

RIT-D FINAL PROJECT ASSESSMENT REPORT

PR437 Catherine Park Greenfield Supply Area

Endeavour Energy

October 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(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(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 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 precinct of Catherine Park (Catherine Field (part)) forms part of the release areas of the South West Priority Growth Area. Rezoning for the precinct of Catherine Field (part) has been accelerated under the Precinct Acceleration Protocol. The precinct is planned to yield over 3,200 new dwellings. The remaining portion of Catherine Field (excluding Catherine Field North) which is yet to be rezoned is expected to yield a further 4,800 residential lots.

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.

Five options have been considered for evaluation in this report. Options 1 to 4 involve the establishment of a 132/11kV zone substation, with the options representing various differences in configuration. Option 5 involves the establishment of three 11kV feeders from Oran Park Zone Substation. This option defers the construction of a zone substation by a number of years.

Option 5 is the preferred option and expected to cost \$5.1 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 Catherine Field (part) Precinct, hereafter referred to as Catherine Park.

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 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.

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 ENQUIRIES

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 Catherine Park development is currently supplied from Narellan ZS by a single 11kV overhead feeder (Turner Road Feeder). In order to keep pace with development in the area, an existing nearby feeder from Oran Park ZS has also been recently extended into the area,

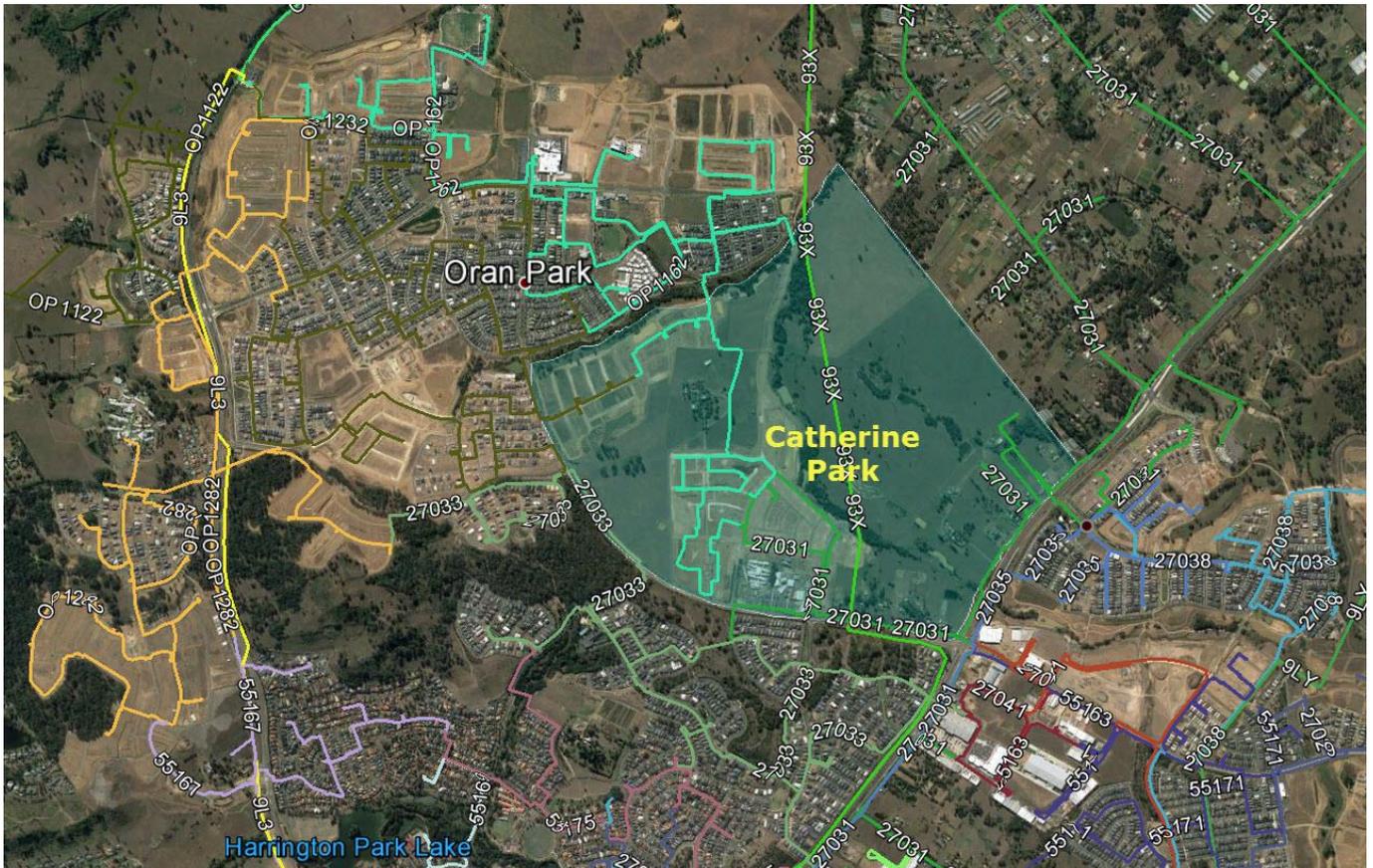


Figure 1 - Overview of Network

Table 1 - Existing Distribution Feeder Capability

| Feeder | No. of Customers | Feeder Length (includes spurs) | Present maximum load | Spare Capacity |
|--------|------------------|--------------------------------|----------------------|----------------|
| 27031 | 610 | 27 | 2.5 MVA | 2 MVA |
| OP1162 | 818 | 17.3 | 3.4 MVA | 1.1 MVA |

Although Table 1 indicates available capacity of 3.1MVA based on current feeder loads, Endeavour Energy is already in receipt of connection applications that have eroded this capacity. Hence additional capacity is required in the area to continue connection of newly created residential lots.

4.2 DESCRIPTION OF NETWORK NEED

Residential subdivision has already commenced in the Catherine Park precinct with strong demand for early stages of land release. The context map in figure 2 illustrates the rezoned development areas of Catherine Park and the relative distance from existing serviced areas. There is a requirement to provide additional supply capacity in the Catherine Park area, starting with additional distribution capacity.



