RIT-D Draft Project Assessment Report

Providing secure supply to the Berrima Junction Enterprise Growth Area

23 August 2024

Endeavour Energy

POWER together

1.0 Executive Summary

This draft project assessment report (DPAR) was prepared by Endeavour Energy in accordance with the requirements of clause 5.17.4 of the National Electricity Rules (NER).

The purpose of this report is to demonstrate the basis for selection of the preferred option to provide secure supply to the Berrima Junction enterprise growth area.

Berrima Junction is located on the southern highlands and is situated between the historic old town of Berrima to the north and Moss Vale to the south. It is named after the railway station in the area between the two towns. The area is zoned for enterprise land use and is the location for substantial development plans for major customers requiring a connection to the network and with a level of supply security to support the continuity of their business operations.

Berrima Junction is in close proximity to the major vehicle access points to the Hume Highway which is the major road connecting Sydney-Canberra-Melbourne and will support enterprise customers with heavy vehicle operations and employees commuting to the location for work.

The existing Berrima Junction Zone Substation was commissioned in 2010 and supplies a small number of business enterprise customers in close proximity to the substation site. The existing substation comprises a single power transformer and a single 33kV supply and is not capable of providing the security of supply required by the new customer connections.

The timing of the identified need for this RIT-D is determined by when the expected customer demand requiring connection will exceed the existing network capacity. This is currently expected to be in 2026/27, based on the demand forecast and the customer connection enquiries received to date.

This report follows publication of an Options Screening Report and subsequent consultation period. The outcome of this process, including consideration of external submissions and representations, is that Endeavour Energy has not identified a technically credible non-network option that was able to meet all or part of the identified need.

Three options were determined to be credible in addressing the network need and have been assessed in comparison to a 'do nothing' (no proactive intervention) base case. These are:

- Option 1 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and use the existing 33kV supply.
- Option 2 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and establish a new 33kV feeder supply from Moss Vale Zone Substation.
- Option 3 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and establish a new 33kV feeder supply from a connection to an existing feeder 7906.

The 'do nothing' option is not considered credible because it will result in significant expected unserved energy in the development area and would not support the connection of new customers and result in the curtailment of growth at sites that would be supplied by the limited existing supply capacity in the area.

Two of the credible options involve augmenting the existing Berrima Junction Zone Substation and establishing a new 33kV feeder supply. The third option involves augmenting the zone substation with the existing 33kV supply.

The economic assessment of the credible options is shown in Table 1. Under the NER, the preferred option is the credible option that maximises the present value of the net economic benefit to all those who produce, consume or transport electricity in the National Electricity Market (NEM). Applying this criteria, Option 2 is the preferred option at this draft stage because it has the highest net market benefit.

Scenario analysis has been undertaken based on three demand forecast scenarios. Sensitivity analysis has been undertaken across a range of assumptions including the discount rate, value of customer reliability (VCR)

and capital expenditure. The scenario and sensitivity analysis has confirmed Option 2 as the preferred option at this stage.

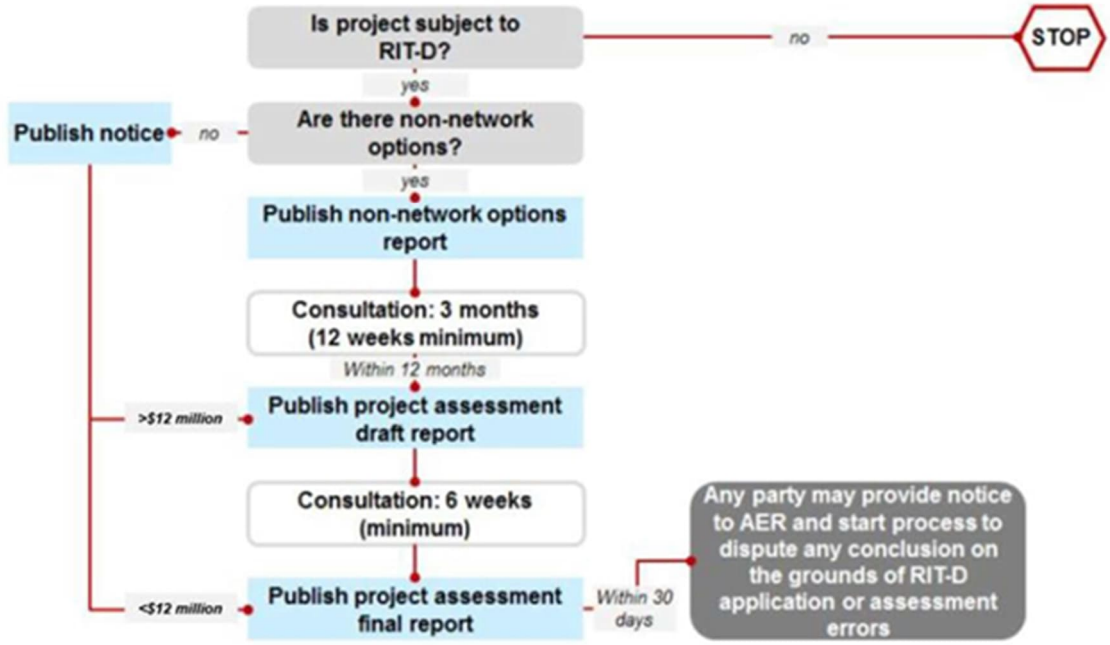
Table 1 – Economic assessment of credible options

Option	Description	Project capex nominal ($M)	PV of market benefits ($M)	PV of costs ($M)	NPV ($M)	Rank
1	Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and use the existing 33kV supply	21.6	139.5	20.8	118.7	3
2	Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and establish a new 33kV feeder supply from Moss Vale Zone Substation	30.2	173.5	24.2	149.3	1
3	Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and establish a new 33kV feeder supply from a connection to an existing feeder 7906	32.9	173.5	26.4	147.1	2

2.0 RIT-D Process

This Draft Project Assessment Report has been prepared by Endeavour Energy in accordance with the requirements of clause 5.17.4 of the NER and represents the second step in the RIT-D process to determine the most efficient means of providing supply and customer connection capability to the Berrima Junction enterprise growth area. The RIT-D process is summarised in Figure 1 below.

Figure 1 – Overview of the RIT-D process



2.1 Submissions received

Endeavour Energy published an Options Screening Report for the Berrima Junction Enterprise Growth Area on 26 May 2023 and two (2) submissions were received.

2.2 Submissions requested to the DPAR

Endeavour Energy seeks written submissions from interested parties in relation to the preferred option outlined in this document. Submissions are due on or before **11 October 2024**.

2.3 Contact details

All submissions and enquiries should be directed to Endeavour Energy's Portfolio Management office at consultation@endeavourenergy.com.au.

3.0 Description of the identified need

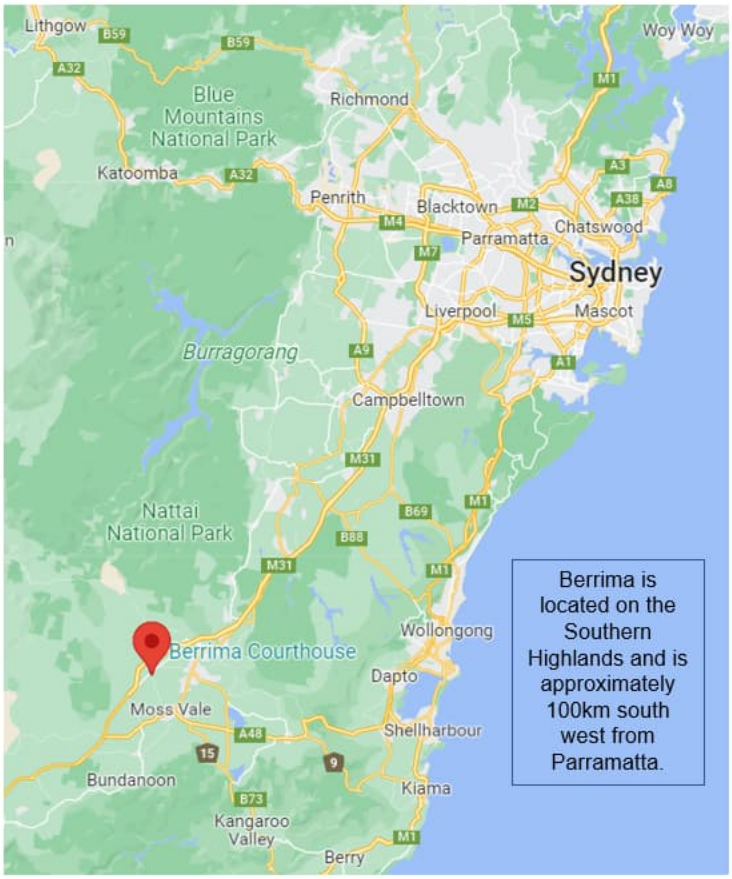
This section provides a description of the identified need and sets out the key assumptions and methodologies that underpin the identified need for this RIT-D.

3.1 Relevant area of our network

Berrima is located in the southern highlands area and is approximately 100km southwest of Parramatta and approximately 3km north of Moss Vale. Endeavour Energy supplies this area and also operates a field service centre in Moss Vale.

Figure 2 below shows the geographic location of Berrima in relation to Western Sydney and Parramatta.

Figure 2 – Berrima in relation to Western Sydney and Parramatta



The area known as Berrima Junction is located between the old historic town of Berrima and Moss Vale. Berrima Junction is the name of the railway station in the area. The area is mainly zoned for enterprise land use and currently includes several large enterprises and there are several enterprises in the advanced stages of planning and development requiring network connection.

For the purpose of our network planning and alignment to the zoning of the land by local government, we have called this area the Berrima Junction Enterprise Growth Area. We note that this is not a formal place name and this area may be renamed in the future by government authorities. Endeavour Energy currently operates the Berrima Junction Zone Substation in this area.

