

RIT-D FINAL PROJECT ASSESSMENT REPORT

PR427 Leppington North Greenfield Supply Area

Endeavour Energy

March 2017

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1.0 EXECUTIVE SUMMARY

This Final Project Assessment Report has been prepared by Endeavour Energy in accordance with the requirements of clauses 5.17.4(o) of the National Electricity Rules (NER). A Draft Project Assessment Report was prepared and published in October 2016. Submissions closed on 31 December 2016. No submissions were received.

The purpose of this report is to demonstrate the basis for the selected option to address the network limitations within the subject area(s). This report has been prepared following a determination by Endeavour Energy that non-network options are not feasible to address the constraints and the subsequent publication of a screening test report outlining the findings.

This Final Project Assessment Report:

- Describes the network need which Endeavour Energy is seeking to address, together with the assumptions used in identifying that need.
- Describes the credible options that are considered in this RIT-D assessment
- Describes the methods used in quantifying each class of market benefit.
- Quantifies costs (with a breakdown of operating and capital expenditure) and classes of market benefits for each of the credible options
- Provides reasons why differences in changes in voluntary load curtailment, costs to other parties, option value and timing of other distribution investment do not apply to a credible option.
- Provides the results of NPV analysis of each credible option and accompanying explanatory statements regarding the results
- Identifies the preferred option.
- Seeks stakeholder input in consideration of the preferred option.
- Provides contact details for queries relating to this RIT-D project.

The Precincts of Leppington and Leppington North are part of the programmed release areas of the South West Growth Centre.

The RIT-D application guidelines currently focus on monetising the risks of interruptions to supply to *connected* customers based on the value of customer reliability (VCR). The RIT-D guidelines currently do not have appropriate mechanisms for monetising the economic risks associated with deriving *unconnected* customers of supply. Endeavour Energy believes that this project belongs to the category of *unconnected* customers awaiting supply, as the investment is required in order to provide supply to customers who would otherwise remain unconnected (development would not proceed due to lack of power supply). As a proxy, therefore, Endeavour Energy has employed the same mechanism as provided in the RIT-D guidelines for the purpose of monetising the risks of non-supply to connected customers. One interpretation of this is that connection of new customers would continue regardless of available capacity and the ensuing risks of losing supply would be evaluated using Value of Customer Reliability (VCR).

Four options have been considered for evaluation in this report. All four options involve the establishment of a zone substation at Leppington North. Option 1 involves the construction of a zone substation with a standard simplified control building initially with one transformer, with the second transformer deferred to a later date. Option 2 is similar to option 1 except it involves the use of a modular control building. Option 3 involves the up-front establishment of the zone substation with 2 transformers with a standard simplified control building. Option 4 is the same as option 3 except it involves modular control buildings to allow for future expansion for a third stage.

A choice from any of the four options forms a key link in the supply strategy for the whole of the South West Sector.

Option 3 is the preferred option which maximizes the net market benefits and is expected to cost \$24.0 Million excluding contingencies. This option establishes a 2 transformer zone substation with a standard simplified control building at North Leppington on a site owned by Endeavour Energy.

For the purpose of the RIT-D analysis, a number of scenarios have been considered for sensitivity analysis. These scenarios are based on higher and lower variations in the following factors: demand growth, VCR, capital cost, discount rate. For all of these scenarios, Option 3 remains the option that delivers the highest net market benefit.

2.0 INTRODUCTION

This Final Project Assessment Report has been prepared by Endeavour Energy in accordance with the requirements of clauses 5.17.4(o) of the National Electricity Rules (NER).

This report describes the application of the Regulatory Investment Test for Distribution (RIT-D) for addressing supply to the Leppington and Leppington North Precincts.

Endeavour Energy has determined that non-network options to address supply constraints in the area are not feasible. A screening test report outlining the reasons for this determination has been published on Endeavour Energy's website.

A Draft Project Assessment Report was published on Endeavour Energy's website in October 2016, with submissions closing on 31 December, 2016.

This Final Project Assessment Report:

- Provides background information on the network limitations within the subject area.
- Describes the network need that Endeavour Energy is seeking to address, together with the assumptions used in identifying that need
- Describes the credible options that are considered in this RIT-D assessment
- Describes the methods used in quantifying each class of market benefit.
- Quantifies costs (with a breakdown of operating and capital expenditure) and classes of market benefits for each of the credible options
- Provides reasons why differences in changes in voluntary load curtailment, costs to other parties, option value and timing of other distribution investment do not apply to a credible option.
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- Provides contact details for queries relating to this RIT-D project.

Endeavour Energy adopts a process of exploring existing feasible methods of supply in assessing the ability to supply development applications. However, for greenfield sites, Endeavour Energy needs to determine the length of time that the existing network will be able to sustain the prevailing precinct development rate. Endeavour Energy needs to balance timely investment with the ramping up of demand as houses are built and occupied. It also needs to mitigate the risks of stalling developments due to delayed supply of power to developments resulting in adverse impacts on the supply of land for housing and employment needs.

3.0 CONSULTATION

3.1 SUBMISSIONS RECEIVED

Endeavour Energy has published a Screening for Non Network Options report. No submissions were received from registered participants and interested parties in relation to this document. Endeavour Energy has also published a Draft Project Assessment Report for this project, with submissions due on or before 31 December 2016. No submissions were received. Based on the Screening Report and lack of submissions, non-network options were not considered feasible for this project.

3.2 ENQUIRIES

All submissions and enquiries regarding this document should be directed to Endeavour Energy's Manager Asset Strategy and Planning at consultation@endeavourenergy.com.au

4.0 NETWORK NEED

4.1 EXISTING NETWORK OVERVIEW

The study area is partially supplied by two 11kV feeders from South Leppington ZS, one from Hinchinbrook ZS, one from Kemps Creek ZS and one from Prestons ZS. These feeders are long and comprise of some small gauge aerial mains making them unsuitable for large scale URD development at the extents of the feeders. Strategic sections of the existing overhead network will require augmentation to overcome excessive voltage drop over the long distances in order to allow substantial subdivision development.