Broader Western Sydney Employment Area

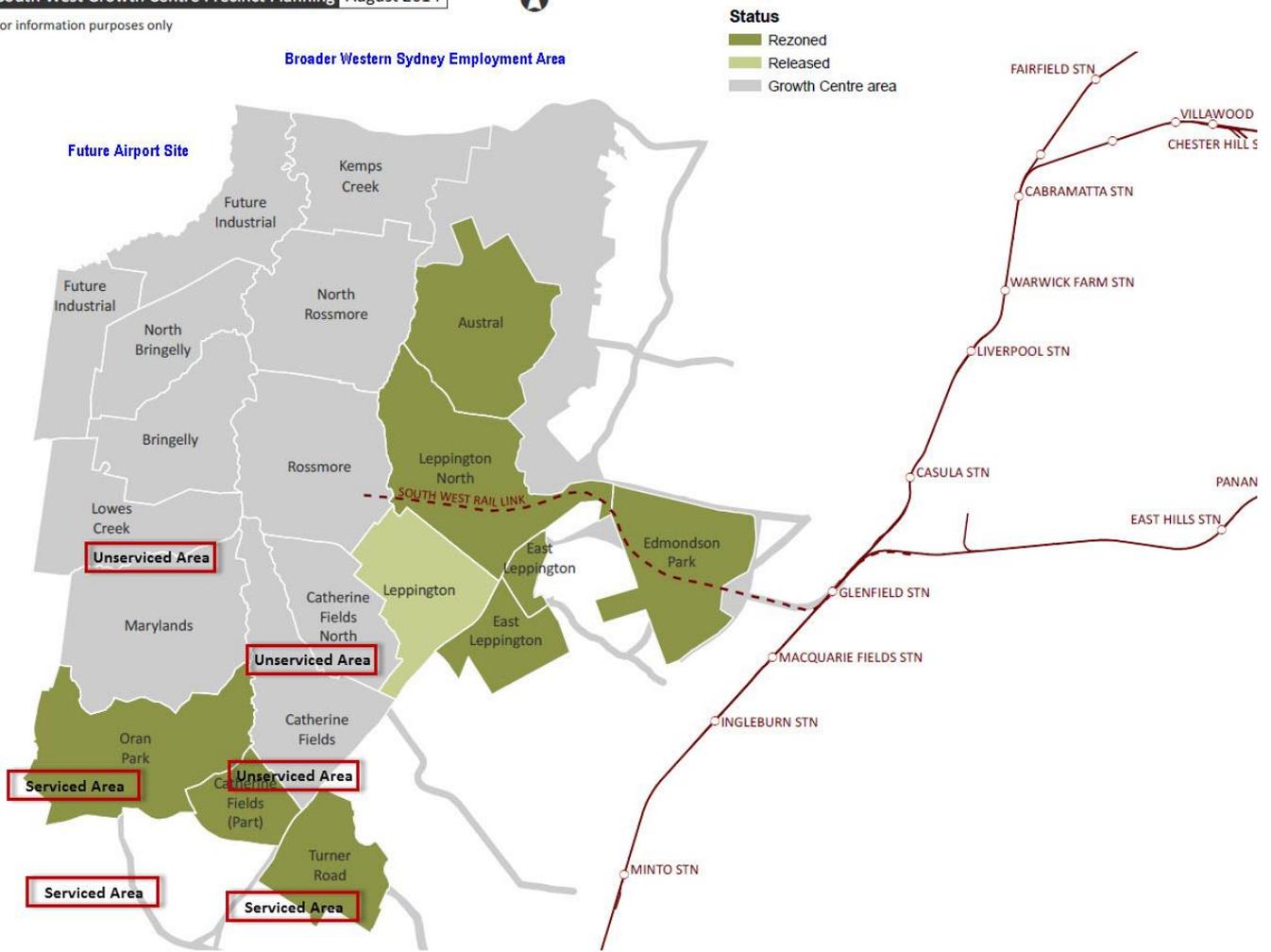


Figure 2 - Context Map

The indicative forecast load, based on lot release forecasts, is shown in figure 3 below.

Catherine Park Load Forecast (MVA)

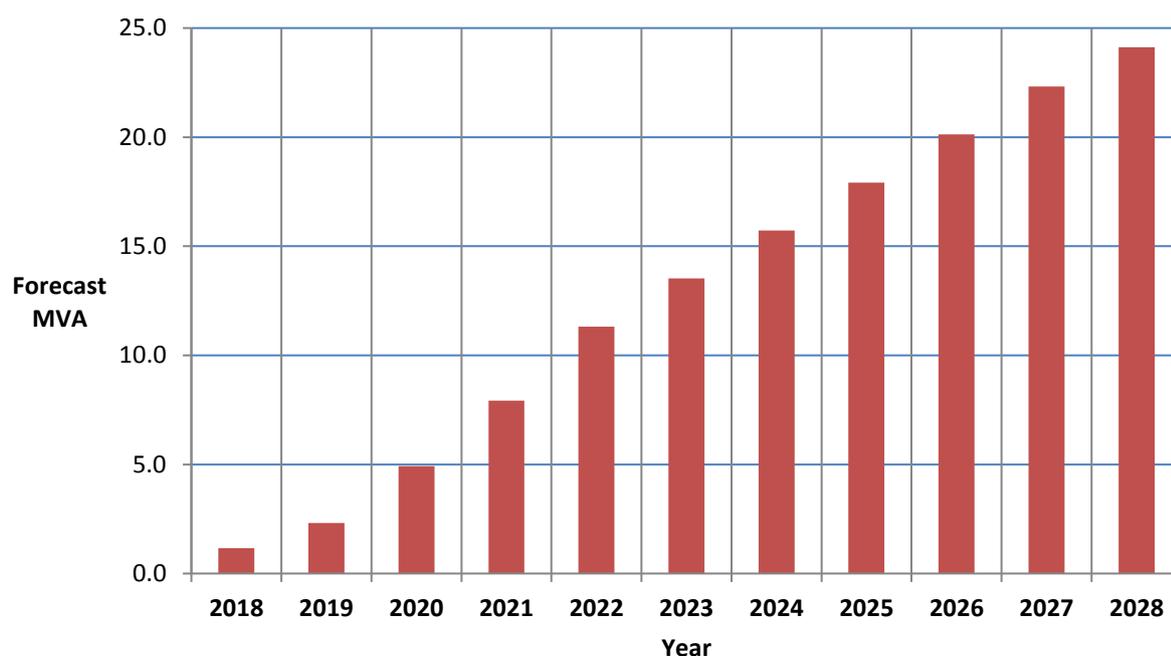


Figure 3 – Catherine Park Forecast Demand

4.2.1 ZONE SUBSTATION CAPACITY

The closest zone substation is Oran Park Zone Substation. Capacity at Narellan ZS is forecast to be constrained beyond 2019, however the firm capacity was exceeded in 2017 summer.