Figure 3 below shows the location of the area and in particular the proximity to the Hume Highway, the major road on the route Sydney-Canberra-Melbourne. The vehicle access points to the Hume Highway are suitable for heavy vehicles with major merge lanes in both directions supporting transport and logistics operations in this area. There are also no vehicle height clearance limitations from overhead bridges on the route from Berrima Junction to the Hume Highway, noting that this limitation exists closer to the town centre at Moss Vale.

Figure 3 also shows the existing major substations at Moss Vale and Fairfax Lane.

Figure 3 – Location of the Berrima Junction Enterprise Growth Area in relation to the Hume Highway and Moss Vale

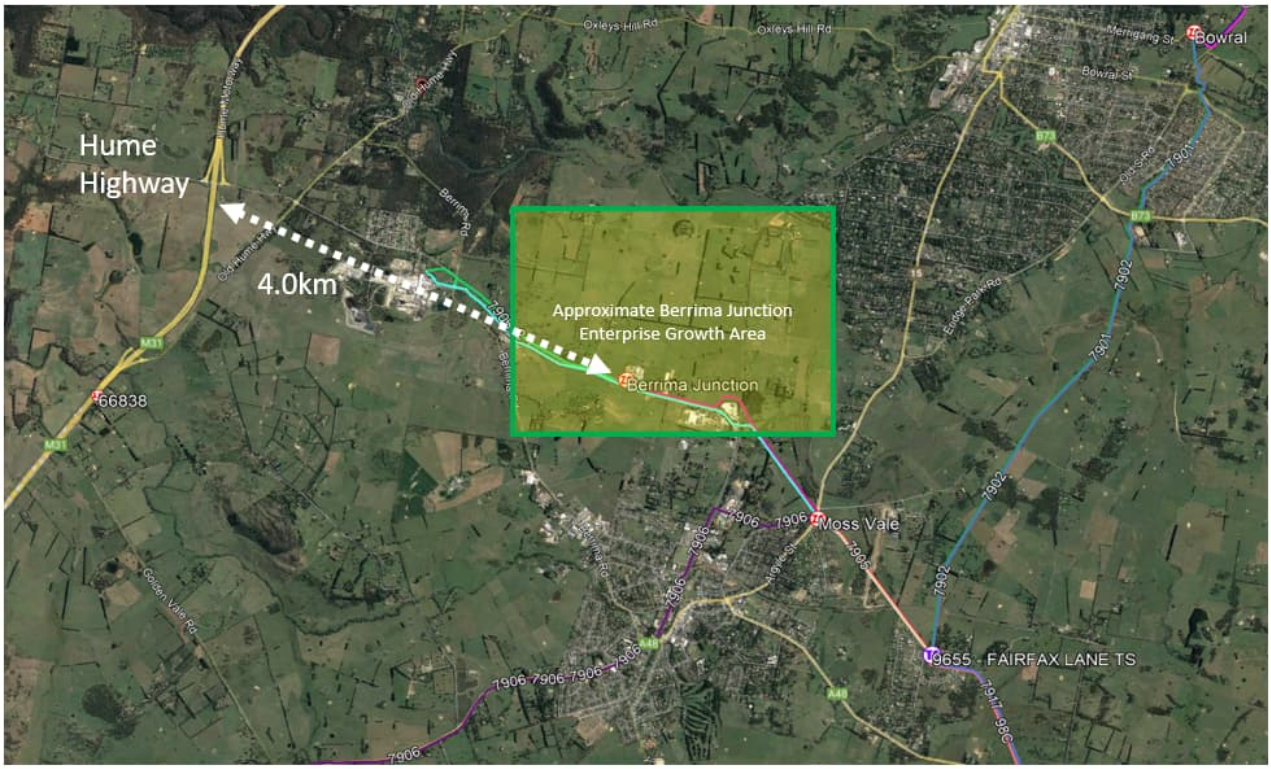


Figure 4 below shows an aerial view of the existing Berrima Junction Zone Substation and the adjacent area that will be the location of enterprise growth. The area is currently largely undeveloped with one major customer in close proximity to the existing zone substation. The enterprise growth area is within 500 to 1000 metres of the existing Berrima Junction Zone Substation.

Figure 4 – Aerial view of the Berrima Junction Enterprise Growth Area including the existing Zone Substation

3.2 Load characteristics and demand forecast

The Berrima Junction enterprise growth area is zoned for enterprise land use. Our demand forecast has been developed by considering the existing major customer connection and the connection applications from major customers that are planned for the near future.

The load characteristics for customers connected to the network in the Berrima Junction Enterprise Growth Area are expected to be similar to patterns of use of other enterprise areas in our supply area such as Moorebank and Smeaton Grange. A composite load profile from these areas was used to develop a forecast as Berrima Junction is expected to have a similar industry type customer base.

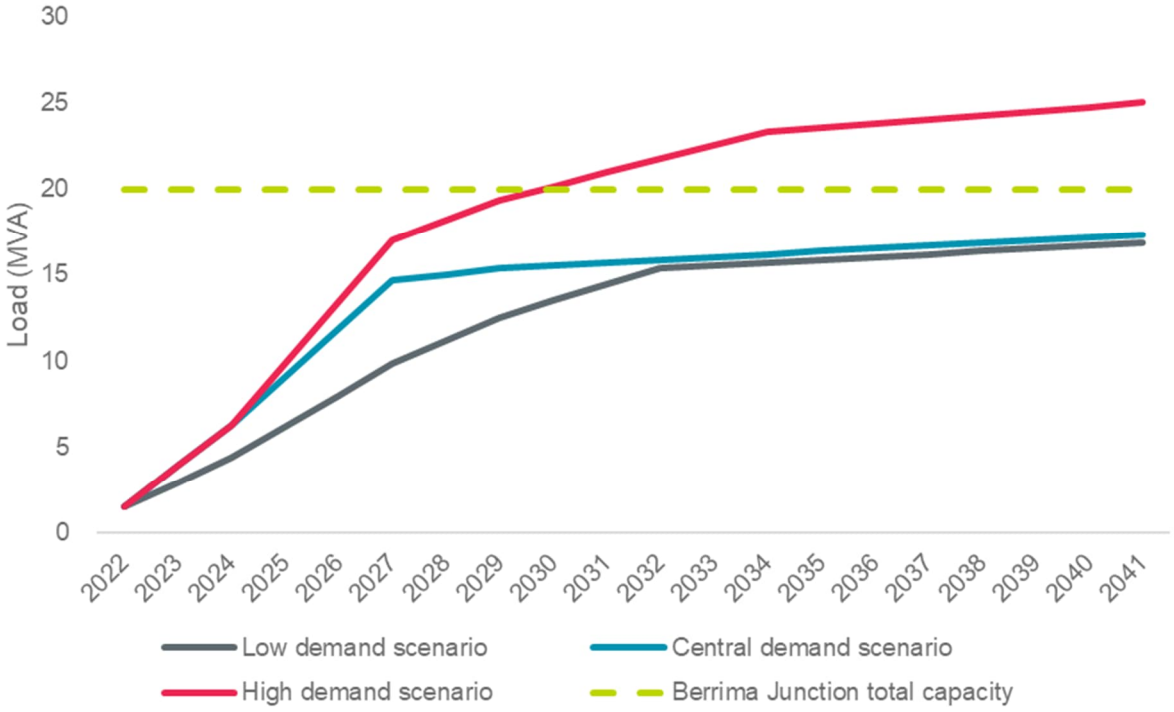
The major customer connections are summarised as follows:

- existing supply arrangements of 5 MVA capacity for the current major customer connections that have been in place since 2010 (peak demand has historically varied between 1.3 to 1.9 MVA); and
- new connections, including:
  - an enterprise major customer connection with a final total demand of 15 MVA, which is assumed to grow from 0 by 2.4 MVA per annum;
  - an industrial subdivision of land with a maximum combined demand of 5.4 MVA (estimated from both the customer applications for connection and the lot size and our energy density calculations for similar industries); and
  - a further industrial facility at one of two locations near Berrima Junction with maximum demand of 16.5 MVA. This facility may be located at another location in our supply area and we have applied an appropriate confidence factor into the demand forecast scenarios to account for this uncertainty.

The total customer demand from these developments in this area are expected to require approximately 16 MVA of capacity by 2031.

Figure 5 below shows our forecast annual maximum demand to 2031 with central, low and high demand scenarios for the Berrima Junction Enterprise Growth Area.

Figure 5 – Berrima Junction Enterprise Growth Area maximum demand forecasts from 2024 to 2031



Drawing on the major customer connections set out above, we have developed three demand forecast scenarios, they are:

- a central demand scenario, where existing customer demand continues at current levels and the enterprise major customer connection grows its demand over **five years** and the industrial subdivision customers are connected in line with current plans;
- a low demand scenario, where existing customer demand continues and the enterprise major customer connection grows its demand over **ten years** and the industrial subdivision customers are connected in line with current plans; and
- a high demand scenario, where existing customer demand continues at current levels and the enterprise major customer connection grows its demand over **five years** and the industrial subdivision customers are connected according to current plans and the further industrial facility locates in the Berrima Junction area.

<u>Excludes any future residential lot release in the “New Berrima” or “Medway Road” areas</u>
The demand forecast scenarios used exclude any future residential lot release. The Berrima Junction Enterprise Growth Area will comprise only enterprise customers with no residential customers included in the scope of our forecasts.

There are long term plans with local and state government for future residential lot releases in the Medway Road area of Berrima which would include a town centre and schools with a total release of 8000 lots over the next 20 years. These plans would require a separate study including options analysis and investment testing which may proceed as further information is released, however these plans are not included in the demand forecast scenarios of this study.

3.3 Expected pattern of use

The expected pattern of use for customers to be connected to the network in the Berrima Junction Enterprise Growth Area has been forecast based on patterns of use for similar enterprise areas in our supply area including a composite load profile from the Moorebank and Smeaton Grange areas. These areas have a similar industry type customer base to that expected at Berrima Junction.

Figure 6 presents the normalised load duration curve for the Berrima Junction Enterprise Growth Area.

