# North East Area Strategic Plan
# System Capacity Planning Project
# Aurora Energy

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## Document control

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# Contents

# Executive summary

The long term plan for North East recommends maintaining the existing 110 kV transmission network and terminal substations. The load growth forecast for the area is low and there are no new transmission network connection points recommended before 2050 in the North East area. The closure of the 110 kV ring from Derby to St Mary's has been assumed to proceed in 2017, as described in the 2009 Transend Annual Planning Report.

The ten year plan for North East recommends the installation of a second transformer at Derby to provide firm capacity for the substation. The replacement of the existing transformer at Derby due to age limitations is also recommended.

The five year plan focuses on the distribution works required in the North East area and there are no major distribution works identified before 2017.

This report is part of a series covering the eleven planning areas in the state of Tasmania. References are made in this report to others in the series which cover adjacent planning areas. An overarching summary document was compiled to highlight the important outcomes and recommendations from each area in the study.

| Report Reference | PLANNING AREA |
|---|---|
| 0 | System capacity planning project summary |
| 1 | Tamar area strategic plan |
| 2 | North Coast area strategic plan |
| 3 | North West area strategic plan |
| 4 | Hobart West area strategic plan |
| 5 | Hobart East area strategic plan |
| 6 | South area strategic plan |
| 7 | Sorell area strategic plan |
| 8 | East Coast area strategic plan |
| **9** | **North East area strategic plan** |
| 10 | Central area strategic plan |
| 11 | West Coast area strategic plan |

# 1. Introduction

Aurora Energy (Aurora) engaged Aurecon (formerly Connell Wagner) to undertake a network system capacity planning study covering the eleven planning areas in the state of Tasmania. A report will be produced for each of the eleven planning areas and will include a long term strategic plan, a ten year plan and a five year plan.

Each area report contains a summary of the planning area, describing the geographical region encompassed, the existing electrical infrastructure and the local council plans as well as Aurora and Transend's committed and proposed works for the area. A load forecast is then presented, with a discussion of the magnitude and location of expected load growth, followed by a discussion of the resulting limitations at each substation. The long term strategic plan, ten year plan and five year plan are then presented.

## 1.1 Background

Aurora is the distribution network service provider of mainland Tasmania, supplying more than 1 GW peak load through its high voltage network in 2008. Transend is the transmission network service provider of Tasmania.

The Aurora HV distribution system consists mainly of 22 and 11 kV feeders, with the connection point generally on the load side of the feeder circuit breakers at Transend's terminal substations. Aurora also owns several 33/11 kV zone substations and 33 kV feeders, which are supplied by Transend's 110/33 kV substations.

This report has been prepared for Aurora and its intent is to review Aurora's short and long term network requirements, however it is understood that Transend is impacted by the recommendations contained within. Therefore all efforts have been made to perform the study in consultation with Transend, and consideration has been given to Transend's future vision and network security standards.

## 1.2 Methodology

The methodology used to carry out the planning study is outlined below.

To begin with, data was reviewed for each of the planning areas including:

- Annual planning reports from Transend and Aurora
- Known developments and constraints
- The existing network configuration (using Webmap)
- Load models and load transfer capacity
- Transformer refurbishment program (Aurora)
- Schematics of Aurora and Transend substations
- Joint planning studies and regulatory test reports
- Council plans and residential strategies for all of the Tasmanian councils (where available)

The load model for each planning area was then refined into smaller growth areas, with each area allocated medium or high growth based on land availability, council plans for the area and information from Aurora on growth hot spots and point loads. This process resulted in a load forecast for each planning area which fell between the medium and high growth forecasts provided by Aurora, with load growth biased towards those areas (and hence substations) where high growth is expected. This forecast is considered the high growth forecast for this study, with the medium and low forecasts being those provided by Aurora.

For the purposes of the long term strategic plan and ten year plan it was decided to use the high growth forecast to determine the timing of limitations. This conservative approach was taken to ensure that Aurora is prepared should a higher than expected forecast eventuate. The five year plan is intended to be used by Aurora for its short-term planning, including regulatory submission for relevant projects, and therefore needs to be as accurate as possible. As a result, the five year plan uses the medium growth forecast to determine the timing of limitations.

The long term strategic plan was produced by projecting the high growth load forecast out to the year 2050 and performing a high level review of the resulting limitations. Substation capacity and condition were the primary limitations considered at this stage, as distribution network limitations are difficult to forecast and can largely be addressed independently of major substation projects. The introduction of new voltage levels and phasing out of non-standard voltage levels were examined at this time. The recommendations considered to address the resulting limitations included load transfers, transformer refurbishment or replacement to increase capacity, installation of additional transformers and switchgear and the establishment of new substations.

The recommended projects which fell within the period from 2012 to 2022 were then examined in greater detail in the ten year plan. An options analysis was undertaken by comparing the technical and financial implications of the recommended option against several other feasible options. The project drivers were also examined in greater detail, with distribution network limitations such as feeder loading and reliability considered at this stage.

The five year plan focused on the distribution works required within the period from 2012 to 2017. An analysis of each of the existing and new substations was completed to determine feeder limitations in the five year period. The medium growth substation forecast provided by Aurora was combined with historical feeder loading data from 2009 to produce a five year forecast for all distribution feeders in the Aurora network. A number of projects were proposed which included works as part of the substation projects identified in the ten year plan and new projects based on the analysis of feeder loading. A brief justification for the new feeder projects has been included and DINIS studies were completed as applicable. A section has been included to discuss the ultimate configuration of the substation areas and the impact on the ultimate plan by any works completed in the five year period.

For each area, a report was compiled including the long term strategic plan, ten year plan and five year plan. An overarching summary document was compiled to highlight the important outcomes and recommendations from each area in the study.

## 1.3 Assumptions

A list of some of the general assumptions made for the study is outlined below.

- Direct connected customers were not included in the original load models. However, where the direct connected load affects the substation, an estimated block load has been incorporated into the substation load to determine the capacity limitation.
- The UES 2008 forecast has been used for all load models. The high and medium growth rates for smaller areas in the substation supply areas have been assumed based on existing feeder configuration, land availability, council plans for the area and information from Aurora on growth hot spots and point loads.
- Draft historical feeder loadings were used for the long term strategic and ten year plans. Revised feeder loadings were provided prior to the commencement of the five year plan and the new figures were incorporated to ensure feeder limitations were accurately determined.
- All committed proposed projects up to 2012 are assumed to be completed for this study
- The assumed substation limitation is load above firm capacity
- Transformer asset life as advised by Aurora is 40 years for zone substations and 45 years for terminal substations. For the purpose of this report, it is assumed that actual transformer life is extended by approximately five years due to the regular condition assessments and transformer loading under normal conditions.

- The four-hour emergency ratings for transformers is based on 1.2 x normal capacity. It has been assumed that remote switching can be completed within four hours.
- Substation general arrangements were not available during the study and it has been assumed that there is space for the proposed upgrades outlined in the long term strategic plan
- The long term strategy does not take into account individual distribution feeder capacity or voltage drop. This has been further reviewed in the five year plan.
- ESI regulations have been taken into consideration where applicable
- Basic costing was provided by Aurora and Transend and any additional assumptions made are shown in Appendix A
- An NPV analysis has been completed for each of the ten year proposed projects. It should be noted that a cost benefit analysis has not been undertaken
- Demand side initiatives have not been considered in this study. Any feasible demand side initiatives that are identified as part of a separate review will in some cases defer or alleviate identified capital expenditure. The focus of this review is to identify network constraints and determine appropriate network solutions.

# 2. Area background

The North East covers an area along the north eastern coast of Tasmania with Scottsdale as the major service centre and a number of small communities scattered across the region.