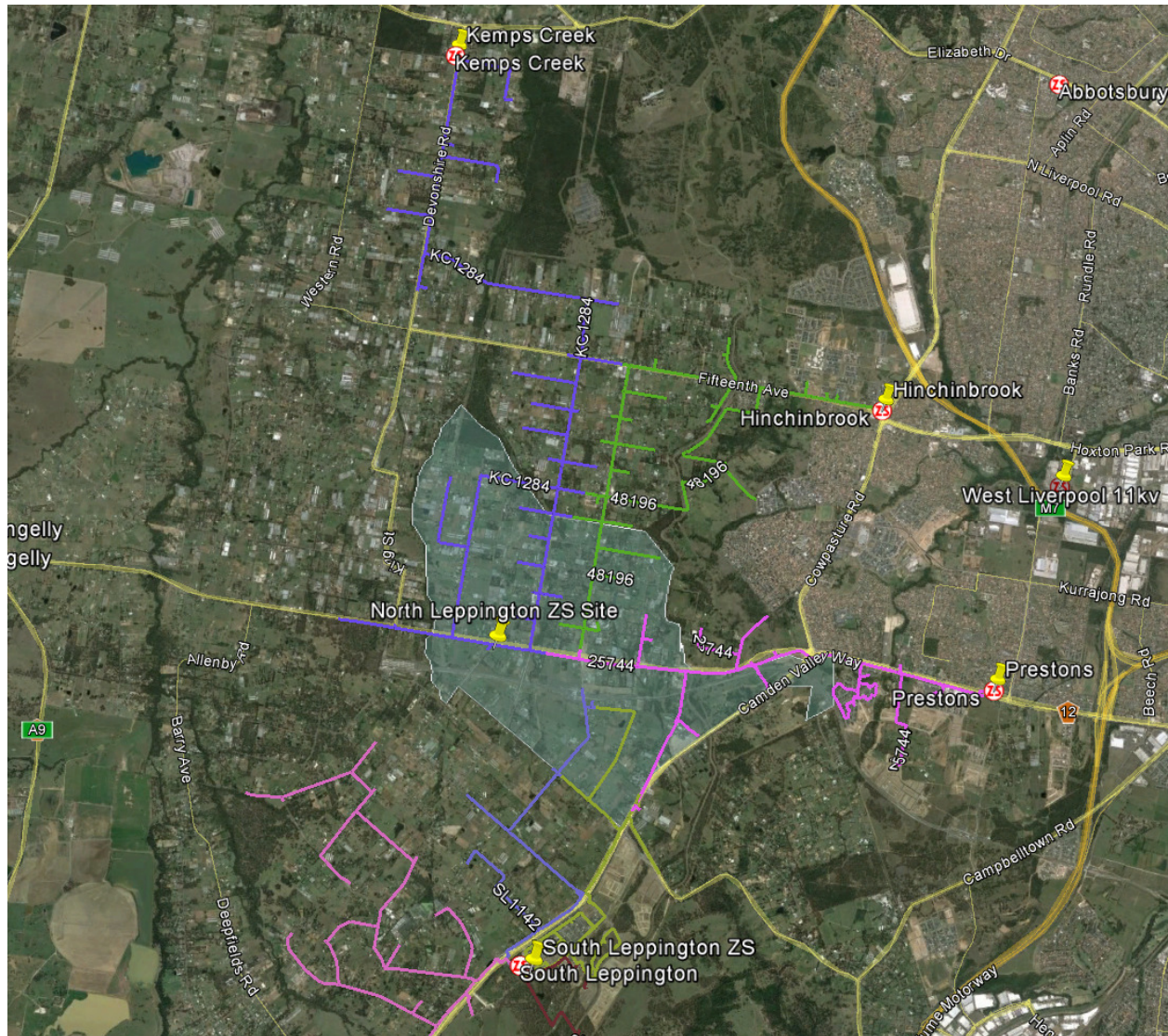


Figure 1 - Overview of Network

4.2 DESCRIPTION OF NETWORK NEED

A new precinct called Leppington North was rezoned by Planning NSW in 2014 and forms part of the South-West Growth Sector. Please refer to the context map in figure 2. The precinct is planned for approximately 7,500 dwellings and a regional town centre comprising retail, commercial and civic facilities. The town centre will become a significant employment hub for the south west growth sector and will be comparable to the combined Rouse Hill Town Centre and Norwest Business Park situated in the North-West Growth Sector. The North Leppington precinct is forecast to have a diversified load of between 85-90MVA.