Figure 7 presents the forecast of the peak day profile for the area based on our assumptions of the major customer pattern of use based on our supply to similar areas of modern enterprise and light industry in Western Sydney. The figure includes the forecast peak day profiles for FY 2026, 2027 and 2028 based on the central demand forecast scenario. The load profile is generally flat indicating the continuous nature of the business operations expected in the area.

Figure 6 – Normalised LDC assumed for customer connections expected in the Berrima Junction enterprise growth Area

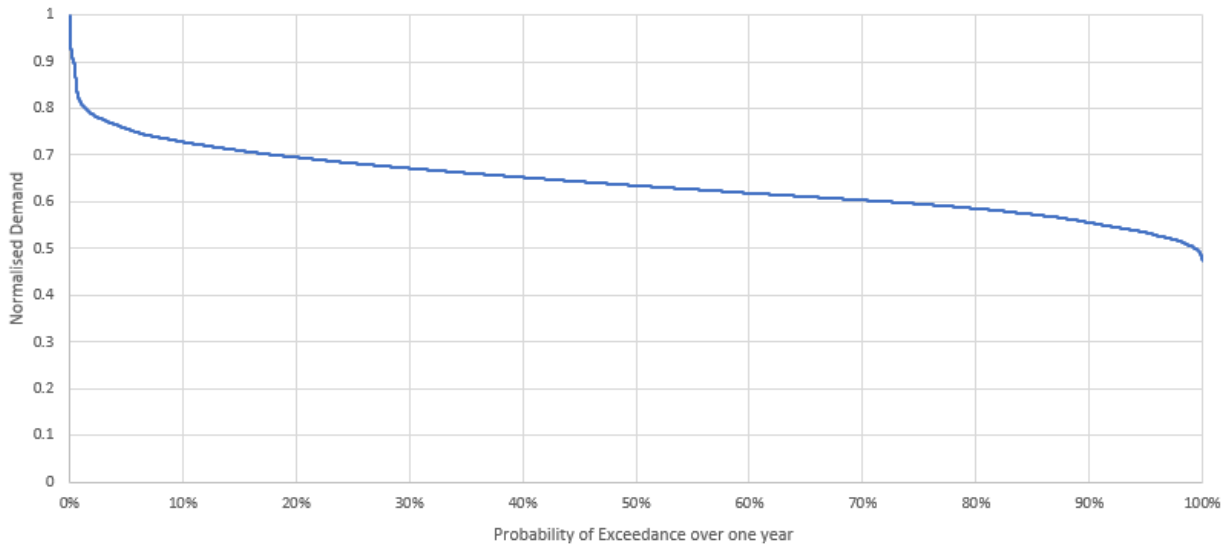
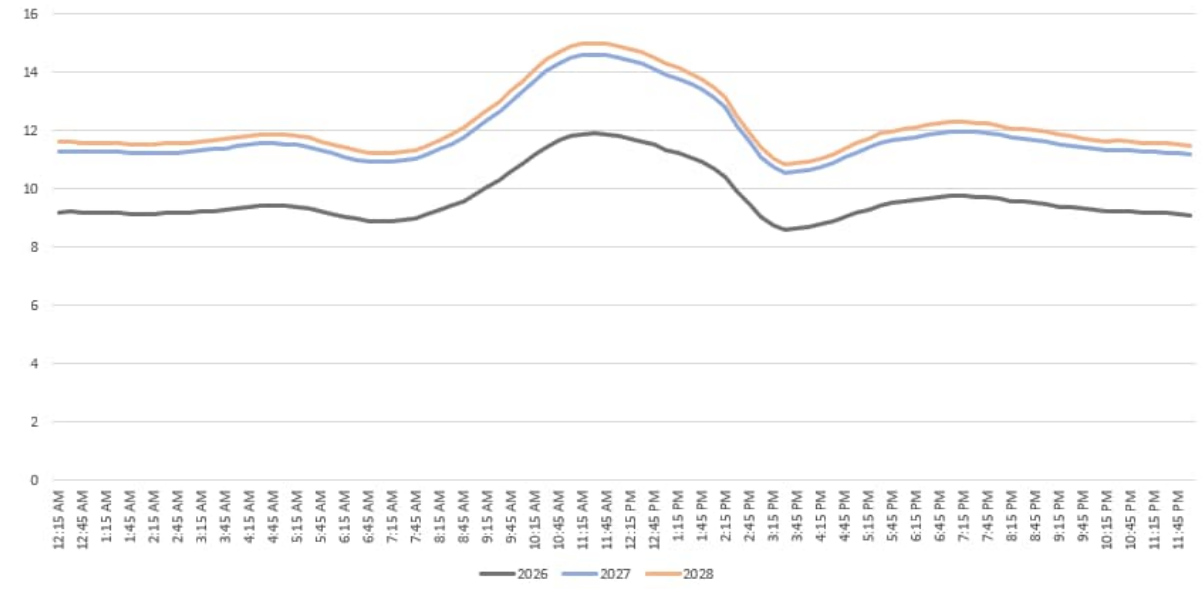


Figure 7 – Peak summer day profile for customer connections expected in the Berrima Junction Enterprise Growth Area



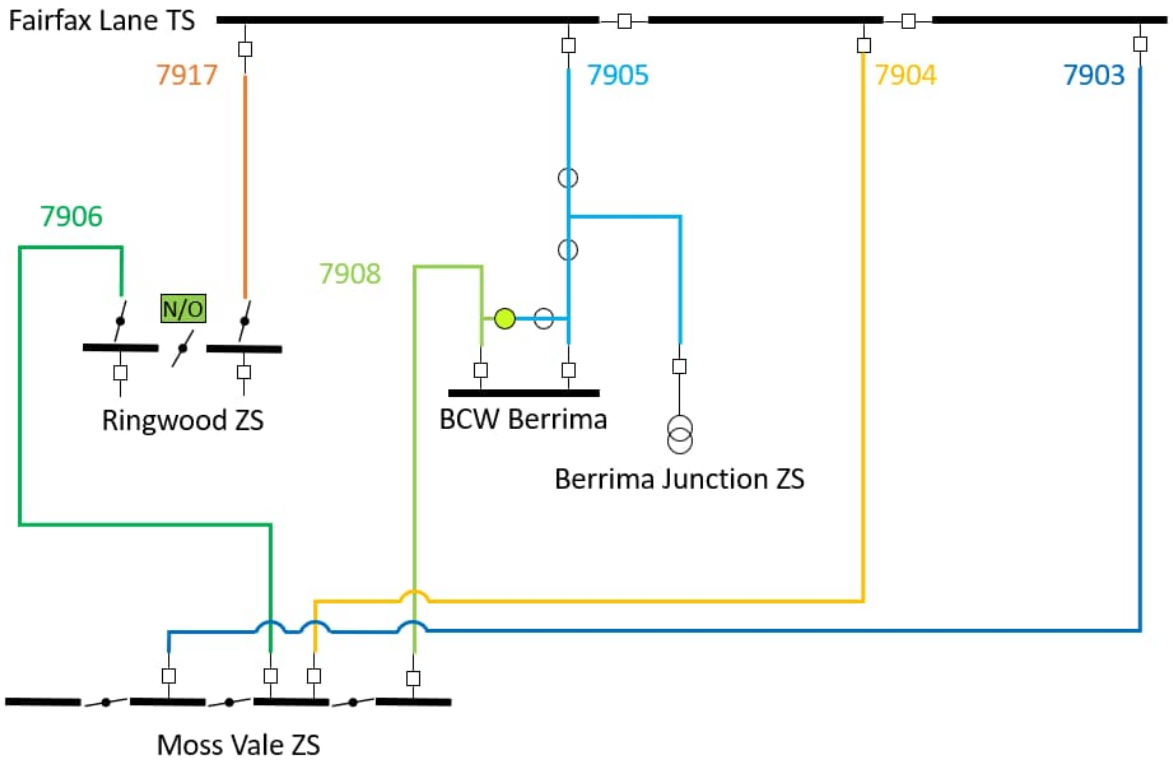
3.4 Existing network

The southern highlands area of the Endeavour Energy network uses a 33kV subtransmission network.

The existing Berrima Junction Zone Substation has a single 20 MVA 33/11kV transformer and is supplied via a tee-connection from the Fairfax Lane 33kV feeder 7905. Feeder 7905 also partly supplies the BCW Berrima High Voltage Customer (HVC). The area is an overhead supply network with the feeder routes being adjacent to local roads.

Figure 8 below shows a simplified diagram of the existing 33kV supply network and the supply to the Berrima Junction ZS.

Figure 8 – Simplified line diagram of the Southern Highlands 33kV network and the Berrima Junction Zone Substation



The existing Berrima Junction Zone Substation was commissioned in 2010 to supply a small number of business enterprise customers in close proximity to the location. The existing 33/11kV 20MVA power transformer was manufactured in 1965 and is approaching the end of its service life.

Due to the single power transformer and single 33kV supply at the zone substation, the level of supply security is potentially below the level required or expected by our future customers in the area. The following section of the report examine the expected unserved energy if action is not taken.

3.5 Expected unserved energy if action is not taken

The existing network supplying the Berrima Junction Enterprise Growth Area is insufficient to meet the supply needs of the major customers in advanced stages of their future network connection.

The existing Berrima Junction ZS has only a single 33/11kV transformer and although it has sufficient capacity to supply significant growth above the current level of customer demand in the area, it lacks a standby transformer. The potential loss of the single transformer in either a planned or unplanned outage would interrupt supply to the major customers who will connect in the area.

The 33kV supply to the existing Berrima Junction ZS is a single overhead line and is exposed to potential unplanned outages in the event of storms, lightning strikes or vehicle impacts on pole structures. The single supply cannot be backup in a significant manner to avoid potentially long outage periods.

There is minimal load transfer capability from adjacent zone substations and feeders. The only feasible load transfer is via the 11kV distribution network and is limited to 3MVA by using a Moss Vale ZS distribution feeder.

Table 2 below is a summary of the network contingency analysis conducted to determine the expected unserved energy if no action is taken in the Berrima Junction Enterprise Growth Area.