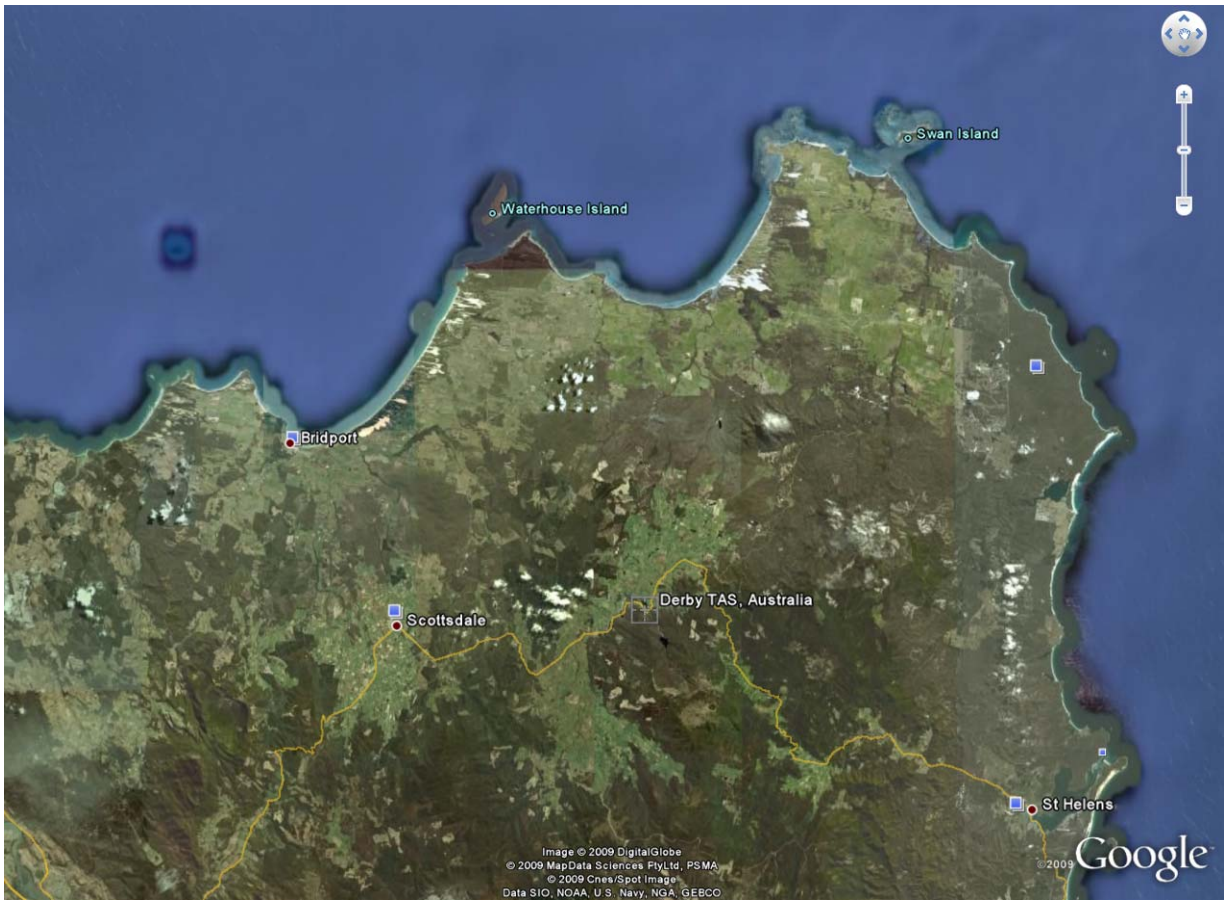


**Figure 2-1 North East supply area**

The main industries in the North East are farming, forestry, viticulture and tourism. The area has an urban centre at Scottsdale, high density rural areas in Derby, Winnaleah and Ringarooma and the remaining area is low density rural fed by a number of SWER systems.

## 2.1 Existing infrastructure

There are two Transend terminal substations in the North East area.

**Table 2-1 North East terminal substations**

| Terminal Substation | Number of Transformers | Rating of each Transformer | Transformer Primary Voltage | Secondary Voltage | Number of Distribution Feeders |
|---|---|---|---|---|---|
| Derby | 1 | 10 MVA | 110 kV | 22 kV | 3 |
| Scottsdale | 2 | 31.5 MVA | 110 kV | 22 kV | 5 |

## 2.2 Council areas and restrictions

The Dorset council has a strategic plan document for 2008-2012. This document outlines corporate objectives, strategies and outcomes including strategies for natural and environmental sustainability, community wellbeing, social and economic development and governance.

## 2.3 Approved and proposed works

The North East area has a number of existing system constraints. The approved projects to be completed by December 2012 are outlined below.

Upgrades to SWER systems will be completed by 2011/12 including Pipers River, Sheepwash and Mussleroe Bay. An upgrade to the Cape Portland and Blessington SWER systems will commence in 2011/12.

Transend has proposed the installation of a second transformer at Derby terminal substation transformer in 2015. This has been reviewed further as part of this study.

# 3. Load forecast

Due to the rural nature of the load in the Scottsdale and Derby supply areas, significant growth above the medium rate is considered unlikely. As a result, for the purposes of the long term strategic study, medium growth has been applied at both Scottsdale and Derby terminal substations

The resulting 38 year load forecast and firm ratings for the terminal substations of the North East planning area are provided below.

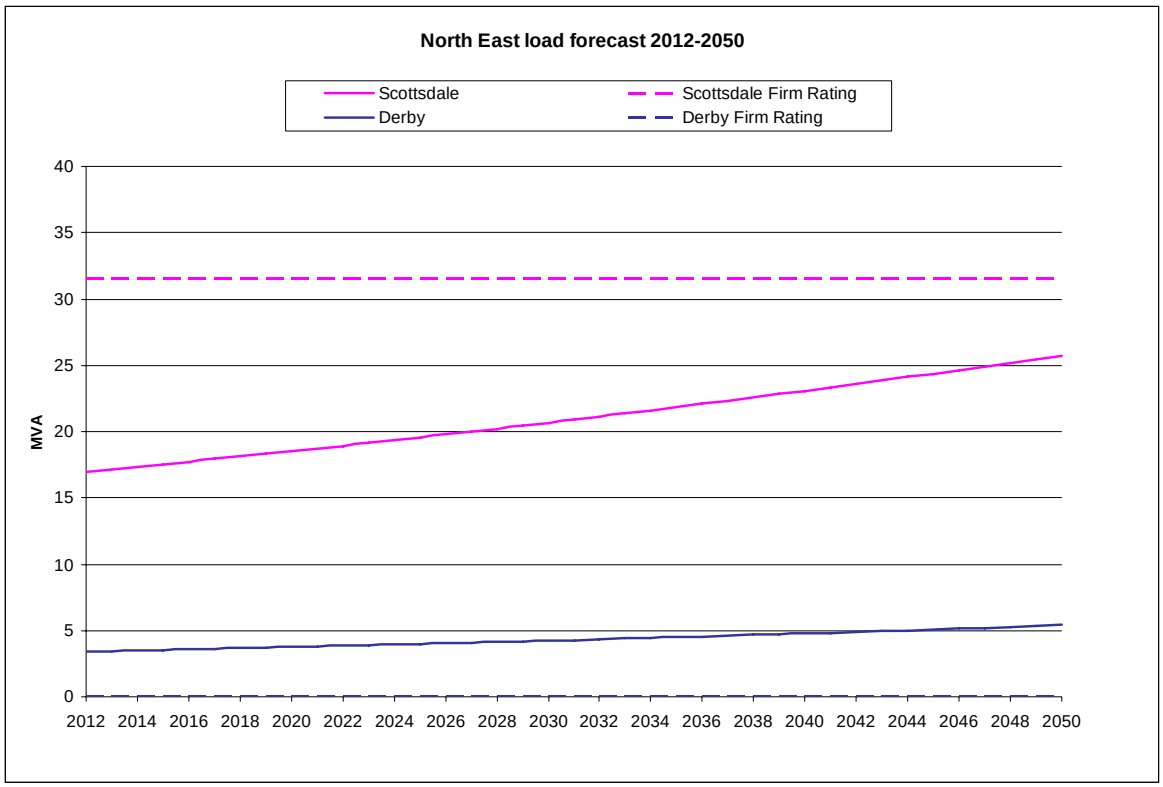


**Figure 3-1 North East substation load forecast**

Figure 3-2 provides a geographic view of the resulting load distribution in 2012 and 2050.