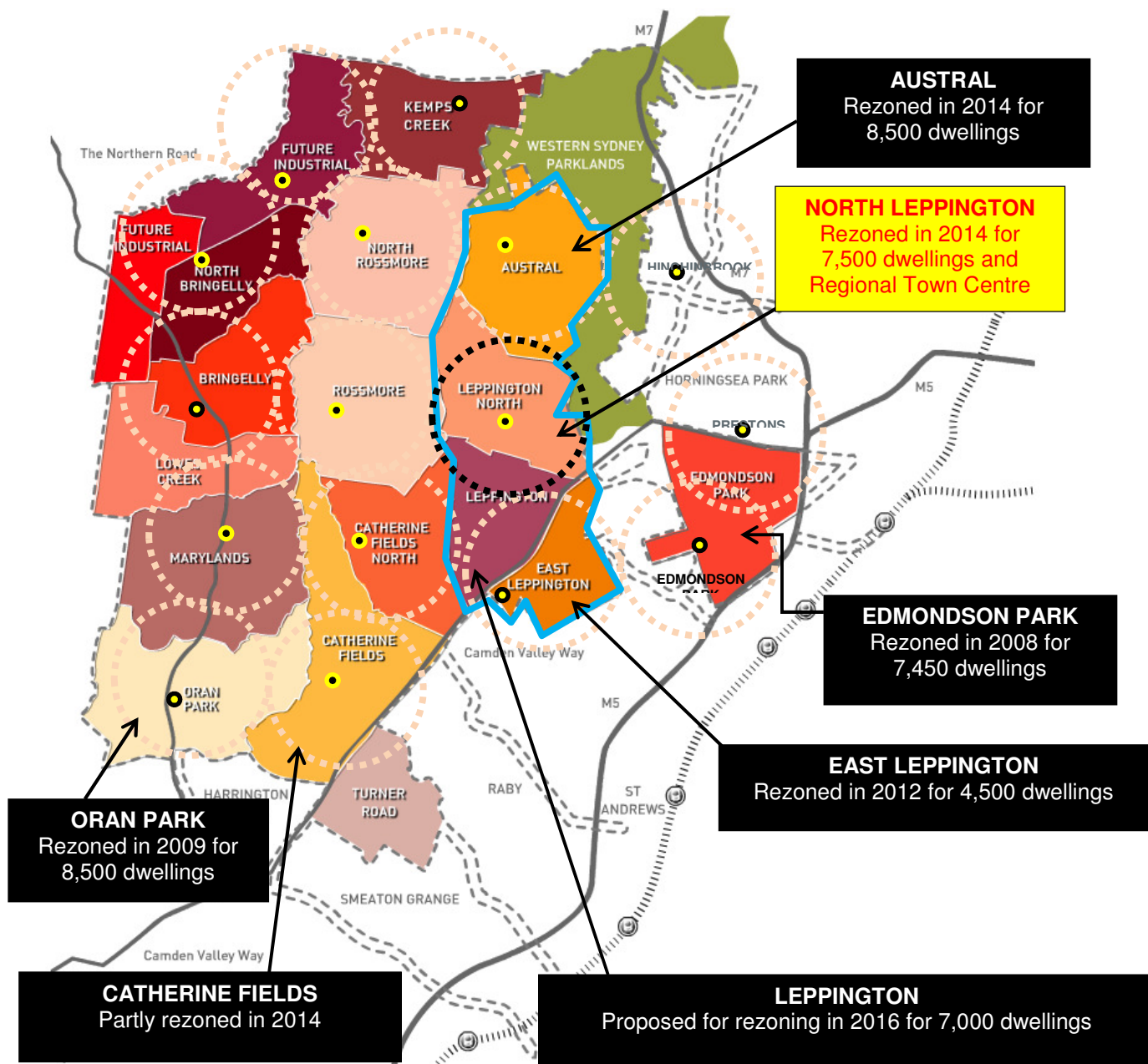


Figure 2 - Context Map

Initial development of between 750 to 1,000 dwellings could be supplied from the South Leppington ZS situated 5km away in St Andrews Rd and from Prestons ZS situated 6km away near Bernera Rd. The variation in serviceable dwelling numbers depends upon the ratio of low density to high density dwellings that are produced with the latter having a lower after diversity maximum demand (ADMD). It is likely that considerable augmentation of strategic portions of the overhead network or deployment of voltage regulators may be required to maintain compliance with quality of supply planning levels, particularly voltage drop.

A new zone substation is required to service ongoing development beyond the initial 1,000 dwellings. The establishment of North Leppington Zone Substation will also provide back-up support to adjacent networks which have reached or are approaching their limits in supplying other customers.

Table 1 reflects a preliminary forecast based on lot production and commercial & industrial expectations for the North Leppington precinct.

Table 1 - Demand Forecast for North Leppington Precinct

Table 1 - Demand Forecast for North Leppington Precinct (All Load Categories) MVA											
Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Existing Rural	5.0	4.8	4.5	4.3	4.0	3.8	3.5	3.3	3.0	2.8	2.5
New Residential	0.7	2.2	3.7	5.2	5.6	6.4	8.1	9.5	10.7	11.8	13.0
New Commercial	0.3	0.6	1.3	2.1	3.0	3.6	4.3	4.9	5.6	6.0	12.5
New Industrial	0.4	0.7	1.2	2.0	3.0	3.7	4.5	5.0	5.3	5.7	6.0
TOTAL Precinct	6.3	8.3	10.7	13.5	15.5	17.5	20.3	22.6	24.5	26.2	34.0

A study of the North Leppington precinct estimated a potential electrical demand of 90MVA. Refer to Table 2. Development is expected to commence in 2015/16 with 7,500 new dwellings over a 20 year period concurrent with substantial town centre commercial development over a longer 40 year period and an industrial component of modest growth over a 12 year concurrent period.

Table 2 - North Leppington Precinct Forecast Load

NORTH LEPPINGTON PRECINCT FORECAST LOAD									
Land Zoning	Load Type	Area (Ha)	Dwellings	GFA (m2)	Allocation (VA)	Load (MVA)	11kV Feeders		
Business / Office Park	Health/Medical			10,000	110	1.10	0.24		
	Commuter Parking			25,000	15	0.38	0.08		
	Office			290,000	100	29.00	6.44	7	
Civic Centre	Court House			7,000	40	0.28	0.06		
	Police Station			5,000	40	0.20	0.04		
	Youth Centre			2,000	25	0.05	0.01		
	Library/Community Centre			7,500	25	0.19	0.04		
	Performing Arts			5,000	40	0.20	0.04		
	Swim/Sports Centre			8,000	40	0.32	0.07		
	Art Centre			3,000	25	0.08	0.02		
	TAFE			30,000	25	0.75	0.17	0.5	
Retail Bulky Goods				245,000	40	9.80	2.18	2	
Retail Office	Retail			143640	80	11.49	2.55		
	Office			6650	100	0.67	0.15	3	
Mixed Use	Office			6650	100	0.67	0.15		
	Retail			15960	80	1.28	0.28		
	Residential		375	46875	3200	1.20	0.27	1	
Residential	High Density	30	4000	46875	3200	12.80	2.84		
	Low Density		3500		4000	14.00	3.11	6	
Urban Services	Light Industrial			460000	12	5.52	1.23	1	
	(excluding easements and railway)								
TOTAL LOAD						90.0	19.99	20	
Other						0	0	0	
TOTAL LOAD FOR NORTH LEPPINGTON ZONE SUBSTATION						90.0	19.99	20	
						MVA	11kV Feeders		

4.2.1 ZONE SUBSTATION CAPACITY

Kemps Creek and Hinchinbrook are the furthest supply sources to the North Leppington precinct at a distance of 9km. These will be relied upon to initially supply the Austral precinct which was simultaneously rezoned in 2014. South Leppington ZS and Prestons ZS are therefore the closest supply sources at a distance of 5km. These are currently supplying new ongoing development in the East Leppington (Willowdale) precinct and the Edmondson Park precinct respectively. Some capacity is available to supply a limited initial development of up to 1000 dwellings.

South Leppington Zone Substation

South Leppington ZS was established as an interim supply solution for the East Leppington precinct (Willowdale) with a portable control building comprising four 11kV feeder circuit breakers. Forecasts for this zone substation are provided in Table 3.

Table 3 – South Leppington ZS Summer Forecast

Table 3 – Modified Load Forecast for South Leppington Zone Substation (MVA)										
Precinct	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Official Forecast [#]	3.7	4.8	6.9	9.5	11.7	14.5	17.0	18.9	20.2	21.1
North Leppington [#]	0	0	3.5	6.1	7.9	8.8	9.6	10.5	11.4	12.3
Leppington	0	0	0.6	2.0	3.4	4.8	6.2	7.6	9.0	10.4
Gledswood Hills	0	0	0.4	0.8	1.2	1.6	2.0	2.0	2.0	2.0
Total Load[@]	3.7	4.8	11.4	18.4	24.2	29.7	34.8	39.0	42.6	45.8
Firm Capacity [^]	10	10	10	10	10	10	10	10	10	10
Load at Risk	0	0	1.4	8.4	14.2	19.7	24.8	29.0	32.6	35.8
Unserviceable Dwellings	0	0	350	2100	3550	4925	6200	7250	8150	8950

[#] North Leppington component subtracted from the official forecast and included in separate North Leppington line. Only includes portion of North Leppington precinct that could potentially be supplied from South Leppington ZS

[^] Back-up capacity available from adjacent distribution networks

[@] Load exceeds planning imposed limit of 15MVA

LAR takes into account a distribution back-up of 10MVA from adjacent networks

South Leppington ZS Feeder Capacity

The capacity available for new development in the North Leppington (and Leppington) precincts is limited to two 11kV feeders from South Leppington ZS. These feeders supply existing rural properties and also new residential housing in the Willowdale Estate (*East Leppington precinct*).