These contingency scenarios have been used to determine the economic benefits of avoiding the expected unserved energy in the economic evaluation of options. The likelihood of the contingency occurring and the corresponding time period of supply interruption are the key values we have used in determining the market benefits in the economic evaluation.

Table 2 – Network contingency analysis for the Berrima Junction Enterprise Growth Area for determining expected unserved energy

Contingency Scenario	Identified Asset	Description
1	Loss of the single Berrima Junction ZS transformer	The loss of the existing single transformer at Berrima Junction ZS in either a planned or unplanned outage would result in loss of supply to all customers supplied from Berrima Junction ZS. There is a limited small load transfer capability available from a distribution feeder from Moss Vale ZS. This would provide a maximum of 3MVA back up supply. This supply would require manual switching in the field which would take some time to complete, although we have a field service centre at Moss Vale. The available capacity for load transfer would depend on the time of day and the demand on the Moss Vale feeder such that the transfer capacity is likely to be less than 3MVA. In the event of a failure of the transformer due to an electrical fault within the transformer this could require an extended period of time for a replacement, potentially several days to transport a replacement to site and for it to be installed.
2	Loss of 33kV Feeder 7905	The loss of feeder 7905 would result in loss of supply to all customers supplied from Berrima Junction. This feeder also supplies the HVC BCW Berrima. This is an overhead feeder and is subject to potential storm damage including lightning strikes or vehicle impact damage to any of the poles on the route of the feeder. Depending on the exact location of a fault on feeder 7905, supply may be restored from feeder 7908 via Moss Vale ZS instead of the normal supply from 7905 via Fairfax Lane TS. This would require manual field switching via our staff having to attend the site of the air break switches in the area. Feeder 7905 and 7908 are rated at 33MVA (and operated at 33kV), the loss of either feeder requires the other feeder for backup and the 33MVA capacity is a limitation in providing backup to both BCW Berrima and Berrima Junction.
3	Loss of 33kV Feeder 7908	The loss of feeder 7908 would result in 7905 having to supply BCW Berrima and Berrima Junction ZS and it is rated at 33MVA. This limitation is included in the expected unserved energy values with the corresponding probability of failure.

Figure 9 below shows the expected unserved energy based on the central demand forecast and based on the Base Case of no proactive intervention.

Figure 10 below shows the load at risk due to the loss of the single power transformer at the Berrima Junction Zone Substation. It includes consideration of the available back up supply via the 11kV network from the adjacent zone substation at Moss Vale.

Figure 11 below shows the load at risk due to the loss of the single 33kV feeder supplying the Berrima Junction Zone Substation. There is no back up supply available at the 33kV level due to only one feeder being connected at the site.

Figure 9 – Expected unserved energy for the Berrima Junction enterprise growth area based on the central demand forecast scenario (Base Case with no proactive intervention)

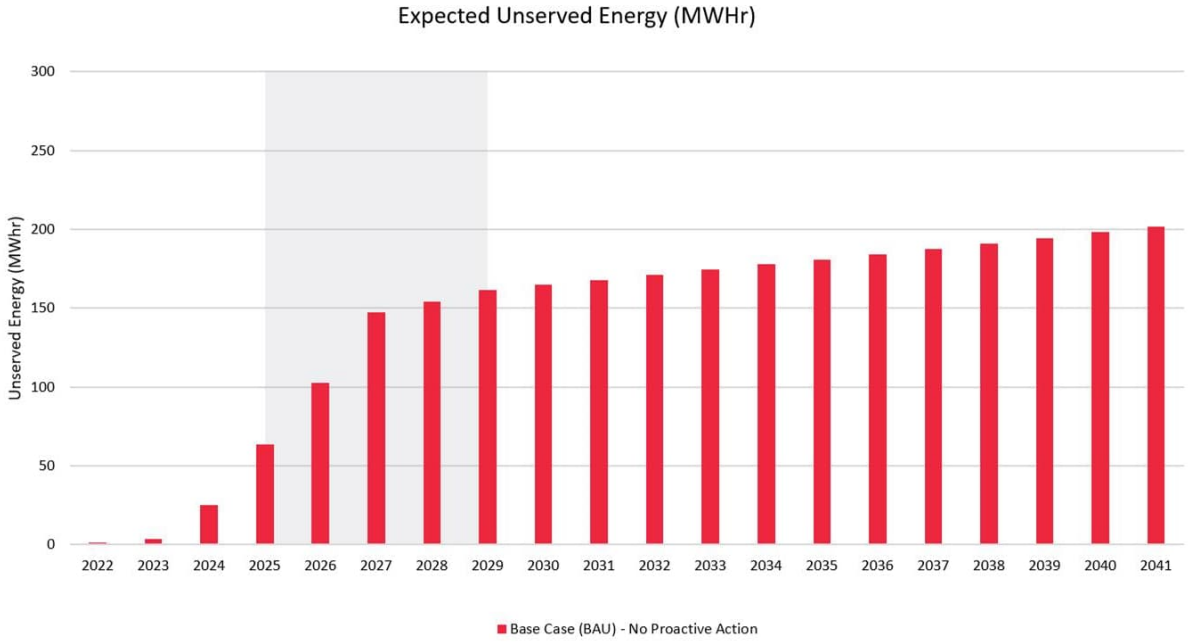


Figure 10 – Load at risk due to the loss of the single Berrima Junction ZS Transformer

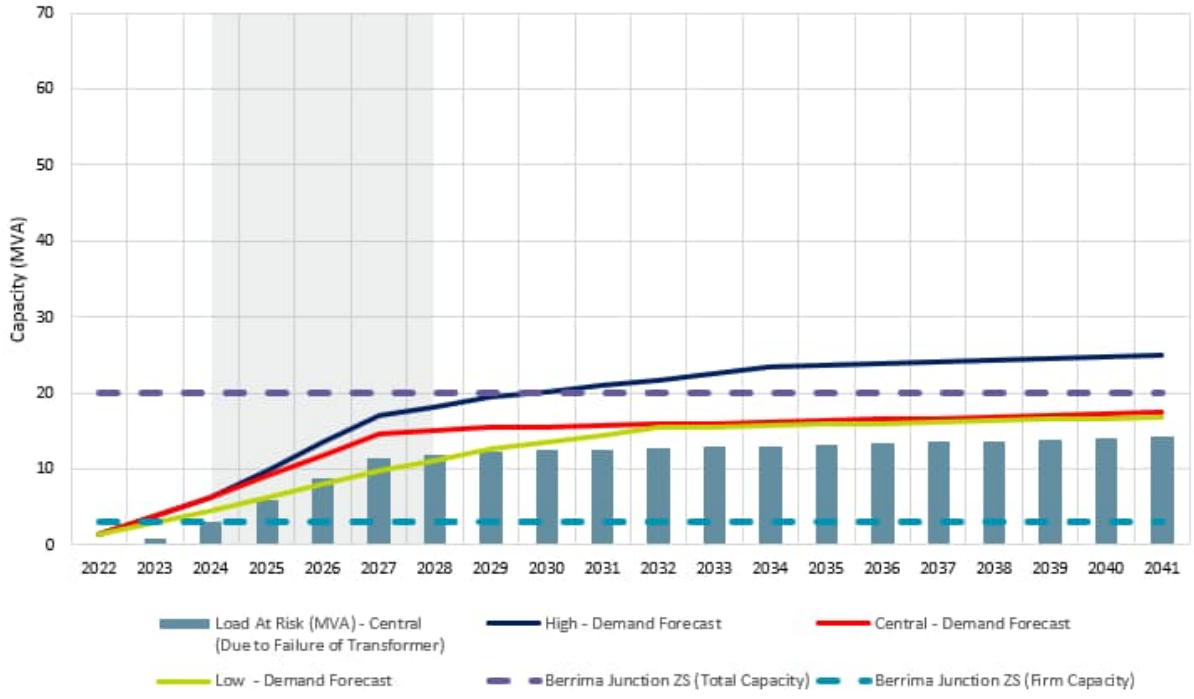
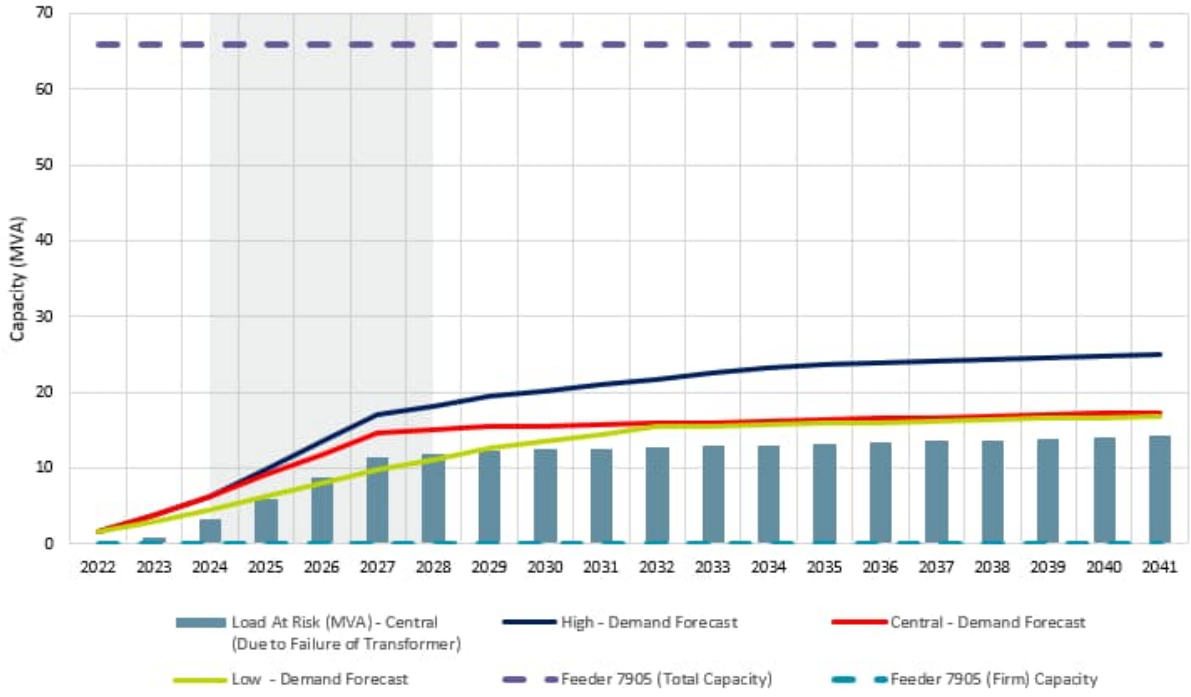


Figure 11 – Load at risk due to the loss of the 33kV Feeder 7905



4.0 Proposed options to meet the identified need

In this section we review the proposed options to meet the identified need of the Berrima Junction Enterprise Growth Area including our proposed network options and the options proposed in response to our Options Screening Report.

