RIT-D FINAL PROJECT ASSESSMENT REPORT

PR184 Box Hill and Box Hill North Greenfield Supply Areas

Endeavour Energy

March 2016

Endeavour Energy

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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(p) of the National Electricity Rules (NER).

The purpose of this report is to demonstrate the basis for the selected option to address the network limitations within the subject area 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.
- Makes a recommendation that the selected option be adopted.

The Precincts of Box Hill and Box Hill Industrial are part of the programmed release areas of the North West Growth Centre. Rezoning for the precinct of Box Hill North has been accelerated under the Precinct Acceleration Protocol.

Endeavour Energy's strategic plans initially only catered for the already rezoned Box Hill and Box Hill Industrial precincts. However, with the accelerated rezoning of Box Hill North and the active development schedule for the area, Endeavour Energy has had to bring forward its investment plans for this area.

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.

Two options have been considered for evaluation in this report. Option 1 involves the extension of 22kV feeders from Mungerie Park Zone Substation into the Box Hill Area. This option involves the conversion of the existing sparse 11kV network in the area to a distribution voltage of 22kV. This option defers the construction of a zone substation by a number of years. Option 2 involves the immediate construction of a zone substation together with the conversion of the sparse 11kV network in the area to 22kV.

Option 1 is the preferred option and expected to cost $8 Million without the construction of a zone sub.

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 1 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 Box Hill and Box Hill 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. On the basis that the selected option will not exceed $10Million, Endeavour Energy has determined that a Draft Project Assessment was not required in accordance with clause 5.17.4(n) of the NER.

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.
- Provides the results of NPV analysis of each credible option and accompanying explanatory statements regarding the results
- Confirms the preferred option, including detailed characteristics, estimated commissioning date, indicative costs and noting that it satisfies the RIT-D
- Provides contact details for queries relating to this RIT-D project.

Initially, the project proposal in Endeavour Energy's growth servicing plans only catered for the Box Hill precinct which has been rezoned as a result of much detailed work by the Department of Planning and Environment as part of its work on the North West Growth Centre. The Box Hill North Precinct is currently not officially part of the North West Growth Centre. Rezoning for the precinct of Box Hill North has been accelerated under the Precinct Acceleration Protocol as a Gateway Determination and has resulted in Endeavour Energy modifying its servicing strategy and bringing forward the Box Hill 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.

3.0 CONSULTATION

3.1 SUBMISSIONS RECEIVED

Endeavour Energy has published a Screening for Non Network Options report recommending that non-network options were not feasible. No submissions were received from registered participants and interested parties in relation to this document.

3.2 ENQURIES

All 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 area which comprises of the proposed Box Hill North and Box Hill developments is currently supplied from Riverstone ZS by three 11kV overhead feeders built to a rural standard. The two 11kV feeders that supply the majority of the load are A051 Nelson St and A055 Dingle St. Feeder A053 McCullogh St also supplies some load. The shaded regions in figure 1 indicated the extent of the Box Hill, Box Hill Industrial and Box Hill North precincts.