Table 4 shows the load on all 11kV feeders from South Leppington ZS. The table indicates that the North Leppington precinct is mostly unserviceable from the existing distribution network with a potential to supply only 505 dwellings (225 + 280) from feeders SL1142A Heath Rd and SL1132A Tunnel St.

Table 4 - Precinct Totals Supplied from South Leppington Interim ZS

Table 4 - Precinct Totals Supplied from South Leppington (Interim) ZS						Prestons ZS
PRECINCT	George Rd SL1112A	Heath Rd SL1142A	Tunnel St SL1132A	Navigator St SL1132B	St Andrews Rd SL1122A	Gellibrand Rd 25744
Existing Customers	535	300	350	100	25	675
North Leppington		225	280			450
Leppington		600				
Willowdale			120	650	725	
Emerald Hills	215					
LOAD[^]	3MVA	4.5MVA	3MVA	3MVA	3MVA	4.5MVA

[^] Feeders limited to 3MVA to contain South Leppington ZS load to approximately 15MVA due to limited back-up capacity

Prestons Zone Substation

This substation was established in 2001 and then augmented in 2007 to service the suburbs of Prestons, Horningsea Park, Carnes Hill, Casula and Glenfield. The establishment of Casula ZS in 2012 to service Casula and Glenfield allowed some Prestons ZS capacity to be released to service 2,750 new dwellings and a commercial hub in the Edmondson Park (*North*) precinct.

Prestons ZS 11kV Feeder Capacity

Table 4 shows that an additional 450 dwellings in North Leppington can be serviced from Prestons ZS on feeder 25744 Gellibrand Rd. This feeder however also supplies the developing north-west area of the Edmondson Park precinct. Efforts are being made to establish and develop new 11kV feeders from Prestons ZS via various subdivision works. These feeders would alleviate the load on the Gellibrand Rd feeder and allow development in the North Leppington precinct to go beyond 450 dwellings and boost back-up capacity. This strategy depends heavily upon the location and rate of developer activity within the Edmondson Park precinct in the vicinity of Prestons ZS to progressively extend the new underground feeders through these subdivisions.

The above network constraints detailed for South Leppington ZS and Prestons ZS leaves an unserviceable balance of 6,545 proposed dwellings in the North Leppington precinct [7,500 – 450 by Gellibrand Rd – 280 by Tunnel St – 225 by Heath Rd] in addition to new commercial, retail and industrial development in and around the Leppington Town Centre.

4.2.2 LOAD TRANSFER CAPACITY

Due to the existing long length and rural nature of the 11kV distribution network in the area supplying other growth precincts from adjacent zone substations, opportunities to transfer load are extremely limited.

4.2.3 DISTRIBUTION FEEDER UTILISATION

Forecast utilisation of distribution feeders within the North Leppington and Leppington supply areas are presented in figure 3. All of the feeders will reach 100% utilisation when the allowable quantities of new residential lots are connected as shown in Table 4. This is expected to occur by 2018.

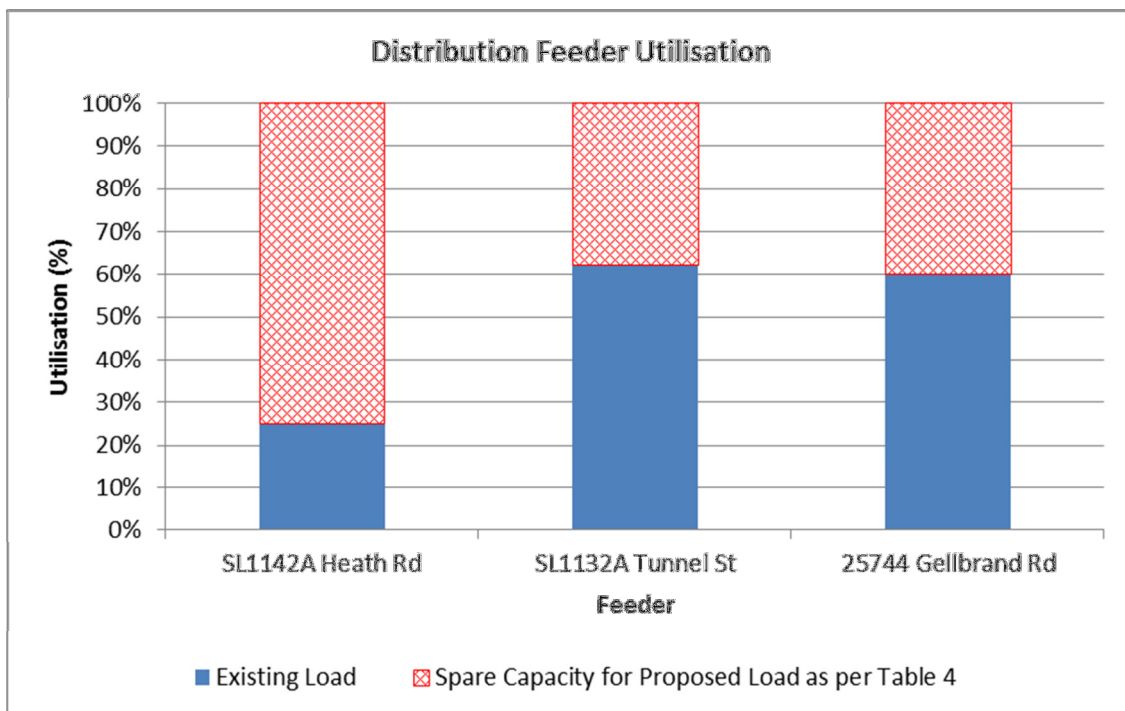


Figure 3 - Distribution Feeder utilisation

4.2.4 DISTRIBUTION FEEDER RELIABILITY PERFORMANCE

The network has been configured so that cross-zone ties and cross-feeder ties provide sufficient avenues for back-up switching of the existing rural residential area including initial new pockets of urban development during contingencies or planned outages on South Leppington ZS. These however are not robust enough to deal with a forecast load of greater than 10MVA.

Minor interruptions can be expected during the development of the precinct and also as a consequence of upstream development in adjacent precincts that are serviced by the same distribution network. These planned interruptions are a normal occurrence as part of the extension and conversion of the network including installation of new pad mount distribution substations and HV underground cable and are generally kept to a minimum.