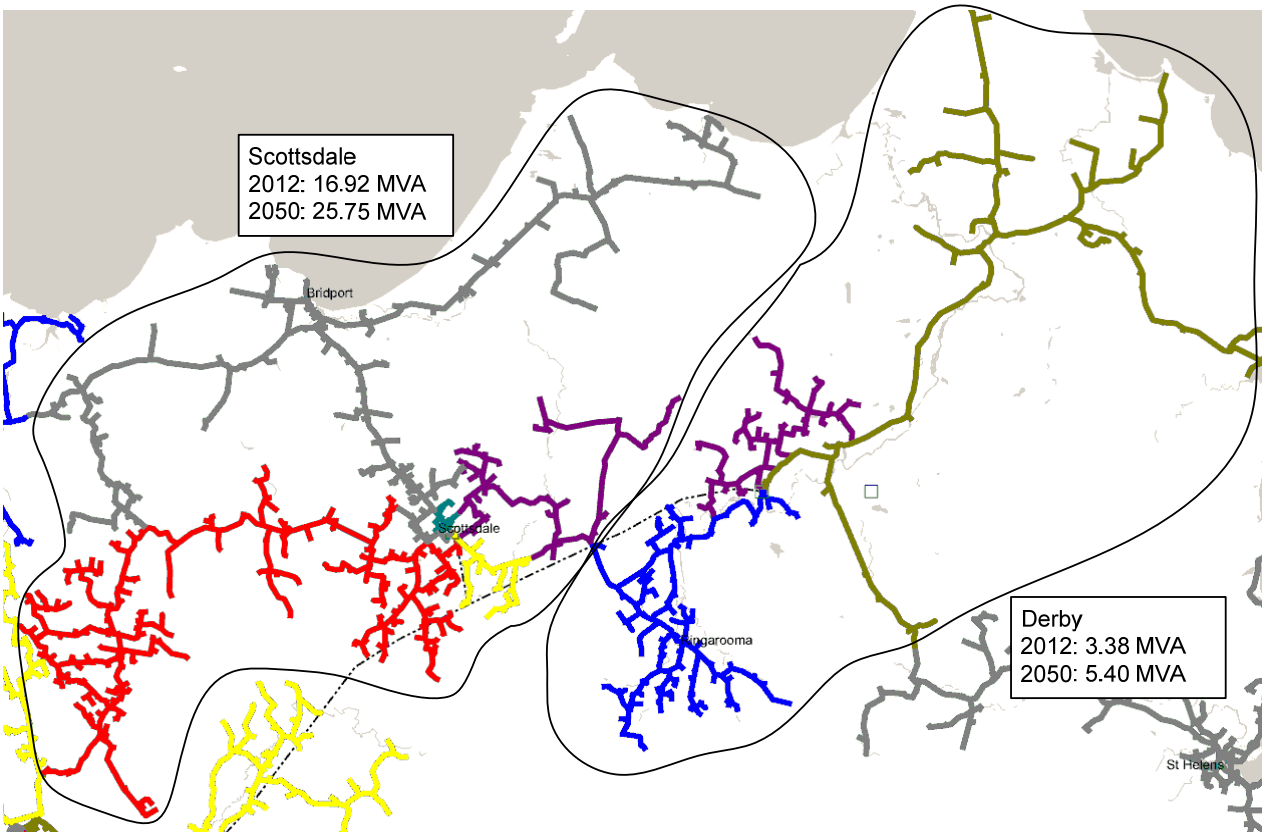


**Figure 3-2 North East substation load distribution**

The two terminal substations in the North East planning area provide 31.5 MVA of firm capacity, resulting in firm capacity for the area being reached in 2050.

# 4. Limitations

### Scottsdale

The Scottsdale terminal substation has two 31.5 MVA 110-88/22 kV transformers. The forecast load in 2012 is 16.92 MVA and the load is forecast to grow to 25.75 MVA in 2050. The firm capacity of the terminal substation is not exceeded in the forecast time frame. The distribution feeders are well within their nominal ratings of 10 MVA.

Scottsdale has an urban centre and supplies a large low density rural area north to Bridport and west towards Launceston. There is limited transfer capability between feeders.

The terminal substation has recently been rebuilt and the transformers were installed in 1985. The transformers will reach their age replacement limit around 2035, assuming an asset life of 50 years.

### Derby

The Derby terminal substation has one 10 MVA 110-88/22/11 kV transformer. The forecast load in 2012 is 6.76 MVA and the load is forecast to grow to 10.8 MVA in 2050. As there is only one transformer, the firm capacity has been exceeded. There is limited backup available for contingencies on the distribution system. The distribution feeders are well within their nominal ratings of 10 MVA.

The Norwood-Scottsdale-Derby 110 kV single transmission line exposes Derby to the risk of loss of supply in the event of a transmission line fault.

Derby terminal substation supplies high density rural areas in Derby, Winnaleah and Ringarooma and the remaining area is low density rural fed by a number of SWER systems. There is limited transfer capability between feeders.

The terminal substation has recently been rebuilt and the transformer was installed in 1966 and refurbished in 1983. The transformer is predicted to reach its age replacement limit around 2016, assuming an asset life of 50 years.

# 5. Planning philosophy

The Scottsdale and Derby areas are predicted to have low load growth over the time frame of the strategic plan but a medium growth forecast has been assumed to be conservative. The existing substations will be capable of supplying the proposed load growth over the study period.

The planning philosophy for the Scottsdale and Derby areas will be affected by the planning philosophy chosen for the East Coast area. Two paths of development have been considered to address the forecast limitations in the East Coast planning area. Both options assume the closure of the 110 kV ring from Derby to St Mary's proceeds in 2017, as described in the Transend Annual Planning Report 2009. For further information on these options, refer to the East Coast strategic area plan – Report 8 in the series.

# 6. Long term strategy

The proposed projects in the long term strategy are discussed in more detail below.

It should be noted that the projects proposed in this section will require further detailed analysis to confirm their economic and technical feasibility. A regulatory investment test will also be required for those projects where the augmentation component exceeds $1 million (RIT-D) or $5 million (RIT-T).

## 6.1 Proposed projects

### 6.1.1 Derby second transformer installation

It is recommended that a second 110/22 kV 10 MVA transformer and 22 kV switchgear be installed at Derby terminal substation. Installation of this transformer will address the firm capacity issue at Derby terminal substation. Transend has proposed to install the second transformer at Derby in 2015 in their 2009 Annual Planning Report. As the terminal substation has already exceeded firm capacity, it is recommended that this timing is followed to improve the reliability of supply to the Derby area.

### 6.1.2 Derby transformer replacement

Assuming an asset life of 50 years, it is recommended that the original transformer (T1) at Derby be replaced in 2016 with a 110/22 kV 10 MVA transformer. The timing can be refined further by completing regular testing on the transformer as it approaches the 50 year mark.

It is recommended that the cost of upgrading this transformer in 2015 (instead of 2016) in conjunction with the installation of the second transformer is considered. This will assist in determining if there are any cost savings to be made by completing the work as a combined project.

### 6.1.3 Establish 110 kV transmission line from Derby to St Mary's

To address the N-1 limitations on the 110 kV network to Avoca, St Mary's and Derby substations, it is proposed that a single circuit 110 kV feeder be installed from Derby to St Mary's substations (approximately 65 km). This project would address the lack of firm capacity to Avoca, St Mary's and Derby substations for 110 kV feeder contingencies.

The timing of the project would be driven by the ESI requirement of no more than 300 MWh of unsupplied energy for a single contingency. Transend have indicated that this requirement is not met as of 2009, and have advised a tentative timing of 2017 for this project.

### 6.1.4 Scottsdale transformer replacement

The transformers at Scottsdale terminal substation were installed in 1983. Assuming an asset life of 50 years, it is predicted that the transformers will need replacement around 2033. If the load trend is closer to the high growth forecast than the medium growth forecast, age replacement will coincide with the terminal substation load reaching firm capacity. The timing can be refined further by completing regular testing on the transformer as it approaches the 50 year mark.

## 6.2 Summary of proposed works

A summary of the proposed works from 2012 to 2050 in the North East planning area is outlined in Table 6-1.

**Table 6-1 North East project summary**

| Year | Proposed Project | Proposed Outcomes |
|---|---|---|
| 2015 | Derby second transformer installation | Increased firm capacity and reliability at Derby |
| 2016 | Derby transformer replacement | Addresses age limitation on existing transformer |
| 2017 | Establish 110 kV transmission line from Derby to St Mary's | Addresses N-1 limitations on the 110 kV network |
| 2033 | Scottsdale transformer replacement | Addresses age limitations on the existing transformers |

The proposed projects have been incorporated and the resulting 38 year load forecast and firm ratings for the terminal substations of the North East planning area are provided below.

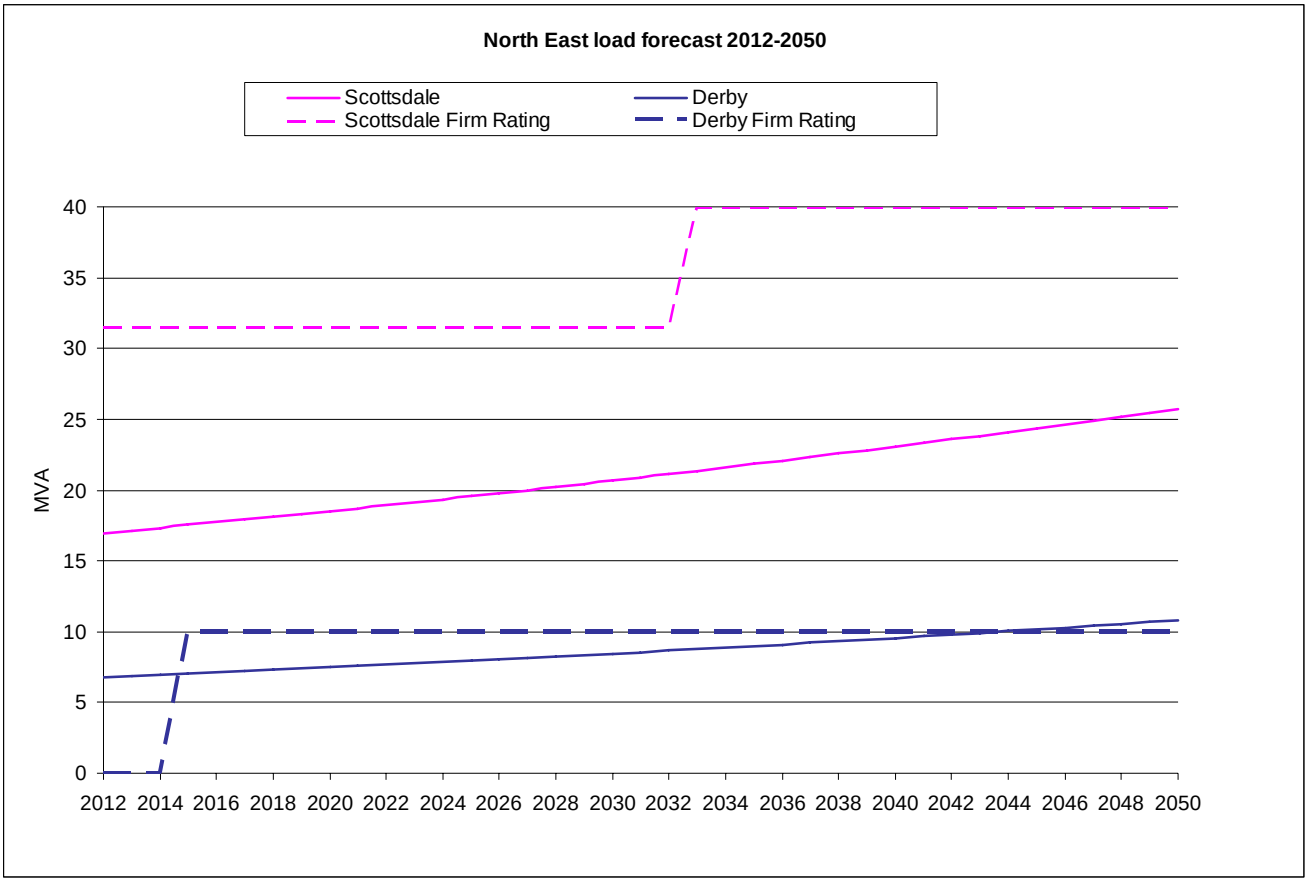


**Figure 6-1 North East substation load forecast with updated firm ratings**

# 7. Ten year plan

## 7.1 Proposed projects

The proposed projects for the ten year plan are outlined below.