We have identified three credible network options for providing secure supply to the Berrima Junction Enterprise Growth Area. All three options involve the augmentation of the existing Berrima Junction Zone Substation. The network options are:

- Option 1 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and use the existing 33kV supply;
- Option 2 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and establish a new 33kV feeder supply from Moss Vale Zone Substation; and
- Option 3 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and establish a new 33kV feeder supply from a connection to an existing feeder 7906.

A high-level summary description is provided below for each of the options.

4.1 Option 1 – Augment Berrima Junction ZS with existing 33kV supply

Option 1 would involve augmenting the existing Berrima Junction Zone Substation by installing two 35 MVA transformers. The new transformers would be installed on the available land at the site. Following commissioning of the new transformers, supply to the area would be transferred from the existing single transformer to the newly installed transformers and the existing transformer would be decommissioned.

Construction would commence in 2024/25 and be completed in two years with commissioning in 2026/27. The decommissioning works could extend shortly beyond this period.

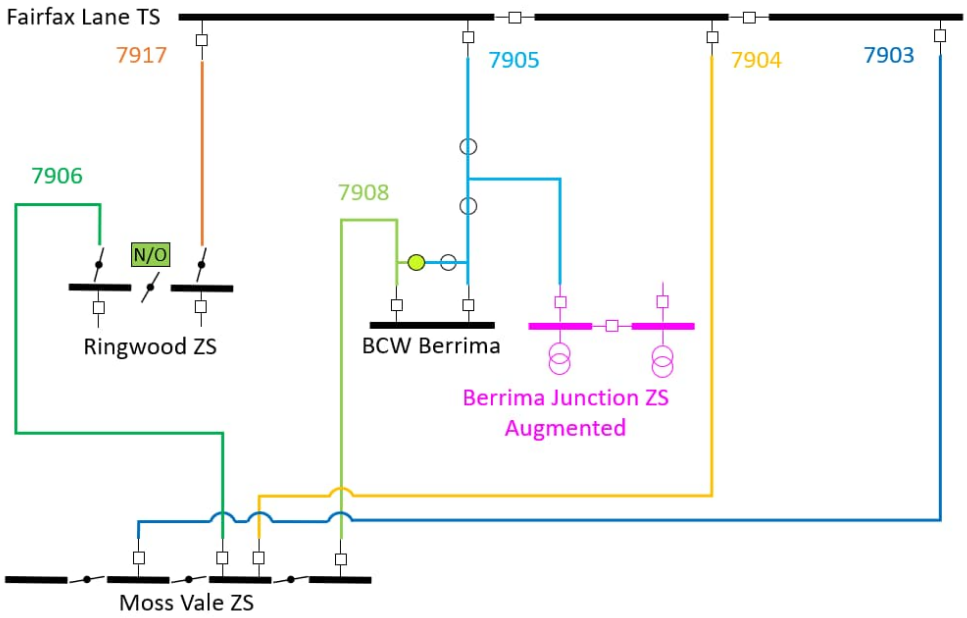
Table 3 shows the scope of work and cost estimates for Option 1.

Table 3 – Scope of works and costs for Option 1

Network Component	Proposed Scope of Works	Cost Estimate ($M)
Substation	Augment the existing Berrima Junction Zone Substation: • Install major equipment: o 2 x 33/11kV 35MVA transformers. o 2 x 33kV feeder bays o 2 x 33kV bus sections o 2 x 11kV bus sections o 2 x 11kV switchboards o Control Building and amenities • Changeover 33kV supply and 11kV cables to the new major equipment. • Decommission the existing 20MVA 33/11kV transformer, switchgear and control room. Salvage value to be credited to the project as a cost reduction.	20.7
Mains	Divert 33kV feeder 7905 to the new 33kV feeder bay.	0.2
Distribution	Divert 11kV feeders to the new 11kV bus sections.	0.7
	Total Cost.	**21.6**

Figure 12 below shows a simplified single line diagram for Option 1. It represents the network configuration provided following the commissioning of Option 1. The total cost of this option is estimated to be $21.6 million with annual operating costs estimated to be 0.4 per cent of the capital expenditure.

Figure 12 – Simplified line diagram of Option 1



This option addresses the network constraint associated with the existing single transformer at the zone substation however it does not address the network constraint associated with the failure of feeder 7905, the single 33kV supply to the location.

4.2 Option 2 – Augment Berrima Junction ZS and establish a new 33kV feeder from Moss Vale ZS

Option 2 would involve augmenting the existing Berrima Junction Zone Substation by installing two 35 MVA transformers and establishing a new 33kV feeder supply from Moss Vale ZS. The new transformers would be installed on the available land at the site. Following commissioning of the new transformers, supply to the area would be transferred from the existing single transformer to the newly installed transformers and the existing transformer would be decommissioned.

Option 2 also requires enabling works at Moss Vale Zone Substation to support the new 33kV feeder and its connection to the existing Moss Vale ZS 33kV busbar.

Construction would commence in 2024/25 and be completed in two years with commissioning in 2026/27. The decommissioning works could extend shortly beyond this period.

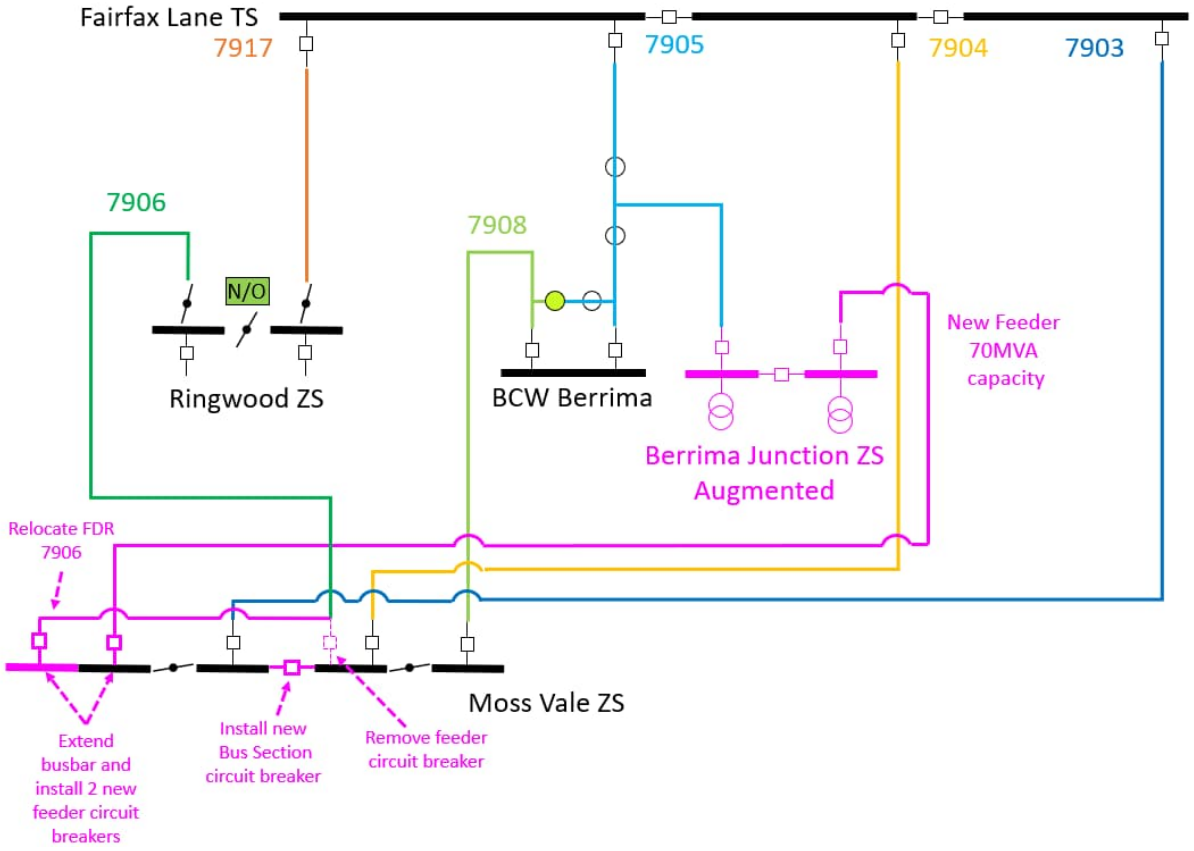
Table 4 below shows the scope of works and the cost estimate for Option 2.

Table 4 – Scope of works and costs for Option 2

Network Component	Proposed Scope of Works	Cost Estimate ($M)
Substation	Augment the existing Berrima Junction Zone Substation: • Install major equipment: o 2 x 33/11kV 35MVA transformers. o 2 x 33kV feeder bays o 2 x 33kV bus sections o 2 x 11kV bus sections o 2 x 11kV switchboards o Control Building and amenities • Changeover 33kV supply and 11kV cables to the new major equipment. • Decommission the existing 20MVA 33/11kV transformer, switchgear and control room. Salvage value to be credited to the project as a cost reduction. Enabling works at **Moss Vale Zone Substation** to provide connection of the new 33kV feeder to Berrima Junction ZS: • Extend 33kV bus section • 1 x 33kV bus section circuit breaker • 2 x 33kV feeder bays • Relocate existing 33 kV feeder 7906 to one of the new feeder bays on the new bus section.	26.4
Mains	Establish a 33kV feeder from Berrima Junction ZS to Moss Vale ZS (3.2km).	3.0
Distribution	Divert 11kV feeders to the new 11kV bus sections.	0.8
	Total Cost.	**30.2**

Figure 13 below shows a simplified line diagram overview of Option 2. The enabling works required at Moss Vale ZS to support the new 33kV feeder to Berrima Junction ZS proposed in Option 2 are shown. The total cost of this option is estimated to be $30.2 million with annual operating costs estimated to be 0.4 per cent of the capital expenditure.