4.3 QUANTIFICATION OF NETWORK NEED

The substantial residential developments proposed for North Leppington cannot be sustained without investment in additional capacity. Spare capacity in the distribution system has already been committed to getting the first stages of the development underway. For the purpose of quantifying the network need, it has been assumed that additional customers continue to get connected to the existing network. In practice, it must be recognised that this will lead to deteriorating reliability and inability of the Network Service Provider to meet System Standards. Eventually this will necessitate “*reliability corrective action*”.

The forecast impact of the identified need discussed in Section 4.2 is presented in Table 5 below. It should be noted that the load at risk stated in the table below represents load that is yet to be connected to the network (or new connections in a greenfield area).

The table shows: Load at risk (MVA) – this is the MVA load that will not be supplied either in the event of a contingency or in the event of not augmenting the network in order to facilitate connections as is the case with North Leppington because of insufficient distribution capacity in the network to sustain the level of expected growth. Expected unserved energy is capped at 350MWh as outlined in section 5.1.

Table 5 - Load at Risk and Value of Expected Unserved Energy

Year	Load At Risk ¹ (MVA)	Expected Unserved Energy (MWh)	Customer Value of Expected Unserved Energy (\$,000)
2017	2.5	0.1	2
2018	4.5	29.2	772
2019	6.9	238.6	6,303
2020	9.7	350	9,246
2021	11.7	350	9,246
2022	13.7	350	9,246
2023	16.5	350	9,246
2024	18.8	350	9,246
2025	20.7	350	9,246
2026	22.4	350	9,246
2027	30.2	350	9,246

¹ Based on Demand Forecast for North Leppington Precinct – Table 1 and connectable load from Table 4

5.0 METHODOLOGY AND ASSUMPTIONS

5.1 METHODOLOGY

The assessment of this project is based on the RIT-D and the RIT-D application guidelines.

A baseline risk position has been established on the basis of a ‘Do-Nothing’ option. The project involves the extension of supply into a greenfield development area which will involve approximately 7,500 dwellings. A do nothing scenario means that supply for 7500 new dwellings is required from feeders that currently supplies approximately 2000 dwellings. Approximately 1500 of the 7500 new dwellings can be supplied from the existing feeders. Connection of these new dwellings in a business as usual scenario will result in Endeavour Energy being unable to meet its NER system standard obligations and hence result in ‘reliability corrective action’.

A core justification for this project is based on load at risk and energy not supplied to customers waiting to connect. This is different to a situation where already connected customers risk losing supply. Arguably, the value that connected customers place on continuity of supply is different to the value customers waiting to connect will place on having access to supply. However, neither the RIT-D application guidelines nor the AEMO VCR guidelines provide any guidance on procedures to follow in such greenfield development situations. Hence, the same VCR value has been applied as a default position to the energy at risk values established from the above proposition. For a greenfield situation such as this, where the forecast demand rapidly exceeds the available capacity in the network, the VCR benefits to be captured from formulating a project to address network shortfalls can quickly rise to extremely large sums. In order to derive meaningful results when comparing options against each other and consistent with industry practice elsewhere, the annual VCR benefits that can be captured in a project has been capped corresponding to an annual expected unserved energy value of 350MWh. This is reflected in Table 5 above.

Other market benefits have been addressed in the relevant sections of this document.

5.2 ENERGY AT RISK

The Energy at Risk (EAR) has been estimated from the annual peak demand forecasts and load duration curves. The energy at risk is considered to be the energy above firm capacity (or above “N-1” capacity). Two components of energy at risk are calculated:

- a) Energy at risk above “N-1” capacity but below “N” capacity
- b) Energy at risk above “N” capacity.

In the former case, the energy at risk is subject to the probability of an outage occurring. In the latter case, if new connections to the existing network continued to be made, the ‘energy at risk’ above N capacity simply refers to the energy that cannot be supplied at all due to insufficient capacity in the network. Hence in this situation, the expected unserved energy is the total energy at risk.

5.3 EXPECTED UNSERVED ENERGY

For the purpose of undertaking the RIT-D, the amount of expected unserved energy was estimated by taking 30% weighting of the unserved energy at 10% PoE maximum demand forecast and 70% weighting of the unserved energy at 50% PoE maximum demand forecast. This is to account for uncertainty in the demand forecast and is consistent with practices adopted by AEMO and other distribution network businesses in Australia.

As stated above, all of the energy at risk above “N” capacity is taken to be “Expected Unserved Energy” where the probability of element loss is used to reduce the “Expected Unserved Energy”. However, where loads are between “N-1” capacity and “N” capacity, the energy at risk is subject to a probability of an outage occurring to determine the “Expected Unserved Energy”.

5.4 LOAD PROFILE CHARACTERISTICS

The supply area forms a part of the rapidly growing South West Sector. As the network will supply entirely new predominantly urban residential subdivisions together with a large town centre, existing load profiles for the area are unrepresentative of the load that will be presented to the network. For the probabilistic planning purposes, it is considered that normalised characteristics of a similar, greenfield development at a more advanced stage, would be an appropriate proxy to use in the absence of actual data. The load duration curves for Mungerie Park Zone substation in the North West Sector which supplies the Rouse Hill Town Centre and surrounding areas, has been used for the purpose of this RIT-D analysis.