It should be noted that while each proposed project has undergone a thorough high level analysis, these projects will require further detailed analysis to confirm their economic and technical feasibility. A regulatory investment test will also be required for those projects where the augmentation component exceeds $1 million (RIT-D) or $5 million (RIT-T).

### 7.1.1 Derby second transformer installation

Derby terminal substation supplies high density rural areas in Derby, Winnaleah and Ringarooma and the remaining area is low density rural fed by a number of SWER systems.


**Figure 7-1 Scottsdale and Derby aerial view**

### Limitations

Derby substation has one 10 MVA 110-88/22-11 kV transformer which was installed in 1966 and refurbished in 1983. The forecast summer peak load in 2012 is 6.76 MVA and it is expected to grow to 7.66 MVA in 2022. As there is only one transformer, the firm capacity of the substation has been exceeded. The loss of the transformer will interrupt more than 300 MWh of energy, which breaches clause 5.(1)(a)(iv) of the ESI Network Performance Requirements.

There are three distribution feeders which are well within their nominal ratings of 10 MVA. The feeders are long and there is limited transfer capability between feeders. Backup supply for part of the load is available from Scottsdale and St. Mary's.

### Option 1 – Install a second transformer at Derby

The first option is to install a second transformer at Derby substation in 2015. This will provide firm capacity at the substation and ensure compliance with the ESI Network Performance Requirements.

### Option 2 – Upgrade the distribution network to provide backup supply from Scottsdale

The second option is to install a new 22 kV feeder from the Scottsdale substation to a spare breaker at the Derby substation. This will provide backup supply for the loss of the existing transformer or the loss of the single circuit 110 kV line from Scottsdale to Derby.

### Option 3 – Install backup generation (non-network solution)

The third option is to install backup generation at the Derby substation. This will provide backup supply for the loss of the existing transformer or the loss of the single circuit 110 kV line from Scottsdale to Derby.

### Option 4 – Do nothing option

The do nothing option is not considered a feasible option as the load is above firm capacity at Derby substation.

### Technical comparison

| Option | Description | Advantages | Disadvantages |
|---|---|---|---|
| 1 | Install a second transformer at Derby | • Addresses transformer firm capacity limitation at Derby substation<br>• Ensures compliance of ESI Network Performance Requirements for the loss of a transformer<br>• Land available at site for expansion<br>• Consistent with network development plan | |
| 2 | Upgrade the distribution network to provide backup supply from Scottsdale | • Ensures compliance of ESI Network Performance Requirements for the loss of a transformer or single circuit 110 kV transmission line<br>• Addresses transformer firm capacity limitation at Derby substation | |

### Cost comparison

**Table 7-1 Cost comparison of options**

| Option | Initial Capital Cost ($M) | Total Capital Cost ($M) | Net Present Value ($M) |
|---|---|---|---|
| 1 | 3.5 | 3.5 | 2.5 |
| 2 | 3.2 | 6.7 | 3.0 |

The above cost comparison of options indicates that option 1 provides the lowest cost solution. Details of the NPV analysis are given in Appendix B.

### Recommended development

Based on the technical and cost comparison, option 1 is considered the preferred option to address the forecast limitations.

The scope of works for Transend includes:

- Installation of one 110 kV circuit breaker
- Installation of 1 x 10 MVA 110/22 kV transformer
- Installation of one new bus of 22 kV switchgear

The scope of works for Aurora includes:

- Nil

### 7.1.2 Derby transformer replacement

Derby terminal substation supplies high density rural areas in Derby, Winnaleah and Ringarooma and the remaining area is low density rural fed by a number of SWER systems.

#### Limitations

A new transformer will be installed at Derby in 2015 to address the firm capacity limitation at the substation. The existing 10 MVA 110-88/22-11 kV transformer was installed in 1966 and refurbished in 1983. Assuming an asset life of 50 years, it is predicted that the transformer will need replacement around 2016.

#### Option 1– Replace the transformer at Derby substation

The first option is to replace the existing 110/22 kV 10 MVA transformer with a new 110/22 kV 10 MVA transformers in 2016. This will address the predicted age limitation of the existing transformer.

#### Option 2 – Non-network option

No non-network alternatives have been considered.

#### Option 3 – Do nothing option

The do nothing option is not considered a feasible option as the Derby transformer is predicted to reach an age limitation around 2016.

#### Recommended development

The scope of works for Transend includes:

- Replacement of the existing transformer with a 110/22 kV 10 MVA transformer

The scope of works for Aurora includes:

- Nil

The estimated cost of the replacement is $2 million.

## 7.2 Summary of proposed works

The proposed works from 2012 to 2022 in the North East planning area are listed in Table 6-1.

**Table 7-2 North East project summary**

| Year | Proposed Project | Proposed Outcomes |
|---|---|---|
| 2015 | Derby second transformer installation | Provides firm capacity at Derby |
| 2016 | Derby transformer replacement | Addresses age limitation on transformer T1 |

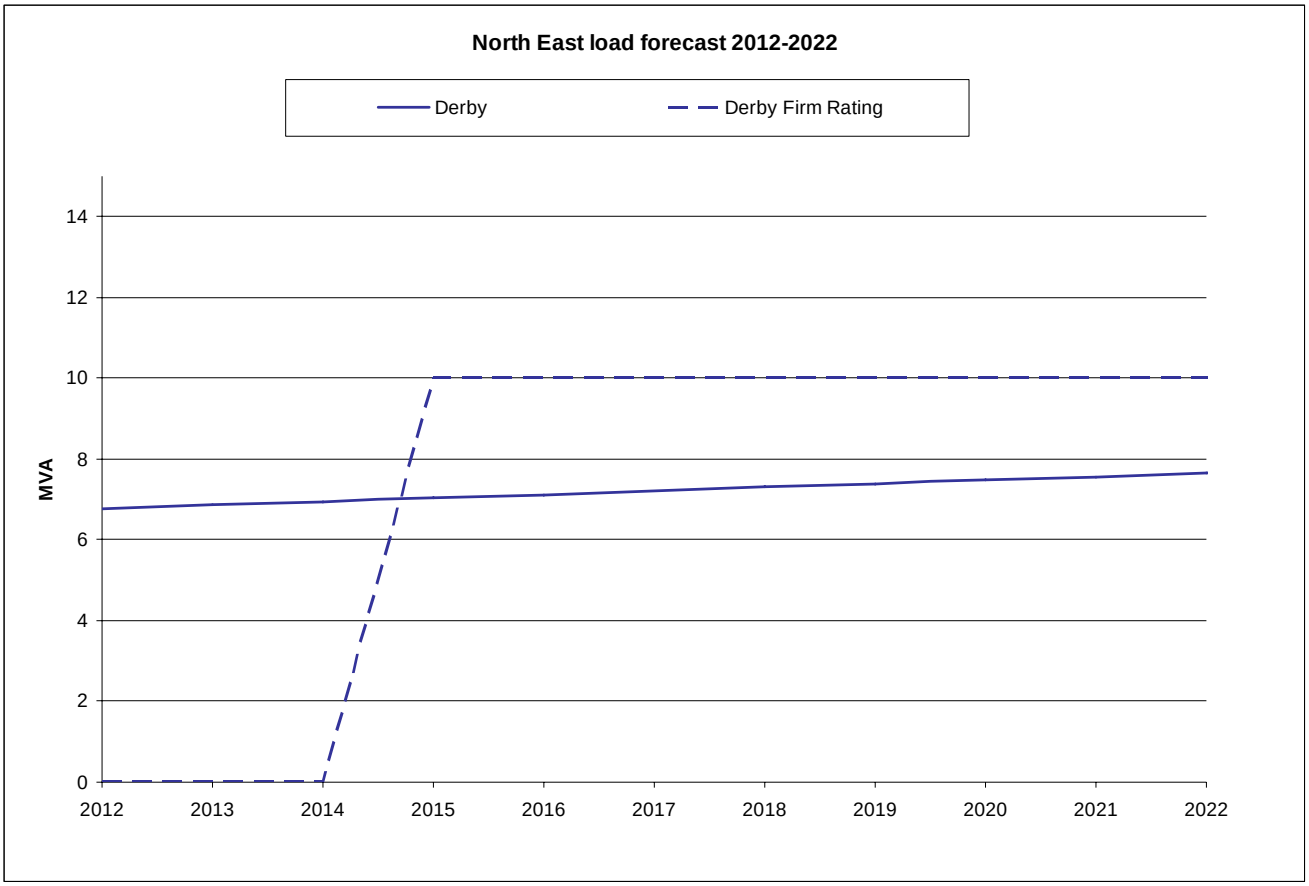


**Figure 7-2 Derby substation forecast**

# 8. Five year plan

A five year plan for each of the substations in the North East area is outlined below.