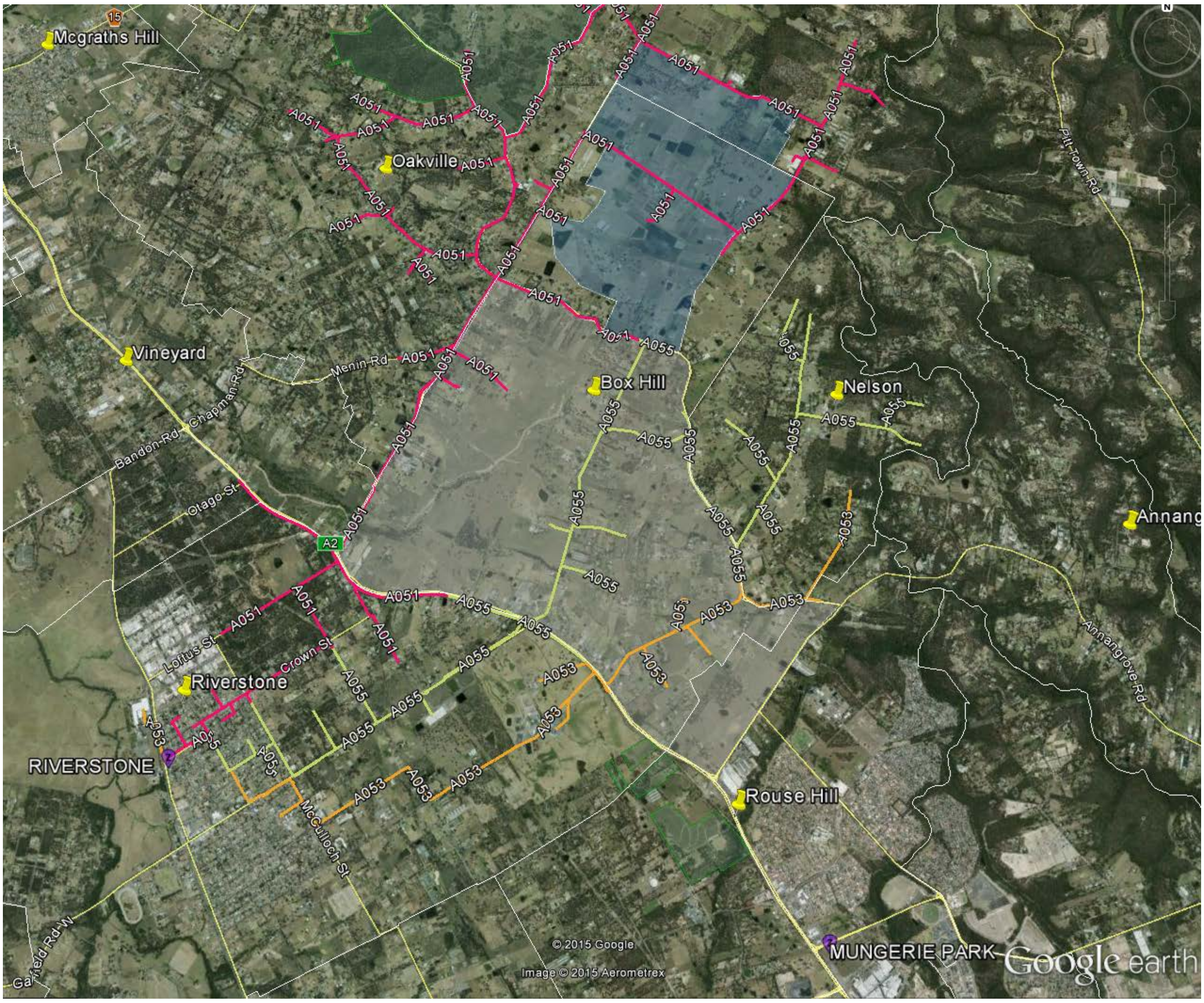

Figure 1 - Overview of Network

Table 1 - Existing Distribution Feeder Capability

Feeder	Customers	Feeder Length	Present maximum load	Spare Capacity	Exceeds Rural voltage regulation Standard
A051	1003	41.5km	4.3 MVA	0.2 MVA	YES
A053	237	12.2km	3.5 MVA	1.0 MVA	NO
A055	738	21.5km	3.1 MVA	1.4 MVA	YES

Analysis indicates that although there is approximately 2.6MVA of capacity in the 11kV distribution network that would be used to supply new developments in the area, existing voltage regulation issues make this proposition unworkable. Similarly, extending further feeders from Riverstone ZS where some zone substation capacity exists would attract the same voltage regulation issues due to the distances involved.

4.2 DESCRIPTION OF NETWORK NEED

Residential subdivision is commencing in the Box Hill North and Box Hill precincts with strong demand for early stages of land release. The context map in figure 2 illustrates the rezoned development areas of Box Hill and the relative distance from existing serviced areas. There is a requirement to provide additional supply capacity in the Box Hill area, starting with additional distribution capacity.

