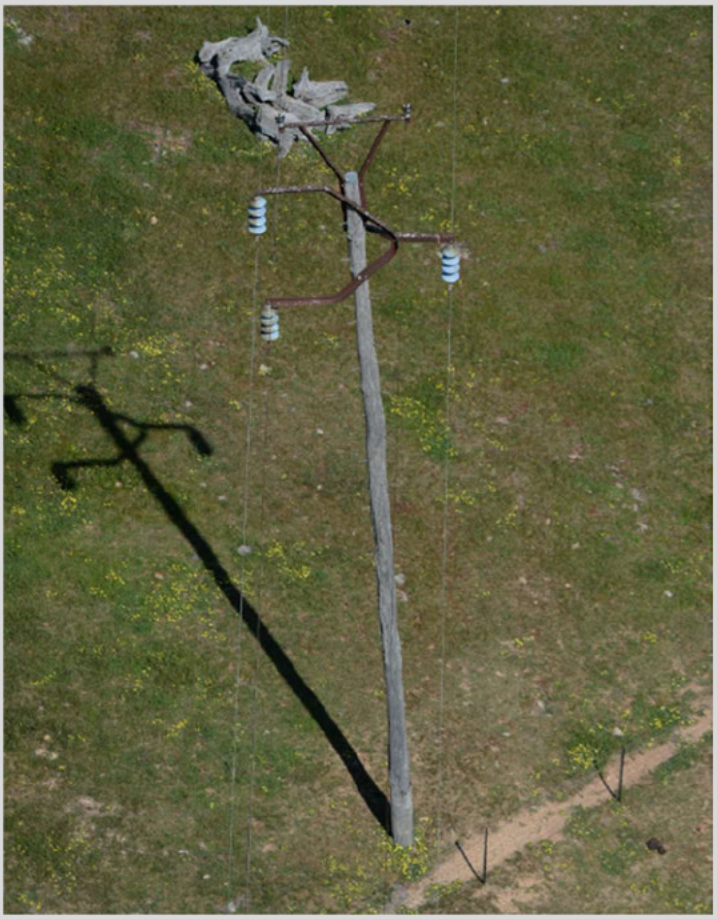
Essential Energy

10.03.06 Yass Line Upgrade Investment Case



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Distribution Major Project

Project:	10.03.06 Yass Line Upgrade Investment Case
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Approvals

	Name	Division	Title & Function	Date
1.	[redacted]	Assets & Operations	Manager Network Planning	14/12/22
2.				

Revisions

Issue Number	Section	Details of Changes in this Revision
1.		Initial Issue
2.		
3.		
4.		
5.		

Table of Contents

1. Executive Summary

Major Project	10.03.06 Yass Line Upgrade Investment Case
Description	Reconductor the 66kV Line 824 from the Yass Transgrid Substation to Yass Town.
Drivers for Investment	The driver of the investment is to reduce risk caused by the overloading of line 824 and improve the reliability of the line by replacing old copper conductor to meet NER 6.5.7 capital objectives. Yass load is forecast to continue increasing into the future, which will increase the corporate risks each year. Safety: Overloading the 824 line causes the clearance to ground to fall below statutory clearance levels. Upgrading the line will minimise the risk of a member of the public contacting the line. [redacted] Network Improve reliability by reducing the number of outages impacting the Yass Town load by replacing the aged copper conductor. [redacted] Bushfire There is an increased chance of a bushfire being started when the line is overloaded by either the conductors clashing or being contacted due to low clearance. [redacted] Reputation There is a risk of damage to reputation if a member of the public contacts the overloaded line or if the overload causes a bushfire. [redacted]
Investment Options	Several options were considered to reduce the risk of overload on the Yass Town line. - Increasing the design temperature of the line - Installing a 132/66kV transformer at the Yass Town ZS - Due to the financial cost of this project an Expression of Interest (EOI) for non-network solutions will be advertised prior to project initiation to enable the private sector to submit non-network options for evaluation. The option recommended from the Net Present Value of cost and benefit is as follows: - Reconductor the 824 Yass 66kV line (NPV $2.9m)