Figure 13 – Simplified line diagram of Option 2



Option 2 would provide an augmented Berrima Junction ZS with two power transformers with one operating as a standby back-up and it would provide a new 33kV supply feeder and also include enabling works at Moss Vale ZS to support the connection of the new feeder and also enhance the operational flexibility at Moss Vale ZS.

4.3 Option 3 – Augment Berrima Junction ZS and establish a new 33kV feeder with a tee connection to feeder 7906

Option 3 would involve augmenting the existing Berrima Junction Zone Substation by installing two 35 MVA transformers and establishing a new 33kV feeder supply using a tee connection to the existing feeder 7906 which has a line route from Moss Vale ZS to Ringwood ZS. The new transformers would be installed on the available land at the site of the existing Berrima Junction Zone Substation. Following commissioning of the new transformers, supply to the area would be transferred from the existing single transformer to the newly installed transformers and the existing transformer would be decommissioned.

Option 3 would also include enabling works at both Moss Vale and Ringwood Zone Substations to support the new 33kV proposed in this option.

Construction would commence in 2024/25 and be completed in two years with commissioning in 2026/27. The decommissioning works could extend shortly beyond this period.

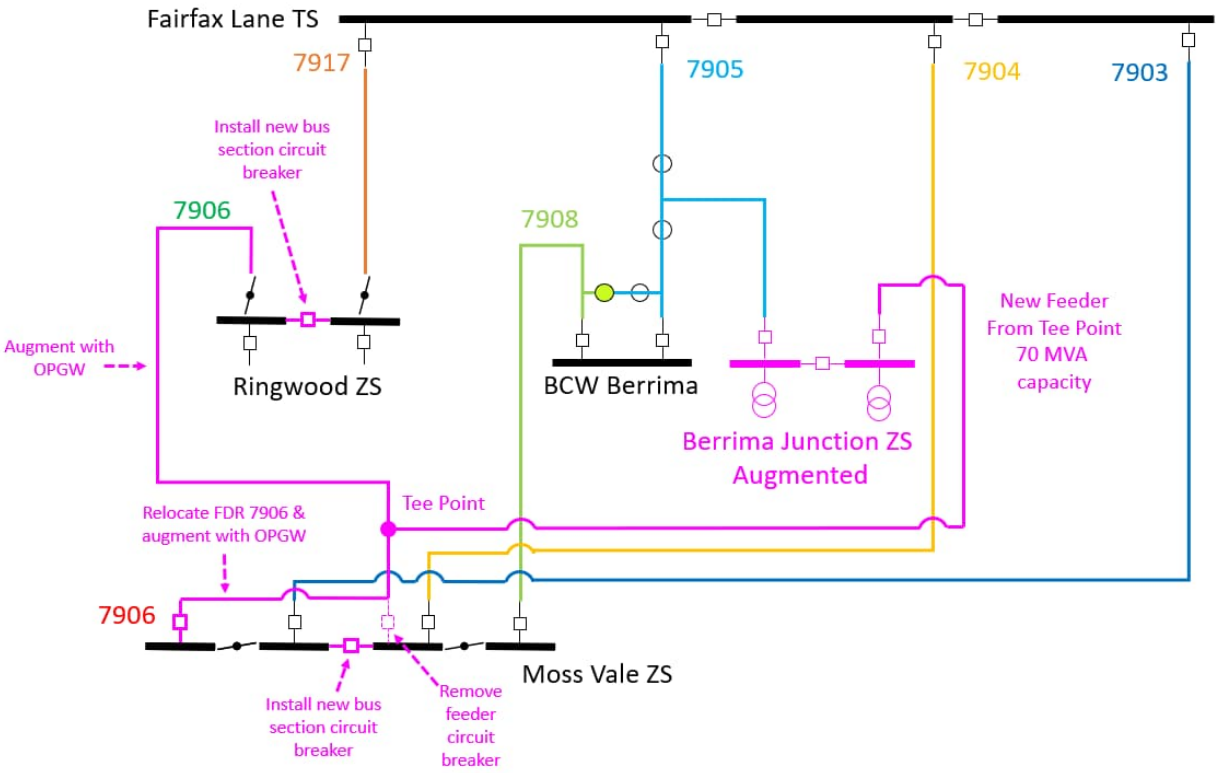
Table 5 below shows the scope of works and the cost estimate for Option 3.

Table 5 – Scope of works and costs for Option 3

Network Component	Proposed Scope of Works	Cost Estimate ($M)
Substation	Augment the existing **Berrima Junction Zone Substation**: • Install major equipment: o 2 x 33/11kV 35MVA transformers. o 2 x 33kV feeder bays o 2 x 33kV bus sections o 2 x 11kV bus sections o 2 x 11kV switchboards o Control Room and Amenities Building • Divert 33kV and 11kV cables from the existing substation to the new major equipment. • Decommission the existing 20MVA 33/11kV transformer, switchgear and control room. Salvage value to offset the decommissioning costs. Enabling works at **Moss Vale Zone Substation** : • 1 x 33kV bus section circuit breaker • 1 x 33kV feeder bays • Relocate existing 33 kV feeder 7906 to the new feeder bay. Enabling works at **Ringwood Zone Substation**: • 1 x 33kV bus section circuit breaker	29.3
Mains	Establish a tee connection to 33kV feeder 7906 Ringwood ZS to Moss Vale ZS to supply Berrima Junction ZS. (Route Length of approximately 3.0km).	2.8
Distribution	Divert 11kV feeders to the new 11kV bus sections.	0.8
	Total Cost.	**32.9**

Figure 14 below shows an overview of Option 3 using a simplified line diagram. It includes the proposed enabling works at Moss Vale and Ringwood Zone Substations. The total cost of this option is estimated to be $32.9 million with annual operating costs estimated to be 0.4 per cent of the capital expenditure.

Figure 14 – Simplified line diagram of Option 3



Option 3 would provide an augmented Berrima Junction ZS with two power transformers with one operating as a standby back-up and it would provide a new 33kV supply feeder and also include enabling works at Moss Vale ZS and Ringwood ZS to support the connection of the new feeder and also enhance the operational flexibility at both Moss Vale ZS and Ringwood ZS.

4.4 Options considered but not progressed

In addition to our network options that we have presented in this Draft Project Assessment Report, we have five (5) other options that were considered but not progressed into the economic evaluation because they have been determined as not being credible options to meet the identified need at Berrima Junction.

Table 6 shows the options considered and our reasons for not progressing them.

Table 6 – Options considered but not proposed to be progressed in the DPAR

Option	Reason not progressed
Augment Berrima Junction Zone Substation by installing two 25MVA transformers.	Not proposed to be progressed because the alternative of installing 35 MVA transformers provides increased capacity at minimal additional cost compared to 25 MVA transformers. The spatial requirement for 25MVA transformers is only marginally less than 35MVA transformers and the option of using 25MVA transformers on this site location would not optimise the land available in comparison to 35MVA transformers. The use of 35MVA transformers and the space to potentially install a third transformer in the future with 105MVA of installed transformer capacity is preferred. The use of 25MVA transformers may require an additional zone substation to supply the enterprise growth area for the time period after 2040. The proposed future residential development plans for New Berrima or Medway Road would eventually require an additional zone substation and the capacity provided by 35MVA transformers will be preferred. Particularly, if there is a requirement to support a load transfer from Moss Vale ZS to support the residential development.
Augment Berrima Junction Zone Substation with two 35 MVA transformers with new feeder from Fairfax Lane transmission substation.	Not proposed to be progressed because it is significantly higher cost compared to the alternative feeder options from Moss Vale Zone Substation and does not provide significant additional benefits. A new feeder from Fairfax Lane TS would have a longer route length to Berrima Junction ZS compared to from Moss Vale ZS and this would result in a higher cost feeder.
Augment Berrima Junction Zone Substation in stages using the existing transformer with a new feeder from Moss Vale Zone Substation.	Not proposed to be progressed because the existing transformer and associated electrical switchgear is approaching the end of service life. The transformer has been in service for over 55 years, in various locations in our network, and is at an elevated risk of oil leakage in the future. Furthermore, there would be operational constraints associated with the impedance mismatch between the old and new transformers limiting the potential supply capacity and operational flexibility of the augmented zone substation. Based on our current technical analysis of the existing transformer including examining the oil within the transformer our plan would be disposal of the existing transformer with the salvage value credited to the augmentation of the Berrima Junction Zone Substation.
A proposed Grid Forming BESS	In response to the Options Screening Report (OSR), a proposal for a grid forming BESS was received and considered. As the existing substation has both limited capacity and almost no redundancy, the proposed non network solution would need to be capable of supplying energy constantly once the capacity of the existing assets are exceeded. As a storage device, the battery-based solution was not able to sustain energy delivery for sufficient duration to meet the identified need.

Option	Reason not progressed
	The grid forming BESS, proposed as either a stand-alone option or combined with a reduced scope network option (enabling deferral of part of the ultimate network solution) was determined to not be technically feasible.
A proposed Renewable Energy Microgrid concept	In response to the Options Screening Report (OSR), a proposal for a renewable energy based microgrid concept was received and considered. The proposal was pitched as a “concept/idea for consideration” and was not a detailed submission. In particular key details such as land and site details, planned installed capacity of renewable energy, target energy output from the proposed renewable energy generation, estimates of availability of renewable energy and any energy storage details were all to be determined or subject to detailed design. Given the lack of firm details a comparative evaluation could not be undertaken and subsequently the proposal considered non credible.