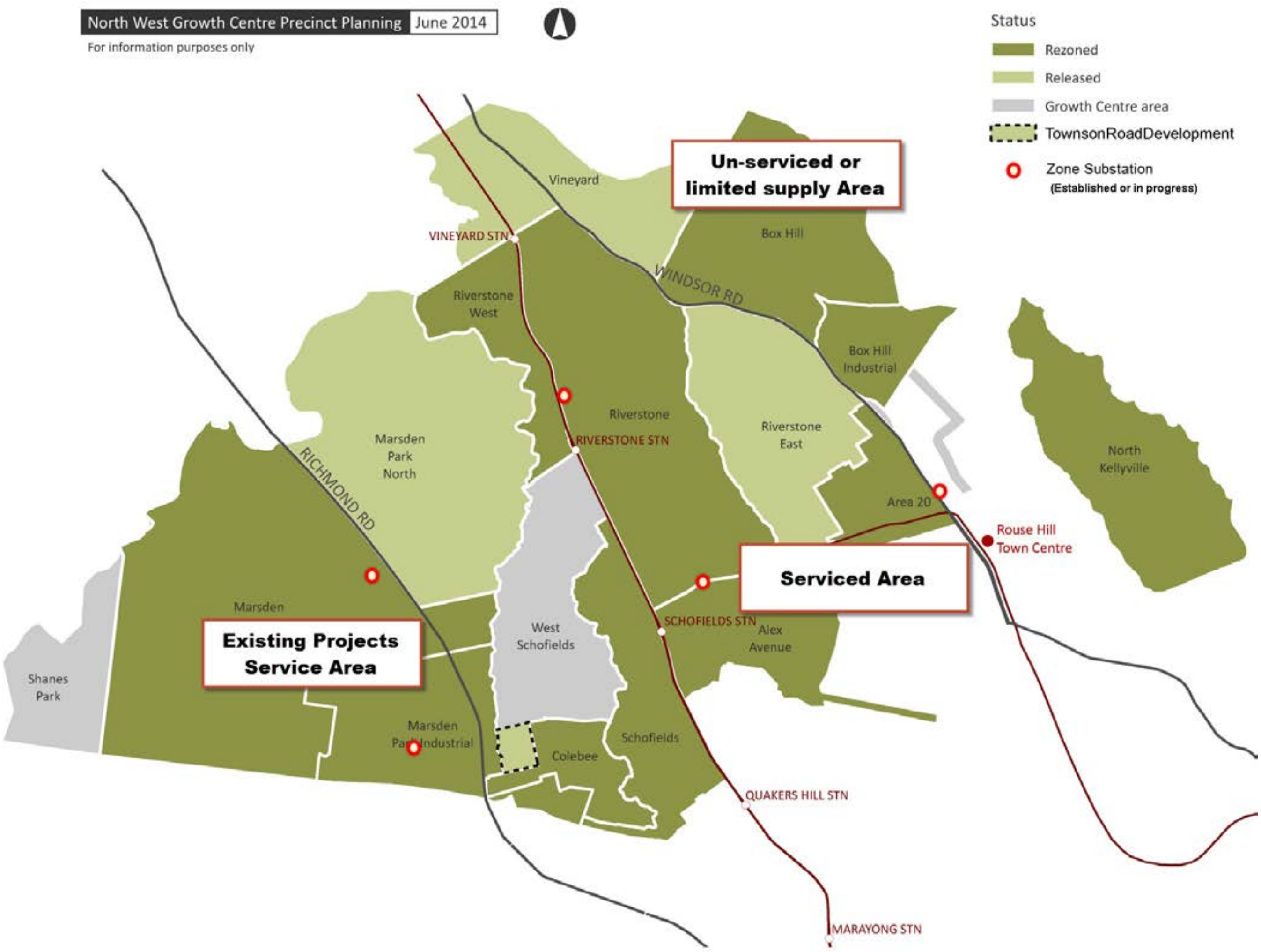

Figure 2 - Context Map

The indicative forecast load, based on lot release forecasts, is shown in figure 3 below. In addition to the zone substation capacity, the main requirements that are driving the augmentation of the network are:

- 11kV feeder voltage regulation limits
- 11kV feeder design capacity

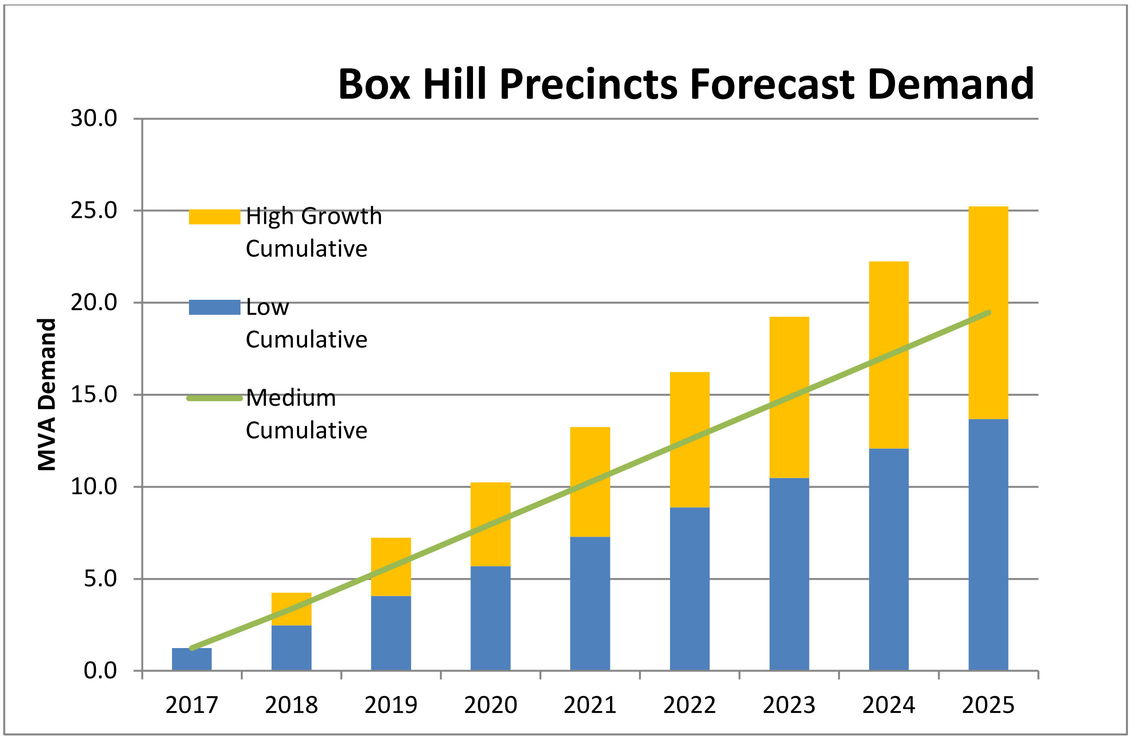

Figure 3 - Box Hill Forecast Demand

4.2.1 ZONE SUBSTATION CAPACITY

As the area is presently reticulated at 11kV, the closest zone substation able to supply at this voltage is Riverstone Zone Substation. The distance between the supply area and the existing zone substation makes maintaining adequate voltages a greater issue of concern than the availability of zone substation capacity. Capacity at Riverstone ZS is forecast to be constrained beyond 2021 even without Box Hill load. Mungerie Park Zone substation is situated a similar distance away but has 22kV as a reticulation voltage. The substation also has capacity available over the forecast period.

Table 2 - Riverstone ZS Summer Forecast excluding Box Hill Load

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
50POE	15.0	15.1	15.7	16.9	18.8	21.2	23.8	26.3	28.8	31.3
10POE	16.4	16.4	17.1	18.3	20.2	22.6	25.1	27.6	30.1	32.7
Firm Capacity	25	25	25	25	25	25	25	25	25	25

Table 3 – Mungerie Park ZS Summer Forecast excluding Box Hill Load

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
50POE	45.3	47.9	50.6	53.4	55.0	56.6	58.9	61.3	63.7	66.1
10POE	50.8	53.3	56.1	58.8	60.5	62.1	64.4	66.7	69.1	71.5
Firm Capacity	90	90	90	90	90	90	90	90	90	90

4.2.2 LOAD TRANSFER CAPACITY

Due to the scarce 11kV distribution network in the area and the adjacent network being 22kV, existing opportunities to transfer load are extremely limited.

4.2.3 DISTRIBUTION FEEDER UTILISATION

Utilisation of distribution feeders within the supply the Box Hill/Box Hill North supply areas are presented in figure 5. All of the feeders either exceed or are close to Endeavour Energy's target 80% utilisation threshold for distribution feeders. This is reflected in the spare capacity shown in Table 1.

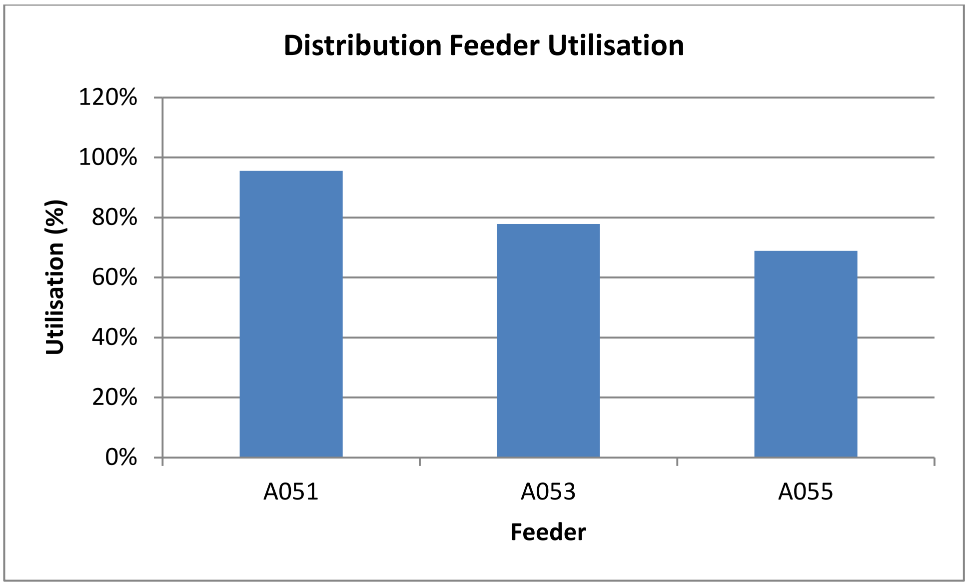

Figure 4 - Distribution Feeder utilisation

4.2.4 DISTRIBUTION FEEDER RELIABILITY PERFORMANCE

There are presently no significant reliability issues with the three feeders concerned.

4.2.5 DISTRIBUTION FEEDER VOLTAGE PERFORMANCE

The graph below indicates that potentially 65 customers supplied via the three feeders have voltage management issues. As the feeders are not contained exclusively within the supply area, not all of these 65 locations are necessarily located within the subject development area. Notably, the rezoning of the precincts necessitates the application of an urban voltage regulation standard rather than a rural standard. This means that in order to comply with Endeavour Energy Standards, the permissible voltage drop is lower than if rural customers continued to be connected to the same network. The number of customers exceeding the standard would be much higher than is implied in figure 5.