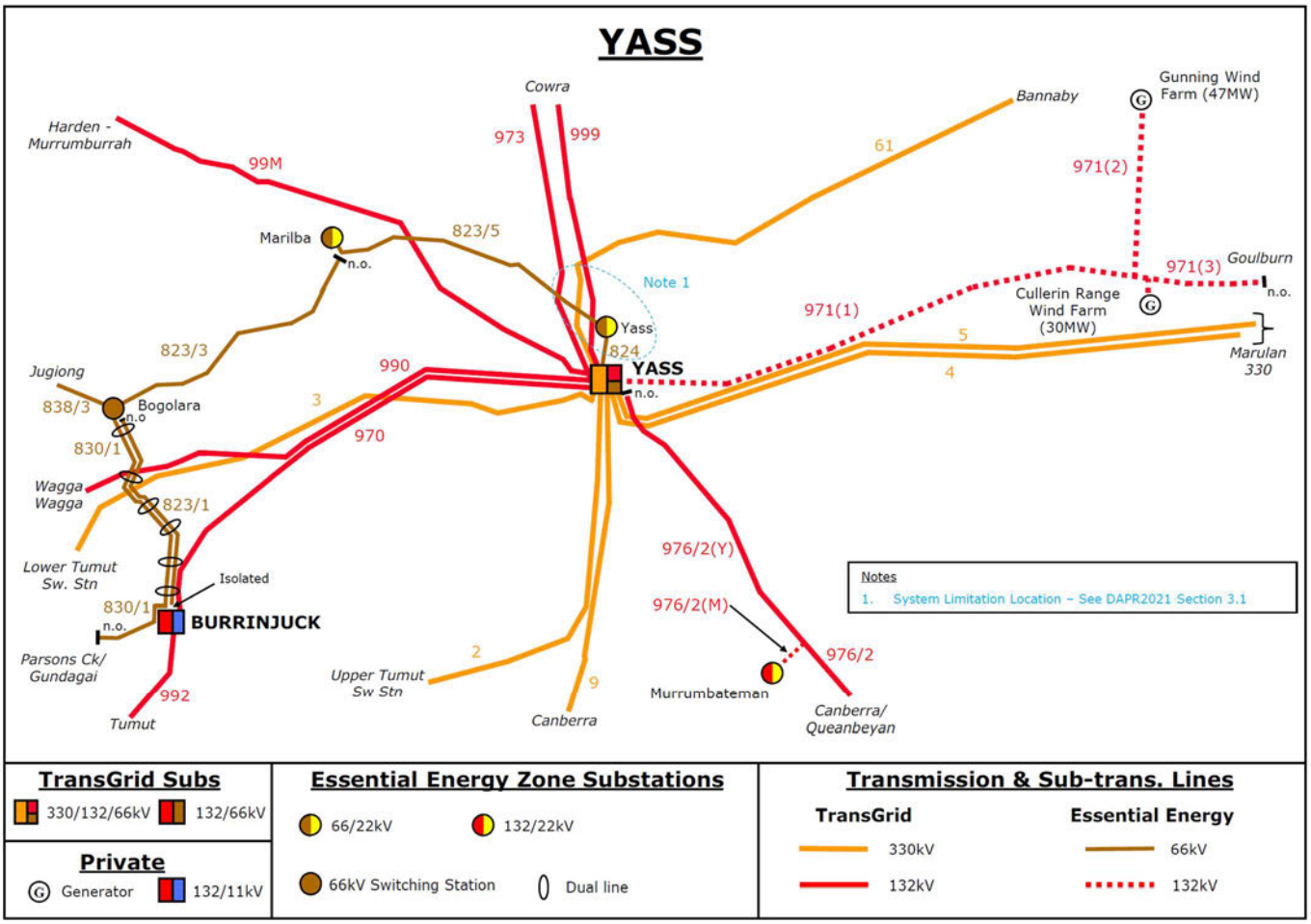
Estimated Expenditure $FY24	2024/25	2025/26	2026/27	2027/28	2028/29
	[redacted]	$0	$0	$0	$0