It should be noted that while each proposed project has undergone a thorough high level analysis, these projects will require further detailed analysis to confirm their economic and technical feasibility. A regulatory investment test will also be required for those projects where the augmentation component exceeds $1 million (RIT-D) or $5 million (RIT-T).

## 8.1 Derby substation

Derby terminal substation supplies high density rural areas in Derby, Winnaleah and Ringarooma and the remaining large area is low density rural fed by a number of SWER systems.

### 8.1.1 Limitations

Using the medium growth forecast, the Derby terminal substation load in 2012 is forecast to be 6.76 MVA and it is forecast to grow to 7.22 MVA in 2017. Derby experiences a summer peak load. The five year forecast is shown in Figure 8-1.

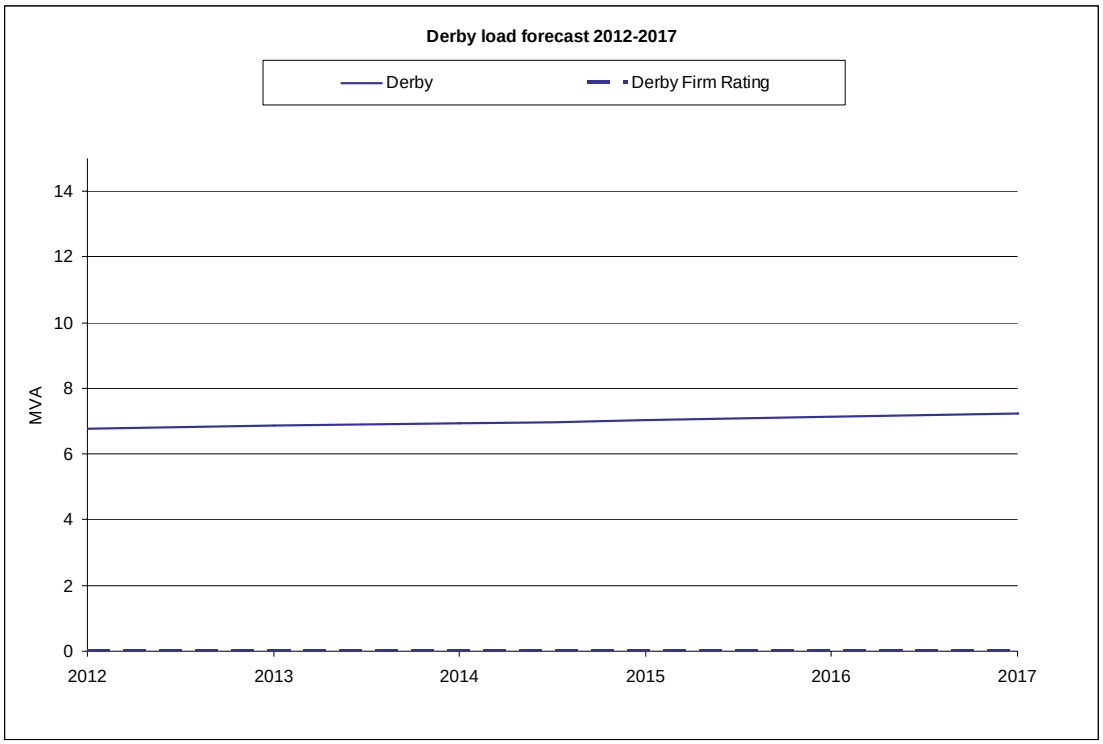


**Figure 8-1 Substation five year medium growth forecast**

The existing 22 kV network consists of three 22 kV feeders and there are two spare 22 kV circuit breakers. The Derby 22 kV supply area and individual 22 kV feeders are shown in the following figures.

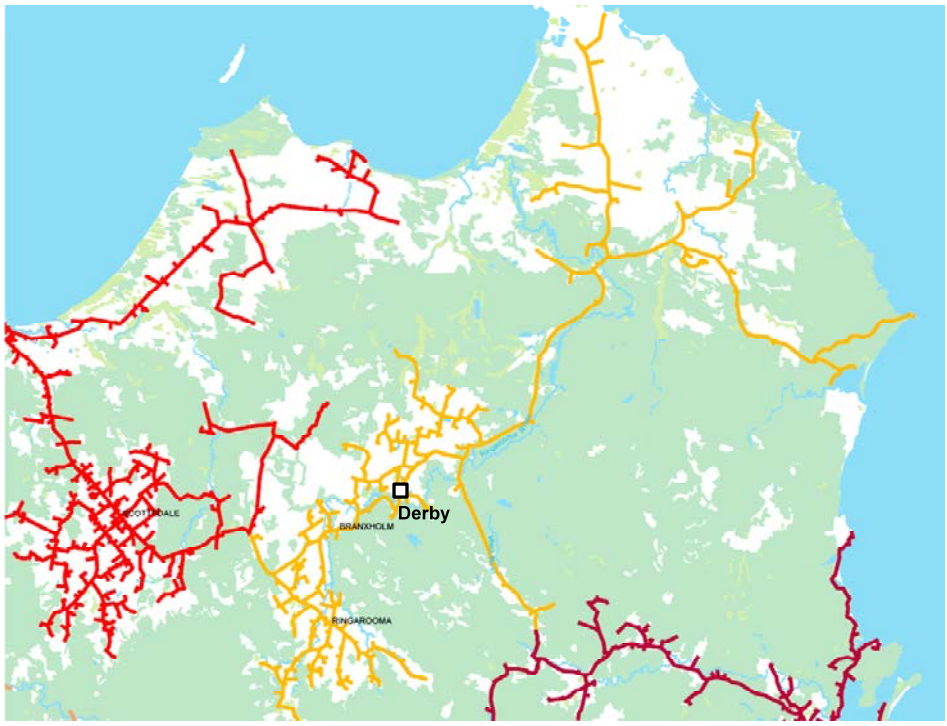


**Figure 8-2 Derby 22 kV supply area**

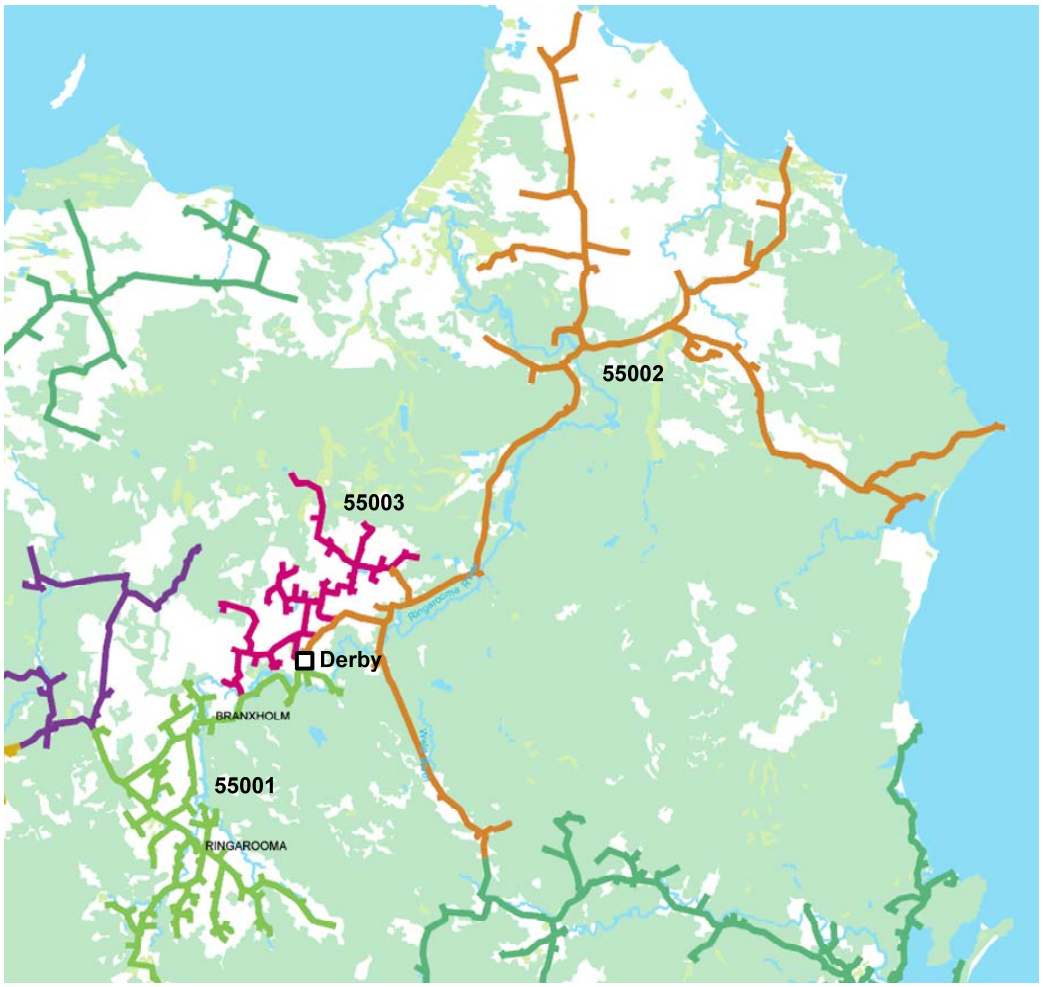


**Figure 8-3 Derby 22 kV individual feeders**

A five year feeder forecast has been developed using the actual peak feeder loads from 2009 and the forecast medium substation growth. The forecast for each feeder is outlined in the following table.