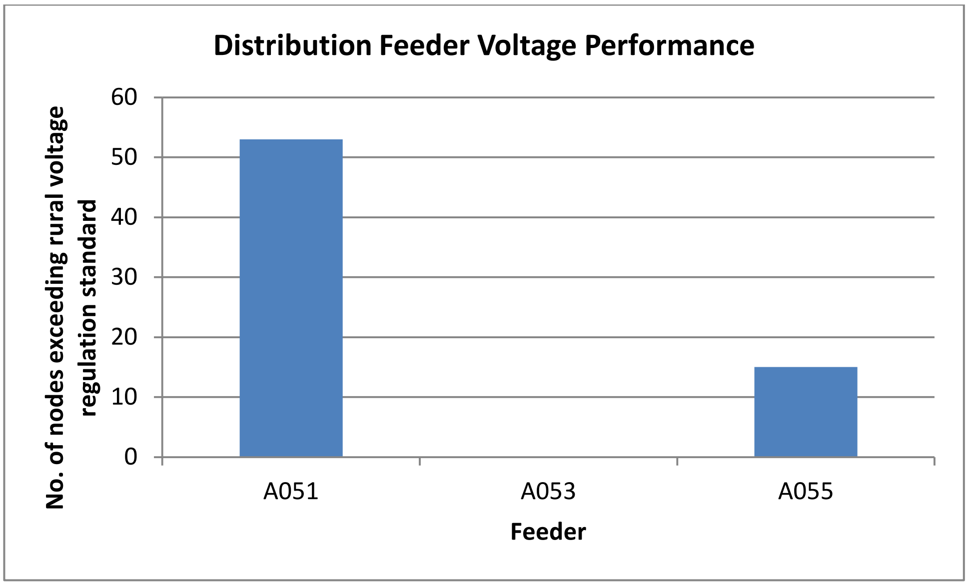

Figure 5 - Distribution Feeder Voltage Performance (Rural standard)

4.3 QUANTIFICATION OF NETWORK NEED

The substantial residential developments proposed for Box Hill and Box Hill North cannot proceed 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 3.2 is presented in Table 4 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 Box Hill 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. Effectively this caps the economic loss from non-supply of electricity to $7.7M for each year supply is not made available.

Table 4 - Load at Risk and Value of Expected Unserved Energy

Year	Load At Risk (MVA)	Expected Unserved Energy (MWh)	Customer Value of Expected Unserved Energy ($,000)
2017	-	-	-
2018	-	-	-
2019	1.2	29	$636
2020	2.6	303	$6,645
2021	4.1	500	$7,672
2022	5.5	500	$7,672
2023	7.0	500	$7,672
2024	8.4	500	$7,672
2025	9.8	500	$7,672
2026	15.1	500	$7,672

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 14,000 dwellings. A do nothing scenario means that supply for 14,000 new dwellings is required from feeders that currently supplies approximately less than 2000 dwellings. 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 4 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, that 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 approaches taken by AEMO and other distribution network businesses.

As stated above, all of the energy at risk above "N" capacity is taken to be "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 North West Sector. As the network will supply entirely new predominantly urban residential subdivisions, 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 has been used for the purpose of this RIT-D analysis.

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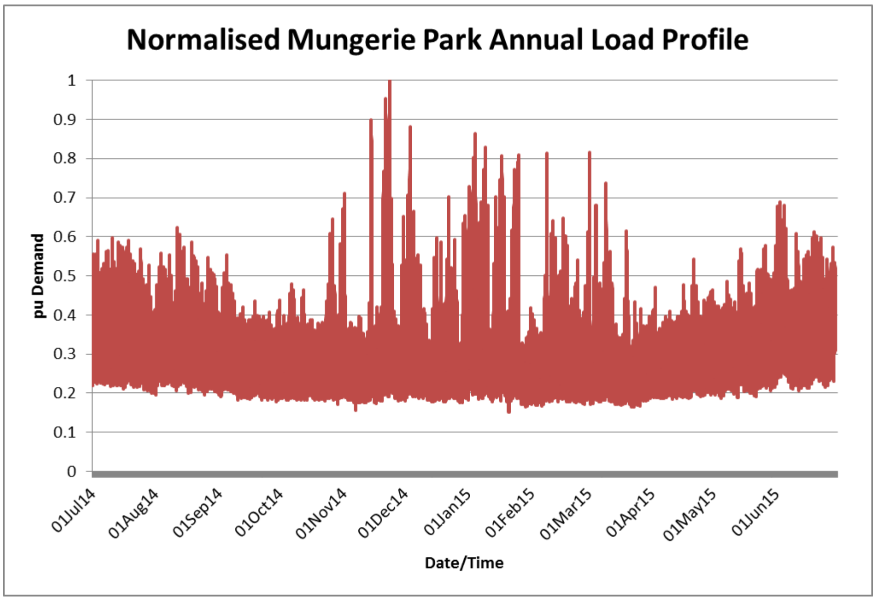