Note: All values are in middle of the year 2023-24 real dollar terms

2. Network

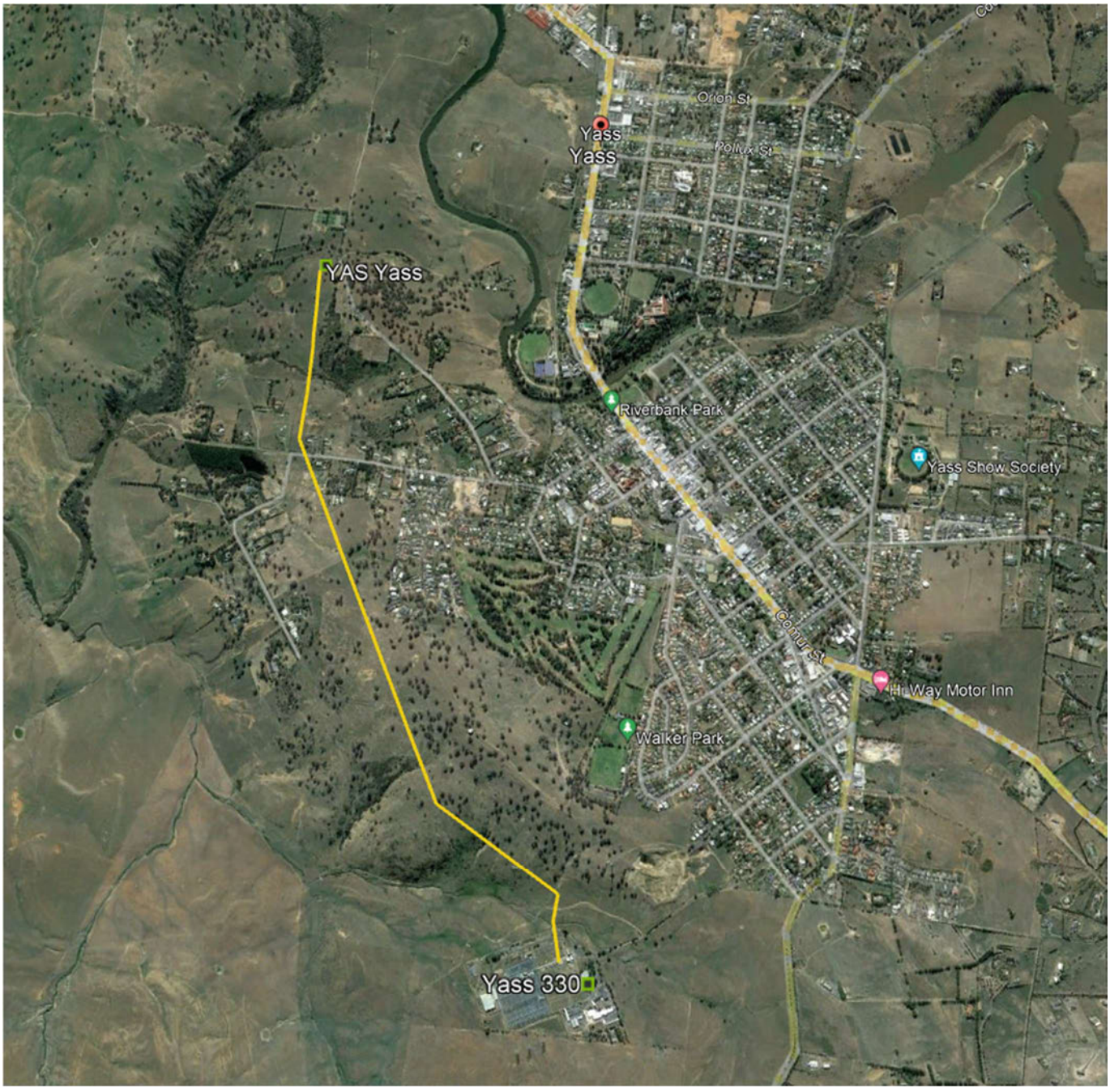
Normal supply to the Yass Town 66/22kV Zone Substation is from the 66kV line 824 from Transgrid's 330/132/66kV Substation at Yass, with a limited capacity alternate supply available from Murrumburrah / Jugiong. 66kV supply at the Yass Transgrid substation is provided by a single 54 year old 132/66kV transformer that Transgrid plan to replace in the next 10 years. Marilba is normally supplied from the Yass Town zone Substation over the 823/5 line, which connects to the Yass Town 66kV bus without a circuit breaker, so faults on this line also take out the Yass Town load. The Yass zone substation also provide an alternate supply for the single 132/22kV transformer at the Murrumbateman zone substation via 22kV interconnectors.