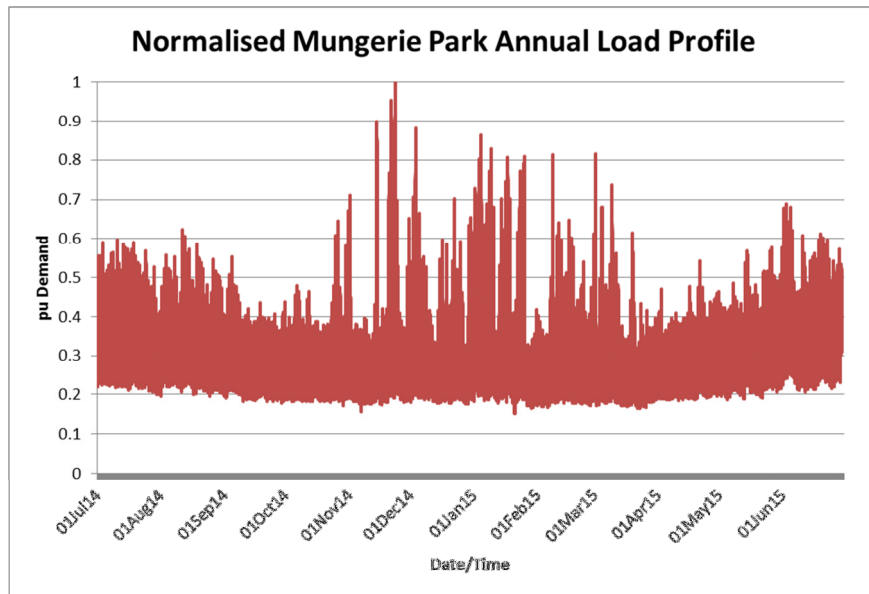


Figure 4 - Normalised Annual Load Profile

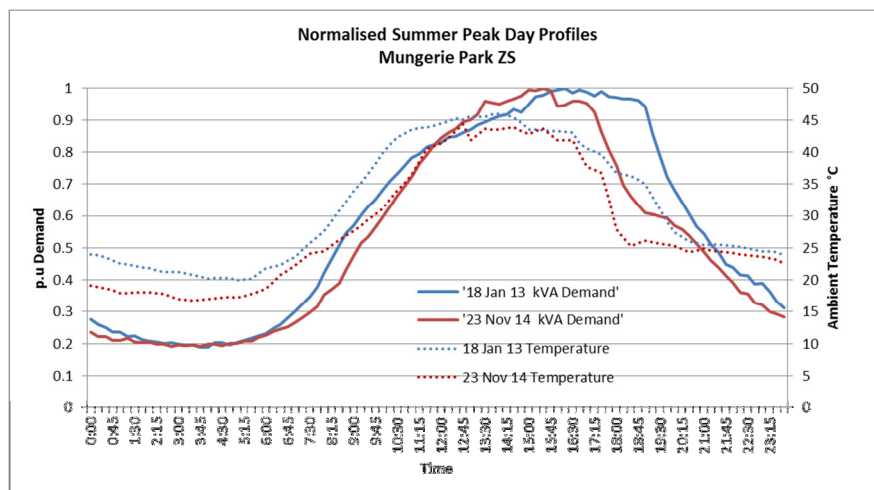


Figure 5- Summer Peak Day Profiles

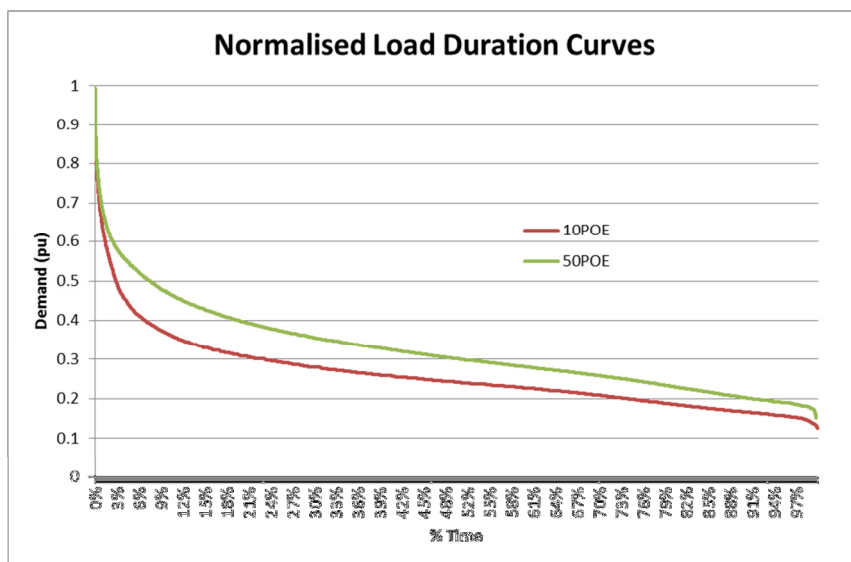


Figure 6 - Load Duration Curves

5.5 LOAD TRANSFER CAPACITY AND SUPPLY RESTORATION TIMES

The Leppington Town Centre and surround regions are expected to grow rapidly. The opportunities for load transfers to adjoining areas are extremely limited due to the sparse existing network and the pace of growth in the area.

If connections to the existing network continued without further investment, the opportunities for load transfer would be further reduced, resulting in long supply restoration times. This will result in significant organisational, economic and local government risks that are not otherwise captured in the RIT-D analysis.

5.6 PLANT FAILURE RATES

As this project involves, as the base case, the extension of additional distribution capacity to facilitate new customer connections from the closest point of supply (being South Leppington Zone Substation), the most significant risk in the base case is the failure of the single transformer or single 132kV feeder at South Leppington Zone Substation. There is extremely limited backup capacity in the region to service the current loads, and any further connections will be subject to the risk of extended outages in the event of failure of the South Leppington transformer/feeder. Hence it has been considered appropriate to use the transformer failure scenario as the most significant risk against which to evaluate this project.

Table 6 - Transformer Failure Rates

Major Plant Item: Transformer		Interpretation
Transformer failure rate per 100 transformers per year (major fault)	1 failure per 100 transformers per annum	A major failure is expected to occur once per 100-transformer years
Duration of outage (major fault)	2.6 months	A total of 2.6 months is required to repair/replace the transformer, during which time the transformer is not available for service.

5.7 DISCOUNT RATES

The choice of discount rate will impact on the estimated present value of net market benefits, and may affect the ranking of alternative options.

The RIT-D recommends the use of the regulated weighted average cost of capital (WACC) as the lower bound in RIT-D analysis. A real, pre-tax discount rate of 6.76% (WACC + 2%) has been adopted in this assessment. The lower bound has been selected as the current real WACC of 4.76%. An upper bound for sensitivity analysis has been selected as 8.76 (or WACC plus 4%).

5.8 PLANT RATINGS

Endeavour Energy standard distribution feeder ratings have been employed for the purposes of this evaluation.

5.9 VALUE OF CUSTOMER RELIABILITY

A volume weighted value of customer reliability (VCR) value has been used for the evaluation. This is based on AEMO published VCR values for residential, commercial, industrial, agricultural sectors.

6.0 CREDIBLE OPTIONS CONSIDERED

Four credible options were considered.

Option 1 comprises the establishment of North Leppington Zone Substation with a standard simplified control building with construction in two stages. The first stage will consist of 1x45MVA transformer which will be augmented to 2 transformers as part of the second stage.

Option 2 comprises the establishment of North Leppington Zone Substation with a modular control building with construction in two stages. The first stage will consist of 1x45MVA transformer which will be augmented to 2 transformers as part of the second stage.

Option 3 comprises the establishment of North Leppington Zone Substation with a standard simplified control building with 2x45MVA transformers from the outset.

Option 4 comprises the establishment of North Leppington Zone Substation with a modular control building with 2x45MVA transformers from the outset.

Options that were not considered further included the additional extension of 11kV feeders from nearby substations due to the adjacent areas undergoing significant growth on their own and due to voltage and distance issues corresponding to the size of development.

7.0 MARKET MODELLING

The RIT-D states that the preferred option is the credible option that maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the NEM.

The market benefit of a credible option is calculated by comparing the state of the world with the credible option in place with the state of the world in the base case.