Figure 6 - Normalised Annual Load Profile

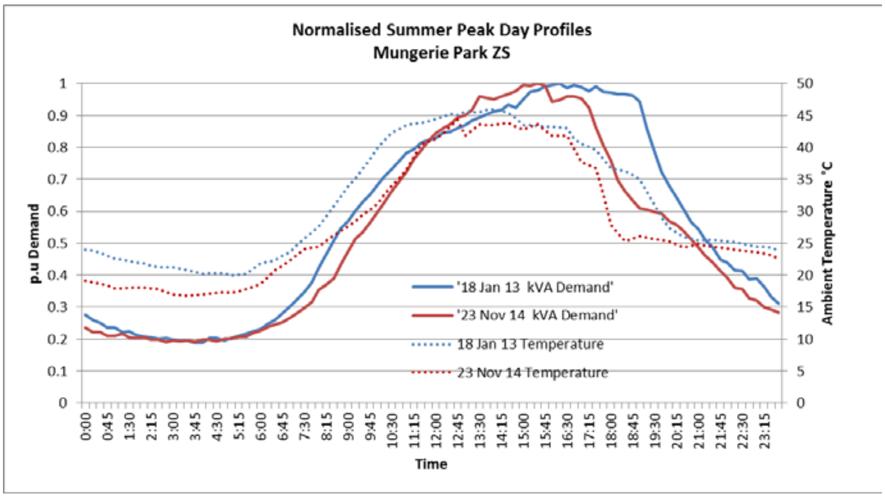

Figure 7- Summer Peak Day Profiles

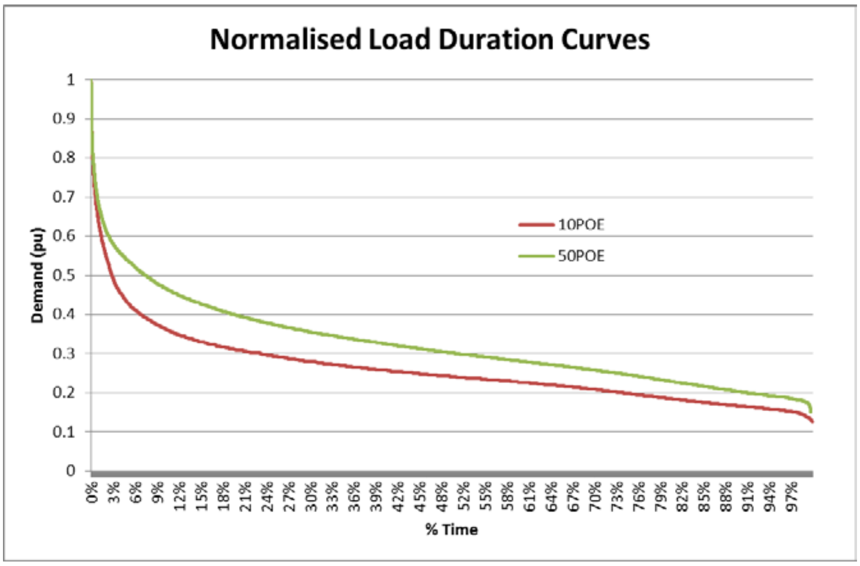

Figure 8 - Load Duration Curves

5.5 LOAD TRANSFER CAPACITY AND SUPPLY RESTORATION TIMES

The Box Hill and Box Hill North precincts currently have a rural reticulation standard at 11kV. The closest adjacent zone substation is Mungerie Park which is 22kV Load transfer capability between the two networks is currently extremely limited.

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.

5.6 PLANT FAILURE RATES

As this project involves the establishment of additional distribution capacity to facilitate new customer connections, the only relevant plant failure rates relate to the ability of the existing distribution network to service the load. It has been established that approximately 2.6MVA of spare capacity exists in this network, following which, if connections were to continue, customer outages would inevitably occur. The contribution of plant failures to the VCR value is therefore negligible when compared with customers who would have to sustain outages as a result of continued connections to the network without any augmentation work being carried out. However, for the purpose of modelling a probability of sustaining an outage on the existing distribution network has been estimated and is described in the following table.

Table 5 - Distribution Feeder Failure Rates

Major Plant Item: distribution feeder		Interpretation
Distribution feeder failure rate per km (major fault)	7 faults per 100km per annum	The average sustained failure rate of Endeavour Energy 's distribution feeders has been estimated to be 7.0 faults per 100km per year
Duration of outage (major fault)	4 hours	A total of 4 hours is required to re-switch the feeder and facilitate repair or replacement – during which time the feeder, or part thereof, 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 states that using 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

Two credible options were considered.

Option 1 comprises the development of 2 x 22kV feeders from Mungerie Park ZS into the area and the conversion of the existing sparse 11kV rural network in the Box Hill area into a 22kV distribution network, together with the future (deferred) construction of a 132/22kV zone substation in the Box Hill area.