Figure 1: Subtransmission Network supplying Yass



The 824 line is 3.65km in length, constructed from 7/.104HDBC with a design temperature of 50degC and runs to the west of Yass town as shown in Figure 2.

Figure 2: 824 line from Yass Transgrid Substation to Yass Town Zone Substation



3. Load Forecast

Peak summer and winter demand on the 66kV line 824 between Yass Transgrid and Yass Town is forecast by Frontier Economics (**Attachment 11.01**) to increase significantly over the next regulatory period as shown in Table 1.

Table 1: Forecast Peak Demand – Line 824

Financial Year	Summer (MVA)	Winter (MVA)
2022	15.5	15.4
2023	15.6	15.6
2024	16.0	16.1
2025	16.3	16.5
2026	16.8	17.0
2027	17.4	17.6
2028	17.8	18.1
2029	18.1	18.5

An example summer load profile from 2020 is shown in **Figure 3** and **Figure 3** below.

Figure 3: Line 824 Demand In 2020

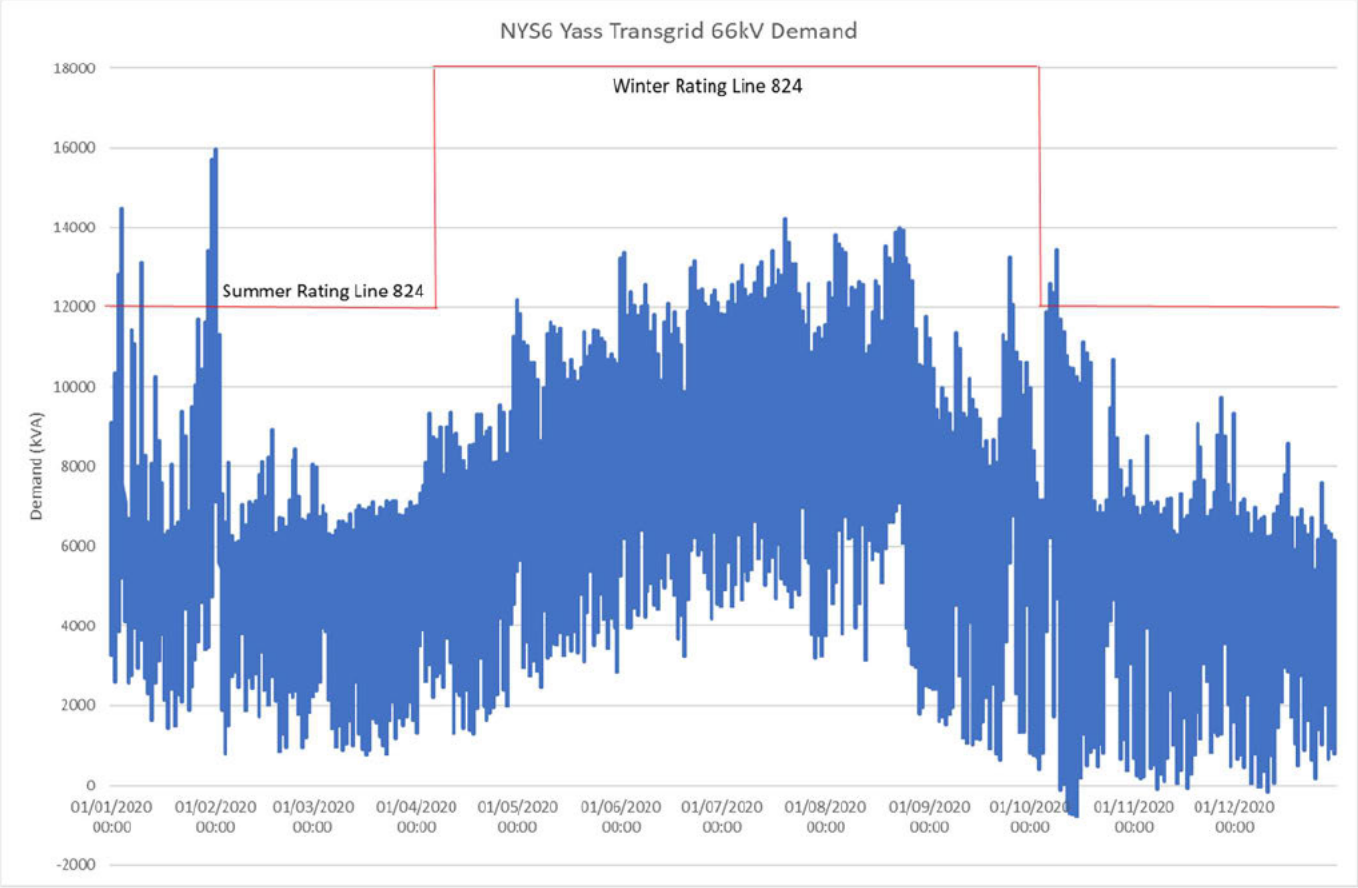
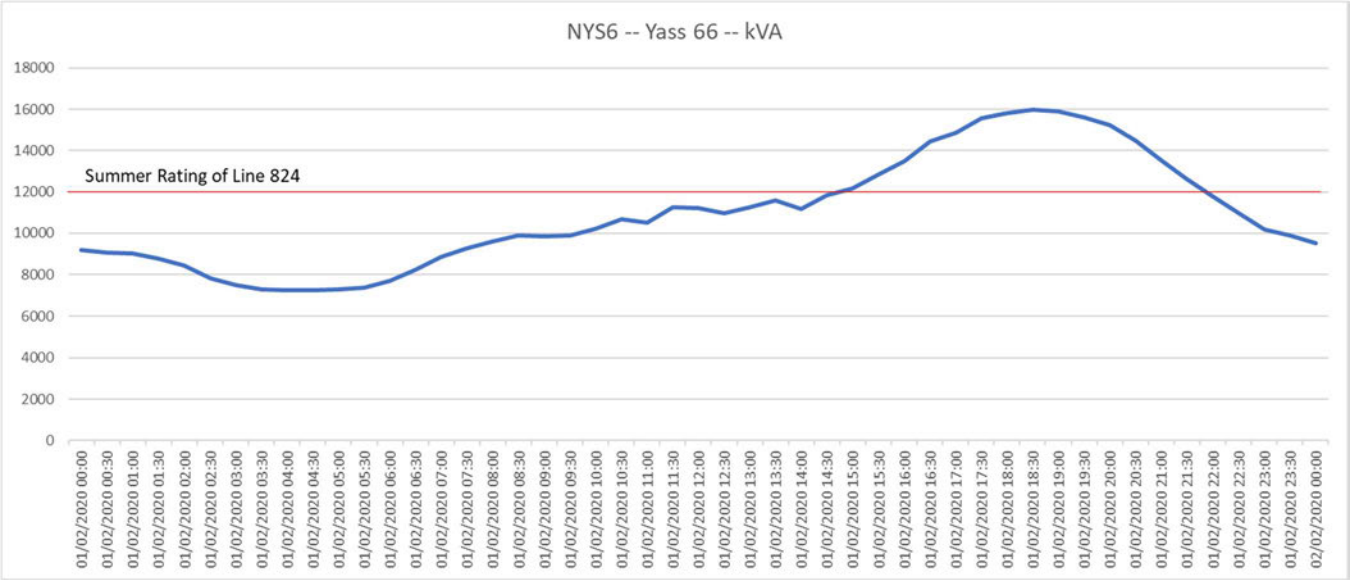


Figure 4: Summer Yass Demand Profile



4. Identified Need

The 824 line has a summer thermal rating of 108A and winter thermal rating of 164A as shown in Table 2

Table 2: Rating of 66kV Line 824

Summer Day Rating	Winter Day Rating
108A / 12MVA	**164A / 18MVA**

From the demand forecast the peak load shown in the Summer 2020 load profile corresponds to a normal summer for the 2024 load forecast. In this case demand exceeded the 12MVA summer thermal rating of the 824 line for 40 hours, with a peak exceedance of 4MVA and average exceedance of 1MVA. The line runs through a P1 bushfire risk area (refer 6.04.02 Bushfire Risk Management Plan), increasing the consequence of a bushfire starting through low conductor clearance or conductors clashing.