**Table 8-1 Forecast feeder growth**

| Area | Feeder/s | 2012 load (MVA) | 2013 load (MVA) | 2014 load (MVA) | 2015 load (MVA) | 2016 load (MVA) | 2017 load (MVA) |
|---|---|---|---|---|---|---|---|
| Derby | 55001 | 4.08 | 4.14 | 4.19 | 4.25 | 4.30 | 4.36 |
| | 55002 | 1.39 | 1.41 | 1.42 | 1.44 | 1.46 | 1.48 |
| | 55003 | 1.53 | 1.56 | 1.57 | 1.60 | 1.61 | 1.64 |

The forecast feeder loads have been assessed against a maximum feeder rating of 10 MVA for overhead and underground feeders. From the table above, it appears that there are no limitations present on the Derby 22 kV feeders.

Derby substation has existing transfer capability with Scottsdale and St Marys. The following figures are from the load transfer models provided by Aurora.

**Table 8-2 Forecast transfer capability**

| Substation | Feeder | 2012 Transfer (MVA) | 2013 Transfer (MVA) | 2014 Transfer (MVA) | 2015 Transfer (MVA) | 2016 Transfer (MVA) | 2017 Transfer (MVA) |
|---|---|---|---|---|---|---|---|
| Derby - Scottsdale | 54006 | 3.9 | 3.9 | 3.8 | 3.8 | 3.8 | 3.8 |
| Derby – St. Mary's | 57006 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.6 |
| Total transfers | - | 5.4 | 5.4 | 5.3 | 5.3 | 5.3 | 5.4 |

There is reasonable transfer capability available to both the Scottsdale and St Marys substations. However, there is no firm capacity at Derby substation so there will be load at risk for the loss of the transformer. This will be addressed in the five year plan with the installation of second transformer and the replacement of the existing transformer.

## 8.1.2 Proposed projects

### Derby second transformer installation

It is recommended that a second 110/22 kV 10 MVA transformer and 22 kV switchgear be installed at Derby terminal substation in 2015. Installation of this transformer will address the firm capacity issue at Derby terminal substation. For information on the options analysis for this project, please refer to ten year plan in Section 6.1.1.

The resulting Derby five year forecast is shown in the following figure.

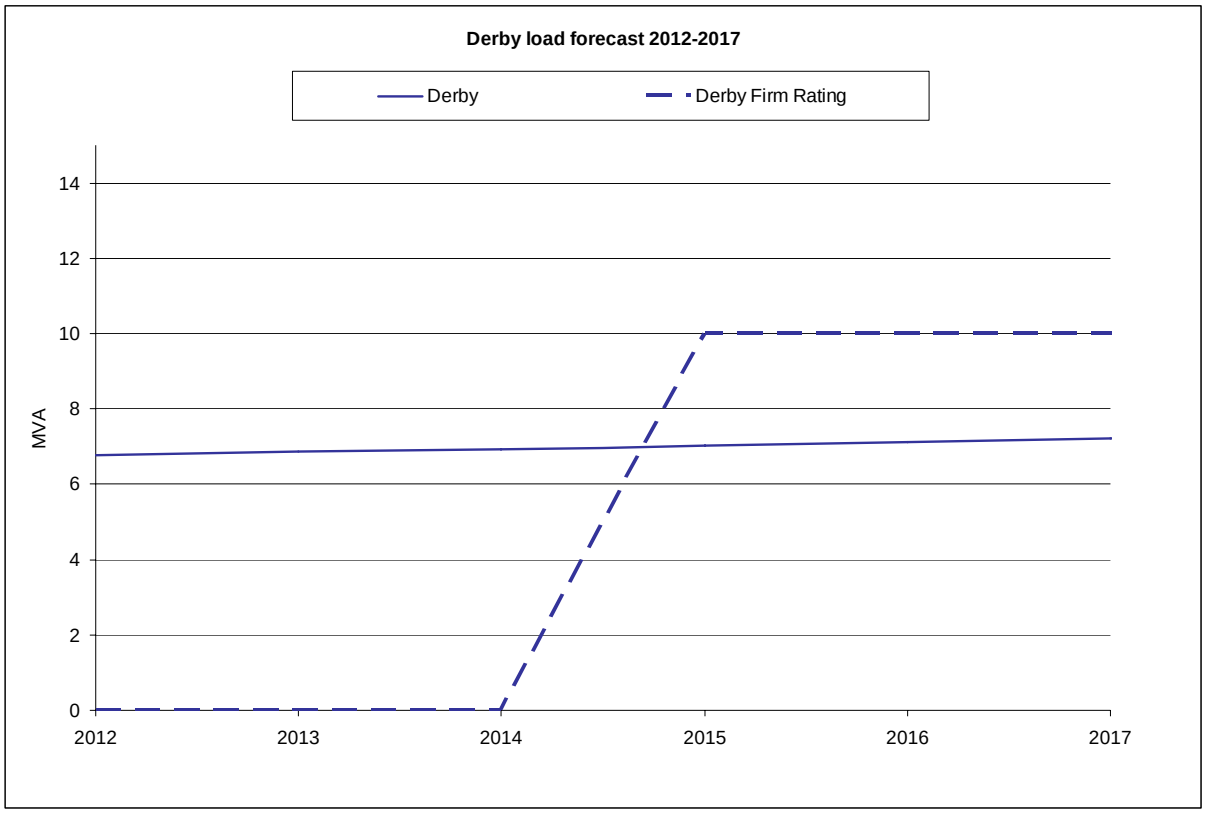


**Figure 8-4 Derby forecast with new firm rating**

As outlined above, Derby load is reduced below firm capacity in 2015.

#### Derby transformer replacement

Assuming an asset life of 50 years, it is recommended that the original transformer (T1) at Derby be replaced around 2016 with a 110/22 kV 10 MVA transformer. It is recommended that the cost of replacing this transformer in 2015 (instead of 2016) in conjunction with the installation of the second transformer is considered. This will assist in determining if there are any cost savings to be made by completing the work as a combined project.

### 8.1.3 Ultimate configuration

#### Substation

Derby is expected to remain a two transformer substation up to 2050. A number of options for the proposed works on the transmission network in the East Coast and North East area have been presented in the East Coast strategic area plan – Report 8 in the series. The chosen option will impact on the ultimate configuration at Derby.

#### Feeders

The growth in the Derby area is forecast to be low and capacity of the existing 22 kV feeders is currently sufficient. There are spare circuit breakers available on the 22 kV board and new feeders may be required throughout the long term plan to address reliability issues on the long 22 kV feeders. The transfer capability of the existing Derby feeders should be monitored and additional ties between feeders installed as required if possible. A comprehensive conduit plan is not required for this substation.

## 8.2 Scottsdale substation

Scottsdale terminal substation supplies the high density rural areas of Scottsdale, Lilydale and Bridport on the coast as well as the surrounding low density rural areas.

### 8.2.1 Limitations

Using the medium growth forecast, the Scottsdale terminal substation load in 2012 is forecast to be 16.92 MVA and it is forecast to grow to 17.93 MVA in 2017.