Table 2 - Narellan ZS Summer Forecast

| Year | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---------------|------|------|------|------|------|------|------|------|------|------|
| 50POE | 66 | 68.6 | 69.6 | 70.5 | 71.1 | 71.6 | 71.8 | 71.8 | 72 | 72.2 |
| 10POE | 72.6 | 75.2 | 76.3 | 77.1 | 77.8 | 78.2 | 78.4 | 78.5 | 78.6 | 78.8 |
| Firm Capacity | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 |

Table 3 – Oran Park ZS Summer Forecast

| Year | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---------------|------|------|------|------|------|------|------|------|------|------|
| 50POE | 15.9 | 20.7 | 24.3 | 28.4 | 32.7 | 36.6 | 39 | 40 | 40.3 | 40.2 |
| 10POE | 15.9 | 20.7 | 24.3 | 28.4 | 32.7 | 36.6 | 39 | 40 | 40.3 | 40.2 |
| Firm Capacity | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |

4.2.2 LOAD TRANSFER CAPACITY

Due to the scarce 11kV distribution network in the area existing opportunities to transfer load are extremely limited.

4.2.3 DISTRIBUTION FEEDER UTILISATION

Utilisation of distribution feeders within the supply the Catherine supply areas are presented in figure 5. Feeder OP1162 is close to Endeavour Energy’s target 80% utilisation threshold for distribution feeders. Feeder 27031 will quickly approach is target threshold as development continues. This is reflected in the spare capacity shown in Table 1.

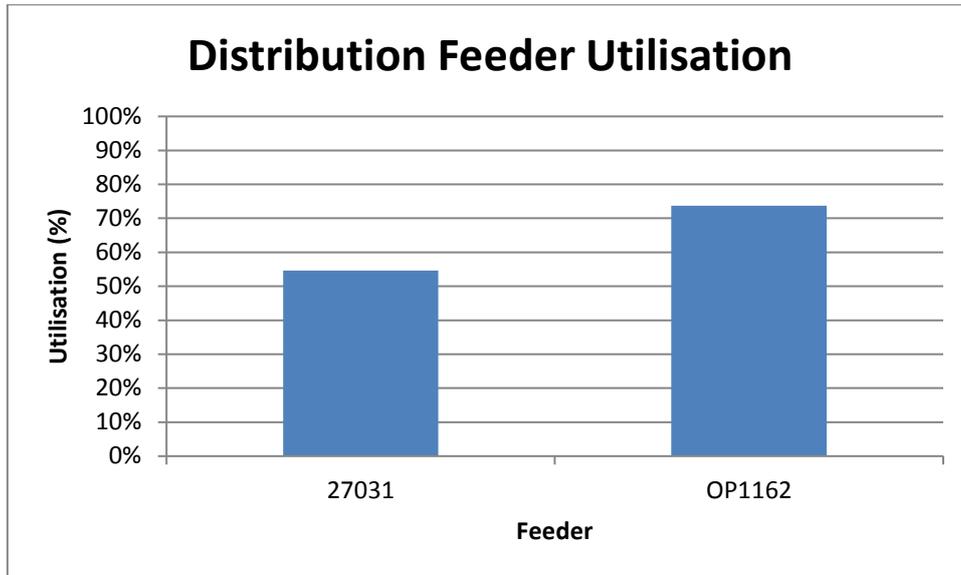


Figure 4 - Distribution Feeder utilisation

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

Although there are no documented issues around voltage performance, as the area is rapidly developing, in the absence of further augmentation works, voltage issues will arise as customers continue to get connected to the existing network. 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.

4.3 QUANTIFICATION OF NETWORK NEED

The substantial residential developments proposed for the Catherine Park area 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).

Table 4 shows the MVA Load at risk – 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.

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) |
|-------------|---------------------------|---------------------------------------|--|
| 2018 | 0 | 0 | - |
| 2019 | 0 | 0 | - |
| 2020 | 1.8 | 63.5 | 1685 |
| 2021 | 4.8 | 1061 | 28141 |
| 2022 | 8.2 | 5206 | 138124 |
| 2023 | 10.4 | 9672 | 256607 |
| 2024 | 12.6 | 14927 | 396022 |
| 2025 | 14.8 | 20304 | 538673 |
| 2026 | 17.0 | 25699 | 681788 |
| 2027 | 19.2 | 31103 | 825157 |
| 2028 | 21.0 | 35526 | 942509 |

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 3,200 dwellings. A do nothing scenario means that supply for 3,200 new dwellings is required from a single 8km long heavily loaded feeder from Narellan ZS and a more recent feeder that already feeds the adjacent suburb of Oran Park. 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 360MWh. This equates to tolerating a sustained outage of 15 MW (for example, the entire suburb of Catherine Park) for 48 hours at 50 percent load factor, or alternatively, for larger suburbs an inability to supply 15 MW peak demand (or close to 4000 customers) for 8 hours on 6 peak days in a year (potentially 6 hot days in summer). This represents Endeavour Energy’s upper envelope on the level of risks of non-supply that can be attributed to a project.