In order to calculate the outcomes in the relevant 'state of the world', Endeavour Energy has developed a model which incorporates the key variables that drive market benefits, with particular emphasis on evaluating risks of involuntary load shedding.

The market benefits that can be considered under the National Electricity Rules are:

- Changes in voluntary load curtailment (considered a negative benefit)
- Changes in involuntary load shedding and customer interruptions caused by network outages
- Changes in costs to other parties (timing of new plant, capital costs, operating and maintenance costs)
- Differences in timing of expenditure
- Changes in load transfer capacity and the capacity of embedded generators to take up load
- Option value
- Changes in electrical energy losses
- Any other class of market benefit determined to be relevant by the AER

7.1 CLASSES OF MARKET BENEFIT CONSIDERED

The classes of market benefits that are considered material and have been quantified in this RIT-D assessment are:

- Changes in involuntary load shedding and customer interruptions caused by network outages
- Differences in timing of expenditure

7.1.1 CHANGES IN INVOLUNTARY LOAD SHEDDING

Increasing the supply capability in Leppington North supply area increases the supply available to meet the growth in demand within these areas. This will provide a greater reliability for this region by reducing potential supply interruptions and consequent risk of involuntary load shedding. The present rules only allow for consideration of changes in involuntary load shedding for connected customers. The establishment of supply in a greenfield housing development where potential customers would otherwise have to go without supply is therefore captured using changes in involuntary load shedding.

7.1.2 DIFFERENCES IN TIMING OF EXPENDITURE

A fundamental difference between the two groups of options considered is whether to build the zone substation in full configuration up front or to carry out the first stage works first and wait for the capacity provided by these works to be exhausted before a second stage is planned to be brought on line.

The NPV calculation intrinsically takes into account the savings from deferring the second stage of the zone substation.

7.2 CLASSES OF MARKET BENEFIT NOT CONSIDERED TO BE MATERIAL

The classes of market benefits that are not considered material are listed below:

- Changes in voluntary load curtailment
- Changes in load transfer capacity and the capacity of embedded generators to take up load
- Changes in costs to other parties
- Option value
- Changes in electrical energy losses

7.2.1 CHANGES IN VOLUNTARY LOAD CURTAILMENT

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

In the absence of any credible demand side options, Endeavour Energy has not estimated any market benefits associated with changes in voluntary load curtailment as there is insufficient capacity in the existing customer base to deliver sufficient voluntary demand reduction.

7.2.2 CHANGES IN LOAD TRANSFER CAPABILITY

The opportunities for further load transfers in relation to the existing supply into the area are limited as the adjacent network supplies other growth areas from other zone substations. There is a need to extend the existing network in order to provide for additional connections from new customers from new residential, commercial and industrial development in the area. Due to the small rural nature of the existing load in the area, and nearby areas growing at significant rates simultaneously, load transfers cannot be considered in a meaningful way.

7.2.3 CHANGES IN COSTS TO OTHER PARTIES

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

7.2.4 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.

Endeavour Energy also notes the AER's view that appropriate identification of the credible option and reasonable scenarios captures any option value as a class of market benefit under the RIT-D.

Endeavour Energy considers that the estimation of any option value benefits captured via the scenario analysis and comparison of the credible option under those scenarios is adequate to meet NER requirements to consider option value as a class of market benefit. Furthermore, based on the high certainty of development and lot release driven by government policy and the inadequate network supply, the need for additional capacity in the area is unlikely to change. Endeavour Energy therefore does not propose to estimate any additional option value market benefit.

7.2.5 CHANGES IN ELECTRICAL LOSSES

Endeavour Energy recognises that there would be small changes in the loss profile for customers serviced out via the two groups of options considered – particularly where there is a difference in the timing of the second transformer. As the majority of the customers to be connected will be general customers (rather than site specific customers), the impact of the small change from one to two transformers is unlikely to have a significant impact on the network wide distribution loss factors which would be applicable to these and other customers. Hence changes in electrical losses have not been modelled.

7.3 OPTION COSTS

The capital and operating cost assumptions for each credible option, based on standard planning estimates, are summarised in Table 7.

Table 7 - Option Costs

Option	Capital Cost	O&M Cost
Baseline Risk	\$0	\$0 incremental
Option 1 – Zone Substation with standard simplified control building built in 2 stages	\$24.5M	2.5% of capital cost per annum
Option 2 - Zone Substation with modular control building built in 2 stages	\$25.0M	2.5% of capital cost per annum
Option 3 - Zone Substation with standard simplified control building built in a single up-front stage	\$24.0M	2.5% of capital cost per annum
Option 4 - Zone Substation with modular control building built in a single up-front stage	\$24.8M	2.5% of capital cost per annum

7.4 SCENARIOS AND SENSITIVITIES

The capital and operating cost assumptions for each credible option are summarised in Table 8.

Table 8 - Capital and Operating Cost Assumptions

Variables	Values
Maximum demand forecasts	Base (expected) growth scenario presented in section 4.2
Capital costs	Base estimates provided in Table 11
O&M costs	2.5% of the capital costs
Value of customer reliability	Base estimates provided in section 7.4.3
Discount Rate	6.76%

7.4.1 DEMAND FORECASTS

The maximum demand forecasts have been derived from a projection of the take up of residential lots released by developers. Notionally, this is on a 50% probability of exceedance basis. For sensitivity analysis, this base forecast has been varied by $\pm 10\%$.

7.4.2 CAPITAL COSTS

Capital cost estimates have been based on standard planning cost estimates of the detailed scope of work including a high level scope of work for the zone substation construction. For sensitivity analysis, these estimates have been varied by $\pm 10\%$.

7.4.3 VALUE OF CUSTOMER RELIABILITY

This analysis adopts the value of customer reliability values published by AEMO to calculate the expected unserved energy. The ratio of load types has been estimated and used to calculate the weighted aggregate VCR value and then applied to the energy at risk. As the values published by AEMO vary quite significantly from data previously published, it was not considered appropriate to use a percentage variation in VCR values for the purpose of sensitivity testing. Based on the estimated load composition of the subject area, a volume weighted VCR value of \$21.921 per kWh has been derived and used in the RIT-D analysis. A variation of $\pm \$10$ has been used for sensitivity testing.

7.4.4 DISCOUNT RATES

The RIT-D guidelines suggest the use of a commercial discount rate appropriate for the analysis of a private enterprise investment in the electricity sector. For historical internal governance purposes, Endeavour Energy has employed the regulated WACC in all its project evaluations. For these historical reasons it has been deemed appropriate to use a base case discount rate referenced to the prevailing regulated WACC. A base case discount rate of 6.76% has been used (WACC+2%). For sensitivity analysis, a lower bound discount rate of the WACC (4.76%) and a higher bound of 8.76% have been used.