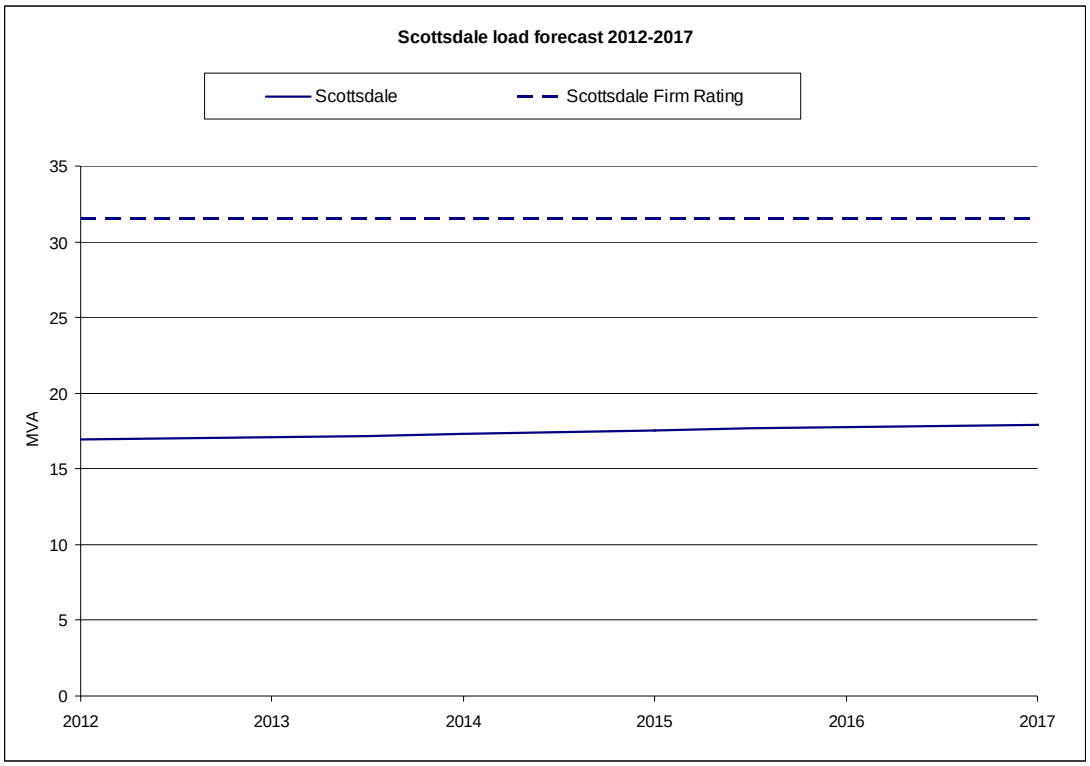


**Figure 8-5 Substation five year medium growth forecast**

The existing 22 kV network consists of five 22 kV feeders and there are five spare 22 kV circuit breakers. The Scottsdale supply area and individual 22 kV feeders are shown in the following figures.

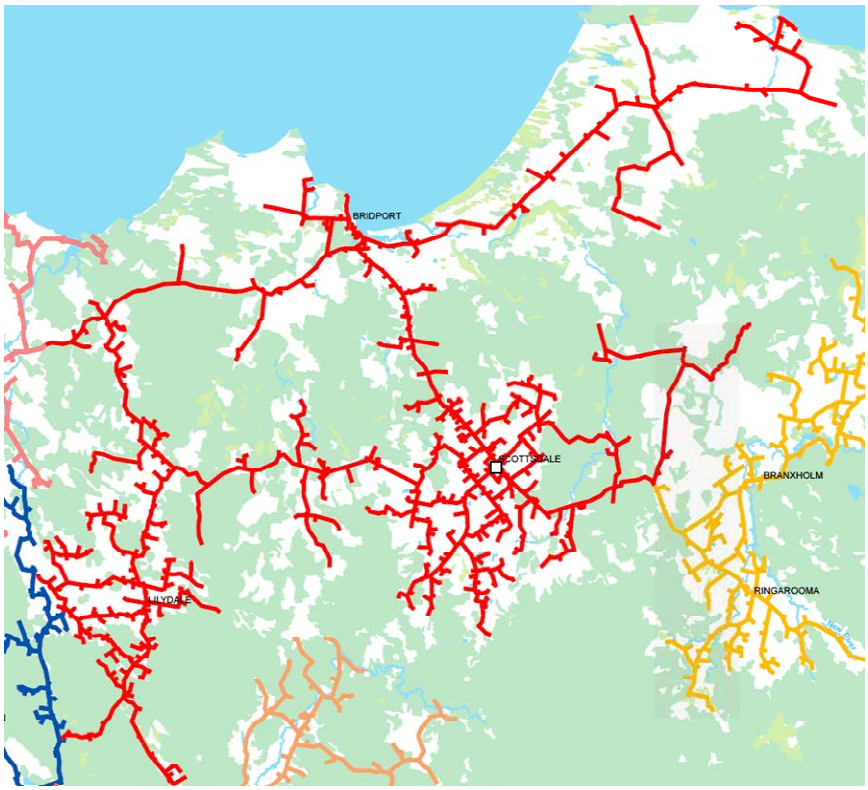


**Figure 8-6 Scottsdale 22 kV supply area**

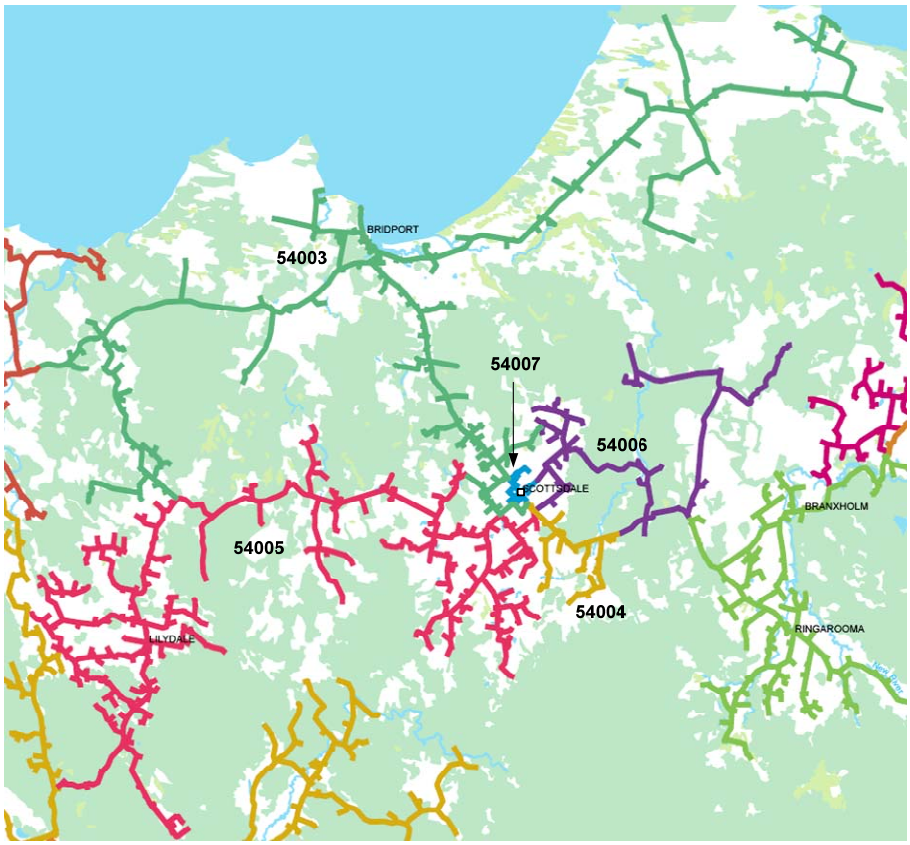


**Figure 8-7 Scottsdale 22 kV individual feeders**

A five year feeder forecast has been developed using the actual peak feeder loads from 2009 and the forecast medium substation growth. The forecast for each feeder is outlined in the following table.

**Table 8-3 Forecast feeder growth**

| Area | Feeder/s | 2012 load (MVA) | 2013 load (MVA) | 2014 load (MVA) | 2015 load (MVA) | 2016 load (MVA) | 2017 load (MVA) |
|---|---|---|---|---|---|---|---|
| Scottsdale | 54003 | 4.41 | 4.46 | 4.51 | 4.57 | 4.62 | 4.67 |
| | 54004 | 5.95 | 6.02 | 6.09 | 6.16 | 6.24 | 6.30 |
| | 54005 | 3.66 | 3.71 | 3.75 | 3.80 | 3.84 | 3.88 |
| | 54006 | 0.78 | 0.79 | 0.79 | 0.80 | 0.81 | 0.82 |
| | 54007 | 4.47 | 4.52 | 4.58 | 4.63 | 4.68 | 4.73 |

The forecast feeder loads have been assessed against a maximum feeder rating of 10 MVA for overhead and underground feeders. From the table above, it appears that there are no limitations present on the Scottsdale 22 kV feeders.

Scottsdale substation has existing transfer capability with Derby and St. Mary's. The following figures are from the load transfer models provided by Aurora.

**Table 8-4 Forecast transfer capability**

| Substation | Feeder | 2012 transfer (MVA) | 2013 transfer (MVA) | 2014 transfer (MVA) | 2015 transfer (MVA) | 2016 transfer (MVA) | 2017 transfer (MVA) |
|---|---|---|---|---|---|---|---|
| Scottsdale – Derby | 55001 | 3.8 | 3.8 | 3.7 | 3.7 | 3.6 | 3.6 |
| Scottsdale – Trevallyn | 61021 | 2.4 | 2.3 | 2.2 | 2.1 | 2.0 | 2.0 |
| Scottsdale – George Town | 53008 | 3.5 | 3.4 | 3.3 | 3.2 | 3.1 | 3.0 |
| Total transfers | - | 9.7 | 9.5 | 9.2 | 9 | 8.7 | 8.6 |

There is reasonable transfer capability available to the Derby, Trevallyn and George Town substations.