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.

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 South West Priority Growth Area. As the network will supply entirely new predominantly urban residential subdivisions, existing load profiles for the neighbouring precinct of Oran Park is considered representative of the load that will be presented to the

network. It should be noted that this profile also includes loads that continue to be connected throughout the year.

Normalised Oran Park Annual Load Profile

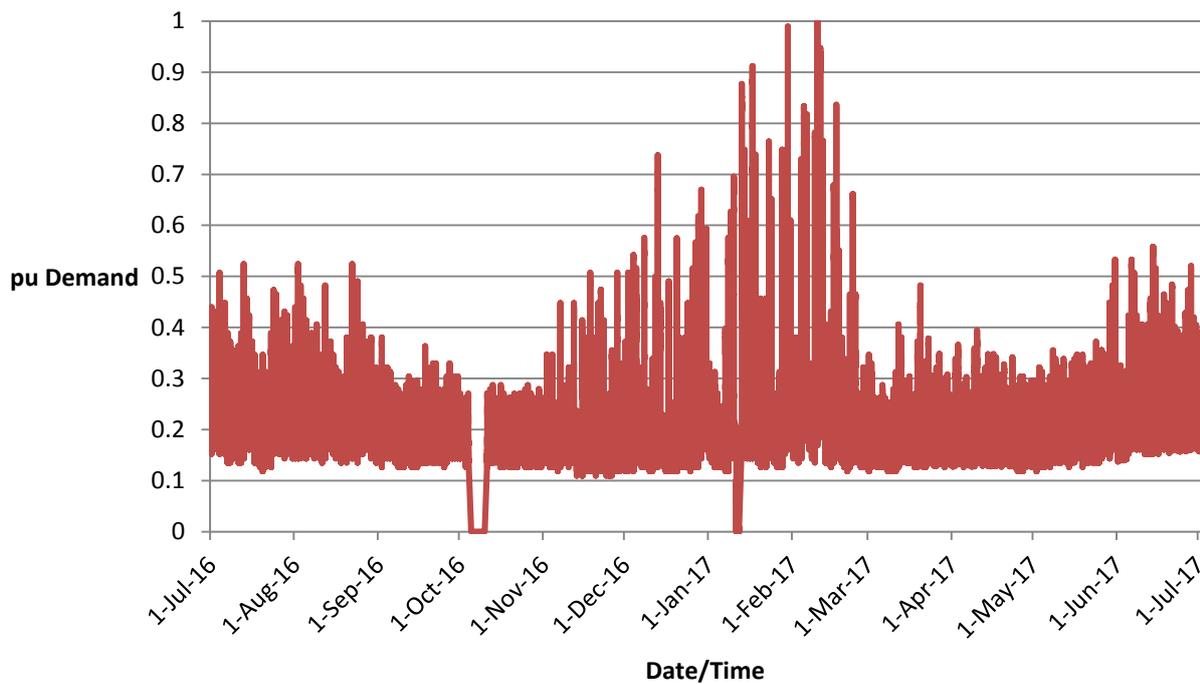


Figure 5 - Normalised Annual Load Profile

Normalised Oran Park Peak Day Profiles

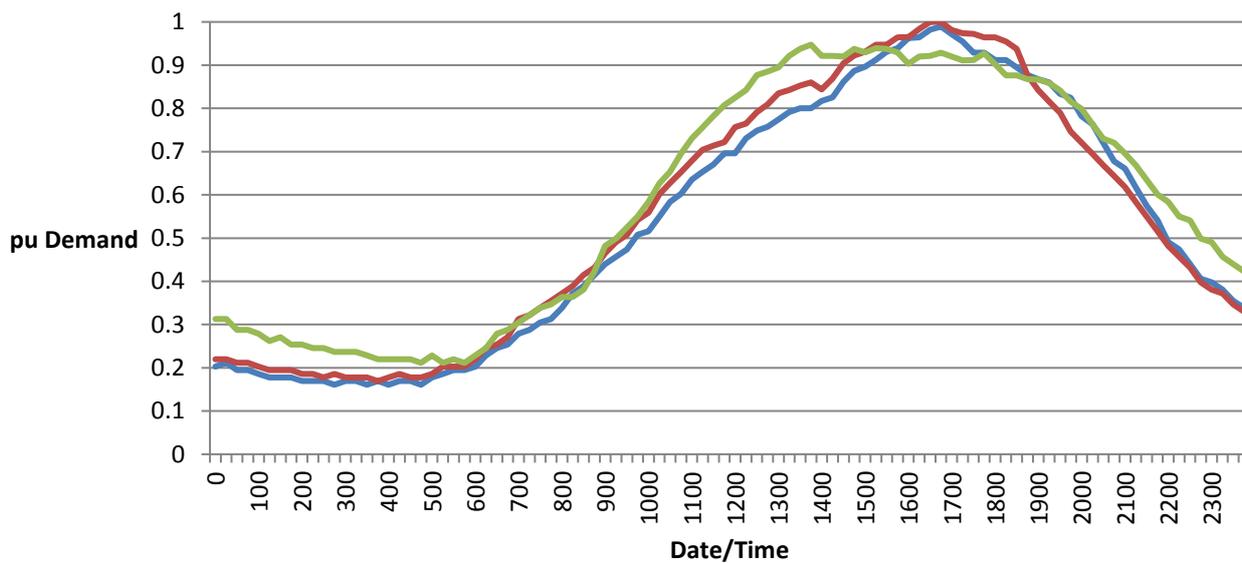


Figure 6- Summer Peak Day Profiles

Normalised Load Duration Curves

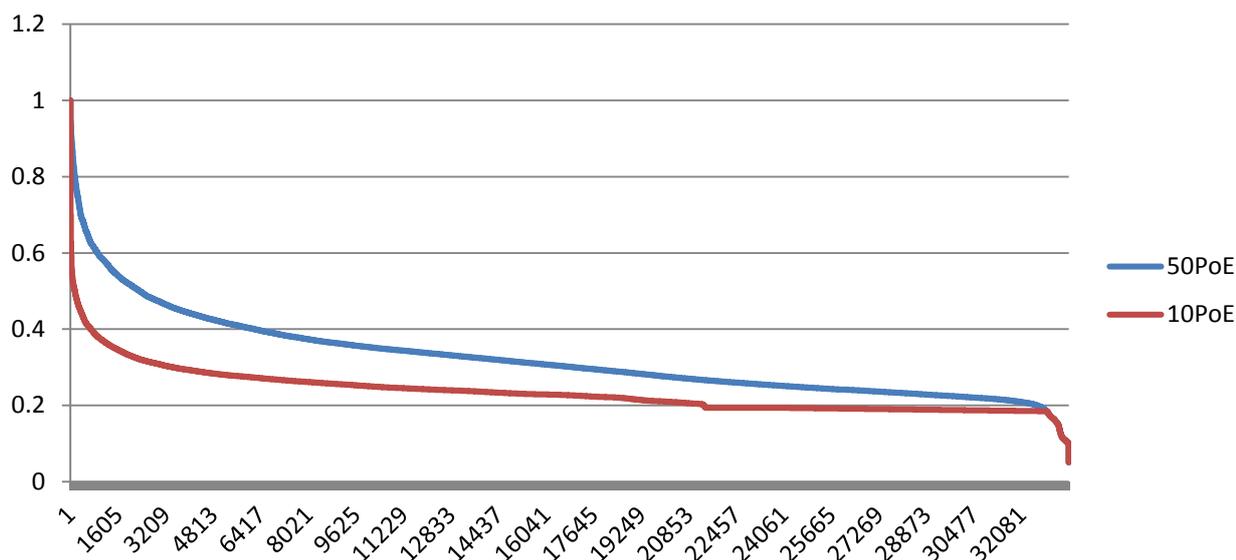


Figure 7 - Load Duration Curves

5.5 LOAD TRANSFER CAPACITY AND SUPPLY RESTORATION TIMES

As Catherine Park is a greenfield area that is yet to be reticulated to an urban standard there are no opportunities for load transfer. If connections to the existing network continued without further investment, connected customers would face long supply restoration times as supply runs out.

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 3.1MVA 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

Five credible options were considered as follows:

Options 1 to 4 are various permutations of establishing a zone substation at Catherine Park while Option 5 is the extension of three 11kV distribution feeders to Catherine Park from Oran Park Zone Substation.

Option 1 involves the establishment of a 15MVA mobile substation with 132kV busbar upfront with construction of a standard permanent zone substation later.

Option 2 involves the establishment of a modular (temporary/relocatable) 132/11kV zone substation with 132kV busbar upfront with construction of a standard permanent zone substation later.