Option 2 comprises of the immediate construction of a 132/22kV zone substation in the Box Hill area as soon as possible, together with 22kV conversion of the rural network in the Box Hill area.

Options that were not considered further included the extension of 11kV feeders from Riverstone Zone substation (not considered a credible option due to voltage and distance issues corresponding to the size of development). The 22kV solution also negates the need for a second 132kV/11kV substation to service the area as it grows due to the increased reach of the 22kV distribution voltage before voltage drop becomes an issue.

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 supply outages.

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 Box Hill and Box Hill 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 options considered is whether to build the zone substation up front or to carry out the 22kV conversion works first and wait for the capacity provided by these works to be exhausted before the a new substation is planned to be brought on line.

The NPV calculation intrinsically takes into account the savings from deferring the construction 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 is 22kV. 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, load transfers cannot be considered in a meaningful way.

7.2.3 CHANGES IN COSTS TO OTHER PARTIES

Endeavour Energy recognises that some options could impact on the Transmission Network Service provider, Embedded Generators or customers.

The construction of a new 132kV/22kV zone substation will require a Switchbay at Transgrid's Vineyard Bulk Supply Point. An allowance for this has been made in the cost estimate for the construction of the zone substation and associated transmission feeders.

In this instance, Endeavour Energy has not identified any other 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 options considered. Therefore, in terms of societal benefits from the proposed options, the difference in loss reduction between the two options is negligible.

There is no customer specific data currently available and the underlying assumption in carrying out this evaluation is that none of the customers would qualify for a site specific tariff. Hence the losses that would be attributed to these customers would be the same generic value attributed to all other network customers connected at the relevant voltage levels. 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 6.

Table 6 - Option Costs

Option	Capital Cost	O&M Cost
Baseline Risk	$0	$0 incremental
Option 1	$3.5 M for 2x22kV feeders + $4.5M for 22kV Upgrade + $28.0M (at a later date) for new zone substation and subtransmission feeders	2.5% of capital cost per annum
Option 2	$4.5 M for 22kV Upgrade + $28.0M immediately for new zone substation and subtransmission feeders	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 7.

Table 7 - 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 6
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 ± 10%.

7.4.2 CAPITAL COSTS

Capital cost estimates have been based on standard planning cost estimates of the detailed scope of work for 22kV conversion including a high level scope of work for the zone substation construction. For sensitivity analysis, these estimates have been varied by ± 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 ±$5 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 8 - 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 9 - Gross Market Benefits

Options	Base Case (PV)
Option 1 – 2x 22kV feeders + 22kV conversion + ZS at a later date	$50.5M
Option 2 – 22 kV conversion +ZS straight away	$50.5M

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. Note that for modelling purposes, the cost of constructing a zone substation has been included in both options because Option 2 involves the immediate construction of the zone substation. The cost of the zone substation does actually not form part of the project under the preferred option, and will be considered as part of a separate project when it is required.

Table 10 - Net Market Benefits

Options	Total Costs	Gross Market Benefits	Net Market Benefits	Ranking under RIT-D
Do Nothing	0	0	0	3
Option 1 – 2x 22kV feeders + 22kV conversion + ZS at a later date	$26.9M	$50.5M	$23.6M	1
Option 2 – 22 kV conversion +ZS straight away	$36.1M	$50.5	$14.4M	2

The RIT-D assessment demonstrates that Option 1 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 11 - Sensitivity and Scenario Assessment

Scenario	NPV ($M)	
	Option 1	Option 2
Base case	$23.6	$14.4
Forecast Low	$20.8	$11.6
Forecast High	$24.5	$15.8
Cost of Investment Low	$26.3	$18.0
Cost of Investment High	$20.9	$10.8
VCR Low	$12.1	$2.9
VCR High	$35.1	$25.9
Discount Rate Low	$28.0	$21.0
Discount Rate High	$19.9	$9.2

The following table describes the scenarios used to test the robustness of this RIT-D assessment.

Table 12 - 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 13 - Net Market Benefits (NPV) for all scenarios

Scenario	Do Nothing		Option 1		Option 2	
	Net Market Benefit	Ranking	Net Market Benefit	Ranking	Net Market Benefit	Ranking
Base case	$0	3	$23.6	1	$14.4	2
Scenario 1	$0	3	$25.0	1	$15.8	2
Scenario 2	$0	3	$20.8	1	$11.6	2
Scenario 3	$0	3	$20.9	1	$10.8	2
Scenario 4	$0	3	$26.3	1	$18.0	2
Scenario 5	$0	3	$35.1	1	$25.9	2
Scenario 6	$0	3	$12.1	1	$2.9	2
Scenario 7	$0	3	$19.9	1	$9.1	2
Scenario 8	$0	3	$28.0	1	$21.0	2
Scenario 9	$0	3	$36.8	1	$27.6	2
Scenario 10	$0	3	$9.9	1	$0.7	2

The results show that Option 1 maximises the net market benefit in the base case as well as all scenarios considered for sensitivity analysis. Option 2 also has positive net market benefits under the scenarios considered making Option 2 favourable in comparison to a do nothing option.