5.0 Assessment framework

This section outlines the methodology that we have applied in assessing the market benefits and costs associated with each of the three (3) credible options considered in this RIT-D.

5.1 Overview of the assessment framework

All costs and benefits for each credible option have been assessed in comparison to a 'do nothing', business-as-usual base case.

Under this base case, Endeavour Energy would continue to utilise the single transformer and feeder 7905 at the existing Berrima Junction Zone substation, which may be unable to provide supply security for future developments in the growth area. The consequence of not proceeding with any investment in a network option for the Berrima Junction enterprise growth area will result in significant unserved energy due to the existing supply network being constrained and incapable of supplying the forecast demand for the area.

The RIT-D analysis has been undertaken over a 30-year period. We consider that this assessment period takes into account the size, complexity and expected life of the relevant credible options to provide a reasonable indication of the market benefits and costs of the option.

Further, the Berrima Junction enterprise growth area is expected to mature over a 30-year period and so the assessment period incorporates the expected demand growth development period. While the capital components of the credible options have asset lives greater than 30 years, we have taken a terminal value approach to incorporated capital costs in the assessment, which ensures that the capital costs of long-lived options are appropriately captured in the 30-year assessment period.

We have adopted a central real, pre-tax discount rate of 3.26 per cent as the central assumption for the NPV analysis presented in this DPAR.

We have also tested the sensitivity of the results to changes in this discount rate assumption with a lower bound real, pre-tax discount rate of 2.22 per cent and an upper bound discount rate of 4.30 per cent (i.e. a symmetrical upwards adjustment).

5.2 Market benefits are expected from reduced involuntary load shedding

We expect that the only relevant categories of market benefits prescribed under the NER for this RIT-D relate to changes in involuntary load shedding and differences in the timing of expenditure. Our approach to valuing these market benefits are outlined below.

5.2.1 Reduced involuntary load shedding

Endeavour Energy has valued reduced involuntary load shedding by reference to our estimate of energy at risk, which is derived from the annual peak demand forecasts and load duration curves set out in the key assumptions.

The value of unserved energy is calculated using the VCR. This represents an estimate of the value electricity consumers place on reliable electricity supply. The VCR has been used in relation to customers who have not yet connected to the network to determine the avoided unserved energy to provide the benefits for the economic analysis.

The VCR value (in dollars per MWh) is applied to the difference in the MWh of unserved energy calculated in comparison to the base case and each credible option.

We used a composite VCR value of $59,969 per MWh in the evaluation. This is based on the 2022 VCR values provided by the AER,[1] weighted in accordance with the forecast composition of the agricultural, commercial, industrial and residential within the Berrima Junction enterprise growth area. The Berrima Junction enterprise growth area will provide a backup supply to adjacent residential areas and this has been included in the composite VCR. We believe that the value of VCR used in this analysis is conservative. Based on the major customer connection requests we have received, many of the major enterprises planning to connect in this area have a high expectation on supply reliability and have proposed high value added business processes reliant on secure and reliable supply of electricity.

A breakdown of this calculation is provided in the table below.

[1] AER, *2022 VCR annual adjustment,* December 2022.

Table 7 – Composite VCR used in evaluation

Parameter	Commercial	Industrial
Demand composition of the Berrima Junction enterprise growth development area	51%	49%
AER VCR	$49,540	$70,970
Demand weighted VCR	**$59,969**	

5.2.2 Differences in timing of expenditure

Differences in the timing of expenditure relates to the potential for a credible option to change the timing (or configuration) of other future investments to be made by or for the RIT-D proponent. Importantly, this relates to distribution investments that address identified needs other than those addressed by the credible option.

All three of the credible options are expected to have similar commissioning dates and construction periods however the different capital costs of the options and the discounted cashflow analysis has been included in the present value of the costs of each option. This has been included in the assessment framework.

5.3 No other categories of market benefit are expected to be material

This section provides a brief overview of the categories of market benefit (other than reduced involuntary load shedding) that are not material for this RIT-D. These are:

- changes in voluntary load curtailment;
- option value;
- changes in load transfer capability;
- changes in costs to other parties; and
- changes in electrical losses.

5.3.1 Changes in voluntary load curtailment

Voluntary load curtailment is when customers agree to reduce their demand (load) to address a network limitation in return for a payment. A credible demand side option to enlist such customers to voluntarily reduce their demand could lead to a reduction in involuntary load shedding.

Endeavour Energy has not estimated any market benefits associated with changes in voluntary load curtailment. Although, generally, customers are now more capable of providing greater levels of voluntary load curtailment, the greenfield nature of this investment is such that the area does not have the capability to deliver sufficient voluntary demand reduction.

5.3.2 Option value

Endeavour Energy notes that the AER's view is that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change and the credible options considered by the RIT-D proponent are sufficiently flexible to respond to that change.

Although we have not explicitly quantified option value for this assessment, it is implicitly captured in the structure of our credible options (each of which have flexibility for future investment and could be accelerated or deferred to respond to customer demand over time).

5.3.3 Changes in load transfer capability

Distribution investments can improve load transfer capacity where a credible option allows customers to gain access to an alternate back-up power supply via the meshed 11kV network. This is a market benefit because the alternate supply can service customers in the event of loss of primary supply. The main objective of this project is to establish a secure connection for existing and new customers in the Berrima Junction enterprise growth area. There is currently minimal load transfer capability from adjacent zone substation and feeders and the available capacity of the Moss Vale feeder would depend on the time of day and demand, with the transfer capacity likely to be less than 3MVA. The three (3) credible options will all increase load transfer capability by providing an augmented Zone Substation enabling the development of additional 11kV feeders which will extend into the 11kV network and allow for more interconnectivity to the adjacent Zone Substations, primarily Moss Vale and Bowral Zone Substations. These changes are far lower than the market benefit of avoided expected unserved energy.

5.3.4 Changes in costs to other parties

Endeavour Energy has not identified any changes in costs to other parties from developing the credible options identified in this document.

5.3.5 Changes in electrical losses

Endeavour Energy recognises that there would be small changes in the loss profiles for customers across the network due to network augmentation. These changes are captured as part of the annual review of distribution loss factors when more information about customer usage patterns is available. Changes in electrical losses have therefore not been modelled for this RIT-D.

5.4 Three different ‘scenarios’ have been modelled to address uncertainty

RIT-D assessments are required to be based on cost-benefit analysis that includes an assessment of ‘reasonable scenarios’, which are designed to test alternate sets of key assumptions and whether they affect the identification of the preferred option.

We have assessed three alternative future scenarios as part of the DPAR NPV assessment, namely:

- a central scenario – consisting of assumptions that reflect a central set of variable estimates, which, in our opinion, provides the most likely scenario;
- a high benefit scenario – reflecting an optimistic set of assumptions which have been selected to investigate an upper bound on reasonably expected market benefits; and
- a low benefit scenario – reflecting a number of assumptions that give rise to a lower bound NPV estimate for each credible option, in order to represent a conservative future state of the world.

A summary of the key variables for each scenario is provided in Table 8 below.

Table 8 – Scenarios used to test the robustness of the Preferred Option

Variable	Central scenario	High benefits	Low benefits
Capex	Central estimates	-25%	+25%
Demand	Central demand forecast (see Section 3)	High demand forecast (see Section 3)	Low demand forecast (see Section 3)
VCR	Load-weighted AER VCR	+30%	-30%
Discount rate	3.26%	2.22%	4.30%
Maintenance costs	Central estimates	-25%	+25%

The selection of the preferred option has been based on the Central scenario. We have used the High and Low benefits scenarios to test the robustness of the preferred option to variations in the key variables. We have also constructed a "weighted scenario" based on a weighting of the central, high and low scenarios to further test and compare the robustness and sensitivity of the preferred option.

We believe that this approach provides a rigorous test of the selection of the preferred option with consideration of variation of the key variables.

6.0 Assessment of credible options

This section summarises the results of the NPV analysis, including the sensitivity analysis undertaken. All credible options have been assessed in comparison to the business-as-usual (no proactive intervention) base case.

6.1 Gross market benefits estimated for each credible option

The table below summarises the gross market benefit of each credible option relative to the base case in present value terms. The gross market benefit has been calculated for each of the scenarios outlined in the previous section.

Table 9 – Present value of gross economic benefits of each credible option relative to the base case ($M)

Option	Central scenario	High benefits	Low benefits	Weighted
Scenario weighting	50%	25%	25%	
Option 1	139.5	1,210.8	77.2	391.7
Option 2	173.5	1,331.0	95.6	443.4
Option 3	173.5	1,331.0	95.6	443.4

6.2 Estimated costs for each credible option

The table below summarises the costs of each credible option relative to the base case in present value terms. The cost is the sum of the project capital costs and the estimated operating and maintenance costs for each option.

The cost of each option has been calculated for each of the three reasonable scenarios described above.

Table 10 – Present value of costs of each credible option under each scenario ($M)

Option	Central scenario	High benefits	Low benefits	Weighted
Scenario weighting	50%	25%	25%	
Option 1	20.8	15.1	26.5	20.8
Option 2	24.2	17.5	30.7	24.1
Option 3	26.4	19.1	33.5	26.4

6.3 Net present value assessment outcomes

The Table 11 below summarises the net market benefit in NPV terms for each credible option under each scenario. The net market benefit is the gross market benefit (as set out in Table 9) with the cost of each option (as set out in Table 10) subtracted to obtain a net present value.

Table 11 – Present value of net market benefit of each credible option relative to the base case ($M)

Option	Central scenario	High benefits	Low benefits	Weighted	Rank
Option 1	118.7	1,195.7	50.7	371.0	3
Option 2	**149.3**	**1,313.5**	**64.8**	**419.2**	**1**
Option 3	147.1	1,311.9	62.0	417.0	2

Under the NER, the preferred option is the credible option that maximises the present value of the net economic benefit to all those who produce, consume or transport electricity in the National Electricity Market (NEM).

Applying this criteria, Option 2 is the preferred option at this draft stage because it has the highest net market benefits.