Option 3 involves the establishment of a standard permanent 2 transformer 132/11kV zone substation with 132kV busbar upfront.

Option 4 involves the establishment of a staged standard permanent 132kV/11kV zone substation with one transformer initially and a second transformer to be installed as part of a second stage at a later date.

Option 5 involves the establishment of a 3 x 11kV feeders from Oran Park Zone Substation and construction of a standard permanent zone substation at a later date.

The options are summarised as follows:

- Option 1 – Establish a mobile 132/11kV zone substation
- Option 2 – Establish a modular 132/11kV zone substation
- Option 3 – Establish a standard permanent 132/11kV zone substation
- Option 4 – Establish a standard permanent 132/11 kV zone substation with one transformer initially
- Option 5 – Establish three 11kV feeders from Oran Park ZS

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 the Catherine Park supply area increases the supply available to meet the growth in demand within this area. 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 zone substation build options considered is whether to build the zone substation up front or to carry out the 11kV distribution feeder 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 due to greenfield nature of the supply area. 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

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 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 – All stages – nominal | Capital Costs for Project Stage 1 - nominal | O&M Cost |
|---------------|-------------------------------------|---|--------------------------------|
| Baseline Risk | \$0 | \$0 | \$0 incremental |
| Option 1 | \$24.4m | \$9.3m | 2.5% of capital cost per annum |
| Option 2 | \$24.5m | \$11.8m | 2.5% of capital cost per annum |
| Option 3 | \$19.8m | \$19.8m | 2.5% of capital cost per annum |
| Option 4 | \$20.6m | \$15.7m | 2.5% of capital cost per annum |
| Option 5 | \$25.7m | \$3.24m | 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 $\pm 10\%$.

7.4.2 CAPITAL COSTS

Capital cost estimates have been based on standard planning cost estimates of the detailed scope of work for the new 11kV feeders and zone substation options. 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, AEMO's published NSW residential VCR of \$26.53 per kWh has been 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 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 all options address similar risks, with the only difference being the timing of commissioning of the permanent zone substation, the market benefits that are captured by each option is similar.

Table 9 - Gross Market Benefits

| Options | Base Case (PV) |
|--|----------------|
| Option 1 – 15MVA Mobile Substation with 132kV busbar + Stage 2 later | \$115.11M |
| Option 2 – Modular (Temp) 132/11kV zone substation + Stage 2 later | \$115.11M |
| Option 3 – Permanent 2x45MVA zone substation (Full ZS) | \$115.11M |
| Option 4 – Permanent single 45MVA transformer ZS + Stage 2 later | \$115.11M |
| Option 5 – Extend 3x11kV feeders from Oran Park ZS + Staged ZS later | \$115.12M |

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 all options. 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 (PV) | Gross Market Benefits (PV) | Net Market Benefits | Ranking under RIT-D |
|--|------------------|----------------------------|---------------------|---------------------|
| Baseline Risk | \$0M | \$0M | \$0M | 6 |
| Option 1 – 15MVA Mobile Substation with 132kV busbar + Stage 2 later | \$18.3M | \$115.11M | \$90.27M | 3 |
| Option 2 – Modular (Temp) 132/11kV zone substation + Stage 2 later | \$18.5M | \$115.11M | \$90.08M | 4 |
| Option 3 – Permanent 2x45MVA zone substation (Full ZS) | \$18.6M | \$115.11M | \$89.88M | 5 |
| Option 4 – Permanent single 45MVA transformer ZS + Stage 2 later | \$17.6M | \$115.11M | \$91.28M | 2 |
| Option 5 – Extend 3x11kV feeders from Oran Park ZS + Staged ZS later | \$15.8M | \$115.12M | \$93.44M | 1 |