Reliability to Yass is impacted by both faults on the 66kV line 824 from Yass Transgrid to Yass Town and the 823/5 line from Yass Town to Marilba. Reliability data shows the fault rate on the line is almost four times the average, with the aged copper conductor being identified as an issue by field staff. Plans are in place to install a 66kV circuit breaker on the Marilba 823/5 circuit at Yass Town Zone Substation in the 2019/24 regulatory period, which will reduce the exposure of the Yass Town loads to faults on the 823/5 line.

The identified need is a thermal constraint on the 66kV line 824. We need to alleviate the constraint in order to meet or manage the expected demand.

5. Options Analysis

There is a 22kV network tie between the Yass Town and Murrumbateman Zone substations that can supply up to 4MVA of the Yass load with field switching on the 22kV network. This alternate supply is relied upon for maintenance and unplanned outages on both the 22kV network and Zone Substation transformers. Utilising this supply would not be a good solution to the network normal overload of the 824 line, as Essential Energy would need to invest in a system to forecast the constraint, organise switching and rely on more than 20km of rural 22kV network to supply the Yass town load. There would only be sufficient capacity in the alternate supply to allow for

the 2024 forecast summer load, before the remaining summer peak load once again exceeded the rating of the 824 line. Conservative estimates put the reliability impact of supplying 4MVA of Yass load from Murrumbateman for two separate one week periods per year at $60k/annum or $1.3M over 40 years as shown in Appendix A.

Below are the feasible options that were considered to address the line rating issue.

5.1 Option 1 – Thermal Upgrade of Yass 66kV line 824

Lifting the conductor on the Yass Transgrid to Yass Town 66kV line to a 75 degC design profile would give the circuit a summer rating of 25MVA, alleviating the summer thermal constraint for an estimated 20 year horizon. This would reduce the risk of bushfire, safety and reputational impact to Essential Energy from low clearance and conductor clashing.

Option 1 has estimated capital cost of [redacted] giving a Net Present Value of $690k.

5.2 Option 2 - Reconductor 66kV line 824 from Yass TG to Yass Town

This option involves replacing the aged 7/.104 Cu conductor with 19/3.75AAAC and increasing the design temperature of the line to 65degC. This would increase the summer thermal rating of the line to 44MVA, alleviating the risks involved with the thermal constraint for the foreseeable future and eliminate faults caused by the condition of the old copper conductor on the 824 line. The ability to replace the conductor on the existing poles and crossarms would be dependent on a design review.

Option 2 has estimated capital cost of [redacted] giving a Net Present Value of $2.9M and an impact to STPIS targets included in Service Target Performance Incentive Scheme (STPIS) Approach (Attachment 8.04).

5.3 Option 3 – Install a 132/22kV Transformer at Yass Zone Substation

Supply to the Yass Zone Substation is dependent on a single 132/66kV transformer at the Transgrid Yass 330/132/66kV substation. For failure of this transformer there is a 10MVA limited capacity alternate supply available from the Murrumburrah substation via Jugiong and Marilba. Installing a 132/22kV transformer at Yass Town, connected by a tee to the 132kV line 999 from Yass to Cowra would provide an alternate supply to both the 132/66kV transformer at the Yass Transgrid substation and the 66kV line 824 from Yass Transgrid to Yass Town. This transformer would be used as the duty transformer at the Yass Town ZS, significantly reducing the impact of the higher than average fault rate and risk of overloading the 824 line. Installation of a second 132/22kV transformer would be timed to coincide with the retirement of the existing 132/66kV transformer at Transgrid's Yass substation.

Option 3 has estimated capital cost of [redacted] and a Net Present Value of -$0.5M.