8.4 ECONOMIC TIMING

The economic timing of the proposed preferred option is taken to be the point when the cost of lost load (or VCR benefits that can be attributed to the project) exceeds the annualised cost of the preferred option. However, using this methodology, the cost of the whole project, including the construction of the zone substation gets annualised and hence indicates a later optimum timing than if only the cost of the first stage of the preferred option were used. Given that the accelerated rezoning of the Box Hill North precinct has imposed some limitations on the available lead times, 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. The resolution of the modelling is not intended to provide a finer resolution than one year. Modelling indicates that the solution will become economically viable at some point in 2020.

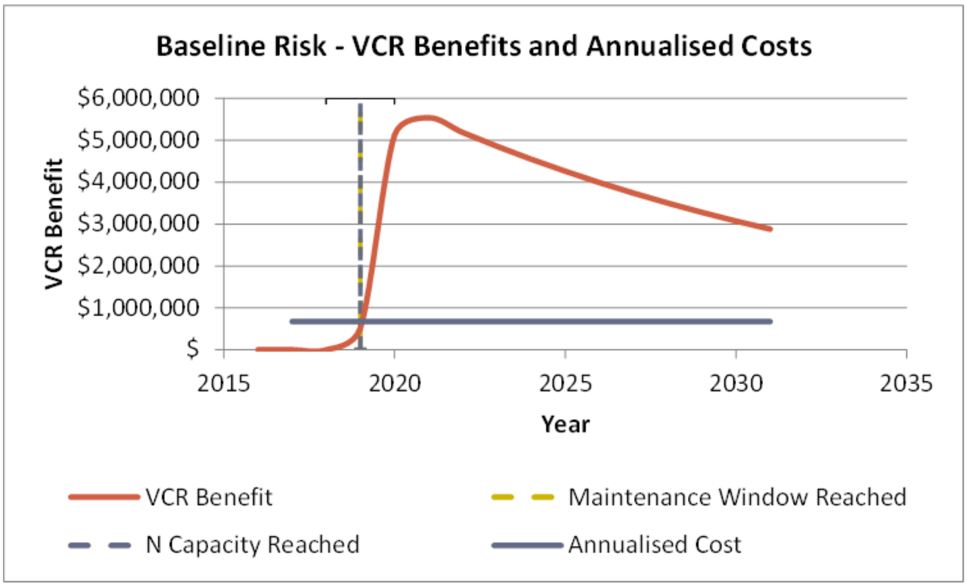

Figure 9- VCR Benefits (based on value of lost load) and Annualised costs

Table 14 - Scenario Timings

Scenario	Demand Forecast	VCR	Investment Cost	Discount Rate	Timing
Base Case	Base	Base	Base	Base	2020
Scenario 1	High	Base	Base	Base	2019
Scenario 2	Low	Base	Base	Base	2020
Scenario 3	Base	Base	High	Base	2020
Scenario 4	Base	Base	Low	Base	2019
Scenario 5	Base	High	Base	Base	2019
Scenario 6	Base	Low	Base	Base	2020
Scenario 7	Base	Base	Base	High	2019
Scenario 8	Base	Base	Base	Low	2020
Scenario 9	High	High	Base	Base	2019
Scenario 10	Low	Low	Base	Base	2020

The above results indicate that the preferred option becomes viable in 2020 and there is no scope for deferring the solution under the scenarios considered. Under certain scenarios, and for reasons discussed above, there is some merit in bringing the commissioning date forward by one year due to the inability of the existing network to otherwise supply the development.

9.0 PREFERRED OPTION

The option that presents the greatest net market benefit is Option 1. This option involves the extension of 2 x 22kV feeders from Mungerie Park Zone Substation together with the conversion of the existing 11kV network in the area to 22kV at a combined cost of $8 Million. This project PR184 comprises the first stage of the overall solution. The second stage of building a 132/22kV zone substation, while considered as part of Option 1, is required at to be constructed at a later date. The Stage 1 project allows for the deferment of the construction of the zone substation.

It is anticipated that the second stage of the solution (construction of zone substation) will be subject to a separate RIT-D evaluation at the appropriate time.

The technical characteristics of project PR184 comprising of Stage 1 works for Option 1 are as follows:

- Establishment of Two new 22kV cables in existing ducts from Mungerie Park ZS towards the southern boundary of the Box Bill precinct along Windsor Road (3km and 5km)
- Conversion of existing overhead lines in Box Hill for 22kV operation including:
  - Replacement of 11kV insulators – approximately 40% of insulators can remain in service as they are rated at 22kV
  - Rebuild sections of 11kV line that are deemed to be unable to support an augmented line or are in unfavourable locations
  - 11kV rated switches and fuses replaced as necessary
  - 11kV pole transformers will need to be replaced with 22kV transformers.