### 8.2.2 Proposed projects

There are no proposed projects in the five year plan for the Scottsdale area.

### 8.2.3 Ultimate configuration

#### Substation

Scottsdale is expected to remain a two transformer substation up to 2050. The transformers will be replaced when the age limitations are reached. A number of options for the proposed works on the transmission network in the East Coast and North East area have been presented in the East Coast strategic area plan – Report 8 in the series. The chosen option will impact on the long term plan for the Scottsdale area.

#### Feeders

The growth in the Scottsdale area is forecast to be low and capacity of the existing 22 kV feeders is currently sufficient. There are spare circuit breakers available on the 22 kV board and new feeders may be required throughout the long term plan to address capacity and reliability issues on the long 22 kV feeders. The transfer capability of the existing Scottsdale feeders should be monitored and additional ties installed as required if possible. Due to the location on the Tasman Highway, it is recommended that additional conduits be installed on the main routes from the substation during the next feeder project to allow for future feeders.

# Appendix A
# Estimating data

# Appendix A

The following tables list the standard feeder and substation costs used for this report.

| Voltage | Feeder Type | Cost ($k/km) | | | Source |
|---|---|---|---|---|---|
| | | Rural | Urban | High Density Urban | |
| 110 kV | Overhead single circuit | 450 | - | - | Transend (advised $400-500k) |
| 110 kV | Over head single circuit (double circuit construction) | 500 | - | - | Transend (advised $400-500) |
| 110 kV | Overhead double circuit | 550 | - | - | Transend (advised $500-600k) |
| 66 kV | Overhead single circuit | 250 | - | - | Aurora |
| 66 kV | Overhead double circuit | 330 | - | - | Aurecon assumption |
| 66 kV | Overbuild of existing 22 kV | 180 | 290 | 360 | Aurecon assumption |
| 33 kV | Underground single circuit | 250 | 300 | 500 | Aurora |
| 33 kV | Underground double circuit | 420 | 500 | 750 | Aurora |
| 33 kV | Overhead single circuit | 150 | 200 | 300 | Aurora |
| 22 kV | Overhead single circuit | 100 | 150 | 200 | Aurora |
| 22 kV | Underground single circuit | 220 | 270 | 470 | Aurora |
| 22 kV | Underground double circuit | 360 | 440 | 690 | Aurora |
| 11 kV | Overhead single circuit | 100 | 150 | 200 | Aurora |
| 11 kV | Underground single circuit | 220 | 270 | 470 | Aurora |
| 11 kV | Underground double circuit | 360 | 440 | 690 | Aurora |

| Component | Cost ($k) | Source |
|---|---|---|
| 110/22/11 kV terminal substation | 17,500 | Transend (advised $15-20M) |
| 110/22/11 kV terminal substation (single 25 MVA transformer) | 9,000 | Transend (advised $8-10M) |
| Install 3rd 110/22/11 kV transformer at existing site | 7,000 | Transend (advised $6-8M) |
| Install 3rd 33/11 kV transformer at existing site | 3,000 | Aurecon assumption |
| Replace 2 x 110/22/11 kV 60 MVA transformers | 6,000 | Aurecon assumption based Transend projects in APR |
| Replace 2 x 110/22/11 kV 25 MVA transformers | 5,000 | Aurecon assumption based Transend projects in APR |
| Establish 110/33 kV substation at existing site | 13,500 | Transend (advised $12-15M) |
| Establish 110/66 kV substation at existing site | 14,000 | Aurecon assumption |
| 66/22 kV zone substation | 9,000 | Aurora |
| 33/11 kV zone substation | 7,000 | Aurora |
| 33 kV switchboard (5 CBs in existing building) | 500 | Aurecon assumption |
| 11 kV switchboard (8 CBs in existing building) | 300 | Aurecon assumption |

# Appendix B
# NPV analysis

# Appendix B

The following table lists the NPV analyses attached in this section of the report.

| NPV | Project | Section reference |
|---|---|---|
| 1 | Derby second transformer installation | 7.1.1 |

# Derby NPV analysis (North East area)

**Base Year**

**2010**

**OPTION 1**

**Install a second transformer at Derby**

| Development Year | | | System Limitation | Description of Works | | Medium Growth Net Present Value in $ M | | | High Growth Net Present Value in $ M | | | Low Growth Net Present Value in $ M | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Medium | High | Low | | | Cost $k | 5.64% | 6.64% | 7.64% | 5.64% | 6.64% | 7.64% | 5.64% | 6.64% | 7.64% |
| 2015 | 2014 | 2013 | Firm capacity at Derby exceeded | Install a second transformer at Derby<br>- 1 x 110/22 kV 10 MVA transformer, 110 kC CB and 22 kV switchgear | $3,500 | $2.66 | $2.54 | $2.42 | $2.81 | $2.71 | $2.61 | $2.97 | $2.89 | $2.81 |
| | | | | | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| | | | | | **Total** | **$2.66** | **$2.54** | **$2.42** | **$2.81** | **$2.71** | **$2.61** | **$2.97** | **$2.89** | **$2.81** |

**OPTION 2**

**Install a backup supply from Scottsdale**

| Development Year | | | System Limitation | Description of Works | | Medium Growth Net Present Value in $ M | | | High Growth Net Present Value in $ M | | | Low Growth Net Present Value in $ M | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Medium | High | Low | | | Cost $k | 5.64% | 6.64% | 7.64% | 5.64% | 6.64% | 7.64% | 5.64% | 6.64% | 7.64% |
| 2015 | 2014 | 2013 | Firm capacity at Derby exceeded | Install a new 22 kV feeder from Scottsdale | $3,200 | $2.43 | $2.32 | $2.21 | $2.57 | $2.47 | $2.38 | $2.71 | $2.64 | $2.57 |
| 2035 | 2034 | 2036 | Firm capacity at Derby exceeded | Install a second transformer at Derby<br>- 1 x 110/22 kV 10 MVA transformer, 110 kC CB and 22 kV switchgear | $3,500 | $0.89 | $0.70 | $0.56 | $0.94 | $0.75 | $0.60 | $0.84 | $0.66 | $0.52 |
| | | | | | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| | | | | | **Total** | **$3.32** | **$3.02** | **$2.77** | **$3.51** | **$3.22** | **$2.98** | **$3.55** | **$3.30** | **$3.08** |

# Appendix C
# Glossary

# Appendix C – Glossary of terms

**AAC** – All Aluminium Conductor

**AAAC** – All Aluminium Alloy Conductor

**ACO** – Auto Change-Over

**APR** – Annual Planning Report

**AVR** – Automatic Voltage Regulation

**CB** – Circuit Breaker

**CBD** – Central Business District

**DCCT** – Double Circuit

**DINIS** – Power systems software package used by Aurora for load flow studies.

**ESI regulations** – Electricity Supply Industry regulations, transmission network performance standards specified by the Tasmanian Department of Energy

**ECC** – Emergency Cyclic Capacity

**FLRS** – Feeder Load Reporting System, Aurora database of historical distribution feeder loading.

**HV** – High Voltage

**NCC** – Normal Cyclic Capacity

**NPV** – Net Present Value

**PMR** – Pole-Mounted Recloser

**RIT** – Regulatory Investment Test

**RMU** – Ring Main Unit

**SCCT** – Single Circuit

**TRIP** – Targeted Reliability Improvement Project

**WACC** – Weighted Average Cost of Capital

**Webmap** – Software package used by Aurora to maintain geographical information about installed assets.

**XLPE** – Cross Linked Poly Ethylene

Adelaide 61 8 8237 9777
Auckland 64 9 520 6019
Bangkok 66 2 260 4560
Blenheim 64 3 520 6060
Brisbane 61 7 3173 8000
Cairns 61 7 4051 6266
Canberra 61 2 6112 0100
Christchurch 64 3 366 0821
Darwin 61 8 8919 9777
Geraldton 61 8 9964 2764
Gladstone 61 7 4962 0600
Gold Coast 61 7 5591 7775
Hamilton 64 7 834 1565
Hanoi 84 4976 1282
Ho Chi Minh City 84 8 3910 0288
Hong Kong 852 3664 6888
Jakarta 62 21 5140 2470
Karratha 61 8 9185 6344
Kuala Lumpur 60 3 2164 7301
Lithgow 61 2 6351 3750
Mackay 61 7 4951 3500
Maroochydore 61 7 5443 4055
Melbourne 61 3 8683 1333
Mildura 61 3 5022 2766
Morwell 61 3 5116 7205
Nelson 64 3 539 0190
Newcastle 61 2 4941 5415
Paraparaumu 64 4 296 1240
Parramatta 61 2 9890 4100
Perth 61 8 9223 1500
Phnom Penh 855 12 923 248
Port Augusta 61 8 8642 3197
Queenstown 64 3 441 0346
Rangiora 64 3 313 8776
Shanghai 86 21 3313 4750
Singapore 65 6256 6188
Sydney 61 2 9465 5599
Tauranga 64 7 578 6183
Toowoomba 61 7 4632 6249
Townsville 61 7 4772 2858
Traralgon 61 3 5176 0113
Wellington 64 4 472 9589
Whyalla 61 8 8645 5755
Wollongong 61 2 4224 7274

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