5.4 Option 4 - Market led Non-Network Solution

The requirements to avoid a thermal constraint and improve reliability on the 66kV line 824 from the Yass Transgrid substation to the Yass Town ZS may be advertised to the market via an EOI process to enable the market to respond with alternative non network solutions. The response from the market could include another option not previously investigated by Essential Energy and could include other market benefits driven from 3rd party owned solutions. The basis of the EOI will be to request alternative energy storage or devices that can provide demand reduction and alternate supply under any business model and operation conditions to ensure all new solutions can be assessed. Because of this approach, submissions may need to be reviewed against any applicable regulatory rules and if a solution is deemed to be economically viable, engagement with regulators may be required. Solutions from this market exercise will then be assessed against network solutions.

As such Option 4 does not have NPV analysis at this stage but will be considered as part of the project development.

5.5 Recommended Option

In recommending a preferred option, the initial capital costs are considered along with the NPV analysis of overall 40-year benefit which is primarily based on improved reliability

Option 1 provides good value for addressing the line overload constraint but does not address the reliability issue from the old copper conductor, giving this option less value overall.

Option 3 has the greatest benefit, but at a capital cost of [redacted] is not considered economically viable as the improvement in reliability at Yass town does not outweigh the cost of the project.

Option 2 is currently the recommended option as it addresses both the overload and asset condition issues at minimal cost, making this option best value.

6. Risk Framework

Essential Energy's Corporate Risk Management Procedure (**Attachment 6.03.01**) and Network Risk Management Manual (**Attachment 6.03.02**) underpins network investments in line with the risk Appraisal Value Framework (**Attachment 6.03.03**) and provide a consistent approach to network asset risk management and augmentation evaluation. The purpose of the procedures is to estimate the level of risk via probability of failure, likelihood of consequence and evaluate cost of consequence for network investments. The framework looks at overall network risk across six key areas: Safety, Network (Reliability), Environment, Compliance, Reputation and Financial.

6.1 Safety

Safety consequence considers the risk to both public and Essential Energy personnel. In this case there is a risk to the public when load exceeds the thermal rating of the line the conductor will sag below statutory ground clearance, with the associated risk of a member of the public coming into contact with the line.

6.2 Environmental

All businesses must manage the risks their activities may pose to human health and the environment from pollution or waste. There is no environmental risk that needs to be addressed with this constraint.

6.3 Compliance

Compliance risk is assessed for issues that may arise because of not complying to relevant Standards, Acts or Guidelines. When the line becomes overloaded the clearance from the conductor to ground falls below the statutory clearance requirement. This project aims to minimise the risk of compliance related costs.

6.4 Reputation

Reputational consequences are categorised as those risks associated with the tarnishing of the company's reputation. If the line is overloaded and the conductors clash there is the possibility of a sustained outage, or the ignition of a bushfire in a P1 rated area that would have a reputational impact on the company. Another case could be a member of the public coming into contact with the line when it has sagged below statutory clearance, impacting the reputation of the company.

6.5 Financial

There are no financial implication for customers or the company in this case beyond the investments captured in the business case.

References

Doc No.	Document Name	Relevance
1	Yass 824 Line Options Comparison NPV.xlsx	NPV Option Analysis
2	ESS_2_Thermal_Value_Calculator	Calculation method to value high voltages
3	6.03.01 Corporate Risk Management Procedure	Reference material
4	6.03.02 Network Risk Management Manual	Reference material
5	6.03.03 Appraisal Value Framework	Reference material, risk evaluation
6	8.04 Service Target Performance Incentive Scheme (STPIS) Approach	Target adjustment
7	11.01 Forecasts of Customer numbers, energy consumption and demand	Reference material

Key Terms and Definitions

Term	Definition
$M	Dollars expressed in millions
FY	Financial Year
MW	Megawatt
NER	National Electricity Rules
NPB	Net Present Benefit (Benefits over 40-year expressed in present value)
NPC	Net Present Cost (Capital and operation costs over 40-year expressed in present value)
NPV	Net Present Value
NPVM	Net Present Value to Market (NPB subtract NPC)
RIT-D	Regulatory Investment Test – Distribution
VCR	Value of Customer Reliability
VUE	Value of Unserved Energy

Appendix A – Distribution Backup Value of Unserved Energy

Table 3: Value of Unserved Energy

Value of Customer Reliability ($/MWh)	Average Load (MVA)	Fault / km/Annum	Distance (km)	Time at Risk	Risk Period /Annum	Outage Duration
[redacted]	3	0.27	22	One Week	2	6 Hours

Value of Customer Reliability

As provided by AEMO

Average Load

Average demand of load transferred to Yass for 4MVA peak demand.