We have used the central scenario to determine the preferred option and we have used the high and low scenarios to test the robustness of the preferred option.

The weighting applied to the scenarios has also been selected to test the robustness of the preferred option.

We have reviewed the recent RIT-D and RIT-T regulatory developments with regards to the use of scenarios. We have used them to test the robustness of the preferred option that has been identified by applying the central values of key variables in the economic evaluation. We believe that the Central scenario is the most likely scenario and intend to use this as the basis for selecting preferred options for our RIT-D assessments in the future.

The following section demonstrates that the sensitivity analysis we have undertaken confirms our view that Option 2 is preferred at this draft stage.

6.4 Sensitivity analysis results

We have undertaken a thorough sensitivity testing exercise to understand the robustness of the RIT-D assessment to underlying assumptions about key variables. Our sensitivity analysis has focused on testing the sensitivity of the total NPV benefit associated with the investment proceeding consistent with the timeframes for customer connection.

We have assessed the sensitivity of the net benefits of each option to:

- changes in the discount rate;
- changes in the capital costs; and
- changes in the VCR.

The figures below demonstrate that these sensitivities confirm the selection of the preferred option.

Figure 15 – Impact of varying the discount rate on the net market benefits of each credible option

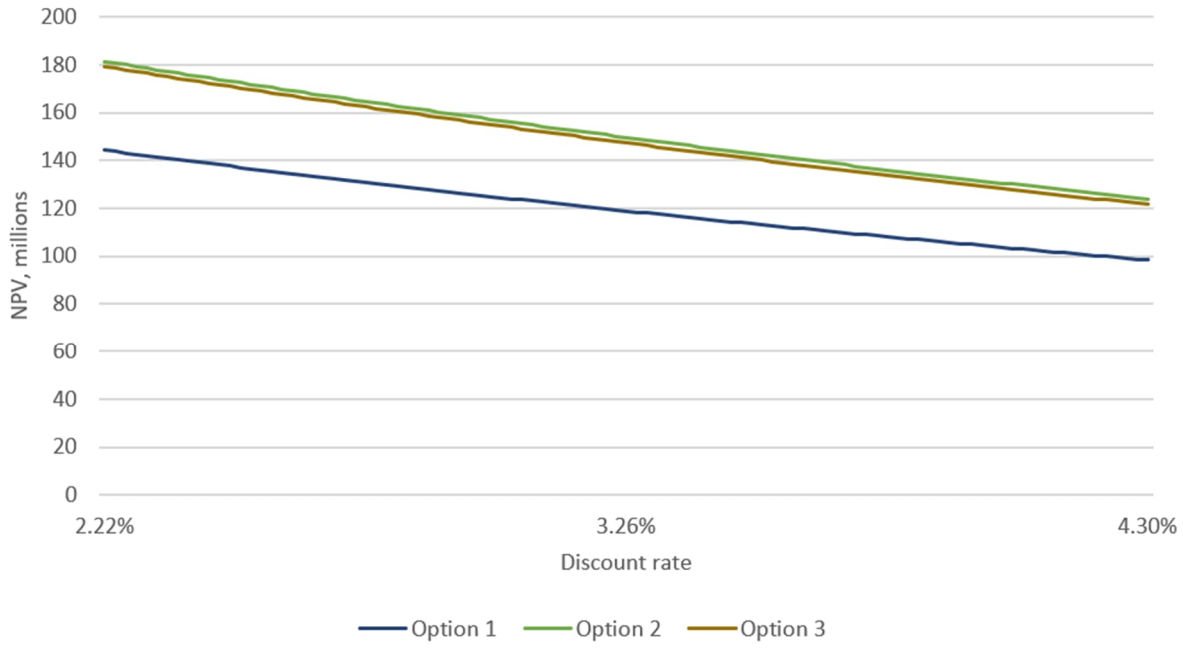


Figure 16 – Impact of varying capital costs on the net market benefits of each credible option

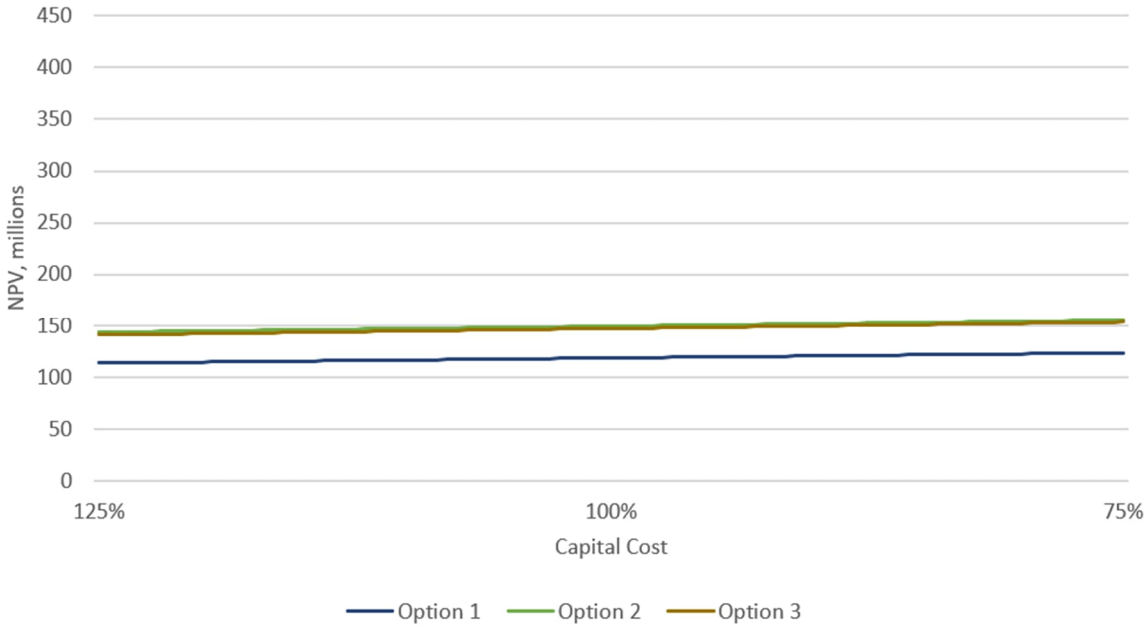
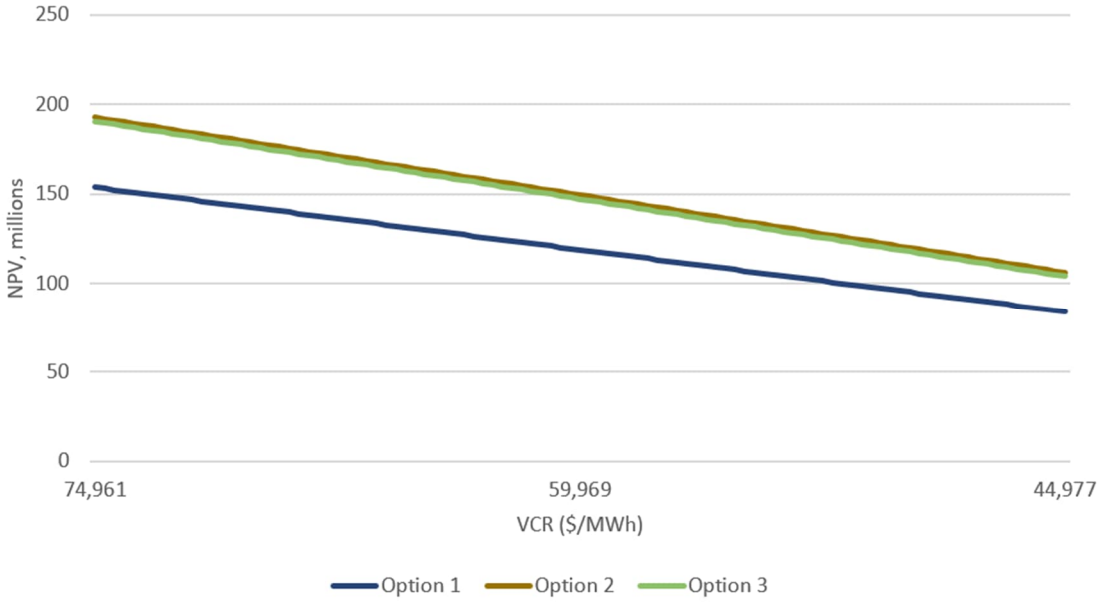


Figure 17 – Impact of varying the VCR on the net market benefits of each credible option



7.0 Conclusion

The Berrima Junction Enterprise Growth Area is forecast to require approximately 16MVA of electricity supply capacity by 2031. The current Berrima Junction Zone Substation consists of a single power transformer and a single 33kV supply and does not have the security of supply to support the development of the growth area.

Through the Options Screening Report notice and consultation, including consideration of submissions, Endeavour Energy has not identified a feasible non-network solution or SAPS solution that will address the needs of the Berrima Junction enterprise growth area.

This DPAR identified three credible network-based options that can meet the required customer demand.

Two of the credible options involve augmenting the existing Berrima Junction Zone Substation and establishing a new 33kV feeder supply. The third option involves augmenting the zone substation with the existing 33kV supply.

These three network options will mitigate the risk of interrupted supply that may result from major transformer or feeder failure at the existing zone substation and support growth in customer demand.

- Option 1 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and use the existing 33kV supply.
- Option 2 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and establish a new 33kV feeder supply from Moss Vale Zone Substation.
- Option 3 – Augment Berrima Junction Zone Substation with the installation of 2 x 35MVA transformers and establish a new 33kV feeder supply from a connection to an existing feeder 7906.

Each of these options were considered in an economic evaluation and Option 2 was selected as the preferred option.

The estimated cost of this option is $30.2 million.

Augmentation of the Berrima Junction Zone substation and construction of the new feeder supply would commence in 2024/25 with commissioning in 2026/27.

Cost Estimate (Option 2)	Value ($M)
Central estimate based on cost outcomes for similar recent project work including the purchase of major equipment, third party contract suppliers and internal labour.	**30.2**

CONTACT

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