7.4.5 SUMMARY OF SENSITIVITIES

The table below describes the variations in input parameters used for the purpose of defining various scenarios.

Table 9 - Variables for Sensitivity Testing

Variable for Sensitivity Testing	Lower Bound	Base Case	Upper Bound
Maximum Demand	Low (Base estimates minus 10%)	Base estimates	High (Base estimates plus 10%)
Capital expenditure	Low (Base estimates minus 10%)	Base estimates	High (Base estimates plus 10%)
Value of Customer Reliability	Low (Base estimates minus \$10)	Base estimates	High (Base estimates plus \$10)
Discount Rate	4.76%	6.76%	8.76%

8.0 RESULTS OF ANALYSIS

This section describes the results of the RIT-D modelling for each of the options considered in this RIT-D assessment.

8.1 GROSS MARKET BENEFITS

The table below summarises the gross market benefits for each option in present value terms. As both options are similar, with the only difference being the timing of commissioning of the zone substation, the market benefits that are captured by each option is similar.

Table 10 - Gross Market Benefits

Options	Base Case (PV)
Option 1 – Zone Substation with standard simplified control building built in 2 stages	\$74.2M
Option 2 - Zone Substation with modular control building built in 2 stages	\$74.2M
Option 3 - Zone Substation with standard simplified control building built in a single up-front stage	\$74.2M
Option 4 - Zone Substation with modular control building built in a single up-front stage	\$74.2M

8.2 NET MARKET BENEFITS

The table below summarises the net market benefit in NPV terms for each credible option. The net market benefit is the gross market benefit minus the present value of total costs for each option. The difference in NPV demonstrates the value of deferring the zone substation construction.

Table 11 - Net Market Benefits

Options	Total Costs	Gross Market Benefits	Net Market Benefits	Ranking under RIT-D
Do Nothing	0	0	0	5
Option 1 – Zone Substation with standard simplified control building built in 2 stages	\$27.5M	\$74.2M	\$46.7M	2
Option 2 - Zone Substation with modular control building built in 2 stages	\$28.0M	\$74.2M	\$46.2M	3
Option 3 - Zone Substation with standard simplified control building built in a single up-front stage	\$27.2M	\$74.2M	\$47.0M	1
Option 4 - Zone Substation with modular control building built in a single up-front stage	\$28.2M	\$74.2M	\$46.1M	4

The RIT-D assessment demonstrates that Option 3 has the highest net market benefit under the base case reasonable scenario.

8.3 SENSITIVITY AND SCENARIO ASSESSMENT

Endeavour Energy has carried out sensitivity analysis on the RIT-D assessment based on variations of key parameters. Specifically, Endeavour Energy has investigated changes in relation to:

- Maximum demand
- Value of Customer reliability
- Investment cost
- Discount Rate

The table below describes the results of the sensitivity analysis

Table 12 - Sensitivity and Scenario Assessment

Scenario	NPV (\$M)			
	Option 1	Option 2	Option 3	Option 3
Base case	46.7	46.2	47.0	46.1
Forecast Low	43.7	42.5	44.0	43.1
Forecast High	49.3	48.3	49.6	48.7
Cost of Investment Low	49.4	49.0	49.7	48.9
Cost of Investment High	48.2	47.5	49.2	48.3
VCR Low	18.6	18.1	18.9	18.0
VCR High	74.8	74.3	75.1	74.2
Discount Rate Low	57.0	56.5	57.4	56.4

Table 13 describes the scenarios used to test the robustness of this RIT-D assessment.

Table 13 - Scenarios Used

Scenario	Demand Forecast	VCR	Investment Cost	Discount Rate
Base Case	Base	Base	Base	Base
Scenario 1	High	Base	Base	Base
Scenario 2	Low	Base	Base	Base
Scenario 3	Base	Base	High	Base
Scenario 4	Base	Base	Low	Base
Scenario 5	Base	High	Base	Base
Scenario 6	Base	Low	Base	Base
Scenario 7	Base	Base	Base	High
Scenario 8	Base	Base	Base	Low
Scenario 9	High	High	Base	Base
Scenario 10	Low	Low	Base	Base

Table 13 below set out the net market benefits (NPV) for each option across all reasonable scenarios considered. The shaded cells indicate the option that maximises the net market benefit under each scenario.

Table 14 - Net Market Benefits (NPV) for all scenarios

Scenario	Do Nothing		Option 1		Option 2		Option 3		Option 4	
	Net Market Benefit	Ranking	Net Market Benefit	Ranking	Net Market Benefit	Ranking	Net Market Benefit	Ranking	Net Market Benefit	Ranking
Base case	\$0	5	46.7	2	46.2	3	47.0	1	46.1	4
Scenario 1	\$0	5	49.3	2	48.3	3	49.6	1	48.7	4
Scenario 2	\$0	5	43.7	2	42.5	3	44.0	1	43.1	4
Scenario 3	\$0	5	48.2	2	47.5	3	49.1	1	48.3	4
Scenario 4	\$0	5	49.5	2	49.0	3	49.7	1	48.9	4
Scenario 5	\$0	5	74.8	2	74.3	3	75.1	1	74.2	4
Scenario 6	\$0	5	18.6	2	18.1	3	18.9	1	18.0	4
Scenario 7	\$0	5	33.9	2	33.5	3	34.1	1	33.2	4
Scenario 8	\$0	5	57.0	2	56.5	3	57.4	1	56.4	4
Scenario 9	\$0	5	78.4	2	77.9	3	78.7	1	77.8	4
Scenario 10	\$0	5	16.7	2	15.8	4	17.0	1	16.1	3

The results show that Option 3 maximises the net market benefit in the base case as well as all scenarios considered for sensitivity analysis.

8.4 TIMING

Given that the pace of development of the Leppington North and surrounding precincts, it is imperative that capacity be made available as soon as the existing available capacity in the network is exhausted.

On the basis of current forecasts, this is expected to occur in 2019. There is little scope for deferring the solution under the scenarios considered. Commissioning dates are likely to be driven by supply requirements of the new town centre and surrounding developments.

9.0 PREFERRED OPTION

The option that presents the greatest net market benefit is Option 3. The difference in net market benefits across all options considered is marginal. Option 3 involves the establishment of a full 2 transformer zone substation with a standard control building at North Leppington, at a cost of \$24.0M (excluding contingencies).

The technical characteristics of project PR427 for Option 3 are as follows:

- Establish a 2 x 45MVA transformer zone substation with a standard control building;
- The primary and alternate 132kV supplies to the zone substation shall be established by cutting into existing feeder 93X which runs past the substation site.
- Distribution works
- Communication links