The RIT-D assessment demonstrates that Option 4 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 | Do Nothing | | Option 1 | | Option 2 | | Option 3 | | Option 4 | | Option 5 | |
|----------|--------------------|------|--------------------|------|--------------------|------|--------------------|------|--------------------|------|--------------------|------|
| | Net Market Benefit | Rank |
| Base | \$0.00 | 6 | \$90.27 | 3 | \$90.08 | 4 | \$89.88 | 5 | \$91.28 | 2 | \$93.44 | 1 |
| 1 | \$0.00 | 6 | \$91.65 | 3 | \$91.46 | 4 | \$91.26 | 5 | \$92.66 | 2 | \$94.82 | 1 |
| 2 | \$0.00 | 6 | \$89.46 | 3 | \$89.27 | 4 | \$89.07 | 5 | \$90.47 | 2 | \$92.63 | 1 |
| 3 | \$0.00 | 6 | \$87.79 | 3 | \$87.58 | 4 | \$87.36 | 5 | \$88.90 | 2 | \$91.27 | 1 |
| 4 | \$0.00 | 6 | \$92.76 | 3 | \$92.59 | 4 | \$92.40 | 5 | \$93.66 | 2 | \$95.61 | 1 |
| 5 | \$0.00 | 6 | \$133.66 | 3 | \$133.47 | 4 | \$133.27 | 5 | \$134.67 | 2 | \$136.83 | 1 |
| 6 | \$0.00 | 6 | \$46.88 | 3 | \$46.69 | 4 | \$46.49 | 5 | \$47.89 | 2 | \$50.05 | 1 |
| 7 | \$0.00 | 6 | \$67.81 | 3 | \$67.54 | 4 | \$66.23 | 5 | \$67.96 | 2 | \$70.77 | 1 |
| 8 | \$0.00 | 6 | \$124.44 | 4 | \$124.32 | 5 | \$125.56 | 3 | \$126.54 | 2 | \$127.75 | 1 |
| 9 | \$0.00 | 6 | \$135.56 | 3 | \$135.38 | 4 | \$135.17 | 5 | \$136.57 | 2 | \$138.74 | 1 |
| 10 | \$0.00 | 6 | \$46.38 | 3 | \$46.19 | 4 | \$45.98 | 5 | \$47.38 | 2 | \$49.54 | 1 |

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 | | Option 3 | | Option 4 | | Option 5 | |
|----------|--------------------|------|--------------------|------|--------------------|------|--------------------|------|--------------------|------|--------------------|------|
| | Net Market Benefit | Rank |
| Base | \$0.00 | 6 | \$90.27 | 3 | \$90.08 | 4 | \$89.88 | 5 | \$91.28 | 2 | \$93.44 | 1 |
| 1 | \$0.00 | 6 | \$91.65 | 3 | \$91.46 | 4 | \$91.26 | 5 | \$92.66 | 2 | \$94.82 | 1 |
| 2 | \$0.00 | 6 | \$89.46 | 3 | \$89.27 | 4 | \$89.07 | 5 | \$90.47 | 2 | \$92.63 | 1 |
| 3 | \$0.00 | 6 | \$87.79 | 3 | \$87.58 | 4 | \$87.36 | 5 | \$88.90 | 2 | \$91.27 | 1 |
| 4 | \$0.00 | 6 | \$92.76 | 3 | \$92.59 | 4 | \$92.40 | 5 | \$93.66 | 2 | \$95.61 | 1 |
| 5 | \$0.00 | 6 | \$133.66 | 3 | \$133.47 | 4 | \$133.27 | 5 | \$134.67 | 2 | \$136.83 | 1 |
| 6 | \$0.00 | 6 | \$46.88 | 3 | \$46.69 | 4 | \$46.49 | 5 | \$47.89 | 2 | \$50.05 | 1 |
| 7 | \$0.00 | 6 | \$67.81 | 3 | \$67.54 | 4 | \$66.23 | 5 | \$67.96 | 2 | \$70.77 | 1 |
| 8 | \$0.00 | 6 | \$124.44 | 4 | \$124.32 | 5 | \$125.56 | 3 | \$126.54 | 2 | \$127.75 | 1 |
| 9 | \$0.00 | 6 | \$135.56 | 3 | \$135.38 | 4 | \$135.17 | 5 | \$136.57 | 2 | \$138.74 | 1 |
| 10 | \$0.00 | 6 | \$46.38 | 3 | \$46.19 | 4 | \$45.98 | 5 | \$47.38 | 2 | \$49.54 | 1 |

The results show that Option 5 maximises the net market benefit in the base case as well as all scenarios considered for sensitivity analysis.

9.0 PREFERRED OPTION

The option that presents the greatest net market benefit is Option 5. This option involves the extension of 3 x 11kV feeders from Oran Park Zone Substation at a cost of \$3.24 Million. This project PR437 comprises the first stage of the overall solution. The second stage of building a 132/11kV 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 and allows the development to proceed in a timely manner.

The technical characteristics of project PR437 comprising of Stage 1 works for Option 5 are as follows:

- Establishment of three new 11kV distribution feeders from Oran Park ZS to service the Catherine Park precinct.
- Distribution works to enable connection to the existing distribution network.