Fault Rate

From MBM6222 Patemans Lane feeder in the Sept 22-23 Qtr Report

Distance

Distance from Murrumbateman ZS to Yass Town

Time At Risk

Time that Yass load is transferred to Murrumbateman

Risk Periods / Annum

Number of Times per Annum Yass is Switched to Murrumbateman

Outage Duration

If there is a fault on the supply from Murrumbateman how long before supply is restored.

Calculation

Faults / Annum = Distance x Fault Rate x Time at Risk x Risk Periods / Annum

Faults / Annum = 22km x 0.27 Fault/km/annum X 1/52 Weeks / Annum x 2 periods / annum = 0.23 faults/annum

Value of Unserved Energy = Value of Customer Reliability x Average Load x Fault / Annum x Fault Duration

[redacted]

[redacted]

Appendix B – Value of Thermal Overload

All figures are based on the ESS_2 Thermal Value Calculator for Distribution lines unless otherwise stated. The likelihood of consequence has been increased by a factor of (line overload)^3 for subtransmission to account for the level of overload seen on the subtransmission network and the highly nonlinear risk of consequence as the clearances reduce. Table 4 shows the risks from thermal overload for FY24, with the values increased in the following years based on the time the line is overloaded and level of overload.

Table 4: FY24 Risks for Line 824 Overload

Safety	Bushfire	Reputation	Annual Cost
[redacted]			

Safety

Cost of contacting a low span, calculated based on the time the line is overloaded and value of a safety event in the ESS_2 value calculator. The probability of a safety event is increased by a factor of 2 for a subtransmission line as the likelihood of a serious consequence is greater for contacting subtransmission.

Bushfire

Cost to the community of a bushfire starting from conductors clashing or low clearance from the EES_2 value calculator. Likelihood of conductors clashing increased by a factor of two to account for the increased risk of a bushfire starting from the high fault level inherent on subtransmission lines.

Reputation

Cost to Essential Energy from complaints due to conductors clashing and low clearance, increased by a factor of two for subtransmission as more customers are affected by faults.

Appendix C – Value of Reliability from 66kV Line Faults

The improvement in reliability from reconductoring the Yass Transgrid to Yass Town considers the following:

Table 5: FY24 Value of Reliability for 824 Line Faults

Winter Peak Demand (MVA)	Average Demand (MW)	Hours at Risk p.a.	Cost Before Switching p.a.	Backup Load at Risk MWh p.a.	Cost After Switching p.a.	Labour Cost of Outage	Faults Related to Condition	TOTAL Condition Cost
16.0	6.1	753	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

- Winter Peak Demand from Frontier Economics Forecast
- Average demand from 2020 load profile with summer peak matching Frontier Economics Forecast, the last two summers have been very mild and do not match the longer term Yass load trend.
- Hours at risk above the 10MVA backup capability of the Murrumburrah supply, calculated from the from 2020 Load Profile
- Cost before switching includes a two hour period before local staff can be dispatched to manually operate the 66kV ABS at the Marilba substation to restore supply from Murrumburrah
- Backup Load at risk is the Yass town and Marilba load from the 2020 load profile that is above the 10MVA backup capability of the supply from Murrumburrah.
- Cost after switching is the cost of load at risk above the 10VA backup capability in the 6 hour period to restore the 66kV supply from Yass Town
- Labour cost of outage is the call out cost for four staff to attend and repair the Yass 66kV line following a conductor fault.
- Faults related to condition are faults above the standard outage rate of the line related to the aged copper conductor.
- Total Condition Cost is the sum of the cost before switching, cost after switching and labour costs, multiplied by the percent of faults related to condition.