This scenario represents a scenario where risk costs and failure probability are central however the lower bound discount rate is modelled	15%
Scenario D	This scenario represents a scenario where risk costs and failure probability are central however the upper bound discount rate is modelled	15%

Table 6: Definition of Scenario parameters

Scenario Inputs	Central Scenario	Scenario A	Scenario B	Scenario C	Scenario D
Probability of failure	Central	Upper	Lower	Central	Central
Safety Cost	Central	Upper	Lower	Central	Central
Capital expenditure	Central	Upper	Lower	Central	Central
Operating Expenditure	Central	Upper	Lower	Central	Central
Cost of Unplanned Loss of Supply	Central	Upper	Lower	Central	Central
Temporary Generation Costs	Central	Upper	Lower	Central	Central
Environmental cost	Central	Upper	Lower	Central	Central
Discount rate	Central	Central	Central	Lower	Upper

Table 7: Definition of scenario input parameters

6.4 Economic Assessment Results

The net present cost and ranking for each scenario for the BAU option and the two credible options is calculated according to the methodology described above and summarised in Table 8 below.

Credible Option	Market Benefits ($M)	Costs ($M)	Net Economic benefit ($M)	Ranking
Network Option BAU	-$5.28	$0.0	-$5.28	**3**
Network Option 1	$12.1	$10.69	$1.45	**1**
Network Option 2	$12.11	$10.94	$1.17	**2**

Table 8: Economic Assessment Results

Credible Option	Scenario					
	Central	A	B	C	D	All
	Most likely scenario inputs	High cost and high failure probability	Low cost and low failure probability	Low Discount Rate	High Discount Rate	Probability Weighted
Network Option BAU Net Present Benefit	-$5.28	-$2.55	-$2.94	-$6.17	-$4.21	-$21.16
Ranking:	3	3	3	3	3	3
Network Option 1 Net Present Benefit	$1.45	$2.41	-$1.81	$3.47	-$0.99	$4.52
Ranking:	1	1	1	1	1	1
Network Option 2 Net Present Benefit	$1.17	$2.08	-$2.01	$3.18	-$1.27	$3.15
Ranking:	2	2	2	2	2	2

Table 9: Net economic benefits of options - business-as-usual, 1 & 2 ($M, $2023) under different credible scenarios

The analysis indicates Network option 1 is ranked as the preferred option for the overall probability weighted scenario. The ranking of Network option 1 as the preferred option is unaffected by plausible variations from the central estimates of economic modelling input parameters. Under each combination of input parameters and the weighted probability **scenario, Network option 1 is the least-cost (or most efficient) option.**

Significant risk is associated with the BAU option due to the increasing failure rates of aged assets, high customer and safety impacts and significant load at risk with limited means of quickly restoring all supply should a failure occur.

Several conservative assumptions have been taken in the analysis that have reduced the risk of the BAU option. Had all possible risks been included the analysis result would have been even more conclusive for Network option 1. Consequently, it was deemed that there was no value in modelling additional failure modes given this would not have impacted on the RIT-D objective of selecting the most beneficial option.

The following conservative assumptions have been made. Allowance has been made in the BAU option to utilise temporary generators to reduce outage durations for customers and significantly reduce the risk cost of unserved energy.

It important to note that Network option 1 also provides benefits not quantified in the analysis.

These benefits include:

- Network operational flexibility and security with greater opportunity to switch load around the 11 kV network in response to faults or network access requirement in the area supplied by lake Cathie zone substation and adjacent areas.

- Increased options to supply future load growth at lower cost.

7 Finalisation of the RIT-D

This report represents the final stage of the RIT-D process. Following our review of the options, the network option chosen to address the identified need is the one that maximises the economic benefit to customers.

The preferred option, Option 1 Establish Bonny Hills zone substation, satisfies the RIT-D. This statement is made based on the detailed analysis set out in this report. The preferred option is the credible option that has the highest net economic benefit under the most likely reasonable scenarios.

In accordance with 5.17.4(j)(12), any questions regarding this report can be provided electronically to the email address provided below:

Email: reginvestment@essentialenergy.com.au

8 Checklist of regulatory compliance

Table 10 lists the sections of this report that contain the information required by clause 5.17.4(j) of the Rules.

Rules Clause	Requirement	Report Section
5.17.4(j)(1)	Description of the identified need for the investment.	Section 3
5.17.4(j)(2)	The assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, reasons that the RIT-D proponent considers reliability corrective action is necessary).	Section 3
5.17.4(j)(3)	If applicable, a summary of, and commentary on, the submissions on the nonnetwork options report.	Not Applicable
5.17.4(j)(4)	Description of each credible option assessed.	Section 4
5.17.4(j)(5)	Where a Distribution Network Service Provider has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit for each credible option.	Section 6
5.17.4(j)(6)	A quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure.	Section 4
5.17.4(j)(7)	A detailed description of the methodologies used in quantifying each class of cost and market benefit.	Sections 6.1 and 6.2
5.17.4(j)(8)	Where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option	Not applicable
5.17.4(j)(9)	The results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results.	Section 6.4
5.17.4(j)(10)	The identification of the proposed preferred option.	Section 6.4
5.17.4(j)(11)	For the proposed preferred option, the RIT-D proponent must provide: • details of the technical characteristics • the estimated construction timetable and commissioning date (where relevant). • the indicative capital and operating cost (where relevant) • a statement and accompanying detailed analysis that the proposed preferred option satisfies the regulatory investment test for distribution.	Section 2, Section 4, Section 4, Section 6 & 7
5.17.4(j)(12)	Contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the draft report may be directed	Section 7

Table 10: Checklist of Regulatory Compliance